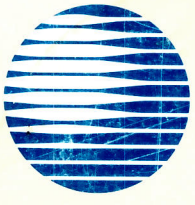
Data Services Reference Handbook

Data Sets-Installation and Maintenance

VOLUME I



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Data Services

Reference Handbook

Volume I

Printed in U.S.A.

PREFACE

Objective

The objective of the Data Services Reference Handbook is to furnish the Telephone Company craft employee with a practical field manual comprised of information pertaining to the description, installation, and maintenance of voice bandwidth data sets and associated data auxiliary apparatus.

Plan of Text

In general, the Bell System Practices (BSPs) have been edited and condensed to offer a wide spectrum of information that would not be possible to include in a handbook in the unedited format. In addition, option and interface tables have been excerpted from descriptive sections when necessary and added to provide complete installation information.

Contents

The Data Services Reference Handbook consists of sixteen parts, divided into five volumes. Parts 1 and 2, covering data sets 100- and 200-types, are placed in Volume I. Parts 3 through 6, covering data sets 407-type, transaction telephone, Digital Data System, data auxiliary equipment, and ADTS testing, are placed in Volume II. Parts 7 and 8 covering general data apparatus and general trade products are placed in Volume III. Parts 9 through 14 covering ***registered*** interfaces, data jacks and mountings, data sets, data stations, and data auxiliary sets, are placed in Volume IV. Parts 15 and 16 covering DATAPHONE®/II Service and DIMENSION®/System 85 data service units are placed in Volume V.

The BSPs are arranged in each part in order of material content rather than by number. This type of presentation is necessary to allow an item to be presented in a subjective manner rather than to be restricted by the 9-digit numbers. For information not contained in this manual, refer to standard BSP files.

As an aid to usability, shown above the 9-digit number of each BSP is an abbreviated description of the apparatus covered in the practice (for example, DS 108D, DS 201C Sta, DAS 828D, etc.), plus a hyphenated number. This number shows the part number and the order in which the practice is placed in the part. (For example, 3-1 is the first practice in Part 3.) Where it is known that a BSP will be added to the manual in a later revision, a number has been skipped to save space for the practice. The page number of each page in the BSP is retained at the bottom of the page for cross-reference purposes.

DATA SERVICES REFERENCE HANDBOOK

Comments concerning content, usability, and adequacy of this manual will be welcomed. This sheet may be removed and mailed directly to the Bell System Practices Organization. This sheet is not to be used for ordering manuals.

Specific comments on particular BSPs should be forwarded by means of Form E-3973.

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Part 1

Part 1 — Data Sets 100-Type

DATA SETS 108D- AND 108E-TYPE
DESCRIPTION
USED IN STATION APPLICATIONS

CONTENTS PAGE

1. GENERAL

1.01 This section covers the physical and functional description of data sets (DSs) 108D- and 108E-types used in private line station applications.

1.02 This section is reissued to incorporate information on the newly introduced DSs 108D-L1A and 108E-L1A.

1.03 Data sets 108D-L1 and 108E-L1 (Fig. 1 and 2) have been redesigned. The new sets are coded DS 108D-L1A and DS 108E-L1A (Fig. 3 and 4). These sets offer the same features and fit into the same mountings as the MD sets they replace. However, there are small differences between the sets. When necessary to describe these differences the sets will be referred to by full designation (DSs 108D-L1, 108E-L1, 108D-L1A and 108E-L1A).

1.04 The following is a list of data mountings in which DSs 108D- and 108E-type can be mounted for station application.

- 28A-type data mounting equipped with 27B1 data unit
- 28D1 data mounting
- Data auxiliary set 830A
- Data auxiliary set 820-type.

1.05 Data sets 108D and 108E are full-duplex (FDX), frequency-shift-keyed (FSK), serial-transmission data sets which provide low-speed (up to 300 baud) data transmission over 2-wire or 4-wire private line (PL) voiceband facilities.

1.06 Data sets 108D and 108E are very similar; they differ in send and receive frequencies and data set restore characteristics. Data set 108E send and receive frequencies complement those of DS 108D.

Data sets 108D and 108E are not designed to handle supervisory line current.

1.07 Data set 108E restores upon detection of either ***marking or spacing*** carrier, whereas all other DS 108-type restore only upon detection of incoming marking carrier.

1.08 Data Set 108D-L1A may be used as a direct replacement for DS 108D-L1 (MD) and DS 108C (MD). Data Set 108D-L1A is also compatible with DS 108B, 108F, 108G, 108J, 108H, and 103F (in orginate mode). Comparison of these data sets are contained in Table A.

1.09 Data Set 108E-L1A may be used as a direct replacement for DS 108E-L1 (MD) and DS 108A (MD). Data Set 108E is also compatible with

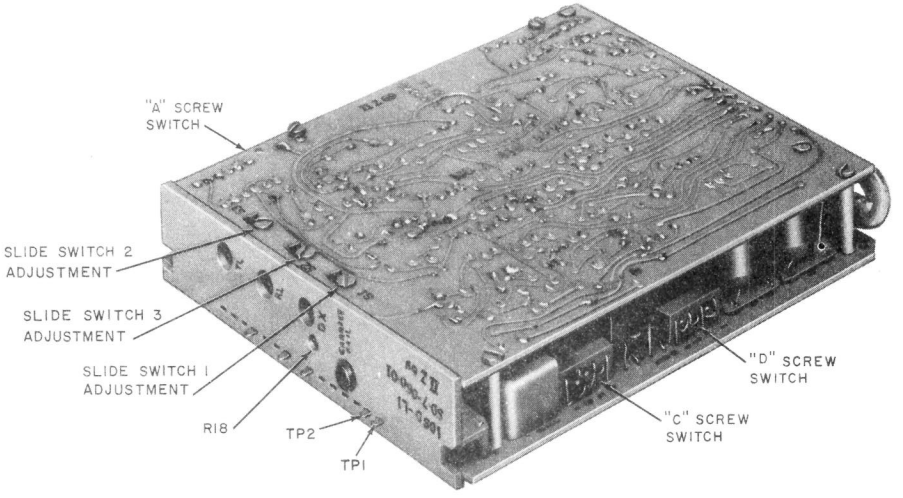


Fig. 1—Data Set 108D-L1

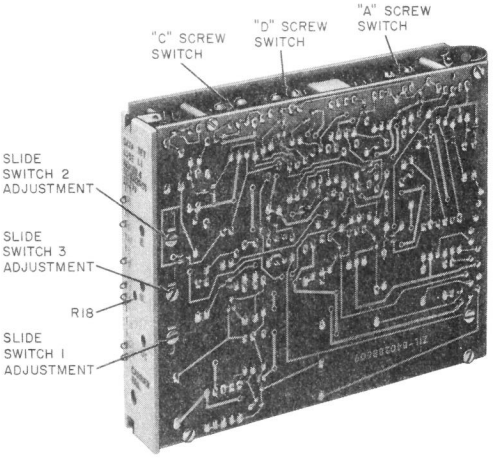


Fig. 2—Data Set 108E-L1

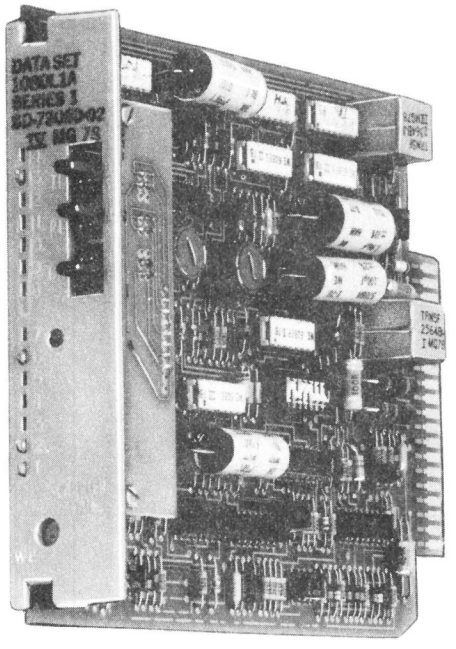


Fig. 3—Data Set 108D-L1A

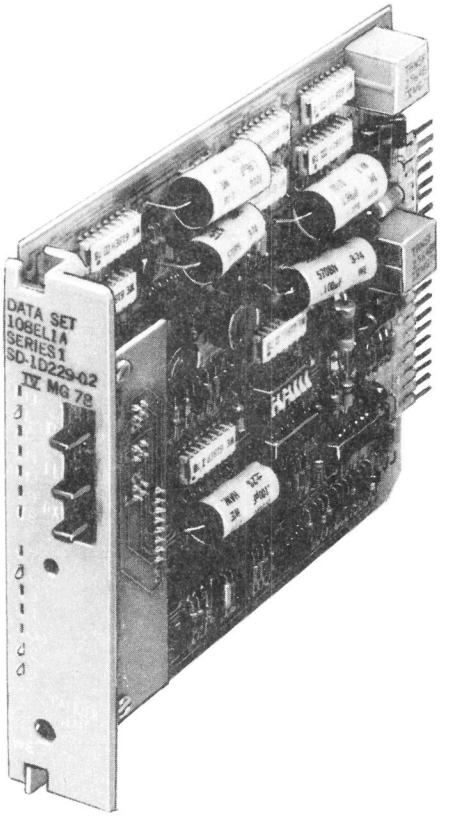


Fig. 4—Data Set 108E-L1A

TABLE A

DATA SET 108-TYPE — A COMPARISON

FEATURES		DATA SET 108D-L1A	DATA SET 108E-L1A	DATA SET 108D-L1	DATA SET 108E-L1	DATA SET 108C	DATA SET 108A
Transmit Level (dBm)		—1 to —26	—1 to —26	Continuous —6 to —26	Continuous 0 to —26	Continuous 0 to —14	Continuous 0 to —14
Loop Termination		600-ohm 2-wire or 600-ohm 4-wire	600-ohm 2-wire or 600-ohm 4-wire	900- ohm 2-wire or 600-ohm 4-wire	900-ohm 2-wire or 600-ohm 4-wire	900-ohm 2-wire	900-ohm 2-wire
Lamp		CF Lamp	CF Lamp	CF Lamp	CF Lamp	None	None
Carrier Squelch		EIA Voltage or Contact Controlled	EIA Voltage or Contact Controlled	EIA Voltage or Contact Controlled	EIA Voltage or Contact Controlled	Contact Controlled	Contact Controlled
BB Lead Condition When Loss of Received Carrier Is Detected		Mark or Space	Mark or Space	Mark or Space	Mark or Space	Mark	Mark
Transmit Frequency	Mark	1270 Hz	2225 Hz	1270 Hz	2225 Hz	1270 Hz	2225 Hz
	Space	1070 Hz	2025 Hz	1070 Hz	2025 Hz	1070 Hz	2025 Hz
Receive Frequency	Mark	2225 Hz	1270 Hz	2225 Hz	1270 Hz	2225 Hz	1270 Hz
	Space	2025 Hz	1070 Hz	2025 Hz	1070 Hz	2025 Hz	1070 Hz
Signal Required to Restore BB Lead Condition Upon Detection of Carrier		Marking	Marking or Spacing	Marking	Marking or Spacing	Marking	Marking
Primary Uses		Station-to-Station Hub Application	Station-to-Station Station-to-Hub	Station-to-Station Hub Application	Station-to-Station Station-to-Hub	Station-to-Station	Station-to-Station Station-to-Hub

DSs 108F, 108G, 108H, 108J, and 103F (in answer mode).

1.10 Transmission from DS 108D is always in the f1 frequency band (1270 Hz for a mark and 1070 Hz for a space), and reception is always in the f2 band (2225 Hz for a mark and 2025 Hz for a space). Transmission from DS 108E is always in the f2 frequency band and reception is always in the f1 band.

1.11 Private line circuits using 108-type data sets may be divided into the following types:

(a) Station-to-hub circuits

(b) Station-to-station circuits.

Examples of typical private line station circuit arrangements are shown in Fig. 5.

1.12 For information on DSs 108D and 108E when used in a hub arrangement, refer to Section 312-805-100.

2. PHYSICAL DESCRIPTION

A. Data Sets 108D-L1 and 108E-L1

2.01 Data sets 108D-L1 and 108E-L1 each consist of two printed wiring circuit boards mounted together in piggyback fashion (Fig. 6 and 7). The piggyback arrangement provides a narrower faceplate than DS 108A or 108C, and occupies only two-thirds of the space necessary for DS 108A or 108C. Data sets 108D-L1 and 108E-L1 are each approximately 5-1/2 inches high, 7-1/5 inches deep, 1-1/8 inches wide, and weigh approximately 2 pounds.

2.02 Figures 1 and 2 show all items and designations visible on the faceplates of DS 108D (series 2) and DS 108E (series 1), respectively. Three slide switches (S1, S2, and S3) are visible from the front faceplate of the data set; however, the data set card must be removed from the data auxiliary set in order to change the slide switch settings. The screw holding the slide in place is loosened to slide the switch contact to the proper option as indicated by the tab. After positioning the contact, the screw is tightened (see Fig. 1 and 2).

2.03 Data set 108D-L1 (series 3) and DS 108E-L1 (series 2) use a 3-part rotary-screw switch S1 in place of the three slide switches. Switch S1 facilitates a change in switch settings ***without*** removing the data set card from the data auxiliary set. Switch S1 is divided into three sections: A, B, and C (Fig. 8). To access the switch screws, the hinged protective cover must first be pried open from the end marked with a dot. Each switch section is individually adjusted to one of two positions using a small screwdriver (KS-20193, L1 or equivalent) to ***gently*** rotate the screw to either the upper or the lower position. The final position of the screw must be such that it butts up against the spacer and the screwdriver slot is parallel with the spacer.

2.04 The power required for the operation of either data set is 3.7 watts. The data sets require filtered +24 ±3 and -24 ±3 volts dc. The dc voltages required are supplied by the associated data auxiliary set or data mounting.

B. Data Sets 108D-L1A and 108E-L1A

2.05 Data sets 108D-L1A and 108E-L1A consist of a single card circuit pack rather than a double-decked circuit pack used on DSs 108D-L1 and 108E-L1. The overall dimensions of DSs 108D-L1A and 108E-L1A are: 7-1/4 inches long (with option jumper plugs inserted, 7-9/16 inches), 1-1/8 inches wide, 5-1/2 inches high, and weigh less than 1/2 pound.

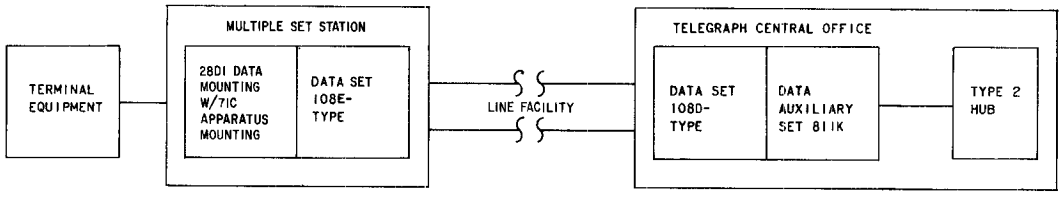
2.06 The circuit pack faceplate of DSs 108D-L1A and 108E-L1A contains a block for option jumper plugs, line facility test points, and a carrier fail indicator lamp.

2.07 Circuit connection is made via printed circuit fingers located on the rear of the circuit pack. This circuit pack is designed to plug into a suitable data mounting.

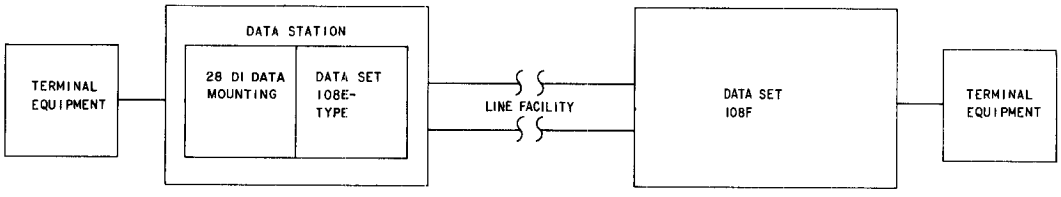
2.08 The power required for the operation of either data set is 4.7 watts. The data sets require filtered +24 ±3 and -24 ±3 volts dc. The dc voltages required are supplied by the data mounting.

3. FUNCTIONAL DESCRIPTION

3.01 This functional description will refer to data sets 108D- and 108E-type as "the data set" since most functions are the same. When an exception occurs, the data set will be referred to



A. STATION-TO-HUB OPERATION



B. STATION-TO-STATION OPERATION

Fig. 5—Data Set 108D- and 108E-Type Typical Station

by full designation. Figure 9 shows a block diagram of the data sets.

3.02 Data sets 108D-L1A and 108E-L1A have a fixed, compromise hybrid balance network, which is equivalent to the network obtained with the H option in DSs 108D-L1 and 108E-L1. The network settings of DSs 108D-L1 and 108E-L1 obtained by options A, B, E, F, or G are not available. The network now provided is always adequate.

Interface Leads

3.03 In addition to power and ground leads, the data set provides six interface leads. The interface between the data set and the associated station equipment conforms to the Electronic Industries Association (EIA) Standard RS-232-C for signal characteristics except where noted. The interface leads and their functions are as follows:

(a) BA on card terminal 3 connects to the EIA interface BA lead (transmitted data lead). A signal on this lead of less than -3 volts represents a mark, and a signal greater than +3 volts represents a space. The BA lead accepts data from the customer data terminal.

(b) TL on card terminal 10 connects to the EIA interface BB lead (received data lead). This lead has a voltage output of less than -5 volts for a mark and greater than +5 volts for a space. The BB lead presents data output from the data station to the customer data terminal.

(c) ON from card terminal 19 connects to the EIA interface CC lead (data set ready lead). This lead is connected to a positive potential in

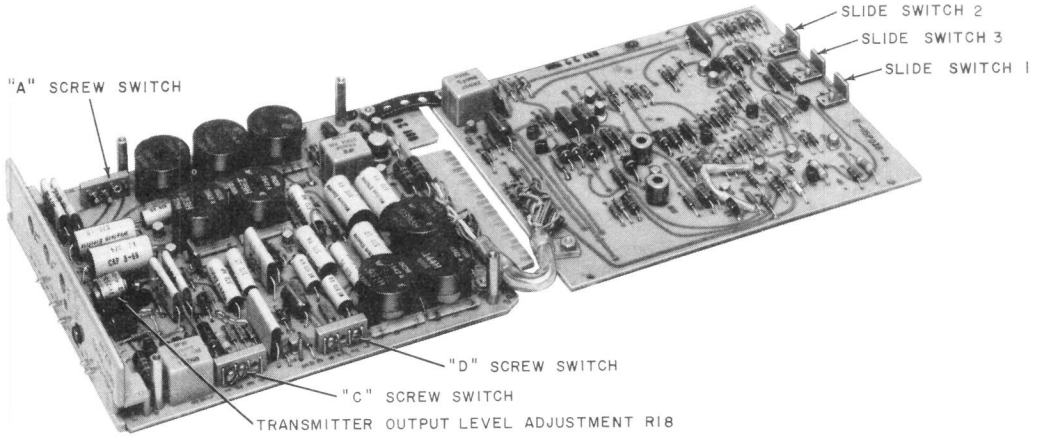


Fig. 6—Data Set 108D-L1 Showing Location of Switches

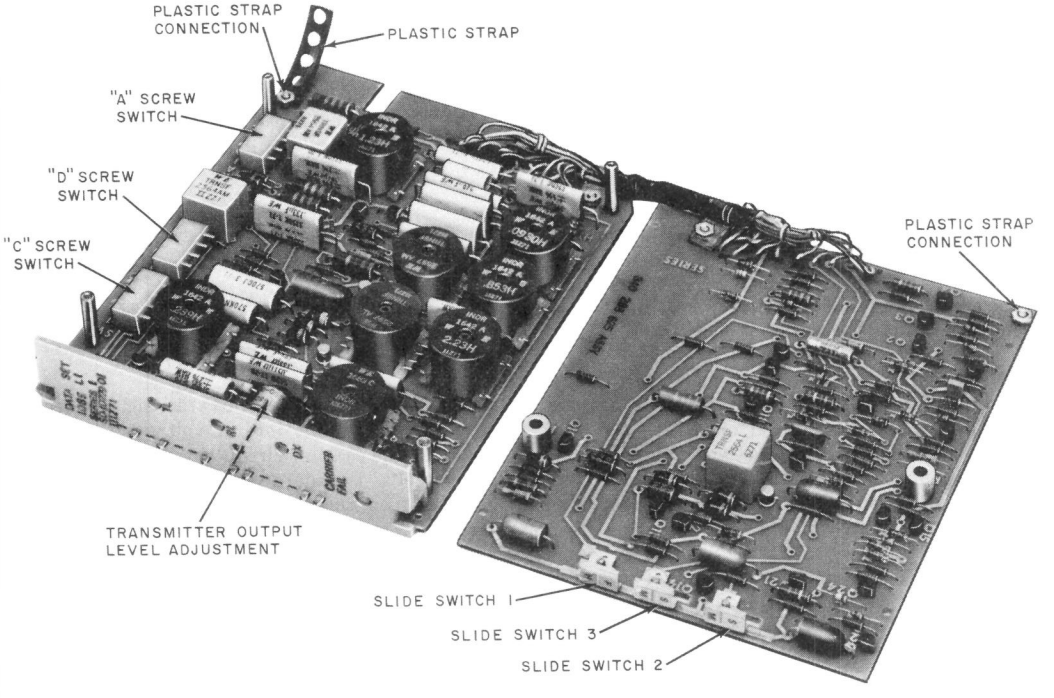
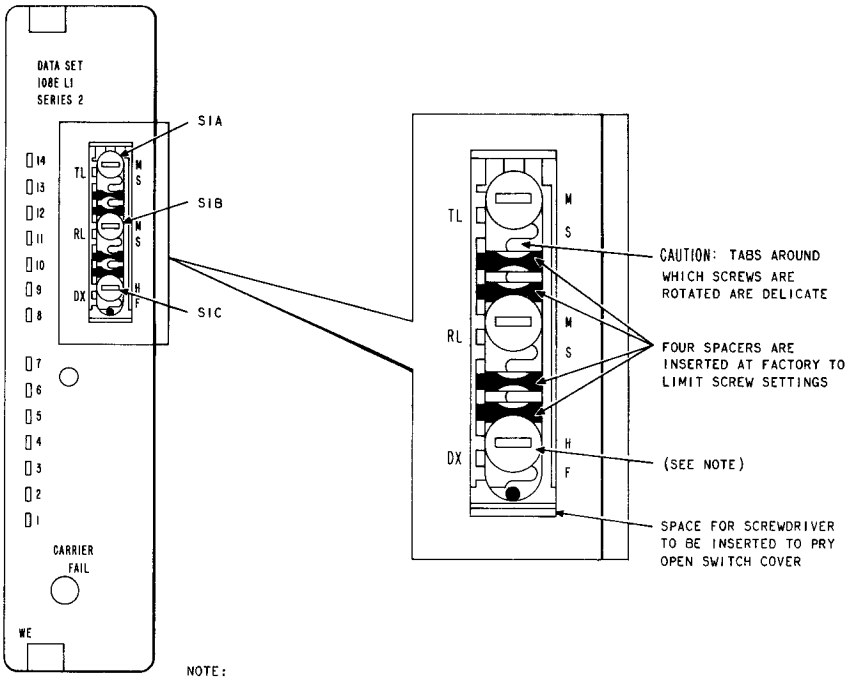


Fig. 7—Data Set 108E-L1 Showing Location of Switches



NOTE:
OPERATE SCREW COUNTER-CLOCKWISE SO THAT THE SCREW ROTATES AROUND THE TAB FROM AN UPPER TO LOWER POSITION WHEN CHANGING FROM POSITION M TO S OR H TO F. OPERATE THE SCREW CLOCKWISE FROM A LOWER TO AN UPPER POSITION WHEN CHANGING FROM POSITION S TO M OR F TO H (DOT IS CONSIDERED TO BE IN LOWEST POSITION).

Fig. 8—Data Set 108D-L1 (Series 3 or Higher) or 108E-L1 (Series 2 or Higher) Rotary Screw Switch S1

the data set. The positive potential is an indication that the data set has power.

(d) RS on card terminal 7 connects to the EIA interface CF lead (received line signal detector lead). This lead will be at a positive potential when a carrier is being received from the line. When a loss of carrier is detected by the data set, the CF lead will have a negative potential and the CF lamp will light.

(e) CSQ (carrier squelch) on terminal 15 can be used for carrier control. This is a non-EIA lead to the station. A negative voltage on this lead squelches the outgoing carrier.

(f) Card terminal 13 can be used for carrier control. This is a non-EIA (contact control) lead to the station. The outgoing carrier can be turned off by connecting a ground to the carrier control leads.

3.04 The data set converts ac signals received from the line into dc voltages and delivers them to the station circuit on the TL (BB) lead. Conversely, the data set converts dc voltages received from the station on the BA lead into voice frequency ac signals and transmits them onto the line. Since the ac signals occupy different frequency bands, the line functions as if it were two separate one-way channels (full-duplex mode).

3.05 Data sets 108D-L1A and 108E-L1A have line impedances of 600 ohms for both 2- and 4-wire line facilities. Data sets 108D-L1 and

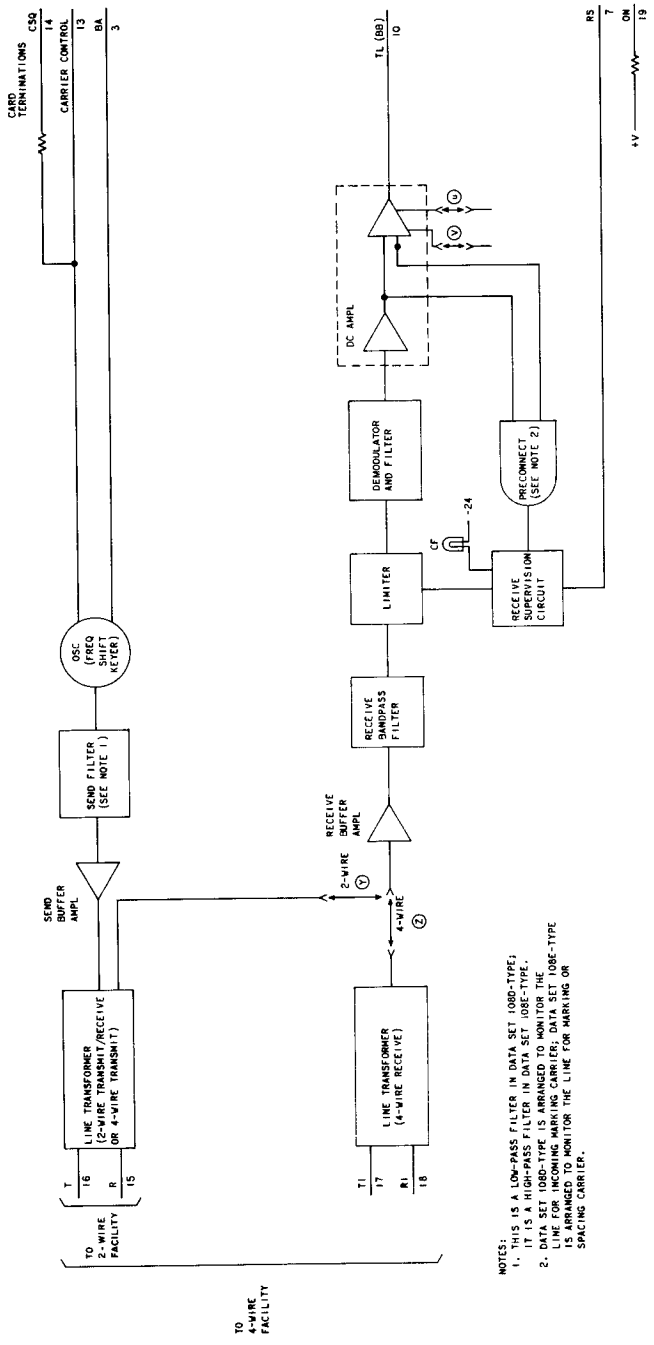


Fig. 9—Block Diagram of Data Sets 108D- and 108E-Type—Station Configuration

108E-L1 have line impedances of 900 ohms for 2-wire and 600 ohms for 4-wire line facilities.

Transmitter Circuit

3.06 The data set transmitter circuit consists of an oscillator (frequency-shift keyer), sending low-pass filter in DS 108D or sending high-pass filter in DS 108E, a sending buffer amplifier, and the transmit and receive line transformer.

3.07 When a mark signal is applied to the BA lead, the oscillator (frequency-shift keyer) has an output of 1270 Hz (mark) for DS 108D or 2225 Hz (mark) for DS 108E. The application of a space to the BA lead causes the oscillator to shift to 1070 Hz (space) for DS 108D or 2025 Hz (space) for DS 108E.

3.08 The output of the oscillator is fed to the sending filter. The filter attenuates the unwanted frequencies in the receiving band, thereby reducing the balance requirements of the hybrid transformer for 2-wire operation of the data set.

3.09 The sending buffer amplifier isolates the line and provides a suitable termination for the sending high-pass filter (DS 108E) or low-pass filter (DS 108D). Level adjustment controls deliver the proper power to the line.

3.10 In a 4-wire line arrangement line connections are made to the send transformer and to the receive transformer at the data set. In a 2-wire line arrangement the line is connected to the send transformer which is arranged as a hybrid transformer.

The data sets are designed for a direct 4-wire loop connection in order to minimize equipment need for those transmission links consisting of 4-wire facilities.

Receiver Circuit

3.11 The receiver circuit consists of the transmit and receive line transformer (4-wire operation) or transmit and receive line transformer (2-wire operation), receiving buffer amplifier, receiving bandpass filter, limiter, demodulator, low-pass detector filter, and dc amplifier.

3.12 Depending on the type of connection (2-wire or 4-wire), the line transformer will be connected to the receiving buffer amplifier. This amplifier isolates the line from variations in impedance of the receive bandpass filter which follows this amplifier.

3.13 The receiving filter has a bandpass of 1170 ±150 Hz (DS 108E) or 2125 ±150 Hz (DS 108D). This serves to reduce interference by attenuating out-of-band line noise. This filter also reduces the balance requirements of the hybrid transformer by providing attenuation of the locally transmitted signals in the f1 band (DS 108D) or in the f2 band (DS 108E).

3.14 The output of the receiving bandpass filter is connected to the limiter. The limiter amplifies the incoming frequencies and limits the output to provide a constant amplitude signal to the demodulator. The limiter also provides an output signal for the receive supervision. The demodulator converts the carrier frequency variations into dc voltage variations and delivers them to the low-pass detector filter and to the dc amplifier.

3.15 In DSs 108D and 108E-L1 the dc voltage presented to the receive supervision circuit is proportional to the limiter output signal. It can be used to determine when the input signal level drops below the minimum operating level of -43 dBm for 4-wire operation (for 2- and 4-wire operation in DSs 108D and 108E-L1A) or -40 dBm for 2-wire operation. When the receive carrier level drops 7 dBm below these values for a period of 75 to 150 ms, the receive supervision circuit is turned off. This places a negative voltage on the RS lead, lights the CF lamp, and causes the TL (BB) lead to send marking or spacing to the terminal devices, depending upon which option is installed in the data set. In addition, the data set will enter the preconnect mode.

3.16 The output dc amplifier amplifies the output from detector low-pass filter. An incoming ***marking*** frequency causes a negative marking signal to be applied to the TL lead. An incoming ***space*** frequency causes a ***positive spacing*** signal to be applied to the TL lead.

Preconnect Mode

3.17 In the preconnect mode, DS 108D is arranged to monitor the line for incoming marking

carrier, while DS 108E is arranged to monitor the line for incoming marking or spacing carrier. When the marking carrier, or marking or spacing carrier, is received for a sufficient period of time (200 to 600 ms to ensure that the data set does not enable on a momentary noise burst), the receive supervision circuit will turn on. This places a positive voltage on the RS lead, extinguishes the CF lamp, and unclamps the TL (BB) lead. In the preconnect mode, the slicer levels are shifted toward the marking and/or spacing frequency. Thus, during the 200 to 600 ms that the carrier is being received for reinitialization of the data set, the signal power must be in either the upper marking or lower spacing band with DS 108E or in the upper marking band with DS 108D.

3.18 Carrier detection in DSs 108D-L1A and 108E-L1A can be reduced to about 100 ms by a simple modification: a wire strap soldered to two land areas of the printed board marked with the letter R. No option letter has been assigned to this local engineering modification.

Fail Safe State

3.19 In DSs 108D-L1A, 108E-L1A, 108D-L1, and 108E-L1, the fail-safe state of the request-to-send (CA) circuit is the ***on*** state. This is the correct state for the commonly used application in which the terminal or mounting does not provide a CA driving circuit. For stations on polling systems, the desirable fail-safe state is ***off.*** This can be obtained in DSs 108D-L1A and 108E-L1A by a simple modification: a wire strap soldered to two land areas on the printed board marked with the letter Q. No option letter has been assigned to this local engineering modification.

4. OPTIONS

2-Wire/4-Wire Option

4.01 Three screw switches (A, C, and D) are provided in DSs 108D-L1 and 108E-L1 to implement 2- or 4-wire service (see Table B). For 4-wire connection, option Z must be installed in DSs 108D-L1 and 108E-L1. The sending loop facility must be connected to the terminals mating with card terminals 15 and 16 (R and T); the receiving loop facility must be connected to the terminals mating with card terminals 17 and 18 (T1 and R1). The 4-wire option requires all of the C screw switches to be opened. For 2-wire connection, option Y must be installed in DSs 108D-L1 and 108E-L1. The loop facility must be connected to the terminals mating with card terminals 15 and 16 (R and T) and the proper hybrid network option installed. Options Y and Z are under control of screw switch A (Fig. 6 and 7). The A screw switch setting for each option is listed in Table B.

4.02 In addition to the screw switch options, DSs 108D-L1 and 108E-L1 are provided with several slide switch or rotary-screw switch (refer to paragraph 2.03) options. The option designations, along with the function and switch setting for each, are given in Table B.

4.03 Data sets 108D-L1A and 108E-L1A are provided with a rocker switch inside the data set and jumper plugs on the faceplate by which options (Table B) are set.

4.04 In station applications the DX switch is always in the F position (option X of Table B).

Receiving Sensitivity Adjustment

4.05 The gain of the receiving buffer amplifier is adjustable to allow compensations to be made for differences in receive level. If the receive carrier level is greater than -30 dBm (-29, -28, etc), the 6-dB reduction of gain should be installed (see Table B).

Transmitting Sensitivity Adjustment

4.06 The transmission level of the DSs 108D-L1 and 108E-L1 are continuously adjustable over a range (see Table A) to allow compensations to be made for differences in local loop loss. Potentiometer R18 (Fig. 6 and 7) adjusts the output power level through a range of -6 to -26 dBm for DS 108D-L1 or 0 to -26 dBm for DS 108E by continuous adjustment into a 600-ohm loop 4-wire circuit or a 900-ohm loop 2-wire circuit.

4.07 Data sets 108D-L1A and 108E-L1A are provided with switches to adjust the transmitting level in 2 dB steps from -1 dBm to -15 dBm (Table C). In addition five send levels between -16.0 and -26.0 dBm (Table C) can be obtained for central office applications.

4.08 All options available with the data set are covered in Tables B, C, D, and E. The

implementation of the desired options is given in the applicable table or paragraph.

5. REFERENCES

5.01 For additional information on DS 108D- or 108E-type, refer to the following:

(1) SD-1D229-01 (DS 108E-L1 Schematic Diagram)

(2) CD-1D229-01 (DS 108E-L1—Circuit Description)

(3) SD-73060-01 (DS 108D-L1—Schematic Diagram)

(4) CD-73060-01 (DS 108D-L1—Circuit Description)

(5) SD-1D229-02 (DS 108E-L1A—Schematic Diagram)

(6) CD-1D229-02 (DS 108E-L1A—Circuit Description)

(7) SD-73060-02 (DS 108D-L1A—Schematic Diagram)

(8) CD-73060-02 (DS 108D-L1A—Circuit Description)

TABLE B

DATA SETS 108D-L1A AND 108E-L1A OPTIONS
(OPTIONS FOR DATA SETS 108D-L1 AND 108E-L1 ARE SHOWN FOR COMPARISON.)

FEATURE			OPTION	108D-L1A OR 108E-L1A SWITCH SETTING S1 SWITCH ON CP1 OPEN	CLOSED		108D-L1 OR 108E-L1 SWITCH SETTING A SCREW SWITCH OPEN	CLOSED
FACILITY	4-WIRE		Z	3	2		2-3	1-2, 3-4
	2-WIRE		Y	2	3		1-2, 3-4	2-3
							SWITCH SETTING D SCREW SWITCH OPEN	CLOSED
RECEIVED GAIN REDUCTION	6 dB		K	1	—		1-2	—
	0 dB		J	—	1		—	1-2
				FACE PLATE DESIGNATION				
DIRECTIONAL CONTROL	C.O. HUB	FDX	X	DX	F		DX	F
		HDX	W		H			H
	STATION		X		F			F
TL LEAD	MARK HOLD		U	TL	M		TL	M
	SPACE HOLD		V		S			S
RL LEAD	MARK HOLD		S	RL	M		RL	M
	SPACE HOLD		T		S			S

Note 1: A fixed hybrid balance is provided in data sets 108D-L1A and 108E-L1A, corresponding to options H of data sets 108D-L1 and 108E-L1, respectively.

Note 2: To obtain an OFF, fail-safe state of the request to send (CA), solder a wire strap to two land areas on the printed board marked with the letter Q (this is a modification not an option).

Note 3: Carrier detection time can be reduced to about 100ms, by soldering a wire strap to two land areas of the printed board marked with the letter R (this is a modification not an option).

TABLE C

TRANSMIT LEVEL ADJUSTMENT OF DATA SETS 108D-L1A AND 108E-L1A

TRANSMIT LEVEL (dBm)	SWITCH SETTING S1 SWITCH ON CP1	
	OPEN	CLOSED
-1	4,5,6,7,8	—
-3	4,6,7,8	5
-5	4,5,7,8	6
-7	4,5,6,8	7
-9	5,6,7,8	4
-11	6,7,8	4,5
-13	5,7,8	4,6
-15	5,6,8	4,7
-16	6,8	4,5,7
-17.5	5,8	4,6,7,
-18.5	8	4,5,6,7
-23	5,6,7	4,8
-26	—	4,5,6,7,8

Note: In data sets 108D-L1 and 108E-L1, the transmit level is adjusted by means of potentiometer R18.

TABLE D
DATA SET 108D-L1
HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 1170 Hz	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	26 NL (HC)	900*	1-2,3-4	2-3		3-4
G	24 NL (HC)	700	1-2,2-3	3-4	3-4	
F	22 NL (HC)	550	2-3	1-2,3-4	3-4	
E	19 NL (HC)	400	1-2,2-3	3-4		3-4
B	16 NL (HC)	280	2-3	1-2,3-4		3-4
A	26 H88 (HC)	1180	1-2,3-4	2-3	3-4	
A	24 H88 (HC)	1080	1-2,3-4	2-3	3-4	
A	22 H88 (HC)	1060	1-2,3-4	2-3	3-4	
A	19 H88 (HC)	1030	1-2,3-4	2-3	3-4	
A	16 H88 (HC)	1130	1-2,3-4	2-3	3-4	

NL — Nonloaded (HC) — High Capacity
*Compromise hybrid network setting.

TABLE E
DATA SET 108E-L1

HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 2125 HZ	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	—	900*	1-2, 3-4	2-3		3-4
G	26 NL (HC)	650	2-3	1-2, 3-4	3-4	
F	24 NL (HC)	500	2-3, 3-4	1-2		3-4
E	22 NL (HC)	400	1-2, 2-3	3-4		3-4
B	19 NL (HC)	280	2-3	1-2, 3-4		3-4
A	16 NL (HC)	200	2-3	1-2, 3-4		3-4
ZA	26 H88 (HC)	1300	1-2, 3-4	2-3	3-4	
ZA	24 H88 (HC)	1260	1-2, 3-4	2-3	3-4	
ZA	22 H88 (HC)	1250	1-2, 3-4	2-3	3-4	
ZA	19 H88 (HC)	1240	1-2, 3-4	2-3	3-4	
ZA	16 H88 (HC)	1340	1-2, 3-4	2-3	3-4	

NL — Nonload (HC) — High Capacity
*Compromise hybrid network setting.

DATA SET 108D- AND E-TYPES
MULTIPLE PRIVATE LINE STATION ARRANGEMENT
USING 28A1 DATA MOUNTING AND 27B1 DATA UNIT
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section provides information on data set 108D- and E-types used in a multiple private line station arrangement for EIA (voltage) interface only. Data set 108D- and E-types perform similar functions as data set 108C- and A-types, respectively. Information is limited to the multiple data set arrangement using the 28A1 data mounting and the 27B1 data unit. In this section, data sets 108D- and E-types will be referred to as data sets 108D and E.

1.02 A multiple private line station consists of the following units:

- Data set 108D or E (as required)
- 27B1 data unit
- 28A1 data mounting
- KS-20575 rectifier (powers up to 16 data sets)
- Mounting rack arrangement (23- or 25-inch) in an appropriate housing, if required.

1.03 Data sets 108D and E are low-speed, full-duplex, FSK serial data sets for transmitting binary data up to 300 baud over either 2-wire or 4-wire private line or voiceband facilities. In a multiple private line system, the data sets work in conjunction with a 28A1 data mounting and a 27B1 data unit. Detailed information pertaining to data sets 108D and E may be found in the section entitled Data Sets 108D- and E-Type Used in Station Applications, Description (591-028-100).

1.04 One 28A1 data mounting will accommodate up to eight data sets 108D or E, one data set mounted in every odd slot (1, 3, 5, 7, etc) of the 28A1 data mounting, in a multiple private line station. The data mounting is arranged to house one KS-20575 rectifier.

1.05 The 27B1 data unit provides the EIA interface and is the means of interconnecting the customer-provided terminal equipment to the data set 108D or E mounted in the 28A1 data mounting. One 27B1 data unit is required per eight data sets and can be mounted on the rear of the 28A1 data mounting. The options that deal with the interface leads to the customer-provided terminal (CPT) are strapping connections which must be made on the 27B1 data unit at the time of installation.

1.06 Data sets other than the 108D and E may be used in a mixed 28A1 data mounting with data sets 108D and E, such as data sets 109E-type. Refer to Section 591-036-101 (Data Set 109E-Type

Multiple Data Set Arrangement Using 28A1 Data Mounting and 27-Type Data Unit—Description.

2. PHYSICAL DESCRIPTION

Data Sets 108D and E

2.01 Data sets 108D and E (Fig. 1 and 2, respectively) consist of two printed wiring circuit boards mounted together in piggyback fashion with a single connector. The data sets (AR-type circuit packs) are approximately 5-1/2 inches high, 7 inches deep, 1-1/8 inches wide, and weigh approximately 2 pounds. The data sets will operate in an ambient temperature range from 40°F to 120°F and in an ambient relative humidity range from 20 to 95 percent. The data sets plug into the 28A1 data mounting and require nominal power sources of +24 ±3 volts and −24 ±3 volts.

28A1 Data Mounting

2.02 The 28A1 data mounting (Fig. 3) is approximately 6 inches high and 10 inches deep. It mounts on either a 23- or 25-inch rack and weighs approximately 15 pounds. The 28A1 data mounting consists of one 59C apparatus mounting, two KS-16786-L4 connectors, one KS-16671-L1 plug, sixteen 927D connectors, and one terminal block.

2.03 The dc voltages to be delivered to the data set via the data mounting must be supplied to the data mounting either from an external source or by a KS-20575 rectifier which must be ordered separately. Space is provided on the 28A1 data mounting for mounting the KS-20575 rectifier which can supply power for a maximum of two fully equipped 28A1 mountings.

27B1 Data Unit

2.04 The 27B1 data unit (Fig. 4) is approximately 4-3/4 inches high, 7 inches wide, 1-1/2 inches deep and weighs approximately 2 pounds. The unit consists of a mounting plate containing eight 25-pin interface connections, eight test switches, option straps, and a cord equipped with two 50-pin plugs. The data unit requires no external power.

3. FUNCTIONAL DESCRIPTION

3.01 Data set 108D or E multiple private line station arrangement provides a maximum of eight EIA interface connections per data mounting between line facilities and customer-provided terminals. A functional block diagram is shown in Fig. 5.

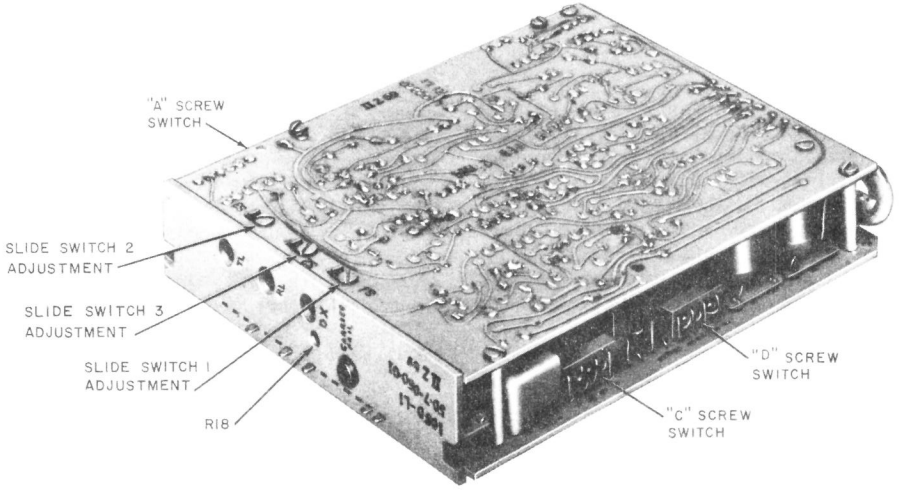


Fig. 1—Data Set 108D-Type

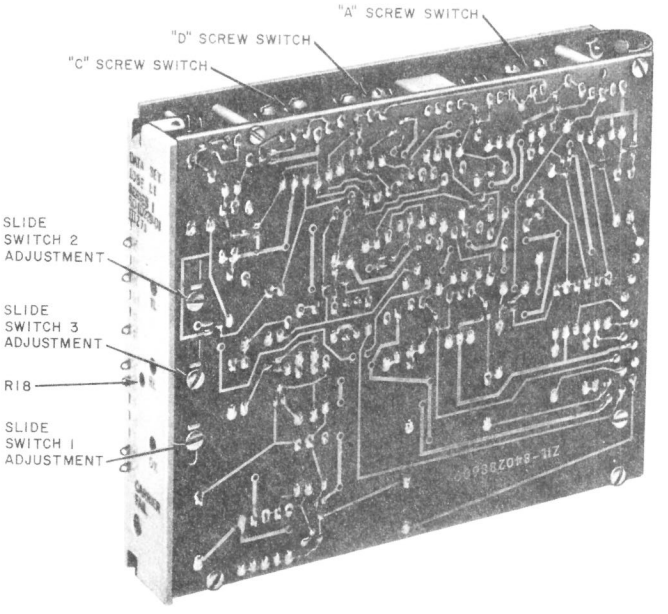


Fig. 2—Data Set 108E-Type

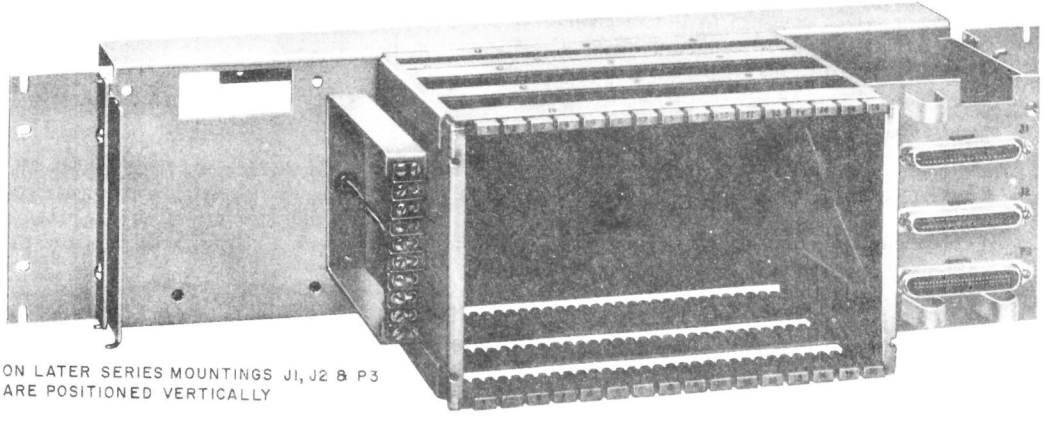


Fig. 3—28A1 Data Mounting

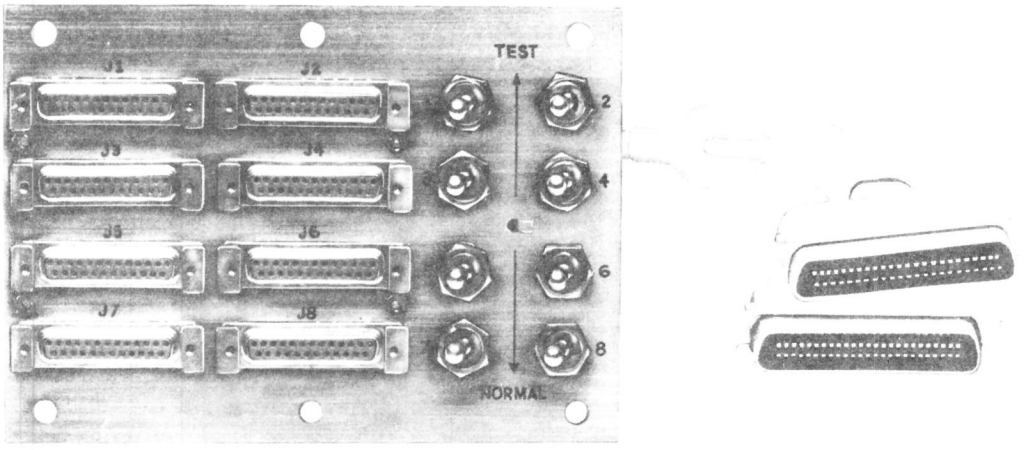


Fig. 4—27B1 Data Unit

3.02 Eight transmission facilities, each consisting of 2-wire or 4-wire metallic loops, are interfaced to the 28A1 data mounting through an intermediate distribution frame (IDF) or connecting block and an A25B-type connector cable (Fig. 5).

3.03 Data set 108D or E receives from and transmits data to a remote station. The data set provides five interface leads with signal characteristics, which conform to the Electronic Industries Association (EIA) Standard RS-232-C. The data set interface leads are as follows:

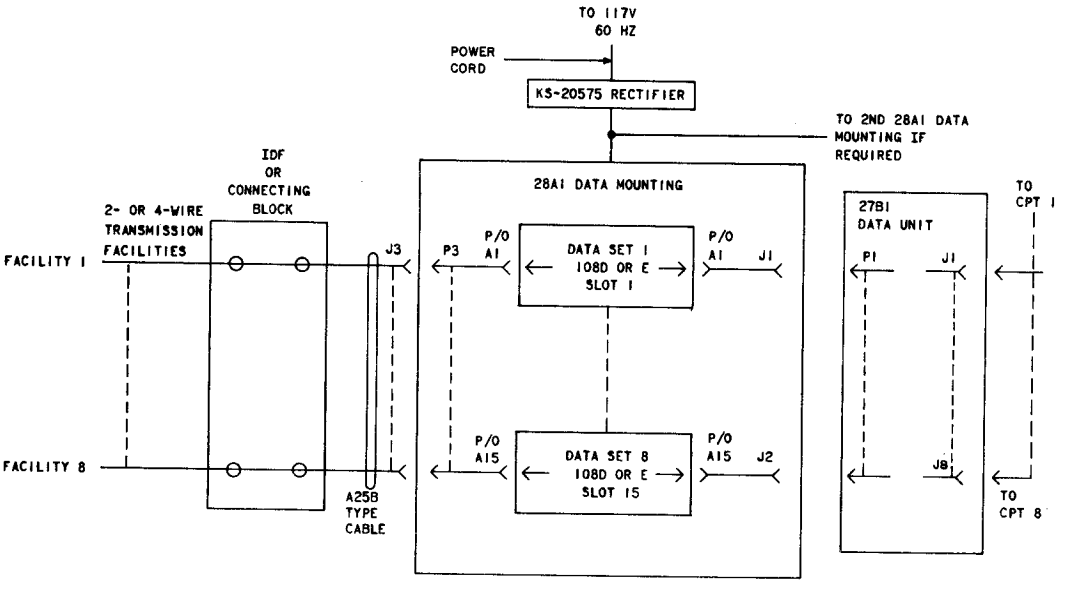
- BA—transmitted data
- BB (labeled TL)—received data
- CF (labeled RS)—received line signal detector (receive supervision)
- CSQ—carrier squelch
- CC (labeled ON)—data set ready.

Data Sets 108D and E

3.04 Data sets 108D and E in a muliple private line station arrangement provide full duplex (FDX) operation. FDX operation enables the data set to disable the directional control circuit to allow proper operation of a private line station. For a functional description of data sets 108D and E, refer to the section entitled Data Sets 108D- and 108E-Type Used in Station Applications—Description (591-028-100).

3.05 Data sets 108D and E functionally provide the following options:

- ***Option J***—This option provides 0-dB reduction in data set gain.
- ***Option K***—This option provides a 6-dB reduction in data set gain.
- ***Option U (Mark Hold on TL [BB] Lead)***—This option enables the data set to provide a marking condition on the TL lead when a loss of receive carrier is detected by the data set.
- ***Option V (Space Hold on TL [BB] Lead)***—This option enables the data set to provide a spacing condition on the TL lead when a loss of receive carrier is detected by the data set.
- ***Option Y***—2-wire service.
- ***Option Z***—4-wire service.



NOTE:
DATA SETS ARE PLUGGED INTO EVERY ODD SLOT (1, 3, 5, 7 FOR LEFT HALF AND 9, 11, 13, 15 FOR RIGHT HALF) OF 28A1 DATA MOUNTING.

Fig. 5—Functional Block Diagram—Data Set 108D or E Multiple Arrangement

28A1 Data Mounting

3.06 The 28A1 data mounting is a multiple apparatus housing which will accommodate a maximum of eight data sets 108D or E. In multiple data set arrangements, the 28A1 data mounting provides mounting space for eight data sets 108D or E and a power unit. Connectors J1 and J2 on the 28A1 data mounting provide interconnection from the data sets to the 27B1 data unit.

3.07 The 28A1 data mounting is electrically divided into two halves. Connector jack J1 and terminals 1, 2, and 3 of terminal block 1 (TB1) are associated with interface and power connections for the data sets in slots 1 through 8. Connector jack J2 and terminals 4, 5, and 6 of TB1 are associated with interface and power connections for the data sets in slots 9 through 16. Connector P3 on the 28A1 data mounting (common to the two halves) provides interconnection from the data sets to the transmission facilities.

3.08 The KS-20575 rectifier is used to supply power to both halves of the data mounting. The +24V of KS-20575 rectifier is connected to terminals 1 and 4 of TB1, the −24V is connected to terminals 2 and 5 of TB1, and signal ground is connected to terminals 3 and 6 of TB1. Terminal 7 is not used and terminal 8 is connected to frame ground on the KS-20575 rectifier.

27B Data Unit

3.09 The data set 108D or E multiple private line station arrangement uses one 27B1 data unit which provides interface connections between eight data sets and eight CPTs. P1 and P2 of the 27B1 data unit connect to J1 and J2 of the 28A1 data mounting. The EIA outputs of the CPTs are connected to the data unit via the customer-provided cables which plug into J1 through J8 on the data unit. The EIA connectors 1 through 4 serve the four data sets in the left half of the 28A1 data mounting while connectors 5 through 8 serve the four data sets on the right half.

3.10 Eight toggle switches (one for each data set) located on the 27B1 data unit are designated TEST—NORMAL. When the toggle switch is in the TEST position, the associated data set is placed in the test mode (loop-back testing). When the toggle switch is in the NORMAL position, the associated data set is in the normal mode.

4. REFERENCES

4.01 The following documents pertain to data set 108D or E multiple private line station:

SD- & CD-73060-01 Data Set 108D

SD- & CD-1D229-01 Data Set 108E

SD- & CD-1D176-01 Data Systems Station 28-Type Data Mounting

SD- & CD-1D183-01 Data Systems 27-Type Data Unit

SECTION	TITLE
590-100-114	27A1 and 27B1 Data Unit—Identification
590-102-124	28A1 Data Mounting—Identification
591-028-100	Data Sets 108D- and 108E-Types Used in Station Applications—Description
591-028-202	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit, Installation and Connections
591-028-302	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit—Maintenance
591-028-502	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit—Test Procedures.

DATA SETS 108D- AND E-TYPE MULTIPLE PRIVATE LINE STATION ARRANGEMENT USING 28A1 DATA MOUNTING AND 27B1 DATA UNIT INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section provides installation and connection procedures to be followed when installing data sets 108D- and E-type in the multiple data set private line station arrangement. This information is limited to the multiple arrangement using the 28A1 data mounting and the 27B1 data unit. In this section, data sets 108D- and E-type will be referred to as data sets 108D and E.

1.02 The multiple arrangement using data set 108D or E (Fig. 1 and 2, respectively) consists of eight data sets per data mounting, a 28A1 data mounting, one 27B1 data unit per data mounting (one for eight data sets), and KS-20575 rectifier or an appropriate power source.

1.03 Plugs and cables for connecting the customer-provided terminals (CPTs) to the data sets are provided by the customer and should not exceed 50 feet in length. The cables for connecting the multiple data set arrangement to the transmission facilities must be terminated at the data mounting end in a 50-pin connector, such as the one on the A25B-type connector cable. The 27B1 data unit, 28A1 data mounting, and A25B-type connector cable are not furnished with the data sets and must be ordered separately.

1.04 Power supplies for the multiple data set arrangement may be external sources or a KS-20575 rectifier, which can be mounted on the 28A1 data mounting. The KS-20575 rectifier or other external power sources is not furnished with the 28A1 data mounting and must be ordered separately. One KS-20575 rectifier may supply power to two 28A1 data mountings.

1.05 The multiple data set arrangement may be installed in any location that is convenient for the customer within 50 feet of the CPT. Verify that the location (selected by the customer) for the installation is adequate for maintenance and that the customer-provided ac power outlet is ***not*** controlled by a switch. The ac power outlet and cable must be arranged to adequately reach the equipment cabinet or mounting rack arrangement.

1.06 The data set 108D and E multiple arrangement using the 28A1 data mounting and 27B1 data unit may be housed in a KS-20018 type or KS-20093 type cabinet, or equivalent, or any mounting rack arrangement that will accept the 23- or 25-inch 28A1 data mounting.

1.07 Reference directions (left, right, front, or rear) on the data mounting are in respect to facing the apparatus mounting side of the data mounting.

1.08 A 748A tool may also be needed if the locking bar is ***not*** functional for extracting the data set from the 28A1 data mounting. A portable station test set TTS-28, or equivalent, is required when making level adjustments.

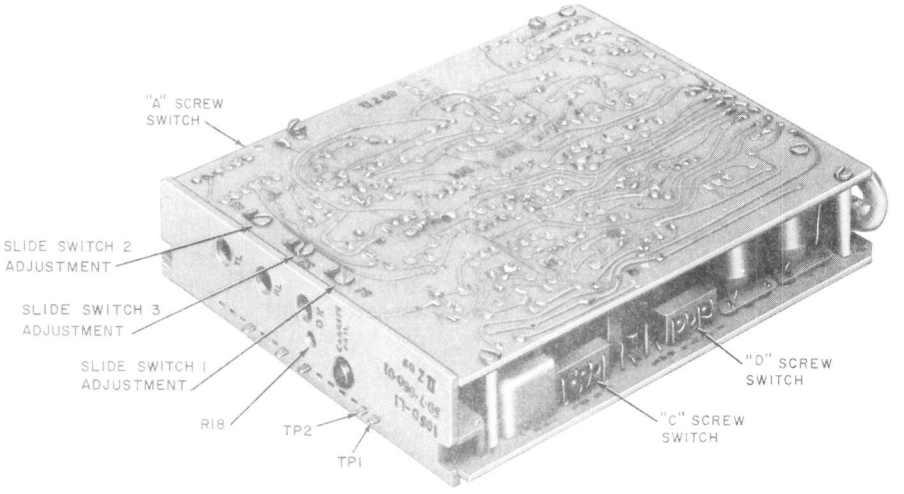


Fig. 1—Data Set 108D-Type

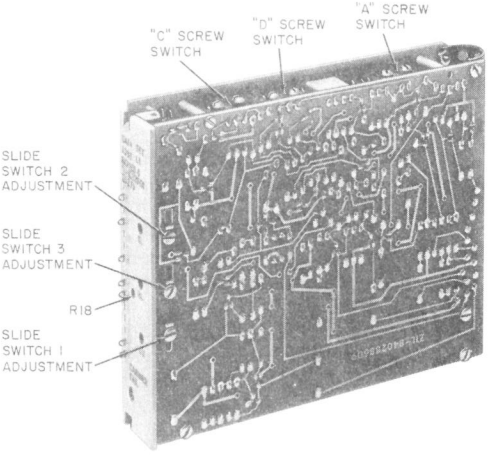


Fig. 2—Data Set 108E-Type

2. OPTIONS

2.01 Options for data sets 108D and E multiple arrangement vary depending on the application of the arrangement. These optional adjustments are made on the data set 108D or E and the 27B1 data unit. The optional strapping connections made on the 27B1 data unit are options that deal with the interface control leads to the CPT. There are no options associated with the 28A1 data mounting.

THINK ***Options should be installed prior to installation.***

A. Data Sets 108D and E

Faceplate-Indicated Options

2.02 Faceplate-indicated option selection on the 108D and E is made by means of slide or rotary switches as shown in Table A. Table A also provides option designation, function of option, and faceplate designation. Installation of options on the data set is made in accordance with specifications on the service order or circuit layout record. See Fig. 1 and 2 for location of switches on data set 108D and E, respectively.

2-Wire or 4-Wire Options

2.03 The option of 2-wire or 4-wire service is also provided with data sets 108D and E. These options are implemented by three screw switches (A, C, and D). Table B provides the applicable information for implementing 2-wire or 4-wire service.

2.04 For 4-wire service, option Z must be installed in the data set. The transmit loop facility is connected to the connector terminals mating with card terminals 15 and 16 (R and T). The receive loop facility is connected to the connector terminals mating with card terminals 17 and 18 (T1 and R1). The screw options are set as shown in Table B.

2.05 For 2-wire service, option Y is installed in the data set. The loop facility is connected to the connector terminals mating with card terminals 15 and 16 (R and T). The screw options are set as shown in Table B.

2.06 When 2-wire service is required (option Y), screw switches C and D are adjusted to provide maximum transhybrid loss. The data set interface with the line is a hybrid network which must be adjusted to provide the correct loss when the facility is 2-wire. Switching of the hybrid is determined by the loop impedance of the facility. Tables C and D show typical loop impedance and provide screw switch settings for maximum transhybrid loss when installing data sets 108D and E, respectively.

> ***Note:*** The hybrid network switching arrangement should be given on the service order or circuit layout record.

If the loop facility is ***not*** known, 900 ohms is a good compromise switch setting of the hybrid network (2-wire) as shown in Tables C and D under the Loop Impedance Measured column.

Receiver Gain Option

2.07 Data set option K may be installed to reduce the gain of the receiver by 6 dB while option J provides full gain. These options are installed when the data set receive level is determined. Option J or K is installed by closing or opening the 1—2 section of screw switch D, respectively. Refer to 5.02 for installation of option J or K.

B. 27B1 Data Unit

2.08 Optional connections on the 27B1 data unit are in the form of strapping arrangements. The CSQ lead appears as a spade-tipped lead in the 27B1 data unit. This lead can be optionally strapped to one of two screw terminals (RS or SPARE) on the 27B1 data unit, as required on the service order or circuit layout record. Options on the 27B1 data unit can be defined and installed as follows:

- ***Option R (Carrier Squelch on Carrier Fail):*** This option turns the data set off if carrier is lost for 110 to 250 ms. To install option R, connect the CSQ lead to the RS screw terminal.

- ***Option Q (No Carrier Squelch on Carrier Fail):*** This option keeps the data set in the data mode even if the carrier fails. To install option Q, connect the CSQ lead to the SPARE screw terminal. (In the test mode, carrier squelch on carrier fail is applied.)

3. INSTALLATION

3.01 The multiple private line arrangement using data set 108D or E, 28A1 data mounting, KS-20575 rectifier, and 27B1 data unit may be installed in any cabinet or any mounting rack arrangement that will accept the 23- or 25-inch 28A1 data mounting. The 28A1 data mounting may be arranged to mount as follows:

- 23-inch mounted in a KS-20018 type cabinet
- 25-inch mounted in a KS-20093 type cabinet.

3.02 The following information contains instructions which can be applied to installations having a multiple arrangement.

28A1 Data Mounting

3.03 If the 28A1 data mounting is to be installed in a 23-inch rack, arrange the brackets so the long sides are against the data mounting. When the data mounting is to be installed in the 25-inch rack, arrange the brackets so the short sides are against the data mounting.

3.04 When the KS-20575 rectifier is to be used as a power source for the data sets, mount it in the space provided on the left-hand side of the data mounting, using the four screws provided with the rectifier.

Do not connect power to the equipment until instructed to do so.

27B1 Data Unit

3.05 Install and interconnect the 27B1 data unit as follows, using the screws supplied with the 28A1 data mounting.

Ensure that the options are properly connected on the 27B1 data unit before installing.

KS-20018 Type Cabinet

(1) Install one 27B1 data unit on the rear of the 28A1 data mounting (either left- or right-hand side as required).

(2) Install the 28A1 data mounting in the cabinet with the eight screws provided.

(3) Route the two 27B1 data unit connector cables as required.

(4) Connect P1 of the 27B1 data unit to connector J1 of the 28A1 data mounting.

(5) Connect P2 of the 27B1 data unit to connector J2 of the 28A1 data mounting.

KS-20093 Type Cabinet

(1) Install the 27B1 data unit behind the customer access door on the front left-hand side of the cabinet.

(2) Install the 28A1 data mounting in the cabinet with the eight screws provided.

(3) Route the two 27B1 data unit connector cables as required.

(4) Connect P1 of the 27B1 data unit to J1 of the 28A1 data mounting.

(5) Connect P2 of the 27B1 data unit to J2 of the 28A1 data mounting.

Data Sets 108D and E

3.06 The installation procedure for data sets 108D and E can be found in 4.03.

4. CONNECTIONS

4.01 The interconnection arrangement for the typical data set 108D or E multiple arrangement is shown in Fig. 3.

4.02 Connect the 28A1 data mounting to the transmission facilities as follows:

(1) Plug the 50-pin J3 (A25B-type) connector cable into P3 of the 28A1 data mounting.

(2) Route the A25B-type connector cable to the intermediate distribution frame (IDF) or connector block and make connections as required.

(3) Connect the appropriate private line facilities to the IDF or connector block as required.

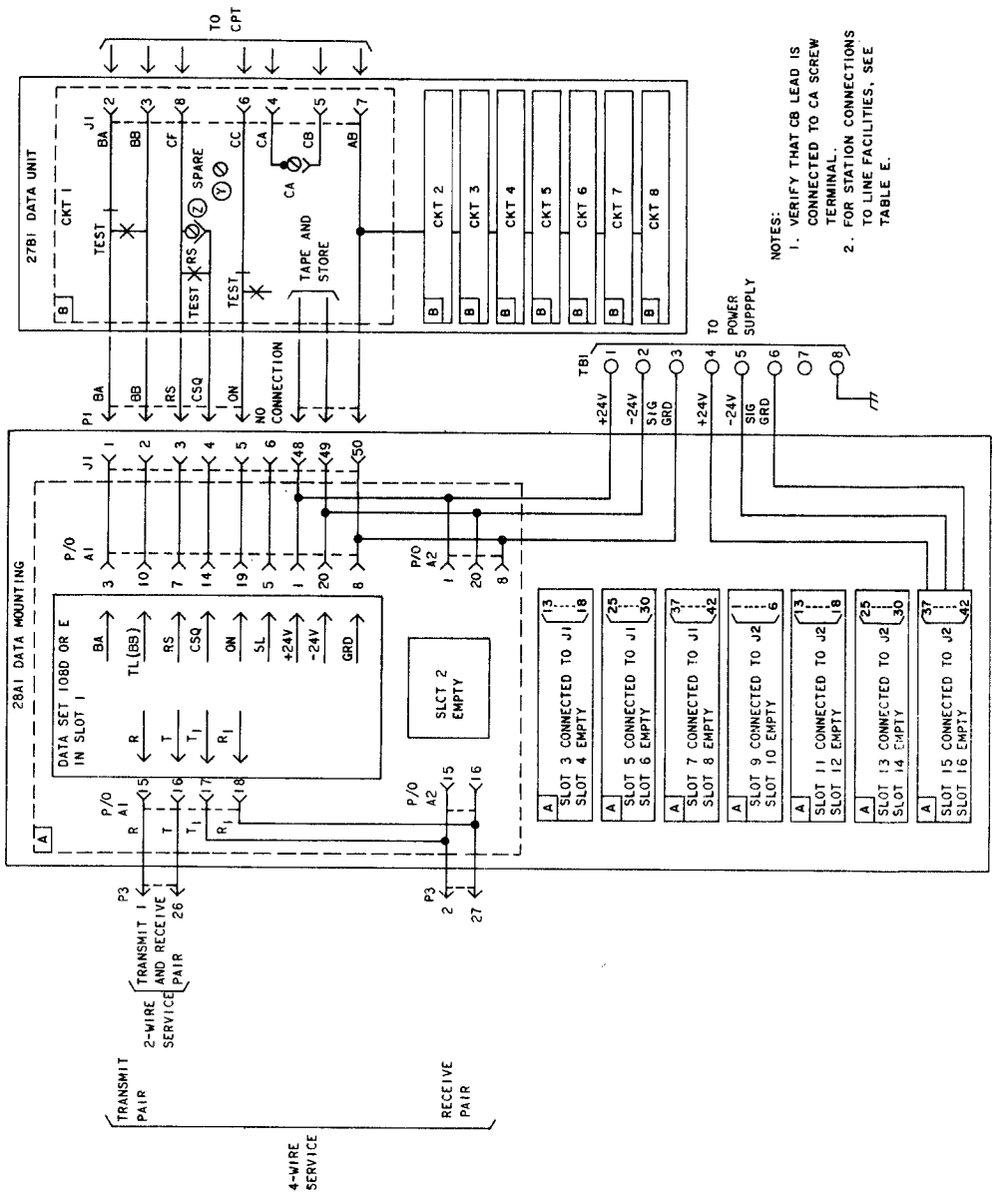


Fig. 3—Data Set 108D- or E-Type Multiple Arrangement Interconnection Block Diagram

TABLE A

DATA SET FACEPLATE-INDICATED OPTIONS

OPTION DESIGNATION	FUNCTION OF OPTION	SLIDE SWITCH *		ROTARY SWITCH S1 †		FACEPLATE DESIGNATION	
		SWITCH	SWITCH POSITION	SWITCH	SWITCH POSITION ‡		
X	FDX Operation—Disables the hub directional control circuit of the data set to allow proper operation of a private line station.	S1	Closed	S1(DX)	Down	DX	F
W	HDX Operation—Not functional in station application.		Open		Up		H
V	Space Hold on TL (BB)—Enables the data set to provide a spacing condition on the TL lead when a loss of received carrier is detected by the data set.	S2	Closed	S1(TL)	Down	TL	S
U	Mark Hold on TL (BB)—Enables the data set to provide a marking condition on the TL lead when a loss of received carrier is detected by the data set.		Open		Up		M
T	Not functional in station application.	S3	Closed	S1(RL)	Down	RL	S
S	Not functional in station application.		Open		Up		M

Note: Options X, U, and S are factory-installed options.
* Data sets 108D (series 2) and 108E (series 1)
† Data sets 108D (series 3) and 108E (series 2)
‡ *Down* refers to position closest to end of switch marked with dot.
Up refers to position farthest from end of switch marked with dot.

TABLE B

2-WIRE/4-WIRE OPTIONS

OPTION	"A" SCREW SWITCH SETTING		"C" SCREW SWITCH SETTING
	CLOSE (CW)	OPEN (CCW)	
Z (4-wire)	1-2, 3-4	2-3	1-2, 2-3, 3-4 all open (ccw)
Y (2-wire)	2-3	1-2, 3-4	Refer to Table C or D.

TABLE C

DATA SET 108D
HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 1170 HZ	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	26 NL (HC)	900*	1-2, 3-4	2-3		3-4
G	24 NL (HC)	700	1-2, 2-3	3-4	3-4	
F	22 NL (HC)	550	2-3	1-2, 3-4	3-4	
E	19 NL (HC)	400	1-2, 2-3	3-4		3-4
B	16 NL (HC)	280	2-3	1-2, 3-4		3-4
A	26 H88 (HC)	1180	1-2, 3-4	2-3	3-4	
A	24 H88 (HC)	1080	1-2, 3-4	2-3	3-4	
A	22 H88 (HC)	1060	1-2, 3-4	2-3	3-4	
A	19 H88 (HC)	1030	1-2, 3-4	2-3	3-4	
A	16 H88 (HC)	1130	1-2, 3-4	2-3	3-4	

NL—Nonloaded (HC)—High Capacity

* Compromise hybrid network switching.

See Table E for connection of line facilities to station.

4.03 Insert data set 108D or E in the proper position on the 28A1 data mounting. One data set mounts in each odd slot of the 28A1 data mounting (1, 3, 5, 7, etc) up to a maximum of eight.

4.04 Ensure that a good connection is made between the data set and the data mounting by using sufficient force when pushing the data set into position.

4.05 Connect the EIA outputs of the CPT to the 27B1 data unit via the eight customer-provided cables which plug into J1 through J8 on the data

TABLE D

DATA SET 108E
HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 2125 HZ	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	—	*900	1-2, 3-4	2-3		3-4
G	26 NL (HC)	650	2-3	1-2, 3-4	3-4	
F	24 NL (HC)	500	2-3, 3-4	1-2		3-4
E	22 NL (HC)	400	1-2, 2-3	3-4		3-4
B	19 NL (HC)	280	2-3	1-2, 3-4		3-4
A	16 NL (HC)	200	2-3	1-2, 3-4		3-4
ZA	26 H88 (HC)	1300	1-2, 3-4	2-3	3-4	
ZA	24 H88 (HC)	1260	1-2, 3-4	2-3	3-4	
ZA	22 H88 (HC)	1250	1-2, 3-4	2-3	3-4	
ZA	19 H88 (HC)	1240	1-2, 3-4	2-3	3-4	
ZA	16 H88 (HC)	1340	1-2, 3-4	2-3	3-4	

NL—Nonloaded (HC)—High Capacity

* Compromise hybrid network switching.

unit. (See 3.05 for connection of the 27B1 data unit to the 28A1 data mounting.

4.06 Make KS-20575 rectifier wiring connections to the 28A1 data mounting as follows:

Note: The wiring connections between the KS-20575 rectifier and the 28A1 data mounting are made with 22-gauge, or larger, solid wire for power, signal ground, and frame ground connections.

(1) Connect +24 volts on the rectifier to terminals 1 and 4 of TB1.

(2) Connect −24 volts on the rectifier to terminals 2 and 5 of TB1.

(3) Connect signal ground on the rectifier to terminals 3 and 6 of TB1.

(4) Connect the frame ground on the rectifier to terminal 8 of TB1.

Note: Verify if customer desires signal ground and frame (protective) ground made common. Connect terminal 8 to terminal 3 of TB1 on 28A1 data mounting if customer desires common grounds.

(5) Connect the ac power cord to a 117-volt 60-Hz ac outlet.

5. PREOPERATIVE ADJUSTMENTS

5.01 Verify that the loop has been tested and meets requirements. Refer to the section entitled Private Line Data Circuits—Voice Bandwidth Circuits for Miscellaneous Data—Overall Tests and Requirements (314-410-500). Loop loss testing procedures and requirements for data sets 108D and E are given in Section 591-028-502.

Data Set Receive Level Adjustment

5.02 At the time of manufacture, option K is provided (screw switch D on data set 108D or E is open) for minimum sensitivity (minimum

TABLE E

STATION CONNECTIONS TO LINE FACILITIES

DATA SET SLOT	2-WIRE		4-WIRE			
	SEND AND RECEIVE		SEND		RECEIVE	
	R	T	R	T	T1	R1
1	1	26	1	26	2	27
3	3	28	3	28	4	29
5	5	30	5	30	6	31
7	7	32	7	32	8	33
9	9	34	9	34	10	35
11	11	36	11	36	12	37
13	13	38	13	38	14	39
15	15	40	15	40	16	41

gain of receive-amplifier stage). If the receive level is less than −30 dBm (−31, −32), the 6-dB reduction of gain should be removed by installing option J (closing the 1—2 section of screw switch D). Table F shows the condition of the screw switch for each gain setting. The screw switch should be set according to the service order or circuit layout record.

TABLE F

SCREW SWITCH D SETTINGS ON THE DATA SET FOR REDUCTION IN GAIN

DB REDUCTION IN GAIN	"D" SCREW SWITCH		DATA SET OPTION
	CLOSED	OPEN	
6	—	1-2	K
0	1-2	—	J

Data Set Transmit Level Adjustment

Tip and ring connections must be disconnected for data set transmit level adjustment.

5.03 Connect terminals + and − of TTS-28 portable station test set to TP1 and TP2 of the data set. Test points are identified by raised numbers on faceplate of data set. Set FUNCTION switch of TTS-28 to DBM 900 Ω TERM 0 position. Connect power to DAS. Adjust potentiometer R18 on the data set for output level specified on service order or circuit layout record. If the line is a 4-wire 600-ohm termination, adjust R18 to indicate 1-1/2 dBm more than the output level specified to allow for use of the TTS-28 with a 900-ohm termination.

If carrier squelch on carrier fail (option R) is installed in the 27B1 data unit, it MUST be removed to measure the output level of the data set. At time of initial installation, unplug the 27B1 data unit from the 28A1 data mounting (P1 and P2 from J1 and J2) to make data set transmit level adjustment via R18.

If installing a data set in an arrangement that is already installed on customer premises, carefully remove 27B1 data unit (from cabinet) and remove option R to make transmit level adjustment for data set being installed. To remove option R, remove CSQ spade tip lead from RS screw. Once the measurements and adjustments (via R18) have been made, reconnect the CSQ lead to RS screw and reinstall 27B1 data unit in cabinet as required.

5.04 Connect the private line facility lines as required.

5.05 Perform installation tests in accordance with Section 591-028-502.

6. REFERENCES

6.01 The following documents pertain to data sets 108D and E multiple private line station:

SD- & CD-73060-01 Data Set 108D
SD- & CD-1D229-01 Data Set 108E
SD- & CD-1D176-01 Data Systems Station 28-Type Data Mounting
SD- & CD-1D183-01 Data Systems 27-Type Data Unit

SECTION	TITLE
590-100-114	27A1 and 27B1 Data Units—Identification
590-102-124	28A1 Data Mounting—Identification
591-028-100	Data Sets 108D- and 108E-Type, Used in Station Applications—Description
591-028-102	Data Sets 108D- and E-Type, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit—Description
591-028-302	Data Sets 108D- and E-Type, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit—Maintenance
591-028-502	Data Sets 108D- and E-Type, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit—Test Procedures.

DATA SETS 108D- AND E-TYPE MULTIPLE PRIVATE LINE STATION ARRANGEMENT USING 28A1 DATA MOUNTING AND 27B1 DATA UNIT TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section describes the test procedures and associated test requirements to be met at the time of installation or when investigating trouble conditions associated with data sets (DS) 108D- or 108E-type multiple private line station arrangement. Information is limited to the multiple data set arrangement using the 28A1 data mounting and the 27B1 data unit. In this section, data sets 108D- and E-type will be referred to as data sets 108D and E.

1.02 This section is to be used in conjunction with Sections 591-028-202 and 591-028-302.

1.03 The following is a complete list of test equipment necessary to perform the test outlined in this section:

Note: If the 911A data test set (DTS) is available, it should be used in place of the 902- and 903-type DTSs used in the distortion measurement test.

- 911A Data test set
- 901B Data test set cover (interface test adapter J79901B)
- 902-Type data test set
- 903-Type data test sets (two required)
- Portable station test set TTS-28, or KS-20538-L1 volt-ohm-milliammeter (VOM)
- 1013-Type handset (dial hand test set)
- Portable telegraph carrier test set (TCTS) (KS-19935-L7)

Note: The TCTS includes the auxiliary power supply.

- W2DW Cords (two required)
- W1AD Cords, or equivalent (three required)
- 1W2A Cords, or equivalent (two required)

1.04 In order to test the near-end station used in a private line arrangement, it is necessary to perform the following:

- Remove the carrier squelch on carrier fail option (option R in 27B1 data unit) if it is installed at either end.
- Ensure that data set is ***not*** in test mode.

Note: If the carrier squelch on carrier fail option is ***not*** removed at a station and a carrier fail condition occurs, the station cannot transmit until the data set at the station receives a connect signal. This condition will cause difficulty isolating receive, loop, or far-end transmit problems. The test mode automatically installs a carrier squelch on carrier fail which can result in the same problem.

- Reestablish connection to DS 108E by sending an unmodulated (steady) marking or spacing frequency.
- Reestablish connection to DS 108D by sending an unmodulated (steady) marking frequency.

1.05 ***Lettered Steps:*** A letter a, b, c, etc, added to a step number of this section indicates an action which may or may not be required, depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the PROCEDURE column, and all steps governed by the same condition are designated by the same letter within the test. Where a condition does not apply, all steps designated by that letter should be omitted.

1.06 The test procedures given in this section are for one data set and must be repeated for each additional data set.

2. CARRIER MONITORING TEST

2.01 This test determines the presence of both near- and far-end carriers. Equipment necessary for this test consists of the following:

- 1013-Type handset
- KS-19935-L7 Telegraph carrier test set (TCTS) and two W1AD cords.

A. Far-End Carrier—Audible Indication

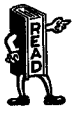
2.02 The following procedure should be used to determine the presence of far-end carrier at the station when using the 1013-type handset.

Verify that carrier squelch on carrier fail option has been disabled at the far end and the far end is not in the test mode.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Operate 1013 handset TALK MON switch to MON.
3a	For a 2-wire line facility, unplug data set to be tested.
4a	Go to connecting block and connect leads of 1013 handset to 2-wire facility.
5b	For 4-wire line facility, connect leads of 1013 handset to data set TP6 and TP13.
6	Monitor incoming carrier frequency. ***Requirement:*** An audible tone is heard. ***Note:*** Modulated incoming carrier will ***not*** extinguish the data set CF lamp if it is lighted (refer to 1.04).
7	Remove 1013 handset and restore station to pretest condition.

B. Near-End Carrier—Audible Indication

2.03 The following procedure should be used to determine the presence of near-end carrier using a 1013 handset.



Verify that near end is not in test mode.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Operate 1013 handset TALK MON switch to MON.
3	Connect leads of 1013 handset to data set TP1 and TP2 (2-wire or 4-wire).
4a	If carrier squelch on carrier fail option (option R) is installed, remove it from 27B1 data unit by removing CSQ spade tip lead from RS screw terminal.
5	Monitor outgoing carrier frequency. ***Requirement:*** An audible tone is heard. ***Note:*** Near-end carrier will be the louder of two tones heard in 2-wire arrangements. In 4-wire operation, only near-end carrier is present on data set TP1 and TP2.
6b	If carrier squelch on carrier fail option (option R) was originally in 27B1 data unit, reinstall it.
7	Remove 1013 handset and restore station to pretest condition.

C. Far-End or Near-End Carrier Frequency Measurement

2.04 The following procedure measures the carrier frequency of the far end or near end, depending on the lettered step indicated. The test equipment used is a KS-19935-L7 TCTS and two W1AD cords.

STEP	PROCEDURE
1	Using a nearby telephone, instruct the far-end station not to send data until instructed to return station to normal operation.
2	Gain access to cabinet as required.

STEP	PROCEDURE
3	Connect one end of the auxiliary power supply interconnection power cord (stored in the CABLES AND SPARE FUSES section of the auxiliary power supply) to the PWR jack of the auxiliary power supply.
4	Connect the other end of the interconnection power cord to the PWR jack of the TCTS.
5	Operate the controls of the TCTS as follows: • AM/FM to FM • SW/DW/F to F • SPKR switch to ON • HI-M/LO-M to HI-M • LEVEL dBm to −17 • CHANNEL SELECT F1 or F2 as required. ***Note:*** For near-end transmit frequency measurement, set CHANNEL SELECT to F1 for DS 108D or F2 for DS 108E. For far-end receive frequency measurement, set CHANNEL SELECT to F1 for DS 108E or F2 for DS 108D.
	Far-End Carrier Frequency Measurement
6a	For 2-wire line facilities, connect alligator clip ends of the two W1AD cords to DS TP1 and TP2.
7b	For 4-wire line facilities, connect alligator clip ends of the two W1AD cords to DS TP6 and TP13.
	Near-End Carrier Frequency Measurement ***Note:*** Verify that near end is not in test mode.
8c	For 2-wire or 4-wire line facilities, connect the alligator clip ends of the two W1AD cords to data set TP1 and TP2.
9c	If carrier squelch on carrier fail option is installed, remove it from 27B1 data unit by removing CSQ spade tip lead from RS screw terminal.
10	Connect spade-tip ends of the two W1AD cords to VF-1 and VF-2 screws of TB1 on back of the TCTS.
11	Connect the power cord of the auxiliary power supply (with TCTS) to an available 120V 60-Hz ac power source.
12	Operate the PWR switch of auxiliary power supply to ON.

STEP	PROCEDURE
13d	Monitor far-end incoming carrier frequency F1 (DS 108E) or F2 (DS 108D). ***Note:*** If far-end station transmits a mark, the SIGS M-ON lamp of the TCTS lights. If far-end station transmits a space, the SIGS M-ON lamp will ***not*** light. The lamp will blink to indicate modulated carrier (refer to 1.04). ***Requirement:*** FREQUENCY DEVIATION meter indicates not less than −6 and not more than +6 Hz from F1 frequencies for DS 108E (1270-Hz mark and 1070-Hz space) or from F2 frequencies for DS 108D (2225-Hz mark and 2025-Hz space).
14e	Monitor near-end carrier frequency F1 (DS 108D) or F2 (DS 108E). ***Note:*** The SIGS M-ON lamp of the TCTS lights. ***Requirement:*** The FREQUENCY DEVIATION meter indicates not less than −6 and not more than +6 Hz from F1 frequency for DS 108D (1270-Hz mark) or from F2 frequency for DS 108E (2225-Hz mark).
15	Operate the PWR switch of the auxiliary power supply to OFF.
16	Disconnect all test cords.
17e	If performing near-end carrier frequency measurement, return carrier squelch on carrier fail option (option R) on 27B1 data unit if required.
18	Return the near-end station and the far-end station to normal operation.

3. CARRIER SHIFT TEST

3.01 This test determines if the near-end carrier can be shifted. The following test equipment is required at the station:

- 901B DTS Cover (interface test adapter)
- 1013-Type handset or KS-19935-L7 TCTS (portable)
- W1AD Cords (three required).

A. Audible Indication

3.02 The following procedure using the 1013 handset is used to determine if the near-end carrier can be shifted.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2a	If carrier squelch on carrier fail option is installed, remove it from the 27B1 data unit by removing CSQ spade tip lead from RS screw terminal.
3	Verify that near-end station is ***not*** in test mode.

STEP	PROCEDURE
4	Remove customer interface cord from J1 of the 27B1 data unit and plug cord from 901B cover (interface test adapter) into J1.
5	Operate 1013 handset TALK MON switch to MON.
6	Connect leads from 1013 handset to data set TP1 and TP2 (2-wire or 4-wire mounted in slot 1 of 28A1 data mounting).
7	Connect one end of W1AD cord to terminal 2 (BA lead) of interface test adapter.
8	Using free end of W1AD cord, momentarily touch ◗terminal 2 (−24V) and then◖ terminal 1 (+24V) of TB1 on the 28A1 data mounting while monitoring with 1013 handset. ***Requirement:*** Shift in tone is heard. ***Note:*** Repeat Steps 4, 6, and 8 for additional data sets as required. In Step 4, plug interface test adapter cord into J2, J3, etc, for each test. In Step 6, connect 1013 handset to TP1 and TP2 of data set mounted in slots 3, 5, 7, etc, of the 28A1 data mounting for each test. Repeat Step 8 as given. (Return customer interface cord to J1 at end of test and repeat for J2, J3, etc, as required.)
9b	If carrier squelch on carrier fail was originally installed in 27B1 data unit, reinstall it.
10	Remove test equipment, restore customer-provided interface cord, and restore station to pretest condition.

B. Frequency Measurement

3.03 The following procedure using the KS-19935-L7 TCTS is used to measure the frequency of the near-end carrier when it is shifted.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2a	If carrier squelch on carrier fail option is installed, remove it from the 27B1 data unit by removing CSQ spade tip lead from RS screw terminal.
3	Verify that near-end station is ***not*** in test mode.
4	Connect the auxiliary power supply (with TCTS) interconnection power cord (stored in its CABLES AND SPARE FUSES section) to the PWR jack of the auxiliary power supply.
5	Connect the other end of the power cord to the PWR jack of the TCTS.

STEP	PROCEDURE
6	Operate the controls of the TCTS as follows: • AM/FM to FM • SW/DW/F to F • SPKR switch to ON • HI-M/LO-M to HI-M • LEVEL dBm to −17 • CHANNEL SELECT F1 or F2 as required (F1 for DS 108D or F2 for DS 108E).
7	Connect alligator clip ends of two of the W1AD cords to data set TP1 and TP2 (2-wire or 4-wire).
8	Connect spade-tip ends of the two W1AD cords to VF-1 and VF-2 screws on the back of the TCTS.
9	Connect spade end of the third W1AD cord to terminal 2 ▶(BA lead)◀ of the interface test adapter.
10	▶Connect the alligator clip of the third W1AD cord to terminal 2 (−24V) of TB1 on the 28A1 data mounting.◀
11	Operate the PWR switch of the auxiliary power supply to ON. ***Requirement:*** The meter will indicate not less than −6 and not more than +6 Hz. A continuous tone is heard. ***Note:*** If near-end station is sending a mark, the SIGS M-ON lamp of TCTS is lighted.
12	▶Disconnect the third W1AD cord (connected in Step 10) from terminal 2 (−24V) of TB1 28A1 data mounting.◀
13	Connect the third W1AD cord to terminal 1 (+24V) of TB1 on the 28A1 data mounting. ***Requirement:*** A shift in tone is heard. FREQUENCY DEVIATION meter indicates not less than −6 and not more than +6 Hz. Near-end station is sending a space and SIGS M-ON lamp is extinguished.
14	Operate the PWR switch of the auxiliary power supply to OFF. ***Note:*** Repeat Steps 7, 11, 12, 13, and 14 for each data set mounted in the 28A1 data mounting.
15b	If carrier squelch on carrier fail option was originally installed in 27B1 data unit, reinstall it.
16	Remove test equipment and restore station to pretest condition.

4. LOOP-BACK TEST

4.01 The loop-back test is required when investigating trouble reports or at the time of installation to ensure proper operation of the data station. If the service offering is a voiceband data circuit, the 904-type data test center (DTC) will perform the test. When the service is station-to-station operation, the far end is placed in the test mode.

4.02 Usually, for station-to-hub arrangement, the loop-back test will have been performed prior to dispatching a telephone company employee in response to a trouble report.

4.03 The data station is conditioned for loop-back testing by operating the test switch associated with the data set to be tested. Eight test switches are located on the 27B1 data unit. One test switch is provided for each of the eight data sets mounted in the 28A1 data mounting. Test switch 1 is associated with the data set mounted in slot 1 of the 28A1 data mounting. Since data sets 108D or E are mounted in every odd slot (1, 3, 5, 7, etc) of the 28A1 data mounting, test switch 2 is associated with the data set mounted in slot 3 (test switch 3—data set in slot 5, etc).

4.04 The following procedure is used to perform loop-back test using equipment at the near station as follows:

- 901B DTS cover (interface test adapter)
- KS-20538 VOM, or TTS-28
- W1AD cord, or equivalent.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Remove customer interface cord from J1 of 27B1 data unit for data set mounted in slot 1.
3	Connect interface test adapter cord to J1 of the 27B1 data unit.
4	Request that far end be placed in the test mode.
5	Set FUNCTION switch of VOM to 30 VDC.
6	Connect + (positive) terminal of VOM to interface test adapter, terminal 7 (signal ground).
7	Connect – (negative) terminal of VOM to interface test adapter, terminal 3 (BB lead). ***Requirement:*** Meter should read between 10 and 16 volts (mark).
8	Remove meter leads from interface test adapter (901B data test set cover).
9	Clip one end of W1AD cord to terminal 2 (BA lead) of the interface test adapter, and clip other end to terminal 1 (+24V) of TB1 on the 28A1 data mounting.
10	Connect – (negative) terminal of VOM to interface test adapter, terminal 7 (signal ground).
11	Connect + (positive) terminal of VOM to interface test adapter, terminal 3 (BB lead). ***Requirement:*** Meter should indicate between 7 and 11 volts (space).

STEP	PROCEDURE
12	Connect interface test adapter cord to J2 of the 27B1 data unit and repeat Steps 6 through 11. (Repeat for J3 through J8 as required.) ***Note:*** Return customer interface cord to J1 at end of test and repeat for J2, J3, etc, at end of test.
13	Remove test equipment and return station to pretest condition.

5. DISTORTION MEASUREMENT TEST

A. Distortion Measurement Test Using 911A Data Test Set

5.01 This test measures the loop-back distortion of the data system. The transmit lead is driven by the test sentence generator. At the receive lead, the data set feeds the data signals to the distortion measuring set, which measures the distortion introduced by the loop-back mode. This checks the transmitter and receiver of both stations and the two directions of transmission of the connecting facilities.

5.02 The following procedure is used to measure distortion using equipment as follows:

- 901B Data test set cover
- W1AD Cords, or equivalent (two required)
- 911A Data test set
- 1W2A Cords, or equivalent (two required)

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Remove customer interface cord from J1 of the 27B1 data unit.
3	Connect interface test adapter cord to J1 of the 27B1 data unit.
4	Make connections as shown in Fig. 1.
5	Set controls of test sentence generator (TSG) as follows: • AUTO. MAN. STEP to AUTO. • BAUDS to speed desired (maximum is 300) • BIAS to 0 • CODE to code desired • DIST 1% to 0 • DIST 5% to 0 • REPEAT to OFF

STEP	PROCEDURE
	• RY OR U* to OFF • OUTPUT to EIA.
6	Set controls of distortion measuring set (DMS) as follows: • BAUDS to speed desired • CODE to code desired • DISCR% to 5 • FILTER to OUT • INPUT to EIA • PARITY to ON • AUTO. PK—PIP to PIP.

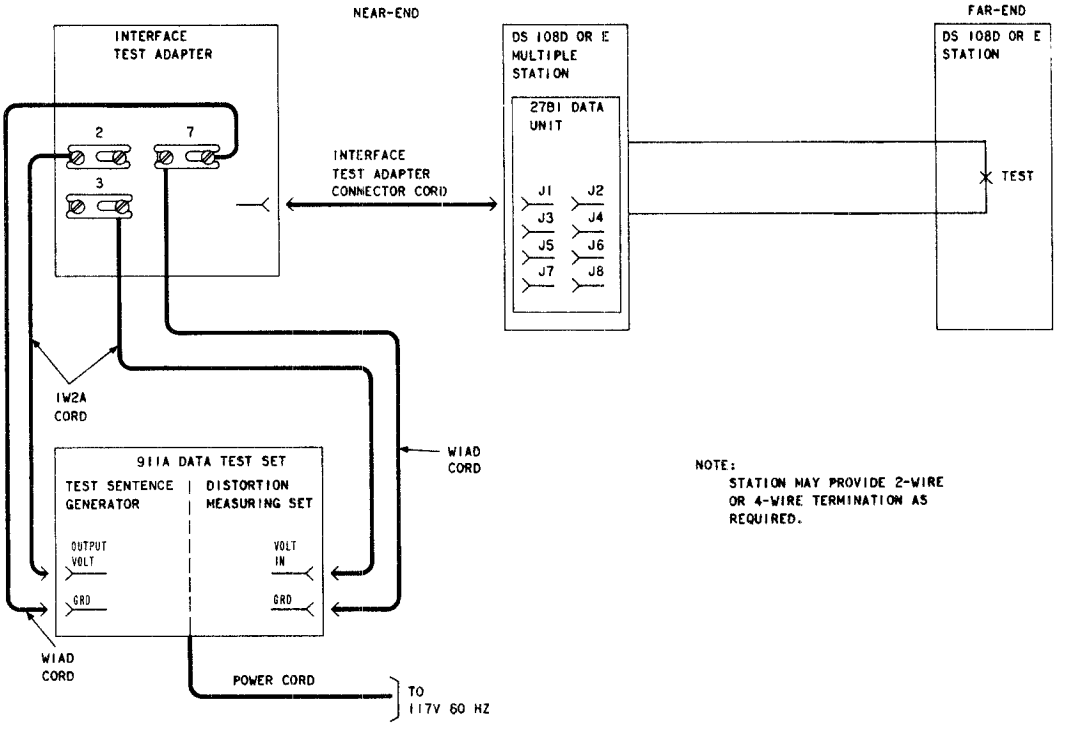


Fig. 1—Distortion Test Arrangement Using 911A Data Test Set

STEP	PROCEDURE
7	Turn power switch ON.
8	Momentarily operate AUTO. PK—PIP switch to PK and then back to PIP.
9	Operate RESET switch on DMS.
	Requirement: Distortion displayed on pixie tubes should be 15 percent or less.
10	Set DIST 5% switch on test sentence generator to 25.
11	Set BIAS switch to SWC.
12	Set DISCR% switch on distortion measuring set to 0.
	Requirement: Distortion displayed on pixie tubes should be equal to or less than 35 percent.
	Note: This checks the ability of the system to operate with high distortion.
13	Connect interface test adapter cord to J2 of the 27B1 data unit and repeat Steps 5 through 12. (Repeat for J3 through J8 as required.)
	Note: Return customer interface cord to J1 at end of test and repeat for J2, J3, etc, at end of test.
14	Remove test equipment and return station to pretest condition.

B. Distortion Measurement Test Using 902- and 903-Type Data Test Sets

5.03 This test measures the distortion and error rate of the data system. The transmit lead is driven by a 903-type data test set (63-bit word generator). At the receive lead, the data set feeds the data signals to the 902-type data test set (distortion measuring and error checking set). Also at the receive lead, a second 903-type data test set is used to deliver to 902-type data test set a signal identical to the signal sent from the transmitting end. The 902-type data test set synchronizes these two signals, measures the peak distortion, and counts the number of errors in the received data.

5.04 The following procedure is used to measure distortion using equipment as follows:

- 901B Data test set cover (interface test adapter)
- 903-Type data test sets (two required)
- 902-Type data test set
- W2DW Cords, or equivalent (two required).

STEP	PROCEDURE
1	Gain access to cabinet as required. ***Caution: Do not connect the 903-type data test set until all other equipment is connected and all of their switches have been placed to proper settings.*** ***Transmit Equipment on Transmit Lead***
2	Set 903-type DTS as follows: • RANDOM—DOT to RANDOM • TRIGGER to + • BIT RATE to speed desired. ***Note:*** Set BIT RATE on 903B to 180. For compatible bit rate, use a 903B and a 902B at the receive lead. Set BIT RATE on 903C to 300. For compatible bit rate, use a second 903C and a 902C at the receive lead. ***Receive Equipment on Receive Lead***
3	Set 902-type DTS as follows: • BIT RATE to speed desired ***Note:*** On 902B data test set, set BIT RATE to 180. On 902C DTS, set BIT RATE to 300. • Meter selection switch to DIST ADJ • TRIGGER—not required.
4	Set 903-type DTS as follows: • BIT RATE to EXT CLOCK • RANDOM—DOT to RANDOM • TRIGGER to +.
5	Remove customer interface cord from J1 of the 27B1 data unit.
6	Connect interface test adapter cord to J1 of the 27B1 data unit.
7	Make connections as shown in Fig. 2.
8	Turn POWER switches of both 903-type DTSs to ON.
9	Request that far end be placed in test mode.

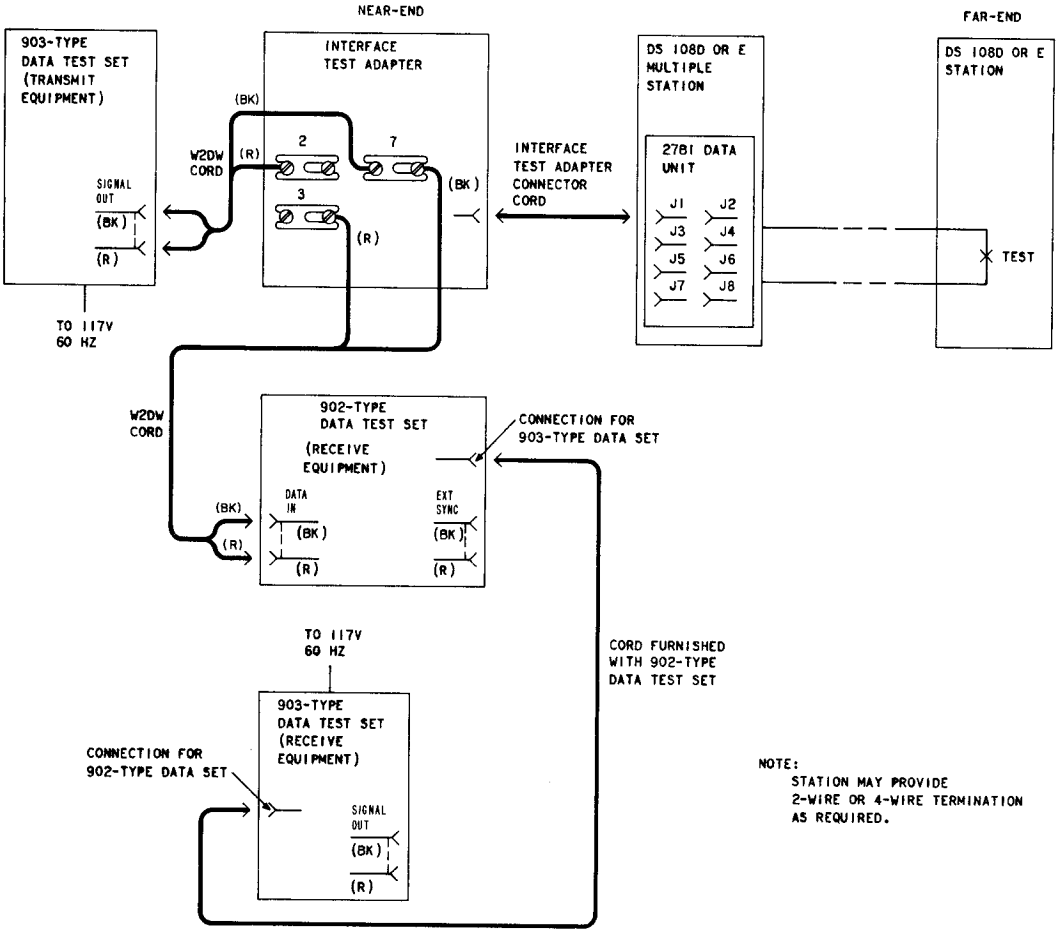


Fig. 2—Distortion Test Arrangement Using 901-, 902-, and 903-Type Data Test Set

STEP	PROCEDURE
10	Momentarily depress START button on both the transmitting and receiving 903-type data test sets. (The transmitting station has no further duties until end of test period.)
	902-Type DTS Adjustments
11	Adjust the DISTORTION control to indicate zero on the meter.
12	Operate meter selection switch to VOLT ADJ.
13	Adjust the VOLTS control to indicate zero on the meter.
14	Operate meter selection switch to PHASE ADJ.
15	Adjust the PHASE control to indicate zero on the meter.
16	Operate meter selection switch to DIST. MEAS.
17	Depress the WORD SYNC & RESET button momentarily and record the time.
	Note: The microammeter should settle down to some relatively stable value that indicates peak distortion. One microamp is equal to 1 percent distortion. For example, a meter indication of 8 microamps would be 8 percent peak distortion. The TOTAL ERRORS lamps lighted on the 902-type DTS indicate the number of errors in received data from the time the WORD SYNC & RESET button was released. For example, should the 8, 4, and 1 lamps be lighted, this would be an indication of a total of 13 errors.
	Requirement: 10 percent or less distortion; 2 or less errors in a 5-minute test.
	Note: For marginal cases of trouble (ie, customer complains of random errors), 15- to 30-minute tests should be made; same limits should be used.
18	Connect interface test adapter cord to J2 and reconnect customer interface cord to J1. Repeat test for J3 through J8 as required.
19	Disconnect test equipment and return station to pretest condition.

6. POWER SUPPLY MEASUREMENT

6.01 The following procedure is used to measure the voltage of the KS-20575 rectifier mounted on the 28A1 data mounting. The voltage measurements are taken from TB1 on the 28A1 data mounting with a KS-20538-L1 VOM or equivalent.

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Set FUNCTION switch on VOM to 30 Vdc.
3	Connect VOM as follows: • Negative lead to terminal 3 of TB1 on 28A1 data mounting • Positive lead to terminal 1 of TB1 on 28A1 data mounting. ***Requirement:*** 24 $\pm$3 Volts
4	Disconnect both VOM leads and reconnect as follows: • Negative lead to terminal 6 of TB1. • Positive lead to terminal 4 of TB1. ***Requirement:*** 24 $\pm$3 Volts
5	Disconnect both VOM leads and reconnect as follows: • Negative lead to terminal 2 of TB1 • Positive lead to terminal 3 of TB1. ***Requirement:*** 24 $\pm$3 Volts
6	Disconnect both VOM leads and reconnect as follows: • Negative lead to terminal 5 of TB1 • Positive lead to terminal 6 of TB1. ***Requirement:*** 24 $\pm$3 Volts
7	Remove test leads and return station to pretest condition.

7. TRANSHYBRID LOSS MEASUREMENT

7.01 The following procedure is used to perform the transhybrid loss measurement test using a TTS-28 or equivalent.

STEP	PROCEDURE
	Note: This measurement requires that a 900-ohm termination be placed on the line at either the far or the near serving office.
1	Gain access to cabinet as required.
2	Request the 900-ohm termination to be placed on the line.
3	Check the send level of the data set as follows: (a) Set FUNCTION switch of TTS-28 to DBM BRDG 0 position. (b) Connect + and – terminals of TTS-28 to TP1 and TP2 of data set mounted in slot 1 of 28A1 data mounting. (c) Read the meter and record reading.
4	Set FUNCTION switch of TTS-28 to DBM BRDG –10 position.
5	Connect + and – leads of TTS-28 to terminal 3 (signal ground) of TB1 on the 28A1 data mounting and TP7 of the data set, respectively. ***Requirement:*** Meter indication should ***not*** be more positive than reading in 3 (c). ***Note:*** Meter actually reads at least a 10-dB difference due to the FUNCTION switch being set to –10.
6	Repeat Steps 2 through 5 for each data set mounted in the 28A1 data mounting.
7	Remove leads and restore station to pretest condition.

8. LOOP-LOSS MEASUREMENT

8.01 This measurement requires the use of the TTS-28 and an oscillator capable of furnishing 1000 Hz and 2300 Hz (at far end or STC). The measurement is made as follows:

STEP	PROCEDURE
1	Gain access to cabinet as required.
2	Disconnect the proper private line facility lines from the 28A1 data mounting.
3	Set FUNCTION switch of TTS-28 to DBM 900Ω TERM 0 position.
4a	If 2-wire service, connect + and – terminals of TTS-28 to telephone lines associated with leads 1 and 26.

STEP	PROCEDURE
5b	If 4-wire service, connect + and − terminals of TTS-28 to telephone lines associated with leads 2 and 27.
6c	Request distant station or STC to send 1000 Hz at 0 dBm if near-end data set is 108E.
7d	Request distant station or STC to send 2300 Hz at 0 dBm if near-end data set is 108D.
8	Read and record TTS-28 meter indication. ***Note:*** It may be necessary to set FUNCTION switch of TTS-28 to DBM 900Ω TERM −10 position to obtain reading. ***Requirement:*** See Table A.

TABLE A

LOOP LIMITS

TYPE OF LOOP	AML LIMITS
Without repeaters or carriers	EML 1 dB
With E7 repeaters only	EML 1 dB
With all other repeaters and/or carriers	EML 2 dB

	Note: Meter readings are the actual measured loss (AML) of the line facilities. These readings should be the same as the readings taken during installation of the data station. The station layout card shows the expected measured loss (EML) when the facilities were designed. The reading taken in Step 8 should not deviate from the limits shown in Table A. If the EML is ***not*** within limits, the loop should be turned back for repair.
9	Reconnect proper private line facility as required.
10	Repeat test (Steps 2 through 9) for each data set mounted in 28A1 data mounting. Refer to Table B for additional TTS-28 connections (2-wire or 4-wire).
11	Remove leads and restore station to pretest condition.

TABLE B

CONNECTION REQUIREMENTS FOR LOOP-LOSS MEASUREMENT

DATA SET SLOT	2-WIRE		4-WIRE	
	R	T	T1	R1
1	1	26	2	27
3	3	28	4	29
5	5	30	6	31
7	7	32	8	33
9	9	34	10	35
11	11	36	12	37
13	13	38	14	39
15	15	40	16	41

9. REFERENCES

9.01 The following documents pertain to data set 108D or E multiple private line station:

SD- & CD-73060-01 Data Set 108D

SD- & CD-1D229-01 Data Set 108E

SD- & CD-1D176-01 Data Systems Station 28-Type Data Mounting

SD- & CD-1D183-01 Data Systems 27-Type Data Unit

SECTION	TITLE
590-100-114	27A1 and 27B1 Data Units, Identification
590-102-124	28A1 Data Mounting, Identification
591-028-100	Data Sets 108D- and 108E-Types Used in Station Applications, Description
591-028-102	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit, Description
591-028-202	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit, Installation and Connections
591-028-302	Data Sets 108D- and E-Types, Multiple Private Line Station Arrangement Using 28A1 Data Mounting and 27B1 Data Unit, Maintenance.

PRIVATE LINE STATION ARRANGEMENTS USING DATA SETS 108F and 108G WITH DATA AUXILIARY SETS 830B AND 830C

DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional descriptions and test facilities for data sets (DSs) 108F and 108G (Fig. 1) in private line (PL) service. These data sets function alone or with data auxiliary sets (DASs) 830B-L1A and 830C-L1A using customer-provided equipment (CPE) or Bell System teletypewriters (TTYs) hereafter referred to, collectively, as terminal equipment. Station arrangements with DS 108F and DS 108G used alone and in conjunction with DASs 830B-L1A and 830C-L1A are shown in Fig. 2.

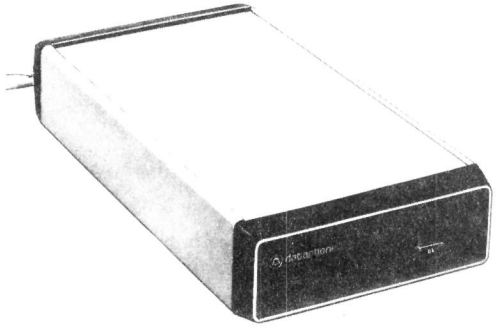


Fig. 1—DS 108F or 108G

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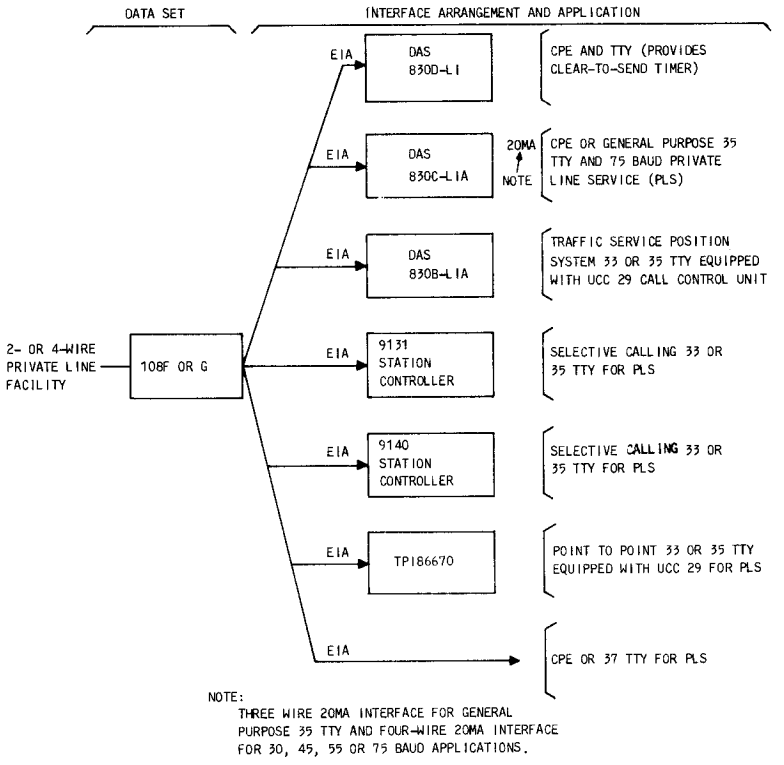


Fig. 2—DS 108F and G Interface Arrangements and Applications

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 DS 108F and G differ only in send and receive frequencies and data set connect characteristics. DS 108F and G send and receive frequencies complement each other.

1.04 DS 108G connects upon detection of either ***marking or spacing*** carrier, whereas DS 108F connects only upon detection of incoming marking carrier.

COMPARISON OF DS 108F AND 108G WITH DS 108D AND 108E

1.05 DS 108F and G provide the same services and features as DS 108D and E, respectively, when the latter data sets are used with a DAS 830A.

1.06 The indicator lamp and the test switch in the older arrangement are located on the DAS 830A and are unlabeled. DS 108D and E are equipped with an indicator lamp (also unlabeled). DS 108F and G are equipped with two indicator lights designated CO and TM and a switch designated DL.

The indicator lamp on DS 108D or E is lighted when the incoming carrier frequency is off. Indicator CO on DS 108F or G is lighted when the incoming carrier frequency is on.

1.07 DS 108F and G make extensive use of integrated circuits, including active filters.

DS 108D and E use discrete transistors throughout, as well as LC filters and tuned circuits. DS 108F and G are substantially smaller and lighter than the DS 108D and E installed in a DAS 830A.

1.08 DS 108F and G have switches to set the output in 2-dB steps from -1 to -15 dBm. There is no option to set the hybrid balance. DS 108D and E have a continuous output adjustment, requiring a meter for proper setting, as well as several hybrid balance setting options. DS 108F and G always present a 600-ohm impedance to the line. DS 108D and E present a 600-ohm impedance for 4-wire and a 900-ohm impedance for 2-wire facilities.

1.09 In DS 108F and G the housing is never grounded. In DS 108D and E, the housing is always connected to the "green wire" ground via the third prong of the transformer.

1.10 DS 108F and G are not compatible with DAS 830B-L1, nor with DAS 830C-L1. All sets are compatible with DAS 830B-L1A and DAS 830C-L1A.

DS 108H and J

1.11 DS 108H and J provide 20-mA current interface between a 2-wire private line facility and terminal equipment for serial, low-speed (0 to 150 baud), asynchronous, half- or full-duplex operation.

CRITERIA FOR SELECTING DS 108F AND G WITH DAS 830C-L1A IN LIEU OF DS 108H AND J

1.12 DS 108F and G with DAS 830C-L1A ***must*** be used when any of the following are required:

- Connection to a 4-wire facility
- Carrier squelch on carrier fail feature
- Broadcast feature
- Remote operation of test mode
- Carrier on (CO) indicator lamp
- Receiver sensitivity of -42 dBm rather than -36 dBm
- Carrier detection characteristics of 108F and G required (see 3.05).

1.13 DS 108F and G provide interface signals as specified in Electronic Industries Association (EIA) Standard RS-232.

1.14 DS 108F and G alone or in conjunction with DAS 830-type provide low-speed, serial, asynchronous, full-duplex operation at the following data rates:

- DS 108F and G used with EIA terminal equipment—300 baud
- DS 108F and G with DAS 830B-L1A used with M33 or M35 TTY—110 baud
- DS 108F and G with DAS 830C-L1A used with CPE or 45-, 55-, or 75-baud TTYs—up to 75 baud
- DS 108F and G with DAS 830C-L1A used with general purpose 35 TTY—110 baud.

1.15 DAS 830B-L1A connects DS 108F or G (EIA interface) to a Model 33- or 35-type TTY interface and replaces DAS 830A (with DS 108-type) in arrangement with DAS 830B-L1. DS 108F and G with DAS 830B-L1A replaces Teletype TP186627 set logic assembly in the TTY interface and most PL and telegraph services provided by DAS 820D (with control card AR17 or AR430). In addition, these DS 108F and G arrangements replace ***all*** services of DAS 830A with DS 108-type.

1.16 DAS 830C-L1A connects with DS 108F or G to convert EIA voltages from the data set to a 3- or 4-wire 20-mA current interface for a maximum rate of 150 baud to terminal equipment requiring a 20-mA current interface of up to 75 baud. Operation of DAS 830C-L1A with the Bell System general purpose 35 TTY is limited to 110 baud by the TTY.

1.17 The 52A1 data unit connects to DS 108F or G to provide remotely activated digital loopback test capability.

1.18 The technical specification for these private line station arrangements follows:

AC Power: 117 volts ±10 percent, 60 Hz ±5 percent. A single data set consumes

approximately 7 watts. The power outlet should be a conventional 3-wire grounded outlet not under switch control.

Operation: Low-speed, asynchronous, binary, serial.

Operating Mode: Full-duplex (with half-duplex operation optional with DAS 830C-L1A).

Data Rates: Up to 300 baud.

Line Impedance: 600 ohms.

Operating Frequencies: DS 108F transmission is in the f_1 band (mark—1270 Hz, space—1070 Hz) and reception is in the f_2 band (mark—2225 Hz, space—2025 Hz). DS 108G transmits in the f_2 band and receives in the f_1 band.

Interface Voltages: Per EIA RS-232-C.

Line Compatibility: DS 108F, an "originate" mode set, is compatible with DS 103F (in the answer mode), 108A, 108E, 108G, and 108J. DS 108G, an "answer" mode set, is compatible with DS 103F (in the originate mode), 108B, 108C, 108D, 108F, and 108H.

Environmental Requirements:

- Ambient temperature range from 40 to 120°F.
- Relative humidity from 20 to 95 percent with no condensation.

2. PHYSICAL DESCRIPTION

A. DS 108F and 108G

2.01 DS 108F and G consist of a single printed circuit pack, an extruded aluminum housing with two plastic covers, and a KS-21239-L4 or -L5 power transformer. Overall dimensions are approximately 5.75 inches wide, 10.9 inches long, and 2.2 inches high. The set weighs approximately 3 pounds and the KS-21239-L4 or -L5 power transformer weighs approximately 1 pound.

2.02 DS 108F or G may be wall mounted using a 193A backboard (ordered separately), desk or table-top mounted. The top surface of each data set mounting is depressed to allow nesting of several data sets.

2.03 The housing is externally similar in appearance to the 47-type data mounting. The housing assembly consists of an aluminum extrusion which provides card guides for mounting the circuit pack (Fig. 3) and front and rear covers. No interface assembly or electrical connections are provided. All connectors are mounted directly on the circuit pack. The circuit pack is held in position by the latching mechanism shown in Fig. 4.

> ***Note:*** The circuit pack should be installed and removed from the rear of the data mounting.

2.04 The data set is equipped with a 25-pin customer interface connector to provide EIA interface to either CPE or DAS 830-type (Fig. 5). Telephone line interface is provided by locally furnished D4BT mounting cord (either 2- or 4-wire lines). A locally furnished D4BT mounting cord must also be provided between power transformer KS-21239-L4 or -L5 and each data set. Terminals are also provided for remote test switch connection.

2.05 DS 108F or G is equipped with two light-emitting diode (LED) status lamps:

- The test mode (TM) lamp is lighted whenever pushbutton DL is depressed or the data mode is entered remotely.
- The carrier on (CO) lamp is lighted whenever the data set is in the data mode.

2.06 The data set is equipped with one locking-type pushbutton switch, designated DL (digital loopback), which is accessible at the front panel. Depressing the DL switch causes the TM lamp to light, internally connects the received data (BB) lead to the transmitted data (BA) lead (with option F installed) and disconnects these interface leads as well as the data set ready (CC) lead.

B. DAS 830B-L1A

2.07 DAS 830B-L1A (Fig. 6) is a 6-button key unit designed for mounting under the faceplate of the TTY in front of the UCC29 (Fig. 7). The

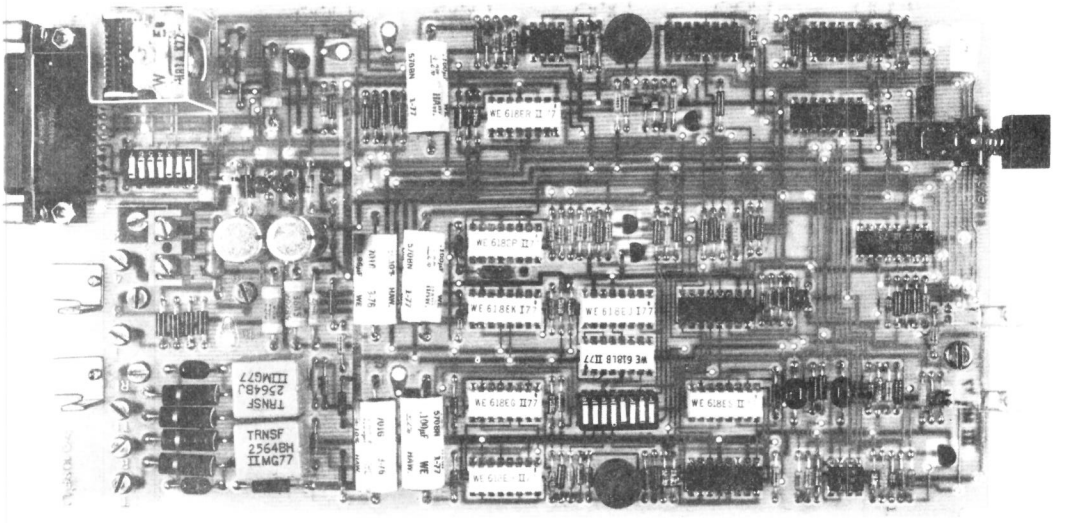


Fig. 3—Circuit Pack of DS 108F (Similar to DS 108G Circuit Pack)

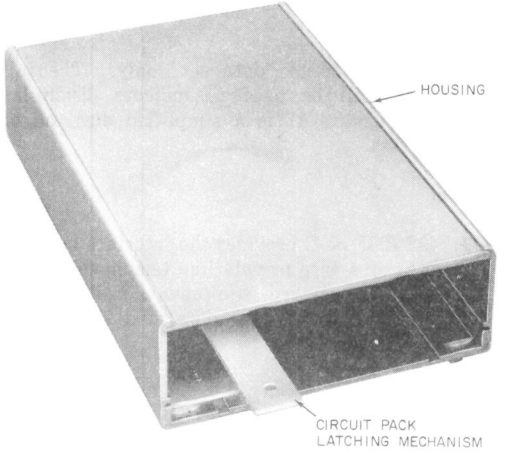


Fig. 4—DS 108F or G Housing

DAS is installed in the TTY by the service center. Table A provides physical and power information for DAS 830B-L1A. DAS 830B-L1A can also be used with DAS 830A or DAS 820D but DAS 830B-L1 ***cannot*** be used in this station arrangement.

C. DAS 830C-L1A

2.08 DAS 830C-L1A (Fig. 8) consists of a printed circuit board mounted on a 168D-49 backboard equipped with a 101A-49 cover. The terminal board (Fig. 9) provides option jacks and screw terminals for connections to terminal equipment.

2.09 DAS 830C-L1A is equipped with a 6-foot cord. One end of the cord is connected to the DAS 830C-L1A and the other end is equipped with a male 25-pin EIA interface plug for connection to either DS 108F or 108G. Leads used in the EIA cord are as indicated below:

- Pin 2—Transmitted data (BA)
- Pin 3—Received data (BB)
- Pin 7—Signal ground (AB)
- Pin 8—CF (not connected on DAS 830C-L1A—lead taped and stored. Lead can be used for local engineering to provide a carrier detector indication)
- Pin 9—positive volts (+P)

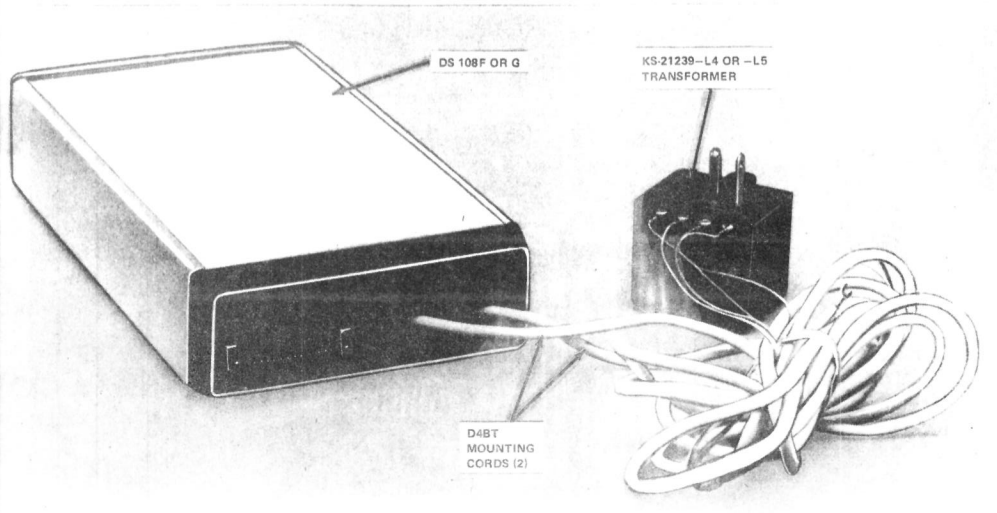


Fig. 5—DS 108F or G Rear View

- Pin 10—negative volts (-9).

2.10 DAS 830C-L1A can be used with DAS 830A or DAS 820D but DAS 830C-L1 ***cannot*** be used in this station arrangement. Table A provides physical and power information for DAS 830C-L1A.

D. 52A1 Data Unit

2.11 The 52A1 data unit (Fig. 10) consists of a printed circuit board which is mounted directly to the circuit pack of DS 108F or G.

2.12 The 52A1 power and signal leads are derived from the DS 108F or G via the metal standoffs used to mount the printed circuit board to the data set.

3. FUNCTIONAL DESCRIPTION

A. DS 108F or 108G

3.01 This part contains information pertaining to DS 108F or G modulation, transmission, reception, interface, and options. Because of functional similarity, all references to DS 108F and 108G will be to "data set" only. The full designation will be used to indicate dissimilar functions. Figure 11 is a simplified diagram of the data sets.

General

3.02 DS 108F or G provides the interface between a 2- or 4-wire private line telephone facility and customer-provided equipment, Bell System teletypewriters, or 830-type data auxiliary sets in various applications.

Modulation

3.03 The data set employs frequency-shift keying (FSK) with a shift of +100 Hz for a mark and -100 Hz for a space. DS 108F converts the dc signals at the customer interface into ac signals in the f_1 frequency band (see Table B) for transmission over the telephone line and receives ac signals in the f_2 frequency band for conversion to dc signals and output to the customer interface. DS 108G transmits in the f_2 band and receives in the f_1 band (see Table B).

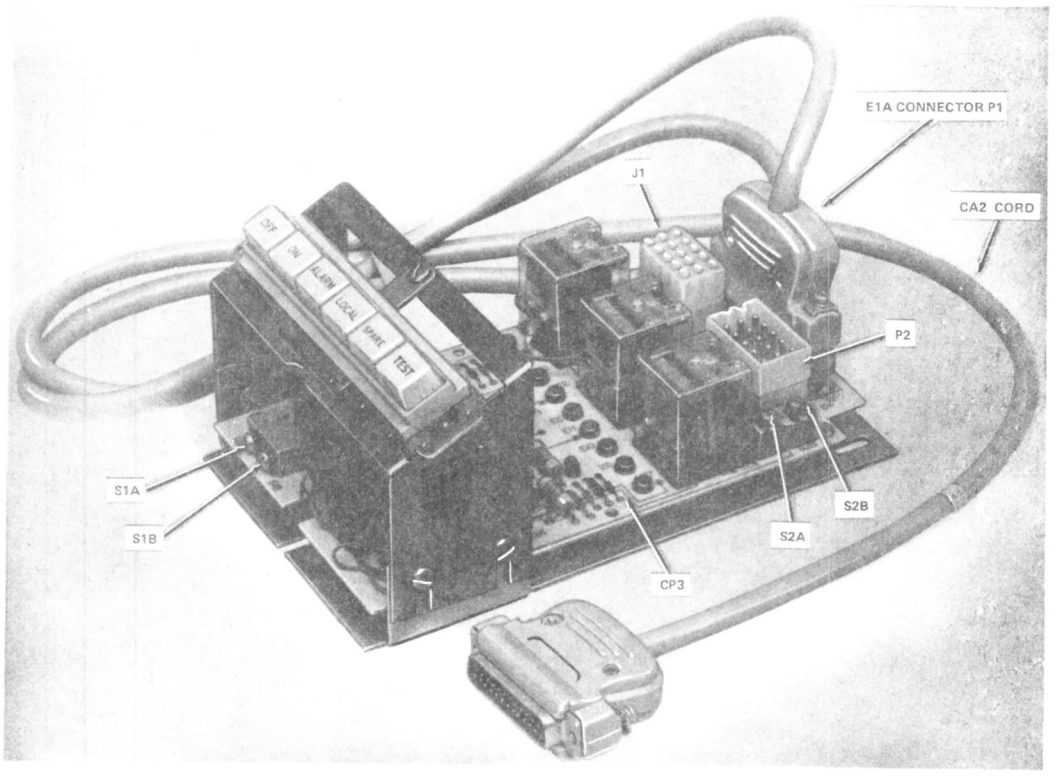


Fig. 6—DAS 830B-L1A

Transmission

3.04 The data set FSK modulates data signals at an output power range of nominally -1 to -15 dBm into a 600-ohm 2- or 4-wire line. The data set transmit level is adjustable in 2-dB steps (refer to Section 591-818-200 for procedures for setting output level).

Reception

3.05 The data set enters the data mode upon receipt of the appropriate carrier frequency (f_1 mark or space for DS 108G, f_2 mark for DS 108F) for at least 300 ms. The data set remains in the data mode until loss of carrier occurs or the signal level drops below approximately -45 or (optionally) -39 dBm.

EIA Interface

3.06 The EIA interface is accessible through the connector at the rear of the data set. The connector pin numbers, EIA designation, and function are shown in Table C.

3.07 Customer interface lead functions are as follows:

(a) ***Transmitted Data (BA) (Pin 2):*** This lead accepts information from the terminal equipment or DAS 830-type.

(b) ***Received Data (BB) (Pin 3):*** This lead outputs demodulated data received from the telephone line to the terminal equipment or DAS 830-type.

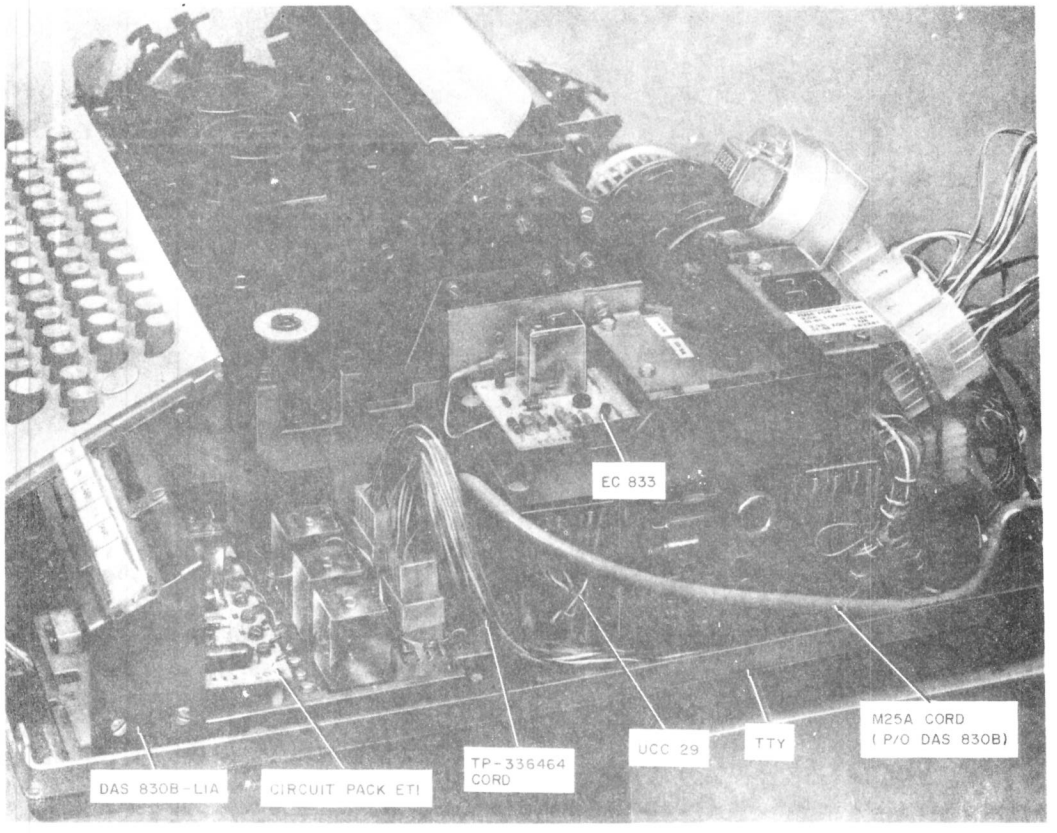


Fig. 7—DAS 830B-L1A Mounted in TTY

(c) ***Request-to-Send (CA) (Pin 4):*** An ***on*** condition of this lead is an indication to the data set that the terminal equipment intends to transmit data.

(d) ***Clear-to-Send (CB) (Pin 5):*** The ***on*** condition of this lead is in response to the ***on*** condition of CA (above) and indicates (optionally) that the data set has detected data carrier.

(e) ***Data Set Ready (CC) (Pin 6):*** An ***on*** condition of this lead indicates the data set is in the data mode and capable of transmitting and receiving data.

(f) ***Signal Ground (AB) (Pin 7):*** This lead establishes a common ground reference for all interface leads.

(g) ***Received Line Signal Detector (CF) (Pin 8):*** An ***on*** condition of this lead indicates to the terminal equipment that the data carrier is being received by the data set.

(h) ***Positive Voltage (+P) (Pin 9):*** This lead provides +16V for telephone company (telco) test purposes.

(i) ***Negative Voltage (-P) (Pin 10):*** This lead provides -16V for telco test purposes.

TABLE A

DAS 830B-L1A AND 830C-L1A GENERAL INFORMATION

DAS	SIZE (INCHES)	WEIGHT (POUNDS)	VOLTAGE	POWER (WATTS)	INTERFACE TO TERMINAL EQUIPMENT
830B-L1A	3.5 high 10.5 wide 8.7 deep	8	+20 to +28V from TTY −12 to −26V from DS	3 1/2	Current for 33 and 35 TTY equipped with UCC29 (***Notes 1 and 2***)
830C-L1A	1.2 high 3.9 wide 2.0 deep	6 oz	+12 to +26V −12 to −26V from DS	3/4 3/4	Current for up to 150 baud PL service or 35 general purpose PL TTY (***Note 1***)

Note 1: DAS 830B-L1A and 830C-L1A provide EIA interface to DS 108F or 108G.

Note 2: A TP-336464 cord is required to interconnect the DAS 830B-L1A to the UCC29 of the TTY.

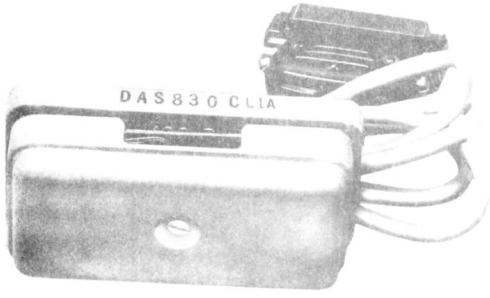


Fig. 8—DAS 830C-L1A

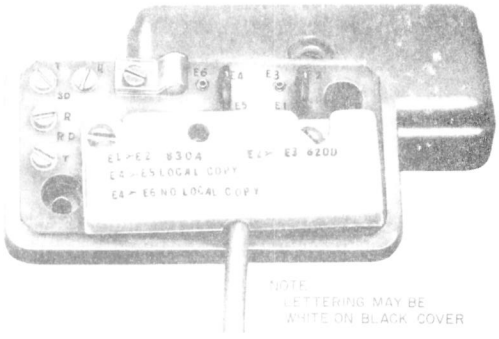


Fig. 9—DAS 830C-L1A Terminal Board

(j) ***Test (Pin 18):*** This is a non-EIA lead (normally open) activated by option P. Refer to Section 591-818-200 for a description of this option.

Telephone Line Interface

3.08 The data set can be connected to either a 2- or a 4-wire telephone facility. Refer to Section 591-818-200 for a complete description of these options.

Test Mode

3.09 Depressing the DL switch places the data set in the test mode and lights indicator TM. In the test mode, data set lead BA is (optionally) internally connected to BB and these customer interface leads as well as CC and CF are disconnected from the terminal equipment or DAS 830-type. This allows a data connection to be established between the data set and the test center and

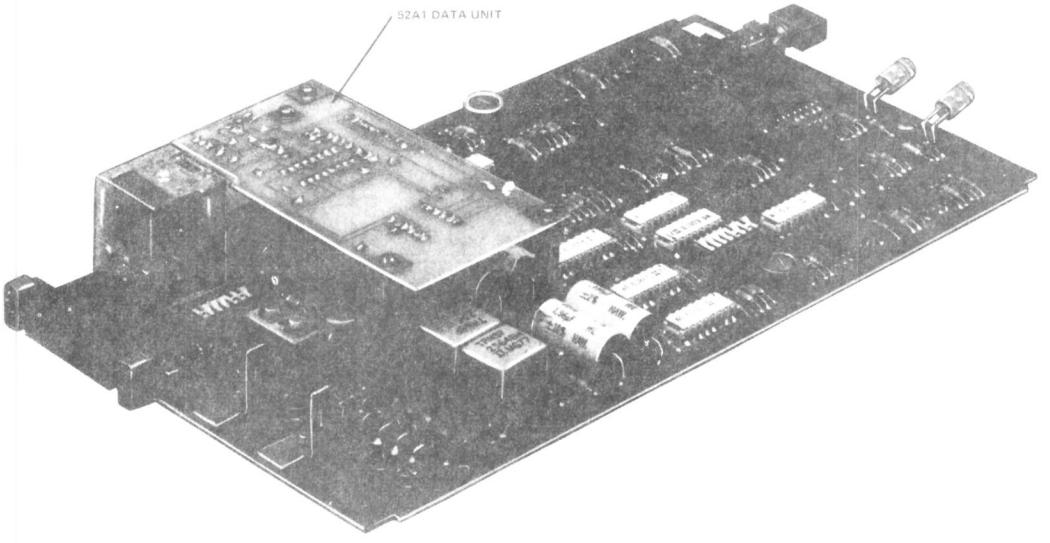


Fig. 10—52A1 Data Unit Mounted on DS 108F

enables the test center to measure round trip data distortion.

Options

3.10 Data set options are listed in Table D. Refer to Section 591-818-200 for a description of these options.

B. DAS 830B-L1A

3.11 DAS 830B-L1A provides current to EIA conversion between a CPE or TTY and the DS 108F or G. In addition, it provides the options or control features shown in Table E.

3.12 When transmitting data, the TTY current-no-current signals are converted by DAS 830B-L1A to EIA signals for use by the data set. When receiving data, the EIA signals are converted to current-no-current signals for use by the TTY.

3.13 DAS 830B-L1A also provides for TTY machine control by end of text (EOT) character. When an EOT is received, the TTY motor is turned off and a mark is placed on the select magnet driver (SMD) lead to guard against spurious characters. The TTY will remain off until the associated data set detects loss of carrier and then redetects carrier. Upon redetection of carrier, the TTY motor will turn on.

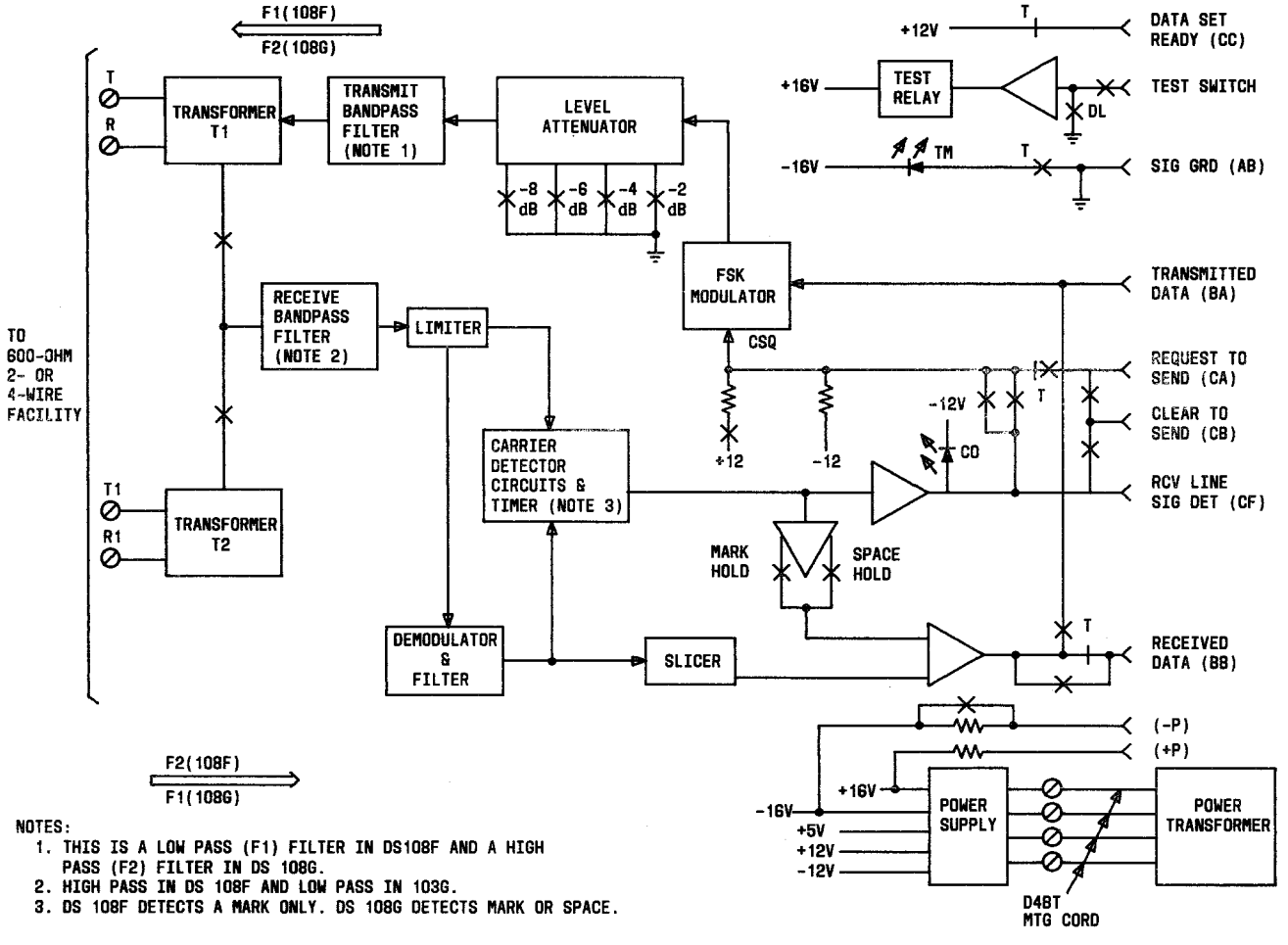
3.14 DAS 830B-L1A provides six buttons for controlling the operation of the station. The 6-button key and the functions provided by each button are shown in Fig. 12.

DAS 830B-L1A With ET1 Circuit Pack

3.15 Two additional arrangements can be implemented by using an ET1 circuit pack (Fig. 13) with DAS 830B. The circuit pack provides:

- a send space timing (SST) circuit.
- a message waiting lamp circuit for use with Traffic Service Position System (TSPS) No. 1 Hotel Billing Information Center TTY.

Screw terminals and holes are provided on DAS 830B-L1A for connecting and mounting of the ET1 circuit pack.



NOTES:
1. THIS IS A LOW PASS (F1) FILTER IN DS108F AND A HIGH PASS (F2) FILTER IN DS 108G.
2. HIGH PASS IN DS 108F AND LOW PASS IN 103G.
3. DS 108F DETECTS A MARK ONLY. DS 108G DETECTS MARK OR SPACE.

Fig. 11—DS 108F and G Simplified Diagram

TABLE B

DATA SET FREQUENCY DATA

DATA SET	TRANSMIT			RECEIVE		
	FREQ BAND	MARK	SPACE	FREQ BAND	MARK	SPACE
108F	F1	1270	1070	F2	2225	2025
108G	F2	2225	2025	F1	1270	1070

TABLE C

EIA INTERFACE CONNECTOR

PIN	FUNCTION	EIA DESIGNATION (RS-232-C)
2	Transmitted Data	BA
3	Received Data	BB
4	Request to Send	CA
5	Clear to Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Received Line Signal Detector	CF
9	Positive Voltage	+P
10	Negative Voltage	−P
18	Test (Note)	

Note: Used in some Bell System applications.

DAS 830B-L1A With TTY Break Detection Circuit EC-833

3.16 The TTY break detection circuit EC-833 (part of Teletype TP186630 modification kit), installed within the UCC29, is compatible with DAS 830B-L1A. The spare lamp and button contacts are already wired to appropriate connectors which interface with the EC-833. The TTY break detection circuit cannot be used in conjunction with the message waiting lamp circuit.

C. DAS 830C-L1A

3.17 DAS 830C-L1A is used to convert the standard EIA voltages of DS 108F and G to a 20-mA, 3- or 4-wire current interface for CPE or Bell

TABLE D

DATA SET 108F OR G OPTIONS

FEATURE		OPTION
Facility	4-Wire	Z
	2-Wire	Y*
Mark or Space Hold	Mark	U*
	Space	V
CB Internally Connected to	None	E
	RS	W
	CA	X*
Carrier Control	Via CA	D
	Via RS	T
	Always on in Data Mode	S*
	Always off in Data Mode	H
Remote Test Connection via J1	Yes	P
	No	N*
Local Copy in Test Mode	Yes	G
	No	F*
Receiver dB Gain Reduction	6	K*
	0	J
Ground Wire (GRD) Connected to Signal Ground (SG)	Yes	M*
	No	L
Resistor Bypass for Negative Voltage (-P) on J1	Yes	R
	No	Q*

* Factory furnished option.

TABLE E

DAS 830B-L1A OPTIONS

FEATURE	OPTION	REMARKS
Mark clamp	S	Mark clamp on the BA lead when TTY is in the OFF condition. (See Note.)
Space clamp	T	Space clamp on the BA lead when TTY is in the OFF condition. (See Note.)
No EOT disconnect	U	The TTY will not turn OFF upon receiving EOT.
EOT disconnect	V	The TTY will turn OFF upon receiving EOT and place a mark on select magnet driver to guard against spurious characters.
Paper alarm — motor stops	X	The TTY motor is stopped upon a low-paper or out-of-paper condition.
Paper alarm — motor does not stop	W	The TTY motor is not stopped upon a low-paper or out-of-paper condition.
Full-duplex	Y	No local copy of transmitted data provided.
Half-duplex	Z	Local copy of transmitted data provided.

Note: When option X is provided, the BA lead can be clamped to the selected option (mark or space) when a low-paper or out-of-paper condition occurs.

System TTY terminals requiring current interface. The options provided are shown in Table F.

D. 52A1 Data Unit

3.18 The 52A1 data unit connects to the "test" and received data (BB) leads of DS 108F or G. The 52A1 data unit detects marking and spacing signals received by the data set. Upon receipt of a steady spacing signal of at least 1-second in duration, the data unit places a ground on the test lead causing the data set to enter the test mode. A steady marking signal of at least 250 ms in duration removes the test lead ground and allows the data set to enter the data mode.

4. DATA STATION TEST FACILITIES

4.01 DS 108F or G provides a test mode which may be entered by depressing the DL switch. The test mode may also be entered remotely via two screw terminals or by the TEST switch of DAS 830B-L1A or the test facility of some TTYs. Any of the above actions light indicator TM.

4.02 The 52A1 data unit causes DS 108F or G to enter the test mode upon receipt of the proper line signal. This feature allows the digital loopback test to be exercised without customer assistance.

5. REFERENCES

5.01 The following Bell System Practices provide additional information on DS 108F and G and associated equipment:

SECTION	TITLE
591-042-100	Data Sets 108F and 108G—Identification

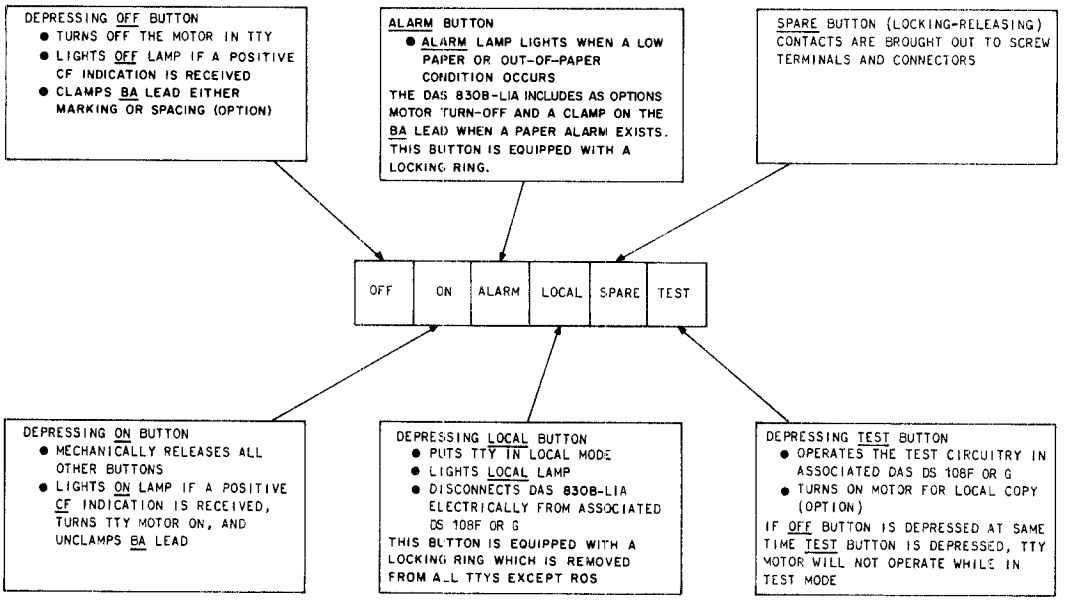


Fig. 12—DAS 830B-L1A—Key Designations and Functions

SECTION	TITLE
591-818-200	Private Line Station Arrangements Using Data Sets 108F and 108G With Data Auxiliary Sets 830B and 830C—Installation and Connections
591-818-500	Private Line Station Arrangements Using Data Sets 108F and 108G With Data Auxiliary Sets 830B and 830C—Maintenance and Test Procedures
598-083-102	Data Auxiliary Set 830B—Identification
598-083-103	Data Auxiliary Set 830C—Description

5.02 The following schematic drawings (SDs) and circuit descriptions (CDs) contain information on DS 108F and 108G or associated equipment.

NUMBER	TITLE
SD- & CD-1D250-01	Data Auxiliary Sets 830A, 830B, and 830C
SD- & CD-1D285-01	Data Set 108F
SD- & CD-1D286-01	Data Set 108G and 52A1 Data Unit

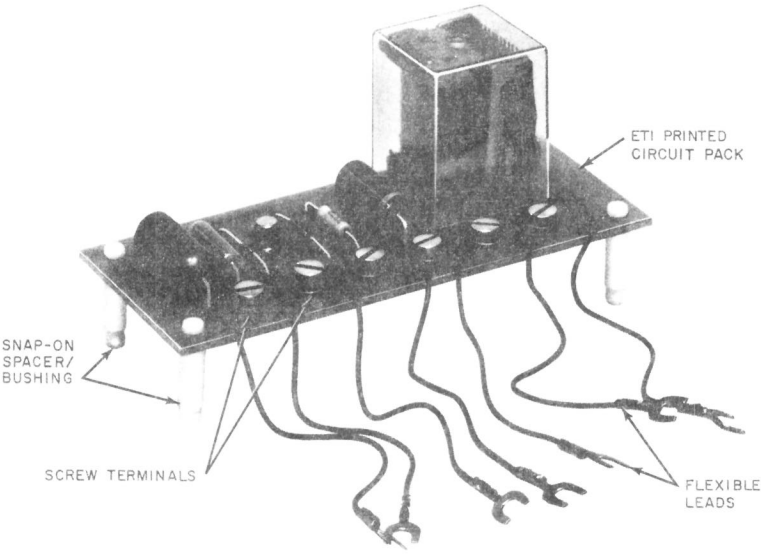


Fig. 13—ET1 Circuit Pack

TABLE F

DAS 830C-L1A OPTIONS

FEATURE	OPTION
Local copy	Z
No local copy	Y
Arranged for use with DS 108F or G	X
Arranged for use with DAS 820D	W

PRIVATE LINE STATION ARRANGEMENTS USING DATA SETS 108F AND 108G WITH DATA AUXILIARY SETS 830B, 830C, AND 830D INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the installation and connection of data sets (DSs) 108F and 108G alone (Fig. 1) and with data auxiliary sets (DASs) 830B-L1A, 830C-L1A, and 830D-L1 (Fig. 2, 3, and 4). A typical arrangement is shown in Fig. 5.

1.02 The reasons for reissuing this section are listed below. Since this reissue is a general revision, no revision arrows have been used to denote significant changes.

(a) Added Uniform Service Order Code (USOC) in Table A.

(b) Added DAS 830D-L1.

(c) Added option table and the connection diagram for DAS 830D-L1.

1.03 Data set 108F and G and associated DASs should be installed in conformance with the general requirements of Section 590-010-200; entitled Data Sets and Data Access Arrangements—General Installation and Connection Information.

1.04 For optimum appearance and utility, locate the data apparatus on a desk, table, stand, or in a Bell System provided equipment cabinet. When required, or upon customer request, a 193A backboard can be used to wall-mount the data apparatus.

1.05 Data set 108F and G will operate over a temperature range of 40°F to 120°F with relative humidity of 20 to 95 percent (applies only if condensation does not accumulate on the circuit pack).

1.06 The data set must be located near the associated customer-provided equipment (CPE) or Bell System teletypewriter (TTY) hereafter referred to, collectively, as terminal equipment. The interface cord supplied by the customer should not exceed 50 feet in length (as recommended by Electronic Industries Association [EIA] standards). In order to minimize inductive interference with data signals, the telephone line should not be carried in the same cable run as cable between the data set and terminal equipment. If this condition cannot be met, the telephone line must be run in type SK (shielded) station wire between the data set and the cable distribution terminal or building entrance. The shield should be grounded at one end only, preferably at the distribution terminal end.

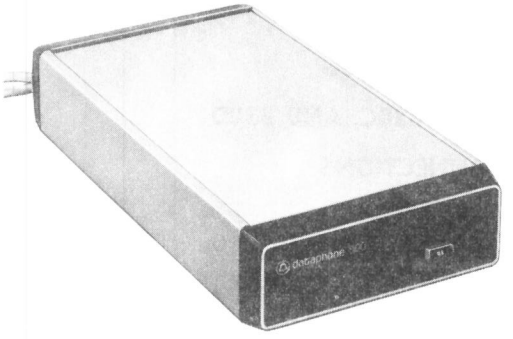


Fig. 1—DS 108F or 108G

2. OPTIONS

A. Data Set 108F and 108G

2.01 Data sets 108F and G are provided with a number of options which are installed prior to placing the data set in service. All options are installed and removed with the switches or option strap shown in Fig. 6. Each option and associated switch (refer to Fig. 7 for switch [S1 and S2] operation) or strap setting is listed in Table A. Similar information is contained on the label located on the underside of the data set housing. Extra labels are available by ordering Form E-10064.

2.02 The installer should verify that the options called for on the service order are installed,

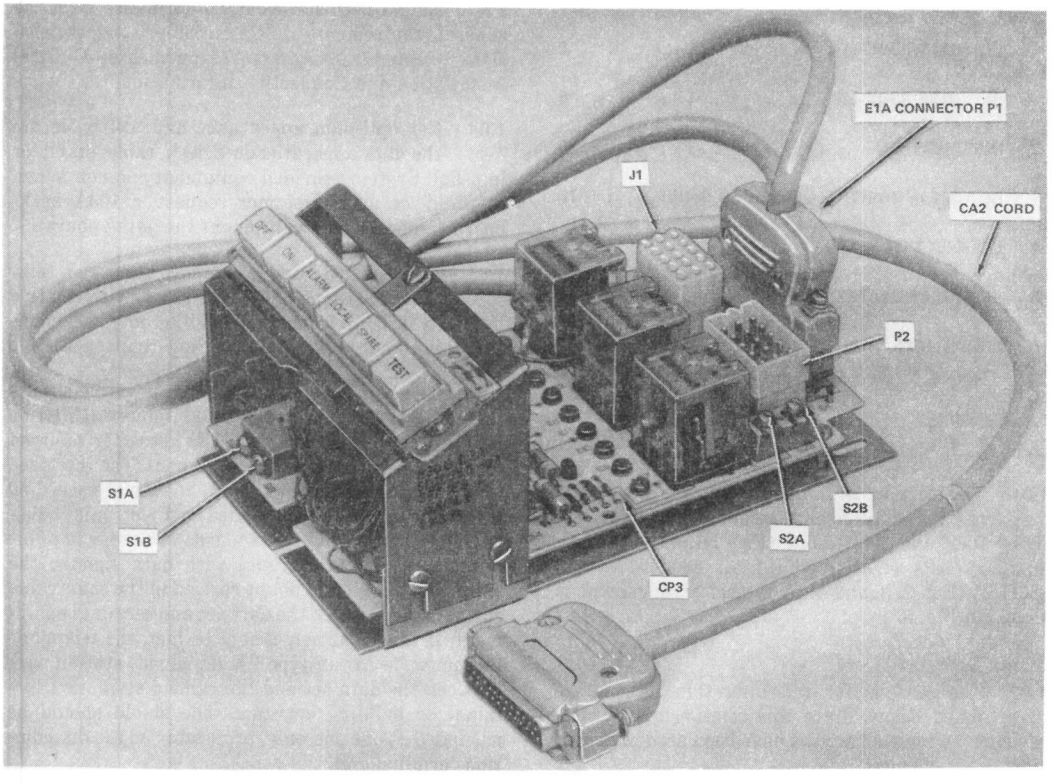


Fig. 2—DAS 830B-L1A

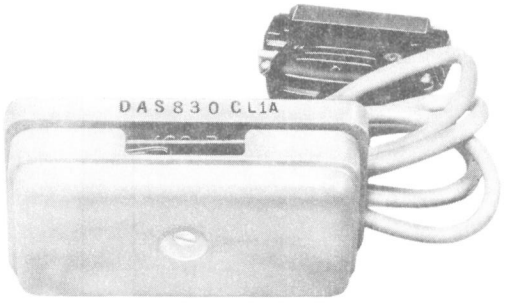


Fig. 3—DAS 830C-L1A

Fig. 4—DAS 830D-L1

which may (as telephone company option) call for equipping the data set circuit pack with a 52A1 data unit to provide the data set with remotely activated digital loopback capability.

2.03 To access the data set option switches, it is necessary to remove the data set from the housing:

Warning: When removing front and rear covers use finger pressure only. No special tools are required. Excessive force may crack the data set cover.

(1) Remove the front and rear covers by gently squeezing on top and bottom and pulling.

Warning: After removal the circuit pack should be placed on a clean, dry, nonconductive surface.

(2) Release the circuit pack latching mechanism of the data mounting (Fig. 8).

(3) Slide the circuit pack out the rear of the housing (Fig. 9).

2.04 ***2-Wire or 4-Wire Operation (Options Y or Z):*** Depends on line facilities available.

2.05 ***Remote Test Connection Via J1 (Yes or No) (Option P or N):*** Allows a DAS 830B-L1A or TTY connected to the data set to remotely activate the test mode.

2.06 ***Resistor Bypass for Negative Voltage (-P) on J1 (Yes or No) (Option R or Q):*** This option is used whenever the data set is arranged with a DAS 830B-L1A or 830C-L1A.

2.07 ***Receiver Gain Reduction (Yes or No) (Option K or J):*** Normally 6 dB (option K) is used. No reduction (option J) is used when the loop shows an unusually high loss.

2.08 ***Mark or Space Hold (Option U or V):*** On loss of carrier frequency this choice of options determines whether the received data (BB) line is held on a negative (marking) voltage or a positive (spacing) voltage.

2.09 ***Clear to Send (CB) Internally Connected*** as follows:

- ***Receive Supervision (RS) (Option W):*** Used only if CPE requires supervision on the received line signal detector line (CF). Refer to the example in Fig. 10.
- ***Request to Send (CA) (Option X):*** Used when the terminal equipment requires CA connected to CB. Refer to the example in Fig. 11.
- ***(Unconnected) (Option E):*** Used when no output to CB is required.

2.10 ***Carrier Control*** is as follows:

- ***Via Request to Send (CA) (Option D):*** This option cannot be selected at the same

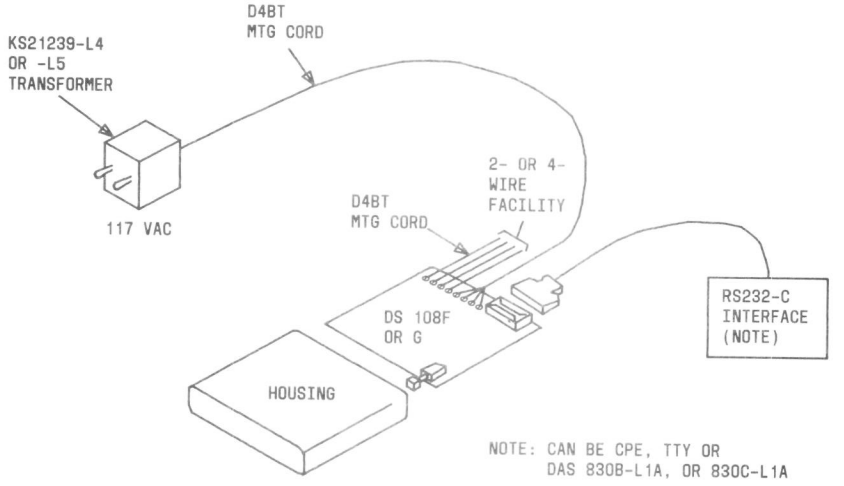


Fig. 5—Typical DS 108F or G Arrangement

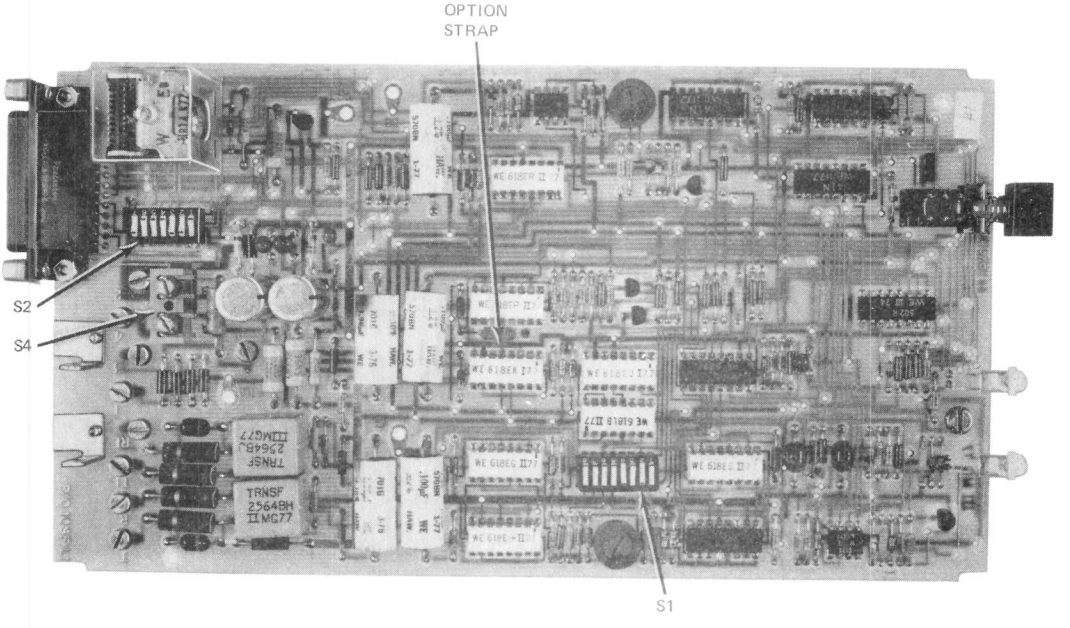


Fig. 6—Circuit Pack of DS 108F (Similar to DS 108G Circuit Pack)

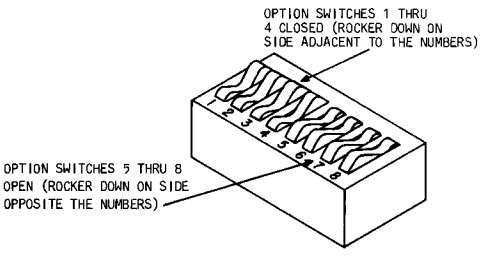


Fig. 7—Dual In-Line Package (DIP) Switch Operation

time as option X above. It is used when carrier control is desired from the terminal equipment (as in polling systems). Refer to the example in Fig. 10.

- ***Via Receive Supervision (RS) (Option T):*** Used when the far-end set is to have full facilities supervision. It provides the "carrier squelch on carrier fail". This option ***cannot*** be installed at both ends of a system.

- ***Always on in Data Mode (Option S):*** Used in normal point-to-point systems and at the polling end of polling systems. The car-

TABLE A
DATA SET 108F OR G OPTIONS

FEATURE		OPTION	SWITCH SETTING (S1-)		USOC DECSN
			OPEN	CLOSED	
Facility	4-Wire	Z	4	3	
	2-Wire	Y*	3	4	
Mark or Space Hold	Mark	U*	2	1	B3
	Space	V	1	2	B4
			SWITCH SETTING (S2-)		
CB Internally Connect to	None	E	5,6	–	
	RS	W	6	5	D7
	CA	X*	7	6	D8
Carrier Control	Via CA	D	2,4,6	7	
	Via RS	T	2,7	4	A1
	Always on in Data Mode	S*	4,7	2	A2
	Always off in Data Mode	H	2,4,7	–	
Remote Test Connection Via J1	Yes	P	–	1	
	No	N*	1	–	
Local Copy in Test Mode	Yes	G	–	3	C5
	No	F*	3	–	C6
			OPTION STRAP		
Receiver dB Gain Reduction	6	K*	E2-E3		
	0	J	E1-E2		
			SCR SWITCH (S4-)		
Ground Wire (GRD) Connected to Signal Ground (SG)	Yes	M*	–	B	E9
	No	L	B	–	E10
Resistor Bypass for Negative Voltage (-P) on J1	Yes	R	–	A	
	No	Q*	A	–	

* Factory furnished option.

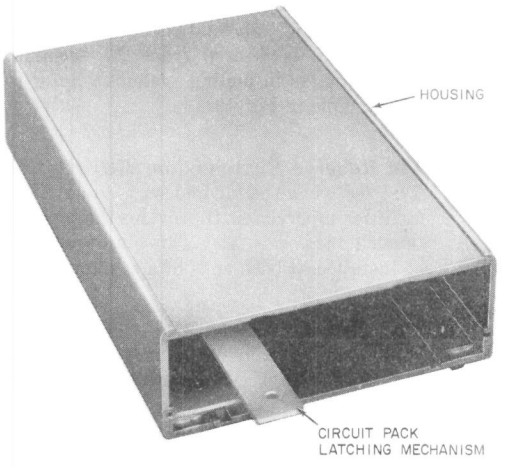


Fig. 8—DS 108F or G Housing

rier is always ***on*** except when controlled by receive supervision in the test mode.

- ***Always off in Data Mode (Option H):*** This option is used in broadcast systems and keeps the carrier ***off*** except when controlled by receive supervision in the test mode. Refer to the example in Fig. 11.

2.11 ***Local Copy in Test Mode (Option G):*** Used when the data interchange code between terminal equipment and testboard is the same and no restrictions exist on the use of the paper in the terminal equipment.

2.12 ***No Local Copy in Test Mode (Option F):*** This option should be used only when the terminal equipment uses a data interchange code that differs from the code used by the testboard, or the terminal equipment uses special paper (such as numbered forms or airline ticket blanks).

2.13 ***Ground Wire Connected to Signal Ground (SG) (Option M):*** Connects SG to the "green wire" ground via the third prong of the

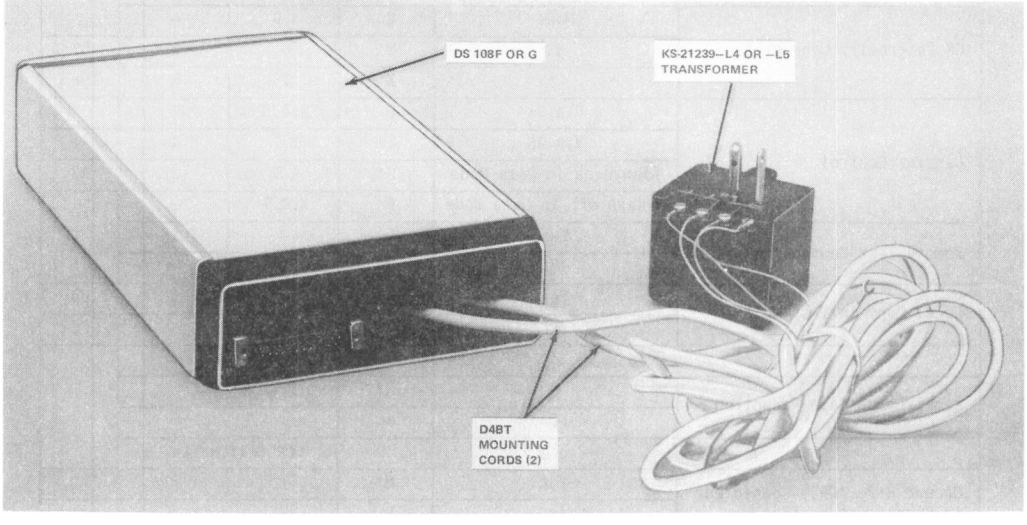
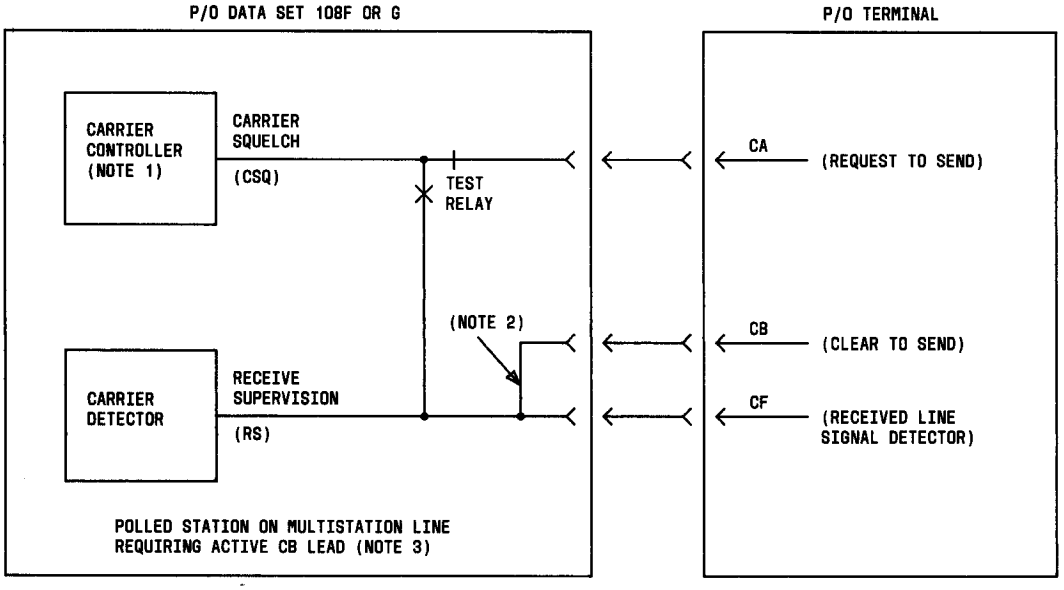


Fig. 9—DS 108F or G Rear View



NOTES:
1. OPTION D, CARRIER CONTROL VIA CA.
2. OPTION W, CB CONNECTED TO RS.
3. THIS IS AN EXAMPLE OF THE APPLICATION OF THESE OPTIONS, AND IS NOT LIMITING.

Fig. 10—Example of DS 108F or G Options D and W

power transformer. The data set housing always remains ungrounded.

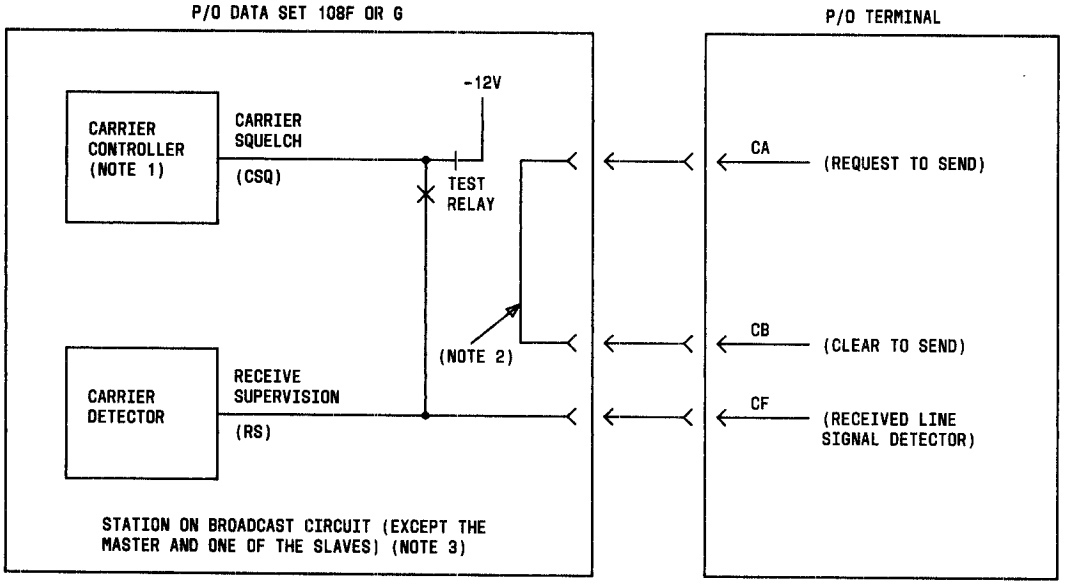
2.14 ***Ground Wire Not Connected to Signal Ground (SG) (Option L):*** Maintains SG as a floating ground.

2.15 ***Remotely Activated Digital Loopback:*** This telephone company option requires installation of a 52A1 data unit on the data set circuit pack as shown in Fig. 12. The 52A1 data unit permits a test center to remotely activate the digital loop test mode of the data set by sending a spacing signal of 1 second or longer duration. The test center can deactivate the test mode after performing the test by sending a marking signal of 0.5 seconds. The following restrictions apply:

- Customer data cannot normally contain spacing signals in excess of 0.6 seconds.
- The 52A1 data unit can be installed on one data set only of any two that communicate with each other.
- Data Set 108G equipped with the 52A1 data unit cannot use the space hold option if the distant data set provides the carrier squelch on carrier rail option.
- Data Set 108E equipped with the 52A1 data unit cannot use the space hold option if the distant data set provides both the carrier squelch on carrier fail option and space hold option.

B. DAS 830B-L1A

2.16 The DAS 830B-L1A provides the options shown in Table B.



NOTES:
1. OPTION H, CARRIER CONTROL ALWAYS IN DATA MODE.
2. OPTION X, CB CONNECTED TO CA.
3. THIS IS AN EXAMPLE OF THE APPLICATION OF THESE OPTIONS, AND IS NOT LIMITING.

Fig. 11—Example of DS 108F or G Options H and X

C. DAS 830C-L1A

2.17 The DAS 830C-L1A (Fig. 13) provides the options shown in Table C.

D. DAS 830D-L1

2.18 The DAS 830D-L1 provides the options shown in Table D.

3. INSTALLATION

3.01 Prior to installing DS 108F or G and the associated data auxiliary sets ensure that:

- The correct private line data set is used.
- Refer to Table E for compatibility.
- The desired options are installed in DS 108F or G and the data auxiliary set.

3.02 The data set requires a power source that provides 105 to 129 volts 7 watts at 57 to 63 Hz. The customer must supply an outlet that will accept the 3-prong plug on the KS-21239-L4 or -L5 power transformer provided with the data set. To prevent the data set from being turned off accidentally, this outlet should not be under the control of a switch. To avoid the possibility of data errors due to a potential difference between data set ground and terminal equipment ground, the outlet for the data set power cord should be served from the same ac distribution panel as the terminal equipment. If this condition cannot be met, a test using the 6H impulse counter should be performed to detect the presence of noise potential. This test is described in Section 591-818-500. If test requirements are not met, data set ground and terminal equipment ground must be bonded together in accordance with local regulations.

3.03 The data set is equipped with a 25-pin female EIA interface connector to provide EIA inter-

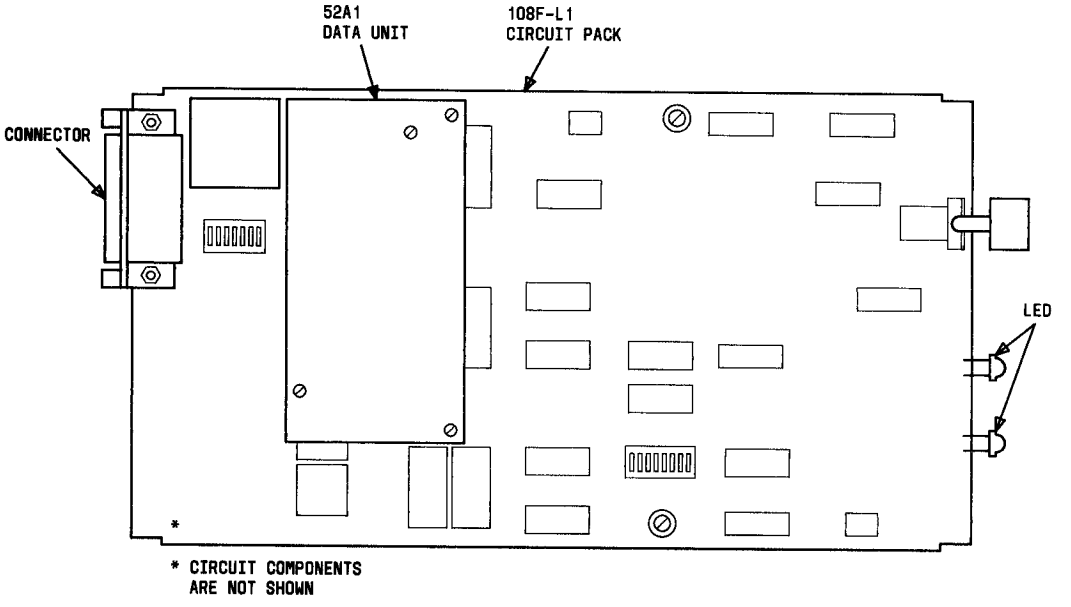


Fig. 12—DS 108F-LI Equipped With 52A1 Data Unit

TABLE B

DAS 830B-L1A OPTIONS

FEATURE	OPTION	SWITCH SETTING	
		OPEN	CLOSED
Local Copy	Z		S1A
No Local Copy	Y*	S1A	
Paper alarm — motor stop†	X*	S2B	
Paper alarm — no motor stop	W		S2B
EOT disconnect‡	V		S2A
No EOT disconnect	U*	S2A	
Space clamp§	T*		S1B
Mark clamp§	S	S1B	

* Factory furnished option.

† Paper alarm (low paper or out of paper) stops TTY motor.

‡ If an end-of-transmission (EOT) character is received by the TTY, the TTY will turn off (placing a mark on select magnet driver to guard against spurious characters).

§ Mark or space clamp on the BA lead when TTY is in OFF condition.

face to either terminal equipment or data auxiliary set. Telephone line interface must be provided using locally furnished wire. Locally furnished wire must also be provided between power transformer KS-21239-L4 or -L5 and the data set. D4BT mounting cords are recommended for power and telephone line connections.

3.04 Installation of the DAS 830B-L1A, ET1 circuit pack (Fig. 14), and EC 833 break detection circuit is made at the service center (Fig. 15). The wiring for ET1 circuit pack arrangement with DAS 830B (Fig. 16) includes a send space timing circuit and a message-waiting lamp circuit.

DS 108F or 108G Transmit Level Setting

3.05 The DS 108F or G transmit level may be set for the output level specified on the CLRC according to Table F.

4. CONNECTIONS

4.01 This part contains information for connecting DS 108F or G alone and with DASs 830B-L1A, 830C-L1A and 830D-L1.

4.02 The connection diagrams are as follows:

- Fig. 17—DS 108F or G Connection Diagram
- Fig. 18—DS 108F and G With DAS 830B-L1A Connection Diagram
- Fig. 19—DS 108F or G With DAS 830C-L1A Connection Diagram
- Fig. 20—DS 108F or G with DAS 830D-L1 Connection Diagram.

5. INSTALLATION TESTS

5.01 After installation is complete refer to Section 591-818-500 for test procedures.

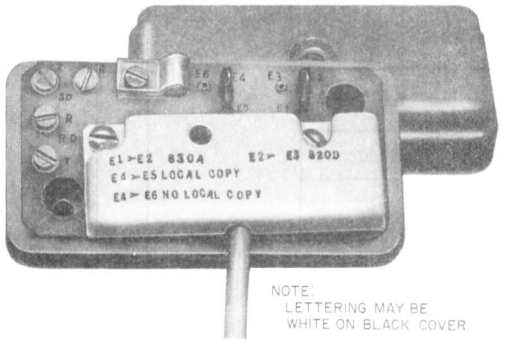


Fig. 13—DAS 830C-L1A Terminal Board

6. REFERENCES

6.01 The following Bell System Practices provide additional information on DS 108F and G and associated equipment:

SECTION	TITLE
591-042-100	Data Sets 108F and 108G—Identification
591-818-100	Private Line Station Arrangements Using Data Sets 108F and 108G With Data Auxiliary Sets 830B and 830C—Description
591-818-500	Private Line Station Arrangements Using Data Sets 108F and 108G With Data Auxiliary Sets 830B and 830C—Maintenance and Test Procedures
598-083-102	Data Auxiliary Set 830B—Identification
598-083-103	Data Auxiliary Set 830C—Description
598-083-107	Data Auxiliary Set 830D—Identification

6.02 The following schematic drawings (SDs) and circuit descriptions (CDs) contain information on DS 108F and 108G or associated equipment:

SECTION	TITLE
SD- & CD-1D250-01	Data Auxiliary Sets 830A, 830B, 830C, and 830D
SD- & CD-1D285-01	Data Set 108F
SD- & CD-1D286-01	Data Set 108G and 52A1 Data Unit

TABLE C

DAS 830C-L1A OPTIONS

FEATURE		OPTION	LINK POSITION
Local Copy	Yes	Z	E4 to E5
	No	Y*	E4 to E6
For Operation With	DAS 830A or DS 108F or G	X	E1 to E2
	DAS 820D	W*	E2 to E3

* Factory furnished option.

TABLE D

DAS 830D-L1 OPTIONS

FEATURE		LINK OPTION	POSITION
Time Delay	Long	Z*	E1 to E2
	Short	Y	E2 to E3

* Factory Furnished Option.

TABLE E

DS 108F AND G LINE COMPATIBILITY

DATA SET	FAR-END DATA SET
108F	103F (In the answer mode) 108A 108E 108G 108J
108G	103F (In the originate mode) 108B 108C 108D 108F 108H

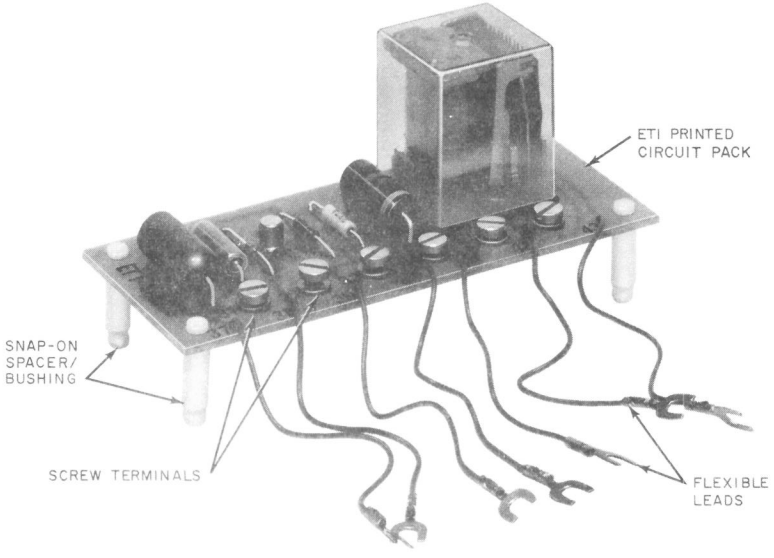


Fig. 14—ET1 Circuit Pack

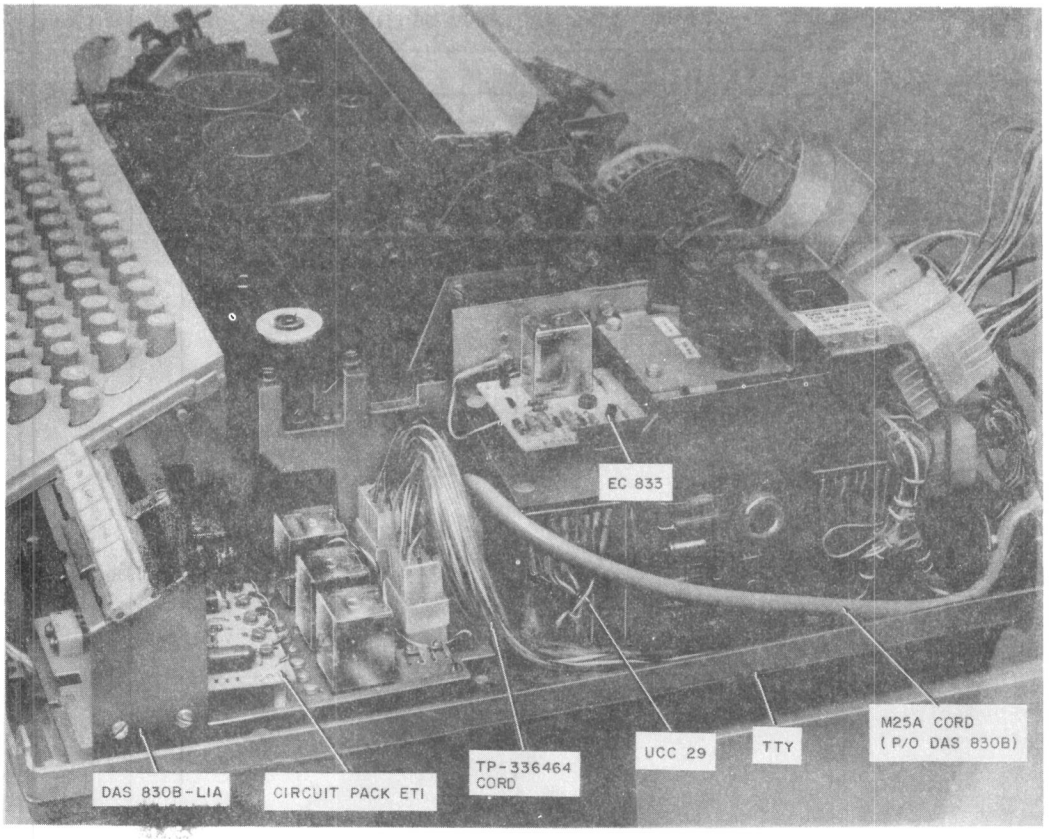
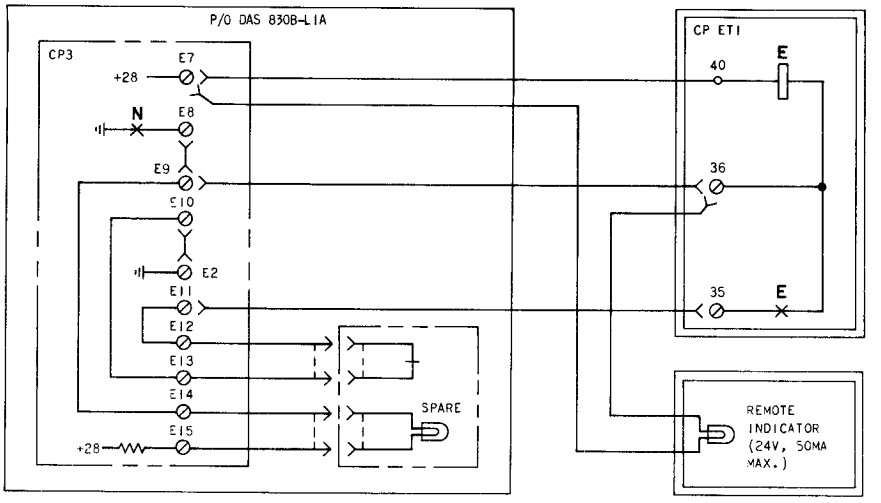
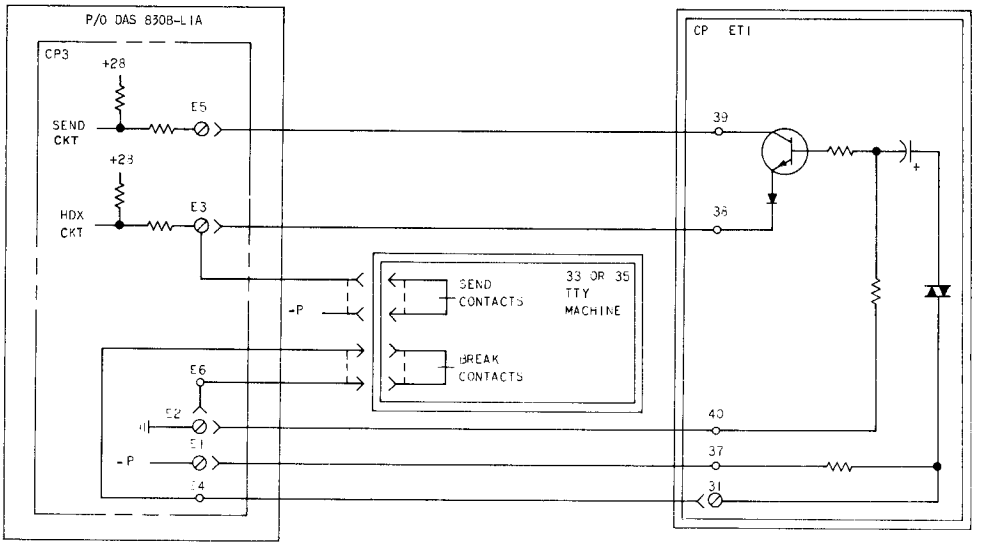


Fig. 15—DAS 830B-L1A Mounted in TTY



WIRING OF CP ETI AND DAS 830B-L1A WITH TSPS NO. 1 HOTEL/MOTEL SERVICE FOR MESSAGE WAITING INDICATION ("SPARE" BUTTON MAY BE RELABLED FOR PROPER IDENTIFICATION, AND LOCKING SCREW MAY BE REMOVED TO CONVERT THE BUTTON TO NONLOCKING, NONRELEASING.) THE ARRANGEMENT FOR MESSAGE WAITING INDICATION CANNOT BE USED WITH EITHER THE ARRANGEMENT FOR SEND SPACE TIMING OR WITH THE TELETYPEWRITER BREAK DETECTION OPTION. THE LOCAL BUTTON MUST RETAIN THE BLOCKING RING 812365948 (P-23F594).



WIRING OF CP ETI AND DAS 830B-L1A FOR SEND SPACE TIMING

Fig. 16—ET1 Circuit Pack Arrangement

TABLE F

DS 108F OR G TRANSMIT LEVEL SETTING

TRANSMIT LEVEL (IN dBm)	SWITCH SETTING (S1 –)	
	OPEN	CLOSED
–1	5, 6, 7, 8	—
–3	5, 7, 8	6
–5	5, 6, 8	7
–7	5, 6, 7	8
–9*	6, 7, 8	5
–11	7, 8	5, 6
–13	6, 8	5, 7
–15	6, 7	5, 8

* Factory furnished option.

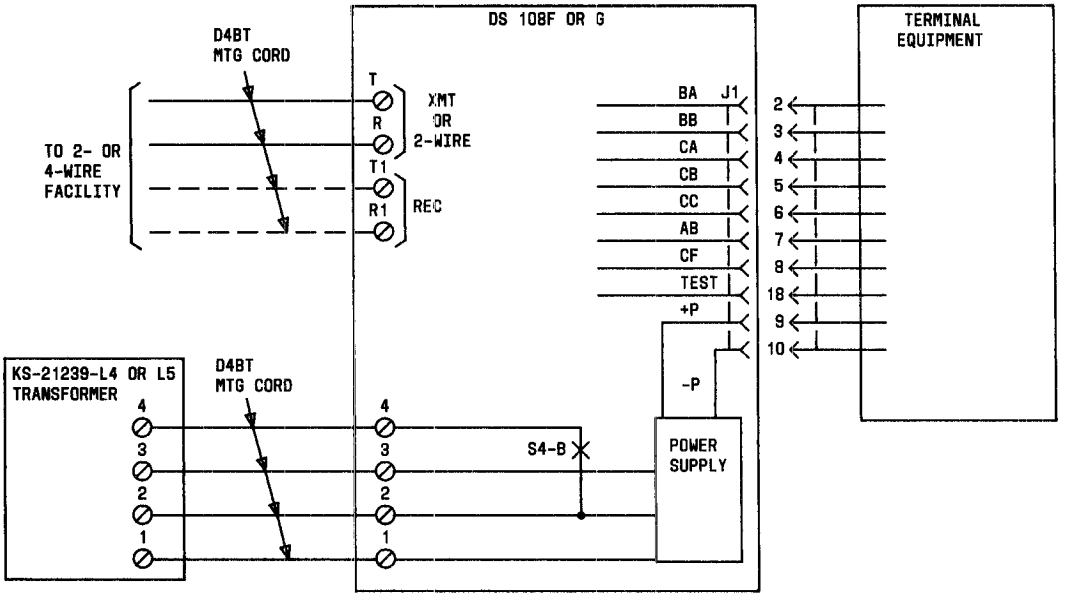


Fig. 17—DS 108F or G Connection Diagram

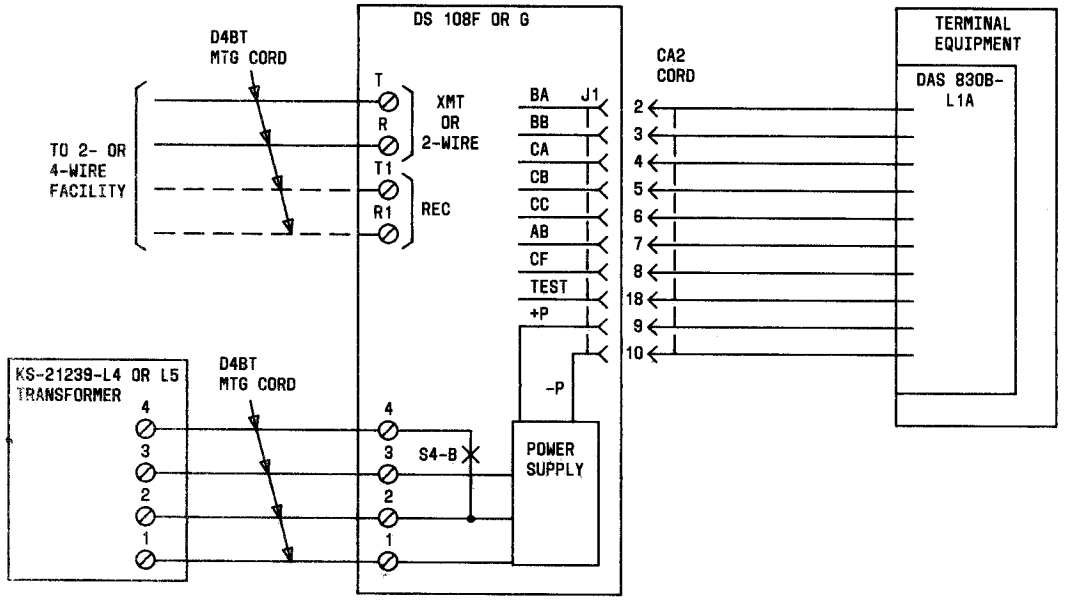
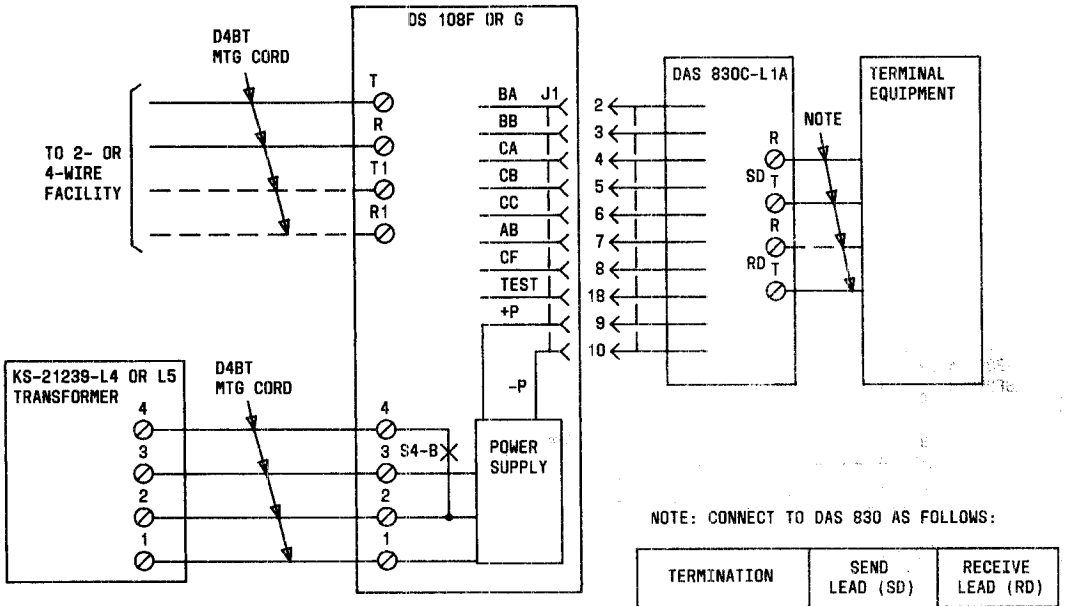


Fig. 18—DS 108F or G With DAS 830B-L1A Connection Diagram



NOTE: CONNECT TO DAS 830 AS FOLLOWS:

TERMINATION	SEND LEAD (SD)	RECEIVE LEAD (RD)
4-WIRE CIRCUIT	+ TO SD-R - TO SD-T	+ TO RD-R - TO RD-T
3-WIRE CIRCUIT	+ TO SD-R	- TO RD-T
	COMMON TO SD-T	

Fig. 19—DS 108F or G With DAS 830C-L1A Connection Diagram

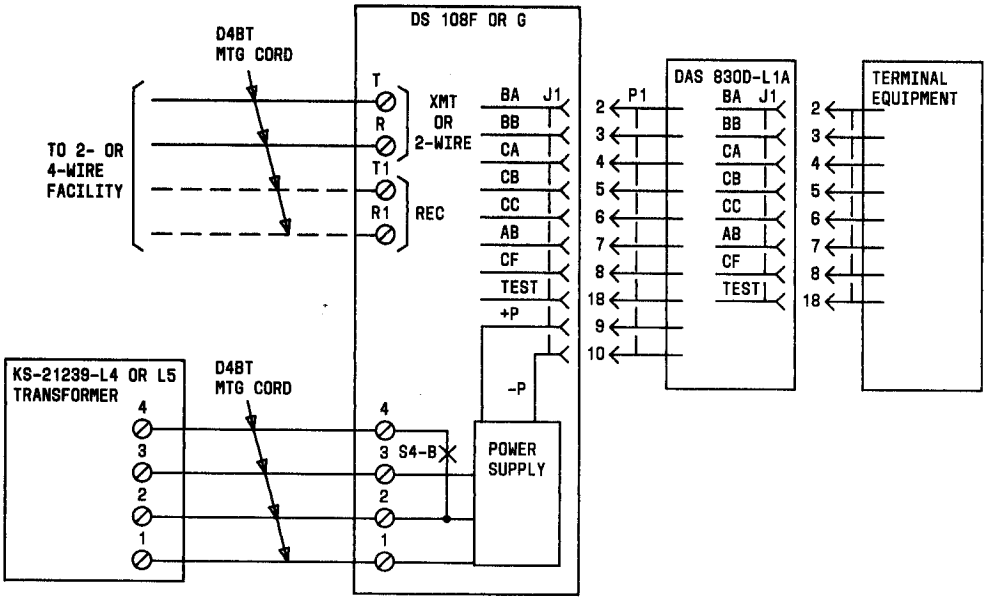


Fig. 20—DS 108F or G With DAS 830D-L1 Connection Diagram

DATA SETS 108H AND 108J

DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional description for data sets (DSs) 108H and J (Fig. 1) in private line service.

Fig. 1—Data Set 108H (Similar to Data Set 108J)

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 The DS 108H and J differ only in send and receive frequencies. The different send and receive frequencies of DS 108H and J complement each other.

1.04 The DS 108H or J provides 20-mA current interface between a 2-wire private line facility and terminal equipment [either customer-provided equipment (CPE) or Bell System teletypewriters (TTYs)] for serial, low-speed (0 to 150 baud), asynchronous half- or full-duplex operation.

DS 108F OR G IN STATION ARRANGEMENT WITH DATA AUXILIARY SET (DAS) 830C-L1A

1.05 The DS 108F or G with DAS 830-L1A provides a 20-mA current interface between a 2- or 4-wire private line facility and terminal equipment for serial, low-speed (up to 150 baud), asynchronous, full-duplex operation.

CRITERIA FOR SELECTING DS 108F OR G WITH DAS 830C-L1A IN LIEU OF DS 108H OR J

1.06 The DS 108F or G with DAS 830C-L1A ***must*** be used when any of the following are required:

- Connection to a 4-wire facility
- Carrier squelch on carrier fail feature
- Broadcast feature
- Remote operate of test mode
- Carrier on (CO) indicator lamp
- Receiver sensitivity of -42 dBm rather than -36 dBm

- Carrier detection characteristics of DS 108F and G required. The DS 108F or G enters the data mode upon receipt of the appropriate carrier frequency (f1 mark or space for DS 108G, f2 mark for DS 108F) for at least 300- ms. The data set remains in the data mode until loss of carrier occurs or the signal level drops below approximately -45 dBm.

1.07 The technical specification for DS 108H or J follows:

AC Power: 117 volts ±10 percent, 60 Hz ±5 percent. The power outlet should be a conventional 3-wire grounded outlet.

Operation: Low-speed, asynchronous, binary, serial.

Operating Mode: Half- or full-duplex.

Data Rates: Up to 150 baud.

Line Impedance: 600 ohms.

Operating Frequencies: The DS 108H transmits in the f1 band (mark—1270 Hz, space—1070 Hz) and receives in the f2 band (mark—2225 Hz, space—2025 Hz). DS 108J transmits in the f2 band and receives in the f1 band.

Line Compatibility: The DS 108H, an "originate" mode set, is compatible with DS 103F (in the answer mode), 108A, 108E, 108G and 108J. DS 108J, and "answer" mode set, is compatible with DS 103F (in the originate mode), 108B, 108C, 108D, 108F, and 108H.

Environmental Requirements:

- Ambient temperature range from 40 to 120°F.
- Relative humidity from 20 to 95 percent with no condensation.

2. PHYSICAL DESCRIPTION

2.01 The DS 108H and J consist of a single circuit pack (Fig. 2), a plastic housing (Fig. 3), and a KS-21239-L4 or -L5 transformer (Fig. 4). Overall dimensions are approximately 4.7 inches wide, 7.1 inches long, and 2 inches high. The set weighs approximately 1 pound, and the KS-21239-L4 or -L5 transformer weighs approximately 1 pound.

2.02 The DS 108H or J may be wall mounted using the adhesive pad or two screws shipped with the data set or it may be desk or table-top mounted.

2.03 The housing is similar in appearance to the housing used for the 1000-type data coupler. The housing assembly consists of a plastic basepan to which the circuit pack is attached and a plastic cover. No interface assembly or electrical connections are provided since all connections are to screw terminals mounted on the circuit pack. A single D6AB mounting cord is recommended for KS-21239-L4 or -L5 transformer and telephone line interface connections. The housing cover incorporates a rocker switch labeled TST (test).

2.04 The TST switch initiates the digital loopback test. In this digital loopback test mode, the data set ignores the output of the terminal equipment and, with option F installed, outputs a steady mark to the terminal equipment to inhibit local copy.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains information pertaining to DS 108H or J modulation, transmission, reception, digital loopback test mode, and options. Because of functional similarity, all references to DS 108H and J will be to "data set" only. The full designation will be used to indicate dissimilar functions. Figure 5 is a simplified diagram of the data sets.

General

3.02 The data set provides the interface between a 2-wire private line telephone facility and terminal equipment requiring 2-, 3-, or 4-wire 20 mA interface.

Modulation

3.03 The data set employs frequency-shift keying (FSK) with a shift of +100 Hz for a mark and -100 Hz for a space. DS 108H converts the dc signals at the customer interface into ac signals in the f1 frequency band (see Table A) for

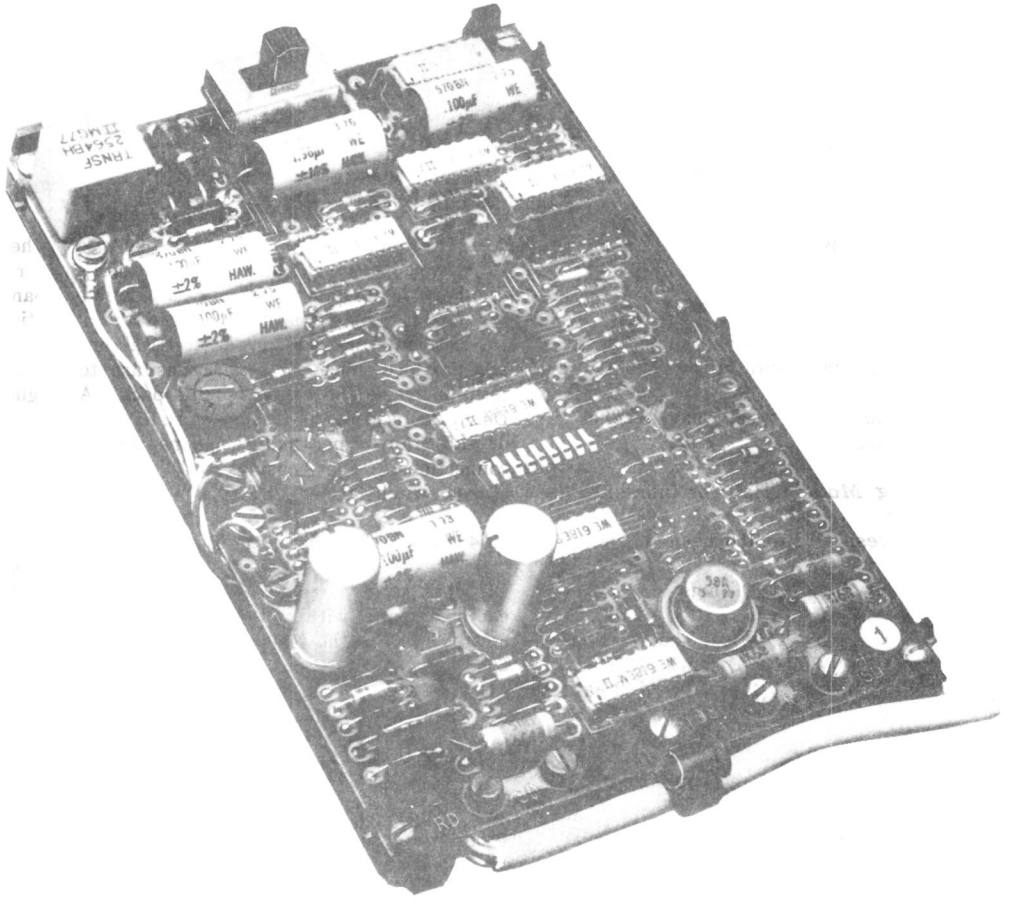


Fig. 2—Circuit Pack of DS 108H (Similar to DS 108J Circuit Pack)

transmission over the frequency band for conversion to dc signals and output to the customer interface. DS 108J transmits in the f2 band and receives in the f1 band (see Table A).

Transmission

3.04 The data set FSK modulates data signals at an output power range of nominally -1 to -15 dBm into a 600-ohm 2-wire line. The data set transmit level is adjustable in 2-dB steps (refer to Section 591-043-200 for procedures for setting output level).

Reception

3.05 The data set enters the data mode upon receipt of the appropriate carrier frequency (f1 band for DS 108J, f2 band for DS 108H) for at least 90 ms. The data set remains in the data mode until loss of carrier occurs or the signal level drops below approximately -36 dBm. The

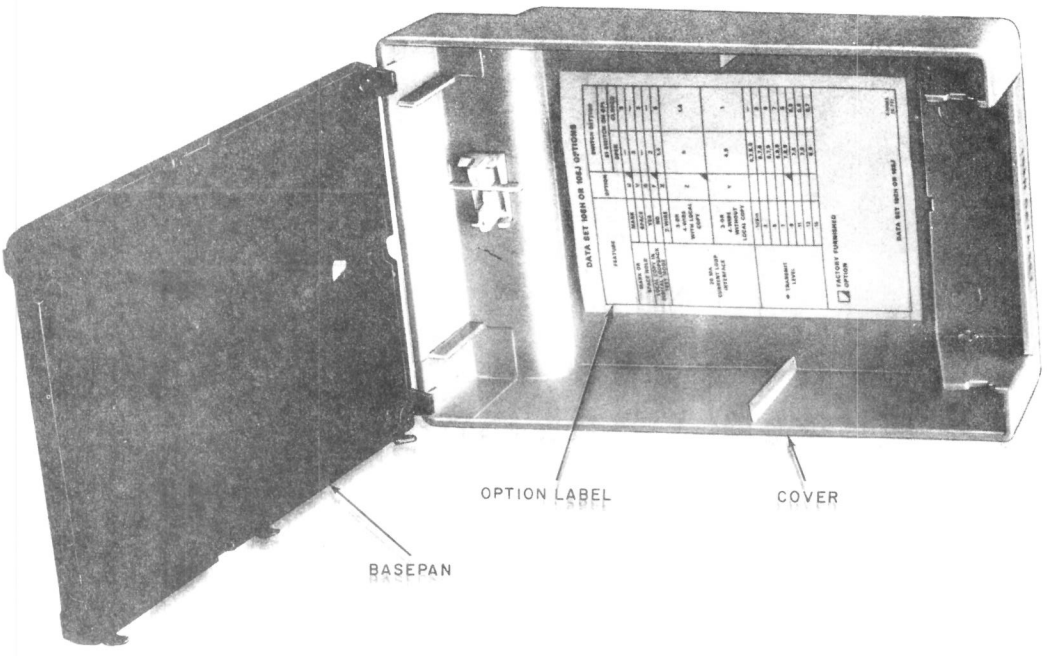


Fig. 3—DS 108H or J Housing

data set will enter the data mode on a mark, space, or any data signal in the appropriate band.

Digital Loopback Test Mode

3.06 Depressing the TST switch places the data set in the digital loopback test mode. This mode internally loops the receiver output to the transmitter. When a data connection is established between the test center and the data set, this mode enables the test center to measure round trip data distorton.

Options

3.07 Data set options are listed in Table B. Refer to Section 591-043-200 for a description of these options.

4. REFERENCES

4.01 The following Bell System Practices provide additional information on DS 108H and J:

SECTION	TITLE
591-043-200	Data Sets 108H and 108J—Installation and Connections
591-043-500	Data Sets 108H and 108J—Test Procedures

4.02 The following schematic drawings (SDs) and circuit descriptions (CDs) contain information on DS 108H and J:

NUMBER	TITLE
SD-&CD-1D287-01	Data Set 108H
SD-&CD-1D284-01	Data Set 108J

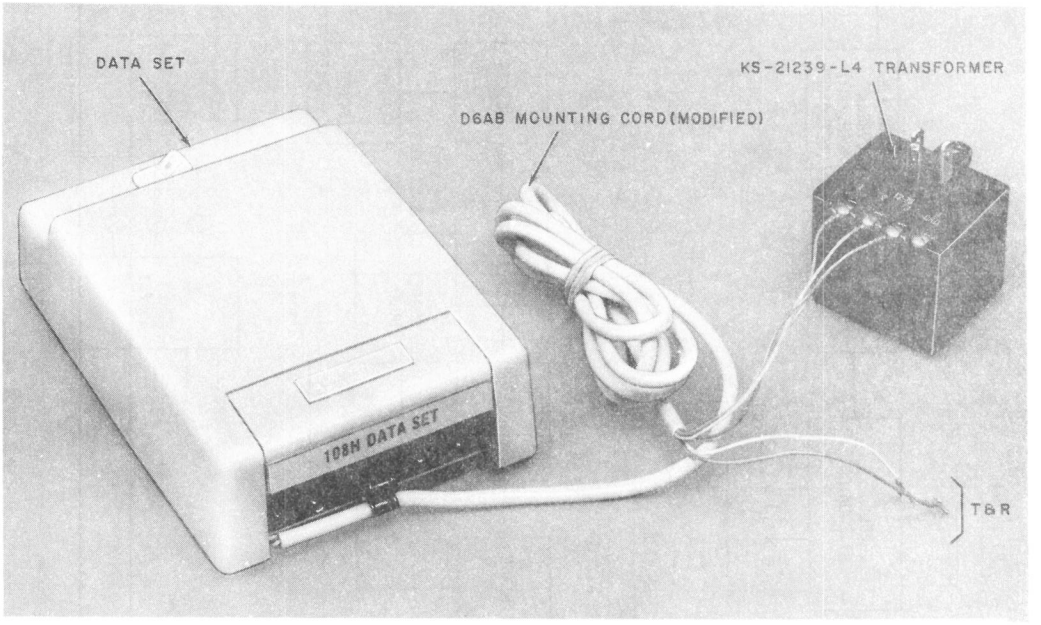


Fig. 4—DS 108H Shown Connected to KS-21239-L4 or -L5 Transformer

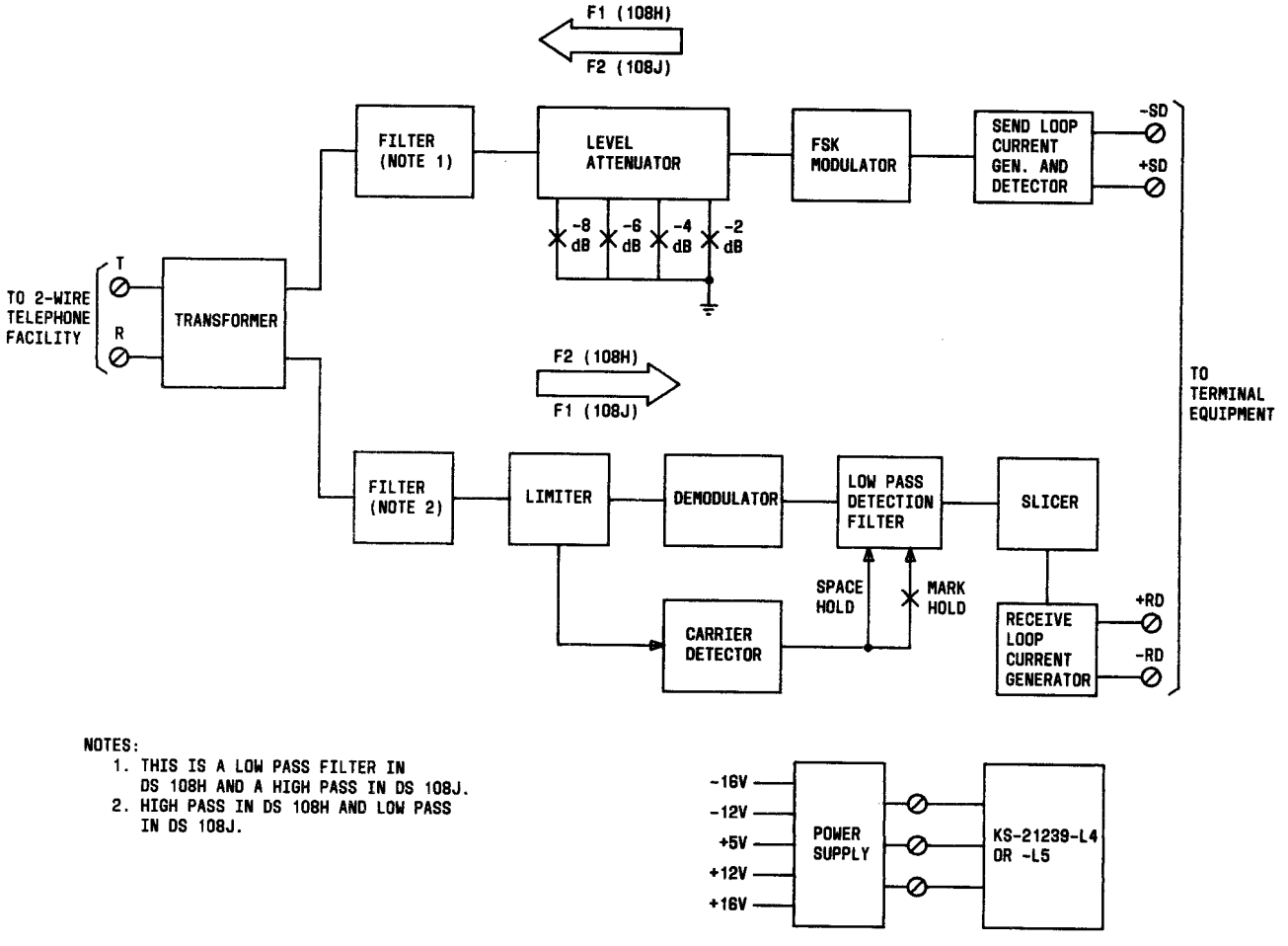


Fig. 5—DS 108H and J Simplified Diagram

TABLE A

DATA SET FREQUENCY DATA

DATA SET	TRANSMIT			RECEIVE		
	FREQ BAND	MARK	SPACE	FREQ BAND	MARK	SPACE
108H	F1	1270	1070	F2	2225	2025
108J	F2	2225	2025	F1	1270	1070

TABLE B

DS 108H OR J OPTIONS

FEATURE		OPTION
Mark or Space Hold	Mark	U*
	Space	V
Local Copy in Digital Loopback Test Mode	Yes	G
	No	F*
20 mA Current Loop Interface	2 - Wire	X
	3 - or 4 - Wire With Local Copy	Z*
	3 - or 4 - Wire Without Local Copy	Y

* Factory furnished option.

DATA SETS 108H AND 108J

INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the installation and connection of data sets (DSs) 108H and J (Fig. 1).

1.02 The reasons for reissuing this section are listed below. Revision arrows have been used to denote significant changes.

- Added Uniform Service Order Code (USOC) decision column in Table A.
- Added notes in Fig. 5.

1.03 The DS 108H and J should be installed in conformance with the general requirements of Section 590-010-200; entitled Data Installation and Connection Information.

1.04 For optimum appearance and utility, locate the data apparatus on a desk, table, stand, wall, or in a Bell System provided equipment cabinet. When required, or upon customer request, the adhesive pad shipped with the data set can be used to mount the data set. In addition, the data set may also be mounted by attaching the basepan to a suitable vertical surface using two No. 6 pan head tapping screws (comcode 841065717), shipped with the data set.

1.05 The DS 108H and J will operate over a temperature range of 40°F to 120°F with relative humidity of 20 to 95 percent (applies only if condensation does not accumulate on the circuit pack).

1.06 The data set should be located near the associated terminal equipment [either customer-provided equipment (CPE) or Bell System teletypewriter (TTY)].

2. OPTIONS

2.01 The DS 108H and J are provided with a number of options which are installed prior to placing the data set in service. All options are installed or removed with the switch (S1) shown in Fig. 2. Each option and associated switch setting is listed in Table A. Similar information is contained on the option label located inside the cover of the data set housing (Fig. 3). Additional option labels may be obtained by ordering Form E-10065.

2.02 The installer should verify that the options specified on the service order are installed.

2.03 ***Mark or Space Hold (Options U or V):*** On loss of carrier frequency this choice of options determines whether the receive current loop is held at a steady marking or spacing current.

2.04 ***Local Copy in Digital Loopback Test Mode:***

- ***Yes (Option G):*** Used when the data interchange code of the terminal equipment and of the testboard is the same, and when no restrictions exist on the use of the paper in the terminal equipment.
- ***No (Option F):*** Used when the terminal equipment uses a data interchange code different from the code used by the testboard, or when the terminal equipment uses special paper (such as numbered forms or airline ticket blanks).

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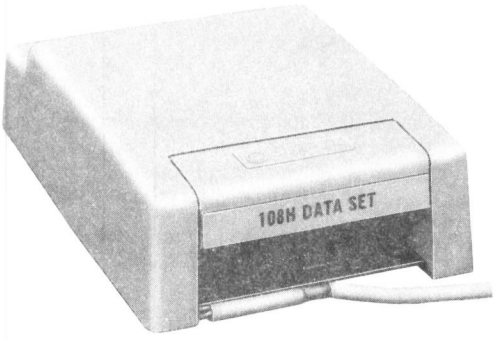


Fig. 1—Data Set 108H (Similar to Data Set 108J)

2.05 *20 mA Current Loop Interface Options:* The desired option is chosen to be compatible with the terminal equipment and to suit the customer's needs, refer to discussion of local copy options in paragraph 2.04:

- *2-Wire (Option X)*
- *3- or 4-Wire With Local Copy (Option Z)*
- *3- or 4-Wire Without Local Copy (Option Y).*

3. INSTALLATION

3.01 Prior to installing DS 108H or J ensure that:

- The correct private line data set is used. Refer to Table B for compatibility.
- The desired options are installed.

3.02 The data set requires a power source that provides 105 to 129 volts at 57 to 63 Hz. The customer must supply an outlet that will accept the 3-prong plug on the KS-21239-L4 or -L5 transformer provided with the data set.

> ***Caution: If the outlet has a metal cover, do not remove the center screw to mount the transformer. When this screw is removed, it is possible for the metal cover to fall across the prongs of the transformer.***

3.03 The data set must be connected to the KS-21239-L4 or -L5 transformer and telephone line using locally furnished wire. A D6AB mounting cord (modified) is recommended (Fig. 4).

A. DS 108H or J Transmit Level Setting

3.04 The DS 108H or J transmit level may be set for the output level specified in the CLRC according to Table C.

4. CONNECTIONS

4.01 Connect DS 108H or J to terminal equipment, telephone line, and KS-21239-L4 or -L5 transformer as shown in Fig. 5.

5. REFERENCES

5.01 The following Bell System Practices provide additional information on DS 108H and J:

SECTION	TITLE
591-043-100	Data Sets 108H and 108J— Description
591-043-500	Data Sets 108H and 108J—Test Procedures

5.02 The following schematic drawings (SDs) and circuit descriptions (CDs) contain information on DS 108H and J:

NUMBER	TITLE
SD- & CD-1D287-01	Data Set 108H
SD- & CD-1D284-01	Data Set 108J

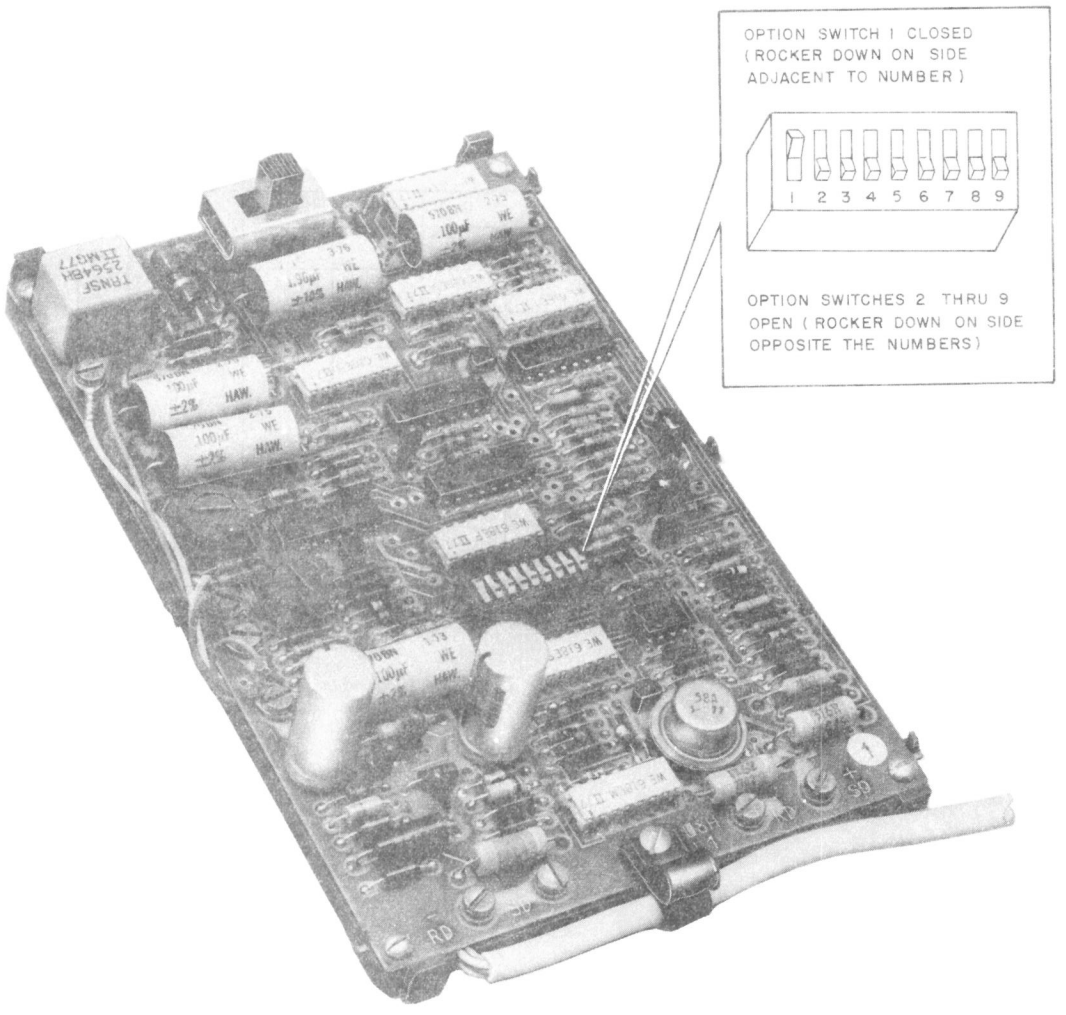


Fig. 2—Circuit Pack of DS 108H Showing Detail of Option Switch S1 (Similar to DS 108J)

◗ TABLE A ◖
DATA SET 108H OR J OPTIONS

FEATURE		OPTION	SWITCH SETTING S1 SWITCH ON CP1		USOC DECSN
			OPEN	CLOSED	
Mark or Space Hold	Mark	U*	--	3	B3
	Space	V	3	–	B4
Local Copy in Digital Loopback Test Mode	Yes	G	–	2	C5
	No	F*	2	–	C6
20 mA Current Loop Interface	2-Wire	X	1,4	5	F11
	3- or 4-Wire With Local Copy	Z*	5	1,4	F12
	3- or 4-Wire Without Local Copy	Y	4,5	1	

* Factory furnished option.

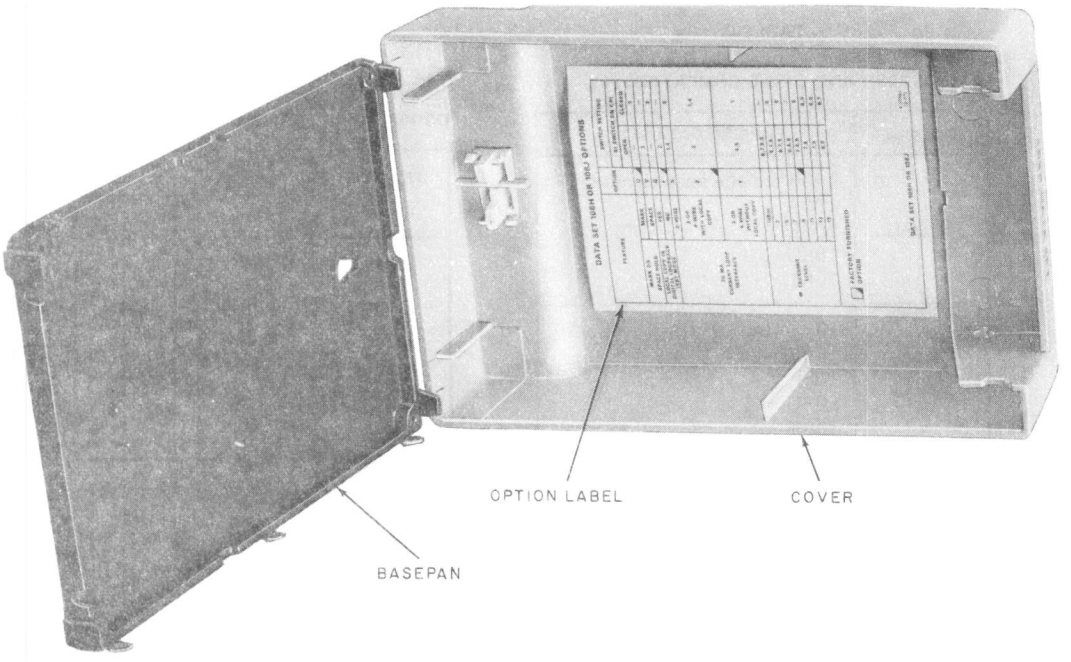


Fig. 3—DS 108H or J Housing With Option Label Installed

TABLE B

DS 108H AND J LINE COMPATIBILITY

DATA SET	FAR-END DATA SET
108H	103F (In the answer mode) 108A 108E 108G 108J
108J	103F (In the originate mode) 108B 108C 108D 108F 108H

TABLE C

DS 108H OR J TRANSMIT LEVEL SETTING

TRANSMIT LEVEL (In dBm)	SWITCH SETTING (S1-)	
	OPEN	CLOSED
−1	6, 7, 8, 9	—
−3	6, 7, 8	9
−5	6, 7, 9	8
−7	6, 8, 9	7
−9*	7, 8, 9	6
−11	7, 8	6,9
−13	7, 9	6,8
−15	8, 9	6,7

* Factory furnished.

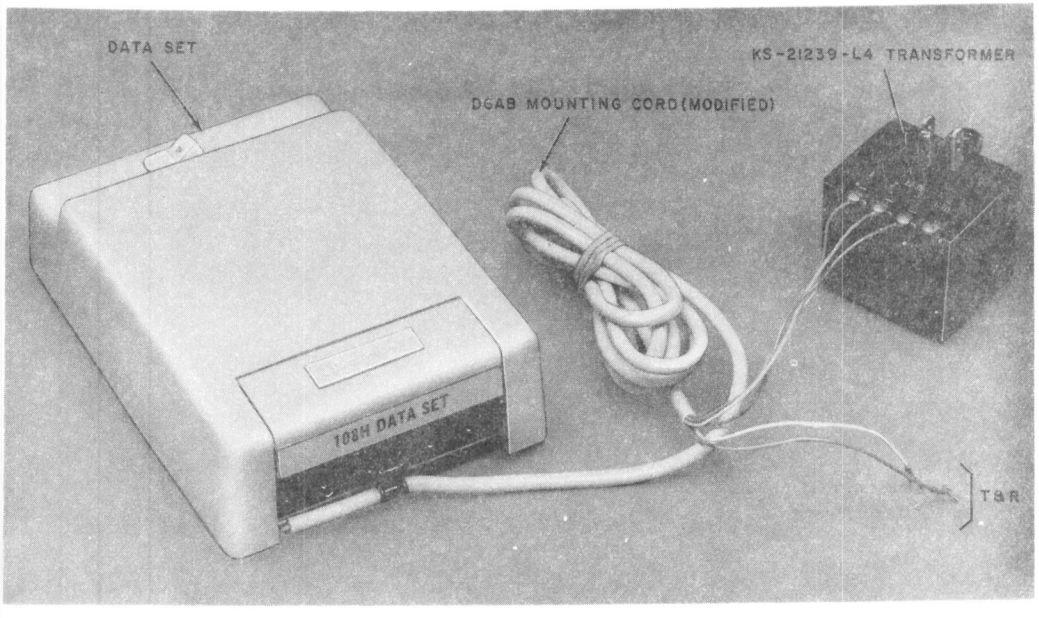
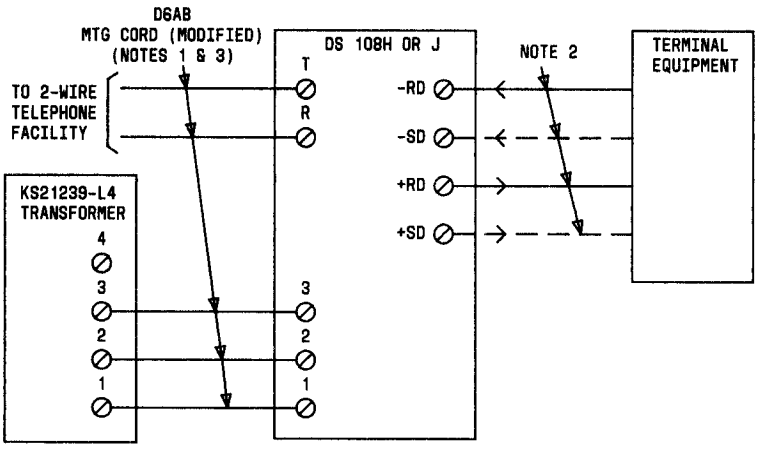


Fig. 4—DS 108H Shown Connected to KS-21239-L4 or -L5 Transformer



NOTES:

1. D6AB CORD (MODIFIED) IS RECOMMENDED. TO MODIFY, REMOVE STAY AND LENGTHEN LEADS TO 7.5 INCHES ON DATA SET END. IF LONGER LEADS ARE REQUIRED AT THE TRANSFORMER END (5 INCHES AT PRESENT), REMOVE STAY AND LENGTHEN LEADS BY REMOVING CORD SLEEVING.
2. CONNECT AS FOLLOWS:

TERMINATION	SEND LEAD (SD)	RECEIVE LEAD (RD)
2-WIRE CIRCUIT	+RD	-RD (COMMON)
3-WIRE CIRCUIT	+SD	+RD
	COMMON TO -RD	
4-WIRE CIRCUIT	+SD -SD	+RD -RD

3. INSIDE STATION WIRE MAY BE USED.

Fig. 5—DS 108H or J Connection Diagram

DATA SETS 108H AND 108J

TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section describes the test procedures to be performed at the time of installation or when investigating trouble conditions associated with data set (DS) 108H and 108J.

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 Data sets 108H and 108J do not require routine maintenance after installation tests and adjustments have been made.

1.04 The following is a list of test equipment necessary to perform the tests outlined in this section:

- 1013 handset
- Two jumper leads
- KS-20538-L1 volt ohm milliamp meter (VOM)

1.05 No special tools are required for DS 108H or 108J.

2. INSTALLATION AND MAINTENANCE TESTS

2.01 This part provides the sequence in which tests are to be performed following an installation and trouble report. Refer to Fig. 1 and 2 for the sequence of tests.

A. Power Supply Test

2.02 This test applies to a data set with option X, Y, or Z (2-, 3-, or 4-wire 20 mA current loop interface).

STEP	ACTION	VERIFICATION
1	Lift up cover.	
2	Disconnect the wire from +RD, if any.	
3	Check the voltage between -RD and +RD (Fig. 3).	Reading of 30 ±6 Vdc, indicating data set is powered.

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B. Carrier Shift Test

2.03 This test applies to a data set with option X (2-wire 20 mA current loop interface), using a 1013 handset.

STEP	ACTION	VERIFICATION
1	Lift up cover.	
2	Disconnect the wire from +RD, if any.	
3	Connect 1013 handset to external tip and ring lead connections.	
3	Connect 1013 handset to tip and ring.	
4	Connect -RD to +RD with wire.	Listen for high pitched tone, which is a marking signal.
5	Open the connection between -RD and +RD.	Listen for low pitched tone, which is a spacing signal.

2.04 This test applies to a data set with option Y or Z (3- or 4-wire 20 mA current loop interface without local copy, or 3- or 4-wire 20 mA current loop interface with local copy).

STEP	ACTION	VERIFICATION
1	Lift up cover.	
2	Disconnect the wire from +SD, if any.	
3	Connect 1013 handset to external tip and ring lead connections.	
4	Connect -SD to +SD with a wire.	Listen for high pitched tone, which is a marking signal.
5	Open the connection between -SD and +SD.	Listen for low pitched tone, which is a spacing signal.

C. Current Test

2.05 This test applies to 108H and 108J data sets, 2-, 3- or 4-wire types.

STEP	ACTION	VERIFICATION
1	Remove data set cover.	
2	Disconnect lead on +RD.	
3	Connect facility leads T and R with a jumper wire.	

STEP	ACTION	VERIFICATION
4	Temporarily close S1-3.	
5	Adjust VOM to read 20 mA.	
6	Connect meter across -RD and +RD.	Meter reads 20 ±4 mA.
7	Open S1-3.	Meter reads less than 1 mA.

D. Digital Loop Test

2.06 A digital loop test is usually set up at the request of the test center, and provides a means whereby the test center can measure round-trip distortion. The test is initiated by operating the TST button located on the cover of the data set. If option F (no local copy in the digital loopback test mode) is installed a steady mark will be delivered to the terminal. During this test the data set will ignore the data output of the terminal.

2.07 The data set internally loops the receiver output to the transmitter. When a data connection is established between the test center and the data set, the test center can measure the round trip data distortion.

2.08 The data set must be manually restored to normal by restoring the TST switch.

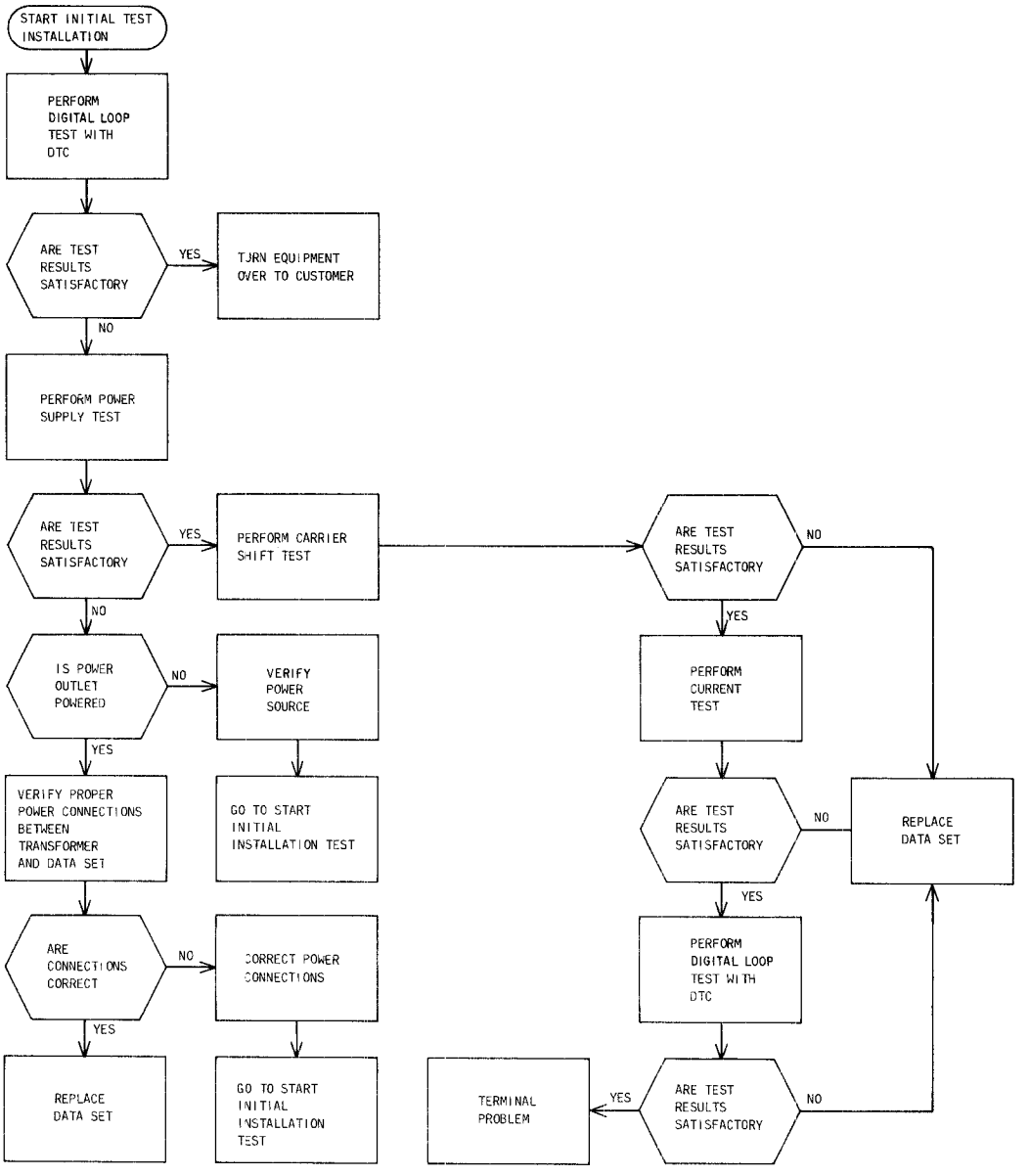


Fig. 1—Installation Test Sequence

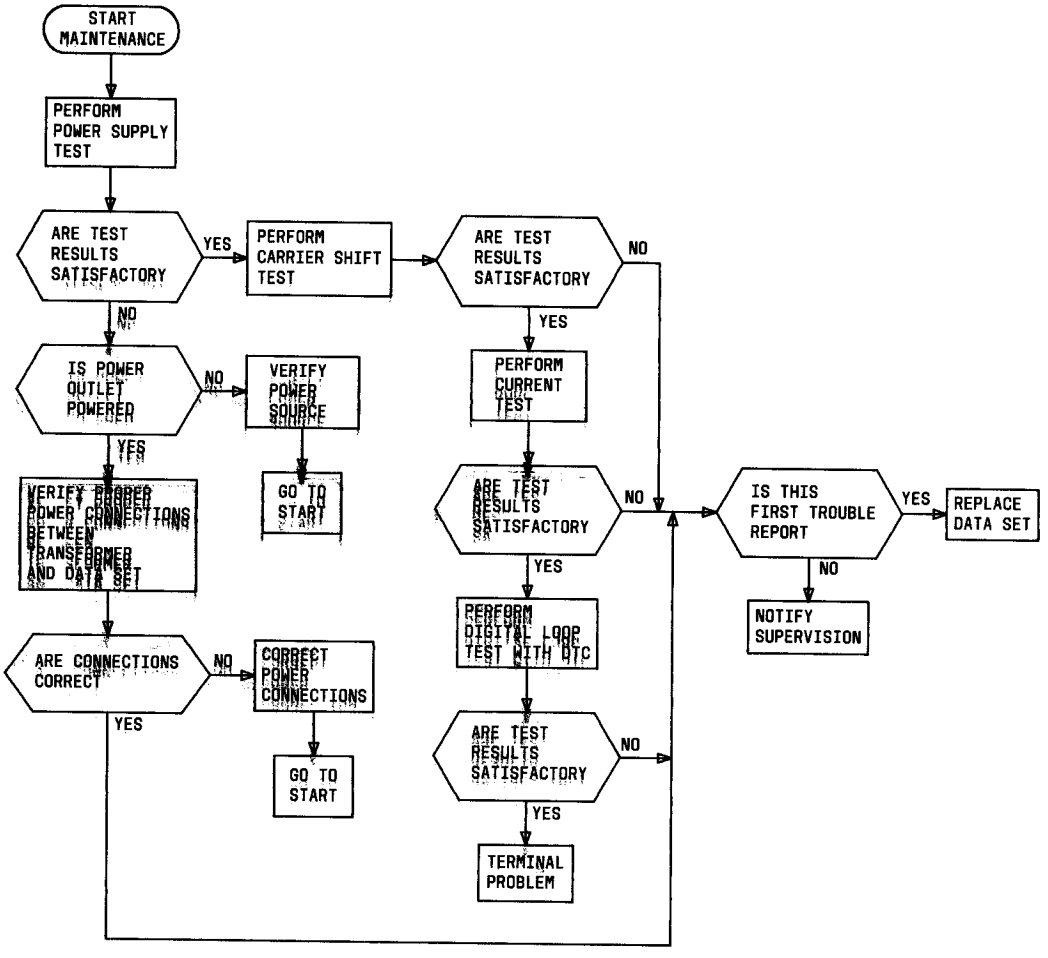


Fig. 2—Maintenance Test Sequence

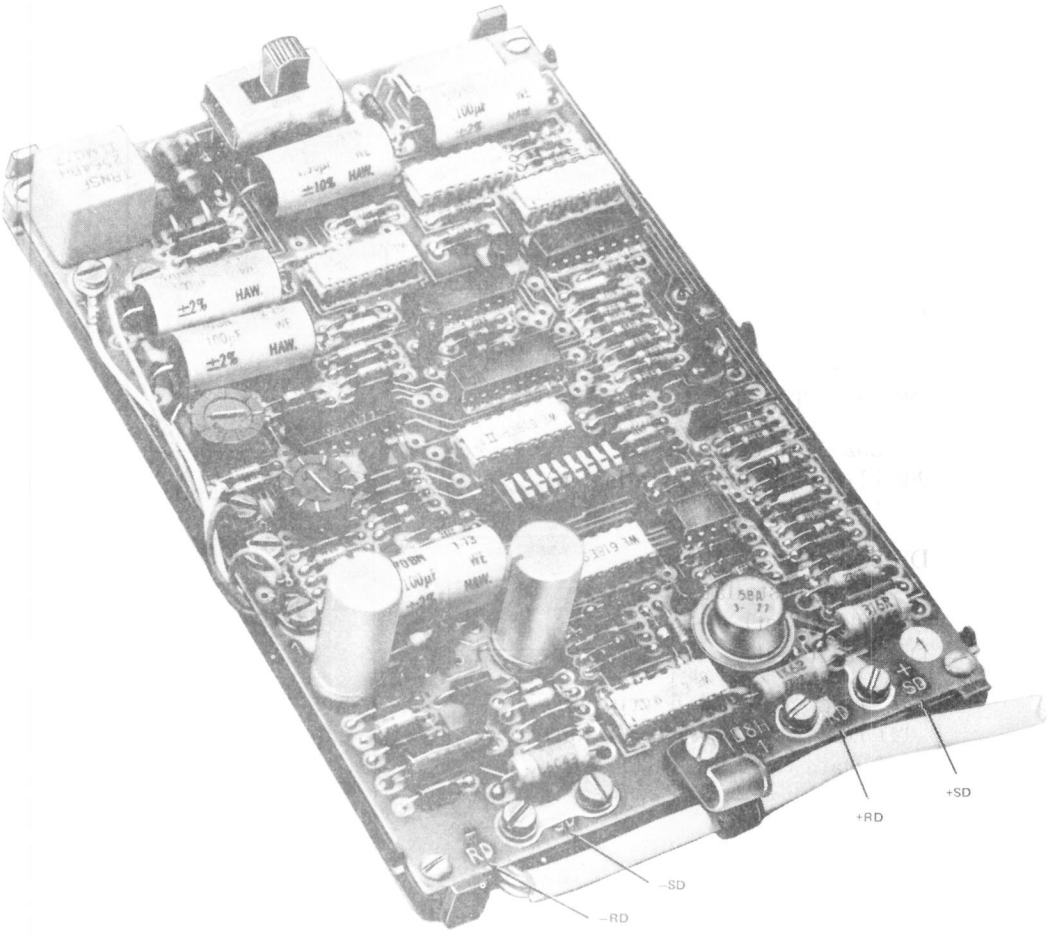


Fig. 3—Circuit Pack of DS 108H (Similar to DS 108J)

Part 2

Part 2 — Data Sets 200-Type

DATA SET 201C-L1D
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional description and operating procedures for data set (DS) 201D-L1D.

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 The DS 201C-L1D (Fig. 1) is a synchronous, serial binary transmitter-receiver that operates at 2400 bps over 2- or 4-wire private lines. This set replaces DS 201C-L1 optioned for private line service. Data set 201C-L1D is designated for private line service and cannot be optioned for switched network operation.

1.04 The DS 201C-L1D is line signal compatible with and can be interchanged for DS 201C-L1 in private line applications.

1.05 The DS 201C-L1D may be used with the following auxiliary apparatus:

- DAS 829-type to provide a standard termination and switched network backup for 4-wire private lines with data only or alternate data/voice.
- DAS 828A-type to provide a standard termination for 4-wire private lines with data only or alternate data/voice.

1.06 The following is a technical specification summary for DS 201C-L1D:

Operation: Synchronous, binary, serial

Fig. 1—Data Set 201C-L1D/2/4/5

Modulation: Differential 4-phase shift keying (PSK)

Data Rate: 2400 bps

Interface Voltages: Per Electronic Industries Association (EIA) RS-232-C

Transmitter Timing: Internal or external

Line Requirements: 2- or 4-wire private line series 2000- or 3002-type (basic) channel.

Operating Modes:

- On 2-wire private line, simplex (1-way) or half-duplex (2-way nonsimultaneous)
- On 4-wire private line, simplex, half-duplex, or duplex (2-way simultaneous)

Power Requirements: 105 to 129 volts, 8 watts maximum, at 57 to 63 Hz

Ambient Temperature Range: +40 to +120°F

Relative Humidity Range: 20 to 95 percent

Dimensions: Width 10.5 inches, height 4.3 inches, depth 14 inches

Weight: 12 pounds

Customer-Provided Equipment: Must be supplied with an interface cord terminated in a Cinch or Cannon DB-19604-432 plug wired in accordance with Table A. This interface cord should not exceed 50 feet in length.

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
2	Transmitted Data	SD	BA
3	Received Data	RD	BB
4	Request to Send	RS	CA
5	Clear to Send	CS	CB
6	Data Set Ready	DSR	CC
7	Signal Ground	SG	AB
8	Received Line Signal Detector	CO	CF
9	Test Voltage	+12V	—
10	Test Voltage	−12V	—
14	New Sync	NS (Non-EIA)	—
15	Transmitter Signal Element Timing	SCT	DB
16	Dibit Clock Transmitter	DCT (Non-EIA)	—
17	Receiver Signal Element Timing	SCR	DD
18	Dibit Clock Receiver* or	DCR (Non-EIA)	—
	Local Analog Loopback Test†	LL (Non-EIA)	—
19	Test Voltage	+5V (Non-EIA)	—
20	Data Terminal Ready	DTR	CD
24	Transmitter Signal Element Timing (External)	SCTE	DA

* Option YT

† Option YS

2. PHYSICAL DESCRIPTION

2.01 List code designations corresponding to the physical configurations of DS 201C-L1D are as follows:

- L1D—Consists of the basic data set that is composed of two circuit packs (Fig. 2) interconnected by a flexible cable.
- L2—Consists of the 100A power unit (Fig. 2) that provides +12, -12, and +5 volts.
- L4—Consists of the stand-alone enclosure and the P3BJ or KS-14532-L24 power cord. The enclosure (Fig. 1) is composed of front and rear molded black plastic covers mounted on an extruded aluminum housing. The housing has a brushed finish. The enclosure and the power cord are also orderable as a 50A1 data mounting.
- L5—Consists of the M8K telephone line interface cord.

2.02 The orderable list codes are as follows:

- 201C—L1D/2/5 for multiple data set installations
- 201C—L1D/2/4/5 for single stand-alone data set installations

2.03 Eight status indicators (Fig. 3) are provided on the data set to monitor the power unit, certain interface leads, and the test switches. These status indicators consist of light emitting diodes (LEDs) that illuminate translucent designations on the data set front cover. These designations identify the functions being monitored. The

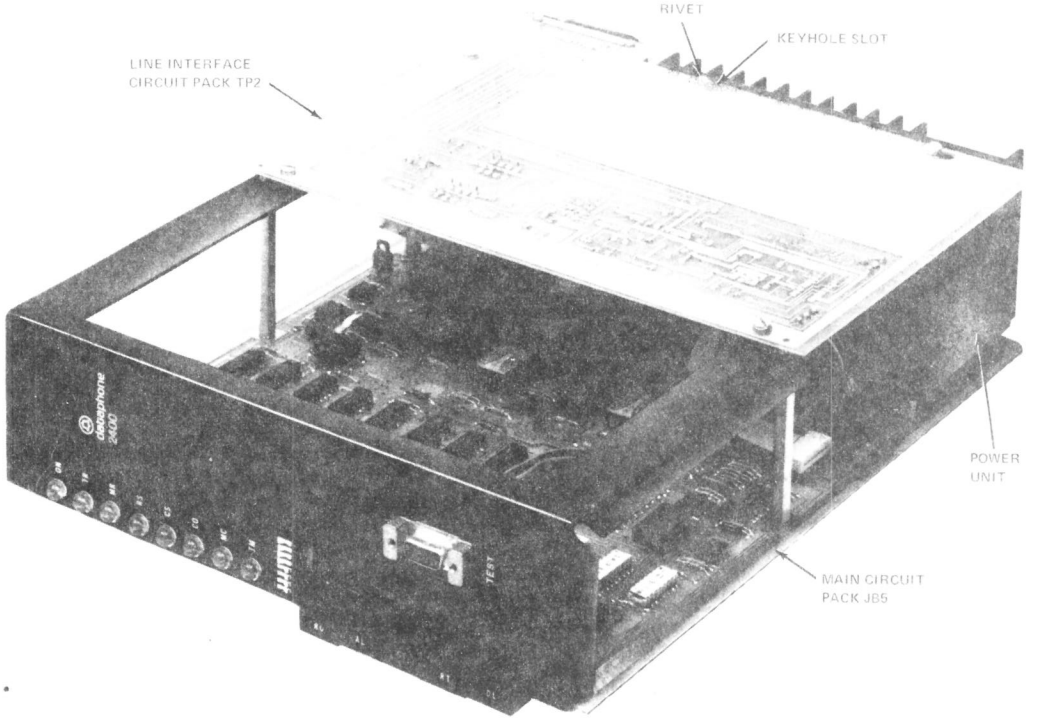


Fig. 2—DS 201C-L1D/2/5—Internal View

indicators and their functions during normal operation are as follows:

- ***ON:*** Lighted when power is supplied to the data set.
- ***TR (Terminal Ready):*** Lighted when the data terminal ready (CD) lead is ***on***.
- ***MR (Modem Ready):*** Lighted when the data set ready (CC) lead is ***on***.
- ***RS (Request to Send):*** Lighted when the request-to-send (CA) lead is ***on***.
- ***CS (Clear to Send):*** Lighted when the clear-to-send (CB) lead is ***on***.
- ***CO (Carrier On):*** Lighted when the received line signal detector (CF) lead is ***on***.
- ***MC (Modem Check):*** Lighted when the receiver signal element timing (DD) lead is ***off***. During self-test operation, also lighted when errors occur in the received data.
- ***TM (Test Mode):*** Lighted when one or more of the AL, ST, RT, and DL test switches are depressed.

2.04 Five pushbutton switches, accessible through the front cover, provide self-test operation of the data set. These test switches are the

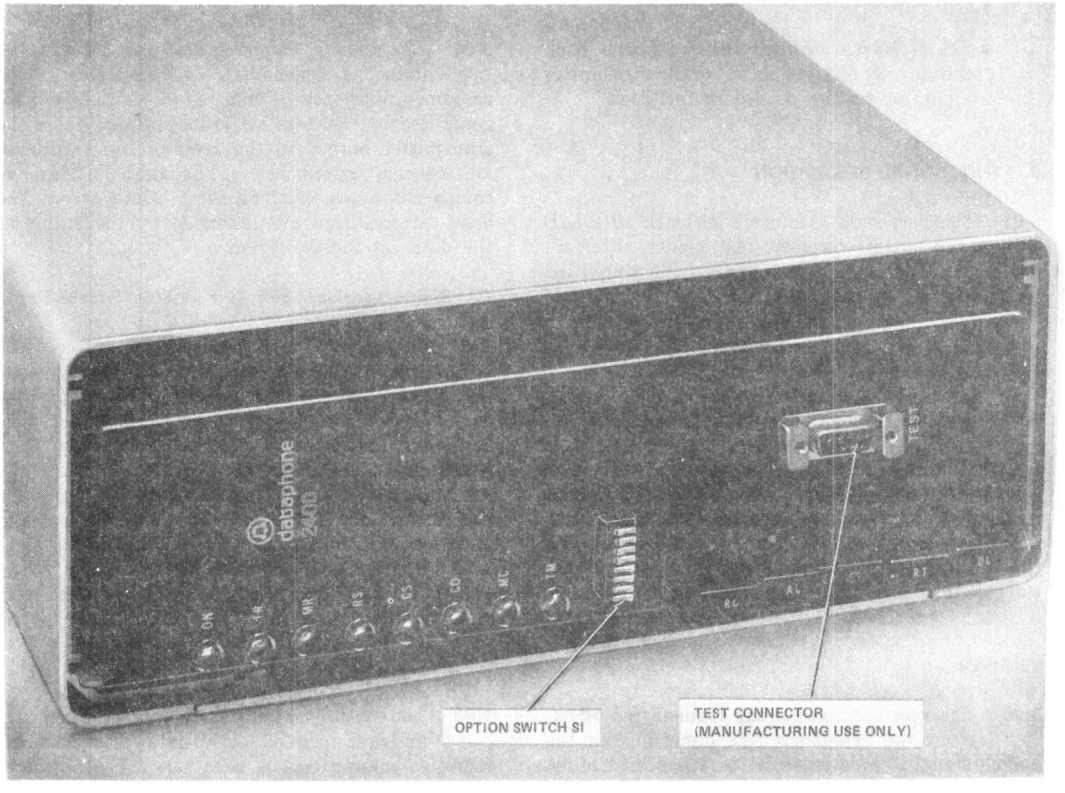


Fig. 3—DS 201C-L1D/2/4/5—Front Cover Removed

push-to-operate and push-to-release type. The switches and their functions are as follows:

- ***RO (Receive Only):*** Conditions the data set to function as a receiver in an end-to-end self test on 2-wire facilities.
- ***AL (Analog Loopback):*** Loops back the data set transmitter output to the receiver input through an internal attenuator.
- ***ST (Self Test):*** Conditions the data set for self-test operation using an internal data generator and comparator.
- ***RT (Receiver Test):*** When used in conjunction with the AL switch, this switch conditions the data set for the local loopback receiver margin test. Used alone, the RT switch merely lights the TR lamp.
- ***DL (Digital Loopback):*** Loops back the data set receiver output to the transmitter input for testing on 4-wire facilities.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains information on DS 201C-L1D transmitter, receiver, test modes, interface leads, and options. Refer to Fig. 4 for a simplified block diagram of DS 201C-L1D.

TRANSMITTER

3.02 The transmitter accepts serial binary data at 2400 bps in synchronism with positive transitions of a 2400-Hz clock provided either by the data set or by the customer-provided equipment (CPE). The transmitter groups the digital data into symbols of two bits each (dibits) and encodes this data in a differential 4-phase modulated signal suitable for transmission on switched network lines.

RECEIVER

3.03 The receiver accepts the transmitted signal from the telephone line, demodulates the analog signal to recover serial data and bit timing, and delivers the data and timing to the CPE through the Electronics Industries Associated (EIA) interface.

TEST MODES

3.04 Data set 201C-L1D provides four test modes for use by the customer or a telephone company (telco) employee: analog loopback test, analog loopback self test, digital loopback self test, and end-to-end self test.

A. Analog Loopback Test

3.05 The analog loopback test checks the data set transmitter and receiver and the customer interface. The data set is internally disconnected from the line interface and the transmitter output is looped back to the receiver input. The CPE transmits data and tests the customer interface by examining transmitter and receiver output signals at the CPE.

B. Analog Loopback Self Test

3.06 The analog loopback self test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back from the transmitter output to the receiver input through an internal attenuator. The received data is compared to the original data. Data errors and data set condition are indicated by the status of the data set indicator lamps.

C. Digital Loopback Self Test (4-Wire Private Line)

3.07 The digital loopback self test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked. Test data generated and transmitted by the near-end data set is looped back from the receiver output to the transmitter input of the far-end data set and retransmitted. This data is received by the near-end data set and compared to the original data. Data errors and data set condition are indicated by the status of the indicator lamps on the near-end data sets.

D. End-to-End Self Test

3.08 The end-to-end self test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked. Identical test data is generated by both data sets, transmitted by one of the data sets, and compared to the data generated

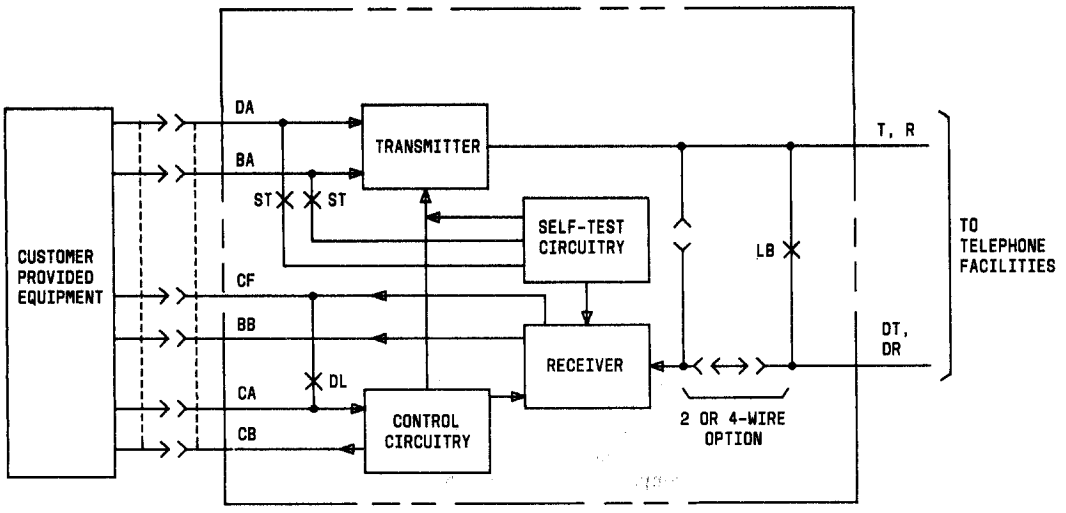


Fig. 4—DS 201C-L1D—Simplified Block Diagram

by the receiving data set. Data errors and data set condition are indicated by the status of the indicator lamps on the data sets. This test is performed with either 2- or 4-wire facilities. In the 2-wire test the transmitter and receiver sections are tested separately. In the 4-wire test both sections are tested simultaneously.

3.09 When DS 201C-L1D is used as an extension of a DS 209A-L1 multiplex system, refer to Section 592-032-100 for more information. Procedures used at the serving test center (STC) to maintain this system are contained in Section 666-511-504.

3.10 When DS 201C-L1D is used as a subrate off-net extension of the digital data system (DDS), refer to Section 314-919-100 for more information. Procedures used at the hub office STC to maintain the analog portion of this system are contained in Section 666-511-501.

3.11 The digital loopback self test cannot be performed from a remote extension (with options as installed) in toward DS 201C-L1D collocated with DS 209A-L1 or a hub office of the DDS. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

INTERFACE

A. Customer Interface

3.12 The customer interface is accessible through the CUST INT connector at the rear of the data set (Fig. 5). The connector pin numbers and the corresponding lead designations are shown in Table A. A detailed description of these leads is contained in the following paragraphs:

3.13 ***Transmitted Data (BA)—Pin 2:*** Mark and space signals generated by the CPE are delivered to the data set on this lead. The data set samples the signals on this lead during the negative transition of the transmitter signal element timing (DB) signal or the clock signal provided by the CPE for externally timed data sets. The CPE must be arranged to transmit data on this lead only when an ***on*** condition is present on both the clear-to-send (CB) and data set ready (CC) leads.

3.14 ***Received Data (BB)—Pin 3:*** Mark and space signals generated by the data set in response to data signals received from the distant-end data set are delivered to the CPE on this lead. The data signals are clocked to the CPE and the CPE is timed to sample the data during the negative transitions of the receiver

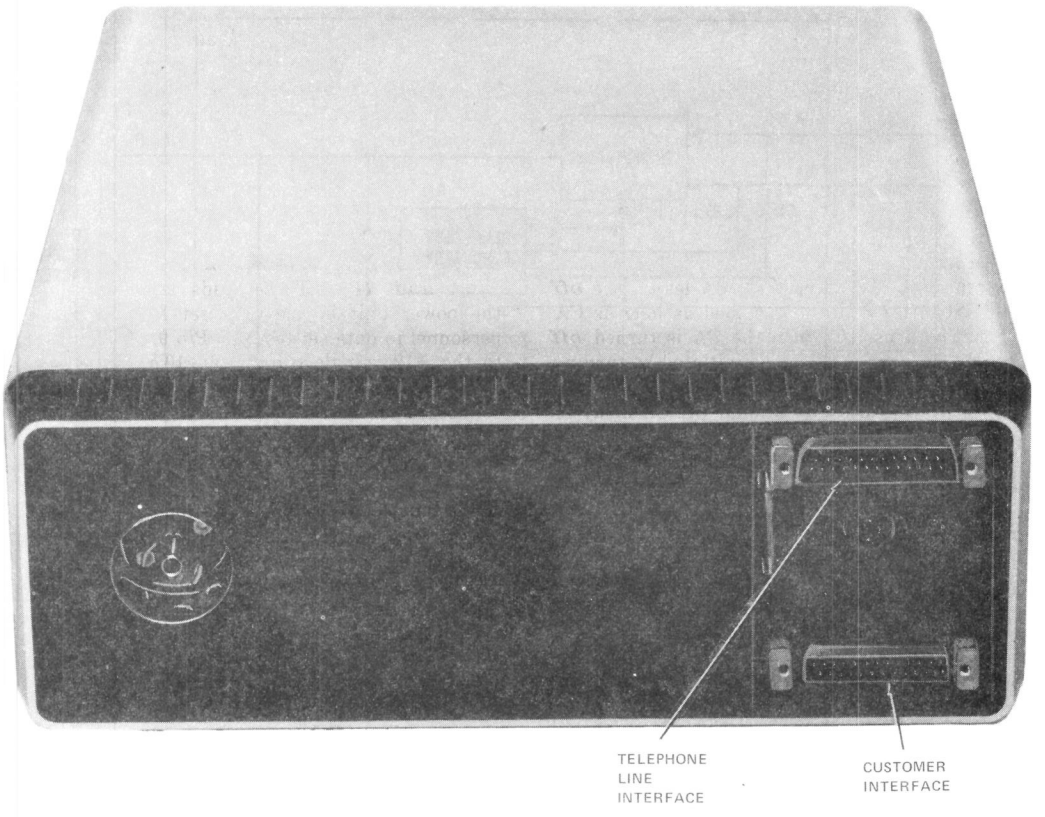


Fig. 5—DS 201C-L1D/2/4/5—Rear View

signal element timing (DD) signals. An ***off*** condition on the received line signal detector (CF) lead causes the received data lead to be clamped in the mark condition. In 2-wire service, an ***on*** condition on the request-to-send (CA) lead causes the received data lead to be clamped in the mark condition. In DL mode the received data lead is clamped in the marked condition.

3.15 ***Request to Send (CA)—Pin 4:*** With switched carrier operation, an ***on*** condition on this lead is an indication to the data set transmitter of the intent of the CPE to transmit data. After turning ***on*** this lead, the CPE should wait for an ***on*** condition on the clear-to-send (CB) lead before starting transmission. For a minimum variation in delay between the ***on*** conditions of CA and CB, the positive going transition of CA should coincide with a positive transition of the dibit clock transmitter (DCT) lead. When the CA lead is turned ***off*** at the end of a message, the data set transmitter remains on about 2 ms to allow the last bits of data to clear the transmitter. With continuous carrier operation, the transmitter is kept on at all times. The user may choose, however, to use the CA lead to control timing functions in the CPE that require the CB lead ***on*** condition. In this case, the data set provides an optional delay of 0 or 7.1 ms between an ***on*** condition of CA and an on condition of CB.

3.16 ***Clear to Send (CB)—Pin 5:*** Signals on this lead are generated by the data set to indicate whether or not the data set is ready

to transmit data. In switched carrier operation, CB is turned ***on*** in response to an ***on*** condition of the request-to-send (CA) lead from the CPE. The CA-CB delay is 148.3 ms for 2-wire private lines and 7.1 ms for 4-wire private lines. This delay allows the distant data set to get into synchronization. The ***on*** condition of the CB lead is an indication to the CPE that signals presented on the transmitted data (BA) lead will be transmitted to the communications channel. The ***off*** condition of this lead is an indication to the CPE that it should not transfer data on the BA lead. The ***off*** condition of CB will be maintained as long as CA is ***off***. CB turns ***off*** when the CA is turned ***off*** so that another message can be initiated by turning CA ***on*** again. In continuous carrier operation, the data set provides an optional CA-CB delay of 0 or 7.1 ms.

3.17 ***Data Set Ready (CC)—Pin 6:*** Signals on this lead are generated by the data set to indicate to the CPE whether or not the data set is in the data mode. The ***on*** condition of this lead indicates that the local data set is capable of transmitting and receiving data signals and is not in the test mode or talk mode (if the data set is arranged for alternate voice service). The ***on*** condition of this lead alone should not be interpreted to mean that a communication channel has been established to a distant data station or should not be used to determine the status of any remote CPE. This lead is used in conjunction with request-to-send and clear-to-send leads when data is being transmitted.

3.18 ***Signal Ground (AB)—Pin 7:*** This lead establishes the common ground reference potential for all interface leads except protective (frame) ground (AA). This lead is normally connected to the protective ground lead to minimize the introduction of power line noise into electronic circuitry through the power transformer. Depending on local procedures and conditions, this connection to protective ground can be removed by the telco employee.

3.19 ***Received Line Signal Detector (CF)—Pin 8:*** The ***on*** condition of this lead indicates that the data carrier signal has been received for 5 ms or more. This lead will go ***off*** if the line signal disappears for more than 5 ms due to the end of transmission or to a transmission line interruption. This ***off*** condition causes the received data (BB) lead to be clamped to the mark condition and the receiver signal element timing (DD) and dibit clock receiver (DCR) leads to be clamped to the ***on*** condition. In 2-wire service, the CF lead is clamped ***off*** when request to send (CA) is ***on*** and for 100 ms after CA is turned ***off*** to prevent the receiver from responding to echoes on the line and processing the transmitted data (providing local copy). In the DL mode the CF lead is clamped in the mark condition.

3.20 ***Test Voltages (+12V, -12V)—Pins 9 and 10:*** These leads are connected to the power unit in the data set for use by telco personnel in data set testing. Pin 9 provides access to the +12 volt dc supply; pin 10 provides access to the -12 volt dc supply. The CPE must not be connected to these leads.

3.21 ***New Sync (NS—Non-EIA)—Pin 14:*** This lead may be used on an optional basis with a data set at the master station of a multistation private line network, such as in a polling operation, to ensure rapid resynchronization of the receiver on a sequence of messages from many different remote transmitters. This feature is necessary because the receiver clock maintains the timing information of the previous message for some interval after it has ended. This may interfere with resynchronization on receipt of the next message. The CPE can condition this lead to turn ***on*** for 1 ms or more to squelch the existing clock after the end of a message is received. At all other times the ***off*** condition should be applied by the CPE. When the new sync option is not used, the new sync lead is held ***off*** within the data set.

3.22 ***Transmitter Signal Element Timing (DB)—Pin 15:*** For internally timed data sets, 2400 Hz square-wave signals on this lead are used to provide the CPE with signal element timing information for the transmitted data (BA) lead. The DB signal is present at all times when power is applied to the data set. The first signal element of the transmitted data (BA) signal should be presented by the CPE on the positive (***off*** to ***on***) transition of DB which coincides with the ***off*** to ***on*** transition of the clear-to-send (CB) signal. (The clear-to-send signal turning ***on*** coincides with a positive transition of DB.) Transmitted data is sampled by the data set on negative transitions of DB. The DB lead provides a timing signal which is phase-locked to the transmitter signal element

timing (external) (DA) signal for data sets timed externally by the CPE.

3.23 ***Dibit Clock Transmitter (DCT—Non-EIA)—Pin 16:*** A square-wave signal at one-half the bit rate appears on this lead whenever power is applied to the data set. Positive and negative transitions of this signal coincide with positive and negative transitions of transmitter signal element timing (DB). The DCT lead indicates the rate at which phase changes are made in the transmitted signal. Two serial bits (dibit) from the CPE are used to determine a phase change by the data set modulator, and the grouping of bits is according to the transitions on this lead so that over one cycle of DCT, two serial bits from the CPE are encoded into one phase shift. If the minimum variation in delay between request to send (CA) ***on*** and clear to send (CB) ***on*** is desired, the positive transition of request to send from the CPE should coincide with a positive transition of DCT.

3.24 ***Receiver Signal Element Timing (DD)—Pin 17:*** The square-wave signal on this lead at the nominal 2400 Hz rate is used to provide the CPE with receiver signal element timing information. The transition from ***on*** to ***off*** indicates the center of each signal element (bit) on the received data (BB) lead. The DD signal is provided when the received line signal detector (CF) lead is ***on***. If CF should go ***off***, DD is clamped to the mark (***off***) condition. In the DL mode the DD lead is clamped to the space condition.

3.25 ***Dibit Clock Receiver (DCR—Non-EIA) or Local Loopback Test (LL—Non-EIA)—Pin 18:*** The function of this customer interface lead is determined by the option chosen. Option YT is dibit clock receiver and option YS is local loopback test. With option YT installed the received dibit clock appears on pin 18. This is a 1200 Hz square-wave clock frequency which is used internally by the data set to synchronize the symbol decoding process in the receiver. DCR is clamped a positive voltage (space) when CO is off. With option YS installed pin 18 becomes an input which allows the customer to activate the analog loopback test through the customer interface.

3.26 ***Test Voltage (+5V)—Pin 19:*** This lead is connected to the power unit in the data set for use by telco personnel in data set testing.

3.27 ***Data Terminal Ready (CD)—Pin 20:*** This lead will function with either a contact closure interface or an EIA voltage interface. This provides the customer with a status indication of the signal on pin 20 via the TR lamp on the data set. The signal is not used by the data set.

3.28 ***Transmitter Signal Element Timing (External) (DA)—Pin 24:*** For externally timed data sets, this lead is used by the CPE to provide bit rate timing to the transmitter. The ***on*** to ***off*** transition of this lead indicates the center of each signal element on the transmitted data (BA) lead. The timing signal from the CPE must have a frequency of 2400 Hz ±0.005 percent with a peak individual distortion on negative transitions of not more than 0.5 percent. The transmitter signal element timing (DB) lead is phase-locked to this signal and the dibit clock transmitter (DCT) signal is derived from it. Signals should be available on this lead whenever the data set is in service.

B. Telephone Line Interface

3.29 The telephone line interface is accessible through an unlabeled connector at the rear of the data set (Fig. 5). The connector pin numbers and the corresponding lead designations are shown in Table B. A detailed description of these leads is contained in the following paragraphs:

3.30 ***Transmit and Receive (T, R, DT, DR)—Pins 7, 8, 9, and 10:*** For 2-wire service, data set and telephone set signals are transmitted and received through leads T (Pin 7) and R (pin 8). For 4-wire service, separate leads are used for transmitting and receiving. Leads T and R are used to transmit only and leads DT (pin 9) and DR (pin 10) are used to receive only.

3.31 ***Data Set Ready Control and Ground (TEK5, TEK6)—Pins 13 and 11:*** These leads are used by a channel interface unit (CIU) (DAS 828-type, DAS 829-type, or equivalent) to provide an indication to the CPE (on the data set ready lead) when the channel is in the loopback mode and not available for use.

OPTIONS

3.32 Data set 201C-L1D has features or options that may be requested by the user. A detailed description of these options is contained

TABLE B

TELEPHONE LINE INTERFACE

PIN NO.	DESIGNATION	FUNCTION
2	−12V	From power supply
3	+5V	From power supply
7	T	Telephone line tip — Transmit/Receive, 2-Wire — Transmit Only, 4-Wire
8	R	Telephone line ring — Transmit/Receive, 2-Wire — Transmit Only, 4-Wire
9	DT	Telephone line tip — Receive Only, 4-Wire
10	DR	Telephone line ring — Receive Only, 4-Wire
11	TEK6	Signal ground
13	TEK5	Data ready control from CIU* to data set
20	+12V	From power supply

* Channel interface unit (DAS 828-type, DAS 829-type, or equivalent).

in Section 592-029-220. A summary of the options is contained in Table C.

4. OPERATION

A. 4-Wire Private Line

4.01 Data set 201C-L1D is compatible with DAS 828-type and DAS 829-type channel interface units (CIUs). These CIUs provide a prewired and tested standard termination for a 4-wire private line voiceband channel with data only or data with alternate voice and/or switched network backup. For more information on the CIUs, refer to Part 5.

B. 2-Wire Private Line

4.02 Arrangements using DS 201C-L1D on a 2-wire private line must be locally engineered. The data set transmits at 0 dBm. The receive level should be a nominal -16 dBm. The DAS 828-type CIU can be used to terminate a 2-wire data set operating over a 4-wire line.

5. REFERENCES

5.01 Additional information concerning DS 201C-L1D and auxiliary apparatus is contained in the following publications:

SECTION	TITLE
314-205-501	Data Systems—DATA-PHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
314-919-100	Digital Data System—Subrate Off-Net Extension Arrangements—Description
502-500-120	Telephone Sets—540, 560, 1560, and 2560 Series—Common Installation and Maintenance Information
590-002-100	Data Services—2000 and 2400 BPS Provided by Data Set 201-Type—Reference Guide
590-010-200	Data Sets and Data Access Arrangements—General Installation and Connection Information
590-010-201	Data Sets—Multiple Installation Information
590-102-133	42A-Type Data Mounting—Identification
590-102-141	50A1 Data Mounting—Identification

SECTION	TITLE
592-029-150	Data Set 201C—Transmitter-Receiver—Supplementary Information
592-029-220	Data Set 201C-L1D—Transmitter-Receiver—Installation and Connections
592-029-520	Data Set 201C-L1D—Transmitter-Receiver—Test Procedures and Maintenance
592-032-100	Data Set 209A-L1—Transmitter-Receiver—Description and Operation
592-862-100	Data Station 201C—Description and Operation
592-862-200	Data Station 201C—Installation and Connections
598-080-100	Data Auxiliary Set 828A—Description and Operation
598-080-101	Data Auxiliary Set 828C—Description and Operation
598-080-200	Data Auxiliary Set 828A—Installation and Connections
598-080-201	Data Auxiliary Set 828C—Installation and Connections
598-080-500	Data Auxiliary Set 828A—Maintenance and Test Procedures
598-080-501	Data Auxiliary Set 828C—Maintenance and Test Procedures
598-082-100	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Description
598-082-101	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Description
598-082-102	Data Auxiliary Set 829-Type—Multiple Channel Arrangements—(Switched Dial Backup)—Description
598-082-200	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Installation and Connections
598-082-201	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Installation and Connections
598-082-202	Data Auxiliary Set 829-Type—Multiple Channel Arrangements—(Switched Dial Backup)—Installation and Connections
598-082-500	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Maintenance and Test Procedures
598-082-501	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Test Procedures
598-082-502	Data Auxiliary Set 829-Type—Multiple Channel Arrangements—(Switched Dial Backup)—Test Procedures
666-511-501	Test of Data Services Provided by Data Set 201C From a Private Line Test Room
666-511-504	Test of Data Services Provided by Data Set 209A-L1 From a Private Line Test Room
999-100-138	Data Set 201C—How to Operate Manual

5.02 Detailed information concerning DS 201C-L1D is contained in Circuit Description (CD) and Schematic Drawing (SD) 1D290-01 entitled Data Systems Station—Data Set 201C-L1D.

TABLE C

DATA SET 201C-LID OPTIONS

FEATURE			OPTION	OPTION STRAP MAIN CKT JB5	SI SWITCH SETTING							
					1	2	3	4	5	6	7	8
New Sync		Not Used	YA*		O							
		Under Customer Control	YB		X							
Transmitter Timing		Internal	YC*			O	O					
		External	YD			X	O					
		Controlled by Receiver Bit Clock (Slave)	WI			X	X					
Use with DAS 828/829-Type		Yes	YI*	Install E5-E6								
		No	YJ	Install E4-E5								
Grounding Option		Signal Ground Connected to Frame Ground	YK*	Install E7-E8								
		Signal Ground not Connected to Frame Ground	YL	Install E8-E9								
Status of DSR During Local Analog Loopback		DSR On	YM									O
		DSR Off	YN*									X
Continuous Receiver Bit Clock		In	YO								O	
		Out	YP*								X	
Function of EIA Interface Pin 18		Initiates Local Analog Loopback	YS	Install E1-E2								
		Provides Receiver Symbol Clock	YT*	Install E2-E3								
FEATURE			OPTION	OPTION STRAP LINE INT. TP2	SI SWITCH SETTING							
					1	2	3	4	5	6	7	8
Type of Operation and Clear to Send Delay	4-Wire	Switched Carrier 7 MSEC Clear to Send Delay	XA*	Install E2-E3 Install E4-E6				O	X	X		
		Continuous Carrier 7 MSEC Clear to Send Delay	XB	Install E2-E3 Install E4-E6				O	O	X		
		Continuous Carrier 0 MSEC Clear to Send Delay	XC	Install E2-E3 Install E4-E6				X	O	X		
	2-Wire	Switched Carrier 150 MSEC Clear to Send Delay	XE	Install E1-E3 Install E5-E6				O	X	O		

* Factory-furnished option

X = Closed

O = Open

DATA SET 201C-L1D

TRANSMITTER-RECEIVER

INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains the installation and connection information for data set (DS) 201C-L1D (Fig. 1). The data set should be installed in conformance with the general instructions in Section 590-010-200.

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 For maximum appearance and utility, install the data set apart from the customer-provided equipment (CPE) on a nearby desk, table, stand, or in a Bell System-provided equipment cabinet. The data set operates in an ambient temperature range of 40 to 120°F and a relative humidity range of 20 to 95 percent.

1.04 The data set must be located near the CPE since the interface cord supplied by the customer should not exceed 50 feet in length (as recommended by Electronic Industries Association [EIA] standards). In order to minimize inductive interference with data signals, the telephone line should not be carried in the same cable run as cable between the data set and CPE or lines connected to teletypewriter services. If this condition cannot be met, the telephone line must be run in type SK (shielded) station wire between the data set and the cable distribution terminal or building entrance. The shield should be grounded at one end only, preferably at the distribution terminal end.

1.05 The data set requires a power source that provides 105 to 129 volts, 12 watts, at 57 to 63 Hz. The customer must supply an outlet that will accept the 3-prong plug on the P2BJ or KS-14532-L24 power cord provided with the data set. To avoid the possibility of data errors due to a potential difference between data set ground and CPE ground, the outlet for the data set power cord should be served from the same ac distribution panel as the CPE. If this condition cannot be met, a test using the 6H impulse counter should be made to detect the presence of noise potential. This test is described in Section 592-029-500. If test requirements are not met, data set ground and CPE ground must be bonded together in accordance with local instructions.

1.06 Connections to the CPE (Table A) are made through the 25-pin CUST INT connector at the rear of the data set (Fig. 2). This connector mates with a customer supplied Cinch or Cannon DB-19604-432 plug wired in accordance with Table A.

1.07 Connections to the telephone line (Table B) are made through a second 25-pin connector at the rear of the data set (Fig. 2). For private line service with a channel interface unit (CIU), an M8K cord is provided with the data set. For private line service without a CIU, a D25D cord (ordered separately) is required.

1.08 To gain access to the circuit packs and option straps in the data set, the data set

Fig. 1—Data Set 201C-L1D/2/4/5

must be removed from the housing as follows (Fig. 3):

(1) Disconnect the three cords from the rear of the data set.

Warning: When removing front and rear covers use finger pressure only. No special tools are required. Excessive force may crack the data set cover.

(2) Remove the front cover by gently squeezing it on the top and bottom and pulling forward.

(3) Loosen the two captive retaining screws at the rear bottom of the housing.

(4) Slide the data set out the front of the housing.

Warning: When the data set is removed from its housing, the data set should be placed on a clean, dry, nonconductive surface.

(5) Remove the three screws from the top of circuit pack TP2.

(6) Slide circuit pack TP2 to the left until the rivets are disengaged from their keyhole slots.

(7) Fold TP2 to the right and place on a flat surface (Fig. 4).

1.09 To reassemble the data set, proceed as follows:

(1) Fold circuit pack TP2 over onto the power unit and data set frame.

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
2	Transmitted Data	SD	BA
3	Received Data	RD	BB
4	Request to Send	RS	CA
5	Clear to Send	CS	CB
6	Data Set Ready	DSR	CC
7	Signal Ground	SG	AB
8	Received Line Signal Detector	CO	CF
9	Test Voltage	+12V	—
10	Test Voltage	−12V	—
14	New Sync	NS (Non-EIA)	—
15	Transmitter Signal Element Timing	SCT	DB
16	Dibit Clock Transmitter	DCT (Non-EIA)	—
17	Receiver Signal Element Timing	SCR	DD
18	Dibit Clock Receiver* or	DCR (Non-EIA)	—
	Local Analog Loopback Test†	LL (Non-EIA)	—
19	Test Voltage	+5V (Non-EIA)	—
20	Data Terminal Ready	DTR	CD
24	Transmitter Signal Element Timing (External)	SCTE	DA

* Option YT

† Option YS

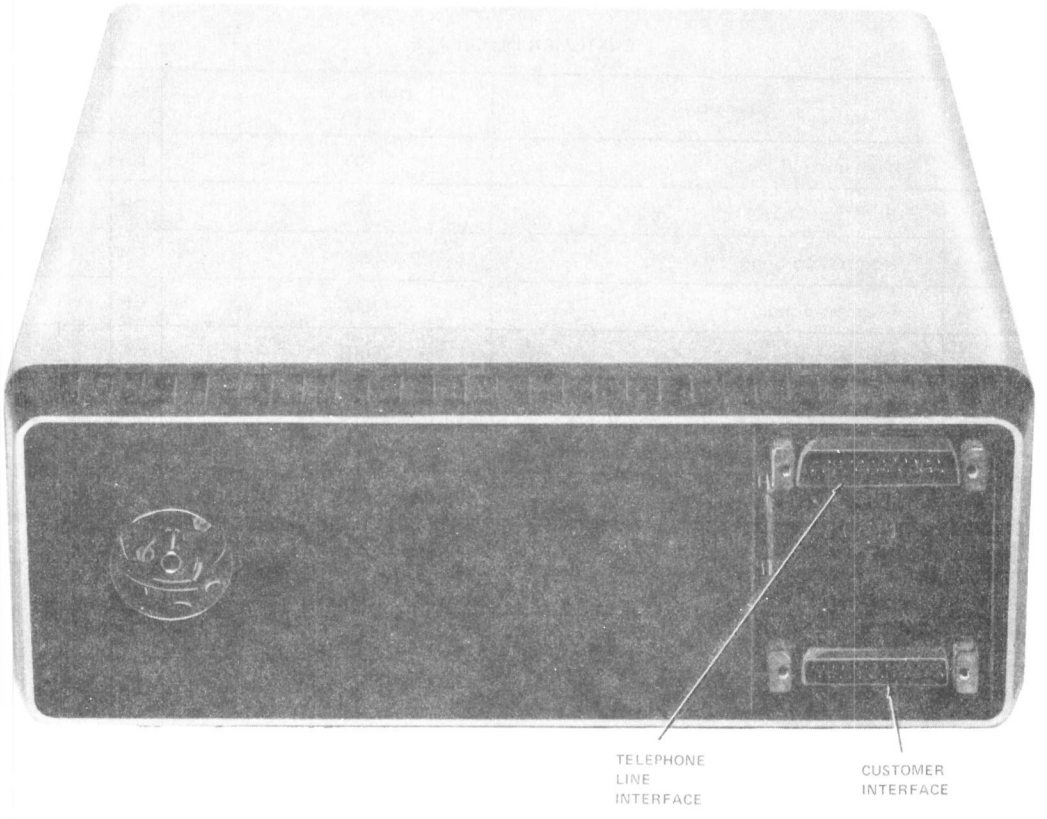


Fig. 2—DS 201C-L1D/2/4/5—Rear View

TABLE B

TELEPHONE LINE INTERFACE

PIN NO.	DESIGNATION	FUNCTION
2	— 12V	From power supply
3	+5V	From power supply
7	T	Telephone line tip — Transmit/Receive, 2-Wire — Transmit Only, 4-Wire
8	R	Telephone line ring
9	DT	Telephone line tip — Receive Only, 4-Wire
10	DR	Telephone line ring
11	TEK6	Signal ground
13	TEK5	Data ready control from CIU* to data set
20	+12V	From power supply

* Channel interface unit (DAS 828-type, DAS 829-type, or equivalent).

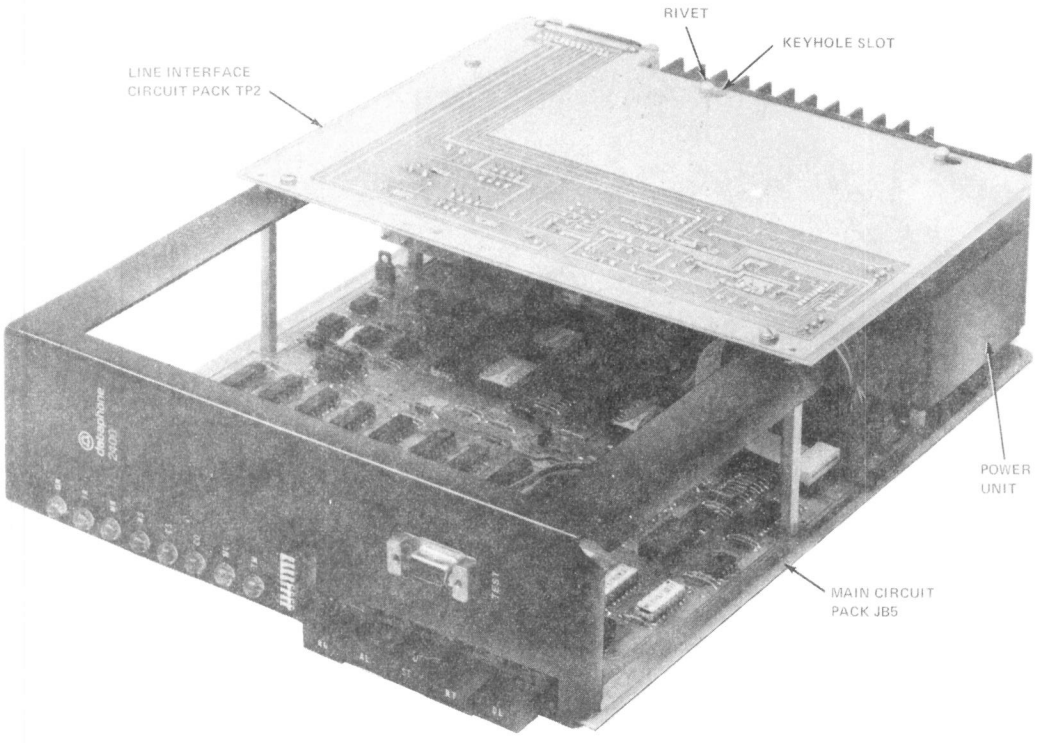


Fig. 3—DS 201C-L1D/2/5 (Without Housing)

(2) Place the TP2 keyhole slots over the rivets and slide TP2 to the right to secure it in place.

(3) Replace the three screws attaching TP2 to the power unit and data set frame.

(4) Slide the data set into the housing.

(5) Tighten the two captive retaining screws at the rear bottom of the housing.

(6) Replace the front cover by gently squeezing it on top and bottom and pushing forward until it snaps into place.

2. OPTIONS

2.01 The DS 201C-L1D is provided with a number of options which are installed prior to placing the data set in service. All options are installed or removed with option switch S1 (Fig. 5) and/or with option straps (Fig. 4). The proper switch settings and strap placements for each option are shown in Table C. Similar information to that contained in Table C may be found on the pressure sensitive option label shipped with the data set. Extra labels are available by ordering Form E-10073.

2.02 The installer should verify that the options called for on the service order are installed.

2.03 ***New Sync:*** With new sync under customer control (option YB), the CPE can reset the receiver timing recovery circuit enabling the data set to rapidly synchronize to a new line signal. This option is generally used in the hub station of a multipoint polling arrangement where there are very short intervals between incoming messages

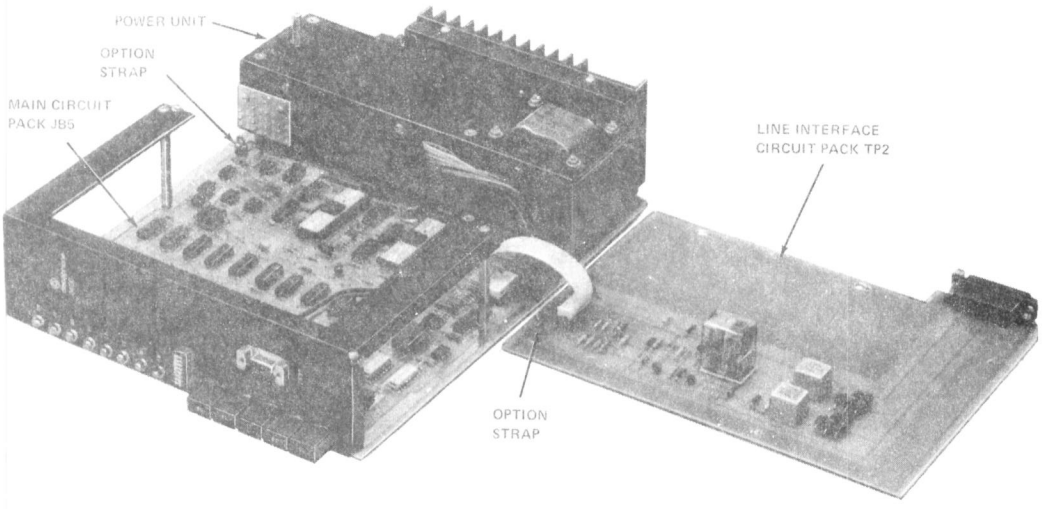


Fig. 4—DS 201C-L1D/2/5—Circuit Pack Access

from remote transmitters. If new sync is not required option YA (new sync not used) is installed.

2.04 ***Transmitter Timing:*** Internal timing, external timing, or timing controlled by the receiver bit clock (sometimes referred to as "slave" timing) can be provided.

(a) With internal timing (option YC), the data set provides serial clock (nominally 2400 Hz) to the CPE on the transmitter signal element timing lead (pin 15).

(b) With external timing (option YD), the CPE provides serial clock (2400 Hz) to the data set on the transmitter signal element timing (external) lead (pin 24). This causes transmitter serial clock to phase-lock to the external clock.

(c) With timing controlled by the receiver bit clock (option WI), the transmitter serial clock is phase-locked internally to the receiver serial clock.

2.05 ***Use With Data Auxiliary Set (DAS) 828/829-Type:*** These options enable or disable the DAS 828- or 829-type CIUs ability to externally control data set ready (CC—pin 6) through the telephone line interface. Option YI (yes) allows the CIU to hold CC on or off by closing or opening the connection between telephone line interface pins 13 (TEK 5) and 11 (TEK 6). Option YJ (no) causes the data set to ignore the status of these telephone line interface pins.

2.06 ***Grounding Option:*** Option YK provides signal ground (pin 7) connected to protective (frame) ground (pin 1) to minimize the introduction of power line noise into the data circuits. If local conditions require that signal ground ***not*** be connected to protective ground, option YL may be installed.

2.07 ***Status of Data Set Ready (DSR) During Local Analog Loopback:*** These options allow the customer to determine if the DSR indication on the CPE is off or on during local analog loopback testing. Option YM provides for DSR to be on and YN provides for it to be off. These options make no distinction between manual testing via the AL test switch or automatic testing through pin 18 (option YS). Operation of any other test switch overrides these options.

2.08 ***Continuous Receiver Bit Clock:*** Option YO ***(In)*** allows the receiver signal element timing (DD) signal to be present even when there is no received carrier signal. This is accomplished

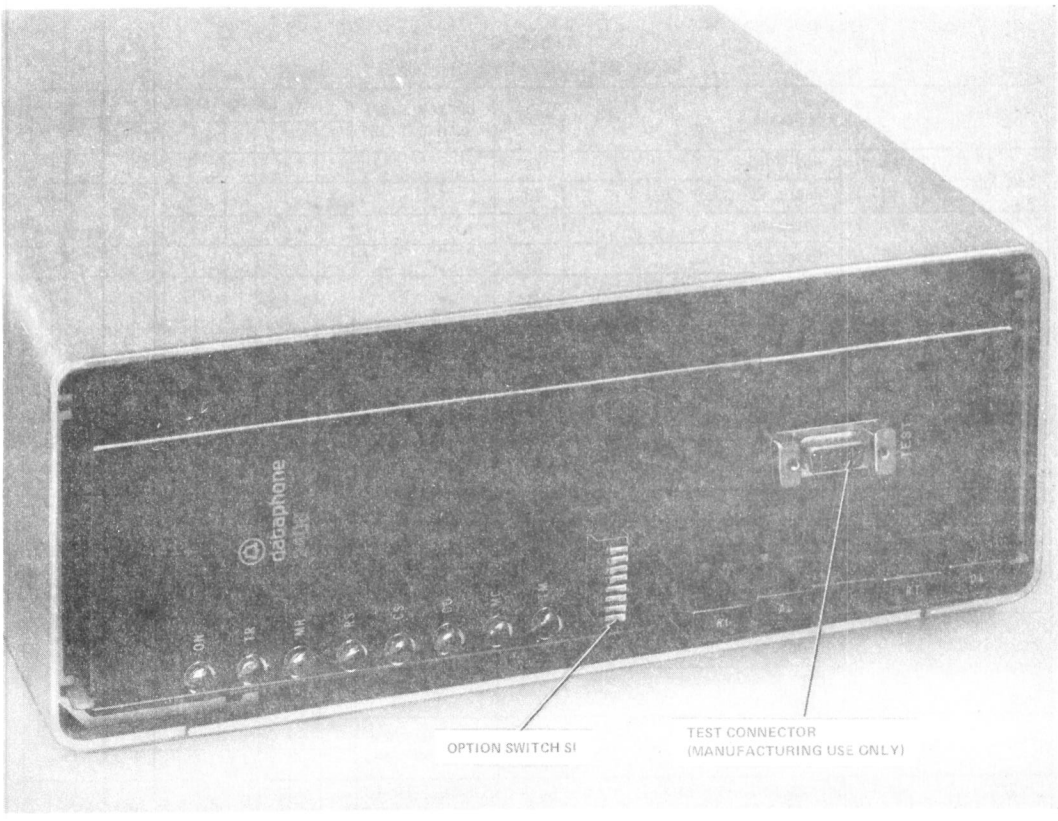


Fig. 5—DS 201C-L1D/2/4/5—Front Cover Removed

by having DD connected to the transmitter signal element timing (DB) signal, which is always present. Option YP ***(Out)*** allows the receiver signal element timing (DD) signal to be derived from the received data signal and to be changed to spacing (positive voltage) when the received line signal detector (CF) is off.

2.09 ***Function of EIA Interface Pin 18:*** Option YS allows analog loopback to be under the control of the CPE through interface pin 18. An EIA ***on*** voltage on pin 18 (LL) has the same effect on the data set as pressing the AL button, except that the data set ready (CC) signal is conditioned ***on.*** Option YT disables the electrically activated analog loopback test feature, and pin 18 becomes an output which provides receiver dibit clock (DCR).

2.10 ***Type of Operation and Clear to Send Delay:*** These options determine whether the data set will operate in the 2-wire or 4-wire mode, switched carrier or continuous carrier mode, and the length of the clear-to-send delay. The 4-wire operating mode is a full-duplex mode where separate lines are required for transmitting and receiving simultaneously, while in the 2-wire half-duplex mode the same line is used for both transmitting and receiving, but not simultaneously.

(a) With 4-wire service, switched carrier or continuous carrier options are available.

TABLE C
DATA SET 201C-L1D OPTIONS

FEATURE		OPTION	OPTION STRAP MAIN CKT JB5	S1 SWITCH SETTING								USOC DECSN
				1	2	3	4	5	6	7	8	
New Sync	Not Used	YA*		0								B3
	Under Customer Control	YB		X								B4
Transmitter Timing	Internal	YC*			0	0						A1
	External	YD			X	0						A2
	Controlled by Receiver Bit Clock (Slave)	WI			X	X						A2
Use with DAS 828/829-Type	Yes	YI*	Install E5-E6									
	No	YJ	Install E4-E5									
Grounding Option	Signal Ground Connected to Frame Ground	YK*	Install E7-E8									F11,F12
	Signal Ground not Connected to Frame Ground	YL	Install E8-E9									F12
Status of DSR During Local Analog Loopback	DSR On	YM									0	F12
	DSR Off	YN*									X	F11,F12
Continuous Receiver Bit Clock	In	YO								0		D7
	Out	YP*								X		D8
Function of EIA Interface Pin 18	Initiates Local Analog Loopback	YS	Install E1-E2									E9
	Provides Receiver Symbol Clock	YT*	Install E2-E3									E10

FEATURE			OPTION	OPTION STRAP LINE INT. TP2	S1 SWITCH SETTINGS								
					1	2	3	4	5	6	7	8	
Type of Operation and Clear to Send Delay	4-Wire	Switched Carrier 7 MSEC Clear to Send Delay	XA*	Install E2-E3 Install E4-E6				0	X	X			C5
		Continuous Carrier 7 MSEC Clear to Send Delay	XB	Install E2-E3 Install E4-E6				0	0	X			C6
		Continuous Carrier 0 MSEC Clear to Send Delay	XC	Install E2-E3 Install E4-E6				X	0	X			C6
	2-Wire	Switched Carrier 150 MSEC Clear to Send Delay	XE	Install E1-E3 Install E5-E6				0	X	0			C5

* Factory-Provided
X = Closed
0 = Open

- With the switched carrier, 7-ms clear-to-send delay option (XA), the data set can transmit (carrier is on) when request-to-send (CA) is ***on.*** The data set transmitter is off when CA is ***off.***

- With the continuous carrier, 7-ms clear-to-send delay option (XB), the data set transmitter remains on continuously to maintain synchronization; however, when CA is ***off,*** the data set transmitter sends an idle code of steady marks.

- With the continuous carrier, 0-ms clear-to-send delay option (XC), data set operation is identical to option XB except that there is no delay between request-to-send and clear-to-send (CB).

(b) With 2-wire service, the only option available is switched carrier with 150-ms of delay between request-to-send and clear-to-send (option XE). This delay allows sufficient time for echo suppressors in the telephone line to turn around and for the distant receiver to establish synchronization. In addition, the receiver is clamped for 100-ms after the transmitter is turned off to permit line echoes to decay.

3. INSTALLATION

3.01 The procedure for installing a DS 201C-L1D is as follows:

(1) Unpack the data set and remove the protective covering from the housing.

(2) Disassemble the data set as directed in paragraph 1.08.

(3) Install the options called for on the service order. Refer to Table C.

(4) Mark the installed options on the option label and attach it to the bottom of the housing.

(5) Reassemble the data set as directed in paragraph 1.09.

(6) Connect the data set to the telephone line or DAS as directed on the appropriate connection diagram.

(7) Perform installation tests as directed in Section 592-029-520.

4. CONNECTIONS

4.01 Connections for the various types of service using DS 201C-L1D are shown in Fig. 6 through 14. The figure numbers and titles of these connection drawings are listed below:

Fig. 6—2-Wire Service Using 66E3 Connecting Block Only

Fig. 7—4-Wire Service Using 66E3 Connecting Block Only

Fig. 8—4-Wire Service (Data Only) Using DAS 828A

Fig. 9—4-Wire Service (Data/Voice) Using DAS 828A

Fig. 10—4-Wire Service (Data Only) With Switched Network Backup Using DAS 828A and DAS 828C

Fig. 11—4-Wire Service (Data/Voice) With Switched Network Backup Using DAS 828A and DAS 828C

Fig. 12—4-Wire Service (Data Only) Using DAS 829-Type

Fig. 13—4-Wire Service (Data/Voice) Using DAS 829-Type

Fig. 14—4-Wire Service (Data Only or Data/Voice) With Switched Network Backup Using DAS 829-Type

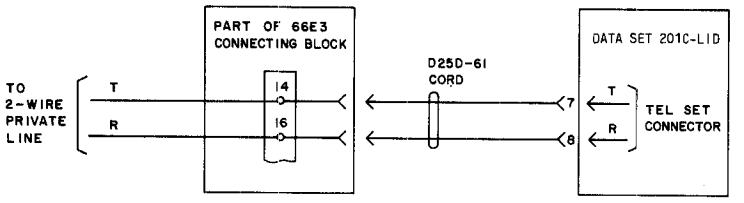
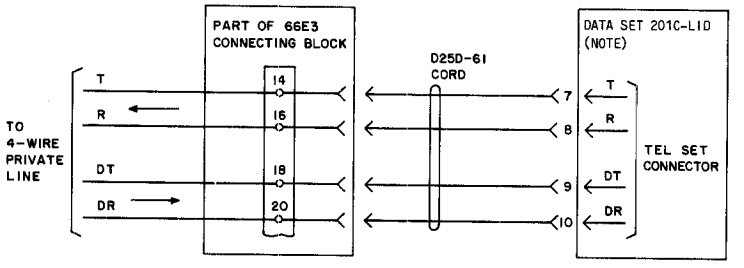


Fig. 6—2-Wire Service Using 66E3 Connecting Block Only



NOTE:
IF THE DATA SET IS USED AS AN EXTENSION OF A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM AND OPTION WI IS NOT INSTALLED, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.

Fig. 7—4-Wire Service Using 66E3 Connecting Block Only

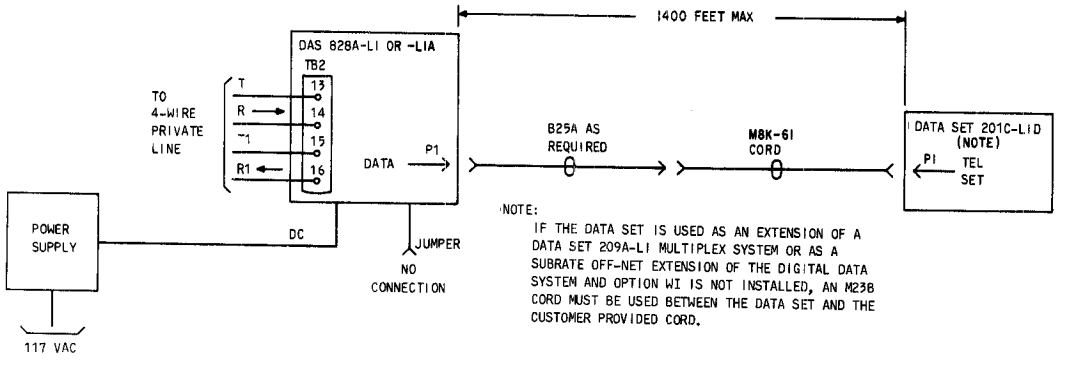


Fig. 8—4-Wire Service (Data Only) Using DAS 828A

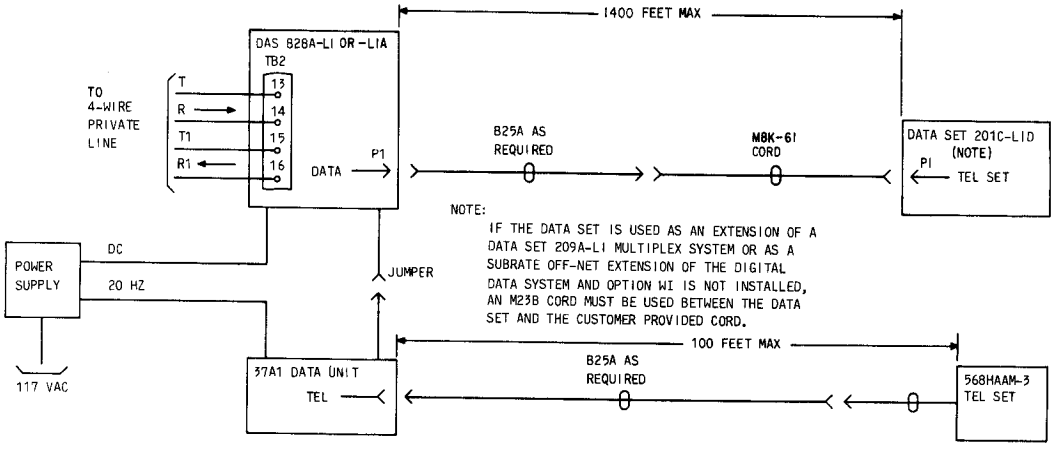
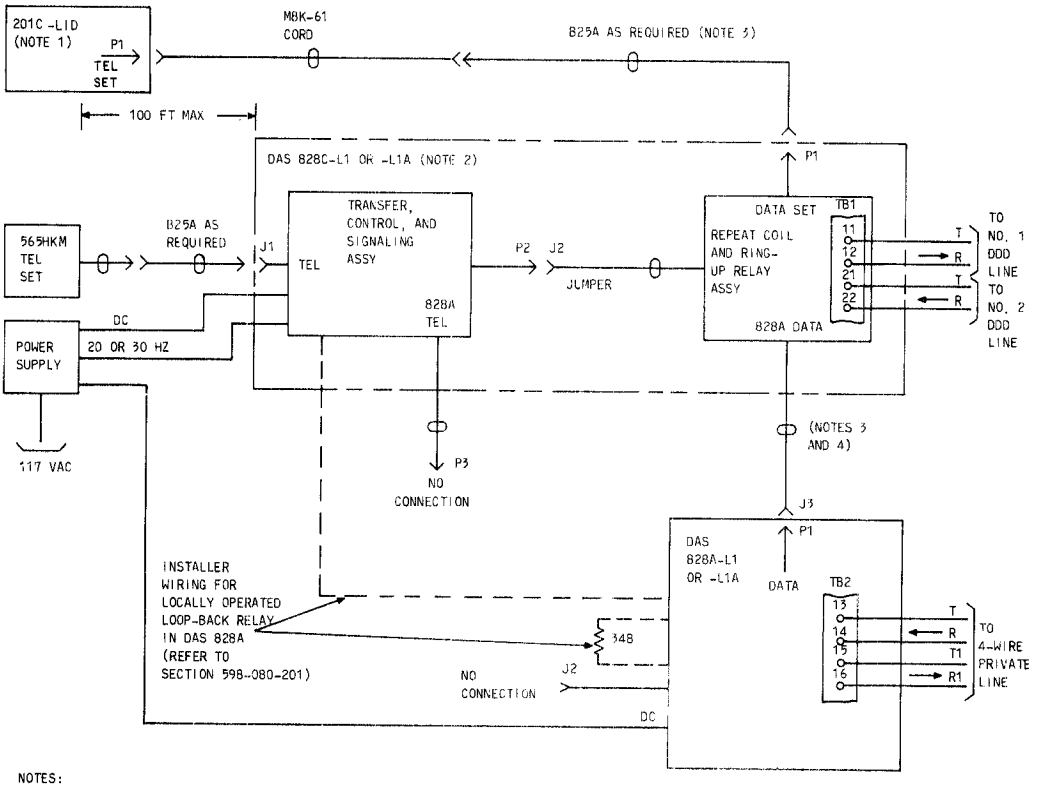


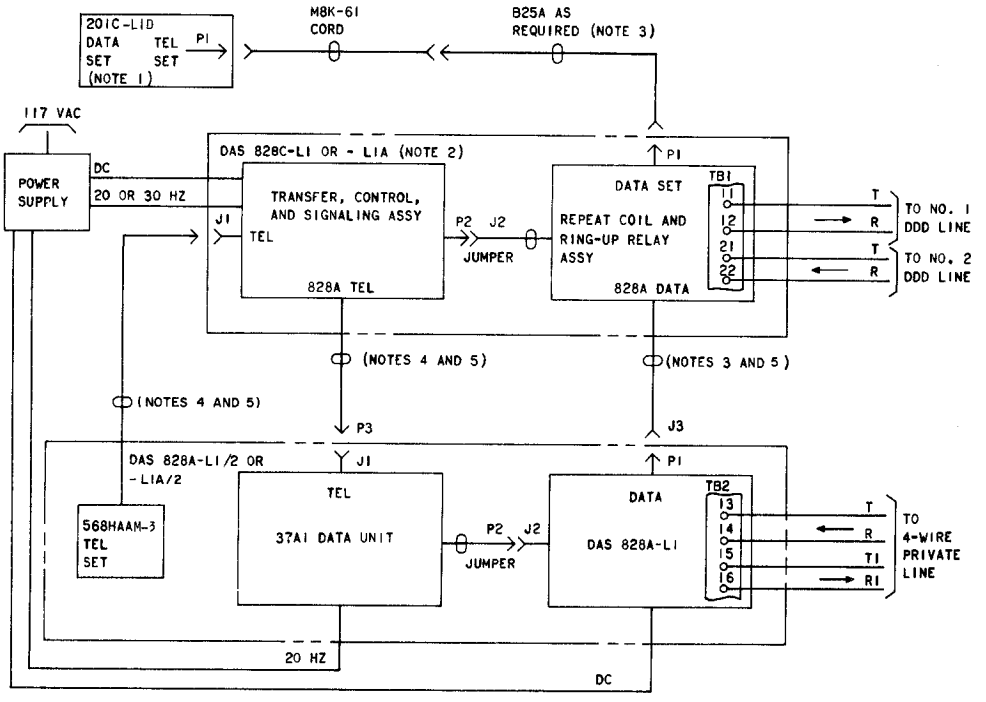
Fig. 9—4-Wire Service (Data/Voice) Using DAS 828A



NOTES:

1. IF THE DATA SET IS USED AS AN EXTENSION OF A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AND OPTION WI IS NOT INSTALLED, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.
2. ADD 227A AMPLIFIER IN RECEIVE PATH AS DIRECTED IN SECTION 598-080-201.
3. MAXIMUM DISTANCE BETWEEN DATA SET AND DAS 828A IS 1400 FEET.
4. MAY BE EXTENDED WITH B25A CABLE.

Fig. 10—4-Wire Service (Data Only) With Switched Network Backup Using DAS 828A and DAS 828C



NOTES:
1. IF THE DATA SET IS USED AS AN EXTENSION OF A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AND OPTION WI IS NOT INSTALLED, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.
2. ADD 227D AMPLIFIER IN RECEIVE PATH AS DIRECTED IN SECTION 598-080-201.
3. MAXIMUM DISTANCE BETWEEN DATA SET AND DAS 828A IS 1400 FEET.
4. MAXIMUM DISTANCE BETWEEN TEL SET AND 37A1 DATA UNIT IS 100 FEET.
5. MAY BE EXTENDED WITH 825A CABLE.

Fig. 11—4-Wire Service (Data/Voice) With Switched Network Backup Using DAS 828A and DAS 828C

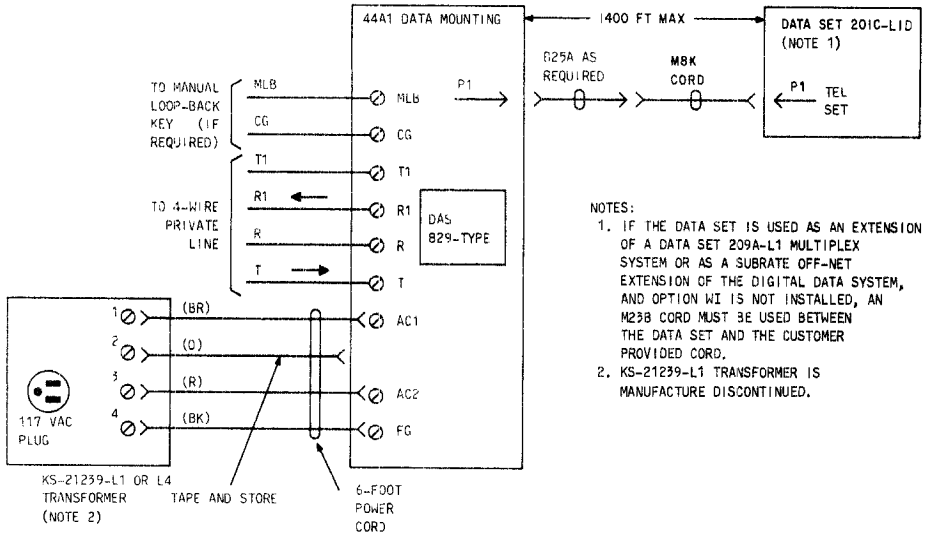
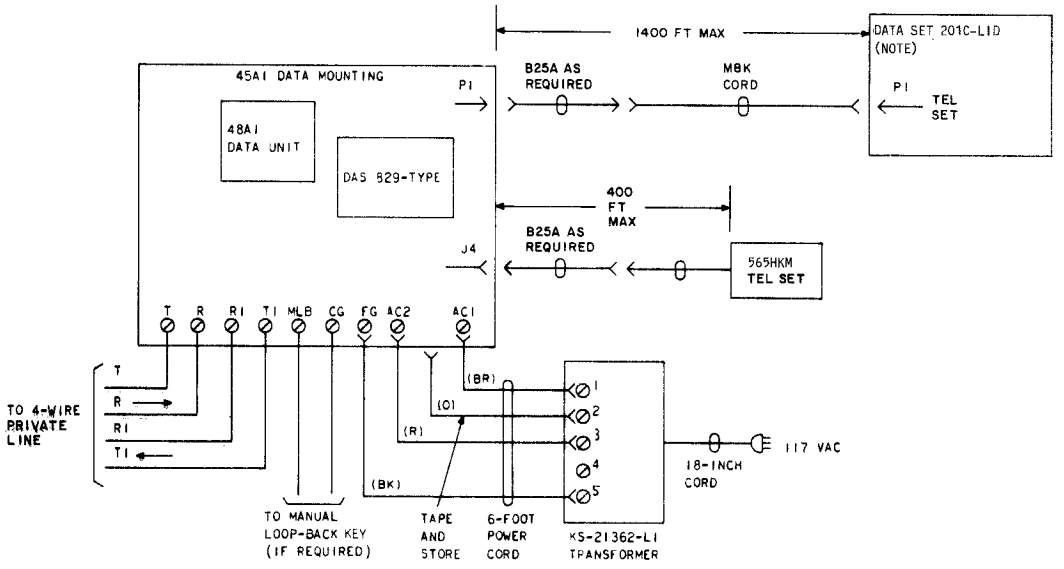
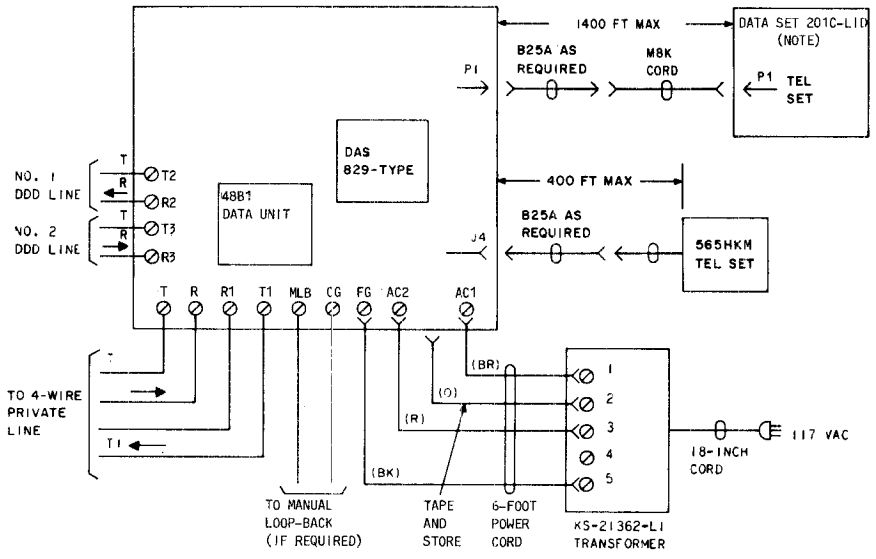


Fig. 12—4-Wire Service (Data Only) Using DAS 829-Type



NOTE:
IF THE DATA SET IS USED AS AN TXTENSION OF A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM AND OPTION WI IS NOT INSTALLED, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.

Fig. 13—4-Wire Service (Data/Voice) Using DAS 829-Type



NOTE:
IF THE DATA SET IS USED AS AN EXTENSION OF A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM AND OPTION WI IS NOT INSTALLED, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.

Fig. 14—4-Wire Service (Data Only or Data/Voice) With Switched Network Backup Using DAS 829-Type

5. REFERENCES

5.01 Additional information concerning DS 201C-L1D and auxiliary apparatus is contained in the following publications:

SECTION	TITLE
314-205-501	Data Systems—DATA-PHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
314-919-100	Digital Data System—Subrate Off-Net Extension Arrangement—Installation and Connections
502-500-120	Telephone Sets—540, 560, 1560, and 2560 Series—Common Installation and Maintenance Information
590-002-100	Data Services—2000 and 2400 BPS Provided by Data Set 201-Type—Reference Guide
590-010-200	Data Sets and Data Access Arrangements—General Installation and Connection Information
590-102-141	50A1 Data Mounting—Identification
592-029-120	Data Set 201C-L1D—Transmitter-Receiver—Description and Operation
592-029-520	Data Set 201C-L1D—Transmitter-Receiver—Test Procedures and Maintenance

SECTION	TITLE
598-080-100	Data Auxiliary Set 828A—Description and Operation
598-080-101	Data Auxiliary Set 828C—Description and Operation
598-080-200	Data Auxiliary Set 828A—Installation and Connections
598-080-201	Data Auxiliary Set 828C—Installation and Connections
598-080-500	Data Auxiliary Set 828A—Maintenance and Test Procedures
598-080-501	Data Auxiliary Set 828C—Maintenance and Test Procedures
598-082-100	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Description
598-082-101	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Description
598-082-200	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Installation and Connections
598-082-201	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Installation and Connections
598-082-500	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Maintenance and Test Procedures
598-082-501	Data Auxiliary Set 829-Type—Supplementary Functions for Voiceband Private Line Channels—(Alternate Voice and Dial Backup)—Test Procedures
666-511-501	Test of Data Services Provided by Data Set 201C From a Private Line Testroom
999-100-138	Data Set 201C—How to Operate Manual.

5.02 Detailed information concerning DS 201C-L1D is contained in Circuit Description (CD) and Schematic Drawing (SD) 1D290-01 entitled Data Systems Station—Data Set 201C-L1D.

NO NEED TO CALL THE DATA TEST CENTER!!!

Data set 201C-L1D can be tested with the Automatic Data Test System (ADTS) using the DIVA feature and TOUCH-TONE® signalling (from a rotary dial phone, use a KS-21799-L1 tone coupler).

DDD	TEST FUNCTION LB RT ER DL
X	X

Use local instructions for DIVA access.

Test commands are entered into ADTS by letters and numbers on the TOUCH-TONE dial. To enter letters depress the number sign (#), then depress the TOUCH-TONE key that has the desired alpha character on it. Then depress the digit (1, 2, or 3) corresponding to the position of the alpha character on the TOUCH-TONE key.

Examples: 202C10 202#2310*
401J 401#51*
208B 208#22*

FUNCTION	CHARACTERS
NO	0*
YES	1*
RESULTS	7*
LIST ALL TEST FUNCTIONS	8*
REPEAT LAST MESSAGE	#*
DIGITAL LOOPBACK (DL)	35*
ERROR RUN (ER)	37*
LOOPBACK TEST (LB)	52*
STOP AND DISCONNECT	#63*
STOP PRESENT FUNCTION	#73*
REMOTE TEST (RT)	78*

For fast test of above, depress 3 before function, eg ,352*. Be sure to use #63* to disconnect in every case.

For more details, see Sections 590-010-500 and 668-600-102.

DATA SET 201C-L1D
TRANSMITTER-RECEIVER
TEST PROCEDURES AND MAINTENANCE

CONTENTS PAGE

1. GENERAL

1.01 This section contains:

- Test procedures using the self-test capabilities of data set (DS) 201C-L1D
- Test procedures using the 914C data test set (DTS)
- Maintenance procedures for the DS 201C-L1D.

These procedures are to be used when testing DS 201C-L1D on an initial installation or during a maintenance visit.

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 This section is divided into six parts. Part 1, General, describes the test modes and the

restrictions on their use. Part 2, Installation Tests, specifies the tests to be performed on an initial installation. Part 3, Maintenance Procedures and Tests, specifies the procedures to be used and the tests to be performed during a maintenance visit. Part 4, Supplementary Test, specifies a special purpose test that ordinarily is not required during installation and maintenance. Part 5, Test Procedures, provides the procedures for all installation, maintenance, and supplementary tests. Part 6, References, lists publications that provide additional information.

Test Capabilities

1.04 Test circuitry built into DS 201C permits the following self tests to be performed: analog loopback, digital loopback, and end-to-end. The analog loopback, digital loopback, and end-to-end tests can also be performed by use of external test equipment such as the 914C DTS. The ground noise test requires the use of a 6H impulse counter or equivalent.

> *Note:* The TEST connector located behind the front cover of DS 201C-LID is used for factory testing only.

Restrictions on Use of Self Tests

1.05 If DS 201C-L1D is used as a remote extension of a DS 209A-L1 multiplex system or as a subrate off-net extension of the digital data system (DDS), the digital loopback self test cannot be performed from a remote extension (with options as installed) in toward a DS 201C-L1D collocated with a DS 209A-L1 or a hub office of the DDS. If the internal timing option (option YC) is temporarily installed at the remote extension, this test can be performed.

Data Set Compatibility

1.06 Except where noted all tests contained in this section may be accomplished using either DS 201C-L1D or the older DS 201C-L1.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory. The self-test features of the data set are used for all installation testing—external test equipment is not required.

2.02 Before proceeding with the tests, verify that the private line meets the requirements specified in Section 314-410-500. For a 2-wire private line, the installation test sequence is shown in Fig. 1. For a 4-wire private line, the installation test sequence is shown in Fig. 2.

3. MAINTENANCE PROCEDURES AND TESTS

Maintenance Procedures

3.01 When investigating a trouble report, proceed as directed in the following figures:

Fig. 3—Maintenance Sequence (2-Wire Private Line)

Fig. 4—Maintenance Sequence (4-Wire Private Line)

3.02 When DS 201C-L1D is used as an extension of a DS 209A-L1 multiplex system, refer to Section 592-032-300 for maintenance information. Procedures used at the serving test center (STC) to maintain this system are contained in Section 666-511-504.

3.03 When DS 201C-L1D is used as a subrate off-net extension of the DDS, refer to Section 314-919-300 for maintenance information. Procedures used at the hub office STC to maintain the analog portion of this system are contained in Section 666-511-501.

3.04 If DS 201C-L1D is used as a remote extension of a DS 209A-L1 multiplex system or as a subrate off-net extension of the DDS, refer to paragraph 1.05 for restrictions on the use of the self tests.

3.05 If it becomes necessary to dispatch a telephone company (telco) employee to the data set location, the following equipment should be taken along:

- 914C data test set (DTS)
- Spare DS 201C-L1D

3.06 If the data set is replaced, the defective data set should be tagged with a tag

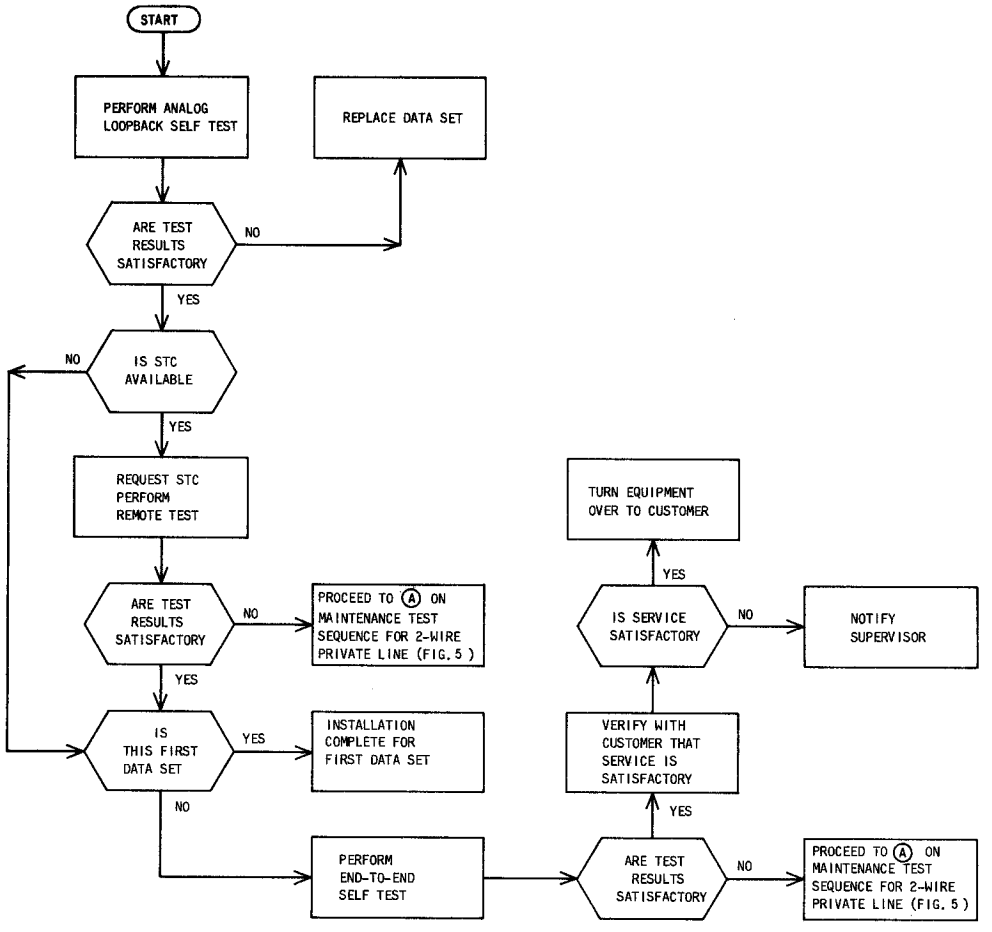


Fig. 1—Installation Test Sequence (2-Wire Private Line)

describing the nature of the trouble, carefully packed, and returned to a service center for repair. After the data set has been replaced, verify with the customer that service is satisfactory.

3.07 If the trouble persists, proceed as follows:

(a) Check that the options installed in the data set agree with those specified on the service order.

(b) Verify that the customer-provided equipment (CPE) has been tested and is operating satisfactorily.

(c) Verify that all the cords and connectors are properly connected.

(d) Check for physical damage.

(e) Check for intermittent trouble in the station wiring.

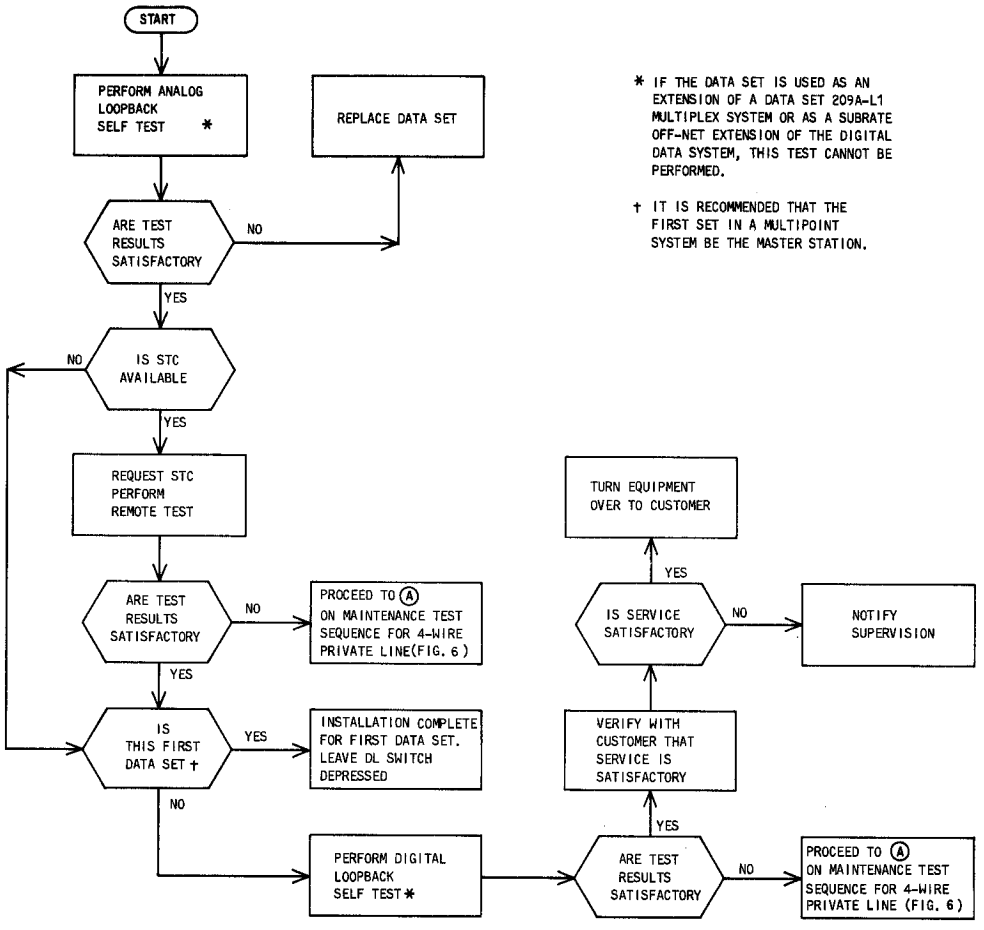


Fig. 2—Installation Test Sequence (4-Wire Private Line)

(f) Verify that the data set and the CPE are connected to a common ground.

(g) If the trouble cannot be cleared, request help from immediate supervisor.

Maintenance Tests

3.08 For a 2-wire private line, the maintenance test sequence is shown in Fig. 5. For a 4-wire private line, the maintenance test sequence is shown in Fig. 6.

4. SUPPLEMENTARY TEST

4.01 The ground noise test ordinarily is not required during installation and maintenance visits but should be performed when needed. This test is performed to detect the presence of noise potentials caused by a potential difference between data set and CPE grounds.

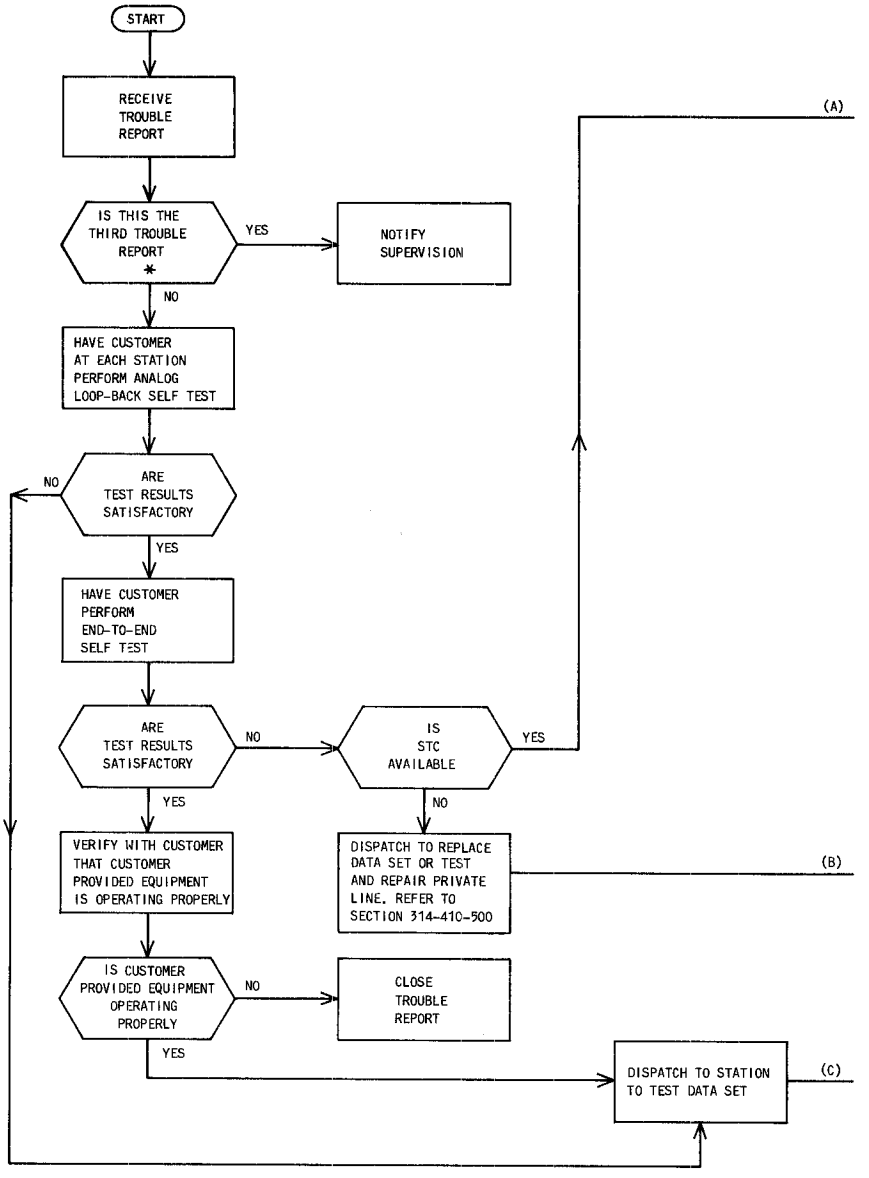


Fig. 3—Maintenance Sequence (2-Wire Private Line) (Sheet 1 of 2)

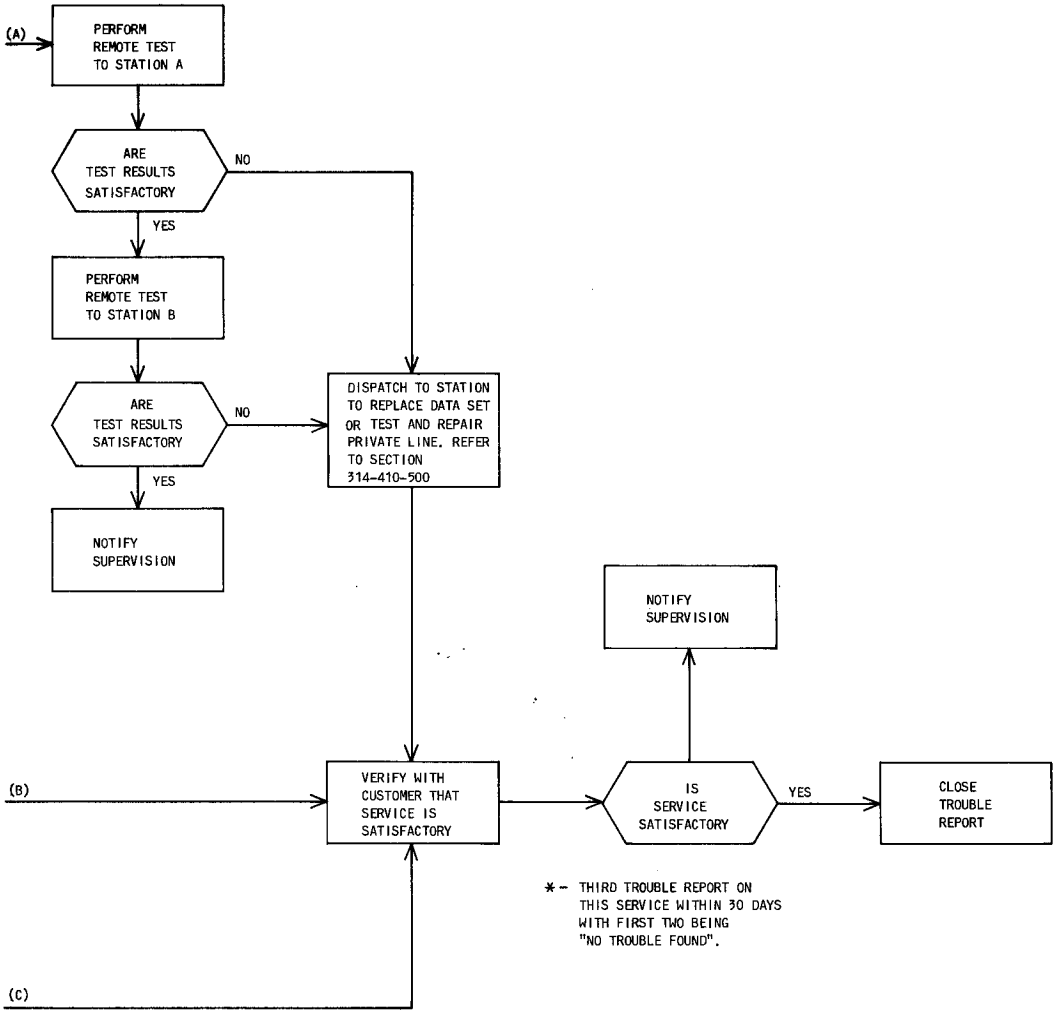


Fig. 3—Maintenance Sequence (2-Wire Private Line) (Sheet 2 of 2)

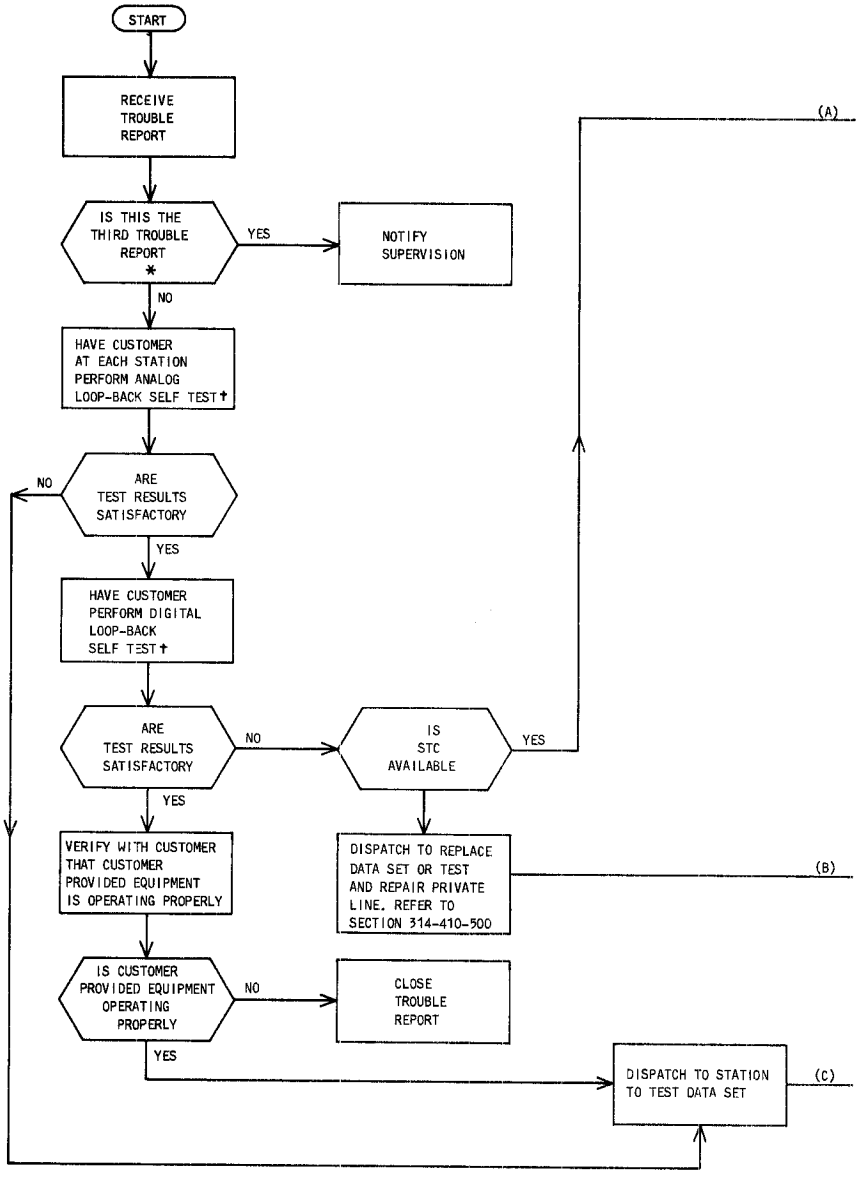


Fig. 4—Maintenance Sequence (4-Wire Private Line) (Sheet 1 of 2)

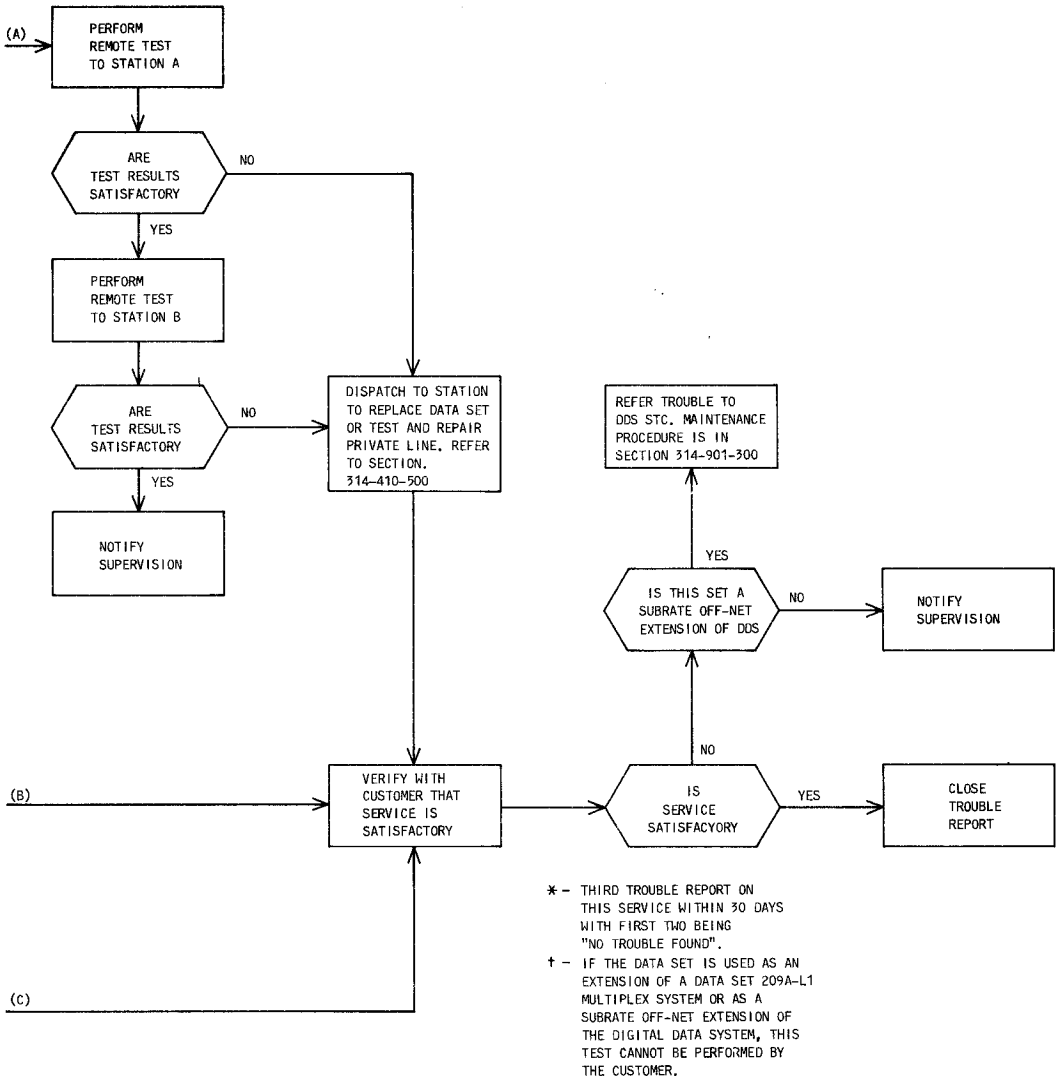


Fig. 4—Maintenance Sequence (4-Wire Private Line (Sheet 2 of 2)

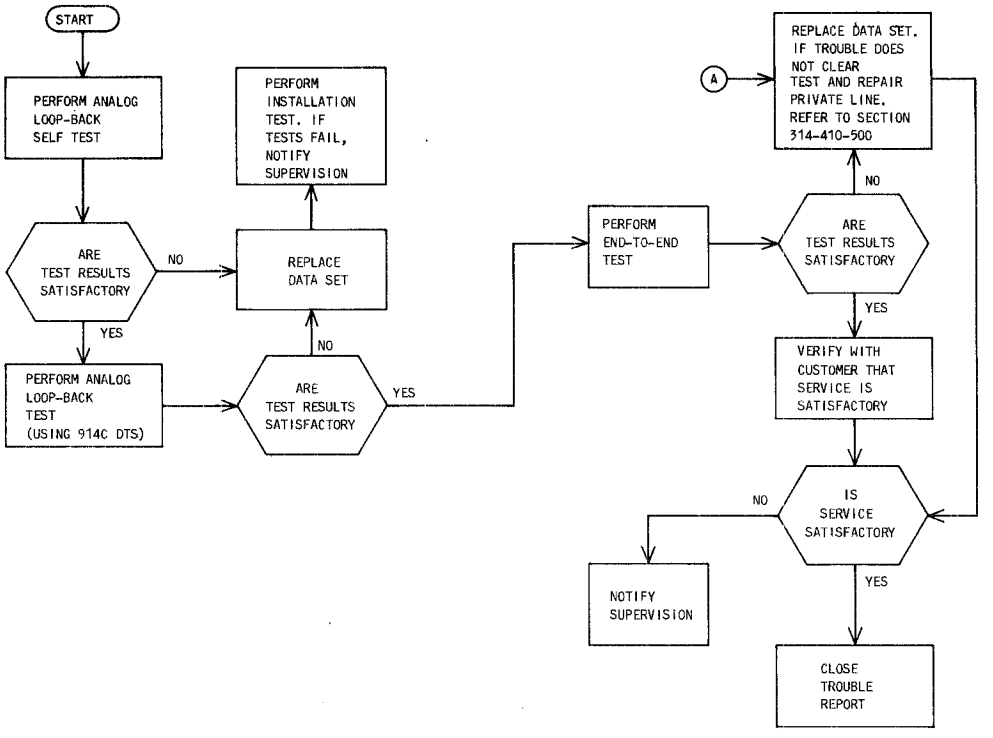


Fig. 5—Maintenance Test Sequence (2-Wire Private Line)

5. TEST PROCEDURES

5.01 This part provides the procedures for the installation, maintenance, and supplementary tests.

A. Analog Loopback Test (Using CPE)

5.02 The analog loopback test checks the data set transmitter and receiver and the customer interface. The data set is internally disconnected from the line interface and the transmitter output is looped back to the receiver input. The CPE transmits data and tests the customer interface by examining transmitter and receiver output signals at the CPE. Data set ready indication can be optioned on or off at the CPE (options YM and YN).

5.03 The analog loopback test can be entered either by depressing the data set AL switch or remotely via customer interface pin 18 (option YS).

5.04 Perform the test as follows (refer to Fig. 7 for data set switch positions and lamp status):

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL switch or condition CPE to turn on customer interface pin 18.

Requirement: ON and TM lamps are lighted.

(3) Release AL switch on data set (if depressed).

Requirement: TM lamp goes off.

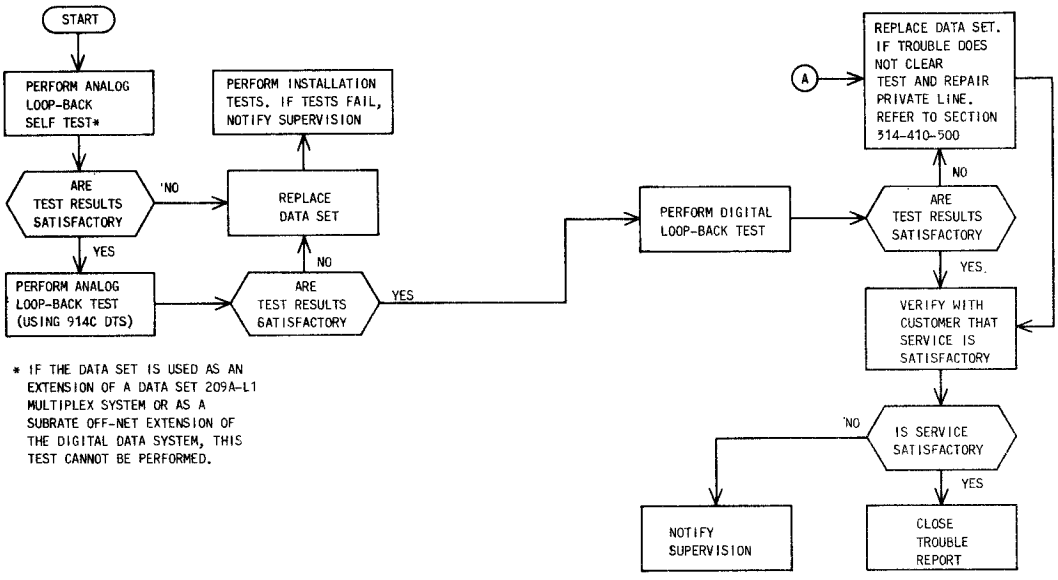
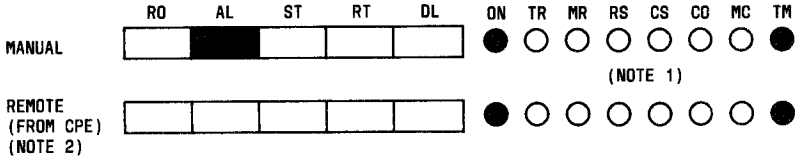


Fig. 6—Maintenance Test Sequence (4-Wire Private Line)



NOTES:
1. ALL LAMPS OTHER THAN ON AND TM ARE UNDER CPE CONTROL.
2. CPE CONTROLS AL VIA PIN 18.

LEGEND:

SWITCH RELEASED

SWITCH DEPRESSED

INDICATOR OFF

INDICATOR ON

Fig. 7—Analog Loopback Test, Data Set Switch Positions, and Lamp Status

B. Analog Loopback Self Test

5.05 The analog loopback self test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back from the transmitter output to the receiver input through an internal attenuator. The received data is compared to the original data. Data errors and data set condition are indicated by the status of the data set indicator lamps.

5.06 Perform the test as follows (refer to Fig. 8 for data set switch positions and lamp status):

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and ST switches on data set.

(3) Observe lamps on data set for at least 30 seconds.

Requirements: (Normal test mode) MC lamp is off continuously (does not blink). All other lamps are lighted.

(4) Depress RO switch on data set.

Requirements: (Idle test mode) RS and CS lamps go off. MC lamp lights. If data set is optioned for switched carrier (option XA or XE), CO lamp goes off. If data set is optioned for continuous carrier (option XB or XC), CO lamp remains lighted.

(5) Release RO switch on data set.

Requirement: All lamps are lighted except MC.

(6) Depress DL switch on data set (DS 201C-L1D only).

Requirements: All lamps are lighted except MC. MC lamp is flashing.

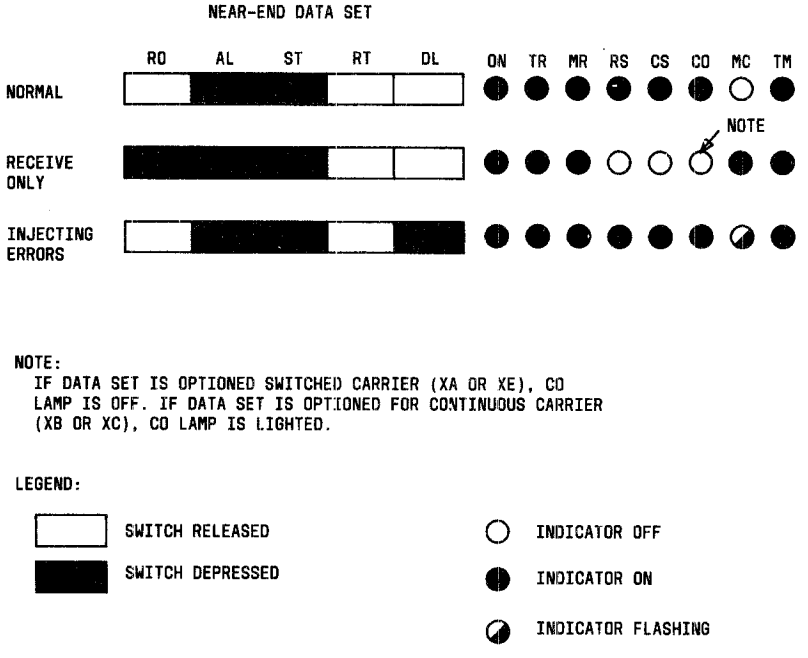


Fig. 8—Analog Loopback Self Test, Data Set Switch Positions, and Lamp Status

(7) Release AL, ST, and DL switches on data set.

Requirement: TM lamp goes off.

C. Digital Loopback Self Test (4-Wire Private Line)

5.07 The digital loopback self test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked. Test data generated and transmitted by the near-end data set is looped back from the receiver output to the transmitter input of the far-end data set and retransmitted. This data is received by the near-end data set and compared to the original data. Data errors and data set condition are indicated by the status of the indicator lamps on the near-end data sets.

5.08 Perform the test as follows (refer to Fig. 9 for data set switch positions and lamp status):

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress ST switch on the near-end data set.

Requirement: TM lamp lights.

(3) Contact far-end data station and have DL switch on data set depressed. (For this portion of the digital loopback self test the far-end data set may be either a DS 201C-LID or 201C-L1.) Verify that TM lamp is lighted.

Requirements: On near-end data set, all lamps are lighted except MC.

(4) Observe MC lamp for ten 1-minute periods.

Requirement: MC lamp does not blink more than an average of two blinks per 1-minute period.

(5) On near-end data set depress DL switch.

Requirement: On near-end data set, all lamps are lighted except MC, which is flashing. (For this requirement to be met the near-end data set must be a DS 201C-L1D.)

(6) Contact far-end data station and have DL switch on data set released. Verify that TM lamp is off.

(7) Release ST and DL switch on near-end data set.

Requirement: TM lamp goes off.

D. End-to-End Self Test

5.09 The end-to-end self test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked. Identical test data is generated by both data sets, transmitted by one of the data sets, and compared to the data generated by the receiving data set. Data errors and data set condition are indicated by the status of the indicator lamps on the data sets. This test is performed with either 2- or 4-wire facilities. In the 2-wire test the transmitter and receiver sections are tested separately. In the 4-wire test both sections and tested simultaneously.

2-Wire Private Line

5.10 Perform the test as follows (refer to Fig. 10 for data set switch positions and lamp status):

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that both data sets are not transmitting or receiving data.

(3) Contact far-end data station and have RO and ST switches depressed on the data set.

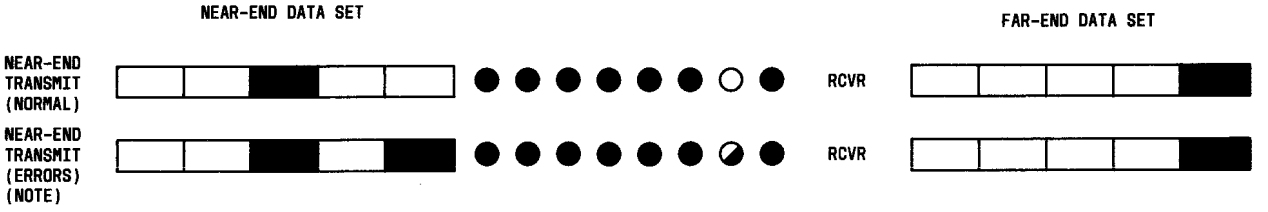
(4) On near-end data set depress ST switch.

Requirements: On far-end data set all lamps are lighted except RS, CS, and MC.

(5) Make a 10-minute error run.

Requirement: At the far-end data set the MC lamp is off and does not blink for more than an average of three times in any 2-minute period.

(6) If the near-end data set is not a 201C-L1D, go to (7), otherwise depress DL switch.



NOTE:
TO OBTAIN PROPER LAMPS STATUS INDICATIONS FOR THIS TEST, THIS DATA SET MUST BE A 201C-LID.

LEGEND:

Fig. 9—Digital Loopback Self Test, Data Set Switch Positions, and Lamp Status

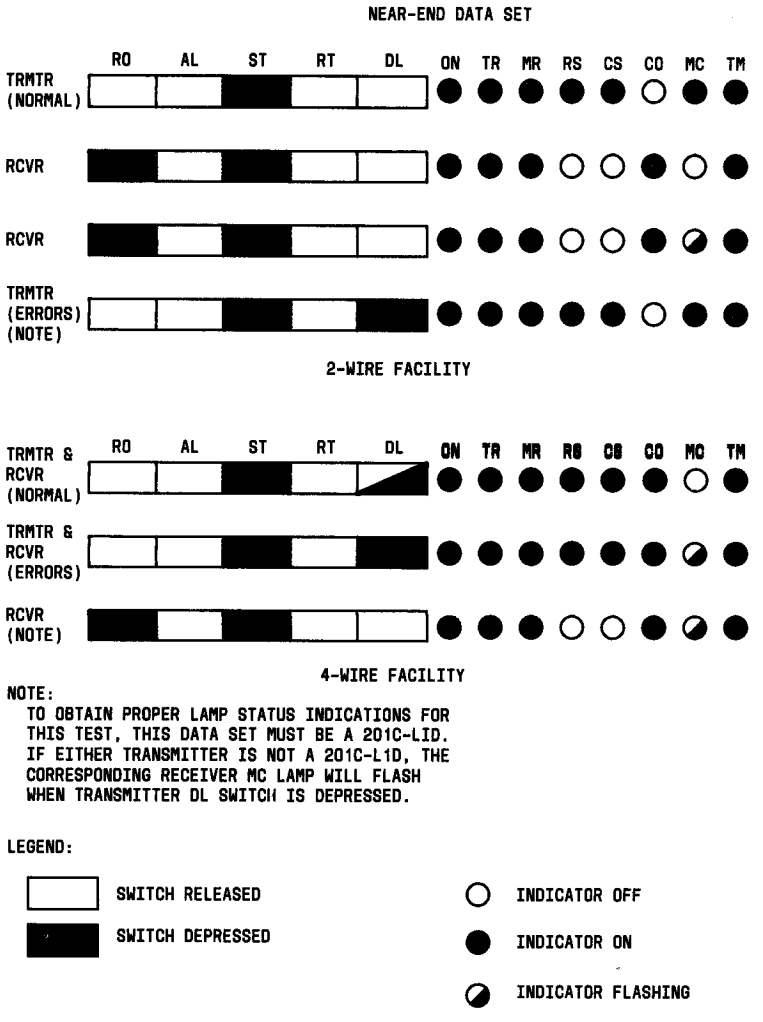


Fig. 10—End-To-End Self Test, Data Set Switch Positions, and Lamp Status (Sheet 1 of 2)

Requirements: At the far-end (receiving) data set all lamps are lighted except RS and CS and MC is flashing.

(7) Contact far-end data station and have RO switch released.

(8) On near-end data set depress RO switch. Release DL switch if depressed.

Requirements: The lamps at the near-end (receiving) data set are all lighted except RS, CS, and MC.

(9) Make a 10-minute error run.

Requirement: At the near-end data set the MC lamp is off and does not blink for

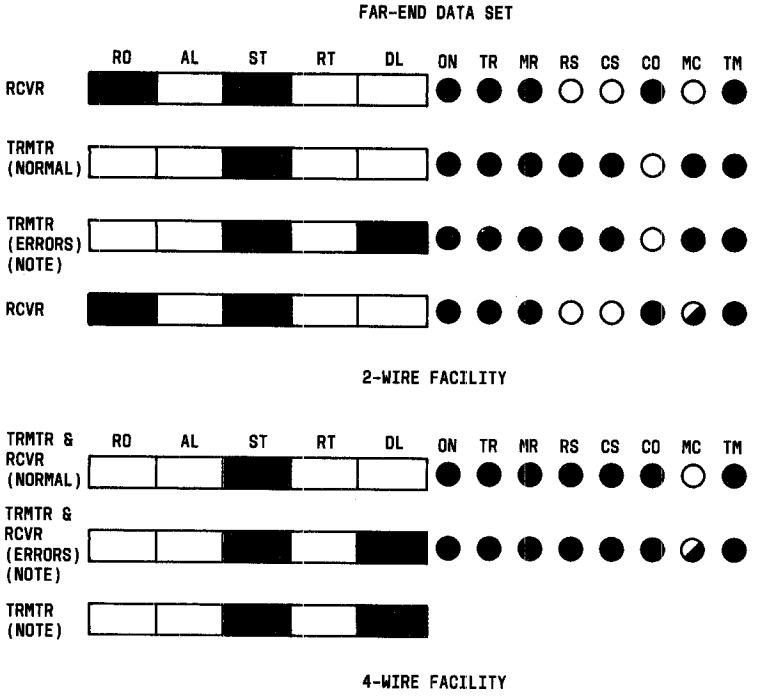


Fig. 10—End-To-End Self Test, Data Set Switch Positions, and Lamp Status (Sheet 2 of 2)

more than an average of three times in any 2-minute period.

(10) If the far-end data station is not a 201C-L1D, go to (11), otherwise contact far-end data station and have DL switch depressed.

Requirements: At the near-end (receiving) data set all lamps are lighted except RS and CS and MC is flashing.

(11) Contact the far-end data station and have any depressed switches released.

Requirement: TM lamp goes out.

(12) At near-end data set release RO switch.

Requirement: TM lamp goes out.

4-Wire Private Line

5.11 Ensure that both data sets are not transmitting or receiving data. Perform the test as follows (refer to Fig. 10 for data set switch positions and lamp status):

(1) Contact far-end data station and have ST switch depressed on the data set.

(2) On near-end data set depress ST switch.

Requirement: All lamps are lighted except MC on both near- and far-end data sets.

(3) Contact far-end data station and have DL switch depressed.

(4) On near-end data set depress DL switch.

Requirements: On both near-end and far-end data sets, all lamps are lighted except MC, which is flashing.

If either near- or far-end transmitter is not a DS 201C-LID, the corresponding receiver MC lamp will not flash.

(5) Contact far-end data station and have ST and DL switches released.

(6) On near-end data set release DL and ST switches.

Requirement: On both near- and far-end sets, TM lamp goes out.

E. Local Loopback Receiver Margin Test

5.12 The local loopback receiver margin test is essentially the same as the analog loopback self test. This test differs in that the receiver compromise equalizer is bypassed and the distortion threshold at which the MC lamp will light is greatly reduced.

5.13 Ensure that both data sets are not transmitting or receiving data. Perform the test as follows (refer to Fig. 11 for data set switch positions and lamp status):

(1) Depress AL and RT switches on data set.

Requirement: All lamps are lighted except MR and MC.

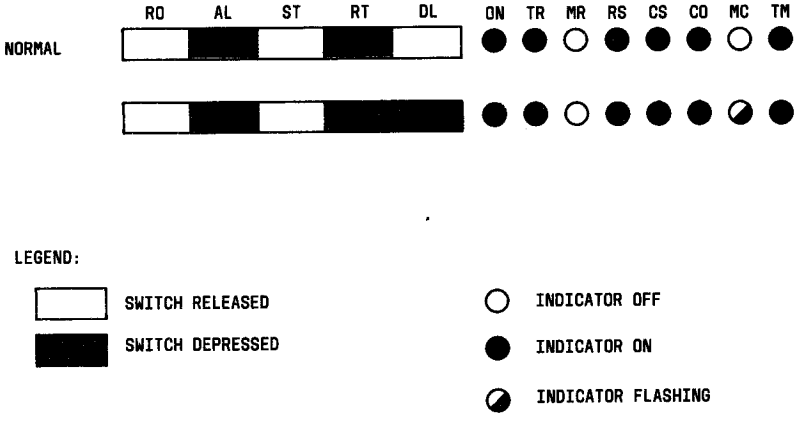


Fig. 11—Local Loopback Receiver Margin Test, Data Set Switch Positions, and Lamp Status

(2) Depress DL switch on data set.

Requirements: ON, TR, RS, CS, CO, and TM lamps are lighted. MR lamp is off. MC lamp is flashing.

(3) Release AL, RT and DL switches on data set.

Requirement: TM lamp goes off.

F. Remote Test

5.14 The remote test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

2-Wire Private Line

5.15 For a 2-wire private line, and end-to-end self test is performed with a serving test center (STC) replacing one of the data sets. Refer to paragraph 5.10 for the required test procedures.

4-Wire Private Line

5.16 For a 4-wire private line, test data is generated and transmitted by the STC. This data is looped back from the receiver output to the transmitter input of the data set and retransmitted. The data is received by the STC and compared to the original data. Perform the test as follows (Refer to Fig. 12 for data set switch positions and lamps status):

(1) Contact STC and request a remote test.

(2) When directed by STC, depress DL switch.

Requirement: TM lamp lights.

(3) STC performs remote test.

(4) When directed by STC, release DL switch.

Requirement: TM lamp goes off.

G. Analog Loopback Test (Using 914C DTS)

5.17 In this test, the power supply voltages are measured, an analog loopback error run is performed, and the CA-CB (RS-CS) interval is checked. The error run checks the data set transmitter and receiver and the customer interface. Test data is generated by a data test set and looped back from the data set transmitter output to the receiver input through an internal attenuator. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS counter. The CA-CB interval check measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) leads turns ***on.***

5.18 The following test equipment is required:

1—914C DTS

5.19 Perform the test as follows:

(1) Connect and condition test equipment as shown in Fig. 13.

(2) Apply power to data set and then to test equipment.

(3) Depress AL switch on data set.

Requirement: TM lamp lights.

(4) On 914C DTS, set S1 to ON.

Requirement: DS1, DS2, and DS3 are lighted.

(5) Set FUNCTION to VOLT INT.

Requirement: +11.0 to +14.5 volts.

(6) Set FUNCTION to OFF, POLARITY to REV, and VERTICAL MONITOR to 10.

(7) Set FUNCTION to VOLT INT.

Requirement: -12.2 to -15.0 volts.

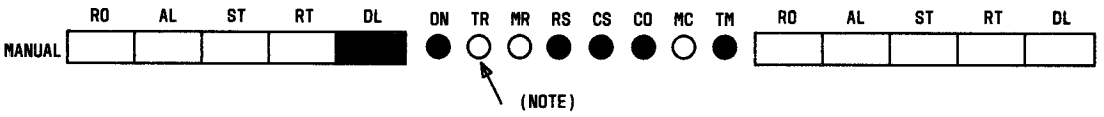
(8) Set FUNCTION to OFF, POLARITY to NOR, RANGE to DCV-10, and VERTICAL MONITOR to 19.

(9) Set FUNCTION to VOLT INT.

Requirement: +4.75 to +5.25 volts.

(10) Set FUNCTION to OFF.

(11) Set WORD SYNC momentarily to MAN.



NOTE:
TR LAMP UNDER CPE CONTROL.

LEGEND:

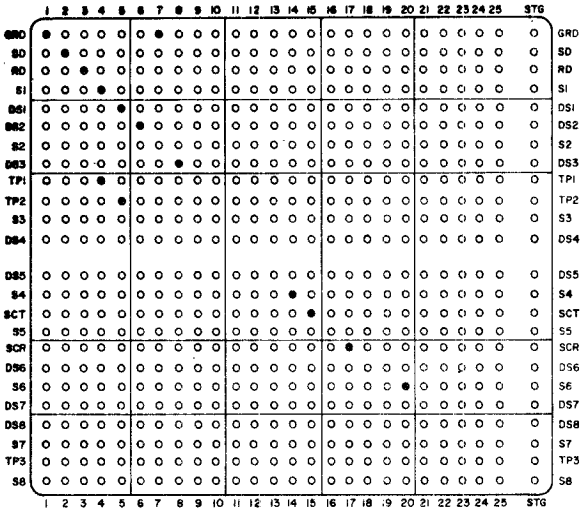
SWITCH RELEASED

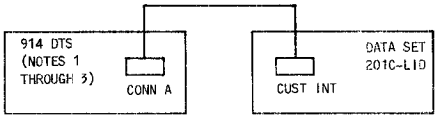
SWITCH DEPRESSED

INDICATOR OFF

INDICATOR ON

Fig. 12—Remote Test Data Set Switch Positions and Lamp Status (4-Wire Private Line)





NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
VERTICAL MONITOR	9
TEST SET MODE	SER
COUNTER	BIT ERRORS
FUNCTION	OFF
RANGE	DCV-30
POLARITY	NOR
SAMPLE WIDTH	.5US
TRIGGER-TP1	+/OPEN
TRIGGER-TP2	+/OPEN
START	A OR B
RCV BIT RATE	EXT +
TRANSMIT BIT RATE	EXT +
RCV WORD LENGTH	511
TRANSMIT WORD LENGTH	511
SIG LEV	+2V
S1	OFF
S4	OFF
S6	ON

2. INSERT RED PROGRAMMING PINS IN 914 DTS MATRIX IN POSITIONS INDICATED ABOVE
3. 914 DTS SWITCHES AND INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS:

SWITCH	LAMP	LEAD	EIA
S1		REQUEST TO SEND (RS)	CA
	DS1	CLEAR TO SEND (CS)	CB
	DS2	DATA SET READY (DSR)	CC
	DS3	RECEIVED LINE SIGNAL DETECTOR (CO)	CF
S4		NEW SYNC (NS)	
S6		DATA TERMINAL READY (DTR)	CD

Fig. 13—Analog and Digital Loopback Test Setup

(12) Depress RESET and allow counter to operate for 5 minutes.

Requirement: No errors indicated.

(13) Set S1 to OFF.

(14) On 914C DTS, set TEST SET MODE to INTERVAL, COUNTER to INTERVAL—X1, and RCV BIT RATE to 1200.

(15) On 914C DTS, depress RESET and then set S1 to ON. CA-CB interval will appear on counter.

Requirements:

- Option XA—7 to 16 ms
- Option XB—7 to 16 ms
- Option XC—0 to 7 ms
- Option XE (On 914C DTS set COUNTER to INTERVAL—X10. Counter indicates 14 to 16)—138 to 158 ms.

(16) To remeasure CA-CB interval, set S1 to OFF, depress RESET, and set S1 to ON.

(17) Release AL switch on data set.

Requirement: TM lamp goes off.

(18) Remove all test equipment and restore data set to pretest condition.

H. Digital Loopback Test (4-Wire Private Line)

5.20 The digital loopback test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interface at the far-end data set is not checked. Test data is generated by a DTS and transmitted by the near-end data set. This data is looped back from the receiver output to the transmitter input of the far-end data set and retransmitted. The data is received by the near-end data set and compared to the original data by the DTS. Data errors are indicated by the DTS counter.

5.21 The following test equipment is required:

1—914C DTS.

5.22 Perform the test as follows:

(1) Connect and condition test equipment as shown in Fig. 13, except on 914C DTS set COUNTER to BLOCK ERRORS—2WL.

(2) Contact far-end data station and have DL switch on data set depressed.

Requirement: TM lamp lights.

(3) Apply power to data set and then to test equipment.

(4) On 914C DTS, set S1 to On.

Requirement: DS1, DS2, and DS3 are lighted.

(5) Set WORD SYNC momentarily to MAN.

(6) Depress RESET and allow counter to operate for 15 minutes. Record total errors indicated.

Requirement: Total errors are less than 23.

(7) Set S1 to OFF.

(8) Contact far-end data station and have DL switch on data set released.

Requirement: TM lamp goes off.

(9) Remove all test equipment and restore data set to pretest condition.

I. End-to-End Test

5.23 The end-to-end test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS counter.

5.24 The following test equipment is required at both transmitting and receiving data stations.

(a) For half-duplex tests (2-wire service):

1—914C DTS.

(b) For duplex tests (4-wire service):

1—914C DTS.

2-Wire Private Line

5.25 For a 2-wire private line, a complete end-to-end test involves making one 15-minute test run in each direction. Perform the test as follows:

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end test.

(2) At both stations, connect and condition test equipment as shown in Fig. 14 except at receiving station, on 914C DTS set S1 to OFF.

(3) At both stations, apply power to data set and then to test equipment.

The receiving station should verify that the 914C DTS NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between the stations. If either lamp lights during the test, the receiving station must contact the transmitting station and arrange to retest.

(4) At receiving station, 914C DTS set WORD SYNC momentarily to MAN.

(5) At receiving station, on 914C DTS depress RESET and allow counter to operate for 15 minutes. Record total errors indicated.

Requirement: Total errors are less than 23.

(6) Perform the end-to-end test in the opposite direction. The receiving station now becomes the transmitting station.

(7) At original receiving station, on 914 DTS set S1 to ON.

(8) At original transmitting station, on 914C DTS set S1 to OFF.

(9) Repeat (4) and (5).

(10) At both stations, remove all test equipment and restore data sets to pretest condition.

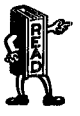
4-Wire Private Line

5.26 For a 4-wire private line, a complete end-to-end test involves making one 15-minute test run in each direction. The runs are made simultaneously (duplex). At both data stations, perform the test as follows:

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end test.

(2) Connect and condition test equipment as shown in Fig. 14.

(3) Apply power to data set and then to test equipment.



Both stations should verify that the 914C DTS NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between the stations. If either lamp lights during the test, the stations must arrange to retest.

(5) On 914C DTS, set WORD SYNC momentarily to MAN.

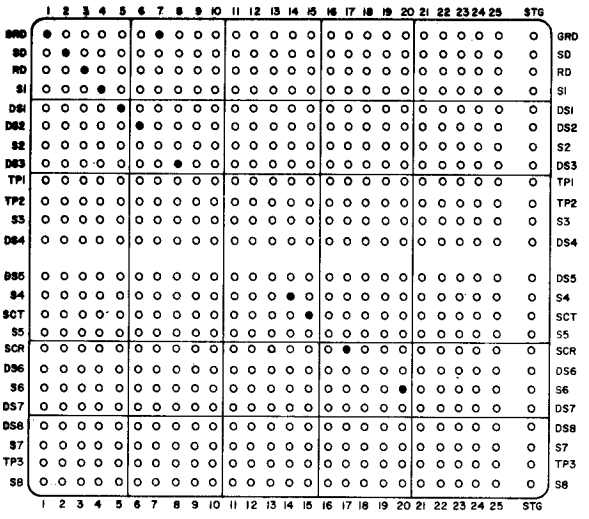
(6) On 914C DTS, depress RESET and allow counter to operate for 15 minutes. Record total errors indicated.

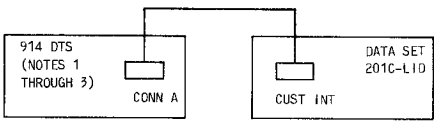
Requirement: Total errors are less than 23.

(7) Remove all test equipment and restore data sets to pretest condition.

J. Ground Noise Test

5.27 If the data set and the CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6-type impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks that exceed a preset amplitude and that are separated by about 150 ms or more.





NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER
COUNTER	BLOCK ERRORS-2WL
FUNCTION	OFF
SAMPLE WIDTH	.5US
RCV BIT RATE	EXT +
TRANSMIT BIT RATE	EXT +
RCV WORD LENGTH	511
TRANSMIT WORD LENGTH	511
SIG LEV	±4V
S1	ON
S4	OFF
S6	ON

2. INSERT RED PROGRAMMING PINS IN 914 DTS MATRIX IN POSITIONS INDICATED ABOVE
3. 914 DTS SWITCHES AND INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS:

SWITCH	LEAD	EIA
S1	REQUEST TO SEND (RS)	CA
S4	NEW SYNC (NS)	
S6	DATA TERMINAL READY (DTR)	CD

Fig. 14—End-To-End Test Setup

5.28 The following test equipment is required:

1—6H impulse counter ***or*** equivalent

1—914C DTS ***or*** interface test adapter (cover of 901B DTS)

1—2W6A test cord (310 plug on one end, alligator clips connected to tip and ring on other end).

Note: Refer to Section 103-620-101 for information on the 6H impulse counter. If the 6H impulse counter is not available, a 6A

impulse counter may be used. Refer to Section 103-620-100 for information on the 6A impulse counter.

5.29 In this test, the impulse counter is connected between the grounds of the data set and the CPE. The impulse counter registers when potential differences of sufficient amplitude have developed between the separated grounds. The 914C DTS is used to gain access to the ground interface leads. It is assumed that protective ground from the CPE appears on pin 1 of the customer interface connector.

5.30 Perform the test as follows:

(1) Using the interface cables provided with the 914C DTS, connect the 914C DTS connector A to the customer connector on the data set, and connect the 914C DTS connector B to the data set connector on the CPE.

(2) On the 914C DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of 2W6A cord to interface selector switch 1B and connect other clip to any unpainted metal on the data set.

(4) Verify that power is applied to data set and CPE.

(5) Insert 310 plug of 2W6A cord into 310 MEAS jack on 6H impulse counter.

(6) Set 6H impulse counter DIAL-MEAS switch to MEAS.

(7) Set 6H impulse counter DBRN dial to 90.

(8) Reset counter on 6H impulse counter to 0.

(9) Set 6H impulse counter MINUTES control to 15. At the end of the 15-minute period, record number of counter indications.

(10) Remove clips of 2W6A cord from 1B and the data set and connect to 7A and 7B.

(11) Repeat (8) and (9).

5.31 At the end of both 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the data set and CPE grounds must be bonded together according to local instructions. At the end of the test, remove all test equipment and restore the data station to pretest condition.

6. REFERENCES

6.01 Additional information concerning DS 201C-L1D is contained in the following publications:

SECTION	TITLE
103-620-100	J94006A(6A) Impulse Counter — Description, Operation, and Maintenance
103-620-101	6H and 6HR Impulse Counters (J9006H and J9006HR) — Description, Operation, and Maintenance
107-101-100	914-Type Data Test Sets — Description and Operation
314-410-500	Voice Bandwidth Private Line Data Circuits — Tests and Requirements
592-029-120	Data Set 201C-L1D — Transmitter-Receiver — Description and Operation
592-029-220	Data Set 201C-L1D — Transmitter-Receiver — Installation and Connections
666-511-501	Test of Data Services Provided by Data Set 201C From a Private Line Testroom
999-100-138	Data Set 201C — How to Operate Manual

6.02 Detailed information concerning DS 201C-L1D is contained in Circuit Description (CD) and Schematic Drawing (SD) 1D-290-01 entitled Data Systems Station — Data Set 201C-L1D.

NO NEED TO CALL THE DATA TEST CENTER!!!

Data set 201C-L1D can be tested with the Automatic Data Test System (ADTS) using the DIVA feature and TOUCH-TONE® signalling (from a rotary dial phone, use a KS-21799-L1 tone coupler).

DDD	TEST FUNCTION LB RT ER DL
X	X

Use local instructions for DIVA access.

Test commands are entered into ADTS by letters and numbers on the TOUCH-TONE dial. To enter letters depress the number sign (#), then depress the TOUCH-TONE key that has the desired alpha character on it. Then depress the digit (1, 2, or 3) corresponding to the position of the alpha character on the TOUCH-TONE key.

Examples:	202C10	202#2310*
	401J	401#51*
	208B	208#22*

FUNCTION	CHARACTERS
NO	0*
YES	1*
RESULTS	7*
LIST ALL TEST FUNCTIONS	8*
REPEAT LAST MESSAGE	#*
DIGITAL LOOPBACK (DL)	35*
ERROR RUN (ER)	37*
LOOPBACK TEST (LB)	52*
STOP AND DISCONNECT	#63*
STOP PRESENT FUNCTION	#73*
REMOTE TEST (RT)	78*

For fast test of above, depress 3 before function, eg,352*. Be sure to use #63* to disconnect in every case.

For more details, see Sections 590-010-500 and 668-600-102.

DATA SET 201C-L1D

TRANSMITTER-RECEIVER

TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 201C-L1D. Test procedures using the 914-type DTS and the self-test capabilities of DS 201C-L1D are contained in Section 592-029-520. These procedures are to be used when testing DS 201C-L1D on an initial installation or during a maintenance visit.

1.02 When this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 When DS 201C-L1D is used as an extension of a DS 209A-L1 multiplex system, refer to Section 592-032-300 for maintenance information. Procedures used at the serving test center (STC)

to maintain this system are contained in Section 666-511-504.

1.04 When DS 201C-L1D is used as a subrate off-net extension of the Digital Data System (DDS), refer to Section 314-919-300 for maintenance information. Procedures used at the hub office STC to maintain the analog portion of this system are contained in Section 666-511-501.

A. Test Capabilities

1.05 Test circuitry built into DS 201C-L1D permits the following self tests to be performed: analog loopback, digital loopback, end-to-end, and receiver margin. The test circuitry also facilitates the remote test of the data set from a test center. Additional tests require the use of external test equipment such as the 921A DTS.

1.06 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C DTS for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

B. Restrictions on Use of Self Tests

1.07 If DS 201C-L1D is used as a remote extension of a DS 209A-L1 multiplex system or as a subrate off-net extension of the digital data system (DDS), the following restrictions apply to the use of the self tests:

(a) The analog loopback self test cannot be performed at a remote extension with options as installed. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

(b) The digital loopback self test cannot be performed from a remote extension (with options as installed) in toward DS 201C-L1D collocated with DS 209A-L1. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

(c) The digital loopback self test cannot be performed from a remote extension (with options as installed) in toward a hub office of the DDS. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory. The self-test features of the data set are used for all installation testing—external test equipment is not required.

2.02 Before proceeding with the tests, verify that the private line meets the requirements specified in Section 314-410-500. For a 2-wire private line, the installation test sequence is shown in Fig. 2. For a 4-wire private line, the installation test sequence is shown in Fig. 3.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed when clearing a trouble report and during a maintenance visit to the data station.

3.02 When a trouble report is received, a test center is responsible for isolating the trouble to the data station or the transmission facility. The procedure for doing this is shown in Fig. 4 (2-wire private line) and Fig. 5 (4-wire private line).

3.03 If the trouble seems to be in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests at the data station. The following equipment should be taken on a trouble visit:

- Spare data set
- 921A DTS

3.04 Refer to Fig. 6 (2-wire private line) and Fig. 7 (4-wire private line) for the sequence in which tests are to be performed by the telco employee at the data station. If the data set is replaced, the defective data set should be tagged

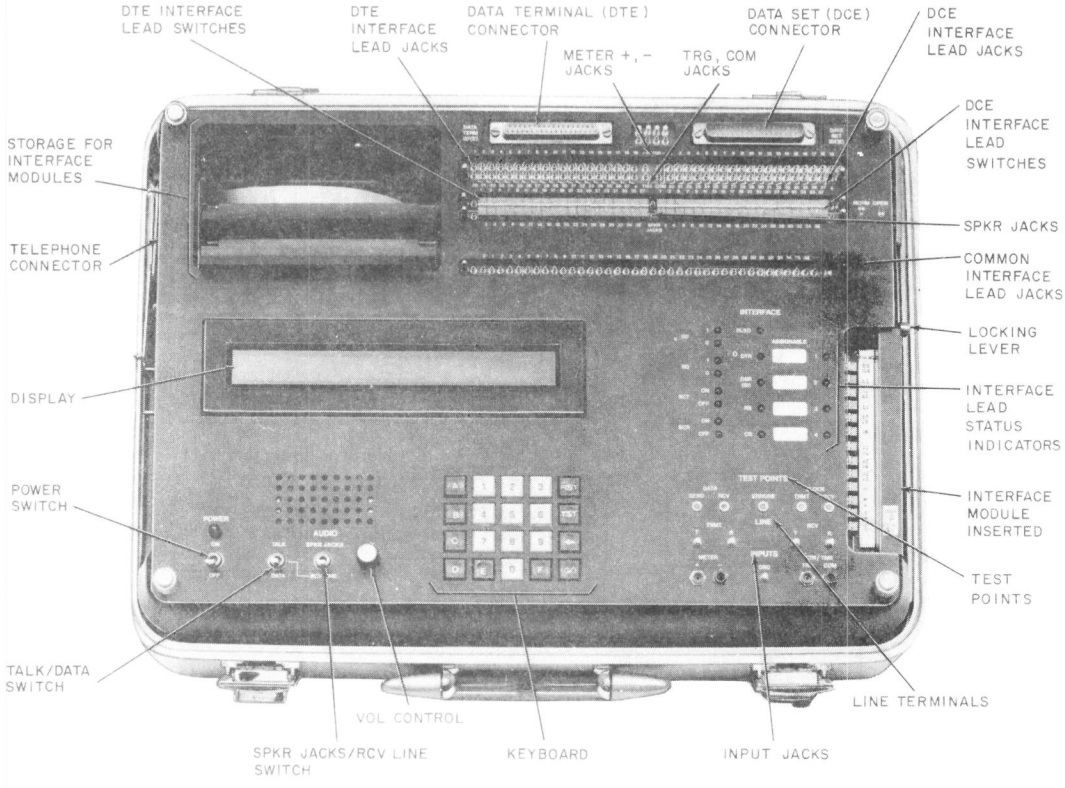


Fig. 1—921A Data Test Set—Front Panel

with a description of the trouble, carefully packed, and returned to the service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists after the tests have been completed, proceed as follows:

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that customer-provided equipment (CPE) has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

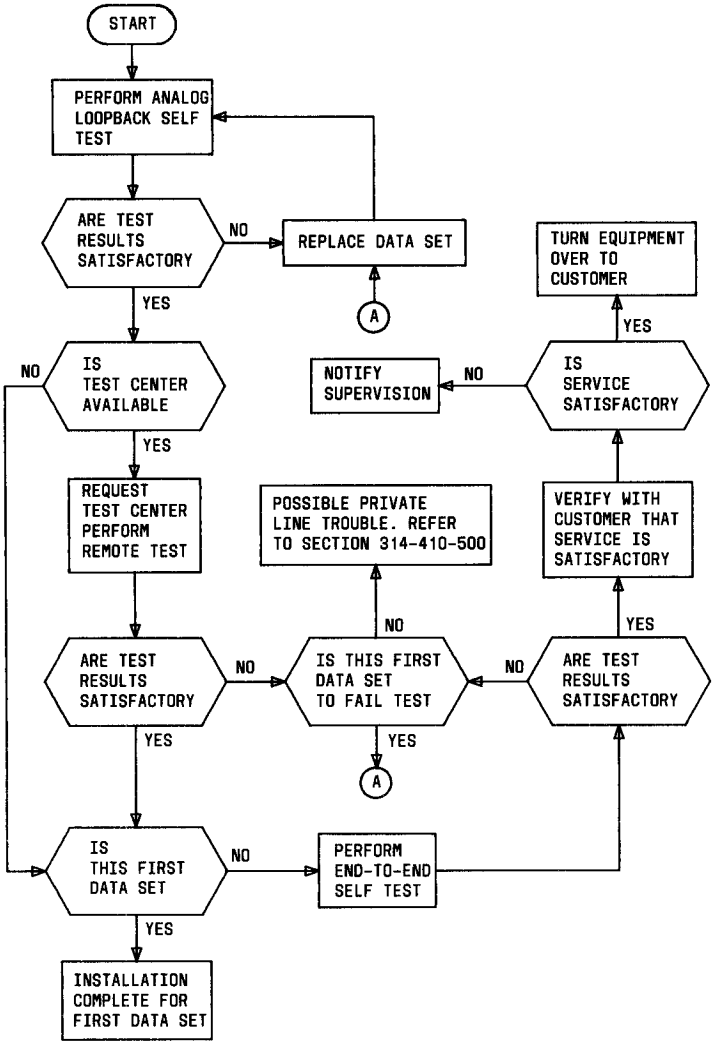


Fig. 2—Installation Test Sequence (2-Wire Private Line)

A. Analog Loopback Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back internally from the transmitter output to the receiver input. The received data is compared to the original data. Data errors and data set condition are indicated by the data set status lamps. The DL switch can be used to force a loss of synchronization to verify that the data set will recognize a data set failure condition.

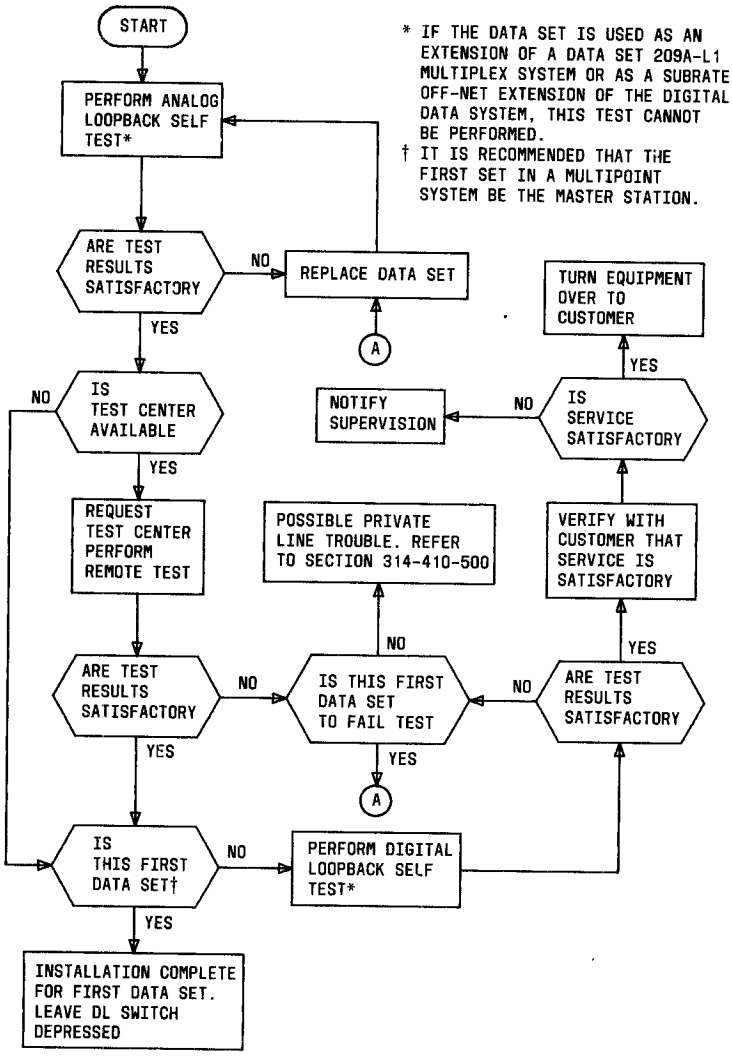


Fig. 3—Installation Test Sequence (4-Wire Private Line)

4.03 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and ST switches on data set.

(3) Observe data set status lamps for at least 30 seconds.

Requirement: MC lamp is off continuously. All other lamps are lighted.

(4) Depress RO switch on data set.

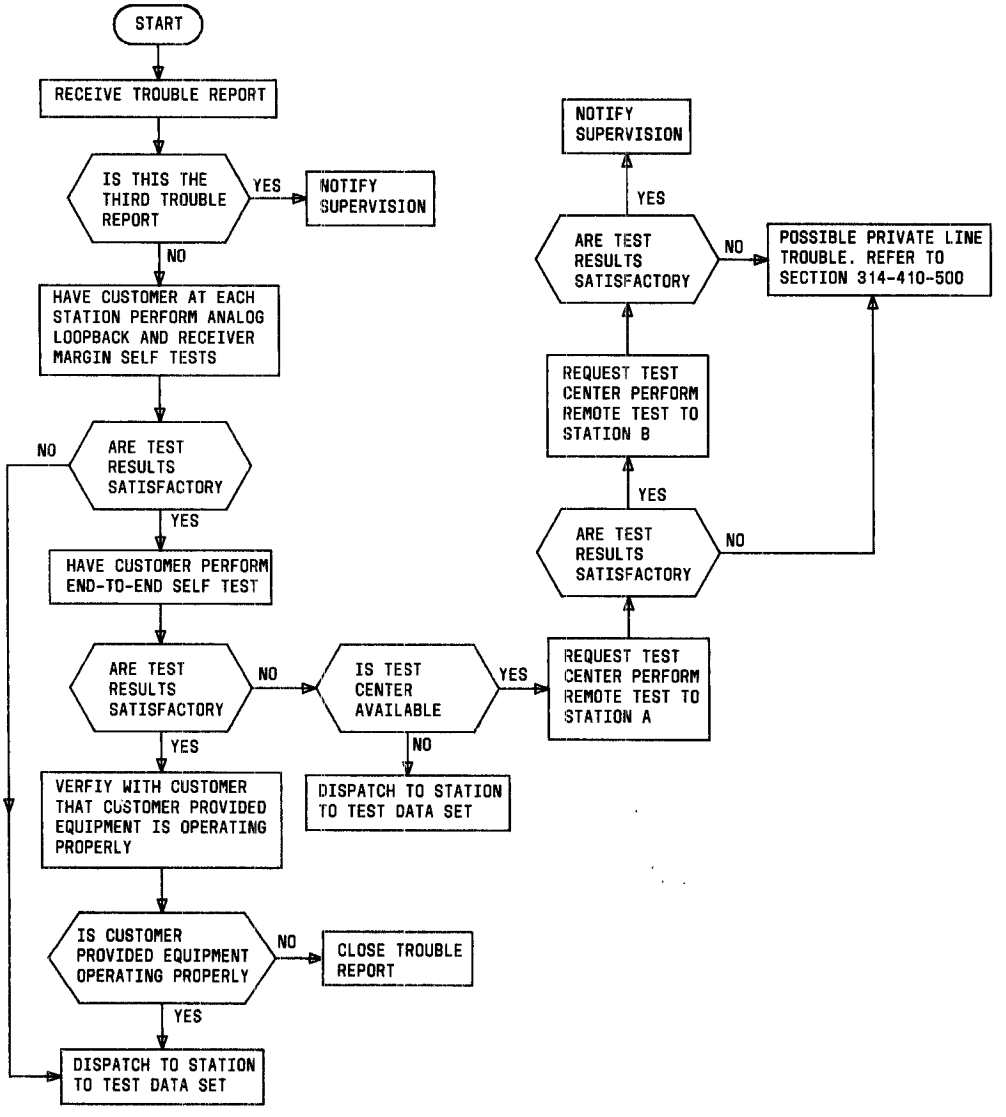


Fig. 4—Clearing Trouble Report (2-Wire Private Line)

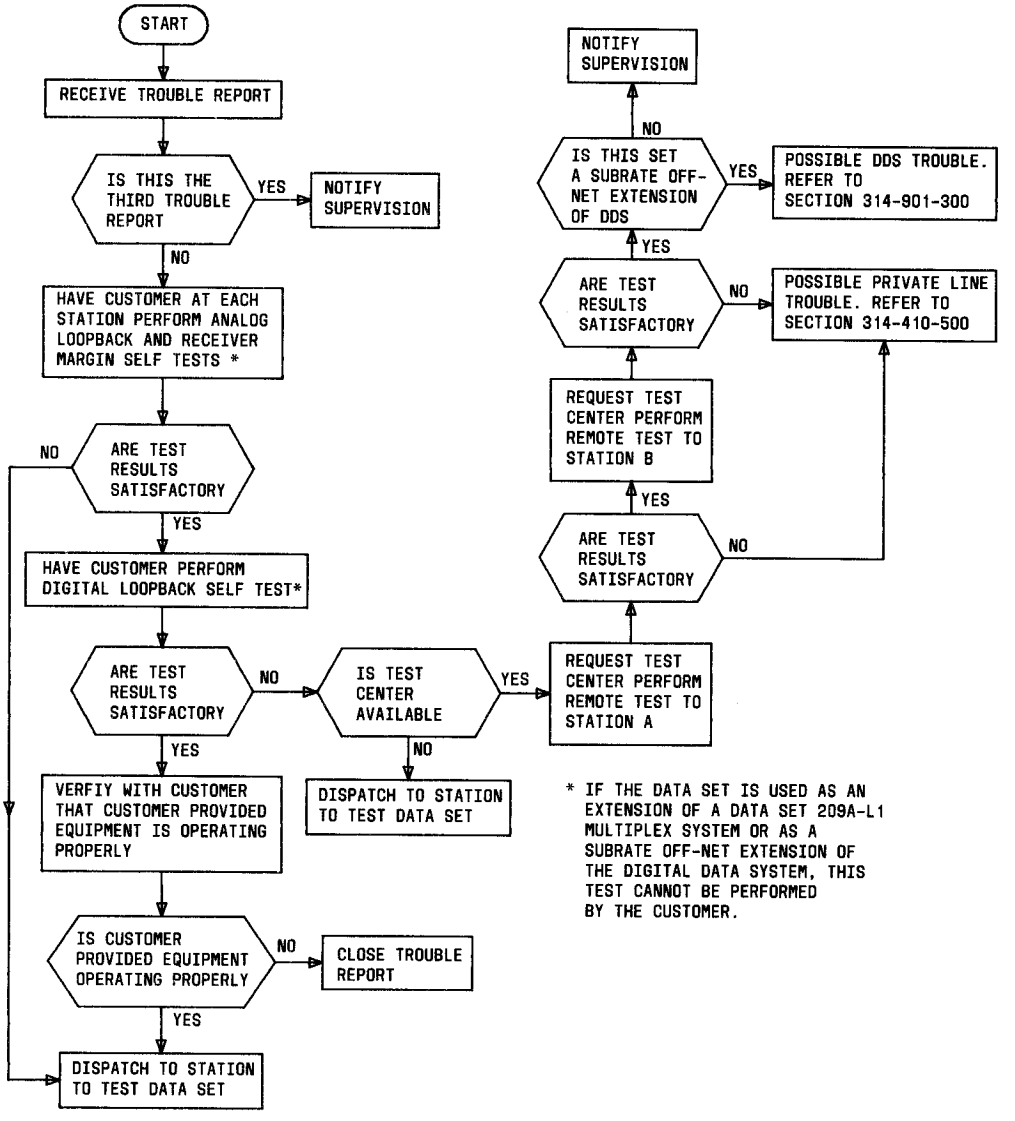


Fig. 5—Clearing Trouble Report (4-Wire Private Line)

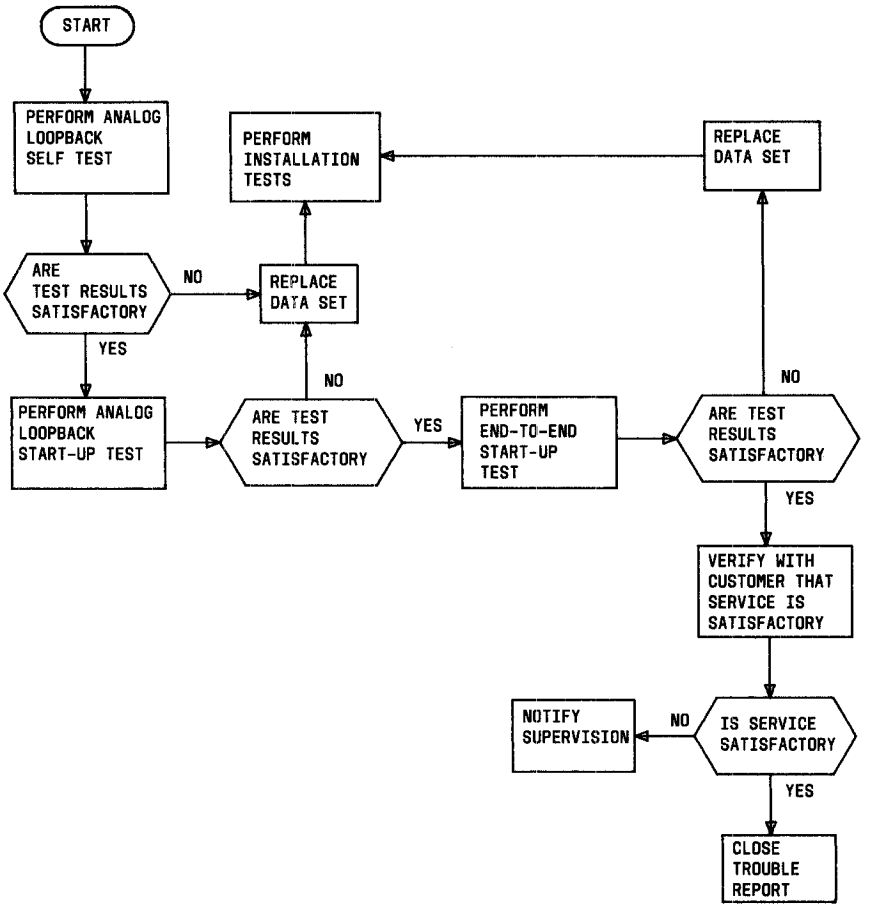


Fig. 6—Maintenance Test Sequence (2-Wire Private Line)

Requirement: RS and CS lamps go off. MC lamp lights. If data set is optioned for switched carrier (option XA or XE), CO lamp goes off. If data set is optioned for continuous carrier (option XB or XC), CO lamp remains lighted.

(5) Release RO switch.

Requirement: All lamps are lighted except MC.

(6) Depress DL switch on data set.

Requirement: MC lamp blinks. All other lamps are lighted.

(7) Release DL, AL, and ST switches.

Requirement: ON, MC, and MR lamps are lighted. All other lamps are off.

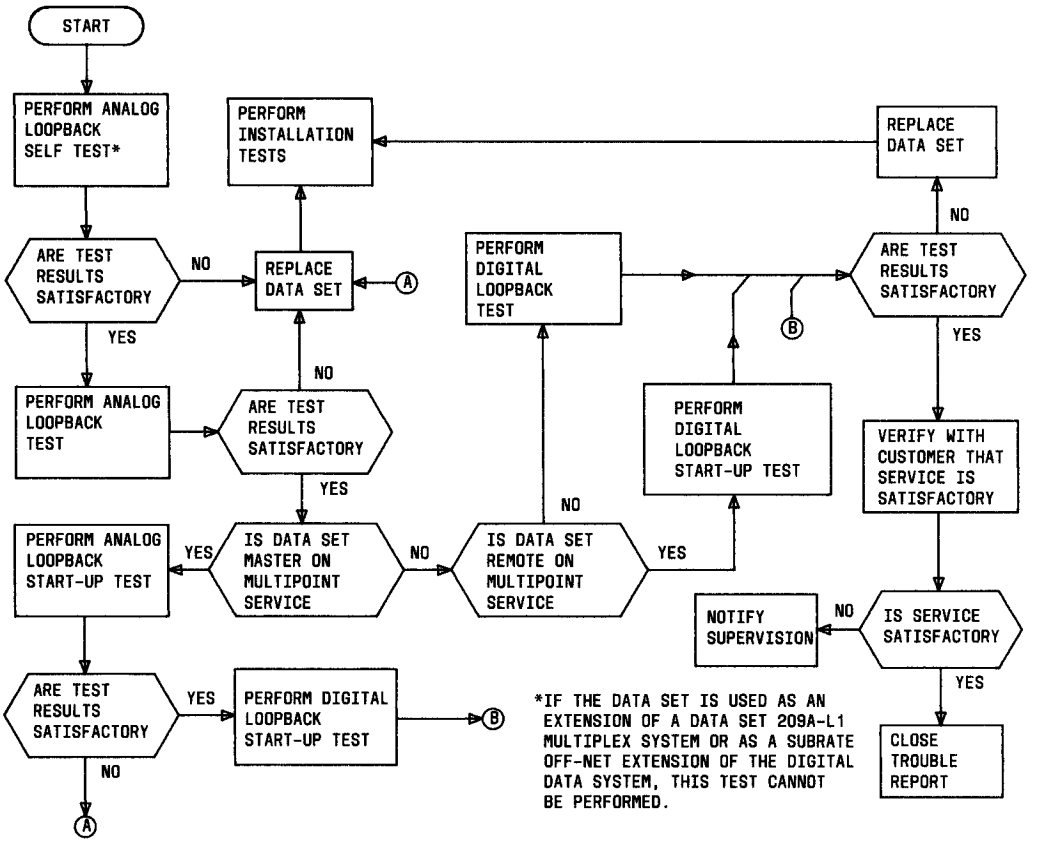


Fig. 7—Maintenance Test Sequence (4-Wire Private Line)

B. Digital Loopback Self Test (4-Wire Private Line)

4.04 This test checks the transmitter and receiver of a local and a distant data set and the facilities connecting the data sets. The customer interfaces are not checked. Test data generated and transmitted by the local data set is looped back internally from the receiver output to the transmitter input of the distant data set and retransmitted. This data is received by the local data set and compared to the original data. Data errors and data set condition are indicated by the status lamps on the local data set. The distant data set may be a 201C-L1D or a 201C-L1.

4.05 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) On local data set, depress ST switch.

Requirement: TM lamp lights.

(3) Contact distant data station and have DL switch on data set depressed. Verify that TM lamp is lighted.

Requirement: On local data set, all lamps are lighted except MC.

(4) On local data set, depress DL switch.

Requirement: MC lamp blinks. All other lamps are lighted.

(5) Observe MC lamp for ten 1-minute periods.

Requirement: MC lamp does not blink more than an average of two blinks per 1-minute period.

(6) Contact distant data station and have DL switch on data set released. Verify that TM lamp is off.

(7) On local data set, release DL and ST switches.

Requirement: TM lamp goes off.

C. End-to-End Self Test

4.06 This test checks the transmitter and receiver of a local and a distant data set and the facilities connecting the data sets. The customer interfaces are not checked. Identical test data is generated by both data sets, transmitted by one of the data sets, and compared to the data generated by the receiving data set. Data errors and data set condition are indicated by the status lamps on the data sets. The distant data set may be a 201C-L1D or a 201C-L1.

2-Wire Private Line

4.07 Perform the test as follows:

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that neither data set is transmitting or receiving data.

(3) On transmitting data set, depress ST switch.

Requirement: All lamps are lighted except CO.

(4) On receiving data set, depress ST and RO switches.

Requirement: All lamps are lighted except RS, CS, and MC.

(5) On transmitting data set, depress DL switch.

Requirement: On receiving data set, MC lamp blinks.

Note: If transmitting data set is not a 201C-L1D, MC lamp on receiving data set will not blink.

(6) On transmitting data set, release DL switch.

(7) On receiving data set, observe MC lamp for ten 1-minute periods.

Requirement: MC lamp does not blink more than an average of two blinks per 1-minute period.

(8) Perform end-to-end self test in opposite direction by releasing RO switch on original receiving data set and depressing RO switch on original transmitting data set.

(9) Repeat (5) through (7).

(10) On both data sets, release test switches.

Requirement: On both data sets, TM lamp goes off.

4-Wire Private Line

4.08 Perform the test as follows:

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that neither data set is transmitting or receiving data.

(3) On both data sets, depress ST switch.

Requirement: On both data sets, all lamps are lighted except MC.

(4) On both data sets, depress DL switch.

Requirement: On both data sets, MC lamp blinks.

Note: If one data set is not a 201C-L1D, MC lamp on other data set will not blink.

(5) On both data sets, release DL switch.

(6) On both data sets, observe MC lamp for ten 1-minute periods.

Requirement: On both data sets, MC lamp does not blink more than an average of two blinks per 1-minute period.

(7) On both data sets, release ST switch.

Requirement: On both data sets, TM lamp goes off.

D. Receiver Margin Self Test

4.09 In this test, the data set is in the analog loopback mode, but the receiver compromise equalizer is bypassed and the distortion threshold at which the MC indicator will light is reduced. The MC indicator acts not only as an indicator of errors in the locally looped data stream, but also blinks on for 50 ms whenever the peak signal distortion measured by the demodulator exceeds the "half-way" point to the receiver decision threshold. The DL switch can be used to force an out-of-sync condition and cause the MC indicator to blink.

4.10 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and RT switches on data set.

(3) Observe data set status lamps for at least 30 seconds.

Requirement: MC and MR lamps are off. All other lamps are lighted.

(4) Depress DL switch on data set.

Requirement: MC lamp blinks.

(5) Release DL switch.

Requirement: MC lamp goes off.

(6) Release AL and RT switches.

Requirement: ON, MC, and MR lamps are lighted. All other lamps are off.

E. Remote Test

4.11 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

2-Wire Private Line

4.12 For a 2-wire private line, an end-to-end self test is performed with a test center replacing one of the data sets. Refer to paragraph 4.07 for the required test procedures.

4-Wire Private Line

4.13 For a 4-wire private line, test data is generated and transmitted by a test center. This data is looped back internally from the receiver output to the transmitter input of the data set and retransmitted. The data is received by the test center and compared to the original data. Perform the test as follows:

(1) Contact test center and request a remote test.

(2) When directed by test center, depress DL switch on data set.

Requirement: TM lamp lights.

(3) Test center performs remote test.

(4) When directed by test center, release DL switch on data set.

Requirement: TM lamp goes off.

F. Initial Test Setup for 921A DTS

4.14 Perform the initial test setup for the 921A DTS when used to test DS 201C-L1D as follows:

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and Electronic Industries Association (EIA) adapter cord provided with DTS.	

STEP	ACTION	VERIFICATION
	Note: The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	Data set ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	Enter 62 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 62
12	Press GO.	Display reads— BIT RATE:
13	Enter 24.	Display reads— BIT RATE: 24

STEP	ACTION	VERIFICATION
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

G. Analog Loopback Test

4.15 In this test, an analog loopback block error run is performed. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.16 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0300. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display.	Display reads (briefly)— 0300 SECONDS Display then reads—

STEP	ACTION	VERIFICATION
	D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.
9	On data set, release AL switch.	TM lamp goes off.

H. CA-CB (RS-CS) Interval Test

4.17 This test measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) lead turns ***on.***

4.18 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 30.	Display reads— TEST SEQ: 30
4	Press GO. ***Note 1:*** Only the option actually installed in the data set need be tested. ***Note 2:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** Option XA—7 to 11 ms Option XB—7 to 11 ms Option XC—0 to 2 ms Option XE—138 to 158 ms
5	On data set, release AL switch.	TM lamp goes off.

I. Transmitter Clock Test

4.19 This test measures the frequency of the transmitter clock signal, DB (SCT), on the transmitter signal element timing lead.

4.20 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
2	Enter 47 48 17 47.	Display reads— TEST SEQ: 47 48 17 47
3	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
4	Enter 04 03.	Display reads (briefly)— SW CONN: X=04 Y=03 Display then reads— SW CONN: X=?? Y=??
5	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads transmitter clock frequency in hertz. ***Requirement:*** 2399 to 2401 Hz.
6	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:

J. Transmitter Output Test

4.21 This test uses the 9 to measure the output level of the ted signal with the DTS providing the pr termination.

4.22 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
2	Connect data set to DTS using telephone interface cable and adapter cord provided with DTS. ***Note:*** The telephone interface cable is equipped with two 9-pin connectors. The 6-inch adapter cord is equipped with a 9-pin connector and a double-faced, 25-pin connector. Connect interface cable from 9-pin telephone connector on left side of DTS to 9-pin connector on adapter cord. Insert double-faced, 25-pin connector on adapter cord between telephone line connector on data set and telephone line cord.	
3	On front of DTS: (a) Connect meter leads from LINE—TRMT terminals T and R to INPUTS—METER jacks + and -. (b) Set TALK/DATA switch to DATA. (c) Set SPKR JACKS/RCV LINE switch to RCV LINE.	
4	Enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
5	Enter 1.	Display reads— TEST SEQ: 36 RS=1 (0 OR 1)
6	Enter 11.	Display reads— :11 R=? 1=135 6=600 9=900 0=N
7	Enter 6.	Display reads (briefly)— :11 R=6 1=135 6=600 9=900 0=N Display then reads— :
8	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads transmitter output level in mV ac and dBm. ***Requirement:*** -2.0 to +2.0 dBm
9	Disconnect meter leads, telephone interface cable, and adapter cord.	

K. Digital Loopback Test (4-Wire Private Line)

4.23 This test checks the transmitter and receiver of a local and a distant data set and the facilities connecting the data sets. The customer interface at the distant data set is not checked. Test data is generated by the 921A DTS and transmitted by the local data set. This data is looped back internally from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.24 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
2	Contact distant data station and have DL switch on data set depressed.	TM lamp lights on distant data set.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0900. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A.

STEP	ACTION	VERIFICATION
		At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 2%.
9	Contact distant data station and have DL switch on data set released.	TM lamp goes off on distant data set.

L. End-to-End Block Error Test

4.25 This test checks the transmitter and receiver of a local and a distant data set and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

2-Wire Private Line

4.26 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads— 511 PAT ERROR TEST

STEP	ACTION	VERIFICATION
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— 511 BIT ERROR TEST
At receiving station, perform Steps 7 through 15.		
7	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
8	Enter 54.	Display reads— TEST SEQ: 54
9	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
10	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
11	Enter 2.	Display reads— ????? BITS IN A BLOCK
12	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
14	Enter 0900. ***Note:*** To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error.

STEP	ACTION	VERIFICATION
		If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 23.
15	Perform the end-to-end block error test in the opposite direction. The receiving station now becomes the transmitting station.	

4-Wire Private Line

4.27 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations.	
At both stations, perform Steps 2 through 8.		
2	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
3	Enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK

STEP	ACTION	VERIFICATION
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0900. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 23.

M. Start-Up Tests

4.28 The start-up tests check the ability of the data set to begin error-free transmission. In these tests, the 921A DTS (1) starts transmitting a 128-bit word, (2) stops transmitting the word, and (3) checks the word for errors. This sequence of operations is automatically repeated for the duration of the tests.

4.29 Three types of start-up tests can be performed.

- ***Analog Loopback:*** The local data set is placed in the analog loopback mode. The local data set must be equipped with switched carrier.
- ***Digital Loopback:*** The local data set is placed in the data mode and the distant data set is placed in the digital loopback mode. Both local and distant data sets must be equipped with switched carrier.
- ***End-to-End:*** Both local and distant data sets are placed in the data mode. Either the local or distant data set must be equipped with switched carrier.

Analog Loopback Start-Up Test

4.30 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	If continuous carrier (option XB or XC) is installed in data set, temporarily install switched carrier (option XA).	

STEP	ACTION	VERIFICATION
2	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
3	On data set, depress AL switch.	TM lamp lights.
4	On DTS, enter 67.	Display reads— TEST SEQ: 67
5	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
6	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
7	Enter 2.	Display reads— PRESS A TO START
8	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
9	At end of about 1 minute, press D.	***Requirement:*** Zero count on ERR and * displays.
10	On data set, release AL switch. ***Note:*** If switched carrier (option XA) was temporarily installed in data set in Step 1, leave this option installed until all remaining tests are completed.	TM lamp goes off.

Digital Loopback Start-Up Test (4-Wire Private Line)

4.31 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	If continuous carrier (option XB or XC) is installed in local or distant data set, temporarily install switched carrier (option XA).	
2	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
3	Contact distant data station and have DL switch on data set depressed.	TM lamp lights on distant data set.
4	On DTS, enter 70.	Display reads— TEST SEQ: 70
5	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
6	Enter 2.	Display reads (briefly)— ENTER HEX CHARS Display then fills with 32 "?"s.
7	Enter FF FF FF 16 16 01 31 32 33 02 53 54 41 52 54 03. ***Note:*** To delete last character entered, press back arrow (←).	Display reads (briefly)— FFFFFF1616013132330253544152540 3 Display then reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
8	Enter 2.	Display reads— PRESS A TO START
9	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.

STEP	ACTION	VERIFICATION
10	At end of about 1 minute, press D.	***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
11	Contact distant data station and have DL switch on data set released. ***Note:*** If switched carrier (option XA) was temporarily installed in local or distant data set in Step 1, leave this option installed until all remaining tests are completed.	TM lamp goes off on distant data set.

End-to-End Start-Up Test

4.32 In this test, one end is arbitrarily selected as the controlling station. This station has operating control of the test. Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-up test. ***Note 1:*** For 4-wire service, if continuous carrier (option XB or XC) is installed in data set at controlled station, temporarily install switched carrier (option XA). ***Note 2:*** Procedure at controlled station must be performed first.	
At controlled station, perform Steps 2 through 7.		
2	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
3	Enter 68.	Display reads— TEST SEQ: 68
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	For 2-wire service, enter 2. For 4-wire service with switched carrier (option XA) at controlling station, enter 2. For 4-wire service with continuous carrier (option XB or XC) at controlling station, enter 3.	Display reads— PRESS A TO START
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***)

STEP	ACTION	VERIFICATION
		Display continues to read— PRESS A TO START
7	Press A. ***Note:*** When A is pressed in Step 14, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 After A is pressed at controlling station, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block. All displays stop counting when D is pressed at controlling station. ***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
At controlling station, perform Steps 8 through 15.		
8	Ensure that initial test setup described in paragraph 4.14 has been performed.	Display reads— TEST SEQ:
9	Enter 67.	Display reads— TEST SEQ: 67
10	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
11	For 2-wire service, enter 2. For 4-wire service with switched carrier (option XA) at controlling station, enter 2. For 4-wire service with continuous carrier (option XB or XC) at controlling station, enter 3.	Display reads— TMRT: 1=MAN 2=TIMED 3=SW CARR
12	Enter 2.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key.	

STEP	ACTION	VERIFICATION
	KEY FUNCTION	
	A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
15	At end of about 1 minute, press D. ***Note:*** If switched carrier (option XA) was temporarily installed in data set at controlled station, leave this option installed until all remaining tests are completed.	***Requirements:*** Count of less than 2 on ERR display and zero count on * display.

5. REFERENCES

5.01 Additional information concerning the testing of DS 201C-L1D is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
314-901-300	Digital Data System—Serving Test Center—Two-Point Private Line Circuit—Maintenance Procedures
314-919-300	Digital Data System— Subrate Off-Net Extension Arrangements—Maintenance
592-029-120	Data Set 201C-L1D—Transmitter-Receiver— Description and Operation
592-029-220	Data Set 201C-L1D—Transmitter-Receiver— Installation and Connections
592-029-520	Data Set 201C-L1D—Transmitter-Receiver—Test Procedures Using 914-Type Data Test Set
592-032-300	Data Set 209A-L1—Transmitter-Receiver—Maintenance
666-511-501	Test of Data Services Provided by Data Set 201C From a Private Line Testroom
666-511-504	Test of Data Services Provided by Data Set 209A-L1 From a Private Line Testroom

5.02 Detailed information concerning DS 201C-L1D is contained in CD- and SD-1D290-01.

DATA SET 202S
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the physical and functional characteristics of data set (DS) 202S (Fig. 1). The key telephone set shown is required if manual calling and/or answer is needed. General operating information is also included.

1.02 This section is reissued to show DS 202S-L1, -L1/2, -L1/3, -L1/2/3, -L1A, -L1A/2, -L1A/3A, and -L1A/2/3A rated manufacture discontinued (MD). The replacing data sets are DS 202S-L1C, -L1C/2, -L1C/2/3B, and -L1C/3B. Circuit pack (CP) JY2 (reverse channel) is also rated MD, and is replaced by CP JY3. CP JY3 meets requirements for registration. The replacing data sets provide the following new options and features not provided on earlier DS 202S-type:

- Echo suppressor enable installer option—This option eliminates echo problems that may be encountered during startup over satellite transmission circuits. ***This option cannot be used with reverse channel installed.***
- Carrier controlled turnaround installer option—This option delays turnon of the clear-to-send circuit until the remote data set has entered the receive mode.
- Early data set ready indication installer option—With this option installed, the data-set-ready circuit turns on at the beginning of the answer tone sequence in the called data set.
- An adjustable output level of -4 to -12 dBm is provided. This can be adjusted to a fixed output level of -4 dBm whenever FCC registration requires this value to be met.
- A filter is provided to prevent "glitches" from causing a call disconnect during talk to data transfer.

Fig. 1—Data Set 202S With 2565HK Telephone Set

- A filter is provided on the request-to-send circuit to eliminate contact bounce problems sometimes encountered when using the 914-type data test set.
- The transmit shaping filter is modified to improve performance when used with DS 202C-type.
- The filter on the D1 lead of the telephone interface is improved to prevent noise from causing the data set to enter the data mode.

Since this reissue constitutes a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 DS 202S is intended for use on 2-wire switched network circuits at speeds up to 1200 bps. An optional reverse channel allows the set to signal at up to 5 bps in the opposite direction to the signal on the primary channel.

1.04 The following is a specification summary for DS 202S.

Operation: Nonsynchronous, binary, serial.

Modulation: Frequency shift keying.

Rate: Up to 1200 bps on 2-wire switched network.

Interface Voltages: Electronic Industries Association (EIA) Standard RS-232-C.

Mode: Simplex (1-way) or half-duplex (2-way nonsimultaneous).

Customer Interface Connection: Customer-provided equipment must connect via a 25-pin Cinch or Cannon DB-19604-432 (male) connector plug with Cinch DB-51226-1 hood (or equivalents). Interface cable must not exceed 50 feet in length per EIA Standard RS-232-C.

Power: 105 to 129 Vac at 57 to 63 Hz; 7 watts maximum per data set.

Environment: Ambient temperature = 4 to 49° Celsius (40 to 120°F), relative humidity = 20 to 95 percent.

Note: These environmental conditions are valid only under the condition that no condensation occurs.

Dimensions: Height 5.6 cm, width 14.7 cm, depth 27.4 cm (2.2 in. by 5.8 in. by 10.8 in.).

Weight: 2 kg (4.3 lbs) 2.4 kg (5.2 lbs) with reverse channel and KS-21239 transformer.

Compatibility: Line signal compatible with all DS 202-type on switched network. Call setup sequence difference between 202C and 202S-L1 (MD) may require modification of latter or replacement with 202S-L1A (MD) or 202S-L1C.

Installation Configuration: Single set or multiple, automatic calling and/or answer.

Testing: Two local modes are local self test and analog loopback; also, a remote test capability is provided.

1.05 A DS 202S multiple installation may be configured in one of two ways.

- Up to five stand-alone (individually housed) sets may be connected to a key telephone set (565HK or 2565HK). A KS-21253-L3 adapter is used to interconnect each of the sets to one of the line keys on the telephone set.

- A maximum of 24 data sets may be installed in a single cabinet in installations using three 40A1 (MD), 40A2 (MD), or 40A3 (or combinations of the three) data mountings. Each 40A-type data mounting can house up to eight sets, and a maximum of three mountings may be installed in one of the available cabinets. Smaller cabinets are available for stations using less than three data mountings. The data mounting provides power, access to the service line for testing, and the necessary hardware to rack-mount the data set.

2. DESCRIPTION

2.01 This description contains information applicable to the following data set list codes.

MD sets: 202S-L1, -L1/2, -L1/3, -L1/2/3, -L1/3A, -L1/2/3A, 202S-L1A, -L1A/2, -L1A/3A, -L1A/2/3A

Orderable codes: 202S-L1C, -L1C/2, -L1C/2/3B, -L1C/3B

PHYSICAL DESCRIPTION

2.02 A description of the DS 202S list codes follows:

- The basic data set (Fig. 2) is a circuit pack with a faceplate coded -L1C.

- The housing, power transformer (with cord) and interface assembly (coded 47A-type data mounting) are specified by adding /2 to the basic data set code, eg, 202S-L1C/2.

- The reverse channel circuit pack (coded JY3) is ordered by adding /3B to the data set code, eg, 202S-L1C/2/3B. For existing service, JY2 (specified by /3A) can be used on 202S-L1 and shall be used on DS 202S-L1A. The MD reverse channel circuit pack specified with /3 (coded JY1) cannot be used on DS 202S-L1A or C, but may be used on DS 202S-L1.

A. Data Sets 202S-L1 (MD), -L1A (MD), and -L1C

2.03 These list codes specify the basic data set, which is a printed wiring board measuring 3.8 cm high, 14.2 cm wide, and 26.4 cm long (1.5 in. by 5.6 in. by 10.4 in.). The data set weighs 0.7 kg (1.5 lb). A faceplate is provided which contains the status indicators described in Table A and the three test switches covered in Part 3. All interconnections to the circuit pack are made via a connector at the rear of the board. The additional circuitry of the -L1C is accommodated on a mother-daughter board arrangement, as opposed to the single-board arrangement of earlier models. Data mounting arrangements have not been changed.

2.04 The miniature rocker switch assemblies (Fig. 2 and 3) S2, S3 and S4 allow the telephone company (telco) employee to select options

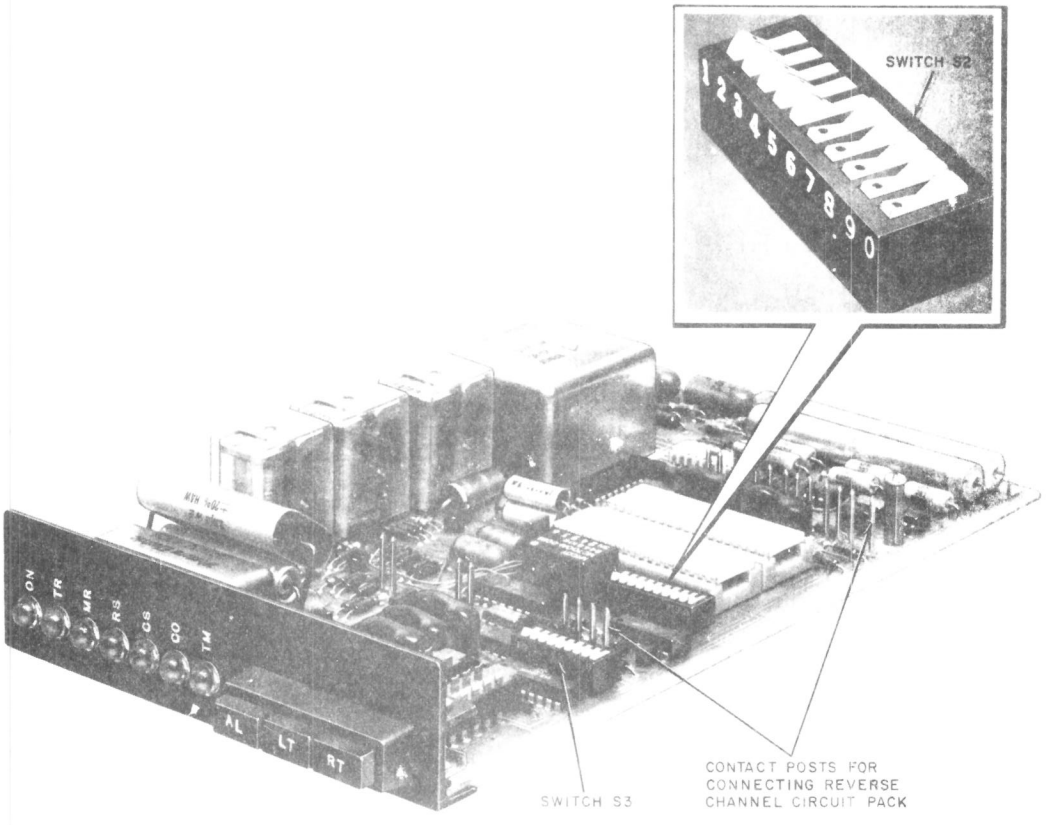


Fig. 2—Data Set 202S-L1 (-L1A Is Similar)

and set transmit signal levels. Switch S3 is closest to the faceplate on DS 202S-L1 and -L1A and is used to set the transmit signal level and the reverse channel option. For DS 202S-L1A, S3 also provides the transmit-only option. S4, not used on DS 202S-L1 or -L1A, is used to set the transmit signal level on DS 202S-L1C, while S3 provides the reverse channel and transmit-only options along with the three new options: echo suppressor enable, carrier controlled turnaround, early CC (DSR) indication. All options are listed in Table B.

B. Data Sets 202S-L1/2 (MD), -L1A/2 (MD), and -L1C/2

2.05 These list codes specify the basic "stand alone" configuration. They consist of the basic data set previously described, enclosed in a housing.

2.06 The housing is an extruded aluminum shell measuring 5.6 cm high, 14.7 cm wide, and 27.4 cm deep (2.2 in. by 5.8 in. by 10.8 in). The set weighs 1 kg (2.3 lb) [1.5 kg (3.2 lb) with KS-21239 transformer] (Fig. 4). The front cover is molded black plastic with seven translucent designations and a cutout for the test switches. The rear cover is also molded black plastic with a cutout for the two interface connectors and the power cord.

2.07 A KS-21239-L1 (MD), -L4 (MD), or -L5 transformer, M13F (1-foot long) telephone set cord, and a line cord are included with the

TABLE A

STATUS INDICATORS

INDICATOR	DESCRIPTION
ON	Lighted when power is applied to data set.
TR (Terminal Ready)	Lighted when data-terminal-ready lead is *on*.
MR (Modem Ready)	Lighted when data-set-ready lead is *on*.
RS (Request-to-Send)	Lighted when request-to-send lead is *on*.
CS (Clear-to-Send)	Lighted when clear-to-send lead is *on*.
CO (Carrier On)	Lighted when received line signal detector lead is *on*.
TM (Test Mode)	Lighted when any of the three test switches are depressed. It extinguishes if an error is detected in the local self test mode.

Note: All indicators are lighted when the RT or LT key is depressed.

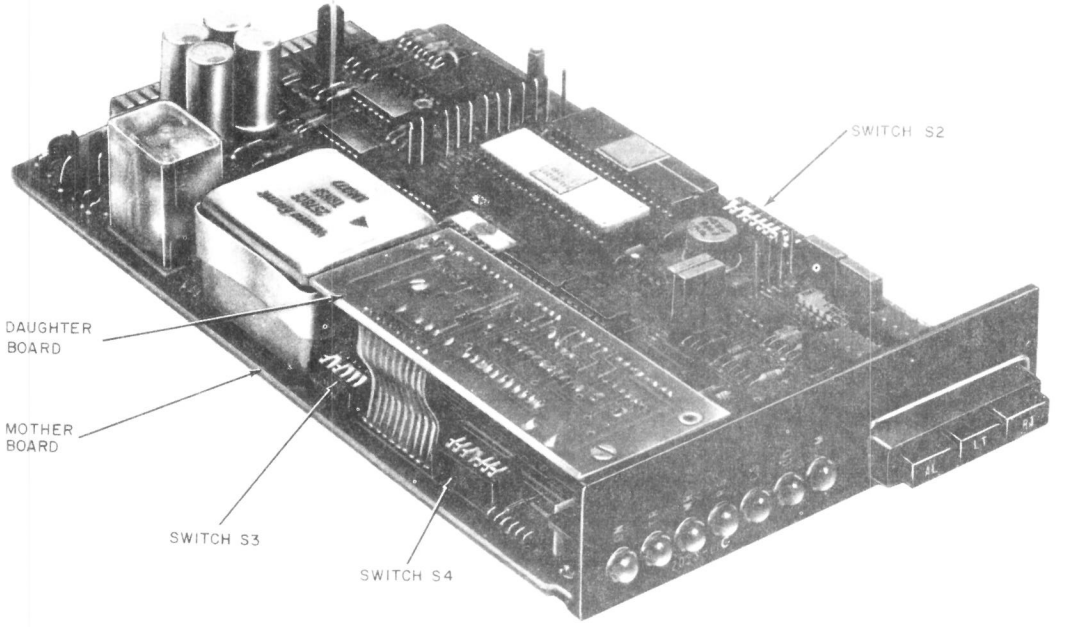


Fig. 3—Data Set 202S-L1C

TABLE B

OPTIONS

FEATURE	DESIGNATION	DESCRIPTION		PROVIDE
Transmit Line Signal Level		Without Reverse Channel[1]	With Reverse Channel	One Per Set
	ZK[2]	0	−1	
	ZL[2]	−1	−2	
	ZM[2]	−2	−3	
	ZN[2]	−3	−4	
	ZO	−4	−5	
	ZP	−5	−6	
	ZQ	−6	−7	
	ZR	−7	−8	
	ZS	−8	−9	
	ZT[3]	−9	−10	
	ZU	−10	−11	
	ZV	−11	−12	
	ZW	−12	−13	
Reverse Channel[4]	ZC[5]	In		One Per Set
	ZD[3]	Out (Remove CP)		
Soft Turnoff and Squelch Intervals		Soft Turnoff	Squelch	One Per Set
	Z	0	0	
	Y	8 ms	0	
	X	24 ms	0	
	W	0	9 ms	
	V	0	156 ms	
	T	8 ms	9 ms	
	S	8 ms	156 ms	
	R[3]	24 ms	156 ms	

TABLE B (Contd)

OPTIONS

FEATURE	DESIGNATION	DESCRIPTION	PROVIDE
Fast Carrier Detection[6]	Q	In (7 ms)	One Per Set
	N[3]	Out (23 ms)	
Clear-to-Send Interval	M	8 ms	One Per Set
	K	30 ms	
	J	60 ms	
	G[3]	180 ms	
Automatic Answer	B[3]	In	One Per Set
	A	Out	
Local Copy on Primary Channel	ZA	In	One Per Set
	ZB[3]	Out	
Clamp (202S-L1 Only)	F[3]	In	Must Be Provided
Condition of CC (DSR) During Analog Loop-back (202S-L1A Only)	Y1	On	One Per Set
	YJ[3]	Off	
Local Copy on Reverse Channel	ZE	In	One Per JY1, JY2, or JY3 Circuit Pack
	ZF[3]	Out	
Grounding Option	ZG[3]	Signal Ground Connected to Frame Ground	One Per 47A-Type Data Mounting
	ZH	Signal Ground Not Connected to Frame Ground	
Transmit Only	YG YH[3]	In Out	One Per Set
Echo Suppressor Enable	YQ YR[3]	In Out	One Per Set
Carrier Controlled Turnaround	YS[3] YT	In Out	One Per Set
Early CC (DSR) Indication	YU YV[3]	In Out	One Per Set

Note 1: This column (-4 through -12) applies for DS 202S-L1C both with and without reverse channel.

Note 2: Does not apply to DS 202S-L1C.

Note 3: Factory furnished.

Note 4: DS 202S-L1A operates with JY2 only. DS 202S-L1C operates with JY3 only.

Note 5: Factory furnished instead of option ZD when reverse channel is installed.

Note 6: Same as carrier acquisition timing in earlier model DS 202-types.

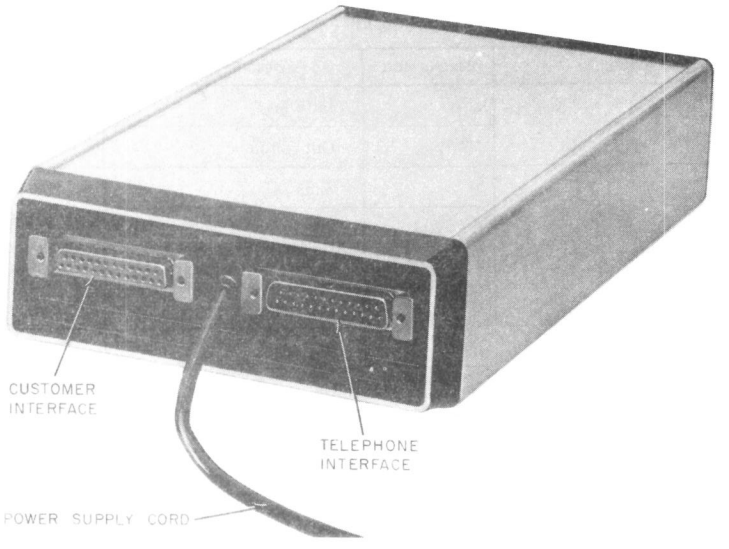


Fig. 4—Data Set 202S Rear View

housing. The transformer plugs into a standard nonswitched, 3-wire 117-volt 60-Hz outlet. It is equipped with a tab which should be secured to the outlet (where allowed by local electrical codes) to prevent inadvertent removal of power from the data set.

C. Data Sets 202S-L1/3 (MD), -L1A/3A (MD), -L1/3A (MD), and -L1C/3B

2.08 These list codes specify the basic data set with the reverse-channel circuit pack installed (Fig. 5 and 6). The reverse-channel circuit pack [JY1 (MD), JY2 (MD) or JY3] is a printed wiring board measuring 2.54 cm high by 8.6 cm wide by 19 cm long (1 in. by 3.4 in. by 7.5 in). It includes filters, switching circuits, and demodulator circuits needed to perform the reverse-channel function. Interconnection to the data set is via 20 female contact receptacles mounted on the bottom of the board which mate with the contact posts on the data set. Four retaining screws secure the circuit packs together mechanically. The screws are stored in threaded eyelets on the front edge of the circuit pack.

2.09 When installed, the reverse channel circuit pack makes option switches S2 and S3 inaccessible on DS 202S-L1 and -L1A. Therefore, it must be removed in order to set the options on these two sets.

Note: The reverse channel circuit pack must not be installed if option ZD is installed (reverse channel OUT).

D. Data Sets 202S-L1/2/3 (MD), -L1/2/3A (MD), -L1A/2/3A (MD), and -L1C/2/3B

2.10 These list codes are the basic data set equipped with reverse channel and enclosed in the housing. These are the only allowable codes.

FUNCTIONAL DESCRIPTION

2.11 DS 202S provides service in the following configurations:

- One data set enclosed in a 47A-type housing and a 565HK or 2565HK key telephone set. An 801A- or C-type automatic calling unit (ACU) may be installed as an option using

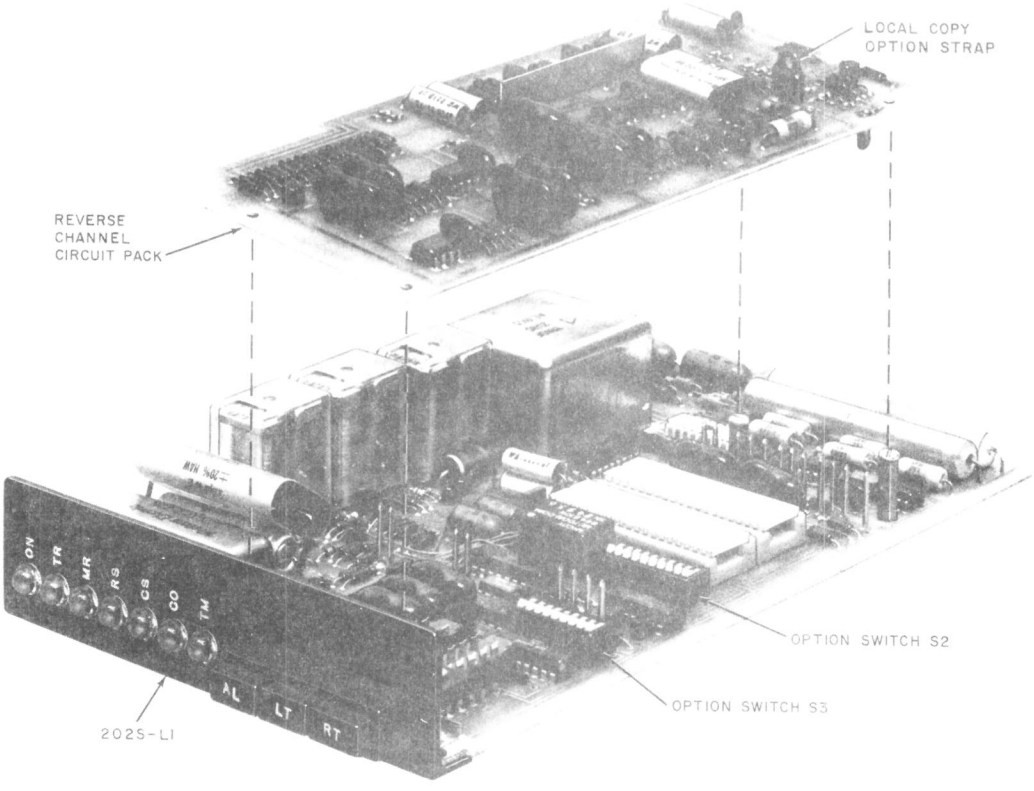


Fig. 5—Data Set 202S-L1/3 (-L1A/3A Is Similar)

a 149B adapter. The telephone set is not required when automatic calling is used or when the automatic answer option is installed and manual operation is not needed.

- A maximum of five data sets in individual housings connected to one key telephone set and a KS-21253-L3 adapter (used to interconnect the data sets to the telephone set). The 801A- or C-type ACU is optional in this configuration and does not require the 149B adapter.

- A maximum of 24 data sets mounted in three 40A-type data mountings which are housed in a KS-20018-type cabinet. A KS-20018-L12A cabinet is used to house one or two mountings while a KS-20018-L11A is needed to house three. A CALL DIRECTOR® may be used to control the data sets, although two key telephone sets may be used to control up to eight sets. As in the case for single data sets, a CALL DIRECTOR or key telephone set is not required in a multiple installation if only automatic calling and/or automatic answering is provided.

A. Customer Interface

2.12 The customer interface is accessible through the female connector at the rear of the data

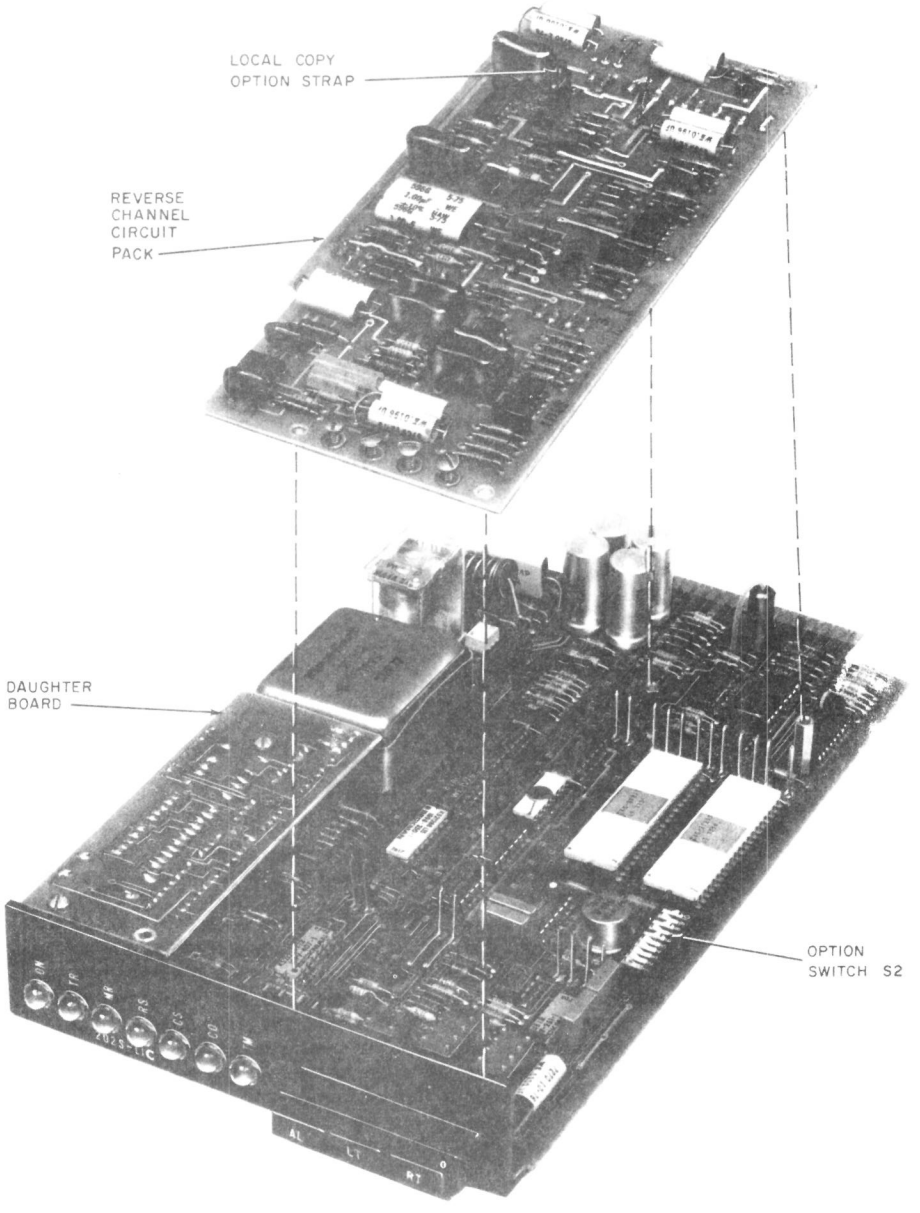


Fig. 6—Data Set 202S-L1C/3B

set. Connector pin designations and functions are itemized in Table C.

B. Telephone Interface

2.13 The telephone interface is accessible through the male connector at the rear of the data set. Connector pin designations and functions are itemized in Table D.

C. Options

2.14 Table B provides a list of available options. The installation section provides descriptive information for each. Recommended options are shown in Table E.

Note: For DS 202S-L1, clamp (option F) must be provided.

3. OPERATION

DATA MODE

3.01 ***Manual Data Call:*** When a data call is placed or answered manually, the following occurs:

(a) Attendant initiates or answers call.

(b) Data terminal ready (CD) lead must be positive.

(c) ***With DS 202S-L1*** (MD), the attendant depresses DATA (red) key which causes the

TABLE C

CUSTOMER INTERFACE

LEAD NO.	FUNCTION	EIA DESIGNATION (RS-232-C)
1	Protective Ground	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request-to-Send	CA
5	Clear-to-Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Received Line Signal Detector	CF
9	Positive 14 Volts	—
10	Negative 14 Volts	—
11 & 19	Secondary Request-to-Send	SCA
12	Secondary Received Line Signal Detector	SCF
20	Data Terminal Ready	CD
22	Ring Indicator	CE

TABLE D

TELEPHONE INTERFACE

LEAD NO.	DESIGNATION	DESCRIPTION
1	L	Telephone set line lamp control from data set
4	LG	Telephone set line lamp ground from data set
5	TD	Talk/data control from telephone set
7	T	Telephone line tip lead
8	R	Telephone line ring lead
12	RD	Common ringer control contact to ground
14	C	Data mode contact closure to ground from set to ACU
16	D1	Data mode contact closure to ground from ACU to data set
21	T1	Telephone set tip lead
22	R1	Telephone set ring lead
23	A	A lead control: Used to provide an indication to ACU or KTU when the line is in use
24	A1	
25	TDG	Talk/data control ground lead

line to transfer to the data set, and the answer sequence consisting of 1.3 seconds of quiet and 1.9 seconds of 2017-Hz answer tone to start. After completion of answer sequence, the data-set-ready indication is sent to the customer.

(d) ***With DS 202S-L1A*** (MD) and -L1C, When the data set is used to originate a call, the attendant depresses DATA (red) key which causes the line to transfer to the data set and the data-set-ready indication to be sent to the customer immediately. When answering a call, the procedure is the same as for DS 202S-L1. On DS 202S-L1C with echo suppressor option in, the length of answer tone is reduced to 1.4 seconds.

3.02 ***Auto-Answer Data Call:*** If the auto-answer option is installed in the data set and the CD lead is positive, the set automatically answers an incoming call, and 1.3 seconds after the end of the first ringing cycle, sends the answer-tone signal (2017 Hz) for 1.9 seconds (or 1.4 seconds).

3.03 ***Data Call With Automatic Calling Unit:*** When a call is placed from an installation equipped with an ACU, the following occurs:

(a) The ACU seizes the line in response to a call request from the customer equipment.

(b) The ACU places the call and detects answer tone from the called station.

(c) At the end of answer tone, the ACU transfers the line to the data set.

TABLE E

RECOMMENDED CUSTOMER OPTIONS

OPTION	202S	202C (MD), 202D* (MD), OR 202R (MD)
Squelch Interval	156 ms	In
Clear-to-Send Interval	180 ms	200 ms
Fast Carrier Detection	Out (normal)	40 ms
Soft Turnoff Interval	24 ms	In
Clamp	In	In
Reverse Channel	Optional	Optional†
Automatic Calling Unit	Optional	Optional†
Automatic Answer	Optional	Optional†
Local Copy	Optional	Always Provided

* 202D used with 804A

† Not available with DS 202R

(d) The data set enters the data mode if CD is positive.

TEST MODE

3.04 ***Local Self Test:*** When the nonlocking LT button is depressed, the data set is conditioned for self test as follows:

(a) All interface leads are made inoperative.

(b) All status indicator lamps light so that they may be checked for lamp failure.

(c) A repeating 63-bit pseudorandom word (identical to the test word in the 914 and 903 test sets) is generated at 1547 bps.

(d) The test word is processed by the transmitter and receiver circuitry and the resulting word is compared to the original.

(e) If an error is detected, the TM lamp extinguishes.

Note: This test should be made with the associated telephone set on-hook.

3.05 ***Analog Loop Test:*** The data set is tested in the analog loopback mode by applying signals to the inputs at the customer interface and monitoring the outputs at the customer interface and the status lamps. When the AL button is depressed until it locks, the data set is conditioned as follows:

(a) The data set is disconnected from the line.

(b) The feedback path from the transmitter to receiver is attenuated to decrease the signal level. This applies for DS 202S-L1 but does not apply for DSs 202S-1A and -L1C.

(c) The local copy control circuit is bypassed to provide local copy.

(d) The TM indicator lights and the auto-answer feature is disabled, if installed.

(e) The data-set-ready lead is turned OFF on DS 202S-L1 only. This is optional for DSs 202S-L1A and -L1C.

Note: The data set should be idle when the AL button is depressed.

3.06 ***Remote Test:*** When the locking RT button is depressed, the data set is conditioned as follows:

(a) All customer interface leads are made inoperative and all status indicator lamps light. The data set is conditioned for automatic answer and a call is received from the data test center.

(b) A repeating 63-bit pseudorandom word is generated at 1547 bps.

(c) The test word is processed by the transmitter and receiver circuitry and the resulting word is compared to the original. In addition, the test word is transmitted to the data test center.

(d) If an error is detected, constant spacing (2200 Hz) is transmitted to the data test center instead of the random word.

(e) If the reverse channel circuit pack is installed, the reverse channel will send an on-off signal at 4.3 bps simultaneously with the line signal of the 63-bit word. After detecting an error or spacing (2200 Hz), the reverse channel transmitter is turned off, and the reverse channel receiver is on. A 387-Hz tone from the data test center switches the data set output from constant spacing to marking (1200 Hz).

4. REFERENCES

SECTION	TITLE
592-028-180	Data Set 202S Transmitter-Receiver–Summarizing Specification
592-028-200	Data Set 202S Transmitter-Receiver—Installation and Connections
592-028-500	Data Set 202S Transmitter-Receiver—Test Procedures
999-100-141	Data Set 202S-How to Operate Manual

DATA SET 202S
TRANSMITTER-RECEIVER
INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains the information needed to install and connect data set (DS) 202S. The data set should be installed in conformance with the general instructions given in Section 590-010-200. The information in this section covers installation of single data sets and multiple installations in individual housings, ie, DS 202S-L1/2, -L1/2/3, -L1A/2, -L1A/2/3A, -L1C/2, and -L1C/2/3B. Refer to Section 590-010-201 for a description of multiple data sets in a data mounting(s) and cabinet.

1.02 This section is reissued to show DS 202S-L1/2, -L1/2/3, -L1A/2, and -L1A/2/3A rated manufacture discontinued (MD). The replacing data sets are DS 202S-L1C/2 and -L1C/2/3B. The replacing data sets provide the following new options and features not provided on earlier DS 202S-type:

- Echo suppressor enable installer option—This option eliminates echo problems that may be encountered during startup over satellite transmission circuits. ***This option cannot be used with reverse channel installed.***
- Carrier controlled turnaround installer option—This option delays turnon of the clear-to-send circuit until the remote data set has entered the receive mode.
- Early data set ready indication installer option—With this option installed, the data-set-ready circuit turns on at the beginning of the answer tone sequence in the called data set.
- An adjustable output level of -4 to -12 dBm is provided. This can be altered to a fixed output level of -4 dBm whenever FCC registration requires this value to be met.
- A filter is provided to prevent "glitches" from causing a call disconnect during talk to data transfer.
- A filter is provided on the request-to-send circuit to eliminate contact bounce problems sometimes encountered when using the 914-type data test set.
- The transmit shaping filter is modified to improve performance when used with DS 202C-type.
- The filter on the D1 lead of the telephone interface is improved to prevent noise from causing the data set to enter the data mode.

The replacement transmitter-receiver is coded DS 202S-L1C and the reverse channel circuit pack (CP) (specified by list 3B) is coded JY3. The 47A-type data mounting (single set housing) remains the same.

Since this reissue constitutes a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 DS 202S operates on a type II DATAPHONE® line described in Section 314-205-501, over an ambient temperature range of 4 to 49° Celsius (40 to 120°F) with a relative humidity range of 20 to 95 percent at 21°C (70°F) or 20 to 40 percent at 49°C (120°F).

> ***Note:*** These environmental conditions are valid only if no condensation occurs.

1.04 DS 202S should be located near the customer-provided equipment (CPE), since the customer-provided interface cord should not exceed 50 feet in length [to reduce stray capacitance and to conform to Electronic Industries Association (EIA) standards]. In order to minimize inductive interference with data signals, the telephone line should not be carried in the same cable run as cable between the data set and CPE or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone line in type-SK (shielded) station wire from the building entrance. The shield should be grounded at one end only, preferably the distribution terminal end.

1.05 Low voltage alternating current is supplied to the data set by wall transformer KS-21239-L5 (-L1 and -L4 are MD) which is shipped loose. The customer must provide a standard 3-wire, grounded 105 to 129V at 57 to 63 Hz power receptacle that is accessible to the data set. The receptacle should not be under control of a switch. The power required per set is approximately 9 watts. Approximately 1.7 watts of this is dissipated in the wall transformer.

> ***Caution: Remove and discard the protective covering from the data set housing. If not removed before operation, excessive heating of the data set will result.***

1.06 A 25-pin KS-19087-L6 connector is provided at the rear of the data set for connection to the CPE. This connector is designed to connect to a customer-provided Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood, or equivalent. The connection between DS 202S and the key telephone set is made with an M13F cord. A key telephone set is required if manual calling and/or answer is needed.

1.07 The CPs comprising the basic DS 202S and reverse channel must be removed from the housing to be accessible.

> ***Caution: Handle the CPs by the nonconductive surfaces only, otherwise certain circuit components may be damaged by static charges.***

The CPs should be removed from the housing as follows:

(1) Remove the front cover by gently squeezing it at the top, then push down and out of the housing.

(2) If provided, remove the retaining screw under the left front side of the housing. This screw has been omitted from late production of -L1 sets and all -L1A and -L1C sets.

(3) Remove the CPs from the housing by gently prying behind the faceplate with a screwdriver or similar tool. On later sets, a wire handle is provided which should be rotated outward and pulled to remove the set.

1.08 If the data set is equipped with the reverse channel CP, it must be removed to gain access to the option switches on -L1 and -L1A sets. Remove the four retaining screws and then exert steady upward pressure at the front and rear of the CP. To replace the CP, align the female connector on the bottom of the card with the contact posts on the data set, then press down on the CP until it makes good contact with the posts, and the front edge is resting on top of the faceplate. Insert and tighten the retaining screws.

1.09 To reassemble, proceed as follows:

(1) Slide the data set into the housing, ensuring that the contacts at the rear of the CP are firmly seated in the connector at the rear of the housing.

(2) If provided, align and tighten the retaining screw.

(3) Hook the tabs on the bottom of the front cover into the detents in the bottom of the housing.

(4) Gently press the top of the front cover into the housing until it snaps into place.

2. OPTIONS

2.01 ***Disassemble the data set as required to verify that the options specified on the service order are installed in the data set prior to placing the set in service.***

2.02 An option label (orderable by specifying E-6573) is shipped affixed to the bottom of the housing.

2.03 The data set output level is controlled by the switch settings on switch S3 (DS 202S-L1 and -L1A) or S4 (DS 202S-L1C) (Fig. 1 through 4). The output level (transmit line signal level) must be set so that the level of the signal reaching the central office does not exceed -12 dBm. The output level is determined by the following formula: the data set output should be equal to the sum of the desired power level at the central office (-12 dBm) and the loop loss. For example, if the loop loss is 5 dB:

Data set output = -12 dBm + 5 dB

= -7 dBm.

Therefore, contacts 2, 5, 8, and 9 on option switch S3 of the -L1 or -L1A sets or contacts 1, 2, 4, 5, and 6 on option switch S4 of the -L1C sets should be closed if the data set *is* equipped with reverse channel, S3 contacts 5, 6, 7, and 9 of the -L1 or -L1A sets or S4 contacts 3, 4, 5, and 6 of the -L1C sets should be closed if it *is not* equipped with reverse channel. (See Tables A and B.)

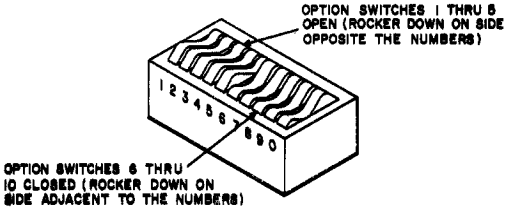


Fig. 1—Option Switch

2.04 In the event the actual loop loss is not known, it may be determined as follows:

(1) Dial the central office milliwatt supply or request the local testboard to send a 1000-Hz tone at 0 dBm on the loop.

(2) Use a transmission test set, such as the TTS-4, with a 900-ohm termination to measure the level of the incoming signal. The numerical reading is equal to the loop loss in dB (for example, -6 dBm on the meter is equal to 6 dB loop loss).

2.05 The other data set options are determined by the switch settings on S2 and S3. A description of the other options shown in Tables A and B follows. The recommended options for switched network service are given in Table C.

- ***Reverse Channel:*** This feature may be used to keep echo suppressors disabled, to provide a break feature, to provide circuit assurance, or as a feedback signal for error detection and retransmission systems. JY2 (MD) and JY3 provide this feature (specified by lists 3A and 3B, respectively), eg, DS 202S-L1C/2/3A or DS 202S-L1C/2/3B. The JY1 CP (MD) (specified by list 3) can be used in DS 202S-L1/2/3 ***only***. JY2 shall be used on DS 202S-L1A and may be used on DS 202S-L1. JY3 shall be used only on DS 202S-L1C.

Note: The reverse channel CP must not be installed if option ZD is installed (reverse channel OUT).

- ***Transmit Only*** (202S-L1A and -L1C only): This option makes it possible to operate the data set as a transmit-only set. When this option is IN, the local copy on primary channel option may be installed in the OUT position to disable the receiver. With the transmitter enabled and the receiver disabled, the data set provides the same service as DS 202E-type [except 202E1 and -E10 (MD)].

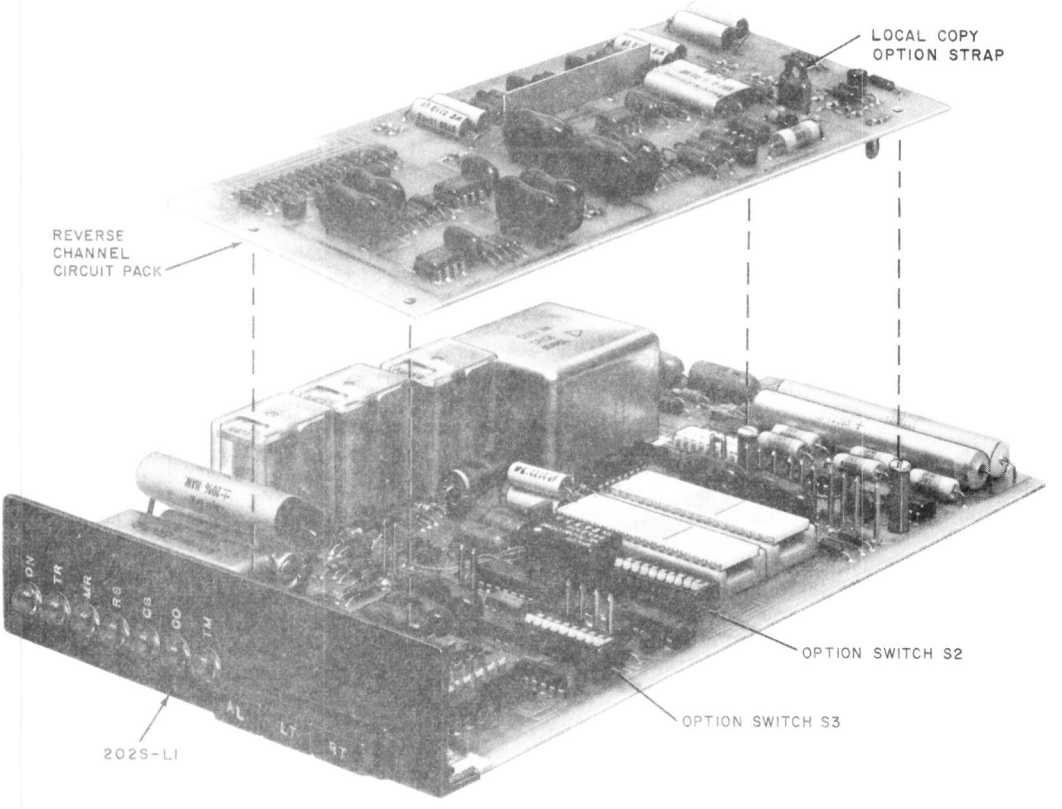


Fig. 2—Data Set 202S-L1/3 (-L1A/3A Is Similar)

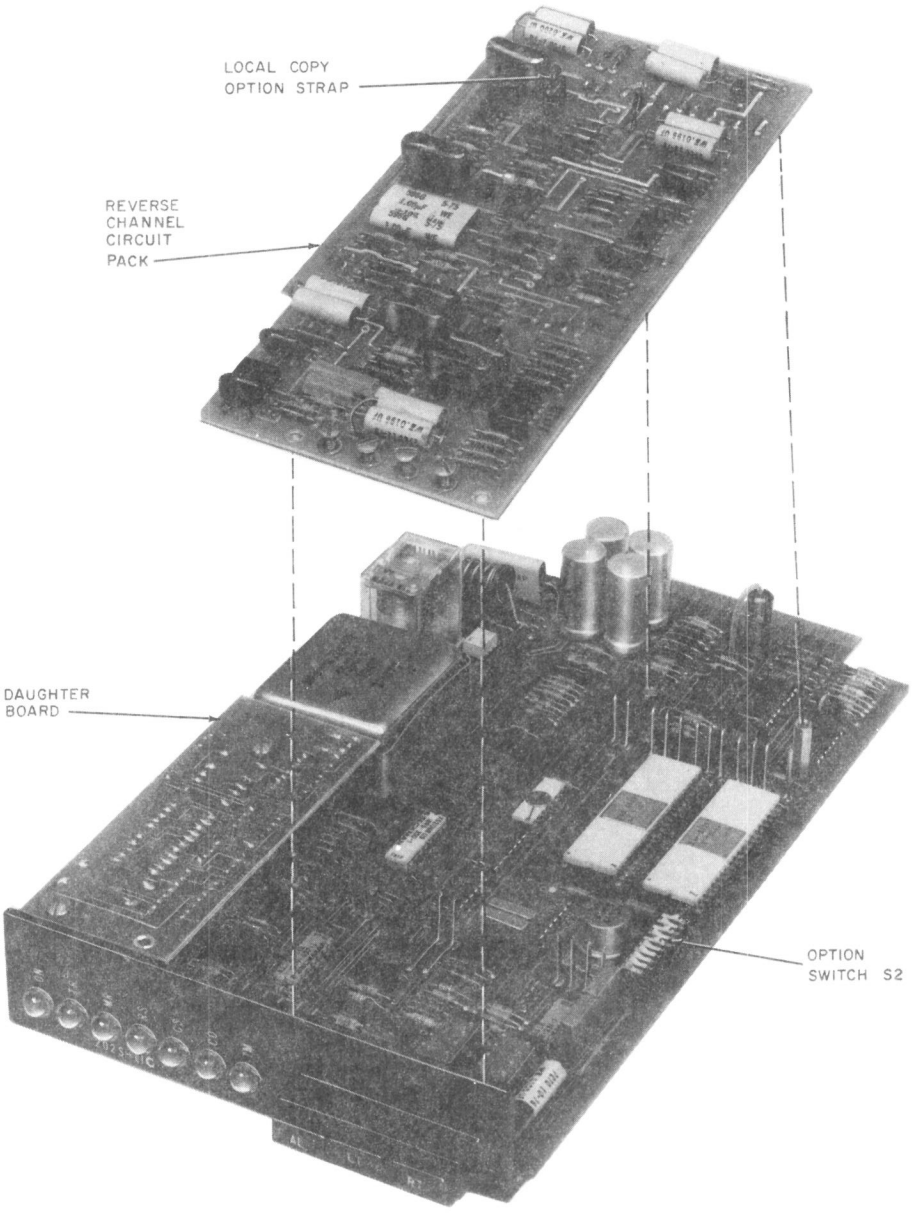


Fig. 3—Data Set 202S-L1C/3B

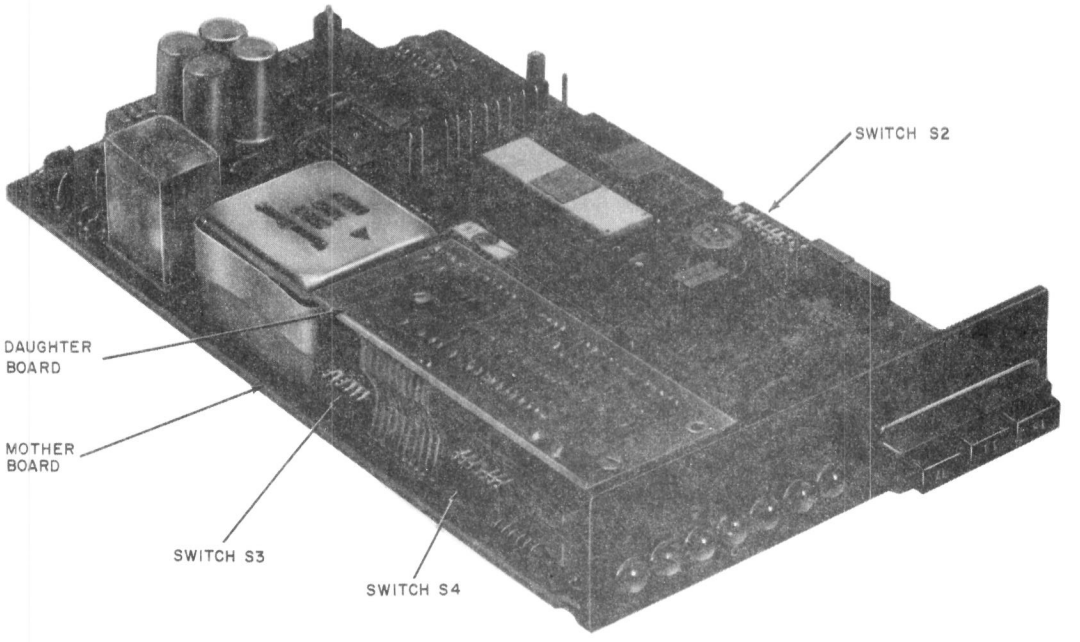


Fig. 4—Data Set 202S-L1C

TABLE A

INSTALLER OPTIONS FOR DS 202S-L1 AND -L1A

OPTION		WITHOUT REVERSE CHANNEL	WITH REVERSE CHANNEL	SWITCH SETTING										PROVIDE
				S3 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER										
DESCRIPTION	DESIG			1	2	3	4	5	6	7	8	9	0	
Transmit Line Signal Level	ZK	0	−1	—	X	—	X	X	X	X	X	X	—	One Per Set
	ZL	−1	−2	—	X	—	O	X	X	X	X	X	—	
	ZM	−2	−3	—	X	—	X	O	X	X	X	X	—	
	ZN	−3	−4	—	X	—	X	X	O	X	X	X	—	
	ZO	−4	−5	—	X	—	X	X	X	O	X	X	—	
	ZP	−5	−6	—	X	—	X	O	X	O	X	X	—	
	ZQ	−6	−7	—	X	—	O	X	O	O	X	X	—	
	ZR	−7	−8	—	O	—	O	X	X	X	O	X	—	
	ZS	−8	−9	—	O	—	O	X	O	X	O	X	—	
	ZT[1]	−9	−10	—	O	—	X	X	X	X	X	O	—	
	ZU	−10	−11	—	O	—	O	X	X	O	X	O	—	
	ZV	−11	−12	—	O	—	X	O	X	X	O	O	—	
	ZW	−12	−13	—	O	—	O	O	O	O	O	O	—	
Reverse Channel[3]	ZC[2]	In		O	—	O	—	—	—	—	—	—	—	One Per Set
	ZD[1]	Out (Remove CP)		X	—	X	—	—	—	—	—	—	—	
Transmit Only (-L1A Only)	YG	In		—	—	—	—	—	—	—	—	—	X	One Per Set[4]
	YH[1]	Out		—	—	—	—	—	—	—	—	—	O	
		SOFT TURNOFF	SQUELCH	S2 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER										
				1	2	3	4	5	6	7	8	9	0	
Soft Turnoff and Squelch Intervals	Z	0	0	—	—	O	X	—	—	—	—	O	X	One Per Set
	Y	8 ms	0	—	—	O	X	—	—	—	—	O	O	
	X	24 ms	0	—	—	O	X	—	—	—	—	X	O	
	W	0	9 ms	—	—	O	O	—	—	—	—	O	X	
	V	0	156 ms	—	—	X	O	—	—	—	—	O	X	
	T	8 ms	9 ms	—	—	O	O	—	—	—	—	O	O	
	S	8 ms	156 ms	—	—	X	O	—	—	—	—	O	O	
	R[1]	24 ms	156 ms	—	—	X	O	—	—	—	—	X	O	
Fast Carrier Detection[5]	Q	In (7 ms)		—	—	—	—	O	—	—	—	—	—	One Per Set
	N[1]	Out (23 ms)		—	—	—	—	X	—	—	—	—	—	
Clear-to-Send Interval	M	8 ms		—	—	—	—	—	O	O	—	—	—	One Per Set
	K	30 ms		—	—	—	—	—	O	X	—	—	—	
	J	60 ms		—	—	—	—	—	X	O	—	—	—	
	G[1]	180 ms		—	—	—	—	—	X	X	—	—	—	

TABLE A (Contd)

INSTALLER OPTIONS FOR DS 202S-L1 AND -L1A

OPTION				SWITCH SETTING										PROVIDE
				S2 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER										
DESCRIPTION		DESIG		1	2	3	4	5	6	7	8	9	0	
Automatic Answer		B[1]	In	—	—	—	—	—	—	—	X	—	—	One Per Set
		A	Out	—	—	—	—	—	—	—	O	—	—	
Local Copy on Primary Channel[6]	202S-L1	ZA	In	X	—	—	—	—	—	—	—	—	—	One Per Set
		ZB[1]	Out	O	—	—	—	—	—	—	—	—	—	
	202S-L1A	ZA	In	O	—	—	—	—	—	—	—	—	—	
		ZB[1]	Out	X	—	—	—	—	—	—	—	—	—	
Clamp (202S-L1 Only)		F[1]	In	—	O	—	—	—	—	—	—	—	—	Must be Provided
Condition of CC (DSR) During Analog Loopback (202S-L1A Only)		YI	On	—	X	—	—	—	—	—	—	—	—	One Per Set
		YJ[1]	Off	—	O	—	—	—	—	—	—	—	—	
Local Copy on Reverse Channel				STRAPPING ON REVERSE CHANNEL										One Per JY1 or JY3 CP[3]
		ZE	In	Install E21-E22										
		ZF[1]	Out	Install E21-E23										
Grounding Option				SCREW SWITCH SETTING ON INTERFACE CIRCUIT										One Per 47A-Type Data Mounting
		ZG[1]	Signal Ground Connected to Frame Ground	Screw Switch S1 Closed										
		ZH	Signal Ground Not Connected to Frame Ground	Screw Switch S1 Open										

X Contact closed

— Contact not applicable

O Contact open

Note 1: Factory furnished.

Note 2: Factory furnished instead of option ZD when reverse channel board is installed.

Note 3: DS 202S-L1A operates with JY3 only.

Note 4: The transmit-only out option (YH) must be selected.

Note 5: Same as carrier acquisition timing in earlier model DS 202-type.

Note 6: Note that IN or OUT status of option requires the opposite position for contact 1 of switch S2 between models L1 and L1A.

TABLE B

INSTALLER OPTIONS FOR DS 202S-L1C

OPTION		OUTPUT LEVEL	SWITCH SETTING														PROVIDE
			S4 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER														
			WITHOUT REVERSE CHANNEL							WITH REVERSE CHANNEL							
DESCRIPTION	DESIG		1	2	3	4	5	6	7	1	2	3	4	5	6	7	
Transmit Line Signal Level	ZO	−4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	One Per Set
	ZP	−5	O	X	X	X	X	X	X	O	X	X	X	X	X	X	
	ZQ	−6	X	O	X	X	X	X	X	O	O	X	X	X	X	X	
	ZR	−7	O	O	X	X	X	X	O	X	X	O	X	X	X	O	
	ZS	−8	X	X	O	X	X	X	O	X	O	O	X	X	X	O	
	ZT[1]	−9	X	O	O	X	X	X	O	X	O	X	O	X	X	O	
	ZU	−10	X	X	X	O	X	X	O	O	O	O	O	X	X	O	
	ZV	−11	O	O	X	O	X	X	O	O	O	O	O	O	X	O	
	ZW	−12	O	O	O	O	X	X	O	O	O	O	O	O	O	O	

		SOFT TURNOFF	SQUELCH	S2 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER										
				1	2	3	4	5	6	7	8	9	0	
Soft Turnoff and Squelch Intervals	Z	0	0	—	O	O	—	—	—	—	X	—	X	One Per Set
	Y	8 ms	0	—	O	O	—	—	—	—	O	—	X	
	X	24 ms	0	—	X	O	—	—	—	—	O	—	X	
	W	0	9 ms	—	O	O	—	—	—	—	X	—	O	
	V	0	156 ms	—	O	X	—	—	—	—	X	—	O	
	T	8 ms	9 ms	—	O	O	—	—	—	—	O	—	O	
	S	8 ms	156 ms	—	O	X	—	—	—	—	O	—	O	
	R[1]	24 ms	156 ms	—	X	X	—	—	—	—	O	—	O	

Fast Carrier Detection	Q	In (7 ms)	—	—	—	—	—	—	O	—	—	—	One Per Set
	N[1]	Out (23 ms)	—	—	—	—	—	—	X	—	—	—	
Clear to Send Interval	M	8 ms	—	—	—	O	O	—	—	—	—	—	One Per Set
	K	30 ms	—	—	—	O	X	—	—	—	—	—	
	J	60 ms	—	—	—	X	O	—	—	—	—	—	
	G[1]	180 ms	—	—	—	X	X	—	—	—	—	—	
Automatic Answer	B[1]	In	X	—	—	—	—	—	—	—	—	—	One Per Set
	A	Out	O	—	—	—	—	—	—	—	—	—	
Local Copy on Primary Channel	ZA	In	—	—	—	—	—	O	—	—	—	—	One Per Set
	ZB[1]	Out	—	—	—	—	—	X	—	—	—	—	
Condition of CC (DSR) During Analog Loopback	YI	On	—	—	—	—	—	—	—	—	X	—	One Per Set
	YJ[1]	Off	—	—	—	—	—	—	—	—	O	—	

			S3 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER						
			1	2	3	4	5	6	
Reverse Channel	ZC[2]	In	O	O	—	—	—	—	One Per Set
	ZD[1]	Out	X	X	—	—	—	—	
Transmit Only	YG	In	—	—	X	—	—	—	One Per Set
	YH[1]	Out	—	—	O	—	—	—	
Echo Suppressor Enable	YQ	In	—	—	—	O	—	—	One Per Set
	YR[1]	Out	—	—	—	X	—	—	
Carrier Controlled Turnaround	YS[1]	In	—	—	—	—	—	O	One Per Set
	YT	Out	—	—	—	—	—	X	
Early CC (DSR) Indication	YU	In	—	—	—	—	O	—	One Per Set
	YV[1]	Out	—	—	—	—	X	—	

TABLE B (Contd)

INSTALLER OPTIONS FOR DS 202S-L1C

OPTION DESCRIPTION	DESIG		STRAPPING ON REVERSE CHANNEL	PROVIDE
Local Copy on Reverse Channel	ZE	In	Install E21-E22	One Per JY1 or JY2 CP[3]
	ZF[1]	Out	Install E21-E23	
Grounding Option			SCREW SWITCH SETTING ON INTERFACE CIRCUIT	One Per 47A-Type Data Mounting
	ZG[1]	Signal Ground Connected to Frame Ground	Screw Switch S1 Closed	
	ZH	Signal Ground Not Connected to Frame Ground	Screw Switch S1 Open	

X Contact closed

— Contact not applicable

O Contact open

Note 1: Factory furnished.

Note 2: Factory furnished instead of option ZD when reverse channel board is installed.

Note 3: DS 202S-L1C operates with JY2 only.

TABLE C

RECOMMENDED CUSTOMER OPTIONS

OPTION	202S	202C(MD), 202D*(MD), OR 202R(MD)
Squelch Interval	156 ms	In
Clear-to-Send Interval	180 ms	200 ms
Fast Carrier Detection	Out (normal)	40 ms
Soft Turnoff Interval	24 ms	In
Clamp	In	In
Reverse Channel	Optional	Optional†
Automatic Calling Unit	Optional	Optional†
Automatic Answer	Optional	Optional†
Local Copy	Optional	Always Provided

* 202D used with 804A

† Not available with DS 202R

Note: The contact closed position (option YG) will cause the data set to become transmit only. The data set will still pass the local and remote tests specified in Section 592-028-500.

- ***Soft Turnoff and Squelch Intervals:*** These two options are implemented in pair via S2 switch contact settings.

  (1) The soft turnoff signal is a 900-Hz tone which is transmitted after the request-to-send lead is turned ***off*** (at the end of a message). This signal prevents transients from causing spurious spacing signals at the distant station. The interval during which this signal is transmitted is optional for either 0, 8, or 24 ms. Use the 24-ms option for all standard switched network installations. The 0- and 8-ms options are provided for some customer-engineered systems where spurious spacing signals will not cause a problem.

  (2) The squelch feature clamps the received line signal detection circuit, which also clamps the received data circuit, to prevent reception of spurious spacing signals due to echoes after the request-to-send lead is turned ***off***. The data set may be optioned for a squelch interval of 0, 9, or 156 ms. Use the 156-ms interval for all standard switched network installations. The 0- and 9-ms options are provided for use under the same conditions as the 0- and 8-ms soft turnoff intervals.

- ***Fast Carrier Detection:*** With this option OUT, the received line signal detection circuit turns ***on*** in approximately 23 ms and turns ***off*** in approximately 11 ms. With this option IN, the turnon and turnoff times are approximately 7 and 6 ms, respectively. Set this option for the OUT position for all standard switched network installations. The IN position is provided for use under the same conditions as the shorter soft turnoff and squelch intervals previously explained. This feature is the same as carrier acquisition timing and/or receive line signal detector timing in earlier model DS 202-types.

- ***Clear-to-Send Interval:*** This feature is provided to delay the turnaround time from reception to transmission of data until echo suppressors are turned around or until echoes have decayed to sufficiently low levels. The data set may be optioned for 8-, 80-, 60-, or 180-ms clear-to-send intervals. Use the 180-ms interval for all standard switched network installations. The shorter intervals are provided for use under the same conditions as the soft turnoff and squelch intervals.

- ***Automatic Answer:*** This feature permits the data set to detect and answer incoming calls automatically.

- ***Local Copy on Primary Channel:*** With this option IN, the receiver continuously monitors the transmitted line signal while in the data mode and provides a local copy on the received data circuit.

Note: The IN or OUT status of this option requires opposite switch setting for contact 1

between models -L1 and -L1A, and for contact 1 of -L1 and contact 6 of -L1C.

- ***Clamp:*** This feature clamps the received data circuit when the received line signal detector is ***off.*** It is intended to prevent noise from causing spurious signals on the received data circuit when the received line signal detector is ***off.***

Note: The clamp function must always be IN for DS 202S-L1 (not to be considered an option). DS 202S-L1A and -L1C have this function permanently wired in.

- ***Condition of CC (DSR) During Analog Loopback:*** This option is available on DS 202S-L1A and -L1C only. With the ON setting, the data set ready circuit turns ***on*** during the analog loopback test mode when the data terminal ready circuit is turned ***on.*** This permits testing with the customer terminal. With the OFF setting, the data set ready circuit is clamped ***off*** during the analog loopback mode as it is with DS 202S-L1.

- ***Local Copy on Reverse Channel:*** With option IN, the local reverse channel receiver monitors the reverse channel transmitted signal. The option is installed (IN or OUT) via a strapping plug (Fig. 2 and 3) on the reverse channel CP.

- ***Grounding Option:*** Signal ground (AB) is normally connected to frame ground (AA) (factory-furnished) to minimize the introduction of longitudinal power line noise into the data circuits. Local procedures or conditions may require that signal ground ***not*** be connected to frame or protective ground. The grounding option is accomplished via a screw switch setting on the interface circuit located at the inside rear of the housing.

A long screwdriver (8-inch blade) is needed to operate the screw switch that controls the grounding option. If the appropriate screwdriver is not available, the backplane may be taken out of the housing by removing the two screws on the bottom of the housing.

- ***Echo Suppressor Enable Option:*** This option eliminates echo problems that may be encountered during startup over satellite transmission circuits. Available on DS 202S-L1C only. ***This option cannot be used with reverse channel installed.***

- ***Carrier Controlled Turnaround:*** This option delays turnon of the clear-to-send circuit until the remote data set has entered the receive mode. Available on DS 202S-L1C only, this option installed should benefit most systems.

- ***Early Data Set Ready Indication:*** With this option installed, the data-set-ready (DSR) circuit turns on at the beginning of the answer tone sequence in the called data set. Available on DS 202S-L1C only, this option installed causes DSR to operate as it does on DS 202C.

3. INTERFACE DATA

3.01 DS 202S provides the customer with the interface leads listed in Table D. These leads conform to EIA Standard RS-232-C.

3.02 The telephone interface leads are listed in Table E and described as they are used in DS 202S installations.

3.03 Figure 5 shows a simplified block diagram of the interface between the telephone set and the data set line control. This diagram provides information needed for modification/troubleshooting of single or multiple housing data set arrangements.

3.04 With DS 202S-L1, both calling and called data sets transmit answer tone except when a call is originated by an automatic calling unit (ACU). DS 202C ***may*** detect answer tone as a spacing signal when called by DS 202A-L1, which causes problems in some systems. The modification shown in Fig. 5 (move O-BK lead of HOLD key from terminal N or storage to screw terminal SG) disables answer tone when DS 202S-L1 is manually placed in the data mode. This modification should be made when DS 202S-L1 is used to originate calls manually and/or answer calls automatically. This modification should not be made if DS 202S-L1 is used to answer calls manually. DS 202S-L1A and -L1C provide answer tone when either is the

TABLE D

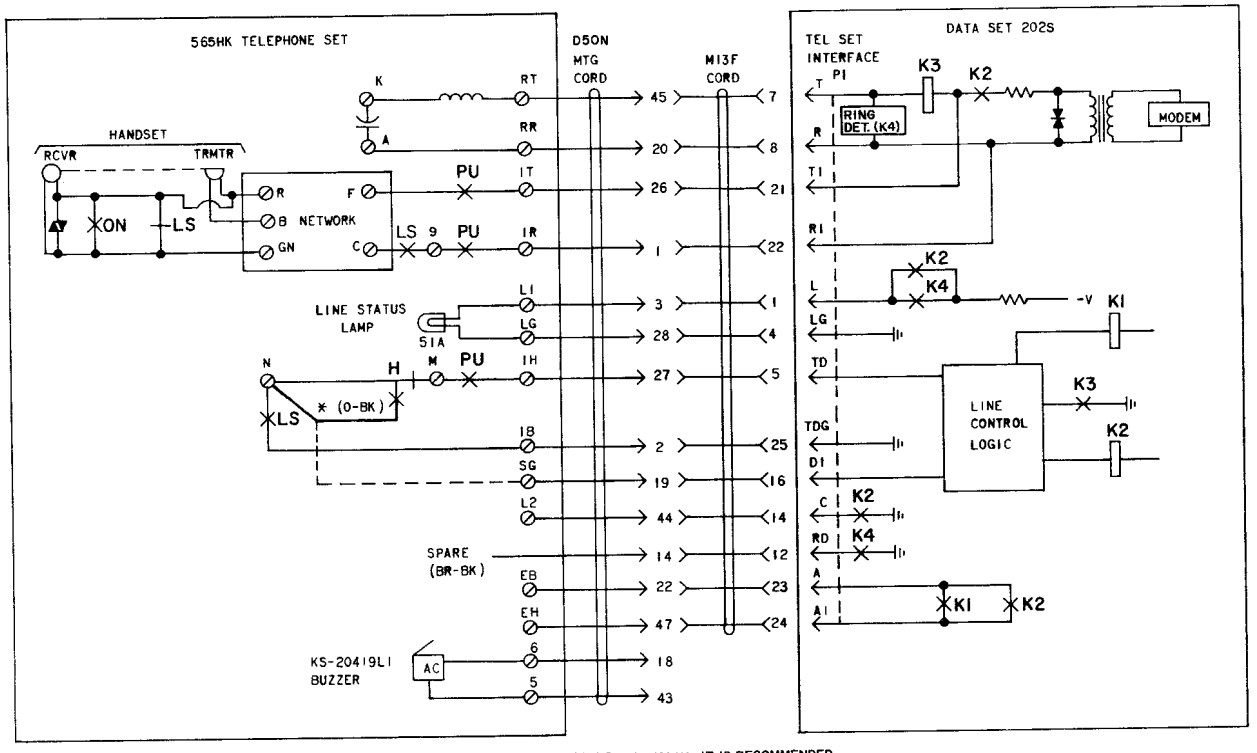
CUSTOMER INTERFACE

LEAD NO.	FUNCTION	EIA DESIGNATION (RS-232-C)
1	Protective Ground	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request-to-Send	CA
5	Clear-to-Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Received Line Signal Detector	CF
9	Positive 14 Volts	—
10	Negative 14 Volts	—
11 & 19	Secondary Request-to-Send	SCA
12	Secondary Received Line Signal Detector	SCF
20	Data Terminal Ready	CD
22	Ring Indicator	CE

TABLE E

TELEPHONE INTERFACE

LEAD NO.	DESIGNATION	DESCRIPTION
1	L	Telephone set line lamp control from data set
4	LG	Telephone set line lamp ground from data set
5	TD	Talk/data control from telephone set
7	T	Telephone line tip lead
8	R	Telephone line ring lead
12	RD	Common ringer control contact to ground
14	C	Data mode contact closure to ground from set to ACU
16	D1	Data mode contact closure to ground from ACU to data set
21	T1	Telephone set tip lead
22	R1	Telephone set ring lead
23	A	A lead control: Used to provide an indication to ACU or KTU when the line is in use
24	A1	
25	TDG	Talk/data control ground lead



* IF 202S-L1 WILL BE CALLING A 202C AND WILL NEVER BE USED TO ANSWER CALLS MANUALLY, IT IS RECOMMENDED THAT THE O-BK LEAD OF THE HOLD KEY (EITHER TAPED & STORED OR CONNECTED TO TERMINAL N) BE CONNECTED TO EITHER OF THE TWO SG SCREW TERMINALS. THIS MODIFICATION PREVENTS THE 202S-L1 FROM SENDING ANSWER TONE WHEN IT IS MANUALLY PLACED IN THE DATA MODE.

Fig. 5—Interface Between Telephone Set and Data Set Line Control

called data set only, in the same manner as DS 202C.

4. CONNECTIONS

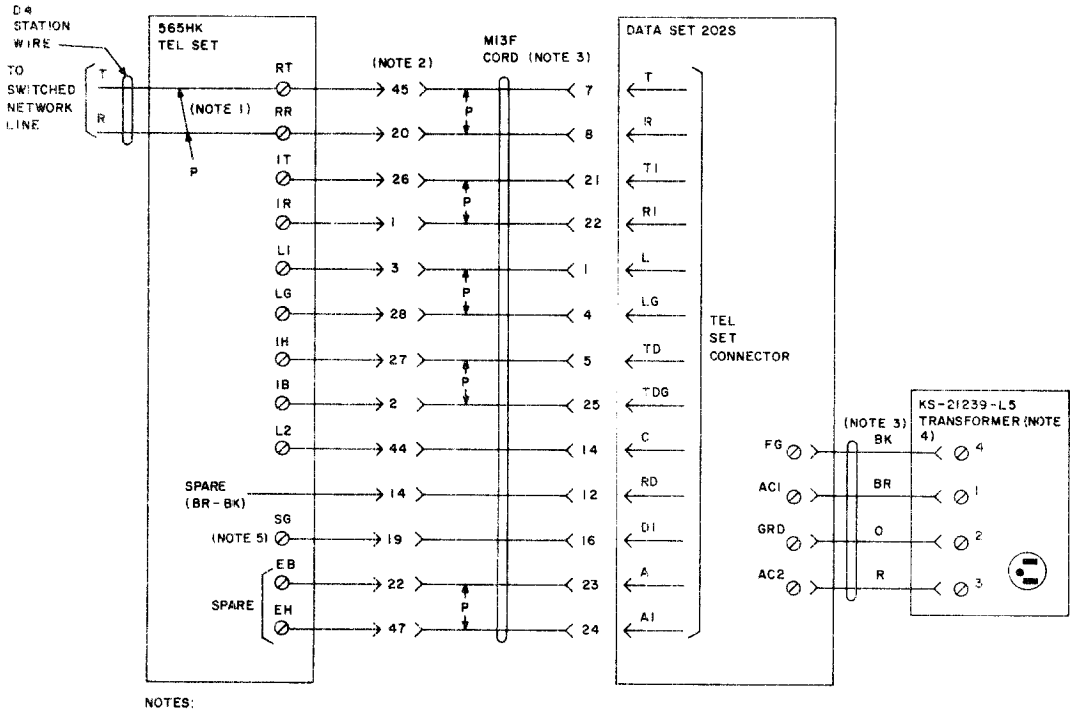
SINGLE DATA SET

4.01 The information given in this part describes the single DS 202S, with and without an ACU.

4.02 The data set should be connected in accordance with Fig. 6 or 7, and 8.

MULTIPLE ARRANGEMENT

4.03 The purpose of a multiple arrangement of individually housed DS 202S is to provide up to five data sets that may be controlled by a single 565HK telephone set. Since these sets are individually housed, this arrangement can utilize available space more efficiently than the same number of sets in a common cabinet. For information pertaining to multiple installations using a data mounting, refer to Section 590-010-201.



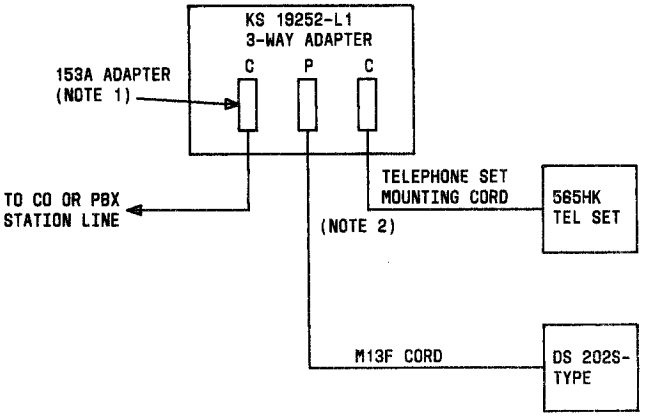
NOTES:
1. RT AND RR ARE LOCATED ON THE TELEPHONE TERMINAL STRIP NEAR THE LAMP STRIP.
2. A B25A CORD MAY BE USED IF ADDITIONAL LENGTH IS REQUIRED (MAXIMUM OF 100 FEET).
3. THIS CORD IS SHIPPED WITH THE DATA SET HOUSING ASSEMBLY.
4. KS-21239-L1 AND -L4 TRANSFORMERS ARE MANUFACTURE DISCONTINUED.
5. SEE FIG. 5 FOR POSSIBLE MODIFICATION.

Fig. 6—Typical Data Set 202S Installation With 565HK Telephone Set

4.04 The KS-21253-L3 adapter makes it possible to assemble a multiple installation with a minimum of effort on the part of the installer, since most of the connections are made via 50-pin connectors.

4.05 Figure 9 shows a typical arrangement of five (maximum) data sets plugged into a KS-21253-L3 adapter, which interfaces them with the controlling 565HK telephone set and the telephone lines. In addition, the adapter is equipped with a relay (Fig. 10) and the necessary wiring to provide a common ringing indication (a buzzer in the 565HK telephone set). The buzzer and relay are powered by low voltage alternating current supplied by the 2012C transformer shown connected to adapter terminals AC1 and AC2 in Fig. 9.

Note: The buzzer is shipped with the 565HK telephone set and the adapter is factory-wired to provide the common ringing indication.



NOTES:
1. CONNECT T AND R OF DDD LINE TO TERMINALS B AND R OF 153A ADAPTER.
2. DATA SET OR TELEPHONE SET CAN BE EXTENDED WITH B25A CABLE IF REQUIRED.

Fig. 7—Single Data Set 202S-Type With 565HK Telephone Set and Without ACU—Alternate Arrangement

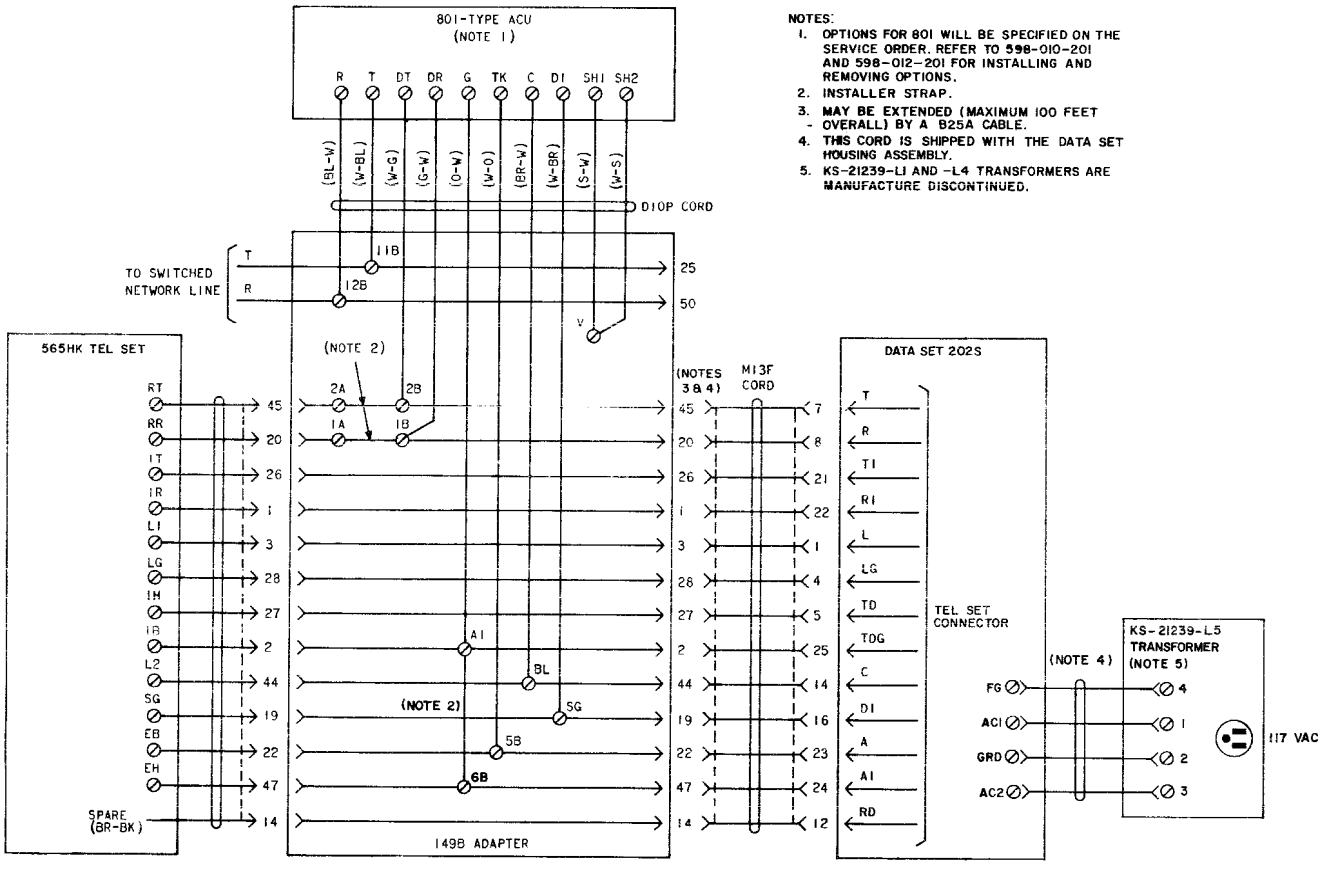


Fig. 8—Typical Data Set 202S Installation With 801-Type ACU

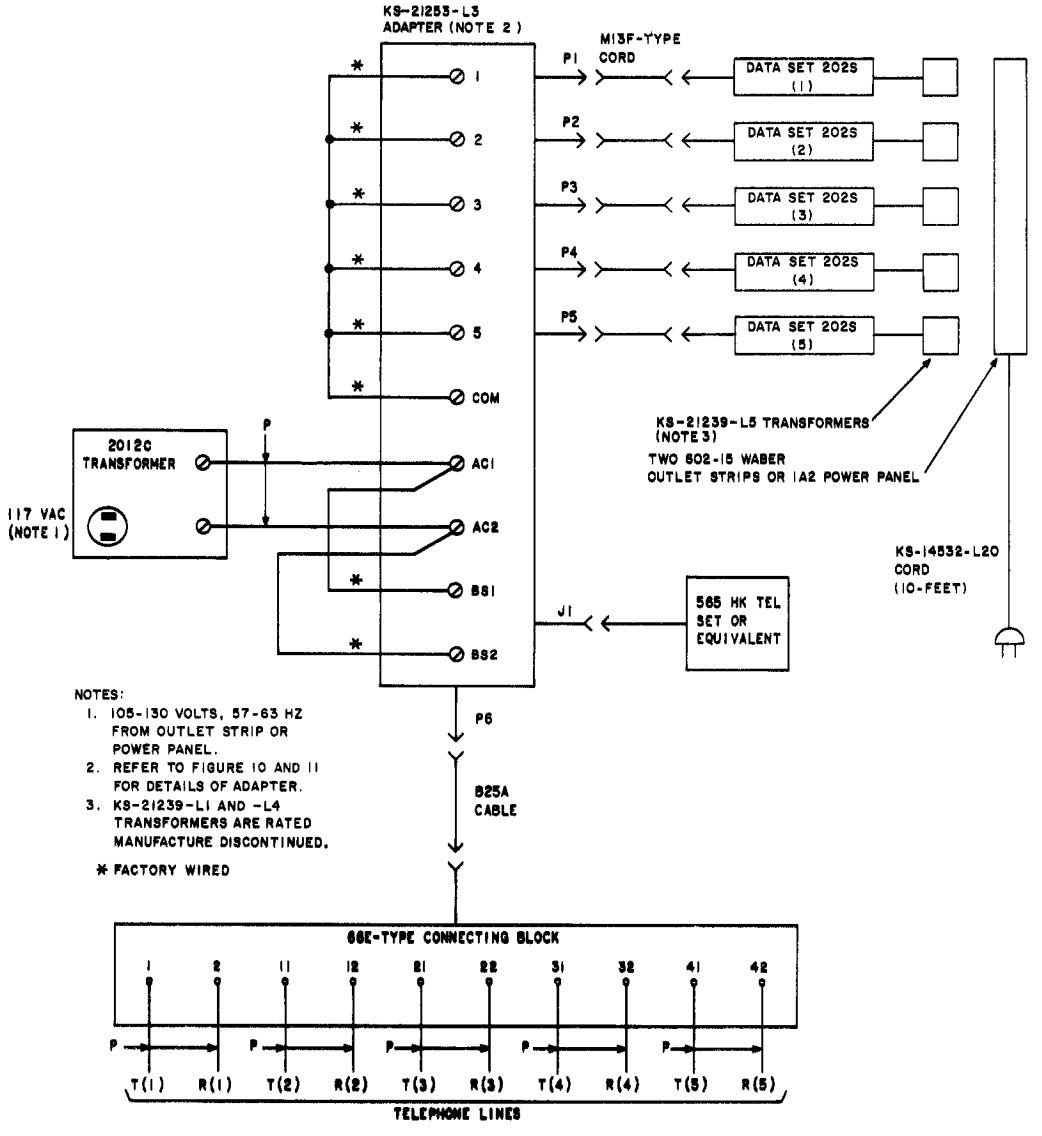


Fig. 9—Multiple Individually Housed Data Set 202S Installation

4.06 To eliminate the need for several 117-Vac outlets, a multiple power outlet strip should be used into which the individual KS-21239-L1 (MD), -L4 (MD) or -L5 transformers can be plugged (Fig. 9). A 602-15 Waber Electric power outlet strip will accommodate three transformers. A 1A2 power panel will accommodate six transformers. A KS-14532-L20 or equivalent cord is required with the 1A2 power panel.

Caution: The KS-21239-type transformer mounts directly on the 117-volt 60-Hz outlet, using the primary connection blades. A possible safety hazard exists when securing the transformer to ac receptacles which are equipped with metal covers. If care is not exercised when securing the transformer, there is a possibility that the metal cover can slip and short the transformer blades if they are only partially inserted into the ac outlet. As soon as pending changes in the present UL Standard covering specialty transformers are approved, the requirement to secure the transformer with the cover retaining screw will be omitted and the tab on the transformer removed. Until such time as the standard is changed, it is recommended that metal covers be taped in place while the retaining screw is removed or that the metal cover be replaced with a plastic cover.

4.07 The buzzer is used for the indication in order to avoid the need for a local ringing generator. If ringing is desired, the telephone set can be rewired to place the ringer across pins 18 and 43 (Fig. 11) of the telephone set connector, and the ringing current supply brought in to screw terminals BS1 and BS2 ***or*** through the telephone line connector on pins 25 and 50. In this case, the connections between terminals AC1 and BS1 and AC2 and BS2 must be removed.

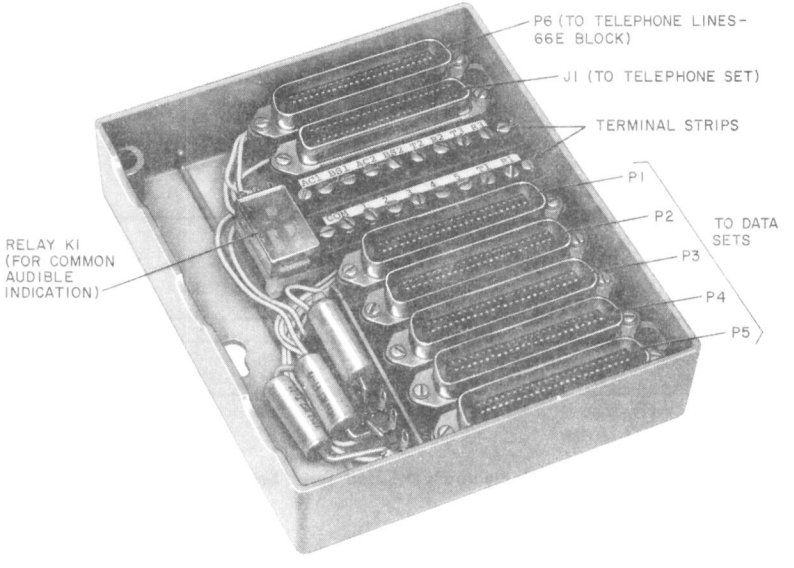


Fig. 10—KS-21253-L3 Adapter With Cover Removed

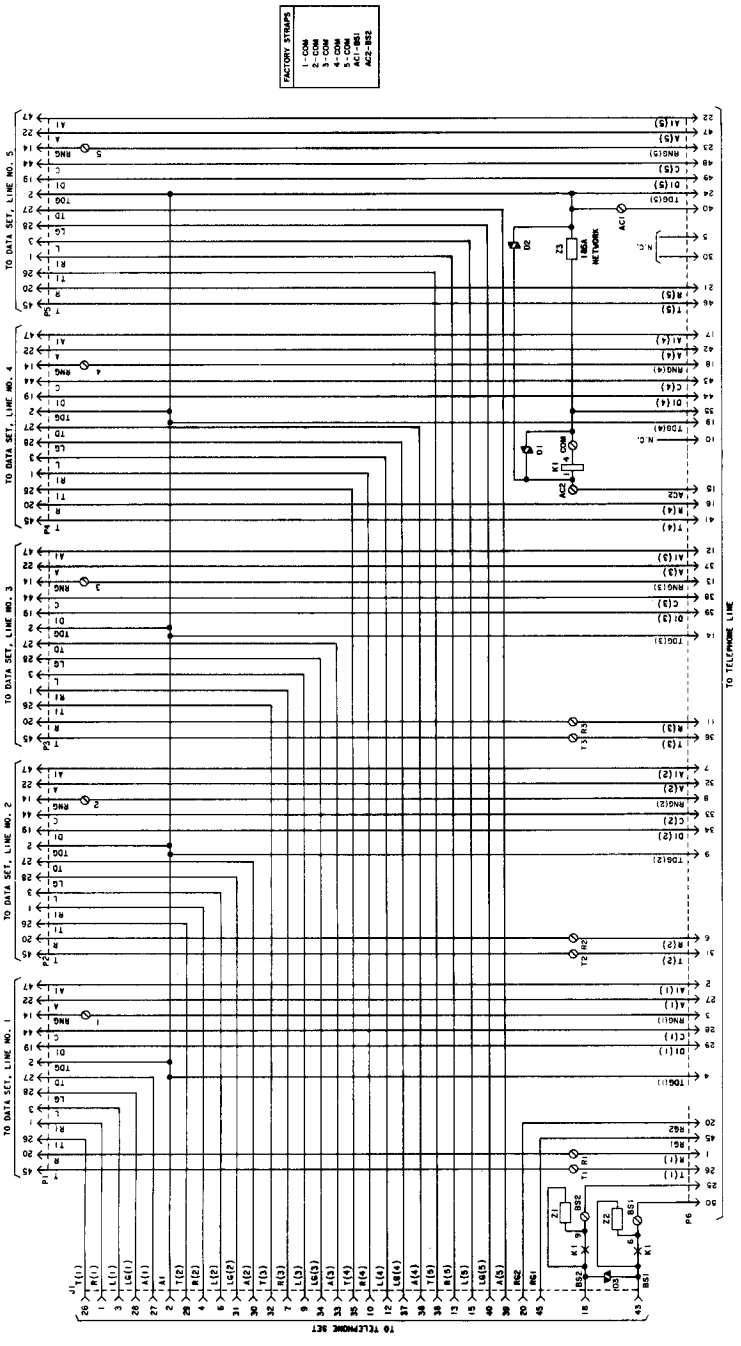


Fig. 11—Adapter for up to Five Data Sets Connected to One Key Telephone Set

Note: Low voltage alternating current is still required.

4.08 At installation of three or fewer data sets, tip and ring pairs may be connected directly to adapter screw terminals T1 and R1, T2 and R2, and T3 and R3, respectively, for the first three data sets. This arrangement eliminates the need for the B25A cable and the 66E-type connecting block.

Note: Low voltage alternating current must be connected to adapter terminals AC1 and AC2.

4.09 ***Multiple Installations Using 801-Type Automatic Calling Unit (ACU):*** Connections for an ACU can be made on the line side of the KS-21253-L3 adapter by using an A25B cable (or equivalent) and a 44A-type connecting block (Fig. 12).

4.10 The ACU can be connected on the data set side of the KS-21253-L3 adapter by using a 149B adapter to make the connections for the ACU and data set (Fig. 8) and a B25A cable to connect the KS-21253-L3 adapter to the 149B adapter.

The B25A cable is connected between the data set plug on the KS-21253-L3 adapter and the telephone set connector on the 149B adapter.

5. INSTALLATION TEST

5.01 After installation is completed, the data set should be tested to determine if it is operating properly in accordance with Section 592-028-500.

5.02 Ensure that a copy of Data Set 202S—How to Operate Manual is readily available to the customer.

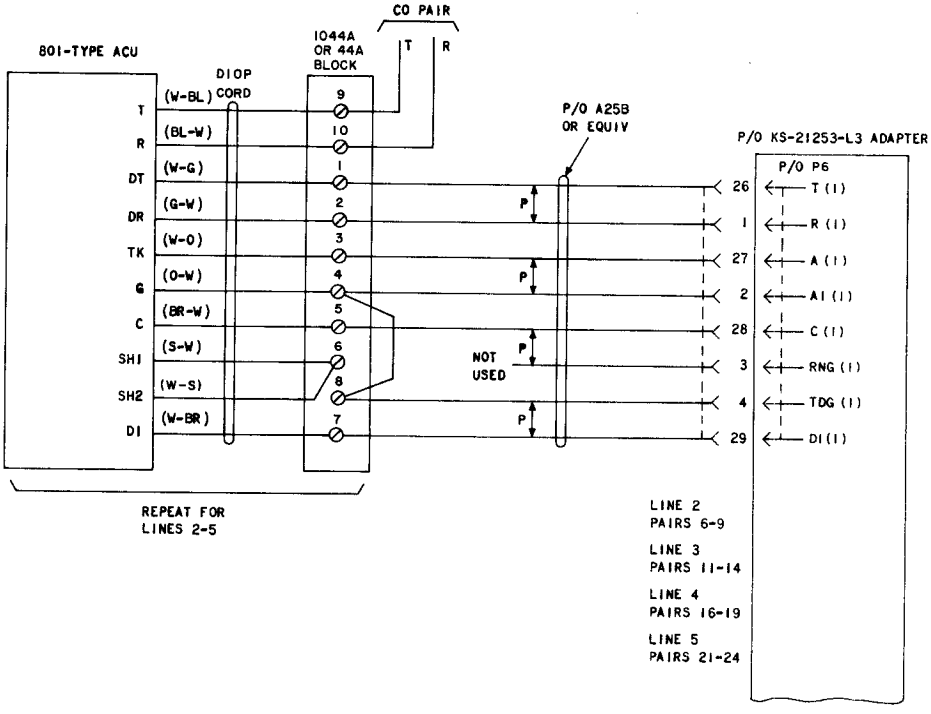


Fig. 12—ACU Wiring Using P6 for ACU Access

6. REFERENCES

6.01 The following BSPs provide additional information:

SECTION	TITLE
314-205-501	Data Systems—DATAPHONE® Service—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
590-010-200	Data Sets and Data Access Arrangements—General Installation and Connection Information
590-010-201	Data Sets—Multiple Installation Information
999-100-141	Data Station 202S—How to Operate Manual

DATA SET 202S
TRANSMITTER-RECEIVER
TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section contains information and procedures needed to test data set (DS) 202S during installation, and prior to and during maintenance visits to the customer premises.

1.02 This section is reissued to add information on testing DS 202S-L1C, -L1C/2, and -L1C/2/3B. Since this reissue constitutes a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 DS 202S does not require routine maintenance after installation tests and adjustments have been made.

1.04 When investigating a trouble report, proceed as directed in Fig. 5.

1.05 If if becomes necessary to dispatch a telephone company (telco) employee to the data set location, the following equipment should be taken along:

- 914C data test set (DTS) ***or*** 914B and 903 DTSs
- Spare DS 202S-L1A/2/3A, L1/2/3 or -L1C/2/3B.

1.06 To minimize time on customer premises, the entire data set should be changed. If existing service includes reverse channel, make sure the JY1, JY2 or JY3 circuit pack is included. If the service does not include reverse channel, make sure JY1, JY2 or JY3 circuit pack is removed and option ZD is installed.

1.07 If DS 202S-L1/2/3 is installed and it is suspected that a problem exists due to incompatibility in communicating with DS 202C, DS 202S-L1A/2/3A or -L1C/2/3B should be tried.

1.08 When the data set is replaced, tag the defective set, describing the nature of the trouble. Carefully pack and return to a service center for repair. After the data set has been replaced, verify with the customer that service has been restored.

1.09 If the trouble persists, proceed as follows:

(a) Check that options in the data set agree with the service order.

(b) Verify that customer-provided equipment has been tested and is operating satisfactorily.

(c) Check that all cords and connectors are properly connected.

(d) Check for physical damage.

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(e) Verify that customer-provided equipment and data set are connected to a common ground.

(f) If the trouble cannot be cleared, request help from immediate supervisor.

1.10 This section is divided into three parts which concern test procedures: 2. TEST CAPABILITIES, 3. INSTALLATION TESTS, and 4. MAINTENANCE TESTS. Part 2 provides information on and procedures for all the tests associated with DS 202S. This includes both tests which require no test equipment and those requiring such equipment as the 914C DTS. Parts 3 and 4 give the proper sequence in which to perform the various tests when installing DS 202S or investigating a trouble report.

Caution: If the data set is removed from the housing, it should be handled by the nonconductive surfaces only. Otherwise, certain circuit components may be damaged.

Note: When inserting data set back into the housing, push it all the way in to ensure proper contact with the connectors in the rear of the housing.

2. TEST CAPABILITIES

2.01 The test circuitry built into DS 202S permits the following tests to be performed.

A. Local Self Test

2.02 Depressing the LT key on the front of the data set initiates the local self test. A repeating 63-bit pseudo-random word is generated at 1547 bps and looped from the transmitter to the receiver through an attenuating circuit. The received word is compared to the original word. Under normal conditions, all the LEDS (light-emitting diodes) are lighted; however, in the event an error is detected, the TM LED is extinguished. Perform the test as follows:

Note: All customer interface leads are made inoperative and are not tested during the test; however, all LEDs are lighted.

(a) Ensure that the data set is not in the data mode.

(b) Depress and hold the nonlocking LT key for approximately 15 seconds.

Requirement: The TM LED remains lighted while the LT key is depressed.

(c) If the requirement of (b) is not met, repeat (b) four times.

Requirement: The TM LED remains lighted throughout the four trials.

B. Remote Test

2.03 The remote test mode allows the attendant at the data test center (DTC) to test the data set circuitry (with the exception of the customer interface). After contacting the DTC, press the RT key and observe that all LEDs are lighted. The remaining test functions are performed by the DTC. At the end of the test, press and release the RT key.

Note: All customer interface leads are made inoperative and are not tested during the test; however, LEDS are lighted.

2.04 Proceed with the test as follows:

(a) Contact the DTC and request a remote test.

(b) When instructed to do so by the DTC, depress the RT key and observe that all the LEDs are lighted.

(c) When instructed to do so, press and release the RT key to take the data set out of the remote test mode. If the data set enters the data mode (MR lighted), depress and release the analog loopback (AL) key to return the data set to the idle mode.

C. Analog Loopback Tests

2.05 The purpose of these tests is to check the interface circuits not checked by the local self test or the remote test. Figure 1 shows the test equipment setup for the following tests:

- Error Run and Power Supply Test
- Clear-to-Send Turnon Interval
- Received Line Signal Detector Interval

- Analog Loopback Reverse Channel Test (DS 202S-L1A/2/3A and -L1C/2/3B only).

In the analog loopback mode, the data signal applied to the transmitted data interface lead is processed through the transmitter, looped through an attenuator (202-L1 only) to the receiver where it is demodulated, and transmitted to the received data lead. Pressing the AL key until it locks performs the following:

- Connects the transmitter and receiver for DS 202S-L1A or -L1C. An attenuator is inserted in this path for DS 202S-L1 only.
- Overrides the local copy control circuit to provide local copy.
- Illuminates the TM LED.
- Disables the auto-answer feature, if installed.
- Turns the data-set-ready lead OFF (all other customer interface leads are operative and may be tested) on DS 202S-L1 only. This is optional for DS 202S-L1A and -L1C.

The following test equipment is required:

- 914C DTS (1) ***or***
- 914B DTS (1) ***and*** 903-type DTS (1).

2.06 ***Error Run and Power Supply Test:*** This test verifies that the data set will transmit and receive a 63-bit random word error-free for 5 minutes. Both the positive and negative 14-volt power supply voltages are also checked during this test. The test equipment is set up as shown in Fig. 1. Proceed as follows:

(1) Disconnect customer-provided equipment (CPE) and connect the 914-type DTS to DS 202S.

(2) Insert red pins in the matrix and position switches as shown in Fig. 1.

(3) Ensure that the line associated with the data set under test is on-hook (required with DS 202S-L1 only).

(4) Apply power to the data set and DTS.

(5) Depress locking AL key on the data set. Wait at least 3 seconds (with DS 202S-L1 only) before proceeding. This allows the answer sequence to be generated in the data set.

Note: The receiver contains a first mark circuit which clamps the received data and received line signal detector circuits ***off*** during the answer sequence. At least 8 ms of marking signal must be received by the receiver before the clamp is removed.

(6) Operate switch S1 to ON. Depress and release START button on 903 DTS if it is being used.

Requirement: DS1 and DS3 lamps are lighted. DS2 is lighted if option YI is installed.

(7) Move FUNCTION switch to VOLTS INT and measure the positive supply voltage.

Requirement: +12 to +17 volts.

(8) Move FUNCTION switch to OFF, POLARITY switch to REV, and VERTICAL MONITOR switch to 10.

(9) Move FUNCTION switch to VOLTS INT and measure the negative power supply voltage.

Requirement: -12.5 to -17.5 volts.

(10) Move FUNCTION switch to OFF.

(11) Move FUNCTION switch on the 914 DTS to PHASE ADJ.

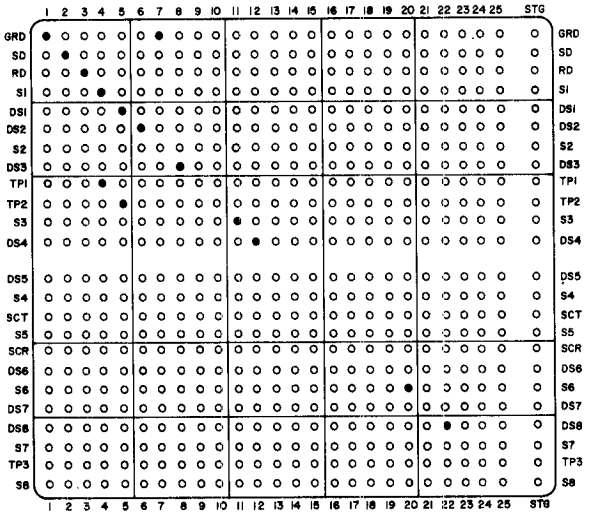
(12) Adjust PHASE control until the meter indicates zero. Move FUNCTION switch to OFF.

(13) Operate WORD SYNC on the 914 DTS and release when the counter stops.

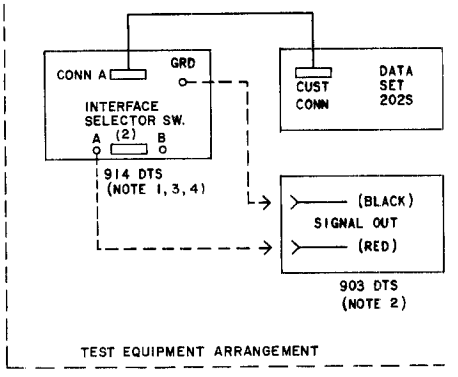
(14) Reset the counter on the 914 DTS.

(15) Allow the test to continue for 5 minutes.

Requirement: No errors.



914 DTS MATRIX



NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C)
	RCV SER (914B)
COUNTER	BIT ERRORS
TRANSMIT BIT RATE (914C)	1200
TRANSMIT WORD LENGTH(914C)	63
VERTICAL MONITOR	9
FUNCTION	OFF
RANGE	DCV-30
POLARITY	NOR
BIT RATE	1200
SIG LEV	±4
WORD LENGTH	63
SAMPLE WIDTH	30%
S1, S3	OFF
S6	ON
TPI	+/OPEN
TP2	+/OPEN

2. THE 903 DTS IS REQUIRED IN CONJUNCTION WITH THE 914B DTS ONLY. POSITION THE SWITCHES ON THE 903 DTS AS FOLLOWS:

SWITCH	SETTING
BIT RATE	1200
TRIGGER	(+) POSITIVE
RANDOM-DOT	RANDOM

3. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO INTERFACE LEADS AS FOLLOWS:

SWITCH	LAMP	LEAD
S1		REQUEST TO SEND
	DS1	CLEAR TO SEND
	DS2	DATA SET READY
	DS3	RECEIVED LINE SIGNAL DETECTOR
S3		SECONDARY REQUEST TO SEND
	DS4	SECONDARY RECEIVED LINE SIGNAL DETECTOR
S6		DATA TERMINAL READY
	DS8	RING INDICATOR

4. ALL A INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN EXCEPT 2A WHEN USING A 903 DTS.

Fig. 1—Analog Loopback Test Setup

(16) If no more tests are to be conducted, disconnect test equipment and press and release AL Key.

(17) If a clear-to-send response test is to be conducted, operate S1 to OFF, then proceed to paragraph 2.07 (4).

2.07 ***Clear-to-Send Response Test:*** This test measures the interval between the time when the CA (request-to-send) lead is turned ***on*** and when the CB (clear-to-send) lead turns ***on.*** Proceed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to DS 202S.

(2) Insert red pins in the matrix and position switches on the DTS as shown in Fig. 1, ***except the COUNTER switch should be positioned to INTERVAL X1.*** Position TEST SET MODE switch to INTERVAL.

(3) Ensure that the telephone line associated with the data set under test is on-hook (required with DS 202S-L1 only).

(4) Place the data set in analog loopback test mode by depressing the AL key until it locks. Wait at least 3 seconds (with DS 202S-L1 only) before proceeding.

(5) Reset the counter. Move switch S1 to ON; the clear-to-send turn-on interval appears on the counter.

Requirements:

- Option M—6 to 12 ms
- Option K—22 to 40 ms
- Option J—52 to 70 ms
- Option G—140 to 200 ms.

Note: Only the option actually installed in the data set should be tested. In order to measure the interval for Option G, the interval switch must be moved to X10. The counter should indicate 14 to 20.

(6) To remeasure the interval, move S1 to OFF, reset the counter, then move S1 to ON.

(7) If a received line signal detector response test is to be performed, move switch S1 to OFF. Proceed to paragraph 2.08(2).

2.08 ***Received Line Signal Detector Response Test:*** This test verifies that the received line signal detector circuit will respond properly within one of the time intervals given as requirements in this test. Only the option actually installed in the data set should be tested. Proceed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to DS 202S.

(2) Insert red pins in the matrix and position switches on the DTS as shown in Fig. 1, ***except the pin at TP2-5 should be moved to TP2-8.*** Also, remove pin SD-2 and disconnect the 903 DTS (if used). Push interface selector switch 2A in and insert a red matrix pin in position S2-2. Leave switch S2 OFF. Position TEST SET MODE switch to INTERVAL.

(3) Ensure that the telephone line associated with the data set under test is on-hook (required with DS 202S-L1 only).

(4) Place the data set in analog loopback test mode by pressing the AL key until it locks. Wait at least 3 seconds (with DS 202S-L1 only) before proceeding.

(5) Reset the counter. Move switch S1 to ON and the response time will appear on the counter.

Requirements:

- Data set equipped with Option Q—5 to 9 ms.
- Data set equipped with Option N—18 to 24 ms.

Note: Check only the interval corresponding to the option installed in the data set.

(6) To remeasure the interval, move switch S1 to OFF, reset the counter, then move S1 to ON. The interval will appear on the counter.

2.09 ***Analog Loopback Reverse Channel Test*** (DS 202S-L1A/2/3A and -L1C/2/3B

only): This test checks the interface circuits used with reverse channel. Proceed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to DS 202S.

(2) Insert red pins in the matrix and position switches as shown in Fig. 1.

(3) Apply power to the data set and DTS.

(4) Depress locking AL key on the data set.

(5) Operate switch S3 to ON.

Requirement: DS4 lamp lights.

(6) Operate switch S1 to ON.

Requirement: DS7 lamp extinguished.

(7) Operate switches S1 and S3 to OFF.

Requirement: DS4 lamp remains extinguished.

D. Automatic Answer Test

2.10 This test verifies that DS 202S will automatically answer and terminate a call. The test checks the data-terminal-ready and ring indicator leads. Proceed as follows:

(1) Ensure that the automatic answer option is installed (contact 8 on option switch S2 closed on DS 202S-L1 and -L1A; contact 1 on option switch S2 closed on DS 202S-L1C).

(2) Connect the data set to the 914 DTS. Use either the 914C or 914B; the 903 is not required.

(3) Insert red pins into the matrix and position switches as shown in Fig. 1, ***except switch S6 should be moved to OFF.*** Apply power to the data set and the 914 DTS.

(4) Have a call made to the data station.

Note: If a reverse channel test is to be performed, a DTC should be contacted and asked to initiate the call, since the DTC will probably perform the reverse channel test as part of the call.

Requirement: DS8 lamp lights (RI is ***on***) during ringing. DS8 extinguishes (RI is ***off***) during the quiet period. The data set does ***not*** answer the call.

(5) Position switch S6 to ON (DTR ***on***) during the quiet period of the ringing cycle.

Requirement: At the end of the next ringing cycle, the data set answers the call. After approximately 3 seconds, DS2 (data set ready) lights. This indicates that the data set is in the data mode.

(6) If a reverse channel test is to be performed, proceed to paragraph 2.11 (3).

(7) If a reverse channel test is not to be performed, terminate the call by moving switch S6 to OFF (DTR ***off***).

Requirement: DS2 extinguishes.

E. Reverse Channel Test

2.11 This test checks the interface circuits used with reverse channel. It will be necessary to contact a DTC for this test. The DTC should be capable of transmitting a tone (387 Hz) to the data set and measuring the frequency of the tone received from the data set. Proceed as follows:

(1) Disconnect the CPE and connect the 914 DTS in its place in accordance with Fig. 1. Insert red pins into the matrix and position switches as shown in Fig. 1, ***except switch S1 should be ON.***

(2) Apply power to the data set and then to the 914 DTS.

(3) Request the DTC to send 387 Hz at -12 dBm at the 0 TLP.

Requirement: DS4 lamp lights (SCF ***on***).

(4) Move S8 to ON and S1 to OFF. This transmits 387 Hz to the DTC.

(5) Request the DTC to measure the frequency of the reverse channel tone.

Requirement: 377 to 397 Hz.

F. Supplementary Tests

2.12 ***End-to-End Test:*** This test should be used to identify problems in the transmission facilities. Proceed as follows:

Note: It will be necessary to establish voice communication during the test.

(1) Set up the test equipment and the data sets in accordance with Fig. 2.

(2) Set switch S1 to ON at the transmitting end and switch S1 to OFF at the receiving end.

(3) Apply power to the data set and test equipment. Establish a data call between the data sets. Momentarily depress START button on the 903 DTS.

Note: Steps (4) through (8) are for the receiving end only.

(4) On the 914 DTS, set FUNCTION switch to PHASE ADJ.

(5) Adjust PHASE control to zero the meter.

(6) Move FUNCTION switch to OFF.

(7) Operate WORD SYNC switch momentarily to MAN.

(8) Press RESET button to clear the counter.

(9) Complete end-to-end tests involve making two 10-minute and six 2-minute test runs. Establish voice communications between tests, using the associated telephone set. Place calls alternately from each end except where one customer location will always be originating the call. These test calls should be made during busy hours. This gives reasonable assurance that all test calls do not use the same trunks and routes.

Requirement: During the 10-minute test calls, count errors at the end of 1-minute intervals. Disregard the test period with the highest number of errors. Total errors in the remaining nine test periods should be no more than six. Four of the six 2-minute calls should have no more than three errors each.

Note: Refer to Fig. 3 for an example of a form which can be used to record test results.

(10) Upon completion of tests, record the results and disconnect the test equipment.

2.13 ***Ground Noise Test:*** If the data set and CPE are not at the same ground potential, errors may be caused by a potential difference between data set ground and business machine ground. To detect the presence of noise potentials at the time of installation or during troubleshooting, a test should be made using the 6H impulse counter.

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

2.14 The 6H impulse counter is connected and the test is performed as follows.

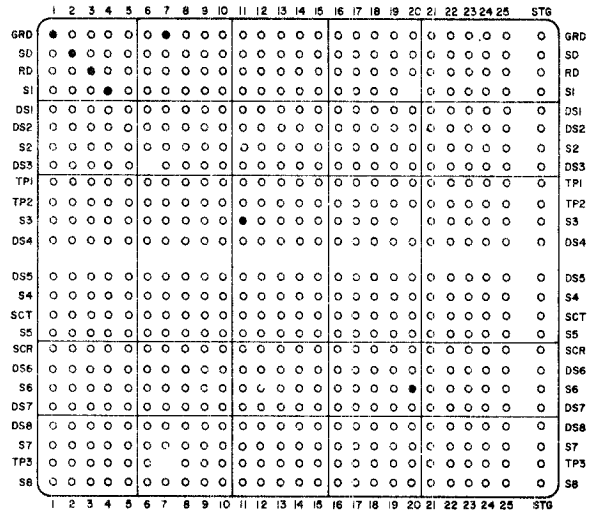
(1) Use a 2W6A test cord or equivalent (310 plug on one end, alligator clips connected to tip and ring on the other end). Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the business machine. This test assumes that protective ground from the business machine appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1A and connect the other clip to switch 1B. Verify that power is applied to data set and business machine.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.



914 DTS MATRIX

NOTES:

1. SET SWITCHES ON THE 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C DTS)
	RCV SER (914B DTS)
COUNTER	BIT ERRORS
RCV BIT RATE	1200
RCV WORD LENGTH	63
TRANSMIT BIT RATE (914C)	1200
TRANSMIT WORD LENGTH (914C)	63
SIG LEV	±4V
SWITCH S1, S3	OFF
SWITCH S6	ON
SAMPLE WIDTH	30%

2. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO THE FOLLOWING INTERFACE LEADS.

SWITCH	LEAD
S1	REQUEST TO SEND
S3	SECONDARY REQUEST TO SEND
S6	DATA TERMINAL READY

3. ALL A INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN EXCEPT 2A WHEN USING A 903 DTS.

Fig. 2—End-to-End Test Setup

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord from 1A and 1B and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

Date:_____

Data Test Calls Placed Between:

	LOCATION	TEL. # OF TEST LINE OR STATION
(A)		
(B)		

Contemplated Customer
S.O. Number's_____

Under Control of Data
Test Center at_____

LONG DURATION TEST CALLS					BIT ERROR COUNT — MINUTE NUMBER														
ORIGINATED #	AT	TIME	PEAK DISTORTION AT	%	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SHORT DURATION TEST CALLS			SHORT CALL — NUMBER (READINGS AT _____)						SHORT CALL — NUMBER (READINGS AT _____)					
ORIGINATED AT	TIME		1	2	3	4	5		1	2	3	4	5	
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												

Billing Adjustment (if required) referred to:_____

Parties involved in Tests:_____

Coordinated with tests to other locations at:_____

Comments and Notes:

Fig. 3—Data Set Preservice Performance Test Record

(10) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

2.15 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect test equipment and restore the data set to pretest condition.

3. INSTALLATION TESTS

3.01 This part provides the sequence in which tests are to be performed following an installation. Before proceeding with the test, verify that the local loop and the end-to-end facilities meet the requirements specified in the sections entitled Data Systems—DATAPHONE® Service—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (315-205-501) and Data Systems—DATAPHONE® Service on Direct Distance Dialing Network—Overall Transmission Maintenance Procedures (314-205-500). Refer to Fig. 4 for the sequence of tests.

4. MAINTENANCE TESTS

4.01 This part provides the sequence in which tests are to be performed before and during a trouble visit. The procedure provides a method of isolating a trouble to either the data set or the transmission facility. Refer to Fig. 5 and 6 for the sequence of tests.

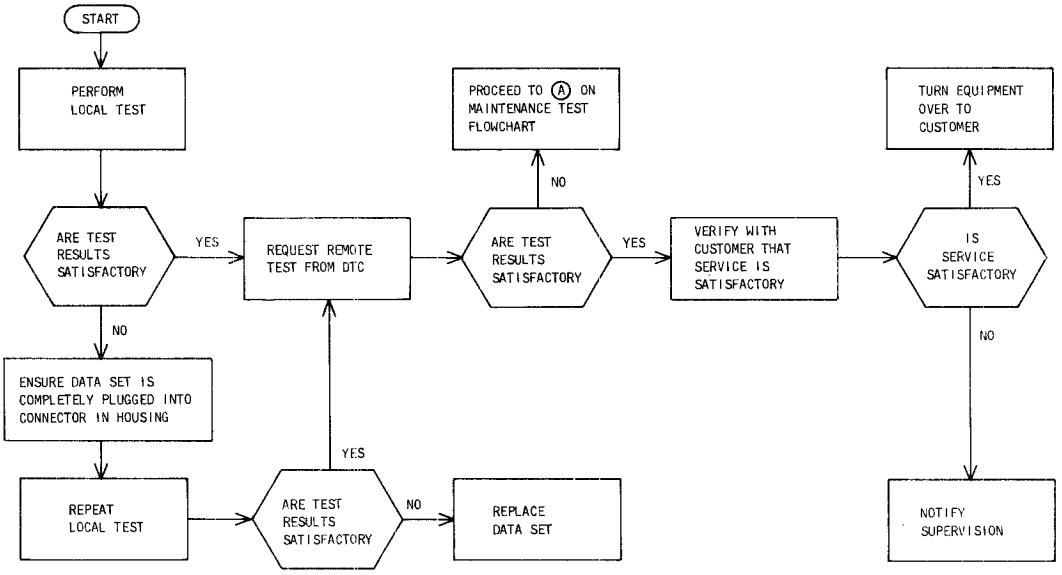


Fig. 4—Installation Test Sequence

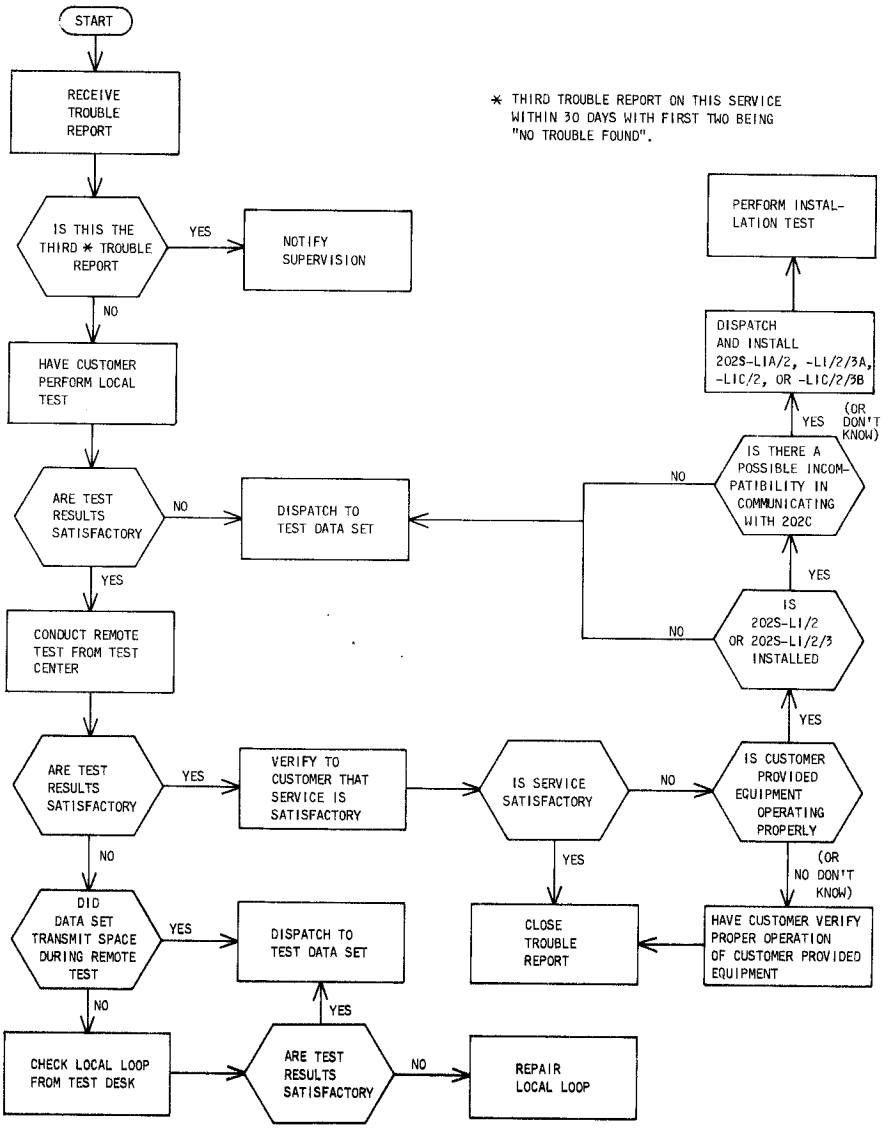


Fig. 5—Maintenance Flowchart (Before Dispatch)

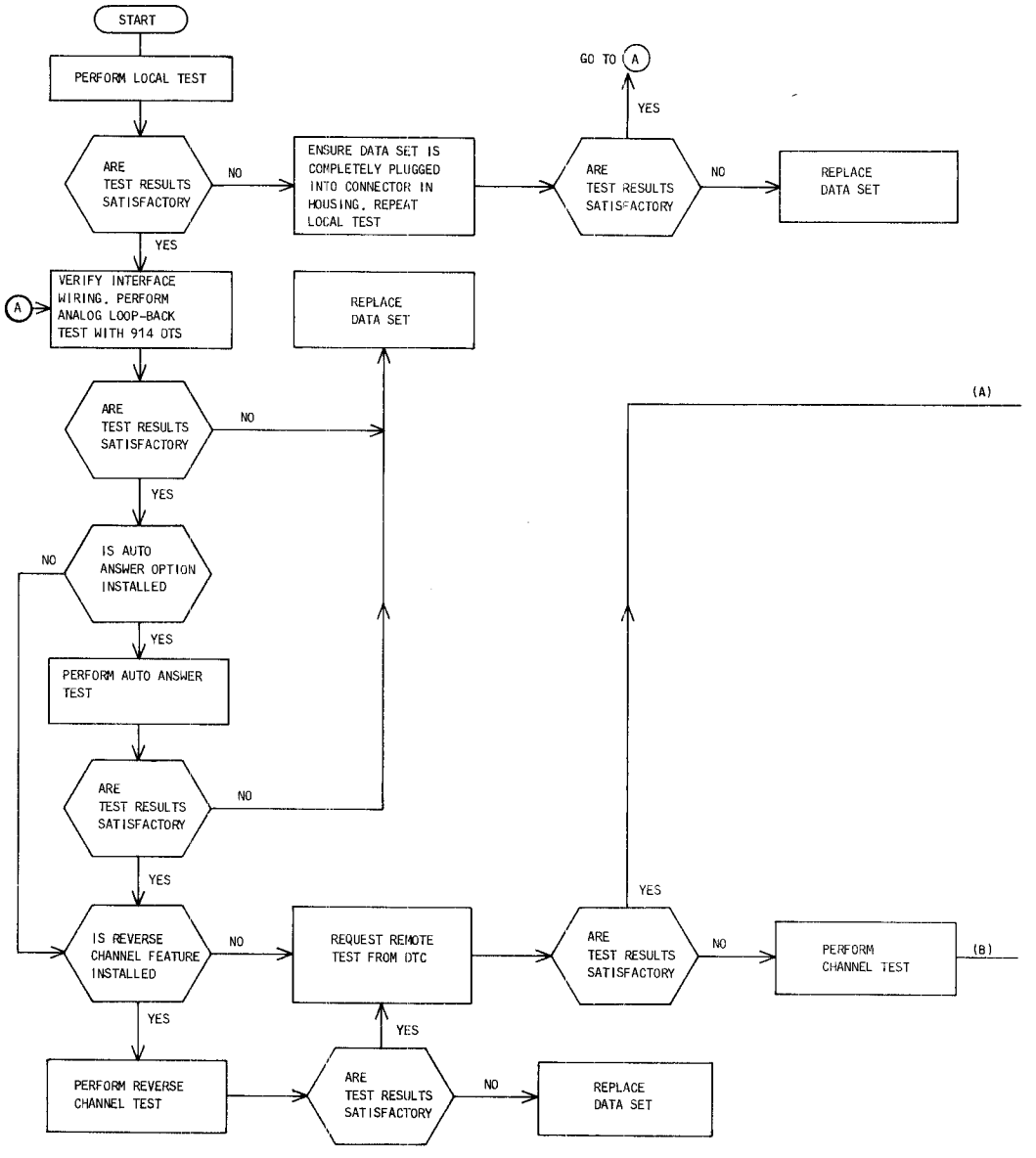


Fig. 6—Maintenance Test Flowchart (Sheet 1 of 2)

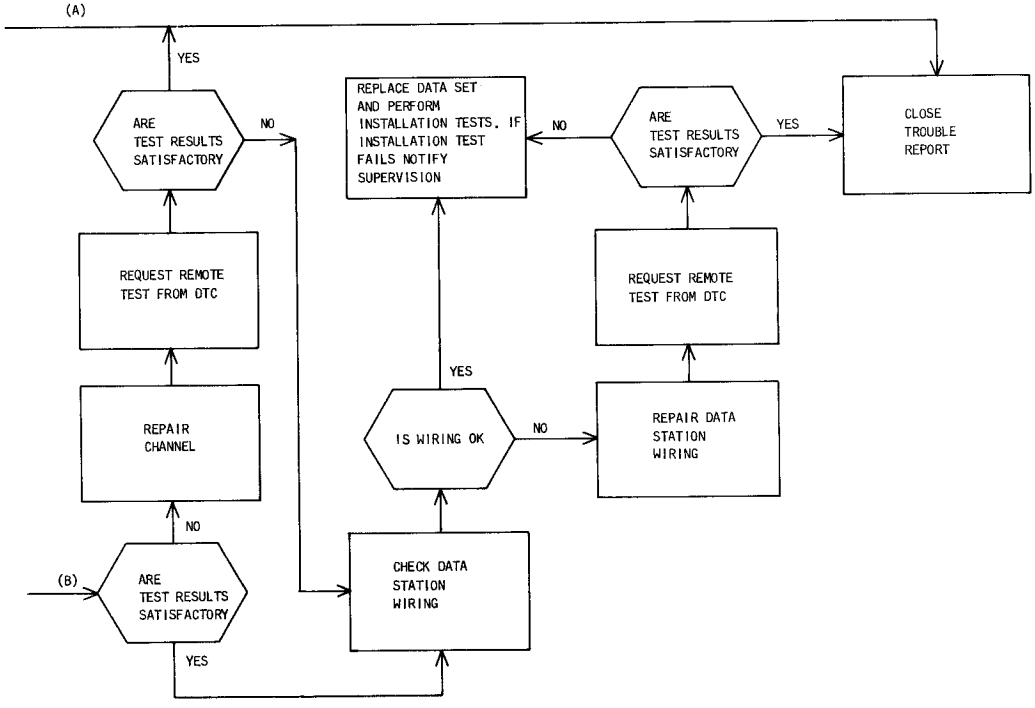


Fig. 6—Maintenance Test Flowchart (Sheet 2 of 2)

DATA SET 202S

TRANSMITTER-RECEIVER

TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 202S. Test procedures using the 914-type DTS and the self-test capabilities of DS 202S are contained in Section 592-028-500. These procedures are to be used when testing DS 202S on an initial installation or during a maintenance visit.

1.02 This section is reissued to add coverage for Version 2 of the 921A DTS. Since this reissue is a general revision, arrows normally used to indicate changes have been omitted.

1.03 Test circuitry built into DS 202S permits a local self test to be performed. The test circuitry also facilitates the remote test of the data set from a test center. Additional tests require the use of external test equipment such as the 921A DTS.

1.04 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C DTS for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory.

2.02 Before proceeding with the tests, verify that the local loop meets the requirements specified in Section 314-205-501. Refer to Fig. 2 for the installation test sequence.

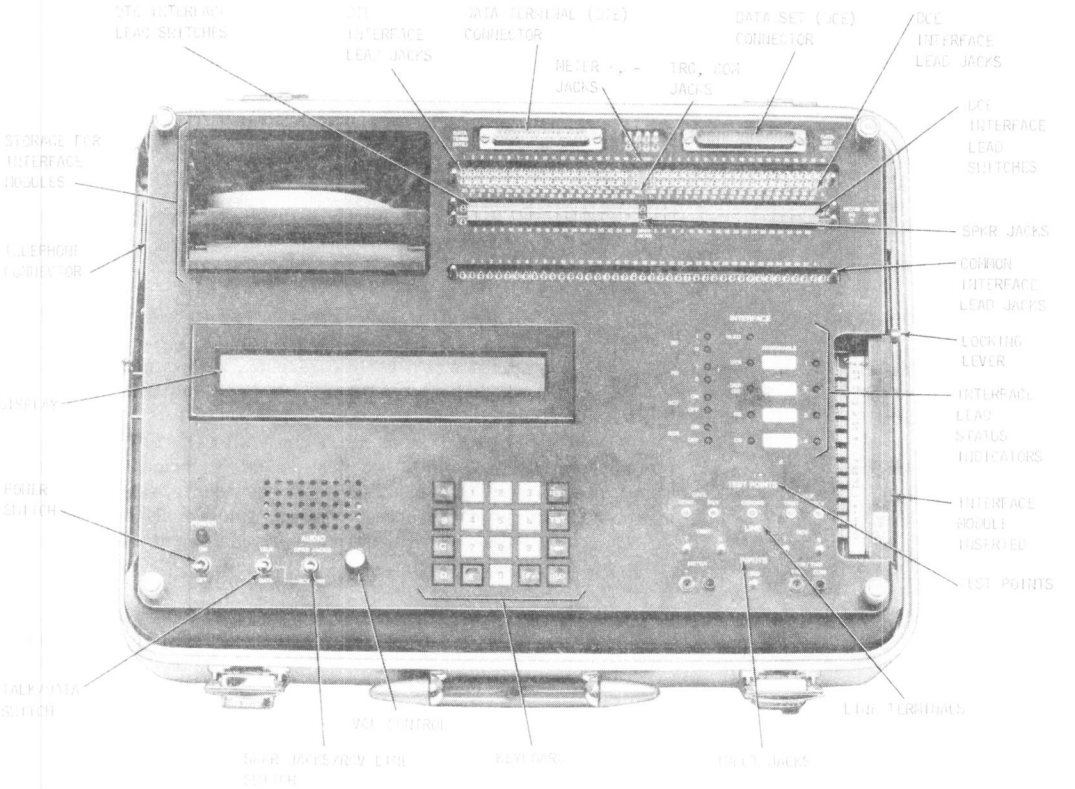


Fig. 1—921A Data Test Set—Front Panel

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed during a maintenance visit. This test sequence provides a method of isolating a trouble to the data set, the transmission facility, or the customer-provided equipment (CPE).

3.02 When a trouble report is received, a data test center (DTC) is responsible for isolating the trouble to the data set or transmission facility. The procedure for doing this is shown in Fig. 3.

3.03 If it is suspected that the trouble is in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests at the data station. The following equipment should be taken on a trouble visit:

- Spare data set
- 921A DTS.

3.04 Refer to Fig. 4 for the sequence in which tests are to be performed by the telco employee at the data station. If the data set is replaced, the defective data set should be tagged with a description of the trouble, carefully packed, and returned to the service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists, proceed as follows.

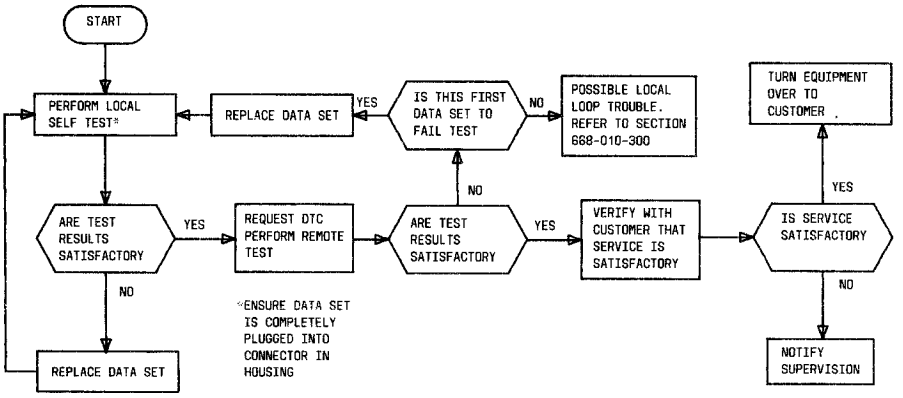


Fig. 2—Installation Test Sequence

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that CPE has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

A. Local Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back internally from the transmitter output to the receiver input. The received data is compared to the original data. Under normal conditions, all the data set indicator lamps are lighted; however, if an error is detected, the TM lamp goes off.

4.03 Perform the test as follows.

(1) Ensure that data set is not transmitting or receiving data.

(2) Firmly depress and hold LT switch for at least 15 seconds.

Note: If LT switch is depressed slowly, TM lamp may go off in a nondefective data set.

Requirement: TM lamp remains lighted while LT switch is depressed.

(3) If requirement specified in (2) is not met, repeat (2) four more times.

Requirement: TM lamp remains lighted during all four repeats.

B. Remote Test

4.04 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

4.05 Perform the test as follows.

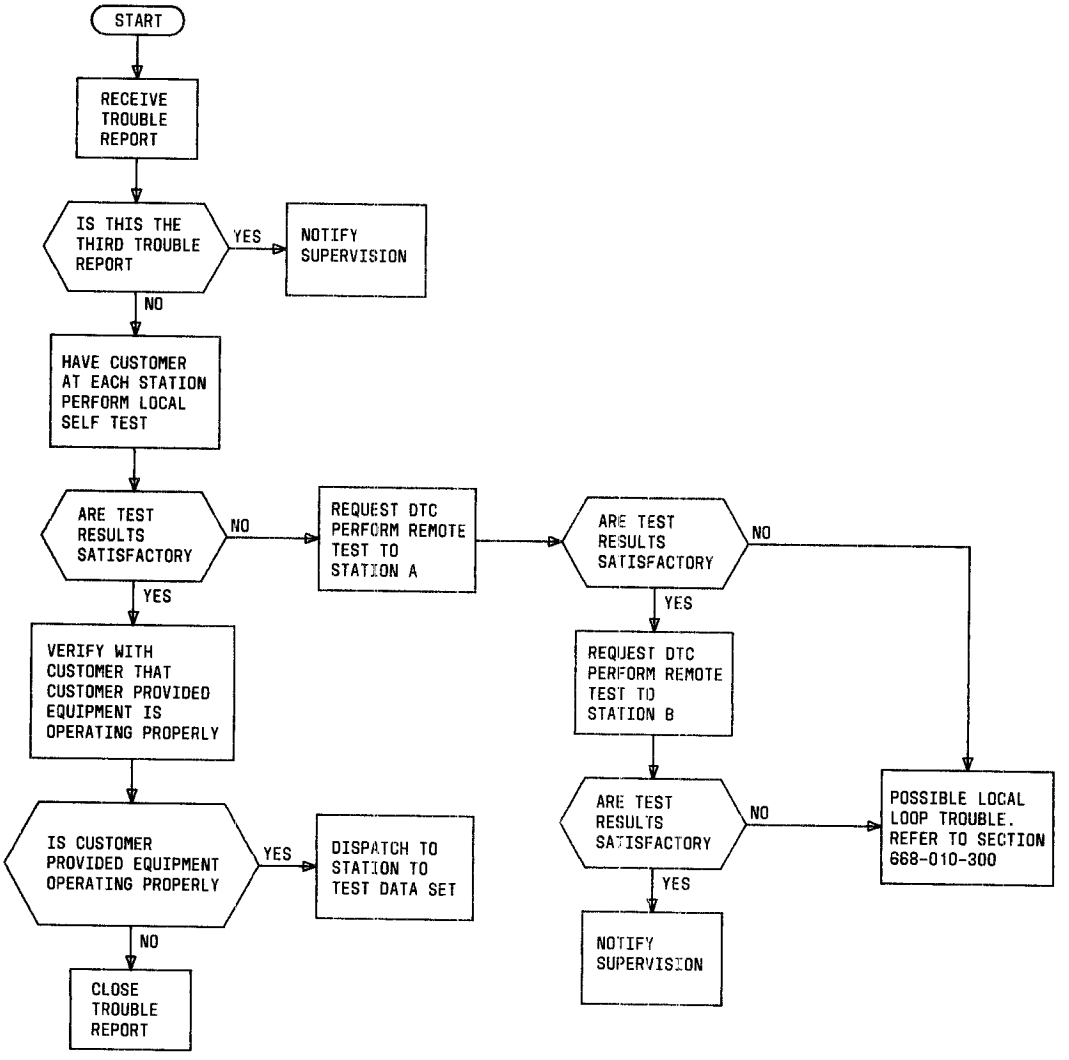


Fig. 3—Clearing Trouble Report

(1) Contact test center and request a remote test.

(2) When directed by test center, depress RT switch.

Requirement: On data set, all indicator lamps are lighted.

(3) Test center performs remote test.

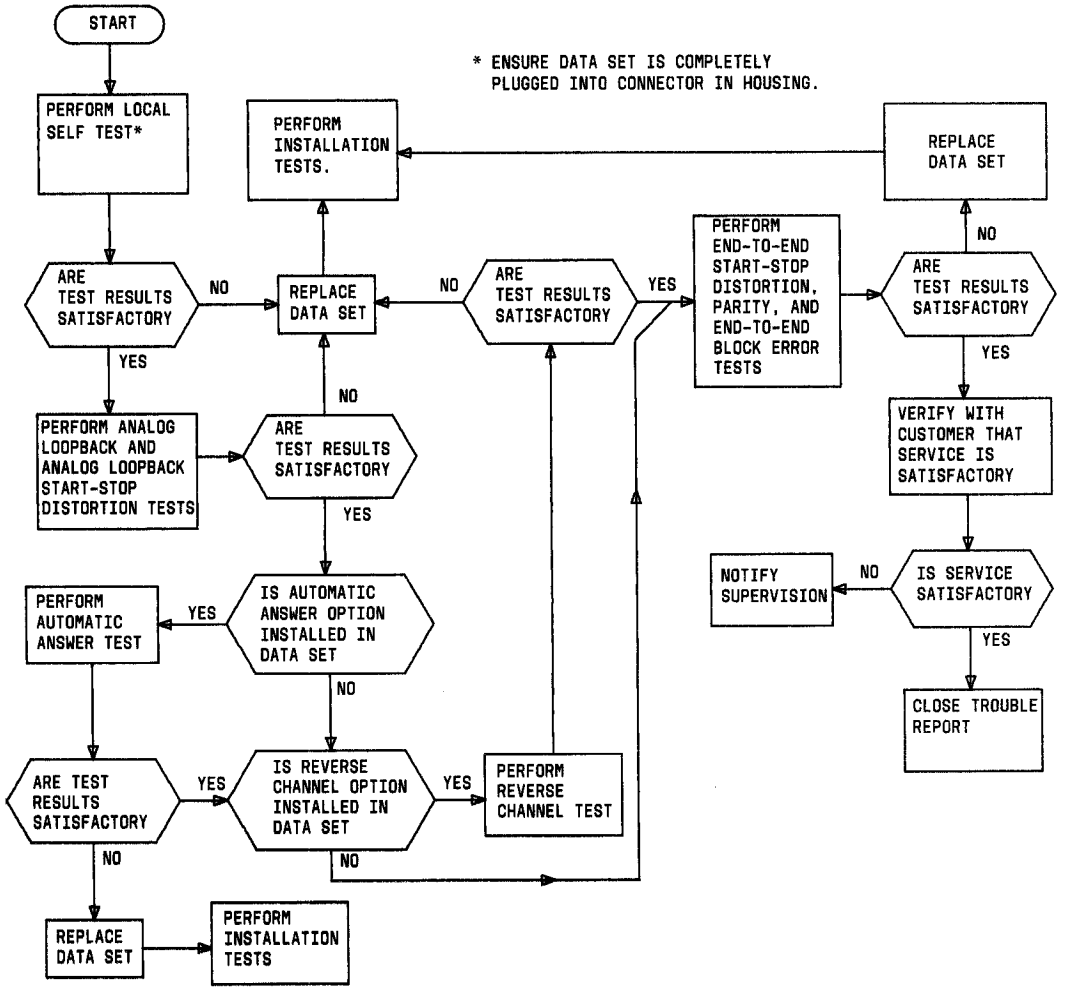


Fig. 4—Maintenance Test Sequence

(4) When directed by test center, release RT switch.

Requirement: TM lamp goes off.

C. Initial Test Setup for 921A DTS

4.06 Perform the initial test setup for the 921A DTS when used to test DS 202S as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a female 37-pin connector and a male 25-pin connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED. If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position except that switch 11 is in OPEN position.	
11	Enter 24 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (◀).	Display reads— DATA SET: 24

STEP	ACTION	VERIFICATION
12	Press GO.	Display reads— BIT RATE:
13	Enter 12.	Display reads— BIT RATE: 12
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:
15	For Version 1 DTS, set DCE interface lead switch 20 to OPEN and connect a jumper wire between DCE interface lead jacks 9 and 20.	

D. Analog Loopback Test

4.07 In this test, an analog loopback block error run is performed, the CA-CB (RS-CS) interval is checked, and the CA-CF (RS-RLSD) interval is checked. The reverse channel is also checked if it is installed in the data set. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display. The CA-CB interval check measures the interval between the time the request-to-send lead is turned ***on*** and the clear-to-send lead turns ***on.*** The CA-CF interval check measures the interval between the beginning of the line signal and the ***on*** condition of the received line signal detector lead.

4.08 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.06 has been performed. ***Note:*** If GO or TST is pressed at an unauthorized point in the following tests, the test in progress is ended and the DTS recycles to the start of that test (last preceding step that display read TEST SEQ:).	Display reads— TEST SEQ:
Block Error Run		
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
5	Enter 1.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903

STEP	ACTION	VERIFICATION
		Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
6	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
7	Enter 2.	Display reads— ????? BITS IN A BLOCK
8	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
9	Enter 0060. ***Note:*** To perform functions listed below, press associated key.	Display reads (briefly)— 0060 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.
E	Inject 8 errors into data stream.
F	Force out-of-sync condition.

10	Press TST.	Display reads— TEST SEQ:

Clear-to-Send Interval Test

11	Enter 30.	Display reads— TEST SEQ: 30
12	Press GO.	Display reads RS-CS (CA-CB) interval in milliseconds.

STEP	ACTION	VERIFICATION
	Note 1: Only the option actually installed in the data set need be tested.	***Requirement:***
	Note 2: To repeat test, press A.	Option M—7 to 9 ms Option K—28 to 32 ms Option J—56 to 64 ms Option G—170 to 191 ms
13	Press TST.	Display reads— TEST SEQ:
Received Line Signal Detector Interval Test		
14	Enter 31.	Display reads— TEST SEQ: 31
15	Press GO.	Display reads RS-RLSD (CA-CF) interval in milliseconds.
	Note 1: Only the option actually installed in the data set need be tested.	***Requirement:***
	Note 2: To repeat test, press A.	Option Q—5.7 to 8 ms Option N—19 to 22 ms
16	Press TST.	Display reads— TEST SEQ:
Analog Loopback Reverse Channel Test (Does Not Apply to DS 202S-L1)		
	Note: If reverse channel is not installed in data set, omit Steps 17 through 27.	
17	Enter 47 48 38 47.	Display reads— TEST SEQ: 47 48 38 47
18	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
19	Enter 05 09.	Display reads (briefly)— SW CONN: X=05 Y=09 Display then reads— SW CONN: X=?? Y=??
20	Enter 15 10.	Display reads (briefly)— SW CONN: X=15 Y=10 Display then reads SW CONN: X=?? Y=??

STEP	ACTION	VERIFICATION
21	Enter 16 11.	Display reads (briefly)— SW CONN: X=16 Y=11 Display then reads— SW CONN: X=?? Y=??
22	Enter 10 05. ***Note:*** Steps 19 through 22 conditioned DTS to control request-to-send (S1), secondary request-to-send (S2), and data terminal ready (S3), and to monitor secondary received line signal detector on ASSIGNABLE 1 indicator.	Display reads (briefly)— SW CONN: X=10 Y=05 Display then reads— SW CONN: X=?? Y=??
23	Press GO. ***Note:*** S1 is controlled by key 1; S2 is controlled by key 2; S3 is controlled by key 3. S4 is not used.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads state of controlled switches. A typical display might read— S1=OFF S2=OFF S3=ON S4=OFF
24	Press keys 1, 2, and 3 until state of S1, S2, and S3 are as shown in verification. Disregard S4.	Display reads— S1=OFF S2=ON S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator lights.
25	Press key 1.	Display reads— S1=ON S2=ON S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator goes off.
26	Press keys 1 and 2.	Display reads— S1=OFF S2=OFF S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator remains off.
27	Press GO.	Display reads (briefly)— TEST INTERRUPTED. For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE

STEP	ACTION	VERIFICATION
		Display then reads— TEST SEQ:
28	On data set, release AL switch.	TM lamp goes off.

E. End-to-End Block Error Test

4.09 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

4.10 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 6.	Display reads— 63 BIT ERROR TEST
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— 63 BIT ERROR TEST

STEP	ACTION	VERIFICATION
	At receiving station, perform Steps 7 through 16.	
7	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
8	Enter 54.	Display reads— TEST SEQ: 54
9	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
10	Enter code for DTS at transmitting station.	Typical display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
11	Enter 6.	Display reads (briefly)— 63 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
12	Enter 2.	Display reads— ????? BITS IN A BLOCK
13	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
14	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
15	Enter 0900. ***Note:*** To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error.

STEP	ACTION	VERIFICATION
		If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 12.
16	If requirement in Step 15 is not met, press A to repeat test one time.	
17	Perform the end-to-end block error test in the opposite direction. The receiving station now becomes the transmitting station.	

F. Automatic Answer Test

4.11 This test uses the 921A DTS to verify that the data set will automatically answer a call, go to the data mode, and end the call.

4.12 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.06 has been performed, ***except omit Step 15.***	Display reads— TEST SEQ:
2	Enter 40.	Display reads— TEST SEQ: 40
3	Press GO.	Display reads— WAITING FOR RI
4	Place a call to data set from any convenient telephone set.	Display reads— RINGING (during ringing period—ring indicator lead ***on***). ASSIGNABLE 1 indicator follows ring indicator lead. After 3 complete ringing cycles, DTR indicator lights (data terminal ready lead ***on***). After several seconds, DSR indicator lights (data set ready lead ***on***). Display then reads— ANSWERED After several more seconds, DTR indicator goes off (data terminal ready lead ***off***). Then DSR indicator immediately goes off (data set ready lead ***off***).

STEP	ACTION	VERIFICATION
		Requirement: Display reads (briefly)— TEST PASSED

G. Reverse Channel Test

4.13 This test checks the interface circuits used with the reverse channel. The 921A DTS and a test center are required for the test. The test center must be capable of transmitting a 387-Hz tone to the data set and measuring the frequency of the tone received from the data set.

4.14 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
2	Enter 39.	Display reads— TEST SEQ: 39
3	Press GO.	Display reads— SRLSD IS OFF
4	Contact test center and request test center to send a 387-Hz tone at -12 dBm at the 0 TLP.	Display reads— SRLSD IS ON After several seconds, display reads— SRS IS ON
5	Request test center to measure frequency of reverse channel tone received from data set.	***Requirement:*** 377 to 397 Hz

H. Analog Loopback Start-Stop Distortion Test (Version 2 and Higher DTS)

4.15 This test uses the 921A DTS to measure three types of start-stop distortion, as follows.

- Peak distortion
- Number of "hits" above a specified threshold
- Average bias distortion.

4.16 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 52 79.	Display reads— TEST SEQ: 52 79
4	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
5	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD)

STEP	ACTION	VERIFICATION
		Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2. ***Note:*** Ignore display, PRESS A TO START.	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
7	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
8	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
9	Enter 29.	Display reads (briefly)— HITS OVER 29% (MAX=49%) Display then reads— ???? SECONDS
10	Enter 0090 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test.	Display reads (briefly)— 0090 SECONDS Display then reads— PEAK=00% HITS=00/29 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results. ***Requirements:*** 1. Less than 29% peak distortion. 2. Less than 01/29 hits. 3. Less than 12% average bias distortion.
11	On data set, release AL switch.	TM lamp goes off.

I. End-to-End Start-Stop Distortion Test

4.17 This test uses the 921A DTS to measure three types of start-stop distortion, as follows.

- Peak distortion
- Number of "hits" above a specified threshold
- Average bias distortion.

4.18 Perform the test as follows.

Note: A 911-type DTS can be used at the distant data station.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-stop distortion test. ***Note:*** Procedure at transmitting station must be performed first.	
	At transmitting station, perform Steps 2 through 8.	
2	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
3	Enter 52.	Display reads— TEST SEQ: 52
4	Press GO.	For Version 1 DTS: Display reads— TRMT: 1=MAN 2=CONT For Version 2 and higher DTS: Display reads— PARITY=? (0=EVEN 1=ODD)
5	For Version 2 and higher DTS, enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2.	For Version 2 and higher DTS: Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
7	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START

STEP	ACTION	VERIFICATION
8	Press A.	For Version 1 DTS: Display reads— SENDING ASCII MESSAGE For Version 2 and higher DTS: Display reads (briefly)— CS MUST BE ON TO TRANSMIT Display then reads— SENDING MESSAGE
At receiving station, perform Steps 9 through 19.		
9	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
10	For Version 1 DTS, enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
11	For version 1 DTS, enter 0.	Display reads— TEST SEQ: 36 RS=0 (0 OR 1)
12	For Version 1 DTS, press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
13	Enter 79.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER ??%
14	For Version 2 and higher DTS, press GO.	Display reads— MODE=? (1=RCV 2=RCV & TRMT)
15	For Version 2 and higher DTS, enter 1.	Display reads (briefly)— MODE=1 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
16	Enter 35.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER 35% For Version 2 and higher DTS: Display reads (briefly)— HITS OVER 35% (MAX=49%) Display then reads— ???? SECONDS
17	For Version 1 DTS, press GO.	Display reads— ???? SECONDS

STEP	ACTION	VERIFICATION
18	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
19	Enter 0180 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A* Repeat test. B* Display time remaining in test. C Clear display. D* End test. * Version 2 and higher DTS.	Display reads (briefly)— 0180 SECONDS Display then reads— PEAK=00% HITS=00/35 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results. ***Requirements:*** 1. Less than 45% peak distortion. 2. Less than 04/45 hits. 3. Less than 15% average bias distortion.
20	Perform the end-to-end start-stop distortion test in the opposite direction. The receiving station now becomes the transmitting station.	

J. Parity Test

4.19 This test uses the 921A DTS to check the number of parity errors that occur in transmitting an ASCII format message.

4.20 Perform the test as follows.

Note: A 911-type DTS can be used at the distant data station.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a parity test. ***Note:*** Procedure at transmitting station must be performed first.	
	At transmitting station, perform Steps 2 through 8.	
2	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
3	Enter 52.	Display reads— TEST SEQ: 52
4	Press GO.	For Version 1 DTS: Display reads— TRMT: 1=MAN 2=CONT For Version 2 and higher DTS: Display reads— PARITY=? (0=EVEN 1=ODD)
5	For Version 2 and higher DTS, enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2.	For Version 2 and higher DTS: Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
7	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
8	Press A.	For Version 1 DTS: Display reads— SENDING ASCII MESSAGE For Version 2 and higher DTS: Display reads (briefly)— CS MUST BE ON TO TRANSMIT Display then reads— SENDING MESSAGE
At receiving station, perform Steps 9 through 15.		
9	Ensure that initial test setup described in paragraph 4.06 has been performed.	Display reads— TEST SEQ:
10	Enter 57.	Display reads— TEST SEQ: 57 ? (0=EVEN 1=ODD)
11	Enter 0.	Display reads (briefly)— TEST SEQ: 57 0 (0=EVEN 1=ODD)

STEP	ACTION	VERIFICATION
		Display then reads—
12	Press GO.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A.	Display reads— PARITY ERRORS=00 From this point, display counts number of parity errors.
15	Conduct test for about 3 minutes.	***Requirement:*** Less than 4 parity errors.
16	Perform the parity test in the opposite direction. The receiving station now becomes the transmitting station.	

5. REFERENCES

5.01 Additional information concerning the testing of DS 202S is contained in the following publications.

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-205-501	Data Systems—DATAPHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
592-028-100	Data Set 202S—Transmitter-Receiver—Description and Operation
592-028-150	Data Set 202S—Transmitter-Receiver—Supplementary Information
592-028-200	Data Set 202S—Transmitter-Receiver—Installation and Connections
592-028-500	Data Set 202S—Transmitter-Receiver—Test Procedures
680-010-300	Data Systems—DATAPHONE® Service on Direct Distance Dialing Network—Data Test Center—Trouble Analysis Procedures
999-100-141	Data Set 202S—How to Operate Manual

5.02 Detailed information concerning DS 202S is contained in CD- and SD-1D238-01.

DATA STATION USING DATA SET 202S
DESCRIPTION AND OPERATION

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section describes the physical and functional characteristics of a data station utilizing up to 24 data sets 202S mounted in 40A1 data mountings and intended to be housed in a KS-20018 cabinet. This arrangement is referred to in this section as a 202S data station.

1.02 This section is reissued for the following reasons:

(a) To add new arrangements using 830C, 2830C, 831C, and 2831C telephones

(b) To remove information concerning arrangements using 565HK and 2565HK telephones

(c) To indicate that arrangements using the 233A adapter and 631DA Call Director® telephone are not recommended for new installations.

Because this reissue constitutes a general revision, change arrows are not used.

1.03 The 202S data station (Fig. 1) will provide up to 1200 bps, serial, FSK, half-duplex data transmission over the switched telecommunications network for a maximum of 24 customer terminals.

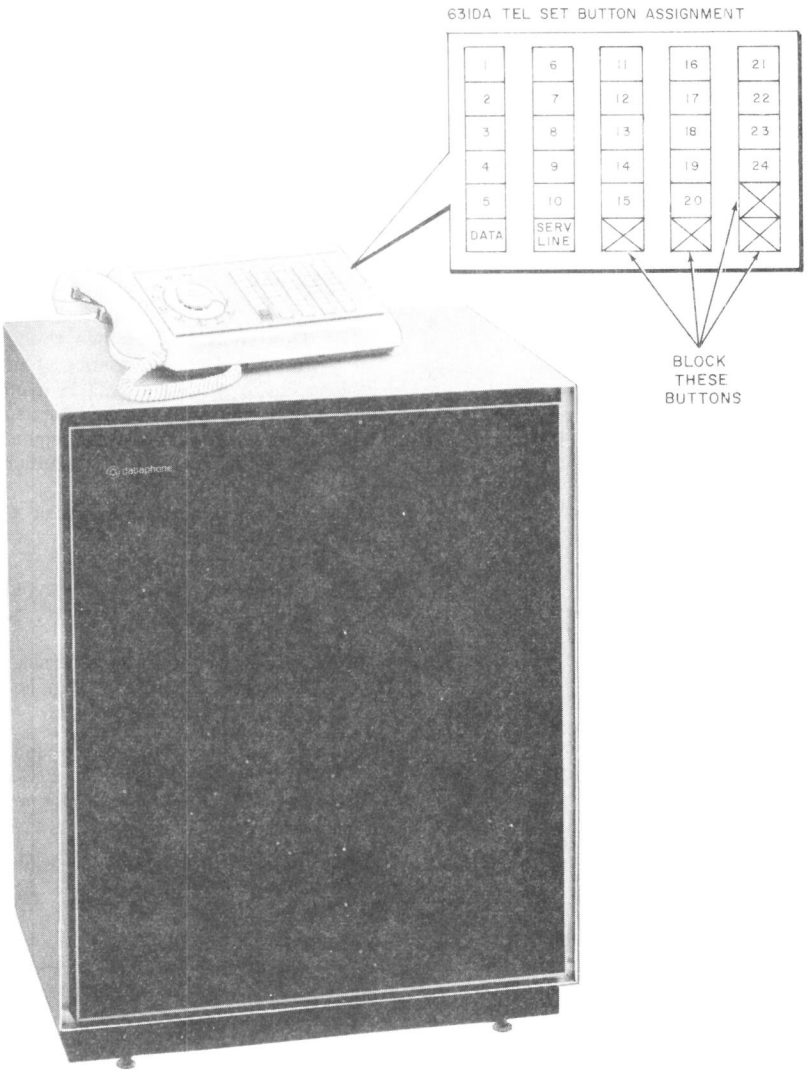


Fig. 1—202S Data Station

2. PHYSICAL DESCRIPTION

2.01 A 202S data station may be installed in one of the basic configurations listed in Table A and described in the text that follows. The choice of a particular configuration depends on customer requirements and expected growth.

TABLE A

DATA STATION CONFIGURATIONS

ARRANGE-MENT *	NUMBER OF DATA SETS	40A1 DATA MTG(S)	KS-20018 CABINET	TEL SET CODE	233A ADAPTER REQUIRED	NOTES
A	2-8	1	—L12A	830C	No	1
B	9-16	2	—L12A	831C	No	1
C	17-24	3	—L11A	1—830C 1—831C	No	1, 3
D	9-16	2	—L12A	631DA3	Yes	2
E	17-24	3	—L11A	631DA3	Yes	2

* These letter designations are not official and are used for explanation purposes in this section only.

Notes:

1. Recommended for new installations.
2. Not recommended for new installations.
3. Service line must be brought into the second tel set. The service line position in the first tel set must be blocked.
4. At least one data set must be in each data mounting so that TDG is connected to ground.

A. Data Set 202S

2.02 The basic data set 202S (coded 202S-L1 or L1A) is a printed wiring board measuring 1.5 inches high, 5.55 inches wide, and 10.4 inches long, and weighing 1.5 pounds. An optional reverse-channel circuit pack may be attached to the basic data set, adding approximately .25 pounds of additional weight. See Fig. 2. The data set with reverse channel is coded 202S-L1/3, L1/3A, or L1A/3A. Refer to Section 592-028-100 for a complete description of the data set.

B. 40A1 Data Mounting

2.03 The 40A1 data mounting shown in Fig. 3 accommodates up to eight data sets 202S-type (with or without reverse channel). The data mounting consists of a metal framework, an interconnection backplane assembly, and a power unit.

2.04 The 40A1 data mounting measures 6.9 inches high, 13.5 inches deep, and 22.9 inches wide, and weighs 20.75 pounds without data sets. The width may be shortened 4 inches by rotating the right-hand mounting bracket for mounting in a 19-inch framework.

2.05 The 24 Vac for each data set and the relays on the backplane are supplied by the power unit located on the left side of the mounting (Fig. 3). The power unit consists of an enclosure, 2 power transformers, a main fuse (type 70A), 16 output fuses (type 70G), and a 4-foot line cord. Each side of the center-tapped 24-Vac line to each data set is fused separately and labeled A for one side and B for the other; for example, the fuses for data set number 1 would be labeled 1 on fuse block A

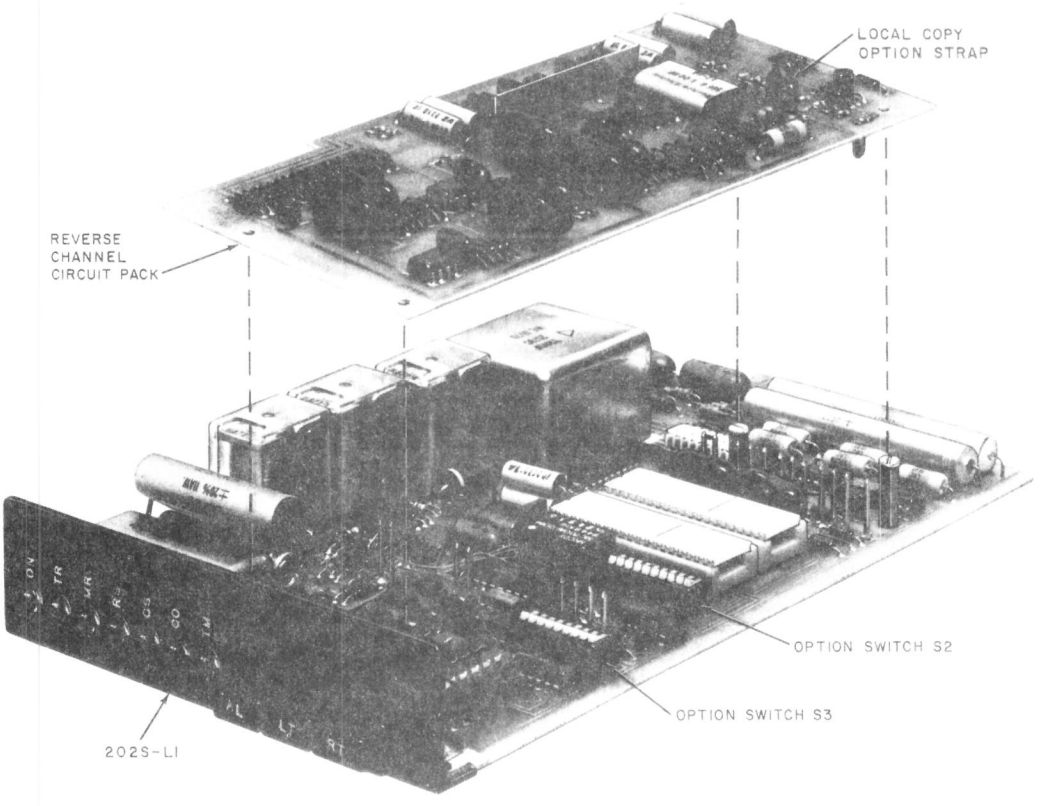


Fig. 2—Data Set 202S-L1/3

and 1 on fuse block B. The power requirement of a 40A1 data mounting containing eight data sets 202S is 50 watts at 105 to 129 Vac and 57 to 63 Hz.

2.06 The mounting is equipped with the circuitry needed for remote testing, connection to automatic calling units (ACUs), and operation behind line-hunting equipment. Each data set is inserted through guides in the top and bottom of the mounting into a 908L connector mounted at the rear of the mounting. The data sets are secured in the mounting by a retaining bar assembly which also serves as a labeling strip. The mounting brackets attached to the side of the housing will align with, and are fastened to, the upright supports in the KS-20018-L11A or -L12A cabinets.

2.07 Manual make-busy switches are provided for use in line-hunting arrangements where the customer desires to make one or more lines busy. The line is made busy when the switch is in the down position (refer to 3.11).

2.08 Interconnections to the data sets are made through the 908L connectors, which accept the contacts on the rear of the data sets. With the exception of power and ground leads (which are wired to the connector), all of the interface leads between the 908L connector, the customer interface connector, and the backplane of the

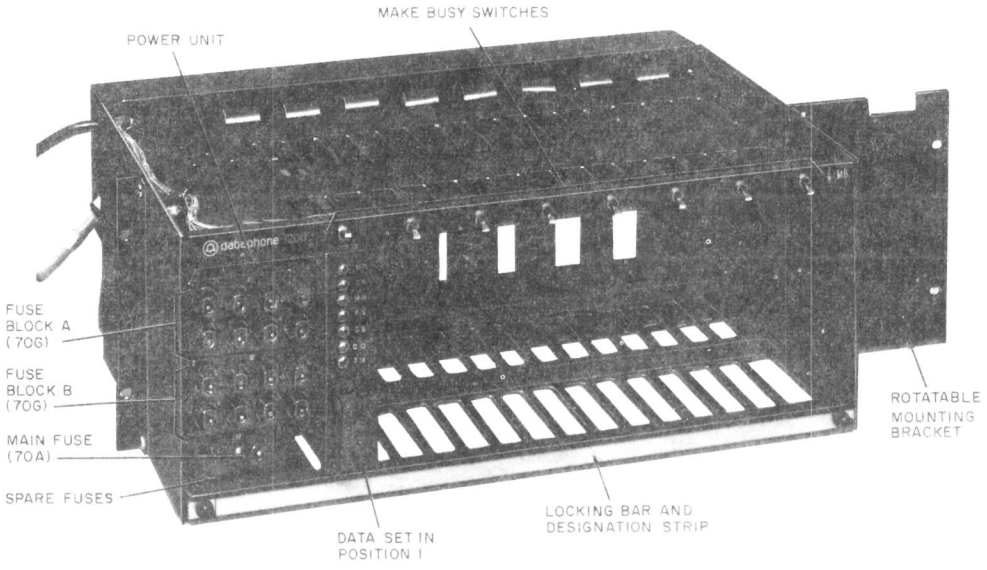


Fig. 3—40A1 Data Mounting (Front View)

mounting are via printed flex tape. Connections for tel set lights, talk-data control, and ACUs are provided on the backplane, where they may be accessed through 50-pin connectors J1 and J2 (Fig. 4). Data sets in positions 1 through 5 will be on J1, and 6 through 8 will be on J2 (except for ACU connections).

2.09 Access to the telephone lines is made through the 50-pin plug (P1) on the stub cable at the rear of the data mounting. This cable can be extended with a B25A cable.

2.10 The 40A1 data mounting does not provide circuitry for audible ringing. If this is needed, the circuits must be locally engineered utilizing the RD contacts available on the stub cable (P1) of the 40A1 data mounting.

C. KS-20018 Cabinet

2.11 The cabinet housing the 202S data station is either a KS-20018-L12A or KS-20018-L11A, depending on whether a maximum of two or three data mountings are installed or anticipated. The front cover on these cabinets is tinted plastic, which allows the illuminated light emitting diodes on the data sets to be seen from the outside. The cabinets have an opening in the rear for admitting the various cables. The cabinets may be secured to the floor by replacing the four leveling bolts with four appropriate 1/4-inch bolts or screws. Refer to the section entitled Data Sets—Multiple Installation Information (590-010-201) for additional information on KS-20018 cabinets.

D. Telephone Sets

2.12 Depending on the configuration, three types of telephone sets can be used with the 202S data station:

- 830C or 2830C
- 831C or 2831C
- 631DA or 2631DA.

The 830C (2830C) and 831C (2831C) telephones are recommended for all new installations and will be discussed first. The 631DA (2631DA) tel set is not recommended for new installations and is included

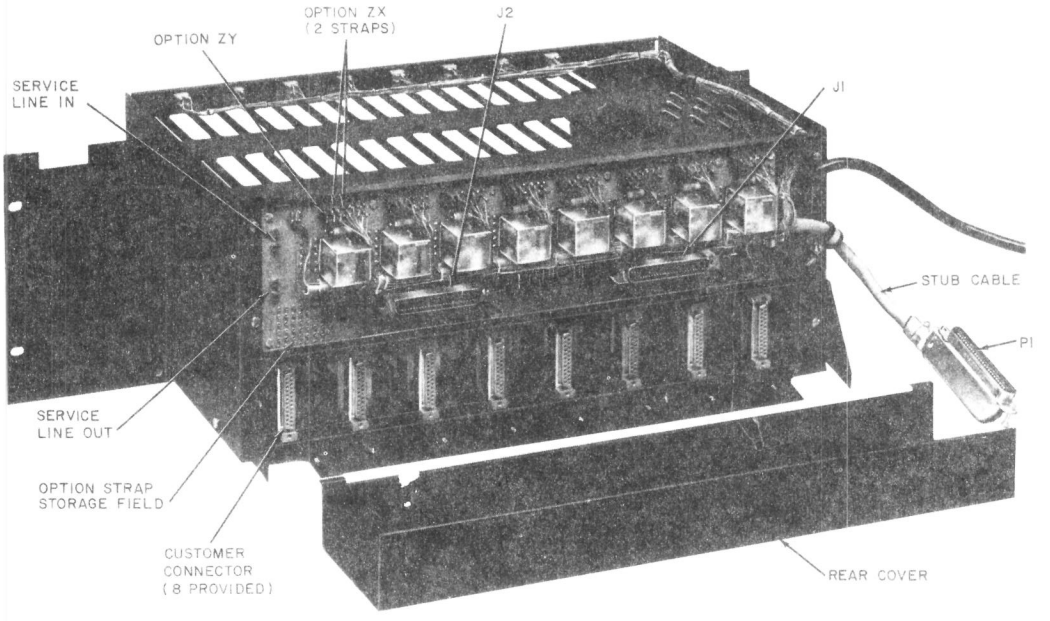


Fig. 4—40A1 Data Mounting (Rear View)

here for maintenance purposes at installations already in service.

2.13 The 565HK telephone can be used to connect a maximum of five individually housed data sets. Installation and connection information for individually housed data sets 202S-type is contained in Section 592-028-200. The 565HK telephone is not recommended for use with data sets 202S-type housed in a 40A1 data mounting.

2.14 ***830C or 2830C Telephone:*** This is a 10-button key telephone which can be used to control the voice/data transfer of up to 8 data sets. It is recommended for arrangements used with or without ACUs.

2.15 ***831C or 2831C Telephone:*** This is a 20-button key telephone which can be used to control the voice/data transfer of up to 16 data sets. It is recommended for arrangements used with or without ACUs.

2.16 ***631DA or 2631DA Telephone:*** This is a 30-button Call Director telephone set which is used in conjunction with the 233A adapter to handle the voice/data transfer functions of up to 24 data sets 202S-type. However, only 16 of the 24 data sets can be provided with ACUs.

E. 233A Adapter

2.17 The 233A adapter shown in Fig. 5 provides the necessary cross-connections between a maximum of 24 telephone lines and 24 data sets, permitting a "plug together" installation. Figure 6 shows a rear view of a data station with one mounting installed (eight data sets). The adapter consists of an 88-type wiring block with seven stub connector cables attached. Three pairs of the cables may be plugged into the data mountings (two per mounting), and the remaining cable is plugged into a 631DA or 2631DA Call Director telephone (if used). The adapter may be used with fewer than the maximum of 24 data sets by using only the appropriate connectors. It may also be used with a maximum of 16 ACUs by using open

terminals on the 233A adapter. The 233A adapter measures 10.6 inches long, 3.6 inches wide, and 3.25 inches high, excluding the cables and connectors.

3. FUNCTIONAL DESCRIPTION

3.01 The 202S data station provides a maximum of 24 interface circuits between the telephone line facilities and customer terminals. The 24 lines are interfaced to the data sets 202S by the 40A1 data mountings.

A. Service Line

3.02 When the data station is used behind line-hunting equipment, a service line is required for remote testing of the data sets. When an 830C (2830C), 831C (2831C), or a Call Director telephone is used, the service line appears on a pickup key.

3.03 The service line also appears on the SERVICE LINE OUT terminals at the rear of the 40A1 data mounting. When a data set is using the service line for remote test, the telephone set is excluded from the service line.

B. Typical 202S Data Station

3.04 The arrangements listed in Table A are described in 3.05 through 3.09.

Note: If the data station is installed with automatic calling and automatic answering and manual operation is not required, a telephone set or Call Director set need not be provided.

3.05 ***Arrangement A (2 to 8 Data Sets):*** This arrangement uses the 10-button 830C telephone. Position 1 is used for the talk/data transfer, positions 2 through 9 are for the data set positions, and position 10 is for the service line (if used). The 830C telephone connects to the 40A1 data mounting through a KS-19252-L5 adapter. If required, connections to ACUs are made on 1044A blocks which connect to KS-19252-L1 adapters with A25D cable.

3.06 ***Arrangement B (9 to 16 Data Sets):*** This arrangement uses 18 of the 20 buttons on an 831C telephone. Positions 1 through 8 and 12 through 19 are for the data sets. Positions 9 and

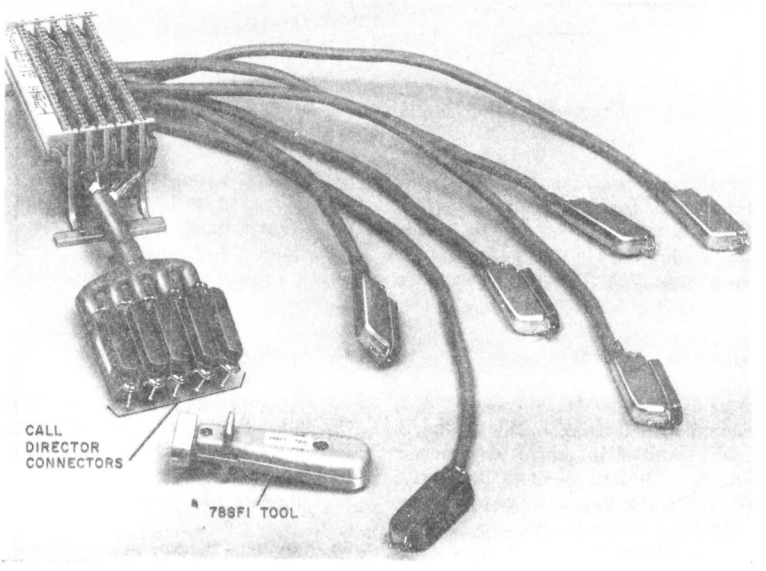


Fig. 5—233A Adapter

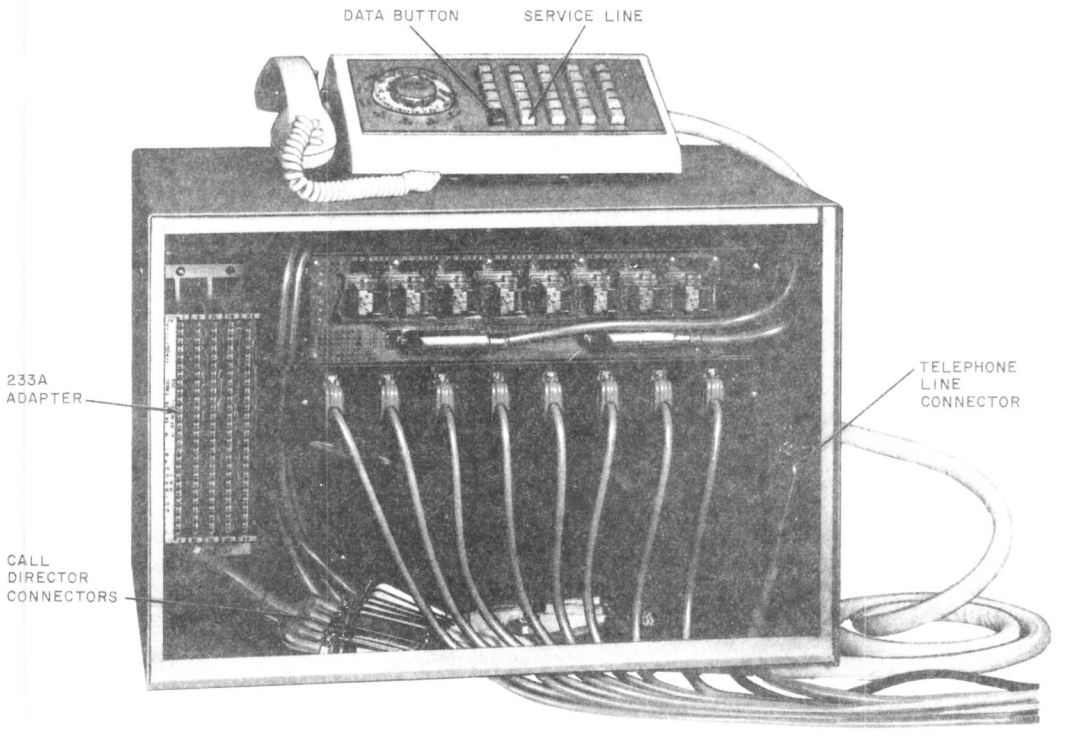


Fig. 6—202S Data Station—Rear Cover Removed

10 are blocked, position 11 is used for the talk/data transfer, and position 20 is for the service line (if required). The 831C telephone connects to the 40A1 data mountings through KS-19252-L5 adapters. If required, connections to ACUs are made on 1044A blocks which connect to KS-19252-L1 adapters with A25D cable.

3.07 ***Arrangement C (17 to 24 Data Sets):*** This is a combination of arrangements A and B. The 830C telephone is used to control data sets 1 to 8, and the 831C telephone is used to control data sets 9 to 24. The tenth button used for the service line on the 830C telephone must be blocked. If a service line is required, it must appear on the twentieth position of the 831C telephone. Connections to the 40A1 data mountings and to ACUs are made as described previously.

3.08 ***Arrangement D (9 to 16 Data Sets):*** This arrangement requires the 233A adapter and a 631DA3 Call Director telephone. The 233A adapter provides a plug-in access for the 631DA3 Call Director set as well as providing connecting points for ACUs.

3.09 ***Arrangement E (17 to 24 Data Sets):*** This arrangement is essentially the same as arrangement D with a third 40A1 data mounting added. However, this arrangement provides connections to ACUs for only the first 16 positions.

C. Remote Test Option

3.10 When the data sets are used behind line-hunting equipment, remote testing of the data set can be accomplished over the service line (option ZY IN). When line-hunting equipment is not used,

remote testing of the data sets can be accomplished over the assigned telephone line (option ZY OUT). There is one remote test relay on the backplane for each data set position. This relay is enabled when option ZY is installed and disabled when option ZY is removed. With the relay enabled, the data set is transferred from the assigned telephone line to the service line whenever the RT (remote test) button on the data set is depressed. In this case the data test center would call the number associated with the service line. With the relay disabled, the data set remains connected to the telephone line and would be accessed on that line by the data test center. Option ZY is installed by inserting a black strapping plug into the terminals above the relays on the backplane. Unused strapping plugs are stored in the storage field labeled SPARES.

Only one data set behind line-hunting equipment should be placed in remote test at a given time. Otherwise, serious service problems could result which will affect the operation of other data sets associated with the line-hunting equipment.

D. Make-Busy Option

3.11 When the data sets are used behind line-hunting equipment, it is sometimes necessary to make the line look busy to avoid tying up the line-hunting equipment. With option ZX installed, the make-busy feature is accomplished for terminate-only lines by connecting 196 ohms across the line when a toggle switch mounted on the framework above each data set position is operated, or when the test relay is operated during remote test. Without option ZX, the make-busy feature is provided for assigned lines by another pair to the central office. Third wire (sleeve) make-busy arrangements are provided by grounding one wire of the pair external to the data mounting. Even if the make-busy circuit is not installed, operation of the make-busy switch will disconnect the data set from the line. Care must be used to avoid accidental operation of these switches. The make-busy pairs appear at the stub cable on P1 of the 40A1 data mounting along with the tip data line pairs (Fig. 4).

3.12 Option ZX for each data set is installed by inserting two red strapping plugs into the terminals (labeled ZX) above the relays on the backplane.

E. Grounding Option

3.13 Frame ground is normally connected to signal ground in the data mounting (option ZI). The frame ground may be disconnected from signal ground (option ZJ) of each 40A1 data mounting by removing the strap from the screw terminals of TS2 located on the rear of the power unit.

4. OPERATION

A. Manual Operation

4.01 A call to or from the 202S data station is answered or placed manually by depressing the line key associated with the appropriate data set and then lifting the handset on the telephone set of Call Director telephone. This action places the telephone set or Call Director telephone in the talk mode. Transfer to the data mode is accomplished by depressing and releasing the DATA key and hanging up the handset. The lamp under the line key blinks at the rate of ringing until depressed and manually answered, or until the data set automatically answers and enters the data mode. The lamp glows steadily as long as the data set is in the data mode, then extinguishes when the line is dropped.

B. Automatic Answer

4.02 A data set in the 202S data station will automatically answer an incoming call if the following conditions are met:

- The data set has the automatic answer option installed.
- The customer is supplying a data terminal ready ON indication to the data set.

C. Operation With ACU

4.03 The ACU initiates a call in response to a call request from the terminal equipment. It seizes the telephone line, places the call, then waits to detect the answer tone from the called data set. After the ACU detects the answer tone, it transfers the line to the data set and causes it to enter the data mode.

D. Test Modes

4.04 Each data set 202S in the data station is capable of operation in the following three test modes, which are controlled by test keys on the data sets.

- Local self test
- Analog loop test
- Remote test.

The front panel of the KS-20018 cabinet must be removed in order to gain access to the test keys on the front panels of the data sets. For information on the operation of the data sets, refer to Section 592-028-100.

5. REFERENCES

5.01 The following BSPs contain additional information concerning the 202S data station.

SECTION	TITLE
590-010-201	Data Sets—Multiple Installation—Installation Information
590-102-131	40-Type Data Mounting—Identification
592-028-100	Data Set 202S—Transmitter-Receiver—Description and Operation
592-028-180	Data Set 202S—Summarizing Specification
592-860-200	Data Station Using Data Set 202S—Installation and Connections
598-010-100	Data Auxiliary Sets 801A1, 801A2, 801A3, and 801A4 for Automatic Calling—Description and Operation
598-010-101	Data Auxiliary Sets 801A5 and 801A6 for Automatic Calling—Description and Operation
598-010-200	Data Auxiliary Sets 801A1, 801A2, 801A3 and 801A4 for Automatic Calling—Installations and Connections
598-010-201	Data Auxiliary Sets 801A5 and 801A6 for Automatic Calling—Installation and Connections
598-010-500	Data Auxiliary Set 801A1, 801A2, 801A3, and 801A4 for Automatic Calling—Test Procedure
598-010-501	Data Auxiliary Set 801A5 and 801A6 for Automatic Calling—Test Procedures
598-012-100	Data Auxiliary Sets 801C1 and 801C2 for Automatic Calling—Identification and Operation
598-012-101	Data Auxiliary Sets 801C3 and 801C4—Description and Operation
598-012-102	Data Auxiliary Set 801C-L1/2—Description and Operation
598-012-200	Data Auxiliary Sets 801C1 and 801C2 for Automatic Calling—Installation
598-012-201	Data Auxiliary Sets 801C3 and 801C4—Installation and Connections
598-012-202	Data Auxiliary Set 801C-L1/2—Installation and Connection
598-012-500	Data Auxiliary Sets 801C1 and 801C2 for Automatic Calling—Test Procedures
598-012-501	Data Auxiliary Sets 801C3 and 801C4—Test Procedures
598-012-502	Data Auxiliary Set 801C-L1/2—Test Procedures

DATA STATION USING DATA SET 202S

INSTALLATION AND CONNECTION

CONTENTS PAGE

1. GENERAL

1.01 This section covers the installation and connection procedures to be followed when installing a data station utilizing data set 202S. This station will be referred to in this section as a 202S data station (Fig. 1).

1.02 This section is reissued primarily for the following reasons:

(a) Change Fig. 2 to add service line connections between data mountings.

(b) Change Fig. 5 to add detail mounting of 1044A and 66E3 connecting blocks

(c) Change Table A to reassign connections to central office

(d) Add arrangement utilizing the 830C and 831C telephone sets.

Due to extensive revision, change arrows are deleted.

1.03 The information in this section covers installation of the following station arrangements:

(a) For ***two to eight data sets,*** a 40A1 data mounting and a KS-20018-L12A cabinet, an 830C or 2830C telephone set (10-button), a KS-19252-L5 adapter, and ***with ACUs***, two KS-19252-L1 bridging adapters.

(b) For ***9 to 16 data sets***, two 40A1 data mountings and a KS-20018-L12A cabinet, plus:

- A 631DA-type Call Director telephone and a 233A adapter ***or***
- An 831C or 2831C telephone set (20-button), two KS-19252-L5 adapters, and ***with ACUs***, four KS-19252-L1 bridging adapters.

(c) For ***17 to 24 data sets***, three 40A1 data mountings and a KS-20018-L11A cabinet, plus:

- A 631DA-type Call Director telephone and a 233A adapter ***or***
- An 831C or 2831C telephone set, an 830C or 2830C telephone set, and three KS-19252-L5 adapters. If ACUs are provided, up to six KS-19252-L1 bridging adapters will be used.

Note: Telephone sets or Call Director telephones are not required at installations equipped for automatic answering or calling if manual operation or voice communication is not required. In this case, the adapters to interconnect the tel set or Call Director set with the 40A1 data mounting are not needed.

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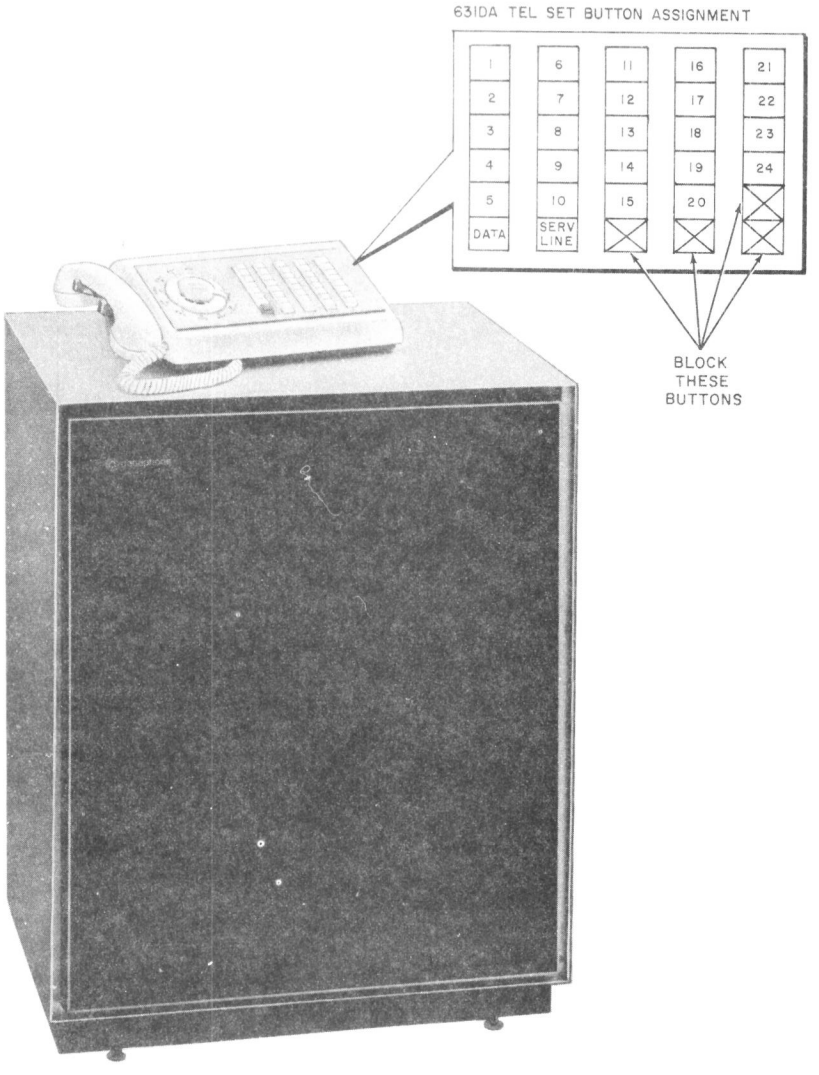


Fig. 1—202S Data Station

1.04 A 202S data station requires a standard 3-wire grounding-type ac power receptacle. The power supplied should be 105 to 129 volts and 57 to 63 Hz.

Note: The ac power receptacle must not be controlled by a switch.

1.05 The power supplies in the 40A1 data mountings use 70G (1/2 amp—red) and 70A (1-1/3 amp—white) fuses which may be easily replaced from the front of the unit. A blown fuse may be recognized by a protruding colored pin in the center of the fuse holder. Remove the fuses by rotating them counterclockwise and pulling out. Spare fuses are stored beneath the main power fuse on the power unit of the 40A1 data mounting.

1.06 In order to minimize the possibility of data errors due to potential differences between the data terminal ground and the data set ground, the receptacle supplying power to the data station should be served by the same distribution panel as the receptacle(s) powering the data terminal(s). If this arrangement is not possible, use a 6-type impulse counter to determine if excessive noise is present. The procedures for this test are given in Section 592-860-500. If the test requirements are not met, bond the data station frame ground and the terminal equipment frame ground together. In addition, frame ground must be connected to signal ground in the data mounting.

The method of providing the bond should be in accordance with local engineering instructions.

1.07 Verify with the plant service center that the overall facilities meet the requirements given in Section 314-205-501.

1.08 Verify that the location selected by the customer for the data station has adequate space for access to the front and rear of the cabinet. The data station should be located near the business machine, since the customer-provided interface cord should not exceed 50 feet in length (to reduce stray capacitance and to conform to Electronics Industries Association [EIA] standards). In order to minimize inductive interference with data signals, the telephone lines should not be carried in the same cable run as cable between the data set and the business machine ***or*** lines connected to teletypewriter services. If this condition cannot be met, the telephone lines should be run in type SK (shielded) station wire from the building entrance. The shield should be grounded at one end only, preferably the distribution terminal end.

1.09 A 202S data station operates in an ambient temperature between 40 to 120°F. The relative humidity should be 20 to 95 percent at 70°F or 20 to 40 percent at 120°F.

Note: These environmental conditions are valid only under the condition that no condensation occurs.

1.10 A KS-20018-L7 cabinet may be substituted for a KS-20018-L11A cabinet provided there is no requirement to see the indicators on the front of the data sets, and the ambient temperature does not exceed 100°F. If higher ambient temperatures are expected, remove the rear panel of the KS-20018-L7 cabinet.

1.11 Audible ringing is not available in the data mounting. If audible ringing is desired, this must be locally engineered using the RD contacts available on the stub cable (P1). The RD contacts appear on the 66E3 connector block as follows:

- Data Set No.1—Term. 42
- Data Set No. 2—Term. 44
- Data Set No. 3—Term. 46
- Data Set No. 4—Term. 48
- Data Set No. 5—Term. 41
- Data Set No. 6—Term. 43
- Data Set No. 7—Term. 45
- Data Set No. 8—Term. 47

2. OPTIONS

2.01 The 40A1 data mounting has three options:

- Remote test option
- Make-busy option
- Grounding option.

A. Remote Test Option

2.02 Remote test on the service line (option ZY IN) in installations with line-hunting equipment is installed by inserting a black strapping plug into the terminals designated ZY above the relay on the backplane. Spare strapping plugs are stored in the space designated SPARES on the lower left side of the backplane. Remote test on the assigned telephone line (option ZY OUT) is installed by removing the black strapping plug from the terminals designated ZY. Store the strapping plug in the SPARE field.

B. Make-Busy Option

2.03 Make-busy option ZX connects a shunt on the line when the make-busy toggle switch is operated. This option is installed by inserting two red strapping plugs into the terminals designated ZX above the relay on the backplane. The data mounting is provided from the factory with the straps in the option strap storage field.

Note 1: Use only on terminate-only lines.

Note 2: For other than terminate-only lines, third wire (sleeve) make-busy is accomplished without option ZX by connecting lead ME2 to frame ground and connecting lead MB1 to the proper central office equipment.

C. Grounding Option

2.04 The 40A1 data mounting is shipped from the factory with frame ground connected to signal ground (option ZI). Frame ground of the 40A1 data mounting may be disconnected from signal ground (option ZJ) by removing the strap from the screw terminals of TS2 located on the rear of the power unit. It may be necessary to loosen the EIA interface connector bracket on the backplane to access this option strap.

2.05 Information pertaining to the options that may be installed in a data set 202S is given in Section 592-028-200.

3. INSTALLATION

A. Common Equipment

3.01 This part gives general installation procedures for the equipment that may be used in an installation. Detailed procedures for installing the various configurations are given in parts 3B through 3E.

3.02 ***KS-20018 Cabinet:*** Position the cabinet in its permanent location and adjust the four leveling bolts until the cabinet is level, then tighten the locking nuts on the bolts. The outside dimensions of the cabinets are as follows:

- KS-20018-L11A: 30 inches high, 24 inches wide, and 19 inches deep
- KS-20018-L12A: 17 inches high, 24 inches wide, and 19 inches deep.

3.03 If the cabinet must be secured to the floor, remove the leveling bolts. Insert four 1/4-inch appropriate bolts or screws through the leveling bolt holes and into the floor.

3.04 ***79 Backboard:*** A KS-20018-L12A cabinet is to be equipped with one wooden 79 backboard, while a KS-20018-L11A is to be equipped with two. The backboards are used to mount the KS-19252 adapters or the 233A adapter and power outlet strip (if used) and as a fastening point for the various cables.

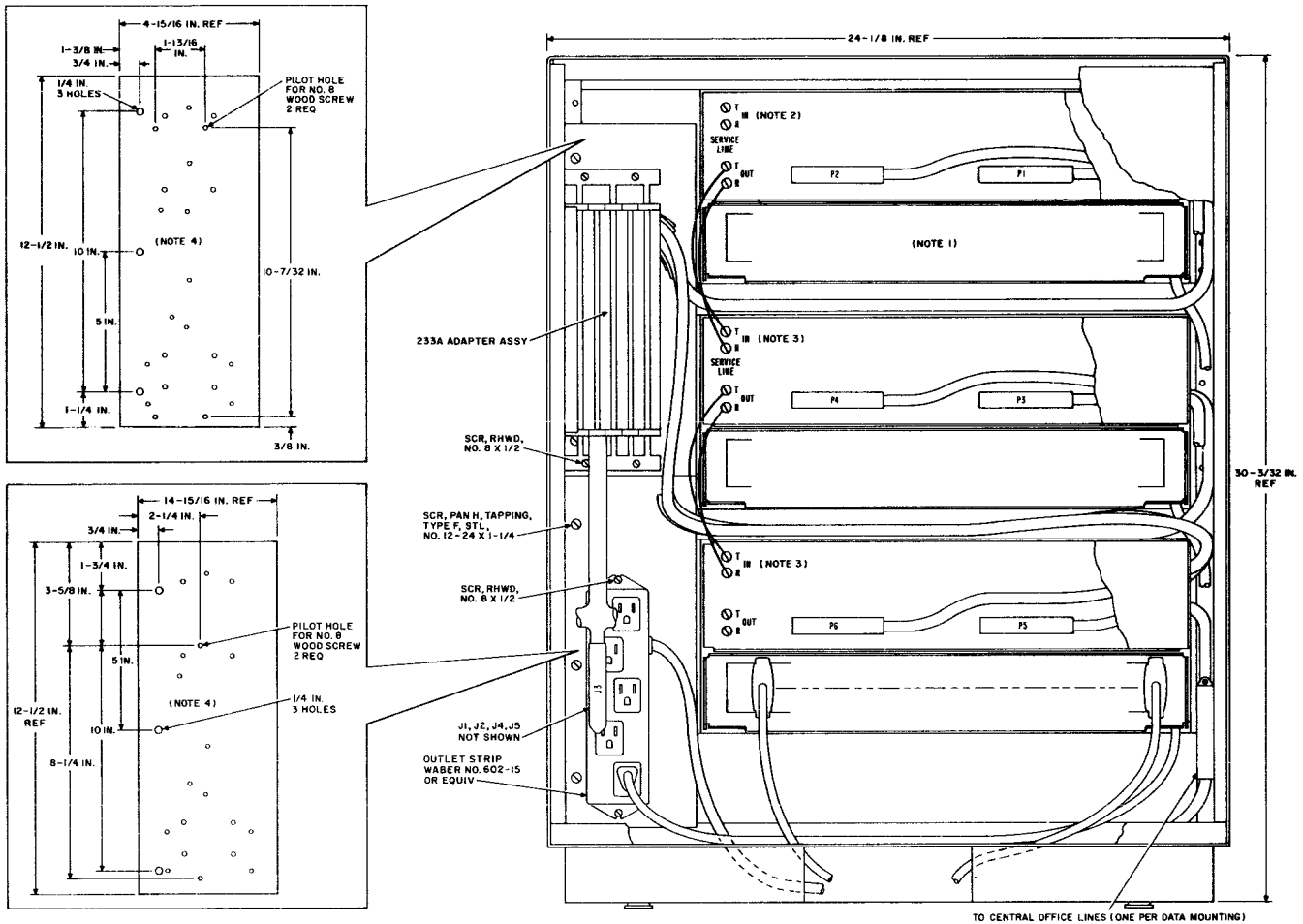
The 79 backboards must have holes drilled in accordance with the dimensions given in Fig. 2 if the 233A adapter is used.

3.05 Fasten the backboard(s) to the rear flange of the right-hand upright in the cabinet with three No. 12-24 × 1-1/4 inch steel screws (shipped loose with each data mounting).

3.06 ***40A1 Data Mounting:*** Rotate the right-hand mounting flange of the 40A1 data mounting for 23-inch mounting if this has not been done. Secure the 40A1 data mounting to the front flange of both uprights with four 12-24 × 1/2-inch screws (supplied with the data mounting).

Note: A long screw starter will facilitate the installation of the mounting in the cabinet.

3.07 If more than one 40A1 mounting is used, wire the SERVICE LINE OUT screw terminals of one to the SERVICE LINE IN screw terminals of the other, as shown in Fig. 2.



NOTES:

1. THE FIRST DATA MOUNTING IN THE CABINET MUST BE INSTALLED AT THE TOP. ADD DATA MOUNTINGS FROM THE TOP DOWN.
2. THE SERVICE LINE IN TERMINALS OF THE FIRST DATA MOUNTING ARE NOT USED.
3. THE SERVICE LINE OUT TERMINALS OF EACH DATA MOUNTING (EXCEPT THE LAST ONE) MUST BE CONNECTED TO THE SERVICE LINE IN TERMINALS OF THE SUCCEEDING DATA MOUNTING.
4. HOLES NOT DIMENSIONED ARE EXISTING HOLES IN THE 79 BACKBOARD.

Fig. 2—KS-20018 Cabinet With 233A Adapter (Rear View)

3.08 ***Data Set 202S:*** Before inserting the data set into the mounting, install options specified on the service order. To insert the data set into the mounting, first remove the designation/retainer strip from the 40A1 data mounting. Release the strip by pulling out on the black knob at each end. After the strip is moved out of the way, insert the data set into the appropriate slot and press firmly into place. Replace the designation/retainer strip.

Note: The data set positions are numbered from left to right from the front, that is, position 1 is nearest the power unit.

3.09 ***233A Adapter:*** Fasten the 233A adapter on the 79 backboard with four No. 8 × 3/4-inch, round-head woodscrews, (shipped with the 233A adapter). Refer to Fig. 2 for the dimensions of the holes that must be drilled in the 79 backboard and for the physical arrangement of the adapter. Make connections on the 88-type connecting blocks of the 233A adapter using a 788F1 tool (Fig. 3). The 233A adapter lead assignments for use with automatic calling units (ACUs) are shown on Fig. 4. Information concerning the 88-type connector block is contained in Section 631-050-120. Plug the Call Director telephone cord into the corresponding connectors on the 233A adapter.

3.10 ***KS-19252-L1 and -L5 Adapters:*** Fasten the adapters on the 79 backboard with two No. 8 × 1/2-inch round-head woodscrews.

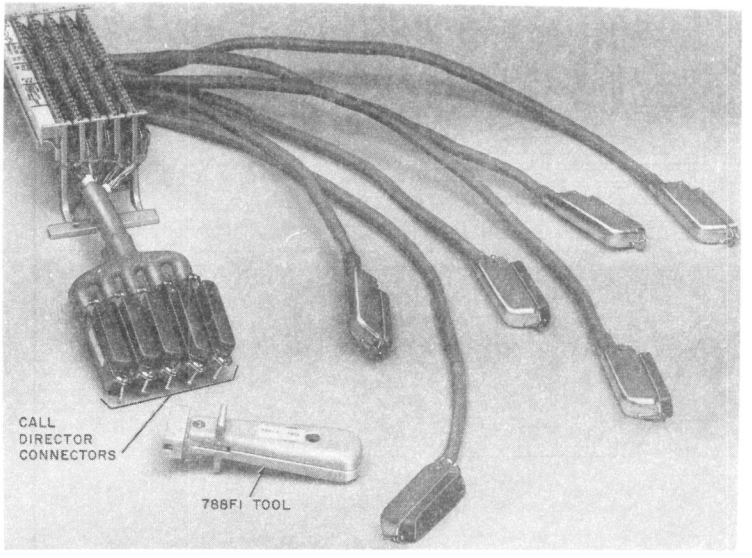
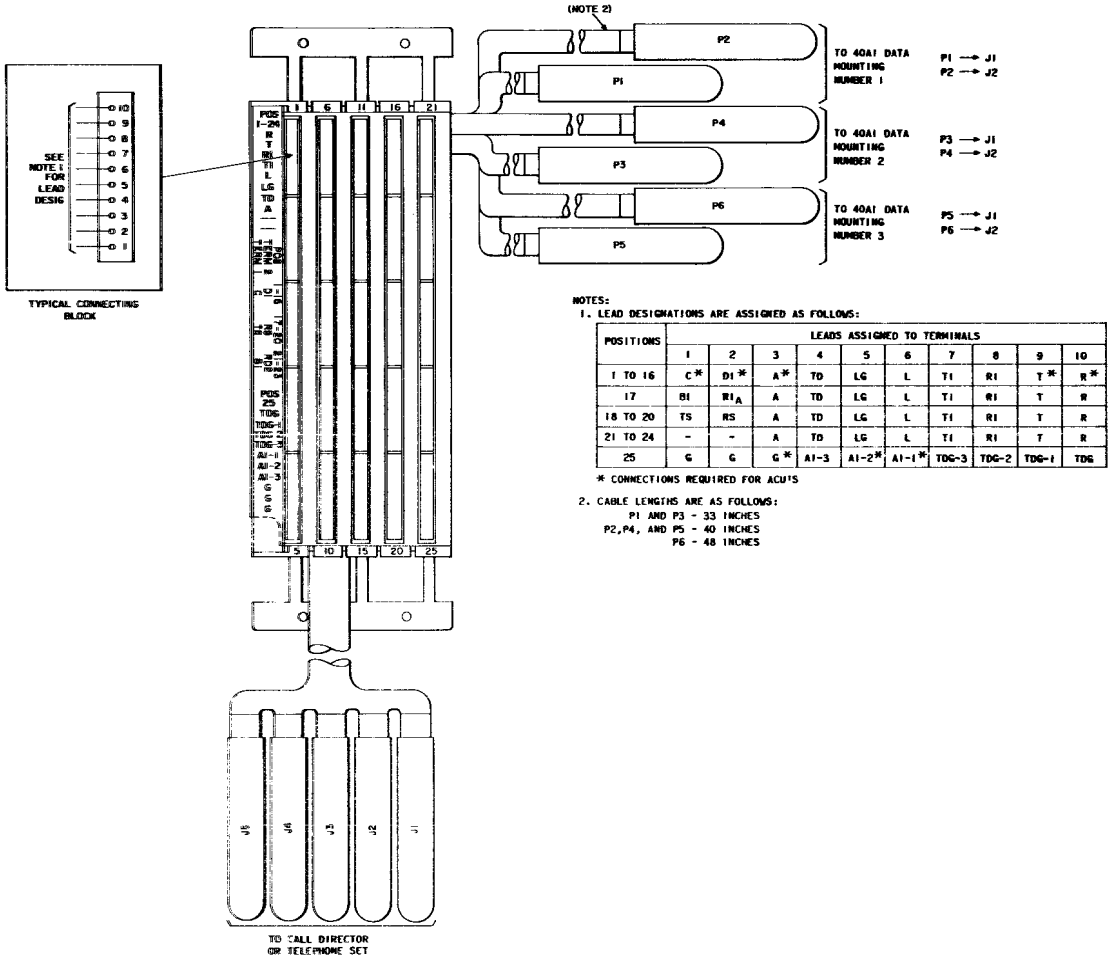


Fig. 3—233A Adapter



NOTES:

1. LEAD DESIGNATIONS ARE ASSIGNED AS FOLLOWS:

POSITIONS	LEADS ASSIGNED TO TERMINALS									
	1	2	3	4	5	6	7	8	9	10
1 TO 16	C*	DI*	A*	TD	LG	L	TI	RI	T*	R*
17	BI	RI_A	A	TD	LG	L	TI	RI	T	R
18 TO 20	TS	RS	A	TD	LG	L	TI	RI	T	R
21 TO 24	-	-	A	TD	LG	L	TI	RI	T	R
25	G	G	G*	AI-3	AI-2*	AI-1*	TDG-3	TDG-2	TDG-1	TDG

* CONNECTIONS REQUIRED FOR ACU'S

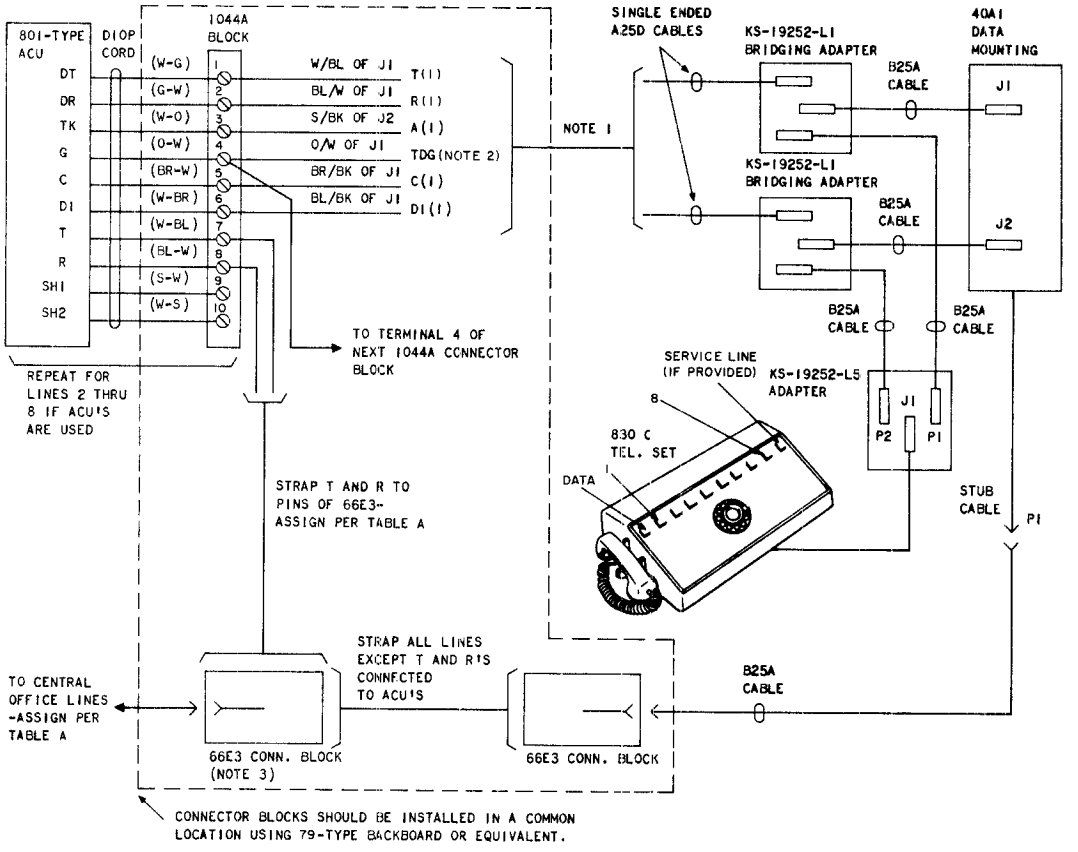
2. CABLE LENGTHS ARE AS FOLLOWS:
   P1 AND P3 - 33 INCHES
   P2,P4, AND P5 - 40 INCHES
   P6 - 48 INCHES

Fig. 4—Lead Assignments on 233A Adapter

3.11 *Automatic Calling Units (ACUs):*

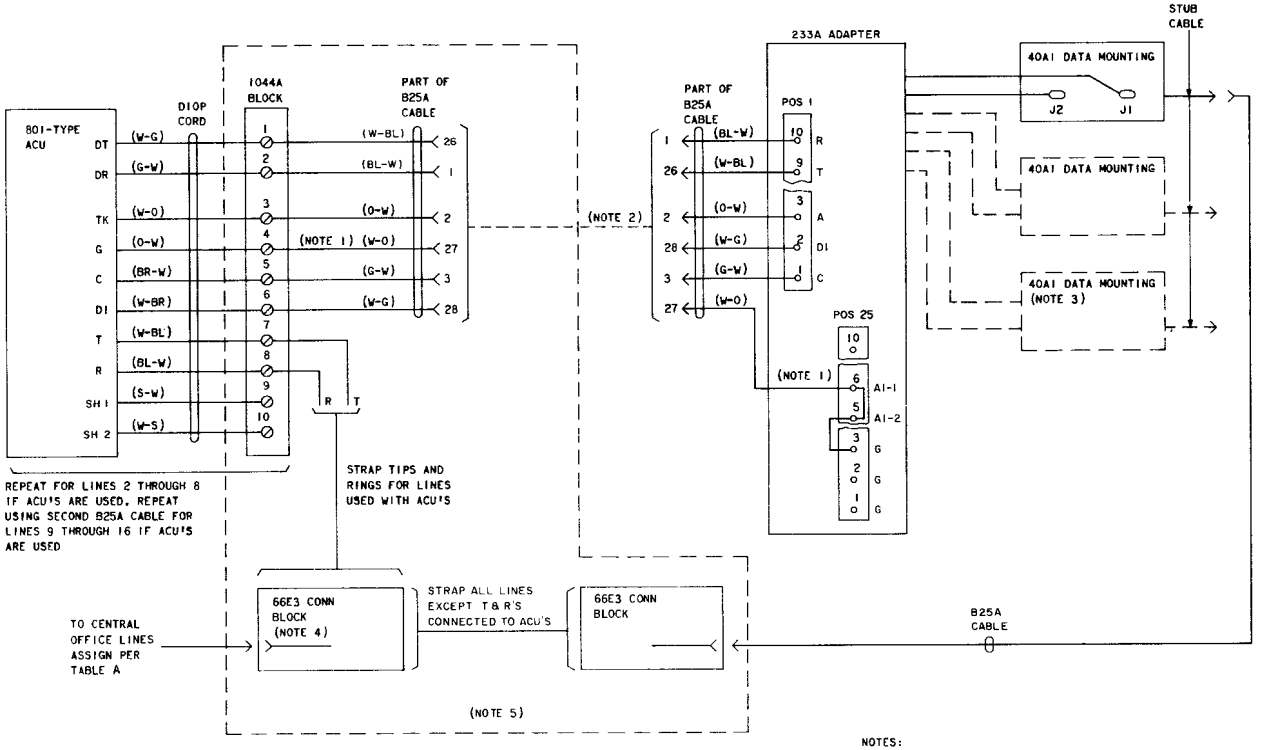
(a) If an 830C or 831C telephone is used, connections to ACUs are made from KS-19252-L1 adapters to 1044A connecting blocks as shown in Fig. 5. Each position equipped with a data set can also be equipped with an ACU.

(b) If a 631DA-type Call Director telephone is used, connections to ACUs are made from the 233A adapter to 1044A connecting blocks as shown in Fig. 6. There are 25 connecting blocks (one block per position) on the upper level of the 233A adapter. ***Each block (or position) has 10 terminals which are numbered from bottom to top.***



NOTES:
1. CONNECTIONS INDICATED ASSUME AN ACU IS ASSIGNED TO DATA SET POSITION ONE OF THE 40A1 DATA MOUNTING. FOR SUCCEEDING POSITIONS ASSIGNED ACU'S, PICK UP FUNCTIONS AND CORRESPONDING A25D CABLE WIRE COLORS TO BE TERMINATED FROM TABLE A (PIN NO. VS COLOR IS SAME AS A25D CABLE).
2. THIS GROUND LEAD IS RUN FOR THE FIRST ACU ONLY. GROUNDS FOR SUCCEEDING ACU'S ARE CONNECTED TOGETHER AT TERMINAL 4 OF THE INDIVIDUAL 1044A CONNECTING BLOCKS.
3. USE LARGER 66-TYPE BLOCK IF A SECOND MOUNTING IS INSTALLED WITH DATA SETS TO BE USED WITH ACU'S.

Fig. 5—202S Data Station Arrangement for 6 to 8 Data Sets With 830C Tel Set and ACUs



NOTES:

1. THIS GROUND LEAD IS RUN FOR THE FIRST ACU ONLY. GROUNDS FOR SUCCEEDING ACU'S CAN BE CONNECTED TOGETHER AT TERMINAL 4 OF THE 1044A CONNECTOR BLOCK
2. THIS CAN BE A B25A CABLE CUT IN HALF. CONNECT HALF TO A MAXIMUM OF EIGHT 1044A CONNECTOR BLOCKS. CONNECT OTHER HALF TO 233A ADAPTER.
3. THIRD MOUNTING CANNOT BE WIRED FOR ACU'S.
4. USE LARGER 66-TYPE BLOCK IF MORE THAN ONE MOUNTING IS INSTALLED WITH DATA SETS TO BE USED WITH ACU'S
5. THE CONNECTOR BLOCKS SHOULD BE INSTALLED IN A COMMON LOCATION USING 79 BACKBOARD OR EQUIVALENT

Fig. 6—202S Data Station Utilizing 233A Adapter With Automatic Calling Units

3.12 On systems using the 631DA-type Call Director telephone, ACUs can be connected to the ***first 16*** lines of the data station. Make the connections on the 233A adapter and 1044A connector blocks as shown in Fig. 6. Terminal 6 of position 25 on the 233A adapter is the common ground connection for the data station. If terminals 1 and 2 on position 25 are filled, make a parallel ground connection to the 1044A connecting block of an ACU that is already installed.

Note: The wire used to connect to the 233A adapter should be PE or PVC 22-, 24-, or 26-gauge solid copper wire.

3.13 ***830C or 2830C Telephone Set:*** If an 830C or 2830C tel set is used, insert plug number 2 of the tel set into the J1 connector of the KS-19252-L5 adapter of the first 40A1 data mounting. Insert plug number 1 into the J1 connector of the KS-19252-L5 adapter of the second 40A1 data mounting. Plug P1 and P2 of the adapter into J1 and J2 of the 40A1 data mounting, respectively, using B25A cables (Fig. 7).

3.14 ***831C or 2831C Telephone Set:*** If an 831C or 2831C tel set is used, plug it into J1 of the KS-19252-L5 adapter. Plug P1 and P2 of each KS-19252-L5 adapter into J1 and J2 of the 40A1 data mountings (Fig. 8 and 9). Positions 9 and 10 on the tel set must be blocked.

B. Two to Eight Data Sets

3.15 The following equipment is included in this arrangement:

- One KS-20018-L12A cabinet
- One 79 backboard
- One 40A1 data mounting
- One KS-19252-L5 adapter
- Two KS-19252-L1 bridging adapters for installations using the 830C tel set and ACUs
- One 1044A block for each ACU installed
- One outlet strip (Waber No. 602-15, or a 1A2 power panel, or equivalent)

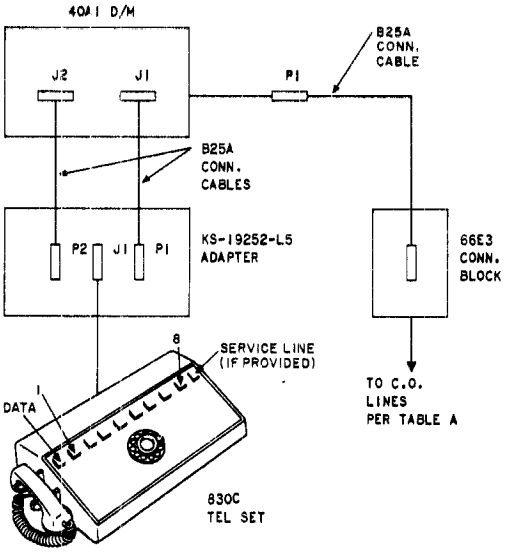


Fig. 7—2025 Data Station Arrangement for 6 to 8 Data Sets With 830C Tel Set

- Maximum of eight data sets 202S
- One 830C tel set or 2830C tel set
- B25A and A25D cables.

3.16 Proceed as follows.

(1) Install the cabinet per 3.02 and 3.03.

(2) Install the 79 backboard per 3.04 and 3.05.

(3) Install the 40A1 data mounting per 3.06.

(4) Install the options for the data sets and data mounting.

(5) Install the data sets per 3.08.

(6) Install the KS-19252-type adapters per 3.10.

(7) If ACUs are required, install per 3.11.

(8) Install the telephone set per 3.13.

(9) Install the outlet strip.

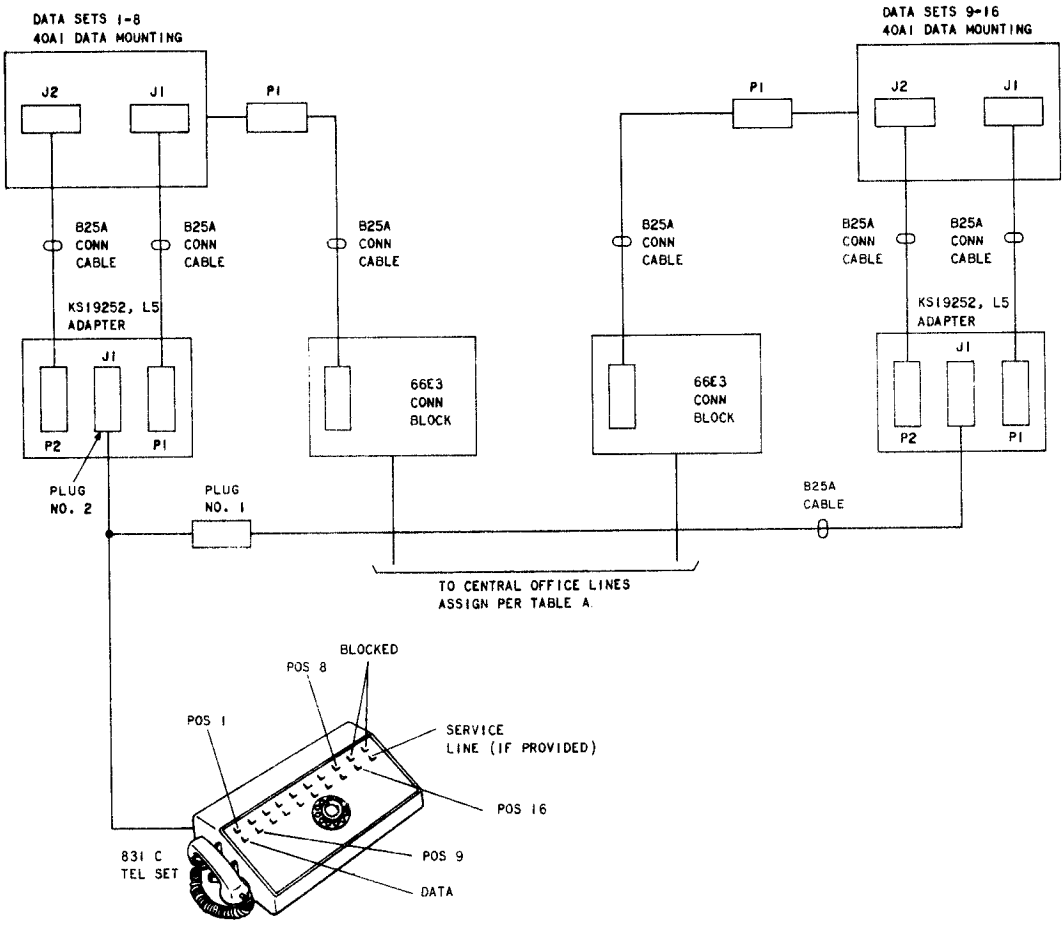


Fig. 8—202S Data Station Arrangement for 9 to 16 Data Sets With 831C Tel Set

(10) Connect lines from the central office to the stub cable on the 40A1 data mounting as specified in Table A.

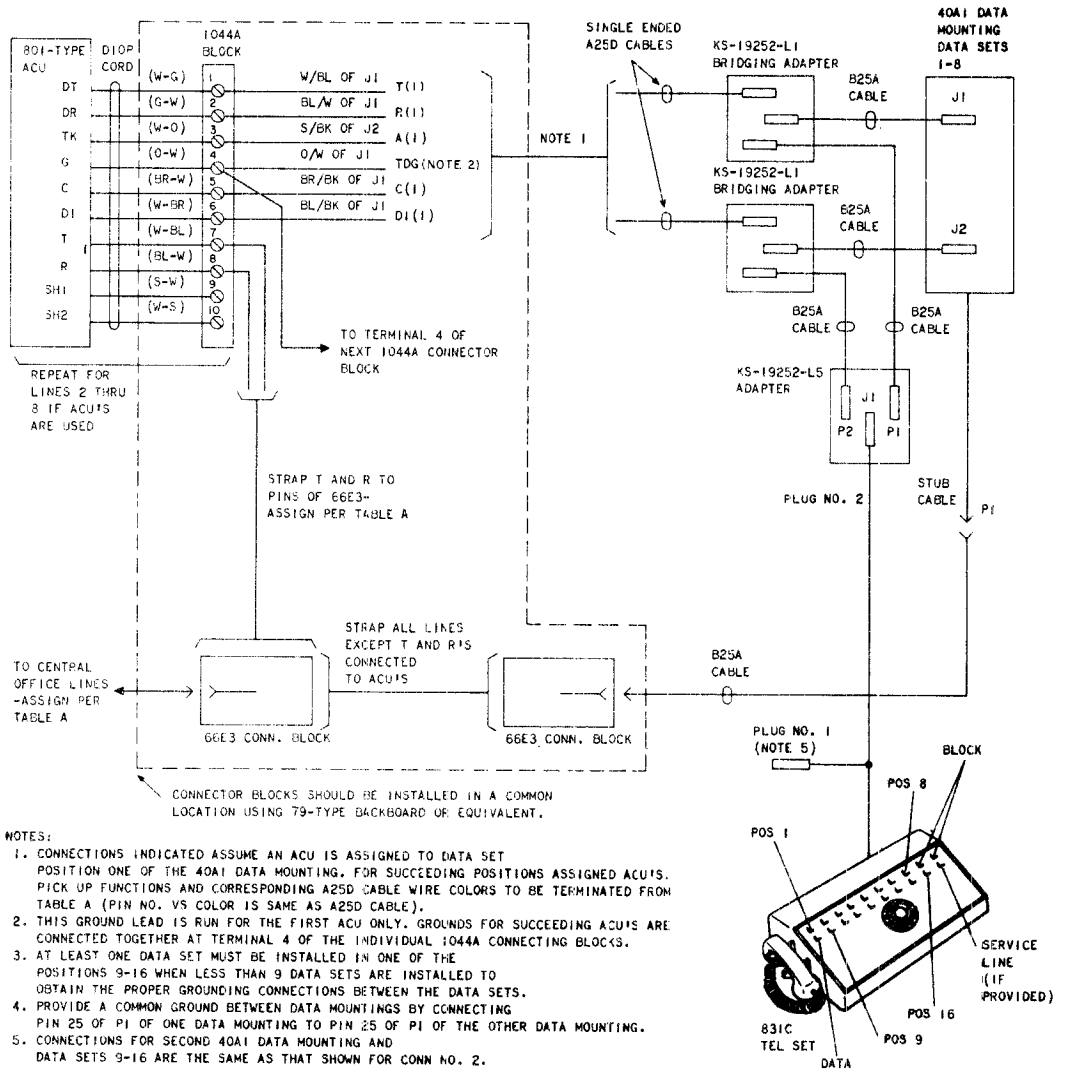
(11) Connect the service line (if required) to the stub cable on the data mounting as specified in Table A.

(12) Connect the make-busy pairs (if required) to the stub cable on the data mounting as specified in Table A.

C. 9 to 16 Data Sets

3.17 The following equipment is included in this arrangement:

- One KS-20018-L12A cabinet
- One 79 backboard
- Two 40A1 data mountings
- One 1044A block for each ACU installed



NOTES:
1. CONNECTIONS INDICATED ASSUME AN ACU IS ASSIGNED TO DATA SET POSITION ONE OF THE 40A1 DATA MOUNTING. FOR SUCCEEDING POSITIONS ASSIGNED ACU'S, PICK UP FUNCTIONS AND CORRESPONDING A25D CABLE WIRE COLORS TO BE TERMINATED FROM TABLE A (PIN NO. VS COLOR IS SAME AS A25D CABLE).
2. THIS GROUND LEAD IS RUN FOR THE FIRST ACU ONLY. GROUNDS FOR SUCCEEDING ACU'S ARE CONNECTED TOGETHER AT TERMINAL 4 OF THE INDIVIDUAL 1044A CONNECTING BLOCKS.
3. AT LEAST ONE DATA SET MUST BE INSTALLED IN ONE OF THE POSITIONS 9-16 WHEN LESS THAN 9 DATA SETS ARE INSTALLED TO OBTAIN THE PROPER GROUNDING CONNECTIONS BETWEEN THE DATA SETS.
4. PROVIDE A COMMON GROUND BETWEEN DATA MOUNTINGS BY CONNECTING PIN 25 OF P1 OF ONE DATA MOUNTING TO PIN 25 OF P1 OF THE OTHER DATA MOUNTING.
5. CONNECTIONS FOR SECOND 40A1 DATA MOUNTING AND DATA SETS 9-16 ARE THE SAME AS THAT SHOWN FOR CONN NO. 2.

Fig. 9—202S Data Station Arrangement for 9 to 16 Data Sets With 831C Tel Set and ACUs

- One 831C, 2831C 0r 631DA-type Call Director telephone set
- Two KS-19252-L5 adapters if 831C or 2831C tel set is used
- Four KS-19252-L1 adapters if 831C or 2831C tel set and ACUs are used.
- One outlet strip (Waber No. 602-15, or a 1A2 power panel, or equivalent)

- Maximum of 16 data sets
- One 233A adapter if 631DA-type Call Director telephone is used
- B25A and A25D cables.

3.18 Proceed as follows.

(1) Install the cabinet per 3.02 and 3.03.

(2) Install the 79 backboard per 3.04 and 3.05.

(3) Install the 40A1 data mountings per 3.06.

(4) Install the options for the data sets and data mounting.

(5) Install the data sets per 3.08.

(6) Install the 233A adapter per 3.09 (if required).

(7) Install the KS-19252-type adapters per 3.10.

(8) If ACUs are required, install per 3.11.

(9) Install the telephone set per 3.14 or plug in the Call Director telephone (if used).

(10) Install the outlet strip.

If a 233A adapter is used, place the outlet strip in the base of the cabinet, since the adapter covers most of the available space on the backboard.

(11) If a service line is being installed, strap from the SERVICE LINE OUT terminals of the upper 40A1 data mounting to the SERVICE LINE IN terminals of the lower mounting.

(12) Connect the lines from the central office to the stub cable on the 40A1 data mounting as specified in Table A.

(13) On position 20 of the 233A adapter (if used), remove the wire straps from upper terminals 1 and 2.

Note: The terminals are numbered from bottom to top at each position.

Do not cut the wires that are removed. They may need to be replaced at a later date.

(14) Connect the service line (if required) to the stub cable of the upper data mounting in accordance with Table A.

(15) Connect the make-busy pairs to the stub cables of the data mountings in accordance with Table A.

D. 17 To 24 Data Sets

3.19 The following equipment is required in this arrangement:

- One KS-20018-L11A cabinet
- Two 79 backboards
- One 1044A connector block for each ACU installed
- Three 40A1 data mountings
- One 830C telephone ***and*** one 831C telephone ***or*** one 631DA Call Director telephone
- Three KS-19252-L5 adapters if 830C and 831C tel sets are used
- Six KS-19252-L1 adapters if 830C and 831C tel sets are used with ACUs
- One 233A adapter if Call Director telephone is used
- Maximum of 24 data sets
- B25A and A25D cables
- One outlet strip (Waber No. 602-15, or a 1A2 power panel, or equivalent).

3.20 Proceed as follows.

(1) Install the cabinet per 3.02 and 3.03.

(2) Install the 79 backboards per 3.04 and 3.05.

(3) Install the 40A1 data mountings per 3.06.

(4) Install the options for the data sets and data mounting.

(5) Install the data sets per 3.08.

(6) Install the 233A adapter (if required).

(7) Install the KS-19252-type adapters per 3.10.

(8) If ACUs are required, install per 3.11.

(9) Fasten the outlet strip to the lower 79 backboard.

(10) If the station is using a Call Director telephone, connect it to the 233A adapter.

(11) If the 830C-831C telephone combination is being used, install per 3.13 and 3.14. The 830C telephone is for data sets 1 through 8; the 831C telephone is for data sets 9 through 24. Block the 10th button on the 830C telephone normally used for this service line. If a service line is required, it must appear on the 20th button on the 831C telephone.

(12) If a service line is being installed, strap the SERVICE LINE OUT terminals of the upper 40A1 data mounting to the SERVICE LINE IN terminals of the middle mounting. Strap from the SERVICE LINE OUT terminals of the middle mounting to the SERVICE LINE IN terminals of the lower mounting.

(13) Connect the lines from the central office to the stub cables on the 40A1 data mounting, as specified in Table A.

(14) On positions 19 and 20 of the 233A adapter, remove the wire straps from upper terminals 1 and 2.

Note: The terminals are numbered from bottom to top at each position.

Do not cut the wires that are removed. They may need to be replaced at a later date.

(15) Connect the service line (if required) to the stub cable of the upper data mounting only, in accordance with Table A.

(16) Connect the make-busy pairs (if required) to the stub cables of the data mountings in accordance with Table A.

4. INSTALLATION TESTS

4.01 After installation is completed, the data station should be tested to determine if it is operating properly. Refer to the section entitled Data Station Using Data Set 202S—Test Procedures (592-860-500).

5. REFERENCES

5.01 Further information on the 202S data station is given in the following sections:

SECTION	TITLE
314-410-501	Data Systems—Dataphone® Service and Data Access Arrangements—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
592-028-100	Data Set 202S Transmitter-Receiver—Description and Operation
592-028-180	Data Sets 202S—Summarizing Specification
592-028-200	Data Set 202S Transmitter-Receiver—Installation and Connections
592-860-100	Data Station Using Data Set 202S—Description and Operation
592-860-500	Data Station Using Data Set 202S—Test Procedures
598-010-201	Data Auxiliary Sets 801A5 and A6 for Automatic Calling—Installation and Connections
598-012-201	Data Auxiliary Sets 801C3 and 801C4—Installation and Connections
598-012-202	Data Auxiliary Sets 801C-L1—Installation and Connections
631-050-120	88-Type Connecting Block—Description and Use

TABLE A

CONNECTIONS FROM DATA MOUNTING TO CENTRAL OFFICE

TERMINAL ON 66E3 CONN BLOCK *	PIN NUMBER ON B25A CABLE ‡ TO DATA MOUNTING	DATA SET POSITION NUMBER §	LEAD DESIG-NATION	TERMINAL ON 66E3 CONN BLOCK *	PIN NUMBER ON B25A CABLE TO DATA MOUNTING	DATA SET POSITION NUMBER	LEAD DESIG-NATION
1	26	1	T	26	13	4	MB1
2	1	1	R	27	39	5	MB2
3	27	2	T	28	14	5	MB1
4	2	2	R	29	40	6	MB2
5	28	3	T	30	15	6	MB1
6	3	3	R	31	41	7	MB2
7	29	4	T	32	16	7	MB1
8	4	4	R	33	42	8	MB2
9	30	5	T	34	17	8	MB1
10	5	5	R	35	43	—	T_S OUT †
11	31	6	T	36	18	—	R_S OUT †
12	6	6	R	37	44	—	—
13	32	7	T	38	19	—	—
14	7	7	R	39	45	—	—
15	33	8	T	40	20	—	—
16	8	8	R	41	46	5	RD
17	34	—	T_S IN †	42	21	1	RD
18	9	—	R_S IN †	43	47	6	RD
19	35	1	MB2	44	22	2	RD
20	10	1	MB1	45	48	7	RD
21	36	2	MB2	46	23	3	RD
22	11	2	MB1	47	49	8	RD
23	37	3	MB2	48	24	4	RD
24	12	3	MB1	49	50	—	FG
25	38	4	MB2	50	25	—	SG

* Refer to Section 461-604-101 for information on 66E3 connecting blocks.

† Service line.

‡ For some station installations, it will be more convenient to substitute an A25D (single-ended) for the B25A cable connected to P1 of the data mounting to interface with the central office via a local distribution terminal instead of the 66E3 connecting block specified.

§ This table will be utilized for stations with more than the eight data sets specified. For lead designation assignments for data sets in a second data mounting (data sets 9 through 16), add 8 to the data set position number column. For lead designation assignments for data sets in a third data mounting (data sets 17 through 24), add 16 to the data set position number column.

DATA STATION USING DATA SETS 202S

TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section describes the test procedures to be followed when installing and maintaining data sets (DS) 202S in multiple data set installations. This information pertains to those installations using 40A1 data mountings. Refer to the section entitled Data Station Using Data Sets 202S—Maintenance Procedures (592-860-300) for additional information that may be used to isolate problems in the data station.

1.02 This section is reissued primarily to add information on testing DS 202S-L1A and L1A/3A. The 914 data test set matrix pin arrangement has also been simplified.

1.03 A known good DS 202S equipped with reverse channel and enclosed in a single set housing (DS 202S-L1/2/3 ▶or -L1A/2/3A)◀ should be taken to the customer location by the repair personnel. The purpose of the housing is to protect the data set in transit. If a DS 202S must be replaced, it should be placed in the housing of the set used to replace it.

Caution: If the data set is removed from the housing or data mounting, it should be handled by the nonconductive surfaces only. Otherwise, certain circuit components may be damaged by static electricity.

2. TEST CAPABILITIES

2.01 The test circuitry built into DS 202S permits the tests described in the following paragraphs to be performed.

A. Local Self Test

2.02 Depressing the LT key on the front of the data set initiates the local self test. A repeating 63-bit pseudorandom word is generated at 1547 bps and looped from the transmitter to the receiver through an attenuating circuit. The word received by the receiver is compared to the original word. Under normal conditions, all the indicators (ON, TR, MR, RS, CS, CO, and TM) are lighted; however, in the event an error is detected, the TM indicator goes off. Perform the test as follows:

Note: All customer interface leads are made inoperative and are not tested during the test; however, all lamps are lighted.

(1) Ensure that the data set is not in the data mode.

(2) Depress and hold the nonlocking LT key for approximately 15 seconds.

Requirement: The TM indicator remains lighted while the LT key is depressed.

(3) If the requirements of (2) are not met, repeat (2) four times.

Requirement: The TM indicator remains lighted throughout the four trials.

B. Remote Test

2.03 Depressing the locking RT key on the data set places that particular set in the remote test mode. The set will then automatically answer a call from the data test center (DTC), since the auto-answer feature is enabled regardless of the option switch setting. As with the self test, a repeating 63-bit pseudorandom word is generated and looped back internally, where it is compared to the original word. In the remote test, the word is also transmitted to the DTC. If the set detects an error, constant spacing is transmitted instead of the random word. This allows an attendant at the DTC to test the data set circuitry (except the customer interface). After the set is placed in the remote test mode, no more action is required until the DTC requests that the data set be returned to normal (by depressing and releasing the RT key).

Note: All the customer interface leads are made inoperative and are not tested during the test; however, the indicators (ON, TR, MR, RS, CS, CO, and TM) are lighted.

2.04 Proceed with the test as follows:

(1) Contact the DTC and request a remote test of the affected data set.

Note: If the set is used with line hunting equipment, the DTC must conduct the test over the service line. In this case, the data set is connected to the service line when the RT key is depressed.

Only one data set at a time should be connected to the service line.

(2) When instructed to do so by the DTC, depress the RT key until it locks and observe that all the indicators on the data set are lighted.

(3) When instructed to do so, press and release the RT key to release the data set from the remote test mode. If the data set enters the data mode (MR lighted), depress and release the analog loop-back (AL) key to return the data set to the idle mode.

C. Analog Loop-Back Tests

2.05 The purpose of these tests is to check the interface circuits not checked by the local self test or the remote test. When the data set is in the analog loop-back mode, the data signals applied to the transmitted data interface lead are processed through the transmitter, looped through an attenuator ▸(202S-L1 only)◂ to the receiver where they are demodulated, and connected to the received data lead. Pressing the AL key until it locks performs the following:

- Connects the transmitter and receiver ▸for DS 202S-L1A. An attenuator is inserted in this path for DS 202S-L1 only.◂
- Overrides the local copy control circuit to provide local copy.
- Illuminates the TM indicator.
- Disables the auto-answer features, if installed.
- Turns the data-set-ready lead and the MR indicator ***off*** (all other customer interface leads and indicators are operative and may be tested) ▸on DS 202S-L1 only. This is optional for DS 202S-L1A.◂

The following test equipment is required to perform these tests:

- A 914C Data Test Set (DTS)

or

- A 914B ***and*** 903-type DTS.

2.06 ***Error Run and Power Supply Test:*** This test verifies that the data set will transmit and receive a 63-bit pseudorandom word error-free for 5 minutes. Both the positive and negative 14-volt power supply voltages are also checked during this test. The test equipment is set up as shown in Fig. 1. Proceed as follows:

(1) Remove the cover from the back of the KS-20018 cabinet to gain access to the

customer interface connector. (Pull out at the top of the cover.)

(2) Disconnect the customer-provided equipment (CPE) and connect the 914-type DTS to the customer interface connector on the rear of the data mounting.

(3) Insert the red pins in the 914 matrix and position the switches as shown in Fig. 1.

(4) Close the make-busy switch (toggle down) for the data set being tested (if make-busy feature is installed).

(5) Press the AL key until it locks. Wait at least 3 seconds ▶(with DS 202S-L1 only)◀ before proceeding to allow the answer sequence to be generated in the data set.

Note: The receiver contains a first mark circuit which clamps the received data and received line signal detector circuits ***off*** during the answer sequence. At least 3 ms of marking signal must be received by the receiver before the clamp is removed.

(6) Operate switch S1 to ON. Depress and release the START button on the 903 DTS if it is being used.

Requirement: DS1 and DS3 lamps are lighted. ▶DS2 is lighted if option YI is installed.◀

(7) Position the FUNCTION switch to VOLTS INT and measure the positive supply voltage.

Requirement: +12 to +17 volts.

(8) Position the FUNCTION switch to OFF, the POLARITY switch to REV, and the VERTICAL MONITOR switch to 10.

(9) Position the FUNCTION switch to VOLTS INT and measure the negative power supply voltage.

Requirement: −12.5 to −17.5 volts.

(10) Position the FUNCTION switch to PHASE ADJ.

(11) Adjust the PHASE control until the meter indicates zero, then move the FUNCTION switch to OFF.

(12) Momentarily position the WORD SYNC to MAN.

(13) Reset the counter on the 914 DTS.

(14) Allow the test to continue for 5 minutes.

Requirement: No errors.

(15) If no more tests are to be conducted, disconnect the test equipment and depress and release the AL key.

(16) If a clear-to-send response test is to be conducted, position S1 to OFF, then proceed to 2.07 (6).

2.07 ***Clear-to-Send Response Test:*** This test measures the interval between the time when the CA (request-to-send) lead is turned ***on*** and the CB (clear-to-send) lead turns ***on.*** Proceed with the test as follows:

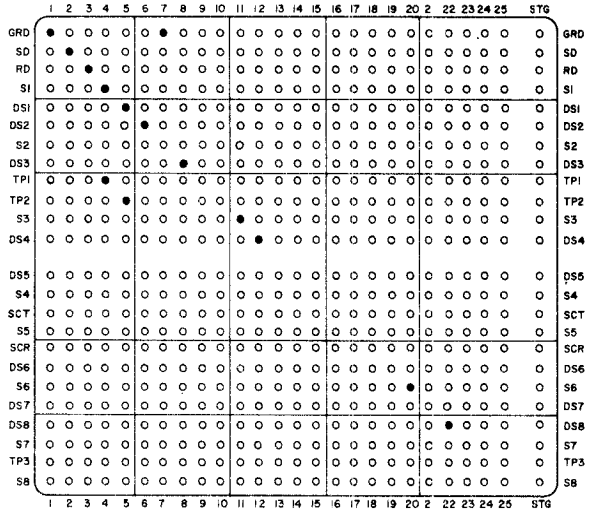
(1) Remove the cover from the back of the KS-20018 cabinet to gain access to the customer interface connector. (Pull out at the top of the cover.)

(2) Disconnect the CPE and connect the 914-type DTS to the customer interface connector on the rear of the data mounting.

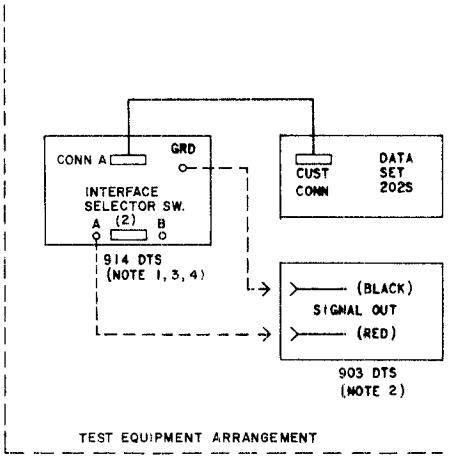
(3) Insert red pins in the matrix and position the switches on the DTS as shown in Fig. 1, ***except the COUNTER switch should be positioned to INTERVAL X1 for options M, K, and J, or X10 for option G.*** Position TEST SET MODE switch to INTERVAL.

(4) Close the make-busy switch (toggle down) for the data set being tested (if the make-busy feature is installed).

(5) Place the data set in the analog loop-back test mode by depressing the AL key until it locks. Wait at least 3 seconds ▶(with DS 202S-L1 only)◀ before proceeding.



914 DTS MATRIX



TEST EQUIPMENT ARRANGEMENT

NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C)
	RCV SER (914B)
COUNTER	BIT ERRORS
TRANSMIT BIT RATE (914C)	1200
TRANSMIT WORD LENGTH(914C)	63
VERTICAL MONITOR	9
FUNCTION	OFF
RANGE	DCV-30
POLARITY	NOR
BIT RATE	1200
SIG LEV	±4
WORD LENGTH	63
SAMPLE WIDTH	30%
S1, S3	OFF
S6	ON
TPI	+/OPEN
TP2	+/OPEN

2. THE 903 DTS IS REQUIRED IN CONJUNCTION WITH THE 914B DTS ONLY. POSITION THE SWITCHES ON THE 903 DTS AS FOLLOWS:

SWITCH	SETTING
BIT RATE	1200
TRIGGER	(+) POSITIVE
RANDOM-DOT	RANDOM

3. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO INTERFACE LEADS AS FOLLOWS:

SWITCH	LAMP	LEAD
SI		REQUEST TO SEND
	DSI	CLEAR TO SEND
	DS2	DATA SET READY
	DS3	RECEIVED LINE SIGNAL DETECTOR
S3		SECONDARY REQUEST TO SEND
	DS4	SECONDARY RECEIVED LINE SIGNAL DETECTOR
S6		DATA TERMINAL READY
	DS8	RING INDICATOR

4. ALL A INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN EXCEPT 2A WHEN USING A 903 DTS.

Fig. 1—Analog Loop-Back Test

(6) Reset the counter. Position switch S1 to ON, and the clear-to-send turn-on interval will appear on the counter.

Requirements:

- Option M—6 to 12 ms
- Option K—22 to 40 ms
- Option J—52 to 70 ms
- Option G—140 to 200 ms.

Note: Only the installed option requires testing.

(7) To measure the interval, move S1 to OFF, reset the counter, then move S1 to ON.

(8) If a received line signal detector response test is to be performed, move switch S1 to OFF. Proceed to 2.08 (3).

2.08 ***Received Line Signal Detector Response Test:*** This test verifies that the received line signal detector circuit will respond properly within one of the time intervals given as requirements in this test. Only the option actually installed in the data set should be tested. Proceed with the test as follows:

(1) Remove the cover from the back of the KS-20018-type cabinet to gain access to the customer interface connector. (Pull out at the top of the cover.)

(2) Disconnect the CPE and connect the 914-type DTS to the customer interface connector on the rear of the data mounting.

(3) Insert red pins in the matrix and position the switches on the DTS as shown in Fig. 1, ***except the pin at TP2-5 should be moved to TP2-8.*** Also, remove pin SD-2 and disconnect the 903 DTS (if used). Push interface selector switch 2A in and insert a red matrix pin in position S2-2. Leave switch S2 OFF. Position TEST SET MODE switch to INTERVAL.

(4) Close the make-busy switch (toggle down) for the data set being tested (if the make-busy feature is installed).

(5) Place the data set in the analog loop-back test mode by depressing the AL key until it locks. Wait at least 3 seconds ▶(with DS 202S-L1 only)◀ before proceeding.

(6) Reset the counter. Move switch S1 to ON; the response time appears on the counter.

Requirements:

- Data set equipped with option Q—5 to 9 ms
- Data set equipped with option N—18 to 24 ms.

Note: Only the installed option need be checked.

(7) To remeasure the interval, move switch S1 to OFF, reset the counter, then move S1 to ON.

2.09 ▶***Analog Loop-Back Reverse Channel Test*** (DS 202S-L1A/3A only): This test checks the interface circuits used with the reverse channel. Proceed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to DS 202S.

(2) Insert the red pins in the matrix and position the switches as shown in Fig. 1.

(3) Apply power to the data set and DTS.

(4) Depress the locking AL key on the data set.

(5) Operate switch S3 to ON.

Requirement: DS4 lamp lights.

(6) Operate switch S1 to ON.

Requirement: DS4 lamp goes off.

(7) Operate switches S1 and S3 to OFF.

Requirement: DS4 lamp remains off.◀

D. Automatic Answer Test

2.10 This test verifies that DS 202S will automatically answer and terminate a call. The test checks the data-terminal-ready and ring indicator leads. Proceed with the test as follows:

(1) Close the make-busy switch (toggle down) for the data set being tested (if the make-busy feature is installed).

(2) Remove the data set from the mounting and verify that the automatic answer option is installed (contact 8 on switch S2 closed.) ***Power to the data set need not be removed.***

(3) Replace the data set in the mounting.

(4) Open the busy switch.

(5) Remove the rear cover from the KS-20018 cabinet to gain access to the customer interface connector (pull out at the top of the cover).

(6) Disconnect the CPE and connect the 914-type DTS to the customer interface connector on the rear of the data mounting.

(7) Insert red pins into the matrix and position the switches as shown in Fig. 1, ***except switch S6 should be OFF.*** Apply power to the 914-type DTS.

(8) Have a call made to the data set.

Note: A DTC should be contacted and asked to initiate the call if the data set is being used with line hunting equipment ***or*** if a reverse channel test is to be performed. The DTC operator will know the procedure required to call up a particular line in a hunting group.

Requirement: DS8 lamp lights (RI is ***on***) during the time when ringing voltage is present. DS8 goes off (RI is ***off***) during the quiet period. The data set does ***not*** answer the call.

(9) Position switch S6 to ON (DTR ***on***).

Requirement: At the end of the next ringing cycle, the data set answers the call. After approximately 3 seconds, DS2 (data set ready) lights. This indicates that the data set is in the data mode.

(10) If a reverse channel test is to be performed, proceed to 2.11 (5).

(11) If a reverse channel test is not to be performed, terminate the call by positioning switch S6 to OFF (DTR ***off***).

Requirement: DS2 lamp goes off.

E. Reverse Channel Test

2.11 This test checks the interface circuits used with reverse channel. It will be necessary to use a DTC for this test. Proceed with the test as follows:

(1) Remove the rear cover from the KS-20018 cabinet to gain access to the customer interface connector (pull out at the top of the cover).

(2) Disconnect the CPE and connect the 914-type DTS to the data set under test.

(3) Insert the red pins in the matrix and position the switches as shown in Fig. 1, ***except switch S1 should be ON.***

(4) Apply power to the 914-type DTS.

(5) Request the DTC to send 387 Hz at −12 dBm at 0 TLP.

Requirement: DS4 lamp lights (SCF ***on***).

(6) Move S3 to ON and S1 to OFF. This transmits the reverse channel tone to the DTC.

(7) Request the DTC to measure the frequency of the reverse channel tone.

Requirement: 377 to 397 Hz.

F. Supplementary Tests

2.12 ***End-to-End Test:*** This test should be performed to identify problems in the

transmission facilities. The following test equipment is required at both locations performing the test:

- A 914C *or* 914B DTS

Note: If a distant data set is not available, this test may be performed with a DTC.

2.13 Proceed with the test as follows:

(1) Set up the test equipment at both locations in accordance with Fig. 2. ***If a 914B DTS is being used at the transmitting end, position the TEST SET MODE switch to TRMT SER.*** Connect the 914-type DTS to the customer interface connector of the data set under test.

(2) Position switch S1 to ON at the transmitting station and switch S1 to OFF at the receiving station.

(3) Apply power to the test equipment.

Note: It will be necessary to establish voice communications periodically during the test.

(4) Establish a data call between data sets.

Note: Steps (5) through (9) are for the receiving end only.

(5) On the 914 DTS, set the FUNCTION switch to PHASE ADJ.

(6) Adjust the PHASE control to zero the meter.

(7) Move the FUNCTION switch to OFF.

(8) Operate the WORD SYNC switch momentarily to MAN.

(9) Press the RESET button to clear the counter.

(10) Complete end-to-end tests involve making two 10-minute and six 2-minute test runs. Establish voice communications between tests using the associated telephone set. Place calls alternately from each end except where one customer location will always be originating the call. These test calls should be made during busy hours. This gives reasonable assurance that all test calls do not use the same trunks and routes.

Requirement: During the 10-minute test calls, count errors at the end of 1-minute intervals. Disregard the test period with the highest number of errors. Total errors in the remaining nine test periods should be no more than six. Four of the six 2-minute calls should have no more than three errors each.

Note: Refer to Fig. 3 for an example of a form which can be used to record test results.

(11) Upon completion of the tests, record the results and disconnect the test equipment.

2.14 ***Ground Noise Test:*** If the data set and CPE are not at the same ground potential, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials at the time of installation or during troubleshooting, a test should be made using the 6-type impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset amplitude and which are separated by 150 ms or more.

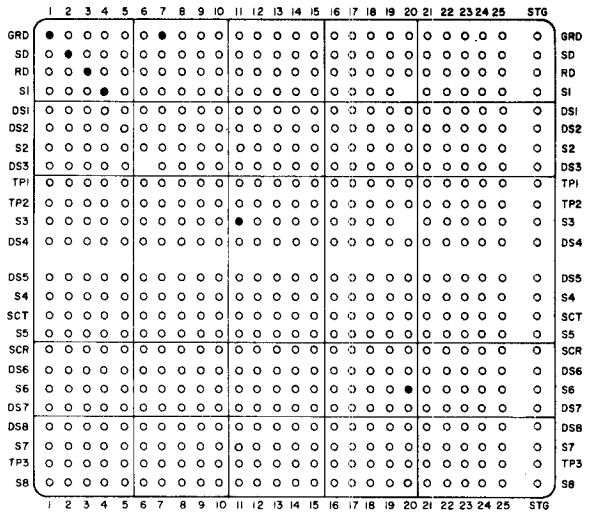
2.15 Test equipment required for this test is as follows:

1—6H impulse counter (or equivalent)

1—914-type DTS

1—2W6A test cord for 6H impulse counter (310 plug on one end, alligator clip connected to tip and ring on the other end).

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).



914 DTS MATRIX

NOTES:

1. SET SWITCHES ON THE 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C DTS)
	RCV SER (914B DTS)
COUNTER	BIT ERRORS
RCV BIT RATE	1200
RCV WORD LENGTH	63
TRANSMIT BIT RATE (914C)	1200
TRANSMIT WORD LENGTH (914C)	63
SIG LEV	±4V
SWITCH S1, S3	OFF
SWITCH S6	ON
SAMPLE WIDTH	30%

2. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO THE FOLLOWING INTERFACE LEADS.

SWITCH	LEAD
S1	REQUEST TO SEND
S3	SECONDARY REQUEST TO SEND
S6	DATA TERMINAL READY

3. ALL A INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN.

Fig. 2—End-to-End Test

Date:_____

Data Test Calls Placed Between:

	LOCATION	TEL. # OF TEST LINE OR STATION
(A)		
(B)		

Contemplated Customer
S.O. Number's_____

Under Control of Data
Test Center at_____

LONG DURATION TEST CALLS					BIT ERROR COUNT — MINUTE NUMBER														
ORIGINATED #	ORIGINATED AT	TIME	PEAK DISTORTION AT	PEAK DISTORTION %	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SHORT DURATION TEST CALLS			SHORT CALL — NUMBER (READINGS AT _____)						SHORT CALL — NUMBER (READINGS AT _____)					
ORIGINATED AT	TIME		1	2	3	4	5		1	2	3	4	5	
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												

Billing Adjustment (if required) referred to:_____

Parties involved in Tests:_____

Coordinated with tests to other locations at:_____

Comments and Notes:

Fig. 3—Data Set Performance Test Record

2.16 The 6H impulse counter is connected and the test is performed as follows:

(1) Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective ground from the business machine appears at the customer interface on pin 1.

Protective ground from the data mounting does not appear on the customer interface connector. Protective ground connections are made to the frame of the data mounting.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1B and the other clip to any clean bare metal surface on the data mounting. Verify that power is applied to the data set and business machine.

Note: A clip lead may be needed to extend the 2W6A cord into the cabinet.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove the clips of the 2W6A cord from the switch and frame of the data mounting.

(9) Connect one clip to switch 7A and the other to 7B.

(10) Reset the counter on the 6H impulse counter to 0.

(11) Position the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

2.16 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

3. INSTALLATION TESTS

3.01 This part provides the sequence in which tests are to be performed following an installation. Before proceeding with the tests, verify that the local loop and the end-to-end facilities meet the requirements specified in the sections entitled Data Systems—DATA-PHONE® Service—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (314-205-501) and Data Systems—DATA-PHONE® Service on Direct Distance Dialing Network—Overall Transmission Maintenance Procedures (314-205-500). Refer to Fig. 4 for the sequence of tests.

4. MAINTENANCE TESTS

4.01 This part provides the sequence in which tests are to be performed during a trouble visit. The procedure provides a method of isolating a trouble to either the data set or the transmission facility. It is assumed that the maintenance procedures outlined in Section 592-860-300 have been followed prior to dispatching the craft employee. Refer to Fig. 5 for the sequence of tests.

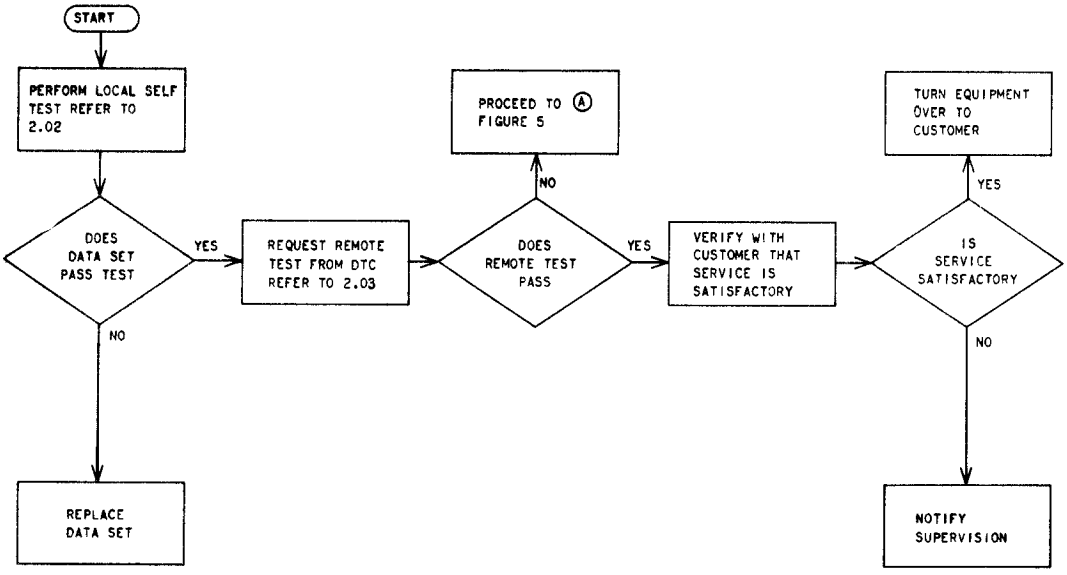


Fig. 4—Installation Tests Flowchart

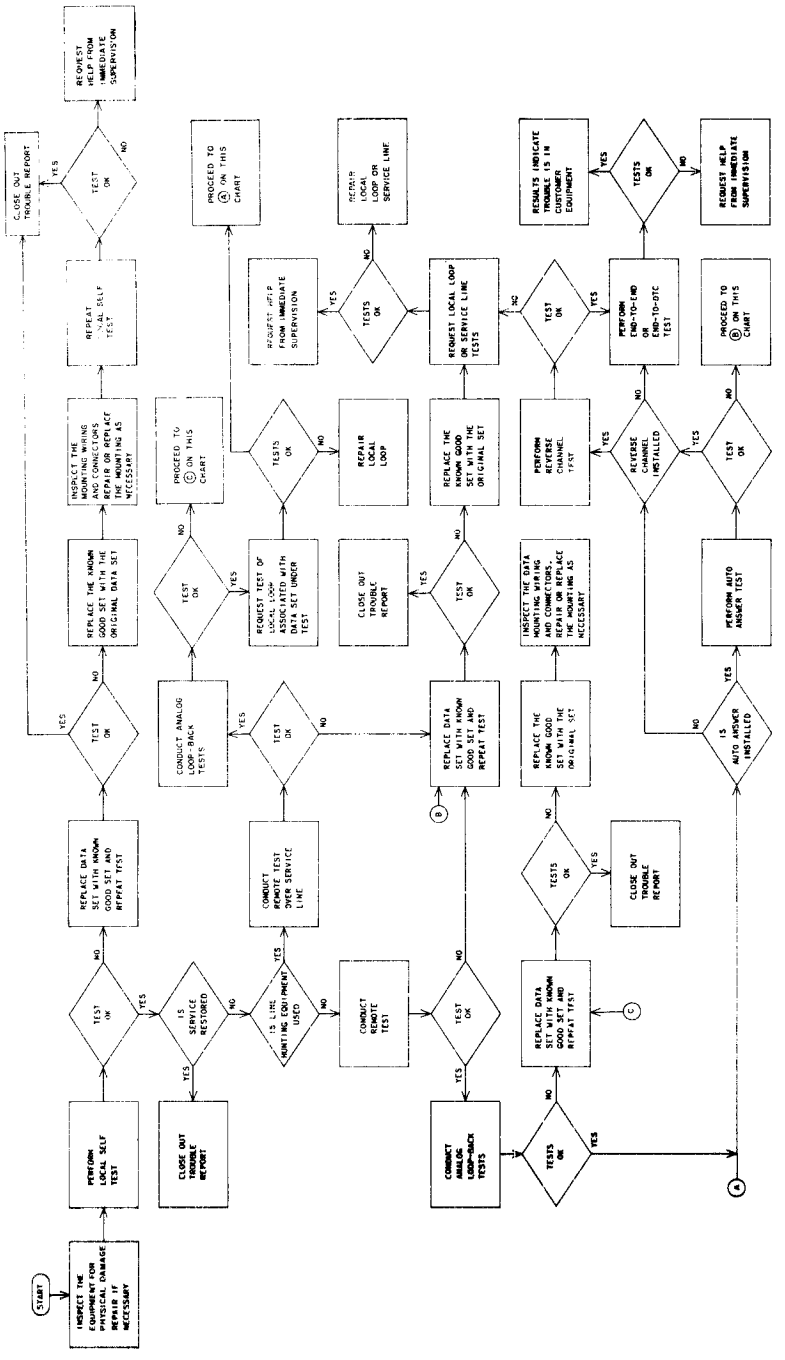


Fig. 5—Maintenance Tests Flowchart

DATA SET 202T-TYPE
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional description and operating procedures for data set (DS) 202T-type (Fig. 1).

1.02 This section is reissued to include information concerning DS 202T-L1A and JY4 reverse channel circuit pack. Due to extensive revision, arrows ordinarily used to denote changes have been omitted.

Fig. 1—Data Set 202T-Type, Front View

1.03 The DS 202T is an asynchronous transmitter-receiver of medium-speed binary serial data. It uses frequency-shift-keying modulation and is capable of transmitting and receiving data at speeds up to 1400 bits per second (bps) on basic 3002 private lines. Speeds between 1400 and 1800 bps require C2 conditioning. When used as a 2-wire data set, it can be equipped with a 387-Hz reverse channel for signaling speeds up to 5 bps. With reverse channel circuit pack JY1 or JY2 installed, DS 202T-L1 is limited to a maximum bit rate of 1200 bps. Data set 202T-L1A with JY4 reverse channel circuit pack installed can operate up to a maximum rate of 1800 bps (over C2-conditioned lines). Data set 202T or DS 202T-L1 or DS 202T-L1A is line compatible with all 202-type sets and can be used (with or without reverse channel) to replace DS 202D and can be used (without reverse channel) to replace DS 202R. In addition, DS 202T-type provides status indicator lamps and built-in test features for local self test, analog loopback tests, and remote tests.

Note: The private line channel must be arranged for -16 dBm receive level and 0 dBm transmit level at the data set telephone interface.

1.04 In 2-wire service, the data set can transmit or receive (but not simultaneously). With the reverse channel option installed, signaling (at 5 bps) is possible in the opposite direction to the primary channel. The local copy feature may be provided for either or both channels by option switches. The data set terminates the 2-wire line with a 600-ohm impedance.

1.05 In 4-wire service, the data set can transmit and receive simultaneously and independently (duplex operation). The reverse channel is not provided in 4-wire service. The data set terminates each pair of the 4-wire line with a 600-ohm impedance.

1.06 The DS 202T-type is designed to work with the data auxiliary set (DAS) 829-type in single or multiple arrangements.

1.07 The following is a specification summary for DS 202T-type:

Operation: Asynchronous, binary, serial.

Modulation: Frequency shift keying.

Rate (DS 202T-L1): Up to 1400 bps on basic 3002 private line without reverse channel. Up to 1800 bps on C2-conditioned 3002 private line without reverse channel. Maximum bit rate of 1200 bps when data set is equipped with reverse channel.

Rate (DS 202T-L1A): Up to 1400 bps channel and up to 1200 bps with reverse channel on basic 3002 private line. Up to 1800 bps on C2-conditioned 3002 private line with or without reverse channel.

Interface Voltage: As specified in Electronic Industries Association (EIA) Standard RS-232C.

Mode: Half duplex (2-wire) or duplex (4-wire)

Power: 105 to 129 Vac at 57 to 63 Hz. A single data set consumes a maximum of 6 watts.

2. PHYSICAL DESCRIPTION

2.01 The DS 202T-type is list coded as follows:

List 1—2-wire or 4-wire data set circuit pack without reverse channel

List 1A—2-wire or 4-wire data set circuit pack without reverse channel

List 2—Data set housing, interface connectors, power transformer, and M8K connector cord

List 3—JY1 reverse channel circuit pack.

List 3A—JY2 reverse channel circuit pack.

List 3B—JY4 reverse channel circuit pack.

List 4—Data set housing and data set interface connectors.

A. DS 202T-L1 or 202T-L1A

2.02 Data set 202T-L1 or 202T-L1A is contained on a printed circuit wiring board (Fig. 2). There are three test switches and six status indicator lamps on the faceplate of the printed circuit wiring board.

2.03 The status indicator lamps monitor test functions and customer interface signals. The lamp names and their normal functions are as follows:

- ***ON:*** Indicates that power is applied to the data set.
- ***MR (Modem Ready):*** Indicates the status of the data-set-ready lead. The lamp lights when the data set is in the data mode (data set ready lead is ***on***).
- ***RS (Request-to-Send):*** Indicates the status of the request-to-send lead from the customer interface. The lamp lights whenever the lead is ***on,*** or during local self test and remote test (2-wire), or when the continuous carrier option (ZN) is installed.
- ***CS (Clear-to-Send):*** Indicates the status of the clear-to-send lead from the data set. The lamp lights whenever the lead is ***on,***

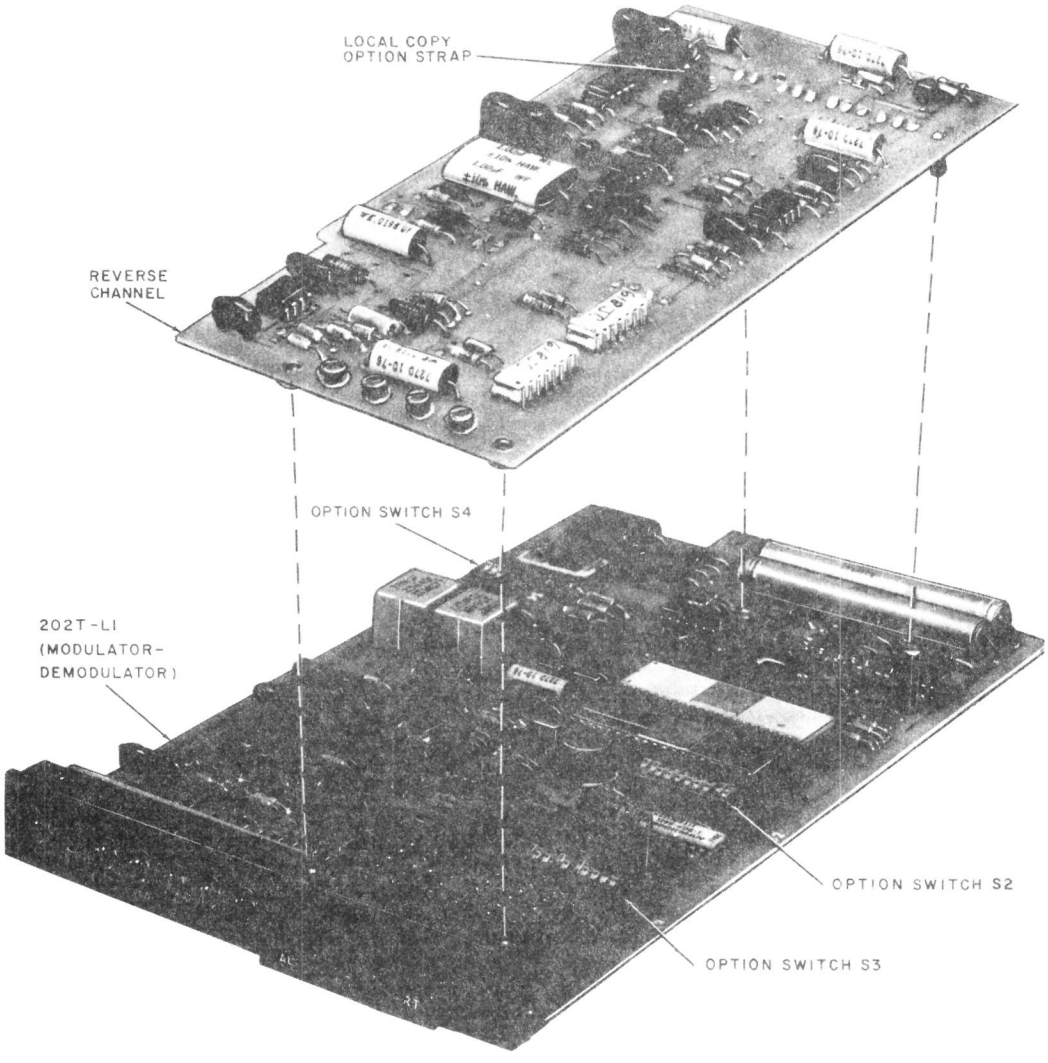


Fig. 2—Data Set 202T-L1A/3B

or during local self test and remote test (2-wire), or when the continuous carrier option (ZN) is installed.

- ***CO (Carrier On):*** Indicates the status of the received line signal detector lead from the data set. The lamp lights whenever the lead is in the ***on*** condition, or during local self test and remote test (2-wire).

- ***TM (Test Mode):*** Indicates that the data set is in the test mode. The lamp

lights whenever one of the test switches is depressed. If an error is detected during local self test, the TM lamp goes off.

2.04 The data set is equipped with three pushbutton switches which are accessible at the front panel. The functions of the switches are as follows:

- ***AL (Analog Loopback):*** This switch is a push-to-operate, push-to-release type. When the button is operated, the TM lamp lights and the output of the data set transmitter is looped back to the receiver input for test purposes.

- ***LT (Local Self Test):*** This switch is a push-to-operate type and must be held in during the test. When the switch is depressed, all status indicator lamps light to provide a lamp test. The output of the transmitter is looped to the input of the receiver and a random 63-bit word is transmitted at 1547 bps.

- ***RT (Remote Test):*** This button is a push-to-operate, push-to-release type. If the data set is operating 4-wire, the RT switch connects received data to send data. This conditions the data set to operate as a repeater for remote testing purposes. If the data set is operating 2-wire, the RT switch conditions the data set to be remote tested from a test center.

2.05 Data set 202T-L1, 202T-L1A, 202T-L1/3, 202T-L1/3A, or 202T-L1A/3B can be used in a 39A1 or 40B1 data mounting or in the housing provided by list 2 or 4. The BSPs associated with the 39A1 and 40B1 data mounting are listed in Part 6 (REFERENCES).

B. DS 202T-L1/2 or 202T-L1A/2

2.06 The DS 202T-L1/2 or 202T-L1A/2 provides the housing, interface connectors, power transformer, and M8K connector cord in addition to the list 1 data set described in paragraph 2.02. The enclosure for the data set consists of front and rear molded black plastic covers mounted on an extruded aluminum housing. The housing has a brushed finish. The top surface of the housing is depressed to allow for nesting of several housings. The overall dimensions of the data set are 5.8 inches across the front, 2.2 inches high, and 10.8 inches deep. The weight is 3-1/2 pounds.

2.07 The housing has two interface connectors and a power cord at the rear of the set (Fig. 3). One connector is a KS-19087-L6 type and provides the digital interface leads to the customer-provided terminal equipment. The other connector is a KS-19088-L22 type and provides the interface connections for the telephone network. The power cord is a 4-conductor, spade-ended type.

2.08 A KS-21239-L4 or -L5 transformer is also included as part of list 2. This transformer is a plug-mounted type designed to mount in a standard 117-Vac 3-conductor outlet. A tab is provided to secure the plug to the outlet and prevent it from being accidentally unplugged. This transformer provides 24 volts ac to the power rectifier in the data set.

Caution: If the outlet has a metal cover, do not remove the center screw to mount the transformer. When this screw is removed, it is possible for the metal cover to fall across the prongs of the transformer.

2.09 The equipment provided as list 2 is also available as the 47B1 data mounting.

C. DS 202T-L1/3, 202T-L1/3A, or 202T-L1A/3B

2.10 Data set 202T-L1/3 (Fig. 2), 202T-L1/3A or 202T-L1A/3B provides everything provided by list 1 plus a reverse channel circuit pack (JY1, JY2, or JY4). This circuit pack is a printed wiring board measuring 1 inch high, 3.4 inches wide, 7.5 inches long, and weighing 0.5 pounds. It includes the filters, switching circuits, and demodulator circuits needed to perform the reverse channel function. Interconnection to the data set is accomplished by 20 female contact receptacles mounted on the bottom of the reverse channel circuit pack. This circuit pack mounts on contact posts on the data set and covers switch assemblies S2 and S3. The circuit pack must be removed when installing or removing options.

2.11 The JY1 circuit pack is rated MD and is replaced by the JY2. In addition to the features provided by the JY1 circuit pack, JY2 provides independent operation of reverse channel. Independent operation means that the reverse

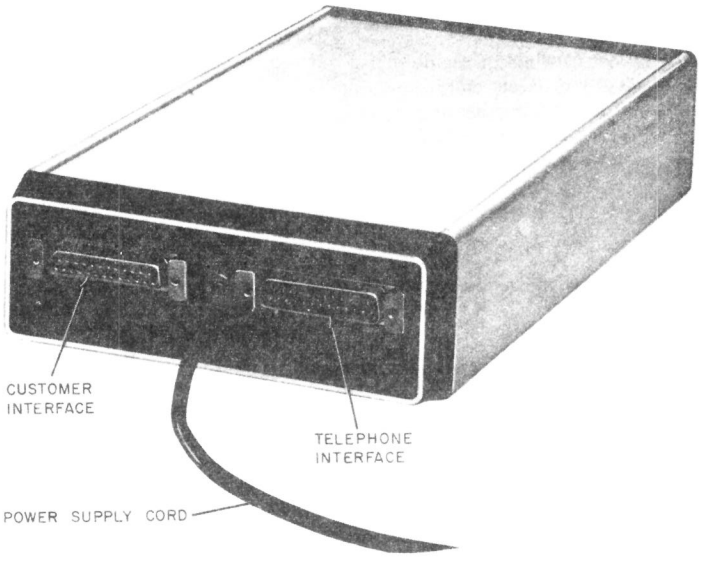


Fig. 3—Data Set 202T-Type, Rear View

channel circuits are able to receive a signal regardless of the state of the request-to-send circuit. The JY1 circuit pack is able to receive a signal from the distant-end data set only if the request-to-send circuit is ***on***.

2.12 The JY4 reverse channel circuit pack is designed for use with DS 202T-L1A but may also be used with DS 202T-L1. In addition to the features provided by the JY2 reverse channel circuit pack, the JY4 together with improvements incorporated in the DS 202T-L1A allows for operation of the primary channel at speeds up to 1800 bps over 3002 C2-conditioned private lines. (JY2 helped to limit the primary channel operation of DS 202T-L1 to 1200 bps in all cases.)

D. DS 202T-L1/2/3, 202T-L1/2/3A, or 202T-L1A/2/3B

2.13 Data set 202T-L1/2/3, 202T-L1/2/3A, or 202T-L1A/2/3B provides everything provided by list 1 plus the housing, connectors, power transformer, and M8K cord provided by list 2 and the reverse channel circuit pack provided by list 3, 3A, or 3B.

2.14 Data set 202T-L1, L1/3, L1/3A, or L1A/3B can be installed in a variety of configurations from a single installation to a multiple installation of up to 48 data sets:

- Single installation consisting of DS 202T-L1/2, L1A/2, L1/2/3, L1/2/3A, L1A/2/3B, or L1A/4.
- Multiple installation of a maximum of 16 DS 202T-L1 or L1A (without reverse channel) in a 39A1 or 40B1 data mounting. Refer to Part 6 for a list of BSPs which contain more information.
- Multiple installation of a maximum of eight data sets 202T-L1/3, 202T-L1/3A, or 202T-L1A/3B (with reverse channel) in a 39A1 or 40B1 data mounting. Refer to Part 6 for a list of BSPs which contain more information.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains a brief description of the data set test modes and interfaces. Refer

to Fig. 4 for a simplified block diagram of DS 202T-type.

3.02 The DS 202T-type consists of an oscillator, transmitter, receiver, test circuitry, and power rectifier on one printed wiring board. An optional reverse channel transceiver can be provided on a separate circuit pack.

TEST MODES

3.03 The data set test modes are as follows:

- Analog loopback
- Local self test
- Remote test (2-wire)
- Remote test (4-wire).

Three test switches on the front of the data set are labeled AL, LT, and RT.

3.04 ***Analog Loopback Test:*** In the analog loopback mode, data signals applied on the BA (transmitted data) interface lead with CA (request-to-send) positive are processed through the transmitter and looped back through the receiver to the BB (received data) interface lead. The customer interface leads may be monitored for proper operation. Depressing the AL switch until it locks conditions the data set as follows:

(a) Disconnects the data set from the line and terminates the line in 600 ohms.

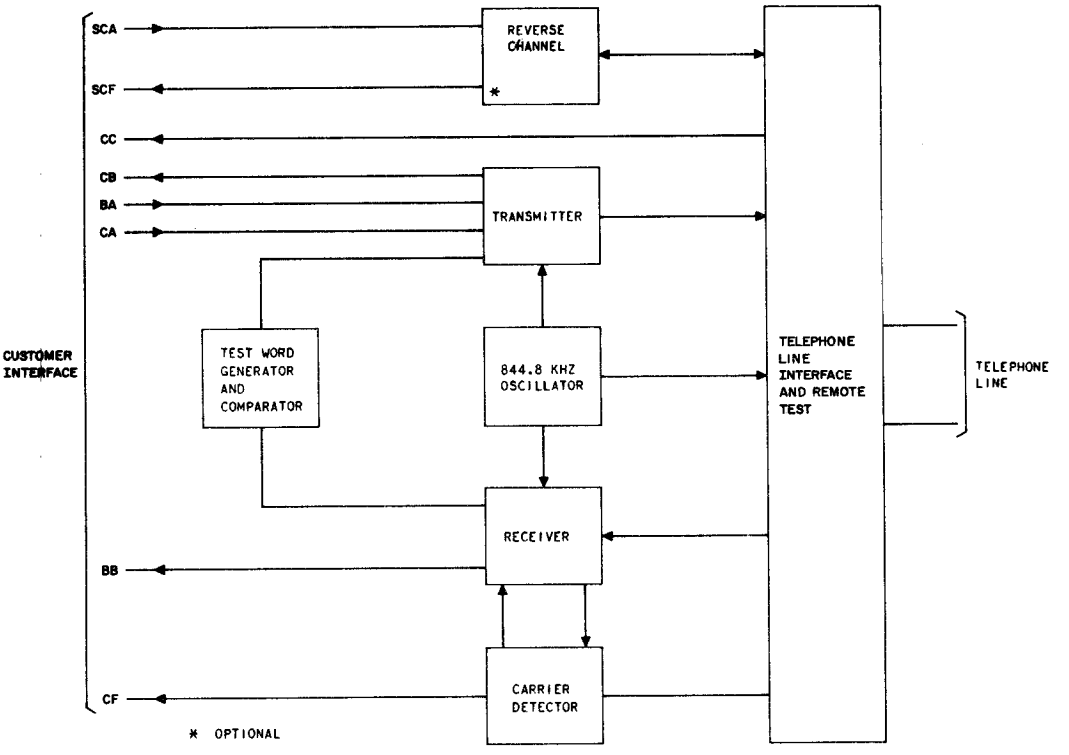


Fig. 4—Data Set 202T-Type, Simplified Block Diagram

(b) Modifies the feedback path from transmitter to receiver to decrease the signal level into the receiver on DS 202T-L1. The level is not decreased in DS 202T-L1A. Rather, the switch is used to enable the minimum compromise delay equalization option (ZV) to reduce distortion during the test.

(c) Lights the TM (test mode) lamp and holds the MR lamp off. The data set ready (CC) lead is held ***off*** on DS 202T-L1. The state of (CC) during this test is optional on DS 202T-L1A.

3.05 ***Local Self Test:*** When the nonlocking LT button is depressed, the data set is conditioned for self test as follows.

(a) All interface leads are made inoperative and the data line is terminated in 600 ohms.

(b) All status indicator lamps light to check for lamp failures.

(c) The feedback path from transmitter to receiver of DS 202T-L1 (the primary channel input to the shaping filter of DS 202T-L1A is attenuated) for a reduced signal level into the receiver.

(d) A repeating 63-bit pseudo-random word (identical to the test word in the 914- and 903-types data test set) is generated at 1547 bps.

(e) The test word is processed by the transmitter and receiver circuitry and the resulting word is compared to the original word.

(f) If an error is detected, the TM lamp goes off.

3.06 A properly operating data set will sometimes fail in a self-test interval of more than 15 seconds because an error in only one bit will cause the TM lamp to go off. However, more than one failure in five successive tests of 15 seconds duration should not occur.

3.07 ***Remote Test (2-Wire):*** The remote test mode for 2-wire operation allows the attendant at the serving test center to test data set circuitry with the exception of the customer interface. When the locking RT button is depressed, the data set is conditioned for remote test as follows:

(a) All customer interface leads are made inoperative and all status indicator lamps light.

(b) A repeating 63-bit pseudo-random word is generated at 1547 bps.

(c) The feedback path from transmitter to receiver is modified in order to reduce the level of the locally generated signal entering the receiver.

(d) The test word is processed by the transmitter and receiver circuitry, and the resulting word is compared to the original word. In addition, the test word is transmitted to the serving test center.

(e) If an error is detected, constant spacing (2200 Hz) is transmitted to the serving test center instead of the random word.

3.08 At the serving test center, the 63-bit pseudo-random word can be checked for errors to establish an error rate (caused by the channel). The attendant at the test center can apply a tone to the line to cause errors in the internal loopback signal of the data set under test. This will cause the data set to transmit constant spacing. If the data set under test is equipped with reverse channel, it will transmit steady marking (1200 Hz) whenever 387 Hz is transmitted by the test center and detected by the reverse channel receiver.

3.09 ***Remote Test (4-Wire):*** The remote test for a 4-wire data set is a digital loopback test. In the digital loopback mode, the attendant at the test center can test data set circuitry with the exception of the customer interface circuits. Depressing the locking RT switch conditions the data set as follows.

(a) All customer interface leads are made inoperative and the ON and TM lamps light.

(b) The output of the demodulator is coupled to the input of the modulator so that the attendant at the test center can perform a digital loopback test.

INTERFACE

A. Customer Interface

3.10 The customer interface is accessible through a 25-pin female connector at the rear of the housing. The pin assignments, lead designations, and lead functions are given in Table A.

3.11 ***Protective Ground (AA):*** This lead is electrically bonded to the data set housing and chassis. It is connected to local power ground through the power transformer. Later model data sets do not provide frame ground at the interface.

3.12 ***Transmitted Data (BA):*** Signals on this lead are generated by the transmitting data terminal and are transferred to the modulator of the data set for transmission to the distant end. A positive signal is a binary "0" or space, and a negative signal is a binary "1" or mark. The CPE must not transmit data unless an ***on*** condition is present on the clear-to-send (CB) and data set ready (CC) interface circuits (except for analog loopback test, described later). The transmitting CPE should hold BA in the marking condition when no data is to be transmitted. With 0 volts on the BA circuit and the clear-to-send and data set ready circuits ***on***, the BA circuit is in an indeterminate state and either a marking or spacing data signal will be transmitted.

3.13 ***Received Data (BB):*** Signals on this lead are generated by the receiving data set in response to data signals received from the distant data set. With the local copy option installed

TABLE A

CUSTOMER INTERFACE

LEAD NO.	FUNCTION	EIA DESIGNATION (RS-232-C)
1	Protective Ground*	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request-to-Send	CA
5	Clear-to-Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Received Line Signal Detector	CF
9	Positive 14 Volts	—†
10	Negative 14 Volts	—†
11 & 19	Secondary Request-to-Send	SCA
12	Secondary Received Line Signal Detector	SCF
25	Carrier Detector Reset	Unassigned

* Not provided on later models of DS 202T-L1 or on DS 202T-L1A.

† Reserved for data set testing.

in half-duplex operation, the BB signal follows the transmitted data signal delayed by less than 2 ms, and may be used to monitor the transmitted data.

3.14 ***Request-to-Send (CA):*** Signals on this lead are generated by the CPE to condition the local data set to transmit data. With the data set ready lead ***on***, the carrier is transmitted in less than 1 ms after the CA lead turns ***on***. The ***on*** condition must be maintained whenever the CPE has information ready for transmission. The data set transmits all signals on the transmitted data lead while the ***on*** condition is maintained on the request-to-send and clear-to-send leads. In half-duplex operation, the ***off*** condition of request-to-send holds the data set in the receive mode, and the ***on*** condition holds the data set in the transmit mode. CPE designed for either transmit-only or duplex operation may continuously hold CA in the ***on*** condition. If the data set is equipped with the JY2 or JY4 reverse channel circuit pack, a signal may be received on the reverse channel regardless of the state of the local CA lead. This type of operation is called independent reverse channel operation. If the data set is equipped with the JY1 reverse channel circuit pack, the local CA circuit must be ***on*** in order for the reverse channel to be able to receive. This is called dependent reverse channel operation.

3.15 ***Clear-to-Send (CB):*** The ***on*** condition of the CB lead is a response to an ***on*** condition on the request-to-send circuit delayed by 180, 60, 30, or 8 ms, depending on the clear-to-send interval option selected. The ***on*** state of CB indicates to the CPE that signals presented on the transmitted data lead will be transmitted to the communication channel. The ***off*** condition is an indication to the CPE that it should not transfer data on the transmitted data lead. When request-to-send is turned ***off*** by the CPE, CB goes ***off*** in less than 1 ms.

3.16 ***Data Set Ready (CC):*** Signals on the CC lead indicate the mode of the data set. The ***on*** condition indicates that the data set is in the data mode and is capable of transmitting and receiving data signals. The ***on*** condition is required in conjunction with an ***on*** condition on the request-to-send and clear-to-send circuits when transmitting data. The ***off*** condition indicates that the data set is in some mode other than the data mode. The ***on*** condition of this circuit should not be interpreted to mean that a communication channel has been established to a remote data station or to determine the status of any remote terminal equipment.

3.17 ***Signal Ground (AB):*** This circuit establishes the common ground reference potential for all interface circuits except protective ground. This circuit is normally connected to protective ground to minimize the introduction of longitudinal power line noise into electronic circuitry through the power transformer. Depending on local procedures and conditions, this connection to protective ground can be removed by the telco installer.

3.18 ***Received Line Signal Detector (CF):*** An ***on*** condition on the CF lead indicates that the data carrier is being received and has been received for at least 7 ms (option Q) or 23 ms (option N). This circuit normally does not turn ***on*** in the presence of noise, out-of-band signals or other non-FSK signals even when the fast mode carrier detection option (Q) is selected. When the data carrier is lost due to an end of transmission or to a telephone line interruption, the ***off*** condition follows after a 10 ms time delay. The ***off*** condition on CF causes the received data circuit to be clamped to the mark condition if the clamp option (F) is installed. The CF circuit responds to carrier signals from either the local or distant transmitting data set when optioned for local copy of the primary channel (option ZA). The CF circuit is ***off*** during the squelch interval when the squelch option is used.

3.19 ***Circuits 9 and 10:*** These circuits originate in the data set for use by the telco personnel in data set testing. Pin 9 provides an access to the +14 volt dc supply; pin 10 provides an access to the -14 volt dc supply. The CPE must not be connected to these leads.

3.20 ***Secondary Request-to-Send (SCA):*** This circuit is available on data sets equipped with reverse channel, and is used to provide communication from the receiving data set to the transmitting data set simultaneously with the primary data channel.

3.21 ***Secondary Received Line Signal Detector (SCF):*** This lead is provided only on data sets equipped with reverse channel. It is used to signal the data set transmitting on the primary channel regarding conditions at the receiving data set simultaneously with the transmission

on the primary data channel. With the local copy option for the reverse channel (option ZE), the SCF circuit responds to reverse channel carrier from either the local or distant data set. If the data set is equipped with the JY1 reverse channel circuit pack, the request-to-send (CA) lead must be ***on*** in order to receive the reverse channel signal from the distant data set. If the data set is equipped with the JY2 or JY4 reverse channel circuit pack, the reverse channel can receive independently of the state of the request-to-send (CA) lead.

3.22 ***Carrier Detector Reset (Non-EIA):*** This circuit is used to reset the carrier detector on systems requiring fast turnaround. A positive pulse of greater than 0.2 μs duration resets the carrier detector so that the receiver is ready for new data. The carrier detector reset terminator is ***off*** for a negative applied voltage or if the terminal is left unconnected. An option is provided to disable the carrier detector reset terminator.

B. Telephone Line Interface

3.23 The telephone interface is a 25-pin male connector which provides access through the M8K cord to the DAS 828-type or 829-type. The pin assignments, lead designations, and lead descriptions are given in Table B.

4. OPTIONS

4.01 The DS 202T-type is provided with a number of options. Refer to Tables C and D for a summary of options provided with DS 202T-L1 and 202-L1A respectively. Refer to Section 592-031-200 for a description of these options.

4.02 Options are installed and removed by means of switches (DS 202T-type) and strapping plugs (DS 202T-L1 only) on the data set circuit pack, by a strapping plug on the reverse channel circuit pack (when provided), and by a screw switch on the backplane (frame ground to signal ground option).

4.03 Refer to Tables E and F for a summary of options recommended for use with DS 202T-L1 and 202T-L1A.

5. OPERATION

5.01 Attendant operation of DS 202T-type is limited to operation of the three test switches and observation of the six status indicators. The data set is in the data mode under the following conditions:

- All test switches are in the OUT position.
- ON and MR status indicators are lighted.

TABLE B

TELEPHONE LINE INTERFACE

PIN NUMBER	DESIGNATION	DESCRIPTION
7	DT1	First tip and ring pair. In 2-wire operation, the data signals are transmitted and received through these terminals. In 4-wire operation, data signals are transmitted through these terminals.
8	DR1	
9	DT	Second tip and ring pair. In 2-wire operation, these terminals are not used. In 4-wire operation, data signals are received through these terminals.
10	DR	
11	TEK6	A relay contact (provided by DAS 828- and 829-types) may be connected to these terminals to remotely control the data set ready (CC) and clear-to-send (CB) customer interface drivers.
13	TEK5	

5.02 The data set is in the test mode when any of the test switches is depressed and the TM status indicator is lighted. Refer to Section 592-031-500 for test procedures and requirements.

6. REFERENCES

6.01 The following Bell System Practices provide additional information concerning DS 202T-type and data stations using DS 202T-type.

SECTION	TITLE
590-102-130	39A Data Mounting—Identification
590-102-131	40-Type Data Mountings—Identification
590-102-137	47-Type Data Mounting—Identification
592-031-180	Data Set 202T Transmitter-Receiver—Summarizing Specification
592-031-200	Data Set 202T-Type Transmitter-Receiver—Installation and Connections
592-031-300	Data Set 202T Transmitter-Receiver—Maintenance
592-031-500	Data Set 202T-Type Transmitter-Receiver—Test Procedures and Maintenance
592-861-100	Data Station Using Data Set 202T—Description and Operation
592-861-200	Data Station Using Data Set 202T—Installation
592-861-500	Data Station Using Data Set 202T—Test Procedures
598-080-100	Data Auxiliary Set 828A—Description and Operation
598-080-200	Data Auxiliary Set 828A—Installation
598-080-101	Data Auxiliary Set 828C—Description and Operation
598-080-201	Data Auxiliary Set 828C—Installation
598-082-100	Data Auxiliary Set 829-Type Channel Interface Units—Voiceband Private Line Channels—Description
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Test Room

6.02 Detailed information concerning DS 202T-type is also contained in CD- and SD-1D243-01.

TABLE C

DATA SET 202T-L1 OPTIONS

FEATURE	OPTION	DESCRIPTION		SWITCH SETTING										PROVIDE
				S3 Switch Contact Setting On Transmitter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			0	0	X	X	0	0	0	X	X	X	One Per Data Set
2-Wire Operation w/o Reverse Channel	ZD			X	0	X	0	0	X	X	0	0	0	
2-Wire Operation With Reverse Channel	ZC†			X	X	0	0	X	0	X	0	0	0	
				S2 Switch Contact Setting On Transmitter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			X	—	—	—	—	—	—	—	—	—	One Per Data Set
Local Copy on Primary Channel in 2-Wire	ZA	IN		X	—	—	—	—	—	—	—	—	—	
	ZB†	OUT		0	—	—	—	—	—	—	—	—	—	
Soft Turnoff and Squelch Intervals		Soft Turnoff	Squelch											One Per Data Set
	Z	0	0	—	—	0	X	—	—	—	—	0	X	
	Y*	8 ms	0	—	—	0	X	—	—	—	—	0	0	
	X	24 ms	0	—	—	0	X	—	—	—	—	X	0	
	W	0	9 ms	—	—	0	0	—	—	—	—	0	X	
	V	0	156 ms	—	—	X	0	—	—	—	—	0	X	
	T	8 ms	9 ms	—	—	0	0	—	—	—	—	0	0	
	S	8 ms	156 ms	—	—	X	0	—	—	—	—	0	0	
	R	24 ms	156 ms	—	—	X	0	—	—	—	—	X	0	
Fast Carrier Detection	Q*	IN		—	—	—	—	0	—	—	—	—	—	One Per Data Set
	N	OUT		—	—	—	—	X	—	—	—	—	—	
Clear-to-Send Interval	M*	8 ms		—	—	—	—	—	0	0	—	—	—	
	K	30 ms		—	—	—	—	—	0	X	—	—	—	
	J	60 ms		—	—	—	—	—	X	0	—	—	—	
	G	180 ms		—	—	—	—	—	X	X	—	—	—	
External Control of CC (Data Set Ready)	B*	IN		—	—	—	—	—	—	—	0	—	—	One Per Data Set
	A	OUT		—	—	—	—	—	—	—	X	—	—	
Clamp	F*	IN		—	0	—	—	—	—	—	—	—	—	One Per Data Set
	E	OUT		—	X	—	—	—	—	—	—	—	—	

TABLE C (Contd)

DATA SET 202T-L1 OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING	PROVIDE
Carrier Detector Reset			Strapping on Transmitter-Receiver CP	One Per Data Set
	ZL	IN	Install E21-E23	
	ZM*	OUT	Install E22-E23	
Continuous Carrier	ZN	IN	Install E24-E25	One Per Data Set
	ZO*	OUT	Install E25-E26	
Compromise Equalization	ZU*	Maximum	Install E27	One Per Data Set
	ZV	Minimum	Install E28	
Local Copy on Reverse Channel			Strapping on Reverse Channel CP	One Per Data Set
	ZE	IN	Install E21-E22	
	ZF*	OUT	Install E21-E23	
Grounding Option			Screw Switch S1 Setting on Interface Circuit	One Per Data Set
	ZG*	Signal Ground Connected to Frame Ground	S1 Closed	
	ZH	Signal Ground Not Connected to Frame Ground	S1 Open	

X Rocker down on side adjacent to numbers.
0 Rocker up on side adjacent to numbers.
— Rocker may be in either position.
* Factory furnished.
† Factory furnished instead of 4-wire option when reverse channel CP is installed.

TABLE D

DATA SET 202T-L1A OPTIONS

FEATURE	OPTION	DESCRIPTION		SWITCH SETTING										PROVIDE
				S3 Switch Contact Setting On Transmittter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			0	—	—	0	—	X	X	X	X	X	One Per Data Set
2-Wire Operation w/o Reverse Channel	ZD			X	—	—	X	—	X	0	0	0	0	
2-Wire Operation With Reverse Channel	ZC†			X	—	—	X	—	0	0	0	0	0	
Compromise Delay Equalization	ZV	Minimum		—	X	—	—	—	—	—	—	—	—	One Per Data Set
	ZU*	Maximum		—	0	—	—	—	—	—	—	—	—	
Compromise Amplitude Equalization	ZX	Minimum		—	—	—	—	X	—	—	—	—	—	One Per Data Set
	ZW*	Maximum		—	—	—	—	0	—	—	—	—	—	
Channel Condition	ZZ	C2		—	—	X	—	—	—	—	—	—	—	One Per Data Set
	ZY*	Basic		—	—	0	—	—	—	—	—	—	—	
				S2 Switch Contact Setting On Transmitter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			X	—	—	—	—	—	—	—	—	—	One Per Data Set
Local Copy on Primary Channel in 2-Wire	ZA	IN		X	—	—	—	—	—	—	—	—	—	
	ZB†	OUT		0	—	—	—	—	—	—	—	—	—	
Soft Turnoff and Squelch Intervals		Soft Turnoff	Squelch											
	Z	0	0	—	X	—	—	—	0	X	0	—	—	One Per Data Set
	Y*	8 ms	0	—	X	—	—	—	0	0	0	—	—	
	X	24 ms	0	—	X	—	—	—	0	0	X	—	—	
	W	0	9 ms	—	0	—	—	—	0	X	0	—	—	
	V	0	156 ms	—	0	—	—	—	X	X	0	—	—	
	T	8 ms	9 ms	—	0	—	—	—	0	0	0	—	—	
	S	8 ms	156 ms	—	0	—	—	—	X	0	0	—	—	
	R	24 ms	156 ms	—	0	—	—	—	X	0	X	—	—	
Fast Carrier Detection	Q*	IN		—	—	0	—	—	—	—	—	—	—	One Per Data Set
	N	OUT		—	—	X	—	—	—	—	—	—	—	
Clear-to-Send Interval	M*	8 ms		—	—	—	0	—	—	—	—	—	0	One Per Data Set
	K	30 ms		—	—	—	0	—	—	—	—	—	X	
	J	60 ms		—	—	—	X	—	—	—	—	—	0	
	G	80 ms		—	—	—	X	—	—	—	—	—	X	

TABLE D (Contd)

DATA SET 202T-L1A OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING	PROVIDE
External Control of CC (Data Set Ready)	B*	IN	— — — — — — — — 0 —	One Per Data Set
	A	OUT	— — — — — — — — X —	
Clamp	F*	IN	— — — — 0 — — — — —	One Per Data Set
	E	OUT	— — — — X — — — — —	
			S4 Switch Contact Setting on Transmitter-Receiver	
			1 2 3	
Carrier Detector Reset	ZL	IN	— X —	One Per Data Set
	ZM*	OUT	— 0 —	
Continuous Carrier	ZN	IN	X — —	One Per Data Set
	ZO*	OUT	0 — —	
State of CC (Data Set Ready) During Analog Loopback	YB	ON	— — X	One Per Data Set
	YA*	OFF	— — 0	
Local Copy on Reverse Channel			Strapping on Reverse Channel CP	One Per Data Set
	ZE	IN	Install E21-E22	
	ZF†	OUT	Install E21-E23	
Grounding Option (Data Set)			Screw Switch S1 Setting on Interface Circuit	One Per Data Set
	ZG*	Signal Ground Connected to Frame Ground	S1 Closed	
	ZH	Signal Ground Not Connected to Frame Ground	S1 Open	
Grounding Option (Data Mounting)			Strapping on 39A1 or 40B1 Data Mounting	
	ZI*	Signal Ground Connected to Frame Ground	Wire Strap of Power Supply In	
	ZJ	Signal Ground Not Connected to Frame Ground	Wire Strap if Power Supply Out	

X Rocker down on side adacent to numbers.
0 Rocker up on side adjacent to numbers.
— Rocker may be in either position.
* Factory furnished.
† Factory furnished instead of 4-wire option when reverse channel CP is installed.

TABLE E

RECOMMENDED CUSTOMER OPTIONS FOR 2-WIRE PRIVATE LINE AND 4-WIRE PRIVATE LINE WITH TALK-BACK USING DATA SET 202T-TYPE

OPTION	NEAR END	FAR END 202C, 202D, OR 202R (NOTE 1)
Received Data Squelch	156 ms	IN
Clear-to-Send Delay	180 ms	200 ms
Fast Carrier Detection	OUT (Normal) (23 ms)	40 ms
Soft Carrier Tunroff	24 ms	IN
Received Data Clamp	IN	IN
Alternate Voice	Optional	Optional
Switched Network Backup	Optional	Optional
Reverse Channel	Optional in 2-Wire Private Line	Optional in 2-Wire Private Line (Note 2)
Carrier Detector Reset	Not Used	Not Offered
Local Copy	Optional in 2-Wire Private Line	Always Provided for 2-Wire Data Set
Continuous Carrier	OUT—Carrier Under Control of Request-to-Send	Carrier Controlled by Request-to-Send (Note 3)

Notes:

1. If far-end data set is a 202T-type the recommended options are the same as those for the near end.
2. Not offered with DS 202R.
3. Not offered with DS 202C or D.

TABLE F

RECOMMENDED OPTIONS FOR 4-WIRE POINT-TO-POINT AND MULTIPOINT WITHOUT TALK-BACK USING DATA SET 202T-TYPE

OPTION	RECOMMENDATION
Clear-to-Send Delay	8 ms if remote data set is a 202T-type with fast mode carrier detection. 30 ms if remote data set is a 202T-type with normal mode carrier detection or a 202R, 202D5, or D6 with 20 ms carrier detector timing. 60 ms if remote data set is a 202C, 202D3, 202D4, or a 202R, 202D5, or 202D6 with the 40 ms carrier detector timing.
Fast Carrier Detection	IN (fast mode) if remote data set is a 202T-type with 8 ms clear-to-send delay. OUT (normal mode) if remote data set is optioned for 30, 60, 180, or 200 ms clear-to-send delay.
Soft Carrier Turnoff	24 ms if remote data set is a 202C, 202D3, D4, D5, D6, 202R, or 202T with normal mode fast carrier detection. (See Note) 8 ms if remote data set is a 202T-type with fast carrier detection option. **0 ms** turnoff if remote data set uses carrier detector reset option.
Received Data Clamp	IN
Carrier Detector Reset	IN—at master station of broadcast polling or bridge multipoint system when remote data sets use the quick carrier turnoff and master station is able to implement this circuit. OUT—all other times.
Continuous Carrier	IN—for point-to-point applications and for data set as master station of split bridge multipoint systems. OUT—may be used for above applications and should be used for data set at the remote station of split bridge multipoint system.
Alternate Voice	Optional (with DAS 828A or 829-type).
Switched Network Backup	Optional (with DAS 828A or 829-type).

Note: Data set 202T-type must be optioned for the 8 ms or **0 ms** turnoff interval when the interval between consecutive turnoffs of the request to send circuit is less than 165 ms.

DATA SET 202T-TYPE
INSTALLATION AND CONNECTIONS
TRANSMITTER-RECEIVER

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the installation and connection of data set (DS) 202T-type. The data set should be installed in conformance with existing installation practices as presented in Section 590-010-200. The information in this section covers installation of data sets in individual housings. For information on multiple installation of DS 202T in a data station, refer to Section 592-861-200.

1.02 This section is reissued to add USOC information pertaining to DS 202T-L1A options, Table B and connecting dc power sources to certain DS 202T-types. Revision arrows are used to emphasize significant changes.

1.03 Prior to installing the data set, verify that the overall facilities meet requirements specified in Section 314-410-500. The private line facility must be arranged for −16 dBm receive level and 0 dBm transmit level.

If DS 202T-type is used to replace a 202D or 202R, the existing facility may have been arranged for different levels.

1.04 It is preferred that the data set be installed on a desk, table, stand, or in a Bell System provided equipment cabinet. The data set will operate over an ambient temperature range of 40 to 120°F with a relative humidity of 20 to 95 percent at 70°F and 20 to 40 percent at 120°F.

Note: These environmental conditions apply only if condensation does not accumulate on the circuits.

1.05 The DS 202T-type should be located near the customer-provided equipment (CPE) because the interface cord supplied by the customer should not exceed 50 feet in length (to reduce stray capacitance and as recommended by Electronic Industries Association [EIA] standards). To minimize inductive interference to data signals on the telephone (data) line, the line should not be carried in the same run as the cable between the data set and CPE or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type SK (shielded), or equivalent, station wire between the data set and cable distribution terminal or building entrance. Ground the shield at one end only, preferably at the distribution terminal end.

Caution 1: If the outlet has a metal cover, do not remove the center screw to mount the transformer. When this screw is removed, it is possible for the metal cover to fall across the prongs of the transformer.

Caution 2: Remove and discard the protective covering from the data set housing. If not removed before operation, excessive heating of the data set will result.

1.06 Low voltage alternating current is supplied to the data set by wall transformer KS-21239-L5. The customer must provide a standard 3-wire,

grounded 105 to 129V at 57 to 63 Hz, power receptacle that is easily accessible to the data set. The power required per set is approximately 7 watts. Approximately 1.7 watts of this is dissipated in the wall transformer.

1.07 ◗Data sets 202T-L1, 202T-L1/4, 202T-L1A/4 and 202T-L1A/3B/4 may be powered from two customer furnished dc sources, one +15 ±1.5 volts and one −15 ±1.5 volts. These supplies connect to the data mounting by the power transformer cord. The transformer is not furnished with these data sets.◖

1.08 A 25-pin KS-19087-L6 connector is provided at the rear of the data set for connection to the CPE. This connector is designed to mate with a customer-provided Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood. Connection between the data set and 4-wire private line facilities is made with the furnished M8K cord. For service on 2-wire private line facilities, connection between the data set and line is made with a D25D cord (ordered separately) to permit connection to the 66E3 connecting block.

1.09 To gain access to the circuit packs and option switches, it will be necessary to remove the data set from the housing. This can be done as follows:

(a) Remove the front cover by gently squeezing it at the top and rotating it down and out of the housing.

(b) If provided, loosen the retaining screw under the left front side of the housing until it is completely disengaged from the data set.

(c) Gently pry the circuit pack(s) out of the housing using a screwdriver or similar tool behind the faceplate. On later sets, a wire handle is provided which should be rotated outward and pulled to remove the circuit packs.

1.10 If the data set is equipped with the reverse channel circuit pack, it must be removed to gain access to the option switches. Remove the reverse channel circuit pack by removing the four screws and exerting steady upward pressure at the front and rear of the card. To replace the reverse channel circuit pack, align the female connectors on the bottom of the card with the contact posts on the data set. Press down on the circuit pack until it makes good contact with the posts and the front edge is resting on top of the faceplate. Insert and tighten the retaining screws.

(1) Slide the circuit pack(s) into the housing, ensuring that the contacts at the rear of the circuit pack are firmly seated in the connector at the rear of the housing.

(2) If provided, align and tighten the retaining screw.

(3) Hook the tabs on the bottom of the front cover into the detents in the bottom of the housing.

(4) Gently rotate the top of the front cover into the housing until it snaps into place.

2. OPTIONS

2.01 The installer should disassemble the data set to verify that the options called for on the service order are installed in the data set prior to placing it in service.

2.02 Options are installed and removed by means of switches (Fig. 1) and straps (DS 202T-L1 only) on the data set printed wiring board (Fig. 2), by a strap on the reverse channel circuit pack (when provided), and by a screw switch on the backplane (frame ground to signal ground option). Refer to Table A or B for the switch settings and strap positions for the various options. Refer to Table C for the recommended options for a DS 202T-type used on 2-wire private line or 4-wire private line with talk-back. Refer to Table D for the recommended options for a DS 202T-type used on 4-wire point-to-point and multipoint systems without talk-back.

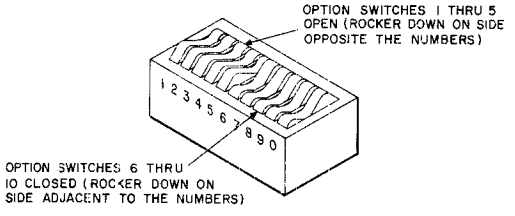


Fig. 1—Option Switch

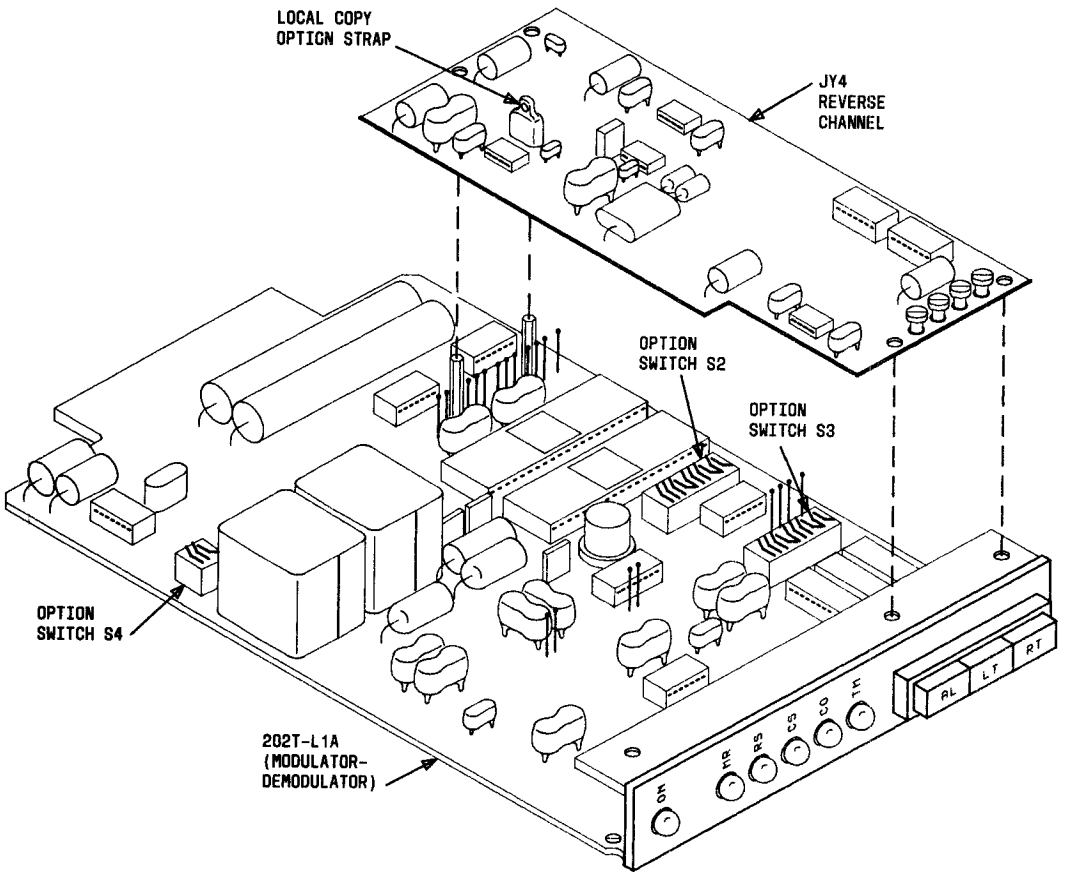


Fig. 2—Location of Option Switches

A long screwdriver (6-inch) is needed to operate the screw switch that controls the grounding option. If the appropriate screwdriver is not available, the backplane may be taken out of the housing by removing the two screws on the bottom of the housing.

2.03 ***2-Wire Operation:*** This option is used when 2-wire facilities are selected and half-duplex service is satisfactory. The 2-wire option can

TABLE A

DATA SET 202T-L1 OPTIONS

FEATURE	OPTION	DESCRIPTION		SWITCH SETTING										PROVIDE
				S3 Switch Contact Setting On Transmitter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			0	0	X	X	0	0	0	X	X	X	One Per Data Set
2-Wire Operation w/o Reverse Channel	ZD			X	0	X	0	0	X	X	0	0	0	
2-Wire Operation With Reverse Channel	ZC†			X	X	0	0	X	0	X	0	0	0	
				S2 Switch Contact Setting On Transmitter-Receiver										
				1	2	3	4	5	6	7	8	9	0	
4-Wire Operation	ZK*			X	—	—	—	—	—	—	—	—	—	One Per Data Set
Local Copy on Primary Channel in 2-Wire	ZA	IN		X	—	—	—	—	—	—	—	—	—	
	ZB†	OUT		0	—	—	—	—	—	—	—	—	—	
Soft Turnoff and Squelch Intervals		Soft Turnoff	Squelch											One Per Data Set
	Z	0	0	—	—	0	X	—	—	—	—	0	X	
	Y*	8-ms	0	—	—	0	X	—	—	—	—	0	0	
	X	24-ms	0	—	—	0	X	—	—	—	—	X	0	
	W	0	9-ms	—	—	0	0	—	—	—	—	0	X	
	V	0	156-ms	—	—	X	0	—	—	—	—	0	X	
	T	8-ms	9-ms	—	—	0	0	—	—	—	—	0	0	
	S	8-ms	156-ms	—	—	X	0	—	—	—	—	0	0	
	R	24-ms	156-ms	—	—	X	0	—	—	—	—	X	0	
Fast Carrier Detection	Q*	IN		—	—	—	—	0	—	—	—	—	—	One Per Data Set
	N	OUT		—	—	—	—	X	—	—	—	—	—	
Clear-to-Send Interval	M*	8-ms		—	—	—	—	—	0	0	—	—	—	
	K	30-ms		—	—	—	—	—	0	X	—	—	—	
	J	60-ms		—	—	—	—	—	X	0	—	—	—	
	G	180-ms		—	—	—	—	—	X	X	—	—	—	
External Control of CC (Data Set Ready)	B*	IN		—	—	—	—	—	—	—	0	—	—	One Per Data Set
	A	OUT		—	—	—	—	—	—	—	X	—	—	
Clamp	F*	IN		—	0	—	—	—	—	—	—	—	—	One Per Data Set
	E	OUT		—	X	—	—	—	—	—	—	—	—	

Table A (Contd)

DATA SET 202T-L1 OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING	PROVIDE
Carrier Detector Reset			Strapping on Transmitter-Receiver CP	One Per Data Set
	ZL	IN	Install E21-E23	
	ZM*	OUT	Install E22-E23	
Continuous Carrier	ZN	IN	Install E24-E25	One Per Data Set
	ZO*	OUT	Install E25-E26	
Compromise Equalization	ZU*	Maximum	Install E27	One Per Data Set
	ZV	Minimum	Install E28	
Local Copy on Reverse Channel			Strapping on Reverse Channel CP	One Per Data Set
	ZE	IN	Install E21-E22	
	ZF*	OUT	Install E21-E23	
Grounding Option			Screw Switch S1 Setting on Interface Circuit	One Per Data Set
	ZG*	Signal Ground Connected to Frame Ground	S1 Closed	
	ZH	Signal Ground Not Connected to Frame Ground	S1 Open	

X Rocker down on side adjacent to numbers.
0 Rocker up on side adjacent to numbers.
— Rocker may be in either position.
* Factory furnished.
† Factory furnished instead of 4-wire option when reverse channel CP is installed.

be selected with reverse channel (ZC) or without reverse channel (ZD). If option ZC is selected, the data set must be equipped with a reverse channel circuit pack (JY1 or JY2 for DS 202T-L1 and JY4 for DS 202T-L1A) and option ZE or ZF must be selected. If option ZD is selected, the reverse channel circuit pack must be physically removed from the data set.

2.04 ***4-Wire Operation:*** This option is used when 4-wire point-to-point or multipoint facilities are selected. The 4-wire option used with 4-wire facilities provides duplex capability.

2.05 ***Compromise Delay Equalization (DS 202T-L1A Only):*** This option is the same as the "compromise equalization" option provided on DS 202T-L1 series 6 and higher. Option ZV (minimum compromise delay equalization) provides reduced envelope delay distortion compensation to eliminate an over-equalization condition on channels with low envelope delay distortion. Option ZU (maximum compromise delay equalization) provides the same delay equalizer characteristics provided on data sets without the delay equalizer options (DS 202T-L1 series 5 and lower). For data bit rates above 1200 bps, it is necessary to perform a data distortion test to determine the proper delay equalizer option setting. The procedure for this data distortion test is contained in Section 592-031-500.

● TABLE B ●

DATA SET 202T-L1A OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING										PROVIDE	USOC DECSN
			S3 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER											
			1	2	3	4	5	6	7	8	9	0		
4-Wire Operation	ZK*		0	–	–	0	–	X	X	X	X	X	One Per Data Set	E10
2-Wire Operation	ZD	w/o Reverse Channel	X	–	–	X	–	X	0	0	0	0	One Per Data Set	E10
	ZC†	With Reverse Channel	X	–	–	X	–	0	0	0	0	0	One Per Data Set	E9
Compromise Delay Equalization	ZV	Minimum	–	X	–	–	–	–	–	–	–	–	One Per Data Set	
	ZU*	Maximum	–	0	–	–	–	–	–	–	–	–	One Per Data Set	
Compromise Amplitude Equalization	ZX	Minimum	–	–	–	–	X	–	–	–	–	–	One Per Data Set	
	ZW*	Maximum	–	–	–	–	0	–	–	–	–	–	One Per Data Set	
Channel Condition	ZZ	C2	–	–	X	–	–	–	–	–	–	–	One Per Data Set	
	ZY*	Basic	–	–	0	–	–	–	–	–	–	–	One Per Data Set	
			S2 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER											
			1	2	3	4	5	6	7	8	9	0		
4-Wire Operation	ZK*		X	–	–	–	–	–	–	–	–	–	One Per Data Set	E10
Local Copy on Primary Channel in 2-Wire	ZA	In	X	–	–	–	–	–	–	–	–	–		A1
	ZB†	Out	0	–	–	–	–	–	–	–	–	–		A2
		SOFT TURNOFF / SQUELCH												
Soft Turnoff and Squelch Intervals	Z	0 / 0	–	X	–	–	–	0	X	0	–	–	One Per Data Set	C6
	Y*	8 ms / 0	–	X	–	–	–	0	0	0	–	–	One Per Data Set	C5,C6
	X	24 ms / 0	–	X	–	–	–	0	0	X	–	–	One Per Data Set	C6
	W	0 / 9 ms	–	0	–	–	–	0	X	0	–	–	One Per Data Set	C6
	V	0 / 156 ms	–	0	–	–	–	X	X	0	–	–	One Per Data Set	C6
	T	8 ms / 9 ms	–	0	–	–	–	0	0	0	–	–	One Per Data Set	C6
	S	8 ms / 156 ms	–	0	–	–	–	X	0	0	–	–	One Per Data Set	C6
	R	24 ms / 156 ms	–	0	–	–	–	X	0	X	–	–	One Per Data Set	C6
Fast Carrier Detection	Q*	In	–	–	0	–	–	–	–	–	–	–	One Per Data Set	C5,C6
	N	Out	–	–	X	–	–	–	–	–	–	–	One Per Data Set	C6
Clear-to-Send Interval	M*	8 ms	–	–	–	0	–	–	–	–	–	0	One Per Data Set	C5,C6
	K	30 ms	–	–	–	0	–	–	–	–	–	X	One Per Data Set	C6
	J	60 ms	–	–	–	X	–	–	–	–	–	0	One Per Data Set	C6
	G	180 ms	–	–	–	X	–	–	–	–	–	X	One Per Data Set	C6

◆ TABLE B ◆ (Contd)
DATA SET 202T-L1A OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING	PROVIDE	USOC DECSN
External Control of CC (Data Set Ready)	B*	In	– – – – – – – – 0 –	One Per Data Set	
	A	Out	– – – – – – – – X –		
Clamp	F*	In	– – – – 0 – – – – –	One Per Data Set	D7
	E	Out	– – – – X – – – – –		D8
			S4 SWITCH CONTACT SETTING ON TRANSMITTER-RECEIVER 1 2 3		
Carrier Detector Reset	ZL	In	– X –	One Per Data Set	D8
	ZM*	Out	– 0 –		D7,D8
Continuous Carrier	ZN	In	X – –	One Per Data Set	D8
	ZO*	Out	0 – –		D7,D8
State of CC (Data Set Ready) During Analog Loopback	YB	On	– – X	One Per Data Set	D8
	YA*	Off	– – 0		D7,D8
Local Copy on Reverse Channel			STRAPPING ON REVERSE CHANNEL CP	One Per Data Set	
	ZE	In	Install E21-E22		B3
	ZF†	Out	Install E21-E23		B4
Grounding Option (Data Set)			SCREW SWITCH S1 SETTING ON INTERFACE CIRCUIT	One Per Data Set	
	ZG*	Signal Ground Connected to Frame Ground	S1 Closed		F11
	ZH	Signal Ground Not Connected to Frame Ground	S1 Open		F12
Grounding Option (Data Mounting)			STRAPPING ON 39A1 or 40B1 DATA MOUNTING		
	ZI*	Signal Ground Connected to Frame Ground	Wire Strap if Power Supply In		F11
	ZJ	Signal Ground Not Connected to Frame Ground	Wire Strap if Power Supply Out		F12

X Rocker down on side adjacent to numbers.
0 Rocker up on side adjacent to numbers.
– Rocker may be in either position.
* Factory furnished.
† Factory furnished instead of 4-wire option when reverse channel CP is installed.

TABLE C

RECOMMENDED CUSTOMER OPTIONS FOR 2-WIRE PRIVATE LINE AND 4-WIRE PRIVATE LINE WITH TALK-BACK USING DATA SET 202T-TYPE

OPTION	NEAR END	FAR END 202C, 202D, OR 202R (NOTE)
Received Data Squelch	156-ms	IN
Clear-to-Send Delay	180-ms	200-ms
Fast Carrier Detection	OUT (Normal) (23-ms)	40-ms
Soft Carrier Tunroff	24-ms	IN
Received Data Clamp	IN	IN
Alternate Voice	Optional	Optional
Switched Network Backup	Optional	Optional
Reverse Channel	Optional in 2-Wire Private Line	Optional in 2-Wire Private Line *
Carrier Detector Reset	Not Used	Not Offered
Local Copy	Optional in 2-Wire Private Line	Always Provided for 2-Wire Data Set
Continuous Carrier	OUT—Carrier Under Control of Request-to-Send	Carrier Controlled by Request-to-Send †

Note : If far-end data set is a 202T-type the recommended options are the same as those for the near end.

* Not offered with DS 202R.

† Not offered with DS 202C or D.

2.06 ***Compromise Amplitude Equalization (DS 202T-L1A Only):*** Option ZX (minimum compromise amplitude equalization) effectively removes compromise amplitude equalization and is required on lines with high end delay distortion near the upper limit and amplitude distortion near the lower limit of the 3002 specification. Without this option this combination of distortions may cause parity errors at 1200 bps. Option ZW (maximum compromise amplitude equalization) provides the same amplitude equalization as DS 202T-L1. The test used to determine the proper option for an installation is described in Section 592-031-500.

2.07 ***Channel Condition (DS 202T-L1A Only):*** These options modify the demodulator for operation over C2 conditioned lines (ZZ) or basic lines (ZY). Option ZY is similar to the demodulator setting provided by DS 202T-L1.

2.08 ***Local Copy on Primary Channel in 2-Wire:*** With this option installed, the receiver continuously monitors the transmitted line signal while in the data mode and provides a local copy on the received data circuit.

2.09 ***Soft Turnoff and Squelch Intervals:***

(a) When a data terminal turns request-to-send ***off*** at the end of a message, transients occur which may cause spurious signals to be received at a distant station. With the soft carrier turnoff option, the data set transmits out-of-band carrier (900 Hz) for a period of either 24- or 8-ms after request-to-send is turned ***off.*** This option should be used in conjunction with the received data clamp option and results in a steady mark on the

TABLE D

RECOMMENDED OPTIONS FOR 4-WIRE POINT-TO-POINT AND MULTIPOINT WITHOUT TALK-BACK USING DATA SET 202T-TYPE

OPTION	RECOMMENDATION
Clear-to-Send Delay	8-ms if remote data set is a 202T-type with fast mode carrier detection. 30-ms if remote data set is a 202T-type with normal mode carrier detection or a 202R, 202D5, or D6 with 40-ms carrier detector timing. 60-ms if remote data set is a 202C, 202D3, 202D4, or a 202R, 202D5, or 202D6 with the 40-ms carrier detector timing.
Fast Carrier Detection	IN (fast mode) if remote data set is a 202T-type with 8-ms clear-to-send delay. OUT (normal mode) if remote data set is optioned for 30- 60- 180- or 200-ms clear-to-send delay.
Soft Carrier Turnoff	24-ms if remote data set is a 202C, 202D3, D4, D5, D6, 202R, or 202T with normal mode fast carrier detection. * 8-ms if remote data set is a 202T-type with fast carrier detection option. Quick turnoff if remote data set uses carrier detector reset option.
Received Data Clamp	IN
Carrier Detector Reset	IN—at master station of broadcast polling or bridge multipoint system when remote data sets use the quick carrier turnoff and master station is able to implement this circuit. OUT—all other times.
Continuous Carrier	IN—for point-to-point applications and for data set as master station of split bridge multipoint systems. OUT—may be used for above applications and should be used for data set at the remote station of split bridge multipoint system.
Alternate Voice	Optional (with DAS 828A or 829-type).
Switched Network Backup	Optional (with DAS 828A or 829-type).

* Data set 202T-type must be optioned for the 8-ms or quick turnoff interval when the interval between consecutive turnoffs of the request to send circuit is less than 165-ms.

received data circuit of the remote data set. The 8-ms option should be used when the remote data set has the fast received line signal detector option. The 24-ms option should be used when the remote data set is a 202D, 202R, or 202T-type with the normal received line signal detector option. However, the 24-ms option must not be used when the interval between consecutive turnoffs of request-to-send circuits is less than 165-ms. Neither the 8- nor 24-ms option should be used at the remote stations of a multipoint system when intermessage intervals are less than 10-ms. For this case, the 0-ms (quick turnoff) option should be used (at the remote stations) in conjunction with the received data clamp and the carrier detector reset options (at the master station). With the 0-ms (quick turnoff) option, carrier will be turned off in less than 1-ms after the request-to-send circuit is turned ***off.***

Note: In 2-wire applications for terminals which immediately turn ***on*** request-to-send as soon as the received line signal detector goes ***off,*** the 8-ms soft turnoff option is incompatible with the 8-ms clear-to-send interval option, and the 24-ms soft turnoff option is incompatible with the 8-ms and 30-ms clear-to-send interval options.

(b) In half-duplex operation on 2-wire facilities, when a station that has been transmitting has its request-to-send circuit turned ***off,*** the telephone line may reflect signals (echoes) back to that station for a period up to the round trip delay of the circuits (about 1-ms per 100 miles each way). The squelch option when used with the received data clamp option prevents the demodulator of the station that has been transmitting from delivering these reflections as data to the received data circuit. The DS 202T-type provides for either 156-, 9-, or 0-ms (no squelch) options. The 156-ms option is recommended for use on 2-wire private line facilities and on 4-wire private lines with talk-back. The 9-ms option may be used on 2-wire private line facilities less than 50 miles. On facilities longer than 50 miles, the 9-ms option may be used only if the customer terminal is able to ignore echoes. The 0-ms option (no squelch) should be used on 4-wire data sets and may be used on 2-wire data sets if the data terminal is able to ignore echoes.

2.10 ***Fast Carrier Detection:*** The DS 202T-type is provided with an option for either normal or fast response of the carrier detector to an incoming data signal. With the fast carrier detection-out option (N), the received line signal detector turns ***on*** in less than 20-ms if data signals are received and turns ***off*** in approximately 10-ms if data signals are not received. This option is compatible with the clear-to-send interval options in DS 202C, 202D, 202E, and 202R and is recommended when the distant data set has either the 180-, 60-, or 30-ms clear-to-send interval. With the fast carrier detection-in option (Q), the received line signal detector circuit turns ***on*** in approximately 6-ms if marking carrier is received. The circuit will turn ***off*** in approximately 5-ms for carrier frequencies between 860 Hz and 940 Hz (soft carrier turnoff). If the carrier frequencies are outside of these limits, but are within the limits for the normal mode, the normal mode response times will occur. This option must be used when the remote data set uses the 8-ms clear-to-send interval option.

2.11 ***Clear-to-Send Interval:*** The ***on*** condition of the clear-to-send circuit from the data set is a response to an ***on*** condition on the request-to-send circuit delayed by a time interval which permits the data set to establish operations with the remote receiver. The DS 202T-type provides four clear-to-send interval options: 180-, 60-, 30-, and 8-ms.

(a) ***180-ms:*** This option is recommended for use on 2-wire private line facilities greater than 400 miles round trip and is required when the remote data set has the 156-ms squelch option.

(b) ***60- and 30-ms:*** The 60- and 30-ms options should be used on 4-wire point-to-point and multipoint facilities to be compatible with the turn-on time of the received line signal detector of DS 202C, 202D, and 202R.

(c) ***8-ms:*** This option is recommended for use on duplex multipoint systems requiring fast start-up of the data set and is compatible only with a DS 202T-type at the distant end. With this option, the data terminal must keep the transmitted data circuits in the mark state when request-to-send is ***on*** until the clear-to-send indication is given. The distant data set must be optioned for fast carrier detection.

2.12 ***External Control of CC (Data Set Ready):***

(a) When this option is installed, the data set ready (CC) lead is externally controlled by the

DAS 828A, 829-type, or equivalent line terminating unit. This indicates to the CPE when the private line channel is in a maintenance mode or other test condition.

(b) When this option is not installed, the data set ready lead is always ***on*** except when the data set is in one of the three test modes.

2.13 ***Clamp:*** With the received data clamp installed, the clamp circuit will squelch the received data circuit when the received line signal detector is ***off.*** If desired by the customer, the clamp circuitry associated with the received line signal detector may be disabled. With option E (clamp out) installed on DS 202T-L1, noise may cause spurious signals on the received data circuit even if the received line signal detector is ***off.*** It is recommended that option F (clamp in) always be installed on DS 202T-L1. Data set 202T-L1A with option E (clamp out) installed is less affected by noise than DS 202T-L1.

2.14 ***Carrier Detector Reset:*** The DS 202T-type provides a carrier detector reset interface circuit on pin 25 of the customer interface. This interface circuit is provided for turning ***off*** the received line signal detector circuit in less than 0.2-ms for those cases where the 0-ms soft turn-off interval of the distant data set is used to minimize the time between received messages at the master station of a split bridge multipoint system. If this circuit is not used by the CPE, this option should not be installed in the data set, because noise may trigger the circuit if it is not held ***off*** by the CPE.

2.15 ***Continuous Carrier:*** With the continuous carrier option installed, carrier is transmitted as long as the data set is in the data mode. The clear-to-send circuit remains ***on;*** therefore, options M, K, J, and G (clear-to-send intervals) are inoperative. This option may be used on duplex facilities and in transmit-only service over 2-wire facilities. With the carrier under control of request-to-send, carrier is transmitted in less than 1 ms after the reqest-to-send circuit is turned ***on.*** This option is required to control the direction of data transmission in half-duplex operation over 2-wire facilities. It may also be used in duplex services to provide a means of signaling the remote terminal (for example, carrier-off could be used as an out-of-service indication).

2.16 ***State of CC (Data Set Ready) During Analog Loopback (DS 202T-L1A Only):*** With option YB (ON) the data set ready circuit turns ***on*** during the analog loopback test mode when the CPE ready circuit is turned ***on.*** This permits testing with the CPE. With option YA (OFF) the data set ready circuit is clamped ***off*** during the analog loopback test mode as it is with DS 202T-L1.

2.17 ***Local Copy on Reverse Channel:*** With the option installed, the receiver monitors the reverse channel transmitter and provides a local copy on the secondary received line signal detector (SCF) circuit. The local copy signal is delayed less than 50-ms.

2.18 ***Compromise Equalization (DS 202T-L1 Only):*** Compromise equalizer options are available on DS 202T-L1 series 6 and higher. Option ZV (minimum compromise equalization) provides reduced envelope delay distortion compensation to eliminate an over-equalization condition on channels with low envelope delay distortion. Option ZU (maximum compromise equalization) provides the same equalizer characteristics provided on data sets without the equalizer options (series 5 and lower). For data bit rates above 1200 bps, it is necessary to perform a data distortion test to determine the proper equalizer option setting. The procedure for this data distortion test is contained in Section 592-031-500.

2.19 ***Grounding Options:*** Protective and signal grounds are normally cross-connected together by means of a screw switch on the interface circuit, located at the inside rear of the housing or by strapping on data mounting power supplies. This arrangement is intended to provide additional margin to longitudinal power line noise. The screw switch or strapping may be opened at the request of the customer with due consideration given to possible noise conditions, ground potential differences, safety conditions, local electrical codes, and the data terminal manufacturer's recommendations.

3. CONNECTIONS

3.01 This part contains information for connecting DS 202T-type in a single data set installation on 2-wire or 4-wire private line facilities. For information on multiple installation of DS 202T, refer to Section 592-861-200.

3.02 ▶Data sets 202T-L1, 202T-L1/4, 202T-L1A/4 and 202T-L1A/3B/4 are powered by two customer-provided dc power sources. To supply power to

these data sets, make the following backplane connections using power transformer cord:

+15v ±1.5v dc source to AC1

−15v ±1.5v dc source to AC2

Common to GRD.

Note: Common can be either grounded or floating depending on whether or not it is desired to have circuit ground of the data set connected to frame ground.

3.03 The connection diagrams are as follows:

- Fig. 3—4-Wire Data Set on 4-Wire Private Line With DAS 829-Type, Data/Voice
- Fig. 4—4-Wire Data Set on 4-Wire Private Line With DAS 829-Type, Data Only
- Fig. 5—4-Wire Data Set on 4-Wire Private Line With Alternate Switched Network Backup With DAS 829-Type, Data Only
- Fig. 6—4-Wire Data Set on 4-Wire Private Line With Alternate Switched Network Backup With DAS 829-Type, Data/Voice
- Fig. 7—2-Wire or 4-Wire Data Set on 4-Wire Private Line With DAS 828A, Data Only
- Fig. 8—2-Wire or 4-Wire Data Set on 4-Wire Private Line With DAS 828A, Data/Voice
- Fig. 9—4-Wire Data Set on 4-Wire Private Line With Switched Network Backup With DAS 828A and 828C, Data Only
- Fig. 10—4-Wire Data Set on 4-Wire Private Line With Switched Network Backup With DAS 828A and 828C, Data/Voice
- Fig. 11—4-Wire Data Set Connected to Locally Engineered Private Line Termination Without DAS 828-Type or 829-Type
- Fig. 12—2-Wire Data Set Connected to Locally Engineered Private Line Termination.

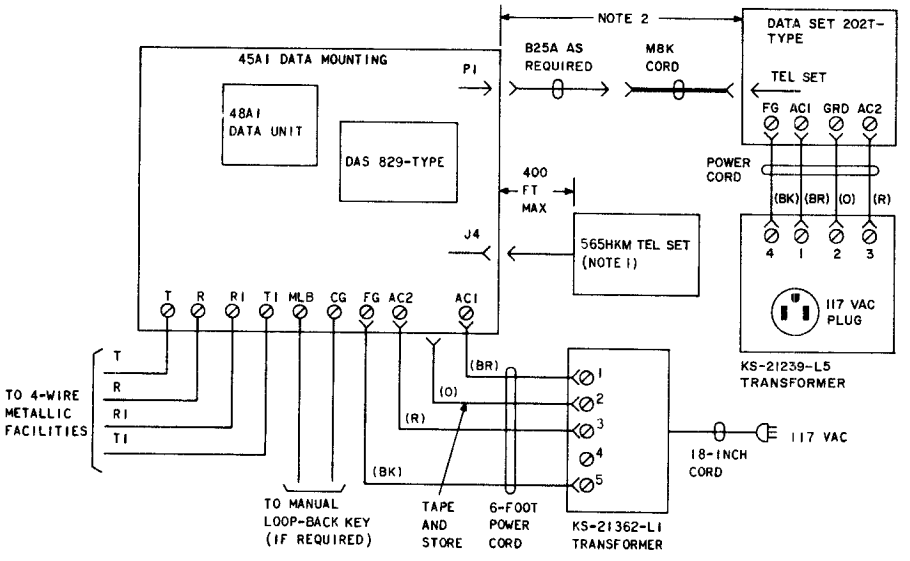
4. INSTALLATION TESTS

4.01 After the data set has been installed, it should be tested to determine if it is operating properly. Perform installation tests as directed in Section 592-031-500.

5. REFERENCES

5.01 The following Bell System Practices provide additional information concerning DS 202T-type and data stations using DS 202T-type.

SECTION	TITLE
590-102-130	39A1 Data Mounting—Identification
590-102-131	40-Type Data Mounting—Identification
590-102-137	47-Type Data Mounting—Identification
592-031-100	Data Set 202T-Type—Transmitter- Receiver—Description and Operation
592-031-180	Data Set 202T Transmitter-Receiver—Summarizing Specification—Data Systems
592-031-500	Data Set 202T-Type Transmitter-Receiver—Test Procedures and Maintenance
592-861-100	Data Station Using Data Set 202T—Description and Operation
592-861-200	Data Station Using Data Set 202T—Installation and Connections
592-861-500	Data Station Using Data Set 202T—Test Procedures
598-080-100	Data Auxiliary Set 828A— Description and Operation
598-080-200	Data Auxiliary Set 828A—Installation and Connections
598-080-101	Data Auxiliary Set 828C—Description and Operation



NOTES:
1. DESIGNATE KEY STRIP AS SHOWN.
   CONVERT RING BUTTON TO NONLOCKING.

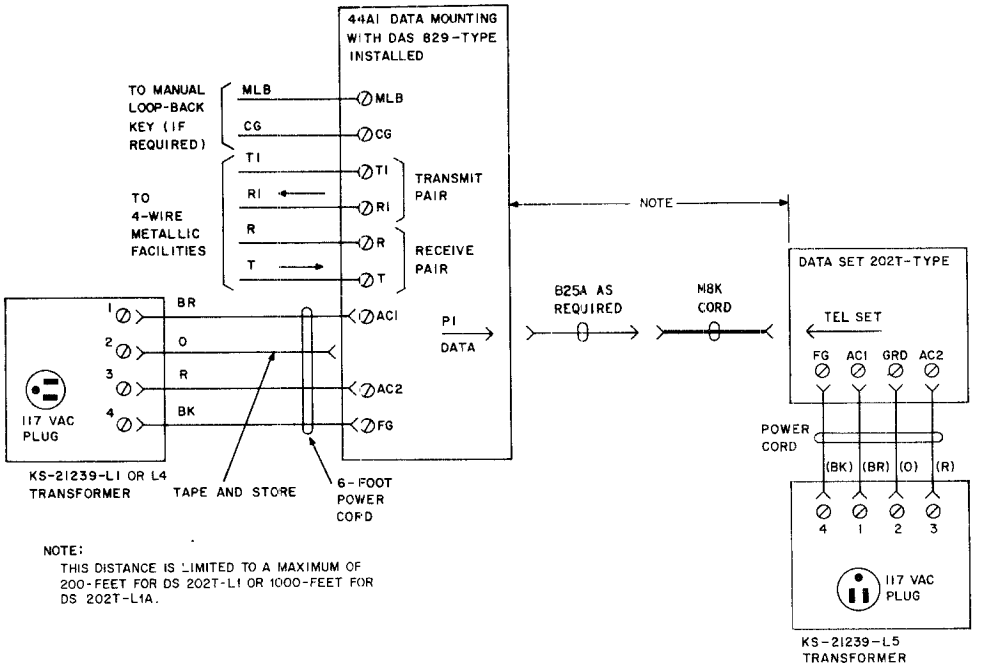
HOLD	—	—	PL TALK	RING	—

2. THIS DISTANCE IS LIMITED TO A MAXIMUM OF 200-FEET FOR DS 202T-L1 OR 1000-FEET FOR DS 202T-L1A.

Fig. 3—4-Wire Data Set on 4-Wire Private Line With DAS 829-Type, Data/Voice

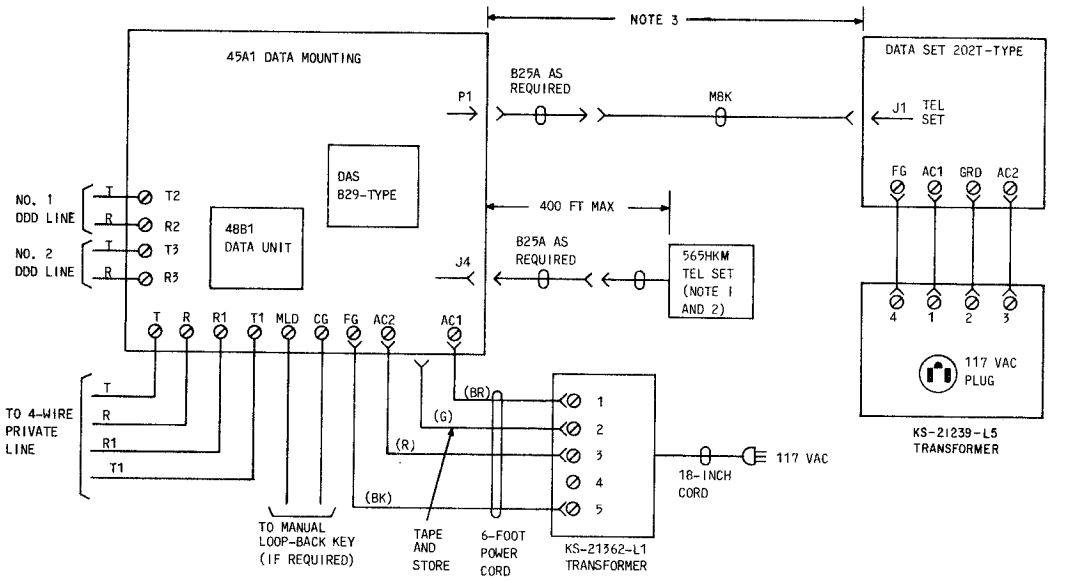
SECTION	TITLE
598-080-201	Data Auxiliary Set 828C—Installation and Connections
598-082-100	Data Auxiliary Set 829-Type Channel Interface Units—Voiceband Private Line Channels—Description
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Test Room

6.02 Detailed information concerning DS 202T-type is also contained in CD- and SD-1D243-01.



NOTE:
THIS DISTANCE IS LIMITED TO A MAXIMUM OF 200-FEET FOR DS 202T-L1 OR 1000-FEET FOR DS 202T-L1A.

Fig. 4—4-Wire Data Set on 4-Wire Private Line With DAS 829-Type, Data Only



NOTES:

1. DESIGNATE KEY STRIP AS SHOWN. CONVERT REL BUTTON TO NONLOCKING.

HOLD	DDD1	DDD2	-		REL

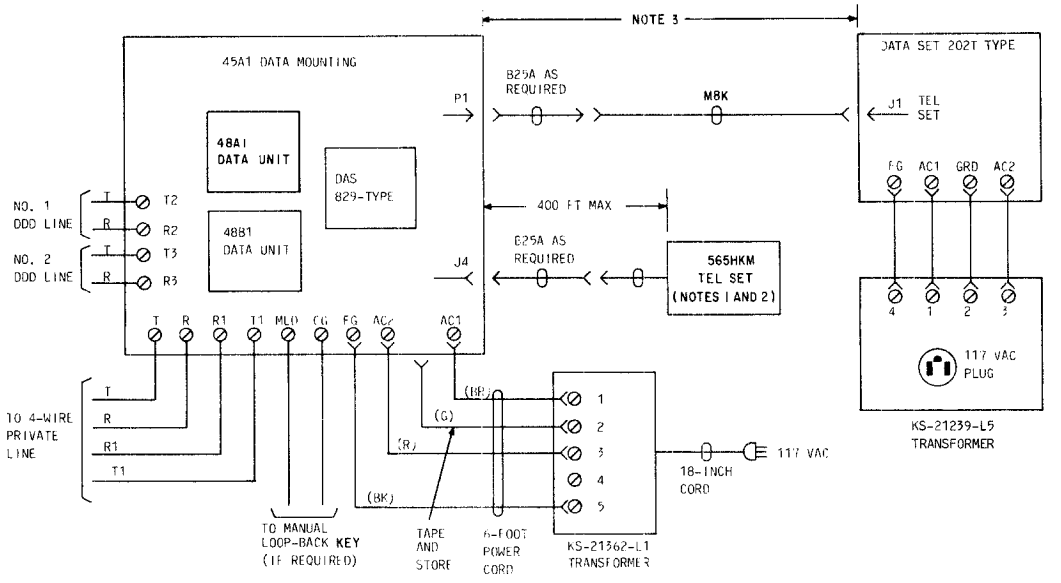
2. CONVERT TEL SET AS SHOWN IN TABLE.

636A KEY LEADS

COLOR	REMOVE	CONNECT
BRN	M	X
S-R	M	N
Y	M	TAPE AND STORE
O-BK	N	M

3. THIS DISTANCE IS LIMITED TO A MAXIMUM OF 200-FEET FOR DS 202T-L1 OR 1000-FEET FOR DS 202T L1A.

Fig. 5—4-Wire Data Set on 4-Wire Private Line With Alternate Switched Network Backup With DAS 829-Type, Data Only



NOTES:

1. DESIGNATE KEY STRIP AS SHOWN CONVERT RING AND REL BUTTONS TO NONLOCKING

HOLD	DDD1	DDD2	PL TALK	RING	REL

2. CONVERT TEL SET AS SHOWN IN TABLE:

636A KEY LEADS

COLOR	REMOVE	CONNECT
BRN	M	X
S-R	M	N
Y	M	TAPE AND STORE
O-BK	N	M

3. THIS DISTANCE IS LIMITED TO A MAXIMUM OF 200-FEET FOR DS 202T-L1 OR 1000-FEET FOR DS 202T-L1A.

Fig. 6—4-Wire Data Set on 4-Wire Private Line With Alternate Switched Network Backup With DAS 829-Type, Data/Voice

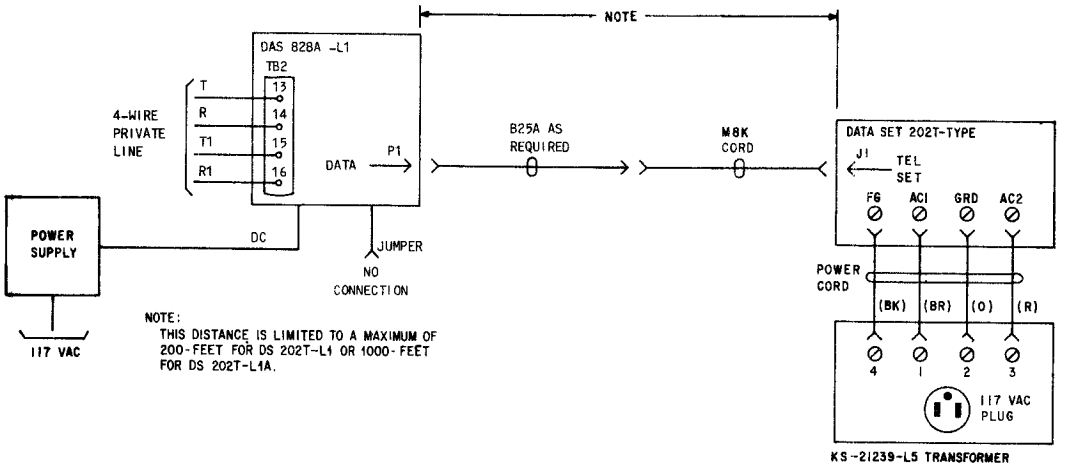


Fig. 7—2-Wire or 4-Wire Data Set on 4-Wire Private Line With DAS 828A, Data Only

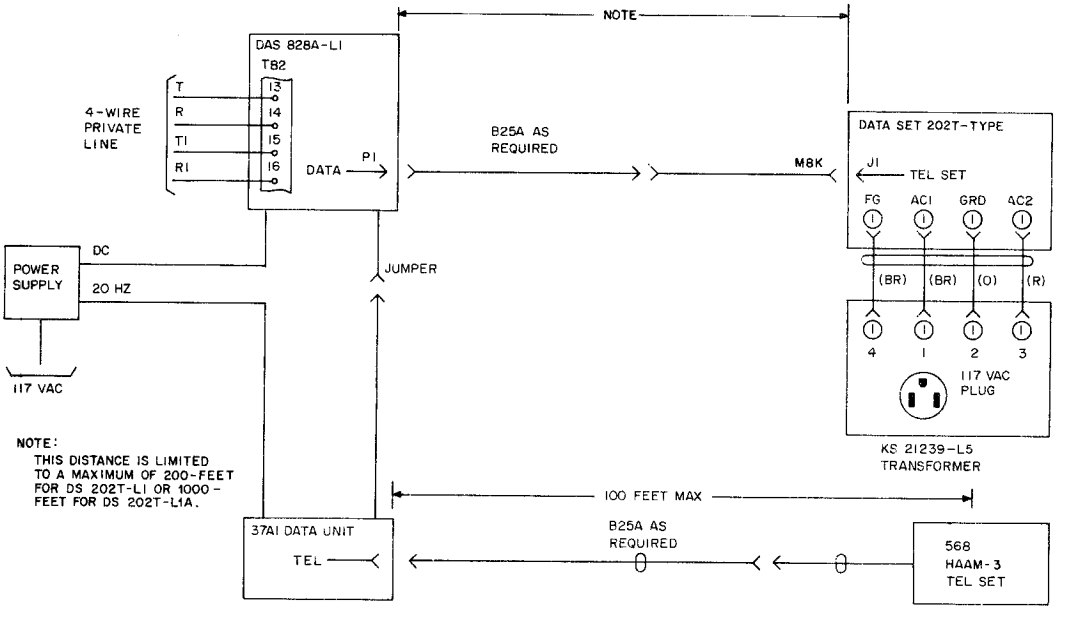


Fig. 8—2-Wire or 4-Wire Data Set on 4-Wire Private Line With DAS 828A, Data/Voice

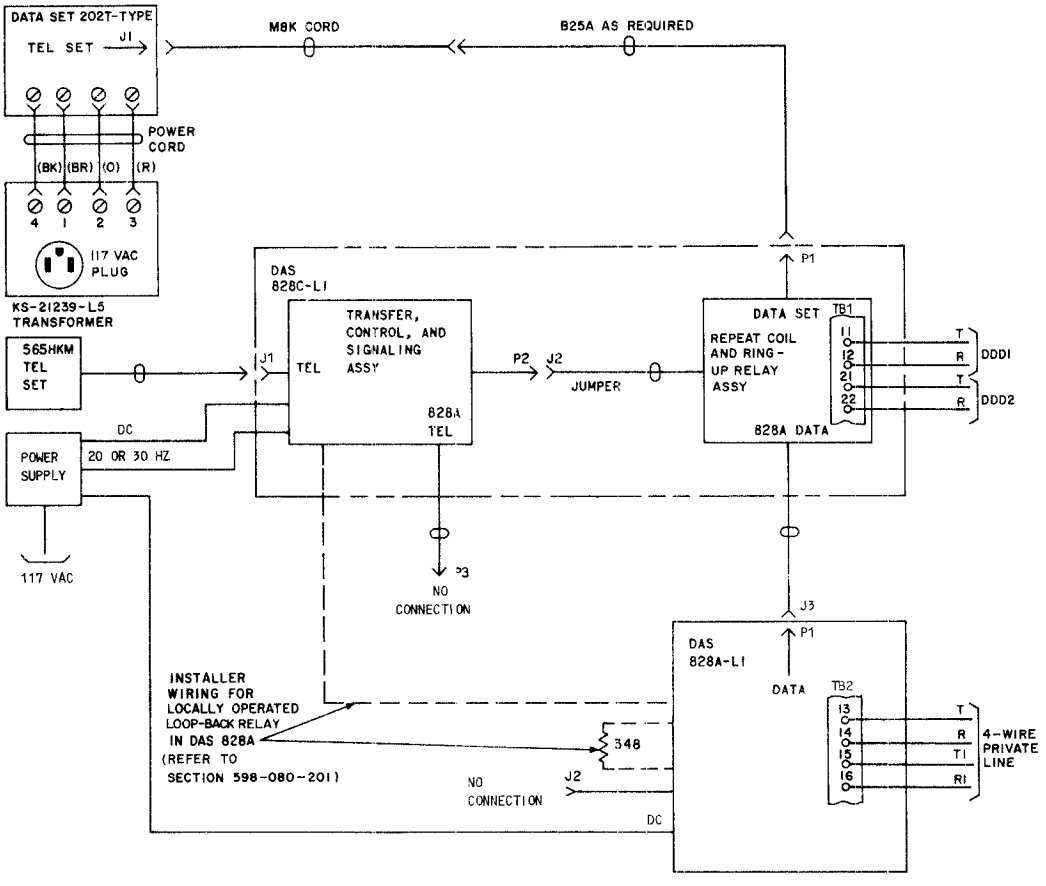


Fig. 9—4-Wire Data Set on 4-Wire Private Line With Switched Network Backup With DAS 828A and 828C, Data Only

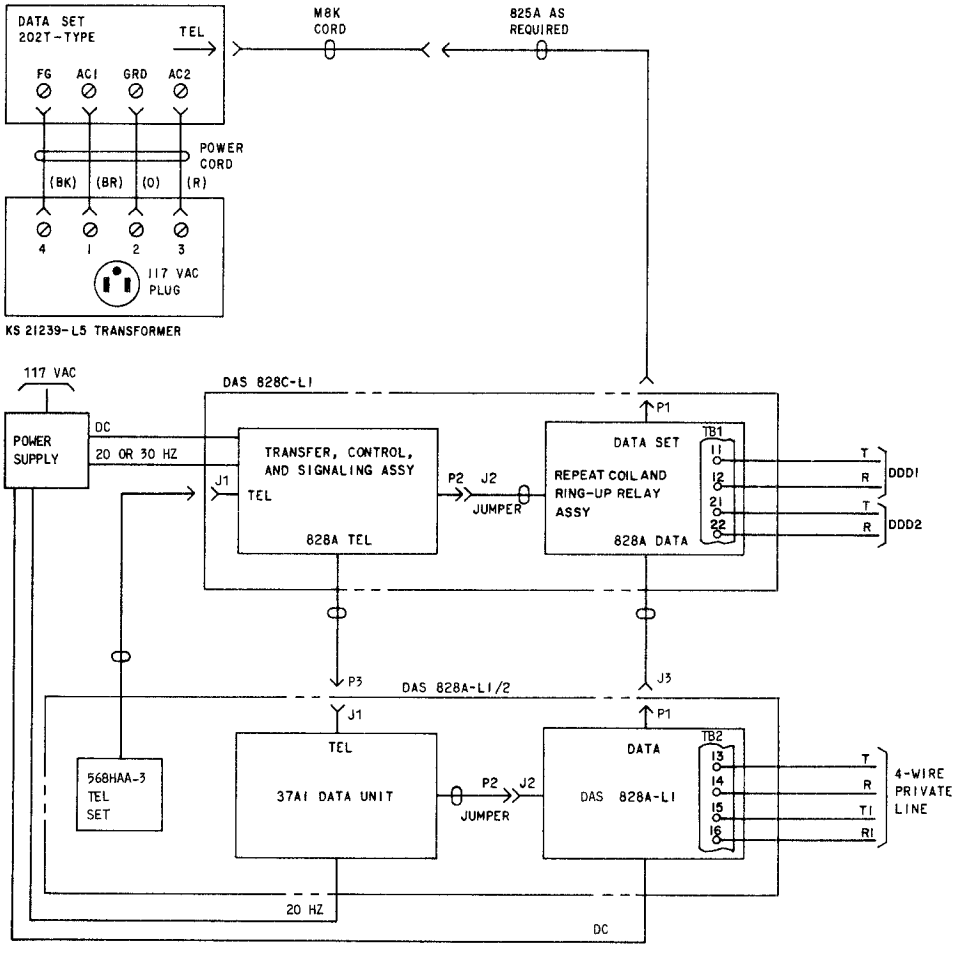


Fig. 10—4-Wire Data Set on 4-Wire Private Line With Switched Network Backup With DAS 828A and 828C, Data/Voice

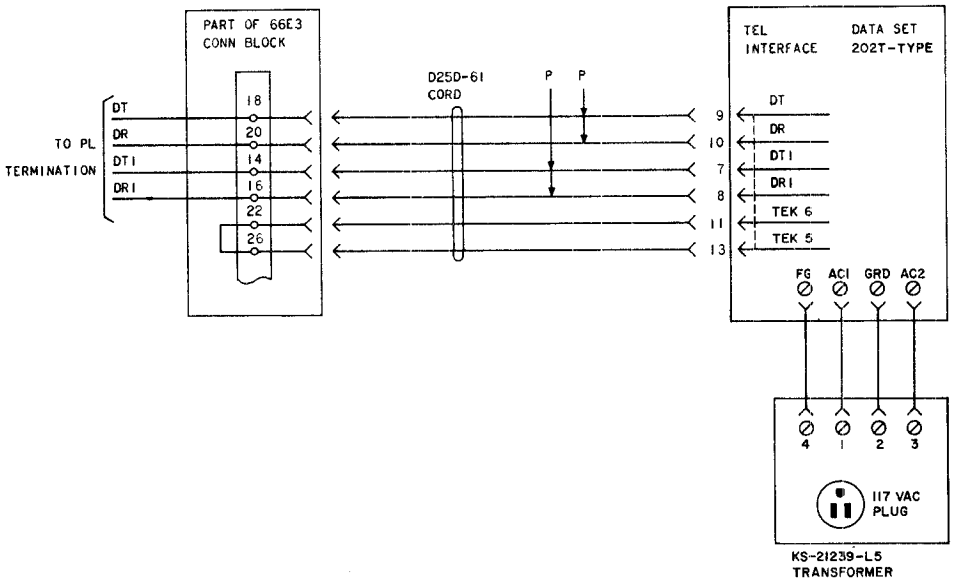


Fig. 11—4-Wire Data Set Connected to Locally Engineered Private Line Termination Without DAS 828- or 829-Type

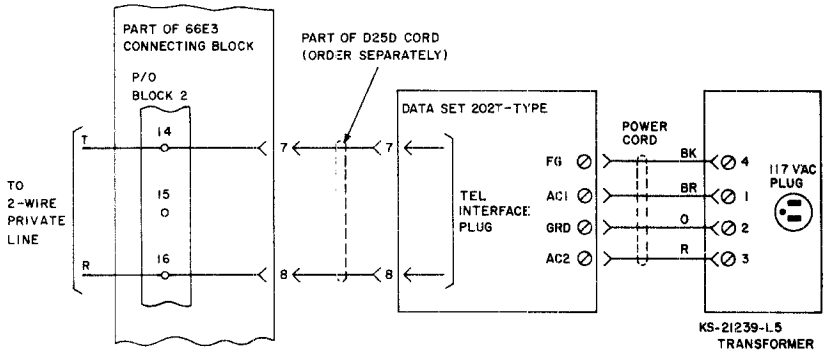


Fig. 12—2-Wire Data Set Connected to Locally Engineered Private Line Termination

NO NEED TO CALL THE DATA TEST CENTER!!!

Data set 202T can be tested with the Automatic Data Test System (ADTS) using the DIVA feature and TOUCH-TONE® signalling (from a rotary dial phone, use a KS-21799-L1 tone coupler).

DDD	TEST FUNCTION
	LB RT ER DL
X	X

Use local instructions for DIVA access.

Test commands are entered into ADTS by letters and numbers on the TOUCH-TONE dial. To enter letters depress the number sign (#), then depress the TOUCH-TONE key that has the desired alpha character on it. Then depress the digit (1, 2, or 3) corresponding to the position of the alpha character on the TOUCH-TONE key.

Examples:

202C10	202#2310*
401J	401#51*
208B	208#22*

FUNCTION	CHARACTERS
NO	0*
YES	1*
RESULTS	7*
LIST ALL TEST FUNCTIONS	8*
REPEAT LAST MESSAGE	#*
DIGITAL LOOPBACK (DL)	35*
ERROR RUN (ER)	37*
LOOPBACK TEST (LB)	52*
STOP AND DISCONNECT	#63*
STOP PRESENT FUNCTION	#73*
REMOTE TEST (RT)	78*

For fast test of above, depress 3 before function, eg, 352*. Be sure to use #63* to disconnect in every case.

For more details, see Sections 590-010-500 and 668-600-102.

DATA SET 202T-TYPE
TRANSMITTER-RECEIVER
TEST PROCEDURES AND MAINTENANCE

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning procedures to be used when testing data set (DS) 202T-type during an installation or while investigating a trouble report.

1.02 This section is reissued to add information pertaining to DS 202T-L1A. Due to extensive revision, arrows ordinarily used to denote changes have been omitted.

1.03 This section is divided into four additional parts: Installation Tests, Maintenance Procedures and Tests, Supplementary Test, and Test Procedures. The part designated Test Procedures provides information on, and procedures for, all the tests described in this section. This includes both the tests which require no test equipment ***and*** those requiring test equipment such as a 914-type DTS. The parts designated Installation Tests and Maintenance Tests give the proper sequence in which to perform the various tests when installing the data set or when investigating a trouble report. The supplementary test is not required for installation or maintenance under normal circumstances.

Caution: If the data set is taken out of the housing, handle by the nonconductive surfaces only. Otherwise, damage to the components may result.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following an installation. Before proceeding with the test, verify that the channel is installed and meets requirements

specified in the section entitled Voice Bandwidth Private Line Data Circuits—Tests and Requirements (314-410-500). Refer to Fig. 1 for the sequence of tests to be performed for 2-wire installations and to Fig. 2 for the sequence of tests to be performed for 4-wire installations.

2.02 The installation tests are as follows:

- Local self test
- Remote test
- End-to-end test
- Remote test to distant end
- Data distortion test.

3. MAINTENANCE PROCEDURES AND TESTS

Maintenance Procedures

3.01 When investigating a trouble report, proceed as directed in Fig. 3 (2-wire) or Fig. 4 (4-wire).

3.02 If it becomes necessary to dispatch a telephone company (telco) employee to the defective data set location, the telco employee should take along the following:

- 914C data test set (DTS) ***or*** 914B and 903 DTS
- Spare DS 202T-type.

3.03 The data set is tested as directed. If the data set is replaced, the defective data set should be tagged with a tag describing the nature of the trouble, carefully packed, and returned to a service center for repair. After the data set has been replaced, verify with the customer that service has been restored.

Caution: Handle the circuit pack by the nonconductive surfaces only, otherwise, certain circuit components may be damaged.

3.04 If the trouble persists, proceed as follows:

(a) Check that options in the data set agree with the service order.

(b) Check that compatible options are used in local and remote data sets. Refer to Section 592-031-200.

(c) Verify that the customer-provided equipment (CPE) has been tested and is operating satisfactorily.

(d) Check that all the cords and connectors are properly connected.

(e) Check for physical damage.

(f) Check that the CPE and the data set are connected to a common ground.

(g) If the trouble cannot be cleared, request help from immediate supervisor.

Maintenance Tests

3.05 This part provides the sequence in which tests are to be performed during a trouble visit. The procedure provides a method of isolating a trouble to either the data set or the transmission facility. It is assumed that the maintenance procedures outlined above have been followed prior to dispatching the craft employee. Refer to Fig. 5 for the sequence of tests to be performed for a 2-wire data set and to Fig. 6 for the sequence of tests to be performed for a 4-wire data set.

3.06 The maintenance tests are as follows:

- Local self test
- Analog loopback test with 914-type DTS
- Remote test
- End-to-end test
- Remote test to distant end
- Remote test from distant end
- Data distortion test
- Reverse channel test.

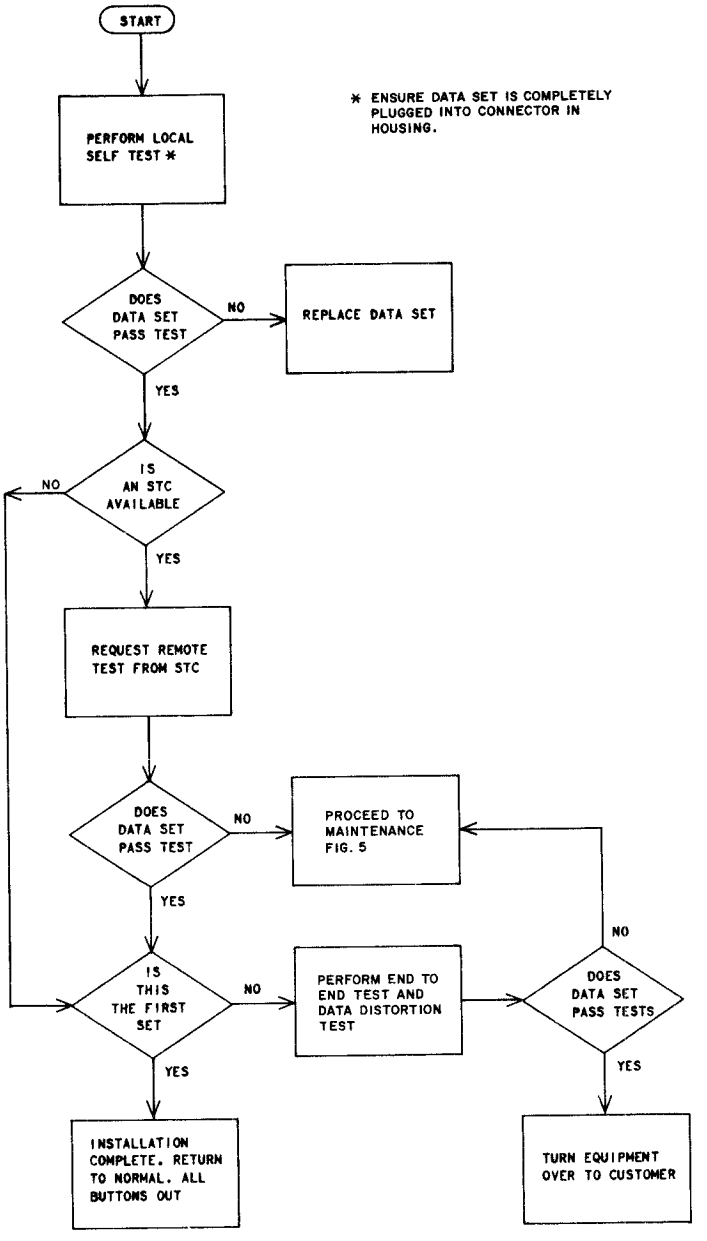


Fig. 1—2-Wire Installation Test Sequence

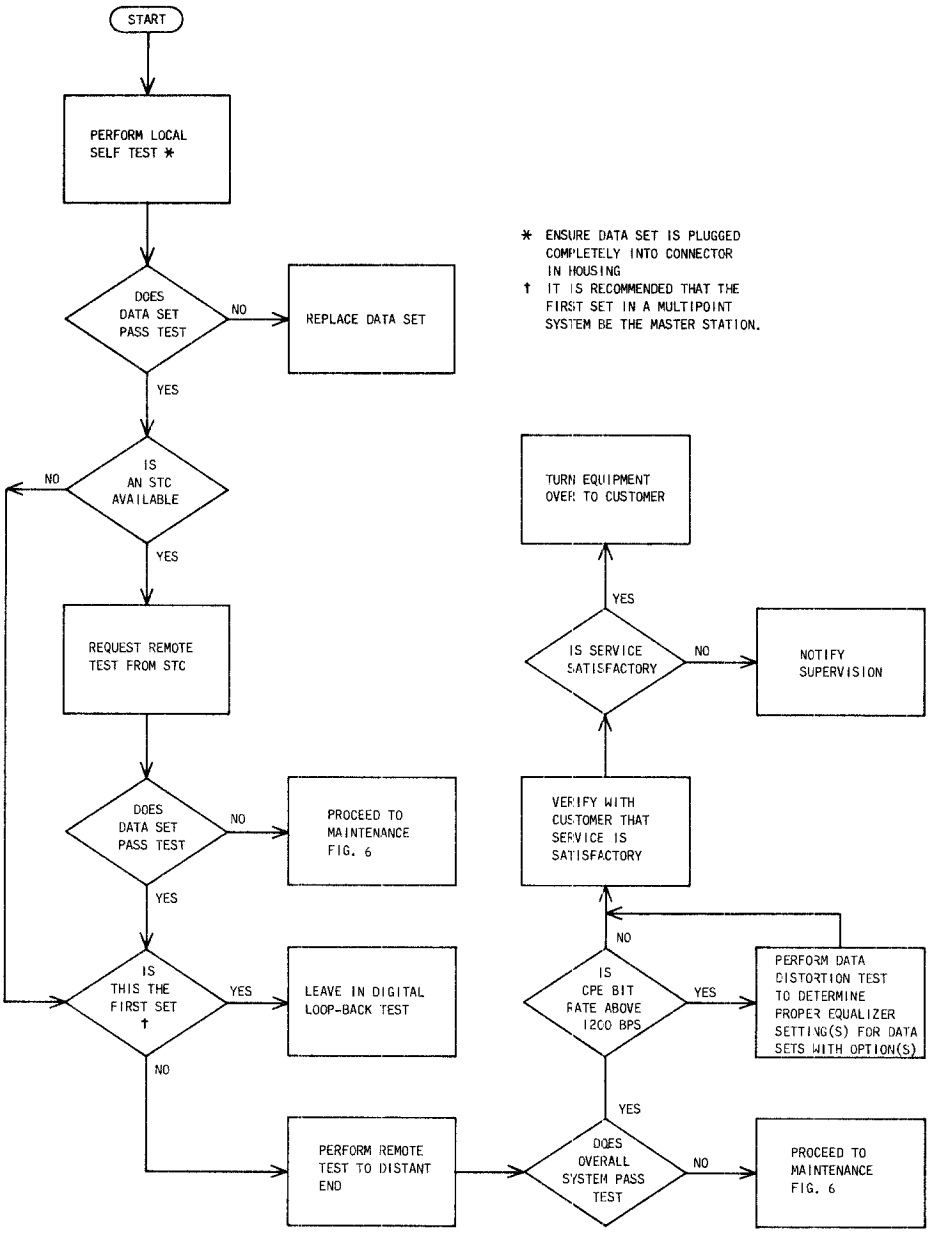


Fig. 2—4-Wire Installation Test Sequence

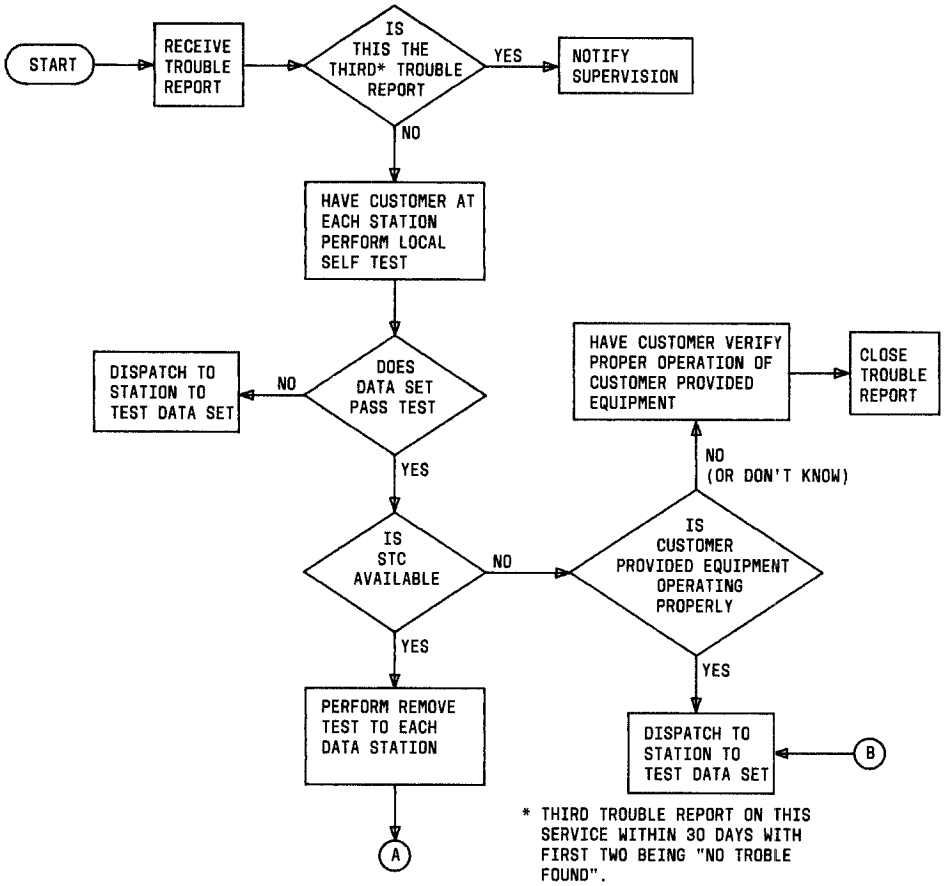


Fig. 3—2-Wire Maintenance Flowchart (Sheet 1 of 2)

4. SUPPLEMENTARY TEST

4.01 The ground noise test is not called for on the installation or maintenance flowchart and should be referred to as required.

5. TEST PROCEDURES

5.01 This part contains various methods of testing DS 202T-type. Test circuitry built into the data set permits testing the data set in a local self test, analog loopback, and a remote test mode. Additional interface tests are provided which require the use of a 914-type DTS.

A. Local Self Test

5.02 Depress the nonlocking LT key on the front of the data set to initiate the local self test. A repeating 63-bit pseudo-random word is generated at 1547 bps and looped from the transmitter to the receiver through an attenuating circuit. The word received by the receiver is compared to the original word. Under normal conditions, all the

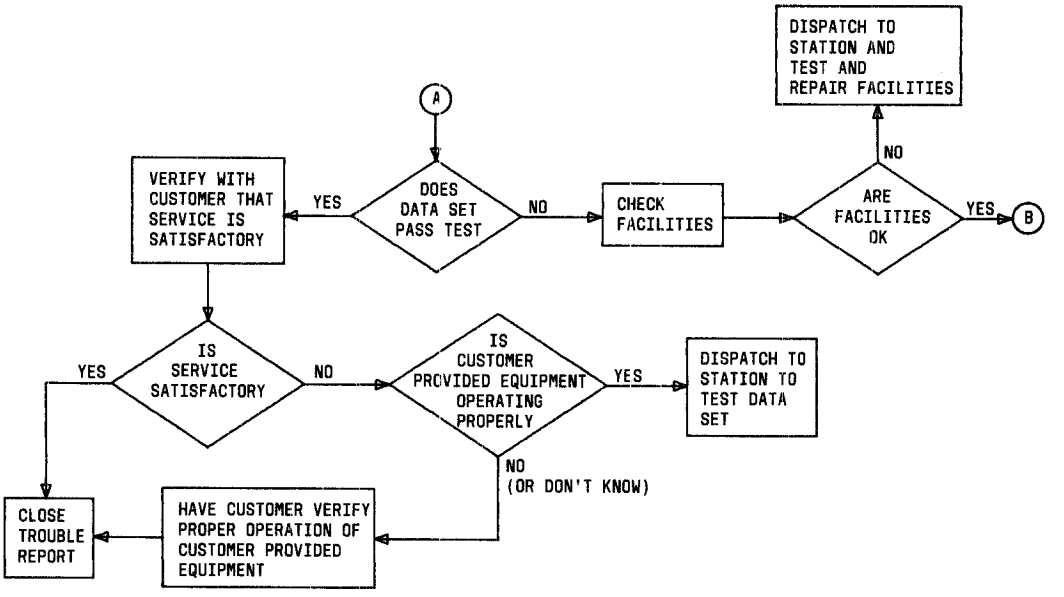


Fig. 3—2-Wire Maintenance Flowchart (Sheet 2 of 2)

indicators are lighted; however, in the event an error is detected, the TM indicator is off.

Note: All customer leads are made inoperative and are not tested.

Perform the test as follows:

(1) Ensure that the data set is not transmitting or receiving data.

(2) Firmly depress and hold the LT key for approximately 15 seconds. If the LT key is depressed slowly, the TM indicator may turn off in a nondefective data set.

Requirement: All data set indicator lamps remain lighted while the LT key is depressed.

(3) If requirement specified in (2) is not met, repeat the test four additional times.

Requirement: All data set indicator lamps remain lighted during the four additional trials.

B. Remote Test (2-Wire Data Set)

5.03 The remote test mode for 2-wire operation allows the attendant at the serving test center (STC) to test all the data set circuitry except the customer interface. After contacting the STC, depress the RT button and observe that all status indicator lamps light. The remaining operations are performed by the STC. To release the data set from the remote test mode, depress the RT button and it will return to the out position.

Note: All customer leads are made inoperative and are not tested. All data set indicator lamps are lighted.

C. Remote Test From Distant End (4-Wire Data Set)

5.04 The 4-wire remote test allows 4-wire data sets to be tested from the STC. The data set acts as a repeater and sends back to the STC the signal it receives from the STC. To place the data set in this digital loopback mode, depress the locking RT button. The remaining operations are performed by the STC. To release the data set

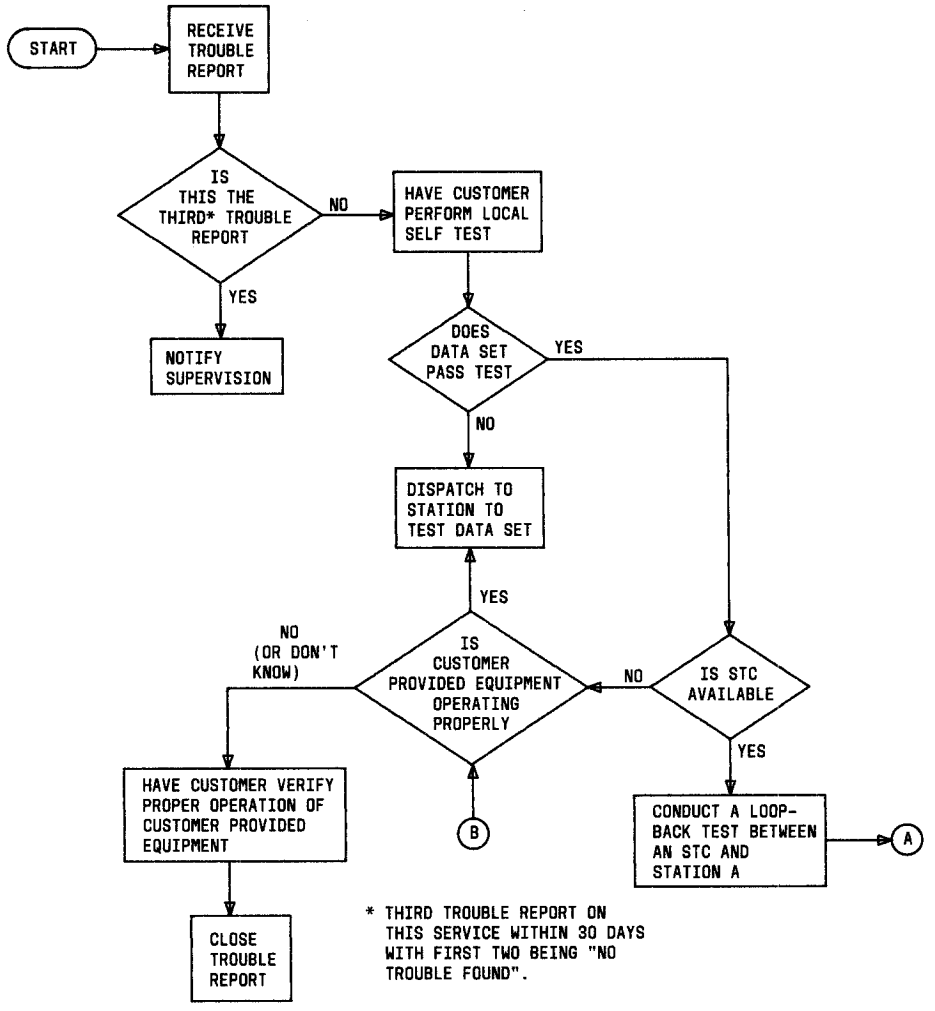


Fig. 4—4-Wire Maintenance Flowchart (Sheet 1 of 2)

from the remote test mode, depress the RT button and it will return to the out position.

Note: All customer interface leads are made inoperative and are not tested. Only the ON and TM data set indicator lamps are lighted.

D. Remote Test to Distant End (4-Wire Data Set)

5.05 In the following test, the 914-type DTS is used to transmit a random word to the distant-end data set. The distant-end data set is placed in the digital loopback mode (by depressing the RT button) and transmits the word back to

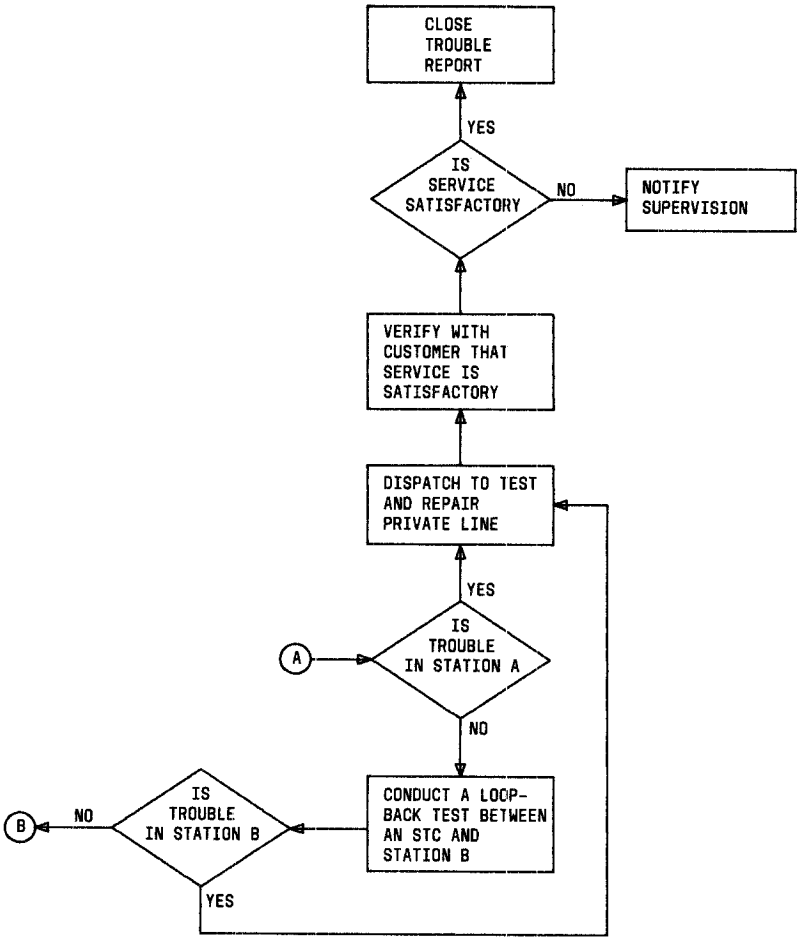


Fig. 4—4-Wire Maintenance Flowchart (Sheet 2 of 2)

the local data set. At the local data set, the 914-type DTS checks the received word for errors. Test equipment required is as follows:

1—914C data test set

or

1—914B data test set ***and***

1—903-type data test set.

5.06 Set up test equipment as shown in Fig. 7 ***except for the SAMPLE WIDTH switch which must be set to the 0.5 μs position.*** The test is performed as follows:

(1) Disconnect the customer-provided equipment (CPE) and connect the 914-type DTS to the data set.

(2) Insert red pins in the matrix and set switches on the test equipment as shown in Fig. 7.

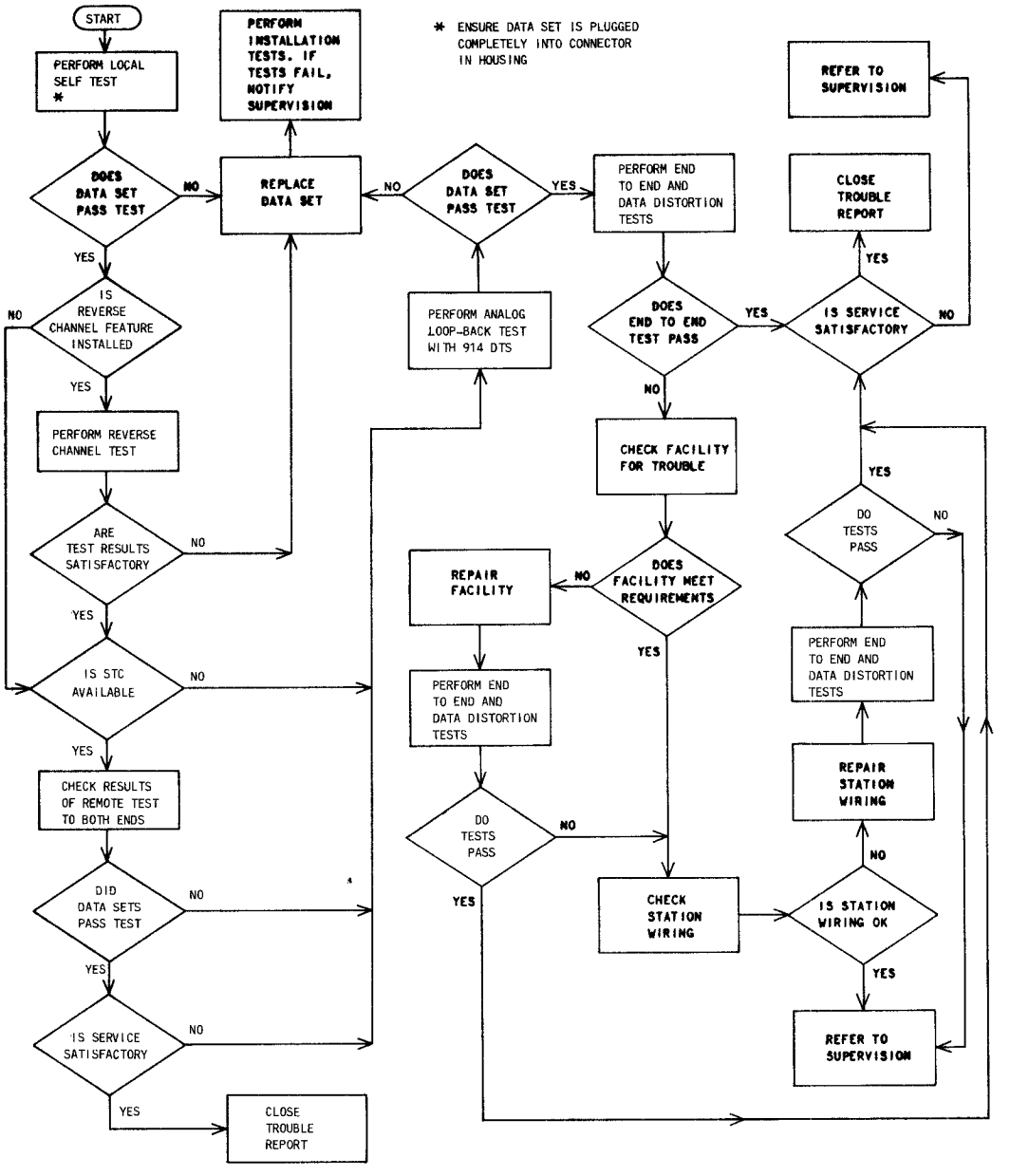


Fig. 5—2-Wire Maintenance Test Sequence

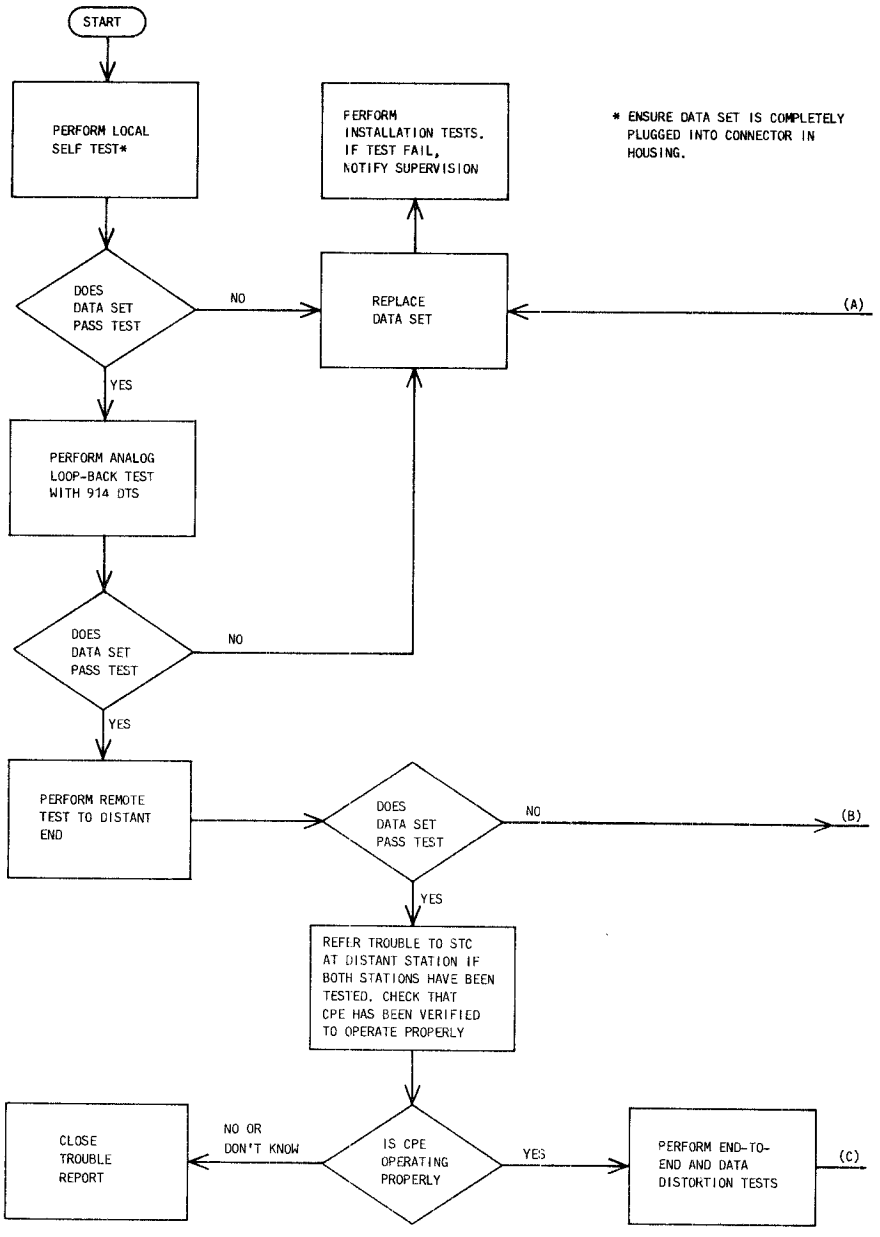


Fig. 6—4-Wire Maintenance Test Sequence (Sheet 1 of 3)

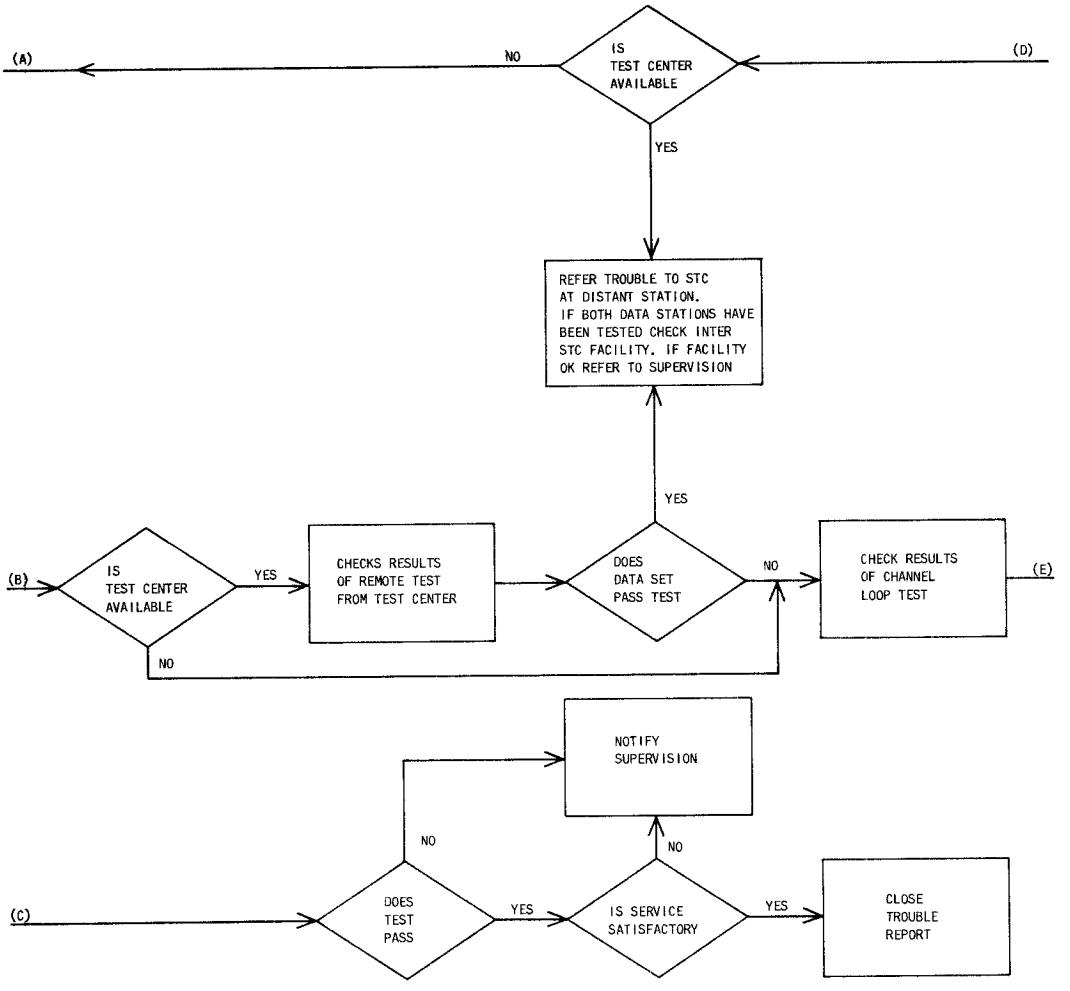


Fig. 6—4-Wire Maintenance Test Sequence (Sheet 2 of 3)

(3) Contact the distant-end data station and have the RT button on the data set pushed in.

(4) Apply power to the data set and to the test equipment.

(5) Operate switch S1 to ON. (Depress and release START button on 903 DTS if it is used.)

Requirement: DS1 and DS2 lamps are lighted.

(6) On the 914 DTS, set the FUNCTION switch to PHASE ADJ.

(7) Adjust the PHASE control to zero the meter.

(8) Move the FUNCTION switch to OFF.

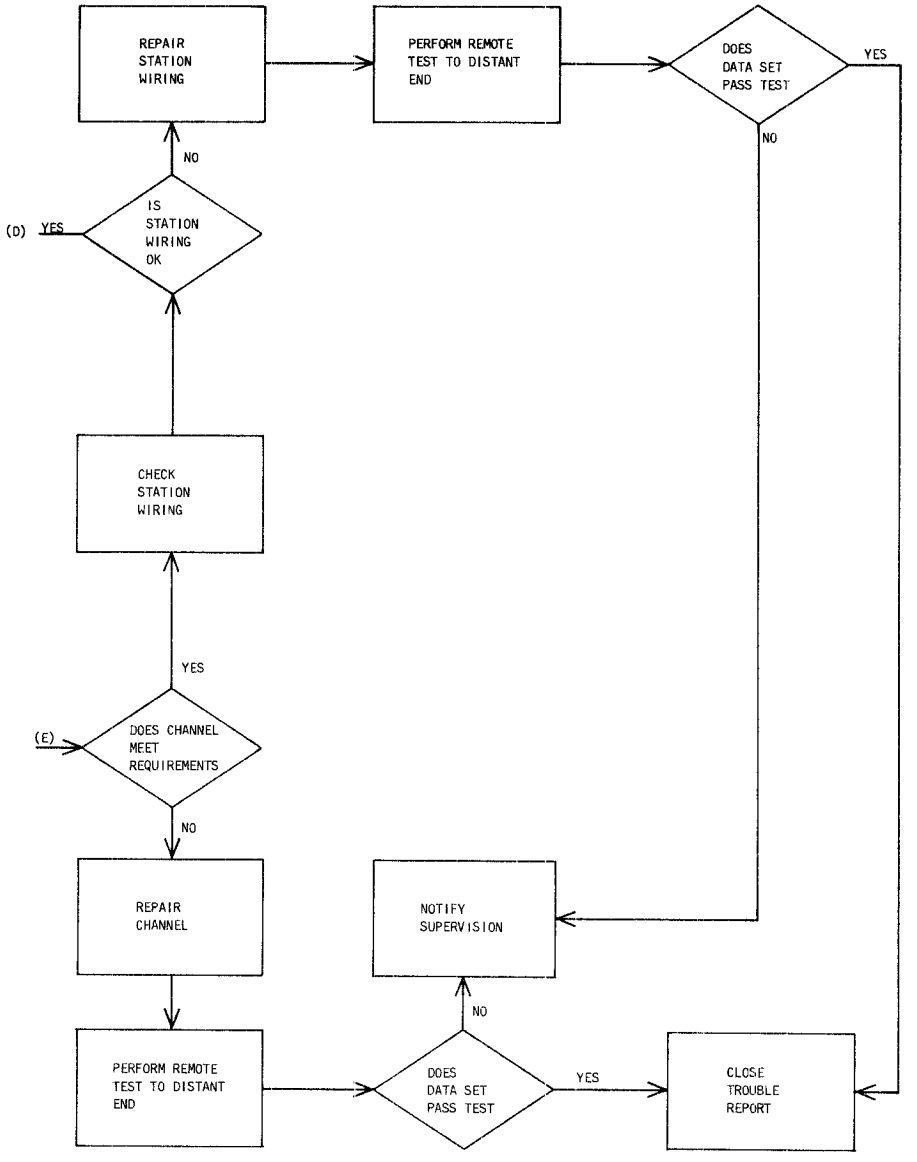
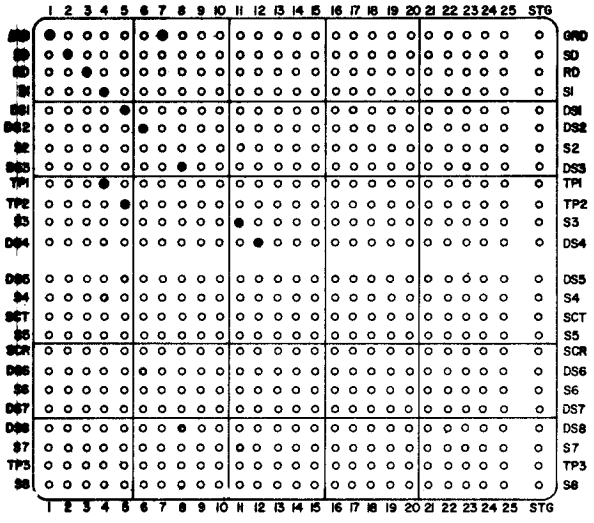
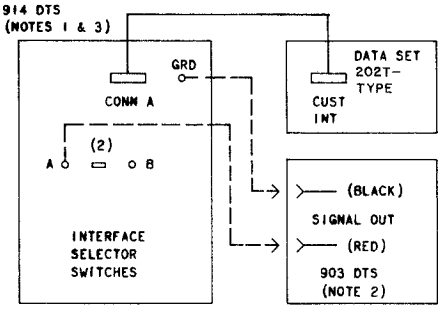


Fig. 6—4-Wire Maintenance Test Sequence (Sheet 3 of 3)



914 DTS MATRIX



1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C DTS) REC. SER (914B DTS)
COUNTER	BIT ERRORS
RCV BIT RATE	1200
RCV WORD LENGTH	63
TRANSMIT BIT RATE (914C)	1200
TRANSMIT WORD LENGTH (914C)	63
SIG LEV	±4V
FUNCTION	OFF
WORD SYNC	OFF
SAMPLE WIDTH	30%
TP1 TRIGGER	+/OPEN
TP2 TRIGGER	+/OPEN
RANGE	DCV-30
POLARITY	NOR
VERTICAL MONITOR	9
SWITCH S1, S3	OFF
INTERFACE SELECTOR SWITCHES	ALL OPERATED (DEPRESSED) EXCEPT 2A WHEN 903 DTS IS USED

2. SET SWITCHES ON 903 DTS AS FOLLOWS
(NOT REQUIRED FOR REVERSE CHANNEL TEST)

SWITCH	SETTING
BIT RATE	1200
TRIGGER	(+) POSITIVE
RANDOM DOT	RANDOM

3. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO INTERFACE LEADS AS FOLLOWS:

SWITCH	LAMP	INTERFACE LEAD
S1		REQUEST TO SEND
	DS1	CLEAR TO SEND
	DS2	DATA SET READY
S3		SECONDARY REQUEST TO SEND
	DS4	SECONDARY RECEIVED LINE SIGNAL DETECTOR
	DS3	RECEIVED LINE SIGNAL DETECTOR

Fig. 7—Equipment Setup for Remote Test to Distant End, Analog Loopback Test and Reverse Channel Test

(9) Operate WORD SYNC switch to MAN and release when counter stops.

(10) Reset the counter on the 914-type DTS.

(11) Conduct a 1-minute error run. Observe the counter at the end of 1 minute and record errors. Move switch S1 to OFF.

(12) Repeat (5) and (9) through (11) until 10 error runs have been conducted. Disregard the 1-minute error run which has the most errors.

Requirement: Total errors for the other 9 error runs are less than 5.

(13) Upon completion of the test, disconnect the data set from the 914 DTS. Call the distant-end data station and have the RT switch returned to the out position. Verify that data set switches at both data sets are in the out position.

E. Analog Loopback Test

5.07 In this series of tests, an analog loopback error run is conducted and the response times for the clear-to-send (CB) and received line signal detector (CF) interface circuits are measured. With the data set in the analog loopback mode (AL button pushed in), data signals applied to the transmitted data interface lead are processed through the transmitter, looped back through an attenuator to the receiver where they are demodulated, and appear on the received-data lead. All interface leads are operative except data-set-ready which is held ***off*** by DS 202T-L1. The state of data-set-ready during analog loopback is a customer option on DS 202T-L1A.

5.08 The following test equipment is required for the test:

1—914C data test set

or

1—914B data test set ***and***

1—903-type data test set.

5.09 ***Analog Loopback Error Run:*** This test verifies that the data set will transmit and receive a 63-bit random word error free for 5 minutes. Prior to performing the error run, the power supply voltages are measured. The test is performed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to the data set.

(2) Connect the 903-type DTS (if used) to the 914-type DTS as shown in Fig. 7.

(3) Insert red pins in the matrix of the 914-type DTS as shown in Fig. 7.

(4) Set switches on the test equipment as shown in the tables of Fig. 7.

(5) Apply power to the data set and to the test equipment.

(6) Depress the locking AL button on the data set.

(7) On the 914-type DTS, move switch S1 to ON (request-to-send lead is ***on***). Depress and release the START button on the 903-type DTS (if used).

Requirement: DS1 lamp is lighted.

(8) Move the FUNCTION switch to VOLTS INT.

Requirement: +12 to +17 volts.

(9) Move the FUNCTION switch to OFF, the VERTICAL MONITOR switch to 10, and the METER POLARITY switch to REV.

(10) Move the FUNCTION switch to VOLTS INT.

Requirement: -12 to -17.5 volts.

(11) On the 914-type DTS, set the FUNCTION switch to PHASE ADJ.

(12) Adjust the PHASE control to zero the meter.

(13) Move the FUNCTION switch to OFF.

(14) Operate the WORD SYNC switch to MAN on the 914-type DTS and release when the counter stops.

(15) Reset the counter on the 914-type DTS.

(16) Allow the test to continue for 5 minutes.

Requirement: No errors.

(17) If the clear-to-send (CB) response time is to be measured, proceed to 5.10. Otherwise, restore equipment to pretest condition.

5.10 ***Clear-to-Send Response Test:*** In this test, the response time of the clear-to-send circuit is measured. Although requirements are given for the four possible options, the data set under test need not be checked for proper operation of all options. However, it should be verified that the measured interval conforms to the option specified on the service order.

Note: If the associated DAS 828A or 829-type is in the facility loopback mode, the CB lead is held ***off*** and the interval cannot be measured. If the data set is provided with option ZN (continuous carrier in), do not perform this test.

(1) Disconnect the CPE and connect the 914-type DTS to the data set.

(2) Insert red pins in the matrix as shown in Fig. 7.

(3) Set switches on the 914-type DTS as shown in Fig. 7 ***except move the COUNTER switch to INT X1 and TEST SET MODE switch to INTERVAL (914C DTS).***

(4) Verify that the locking AL button on the data set is depressed.

(5) Verify that switch S1 is OFF. Reset the counter.

(6) Move switch S1 to ON, and the clear-to-send response time appears on the counter.

Requirement: Option M—6- to 12-ms
Requirement: Option K—22- to 40-ms
Requirement: Option J—52- to 70-ms
Requirement: Option G—140- to 200-ms

Note: To measure the interval for option G, move the interval switch to X10. The counter indicates 14 to 20.

(7) To remeasure the clear-to-send response time, move switch S1 to OFF, reset the counter, and move switch S1 to ON.

(8) If the received line signal detector response time is to be measured, proceed to 5.11. Otherwise, restore the equipment to pretest condition.

5.11 ***Received Line Signal Detector Response Test:*** In this test, the response time of the received line signal detector circuit is measured. ***The data set must be provided with option ZO (continuous carrier OUT) for this test. If option ZO is installed, it must be removed at the end of the test.*** Although requirements are given for two possible options, the data set under test need not be checked for proper operation of both options. However, it should be verified that the measured interval conforms to the option specified on the service order. The test is performed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to the data set.

(2) Insert red pins in the matrix as shown in Fig. 7 ***except move the pin in TP2-5 to TP2-8.***

(3) Set switches on the 914-type DTS as shown in Fig. 7 ***except move the COUNTER switch to INT X1 and TEST SET MODE switch to INTERVAL (914C DTS).***

(4) Apply power to the data set and 914-type DTS.

(5) Verify that the locking AL button on the data set is depressed.

(6) Verify that switch S1 is OFF.

(7) Reset the counter. Move switch S1 to ON and the received line signal detector response time will appear on the counter.

Requirement: Option Q—5- to 9-ms
Requirement: Option N—18- to 24-ms.

(8) To remeasure the response time, move S1 to OFF, reset the counter, and move S1 to ON.

(9) End of analog loopback test. Unless further testing is to be done, disconnect the test equipment from the data set and restore the equipment to pretest condition.

F. End-to-End Test

5.12 The procedure for performing an end-to-end test using the 914-type DTS is essentially the same for testing either 2-wire or 4-wire data sets. The following procedure is for 2-wire (half-duplex) testing. If 4-wire (duplex) testing is possible, the transmitting and receiving end-to-end tests will be performed simultaneously by ensuring that switch S1 (request-to-send) is ON at both ends.

Note: One end may be in a test center.

5.13 It will be necessary to establish voice communication during the test. The test is performed as follows:

(1) Establish test connections and set switches at both ends as shown in Fig. 8 ***except for the BIT RATE switch which must be set at the bit rate used by the CPE.***

(2) If testing 2-wire (half-duplex), set switch S1 to ON at the transmitting end and switch S1 to OFF at the receiving end. If testing 4-wire (duplex), set switch S1 to ON at both ends.

(3) Apply power to the data set and test equipment.

(4) Depress and release the START button on the 903-type DTS (if used).

Note: Steps (5) through (9) are for the receiving end only.

(5) On the 914-type DTS, set the FUNCTION switch to PHASE ADJ.

(6) Adjust the PHASE control to zero the meter.

(7) Move the FUNCTION switch to OFF.

(8) Operate the WORD SYNC switch to MAN and release when the counter stops.

(9) Press the RESET button to clear the counter.

(10) Conduct ten 1-minute error runs. Record the errors and reset the counter at the end of each 1-minute interval.

(11) Disregard the 1-minute interval with the most errors.

Requirement: Total errors for the remaining nine runs are shown in Table A.

(12) This completes the end-to-end test. Record the results. If the data distortion test is to be performed, proceed to paragraph 5.14. Otherwise, disconnect test equipment and restore the data station to pretest condition.

G. Data Distortion Test

5.14 At time of installation, whenever the data set will be used at a bit rate above 1200 bits per second (bps), perform this test and the end-to-end test (paragraphs 5.12 and 5.13). For all other conditions, perform this test whenever an end-to-end test is performed.

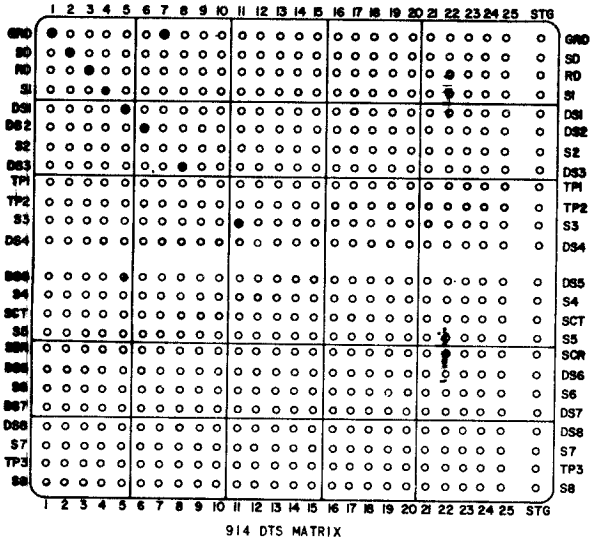
5.15 When performing these tests for data sets with delay equalizer options ZU and ZV (DS 202T-L1 series 6 and higher and DS 202T-L1A), do them for each option. Ensure option ZW (maximum compromise amplitude equalization) is installed in DS 202T-L1A. When performing these tests for data sets without the equalizer options (DS 202T-L1 series 5 and earlier), verify whether the requirements are met. If the requirements are not met, replace the data set with a series 6 set and repeat the tests.

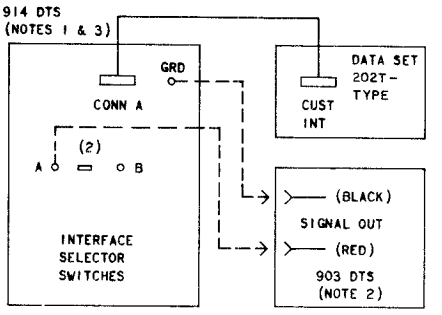
5.16 Perform the test as follows: Set up the equipment as described for an end-to-end test with the following exceptions.

- Set sample width switch to 50% position.
- Set bit rate switches to 1800 if channels meeting C2 conditioning requirements are used.

or

- Set bit rate switches to 1200 if unconditioned channels are used.





NOTES:

1. SET SWITCHES ON THE 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C DTS) RCV SER (914B DTS)
COUNTER	BIT ERRORS
RCV BIT RATE	1800
RCV WORD LENGTH	63
TRANSMIT BIT RATE (914C)	1800
TRANSMIT WORD LENGTH (914C)	63
SAMPLE WIDTH	30%
SIG LEV	±4V
SWITCH S1, S3	OFF
INTERFACE SELECTOR SWITCHES	ALL SWITCHES MUST BE PUSHED IN EXCEPT 2A WHEN 903 DTS USED

2. SET SWITCHES ON 903 DTS AS FOLLOWS:

SWITCH	SETTING
BIT RATE	1800
TRIGGER	(+) POSITIVE
RANDOM-DOT	RANDOM

3. 914 DTS INDICATOR LAMPS AND SWITCHES CORRESPOND TO INTERFACE LEADS AS FOLLOWS:

SWITCH	LAMP	INTERFACE LEAD
S1		REQUEST TO SEND
	DS1	CLEAR TO SEND
	DS2	DATA SET READY
	DS3	RECEIVED LINE SIGNAL DETECTOR
S3		SECONDARY REQUEST TO SEND

Fig. 8—Equipment Setup for End-to-End Test

5.17 Conduct two 1-minute tests. Record the error count of the run with the fewest errors; disregard the other count.

Requirement: 20 or less errors at 1800 bps rate; 10 or less errors at 1200 bps rate.

5.18 If the data set under test is a DS 202T-L1 series 6 or higher or DS 202T-L1A install the option (ZU or ZV) which gives the best performance even if the requirements are met for both options.

5.19 If the data set under test is a DS 202T-L1A operating over unconditioned 3002 telephone facility at 1100 to 1400 bps repeat the data distortion test with option ZX (minimum compromise amplitude equalization) installed. Upon completion of the test install the option (ZX or ZW) which gives the

TABLE A

MAXIMUM ERRORS ALLOWED
(PRIVATE LINE USING 914-TYPE DTS)

BPS	MAXIMUM NUMBER
1000	4
1200	5
1400	6
1600	7
1800	8

best performance. If no errors result with either option used, install option ZW.

H. Reverse Channel Test

5.20 This test checks the interface circuits used with the reverse channel. It will be necessary to use a test center for this test. The test center must be capable of transmitting a tone (387 Hz) to the data set and measuring the frequency of the tone received from the data set. The test is performed as follows:

(1) Disconnect the CPE and connect the 914-type DTS to the data set.

(2) Insert red pins in the matrix as shown in Fig. 7.

(3) Set switches on the 914-type DTS as shown on the tables associated with Fig. 7 except move switch S1 to ON.

(4) Apply power to the data set and to the 914-type DTS.

(5) Request the test center to send 387 Hz at -12 dBm at the 0 TLP.

Requirement: DS4 lamp lights (SCF ***on***).

(6) On the 914-type DTS, move switch S3 to ON and S1 to OFF. This transmits 387 Hz to the test center.

(7) Request the test center to measure the frequency of the reverse channel tone.

Requirement: 387 (±10) Hz.

(8) Upon completion of the test, disconnect the 914-type DTS and restore the data set to pretest condition.

I. Ground Noise Test

5.21 If the data set and CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6-type impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset level and which are separated by approximately 150-ms or more.

5.22 Test equipment required for this test is as follows:

1—6H impulse counter (or equivalent)

1—914-type DTS

1—2W6A test cord for 6H impulse counter (310 plug on one end, alligator clips connected to tip and ring on the other end).

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

5.23 In this test, the impulse counter is connected between the grounds of the data set and the CPE. The counter registers when potential differences of sufficient amplitude have developed between the separated grounds. The 914-type DTS is used to gain access to the ground interface leads. If a 914-type DTS is not available, any suitable method of access (such as 901 test adapter) may be used.

5.24 The 6H impulse counter is connected and the test is performed as follows.

(1) Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective ground from the CPE appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1B and the other clip to any clear, bare metal on the data set housing. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

5.25 At the end of both the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

6. REFERENCES

6.01 The following Bell System Practices provide additional information concerning DS 202T-type and data stations using DS 202T-type.

SECTION	TITLE
590-002-114	Data Set 202T—Reference Guide
590-102-130	39A1 Data Mounting—Identification
590-102-131	40-Type Data Mounting—Identification
590-102-137	47-Type Data Mounting—Identification
592-031-100	Data Set 202T-Type Transmitter-Receiver—Description and Operation
592-031-180	Data Set 202T Transmitter-Receiver—SummarizingSpecification
592-031-200	Data Set 202T-Type Transmitter-Receiver—Installation and Connections
592-861-100	Data Station Using Data Set 202T—Description and Operation
592-861-200	Data Station Using Data Set 202T—Installation and Connection
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Test Room

6.02 Detailed information concerning DS 202T is also contained in CD- and SD-1D243-01.

NO NEED TO CALL THE DATA TEST CENTER!!!

Data set 202T can be tested with the Automatic Data Test System (ADTS) using the DIVA feature and TOUCH-TONE® signalling (from a rotary dial phone, use a KS-21799-L1 tone coupler).

DDD	TEST FUNCTION LB RT ER DL
X	X

Use local instructions for DIVA access.

Test commands are entered into ADTS by letters and numbers on the TOUCH-TONE dial. To enter letters depress the number sign (#), then depress the TOUCH-TONE key that has the desired alpha character on it. Then depress the digit (1, 2, or 3) corresponding to the position of the alpha character on the TOUCH-TONE key.

Examples:

202C10	202#2310*
401J	401#51*
208B	208#22*

FUNCTION	CHARACTERS
NO	0*
YES	1*
RESULTS	7*
LIST ALL TEST FUNCTIONS	8*
REPEAT LAST MESSAGE	#*
DIGITAL LOOPBACK (DL)	35*
ERROR RUN (ER)	37*
LOOPBACK TEST (LB)	52*
STOP AND DISCONNECT	#63*
STOP PRESENT FUNCTION	#73*
REMOTE TEST (RT)	78*

For fast test of above, depress 3 before function, eg, 352*. Be sure to use #63* to disconnect in every case.

For more details, see Sections 590-010-500 and 668-600-102.

DATA SET 202T

TRANSMITTER-RECEIVER

TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 202T. Test procedures using the 914-type DTS and the self-test capabilities of DS 202T are contained in Section 592-031-500. These procedures are to be used when testing DS 202T on an initial installation or during a maintenance visit.

1.02 This section is reissued to add coverage for Version 2 of the 921A DTS. Since this reissue is a general revision, arrows normally used to indicate changes have been omitted.

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1.03 Test circuitry built into DS 202T permits a local self test to be performed. The test circuitry also facilitates the remote test of the data set from a test center. Additional tests require the use of external test equipment such as the 921A DTS.

1.04 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C DTS for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory.

2.02 Before proceeding with the tests, verify that the private line meets the requirements specified in Section 314-410-500. For a 2-wire private line, the installation test sequence is shown in Fig. 2. For a 4-wire private line, the installation test sequence is shown in Fig. 3.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed during a maintenance visit. This test sequence provides a method of isolating a trouble to the data set, the transmission facility, or the customer-provided equipment (CPE).

3.02 When a trouble report is received, a test center is responsible for isolating the trouble to the data set or transmission facility. The procedure for doing this is shown in Fig. 4.

3.03 If it is suspected that the trouble is in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests at the data station. The following equipment should be taken on a trouble visit:

- Spare data set
- 921A DTS.

3.04 Refer to Fig. 5 (2-wire private line) and Fig. 6 (4-wire private line) for the sequence in which tests are to be performed by the telco employee at the data station. If the data set is replaced, the defective data set should be tagged with a description of the trouble, carefully packed, and returned to the service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists, proceed as follows.

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that CPE has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

A. Local Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back internally from the transmitter output to the receiver input. The received data is compared

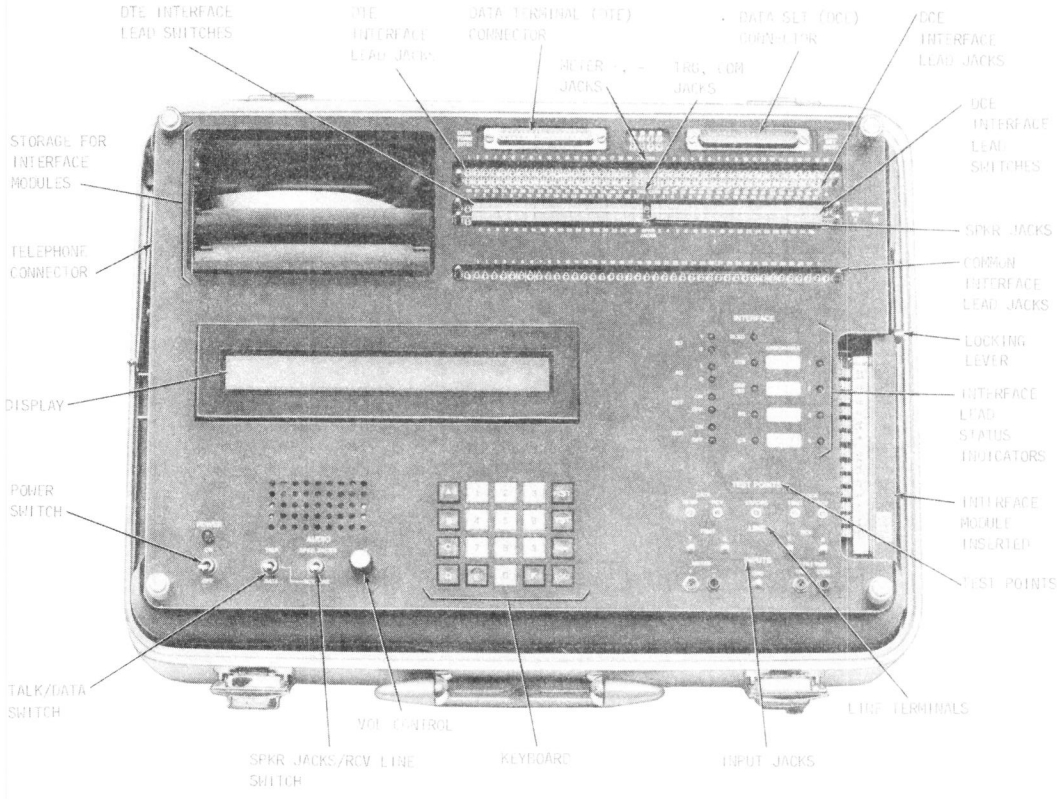


Fig. 1—921A Data Test Set—Front Panel

to the original data. Under normal conditions, all the data set indicator lamps are lighted; however, if an error is detected, the TM lamp goes off.

4.03 Perform the test as follows.

(1) Ensure that data set is not transmitting or receiving data.

(2) Firmly depress and hold LT switch for at least 15 seconds.

Note: If LT switch is depressed slowly, TM lamp may go off in a nondefective data set.

Requirement: TM lamp remains lighted while LT switch is depressed.

(3) If requirement specified in (2) is not met, repeat (2) four more times.

Requirement: TM lamp remains lighted during all four repeats.

B. Remote Test

4.04 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

2-Wire Private Line

4.05 For a 2-wire private line, the data set RT switch conditions the data set for testing by a test center. Perform the test as follows.

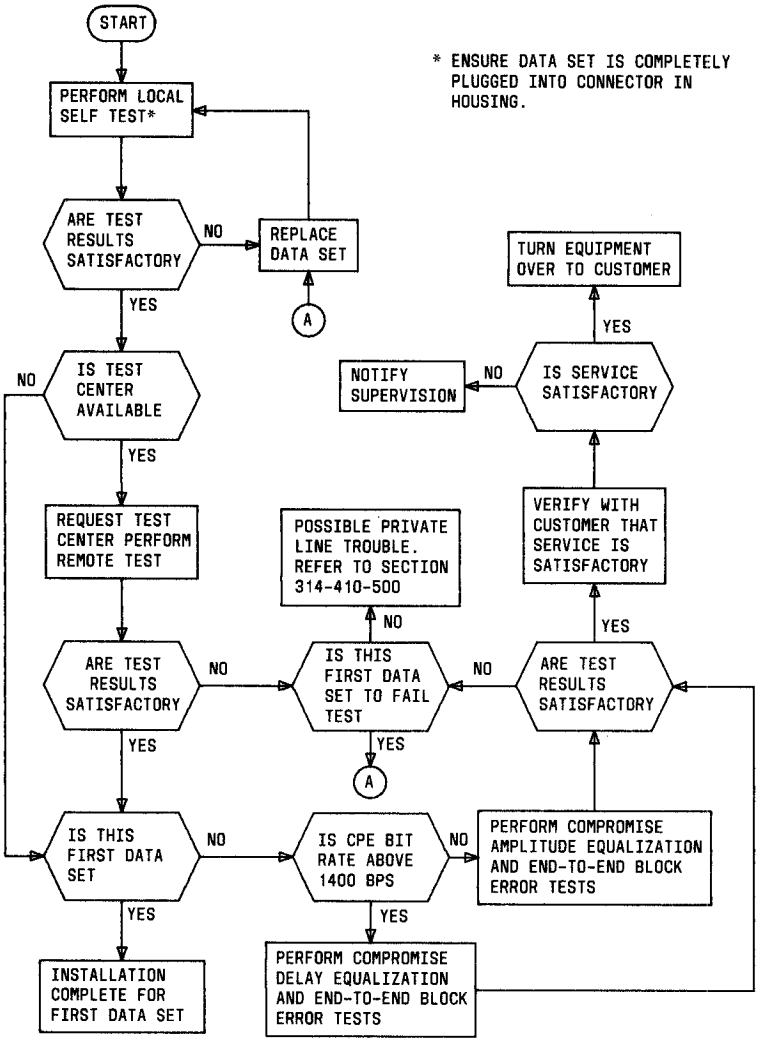


Fig. 2—Installation Test Sequence (2-Wire Private Line)

(1) Contact test center and request a remote test.

(2) When directed by test center, depress RT switch.

Requirement: On data set, all indicator lamps are lighted.

(3) Test center performs remote test.

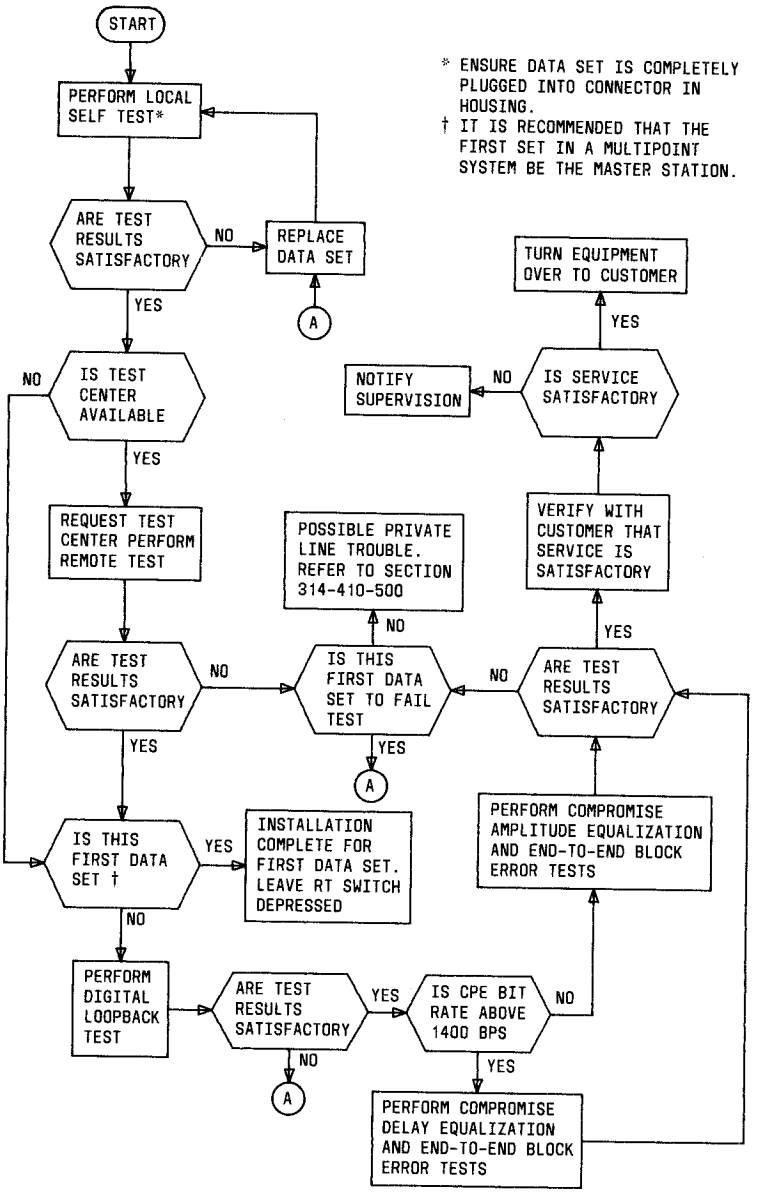


Fig. 3—Installation Test Sequence (4-Wire Private Line)

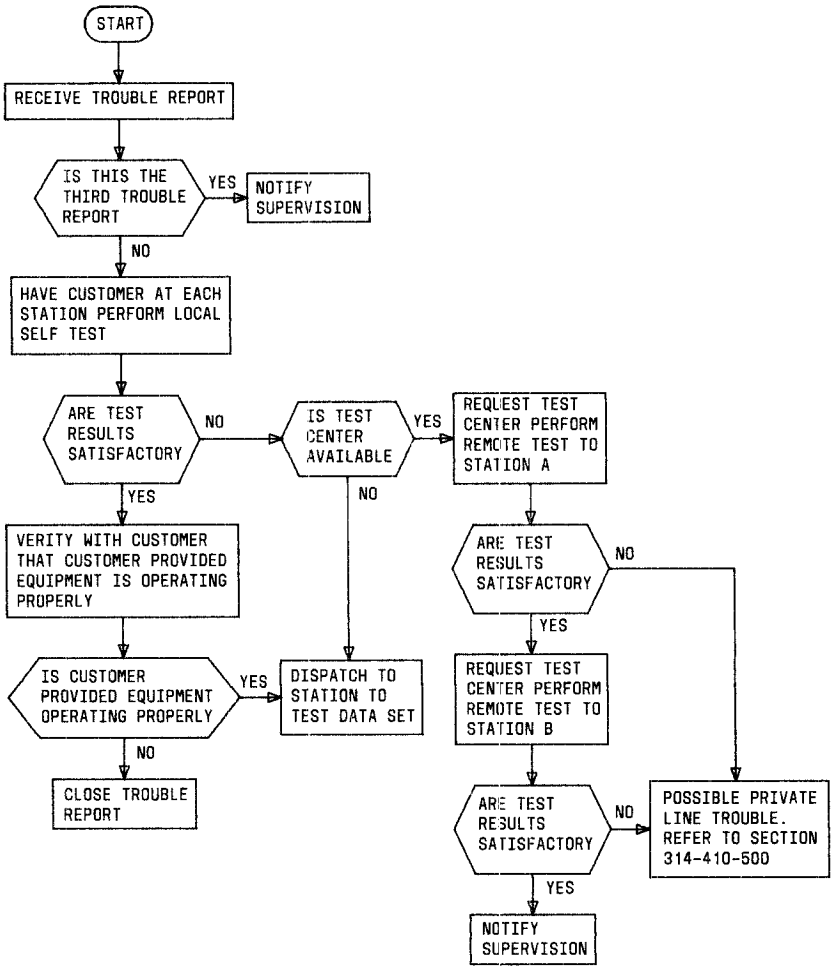


Fig. 4—Clearing Trouble Report (2-Wire or 4-Wire Private Line)

(4) When directed by test center, release RT switch.

Requirement: TM lamp goes off.

4-Wire Private Line

4.06 For a 4-wire private line, test data is generated and transmitted by a test center. The data set RT switch loops back this data internally from the receiver output to the transmitter input of the data set. The data is retransmitted, received by the test center, and compared to the original data. Perform the test as follows.

(1) Contact test center and request a remote test.

(2) When directed by test center, depress RT switch.

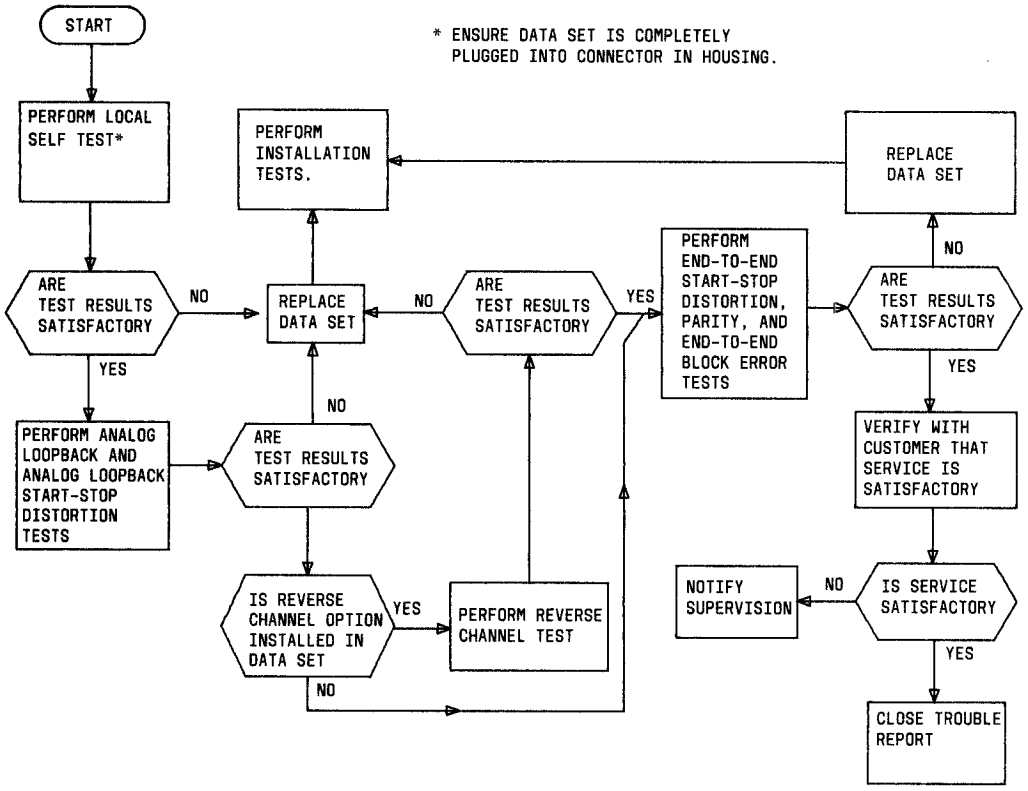


Fig. 5—Maintenance Test Sequence (2-Wire Private Line)

Requirement: On data set, only ON and TM indicator lamps are lighted.

(3) Test center performs remote test.

(4) When directed by test center, release RT switch.

Requirement: TM lamp goes off.

C. Initial Test Setup for 921A DTS

4.07 Perform the initial test setup for the 921A DTS when used to test DS 202T as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a female 37-pin connector and a male 25-pin connector. Connect interface cable from DATA SET (DCE) connector on	

STEP	ACTION	VERIFICATION

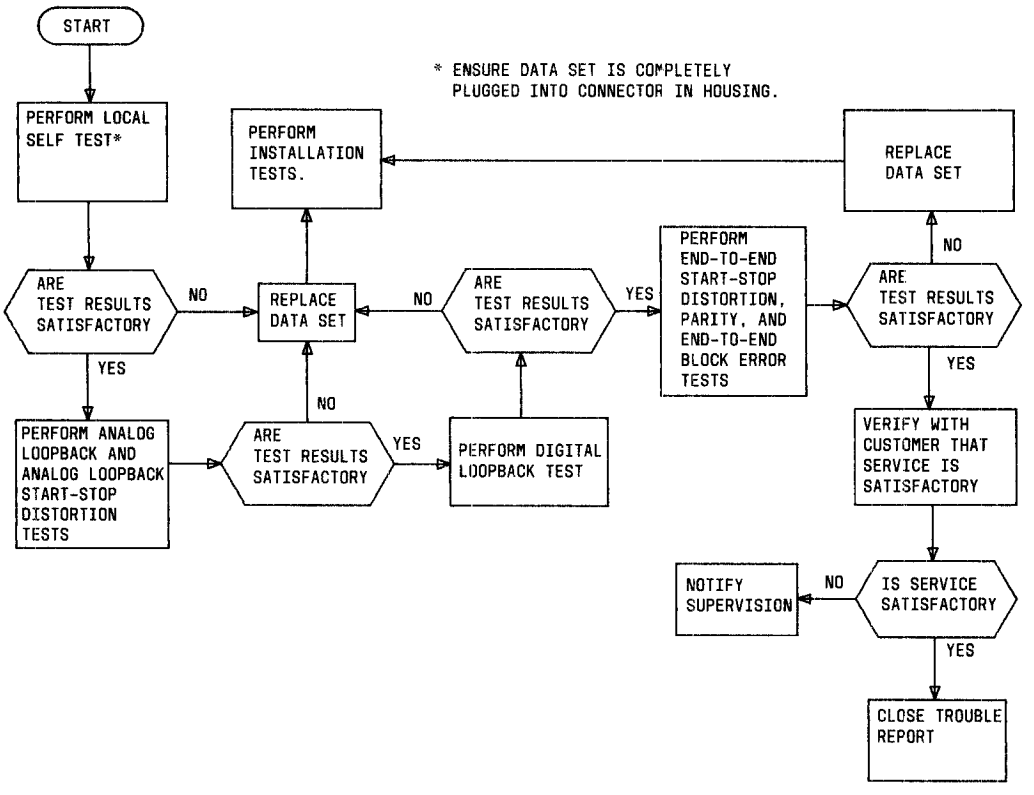


Fig. 6—Maintenance Test Sequence (4-Wire Private Line)

	DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard.	Display reads (briefly) version number of DTS.
	Note: If RST is pressed during a test, the	DTS then performs self tests.

STEP	ACTION	VERIFICATION
	test is ended and the DTS recycles to this step.	If DTS is defective, display reads— TEST FAILED. If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position except that switch 11 is in OPEN position.	
11	Enter 25 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (◀).	Display reads— DATA SET: 25
12	Press GO.	Display reads— BIT RATE:
13	Enter 12.	Display reads— BIT RATE: 12
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

D. Analog Loopback Test

4.08 In this test, an analog loopback block error run is performed, the CA-CB (RS-CS) interval is checked, and the CA-CF (RS-RLSD) interval is checked. The reverse channel is also checked, if it is installed in the data set. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display. The CA-CB interval check measures the interval between the time the request-to-send lead is turned ***on*** and the clear-to-send lead turns ***on.*** The CA-CF interval check measures the interval between the beginning of the line signal and the ***on*** condition of the received line signal detector lead.

4.09 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.07 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
	Note: If GO or TST is pressed at an unauthorized point in the following tests, the test in progress is ended and the DTS recycles to the start of that test (last preceding step that display read TEST SEQ:).	
Block Error Run		
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
5	Enter 1.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
6	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
7	Enter 2.	Display reads— ????? BITS IN A BLOCK
8	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
9	Enter 0060. ***Note:*** To perform functions listed below, press associated key.	Display reads (briefly)— 0060 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error.

STEP	ACTION	VERIFICATION
		Requirement: No blocks in error.
	KEY FUNCTION A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	
10	Press TST. ***Note:*** If option ZN (continuous carrier IN) is installed in data set, omit Steps 11 through 13.	Display reads— TEST SEQ:
	Clear-to-Send Interval Test	
11	Enter 30.	Display reads— TEST SEQ: 30
12	Press GO. ***Note 1:*** This test cannot be performed while an associated channel interface unit (DAS 828-type, DAS 829-type, or equivalent) is in the facility loopback mode. ***Note 2:*** Only the option actually installed in the data set need be tested. ***Note 3:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** Option M—7 to 9 ms Option K—28 to 32 ms Option J—56 to 64 ms Option G—170 to 191 ms
13	Press TST.	Display reads— TEST SEQ:
	Received Line Signal Detector Interval Test	
14	If option ZN (continuous carrier IN) is installed in data set, remove this option and install option ZO (continuous carrier OUT).	
15	Enter 31.	Display reads— TEST SEQ: 31
16	Press GO.	Display reads RS-RLSD (CA-CF) interval in milliseconds.

STEP	ACTION	VERIFICATION
	Note 1: Only the option actually installed in the data set need be tested.	***Requirement:***
	Note 2: To repeat test, press A.	Option Q—5.7 to 8 ms Option N—19 to 22 ms
17	Press TST.	Display reads— TEST SEQ:
18	If option ZO was installed in data set in Step 14, remove this option and install option ZN.	
Analog Loopback Reverse Channel Test (Does Not Apply to DS 202T-L1)		
	Note: If reverse channel is not installed in data set, omit Steps 19 through 29.	
19	Enter 47 48 38 47.	Display reads— TEST SEQ: 47 48 38 47
20	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
21	Enter 05 09.	Display reads (briefly)— SW CONN: X=05 Y=09 Display then reads— SW CONN: X=?? Y=??
22	Enter 15 10.	Display reads (briefly)— SW CONN: X=15 Y=10 Display then reads— SW CONN: X=?? Y=??
23	Enter 16 11.	Display reads (briefly)— SW CONN: X=16 Y=11 Display then reads— SW CONN: X=?? Y=??
24	Enter 10 05. ***Note:*** Steps 19 through 22 conditioned DTS to control request-to-send (S1), secondary request-to-send (S2), and data terminal ready (S3), and to monitor secondary received line signal detector on ASSIGNABLE 1 indicator.	Display reads (briefly)— SW CONN: X=10 Y=05 Display then reads— SW CONN: X=?? Y=??
25	Press GO.	Display reads (briefly)— TEST INTERRUPTED

STEP	ACTION	VERIFICATION
	Note: S1 is controlled by key 1; S2 is controlled by key 2; S3 is controlled by key 3. S4 is not used.	For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads state of controlled switches. A typical display might read— S1=OFF S2=OFF S3=ON S4=OFF
26	Press keys 1, 2, and 3 until state of S1, S2, and S3 are as shown in verification. Disregard S4.	Display reads— S1=OFF S2=ON S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator lights.
27	Press key 1.	Display reads— S1=ON S2=ON S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator goes off.
28	Press keys 1 and 2.	Display reads— S1=OFF S2=OFF S3=ON S4=OFF ***Requirement:*** ASSIGNABLE 1 indicator remains off.
29	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
30	On data set, release AL switch.	TM lamp goes off.

E. Digital Loopback Test (4-Wire Private Line)

4.10 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interface at the distant data set is not checked. Test data is generated by the 921A DTS and transmitted by the local data set. This data is looped back internally from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.11 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.07 has been performed.	Display reads— TEST SEQ:
2	Contact distant data station and have RT switch on data set depressed.	TM lamp lights on distant data set.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
5	Enter 1.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
6	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
7	Enter 2.	Display reads— ????? BITS IN A BLOCK
8	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
9	Enter 0900. ***Note:*** To perform functions listed below, press associated key.	

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.
E	Inject 8 errors into data stream.
F	Force out-of-sync condition.

Display reads (briefly)—
0900 SECONDS
Display then reads—
BLK RCVD=0000 ERR=0000
From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A.
At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error.

STEP	ACTION	VERIFICATION
		Requirement: Total blocks in error are less than 12.
10	Contact distant data station and have RT switch on data set released.	TM lamp goes off on distant data set.

F. Compromise Amplitude Equalization Test

4.12 This test determines the proper compromise amplitude equalization option (ZX or ZW) to install in DS 202T-L1A. Four 90-second bit error tests are made, two with option ZX installed (minimum compromise amplitude equalization) and two with option ZW installed (maximum compromise amplitude equalization). The option that has the lowest number of bits in error in any of the four tests is then installed. If there is no difference, option ZW is installed. Option ZU (maximum compromise delay equalization) should be installed during this test and should remain installed.

Note: This test is required only for DS 202T-L1A operating over unconditioned channels at bit rates from 1000 to 1400 bps.

2-Wire Private Line (Half Duplex)

4.13 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a compromise amplitude equalization test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 6.	Display reads— 63 BIT ERROR TEST

STEP	ACTION	VERIFICATION
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read-- 63 BIT ERROR TEST
	At receiving station, perform Steps 7 through 20.	
7	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
8	Install options ZU and ZX in data set.	
9	On DTS, enter 54.	Display reads— TEST SEQ: 54
10	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
11	Enter code for DTS at transmitting station.	Typical display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
12	Enter 6.	Display reads (briefly)-- 63 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
13	Enter 1.	Display reads— ???? SECONDS
14	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read-- ???? SECONDS
15	Enter 0090.	
	Note: To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only.	

STEP	ACTION	VERIFICATION
	KEY FUNCTION A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0090 SECONDS Display then reads— 0000 BITS IN ERROR From this point, display counts number of bits in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, and total bits in error.
16	Record number of bits in error.	
17	Repeat test one time, by pressing A on DTS, and again record number of bits in error.	
18	Remove option ZX and install option ZW in data set.	
19	Repeat test two times and each time record number of bits in error.	
20	Select option (ZX or ZW) that had the lowest number of bits in error in any of the four tests, and install selected option in data set. If there is no difference, install option ZW in data set.	
21	Perform the compromise amplitude equalization test in the opposite direction. The receiving station now becomes the transmitting station.	

4-Wire Private Line (Full Duplex)

4.14 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a compromise amplitude equalization test. ***Note:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations.	

STEP	ACTION	VERIFICATION
	At both stations, perform Steps 2 through 15.	
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
3	Install options ZU and ZX in data set.	
4	On DTS, enter 55.	Display reads— TEST SEQ: 55
5	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
6	Enter code for DTS at other station.	Typical display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
7	Enter 6.	Display reads (briefly)— 63 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
8	Enter 1.	Display reads— ???? SECONDS
9	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
10	Enter 0090. ***Note:*** To perform functions listed below, press associated key.	

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.
E	Inject 8 errors into data stream.
F	Force out-of-sync condition.

Display reads (briefly)—
0090 SECONDS
Display then reads—
0000 BITS IN ERROR
From this point, display counts number of bits in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A.

STEP	ACTION	VERIFICATION
		At end of test, display reads TEST COMPLETE, total sync losses, and total bits in error.
11	Record number of bits in error.	
12	Repeat test one time, by pressing A on DTS, and again record number of bits in error.	
13	Remove option ZX and install option ZW in data set.	
14	Repeat test two times and each time record number of bits in error.	
15	Select option (ZX or ZW) that had the lowest number of bits in error in any of the four tests, and install selected option in data set. If there is no difference, install option ZW in data set.	

G. Compromise Delay Equalization Test

4.15 This test determines the proper compromise delay equalization option (ZV or ZU) to install in DS 202T-L1 (series 6 and higher) or DS 202T-L1A. Four 180-second start-stop distortion tests are made, two with option ZV installed (minimum compromise delay equalization) and two with option ZU installed (maximum compromise delay equalization). The option that has the lowest peak distortion in any of the four tests is then installed. If there is no difference, option ZU is installed. Option ZW (maximum compromise amplitude equalization) should be installed during this test and should remain installed.

Note: This test is required only for DS 202T-L1 (series 6 and higher) or DS 202T-L1A operating over channels with C2 conditioning at bit rates above 1400 bps.

2-Wire or 4-Wire Private Line (Half Duplex)

4.16 Perform the test as follows.

Note: A 911-type DTS can be used at the distant data station.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a compromise delay equalization test. ***Note:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 8.		
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter 18. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
3	Enter 52.	Display reads— TEST SEQ: 52
4	Press GO.	For Version 1 DTS: Display reads— TRMT: 1=MAN 2=CONT For Version 2 and higher DTS: Display reads— PARITY=? (0=EVEN 1=ODD)
5	For Version 2 and higher DTS, enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2.	For Version 2 and higher DTS: Display reads (briefly)— TRMT=2 (1=MAN 2=CONT)
7	Place data set in data mode.	Display then reads— PRESS A TO START On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
8	Press A.	For Version 1 DTS: Display reads— SENDING ASCII MESSAGE For Version 2 and higher DTS: Display reads (briefly)— CS MUST BE ON TO TRANSMIT Display then reads— SENDING MESSAGE
At receiving station, perform Steps 9 through 25.		
9	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter 18. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
10	Install options ZW and ZV in data set.	
11	For Version 1 DTS, enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
12	For Version 1 DTS, enter 0.	Display reads— TEST SEQ: 36 RS=0 (0 OR 1)

STEP	ACTION	VERIFICATION
13	For Version 1 DTS, press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
14	Enter 79.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER ??%
15	For Version 2 and higher DTS, press GO.	Display reads— MODE=? (1=RCV 2=RCV & TRMT)
16	For Version 2 and higher DTS, enter 1.	Display reads (briefly)— MODE=1 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
17	Enter 40.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER 40% For Version 2 and higher DTS: Display reads (briefly)— HITS OVER 40% (MAX=49%) Display then reads— ???? SECONDS
18	For Version 1 DTS, press GO.	Display reads— ???? SECONDS
19	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
20	Enter 0180 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A* Repeat test. B* Display time remaining in test. C Clear display. D* End test. *Version 2 and higher DTS.	Display reads (briefly)— 0180 SECONDS Display then reads— PEAK=00% HITS=00/40 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results.
21	Record peak distortion.	

STEP	ACTION	VERIFICATION
22	Repeat test one time and again record peak distortion. ***Note:*** To repeat test—For Version 1 DTS, press TST on DTS and repeat Steps 14 through 20. For Version 2 and higher DTS, press A on DTS.	
23	Remove option ZV and install option ZU in data set.	
24	Repeat test two times and each time record peak distortion.	
25	Select option (ZV or ZU) that had the lowest peak distortion in any of the four tests, and install selected option in data set. If there is no difference, install option ZU in data set.	
26	Perform the compromise delay equalization test in the opposite direction. The receiving station now becomes the transmitting station.	

4-Wire Private Line (Full Duplex) (Version 2 and Higher DTS)

Note: A 911-type DTS can be used at the distant data station.

4.17 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a compromise delay equalization test.	
At both stations, perform Steps 2 through 16.		
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter 18. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
3	Enter 52 79.	Display reads— TEST SEQ: 52 79
4	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
5	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD)

STEP	ACTION	VERIFICATION
		Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2. ***Note:*** Ignore display, PRESS A TO START	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
7	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
8	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
9	Enter 40.	Display reads (briefly)— HITS OVER 40% (MAX=49%) Display then reads— ???? SECONDS
10	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
11	Enter 0180 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test.	Display reads (briefly)— 0180 SECONDS Display then reads— PEAK=00% HITS=00/40 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results.
12	Record peak distortion.	
13	Repeat test one time, by pressing A on DTS, and again record peak distortion.	
14	Remove option ZV and install option ZU in data set.	
15	Repeat test two times and each time record peak distortion.	

STEP	ACTION	VERIFICATION
16	Select option (ZV or ZU) that had the lowest peak distortion in any of the four tests, and install selected option in data set. If there is no difference, install option ZU in data set.	

H. End-to-End Block Error Test

4.18 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

Note 1: For DS 202T-L1A operating over unconditioned channels at bit rates from 1000 to 1400 bps, perform the compromise amplitude equalization test before performing the end-to-end error test. If the compromise amplitude equalization test is not required, ensure that option ZW (maximum compromise amplitude equalization) is installed in the data set before performing the end-to-end error test.

Note 2: For DS 202T-L1 (series 6 and higher) and DS 202T-L1A operating over channels with C2 conditioning at bit rates above 1400 bps, perform the compromise delay equalization test before performing the end-to-end error test. If the compromise delay equalization test is not required, ensure that option ZU (maximum compromise delay equalization) is installed in the data set before performing the end-to-end error test.

2-Wire Private Line (Half Duplex)

4.19 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53

STEP	ACTION	VERIFICATION
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 6.	Display reads— 63 BIT ERROR TEST
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— 63 BIT ERROR TEST
At receiving station, perform Steps 7 through 15.		
7	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
8	Enter 54.	Display reads— TEST SEQ: 54
9	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
10	Enter code for DTS at transmitting station.	Typical display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
11	Enter 6.	Display reads (briefly)— 63 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
12	Enter 2.	Display reads— ????? BITS IN A BLOCK
13	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
14	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS

STEP	ACTION	VERIFICATION
15	Enter 0900. ***Note:*** To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are as follows: 1000 bps—less than 10 1200 bps—less than 12 1400 bps—less than 14 1600 bps—less than 16 1800 bps—less than 18
16	Perform the end-to-end block error test in the opposite direction. The receiving station now becomes the transmitting station.	

4-Wire Private Line (Full Duplex)

4.20 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations.	

STEP	ACTION	VERIFICATION
	At both stations, perform Steps 2 through 9.	
2	Ensure that initial test setup described in paragraph 4.07 has been performed, except in Step 13 enter first two digits of bit rate used by customer-provided equipment (CPE). Display in Step 13 reads digits entered.	Display reads— TEST SEQ:
3	Enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
5	Enter code for DTS at other station.	Typical display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
6	Enter 6.	Display reads (briefly)— 63 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
7	Enter 2.	Display reads— ????? BITS IN A BLOCK
8	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
9	Enter 0900. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE,

STEP	ACTION	VERIFICATION
		total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are as follows: 1000 bps—less than 10 1200 bps—less than 12 1400 bps—less than 14 1600 bps—less than 16 1800 bps—less than 18

I. Reverse Channel Test

4.21 This test checks the interface circuits used with the reverse channel. The 921A DTS and a test center are required for the test. The test center must be capable of transmitting a 387-Hz tone to the data set and measuring the frequency of the tone received from the data set.

4.22 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.07 has been performed.	Display reads— TEST SEQ:
2	Enter 39.	Display reads— TEST SEQ: 39
3	Press GO.	Display reads— SRLSD IS OFF
4	Contact test center and request test center to send a 387-Hz tone at -12 dBm at the O TLP.	Display reads— SRLSD IS ON After several seconds, display reads— SRS IS ON
5	Request test center to measure frequency of reverse channel tone received from data set.	***Requirement:*** 377 to 397 Hz

J. Analog Loopback Start-Stop Distortion Test (Version 2 and Higher DTS)

4.23 This test uses the 921A DTS to measure three types of start-stop distortion, as follows.

- Peak distortion
- Number of "hits" above a specified threshold
- Average bias distortion.

4.24 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for DS 202T-L1 with reverse channel.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
	For DS 202T-L1 without reverse channel and for DS 202T-L1A with or without reverse channel, enter 18 in Step 13. Display in Step 13 reads BIT RATE: 18.	
2	If option ZU (maximum compromise delay equalization) is installed in DS 202T-L1, remove this option and install option ZV (minimum compromise delay equalization).	
3	If option ZY (basic channel condition) is installed in DS 202T-L1A, remove this option and install option ZZ (C2 channel condition).	
4	On data set, depress AL switch.	TM lamp lights.
5	On DTS, enter 52 79.	Display reads— TEST SEQ: 52 79
6	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
7	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
8	Enter 2. ***Note:*** Ignore display, PRESS A TO START	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
9	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
10	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
11	Enter YY. ***Note:*** Select the two digits to be entered for YY from the values shown in the PEAK column in Table A.	Display reads (briefly)— HITS OVER YY% (MAX=49%) Display then reads— ???? SECONDS
12	Enter 0090 and after about 2 seconds, press C. ***Note:*** To perform functions listed below,	Display reads (briefly)— 0090 SECONDS Display then reads— PEAK=00% HITS=00/YY AVG BIAS=00%

STEP	ACTION	VERIFICATION
	press associated key.	At end of test, display reads TEST COMPLETE and test results.
	KEY FUNCTION A Repeat test. B Display time remaining in test. C Clear display. D End test.	***Requirements:*** As shown in Table A.
13	On data set, release AL switch.	TM lamp goes off.

TABLE A

ANALOG LOOPBACK START–STOP DISTORTION

202T-TYPE	REVERSE CHANNEL	MAXIMUM DISTORTION		
		PEAK	HITS	AVG BIAS
L1	In	19	00/19	05
	Out	34	00/34	13
L1A	In	25	00/25	07
	Out	21	00/21	06

14	If option ZV (minimum compromise delay equalization) was installed in DS 202T-L1 in Step 2, remove this option and install option ZU (maximum compromise delay equalization).	
15	If option ZZ (C2 channel condition) was installed in DS 202T-L1A) in Step 3, remove this option and install option ZY (basic channel condition).	

K. End-to-End Start-Stop Distortion Test

4.25 This test uses the 921A DTS to measure three types of start-stop distortion, as follows.

- Peak distortion
- Number of "hits" above a specified threshold
- Average bias distortion.

Note 1: For DS 202T-L1A operating over unconditioned channels at bit rates from 1000 to 1400 bps, perform the compromise amplitude equalization test before performing the end-to-end start-stop distortion test. If the compromise amplitude equalization test is not required, ensure that option ZW (maximum compromise amplitude equalization) is installed in the data set before performing the end-to-end start-stop distortion test.

Note 2: For DS 202T-L1 (series 6 and higher) and DS 202T-L1A operating over

channels with C2 conditioning at bit rates above 1400 bps, perform the compromise delay equalization test before performing the end-to-end start-stop distortion test. If the compromise delay equalization test is not required, ensure that option ZU (maximum compromise delay equalization) is installed in the data set before performing the end-to-end start-stop distortion test.

2-Wire or 4-Wire Private Line (Half Duplex)

4.26 Perform the test as follows.

Note: A 911-type DTS can be used at the distant data station.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-stop distortion test. ***Note:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 8.		
2	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for unconditioned channels. For channels with C2 conditioning, enter 18 in Step 13 of paragraph 4.07. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
3	Enter 52.	Display reads— TEST SEQ: 52
4	Press GO.	For Version 1 DTS: Display reads— TRMT: 1=MAN 2=CONT For Version 2 and higher DTS: Display reads— PARITY=? (0=EVEN 1=ODD)
5	For Version 2 and higher DTS, enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2.	For Version 2 and higher DTS: Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START

STEP	ACTION	VERIFICATION
7	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
8	Press A.	For Version 1 DTS: Display reads— SENDING ASCII MESSAGE For Version 2 and higher DTS: Display reads (briefly)— CS MUST BE ON TO TRANSMIT Display then reads— SENDING MESSAGE
At receiving station, perform Steps 9 through 20.		
9	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for unconditioned channels. For channels with C2 conditioning, enter 18 in Step 13. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
10	For Version 1 DTS, enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
11	For Version 1 DTS, enter 0.	Display reads— TEST SEQ: 36 RS=0 (0 OR 1)
12	For Version 1 DTS, press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
13	Enter 79.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER ??%
14	For Version 2 and higher DTS, press GO.	Display reads— MODE=? (1=RCV 2=RCV & TRMT)
15	For Version 2 and higher DTS, enter 1.	Display reads (briefly)— MODE=1 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)

STEP	ACTION	VERIFICATION
16	For unconditioned channels, enter 35.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER 35% For Version 2 and higher DTS: Display reads (briefly)— HITS OVER 35% (MAX=49%) Display then reads— ???? SECONDS
17	For channels with C2 conditioning, enter 40.	For Version 1 DTS: Display reads— TEST SEQ: 79 HITS OVER 40% For Version 2 and higher DTS: Display reads (briefly)— HITS OVER 40% (MAX=49%) Display then reads— ???? SECONDS
18	For Version 1 DTS, press GO.	Display reads— ???? SECONDS
19	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
20	Enter 0180 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key.	Display reads (briefly)— 0180 SECONDS Display then reads— For unconditioned channels— PEAK=00% HITS=00/35 AVG BIAS=00% For channels with C2 conditioning— PEAK=00% HITS=00/40 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results. ***Requirements:*** For unconditioned channels— 1. Less than 45% peak distortion. 2. Less than 04/35 hits. 3. Less than 15% average bias distortion. For channels with C2 conditioning— 1. Less than 45% peak distortion. 2. Less than 05/40 hits. 3. Less than 15% average bias distortion.

STEP	ACTION	VERIFICATION
	KEY FUNCTION A* Repeat test. B* Display time remaining in test. C Clear display. D* End test. *Version 2 and higher DTS.	
21	Perform the end-to-end start-stop distortion test in the opposite direction. The receiving station now becomes the transmitting station.	

4-Wire Private Line (Full Duplex) (Version 2 and Higher DTS)

Note: A 911-type DTS can be used at the distant data station.

4.27 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-stop distortion test.	
	At both stations, perform Steps 2 through 12.	
2	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for unconditioned channels. For channels with C2 conditioning, enter 18 in Step 13 of paragraph 4.07. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
3	Enter 52 79.	Display reads— TEST SEQ: 52 79
4	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
5	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
6	Enter 2. ***Note:*** Ignore display, PRESS A TO START	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START

STEP	ACTION	VERIFICATION
7	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
8	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER ??% (MAX=49%)
9	For unconditioned channels, enter 35.	Display reads (briefly)— HITS OVER 35% (MAX=49%) Display then reads— ???? SECONDS
10	For channels with C2 conditioning, enter 40.	Display reads (briefly)— HITS OVER 40% (MAX=49%) Display then reads— ???? SECONDS
11	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
12	Enter 0180 and after about 2 seconds, press C. ***Note:*** To perform functions listed below, press associated key.	Display reads (briefly)— 0180 SECONDS Display then reads— For unconditioned channels— PEAK=00% HITS=00/35 AVG BIAS=00% For channels with C2 conditioning— PEAK=00% HITS=00/40 AVG BIAS=00% At end of test, display reads TEST COMPLETE and test results.

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.

Requirements:

For unconditioned channels—
1. Less than 45% peak distortion.
2. Less than 04/35 hits.
3. Less than 15% average bias distortion.

For channels with C2 conditioning—
1. Less than 45% peak distortion.
2. Less than 05/40 hits.
3. Less than 15% average bias distortion.

L. Parity Test

4.28 This test uses the 921A DTS to check the number of parity errors that occur in transmitting an ASCII format message.

Note 1: For DS 202T-L1A operating over unconditioned channels at bit rates from 1000 to 1400 bps, perform the compromise amplitude equalization test before performing the parity test. If the compromise amplitude equalization test is not required, ensure that option ZW (maximum compromise amplitude equalization) is installed in the data set before performing the parity test.

Note 2: For DS 202T-L1 (series 6 and higher) and DS 202T-L1A operating over channels with C2 conditioning at bit rates above 1400 bps, perform the compromise delay equalization test before performing the parity test. If the compromise delay equalization test is not required, ensure that option ZU (maximum compromise delay equalization) is installed in the data set before performing the parity test.

4.29 Perform the test as follows.

Note: A 911-type DTS can be used at the distant data station.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct a parity test. ***Note:*** Procedure at transmitting station must be performed first.	
	At transmitting station, perform Steps 2 through 8.	
2	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for unconditioned channels. For channels with C2 conditioning, enter 18 in Step 13 of paragraph 4.07. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
3	Enter 52.	Display reads— TEST SEQ: 52
4	Press GO.	For Version 1 DTS: Display reads— TRMT: 1=MAN 2=CONT For Version 2 and higher DTS: Display reads— PARITY=? (0=EVEN 1=ODD)
5	For Version 2 and higher DTS, enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)

STEP	ACTION	VERIFICATION
6	Enter 2.	For Version 2 and higher DTS: Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START
7	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
8	Press A.	For Version 1 DTS: Display reads— SENDING ASCII MESSAGE For Version 2 and higher DTS: Display reads (briefly)— CS MUST BE ON TO TRANSMIT Display then reads— SENDING MESSAGE
At receiving station, perform Steps 9 through 15.		
9	Ensure that initial test setup described in paragraph 4.07 has been performed. ***Note:*** Procedure in Step 13 of paragraph 4.07 is for unconditioned channels. For channels with C2 conditioning, enter 18 in Step 13 of paragraph 4.07. Display in Step 13 reads BIT RATE: 18.	Display reads— TEST SEQ:
10	Enter 57.	Display reads— TEST SEQ: 57 ? (0=EVEN 1=ODD)
11	Enter 0.	Display reads (briefly)— TEST SEQ: 57 0 (0=EVEN 1=ODD) DISPLAY then reads— :
12	Press GO.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A.	Display reads— PARITY ERRORS=00

STEP	ACTION	VERIFICATION
		From this point, display counts number of parity errors.
15	Conduct test for about 3 minutes.	***Requirement:*** For unconditioned channels— less than 4 parity errors. For channels with C2 conditioning— less than 5 parity errors.
16	Perform the parity test in the opposite direction. The receiving station now becomes the transmitting station.	

5. REFERENCES

5.01 Additional information concerning the testing of DS 202T is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
592-031-100	Data Set 202T—Transmitter-Receiver—Description and Operation
592-031-150	Data Set 202T—Transmitter-Receiver—Supplementary Information
592-031-200	Data Set 202T—Transmitter-Receiver—Installation and Connections
592-031-500	Data Set 202T—Transmitter-Receiver—Test Procedures and Maintenance
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Testroom
999-100-142	Data Set 202T—How to Operate Manual

5.02 Detailed information concerning DS 202T is contained in CD- and SD-1D243-01.

DATA STATION USING DATA SET 202T
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains a physical and functional description of the data station used with data set 202T. Operating procedures for normal use and for testing are also provided.

1.02 This section is reissued to correct Fig. 4 and 7.

1.03 The purpose of the data station is to provide a multiple arrangement of data sets 202T. For a description of data set 202T, refer to Section 592-031-100. Three typical station arrangements are described:

- Up to 8 data sets with reverse channel (or 16 data sets without reverse channel) in a 39A1 data mounting for installation in a 19- or 23-inch relay rack (Fig. 1), or in a 40B1 data mounting in a KS-20018-L12A cabinet
- Up to 16 data sets with reverse channel (or 32 data sets without reverse channel) in two 40B1 data mountings in a KS-20018-L12A cabinet
- Up to 24 data sets with reverse channel (or 48 data sets without reverse channel) in three 40B1 data mountings in a KS-20018-L11A cabinet.

2. PHYSICAL DESCRIPTION

2.01 This part contains a physical description of the data mountings and cabinets which make up the data station. Power requirements and fusing information are also provided.

A. 39A1 Data Mounting

2.02 The 39A1 data mounting includes the necessary framework, wiring, and hardware to mount up to 8 data sets with reverse channel, or up to 16 data sets without reverse channel. All connections to the data sets (except power) must be made on wire-wrap terminals at the rear of the data mounting (Fig. 2). Each data set is inserted through guides in the top and bottom of the mounting into a 908C connector. The data sets are secured in the mounting by a retaining bar assembly which also serves as a labeling strip.

2.03 The 39A1 data mounting can be installed in 19-inch or 23-inch relay racks where it is desired to permanently wire input-output connections rather than provide plug-in connections. It measures 22.9 inches wide, 11-1/2 inches deep, and 7 inches high. The width may be shortened 4 inches by rotating the right-hand mounting bracket. The weight is approximately 14.3 pounds without data sets installed.

B. 40B1 Data Mounting

2.04 The 40B1 data mounting (Fig. 3) has the same data set capacity as the 39A1; however, Electronic Industries Association (EIA) interface connection to the data sets is made on 25-pin KS-19087-L6 connectors. The customer must provide a cable terminated in a Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood. Connections to telephone lines are made on 50-pin connectors labeled J1 and J2 on the backplane. Each data set is inserted through guides in the top and bottom of the mounting into a 908L connector. The data

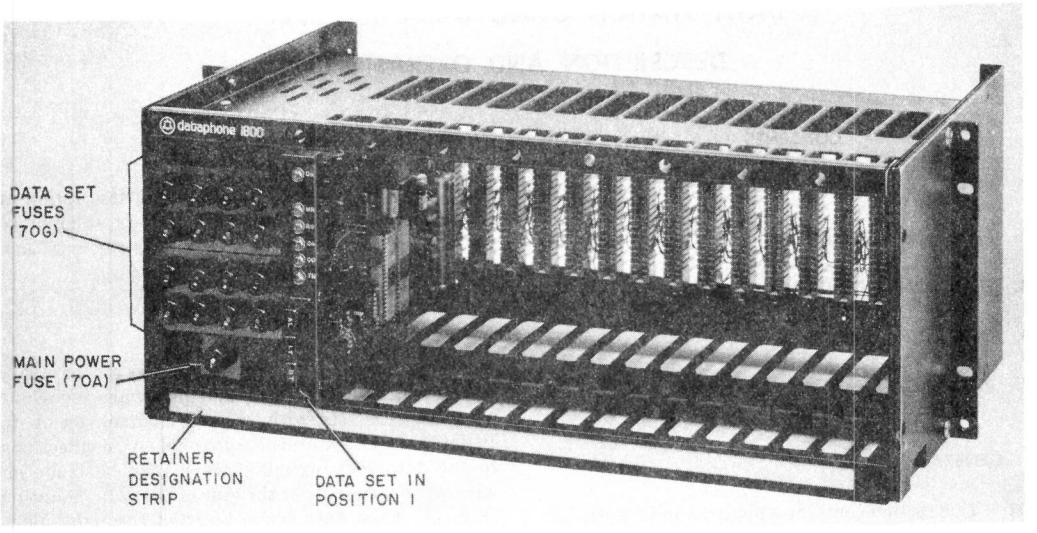


Fig. 1—Front View of 39A1 Data Mounting

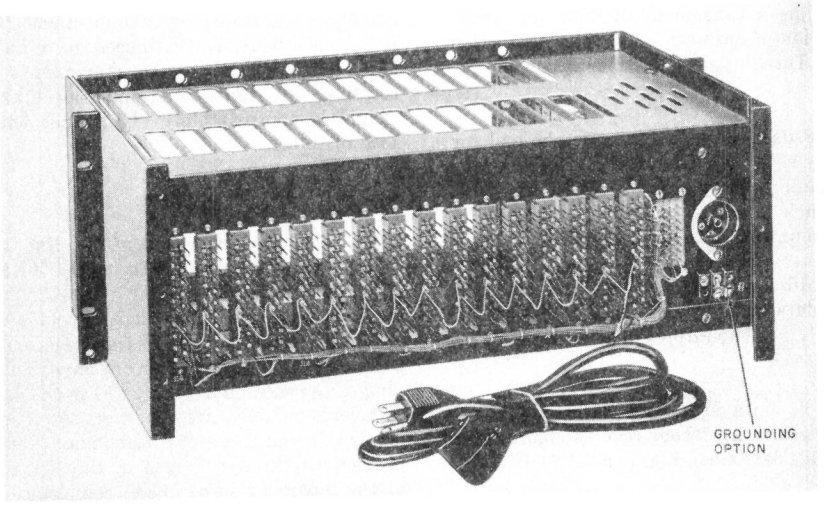


Fig. 2—Rear View of 39A1 Data Mounting

sets are secured in the mounting by a retaining bar assembly which also serves as a labeling strip.

2.05 The 40B1 data mounting measures approximately 22.9 inches wide, 13.5 inches deep, and 7 inches high. The width may be shortened 4 inches by rotating the right-hand mounting bracket. The weight is approximately 20 pounds without data sets. As part of this data station, the 40B1 mounting is installed in a KS-20018-L11A or -L12A cabinet.

C. Power Supply

2.06 The power supply provided as part of the 39A1 or 40B1 data mounting converts 117 Vac into 24 Vac for use by the data sets. The ac power to each pair of data sets is separately fused, as is the line side of the power supply. The fuses are accessible from the front of the mounting, and spare fuses are provided beneath the main power fuse. The power requirement of a data mounting containing 16 data sets is approximately 80 watts at 105 to 129 volts ac. This is equivalent to approximately 270 BTUs per hour.

2.07 The 39A1 data mounting is furnished with a 4-foot 117-Vac power cord which terminates in a Twist-lock connector. The cord may be readily replaced with one of a different length as required. The power cord provided with the 40B1 data mounting also terminates in a Twist-lock connector; however, it is more difficult to remove, since the backplane panels must be moved out of the way before the cord can be disconnected.

D. Cabinets

2.08 The cabinet intended for this data station is a KS-20018-L11A or -L12A. The KS-20018 cabinet is made of aluminum with a sandblasted finish and a rear cover of perforated black anodized aluminum. The front panel is tinted plastic, which allows the light emitting diode display on the data sets to be visible from the outside.

2.09 The KS-20018-L11A cabinet has a 2-inch louvered skirt which runs completely around the base of the cabinet. A 13-inch opening at the rear of the base allows cable to be run into or out of the cabinet. Four leveling bolts are provided with the skirt. The -L12A cabinet has four tapered circular legs equipped with rubber feet to prevent

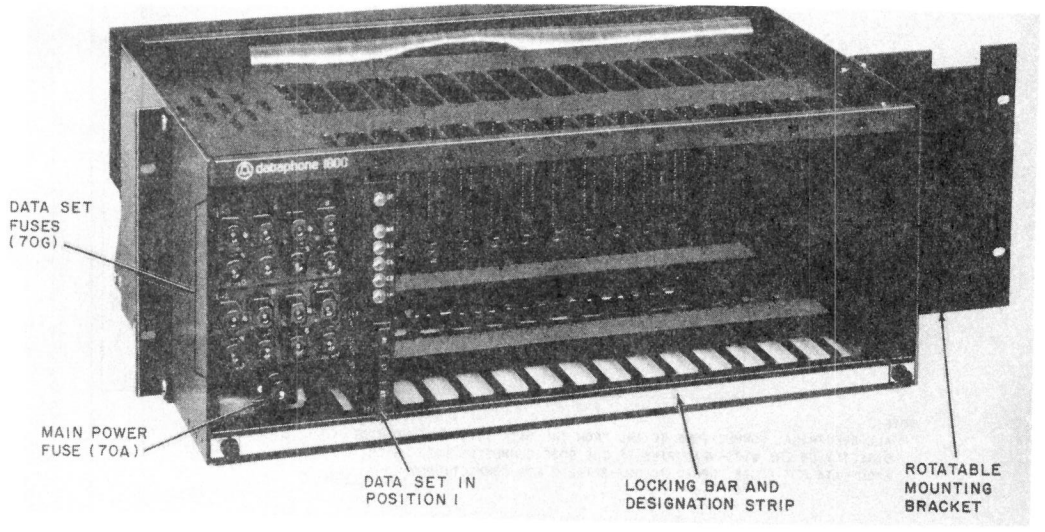


Fig. 3—Front View of 40B1 Data Mounting

slippage. Either cabinet may be secured to the floor by replacing the leveling bolts or legs with 1/4-20 bolts.

2.10 The front and rear panels are each held in place by spring-loaded latches. Either panel may be removed by pulling outward at the top until the latches disengage. Lift the panel up and away from the brackets holding the bottom in position.

2.11 The dimensions of the KS-20018-L11A and -L12A cabinets are as follows:

- L11A—30 inches high, 24 inches wide, and 19 inches deep
- L12A—24 inches high, 24 inches wide, and 19 inches deep.

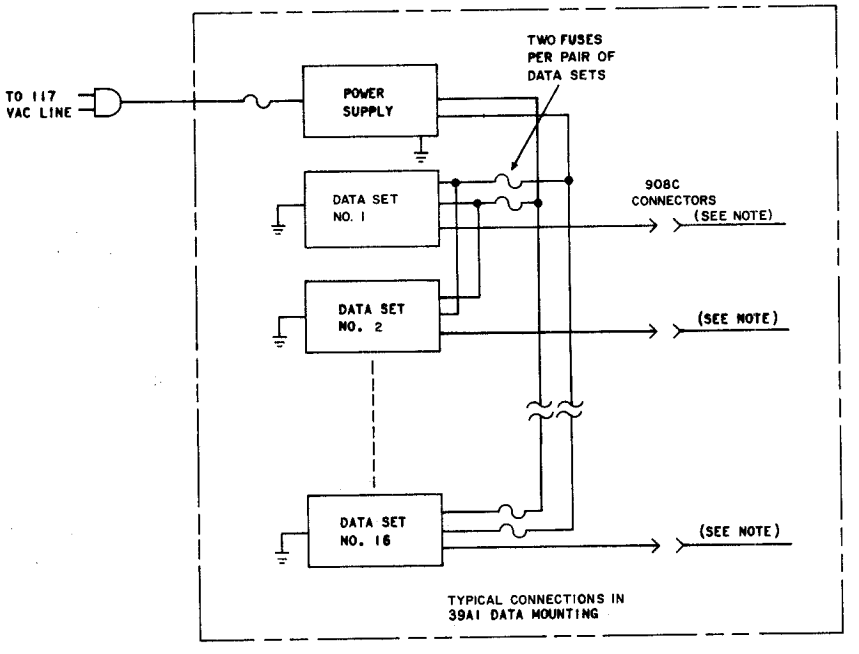
Refer to Section 590-010-201 for more information on KS-20018 cabinets.

3. FUNCTIONAL DESCRIPTION

3.01 This part covers the functions of the data mountings and the data station as a whole.

A. 39A1 Data Mounting

3.02 A block diagram of the 39A1 data mounting is shown in Fig. 4. The data sets plug into 908C connectors in the data mounting. Power from the 24-Vac supply is wired to each connector. All other electrical connections to and from the data sets must be made directly on the wire-wrap pins of the 908C connector. Refer to Section 592-861-200 for connection information.



NOTE:
ALL ELECTRICAL CONNECTIONS TO AND FROM THE DATA SETS MUST BE MADE DIRECTLY ON THE WIRE-WRAP PINS OF THE 908C CONNECTOR INTO WHICH EACH DATA SET PLUGS. REFER TO 592-861-200 FOR CONNECTIONS.

Fig. 4—Block Diagram of 39A1 Data Mounting

B. 40B1 Data Mounting

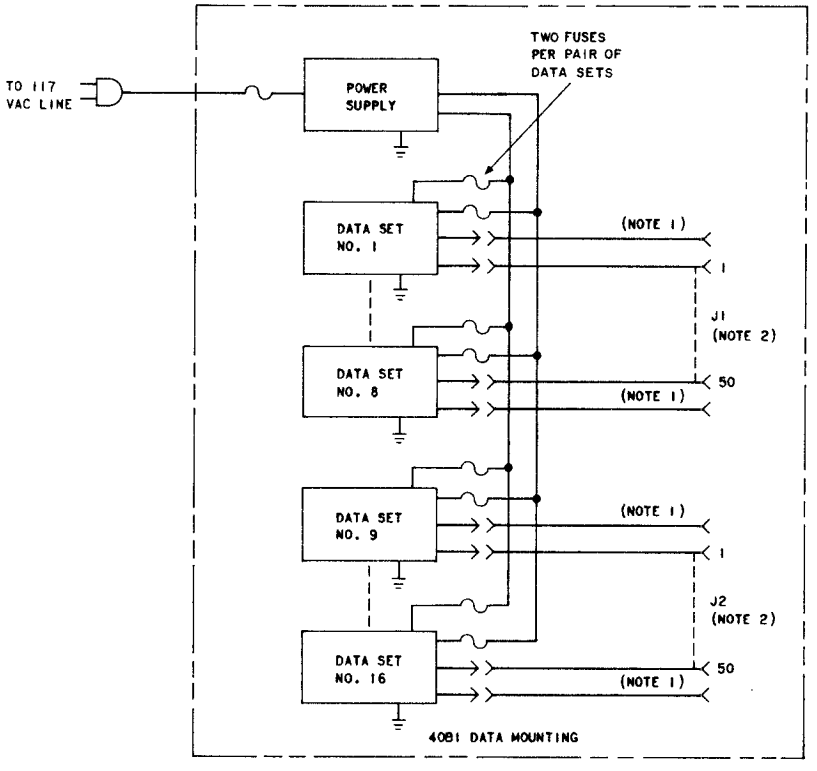
3.03 A block diagram of the 40B1 data mounting is shown in Fig. 5. The data sets plug into 908L connectors in the data mounting. A flexible printed wiring backplane connects the 908L connectors to connectors for telephone and customer equipment. Data sets in positions 1 through 8 appear on connector J1. Data sets in positions 9 through 16 appear on connector J2.

C. Data Station Used With DAS 828A-Type

3.04 The 40B1 data mounting used in a data station is shown in Fig. 6. This shows a data station with 3 data mountings and a maximum of 48 data sets. Each group of 16 data sets requires two B25A cables and two KS-21253-L2 adapters to connect to the data auxiliary set (DAS) 828A-type (if used). This station uses a KS-20018-L11A cabinet. A station composed of 2 data mountings and a maximum of 32 data sets will fit in a KS-20018-L12A cabinet. Refer to Section 592-861-200 for the equipment required for a data station and for instructions on assembling a data station.

D. Data Station Used With DAS 829-Type

3.05 The 40B1 data mounting used with DAS 829-type is shown in Fig. 7. This shows a



NOTES:
1. THIS IS A 25-PIN KS-19087-L6 CONNECTOR AND GOES TO CUSTOMER EQUIPMENT.
2. THIS IS A 50-PIN KS-16672-L13 CONNECTOR FOR CONNECTION TO TELCO EQUIPMENT.

Fig. 5—Block Diagram of 40B1 Data Mounting

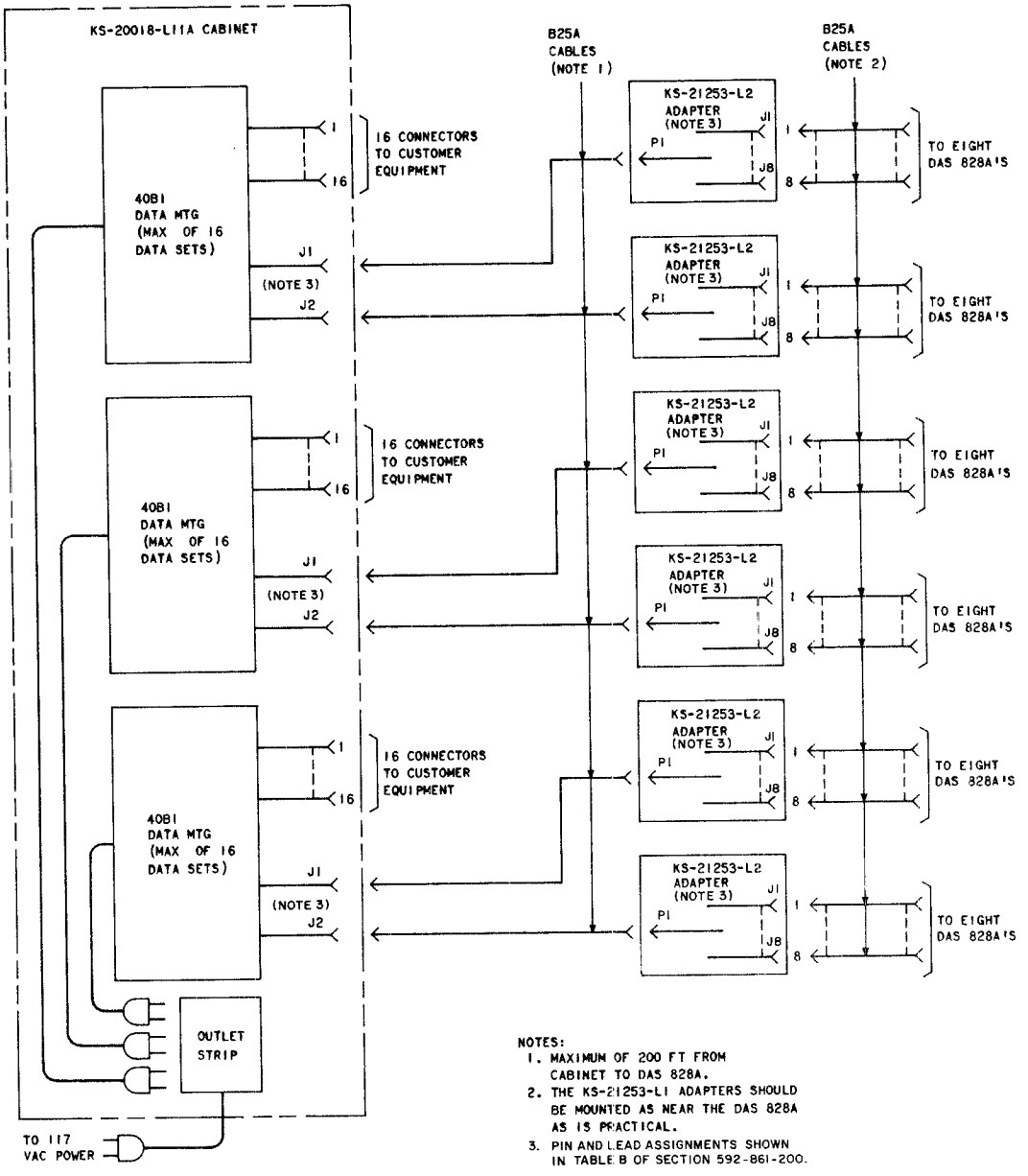


Fig. 6—Data Station Using DAS 828A-Type

data station with one 40B1 data mounting, 16 data sets, two 46A1 data mountings, and 16 DAS 829-type. This station will fit in the KS-20018-L11A cabinet.

4. OPERATION

4.01 In private line operation, the line facilities are dedicated between data set locations. With power applied, the data set is either in the data or test mode (or talk mode if alternate voice service is used). In the data mode, the data-set-ready (CC) circuit will be ***on,*** and transmission is initiated by the business machine by control of the request-to-send lead.

4.02 Data sets in the data station are used with DAS 828A-, 828C-, and 829-types on a one-for-one basis. Bell System Practices providing information on these sets are listed in Part 5.

4.03 DAS 828A provides standard, prewired, pretested arrangements for terminating

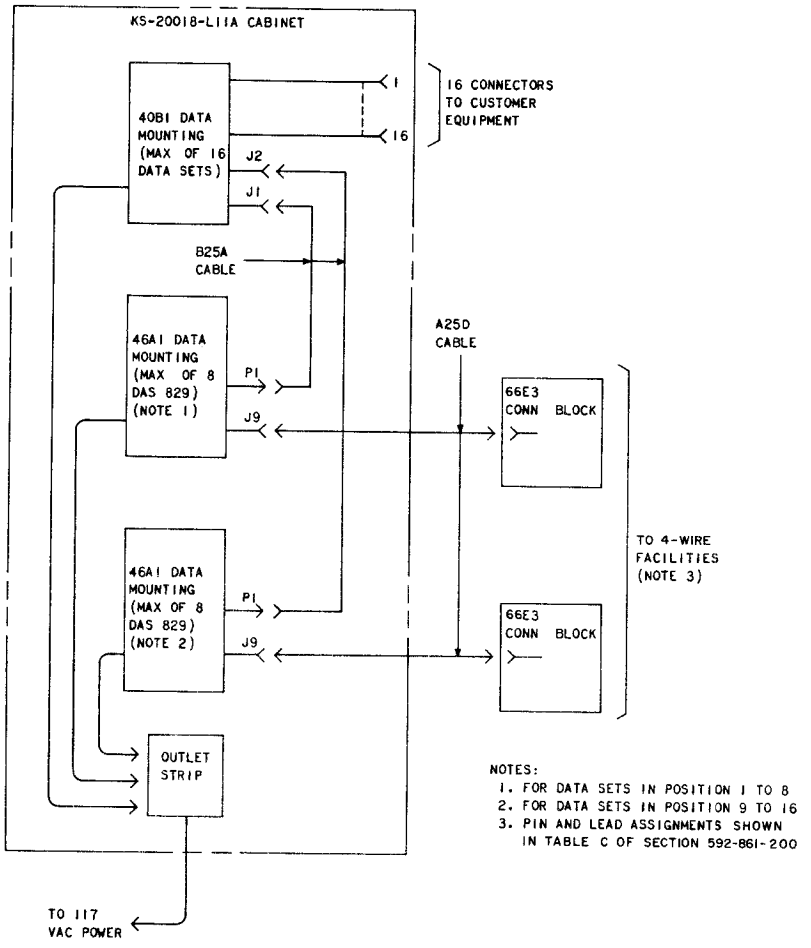


Fig. 7—Data Station Using DAS 829-Type

4-wire private line voiceband channels. DAS 828A is available for data use only or for data with alternate voice. When DAS 828C is used with DAS 828A, the data set can operate on private lines with switched network lines as backup.

4.04 DAS 829-type provides a standard means to terminate 4-wire private line voiceband data channels. With the addition of 48-type data units and 46-type data mountings, DAS 829-type provides private line termination with switched network lines as backup (data only or data/voice). Tone-activated loop-back is also provided. DAS 829-type is smaller in size and more suitable for use in multiple arrangements.

5. REFERENCES

5.01 The following Bell System Practices provide additional information concerning data set 202T and data stations using data set 202T.

SECTION	TITLE
590-010-201	Data Sets—Multiple Installation Information
590-102-114	Data Set 202T—Reference Guide
590-102-130	39A1 Data Mounting—Identification
590-102-131	40-Type Data Mounting—Identification
592-031-100	Data Set 202T Transmitter-Receiver—Description and Operation
592-031-180	Data Set 202T Transmitter-Receiver—Summarizing Specification
592-031-200	Data Set 202T Transmitter-Receiver—Installation and Connections
592-031-300	Data Set 202T Transmitter-Receiver—Maintenance
592-031-500	Data Set 202T Transmitter-Receiver—Test Procedures
592-861-200	Data Station Using Data Set 202T—Installation
592-861-300	Data Station Using Data Set 202T — Maintenance
598-080-100	Data Auxiliary Set 828A—Description and Operation
598-082-100	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Data Only—Description
598-082-101	Supplementary Functions for Voiceband Private Line Channels (Alternate Voice and Dial Backup)—Description
598-082-102	Multiple Channel Arrangements (Switched Dial Backup)—Description
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Data Testroom

DATA STATION USING DATA SET 202T
INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains instructions to be followed when installing and connecting a multiple arrangement of data sets 202T in a 39A1 (Fig. 1) or 40B1 (Fig. 2) data mounting. Refer to the section entitled Data Station Using Data Set 202T—Description and Operation (592-861-100) for a physical and functional description of these arrangements.

1.02 This section is reissued to:

- Correct Fig. 7
- Correct Table C
- Add Part 6—References.

1.03 The typical arrangements which can be installed and connected using this section are as follows:

(a) Up to 16 data sets in a 39A1 data mounting or 40B1 data mounting

(b) Up to 32 data sets in two 40B1 data mountings in a KS-20018-L12A cabinet

(c) Up to 48 data sets in three 40B1 data mountings in a KS-20018-L11A cabinet.

1.04 These arrangements require a standard 3-wire grounding-type power receptacle. The power furnished must be 105 to 129 volts, 57 to 63-Hz ac. The outlet must not be under control of a switch.

1.05 To minimize the possibility of data errors due to potential differences between the data sets and data terminal grounds, the power receptacle to the data mounting should be served from the same distribution panel as the receptacle for the data terminal.

1.06 Verify with the plant service center that the overall facilities meet transmission requirements specified in the section entitled Voice Bandwidth Private Line Data Circuits—Tests and Requirements (314-410-500).

1.07 Verify that the location selected by the customer for the KS-20018-L11A or -L12A cabinets is adequate for maintenance, with sufficient room provided for ventilation and to remove the covers and install and remove data sets and connector cords. In addition, locate the cabinet near enough to the business machine so that the customer-provided interface cord will not exceed 50 feet in length [to reduce stray capacitance and to conform to Electronic Industries Association (EIA) standards].

1.08 In order to minimize inductive interference with data signals, the telephone (data) line should not be carried in the same cable run as cable between the data set and business machine or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type SK (shielded) station wire between the data station and cable distribution terminal or building entrance. Ground the shield at one end only, preferably at the distribution terminal end.

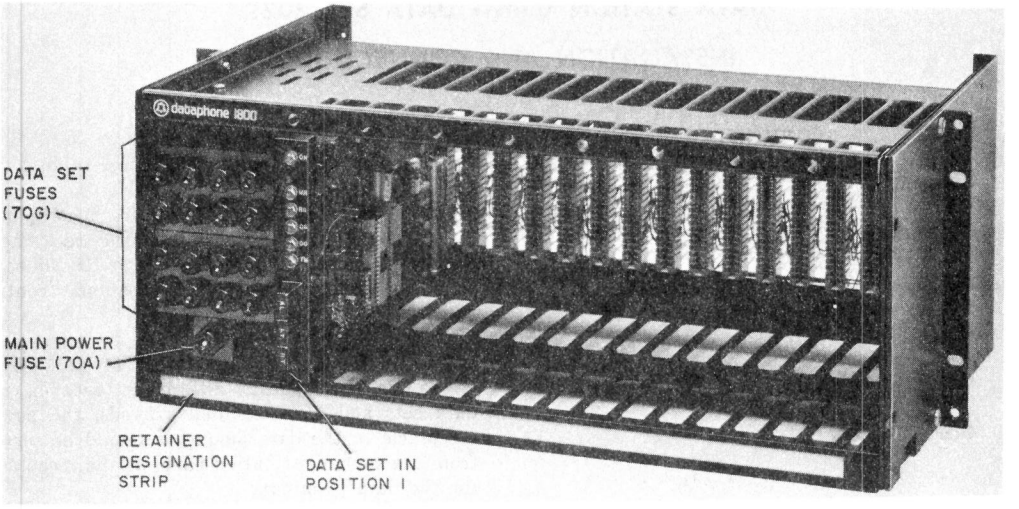


Fig. 1—Front View of 39A1 Data Mounting

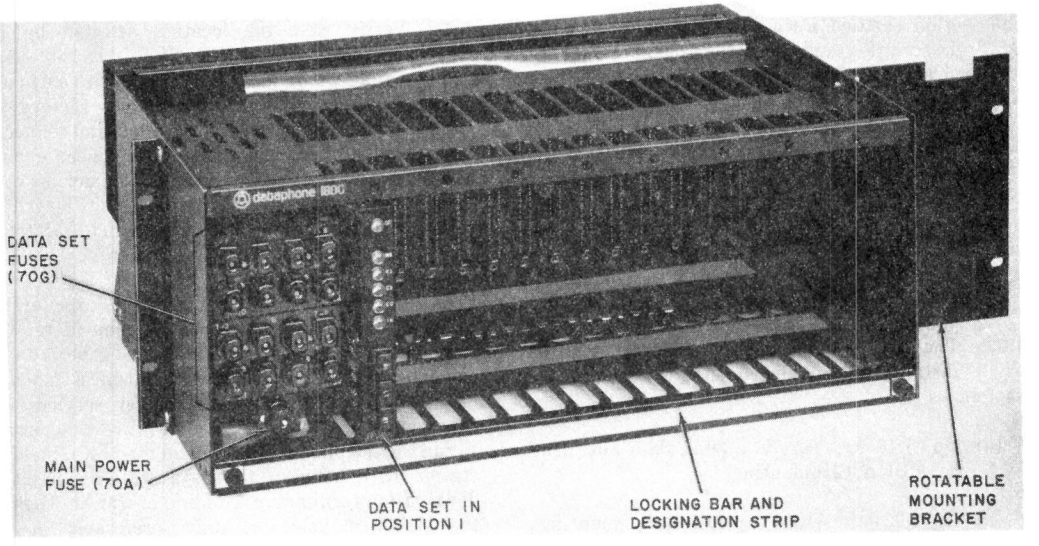


Fig. 2—Front View of 40B1 Data Mounting

1.09 The data station will operate in an ambient temperature between 40 and 120°F, and it is recommended that the temperature be kept between these limits if possible. The relative humidity should be 20 to 95 percent at 70°F or 20 to 40 percent at 120°F.

Caution: Under no condition shall condensation occur on the data set.

1.10 A KS-20018-L7 cabinet may be substituted for a KS-20018-L11A cabinet, provided that there is no requirement to see the indicators on the front of the data sets and the ambient temperature does not exceed 100°F. If higher ambient temperatures are expected, remove the rear panel of the KS-20018-L7 cabinet.

1.11 The data mounting is equipped with a main power fuse between the 117-Vac line and the power supply, and 16 fuses between the power supply and the data sets. Prior to installing the 39A1 or 40B1 data mounting, verify that the proper fuses are in place and are not blown. A blown fuse is indicated by the colored center pin protruding from the holder. Spare fuses are stored beneath the main power fuse.

1.12 Two data sets share each fuse. Each side of the low voltage, ac output is separately fused and is labeled "A" for one side and "B" for the other. For example, the fuses for data sets 1 and 2 are the fuses designated 1-2 on fuse block A and fuse block B. Remove the appropriate data sets from the data mounting if a fuse must be replaced.

1.13 The main power fuse is a 70A (1-1/3 amp—white). The data set fuses are 70G (1/2 amp—red).

2. OPTIONS

2.01 Data set options are described in the section entitled Data Set 202T Transmitter-Receiver —Description and Operation (591-031-100). Refer to the section entitled Data Set 202T Transmitter-Receiver—Installation and Connections (592-031-200) for information on installing and removing data set options.

2.02 The only option provided in the 39A1 or 40B1 data mounting is the frame ground connection to signal ground. This option is a strap near the power cord at the rear of the data mounting and should be installed unless requested otherwise by the user.

2.03 To access the frame ground option in the 40B1 data mounting, it will be necessary to loosen the EIA interface connector bracket on the backplane. Remove the two screws holding the bracket and swing it down from the top.

3. INSTALLATION PROCEDURES

3.01 This part contains information on assembling a data station consisting of data sets, data mountings and associated connecting blocks and cords.

A. 39A1 Data Mounting

3.02 The 39A1 data mounting can be installed in 19-inch or 23-inch uprights. Use four 12-24 by 1/2-inch (801743972) mounting screws (supplied) with the data mounting) to attach the mounting to the uprights. Make connections to the 39A1 data mounting according to Table A.

3.03 The width of the data mounting is approximately 19 inches. Therefore, to install the data mounting in a 23-inch relay rack, remove, rotate and fasten one mounting bracket to the data mounting (with the short side of the mounting bracket against the data mounting).

B. KS-20018 Cabinet

3.04 Position the cabinet in its permanent location and adjust the four leveling bolts until the cabinet is level. Tighten the locking nuts on the bolts. If the cabinet must be secured to the floor, remove the leveling bolts. Insert four 1/4-inch bolts through the 3/8-inch holes in the base of the cabinet, through the leveling bolt holes, and into the floor.

C. 79 Backboard

3.05 The KS-20018-L12A cabinet may be equipped with one 79 backboard, while a KS-20018-L11A may be equipped with two. The backboard is used to mount the power outlet strip (if used) and as a fastening point for the various cables. Drill the 79 backboard in accordance with dimensions given in Fig. 3.

TABLE A

908C CONNECTOR PIN ASSIGNMENT
ON 39A1 DATA MOUNTING

PIN	LEAD	NOTE	PIN	LEAD	NOTE
1	—	3	21	SCA	1
2	BA	1	22	—	3
3	BB	1	23	—	3
4	CA	1	24	SCF	1
5	CB	1	25	CR	1
6	CC	1	26	—P	3
7	AB	1	27	+P	3
8	CF	1	28	—	3
9	—	3	29	—	3
10	—	3	30	AC1	2
11	—	3	31	GRD	2
12	—	3	32	AC2	2
13	—	3	33	DR	4
14	—	3	34	DT	4
15	—	3	35	—	3
16	—	3	36	—	3
17	—	3	37	TEK6	4
18	—	3	38	TEK5	4
19	DR1	4	39	—	3
20	DT1	4	40	—	3

Note 1: To data terminal equipment.

Note 2: From power supply in 39A1 data mounting. These leads are already connected.

Note 3: No connection.

Note 4: To telephone channel.

3.06 Fasten the 79 backboard(s) to the rear flange of the right-hand upright in the cabinet with three No. 12-24 by 1-1/4 inch long screws (furnished with the data mounting).

D. 40B1 Data Mounting

3.07 The 40B1 data mounting can be installed in 19-inch or 23-inch uprights. KS-20018-L11A or -L12A cabinets are available to permit a stand-alone data station. Use four 12-24 by 1/2-inch (801743972) mounting screws (supplied with the data mounting) to attach the mounting to the upright columns in the cabinet. The width of the data mounting is approximately 23 inches. Therefore, if it is necessary to install the data mounting in a 19-inch space, remove, rotate, and fasten one mounting bracket to the data mounting (long side of mounting bracket against data mounting). Refer to Fig. 3 and 4 for a typical installation of 40B1 data mountings in a KS-20018 cabinet.

E. Data Sets

3.08 Prior to inserting data sets in the data mounting, install options called for on the service order. To insert the data sets into the mounting, first remove the designation/retainer strip by pulling out on the black knob at each end. After the strip is moved out of the way, the data sets can be inserted into appropriate slots and pressed firmly into place. Replace the designation/retainer strip.

4. CONNECTIONS

4.01 This part contains connector information for the data station consisting of data sets 202T in a 39A1 or 40B1 data mounting. For all connections to the 39A1 data mounting, refer to Table A. Figure 5 shows pins locations on the 908C connector which is used with the 39A1 data mounting.

4.02 Refer to Fig. 6 for a connection diagram of the data station used with data auxiliary set (DAS) 828A. Table B provides pin and lead assignments for the cables shown in Fig. 6.

4.03 Refer to Fig. 7 for a connecting diagram of the data station used with DAS 829-type. Table C provides pin and lead assignments for the cables shown in Fig. 7.

Note: This is a plug-together installation. The information contained in Table B or C will not be required in a standard installation.

5. INSTALLATION TESTS

5.01 When the data sets have been installed in the data station, they should be tested as directed in the section entitled Data Set 202T Transmitter-Receiver — Test Procedures (592-031-500). The tests for an individually housed data set are the same as for the data station, with the following exceptions.

- The data sets in a 39A1 or 40B1 mounting have a common power supply. If more than

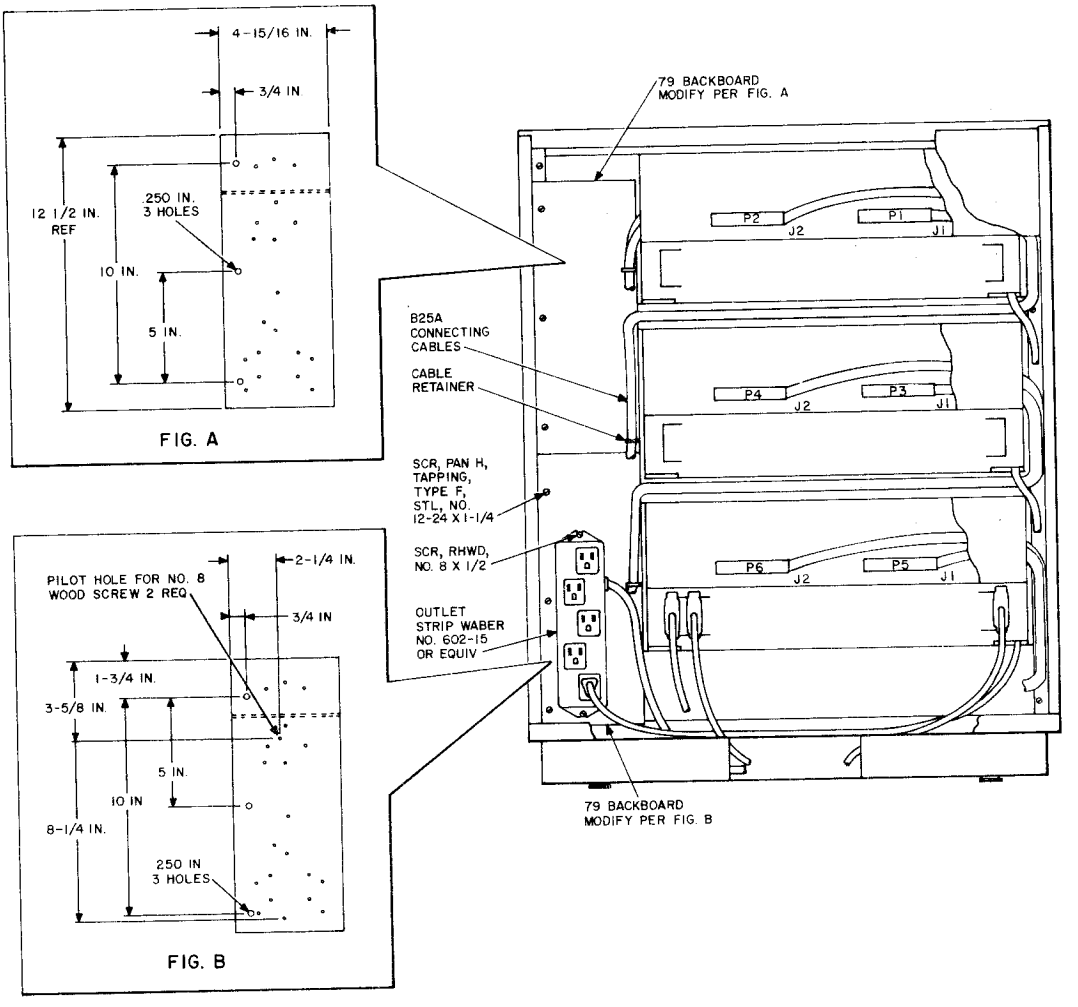


Fig. 3—Rear View of Data Station

one data set in a mounting has a power-related trouble, the power supply should be investigated.

- The frame ground (AA) lead is not brought out on customer interface pin 1 when a data set is plugged into the mounting. Therefore, a normal ground noise test cannot be made as directed in Section 592-031-500. If ground noise is suspected, the test should be performed between the actual frame of the data mounting and frame ground of the customer-provided equipment.

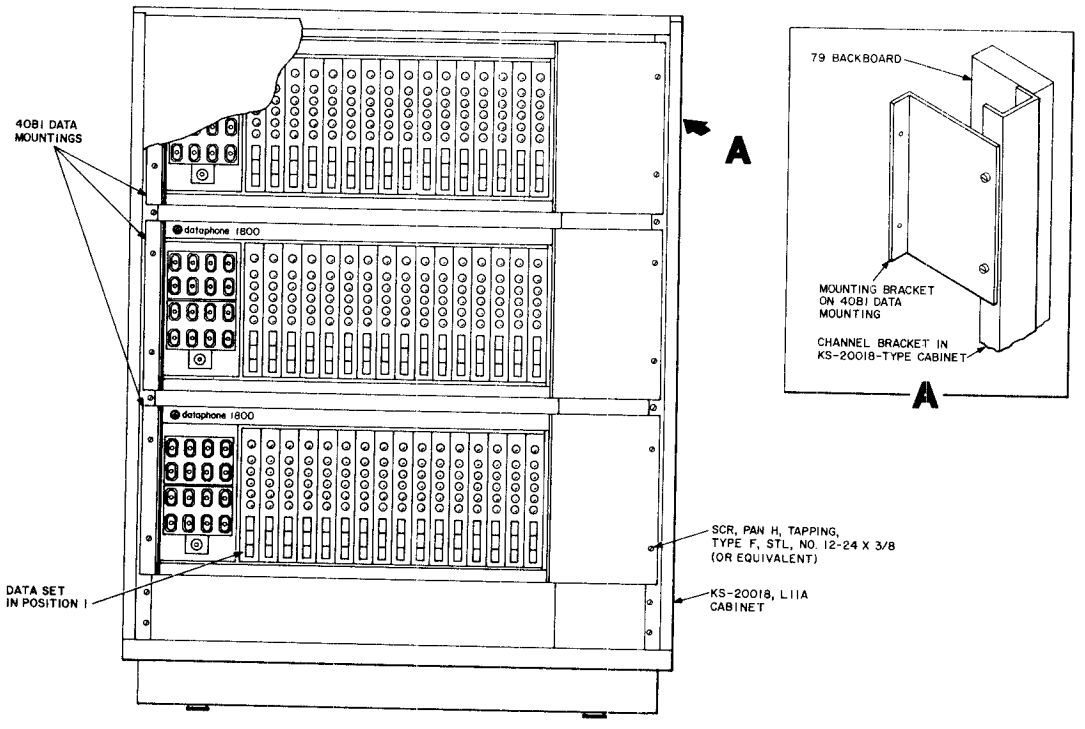


Fig. 4—Front View of Data Station

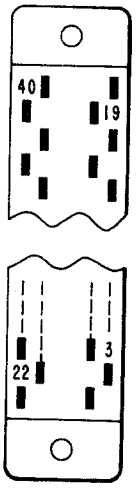


Fig. 5—Pin Location on 908C Connector

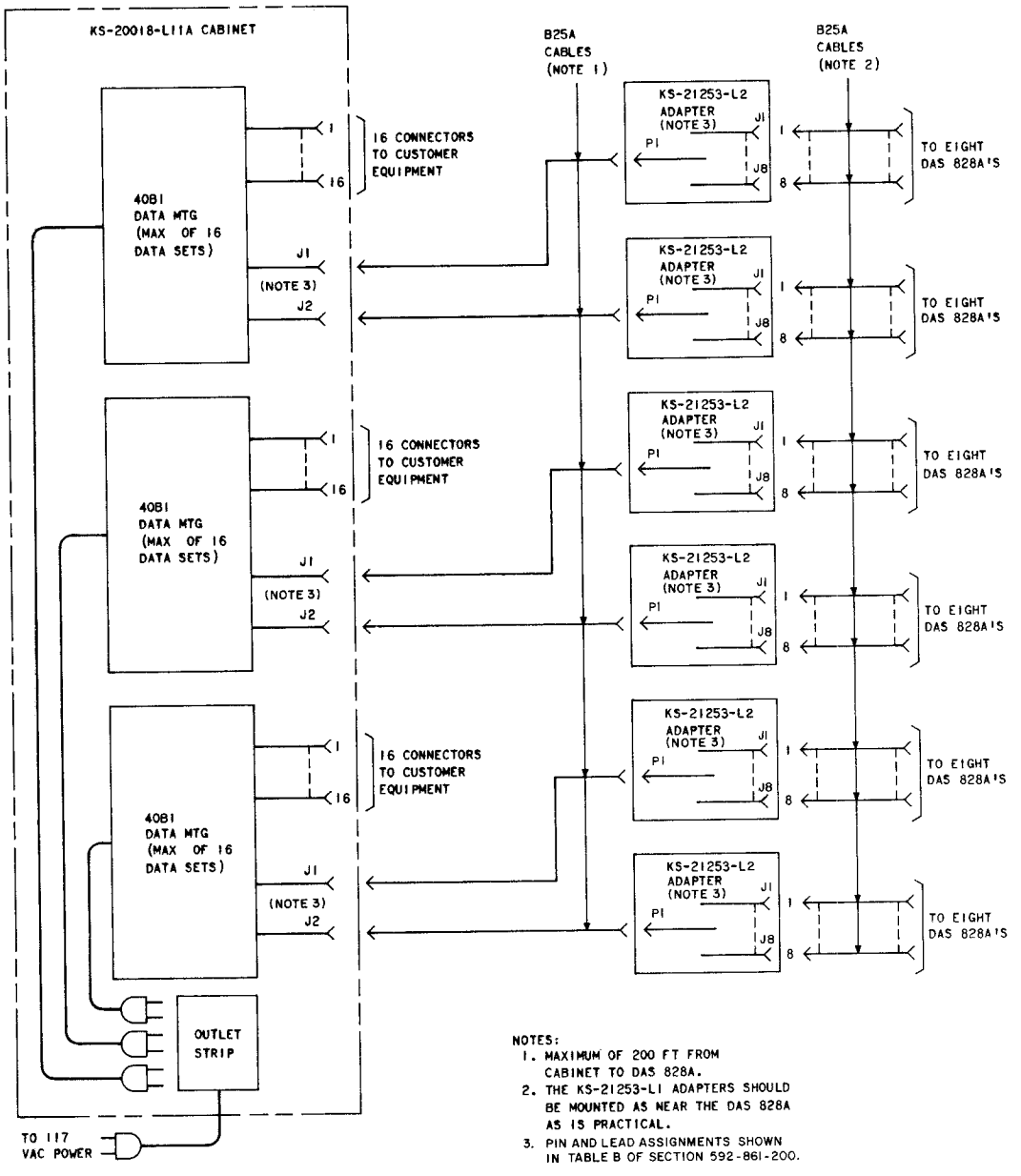


Fig. 6—Data Station Using DAS 828A

TABLE B

PIN AND LEAD ASSIGNMENTS FOR CONNECTORS
AND CABLES IN 202T DATA STATION
USING DAS 828-TYPE

B25A CABLE COLOR	40B1 J1 PIN NO.	PIN DESIG	KS-21253-L2 ADAPTER		40B1 J2 PIN NO.	PIN DESIG	KS-2153-L2 ADAPTER	
			P1 PIN NO.	J-CONN			P1 PIN NO.	J-CONN
BL-W	1	DR (1)	1	5-J1	1	DR (9)	1	5-J1
O-W	2	DR1 (1)	2	4-J1	2	DR1 (9)	2	4-J1
G-W	3	TEK5 (1)	3	3-J1	3	TEK5 (9)	3	3-J1
BR-W	4	DR (2)	4	5-J2	4	DR (10)	4	5-J2
S-W	5	DR1 (2)	5	4-J2	5	DR1 (10)	5	4-J2
BL-R	6	TEK5 (2)	6	3-J2	6	TEK5 (10)	6	3-J2
O-R	7	DR (3)	7	5-J3	7	DR (11)	7	5-J3
G-R	8	DR1 (3)	8	4-J3	8	DR1 (11)	8	4-J3
BR-R	9	TEK5 (3)	9	3-J3	9	TEK5 (11)	9	3-J3
S-R	10	DR (4)	10	5-J4	10	DR (12)	10	5-J4
BL-BK	11	DR1 (4)	11	4-J4	11	DR1 (12)	11	4-J4
O-BK	12	TEK5 (4)	12	3-J4	12	TEK5 (12)	12	3-J4
G-BK	13	DR (5)	13	5-J5	13	DR (13)	13	5-J5
BR-BK	14	DR1 (5)	14	4-J5	14	DR1 (13)	14	4-J5
S-BK	15	TEK5 (5)	15	3-J5	15	TEK5 (13)	15	3-J5
BL-Y	16	DR (6)	16	5-J6	16	DR (14)	16	5-J6
O-Y	17	DR1 (6)	17	4-J6	17	DR1 (14)	17	4-J6
G-Y	18	TEK5 (6)	18	3-J6	18	TEK5 (14)	18	3-J6
BR-Y	19	DR (7)	19	5-J7	19	DR (15)	19	5-J7
S-Y	20	DR1 (7)	20	4-J7	20	DR1 (15)	20	4-J7
BL-V	21	TEK5 (7)	21	3-J7	21	TEK5 (15)	21	3-J7
O-V	22	DR (8)	22	5-J8	22	DR (16)	22	5-J8
G-V	23	DR1 (8)	23	4-J8	23	DR1 (16)	23	4-J8
BR-V	24	TEK5 (8)	24	3-J8	24	TEK5 (16)	24	3-J8
S-V	25	—	25	—	25	—	25	—
W-B	26	DT (1)	26	30-J1	26	DT (9)	26	30-J1
W-O	27	DT1 (1)	27	29-J1	27	DT1 (9)	27	29-J1
W-G	28	TEK6 (1)	28	28-J1	28	TEK6 (9)	28	28-J1
W-BR	29	DT (2)	29	30-J2	29	DT (10)	29	30-J2
W-S	30	DT1 (2)	30	29-J2	30	DT1 (10)	30	29-J2
R-BL	31	TEK6 (2)	31	28-J2	31	TEK6 (10)	31	28-J2
R-O	32	DT (3)	32	30-J3	32	DT (11)	32	30-J3
R-G	33	DT1 (3)	33	29-J3	33	DT1 (11)	33	29-J3
R-BR	34	TEK6 (3)	34	28-J3	34	TEK6 (11)	34	28-J3
R-S	35	DT (4)	35	30-J4	35	DT (12)	35	30-J4

TABLE B (Cont)

PIN AND LEAD ASSIGNMENTS FOR CONNECTORS
AND CABLES IN 202T DATA STATION
USING DAS 828-TYPE

B25A CABLE COLOR	40B1 J1 PIN NO.	PIN DESIG	KS-21253-L2 ADAPTER		40B1 J2 PIN NO.	PIN DESIG	KS-21253-L2 ADAPTER	
			P1 PIN NO.	J-CONN			P1 PIN NO.	J-CONN
BK-BL	36	DT1 (4)	36	29-J4	36	DT1 (12)	36	29-J4
BK-O	37	TEK6 (4)	37	28-J4	37	TEK6 (12)	37	28-J4
BK-G	38	DT (5)	38	30-J5	38	DT (13)	38	30-J5
BK-BR	39	DT1 (5)	39	29-J5	39	DT1 (13)	39	29-J5
BK-S	40	TEK6 (5)	40	28-J5	40	TEK6 (13)	40	28-J5
Y-BL	41	DT (6)	41	30-J6	41	DT (14)	41	30-J6
Y-O	42	DT1 (6)	42	29-J6	42	DT1 (14)	42	29-J6
Y-G	43	TEK6 (6)	43	28-J6	43	TEK6 (14)	43	28-J6
Y-BR	44	DT (7)	44	30-J7	44	DT (15)	44	30-J7
Y-S	45	DT1 (7)	45	29-J7	45	DT1 (15)	45	29-J7
V-BL	46	TEK6 (7)	46	28-J7	46	TEK6 (15)	46	28-J7
V-O	47	DT (8)	47	30-J8	47	DT (16)	47	30-J8
V-G	48	DT1 (8)	48	29-J8	48	DT1 (16)	48	29-J8
V-BR	49	TEK6 (8)	49	28-J8	49	TEK6 (16)	49	28-J8
V-S	50	—	50	—	50	—	50	—

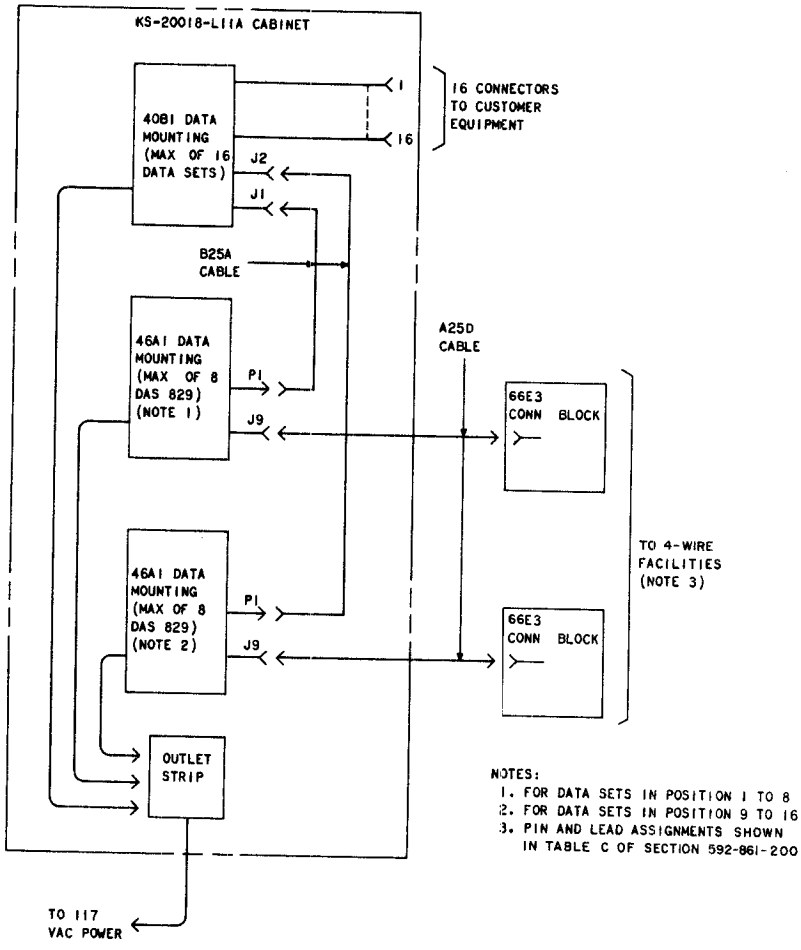


Fig. 7—Data Station Using DAS 829-Type

▶ TABLE C ◀

CONNECTION FROM CENTRAL OFFICE TO 66E3 CONNECTOR BLOCK

TELCO CONN ON 66E3 BLOCK	LEAD DESIGNATION	DAS 829 POSITION NUMBER
1	T	1
2	R	1
3	T1	1
4	R1	1
7	T	2
8	R	2
9	T1	2
10	R1	2
13	T	3
14	R	3
15	T1	3
16	R1	3
19	T	4
20	R	4
21	T1	4
22	R1	4
25	T	5
26	R	5
27	T1	5
28	R1	5
31	T	6
32	R	6
33	T1	6
34	R1	6
37	T	7
38	R	7
39	T1	7
40	R1	7
43	T	8
44	R	8
45	T1	8
46	R1	8

6. ▶REFERENCES◀

6.01 ▶The following Bell System Practices provide additional information concerning data set 202T and data stations using data set 202T.

SECTION	TITLE
590-010-201	Data Sets—Multiple Installation Information
590-102-114	Data Set 202T—Reference Guide
590-102-130	39A1 Data Mounting—Identification
590-102-131	40-Type Data Mounting—Identification
592-031-100	Data Set 202T Transmitter-Receiver — Description and Operation
592-031-180	Data Set 202T Transmitter-Receiver — Summarizing Specification
592-031-200	Data Set 202T Transmitter-Receiver — Installation and Connections
592-031-300	Data Set 202T Transmitter-Receiver — Maintenance
592-031-500	Data Set 202T Transmitter-Receiver — Test Procedures
592-861-100	Data Station Using Data Set 202T — Description and Operation
598-080-100	Data Auxiliary Set 828A — Description and Operation
598-080-101	Data Auxiliary Set 828C — Description and Operation
598-082-100	Data Auxiliary Set 829-Type Channel Interface Units — Voiceband Private Line Channels — Data Only — Description
598-082-101	Supplementary Functions for Voiceband Private Line Channels (Alternate Voice and Dial Backup)—Description
598-082-102	Multiple Channel Arrangements (Switched Dial Backup)—Description
666-511-502	Test of Data Services Provided by Data Set 202T From a Private Line Data Testroom◀

DATA STATION
USING DATA SET 202T
TEST PROCEDURES

1. GENERAL

1.01 This section contains information on testing data sets 202T when they are installed in 39A1 or 40B1 data mountings. This type of installation will be referred to in this section as a 202T data station. The information in this section supplements Section 592-031-500.

1.02 Installation and maintenance tests for data sets in a 202T data station are the same as for data sets 202T in individual housings. Refer to Section 592-031-500 for these procedures. For procedures to be followed when investigating a trouble report, refer to Section 592-031-300.

1.03 The data sets in a 39A1 or 40B1 data mounting have a common power supply. If more than one data set in a mounting has a power-related trouble, the power supply should be investigated. If the power supply is defective, the mounting must be replaced.

1.06 The frame ground (AA) lead is not brought out on customer interface pin 1 when data set is plugged into the mounting. Therefore, a ground noise test cannot be made as directed in Section 592-031-500. If ground noise is suspected, conduct a ground noise test as directed in 2.01 through 2.03.

2. TEST PROCEDURE

A. Ground Noise Test

2.01 If the data set and business machine are not at the same ground potential, errors may be caused by a potential difference between data set ground and business machine ground. To detect the presence of noise potentials, a test should be made using the 6H impulse counter.

> ***Note:*** For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J95006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A inpulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

2.02 The 6H impulse counter is connected and the test is performed as follows:

(1) Use a 2W6A test cord or equivalent (310 plug on one end, alligator clips connected to tip and ring on the other end). Connect the 914-type DTS connector A to the customer connector on the data set mounted in the 40B1 data mounting. The 39A1 data mounting does not have a customer connector. Connect the 914-type DTS connector B to the data set connector on the business machine. This test assumes that protective ground from the business machine appears at the customer interface on pin 1.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1B and the other clip to any clean, bare metal point on the data mounting. Verify that power is applied to the data set and business machine.

> ***Note:*** A clip lead may be needed to extend one of the 2W6A cord leads into the cabinet.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elaspsed, record the number of indications on the counter.

(8) Remove the clips of the 2W6A cord from switch and the frame of the data mounting.

(9) Connect one of the clips to switch 7A and the other clip to switch 7B (on the 914-type DTS) if the 40B1 data mounting is used. If the 39A1 data mounting is used, connect one clip to pin 7 on the 908C connector (at the rear of the mounting) and the other clip to switch 7B on the 914-type DTS.

(10) Reset the counter on the 6H impulse counter to 0.

(11) Position the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

2.03 At the end of both the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

3. REFERENCES

3.01 The following documents may be referred to for information needed to maintain or test Data Set 202T, 39A1 and 40B1 data mountings.

SECTION	TITLE
666-511-502	Test of Data Services Provided by Data Set 202T from a Private Line Test Room
592-031-300	Data Set 202T Transmitter-Receiver—Maintenance
592-031-500	Data Set 202T Transmitter-Recevier—Test Procedures
592-861-300	Data Station Using Data Set 202T—Maintenance

DATA SET 208A-TYPE
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains physical and functional descriptions and operating procedures for data set (DS) 208A-type. More detailed information pertaining to DS 208A-type is contained in Section 592-027-150.

1.02 This section is reissued to add information pertaining to DS 208A-L1B.

1.03 ▶DS 208A-L1 and DS 208A-L1A are rated manufacture discontinued (MD). They are replaced by DS 208A-L1B (Fig. 1) which provides all the features of DS 208A-L1A and is electrically, but not physically, identical to DS 208A-L1A. Three circuit packs (CPs) contained in DS 208A-L1A have been consolidated into one CP for DS 208A-L1B. This CP utilizes large scale integration (LSI) technology and provides a more simplified data set. DS 208A-L1A cannot be converted to a DS 208A-L1B because of backplane wiring differences. Refer to Part 2 of this section for detailed CP information.◀

1.04 Data sets 208A-L1A and 208A-L1B have self-test capabilities that make possible data set and data channel tests without external test equipment. DS 208A-L1 (Fig. 2) may be converted to DS 208A-L1A by removing CP HG9 and replacing it with CP HG23. This CP requires a different front cover (840807655) for the data set.

1.05 The following is a technical specification summary for DS 208A-type.

Data rate: 4800 bps

Modulation: Phase shift keyed

Operation: Synchronous

Line requirements: Basic 3002-type channel

Interface voltages: Per EIA RS-232-C

Transmitter output level: 0 dBm

Receiver input level: -16 dBm

Line impedance: 600 ohms

Operating modes: Half duplex or duplex

Clocking: Internal or external.

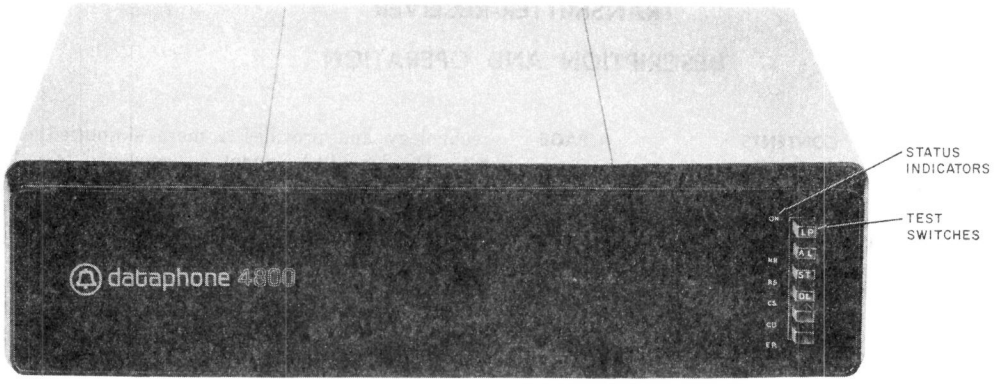


Fig. 1—Front View of DS 208-L1A or DS 208A-L1B

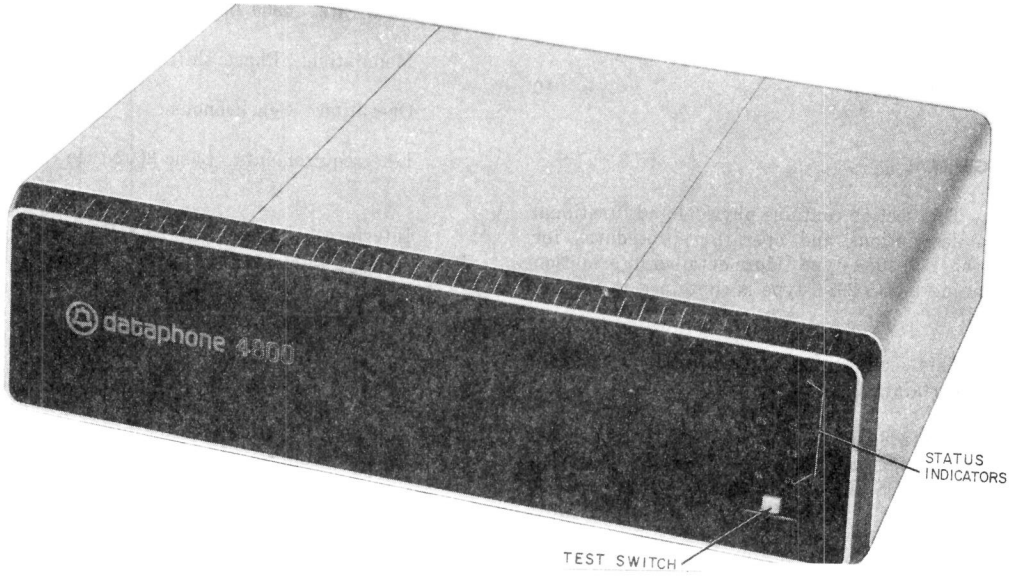


Fig. 2—Front View of DS 208A-L1

2. DESCRIPTION

PHYSICAL DESCRIPTION

2.01 DS 208A-type consists of a transmitter, receiver, and control circuits mounted on plug-in circuit boards. The exterior of the data set consists of front and rear molded black plastic covers mounted on an extruded aluminum housing. The extrusion has a brushed finish. The overall dimensions of the data set are approximately 16 inches across the front, 4-1/4 inches high, and 11-1/2 inches deep. The weight is approximately 20 pounds.

2.02 The data set is designed for shelf or desk-top installation, while mounting brackets (D180556) are available for mounting in a 19- or 23-inch relay rack.

2.03 ▶Using previously mentioned LSI circuitry, the transmitter and descrambler CP, coded HG26 for DS 208A-L1B, replaces CPs HG5, HG6, and HG17 which are used in DS 208A-L1 and DS 208A-L1A. A summary of the CPs contained in each DS 208A-type is given in Table A.

2.04 The functions of CP HG26 are electrically identical to the circuits that it replaces, but due to LSI, different terminal arrangements are required. For this reason, the backplane wiring in DS 208A-L1B is different from that of former DS 208A-types; therefore, CP HG26 is not compatible with other DS 208A-types.

2.05 DS 208A-L1B utilizes the same housing and 83A power unit as previous DS 208A-types. DS 208A-L1B is line compatible with all DS 208A types and operation is identical to DS 208A-L1A.◀

2.06 DS 208A-type has two interface connectors and a power cord connector at the rear of the set. The CUST INT connector is a KS-19087-L2 type and provides the digital interface leads for interface with the customer-provided equipment (CPE). The CPE must be equipped with a cable terminated in a Cinch or Cannon DB-19604-432 plug wired in accordance with Table B. The TEL INT connector is a KS-19088-L2 and provides the interface for connection to the 4-wire line termination via an M8K cord (or equivalent). The power cord connector is a twist-lock type to accept the KS-14532-L24 cord provided with the data set.

2.07 Data set power is provided by the internally mounted 83A power unit which provides +12, -12, +5, and -6 volts. The power unit requires 105- to 130-volts ac power at 57 to 63 Hz. Power consumption is approximately 26 watts. The power unit is provided with a self-resetting thermal overload switch that disables the power unit if the temperature rises excessively.

If for any reason the output voltages of the power unit rise excessively, the power unit will protect the data set from the overvoltage and the ON indicator will extinguish. When the cause of the overvoltage has been corrected and the power unit is operating normally, the power ON indicator will illuminate only after the data set power cord has been unplugged and plugged in again.

2.08 ▶Figure 3 shows a front view of DS 208A-L1A with the plastic cover removed, while Fig. 4 shows DS 208A-L1B.◀

2.09 The data set status indicators monitor the power unit, certain interface leads, and the test switch(es). The status indicators consist of light-emitting diodes (LEDs) which are visible through translucent designations located on the data set front cover. Refer to Table C for the status indicators present on DS 208A-L1. Refer to Table D for the status indicators present on data sets 208A-L1A and 208A-L1B.

2.10 DS 208A-L1 is provided with a 3-position loop-back test switch. In the center position, the switch allows data to proceed normally through the data set. In the digital loop-back (DL) position, the receiver is looped back to the transmitter at the customer interface. In the analog loop-back (AL) position, the transmitter is looped back to the receiver through an attenuator network on the line side. These test positions allow the data set to be tested remotely (digital loop-back) or locally (analog loop-back).

2.11 Data sets 208A-L1A and 208A-L1B are provided with four test switches which are accessible through the front cover. The switches are depress-to-operate and depress-to-release type with the exception of the LP (lamp test) switch,

→TABLE A←

CIRCUIT PACK COMPLEMENT FOR DS 208A-TYPE

DS 208A-L1 (MD)		DS 208A-L1A (MD)		DS 208A-L1B	
CIRCUIT PACK	SEE NOTE	CIRCUIT PACK	SEE NOTE	CIRCUIT PACK	SEE NOTE
HG2		HG2		HG2	
HG3		HG3		HG3	
HG4		HG4		HG4	
HG5 (A&M)		HG5 (A&M)		—	
HG6 (A&M)		HG6 (A&M)		—	
HG7		HG7		HG7	
HG8		HG8		HG8	
HG9 (MD)		—		—	
HG11		HG11		HG11	
HG12	1	HG12	1	HG12	1
HG13		HG13		HG13	
HG14 (MD)		HG14B	3	HG14B	3
HG15 (MD)		HG15B	3	HG15B	3
HG16 (MD)		HG16B	3	HG16B	3
HG17 (A&M)		HG17 (A&M)		—	
HG21	2	HG21		HG21	
—		HG23	4	HG23	4
—		—		HG26	5

Note 1: Two CPs HG12 are required in each data set.

Note 2: Early models of DS 208A-L1 may contain CP HG1.

Note 3: CPs HG14B, HG15B, and HG16B are direct replacements for CPs HG14, HG15, and HG16, respectively.

Note 4: CP HG9 is replaced by HG23 in DS 208A-L1A and DS 208A-L1B.

Note 5: CPs HG5, HG6, and HG17 are replaced by CP HG26 in DS 208A-L1B.

which is nonlocking. Test switch functions are as follows:

- ***LP (Lamp Test):*** This switch, when depressed, illuminates all status indicators with the exception of the ON indicator (which should be illuminated whenever power is applied to the data set). Depressing this switch does not affect data set operation. When the compromise equalizer test enabled option is temporarily installed during data set installation, depressing the LP switch, in addition to illuminating the LEDs, also shorts the transmitted line signal.

Note: The compromise equalizer test enabled option is ***only*** used during initial installation and should not be installed for normal operation.

- ***AL (Analog Loop-Back):*** This switch, when depressed, loops back the transmitter to the receiver through a channel simulator on the line side. This permits testing of the local data set with self-contained test

TABLE B

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
1	Frame Ground	FG	AA
2	Send Data	SD	BA
3	Receive Data	RD	BB
4	Request to Send	RS	CA
5	Clear to Send	CS	CB
6	Data Set Ready	DSR	CC
7	Signal Ground	SG	AB
8	Carrier On	COD	CF
9	+12V	CI9 (+12V)	Reserved for Data Set Testing
10	−12V	CI10 (−12V)	Reserved for Data Set Testing
11	Equalizer Mode	QM (Non-EIA)	Unassigned
14	New Sync	NS (Non-EIA)	SBA
15	Serial Clock Transmitter	SCT	DB
16	Divided Clock Transmitter	DCT (Non-EIA)	SBB
17	Serial Clock Receiver	SCR	DD
18	Divided Clock Receiver	DCR (Non-EIA)	Unassigned
21	Signal Quality Detector	COV	CG
24	Serial Clock Transmitter External	SCTE	DA
25	+5V	CI25 (+5V)	Unassigned

circuitry or with external test equipment through the customer interface.

- ***ST (Self-Test):*** This switch, when depressed, conditions the data set to transmit steady marks. The request-to-send interface lead is held ***on*** by this switch. The ER indicator blinks in response to the occurrence of errors in the received data. This indicator illuminates for approximately 100 ms whenever an error is detected.

- ***DL (Digital Loop-Back):*** This switch, when depressed, causes a loop-back at the data set customer interface. The received data (BB) lead is connected to the transmitted data (BA) lead; the serial clock receive (DD) lead is connected to the serial clock transmit external (DA) lead; and the signal quality detector (CG) lead is connected to the request-to-send (CA) lead. The data set functions as a regenerator. This permits testing of the facilities and both data sets

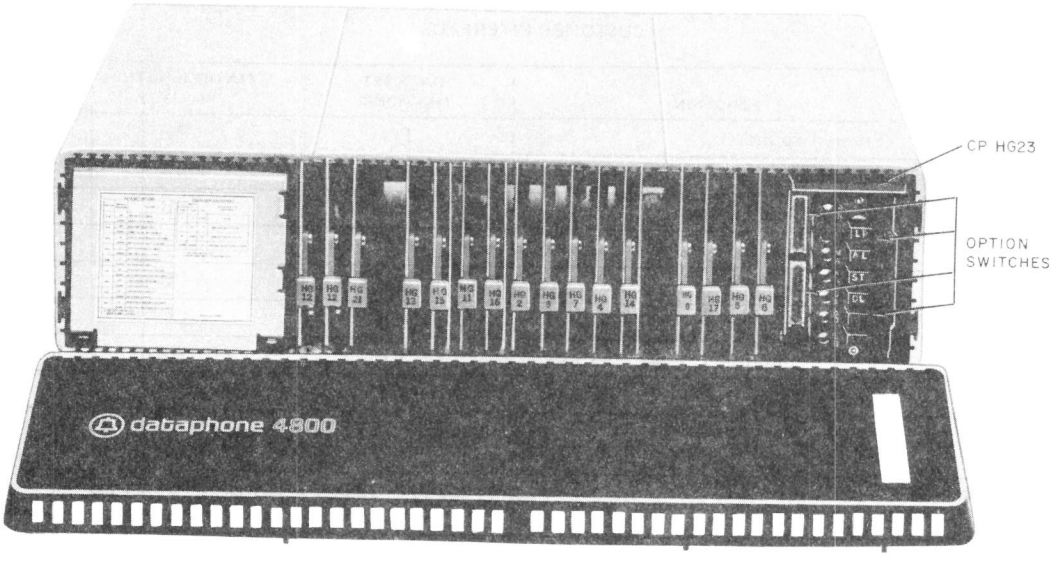


Fig. 3—DS 208A-L1A—Front View With Cover Removed

by self-contained test circuitry activated by the ST switch or with external test equipment through the data set interface.

Note: The DL and AL test switches should not be operated simultaneously.

FUNCTIONAL DESCRIPTION

2.12 This part contains information pertaining to data set test modes, interface leads, and options. Refer to Section 592-027-150 for a detailed functional description of the data set.

A. Test Modes

2.13 Data set 208A-type is equipped with two test features which enable the customer or Telco employee to test the data set in analog loop-back and digital loop-back modes.

- ***Analog Loop-Back:*** This test mode is entered by operating the AL switch on the data set. The CPE or external test equipment must be capable of duplex operation. If the CPE must have the data set ready lead ***on,*** DS 208A-L1A or 208A-L1B must be used and must have option YM installed (DSR ***on*** in AL mode). Test data is transmitted through the local data set, looped back at the telephone line interface, and received by the CPE from the local data set. There is a propagation delay of 7 ms within the data set. The analog loop-back is a test of the local data set and customer interface only and not the facilities or the remote data set.

- ***Digital Loop-Back:*** This test mode is entered by operating the DL switch located on the ***remote*** data set and conditioning the local CPE or external test equipment for duplex operation. Test data is transmitted by the ***local*** data set with the remote data set functioning as a regenerator. The digital loop-back is an inclusive test of the data sets and the channel facilities.

2.14 In addition to the preceding test modes, data sets 208A-L1A and 208A-L1B are equipped with two self tests which provide test capability independent of the CPE or external test equipment.

- ***Analog Loop-Back Self Test:*** This test mode is entered by depressing the AL and ST switches. This test allows the

TABLE C

STATUS INDICATORS ON DATA SET 208A-L1

INDICATOR	DESCRIPTION
ON	This indicator lights when the power cord is plugged into a nominal 117-Vac 60-Hz source and the power unit is operating normally.
RS	This indicator monitors the request-to-send lead and is lighted whenever that lead is in the *on* condition. When the data set is equipped for continuous request-to-send, the RS indicator is permanently lighted.
CS	This indicator monitors the clear-to-send lead and is lighted whenever that lead is in the *on* condition. This indicates that the data set is ready and will transmit the data present on the send data lead.
CO	This indicator monitors the carrier-on interface lead and is lighted whenever that lead is in the *on* condition. This indicates that the receiver has detected a signal which is within the data band.
ER	This indicator monitors the equalizer mode (QM) interface lead and is lighted whenever the CO indicator is off. During normal operation (CO indicator lighted) the ER indicator is lighted whenever the QM interface lead is in the *off* condition. This indicates marginal performance of the data set due to either excessive channel impairments or a faulty data set, and that the equalizer is retraining. Data on the receive data interface lead is not valid.
AL	This indicator monitors the test switch and is lighted whenever the data set test switch is placed in the analog loop-back test position.
DL	This indicator monitors the test switch and is lighted whenever the data set test switch is placed in the digital loop-back test position.

operation of the data set to be tested independently of options, connections to the telephone line interface, or customer interface. The AL switch disconnects the transmitter from the telephone line and loops the transmitter output back to the receiver through a channel simulator. The signal applied to the receiver is at a level of approximately -16 dBm. The ST switch causes the transmitter to transmit steady marks and conditions the ER lamp to flash when errors (spaces) are received.

- ***Digital Loop-Back Self Test:*** This test mode is entered by depressing the DL switch on the remote data set and depressing the ST switch on the local data set. Depressing the DL switch on the remote data set conditions the data set to disconnect the associated CPE and function as a regenerator. Depressing the ST switch on the local data set conditions the data set to transmit steady marks. The ER indicator flashes as errors (spaces) are received. This end-to-end self test allows inclusive testing of the data sets and channel facilities.

2.15 When DS 208A-type is used as an extension of a DS 209A-L1 multiplex system, refer to Section 592-032-200 for detailed information. Procedures used at the serving test center (STC) to maintain such systems are contained in Section 666-511-504.

2.16 When DS 208A-type is used as a subrate off-net extension of the digital data system, refer to Section 314-919-100 for more information. Procedures used at the hub office STC to maintain

TABLE D

STATUS INDICATORS ON DATA SET 208A-L1A AND DATA SET 208A-L1B

INDICATOR.	DESCRIPTION
ON	This indicator lights when the power cord is plugged into a nominal 117 Vac 60 Hz source and the power unit is operating normally.
MR	This indicator monitors the data set ready lead, and in normal operation, it is lighted whenever this lead is in the *on* condition. When DAS 828 or 829 is used and is in the test mode or when the data set is in the ST or DL test mode, the MR indicator is off. When the data set is in the AL mode, the MR indicator is extinguished except when the DSR-ON-in-AL-mode option is installed.
RS	This indicator monitors the request-to-send lead, and in normal operation, is lighted whenever the lead is in the *on* condition. When the data set is equipped for continuous request-to-send, the RS indicator is permanently lighted. It is also lighted when the data set is in the self-test mode.
CS	This indicator monitors the clear-to-send interface lead and is lighted whenever this lead is in the *on* condition. This indicates that the data set is ready and will transmit the data present on the send data lead.
CO	This indicator monitors the carrier-on interface lead and is lighted whenever this lead is in the *on* condition. This indicates that the receiver has detected a signal on the line which is in the data band.
ER	This indicator monitors the equalizer mode (QM) interface lead, and is lighted whenever the CO indicator is OFF. During normal operation (CO indicator lighted), the ER indicator is lighted whenever the QM interface lead is in the *off* condition. This indicates marginal performance of the data set due to either excessive channel impairments or a faulty data set, and that the automatic adaptive equalizer is retraining. During this time, data appearing on the receive data lead is not valid. In the self-test (ST) mode, the ER indicator is conditioned to momentarily light any time an error is detected.

the analog portion of such systems are contained in Section 666-511-503.

2.17 If the data set being used as a remote extension is DS 208A-L1A or 208A-L1B, the self-test features are restricted as follows:

(a) Analog loop-back self test cannot be performed (at a remote extension) with options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

(b) Digital loop-back test cannot be performed from a remote extension in toward the DS 208A-type collocated with DS 209A-L1 (with options as installed). If the internal timing option is temporarily installed at the remote extension, this test can be performed.

(c) Digital loop-back test cannot be performed from a remote extension in toward a hub office of the digital data system with data set options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

B. Customer Interface

2.18 The customer interface is accessible through the CUST INT connector at the rear of the data set. The connector pin numbers and the corresponding lead designations are shown in Table

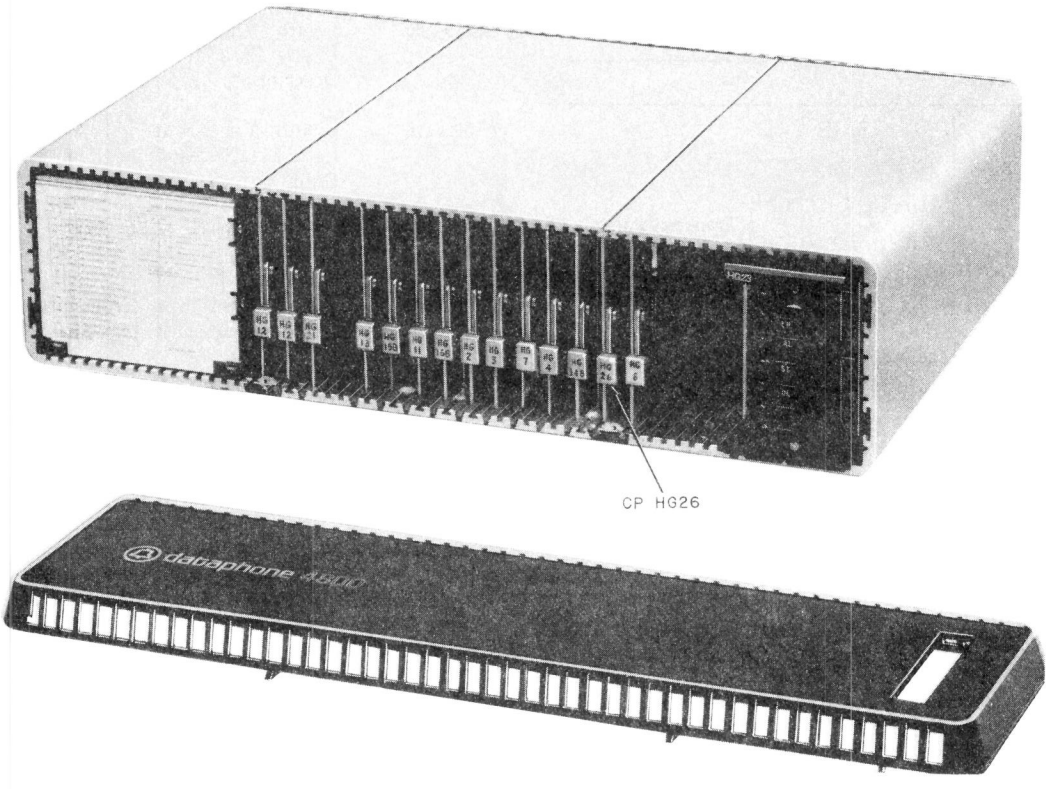


Fig. 4—DS 208A-L1B—Front View With Cover Removed

B. For a complete description of the interface leads, refer to Section 592-027-150.

C. Telephone Line Interface

2.19 The telephone line interface is accessible through the TEL INT connector at the rear of the data set. The connector pin numbers and the corresponding lead designations are shown in Table E.

D. Options

2.20 DS 208A-type is provided with a number of features or options which may be requested by the user. A detailed description of these options is given in Section 592-027-150 and 592-027-200. These options are added and removed by switches shown on Fig. 5. A summary of these options is given in the table associated with Fig. 5.

3. OPERATION

3.01 DS 208A-L1 is provided with a 3-position loop-back test switch.

- Operate the switch to the DL position to initiate a digital loop-back test.
- Operate the switch to the AL position to initiate an analog loop-back test.

TABLE E

TELEPHONE LINE INTERFACE LEADS

PIN NO.	DESCRIPTION
2	−12 volts dc
3	+5 volts dc
7	Data tip 1 (DT1) } Transmit Pair
8	Data ring 1 (DR1) } Transmit Pair
9	Data tip (DT) } Receive Pair
10	Data ring (DR) } Receive Pair
11	Digital ground
13	DSR control from line terminating units
20	+12 volts dc

- Operate the switch to the center position to allow data to proceed normally through the data set.

3.02 Data sets 208A-L1A and 208A-L1B are provided with four test switches.

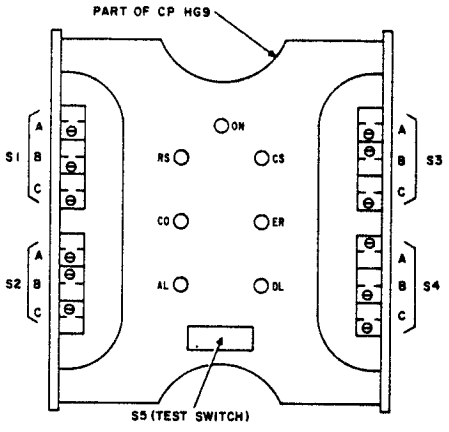
- Momentarily depress the LP switch to illuminate the status indicators for test purposes.
- Depress the DL switch to initiate a digital loop-back test.
- Depress the AL switch to initiate an analog loop-back test.
- Depress the AL and ST switches to initiate a self test of the local data set independent of external equipment.
- Depress the ST switch on the local data set and have the DL switch on the remote set depressed to initiate a self test of both data sets and the channel facility independent of external equipment.

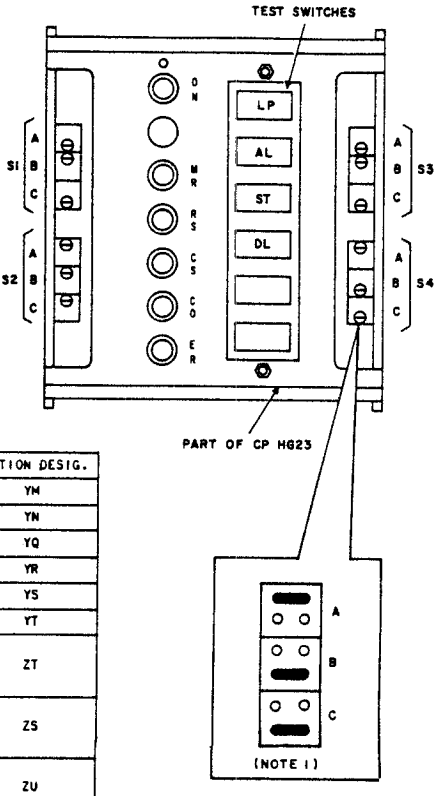
4. REFERENCES

4.01 Documents listed in this part contain information pertaining to DS 208A-type.

SECTION	TITLE
314-919-100	Digital Data System—Subrate Off-Net Extension Arrangements—Description
590-002-110	4800-Bit Per Second (BPS) Service Using Data Set 208-Type—Reference Guide
592-027-150	Data Set 208A-Type—Supplementary Information
592-027-180	Data Set 208A-Type—Transmitter-Receiver—SummarizingSpecification
592-027-200	Data Set 208A-Type—Transmitter-Receiver—Installation and Connections
592-027-300	Data Set 208A-Type—Transmitter-Receiver—Maintenance
592-027-400	Data Set 208A-Type—Transmitter-Receiver—Wiring Information
592-027-500	Data Set 208A-Type—Transmitter-Receiver—Test Procedures
592-027-501	Data Set 208A-Type—Transmitter -Receiver—Test Procedures Using 921A Data Test Set
592-032-200	Data Set 209A-L1—Transmitter-Receiver—Installation and Connections
592-032-300	Data Set 209A-L1—Transmitter-Receiver—Maintenance
666-511-503	Test of Data Services Provided by Data Set 208A-Type From a Private Line Test Room
666-511-504	Test of Data Services Provided by Data Set 209A-L1 from a Private Line Test Room
999-100-105	Data Set 208A-Type—How to Operate Manual

4.02 Detailed information pertaining to data set 208A-type is contained in CD- and SD-1D232-01.





DATA SET 208A-TYPE OPTIONS

FEATURE OR OPTION		SWITCH	SWITCH POSITION	OPTION DESIG.
DSR ON IN AL MODE		S1A (NOTE 5)	UP	YM
DSR OFF IN AL MODE			DOWN	YN
NO COMP EQUALIZER TEST		S1B (NOTE 5)	UP	YQ
COMP EQUALIZER TEST ENABLED (NOTE 7)			DOWN	YR
CONTINUOUS REQUEST-TO-SEND		S1C	UP	YS
SWITCHED REQUEST-TO-SEND			DOWN	YT
EQUALIZATION	NO EQUALIZATION	S2A, S2B, S2C (NOTE 2)	DOWN	ZT
	AMP AND DELAY (SYM) (NOTE 3)	S2A (NOTE 2) S2B S2C	UP UP	ZS
	AMP AND DELAY (HI END)	S2A S2B S2C	UP DOWN UP	ZU
	AMP AND DELAY (SYM + HI END)	S2A S2B S2C	DOWN DOWN UP	ZV
TRANSMIT EXTERNALLY TIMED		S3A	UP	YD
TRANSMIT INTERNALLY TIMED			DOWN	YC
RETRAIN AUTOMATICALLY (NOTE 4)		S3B	UP	YU
RETRAIN NOT USED			DOWN	YV
DAS IS USED		S3C	UP	YI
DAS NOT USED			DOWN	YJ
1-SEC HOLDOVER DISABLE		S4A	UP	YW
1-SEC HOLDOVER			DOWN	YX
CONTINUOUS CARRIER		S4B	UP	XB
SWITCHED CARRIER			DOWN	XA
NEW SYNC USED BY CUSTOMER (NOTE 6)		S4C	UP	YB
NEW SYNC NOT USED BY CUSTOMER			DOWN	YA

NOTES:
1. CP HG23 MAY HAVE OPTION SWITCHES AS SHOWN IN INSET. EACH SWITCH SECTION (A, B, OR C) CONSISTS OF AN UPPER AND LOWER PAIR OF TERMINALS DESIGNATED UP AND DOWN. INSTALL DESIRED OPTION BY PLACING SHORTING PLUG ACROSS RESPECTIVE TERMINALS AS SHOWN.
2. SWITCH MAY BE IN EITHER POSITION
3. ALWAYS USE WHEN OPTIONED FOR CONTINUOUS CARRIER OPERATION (S4B UP)
4. THIS OPTION MUST ALWAYS BE INSTALLED
5. THIS OPTION AVAILABLE ONLY ON DS 208A-L1A AND DS 208A-L1B
6. NOT USED WHEN FAR-END DATA SET IS OPTIONED FOR CONTINUOUS CARRIER
7. USED ONLY DURING INSTALLATION AND SHOULD NOT BE INSTALLED FOR NORMAL OPERATION.

Fig. 5—Summary of Data Set Options

DATA SET 208A-TYPE

INSTALLATION AND CONNECTIONS

TRANSMITTER-RECEIVER

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the installation and connection of data set (DS) 208A-type. The data set should be installed in conformance with existing installation practices. Refer to the section entitled Data Sets and Data Access Arrangements—General Installation and Connection Information (590-010-200). Data set 208A-type is recommended for use with data auxiliary set (DAS) 828- or 829-type (ordered separately).

1.02 Revision arrows are used to emphasize significant changes. The reasons for reissue are listed below.

(a) Adds uniform service order codes (USOC) information pertaining to DS 208A options

(b) Adds precautionary information

(c) Adds note in Fig. 1

(d) Changes key strip in Fig. 4.

1.03 ***Caution: Remove and discard the foam packing material located inside the data set front cover. Also remove and discard the protective covering from the data set housing. If not removed before operation, unnecessary heating of the data set will result.*** It is preferred that the data set be installed apart from the customer provided equipment (CPE) on a nearby desk, table, stand, or in a Bell System provided equipment cabinet. The data set will operate in an ambient temperature range of 40 to 120°F and a relative humidity of 20 to 95 percent ▶noncondensing.◀

1.04 Data set 208A-type must be located near the CPE since the interface cord supplied by the customer should not exceed 50 feet in length [to reduce stray capacitance and to conform to Electronic Industries Association (EIA) standards]. To minimize inductive interference to data signals on the telephone (data) line, the line should not be carried in the same run as cable between the data set and business machine or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type SK (shielded) station wire between the data set and the cable distribution terminal or building entrance. Ground the shield at one end only, preferably at the distribution terminal end.

1.05 Data set 208A-type requires an outlet that will accept the 3-prong plug on the P3BJ or KS-14532, L23 power cord.

1.06 A 25-pin KS-19087, L2 connector is provided at the rear of the data set for connection to the CPE. This connector is designed to mate with a customer-provided Cinch or Cannon DB-19604-432 plug wired in accordance with Table A. Connection between the data set and DAS 828- or 829-type is made with an M8K cord which comes with the data set.

1.07 ▶***Warning: When removing front cover use finger pressure only. No special***

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
2	Send Data	SD	BA
3	Receive Data	RD	BB
4	Request to Send	RS	CA
5	Clear to Send	CS	CB
6	Data Set Ready	DSR	CC
7	Signal Ground	SG	AB
8	Carrier On	COD	CF
9	+12V	CI9 (+12V)	Reserved for Data Set Testing
10	−12V	CI10 (−12V)	Reserved for Data Set Testing
11	Equalizer Mode	QM (Non-EIA)	Unassigned
14	New Sync	NS (Non-EIA)	SBA
15	Serial Clock Transmitter	SCT	DB
16	Divided Clock Transmitter	DCT (Non-EIA)	SBB
17	Serial Clock Receiver	SCR	DD
18	Divided Clock Receiver	DCR (Non-EIA)	Unassigned
21	Signal Quality Detector	COV	CG
24	Serial Clock Transmitter External	SCTE	DA
25	+5V	CI25 (+5V)	Unassigned

tools are required. Excessive force may crack the data set cover. Removal of the front cover is necessary to gain access to the option switch panel and the circuit packs (CPs). This cover can be removed by gently squeezing it on top and bottom and pulling forward. To replace the cover, position it properly, gently squeeze at top and bottom, and push it into place.

1.08 ***Warning: When the data set is removed from its mounting, an approved wrist strap should be used (or handle only by faceplate, edges, or brackets) to prevent static discharge to integrated circuits (ICs). The data set should be placed on a clean, dry, nonconductive surface.*** In order to gain access to the CPs, remove the front cover and CP locking bar. With the exception of HG9 and HG23, the CPs can be removed by pulling forward on the plastic tab. To replace the card, align it in the proper slot and push gently into place. The locking bar should be replaced before replacing the front cover.

1.09 A label (E-6650) and holder (841 788 292) are available for use with DS 208A-type to provide identification of the circuit number and trouble call number. The label has a pressure-sensitive adhesive to adhere to the bottom front of the data set housing 1 inch from the left side and flush with the front edge.

2. OPTIONS

2.01 Data set 208A-type is provided with a number of options which must be installed prior to placing the data set in service. The options to be installed in the data set should be specified on the service order. Refer to Fig. 1 for a cross reference between options and the switches which control the options.

A. Customer Options

2.02 ***Carrier Control:*** The carrier control options are listed below.

- With the switched carrier (XA) and switched request-to-send (YT) options, the data set transmits only when the request-to-send lead is ***on.*** The CA-CB delay for switched carrier is approximately 48.5 ms. The data set transmitter turns off within 2 ms after request-to-send goes ***off.***

- With the continuous carrier (XB) and continuous request-to-send (YS) options, request-to-send is held ***on*** internally and the transmitter remains on continuously to maintain synchronization.

- With the continuous carrier (XB) and switched request-to-send (YT) options, the transmitter remains on continuously to maintain synchronization; however, the customer may continue to control request-to-send with a shortened CA-CB delay of approximately 8 ms.

2.03 ***Internal or External Timing:*** Internal or external timing options are listed below.

- With the internal timing option (YC), the data set provides serial clock to the customer on the serial clock transmitter lead (pin 15).

- With the external timing option (YD), the customer provides serial clock to the data set on the serial clock transmitter external lead (pin 24). This clock must be stable to $\pm 4.8 \times 10^{-7}$ (± 48 ppm). On data sets with external timing, the serial clock transmitter signal is present and is phase-locked to the clock received from the customer on the serial clock transmitter external lead.

2.04 ***New Sync:*** The new sync option (YB) is recommended for use in the master DS 208A-type of a multipoint arrangement. Use of this option ensures rapid resynchronization on a series of incoming messages from remote transmitters. A pulse of 1 ms duration applied by the CPE on the new sync interface lead (SBA) when option YB is installed squelches the data set receiver for receipt of the next message. This option should not be installed in the local data set if the remote data set is optioned for continuous carrier (XB). It should not be installed in the master DS 208A-type if the DS 208A-type is an extension of a DS 209A-L1 multiple system. The new sync interface lead can be disabled by installing option YA.

2.05 ***1-Second Holdover:*** With the 1-second holdover option (YX), the timing recovery circuits in the data set receiver can maintain synchronization during line dropouts which do not exceed 1 second. This option can be disabled by the use of option YW.

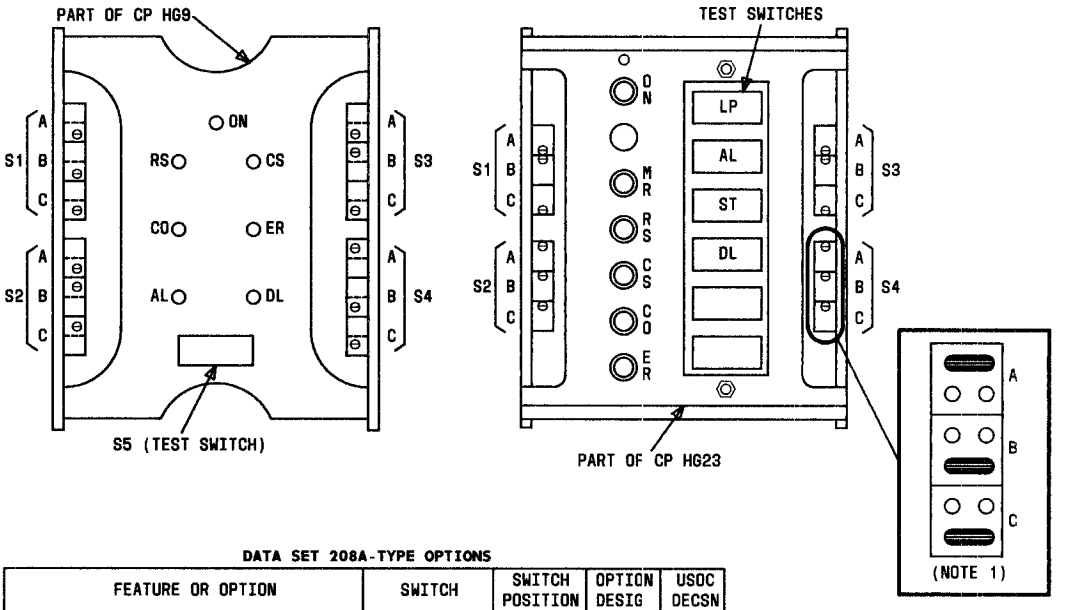
2.06 Data set 208A-L1A and -L1B provide all the preceding customer options listed for DS 208A-L1, plus one additional option.

2.07 ***Data Set Ready (DSR) On in AL Mode:*** This option provides an ***on*** indication to the CPE via the data-set-ready lead when the data set is in the analog loopback mode. This option, provided by DS 208A-L1A or -L1B only, allows a customer to loop back signals through the data set for testing of the CPE.

B. Telco Options

2.08 ***Data Auxiliary Set Used or Not Used:*** The data auxiliary set used or not used options are listed below.

- When the DAS used option (YI) is installed, the data-set-ready lead is externally controlled by the DAS 828A, 829-type, or equivalent line terminating unit. This indicates



DATA SET 208A-TYPE OPTIONS

FEATURE OR OPTION	SWITCH	SWITCH POSITION	OPTION DESIG	USOC DECSN
DSR ON IN AL MODE	S1A (NOTE 5)	UP	YM	F11
DSR OFF IN AL MODE		DOWN	YN	F12
NO COMP EQUALIZER TEST	S1B (NOTE 5)	UP	YQ	
COMP EQUALIZER TEST ENABLED (NOTE 7)		DOWN	YR	
CONTINUOUS REQUEST-TO-SEND	S1C	UP	YS	C6
SWITCHED REQUEST-TO-SEND (NOTE 8)		DOWN	YT	C5
EQUALIZATION: NO EQUALIZATION	S2A, S2B, S2C (NOTE 2)	DOWN	ZT	
EQUALIZATION: AMP AND DELAY (SYM) (NOTE 3)	S2A (NOTE 2)	UP	ZS	
	S2B	UP		
	S2C	UP		
EQUALIZATION: AMP AND DELAY (HI END)	S2A	UP	ZU	
	S2B	DOWN		
	S2C	UP		
EQUALIZATION: AMP AND DELAY (SYM + HI END)	S2A	DOWN	ZV	
	S2B	DOWN		
	S2C	UP		
TRANSMIT EXTERNALLY TIMED	S3A	UP	YD	A2
TRANSMIT INTERNALLY TIMED		DOWN	YC	A1
RETRAIN AUTOMATICALLY (NOTE 4)	S3B	UP	YU	
RETRAIN NOT USED		DOWN	YV	
DAS IS USED	S3C	UP	YI	
DAS NOT USED		DOWN	YJ	
1-SEC HOLDOVER DISABLE	S4A	UP	YW	D8
1-SEC HOLDOVER		DOWN	YX	D7
CONTINUOUS CARRIER	S4B	UP	XB	B3
SWITCHED CARRIER		DOWN	XA	B4
NEW SYNC USED BY CUSTOMER (NOTE 6)	S4C	UP	YB	E9
NEW SYNC NOT USED BY CUSTOMER		DOWN	YA	E10

NOTES:
1. CP HG23 MAY HAVE OPTION SWITCHES AS SHOWN IN INSET. EACH SWITCH SECTION (A, B, OR C) CONSISTS OF AN UPPER AND LOWER PAIR OF TERMINALS DESIGNATED UP AND DOWN. INSTALL DESIRED OPTION BY PLACING SHORTING PLUG ACROSS RESPECTIVE TERMINALS AS SHOWN.
2. SWITCH MAY BE IN EITHER POSITION.
3. ALWAYS USE WHEN OPTIONED FOR CONTINUOUS CARRIER OPERATION (S4B UP).
4. THIS OPTION MUST ALWAYS BE INSTALLED.
5. THIS OPTION AVAILABLE ONLY ON DS 208A-L1A AND DS 208A-L1B.
6. NOT USED WHEN FAR-END DATA SET IS OPTIONED FOR CONTINUOUS CARRIER.
7. USED ONLY DURING INSTALLATION AND SHOULD NOT BE INSTALLED FOR NORMAL OPERATION.
8. ALWAYS USE WHEN OPTIONED FOR SWITCHED CARRIER OPERATION (S4B DOWN).

Fig. 1—Location of Option Switches

when the private line channel is in a maintenance mode, a test condition, or alternate voice mode.

- When the DAS not used option (YJ) is installed, the data-set-ready lead is always ***on*** except when the data set is in the analog loopback mode (option YN installed), digital loopback mode, or option YR is installed.

2.09 ***Compromise Equalizer Test Control:*** This option, provided by DS 208A-L1A or -L1B only, facilitates testing of the compromise equalizer. Option YR should only be installed during the compromise equalizer setup. When this option is installed, the LP switch can be used to short the line signal. This option replaces the necessity to withdraw CP HG5, which must be done when setting the compromise equalizer on DS 208A-L1. ***This option must be removed upon completion of the compromise equalizer adjustment.***

Note: When this option is installed, the CC lead will always be ***off.***

2.10 ***Automatic Equalizer Retraining:*** With this option (YU), the data set receiver is able to determine if the automatic equalizer has been properly adjusted. If the automatic equalizer has not been properly adjusted, the data set receiver initiates local retraining of the equalizer while the remote transmitter continues to transmit data.

The automatic retrain option (YU) should always be installed during normal data set operation.

2.11 ***Caution: The final position of the screw must be such that it butts up against the spacer and the screwdriver slot is parallel with the spacer. Care must be taken not to turn the screw roughly or too far past the final position, as this could damage the switch.*** Option switches S1, S2, S3, and S4 are located on CP HG9 or HG23. Data set 208A-L1 contains CP HG9 while DS 208A-L1A and -L1B contain CP HG23. Each switch is divided into three sections: A, B, and C. To access the switch screws, the hinged protective cover must first be opened by pulling it from the end with the dot. Each switch section is individually adjusted to one of two positions using a screwdriver (provided with CP HG23) to gently rotate the adjustable screw to either the up or down position.

2.12 If CP HG23 is equipped with option switches which use shorting plugs, a method such as using long-nose pliers facilitates positioning the plugs. The plug is inserted horizontally in either the up or down position to install the respective option.

2.13 Switch sections are referred to by adding the letter designation (either A, B, or C) to the switch number. Thus, S2B refers to switch S2, section B.

2.14 The data set is supplied from the factory with a strap at the bottom of the power supply terminal strip to connect frame ground to signal ground. This strap can be disconnected during installation if the customer specifies a different grounding arrangement. To disconnect the strap, loosen the screws, pull back on the strap until the connection is broken, and tighten the strap under the frame ground (FG) screw.

2.15 When the data set is installed, verify that the correct options are installed before requesting a loopback test from the serving test center (STC).

2.16 A gummed option label designated E-6327 should be ordered for the data set. It can be attached to the front of the 83A power unit, and the installed options should be indicated for easy reference on subsequent maintenance visits.

3. CONNECTIONS

3.01 This part contains the information for connecting DS 208A-type to DAS 829-type or to DAS 828A-L1 and DAS 828C. For further information pertaining to these data auxiliary sets, refer to Part 6.

3.02 Refer to Fig. 2 and Fig. 3 for connection between DS 208A-type and DAS 829-type. The data-only connection is shown in Fig. 2 and the data/voice connection is shown in Fig. 3.

3.03 Connections for DAS 829-type to provide alternate switched network backup are shown in Fig. 4. The 48A1 data unit is not required for data-only service. Detailed information pertaining to DAS 829-type is contained in Section 598-082-101.

3.04 Refer to Fig. 5 and Fig. 6 for connection between DS 208A-type and DAS 828A-L1. The data-only connection is shown in Fig. 5 and the data/voice connection is shown in Fig. 6.

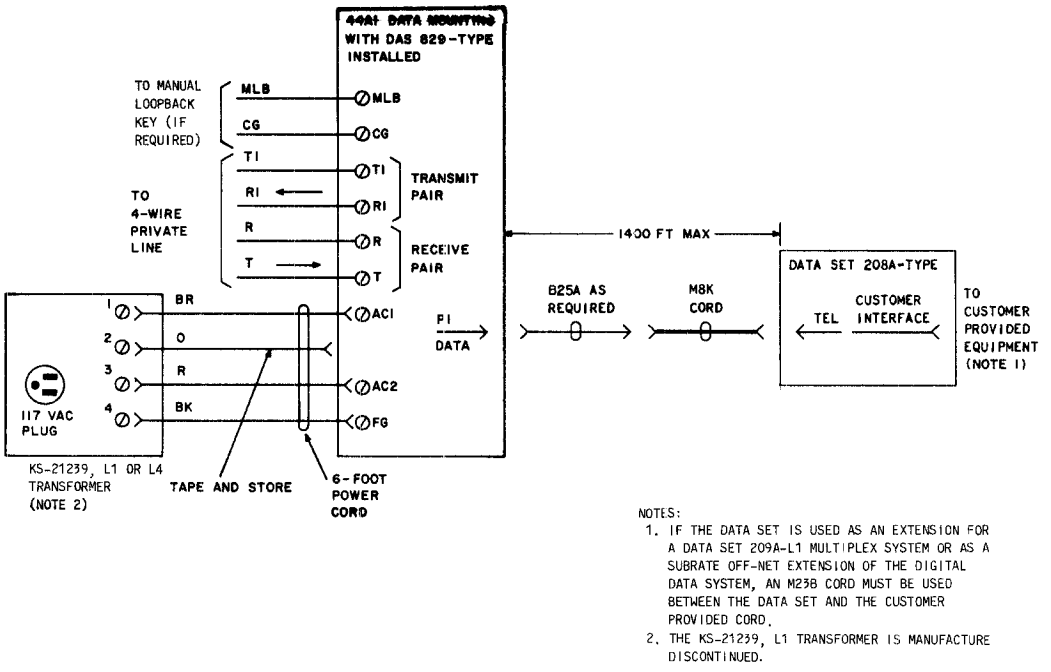


Fig. 2—DS 208A-Type Used With DAS 829-Type, Data Only

3.05 Connections for DAS 828C to provide alternate switched network backup are shown in Fig. 7 and Fig. 8. The connections for data only are shown in Fig. 7, while the connections for data/voice are shown in Fig. 8. Detailed information pertaining to DAS 828C is contained in Section 598-080-101.

3.06 If DS 208A-type is to be installed without a DAS 829-type, DAS 828A, or DAS 828C, connection to the locally engineered termination equipment may be accomplished by using a D25D-61 cord and a 66E3 connector block. Connections are shown in Fig. 9.

3.07 If DS 208A-type is used as an extension for a DS 209A-L1 multiplex system or as a subrate off-net extension of the digital data system (DDS), an M23B cord must be used. The M23B cord is approximately 6 inches long and connects between the data set and the customer provided cord. This is shown in Fig. 2 through 9.

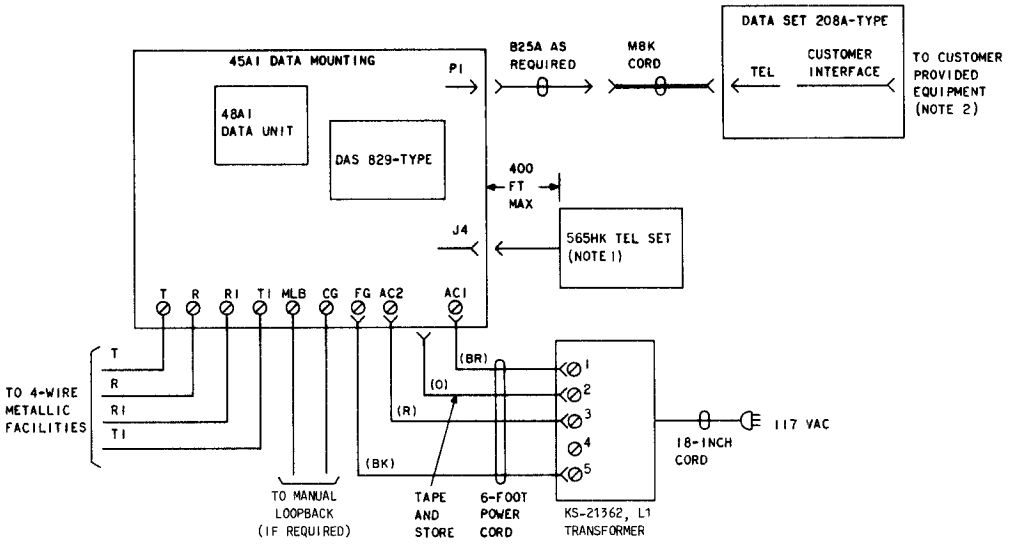
4. MULTIPLE ARRANGEMENTS

4.01 There are two ways in which DSs 208A-type can be installed for multiple arrangements.

(a) The data sets can be stacked on each other as follows:

MAX ROOM TEMP	NO. OF DATA SETS
85°F	3
110°F	2
120°F	1

(b) With suitable mounting brackets [D-180467 (MD) or D-180556], the data sets (including



NOTES:

1. DESIGNATE KEY STRIP AS SHOWN. CONVERT RING BUTTON TO NONLOCKING.

HOLD	—	—	PL TALK	RING	—

2. IF THE DATA SET IS USED AS AN EXTENSION FOR A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND CUSTOMER PROVIDED CORD.

Fig. 3—DS 208A-Type Used With DAS 829-Type, Data/Voice

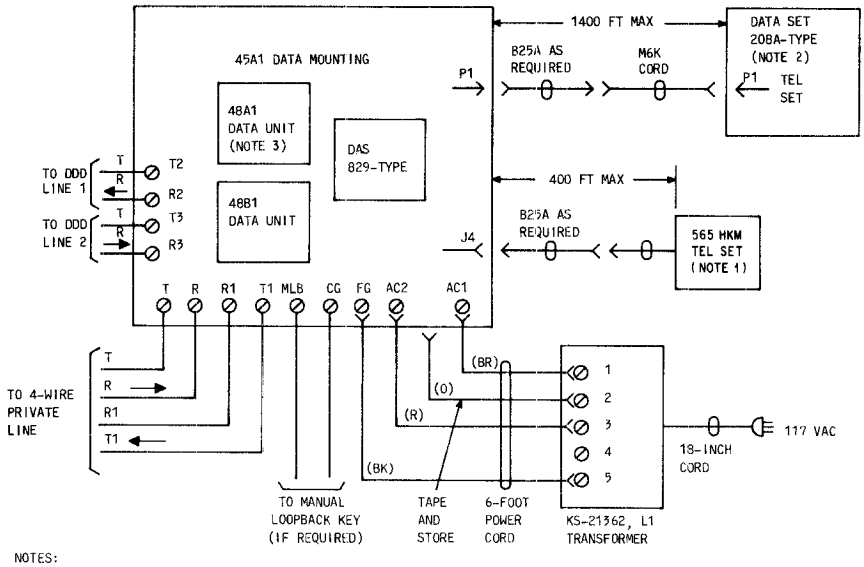
cover) can be mounted on a 19- or 23-inch rack mounting (Fig. 10).

(c) In cases where the DS 208A-type is replacing another data set in a cabinet arrangement, replace the data sets with DS 208A-type on a one-for-one basis. If a higher density of data sets is required, remove the cabinet shelves and use mounting brackets. For additional information, refer to Section 590-010-201.

4.02 When DSs 208A-type are used with the mounting brackets, it is possible to mount the data sets in KS-20018 cabinets. However, because of heat limitations, only a limited number of data sets can be mounted in a cabinet. Criteria for calculating the maximum number of data sets for a given cabinet is contained in Section 592-027-150.

5. INSTALLATION PROCEDURES

5.01 The 4-wire private line channel to be used with DS 208A-type must meet the requirements given in Section 314-410-500. Connections for the various data station configurations are shown in Fig. 2 through 9. Install DAS 829 (or equivalent), if required, per Section 598-082-200 or Section 598-082-201 as required. Install DAS 828A and DAS 828C (or equivalent), if required, per Sections 598-080-200 and 598-080-201, respectively.



NOTES:

1. DESIGNATE KEY STRIP AS SHOWN.
   CONVERT RING KEY TO NONLOCKING.

HOLD	DDD1	DDD2	PL TALK	RING	—

2. IF THE DATA SET IS USED AS AN EXTENSION FOR A DATA SET 209A-L1 MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND CUSTOMER PROVIDED CORD.
3. FOR DATA ONLY SERVICE, THE 48A1 DATA UNIT IS NOT REQUIRED.

Fig. 4—DS 208A-Type Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 829-Type, Data/Voice

5.02 Refer to Fig. 1 for the location and positions of the data set option switches which provide the options specified on the service order.

5.03 After the data set has been installed, it should be tested to determine if it is operating properly. Tests to be performed are as follows:

- Analog loopback self test (DS 208A-L1A and -L1B)
- Digital loopback test from STC
- Digital loopback test to distant end
- Analog loopback test (to be performed if either of the digital loopback tests fails)
- Compromise equalizer test (if required).

5.04 In addition to the loopback tests, the correct setting of the compromise equalizer must be determined if the data set being installed is optioned for switched carrier. Testing of the compromise equalizer setting is ***not*** required if the data set is optioned for continuous carrier operation. In this case, the compromise equalizer should be set for symmetric compromise equalization (S2B up; S2C up).

5.05 When the compromise equalizer test is required, the test procedure will be performed

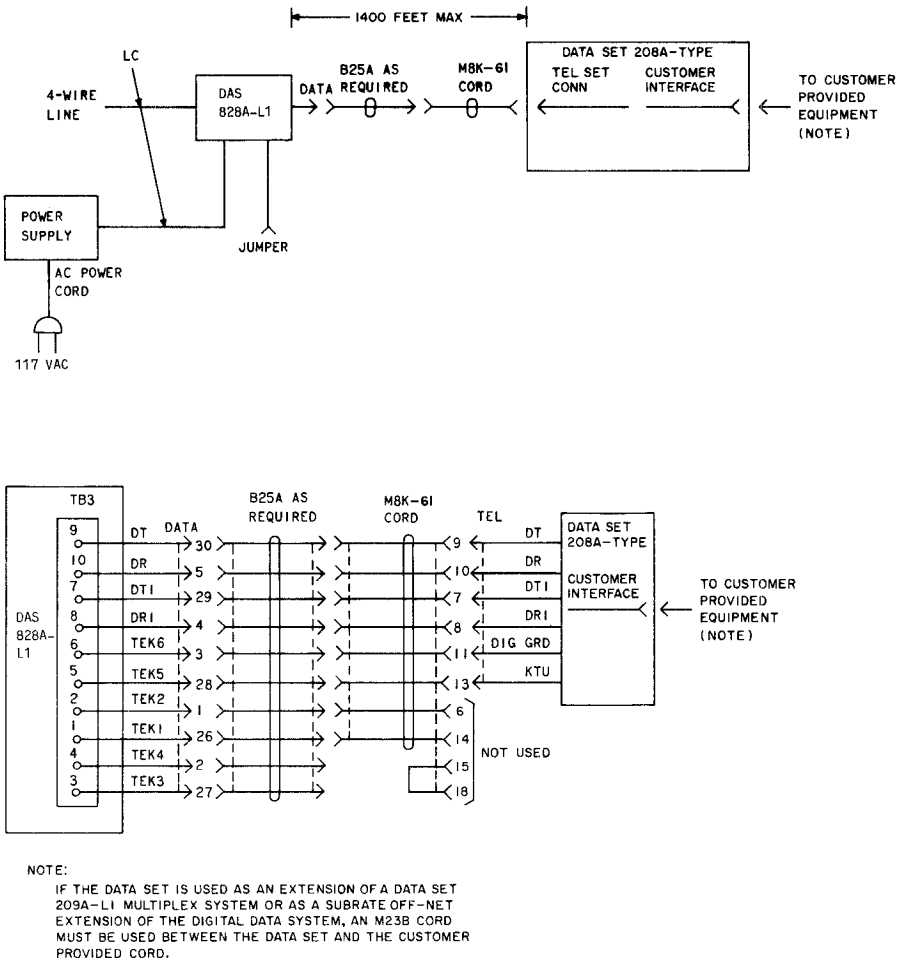


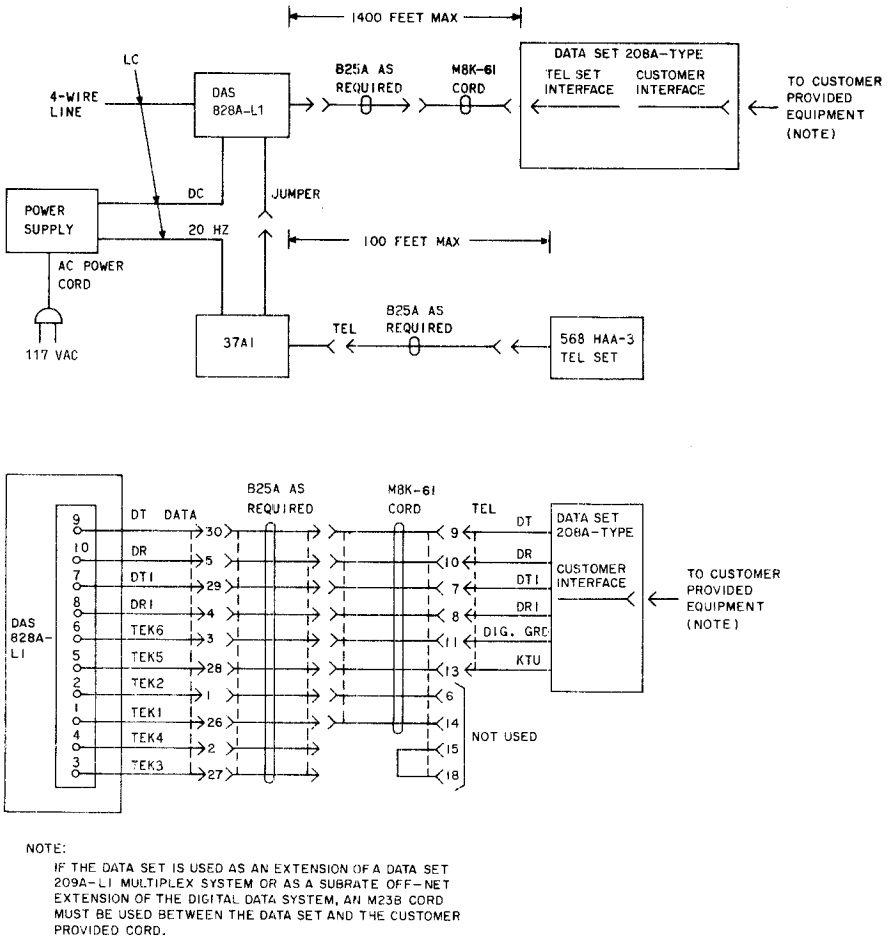
Fig. 5—DS 208A-Type Used With DAS 828A, Data Only

after the digital loopback test to distant end has been performed. The distant-end data set should have been tested previously by the STC and must be in the digital loopback (DL) test mode.

5.06 The proper test to be performed will be determined by the STC. Test procedures are given in Section 592-027-500.

5.07 Affix the label holder (841 788 292) to DS 208A-type and record both the circuit number and trouble call number on the label. ***Do not place identification of any type on the data set housing.***

5.08 Ensure that a copy of Data Set 208A-Type, How to Operate Manual (999-100-105) is readily available to the customer.



NOTE:
IF THE DATA SET IS USED AS AN EXTENSION OF A DATA SET 209A-LI MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.

Fig. 6—DS 208A-Type Used With DAS 828A, Data/Voice

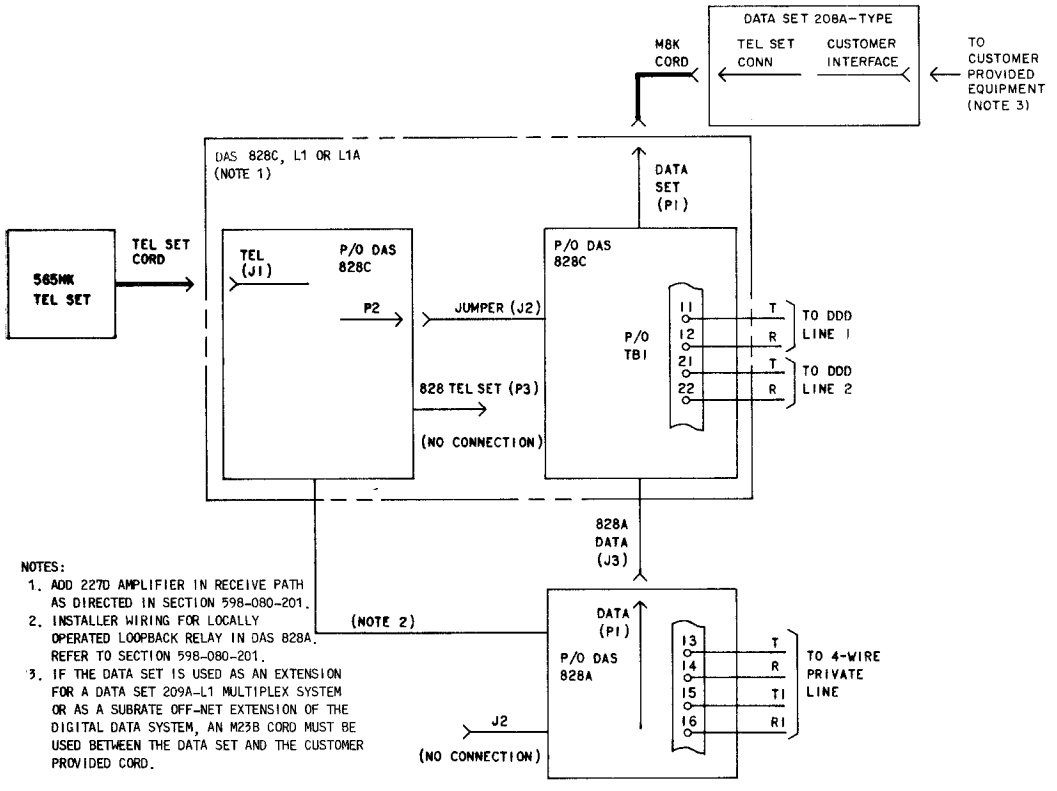


Fig. 7—DS 208A-Type Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 828A and 828C, Data Only

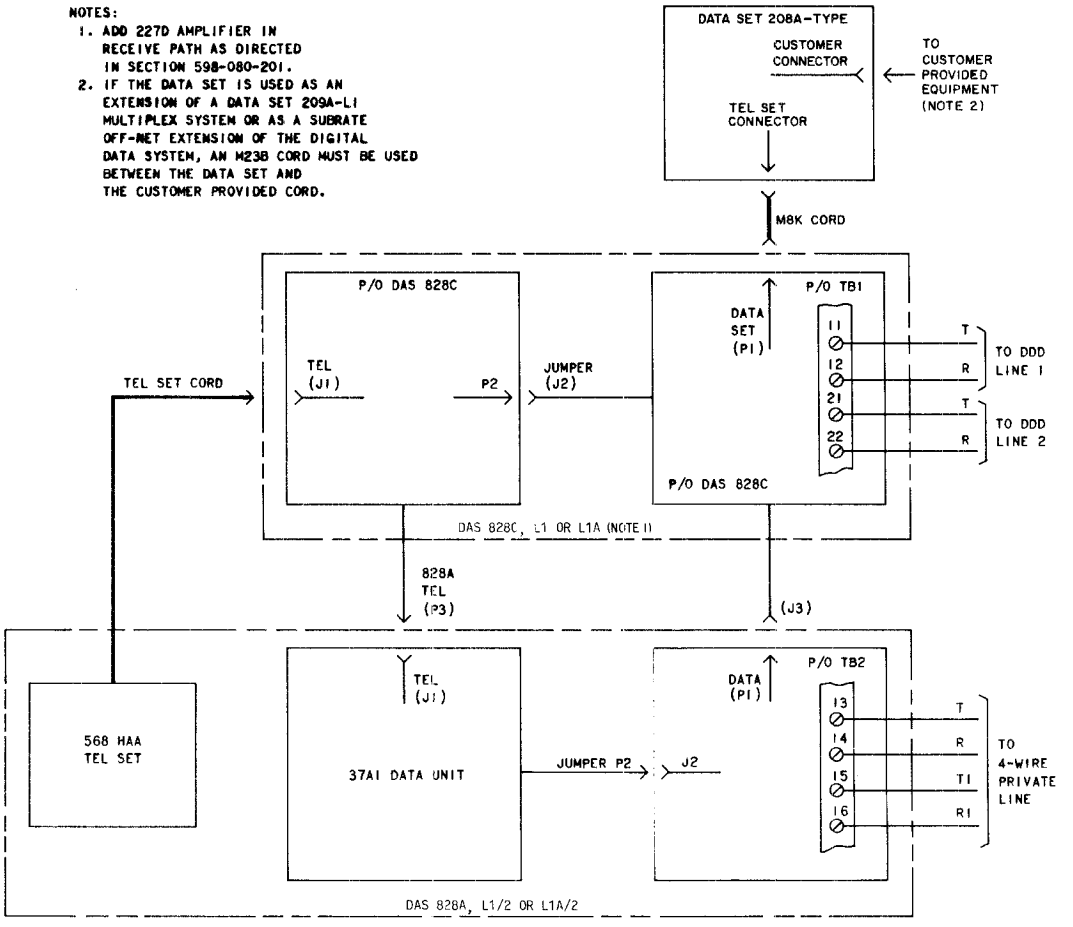
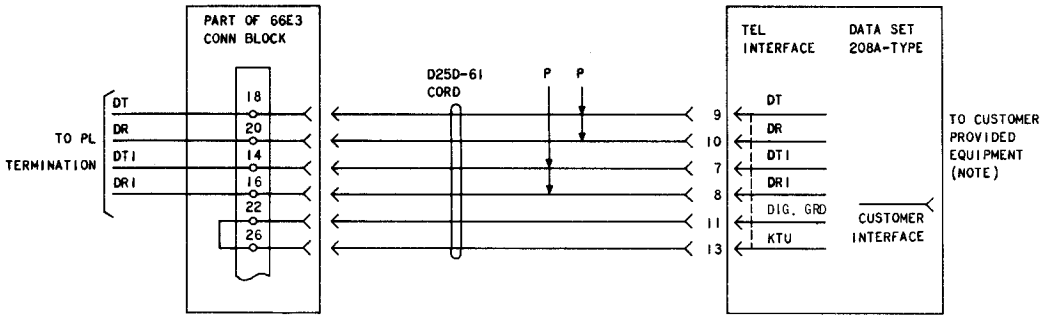


Fig. 8—DS 208A-Type Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 828A and 828C, Data/Voice



NOTE:
IF THE DATA SET IS USED AS AN EXTENSION FOR A DATA SET 209A-LI MULTIPLEX SYSTEM OR AS A SUBRATE OFF-NET EXTENSION OF THE DIGITAL DATA SYSTEM, AN M23B CORD MUST BE USED BETWEEN THE DATA SET AND THE CUSTOMER PROVIDED CORD.

Fig. 9—DS 208A-Type Connections to Locally Engineered Private Line Termination Without DAS 828- or 829-Type

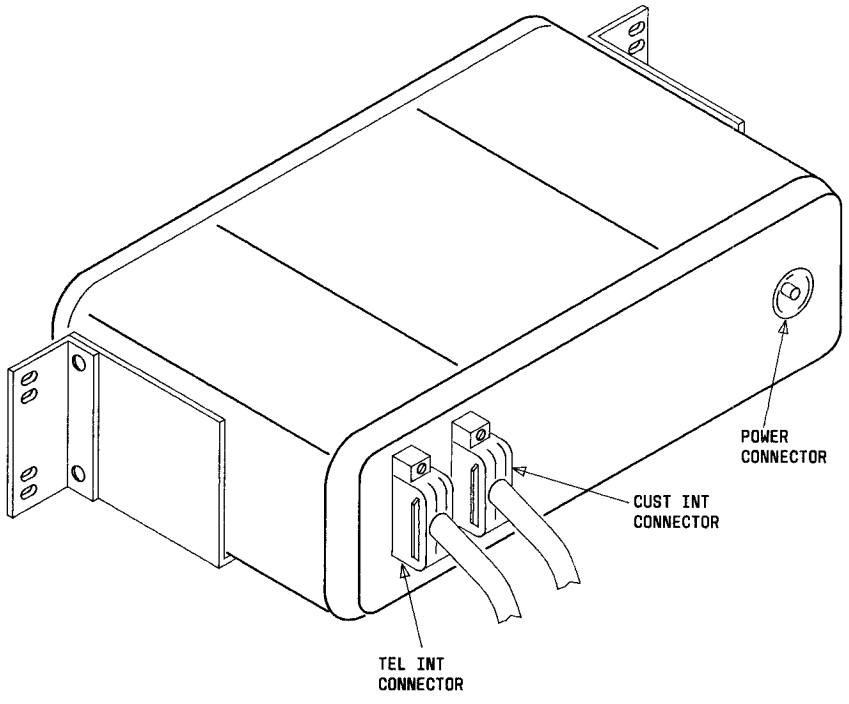


Fig. 10—DS 208A-Type With D-180467 (MD) Mounting Bracket Kit Installed, Rear View

6. REFERENCES

6.01 Documents listed in this part contain information pertaining to DS 208A-type.

SECTION	TITLE
590-002-110	4800-Bit Per Second (BPS) Service Using Data Set 208-Type—Reference Guide
592-027-100	Data Set 208A-Type—Transmitter-Receiver — Description and Operation
592-027-150	Data Set 208A-Type—Transmitter-Receiver — Supplementary Information
592-027-180	Data Set 208A-Type—Transmitter-Receiver — Summarizing Specification
592-027-300	Data Set 208A-Type—Transmitter-Receiver — Maintenance
592-027-400	Data Set 208A-Type—Transmitter-Receiver — Wiring Information
592-027-500	Data Set 208A-Type—Transmitter-Receiver — Test Procedures
592-027-501	Data Set 208A-Type—Transmitter-Receiver — Test Procedures Using 921A Data Test Set
598-080-100	Data Auxiliary Set 828A— Description and Operation
598-080-101	Data Auxiliary Set 828C—Description and Operation
598-080-200	Data Auxiliary Set 828A— Installation and Connections
598-080-201	Data Auxiliary Set 828C—Installation and Connections
598-080-500	Data Auxiliary Set 828A— Maintenance and Test Procedures
598-080-501	Data Auxiliary Set 828C—Maintenance and Test Procedures
598-082-100	Data Auxiliary Set 829-Type—Description
598-082-101	Data Auxiliary Set 829-Type—(Alternate Voice and Dial Backup)— Description
598-082-200	Data Auxiliary Set 829-Type—Installation and Connections
598-082-201	Data Auxiliary Set 829-Type—(Alternate Voice and Dial Backup)—Installation and Connections
666-511-503	Test of Data Services Provided by Data Set 208A-Type From a Private Line Test Room
999-100-105	Data Set 208A-Type—How to Operate Manual

DATA SET 208A-TYPE TRANSMITTER-RECEIVER TEST PROCEDURES

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning procedures to be used when testing data set (DS) 208A-type on an initial installation or during a maintenance visit. Overall procedures to be followed when investigating the trouble report are outlined in Section 592-027-300. When DS 208A-type is used as an extension of a DS 209A-L1 multiplex system, overall procedures are contained in Section

592-032-300. When DS 208A-type is used as a subrate off-net extension of the digital data system, refer to Section 314-919-300. Procedures used at the serving test center (STC) to maintain and test such systems are contained in Section 666-511-504.

1.02 This section is reissued to add information pertaining to DS 208A-L1B and equalizer start-up testing for DS 208A-types. Since this issue is a general revision, change arrows are deleted.

1.03 This section is divided into seven parts. Part 1, GENERAL, contains general information pertaining to DS 208A-type. Part 2, TEST FACILITIES AVAILABLE, describes the test capabilities of the data set. Part 3, INSTALLATION TESTS, describes the tests necessary to verify an installation. Part 4, MAINTENANCE TESTS, describes the tests to be performed during a trouble visit. Part 5, TEST PROCEDURES, describes and gives a step-by-step procedure for the various tests necessary to install and maintain DS 208A-type. Part 6, SUPPLEMENTARY TEST, describes a test to be performed when normal testing has failed to isolate an intermittent source of errors. Part 7, REFERENCES, provides documentation information pertaining to associated equipment.

1.04 The compromise equalizer test requires a diode pin (white) and a resistor pin (yellow) for use with a 914B data test set (DTS). The diode pin contains a general purpose diode, while the resistor pin contains a 3010-ohm resistor.

1.05 The CA-CB and CG-CF interval tests and start-up tests require the use of a 3010-ohm resistor pin (yellow), which is used to eliminate the effect of contact bounce caused by the 914-type DTS switches. If this pin is not available, a 3000- to 4000-ohm resistor can be connected from pin 9 to pin 4 on the 914B interface selector switch panel.

> ***Note:*** If the 914B DTS has been modified with CP 17, the resistor pin or equivalent can be omitted.

1.06 In addition to the 914-type DTS, the following equipment is required for the maintenance test procedure:

- One KS-19252-L2 bridging adapter
- Two B25A cables
- One 66E3 block
- One 903-type DTS (if 914B DTS is used).

2. TEST FACILITIES AVAILABLE

DS 208A-L1

2.01 DS 208A-L1 is tested with the use of a 914-type DTS. An analog loopback test, an end-to-end test, and a digital loopback test to either an STC or distant data set can be performed. These tests check for proper status of interface signals and record data errors. The compromise equalizer test, which determines the optimum compromise equalizer option, also uses the 914-type DTS. The 914-type DTS is also used for maintenance to test various data set functions. Table A depicts the test switch positions and status indicators during test and normal operation for DS 208A-L1.

DS 208A-L1A AND DS 208A-L1B

2.02 Test circuitry built into DS 208A-L1A and DS 208A-L1B permits testing of the data set in the analog loopback, end-to-end, and the digital loopback modes to either an STC or distant data set without the use of any external test equipment. The same tests can also be made in greater depth using the 914-type DTS (to verify interface connector wiring, EIA voltage levels, etc).

A. Self Test Features (DS 208A-L1A and DS 208A-L1B Only)

2.03 The self test features of the data set make use of the pushbutton switches and status indicators located at the front of the data set. For a description of the switches and status indicators, refer to Section 592-027-100. Table B depicts the test switch positions and status indicators during test and normal operation.

Status Indicator Test

2.04 The lamp test (LP) switch is a nonlocking switch that when depressed lights the MR, RS, CS, CO, and ER indicators to verify proper operation of these status indicators. The LP switch can be depressed at any time, since it does not affect normal data operation.

TABLE A

DATA SET 208A-L1 TEST SWITCH POSITIONS AND INDICATOR STATUS

TEST SWITCH POSITION OR INDICATOR	NORMAL OPERATION	ANALOG LOOPBACK	REMOTE LOOPBACK FROM STC	REMOTE LOOPBACK* TO DISTANT END	END-TO-END	
					LOCAL DATA SET	DISTANT-END DATA SET
Test Switch in Center Position	X			X	X	X
Test Switch in Analog Loop Position		X				
Test Switch in Digital Loop Position			X			
ON Indicator	Lighted	Lighted	Lighted	Lighted	Lighted	Lighted
RS Indicator	Note 1	Note 1	Note 3	Note 1	Note 1	Note 1
CS Indicator	Note 2	Note 2	Note 2	Note 2	Note 2	Note 2
CO Indicator	Note 3	Note 3	Note 3	Note 3	Note 3	Note 3
ER Indicator	Note 4	Note 4	Note 4	Note 4	Note 4	Note 4
AL Indicator	Off	Lighted	Off	Off	Off	Off
DL Indicator	Off	Off	Lighted	Off	Off	Off

* Assumes distant-end data set is in digital loop mode.

Notes:

1. Lighted when CA is ON (could be off when line signal is being transmitted if data set is optioned for switched request-to-send and continuous carrier).
2. Lighted after completion of CA-CB interval (7.5 or 50 ms). Stays lighted for completion of data transmission.
3. Lighted when line signal is being received.
4. Lighted when CO indicator is off. When CO indicator is lighted, indicates state of adaptive equalizer. When lighted, equalizer is retraining.

During the compromise equalizer test, the data set is optioned such that the LP switch, when depressed, is used to short the transmitted signal, causing the status indicators listed in 2.04 to light. If the compromise equalizer test option is inadvertently installed during normal operation, the MR indicator on the data set will not be lighted and the CC (data set ready) lead at the customer interface will be OFF.

TABLE B

DATA SET 208A-L1A OR -L1B TEST SWITCH POSITIONS AND INDICATOR STATUS

SWITCH OR INDICATOR	NORMAL OPERATION	ANALOG LOOPBACK SELF TEST	REMOTE LOOPBACK FROM STC	REMOTE LOOPBACK* SELF TEST TO DISTANT END	END-TO-END SELF TEST		INDICATOR TEST
					LOCAL DATA SET	DISTANT-END DATA SET	
LP Switch							X
AL Switch		X					
ST Switch		X		X	X	X	
DL Switch			X				
ON Indicator	Lighted	Lighted	Lighted	Lighted	Lighted	Lighted	Lighted
MR Indicator	Note 1	Off	Off	Off	Off	Off	Lighted
RS Indicator	Note 2	Lighted	Note 4	Lighted	Lighted	Lighted	Lighted
CS Indicator	Note 3	Lighted	Note 3	Lighted	Lighted	Lighted	Lighted
CO Indicator	Note 4	Lighted	Note 4	Lighted	Lighted	Lighted	Lighted
ER Indicator	Note 6	Note 5	Note 6	Note 5	Note 5	Note 5	Lighted

X = Switch depressed; Blank = Switch not depressed.

* = Assumes distant-end data set is in digital loop mode.

Note 1: Monitors state of data set ready circuit.

Note 2: Lighted when CA is ON (could be off when line signal is being transmitted if data set is optioned for switched request to send and continuous carrier).

Note 3: Lighted after completion of CA-CB interval (7.5 or 50 ms). Stays lighted for completion of data transmission.

Note 4: Lighted when line signal is being received.

Note 5: Off except when errors occur.

Note 6: Lighted when CO indicator is off. When CO indicator is lighted, indicates state of adaptive equalizer. When lighted, equalizer is retraining.

Analog Loopback Self Test

2.05 The analog loopback self test mode is entered by depressing the analog loop (AL) and self test (ST) locking switches. Depression of the AL switch connects the data set transmitter to its own receiver through a channel simulator on the data set side. Depressing the ST switch forces the internal request-to-send (CA) lead ***on,*** transmits a steady mark on the data set internal SD lead, and enables the ER indicator to be used to indicate received errors.

End-to-End Self Test

2.06 The end-to-end self test mode is entered by depressing the ST switches at both data sets (DS 208A-L1A or DS 208A-L1B). This action causes both transmitters to turn on and transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission.

Digital Loopback Test to Distant End

2.07 In this test the distant-end data set is placed in the digital loop (DL) mode to act as a regenerator. The local data set is placed in the self test mode by depressing the ST switch. The local transmitter is then turned on and transmits steady marks to the distant-end receiver, where the recovered data present on the BB interface lead is looped around to the BA lead at the customer interface. Also connected at the customer interface are signal quality detector (CG) to request-to-send (CA) and serial clock receive (DD) to serial clock transmitter external (DA). These interface leads are disconnected so that the associated CPE cannot monitor them. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is conditioned to indicate any errors made in transmission.

Restrictions on Use of Self Test (DS 208A Used With DS 209A or DDS Off-Net)

2.08 If either DS 208A-L1A or DS 208A-L1B is used as a remote extension of a DS 209A-L1 multiplex system or as a subrate off-net extension of DDS, the self-test features can be used with the following restrictions:

(a) Analog loopback self test cannot be performed at a remote extension with options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

(b) Analog loopback self test cannot be performed from a remote extension in toward DS 208A-type collocated with DS 209A-L1 with options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

(c) Digital loopback test cannot be performed from a remote extension in toward a hub office of the DDS with data set options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

B. Tests Using the 914-Type DTS

2.09 The 914-type DTS is used to perform all tests necessary to install and maintain DS 208A-L1. By using the 914-type DTS, the customer interface is checked, timing intervals and transmit levels are measured; certain power supply voltages are checked, and actual error runs are performed.

2.10 In addition to the data set self tests, the 914-type DTS is used to provide a more thorough series of tests for DS 208A-L1A and DS 208A-L1B.

Caution: Certain 914B DTSs are susceptible to power line transients which may cause the fuse in the 914 DTS 5-volt power supply to fail. To avoid this problem, do not unplug the data set while power is applied to the 914B. If the fuse in the 914 DTS 5-volt supply fails, the counter indicates continuously and cannot be reset.

3. INSTALLATION TESTS

3.01 After the data set has been installed, it must be tested for acceptable operation. Refer to Fig. 1 for the sequence of tests to be performed. If trouble exists and appears to be start-up errors, perform the appropriate equalizer start-up test given in Part 5.

4. MAINTENANCE TESTS

4.01 Maintenance tests consist of an equalizer start-up test, end-to-end tests, a ground noise test, and a repair test sequence that provides a method of isolating a trouble within the data set to a circuit pack (CP) or group of CPs. It is assumed that the maintenance procedures outlined in Section 592-027-300 have been followed prior to dispatching the telephone company (telco) employee. If the probable cause of trouble is in the private line (PL) facilities, refer to Section 314-410-500. If the probable cause of trouble is in data auxiliary set (DAS) 828A or 829-type, refer to Part 7 for the appropriate BSP.

4.02 DS 208A-L1 can be converted to DS 208A-L1A by removing HG9 CP and replacing it with HG23 CP, and replacing the front cover with front cover 840807655. When this conversion is made, ensure that the customer receives a copy of the data set How to Operate Manual (999-100-105).

4.03 Due to backplane wiring changes required by the employment of large scale integration (LSI) in DS 208A-L1B, DS 208A-L1A ***cannot*** be converted to DS 208A-L1B. The transmitter and descrambler CP used in DS 208A-L1B is coded HG26 and replaces HG5, HG6, and HG17 used in previous DS 208A-types. Before replacing CPs in DS 208A-type, identification of the data set must be determined using the code stamped under the chassis or printed on the option label. Care must be taken ***not*** to insert HG26 CP in DS 208A-L1 or 208A-L1A. Although no equipment damage will occur, HG5, HG6, and HG17 CPs will not function if inserted in a DS 208A-L1B chassis. All other circuit packs with the same code can be used interchangeably in DS 208A-type. A summary of the CPs contained in each DS 208A-type is given in Table C.

4.04 The overall repair tests sequence, contained in the flowchart shown in Fig. 2, consists of five basic functional tests:

- Power Supply Test
- CA-CB Interval Test
- Transmit Level Test
- CG-CF Interval Test
- Analog Loop-back Test.

The tests are written so that the flowchart may be entered at any point without performing all preceding tests. The equalizer start-up test, end-to-end test, and ground noise test are not included in Fig. 2. These tests should be performed as required.

4.05 When any test shown in Fig. 2 (except the power supply test) fails, perform the following procedure: Refer to the list of CPs involved in the test being performed. Replace each CP individually (in order of appearance on the list) and repeat the test after each CP replacement. If after a CP is replaced the test fails, in order to avoid replacing a CP which may not be defective, reinstall the original CP and replace the next CP on the list. Repeat this procedure until all the recommended CPs have been replaced.

> ***Note:*** This procedure of CP replacements does not check for multiple circuit pack failures unless the circuit packs in question are related to different tests in the repair sequence.

4.06 The repair sequence shown in Fig. 2 should quickly isolate the trouble to a CP or group of CPs. It is evident that, in all the tests, one of the CP replacements recommended is HG9 (208A-L1) or HG23 (208A-L1A and 208A-L1B). This is the interface CP and the majority of data and control signals appear on this CP.

4.07 Whenever HG9 or HG23 CP is replaced, install the correct options before proceeding with the test.

4.08 If a defective CP is located, it must be tagged with the nature of the trouble, carefully packed in the shipping carton provided with the maintenance kit, and returned to a Western Electric repair center for repair. No attempt should be made to repair CPs in the field. After the data set has been repaired and tested, verify with the customer that service is satisfactory by requesting the customer to make a data call.

4.09 In the unusual instance when the data set is obviously malfunctioning but maintenance tests do not clear up the cause of trouble, it is recommended that the problem be referred to supervision according to local instructions.

TABLE C

CIRCUIT PACK COMPLEMENT FOR DS 208A-TYPE

DS 208A-L1 (MD)		DS 208A-L1A (MD)		DS 208A-L1B	
CIRCUIT PACK	SEE NOTE	CIRCUIT PACK	SEE NOTE	CIRCUIT PACK	SEE NOTE
HG2		HG2		HG2	
HG3		HG3		HG3	
HG4		HG4		HG4	
HG5 (A&M)		HG5 (A&M)		—	
HG6 (A&M)		HG6 (A&M)		—	
HG7		HG7		HG7	
HG8		HG8		HG8	
HG9 (MD)		—		—	
HG11		HG11		HG11	
HG12	1	HG12	1	HG12	1
HG13		HG13		HG13	
HG14 (MD)		HG14B	3	HG14B	3
HG15 (MD)		HG15B	3	HG15B	3
HG16 (MD)		HG16B	3	HG16B	3
HG17 (A&M)		HG17 (A&M)		—	
HG21	2	HG21		HG21	
—		HG23	4	HG23	4
—		—		HG26	5

Note 1: Two HG12 CPs are required in each data set.

Note 2: Early models of DS 208A-L1 may contain HG1 CP.

Note 3: HG14B, HG15B, and HG16B are direct replacements for HG14, HG15, and HG16, respectively.

Note 4: HG9 CP is replaced by HG23 in DS 208A-L1A and DS 208A-L1B.

Note 5: HG5, HG6, and HG17 are replaced by HG26 in 208A-L1B.

4.10 Proceed to Fig. 2 to begin the repair test sequence.

5. TEST PROCEDURES

5.01 This part provides a description of the various test procedures and step-by-step instructions for performing the tests.

5.02 If a procedure requires that an option be installed in the set which is not specified on the service order or circuit layout record card, remove the option at the end of the test and verify that all specified options are installed in the set.

A. Analog Loopback Self Test (DS 208A-L1A AND DS 208A-L1B)

5.03 The analog loopback self test is entered by depressing the AL and ST locking switches located on the front of the data set. Depressing the AL switch connects the transmitter to the receiver through a channel simulator. Depressing the ST switch turns ***on*** the data set internal request-to-send lead, transmits steady marks on the data set internal SD lead, and conditions the ER indicator to be used to indicate errors. Since steady marks are being transmitted, any spaces detected by the error circuitry constitute errors.

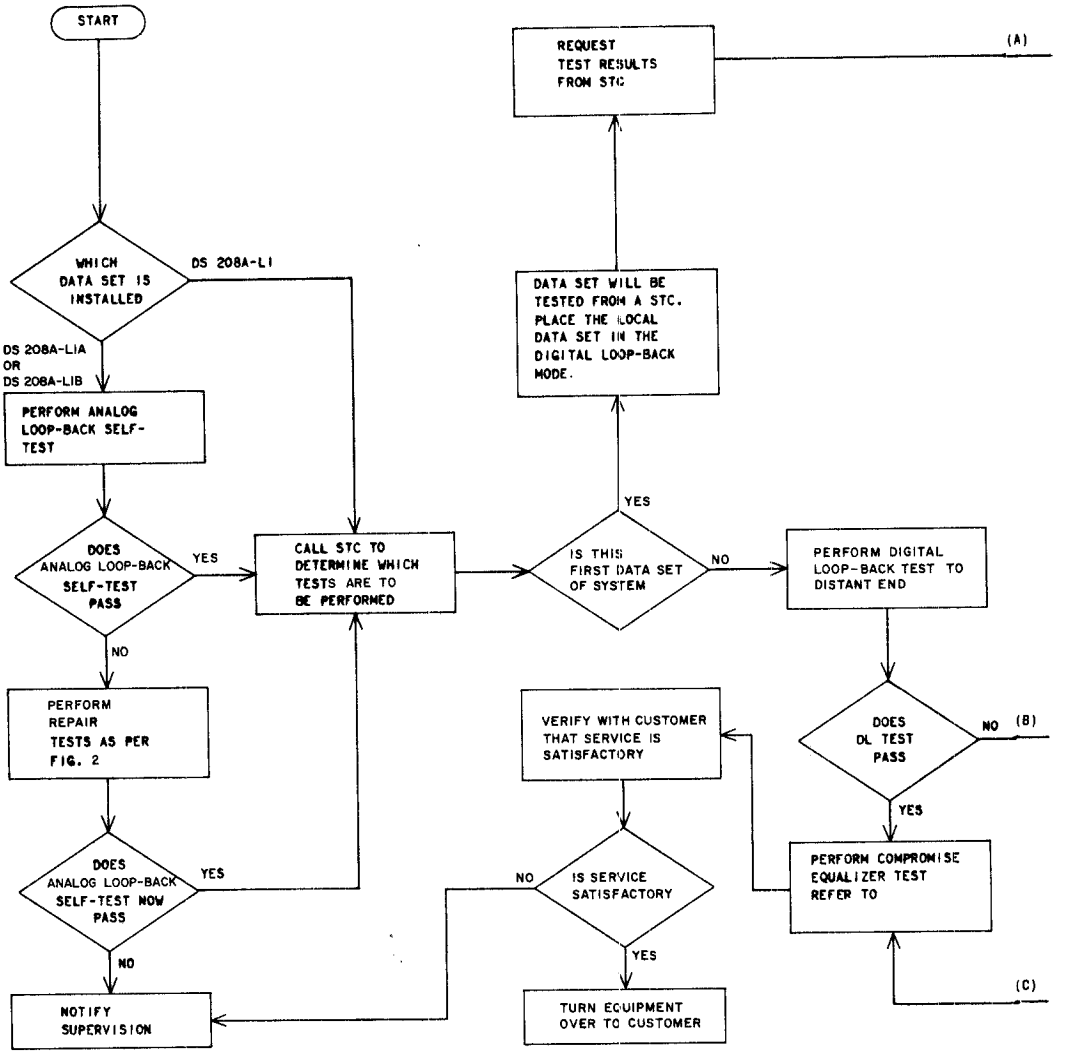


Fig. 1—Installation Testing Flowchart (Sheet 1 of 2)

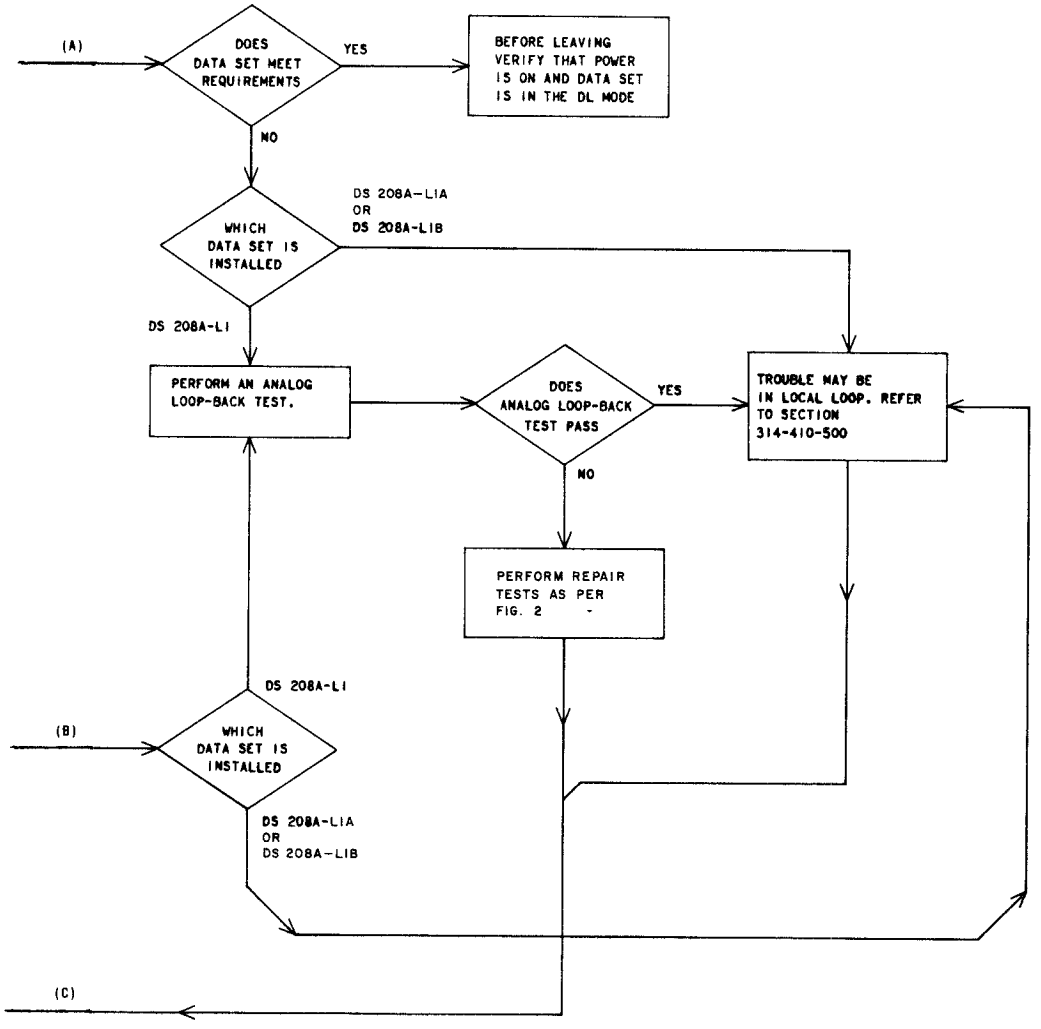


Fig. 1—Installation Testing Flowchart (Sheet 2 of 2)

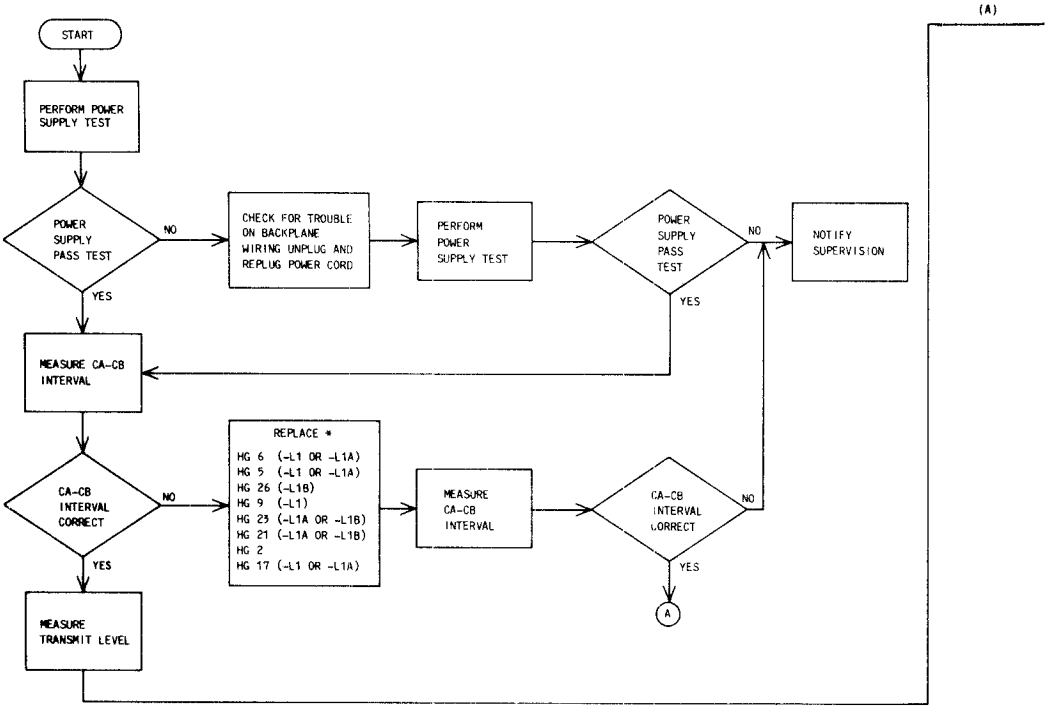


Fig. 2—Repair Test Sequence (Sheet 1 of 2)

* USING THE METHODS GIVEN IN SECTION 592-027-200

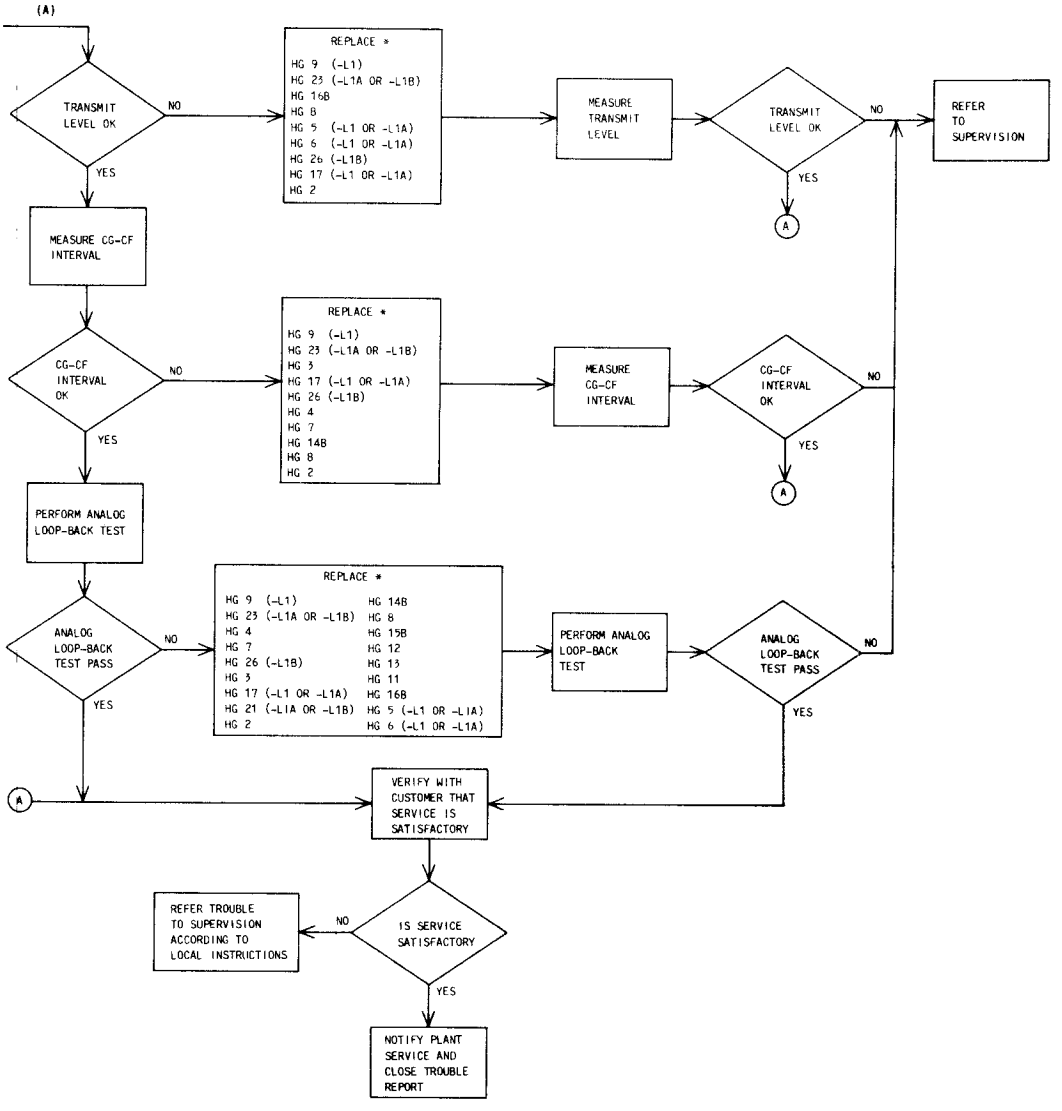


Fig. 2—Repair Test Sequence (Sheet 2 of 2)

One bit error lights the ER indicator for approximately 100 ms.

5.04 Perform the following procedure for the analog loopback self test.

(1) Apply ac power to DS 208A-L1A or DS 208A-L1B.

(2) Depress and hold the LP switch.

Requirement: All indicators on the data set are lighted.

(3) Release the LP switch and depress the AL and then the ST switch.

Requirements: The ON, RS, CS, and CO indicators are lighted. The MR and ER indicators are off.

Note: If the ER indicator is lighted or blinks, the data set has failed the analog loopback self test.

(4) End of test. Depress, then release the AL and ST switches to restore the data set to normal operating condition.

B. Analog Loopback Test Using a 914-Type DTS

5.05 The analog loopback test using a 914-type DTS is functionally the same as the analog loopback self test. The 914-type DTS provides a more inclusive test of the data set customer interface circuits and data set scrambler/descramber circuits by transmitting random data and monitoring the received data for errors. The test equipment required for this test consists of a 914C DTS or a 903-type DTS and a 914B DTS. When using the 914C DTS, a 511-bit word is used; when using the 903/914B DTS combination, a 63-bit word is used. The 511-bit word is preferred to test the scrambler/descrambler circuits more comprehensively.

5.06 Perform the following procedure:

(1) Connect the equipment as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown in Fig. 3.

(2) Place the DS 208A-type in the AL mode.

(3) Apply power to the data set and then to the DTS.

(4) If a 903-type DTS is used, depress and release the START switch.

(5) At the 914-type DTS, position S1 (CA) to ON and reset the counter by depressing the RESET switch.

Requirements: On the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CG), DS4 (CF), and DS7 (QM) are lighted. DS5 (BA) and DS6 (BB) are ***dimly*** lighted. DS8 (CC) is off. The counter is not indicating.

(6) Verify that the test equipment is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: On the 914-type DTS, the counter indicates rapidly, and shortly thereafter the NO DATA and OVERFLOW lamps light.

(7) Depress the interface selector switch 3A.

(8) Reset the counter to zero by pressing the RESET switch.

(9) Perform a 2-minute error run and record the number of errors.

Requirement: DTS counter registers 0 block errors during a 2-minute error run.

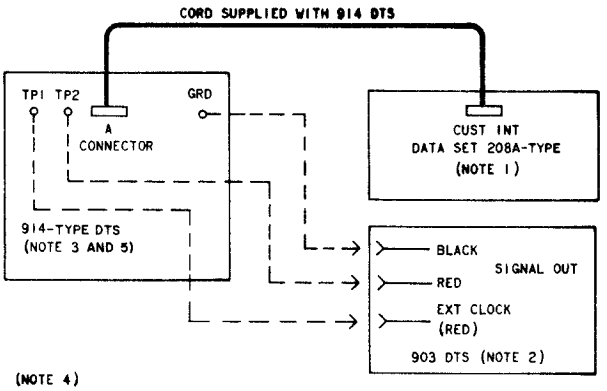
(10) End of test. Restore the data set to normal operating condition.

C. Digital Loopback Test From STC

5.07 When instructed by the STC, place the data set in the digital loopback (DL) mode.

(1) If testing a DS 208A-L1, position the test switch to the right (DL position) and verify that the DL indicator is lighted.

(2) If testing a DS 208A-L1A or DS 208A-L1B, depress the DL switch and verify that the MR indicator is off.



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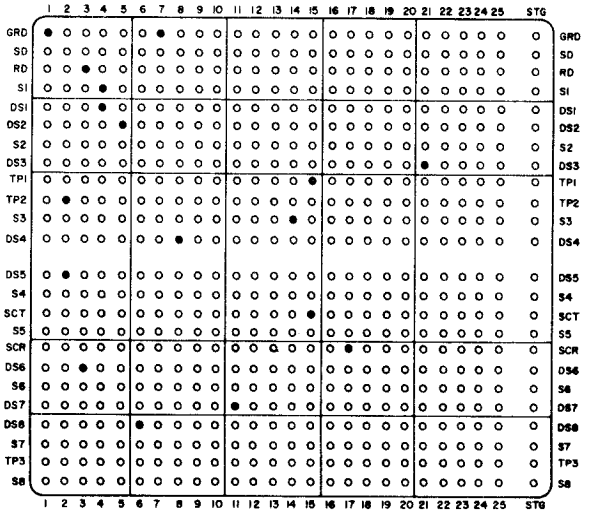


NOTES:

1. VERIFY THE FOLLOWING OPTIONS ARE INSTALLED:

OPTION	SETTING
DSR OFF IN AL MODE (DS208A-L1A OR -L1B)	S1A DOWN
NO COMP EQL TEST (DS208A-L1A OR -L1B	S1B UP
SWITCHED REQUEST-TO-SEND	S1C DOWN
TRANSMITTER INTERNALLY TIMED	S3A DOWN
SWITCHED CARRIER	S4B DOWN

2. IF 903 AND 914B DTS ARE USED, CONNECT 903 AS SHOWN AND SET THE FOLLOWING 903 CONTROLS.

CONTROL	SETTING
BIT RATE	EXT CLOCK
RANDOM-DOT	RANDOM

3. SET SWITCHES ON 914-TYPE DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C DTS) RCV SER (914B BTS)
BIT RATE(S)	EXT +
COUNTER	2WB (914C DTS) 16WL (914B DTS)
FUNCTION	OFF
SIGNAL LEVEL	±4V
SAMPLE WIDTH	.5μS
WORD SYNC	AUTO
S1-S8	OFF
WORD LENGTH(S)	63 (IF 903 DTS IS USED) 511 (IF 914C DTS IS USED)

4. IF 914C IS USED REMOVE PINS FROM TP1-15 AND TP2-2. INSERT PIN IN SD-2.

5. 914 DTS INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

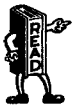
LAMP	FUNCTION	EIA
DS1	REQUEST TO SEND (RS)	CA
DS2	CLEAR TO SEND (CS)	CB
DS3	SIGNAL QUALITY DETECTOR	CG
DS4	RECEIVED LINE SIGNAL DETECTOR (CO)	CF
DS5	TRANSMITTED DATA (SD)	BA
DS6	RECEIVED DATA (RD)	BB
DS7	EQUALIZER MODE (QM)	NON-EIA
DS8	DATA SET READY (DSR)	CC

Fig. 3—Test Setup Using 914-Type and 903-Type DTSs

5.08 After receiving the test results from the STC, restore the data set to normal operating condition as follows.

(1) If testing a DS 208A-L1, position the test switch to the center position and verify that the AL and DL indicators are off.

(2) If testing a DS 208A-L1A or DS 208A-L1B, depress to release the DL switch and verify that the MR indicator is lighted.



If the DL loopback test is successful, depress the DL switch to permit a digital loopback test to be performed when the distant end is installed. Notify the customer to leave the data set in the DL mode.

D. Digital Loopback Test Using a 914-Type DTS

5.09 When instructed by the STC, this test is performed in conjunction with a distant-end data set. The distant-end data set must be in the digital loopback (DL) mode and should have been previously tested by the STC. This test verifies that data can be sent from the local transmitter to the distant-end receiver, looped back on the digital side to the distant-end transmitter, and be transmitted back to the local receiver. The received data (BB) lead at the local receiver is then checked for errors.

5.10 Perform the following procedure for the digital loopback test to distant end.

(1) Connect the equipment and set the controls of the 914-type DTS as shown in Fig. 3.

Note: Verify that switch S1 (CA) is OFF.

(2) On the data set option panel (HG9 or HG23), verify that options are installed as shown in Fig. 3.

(3) If testing DS 208A-L1, position the test switch on the local data set to the center position and verify that both AL and DL indicators are off.

(4) If testing DS 208A-L1A or DS 208A-L1B, ensure all switches are released and the MR indicator is lighted.

(5) Verify that the distant-end data set is in the DL mode.

(6) Apply power to the data set and then to the 914-type DTS.

Requirements: At the data set, the AL, DL, RS, and CS indicators are off and the ON indicator is lighted. At the 914-type DTS, the DS8 (CC) lamp is lighted. If the distant-end data set is optioned for continuous carrier, the data set CO indicator and the 914-type DTS DS3 (CG) and DS4 (CF) lamps are lighted. If the distant-end data set is optioned for switched request-to-send and switched carrier, the data set CO indicator is off and the ER indicator is lighted.

Record whether the distant-end data set is optioned for switched or continuous carrier. This information will be required for the compromise equalizer test, if performed.

(7) At the 914-type DTS, position switch S1 to ON. This turns ***on*** request-to-send to the local transmitter.

Requirements: At the data set, the ON, RS, CS, and CO indicators are lighted; the ER, AL, and DL indicators are off. At the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CG), DS4 (CF), DS7 (QM), and DS8 (CC) lamps are lighted. The NO CLOCK and NO DATA lamps are off.

(8) Reset the counter on the 914-type DTS by depressing the RESET switch. The counter indicates transmission errors that occur.

(9) Verify that the test equipment is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: On the 914-type DTS, the counter indicates rapidly; shortly thereafter, the NO DATA and OVERFLOW lamps light.

(10) Depress the interface selector switch 3A.

(11) Reset the counter to zero by depressing the RESET switch.

(12) Conduct a 10-minute error run.

Requirement: Total is less than 30 block errors.

(13) If the compromise equalizer options are ***not*** to be tested, restore the customer options according to the service order and restore the data station to normal.

E. Digital Loopback Self Test to Distant End (DS 208A-L1A and DS-208A-L1B)

5.11 This test is performed in conjunction with a distant-end data set in the DL mode that has been previously tested by the STC. The local data set is placed into the self test mode by depressing the locking ST switch. This turns on the local transmitter and applies steady marks to the data set internal SD lead. The steady marks are transmitted to the distant-end receiver, where the recovered data is looped around to the transmitter on the digital side of the data set. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is used to indicate any errors made in transmission.

5.12 Perform the following procedure:

(1) Verify that the distant-end data set is in the DL mode.

(2) On the DS-208A-L1A or DS 208A-L1B option panel (HG23), verify that the following options are installed:

- Switched request-to-send (S1C down)
- Switched carrier (S4B down)
- Transmitter internally timed (S3A down)
- DAS not used (S3C down)
- New sync not used by customer (S4C down).

(3) Apply power to the data set.

Requirements: The ON and MR indicators are lighted and the RS and CS indicators are off. If the distant-end data set is optioned for continuous carrier, the CO indicator is lighted. If the distant-end data set is optioned for switched request-to-send and switched carrier, the CO indicator is off and the ER indicator is lighted.

Record whether the distant-end data set is optioned for switched or continuous carrier. This information will be required for the compromise equalizer test, if performed.

(4) Depress the self-test (ST) locking switch.

Requirements: The ON, RS, CS, and CO indicators are lighted and the MR indicator is off. Since the ER indicator responds to errors received, it is off.

(5) Perform a 10-minute error run.

Requirement: The ER indicator is off and does not blink more than an average of 3 times in any 1-minute period.

(6) If the compromise equalizer options are ***not*** to be tested, restore the customer options according to the service order and return the data station to normal.

F. Compromise Equalizer Test

5.13 If the data set under test is optioned for switched carrier, this test is ***required*** on initial data set installation to determine the correct compromise equalizer option. Testing of the compromise equalizer options is ***not*** required if the data set is optioned for continuous carrier operation. In this case, the compromise equalizer should be set for symmetric compromise equalization (S2B up; S2C up).

5.14 When the compromise equalizer test is required, the test procedure is to be performed after the digital loopback test to distant end. The distant-end data set (master station) should have been tested previously by the STC and must be in the DL test mode.

5.15 This test determines how well a receiving data set can retrain using an 8-phase signal instead of receiving a start-up sequence. By turning ***on*** request-to-send at the local data set, carrier is transmitted to the distant-end data set. When the transmitted line signal is interrupted and then reestablished at the local data set, the distant-end data set is forced to retrain without receiving a start-up sequence. Since the distant-end data set is in DL mode, errors which occur at the distant-end data set will be retransmitted back to

the local data set as the distant-end data set retrains. The number of errors occurring during the retrain is an indication of the match between the local transmitter compromise equalizer and the channel characteristics. By comparing the four options of the local transmitter compromise equalizer and selecting the one that produces the least errors at the distant-end receiver, the optimum match of the compromise equalizer to the channel characteristics is obtained.

5.16 Perform the following procedure:

(1) Ensure that the distant-end data set is in the DL test mode and equipped with the following options:

- Symmetric compromise equalization (S2B up; S2C up)
- Retrain automatically (S3B up)
- 1-second holdover disabled (S4A up)
- Continuous carrier (S4B up).

Note: These options are normally installed in a master data set on a multipoint network.

(2) Position the 914-type DTS switches and controls as shown in Fig. 4.

(3) Ensure that the following options are installed in the data set under test:

- Switched request-to-send (S1C down)
- Symmetric compromise equalization (S2B up; S2C up)
- Transmitter internally timed (S3A down)
- Retrain automatically (S3B up)
- 1-second holdover (S4A down)
- Switched carrier (S4B down)
- New sync not used (S4C down).

Note: Except for the compromise equalizer option, these options are normally installed in remote data sets on a multipoint network.

(4) If testing DS 208A-L1A or DS 208A-L1B, install the following additional option:

- Compromise equalizer test enabled (S1B down).

(5) Ensure that the data set under test is in the data mode (all test switches released).

(6) Apply power, first to the data set and then to the 914-type DTS.

(7) At the 914-type DTS, ensure switch S1 (CA) is OFF.

Requirements if testing DS 208A-L1: At the data set, RS, CS, AL, DL, and ER indicators are off. CO and ON indicators are lighted.

Requirements if testing DS 208A-L1A or -L1B: At the data set, MR, RS, CS, and ER indicators are off. ON and CO indicators are lighted.

(8) At the 914-type DTS, position switch S1 to ON.

Requirements if testing DS 208A-L1: At the DTS, DS1 (CA), DS2 (CB), DS3 (CG), DS4 (CF), DS7 (QM), and DS8 (CC) lamps are lighted. DS5 (BA) and DS6 (BB) lamps are off.

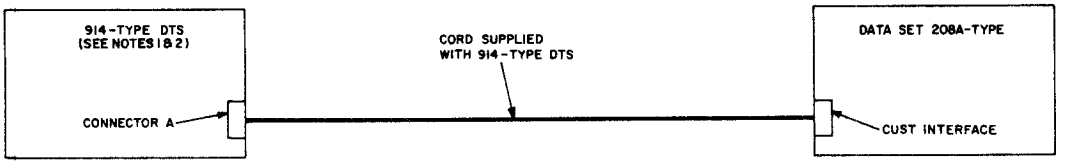
Requirements if testing DS 208A-L1A or -L1B: At the DTS, DS1 (CA), DS2 (CB), DS3 (CG), DS4 (CF), and DS7 (QM) lamps are lighted. DS5 (BA), DS6 (BB), and DS8 (CC) lamps are off.

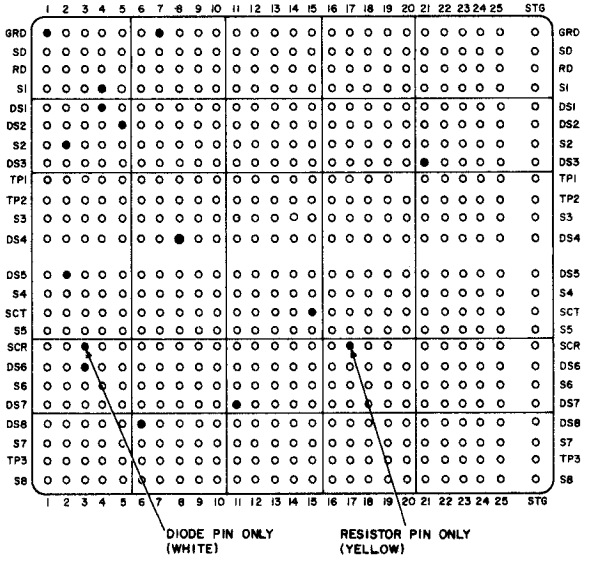
Note: If either the ER indicator (located on the data set) or DS7 (QM) lamp (located on the DTS) blinks, discontinue testing until the blinking ceases.

(9) At the DTS, position switch S1 to OFF.

Requirements if testing DS 208A-L1: At the DTS, DS3, DS4, DS7, DS8, NO CLOCK, and NO DATA lamps are lighted. DS1, DS2, DS5, and DS6 lamps are off.

Requirements if testing DS 208A-L1A or -L1B: At the DTS, DS3, DS4, DS7, NO





NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER(914C); RCV SER(914B)
COUNTER	2WL
TP1 TRIGGER	+/OPEN
TP2 TRIGGER	+/OPEN
FUNCTION	OFF
BIT RATE	EXT +
WORD LENGTH	5II
S1 (CA)	OFF
S2 (BA)	OFF

2. 914 DTS INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS.

LAMP	FUNCTION	EIA
DS 1	REQUEST TO SEND (RS)	CA
DS 2	CLEAR TO SEND (CS)	CB
DS 3	SIGNAL QUALITY DETECTOR	CG
DS 4	RECEIVED LINE SIGNAL DETECTOR (CO)	CF
DS 5	TRANSMITTED DATA (SD)	BA
DS 6	RECEIVED DATA (RD)	BB
DS 7	EQUALIZER MODE (QM)	NON-EIA
DS 8	DATA SET READY (DSR)	CC

Fig. 4—Compromise Equalizer Test Setup

CLOCK, and NO DATA lamps are lighted. DS1, DS2, DS5, DS6, and DS8 lamps are off.

(10) At the DTS, position switches S1 and S2 to ON.

(11) At the DTS, depress the WORD SYNC switch to MAN and release.

Requirement: The DTS counter indicates. If not, repeat (11) until the counter begins indicating. After completing (11), do not depress the WORD SYNC switch for the remainder of the test.

(12) At the DTS, position S2 to OFF.

Requirement: The counter stops indicating and the NO CLOCK lamp lights.

Note: The counter should stop indicating unless the compromise equalizer of the

distant-end data set is grossly misadjusted to the channel, the data sets are defective, or the channel is defective.

(13) Reset the DTS counter.

(14) If testing DS 208A-L1, remove and then reinsert HG5 CP. When HG5 CP is reinserted, the NO CLOCK lamp may turn off and the counter begin to indicate rapidly. Wait for the NO CLOCK lamp to light, if it had turned off, before removing HG5 again.

Note: HG5 CP must be withdrawn from the connector before being reinserted.

(15) If testing DS 208A-L1A or -L1B, momentarily depress and release the nonlocking LP switch. When the LP switch is released, the NO CLOCK lamp may turn off and the counter begin to indicate rapidly. Wait for the NO CLOCK lamp to light, if it had turned off, before depressing the LP switch again.

(16) Repeat (14) or (15) for a total of six times and record the cumulative indication of the DTS counter and the positions of option switches S2A, S2B, and S2C.

Note 1: If during the procedures the counter exceeds 99, record the trial number on which this occurs together with a count of 100 and reset the counter. (For example, if on the fourth trial the counter exceeds 99, reset the counter and continue the test. If, at the end of the sixth trial, the DTS counter indicates 46, the total for the test should be recorded as 146.)

Note 2: In order to reset the counter, the NO CLOCK lamp on the DTS must be lighted.

(17) Position the compromise equalier to the nonequalization condition (S2C down).

(18) Reset the DTS counter.

(19) Repeat (14) or (15) for a total of six times, with each trial allowing the DTS counter to indicate until the NO CLOCK lamp lights.

Note: The notes given in (14) and (16) also apply to (19).

(20) Record the counter indication and the positions of option switches S2A, S2B, and S2C.

(21) Position the compromise equalizer to hi-end compromise equalization (S2A up, S2B down, S2C up).

(22) Reset the DTS counter and repeat (14) or (15) for a total of six times (each time allow the counter to indicate until the NO CLOCK lamp lights). Record the cumulative indication of the DTS counter and the positions of option switches S2A, S2B, and S2C.

(23) Position the compromise equalizer for symmetric and hi-end compromise equalization (S2A down, S2B down, S2C up).

(24) Reset the DTS counter and repeat (14) or (15) for a total of six times (each time allow the counter to indicate until the NO CLOCK lamp lights). Record the cumulative indication of the DTS counter and the positions of option switches S2A, S2B, and S2C.

Requirement: The compromise equalizer option which gives the minimum indication on the counter is the optimum. If two options give minimum but identical indications, position the word length (WL) switch on the 914 DTS to 1WL and repeat the test. Install the compromise equalizer option according to the test results.

(25) Upon completion of the test, restore the data set options specified on the service order and return the data set to normal.

G. Equalizer Start-Up Test

5.17 The purpose of the equalizer start-up test is to verify that a data set which is optioned for switched carrier can start up error-free to the distant end. In order for this to occur, the following conditions must exist:

- The local data set has the correct compromise equalizer option installed.
- The data sets at each end of the circuit are functioning properly.

- The connecting channel meets the requirements given in Section 314-410-500.

5.18 The equalizer start-up test should be performed on maintenance visits ***only*** when the data set is optioned for switched carrier. If switched carrier is installed in both data sets, this test must be performed at each data set. However, the compromise equalizer test should have been performed prior to this start-up test.

5.19 This test consists of switching the CA (request-to-send) lead ***on*** at the local data set and counting any errors received from the distant-end data set (in DL mode) immediately after the CA lead is turned ***on.*** With the correct transmit compromise equalizer options, basic channel conditioning, and a working adaptive equalizer in the receiver, no errors should occur when CA is switched ***on.*** An error or burst of errors, occurring in response to CA being switched ***on,*** indicates that a receiver is not attaining equalization during the start-up sequence. Errors can result from an incorrect transmit compromise equalizer option at either end of the circuit.

Switched Carrier Both Directions

5.20 This test can be performed by one telco employee at either end of the circuit. Both data sets should have been self-tested and remotely tested by the STC before the equalizer start-up test is performed.

5.21 Perform the following procedure:

(1) Ensure that the distant-end data set is in the DL test mode and equipped with the following options:

- Automatic retrain (S3B up)
- Switched request to send (S1C down)
- Switched carrier (S4B down).

Note: These options are normally installed for switched carrier operation.

(2) At the local data set, position the 914-type DTS switches and controls as shown in Fig. 5.

(3) Install the following options in the local data set under test:

- Switched request to send (S1C down)
- Switched carrier (S4B down)
- Internal timing (S3A down)
- Automatic retrain (S3B up).

Note: These options are normally installed for switched carrier operation.

(4) Ensure that the local data set under test is in the data mode (all test switches released).

(5) Apply power to the data set and then to the DTS.

(6) At the DTS, position S1(CA) and S2(BA) to ON.

Requirement: The counter indicates rapidly.

(7) Position S1 and S2 to OFF.

(8) Reset the DTS counter by momentarily depressing the RESET switch.

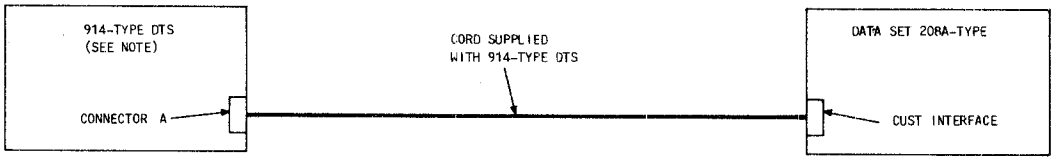
(9) Position S1 to ON.

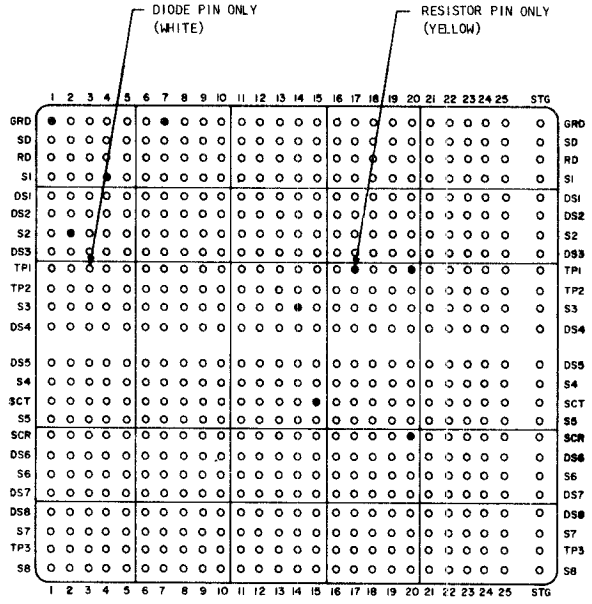
Requirement: The counter indicates ***start-up*** errors that occur immediately after CA is switched ***on.***

Note: Disregard any transient errors that may occur when S1 is positioned to OFF. If either data set has 1-second holdover enabled (S4A up) installed, a burst of errors will occur as S1 is positioned to OFF.

(10) If no start-up errors occur, repeat (8) and (9) for a total of six trials.

If no start-up errors occur in six trials, the compromise equalizer option at each end of the channel is correct. In this case, leave the compromise equalizer option as installed and restore all options as specified on the service order. If start-up errors do occur, this indicates incorrect compromise equalizer





NOTE:
SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER(914C): RCV SER(914B)
COUNTER	INTERVAL X.1
TP1 TRIGGER	+/OPEN
TP2 TRIGGER	+/OPEN
FUNCTION	OFF
BIT RATE	EXT +
S1 (CA)	OFF
S2 (BA)	OFF
S3 (NS)	OFF

Fig. 5—Start-Up Test Setup

option in the distant-end data set, the local data set, or both. The compromise equalizer option of the local data set will be checked first.

(11) Note the local compromise equalizer option and change to a different option.

(12) Repeat (6) through (10) until an option is found that results in no start-up errors or until all possible options have been tried without success.

(13) If no option is satisfactory, a telco employee must be dispatched to the distant-end data set. Each data set compromise equalizer is adjusted in turn while the data set at the other end of the channel is optioned for continuous carrier.

(14) Perform the compromise equalizer test using the procedure given in 5.16.

(15) When both data sets have been tested, restore them to switched carrier option and repeat (6) through (13).

(16) If errors still occur, either the data set is defective and repair procedures given in Fig. 2 must be performed, or the channel does not meet specifications and must be tested as instructed in Section 314-410-500.

(17) End of test. Restore data set options as specified on the service order and return to pretest conditions.

Switched Carrier One Direction

5.22 This test can be performed by either of two methods. If the telco employee is located at the data set optioned for continuous carrier (master data set), this option (S4B up) can be temporarily removed and switched carrier option (S4B down) installed. Since both data sets are now optioned for switched carrier, the procedure given in 5.21 can be performed. Alternatively, if a telco employee is located at each end of the channel, a half-duplex test can be performed as follows:

(1) Ensure that the distant-end data set is equipped with the following options:

- Switched request-to-send (S1C down)
- Switched carrier (S4B down)
- Transmitter internally timed (S3A down)
- New sync not used by customer (S4C down).

Note: These options are normally installed in a remote station of a multipoint network.

(2) At the distant end, position the 914-type DTS switches and controls as shown in Fig. 6.

(3) At the local end, position the 914-type DTS switches and controls as shown in Fig. 5.

(4) Ensure that the local data set is equipped with the following options:

- 1-second holdover disabled (S4A up)
- Retrain automatically (S3B up)
- Transmitter internally timed (S3A down).

Note: These options are normally installed in a master station of a multipoint network.

(5) Ensure that both data sets (local and distant-end) are in the data mode (all test switches released).

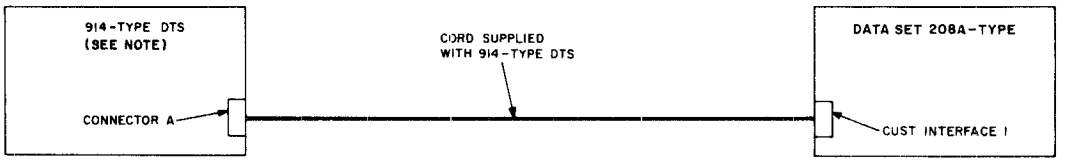
(6) Apply power to both data sets and then to both DTSs.

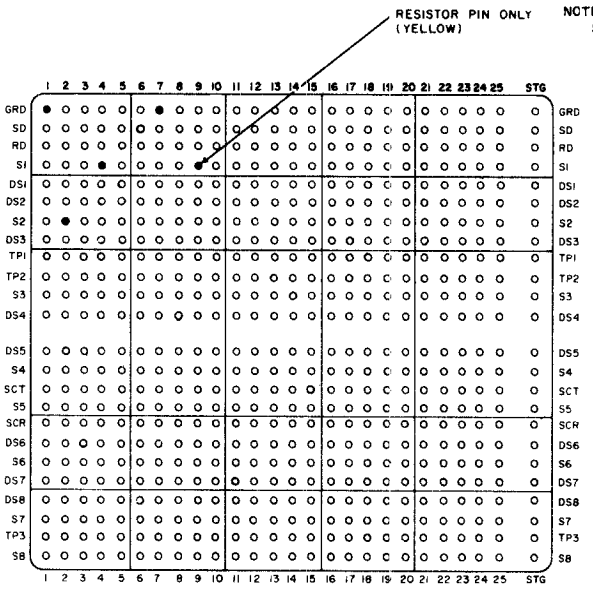
(7) At the distant-end DTS, position S1 (CA) and S2 (BA) to ON.

Requirement: The local counter indicates rapidly.

(8) Position S1 and S2 to OFF.

(9) At the local DTS, reset the counter by momentarily depressing the RESET switch.





NOTE:
SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	INTERVAL (914C); RCV SER(914B)
COUNTER	INTERVAL X.1
FUNCTION	OFF
BIT RATE	2000
TPI TRIGGER	+/OPEN
TP2 TRIGGER	+/OPEN
SI (CA)	OFF
S2 (BA)	OFF

Fig. 6—Interval Test Setup

Requirement: NO CLOCK lamp is lighted.

(10) At the distant end, position S1 to ON.

Requirement: At the local end, the DTS counter indicates start-up errors that occur immediately after CA is switched ***on.***

Note: Disregard transient errors that may occur when S1 (CA) is positioned to OFF.

(11) If no start-up errors occur, repeat (9) and (10) for a total of six trials.

If no errors are counted in six trials, the compromise equalizer option at the distant end of the channel is correct. Restore all options as specified on the service order or record card. If start-up errors do occur, this indicates an incoreect compromise equalizer option in the distant-end data set. In this

case, the compromise equalizer option is the distant-end data set must be changed.

(12) At the distant end, note the compromise equalizer option and change to a different option.

(13) Repeat (7) through (11) until an option is found that results in no start-up errors or until all possible settings have been tested without success.

(14) If errors still occur, either data set may be defective or the channel may not meet requirements. Perform data set repair procedures given in Fig. 2 or test the channel per Section 314-410-500.

(15) End of test. Remove test equipment and return to pretest conditions.

H. Power Supply Test

5.23 The power supply test checks that ac voltage appears at the power supply input and then measures the +12, +5, and -12 volt supply voltages at the customer interface. The only test equipment required is a 914-type DTS and a VOM to measure the ac input voltage if a trouble occurs.

5.24 Perform the following procedure:

(1) Connect the data set to the 914-type DTS. The only programming pins required in the matrix are at crosspoints GRD-1 and GRD-7.

(2) Apply power to the data set and then to 914-type DTS.

Requirement: The data set ON indicator lights.

(3) If the ON indicator fails to light or lights momentarily and goes off, check the ac source voltage with a volt-ohm-milliammeter (VOM).

Requirement: 105 to 130 volts RMS.

DS 208A-type is equipped with an overvoltage protection circuit in the power unit which protects the data set if the output voltages rise excessively. To reset the power unit, unplug the power cord and plug it in again. The data set is also provided with a self-resetting thermal overload switch which shuts off the power unit if the power unit temperature rises excessively.

(4) Position the VERTICAL MONITOR switch to 9 and the RANGE switch to 30 DCV.

(5) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI9 lead (pin 9 of customer interface).

Requirement: 11.0 to 13.0 volts.

(6) Position the FUNCTION switch to OFF and the VERTICAL MONITOR switch to 25.

(7) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI25 lead (pin 25 of customer interface).

Requirement: 4.0 to 6.0 volts.

(8) Position the FUNCTION switch to OFF, the VERTICAL MONITOR switch to 10, and the POLARITY switch to REV.

(9) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI10 lead (pin 10 of customer interface).

Requirement: 11.0 to 13.0 volts.

(10) Position the FUNCTION switch to OFF.

(11) End of test. Remove test equipment and return to pretest conditions.

I. CA-CB Interval Test

5.25 The CA-CB interval test checks both the 7.5-ms and 50-ms request-to-send/clear-to-send (CA-CB) intervals. As part of the test, the transmitter clocks and certain interface signals are checked. Although requirements are given for the two possible options, the data set under test need not be checked for proper operation of both. Check only the CA-CB interval provided by the option specified on the service order. This test is required ***only*** when the data set under test is optioned

for switched request-to-send. The only test equipment required for this test is a 914-type DTS and the 3010-ohm (yellow) pin or equivalent circuit as described in 1.05.

5.26 Perform the following procedure.

(1) Connect the data set to the 914-type DTS and set the controls as shown in Fig. 6.

(2) If a 914C DTS is used, position START switch to A ONLY.

(3) Apply power to the data set and then to the DTS.

(4) On the 914-type DTS, add red pins to the programmable matrix in the following positions: TP1-4, TP2-5.

(5) Install the following options in the data set:

- Switched request-to-send (S1C down)
- Transmitter internally timed (S3A down)
- Carrier option specified by service order [XA (S4B down) or XB (S4B up)]

(6) On the 914 DTS, ensure that switch S1 is OFF. Reset the counter by pressing the RESET switch.

(7) Position switch S1 to ON and record the CA-CB interval on the counter.

Requirements:

Option XA—45 to 52 ms

Option XB—7.0 to 8.7 ms.

Note: If testing option XB, position the DTS COUNTER switch to INTERVAL X.1, resulting in a meter indicaton of 70 to 87.

(8) To remeasure the CA-CB interval, position switch S1 to OFF and depress the RESET switch. When S1 is positioned to ON, the CA-CB interval appears on the counter.

(9) End of test. Remove test equipment and restore data set to normal operating condition.

J. Transmit Level Test

5.27 In this test, the meter on the 914-type DTS is used to measure the transmit level of the data set. The following equipment is required for this test:

(1) One 914-type DTS

(2) One KS-19252-L2 bridging adapter

(3) Two B25A cables

(4) One 66E3 connector block.

(5) One 310 plug.

Note: If a DAS 829 is used, the transmit level can be measured at the TRANS MON jack on the DAS 829 by using a 310 plug. If that is possible, proceed to (5) after connection has been made.

5.28 Perform the following procedure.

(1) Connect the DTS to the data set with the cord provided with the DTS.

(2) If the M8K cord from the data set is connected directly to the DAS, perform the following procedure.

(a) Disconnect the M8K cord from the DAS.

(b) Connect the 50-pin side of the M8K cord to a plug on the KS-19252-L2 bridging adapter.

(c) Connect the connector end of a B25A cable to the remaining plug on the KS-19252-L2 bridging adapter.

(d) Connect the other end of B25A cable to the 66E3 connector block.

(e) Connect the connector end of a B25A cable to the plug on the DAS where the M8K cord was previously connected.

(f) Connect the other end of this B25A cable to the connector on the KS-19252-L2 adapter.

(3) If the M8K cord from the data set is connected to a B25A cable (or any extension cable), perform the following procedure.

(a) Disconnect the M8K cord from the B25A (or extension) cable.

(b) Connect the 50-pin side of the M8K cord to a plug on the KS-19252-L2 bridging adapter.

(c) Connect the connector end of a B25A cable to the remaining plug on the KS-19252-L2 bridging adapter.

(d) Connect the other end of this B25A cable to the 66E3 connector block.

(e) Connect the connector end of a B25A cable to the cable to which the M8K cord was previously connected.

(f) Connect the other end of this B25A cable to the connector on the KS-19252-L2 bridging adapter.

(4) On the 66E3 connector block, connect the meter input to terminals 7 and 8.

Note: If a D25C-61 cord or equivalent is used in a locally engineered PL termination, connect the meter input to terminals 14 and 16.

(5) On the 914-type DTS, set the RANGE switch to 0 dB and set the FUNCTION switch to VOLT/OHM EXT.

(6) If using the 914C DTS, position the TERM switch to IN.

(7) Insert the red pins in the programmable matrix at the following positions: GRD-1, GRD-7, and S1-4.

(8) Apply power to the data set and then to the DTS.

(9) Position switch S1 to ON.

(10) Install switched carrier option (S4B down) and switched request-to-send option (S1C down) in the data set.

(11) If testing DS 208A-L1, verify that the data set test switch is in the center (normal) position and that the AL and DL indicators are off. If testing DS 208A-L1A or -L1B, verify that all switches are in the out (normal) position.

(12) Apply power to the data set and then to the 914-type DTS. Measure the data set transmit level.

Requirement: -3 dBm to +3 dBm.

(13) On the 914-type DTS, position switch S1 to OFF.

Requirement: Transmit level drops to less than -20 dBm.

(14) End of the test. Remove the test equipment and return the data set to pretest conditions.

K. CG-CF Interval Test

5.29 In this test, the interval between CG (initial detection of carrier) and CF (indication to the customer that the data set is in the proper state to receive data) is measured. The only test equipment required is the 914-type DTS and the yellow pin (3010 ohms) or the special circuit as described in 1.05.

5.30 Perform the following procedures.

(1) Connect the data set to the 914-type DTS and position the controls as shown in Fig. 6.

(2) If a 914C DTS is used, position START switch to A ONLY.

(3) Install switched request-to-send (S1C down) and switched carrier (S4B down) options.

(4) Apply power to the data set and then to the 914-type DTS.

(5) Place the DS 208A-type in the AL mode.

(6) At the 914-type DTS, add red pins to the programmable matrix positions TP1-21 and TP2-8.

(7) Verify switch S1 is positioned to OFF. Reset the counter by depressing the RESET switch.

(8) Position switch S1 to ON and read the CG-CF interval on the counter.

Requirement: 38.0 to 44.0 ms.

(9) To remeasure the CG-CF interval, position switch S1 to OFF and reset the counter. Position switch S1 to ON and read the CG-CF interval on the counter.

(10) End of test. Remove test equipment and return the data set to pretest conditions.

L. End-to-End Self Test (DS 208A-L1A and DS 208A-L1B Only)

5.31 The performance of the data channel is quickly tested by the end-to-end self test. Depressing the ST switch on both data sets conditions the respective transmitters to transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission. This test checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facility. The customer interface circuits are not tested by the end-to-end self test.

5.32 Perform the following procedure for the end-to-end self test.

(1) Ensure that the data sets are connected to the facility and that ac power is applied.

Requirement: ON and MR indicators are lighted.

(2) Depress the ST switch on each data set.

Requirement: ON, RS, CS, and CO indicators are lighted. MR and ER indicators are off.

(3) Perform a 5-minute error run.

Requirement: Acceptable performance is indicated by a total of 15 or fewer blinks of the ER indicator.

(4) End of test. Restore both data sets (local and distant-end) to normal operating condition.

M. End-to-End Test Using 914-Type DTS

5.33 The end-to-end test is performed when it is necessary to identify facility troubles which the data set has been occasionally experiencing over a period of time. This test checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facility. The end-to-end test consists of transmitting a random word and establishing an error rate at the receiving end. The block size is measured in approximately 1000-bit blocks.

End-to-End Test (Duplex)

5.34 Perform the following procedure for a duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect a 903-type DTS to a 914B DTS as shown in Fig. 3.

(2) Apply power to the data set and then to the 914-type (903-type) DTS.

(3) At the 914-type DTS, position S1 (CA) to ON.

(4) Establish voice communications between the data stations and verify that neither of the data sets is in a test mode.

(5) If using a 903-type DTS, depress and release the START switch.

Requirements: At each data set, the ON, ME, RS, CS, and CO indicators are lighted. The ER indicator is off. At each 914-type DTS, the DS1, DS2, DS3, DS4, DS5, DS6, and DS8 lamps are lighted.

The attendant at each data station must verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the test must be restarted.

(6) At both data stations, simultaneously depress the DTS RESET and perform a 10-minute error run and record the total errors.

Requirement: Total errors are fewer than 30 block errors.

(7) End of test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

End-to-End Test (Half-Duplex)

5.35 Perform the following procedure for a half-duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914-type DTS as shown in Fig. 3.

Note: The 903-type DTS is not required for a half-duplex test.

(2) Apply power to the data set and then to the 914-type DTS.

(3) On the 914-type DTS at the transmitting end only, position S1 (CA) to ON.

(4) Establish voice communications between the data situations and verify that neither of the data sets is in a test mode.

(5) On the 914-type DTS at the transmitting end only, position the TEST SET MODE switch to TRMT SER (914B DTS) or SER (914C DTS).

(6) On the 914-type DTS at the receiving end only, position the TEST SET MODE switch to the RCV SER (914B DTS) or SER (914C DTS).

Requirement: See Table D.

The attendant at the receiving station should verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the receiving station attendant must contact the transmitting station and agree to retest.

(7) On the 914-type DTS at the receiving end, depress the DTS RESET and perform a 10-minute error run and record the total errors.

Requirement: Total errors are fewer than 30 block errors.

(8) At the end of the prearranged time interval, establish voice communication to discuss the test results and agree to repeat the end-to-end test in the opposite direction if necessary. The transmitting data station now becomes the receiving data station. Repeat (5) through (7).

(9) End of test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

6. SUPPLEMENTARY TEST

6.01 This test is not required for either installation or maintenance, but is designed to aid in locating a source of intermittent errors introduced into the data communication channel.

Ground Noise Test

6.02 If the data set and CPE are not at the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6H impulse counter.

Note: For information pertaining to the 6H impulse counter, refer to Section 103-620-101. If the 6H impulse counter is ***not*** available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to Section 103-620-100.

6.03 Connect the 6H impulse counter and perform the test as follows.

(1) Use a 2W6A test cord or equivalent (310 plug on one end; alligator clips connected to tip and ring on the other end). Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective

TABLE D

TRANSMIT – RECEIVE TEST REQUIREMENTS

TRANSMITTER								RECEIVER							
208A-L1				208A-L1A OR -L1B				208A-L1				208A-L1A OR -L1B			
INDICATORS ON DATA SET		INDICATORS ON 914 DTS		INDICATORS ON DATA SET		INDICATORS ON 914 DTS		INDICATORS ON DATA SET		INDICATORS ON 914 DTS		INDICATORS ON DATA SET		INDICATORS ON 914 DTS	
ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF
ON	CO*	DS1 (CA)	DS3 (CG)	ON	CO*	DS1 (CA)	DS3 (CG)	ON	RS	DS3 (CG)	DS1 (CA)	ON	RS	DS3 (CG)	DS1 (CA)
RS	AL	DS2 (CB)	DS4 (CF)	MR		DS2 (CB)	DS4 (CF)	CO	CS	DS4 (CF)	DS2 (CB)	MR	CS	DS4 (CF)	DS2 (CB)
CS	DL	DS5† (BA)	DS6 (BB)	RS		DS5† (BA)	DS6 (BB)		ER	DS5‡ (BA)	DS5§ (BA)	CO	ER	DS5‡ (BA)	DS5§ (BA)
ER		DS8 (CC)	DS7 (QM)	CS		DS8 (CC)	DS7 (QM)		AL	DS6† (BB)				DS6† (BB)	
				ER					DL	DS7 (QM)				DS7 (QM)	
										DS8 (CC)				DS8 (CC)	

* If the receiving end data set is equipped with continuous carrier, the CO indicator will be lighted and the ER indicator will be off.

† Dimly lighted (random data appears on these leads).

‡ If 914C DTS is used, this indicator will be dimly lighted.

§ If 914B DTS is used.

ground from the CPE appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1A and connect the other clip to switch 1B. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, position the DIAL-MEAS switch to MEAS and the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Position the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord from 1A and 1B and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Position the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

6.04 At the end of both 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

7. REFERENCES

7.01 The following Bell System Practices provide additional information pertaining to test procedures for DS 208A-type.

SECTION	TITLE
103-620-100	J94006A (6A) Impulse Counter—Description, Operation, and Maintenance
103-620-101	6H and 6HR Impulse Counters (J9006H and J9006HR)—Description, Operation, and Maintenance
314-410-500	Private Line Data Circuits—Voice Bandwidth Circuits for Miscellaneous Data—Overall Tests and Requirements
592-027-100	Data Set 208A-Type—Transmitter-Receiver—Description and Operation
592-027-150	Data Set 208A-Type—Transmitter-Receiver—Supplementary Information
592-027-300	Data Set 208A-Type—Transmitter-Receiver—Installation and Connections
592-027-501	Data Set 208A-Type—Transmitter-Receiver—Test Procedures Using 921A Data Test Set
598-080-500	Data Auxiliary Set 828A—Data Service Unit—Maintenance and Test Procedures
598-082-500	Data Auxiliary Set 829-Type Channel Interface Units—Voiceband Private Line Channels—Test Procedures
666-511-503	Test of Data Service Provided by Data Set 208A-Type from a Private Line Test Room
666-511-504	Test of Data Service Provided by Data Set 209A-L1 from a Private Line Test Room
999-100-105	Data Set 208A-Type—How to Operate Manual

DATA SET 208A-TYPE
TRANSMITTER-RECEIVER
TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 208A-type. Test procedures using the 914-type DTS and self-test capabilities of DS 208A-type are contained in Section 592-027-500. These procedures are to be used when testing DS 208A-type on an initial installation or during a maintenance visit.

1.02 This section is reissued to add coverage for Version 2 of the 921A DTS. Since this reissue is a general revision, arrows normally used to indicate changes have been omitted.

1.03 When DS 208A-type is used as an extension of a DS 209A-L1 multiplex system, refer to Section 592-032-300 for maintenance information. Procedures used at the serving test center (STC) to maintain this system are contained in Section 666-511-504.

1.04 When DS 208A-type is used as a subrate off-net extension of the DDS, refer to Section 314-919-300 for maintenance information. Procedures used at the hub office STC to maintain the analog portion of this system are contained in Section 666-511-501.

A. Test Capabilities

1.05 Test circuitry built into DS 208A-L1A and -L1B permits the following self tests to be performed: lamp, analog loopback, digital loopback, and end-to-end. Additional tests require the use of external test equipment such as the 921A DTS. DS 208A-L1 has analog loopback and digital loopback test capabilities, but does not have the self-test capabilities provided by DS 208A-L1A and -L1B.

1.06 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

B. Self Tests

Lamp Test

1.07 The lamp test (LP) nonlocking switch, when depressed, lights the MR, RS, CS, CO, and ER indicator lamps to verify proper operation of these lamps. The LP switch can be depressed at any time, since it does not affect normal data set operation.

> ***Note:*** During the compromise equalizer test, the data set is optioned such that the LP switch, when depressed, shorts the transmitted signal. The lamps listed above will light. If the compromise equalizer test option is inadvertently installed during normal operation, the MR lamp will not be lighted and the CC (data set ready) lead at the customer interface will be off.

Analog Loopback Self Test (DS 208A-L1A or -L1B)

1.08 This test is initiated by depressing the analog loopback (AL) and self-test (ST) locking switches. Depressing the AL switch connects the data set transmitter to the data set receiver through an internal pad. Depressing the ST switch turns ***on*** the internal request-to-send (CA) lead, transmits steady marks on the internal send data (BA) lead, and conditions the ER lamp to indicate received errors.

Digital Loopback Self Test (DS 208A-L1A or -L1B)

1.09 This test is performed from the local data set to a distant data set. The distant data set must be in the digital loopback (DL) mode. The local data set is placed in the self-test mode by depressing the ST locking switch. This turns on the local transmitter and applies steady marks to the internal send data (BA) lead. The steady marks are transmitted to the distant receiver, where the recovered data is looped back internally to the distant transmitter. The distant transmitter now transmits this data back to the local receiver, where the ER lamp indicates any errors made in transmission.

End-to-End Self Test (DS 208A-L1A or -L1B)

1.10 This test is initiated by depressing the ST locking switches on both data sets. This action conditions the respective transmitters to transmit steady marks. At both receivers, the ER lamps indicate any errors made in transmission.

C. Restrictions on Use of Self Tests

1.11 If DS 208A-L1A or -L1B is used as a remote extension of a DS 209A-L1 multiplex system or as a subrate off-net extension of the digital data system (DDS), the following restrictions apply to the use of the self tests:

(a) The analog loopback self test cannot be performed at a remote extension with options as installed. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

(b) The digital loopback self test cannot be performed from a remote extension (with options as installed) in toward DS 208A-type collocated with DS 209A-L1. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

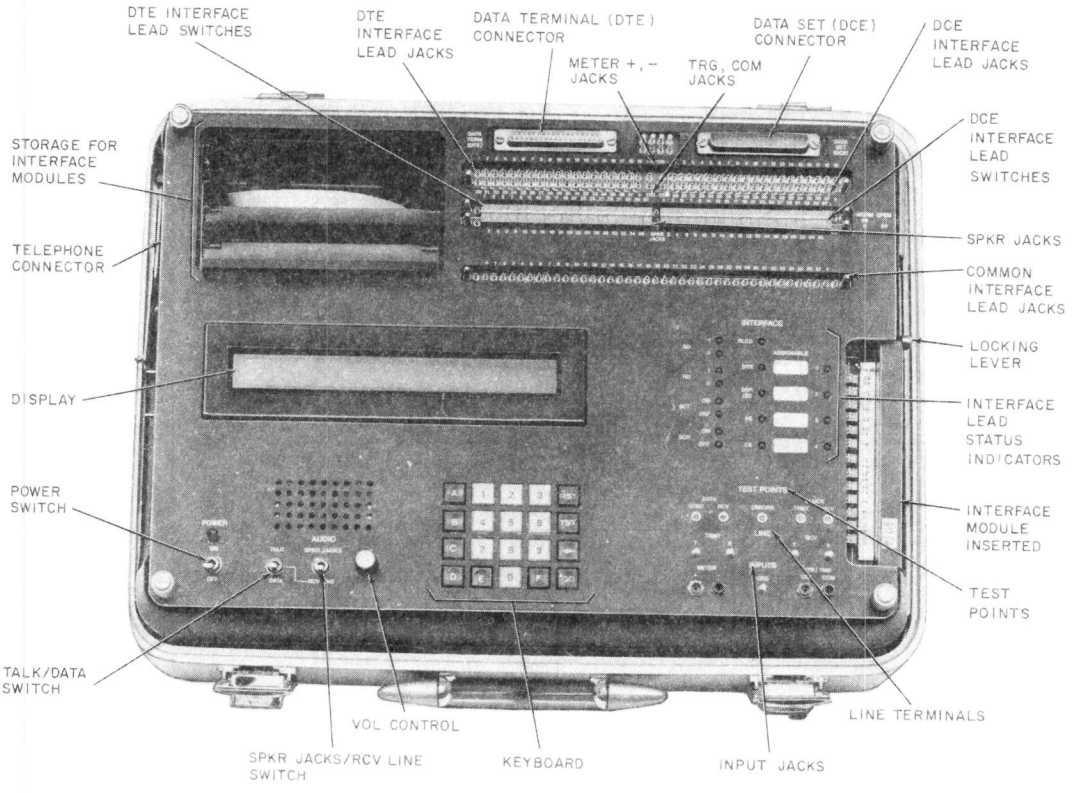


Fig. 1—921A Data Test Set—Front Panel

(c) The digital loopback self test cannot be performed from a remote extension (with options as installed) in toward a hub office of the DDS. If the internal timing option is temporarily installed or the M23B cord is temporarily removed at the remote extension, this test can be performed.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence (Fig. 2) provides a method of verifying that the installation is satisfactory. Before proceeding with the tests, verify that the private line meets the requirements specified in Section 314-410-500.

2.02 If the system being installed is a multipoint system, it is recommended that the data set associated with the master station be installed first. Set the compromise equalizer option for symmetric compromise equalization, (S2B up; S2C up) and test the data set from a test center. As each of the remote data sets are installed, perform the compromise equalizer test and install the optimum setting. Perform a digital loopback start-up test from each remote data set to the master data set to verify that the system will operate with the installed settings.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed when clearing a

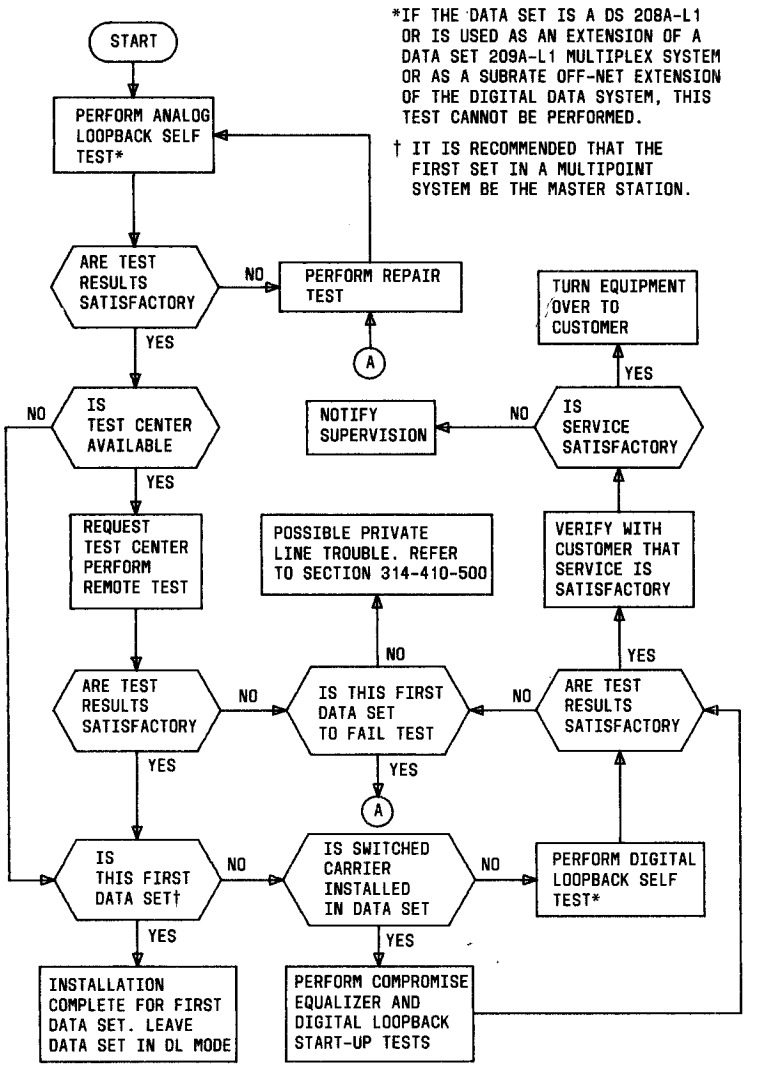


Fig. 2—Installation Test Sequence

trouble report and during a maintenance visit to the data station.

3.02 When a trouble report is received, a test center is reponsible for isolating the trouble to the data station or the transmission facility. The procedure for doing this is shown in Fig. 3.

3.03 If the trouble seems to be in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more

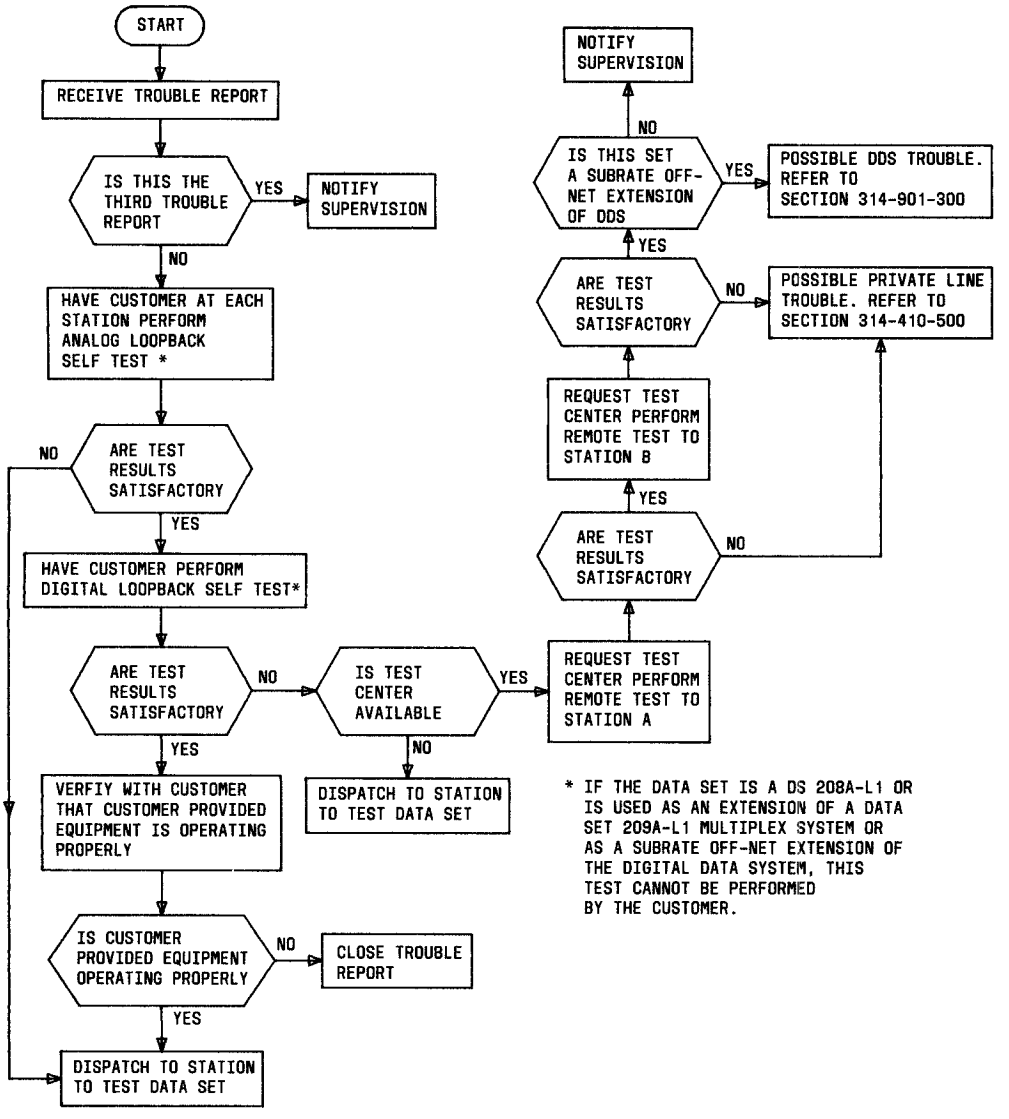


Fig. 3—Clearing Trouble Report

extensive tests at the data station. The following equipment should be taken on a trouble visit:

- 921A DTS
- Maintenance Kit

3.04 The maintenance kits consist of replacement circuit packs for DS 208-type. Circuit packs in the maintenance kits not used in DS 208A-type are used to support DS 208B-type. The available maintenance kits are as follows.

- D-180497 for DS 208A-L1
- D-180657 for DS 208A-L1 or -L1A
- D-180718 for DS 208A-L1, -L1A, or -L1B

3.05 The sequence in which tests are to be performed by the telco employee at the data station is shown in Fig. 4. If the trouble is isolated to the data set, the repair test procedures in paragraphs 4.35 and 4.36 are to be performed to isolate the trouble to a circuit pack in the data set.

3.06 If a circuit pack is replaced, tag the defective circuit pack with a description of the trouble and carefully pack the circuit pack in the shipping carton supplied with the maintenance kit. Mark the carton with the data set code, circuit pack code, and date of manufacture. For example:

Data set 208A

HG11 IV 75

Send the properly packed and marked carton to the telco supplies operation group and notify that group in the normal manner that a replacement circuit pack is needed. The telco supplies operation group will place a requisition for a replacement circuit pack with the local Western Electric service center which will expedite the requisition to the Montgomery (ILL) merchandise organization to ensure its receipt within 24 hours. The Montgomery merchandise organization will ship the circuit pack (via fastest method) directly to the designated telco location within 24 hours after receiving the requisition.

3.07 If the trouble persists after the tests have been completed, proceed as follows.

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that CPE has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

A. Analog Loopback Self Test (DS 208A-L1A or -L1B)

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked.

4.03 Perform the test as follows.

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and ST switches on data set.

Requirements: ON, RS, CS, and CO lamps are lighted. MR and ER lamps are off.

(3) Observe lamps on data set for at least 30 seconds.

Requirement: ER lamp is off continuously (does not blink).

(4) Release ST and AL switches on data set.

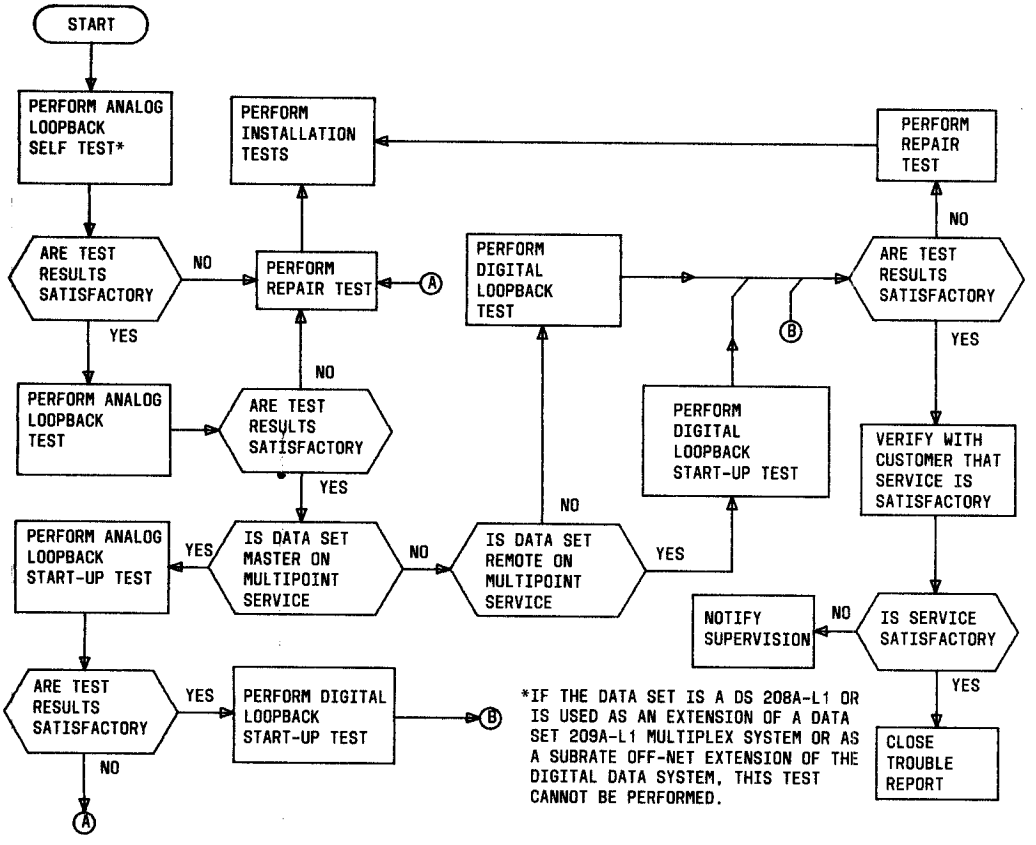


Fig. 4—Maintenance Test Sequence

B. Digital Loopback Self Test (DS 208A-L1A or -L1B)

4.04 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked.

4.05 Perform the test as follows.

(1) Ensure that the following options are installed in local data set.

- No compromise equalizer test (S1B up)
- Switched request-to-send (S1C down)
- Switched carrier (S4B down)
- Transmitter internally timed (S3A down)
- DAS not used (S3C down)
- New sync not used by customer (S4C down).

(2) Ensure that distant data set is in DL mode.

(3) Apply power to local data set.

Requirements: On local data set, ON and MR lamps are lighted and RS and CS lamps are off. If distant data set is optioned for

continuous carrier (S4B up), CO lamp on local data set is lighted. If distant data set is optioned for switched request-to-send (S1C down) and switched carrier (S4B down) CO lamp on local data set is off and ER lamp is lighted.

(4) Depress ST switch on local data set.

Requirements: On local data set, ON, RS, CS, and CO lamps are lighted. MR and ER lamps are off.

(5) Observe ER lamp for ten 1-minute periods.

Requirement: ER lamp does not blink more than an average of three blinks per 1-minute period.

(6) Release ST switch on local data set.

(7) Have distant data set taken out of DL mode.

(8) Restore local data set to pre-test condition.

C. End-to-End Self Test (DS 208A-L1A or -L1B)

4.06 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked.

4.07 Perform the test set as follows.

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that neither data set is transmitting or receiving data.

(3) On both data sets, depress ST switch.

Requirements: On both data sets, ON, RS, CS, and CO lamps are lighted. MR and ER lamps are off.

(4) Observe ER lamp for ten 1-minute periods.

Requirement: ER lamp does not blink more than an average of three blinks per 1-minute period.

(5) On both data sets, release ST switch.

D. Remote Test

4.08 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

4.09 Perform the test as follows.

(1) Contact test center and request a remote test.

(2) When directed by test center, place data set in DL mode.

(3) Test center performs remote test.

(4) When directed by test center, take data set out of DL mode.

E. Initial Test Setup for 921A DTS

4.10 Perform the initial test setup for the 921A DTS when used to test DS 208A-type as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	

STEP	ACTION	VERIFICATION
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs shelf tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	Enter 70 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 70
12	Press GO.	Display reads— BIT RATE:
13	Enter 48.	Display reads— BIT RATE: 48
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

F. Analog Loopback Test

4.11 In this test, an analog loopback block error run is performed. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.12 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Place data set in AL mode.	
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0120. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0120 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error.

STEP	ACTION	VERIFICATION
		Requirement: No blocks in error.
9	Take data set out of AL mode.	

G. Digital Loopback Test

4.13 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interface at the distant data set is not checked. Test data is generated by the 921A DTS and transmitted by the local data set. This data is looped back internally from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.14 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Contact distant data station and have data set placed in DL mode.	
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS

STEP	ACTION	VERIFICATION
8	Enter 0600. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0600 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 30.
9	Contact distant data station and have data set taken out of DL mode.	

H. Start-Up Tests

4.15 The start-up tests check the ability of the data set to begin error-free transmission. In these tests, the 921A DTS (1) starts transmitting a 128-bit word, (2) stops transmitting the word, and (3) checks the word for errors. This sequence of operations is automatically repeated for the duration of the tests.

4.16 Three types of start-up tests can be performed.

- ***Analog Loopback:*** The local data set is placed in the analog loopback mode. The local data set must be equipped with switched carrier, switched request-to-send, and 1-second holdover disabled.

- ***Digital Loopback:*** The local data set is placed in the data mode and the distant data set is placed in the digital loopback mode. Both local and distant data sets must be equipped with switched carrier and switched request-to-send. If this test is a timed test, both local and distant data sets must also be equipped with 1-second holdover disabled.

For a multipoint circuit, to perform this test with the 921A DTS at the master station and the remote station in the digital loopback mode, the following conditions must be met.

(a) Change the master station to switched carrier and switched request-to-send.

(b) Perform the test manually with the 921A DTS, if the remote station is ***not*** changed to 1-second holdover disabled. Allow a 2-second interval between manual steps of the 921A DTS.

(c) Perform the test timed or manually, if the remote station is changed to 1-second holdover disabled.

To perform this test with the 921A DTS at the remote station and the master station in the digital loopback mode, the preceding three conditions must be met. Therefore, normally this test can not be performed with the 921A DTS at the remote station unless a telco employee is dispatched to the master station to change the master station to switched carrier and switched request-to-send.

- ***End-to-End:*** Both local and distant data sets are placed in the data mode. Either the local or distant data set must be equipped with switched carrier, switched request-to-send, and 1-second holdover disabled.

Analog Loopback Start-Up Test

4.17 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	If continuous carrier (S4B up), continuous request-to-send (S1C up), and/or 1-second holdover (S4A down) are installed in data set, temporarily install switched carrier (S4B down), switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up).	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Place data set in AL mode.	
4	On DTS, enter 67.	Display reads— TEST SEQ: 67
5	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
6	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
7	Enter 2.	Display reads— PRESS A TO START
8	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
9	At end of about 1 minute, press D.	***Requirement:*** Zero count on ERR and * displays.

STEP	ACTION	VERIFICATION
10	Take data set out of AL mode.	
11	If switched carrier (S4B down), switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up) were temporarily installed in data set in Step 1, install continuous carrier (S4B up), continuous request-to-send (S1C up), and/or 1-second holdover (S4A down).	

Digital Loopback Start-Up Test

4.18 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	If continuous (S4B up) continuous request-to-send (S1C up), and/or 1-second holdover (S4A down) are installed in local or distant data set, temporarily install switched carrier (S4B down), switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up).	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Contact distant data station and have data set placed in DL mode.	
4	On DTS, enter 70.	Display reads— TEST SEQ: 70
5	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
6	Enter 2.	Display reads (briefly)— ENTER HEX CHARS Display then fills with 32 "?"s.
7	Enter FF FF FF 16 16 01 31 32 33 02 53 54 41 52 54 03. ***Note:*** To delete last character entered, press back arrow (←).	Display reads (briefly)— FFFFFF16160131323302535441525403 Display then reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
8	Enter 2.	Display reads— PRESS A TO START

STEP	ACTION	VERIFICATION
9	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. KEY — FUNCTION A — Restart test. C — Clear display. D — Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
10	At end of about 1 minute, press D.	***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
11	Contact distant data station and have data set taken out of DL mode.	
12	If switched carrier (S4B down) switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up) were temporarily installed in local or distant data set in Step 1, install continuous carrier (S4B up), continuous request-to-send (S1C), and/or 1-second holdover (S4A down).	

End-to-End Start-Up Test

4.19 In this test, one end is arbitrarily selected as the controlling station. This station has operating control of the test. Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-up test. ***Note 1:*** If continuous carrier (S4B up), continuous request-to-send (S1C up), and/or 1-second holdover (S4A down) are installed in data set at controlled station, temporarily install switched carrier (S4B down), switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up). ***Note 2:*** Procedure at controlled station must be performed first.	

STEP	ACTION	VERIFICATION
	At controlled station, perform Steps 2 through 7.	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 68.	Display reads— TEST SEQ: 68
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	If switched carrier (S4B down) is installed in data set at controlling station, enter 2. If continuous carrier (S4B up) is installed in data set at controlling station, enter 3.	Display reads— PRESS A TO START
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
7	Press A. ***Note:*** When A is pressed in Step 14, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 After A is pressed at controlling station, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block. All displays stop counting when D is pressed at controlling station. ***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
	At controlling station, perform Steps 8 through 15.	
8	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
9	Enter 67.	Display reads— TEST SEQ: 67
10	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
11	If switched carrier (S4B down) is installed in data set at controlling station, enter 2. If continuous carrier (S4B up) is installed in data set at controlling station, enter 3.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR

STEP	ACTION	VERIFICATION
12	Enter 2.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A — Restart test. C — Clear display. D — Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
15	At end of about 1 minute, press D. ***Note:*** If switched carrier (S4B down), switched request-to-send (S1C down), and/or 1-second holdover disabled (S4A up) were temporarily installed in data set at controlled station, install continuous carrier (S4B up), continuous request-to-send (S1C up), and/or 1-second holdover (S4A down).	***Requirements:*** Count of less than 2 on ERR display and zero count on * display.

I. Power Supply Test

4.20 This test measures the +12, +5, and -12 volt supply voltages at the customer interface.

4.21 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Enter 12.	Display reads— TEST SEQ: 12

STEP	ACTION	VERIFICATION
3	Connect jumper wire from DCE interface lead jack 7 to - METER jack.	
4	Connect jumper wire from DCE interface lead jack 9 to + METER jack.	
5	Press GO.	Display reads voltage present on jack 9. ***Requirement:*** +11.0 to +13.0 volts.
6	Move jumper wire from jack 9 to jack 10.	Display reads voltage present on jack 10. ***Requirement:*** -11.0 to -13.0 volts.
7	Move jumper wire from jack 10 to jack 25.	Display reads voltage present on jack 25. ***Requirement:*** +4.5 to +5.5 volts.
8	Remove jumper wires from DCE interface lead and METER jacks.	

J. CA-CB (RS-CS) Interval Test

4.22 This test measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) lead turns ***on***. If the data set is equipped with continuous carrier (S4B up) and continuous request-to-send (S1C up), this test cannot be performed.

4.23 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Place data set in AL mode.	
3	On DTS, enter 30.	Display reads— TEST SEQ: 30
4	Press GO. ***Note:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** 7.0 to 8.7 ms if continuous carrier (S4B up) and switched request-to-send (S1C down) are installed in data set; 45 to 52 ms if switched carrier (S4B down) and switched request-to-send (S1C down) are installed in data set.
5	Take data set out of AL mode.	

K. Transmitter Output Test

4.24 This test measures the output level of the transmitted signal.

4.25 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Connect data set to DTS using telephone interface cable and adapter cord provided with DTS. ***Note:*** The telephone interface cable is equipped with two 9-pin connectors. The 6-inch adapter cord is equipped with a 9-pin connector and a double-faced, 25-pin connector. Connect interface cable from 9-pin telephone connector on left side of DTS to 9-pin connector on adapter cord. Insert double-faced, 25-pin connector on adapter cord between telephone line connector on data set and telephone line cord.	
3	On front of DTS: (a) Connect meter leads from LINE—TRMT terminals T and R to INPUTS—METER jacks + and -. (b) Set TALK/DATA switch to DATA. (c) Set SPKR JACKS/RCV LINE switch to RCV LINE.	
4	Enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
5	Enter 1.	Display reads— TEST SEQ: 36 RS=1 (0 OR 1)
6	Enter 11.	Display reads— :11 R=? 1=135 6=600 9=900 0=N
7	Enter 6.	Display reads (briefly)— :11 R=6 1=135 6=600 9=900 0=N Display then reads— :
8	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads transmitter output level in mV ac and dBm.

STEP	ACTION	VERIFICATION
		Requirement: -1.5 to +1.0 dBm.
9	Disconnect meter leads, telephone interface cable, and adapter cord.	

L. Transmitter Clock Test

4.26 This test measures the frequency of the transmitter clock signal, DB (SCT), on the transmitter signal element timing lead.

4.27 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Enter 47 48 17 47.	Display reads— TEST SEQ: 47 48 17 47
3	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
4	Enter 04 03.	Display reads (briefly)— SW CONN: X=04 Y=03 Display then reads— SW CONN X=?? Y=??
5	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads transmitter clock frequency in hertz. ***Requirement:*** 4799 to 4801 Hz.
6	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE

STEP	ACTION	VERIFICATION
		Display then reads— TEST SEQ:

M. CA-CF (RS-COD) Interval Test

4.28 This test measures the interval between CA (request-to-send) and CF (carrier on).

4.29 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	If continuous carrier (S4B up) and/or continuous request-to-send (S1C up) are installed in data set, temporarily install switched carrier (S4B down) and/or switched request-to-send (S1C down).	
3	Place data set in AL mode.	
4	On DTS, enter 31.	Display reads— TEST SEQ: 31
5	Press GO. ***Note:*** To repeat test, press A.	Display reads RS-RLSD (CA-CF) interval in milliseconds. ***Requirement:*** 47 to 55 ms.
6	Take data set out of AL mode.	
7	If switched carrier (S4B down) and/or switched request-to-send (S1C down) were temporarily installed in data set in Step 2, install continuous carrier (S4B up) and/or continuous request-to-send (S1C up).	

N. Compromise Equalizer Test

4.30 This test determines the correct setting of the compromise equalizer option and is required only if the data set under test is optioned for switched carrier (S4B down). This test is not required if the data set is optioned for continuous carrier (S4B up). In that case, set the compromise equalizer option for symmetric compromise equalization (S2B up; S2C up).

4.31 This test consists of a series of digital loopback tests from the remote data set to the master data set on a multipoint network. Each series of digital loopback tests is performed with a different setting on the compromise equalizer. The setting with the fewest block errors is then selected. After this test is completed, perform a digital loopback start-up test to verify that the data set meets start-up requirements with the setting selected.

4.32 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Ensure that the following options are installed in distant (master) data set: Symmetric compromise equalization (S2B up; S2C up) Retrain automatically (S3B up) 1-second holdover disabled (S4A up) Continuous carrier (S4B up).	
3	Ensure that distant data set is in DL mode.	
4	Ensure that the following options are installed in data set under test: Switched request-to-send (S1C down) Symmetric compromise equalization (S2B up; S2C up) Transmitter internally timed (S3A down) Retrain automatically (S3B up) 1-second holdover disabled (S4A up) Switched carrier (S4B down) New sync not used by customer (S4C down). If data set under test is a DS 208A-L1A or -L1B, install compromise equalizer test enabled option (S1B down).	
5	On DTS, enter 55.	Display reads — TEST SEQ: 55
6	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
7	Enter 1.	Display reads (briefly)— MARKING BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
8	Enter 2.	Display reads — ????? BITS IN A BLOCK
9	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
10	Enter 9999.	Display reads (briefly)— 9999 SEC IS AN UNTIMED TEST

STEP	ACTION	VERIFICATION
		Display then reads— BLK RCVD=0000 ERR=0000
11	If testing DS 208A-L1, remove and then reinsert CP HG5. ***Note:*** CP HG5 must be withdrawn from connector before being reinserted.	When CP HG5 is reinserted, ERR counter starts counting. When ERR counter stops, test can be repeated.
12	If testing DS 208A-L1A or -L1B, momentarily depress and release nonlocking LP switch on data set.	When LP switch is released, ERR counter starts counting. When ERR counter stops, test can be repeated.
13	Repeat Step 11 or 12 for a total of six times and record cumulative reading from counter. Record position of option switches S2A, S2B, and S2C.	
14	Install compromise equalizer option ZT (S2C down).	
15	On DTS, reset counter by pressing C.	Display reads — BLK RCVD=0000 ERR=0000
16	Repeat Step 11 or 12 for a total of six times and record cumulative reading from counter. Record position of option switches S2A, S2B, and S2C.	
17	Install compromise equalizer option ZU (S2A up, S2B down, S2C up).	
18	On DTS, reset counter by pressing C.	Display reads— BLK RCVD=0000 ERR=0000
19	Repeat Step 11 or 12 for a total of six times and record cumulative reading from counter. Record position of option switches S2A, S2B, and S2C.	
20	Install compromise equalizer option ZV (S2A down, S2B down, S2C up).	
21	On DTS, reset counter by pressing C.	Display reads— BLK RCVD=0000 ERR=0000
22	Repeat Step 11 or 12 for a total of six times and record cumulative reading from counter. Record position of option switches S2A, S2B, and S2C.	

STEP	ACTION	VERIFICATION
23	Compare results of test for each equalizer setting. The compromise equalizer option that gives minimum reading on counter is optimum setting. Install that option in data set.	
24	If data set under test is a DS 208A-L1A or -L1B, install no compromise equalizer test option (S1B up).	
25	Disconnect test equipment and restore both data sets to pre-test condition. Have distant data set taken out of DL mode.	

O. End-to-End Block Error Test

4.33 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

4.34 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations.	
At both stations, perform Steps 2 through 8.		
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS

STEP	ACTION	VERIFICATION
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0600. ***Note:*** To perform functions listed below, press associated key. **KEY** — **FUNCTION** A — Repeat test. B — Display time remaining in test. C — Clear display. D — End test. E — Inject 8 errors into data stream. F — Force out-of-sync condition.	Display reads (briefly)— 0600 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 30.

P. Repair Test

4.35 This test provides a method for isolating a data set trouble to a single circuit pack (CP). Table A lists the individual tests in the sequence in which they are to be performed, and also lists the associated CPs that might be defective if the test fails.

4.36 If the data set fails a test listed in Table A, proceed as follows.

(1) Refer to list of CPs associated with test that failed.

(2) Replace first CP in list and repeat test.

(3) If data set still fails test, restore original CP in data set.

(4) Continue replacing, testing, and restoring CPs in sequence in which they are listed until data set passes test. The last CP replaced is cause of trouble.

Note: If CP HG9 or HG23 is replaced, install correct options before proceeding.

(5) If all CPs have been replaced and cause of trouble has not been found, notify supervision.

TABLE A

REPAIR PROCEDURES

TEST	CP REPLACEMENT SEQUENCE		
	DS 208A-L1	DS 208A-L1A	DS 208A-L1B
CA-CB (RS-CS) Interval	HG5 HG6 HG9 HG1 or HG21 HG2 HG17	HG5 HG6 HG23 HG21 HG2 HG17	HG26 HG23 HG21 HG2
Transmitter Output	HG9 HG16 or HG16B HG8 HG1 or HG21 HG5 HG6 HG17 HG2	HG23 HG16B HG8 HG21 HG5 HG6 HG17 HG2	HG23 HG16B HG8 HG21 HG26 HG2
Transmitter Clock	HG1 or HG21 HG5	HG21 HG5	HG21 HG26
CA-CF (RS-COD) Interval	HG9 HG3 HG17 HG4 HG7 HG14 or HG14B HG8 HG2	HG23 HG3 HG17 HG4 HG7 HG14B HG8 HG2	HG23 HG3 HG26 HG4 HG7 HG14B HG8 HG2
Analog Loopback	HG12 (No. 1) HG12 (No. 2) HG1 or HG21 HG13 HG15 or HG15B HG11 HG16 or HG16B HG2 HG3 HG7 HG4 HG14 or HG14B HG8 HG17 HG5 HG6 HG9	HG12 (No. 1) HG12 (No. 2) HG21 HG13 HG15B HG11 HG16B HG2 HG3 HG7 HG4 HG14B HG8 HG17 HG5 HG6 HG23	HG12 (No. 1) HG12 (No. 2) HG21 HG13 HG15B HG11 HG16B HG2 HG3 HG7 HG4 HG14B HG8 HG26 HG23

5. REFERENCES

5.01 Additional information concerning the testing of DS 208A-type is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
314-901-300	Digital Data System—Serving Test Center—Two-Point Private Line Circuit—Maintenance Procedures
314-919-300	Digital Data System—Subrate Off-Net Extension Arrangement—Maintenance
592-027-100	Data Set 208A-Type—Transmitter-Receiver—Description and Operation
592-027-150	Data Set 208A-Type—Transmitter-Receiver—Supplementary Information
592-027-200	Data Set 208A-Type—Transmitter-Receiver—Installation and Connections
592-027-500	Data Set 208A-Type—Transmitter-Receiver—Test Procedures Using 914-Type Data Test Set
592-032-300	Data Set 209A-L1—Transmitter-Receiver—Maintenance
666-511-503	Test of Data Services Provided by Data Set 208A-Type From a Private Line Testroom
666-511-504	Test of Data Services Provided by Data Set 209A-L1 From a Private Line Testroom

5.02 Detailed information concerning DS 208A-Type is contained in CD- and SD-1D232-01.

DATA SET 208B-TYPE
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains a physical and functional description and operating procedures for data set (DS) 208B-type. Other than a description of interface signals and customer options, information pertaining to the customer-provided terminal is not provided. For a more detailed description of DS 208B-type, refer to Section 592-030-150.

1.02 This section is reissued to include information pertaining to DS 208B-L1B which replaces DS 208B-L1A. Concurrent with the introduction of DS 208B-L1B, DS 208B-L1A has been rated Manufacture Discontinued/Not Orderable (MD/NO).

1.03 DS 208B-type is a synchronous, binary, serial 4800-bit per second (bps) data set for use on the 2-wire switched telecommunications network. The data set requires a type III DATA-PHONE® loop. This data set is compatible for use ***only*** with another DS 208B-type.

1.04 DS 208B-L1A ▶and -L1B◀ have ring memory and other features which make them less susceptible to data errors during call setup procedures or talk/data transfers. DS 208B-L1 can be converted to a 208B-L1A by replacing circuit pack (CP) HG19 with a CP HG24 and CP HG18 with a CP HG18B. ▶DS 208B-L1A cannot be converted to a DS 208B-L1B because of differences in backplane wiring.◀

1.05 ▶DS 208B-L1B provides all the features contained in DS 208B-L1A, plus the following additional features:

- Self-test error inject
- Start-up test in remote test.

Five CPs in DS 208B-L1A have been replaced by two CPs in DS 208B-L1B. The two new CPs use large scale integration (LSI) thus requiring only two instead of five CPs.◀

1.06 DS 208B-type is recommended for use with a 565HK-type or equivalent key telephone set which allows manual call origination and voice/data transfer. The HOLD button on the telephone set should be relabeled DATA. Up to five data sets may be connected to one telephone set by the use of a KS-21253, L3 adapter.

1.07 A Bell System 801-type automatic calling unit (ACU) may be used in addition to the telephone set to provide automatic call origination.

2. PHYSICAL DESCRIPTION

2.01 DS 208B-type (Fig. 1) consists of a transmitter, receiver, and control circuits mounted on 18 plug-in CPs in DS 208B-L1 and -L1A, ▶and 15 CPs in the -L1B.◀ The exterior of the data set consists of front and rear molded black plastic covers mounted on an extruded aluminum housing. The extrusion has a brushed finish. Overall dimensions of the data set are approximately 16 inches wide, 4-1/4 inches high, and 11-1/2 inches deep. The set weighs approximately 20 pounds.

2.02 The data set can also be equipped for rack mounting in either 19- or 23-inch type racks or a KS-20018-type cabinet. The data set with a D-180467 mounting bracket kit (ordered separately) attached is shown in Fig. 2.

2.03 The data set is provided with two interface connectors and a power cord connector at the rear of the set (Fig. 3). The customer interface (CUST INT) connector is a KS-19087-L2 type and provides the digital interface leads for interfacing with customer-provided terminal equipment. The telephone interface (TELE INT) connector is a KS-19088-L2 type and provides the interface for connection to the telephone network through an M13F (5-foot 6-inch) cord supplied with the data set. The M13F cord may be extended up to 200 feet by use of a B25A cable, which must be ordered separately. Customer data equipment must be equipped with a cable not exceeding 50 feet in length, and terminated in a Cinch or Cannon DB-19604-432 plug. The power connector is a Twist-lock connector which will accept the KS-14532, L24 cord provided with the data set.

2.04 A front view of DS 208B-L1 and -L1A with plastic cover removed is shown in Fig. 4. ▶A front view of DS 208B-L1B with plastic cover removed is shown in Fig. 5.◀ Option switches, data set status lamps, and test switches are shown. ▶A summary of the CPs used in each of the DS 208B-type is presented in Table A.◀ Methods used for installing and removing options are explained in detail in Section 592-030-200.

2.05 Seven light emitting diode (LED) status lamps are provided on the data set to monitor the power supply and certain interface leads. These lamps illuminate a portion of the front cover which depict the control lead or condition being monitored. Lamp names and functions are as follows:

(a) The ON (power) lamp is illuminated when the power cord is plugged into a 105- to 129-Vac 60-Hz ±5% source.

If for any reason the output voltages of the power unit rise excessively, the power unit will protect the data set from the overvoltage by automatically reducing the output voltage. When the cause of the overvoltage has been corrected, normal output voltages will be obtained only after the data set power cord has been unplugged and plugged in again.

(b) On DS 208B-L1B, power unit overvoltage is indicated by the ON lamp extinguishing. This is not true on -L1 and -L1A sets.

Fig. 1—Data Set 208B-Type and 2565HK-Type Telephone Set—Front View

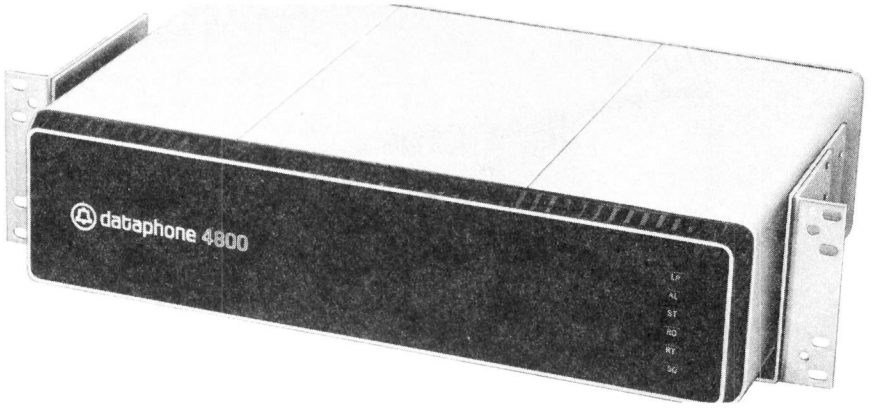


Fig. 2—Data Set 208B-Type With D-180467 Mounting Bracket Kit Installed—Front View

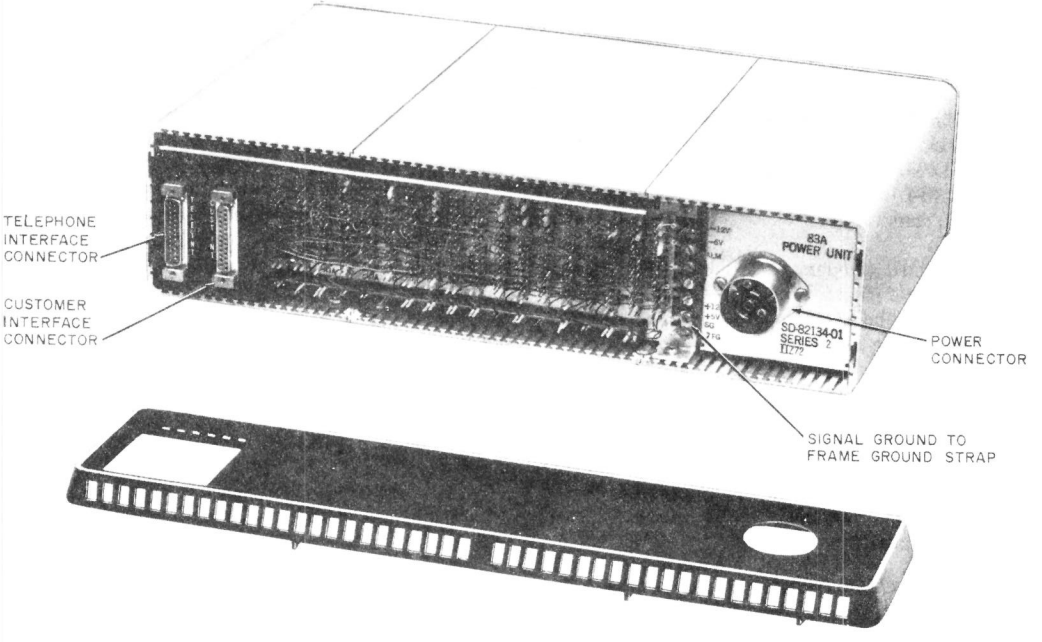


Fig. 3—Data Set 208B-Type—Rear View With Cover Removed

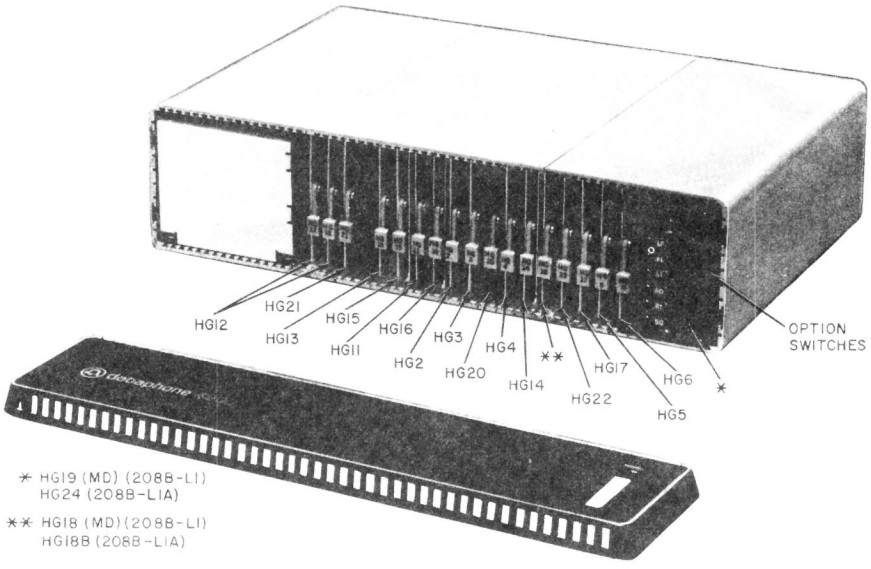


Fig. 4—Data Set 208B-L1 or -L1A—Front View With Cover Removed

(c) The TR (terminal ready) lamp monitors the state of the CD lead and is illuminated when the CD signal from the customer is ON. On DS 208B-L1B, the TR lamp is also ON in ST and RT modes.

(d) The MR (modem ready) lamp monitors the state of the CC (data set ready) lead and is on when the CC lead is ON. On DS 208B-L1B, the MR lamp is also ON in AL mode.

(e) The RS (request-to-send) lamp monitors the condition of the CA (request-to-send) lead internal to the data set. This lamp is illuminated only when the data set is in data mode and the voltage on the CA lead is more positive than +3 volts (ON condition), or when the data set is in certain test modes.

(f) The CS (clear-to-send) lamp monitors the condition of the clear-to-send (CB) lead and is illuminated whenever the CB lead is in the ON condition. This indicates that the data set is ready and will transmit data present on the BA (send data) lead.

(g) The CO (carrier on) lamp monitors the condition of the carrier on (CF) interface lead and is illuminated whenever the CF lead is in the ON condition. This indicates that the receiver has detected a signal on the line which is within the data band. The signal must be received for approximately 45 ms before the CO lamp will illuminate.

(h) The ER (equalizer retrain) lamp monitors the condition of the automatic retrain mode. If the CO lamp is on and the ER lamp is flashing, it indicates that the automatic equalizer is retraining and data on the receive data (BB) interface lead may not be valid. Continuous flashing is an indication of marginal performance. When the data set is in self-test or remote test mode, the ER lamp will flash when an error is detected in the received data.

2.06 The data set is equipped with six pushbutton switches which are accessible at the front panel. All of the switches are locking-type switches

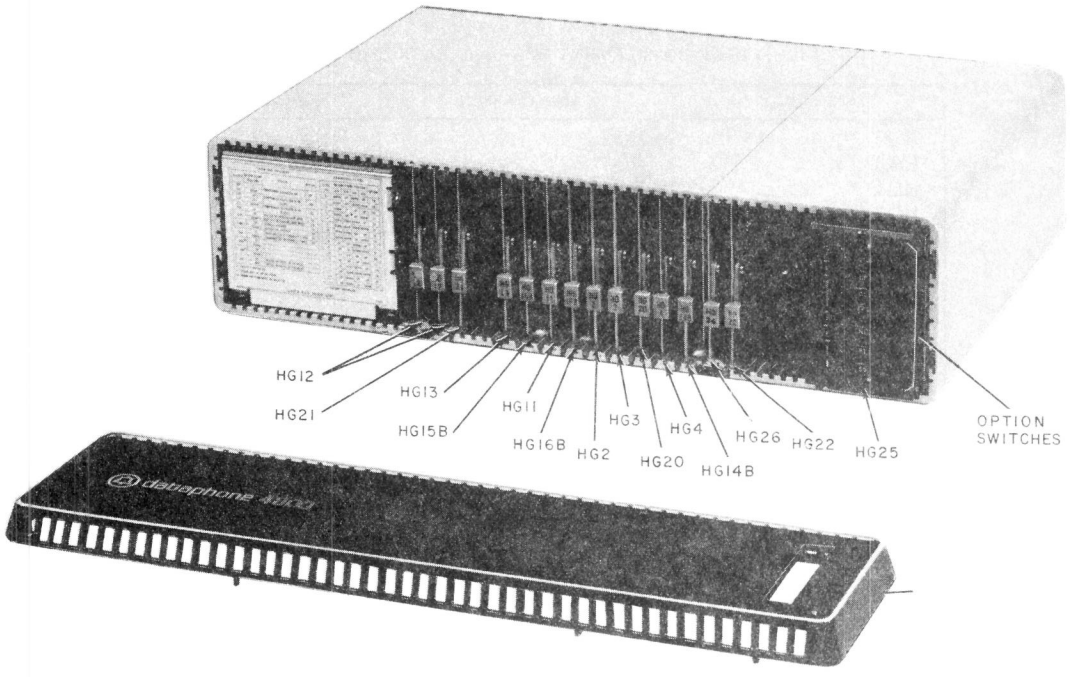


Fig. 5—Data Set 208B-L1B—Front View With Cover Removed

except for the lamp test (LP) switch. Functions of the switches are as follows:

(a) Depressing the LP (lamp test) switch causes all of the lamps except the ON lamp to light. The ON lamp should be on normally if power is applied. The switch does not affect normal data set operation. When the AL and/or ST test switches are depressed, the lamp test circuit is reconfigured to become an error inject circuit (DS 208B-L1B only). The LP switch may then be used to inject errors (spaces) in the analog loop-back and end-to-end self-test modes in the -L1B.

(b) Depressing the AL (analog loop) switch loops the output of the transmitter to the receiver through an internal pad. If the data set is connected to the line when the AL switch is depressed, the line will be dropped. If the data set is not connected to the line and is optioned for automatic answer, the set will not automatically answer an incoming call when the AL switch is depressed. Also, the data set cannot be transferred from talk to data mode with the AL switch depressed.

(c) Depressing the ST (self test) switch causes the transmitter to turn on and transmit steady marks. When both the AL and ST switches are depressed, the ER lamp will flash when the receiver detects a space signal.

(d) When depressed, the RO (receive only) switch internally conditions the request-to-send lead to OFF, regardless of the state of CA from the customer interface, or other test switches.

(e) When both the ST and RO switches are depressed, the ER lamp will flash when the receiver detects a space signal from a distant station.

→TABLE A←

CIRCUIT PACK COMPLEMENT FOR DATA SETS 208B-TYPE

208B-L1 (MD)	208B-L1A (MD)	208B-L1B
HG2	HG2	HG2
HG3	HG3	HG3
HG4	HG4	HG4
HG5 (A&M)	HG5 (A&M) (Note 1)	—
HG6 (A&M)	HG6 (A&M) (Note 1)	—
HG11	HG11	HG11
HG12 (Note 2)	HG12 (Note 2)	HG12 (Note 2)
HG13	HG13	HG13
HG14 (MD) (Note 3)	HG14 (MD) (Note 3)	HG14B
HG15 (MD) (Note 3)	HG15 (MD) (Note 3)	HG15B
HG16 (MD) (Note 3)	HG16 (MD) (Note 3)	HG16B
HG17 (A&M)	HG17 (A&M) (Note 1)	—
HG18 (MD) (Note 4)	HG18B (A&M) (Note 6)	—
HG19 (MD) (Note 5)	—	—
HG20	HG20	HG20
HG21	HG21	HG21
HG22	HG22	HG22
—	HG24 (A&M) (Note 6)	—
—	—	HG25
—	—	HG26

Note 1: The functions of CP HG5, HG6, and HG17 in DS 208B-L1A are performed by CP HG26 in DS 208B-L1B.

Note 2: Two CP HG12 required in each data set.

Note 3: CP HG14B, HG15B, and HG16B are direct replacements for CP HG14, HG15, and HG16, respectively.

Note 4: CP HG18 in DS 208B-L1 is replaced by CP HG18B in DS 208B-L1A.

Note 5: CP HG19 in DS 208B-L1 is replaced by CP HG24 in DS 208B-L1A. When a CP HG24 is installed in a DS 208B-L1, CP HG18 *must also* be replaced with a CP HG18B.

Note 6: The functions of CP HG18B and HG24 in DS 208B-L1A are performed by CP HG25 in DS 208B-L1B.

(f) Depressing the RT (remote test) switch conditions the data set for testing from a telephone company (telco) data test center (DTC).

(g) The "50" switch is an option switch. When it is depressed, the request-to-send/clear-to-send (CA-CB) interval is 50 ms. When the switch is not operated, the CA-CB interval is 150 ms.

2.07 Data set power is provided by an 83A power unit in the data set, which provides +12, -12, +5, and -6 volts. The power unit requires 105- to 129-volt ac power at 60 Hz. Power consumption is approximately 26 watts. The power unit is provided with a self-resetting thermal overload switch which shuts off the power unit if internal temperature rises excessively.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains information pertaining to the data set transmitter, receiver, interface

leads, and options. Refer to Fig. 6 for a block diagram of the data set.

3.02 Like DS 201-type and 208A-type, DS 208B-type uses phase-shift keying to transmit binary data signals over the analog telephone channel. In contrast to DS 201-type, which uses 4-phase modulation, DS 208B-type uses 8-phase modulation.

A. Transmitter

3.03 The transmitter converts serial binary data into groups of three bits called tribits, which modulate the 1800-Hz carrier. Each tribit is encoded into one of eight possible carrier phase shifts. The line signal consists of a serial train of phase shifted signaling elements at one-third the bit rate. A step attenuator is provided in the transmitter to adjust the transmitter output level in 1-dB increments from 0 to -15 dBm. Refer to Section 592-030-200 for procedures for setting the data set output level.

B. Receiver

3.04 At the receiver, DS 208B-type recovers timing in a manner equivalent to DS 201-type. The line signal is demodulated using differential detection. This requires that the phase of each signaling element relative to the previous signaling element be determined for decoding the received baseband signal.

3.05 The receiver sensitivity threshold is -43 dBm with the transmit attenuator set at 0 dB. Receiver sensitivity is dependent on the transmit attenuator setting. For example, if the transmit attenuator were set at 12 dB, the receiver threshold level would be -31 dBm.

3.06 The maximum level that the receiver can handle is 19 dB above the threshold. For example, at a -43 dBm threshold, the maximum level is -24 dBm.

3.07 The higher speed of the data set results in increased sensitivity to delay and amplitude distortion of the telephone channel and requires that greater attention be paid to equalization to assure proper demodulation. This is accomplished with an automatic equalizer, which is included in the data set and which automatically corrects for the delay and amplitude variation introduced by the telephone channel. In addition, there is a fixed compromise equalizer in the transmitter which provides amplitude and delay equalization and must always be installed for normal operation. In DS 208B-L1, the compromise equalizer option provides for 8 dB of slope equalization. In the case of the 208B-L1A and -L1B there are two optional choices of slope equalization (4-dB and 8-dB) one of which must be installed by telco personnel. The 4-dB slope option is preferred for initial installation. Installation information is contained in Section 592-030-200. Absolute delay through the set (transmitter and receiver) is approximately 7 ms.

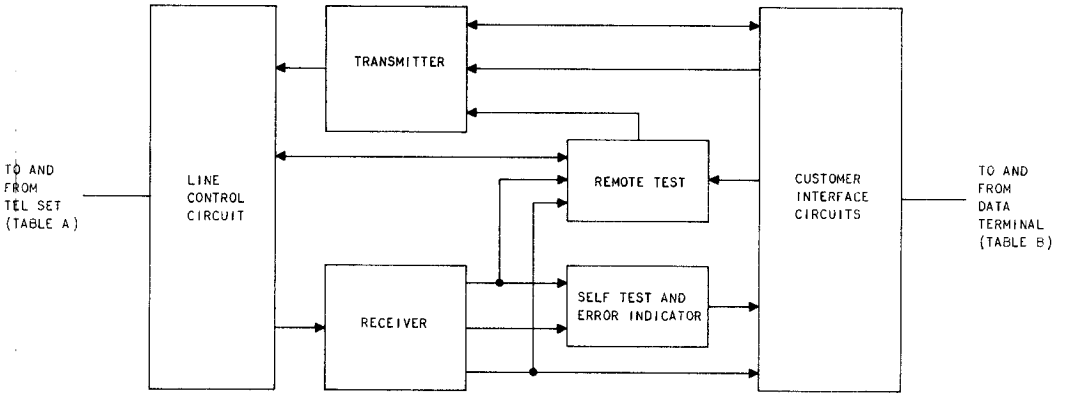


Fig. 6—Block Diagram—Data Set 208B-Type

C. Line Control Circuit

3.08 The line control circuit controls events associated with originating and answering a call and transferring the data set into data mode. The line control circuit provides the following for DS 208B-L1, -L1A, ▶and -L1B:◀

- Ring detection
- Line impedance matching
- Lightning protection
- 2-second quiet interval timing (1 second for -L1B)
- 2021-Hz answer tone to disable echo suppressors
- 600-Hz tone to keep echo suppressors disabled
- Answer sequence timing and control circuitry
- Talk-to-data transfer circuitry
- ACU-to-data control circuitry
- Call termination circuitry.

In addition, ring memory is provided for DS 208B-L1A ▶and -L1B. With ring memory only, the called set will send answer tone and 600 Hz tone. With DS 208B-L1, the tones are sent whether the set is called or calling. Also, with ring memory the called set lights the line lamp even in the TALK mode.◀

D. Test Modes

3.09 DS 208B-type is equipped with various test features which enable the customer or telco employee to test the data set in local loop-back, end-to-end, and switched network test modes.

3.10 The ***analog loop-back test*** allows the customer to perform a local test of terminal equipment by connecting the data set transmitter to the receiver at the line control circuit. This test requires that the terminal equipment be capable of operating in full duplex mode.

3.11 The ***analog loop-back self test*** allows operation of the data set to be checked without depending on connections to the telephone line interface or customer interface. In this test mode, terminal equipment is disconnected from the data set, the self test and error indicator circuits are connected to the transmitter and receiver, and the data set is looped back as for the analog loop-back test (3.08). This test can be performed regardless of data set options or connections to external equipment. ▶On DS 208B-L1B, errors (spaces) may be injected by depressing the LP switch. The ER lamp will light; TR and MR lamps will remain ***off*** when the LP switch is depressed.◀

3.12 The ***end-to-end self test*** allows testing the data set and telephone facilities. In this test mode, the terminal equipment is disconnected from the data set and the self test circuit is connected to the transmitter and the data set will send steady mark. This test requires that a connection be made to a remote data set and that the remote data set be conditioned for self test and receive-only mode of operation. ▶On DS 208B-L1B, errors (spaces) may be injected by depressing the LP switch at the transmitting end. The ER lamp will light at the receiving end.◀

3.13 The ***remote test*** feature of DS 208B-type allows the data set to be tested by a DTC. In this test mode, the data set automatically answers the next incoming call and transfers to data mode. If the DTC transmits a steady mark for 1 second ▶(1.25 second for -L1B)◀ and no errors are detected by the data set, the data set responds by transmitting a steady mark for 1 second ▶(2.0 second for -L1B).◀ If errors are received, the data set responds with a steady space for 1 second ▶(2.0 second for -L1B).◀ Upon receipt of a 1-second space signal from the DTC, the data set disconnects from the line (DS 208B-L1 and DS 208B-L1A). ▶A minimum of 3 seconds of steady space signals from the DTC is required for DS 208B-L1B to cause automatic disconnect.◀ After disconnecting from the line, the data set does not answer further calls automatically until the RT switch is released.

E. Telephone Interface

3.14 The telephone interface is accessible through the telephone connector at the rear of the data set. The connector pin numbers and corresponding lead designations and functions are shown in Table B.

TABLE B

TELEPHONE INTERFACE

PIN	DESIGNATION	FUNCTION
1	L (Lamp)	Used to light lamp on associated telephone set when ringing is received or data set is in data mode or ring memory is set in the -L1A or -L1B.
2	—12V	Provides voltage for test purposes.
3	+5V	Provides voltage for test purposes.
4	LG (Lamp Ground)	Provides ground path for lamp on associated telephone set.
5	TD (Talk-Data)	A ground on this lead indicates to the data set that the associated telephone is in the talk mode.
7	T (Tip)	Tip of telephone line (from CO).
8	R (Ring)	Ring of telephone line (from CO).
12	RNG (Ringing)	Provides ground indication during ringing.
14	C	Provides ground to ACU when data set is in data mode.
16	D1	ACU places ground on this lead when answer tone has been received.
21	T1	Tip of telephone line (internal).
22	R1	Ring of telephone line (internal).
23	A	A lead control.
24	A1	A lead control.
25	TDG	Talk-Data-Ground lead.

F. Customer Interface

3.15 The customer interface is accessible through the connector at the rear of the data set. The connector pin numbers and corresponding lead designations are shown in Table C.

3.16 Customer interface lead functions are as follows:

(a) ***Frame Ground (AA) (Pin 1):*** This lead is connected to the data set housing and local power ground through the third conductor in the power cord. It is normally connected to signal ground, as explained in (g) below.

(b) ***Send Data (BA) (Pin 2):*** The business machine transmits positive and negative voltages to the data set on this lead. These voltage levels must conform to requirements of Electronic Industries Association (EIA) Standard RS-232-C.

(c) ***Receive Data (BB) (Pin 3):*** Data received from the telephone line is converted to positive and negative EIA voltages which are

TABLE C

CUSTOMER INTERFACE CONNECTOR PIN ASSIGNMENTS

PIN NO.	NOTE 1	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
1	—	Frame Ground	FG	AA
2	T	Send Data	SD	BA
3	D	Receive Data	RD	BB
4	T	Request to Send	RS	CA
5	D	Clear to Send	CS	CB
6	D	Data Set Ready	DSR	CC
7	—	Signal Ground	SG	AB
8	D	Carrier On	COD	CF
9	—	+12V	CI9 (+12V)	Reserved for Data Set Testing
10	—	—12V	CI10 (—12V)	Reserved for Data Set Testing
15	D	Serial Clock Transmitter	SCT	DB
16	D	Divided Clock Transmitter (Note 2)	DCT	SBB (Note 3)
17	D	Serial Clock Receiver	SCR	DD
18	D	Divided Clock Receiver (Note 2)	DCR	Unassigned
20	T	Data Terminal Ready	DTR	CD
22	D	Ring Indicator	RI	CE
24	T	Serial Clock Transmitter External	SCTE	DA
25	—	+5V (Note 2)	CI25 (+5V)	Unassigned

Note 1: T = terminator; D = driver.

Note 2: Functions not defined by EIA Standard RS-232-C.

Note 3: DS 208B uses pin 16 for a different function than that specified by EIA Standard RS-232-C.

presented to the business machine on positive transitions of the serial clock receiver. Polarities on this lead agree with those on the send data lead of the distant transmitter. The BB lead is clamped negative (mark-hold) when the carrier on signal is OFF.

(d) ***Request-to-Send (CA) (Pin 4):*** Signals on this lead are EIA voltages generated by the business machine to turn the local data transmitter on. CA must be held high as long as data needs to be transmitted.

(e) ***Clear-to-Send (CB) (Pin 5):*** Signals present on this lead are EIA voltages generated by the local data set to indicate to the business machine that it is ready to transmit data. The ON condition of CB is in response to an ON condition of CA. The CA-CB interval may be 50 or 150 ms, depending on the option selected. CB goes OFF with essentially no delay when CA is turned OFF.

(f) ***Data Set Ready (CC) (Pin 6):*** This lead provides an EIA voltage ON indication to the business machine when the data set is in data mode and is capable of transmitting or receiving data.

Note: An ON indication should not be interpreted as an indication that a communication channel has been established to a remote station.

(g) ***Signal Ground (AB) (Pin 7):*** This lead establishes a common ground reference for all interface leads. Signal ground is strapped to frame ground at the power supply. This strap can be disconnected by the installer if desired by the customer.

(h) ***Carrier ON (CF) (Pin 8):*** This lead provides an EIA voltage ON indication to the business machine when data signals are being received by the data set.

(i) ***+12V (Pin 9):*** +12 volts for telco test purposes.

(j) ***-12V (Pin 10):*** -12 volts for telco test purposes.

(k) ***Serial Clock Transmitter (DB) (Pin 15):*** A square wave of 4800 Hz appears on this lead. This is the transmitter bit rate clock and conforms to EIA Standard RS-232-C.

(l) ***Divided Clock Transmitter (Pin 16):*** A 1600-Hz clock non-EIA signal used internally by the data set appears on this lead.

(m) ***Serial Clock Receiver (DD) (Pin 17):*** This lead provides an EIA square wave timing signal which is used for clocking received data. This timing signal is at the bit rate (4800 Hz). The BB lead should be sampled on the negative transition of the DD lead.

(n) ***Divided Clock Receiver (Pin 18):*** A non-EIA 1600-Hz clock signal used internally by the data set appears on this lead.

(o) ***Data Terminal Ready (CD) (Pin 20):*** This EIA signal is used by the data set line control. CD must be ON before entering data mode, and OFF for at least 6 to 10 ms for -L1 and -L1A, and 16 to 20 ms for -L1B or until DTR goes off in order to ensure termination of the call while in data mode.

(p) ***Ring Indicator (CE) (Pin 22):*** EIA signals on this lead indicate to the customer that a ringing signal is being received on the telephone channel.

(q) ***Serial Clock Transmitter External (DA) (Pin 24):*** On externally timed data sets, this lead is used by the business machine to furnish bit rate timing to the transmitter. External timing should be 4800 bps ±0.01 percent and meet EIA signal requirements.

(r) ***+5V (Pin 25):*** +5 volts for telco test purposes.

G. Options

3.17 Data set 208B-type is provided with a number of options. Some of these are available as customer options; others are available as telco engineering options. These options are listed in Tables D ◗and E◖ and described in Section 592-030-200. All options are added and removed by switches.

TABLE D

OPTIONS FOR DATA SETS 208B-L1 AND -L1A

DS 208B-L1 (HG19)			
SWITCH		OPTION	
DESIG.	POSITION	DESCRIPTION	DESIGNATION
S2C [1]	UP [2] DOWN	Compromise equalizer IN Compromise equalizer OUT	ZS ZT
S3A [3]	UP DOWN [2]	CC ON in AL mode CC OFF in AL mode	YM YN
S3B [3]	UP DOWN [2]	Manual answer Automatic answer	YO YP
S3C [3]	UP DOWN [2]	Transmitter externally timed Transmitter internally timed	YD YC
"50" [3,4]	IN OUT	50 ms CA-CB interval 150 ms CA-CB interval	— —

DS 208B-L1A			
SWITCH		COMPROMISE EQUALIZER SLOPE	OPTION DESIGNATION
S2B	S2C		
UP OR DOWN	DOWN	None (0 dB)	ZT
UP	UP	4-dB slope & symmetric delay	WU [2]
DOWN	UP	8-dB slope & symmetric delay	ZS

TRANSMIT LEVEL (dBm)	SWITCH				OPTION DESIGNATION
	S1A	S1B	S1C	S2A	
0 [2]	DOWN	UP	DOWN	UP	ZA
−1	DOWN	UP	DOWN	DOWN	ZB
−2	DOWN	UP	UP	UP	ZC
−3	DOWN	UP	UP	DOWN	ZD
−4	DOWN	DOWN	DOWN	UP	ZE
−5	DOWN	DOWN	DOWN	DOWN	ZF
−6	DOWN	DOWN	UP	UP	ZG
−7	DOWN	DOWN	UP	DOWN	ZH
−8	UP	UP	DOWN	UP	ZI
−9	UP	UP	DOWN	DOWN	ZJ
−10	UP	UP	UP	UP	ZK
−11	UP	UP	UP	DOWN	ZL
−12	UP	DOWN	DOWN	UP	ZM
−13	UP	DOWN	DOWN	DOWN	ZN
−14	UP	DOWN	UP	UP	ZO
−15	UP	DOWN	UP	DOWN	ZP

Note 1: Compromise equalizer should always be in.

Note 2: Factory installed.

Note 3: Options for S3 and "50" switches are the same for DS 208B-L1 and -L1A.

Note 4: If not specified on service order, install 50-ms interval.

→TABLE E←

DS 208B-L1B OPTIONS (CP HG25)

SWITCH	OPTION STRAP POSITION	OPTION FEATURE	OPTION DESIGNATION
S2B	†	Compromise Equalizer Out	ZT
S2C	Down		
S2B	Up	Compromise Equalizer (4-dB Slope)	WU*
S2C	Up		
S2B	Down	Compromise Equalizer (8-dB Slope)	ZS
S2C	Up		
S3A	Up	DSR *on* in Analog Loop Mode	YM
	Down	DSR *off* in Analog Loop Mode	YN*
S3B	Up	Manual Answer	YO
	Down	Automatic Answer	YP*
S3C	Up	Transmitter Externally Timed	YD
	Down	Transmitter Internally Timed	YC*
S4A‡	Up		
	Down*		
S4B‡	Up		
	Down*		
"50"	In	RS-CS Interval of 50 ms	(Customer Switch)
	Out	RS-CS Interval of 150 ms	

* Factory installed.

† Strap may be up or down.

‡ Down position must be selected.

4. OPERATION

4.01 DS 208B-type provides the capability for the following:

- Manual call handling
- Automatic answering and disconnect
- Use of telephone line for both talk and data transmission.

4.02 ***Answering:*** DS 208B-type allows both manual and automatic answering.

(a) To manually answer a call:

(1) When ringing is heard, operate the appropriate telephone set LINE button (lamp under button flashes in response to ringing).

(2) Remove telephone handset from cradle.

(3) ***On DS 208B-L1,*** when both data terminals are ready (TR lamp on both data sets lighted), operate the DATA button ***at about the same time*** as the far-end attendant does (lamp under LINE button

lights, LINE button releases, the data set transmits answer tone, and MR lamp on data set lights).

(4) ***On DS 208B-L1A or L1B,*** when both data terminals are ready (TR lamp on both data sets lighted), operate the DATA button ***before*** the far-end attendant does (lamp under LINE button remains lighted, LINE button releases, the data set transmits answer tone, and MR lamp on data set lights).

(5) Replace telephone handset on cradle.

The data set will answer the incoming call automatically if the automatic answer option is installed and the data terminal ready (DTR) lead is on.

4.03 The answering sequence consists initially of a 2-second quiet interval (1 second for -L1B) during which no signal is transmitted from the data set, followed by a 2-second period of 2021-Hz answer tone which disables any echo suppressors on the line. This is followed by another quiet period lasting 63 ms. The data set then enters the data mode. DTR must be high at the customer interface for the answer sequence to occur. If DTR is not on, the call will not be answered automatically and an attempt to transfer to data mode manually will result in the call being dropped.

4.04 ***Originating:*** Calling may be done manually or by an automatic calling unit. Automatic calling is controlled by customer-provided equipment (CPE), and is not discussed here. Manual steps involved in each case are as follows, and are understood to be performed in each subparagraph (b) through (e) below:

(a) To manually originate a call to any station, perform the following common operations.

(1) Verify that data set is ready (TR lamp lighted).

(2) Operate appropriate telephone set LINE button.

(3) Remove telephone handset from cradle, listen for dial tone, then dial the call in the usual manner.

(4) In all cases, replace handset on cradle when both data sets have entered data mode.

(b) ***To Originate a Call From a DS 208B-L1 to a Station That Is Not Arranged for Automatic Answer:***

(1) After the called station answers, verify with attendant that TR lamp is lighted.

(2) Operate DATA button ***at about the same time*** as the called station attendant does (lamp under LINE button lights, LINE button releases, data set transmits answer tone, and MR lamp lights).

(c) ***To Originate a Call From a DS 208B-L1 to a Station That Is Arranged for Automatic Answer:***

(1) At the ***start*** of answer tone, operate DATA button (lamp under LINE button lights, LINE button releases, data set transmits answer tone, and MR lamp lights).

(d) ***To Originate a Call From a DS 208B-L1A or -L1B to a Station That Is Not Arranged for Automatic Answer:***

(1) After the called station answers, verify with attendant that TR lamp is lighted.

(2) Have called station attendant operate DATA button (called station transmits answer tone).

(3) At the ***end*** of answer tone, operate DATA button (lamp under LINE button lights, LINE button releases, and MR lamp on data set lights).

Note: When the DATA button is operated at the originate end, ***DS 208B-L1A or -L1B immediately*** transfers to data mode without transmitting the answer tone.

(e) ***To Originate a Call From a DS 208B-L1A or -L1B to a Station That Is Arranged for Automatic Answer:***

(1) At the ***end*** of answer tone, operate DATA button (lamp under LINE button

lights, LINE button releases, and MR lamp on data set lights).

Note: When the DATA button is operated at the originate end, ***DS 208B-L1A or -L1B immediately*** transfers to data mode without transmitting answer tone.

4.05 Data Mode-to-Talk Mode Transfer: An attendant may return the station to the talk mode at any time by removing the telephone handset and operating the appropriate LINE button.

Caution: At multiple data set installations where more than one data set is controlled by the telephone set, be sure to operate the correct LINE button. If the wrong LINE button is operated, the data exchange on the wrong channel may be interrupted. Upon transferring to talk mode, the MR lamp on the data set will extinguish and the lamp under the LINE button will react as follows:

(a) At originate end on ***all DS 208B-type,*** the LINE button will extinguish.

(b) At answering end on ***DS 208B-L1,*** the LINE button will extinguish.

(c) At answering end on ***DS 208B-L1A or -L1B,*** the LINE button will remain lighted as a reminder that the called station must always be the first to operate the DATA button on a talk-to-data mode transfer. In this case, the depressed LINE button and extinguished MR lamp on the data set are the indications that identify the talk mode. Procedures for returning to data mode are as previously described in 4.04.

4.06 When calling is performed automatically by an ACU, the automatic calling unit responds to the end of 2021-Hz answer tone from the called end, and then puts the data set into data mode, bypassing the quiet and answer-tone periods of the answer sequence.

4.07 ***Hang up:*** The call is terminated and the terminal is disconnected from the telephone line if DTR at the customer interface goes low, or depending upon the central office involved, if the distant terminal hangs up, and causes the loop current to drop for more than 6 to 10 ms for -L1 and -L1A, and 16 to 20 ms for -L1B to ensure termination.◀

5. REFERENCES

5.01 The following documents provide additional information on data sets 208B-type.

NUMBER	TITLE
CD & SD-1D242-01	Data Set 208B-Type
SECTION	**TITLE**
502-543-405	2565HK Telephone Set
592-030-150	Data Set 208B-Type Transmitter-Receiver — Supplementary Information
592-030-180	Data Set 208B-Type Transmitter-Receiver—Summarizing Specification
592-030-200	Data Set 208B-Type Transmitter-Receiver—Installation
592-030-300	Data Set 208B-Type Transmitter-Receiver—Maintenance
592-030-500	Data Set 208B-Type Transmitter-Receiver—TestProcedures
598-010-Series	801A-Type Automatic Calling Units
598-012-Series	801C-Type Automatic Calling Units.

DATA SET 208B-TYPE
TRANSMITTER-RECEIVER
INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning installation and connection of data set (DS) 208B-type. DS 208B-type is a synchronous, binary, serial 4800-bps data set for use on the 2-wire switched telecommunications network. The data set should be installed in conformance with existing installation practices. Refer to the section entitled Data Sets and Data Access Arrangements—General Installation and Connection Information (590-010-200). DS 208B-type is recommended for use with a 565HK-type telephone set for manual call origination and voice/data transfer on the switched network. The telephone set must be ordered separately. If automatic call origination is required, a Bell System data auxiliary set (DAS) 801-type automatic calling unit (ACU) must be ordered separately. Station components required for an installation using an ACU are shown in Fig. 1.

1.02 This section is reissued to include information pertaining to DS 208B-L1B which replaces DS 208B-L1A. Concurrent with the introduction of DS 208B-L1B, DS 208B-L1A is rated Manufacture Discontinued/Not Orderable (MD/NO).

1.03 It is preferred that the data set be installed on a desk, table, stand, or in a Bell System-provided equipment cabinet. The data set will operate in an ambient temperature range of 40 to 120°F and a relative humidity of 20 to 95 percent.

1.04 DS 208B-type should be located near the business machine because the interface cord supplied by the customer should not exceed 50 feet in length (to reduce stray capacitance and to conform to EIA standards). To minimize inductive interference to data signals on the telephone (data) line, the line should not be carried in the same run as cable between the data set and business machine or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type SK (shielded) station wire between the data set and the cable distribution terminal or building entrance. Ground the shield at one end only, preferably at the distribution terminal end.

1.05 DS 208B-type requires a 117 Vac 60 Hz outlet to accept the 3-prong plug on the KS-14532, L24 power cord. To prevent the data set from being turned off accidentally, the outlet should not be under control of a switch.

1.06 The customer interface connector is a 25-pin KS-19087-L2 connector located at the rear of the data set. This connector is designed to mate with a customer-provided Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood. Pin assignments for the customer interface connector are given in Table A. Connection between the data set and telephone set or 149B adapter is by an M13F cord when an ACU is required. The

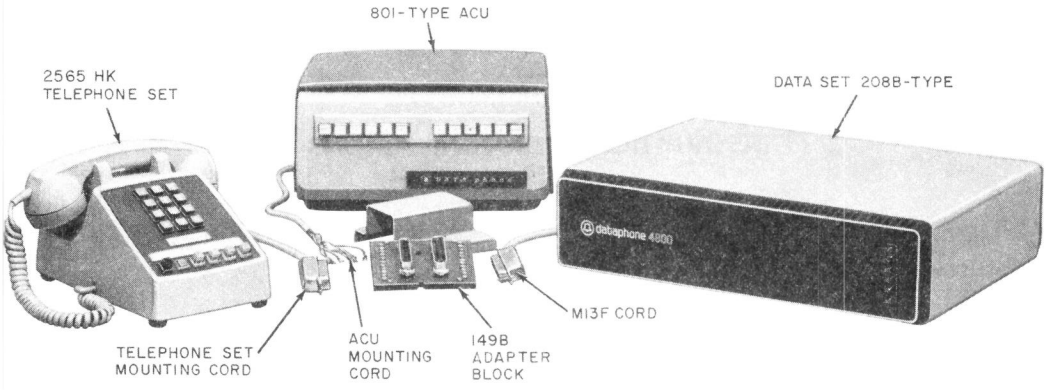


Fig. 1—Single Data Set 208B-Type With ACU—Station Components

interface between the telephone set and the data set line control circuitry is shown in Fig. 2 and 3.

1.07 DS 208B-type requires a type III DATA-PHONE® loop. Verify that the loop has been installed and meets requirements specified in the section entitled Data Systems—DATA-PHONE Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (314-205-501).

2. TOOLS AND APPARATUS

2.01 A TTS-4 or equivalent transmission measuring set should be taken to the station installation site in addition to regular installation tools.

2.02 DS 208B-type comes equipped with an M13F (5-foot 6-inch) telephone cord and a KS-14532, L24 power cord (6 feet long).

2.03 For single data set installations not requiring an ACU (Fig. 2 and 3), the following apparatus must be ordered separately:

- 42A connecting block for telephone connection
- B25A cable for extension of M13F cord if required
- 565HK-type (or equivalent) telephone set
- D4-type cord to connect telephone set to connecting block.

2.04 In addition to the apparatus listed in 2.03, a single data set installation using an ACU (Fig. 4), requires the following apparatus which also must be ordered separately:

- 801-type ACU
- 149B adapter block

2.05 For multiple data set installations not requiring an ACU (Fig. 5), the following apparatus must be ordered separately:

- 565HK-type (or equivalent) telephone set—One for every five data sets.
- KS-21253, L3 line interface adapter—One for every five data sets
- 66E-type connecting block—One for each KS-21253, L3 line interface adapter. (Not needed when ACUs are used.)
- B25A cable—One for each data set (if extension of M13F cord if required).
- B25A cable—One for every KS-21253, L3 line interface adapter (to connect P6 of adapter to 66E-type connecting block). (Not needed when ACUs are used.)

→TABLE A←

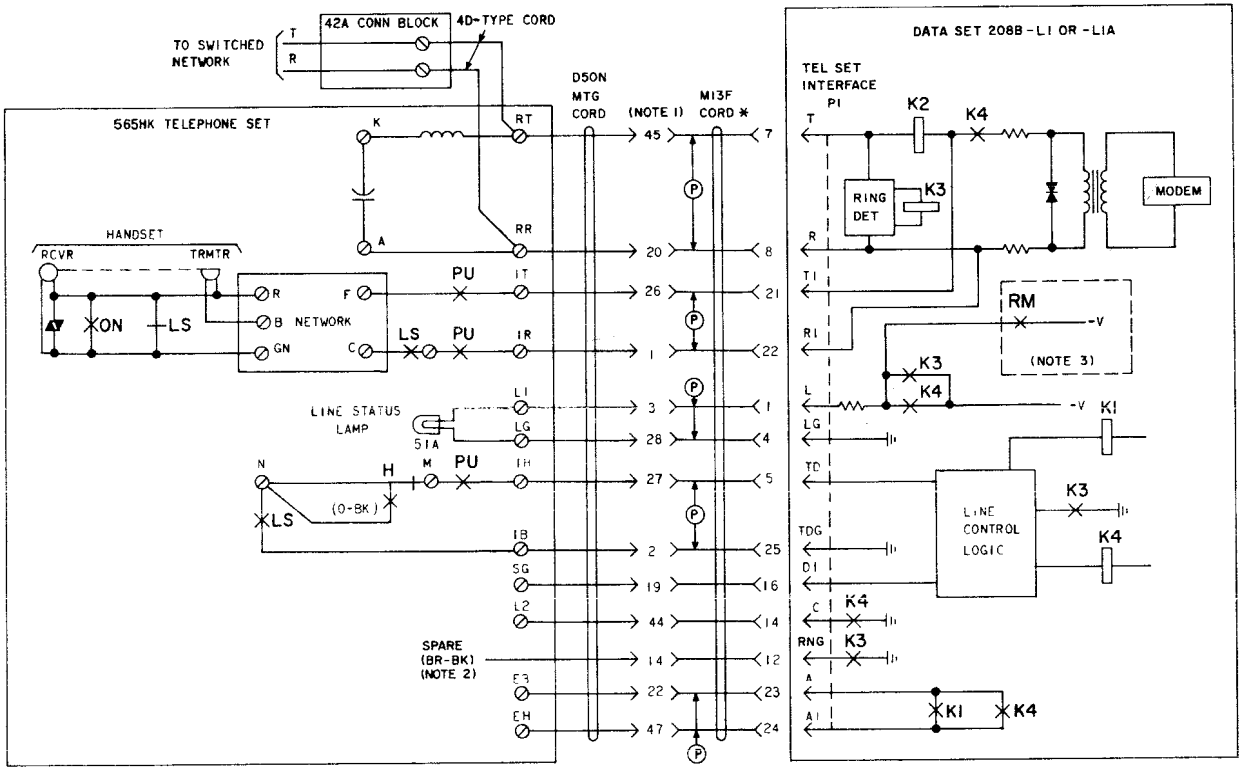
CUSTOMER INTERFACE CONNECTOR PIN ASSIGNMENTS

PIN NO.	NOTE 1	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
1	—	Frame Ground	FG	AA
2	T	Send Data	SD	BA
3	D	Receive Data	RD	BB
4	T	Request to Send	RS	CA
5	D	Clear to Send	CS	CB
6	D	Data Set Ready	DSR	CC
7	—	Signal Ground	SG	AB
8	D	Carrier On	COD	CF
9	—	+12V	CI9 (+12V)	Reserved for Data Set Testing
10	—	−12V	CI10 (−12V)	Reserved for Data Set Testing
15	D	Serial Clock Transmitter	SCT	DB
16	D	Divided Clock Transmitter (Note 2)	DCT	SBB (Note 3)
17	D	Serial Clock Receiver	SCR	DD
18	D	Divided Clock Receiver (Note 2)	DCR	Unassigned
20	T	Data Terminal Ready	DTR	CD
22	D	Ring Indicator	RI	CE
24	T	Serial Clock Transmitter External	SCTE	DA
25	—	+5V (Note 2)	CI25 (+5V)	Unassigned

Note 1: T = terminator; D = driver.

Note 2: Functions not defined by EIA Standard RS-232-C.

Note 3: DS 208B uses pin 16 for a different function than that specified by EIA Standard RS-232-C.



NOTES:
1. CAN BE EXTENDED UP TO 200 FEET BY USE OF B25A CABLE
2. INSULATE AND STORE
3. -L1A SET ONLY (RING MEMORY)

(P) DENOTES PAIR

Fig. 2—Data Set 208B-L1 or -L1A/Telephone Set Without ACU—Interface Diagram

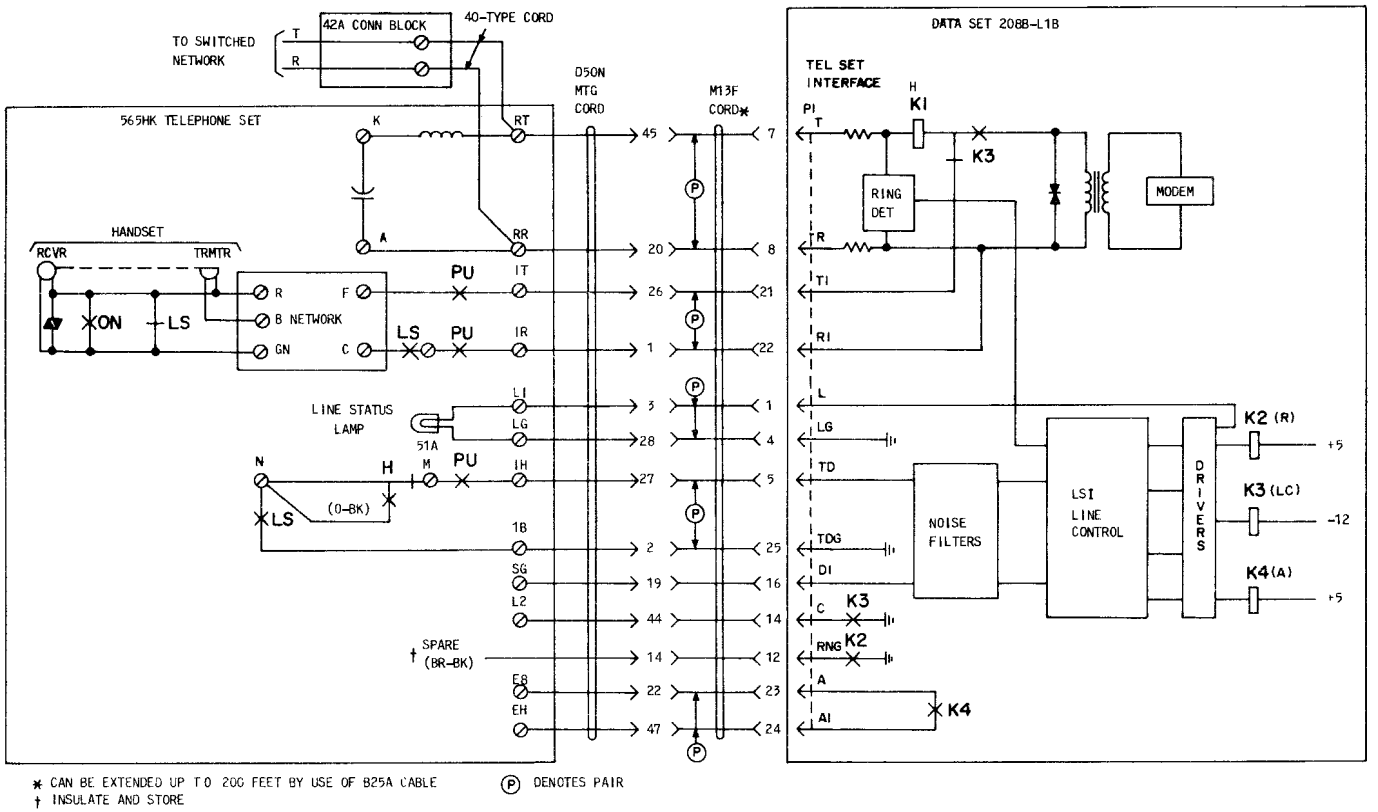


Fig. 3—Data Set 208B-L1B/Telephone Set Without ACU—Interface Diagram

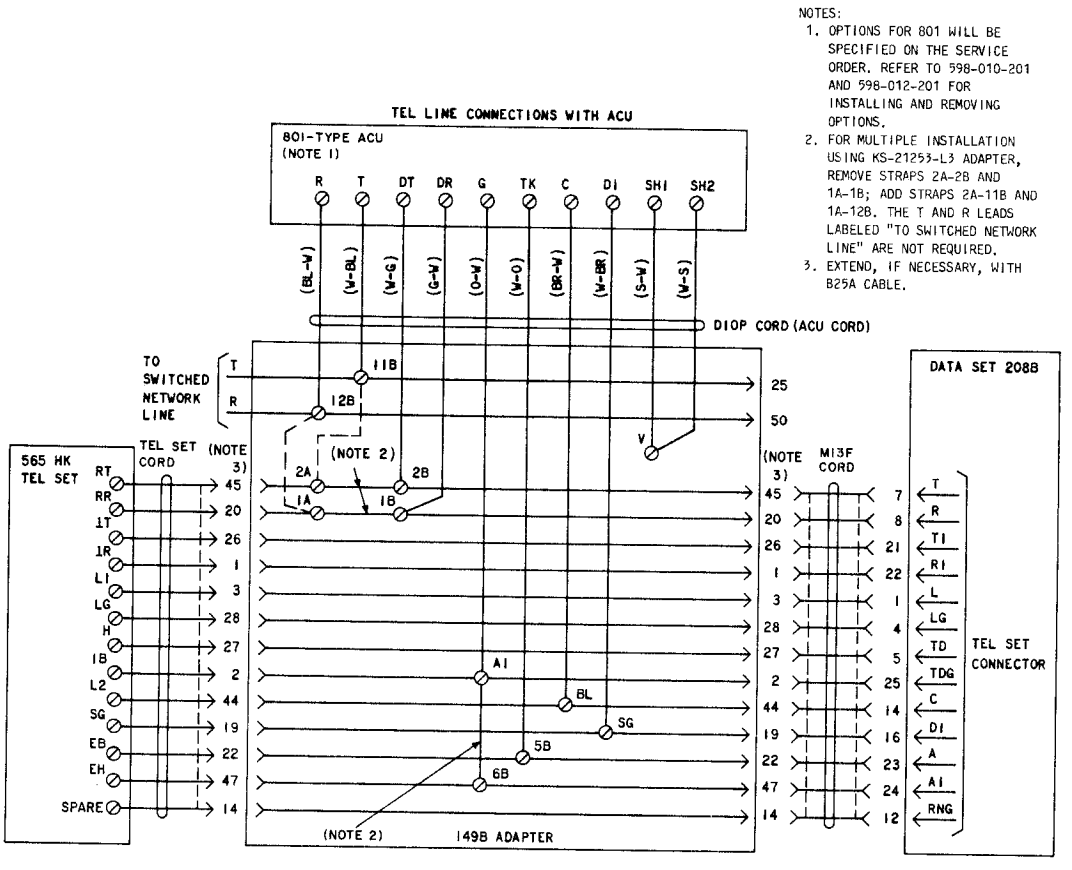


Fig. 4—Connection Diagram—Single Data Set 208B-Type With ACU Installation

- 2012A transformer—One for every KS-21253, L3 line interface adapter.

2.06 In addition to the apparatus listed in 2.05, multiple data station installations using an ACU (Fig. 6 and 7) require the following apparatus which also must be ordered separately:

- 801-type ACU—One for every data set requiring automatic call origination.

- 1044A connecting block—One for each ACU

OR

- 66E7-25 connecting block—One for each KS-21253, L3 line interface adapter.

- A25B cable—One for each KS-21253, L3 line interface adapter (for connecting P6 of adapter to connecting block).

Note: The 1044A or 66E7-25 connecting block and A25B cable are not needed if 149B adapters are used.

- 149B adapter—One for each ACU.

- B25A cable—One for each 149B adapter (for connecting 149B adapter to KS-21253, L3 line interface adapter).

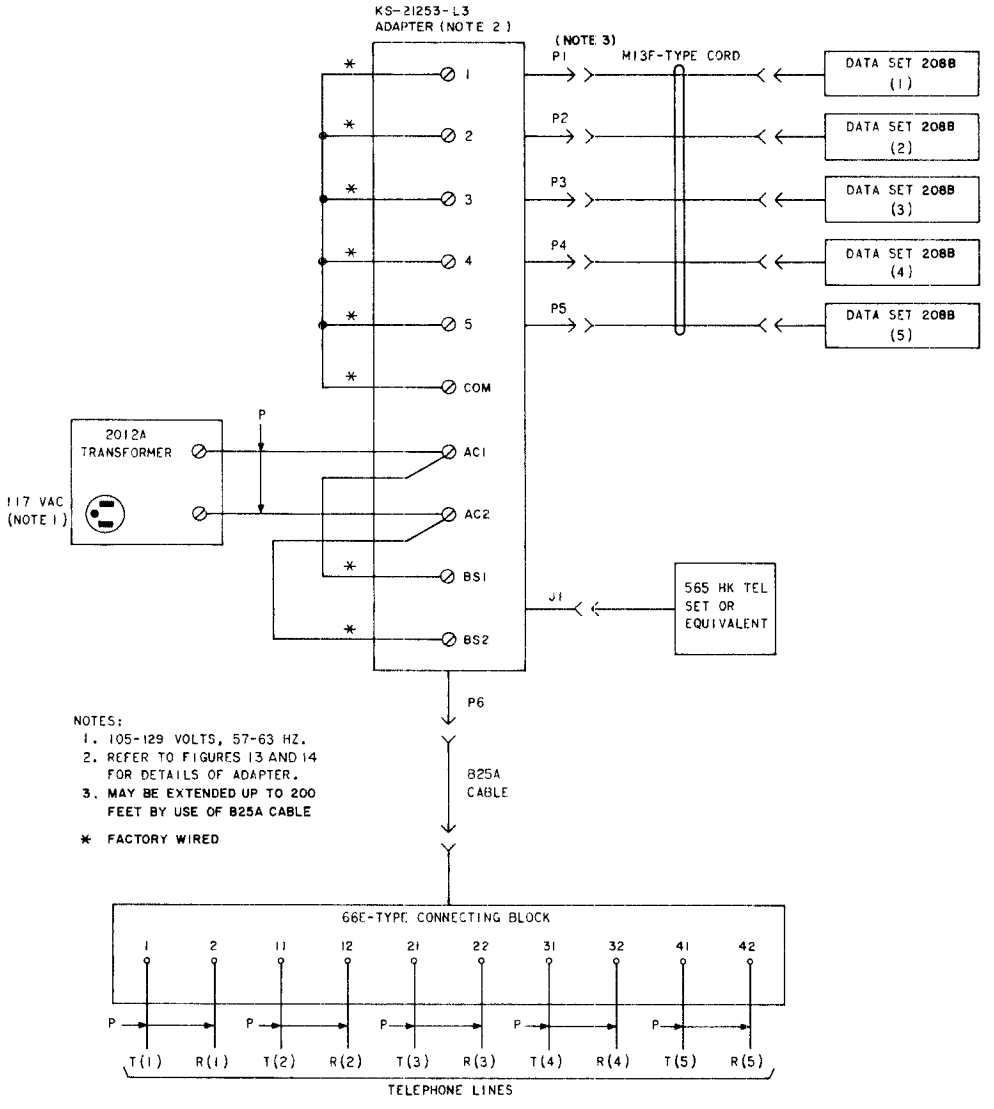


Fig. 5—Connection Diagram—Multiple Data Set 208B-Type W/O ACU Installation

Note: 149B adapter and B25A cable are not needed when 1044A or 66E7-25 connecting block and A25B cable are used.

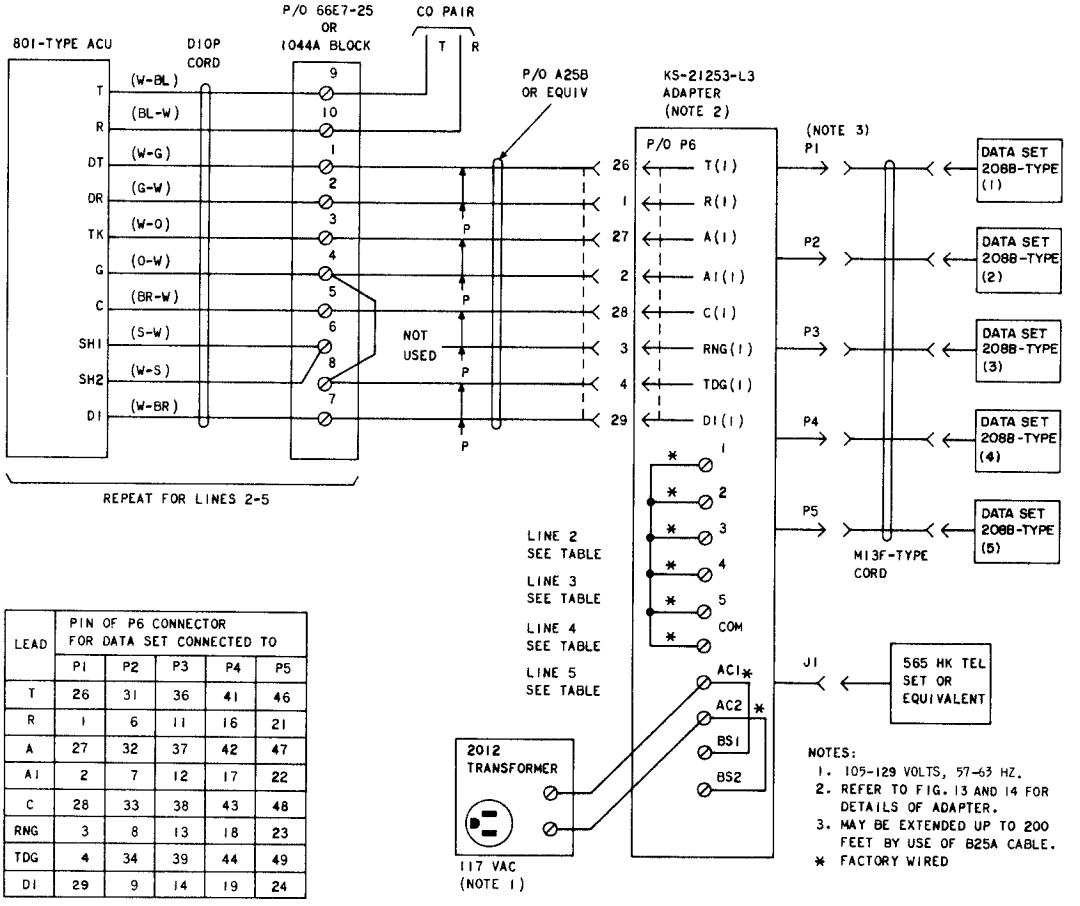
3. OPTIONS

A. Data Set 208B-Type

3.01 DS 208B-type is provided with a number of options which must be installed prior to placing the data set in service. These options should be installed as specified on the service order or circuit layout record card (CLRC) in accordance with Fig. 8, ▶or Fig. 9 and Table B,◀ or the option label (form E-6390 for -L1 sets, form E-6634 for -L1A sets, ▶and form E-6696 for -L1B sets).◀

3.02 The options and their functions are as follows:

(a) ***Compromise Equalizer IN:*** This is a filter used to provide nominal equalization to compensate for distortion present on the



LEAD	PIN OF P6 CONNECTOR FOR DATA SET CONNECTED TO				
	P1	P2	P3	P4	P5
T	26	31	36	41	46
R	1	6	11	16	21
A	27	32	37	42	47
A1	2	7	12	17	22
C	28	33	38	43	48
RNG	3	8	13	18	23
TDG	4	34	39	44	49
DI	29	9	14	19	24

Fig. 6—Connection Diagram—Multiple Data Set 208B-Type Installation Using P6 of KS-21253, L3 Line Interface Adapter for ACU Access

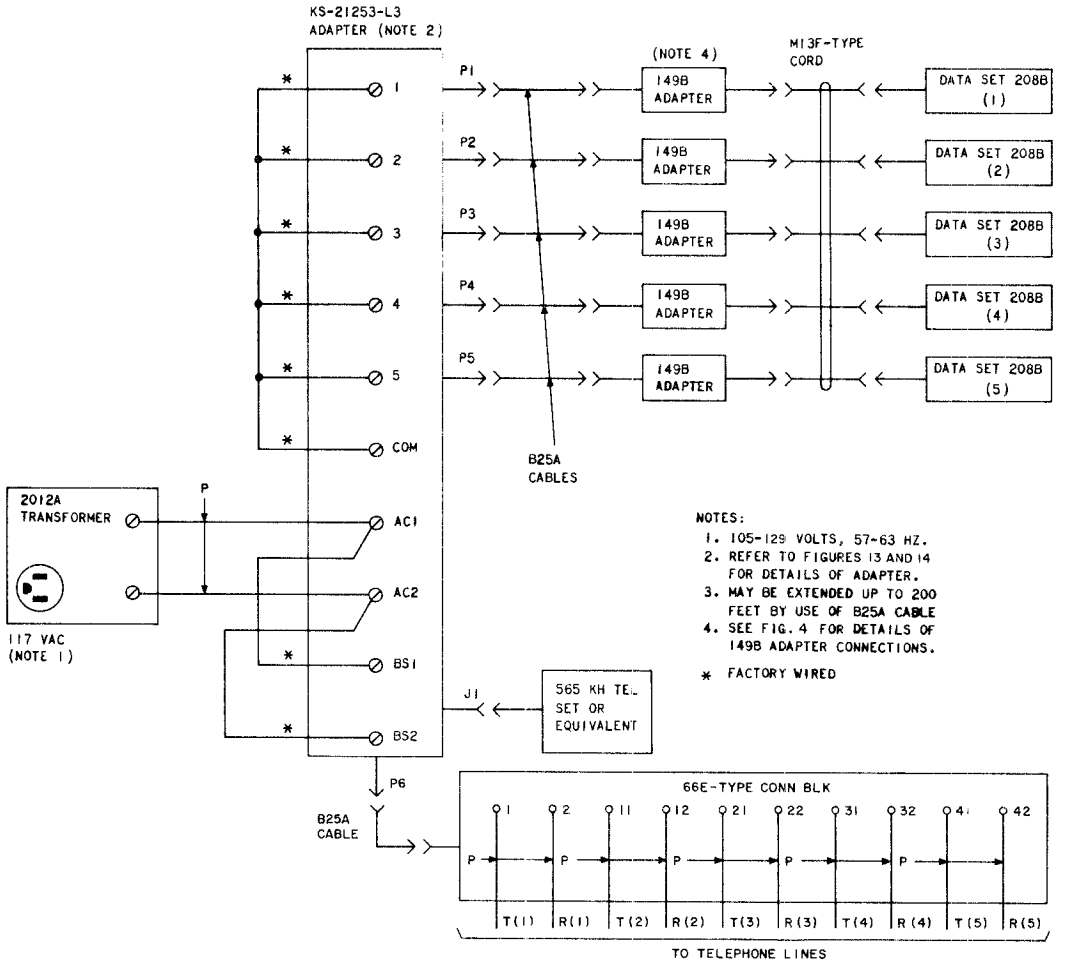
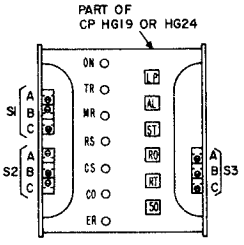


Fig. 7—Connection Diagram—Multiple Data Set 208B-Type Installation Using 149B Adapter for ACU Access

telephone channel. For ***DS 208B-L1,*** the compromise equalizer option (ZS) must always be installed; this provides an 8-dB slope. For ***DS 208B-L1A ▮and -L1B,▮*** there are two compromise equalizer IN options. One provides a 4-dB slope (WU) and the other provides an 8-dB slope (ZS). One of these options must always be installed except during test. The equalizer slope to be used is dependent on channel conditions and the proper option must be selected by telephone company personnel in accordance with tests described in Section 592-030-500. The 4-dB slope option is preferred for initial installation when tests cannot be made.

(b) ***Compromise Equalizer OUT (Option ZT):*** This option should only be installed for test purposes. It removes the compromise equalizer from the data set transmit circuit.

(c) ***CC ON in AL Mode (Option YM):*** This option provides an ON indication on



208B-L1A DATA SET OPTIONS (HG24)

SWITCH		COMPROMISE EQUALIZER SLOPE	OPTION
S2B	S2C		
§	DOWN	NONE (0DB)	ZT
UP	UP	4DB SLOPE & SYMMETRIC DELAY	WU *
DOWN	UP	8DB SLOPE & SYMMETRIC DELAY	ZS
OPTIONS FOR S3 AND 50 SWITCHES SAME AS 208B-L1			

208B-L1 DATA SET OPTIONS (HG19)

SWITCH	SWITCH POSITION	FEATURE	OPTION
S2C†	UP *	COMPROMISE EQUALIZER IN	ZS
	DOWN	COMPROMISE EQUALIZER OUT	ZT
S3A	UP	CC ON IN ANALOG LOOP MODE	YM
	DOWN *	CC OFF IN ANALOG LOOP MODE	YN
S3B	UP	MANUAL ANSWER	YO
	DOWN *	AUTOMATIC ANSWER	YP
S3C	UP	TRANSMITTER EXTERNALLY TIMED	YD
	DOWN *	TRANSMITTER INTERNALLY TIMED	YC
50††	IN	CA-CB INTERVAL OF 50 MSEC	
	OUT	CA-CB INTERVAL OF 150 MSEC	

* FACTORY INSTALLED
† COMPROMISE EQUALIZER SHOULD ALWAYS BE IN
†† IF NOT SPECIFIED ON SERVICE ORDER, INSTALL 50 INTERVAL
§ SWITCH MAY BE IN EITHER POSITION

TRANSMIT LEVEL

LEVEL (DBM)	SWITCH				OPTION
	S1A	S1B	S1C	S2A	
0 *	DOWN	UP	DOWN	UP	ZA
-1	DOWN	UP	DOWN	DOWN	ZB
-2	DOWN	UP	UP	UP	ZC
-3	DOWN	UP	UP	DOWN	ZD
-4	DOWN	DOWN	DOWN	UP	ZE
-5	DOWN	DOWN	DOWN	DOWN	ZF
-6	DOWN	DOWN	UP	UP	ZG
-7	DOWN	DOWN	UP	DOWN	ZH
-8	UP	UP	DOWN	UP	ZI
-9	UP	UP	DOWN	DOWN	ZJ
-10	UP	UP	UP	UP	ZK
-11	UP	UP	UP	DOWN	ZL
-12	UP	DOWN	DOWN	UP	ZM
-13	UP	DOWN	DOWN	DOWN	ZN
-14	UP	DOWN	UP	UP	ZO
-15	UP	DOWN	UP	DOWN	ZP

* FACTORY INSTALLED

Fig. 8—Data Set 208B-L1 and -L1A Option Switches

the CC interface lead when the data set is in AL test mode. This allows a customer to loop back signals through the data set for testing with terminal equipment.

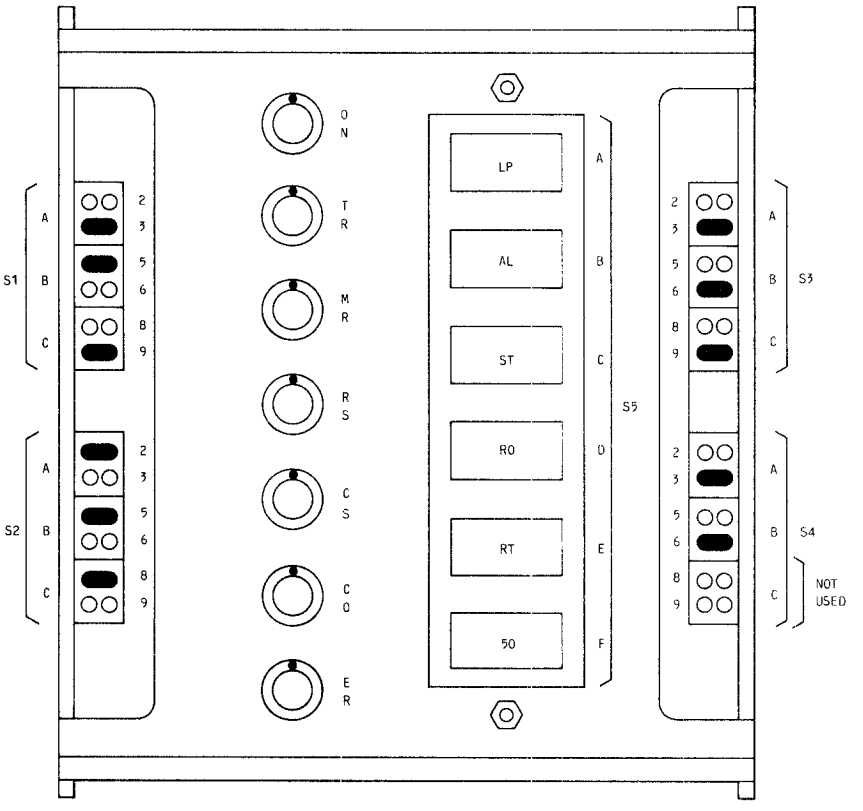
(d) ***CC OFF in AL Mode (Option YN):*** This option provides an OFF indication on the CC interface lead when the data set is in AL test mode. With this option installed, loop-back tests of the data set with terminal equipment may not be possible.

(e) ***Manual Answer (Option YO):*** With this option installed, all incoming calls ***must*** be answered manually.

(f) ***Automatic Answer (Option YP):*** This option allows the data set to answer incoming calls automatically and enter the data mode under control of the CD interface lead.

(g) ***Transmitter Externally Timed (Option YD):*** With this option installed, the customer ***must*** provide serial clock to the data set on the DA interface lead. The DB clock signal is present and is phase-locked to the signal on the DA lead.

(h) ***Transmitter Internally Timed (Option YC):*** With this option installed, the ***data***



NOTES:
1. OPTIONS ON THE CAMBION SWITCHES OF CP HG25 ARE SELECTED BY PLACING SHORTING PLUGS ACROSS THE DESIRED PAIRS OF TERMINALS AS SHOWN. EACH SWITCH SECTION A, B AND C CONSISTS OF AN UPPER AND LOWER PAIR (EG 2 AND 3) OF TERMINALS DESIGNATED UP AND DOWN, RESPECTIVELY. SHORTING PLUGS ARE SHOWN THUSLY ▬ IN FACTORY-INSTALLED POSITIONS. BE CAREFUL TO ALWAYS PLACE STRAPS IN HORIZONTAL POSITION TO IMPLEMENT DESIRED OPTION. (SEE OPTION LABEL E-6696)
2. LEDS ARE POLARIZED. INSTALL REPLACEMENT LEDS WITH RED DOT ADJACENT TO DOT SHOWN IN CONCENTRIC CIRCLES REPRESENTING LEDS.

Fig. 9—Data Set 208B-L1B Option Switches

set provides serial clock to the customer on the DB interface lead.

(i) ***CA-CB Interval 50 ms ("50" Button Depressed):*** This option causes the CB lead to remain off for approximately 50 ms after the CA lead is turned on. Unless otherwise specified on the service order or CLRC, this option should always be provided.

(j) ***CA-CB Interval 150 ms ("50" Button Released):*** This option causes the CB lead to remain off for approximately 150 ms after the CA lead is turned on. Unless specified

→TABLE B←

DS 208B-L1B OPTIONS (CP HG25)

SWITCH	OPTION STRAP POSITION	OPTION FEATURE	OPTION DESIGNATION
S2B	†	Compromise Equalizer Out	ZT
S2C	Down		
S2B	Up	Compromise Equalizer (4-dB Slope)	WU*
S2C	Up		
S2B	Down	Compromise Equalizer (8-dB Slope)	ZS
S2C	Up		
S3A	Up	DSR *on* in Analog Loop Mode	YM
	Down	DSR *off* in Analog Loop Mode	YN*
S3B	Up	Manual Answer	YO
	Down	Automatic Answer	YP*
S3C	Up	Transmitter Externally Timed	YD
	Down	Transmitter Internally Timed	YC*
S4A‡	Up		
	Down*		
S4B‡	Up		
	Down*		
"50"	In	RS-CS Interval of 50 ms	(Customer Switch)
	Out	RS-CS Interval of 150 ms	

* Factory installed.
† Strap may be up or down.
‡ Down position must be selected.

on the service order or CLRC, this option is never provided.

(k) ***Transmit Line Signal Level:*** This option allows for adjustment of the data set transmit level to compensate for losses in various local loops.

3.03 To gain access to the option switch panel and to the circuit packs, remove the front cover (Fig. ▶10 or 11◀) by gently squeezing it on

top and bottom and pulling forward. To replace the cover, position it properly, gently squeeze it at top and bottom, and push it into place.

3.04 All of the option switches are located on CP HG19 (DS 208B-L1), CP HG24 (DS 208B-L1A) ▶or CP HG25 (DS 208B-L1B).◀ The request-to-send/clear-to-send (CA-CB) timer option switch is activated by depressing or releasing the locking pushbutton labeled "50". All other options are located on switches S1, S2, S3, ▶and S4.◀ Each switch is divided into three sections: A, B, and C. To access the switch screws (-L1 or -L1A), the hinged protective cover must first be opened by pulling it from the end with the dot. Each switch section is individually adjusted to one of two positions, using a screwdriver mounted on the CP to gently rotate the adjustable screw to either the up or down position (-L1 or -L1A), or by using long nose pliers to position the straps to the up or down position (-L1B). Failure to properly position the screwdriver slot may result in improper data set operation.

Caution: On DS 208B-L1 and -L1A, the final position of the screw must be such that screwdriver slot is parallel with the spacer. Care must be taken not to force the screw, as this could damage the switch. ▶On DS 208B-L1B, always place straps horizontally, eg, 3 to 3.◀

3.05 Switch sections are referred to by adding the letter designation (either A, B, or C) to the switch number. Thus, S2B refers to switch S2, section B.

3.06 If it becomes necessary to remove CP HG19 (DS 208B-L1), CP HG24 (DS 208B-L1A), ▶or CP HG25 (DS 208B-L1B),◀ first remove the locking bar, then (on DS 208B-L1 or -L1A) remove the screwdriver by gently pulling it forward. Remove the CP by grasping the black plastic block and gently pulling forward. To replace the CP, align it in the proper slot and push gently into place. Replace screwdriver (on DS 208B-L1 or -L1A) by aligning it in the captive slots and pushing gently in.

3.07 The data set is supplied from the factory with a strap at the power supply terminal

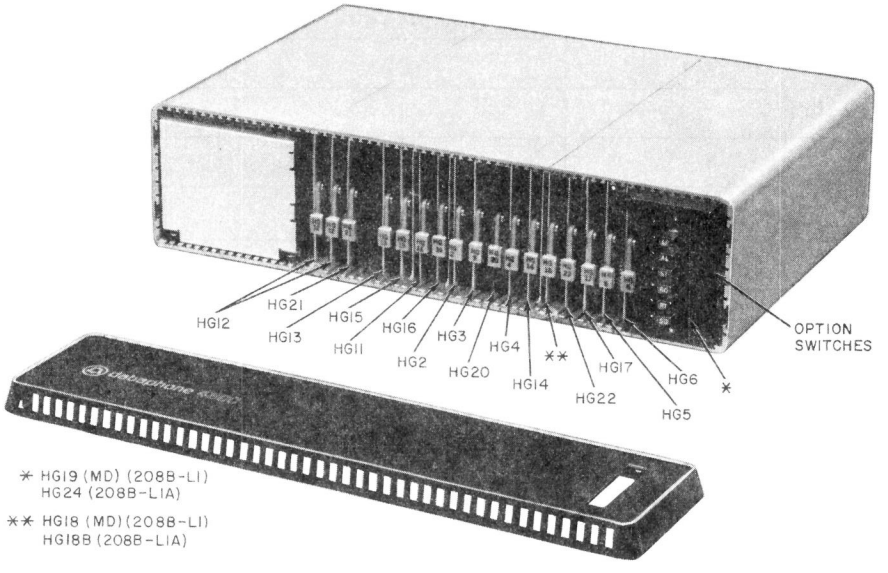


Fig. 10—▶Data Set 208B-L1 or -L1A—Front View With Cover Removed◀

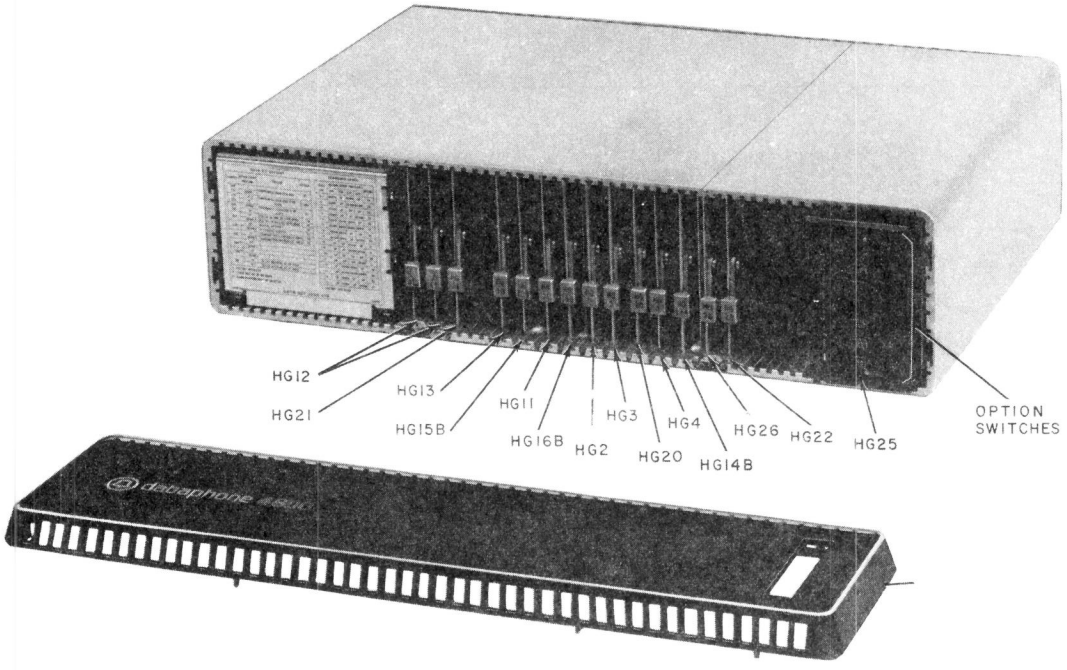


Fig. 11—Data Set 208B-L1B—Front View With Cover Removed

strip to connect frame ground to signal ground (Fig. 12). This strap can be disconnected if the customer specifies a different grounding arrangement. This should be determined at installation. To disconnect the strap, loosen the screws, pull back on the strap until the connection is broken, then tighten the strap under the frame ground screw.

3.08 The data set output level must be set so that the signal reaching the serving central office does not exceed -12 dBm. In order to do this, it is necessary to know the loop loss between the serving central office and the data station. This information can be obtained from the CLRC. In the event the information is not available, determine loop loss as follows:

(1) Dial the serving central office milliwatt supply or request that the local testboard transmit a 1000-Hz tone at 0 dBm on the loop.

(2) Use a TTS-4 (or equivalent) transmission measuring set to measure the incoming signal across the line tip and ring. The reading on the meter is the loop loss.

(3) The data set output level required is equal to the difference of the desired power level of -12 dBm and the loop loss obtained in step 2. For example, if the loop loss is 5 dB:

$$\text{Data Set Output} = -12 \text{ dBm} - (-5 \text{ dB})$$

$$= -12 + 5$$

$$= -7 \text{ dBm.}$$

(4) The data set output signal level should be set to -7 dBm.

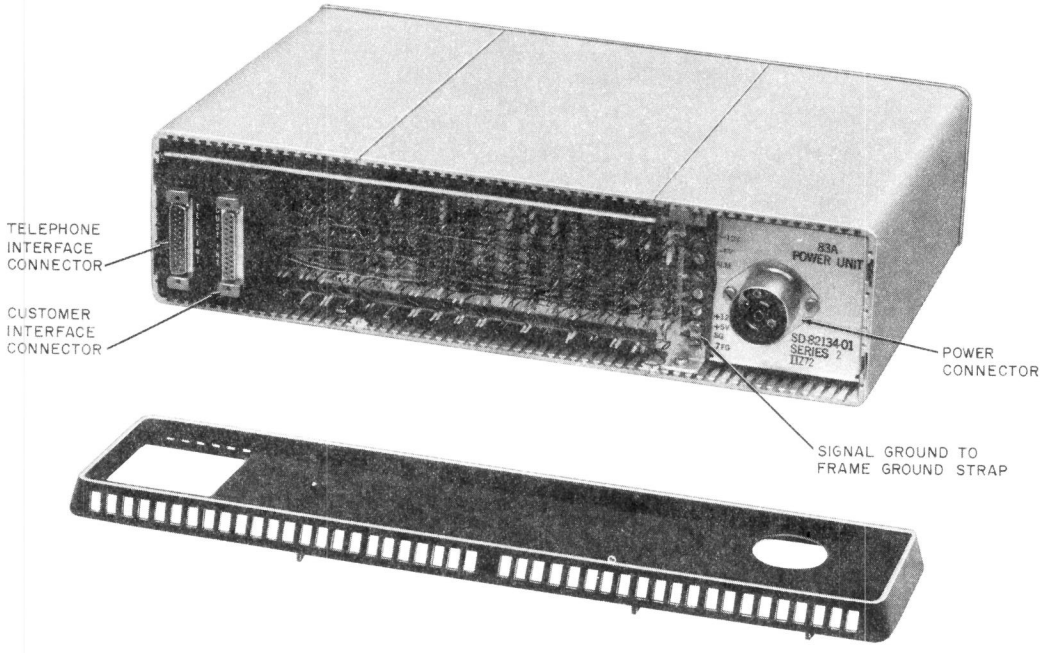


Fig. 12—Data Set 208B-Type—Rear View With Cover Removed

B. DAS 801-Type ACU

3.09 DS 208B-type can be used with either DAS 801A6, 801C4 or 801C-L1 ACU. DAS 801A6, 801C4, and 801C-L1 options are listed in Table C. Options to be used are identified in the REMARKS column of Table C as follows:

- REQUIRED: ***Always*** install these options for DS 208B-type installations.
- DO NOT USE: ***Never*** install these options for DS 208B-type installations.
- CUSTOMER SELECTS ONE: Refer to service order or CLRC to determine which option to install.
- TELCO SELECTS ONE: Refer to service order or CLRC to determine which option to install.

3.10 After determining which options must be installed, refer to one of the following sections for installation procedures.

- 598-010-201—Data Auxiliary Sets 801A5 and 801A6 for Automatic Calling—Installation and Connections.
- 598-012-201—Data Auxiliary Sets 801C3 and 801C4—Installation and Connections.
- 598-012-202 Data Auxiliary Set 801C-L1/2—Installation and Connections.

4. CONNECTIONS

4.01 This part covers the connections required for the following DS 208B-type arrangements:

(a) Single data set without ACU—4.02 and Fig. 2 ▶or 3◀

→TABLE C←

DAS 801A6 AND 801C4 ACU OPTIONS FOR USE WITH DS 208B-TYPE

OPTION				REMARKS*
FEATURE	DESIGNATION			
	801A6	801C4	801C-L1	
Mounting Cord D10P-61 Mounting Cord D14C-61	M N	M N	M13G	Required Do not use
2-Wire 4-Wire	Not avail. Not avail.	ZH ZJ	Fact. wired Not avail.	Required Do not use
ACU answer detection or end of number Data set answer detection w/o end of number	B E	B E	B E	Required Do not use
Detect end of answer tone Detect beginning of answer tone	W X	W X	W X	Required Do not use
Detect 2025 answer tone Detect 2225 answer tone	S T	S T	S T	Required Do not use
DLO controlled by ACU DLO controlled by ACU and data set	Not avail. Not avail.	ZM ZL	Fact. wired Not avail.	Required Do not use
Data set to data mode by grounded contact Data set to data mode by contact to DT Data set to data mode by isolated contact	ZG Q F	ZG Q F	ZG Q Not avail.	Required Do not use Do not use
Isolated TK contact Grounded TK and CL contacts Isolated CL contact	ZA ZB ZC	ZA ZB ZC	ZA Use ZP Not avail.	Required † Do not use Do not use
Stop ACR timer when DSS goes on Do not stop ACR timer when DSS goes on	R H	R H	R H	Customer selects one
Terminate call via data set after DSS on (line transfer in test) Terminate call via CRQ after DSS on (line transfer)	G Z	G Z	G Z	Customer selects one
Terminate call via data set after DSS on (CL contact in test) Terminate call via CRQ after DSS on (CL contact)	ZD A	ZD A	G Z	Do not use Do not use
Voltage interface Contact interface	ZF ZE	Not avail. Not avail.	Fact. wired Not avail.	Customer selects one
Long loop (over 400 ohms) Short loop (under 400 ohms)	ZU w/o ZU	Not avail. Not avail.	Not avail. Not avail.	Telco. selects one
Ground start (2-wire) w/o ground start (loop start)	Not avail. Not avail.	V Y	V Y	Telco selects one
Ground start (4-wire)	Not avail.	ZK	Not avail.	Do not use
7-second ACR timing interval 14-second ACR timing interval 28-second ACR timing interval 56-second ACR timing interval	Screwdriver Adjustment		ZQ ZR ZS ZT	Telco selects one
SG connected to FG SG not connected to FG	Strap No strap	Strap No strap	ZU ZV	Telco selects one

* Refer to 3.09 and 3.10.
† CL and TK contacts are not used by DS 208B-type. Option ZA is specified to provide uniformity of installation.

(b) Single data set with ACU—4.03 and Fig. 4

(c) Multiple data sets without ACUs—4.04 and Fig. 5, 13, and 14.

(d) Multiple data sets with ACUs—4.05 through 4.07 and Fig. 6, 7, 13, and 14.

4.02 A single data set ***without an ACU*** is shown in Fig. 2 and 3. DS 208B-type is connected to the telephone set via an M13F cord. The telephone set can be located up to a maximum of 200 feet from the data set by using a B25A cable to extend the M13F cord. The telephone set is connected via the telephone line to the switched network at the 42A connecting block by use of a D4-type cord.

4.03 A single data set ***with an ACU*** arrangement is shown in Fig. 4. The data set, telephone set, and ACU are interconnected by use of a 149B adapter as follows:

(a) Telephone set—to 149B adapter via the telephone set cord.

(b) ACU—via a D10P-61 cord.

(c) Data set—via an M13F cord. The telephone set, ACU, and 149B adapter can be located up to a maximum of 200 feet from the data set by using a B25A cable to extend the M13F cord.

The 149B adapter requires the installation of three straps as shown in Fig. 4. The telephone line to the switched network is connected to the data station at the 149B adapter.

4.04 A multiple data set ***without ACUs*** is shown in Fig. 5. This arrangement requires the use of a KS-21253, L3 line interface adapter (Fig. 13) which allows up to five data sets to be associated with one telephone set. A wiring diagram of the KS-21253, L3 line interface adapter is given in Fig. 14. The data set(s) are connected to plugs P1 through P5 of the KS-21253, L3 adapter via M13F cord(s) and the telephone set cord is connected via connector J1. Tip and ring leads of the data set(s) are fed via the B25A cable between plug P6 of the KS-21253, L3 adapter and the 66E-type connecting block where they are cross-connected to the telephone line(s) to the switched network.

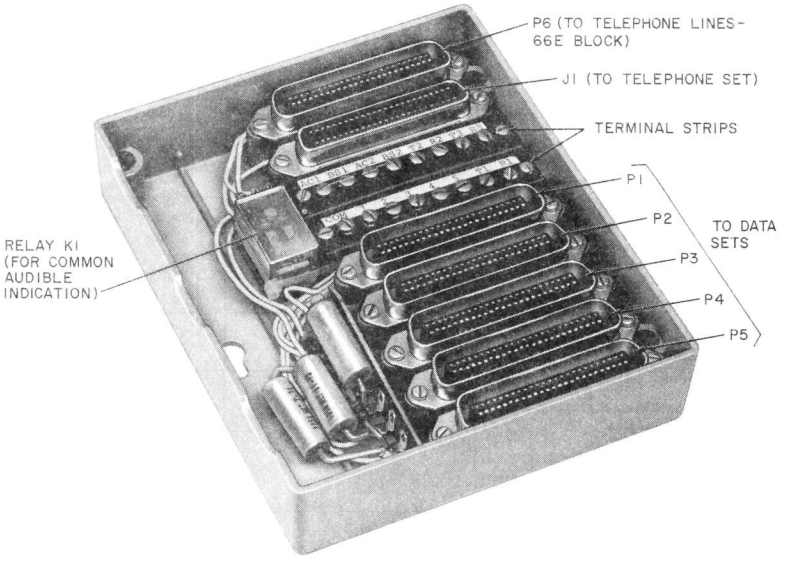


Fig. 13—KS-21253, L3 Line Interface Adapter With Cover Removed

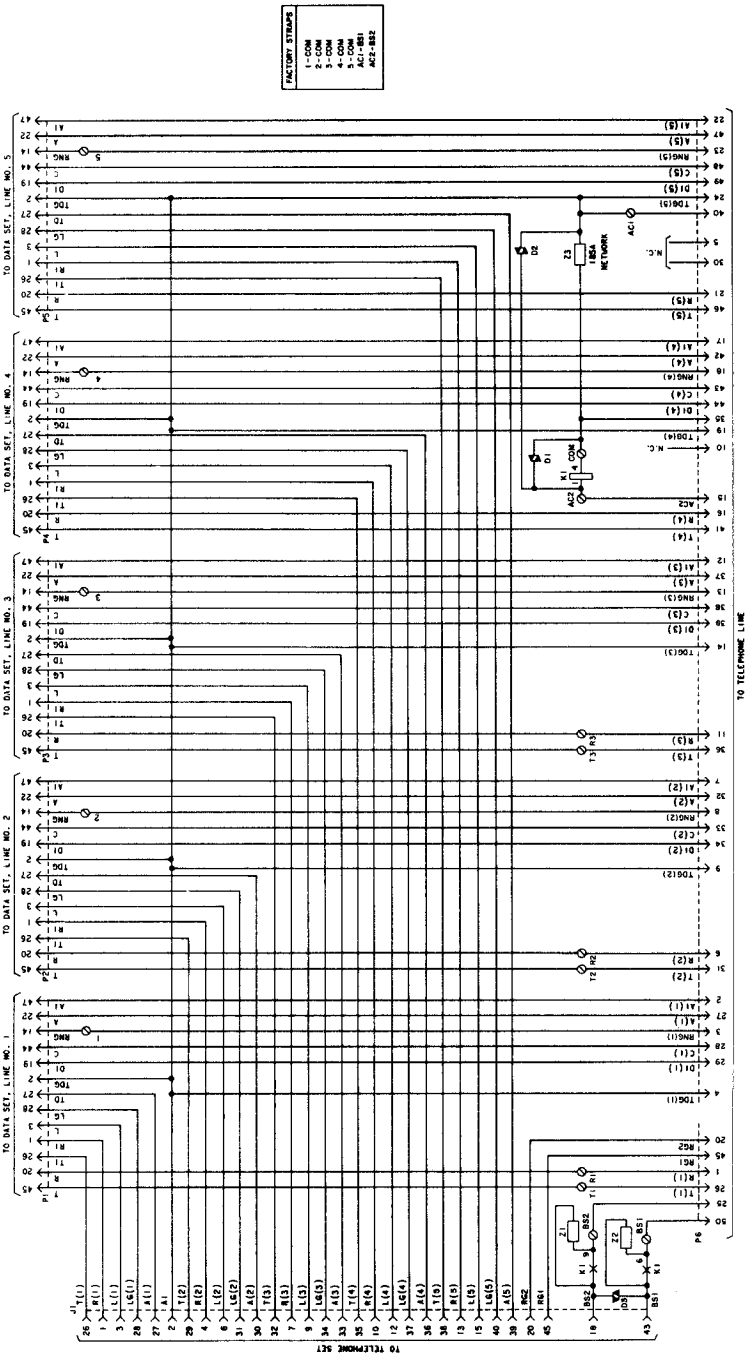


Fig. 14—Wiring Diagram—KS-21253, L3 Adapter

Power is supplied to the KS-21253, L3 adapter by a 2012A transformer.

4.05 There are two possible multiple data set arrangements ***with ACUs.*** Fig. 6 shows the arrangement where ACU access is provided via plug P6 of the KS-21253, L3 adapter. Fig. 7 shows the arrangement where ACU access is provided by the 149B adapter(s).

4.06 ***ACU Access Provided Via P6 of KS Adapter (Fig. 6):*** In this arrangement the data set(s) are connected to plugs P1 through P5 of the KS-21253, L3 adapter via M13F cord(s). The telephone set is connected to connector J1 of the KS-21253, L3 adapter. The data set leads required by the ACU that appear at P6 are fed to the 1044A connecting block(s) or a 66E7-25 connecting block via the A25B cable where they are cross-connected to the ACU.

> ***Note:*** The 1044A connecting block provides ten terminals. Therefore, one 1044A is required for each ACU. The 66E7-25 connecting block provides five rows of ten terminals each allowing up to five ACUs to be cross-connected. Telephone lines to the switched network are connected to the data station at the 1044A or 66E7-25 connecting blocks.

4.07 ***ACU Access Provided Via 149B Adapters (Fig. 7):*** In this arrangement one 149B adapter is required for each data set to be associated with an ACU. The data set, ACU, telephone set, 149B adapter, and KS-21253, L3 adapter are interconnected as follows:

(a) Data set—to the 149B adapter via the M13F cord.

(b) ACU—to the 149B adapter via the D10P-61 cord.

(c) Telephone set—via the telephone set cord to J1 of the KS-21253, L3 adapter.

(d) KS-21253, L3 adapter—to the 149B adapter via B25A cable connected to plugs P1, P2, P3, P4, or P5 of KS-21253, L3 adapter. Tip and ring leads of each data station are fed via a B25A cable between P6 of the KS-21253, L3 adapter and the 66E-type connecting block where they are cross-connected to telephone lines to the switched network. Power is supplied to the KS-21253, L3 adapter by a 2012A transformer.

5. MULTIPLE MOUNTINGS

5.01 There are three ways in which DS 208B-type can be installed for multiple arrangements. They are:

(a) Up to three data sets can be stacked on top of each other.

(b) By use of the D-180467 mounting bracket, they can be mounted (including complete housing) on a 19- or 23-inch rack mounting (Fig. 15).

(c) By use of the D-180467 or D-180556 mounting brackets, they can be mounted (including complete housing) in a KS-20018, L15 or L17 cabinet.

5.02 KS-20018, L15 and L17 cabinets will accommodate up to 12 DS 208B-type. However, because of temperature limitations, no more than eight DS 208B-type shall be mounted in the KS-20018, L15 or L17 cabinet. Figure 16 gives a typical arrangement for DS 208B-type mounted in a KS-20018, L15 or L17 cabinet. For the KS-20018, L15 and L17 cabinet installation procedures, refer to the section entitled Data Sets—Multiple Installation Information (590-010-201).

6. INSTALLATION TEST

6.01 After the data set has been installed, it should be tested to determine if it is operating properly. Perform appropriate installation tests specified in the test section (592-030-500).

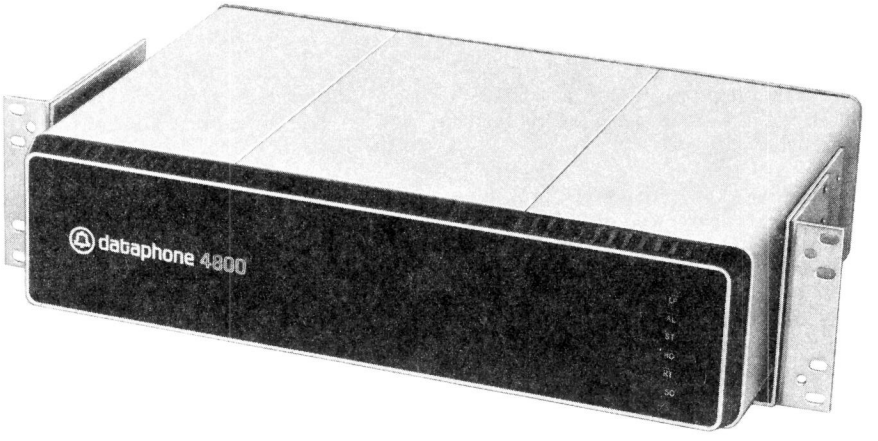


Fig. 15—Data Set 208B-Type With D-180467 Mounting Bracket Installed—Front View

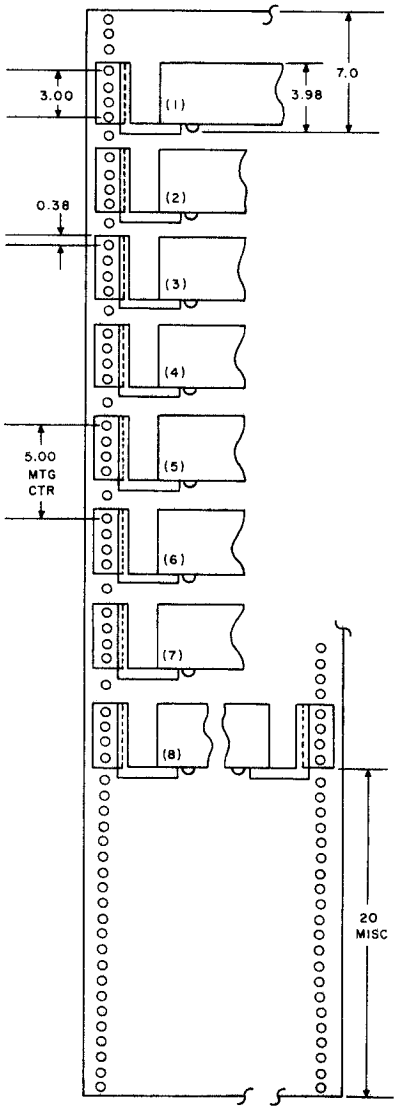


Fig. 16—Eight Data Sets 208B-Type Mounted in KS-20018, L15 or L17 Cabinet

DATA SET 208B-TYPE TRANSMITTER-RECEIVER TEST PROCEDURES USING THE 914-TYPE DATA TEST SET (DTS)

CONTENTS PAGE

1. GENERAL

1.01 This section contains procedures to be used when testing data set (DS) 208B-type on an initial installation or during a maintenance visit. Procedures required when investigating reported trouble are found in Section 592-030-300.

1.02 This section is reissued to include:

- Information pertaining to DS 208B-L1B, which replaces DS 208B-L1A. Concurrent with the introduction of DS 208B-L1B, DS 208B-L1A is rated Manufacture Discontinued/ Not Orderable (MD/NO).
- End-to-End Start-up Test.

1.03 This section is divided into six parts:

- General
- Test Facilities Available
- Installation Testing

- Maintenance Testing
- Test Procedures
- Ground Noise Test.

Part 2 describes the test capabilities of the data set. Part 3 specifies the tests to be made during installation. Part 4 specifies the tests to be made during a maintenance visit. Part 5 outlines the step-by-step procedures for performing the various tests. Part 6 provides a test of the grounding arrangement between data set and business machine.

1.04 In Part 5, the CA-CB interval test and CA-CF interval test require a yellow resistor pin for use with the 914-type data test set (DTS). The pin contains a 3300-ohm resistor, and is used to eliminate the effects of contact bounce produced by the S switches of the 914-type DTS, during timing interval tests.

1.05 If the resistor pin is not available, connect a 3300-ohm resistor between the center posts of terminals 9 and 4 of the interface selector switches on the 914-type DTS before performing tests.

2. TEST FACILITIES AVAILABLE

2.01 Test circuitry built into DS 208B-type permits testing of the data set in analog loop-back and end-to-end modes without the use of external test equipment. The same tests can also be made in greater depth using the 914-type DTS. Remote test circuitry enables the data set to be tested and evaluated by telephone company (telco) data test center (DTC) personnel.

A. Self-Test Features

2.02 The self-test features of the data set make use of pushbutton switches and lamps on the front of the data set. For a description of switches and lamps, refer to the section entitled Data Set 208B-Type Transmitter-Receiver— Description and Operation (592-030-100). Table A gives the test switch positions and lamp status during test and normal operation.

Lamp Test

2.03 The lamp test (LP) switch is a nonlocking button which when depressed lights the TR, MR, RS, CS, CO, and ER lamps to ensure proper operation of these lamps. The LP switch can be depressed at any time, as it does not affect normal data set operation. ▶On DS 208B-L1B, the LP switch is also used to inject errors (spaces) for test purposes. This feature is enabled only when the ST switch is depressed.◀

Analog Loop-Back Test

2.04 The analog loop-back test checks operation of the terminal equipment with the data set by allowing the terminal to loop back test signals through the data set. The terminal should be connected to the data set, the DSR-ON-in-AL-mode option should be installed in the data set, and the AL switch on the data set should be depressed to perform the test. The terminal should be able to operate full duplex and verify that the test signal is being sent through the local data set and back to the terminal without errors.

Analog Loop-Back Self Test

2.05 The analog loop-back self-test mode is entered by depressing the analog loop (AL) and self-test (ST) locking switches. Depressing the AL button connects the data set transmitter to its own receiver through an internal pad on the data set side. Depressing the ST button forces the internal request-to-send (CA) ON, transmits a steady mark on data set BA lead and enables the ER lamp to be used to indicate received errors (spaces). ▶On DS 208B-L1B, depressing the LP switch causes steady spaces to be sent.◀

End-to-End Self Test

2.06 The end-to-end self-test mode is entered, after a call connection has been established, by depressing the ST switch at the transmitting end and the ST and RO (receive only) switches at the receiving end and then transferring to data mode. This conditions the transmitting end to transmit steady marks. The ER lamp at the receiving end indicates any errors made in transmission. The direction of transmission can be reversed by releasing the RO switch at the receiving end (which now becomes the transmitting end) and depressing the RO switch at the transmitting end (which now becomes the receiving end). ▶On DS 208B-L1B, depressing the LP switch causes steady spaces to be sent which are detected as errors at the receiving end.◀

→TABLE A←

DATA SET 208B-TYPE SWITCH POSITIONS AND LAMP STATUS

SWITCH OR LAMP	NORMAL OPR	ANALOG LOOP-BACK SELF TEST	END-TO-END SELF TEST		REMOTE TEST	LAMP TEST	ANALOG LOOP-BACK TEST	END-TO-END START-UP TEST	
			XMT END	RCV END				RCV END	XMT END
LP Switch (Nonlock)*		Note 1	Note 1			X			
AL Switch*		X					X		
ST Switch*		X	X	X				X	X
RO Switch*				X				X	
RT Switch*					X				
ON Lamp	ON	ON	ON	ON	ON	ON	ON	ON	ON
TR Lamp	Note 2	Note 2	Note 3	Note 3	Note 3	ON	Note 2	Note 3	Note 3
MR Lamp	Note 4	OFF	Note 13	Note 13	Note 13	ON	Note 5	Note 13	Note 13
RS Lamp	Note 6	ON	ON	OFF	Note 7	ON	Note 6	OFF	ON
CS Lamp	Note 8	ON	ON	OFF	Note 8	ON	Note 8	OFF	ON
CO Lamp	Note 9	ON	OFF	ON	Note 9	ON	Note 9	ON	OFF
ER Lamp	Note 10	Note 11	ON	Note 11	Note 12	ON	Note 10	OFF	ON

* X = Switch Depressed; Blank = Switch Not Depressed.

Note 1: On DS 208B-L1B, LP switch is depressed to inject errors (steady space).

Note 2: Under control of customer interface (-L1 and -L1A only) -L1B — OFF.

Note 3: Under control of customer interface (-L1 and -L1A only) -L1B — ON.

Note 4: Monitors state of CC circuit. Lamp will be ON when CC-ON-in-AL-mode option is in set and the AL switch is depressed, or when set is in data mode.

Note 5: Monitors state of CC circuit. Lamp will be ON when CC-ON-in-AL-mode option is in set and the AL switch is depressed, or when set is in data mode (-L1 and -L1A only) -L1B — ON.

Note 6: ON when line signal is being transmitted.

Note 7: ON for approximately 2 seconds after CO lamp goes off.

Note 8: ON after completion of CA-CB interval (50 or 150 ms). Stays ON for completion of data transmission.

Note 9: ON when line signal is being received.

Note 10: ON when CO lamp is OFF. When CO lamp is ON, indicates state of adaptive equalizer. When both CO and ER lamps are ON, equalizer is retraining.

Note 11: OFF except when errors occur.

Note 12: ON when CO lamp is OFF. When CO lamp is ON, ER lamp is OFF except when errors occur.

Note 13: On DS 208B-L1 and -L1A — OFF; on -L1B — ON.

B. Tests Using 914-Type DTS

2.07 In this series of tests, the 914-type DTS is used to provide a more thorough test of the data set. By using the 914-type DTS, the customer interface is checked and facilities are available to perform an actual error count.

Caution: Certain 914B DTSs are susceptible to power line transients which may cause the fuse in the 5-volt power supply of the DTS to fail. To avoid this problem, do not unplug the data set while power is applied to the 914B. If the fuse in the 5-volt supply fails, the counter

will count continuously and will refuse to reset.

C. Remote Test From DTC

2.08 The RT switch is the only switch depressed. The remaining operations are performed by the DTC, which reports the results at the end of the test. ▶When testing of a DS 208B-L1B is completed, the DTC must send a minimum of 3 seconds of space signals for automatic disconnect, whereas earlier DS 208Bs typically required only 1.0 second of space signals.◀

3. INSTALLATION TESTING

3.01 Before proceeding with tests, verify that the channel is installed and meets requirements specified in the section entitled Data Systems—DATA-PHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (314-205-501) (DATA-PHONE Type III).

3.02 Refer to Fig. 1 for the sequence of tests to be performed.

4. MAINTENANCE TESTING

4.01 Maintenance testing involves troubleshooting to isolate trouble to either the local loop, station wiring, or data set. The maintenance testing procedure is outlined in Fig. 2. Once the trouble has been isolated to the data set, the repair test procedures in Fig. 3 (DS 208B-L1 and -L1A) ▶or Fig. 4 (DS 208B-L1B)◀ should be used to isolate the trouble within the data set to a circuit pack (CP). It is assumed that the maintenance procedures outlined in Section 592-030-300 have been followed prior to dispatching the telco employee.

4.02 The overall repair test sequence is shown on the flowchart in Fig. 3 ▶and 4.◀ The test sequence is made up of six basic parts.

A. Power Supply Test

B. Automatic Answer Circuit Test

C. CA-CB Interval Test

D. Transmit Level Test

E. CA-CF Interval Test

F. Analog Loop-Back Test.

The End-to-End Test, Remote Start-up Test, Analog Loop Start-up Test, End-to-End Start-up Test, and Ground Noise Test are supplementary tests and are not specified in Fig. 3 ▶and 4.◀ These tests should be done as required.

4.03 When any test shown in Fig. 3 ▶or 4◀ (except the power supply) fails, a list of CPs associated with that particular test is given. The first CP in the list should be replaced with one that is known to be good, and the test repeated. If the data set still fails the test, the original card should be returned to the set and the next CP replaced. This procedure should be continued until a defective CP is located or the list of CPs is exhausted.

4.04 Following the repair procedure should quickly isolate the trouble to a CP or group of CPs. It is evident that in all the tests, one of the CP replacements recommended is HG19 (208B-L1), HG24 (208B-L1A) ▶or HG25 (208B-L1B).◀ This is the interface CP and the majority of data and control signals appear on this CP. If HG19, HG24, ▶or HG25◀ (or any other CP) has been replaced earlier in the test and further on it is a recommended replacement again, omit that replacement and proceed to the next CP in the CP replacement list in Fig. 3 or 4.

When CP HG19, HG24, ▶or HG25◀ is replaced, install correct options before proceeding with test. Refer to Sections 592-030-200 and 592-030-300 for option information and procedures for converting DS 208B-L1 to data set 208B-L1A. ▶DS 208B-L1A cannot be converted to a DS 208B-L1B because of backplane differences.◀

4.05 If a defective CP is located, it should be disposed of as outlined in Part 1 of Section 592-030-300. After the data set has been repaired and tested, verify to the customer that service is satisfactory by allowing the customer to make a data call.

4.06 In the unusual instance when the data set is obviously malfunctioning but CP replacements

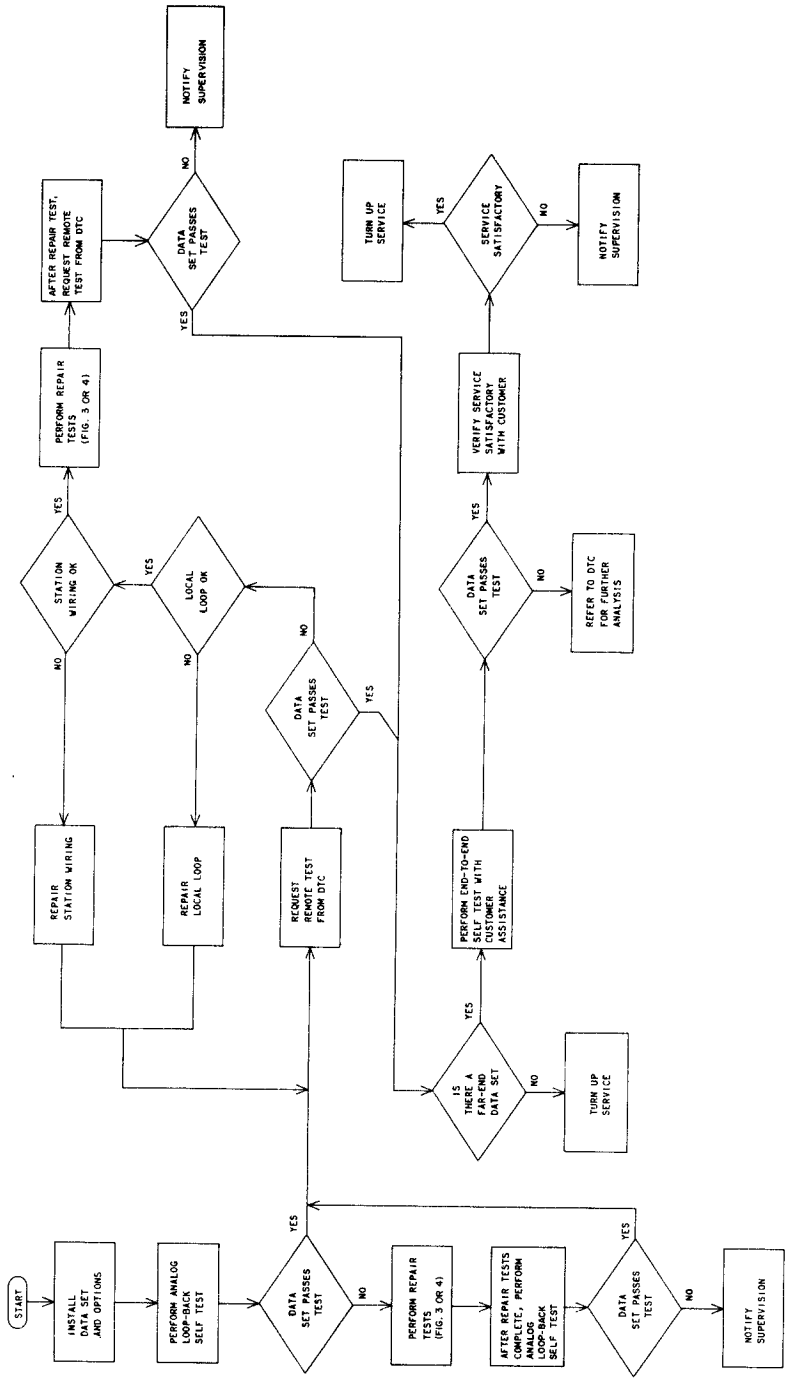


Fig. 1—Installation Test Procedures

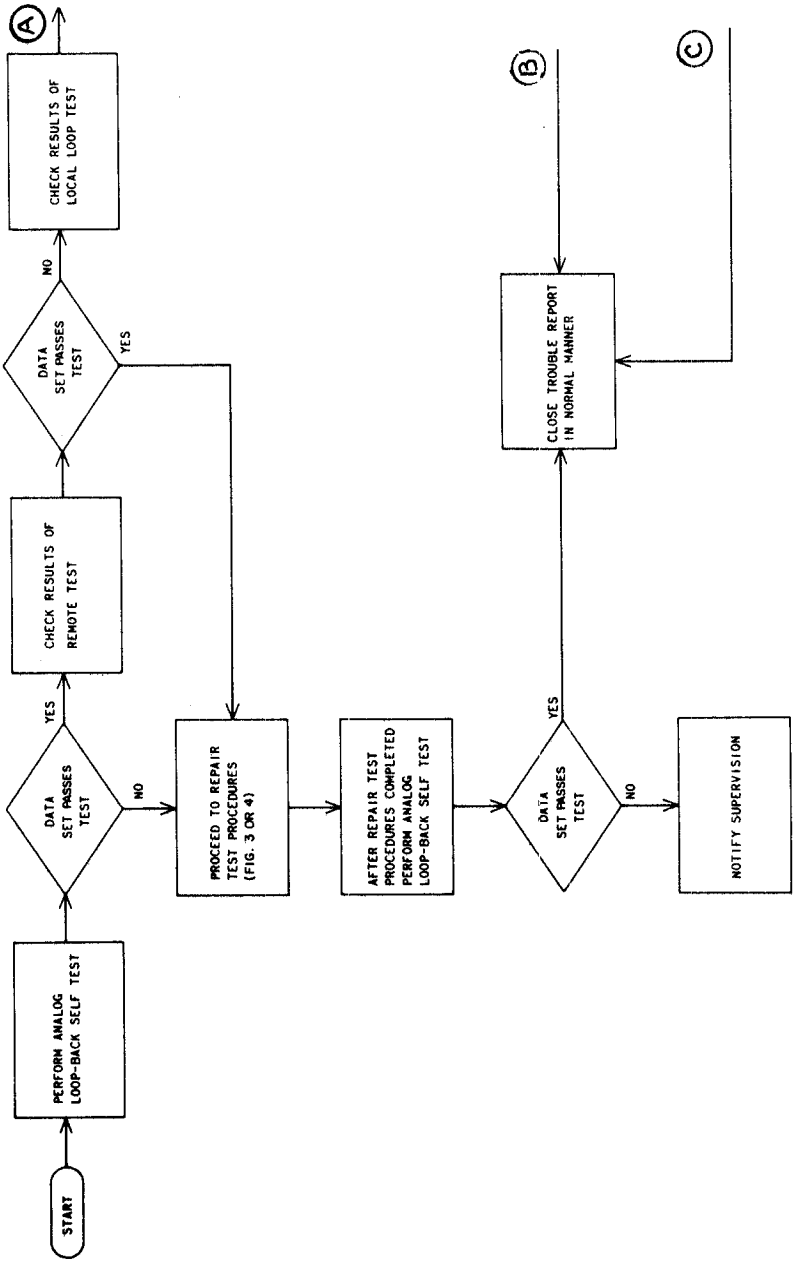


Fig. 2—Maintenance Test Procedures (Sheet 1 of 2)

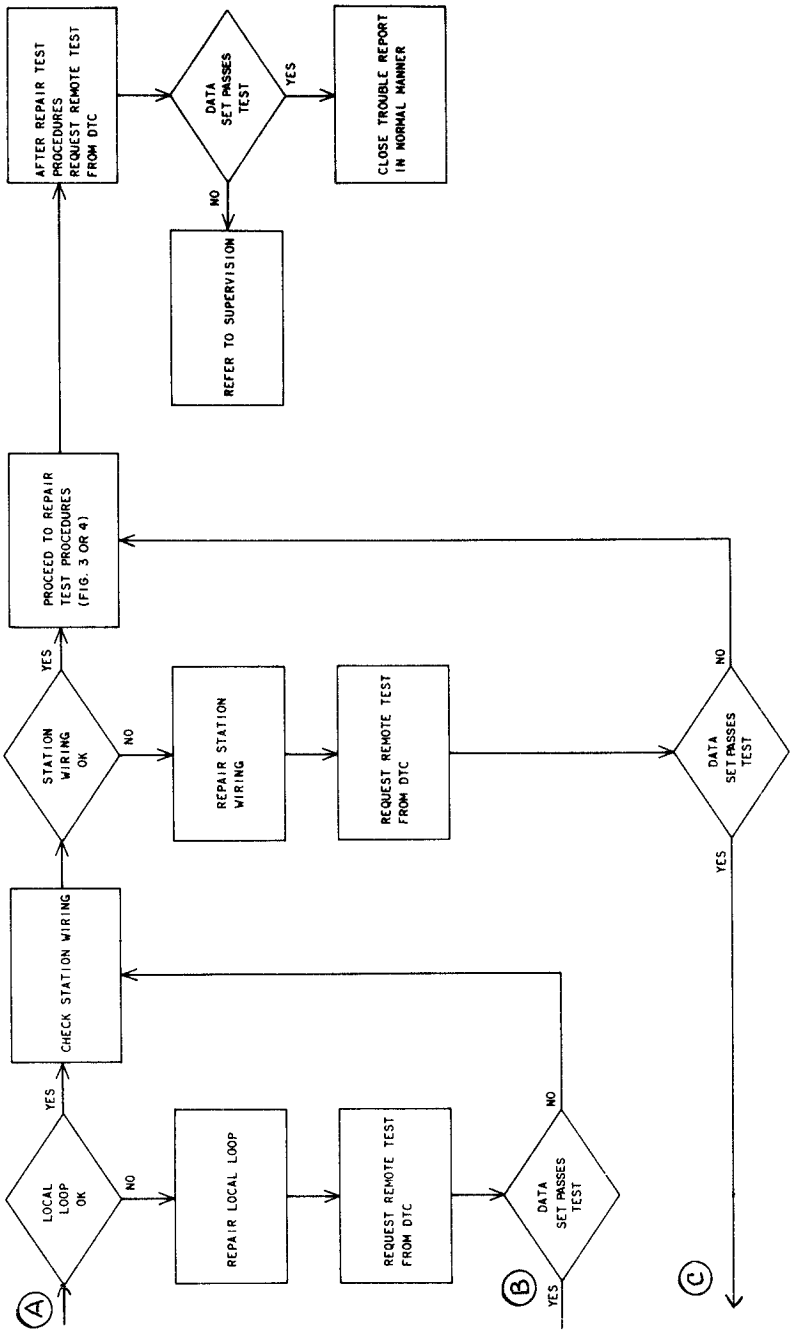


Fig. 2—Maintenance Test Procedures (Sheet 2 of 2)

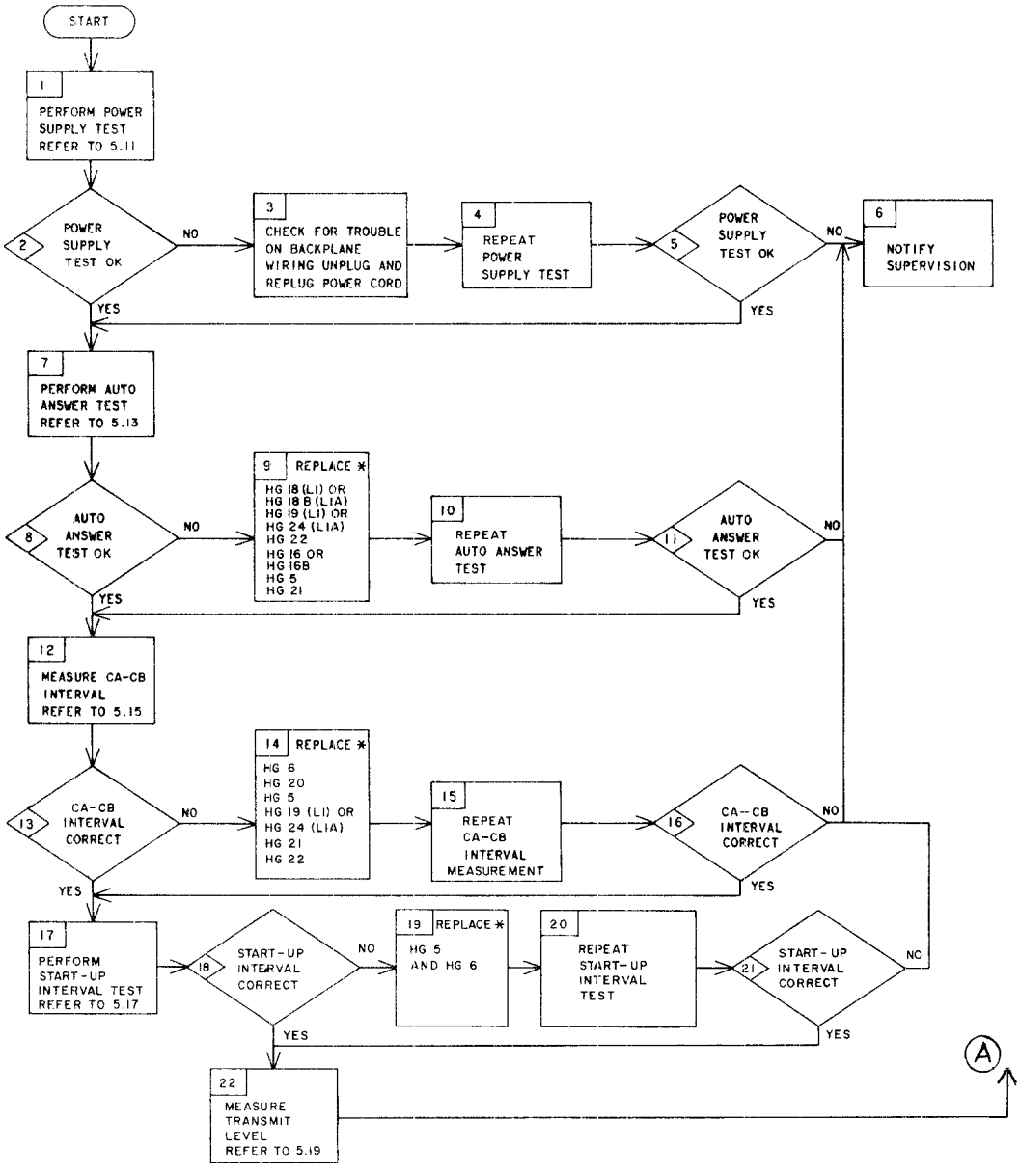


Fig. 3—Repair Procedures for DS 208B-L1 and DS 208B-L1A (Sheet 1 of 2)

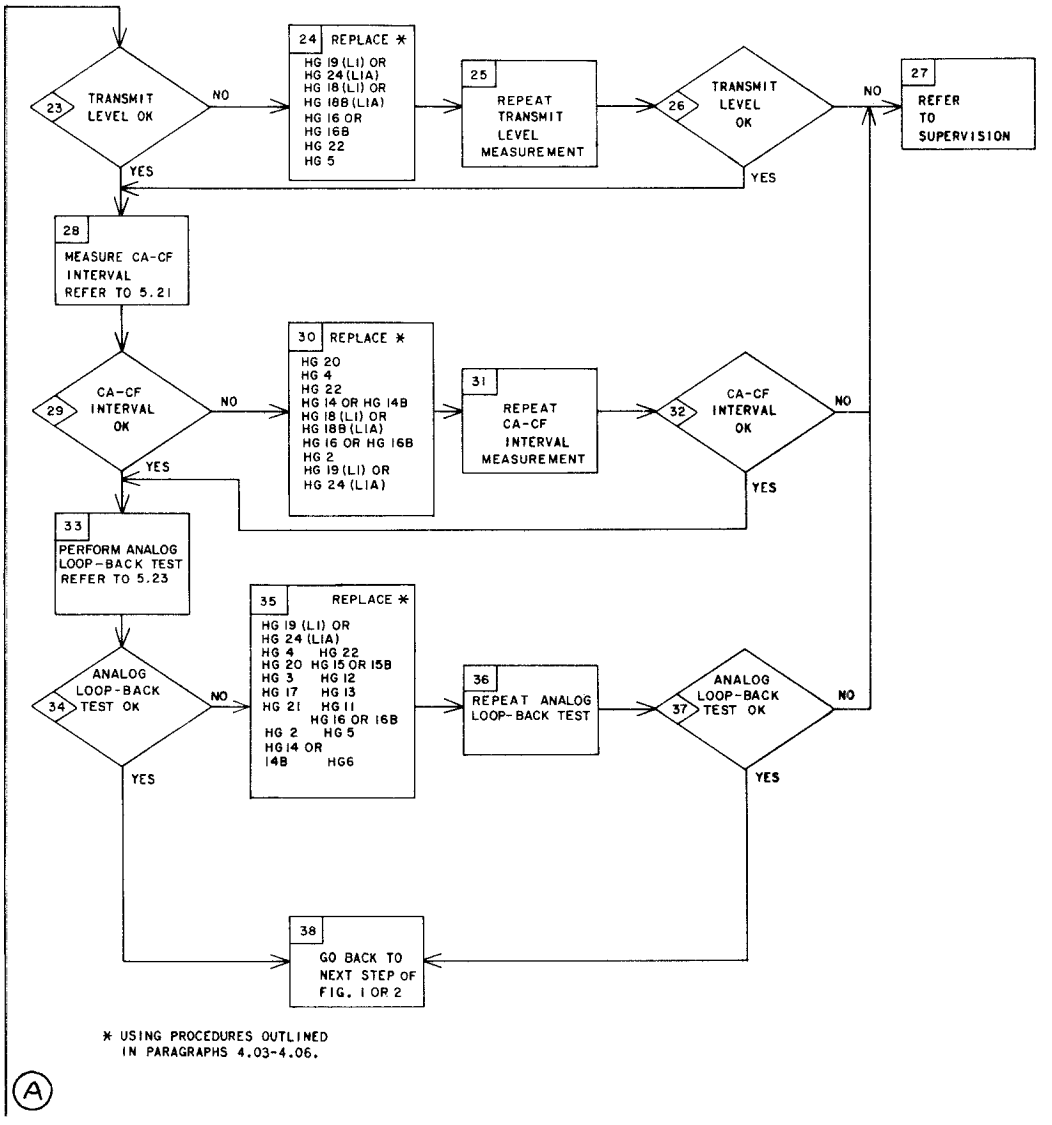


Fig. 3—Repair Procedures for DS 208B-L1 and DS 208B-L1A (Sheet 2 of 2)

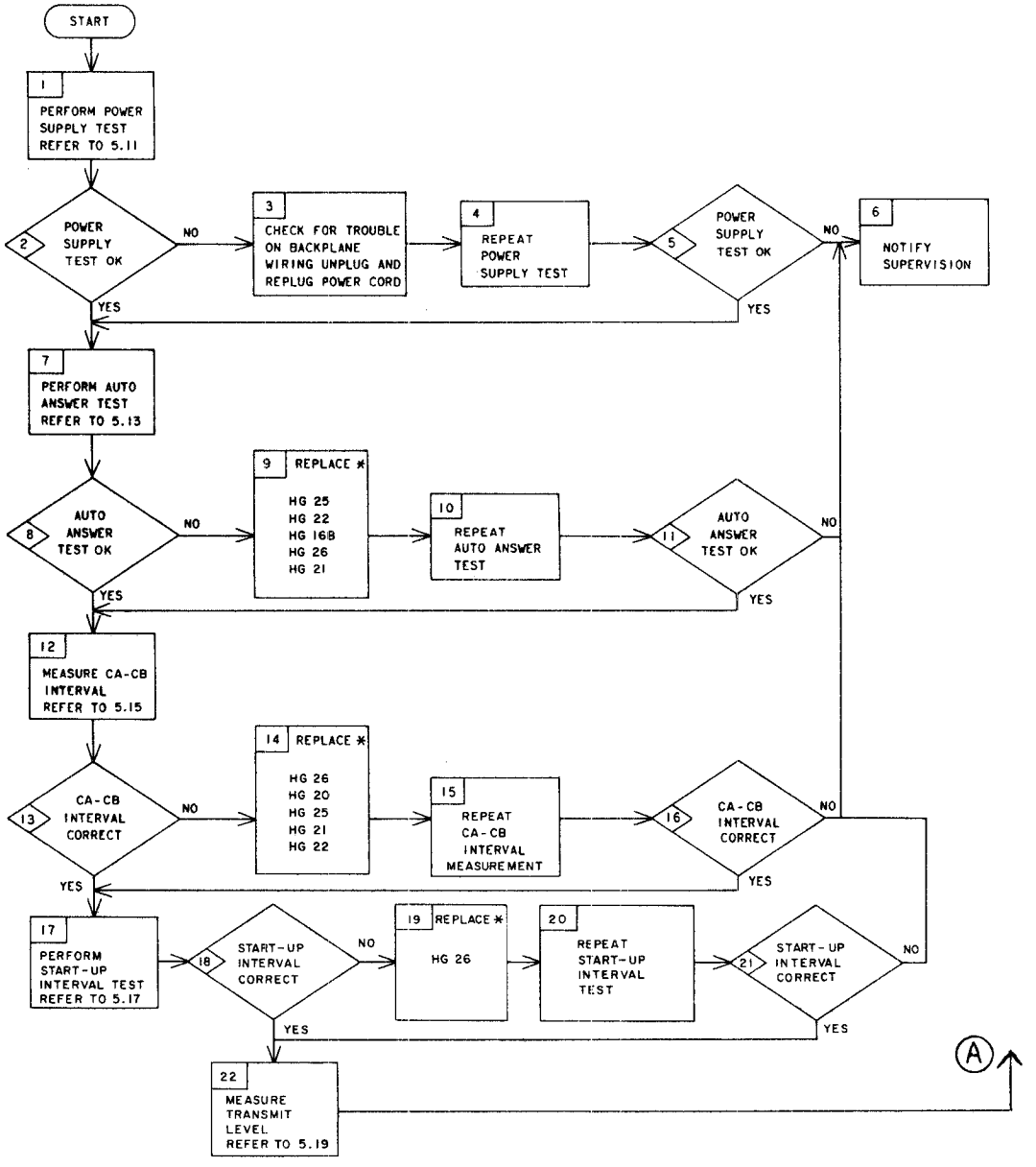


Fig. 4—Repair Procedures for DS 208B-1.1B (Sheet 1 of 2)

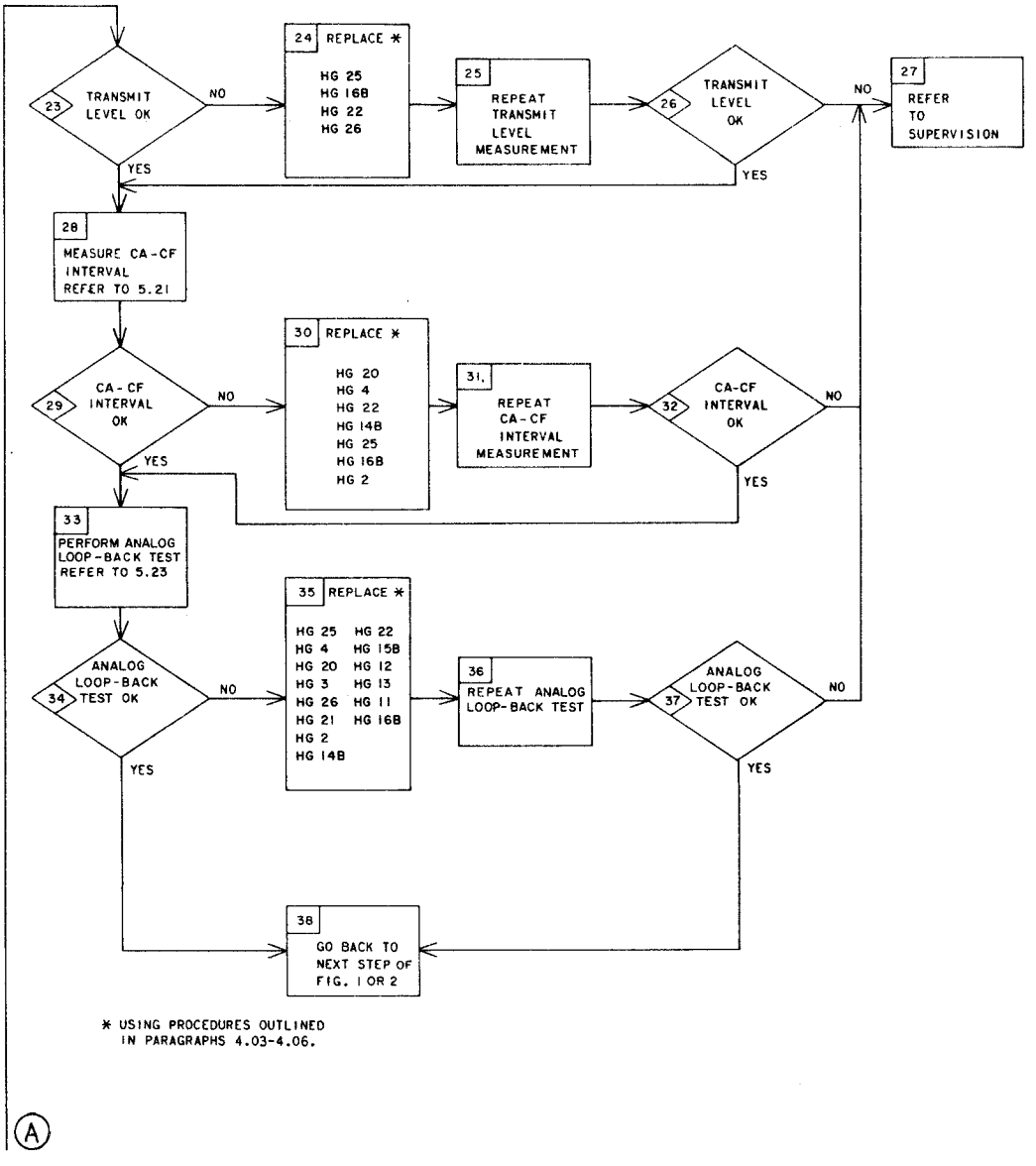


Fig. 4—Repair Procedures for DS 208B-L1B (Sheet 2 of 2)

do not clear the cause of trouble, it is recommended that the problem be referred to supervision, according to local instructions.

5. TEST PROCEDURES

5.01 This part provides a description of the various test procedures and a step-by-step procedure for performing the tests.

5.02 If a procedure requires that an option be installed in the set which is not specified on the service order or circuit layout card, remove the option at the end of the test, and verify that all specified options are installed in the set.

A. Analog Loop-Back Self Test

5.03 The analog loop-back self test provides a test of the data set without the use of external test equipment.

5.04 Perform the following procedure.

(1) Apply power to the data set.

(2) Depress LP switch.

Requirement: All lamps are lighted.

(3) Depress AL switch first, then depress ST switch.

Requirement: ON, RS, CS, and CO lamps are lighted. ER and MR lamps are extinguished. On DS 208B-L1 and -L1A, the TR lamp may be lighted or extinguished depending on the state of the CD lead from the customer. The TR lamp is extinguished on -L1B sets.

Note: ▶The ER lamp must extinguish immediately after the CO lamp lights. If there is a delay, the data set is defective.◀ If the ER lamp is lighted or blinks, the data set has failed the analog loop-back self test. ▶A blinking ER lamp which alternates with the CS lamp may indicate that CP HG19 is not the current series (series 8 or later).◀

(4) ▶**Depress LP switch (DS 208B-L1B only).**

Requirement: ER lamp lights. TR and MR lamps remain ***off*** when LP switch is depressed. The TR lamp depends on the state of the CD lead and may be ***on*** or ***off.***◀

(5) End of test. Depress to release AL and ST switches to restore set to its normal operating condition.

B. Remote Test From DTC

5.05 The remote test from the DTC checks data set performance, station wiring, and the local loop. No external test equipment is required for this test except a telco DTC.

5.06 Perform the following procedure.

(1) Call the nearest DTC and request that a remote test of the data set be conducted.

(2) After agreeing with the DTC to perform the test, depress RT switch, depress the "50" switch (if not already depressed), and hang up.

Requirement: ▶The TR lamp is under control of the customer in -L1 and -L1A sets but is ***on*** in -L1B sets. MR lamp is extinguished in all sets.◀

(3) The DTC will place a call to the set. The set will answer automatically and enter data mode. The DTC will then perform the test and cause the set to terminate the call ▶by sending a 1-second space level (DS 208B-L1 or -L1A) or a 3-second space level (DS 208B-L1B).◀

(4) The DTC will place a second call to the data station to report results of the test. Answer the second call and receive the test results.

(5) After receiving test results from the DTC, release RT and "50" switches (if necessary) and hang up to return data set to its normal operating condition.

C. ▶End-to-End Start-up Self Test◀

5.07 ▶This test checks the start-up performance with the 4-dB and 8-dB slope compromise equalizers.

5.08 To perform the end-to-end start-up test perform the following procedure.

(1) Call a distant data set and arrange for the test. ▶(The distant data set should be one the customer will normally call or receive calls from.)◀

(2) Request that the ST switch be depressed on the distant end data set, and that the data set be transferred to data mode.

Requirement: The ON, RS, CS, and ER lamps on the distant data set are illuminated. ▶On DS 208B-L1 and -L1A,◀ the MR and CO lamps are extinguished. The TR lamp may be illuminated or extinguished (depending on state of CD lead). ▶On DS 208B-L1B, the TR and MR lamps are illuminated.◀

(3) Depress ST and RO switches on the local data set, then transfer to data mode by depressing the DATA button on the telephone set.

Requirement: The ON and CO lamps are illuminated. On DS 208B-L1 and -L1A, the RS, CS, MR, and ER lamps are extinguished. The TR lamp may be illuminated or extinguished (depending on state of CD lead). ▶On DS 208B-L1B, the TR and MR lamps are illuminated.◀ The ER lamp will flash each time an error is detected.

(4) Install the 4-dB slope compromise equalizer (option WU). Request the distant operator to depress and release RO at 5-second intervals for 1 minute.

Requirement: Observe that the local CO lamp illuminates at the same time the ER lamp is extinguished, without flickering.

(5) If the ER lamp flickers more than twice during the start-up interval [step (4)], install the 8-dB slope compromise equalizer (option ZS) and repeat step (4).

(6) If one slope produces substantially less flicker of the ER lamp than the other slope, use the slope compromise equalizer producing the least flicker. Unless the 8-dB slope compromise equalizer produces ***significantly*** less flicker of the ER lamp, use the 4-dB slope compromise equalizer (option WU).

(7) End of test. Return data sets to normal by having the distant end operator release the ST switch, and release the ST and RO switches on the local data set.◀

D. End-to-End Self Test

5.09 This test checks the operation of both far-end and a near-end data set and the telephone channel.

5.10 Perform the following procedure.

(1) Call the far-end data set and arrange to perform the end-to-end self test.

(2) Request that the ST switch be depressed on the far-end data set, and that the far-end data set be transferred to data mode by depressing the DATA button on the telephone set.

Requirement: The ON, RS, CS, and ER lamps on the far-end data set are illuminated. On DS 208B-L1 and -L1A, the MR and CO lamps are extinguished; the TR lamp may be illuminated or extinguished (depending on state of CD lead from customer). ▶On DS 208B-L1B, the TR and MR lamps are illuminated.◀

(3) Depress ST and RO switches on near-end data set, and then transfer to data mode by depressing the DATA button on the telephone set.

Requirement: The ON and CO lamps are illuminated. The RS, CS, MR, and ER lamps are extinguished. On DS 208B-L1 and -L1A, the TR lamp may be illuminated or extinguished (depending on the state of the CD lead from the customer). ▶On DS 208B-L1B, the TR and MR lamps are illuminated.◀

(4) Conduct at least a 5-minute error run.

Requirement: The ER lamp ▶on the near-end data set◀ remains extinguished and does not blink more than an average of three times in any 1-minute period.

(5) ▶At a prearranged time, the attendant at the ***far-end*** data set should depress the LP switch (DS 208B-L1B only) after the 5-minute error run.

Requirement: ER lamp lights on near-end data set. TR and MR lamps remain ***off*** at the far-end data set when LP switch is depressed.

(6) After a prearranged time, return to talk mode to discuss results of test. If the test failed for any reason, terminate the call, place a second call to involve a different connecting path, and repeat the test.

(7) To repeat the test in the opposite direction, have the RO button depressed on the far-end set, release the RO button on the near-end data set, and return both data sets to data mode.

Requirement: The near-end data set meets the requirements of step (2) and the far-end data set meets the requirements of steps (3), (4), and (5).

(8) End of test. Return data sets to their normal operating condition by releasing the ST buttons and the RO button at the end where it had been depressed.

E. Power Supply Test

5.11 The power supply test checks that ac voltage appears at the power supply input and then measures the +12, +5 and -12 volt supply voltages at the customer interface. The only test equipment required is a 914-type DTS and a volt-ohm-milliammeter (VOM).

5.12 Perform the following procedure.

(1) Connect the data set to the 914-type DTS as shown in Fig. 5. The only programming pins required in the matrix are at crosspoints GRD-1 and GRD-7.

(2) Apply power to the data set and then to 914-type DTS.

Requirement: The data set ON lamp lights.

(3) If the ON lamp fails to light or lights momentarily and goes out, check the ac source voltage with a VOM.

Requirement: 105 to 129 volts RMS

(4) Move the FUNCTION switch to VOLT INT and POLARITY to NORM. Measure the voltage on terminal 9 of customer interface.

Requirement: 11 to 13 volts

(5) Move the FUNCTION switch to OFF and move the VERTICAL MONITOR switch to 25.

(6) Move the FUNCTION switch to VOLT INT and measure the voltage on terminal 25 of customer interface.

Requirement: 4 to 6 volts

(7) Move the FUNCTION switch to OFF, move the VERTICAL MONITOR switch to 10, and move the POLARITY switch to REV.

(8) Move the FUNCTION switch to VOLT INT and measure the voltage on terminal 10 of customer interface.

Requirement: 11 to 13 volts

(9) Move the FUNCTION switch to OFF.

(10) End of test. Remove test equipment and return to pretest condition.

F. Automatic Answer Test

5.13 The automatic answer test checks the ability of the data set to answer and terminate calls properly. The CC, CD, and CE leads are checked along with an audio verification that the answer tone and 600-Hz tone are generated. The only test equipment required for this test is a 914-type DTS.

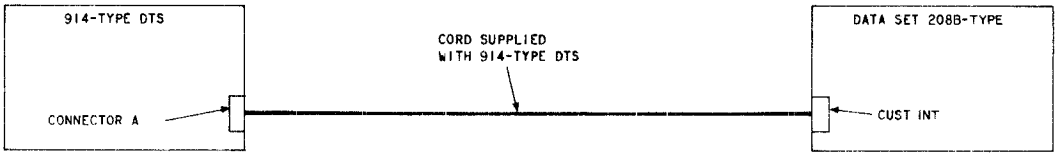
5.14 Perform the following procedure.

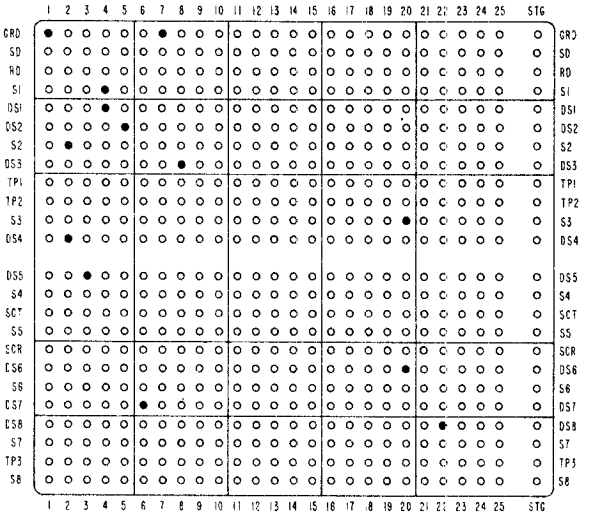
(1) Remove the front cover of the data set. Verify that the following options are installed:

- Compromise Equalizer IN:

  DS 208B-L1—(S2C UP)

  DS 208B-L1A and -L1B —(S2B UP and S2C UP)





SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
VERTICAL MONITOR	9
TEST SET MODE	SER(914C) RCV SER(914B)
COUNTER	INTERVAL XI
FUNCTION	OFF
RANGE	30 DCV
BIT RATE	EXT +
METER POLARITY	NOR
TPI TRIGGER	+/OPEN
TP2 TRIGGER	+/OPEN
SI (RS)	OFF
S2 (SD)	OFF
S3 (DTR)	OFF

INDICATOR LIGHTS	
DSI	RS
DS2	CS
DS3	COD
DS4	SD
DS5	RD
DS6	DTR
DS7	DSR
DS8	RI

Fig. 5—Repair Test Setup

- DSR OFF in Analog Loop-Back Mode (S3A DOWN)
- Manual Answer (S3B UP)
- Transmitter Internally Timed (S3C DOWN)
- -3 dBm Transmit Level (S1A DOWN; S1B UP; S1C UP; S2A DOWN)

(2) Verify that all pushbutton switches located on the front of the data set except the "50" switch are in the OUT (normal) position. The

"50" switch may be IN or OUT depending on the option installed.

(3) Verify that the data set is connected to the associated telephone set and the telephone set is connected to a working telephone line.

(4) Connect the data set to the 914-type DTS and set the controls per Fig. 5. Apply power first to the data set then to the DTS.

(5) Depress the nonlocking lamp test (LP) switch.

Requirement: On the data set, the TR, MR, RS, CS, CO, and ER lamps light.

(6) From a nearby telephone, dial a call to the data station.

Requirement: On the 914-type DTS, DS8 (RI) and on the telephone set, the lamp under the line key associated with the data set under test lights during the ringing cycle (approximately 2 seconds) and then go off during the quiet period (approximately 4 seconds).

(7) On the 914-type DTS, move switch S3 (DTR) to ON. The data station telephone set will continue to ring. After two or three ring cycles, move switch S3 to OFF.

(8) On the data set, install the automatic answer option (S3B DOWN). The data station telephone set will continue to ring. At the end of a ringing cycle, move switch S3 (DTR) on the DTS to ON.

Requirement: On the 914-type DTS, the DS6 (DTR) lamp lights; on the data set, the TR lamp lights. On the DTS, the DS8 (RI) lamp lights during the next ring cycle and at the end of ringing extinguishes. During ringing and at the end of this ring cycle, the lamp under the line key associated with the data set lights. Approximately 2 seconds after end of ringing, a high-pitched tone is heard for approximately 2 seconds (2021-Hz answer tone). At the end of this tone, the DS7 (DSR) lamp on the DTS and the MR lamp on the data set light. A lower pitched tone (600-Hz idle tone) should now be heard.

The data set has now automatically answered the call and switched to data mode.

(9) On the 914-type DTS, set switch S1 (RS) to ON.

Requirement: The 600-Hz idle tone ceases and a data signal is now heard.

(10) Set S1 OFF.

Requirement: The data signal ceases and the 600-Hz tone is heard.

(11) On the 914 DTS, set S3 to OFF.

Requirement: The MR and TR lamps on the data set, the DS6 (DTR) and DS7 (DSR) lamps on the 914-type DTS, and the lamp under the line key on the data station telephone set extinguish, indicating the data set has terminated the call.

(12) End of test. Remove test equipment and return to pretest condition.

G. CA-CB Interval Test

5.15 The CA-CB interval test checks both the 50-ms and 150-ms request-to-send/clear-to-send (CA-CB) intervals. As part of the test the transmitter clocks, as well as certain interface signals, are checked. The only test equipment required for this test is a 914-type DTS and the 3300-ohm (yellow) pin or equivalent circuit as described in 1.04 and 1.05.

5.16 Perform the following procedure.

(1) Connect the data set to the 914-type DTS and set the controls as shown in Fig. 5. Set BIT RATE switch to 2000.

(2) Place yellow pin in matrix position S1-9 or 3300-ohm resistor as described in 1.05 across 9 and 4 on the interface selector switches on the 914-type DTS.

(3) Apply power to the data set and then to the DTS.

(4) Depress AL button on data set.

(5) On the DTS, add red pins to the programmable matrix in the following positions: 4-TP1, 5-TP2.

(6) If a 914C DTS is used, place TEST SET MODE to INTERVAL and START A ONLY—A or B switch to START A ONLY. If a 914B DTS is used, set TEST SET MODE switch to TRMT SER position.

(7) Verify that the "50" switch on the data set is depressed and the transmitter internally timed option (S3C DOWN) is installed.

(8) Verify that switch S1 (RS) is OFF.

(9) On the DTS, zero the counter by pressing the RESET button.

(10) Move switch S1 to ON and record the CA-CB interval on the counter.

Requirement: 45 to 52 ms.

(11) To remeasure the CA-CB interval, move switch S1 to OFF and press the RESET button. When S1 is moved to ON, the CA-CB interval will appear on the counter.

(12) On the data set, release the "50" switch. On the DTS, move switch S1 to OFF, move the counter switch to INTERVAL X10, and reset the counter.

(13) Move switch S1 to ON, and record the CA-CB interval on the counter.

Requirement: 14 to 18 on counter (corresponds to 140 to 180 ms).

(14) To remeasure the CA-CB interval, move switch S1 to OFF and press the RESET button. When S1 is moved to ON, the CA-CB interval will appear on the counter.

(15) Move S1 to OFF.

(16) End of test. Remove test equipment and return to pretest condition.

H. ▶Remote Start-up Interval Self Test (DS 208B-L1B Only)◀

5.17 ▶This procedure tests a ***remote*** data set by making use of the ST and RO switches on a near-end data set to send blocks of data to a far-end data set, which is in remote test mode. Start-up errors made at the far-end data set will cause SPACE signals to be returned to the local data set. A MARK (no errors) will cause the near-end ER lamp to remain extinguished; a SPACE (one or more errors) will cause the near-end ER lamp to illuminate. If the ER lamp illuminates as a result of one operation of the RO switch, it is counted as one error.

5.18 Perform the following procedures:

(1) Have the far-end data set placed in RT mode.

(2) Depress ST and RO switches on local data set.

(3) Call the far end, check for auto answer, then go to DATA mode.

(4) Release RO (RS = ***on***) for at least 2 seconds to send blocks of data to the far end. The data set under test (far-end) samples RD for 1.25 seconds (6000 bits), beginning on a positive transition of COD.

(5) Depress RO (RS = ***off***) to receive 2-second MARK (no errors) or SPACE (one or more errors) from the far end. (MARK = ER lamp extinguished when CO lamp is lighted; SPACE = ER lamp lighted when CO lamp is lighted.)

(6) Repeat steps (4) and (5) a minimum of 19 times, (ie, 20 blocks of data).

Requirement: No more than 1 error in 20 blocks.

(7) If more than 1 block in 20 is reported in error at the far end, the test should be extended to 100 times, or a more specific test such as subpart M should be used.

Requirement: No more than 6 errors in 100 blocks.

(8) If testing from a DS 208B-L1B (near-end), quickly depress and release the LP switch within 1.25 seconds after RO is released. This should force an error and cause a SPACE to be returned. Since LP ***in*** and RO ***out*** cause a steady space to be transmitted, the LP switch should not be depressed for more than 2 seconds after RO is released, or the far end will go on-hook and auto answer will be inhibited.

Note: This step cannot be performed when the near-end data set is a DS 208B-L1 or -L1A.◀

I. Transmit Level Test

5.19 The transmit level test measures the 2021-Hz answer tone signal, the data transmit level, and the 600-Hz idle tone. These levels are measured at two different settings of the transmitter level adjust pad. The only test equipment required is a 914-type DTS.

5.20 Perform the following procedure.

(1) Remove the front cover of the data set and install the following options:

- Compromise Equalizer IN:

  DS 208B-L1—(S2C UP)

  DS 208B-L1A ▶and -L1B◀ —See Table B

- CC OFF in Analog Loop Mode (S3A DOWN)
- Manual Answer (S3B UP)
- Transmitter Internally Timed (S3C DOWN)
- -3 dBm Transmit Level (S1A DOWN; S1B UP; S1C UP; S2A DOWN).

(2) Verify that the data set is connected to the associated telephone set and the telephone set is connected to the telephone line.

(3) Verify that all switches on the data set except the "50" switch are in the OUT (normal) position. The "50" switch may be IN or OUT, depending on the option installed.

(4) Connect the data set to the 914-type DTS and set the controls as shown in Fig. 5.

(5) Apply power to the data set and then to the DTS.

(6) On the 914-type DTS, move switch S3 (DTR) to ON.

(7) From a nearby telephone, dial the data station. When the data station telephone set rings, answer it and go into data mode by depressing the nonlocking DATA button on the telephone set.

(8) On the DTS, set the RANGE switch to 0 DB, and set the FUNCTION switch to VOLT/OHM EXT.

→TABLE B←

DATA SET 208B-TYPE TRANSMIT LEVEL METER INDICATIONS
(ALL READINGS IN dBm WITH RESPECT TO 900 Ω)*

DATA SET	COMP EQUAL OPTION	ANSWER TONE 1	DATA 1	600 Hz 1†	ANSWER TONE 2	DATA 2	600 Hz 2†
208B-L1	IN (S2C-UP)	−1.2 (±2 dB)	−1.2 (±2 dB)	−8.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−12.2 (±2 dB)
208B-L1A 208B-L1B	8-dB SLOPE (S2B-DOWN; S2C-UP)	−1.2 (±2 dB)	−1.2 (±2 dB)	−10.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−14.2 (±2 dB)
208B-L1A 208B-L1B	4-dB SLOPE (S2B-UP; S2C-UP)	−1.2 (±2 dB)	−1.2 (±2 dB)	−8.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−12.2 (±2 dB)

* Note that data levels and answer tone levels are independent of compromise equalizer options; whereas, 600-Hz levels are about 7 dB lower than data levels. Refer to Section 592-030-100 for information on compromise equalizer options.

† Meter RANGE switch may have to be changed to make these readings. In any case, these figures are relative to 0 dBm.

(9) Connect the meter INPUT terminals of the 914-type DTS across the telephone line tip and ring leads at the connecting block.

(10) If a 914C DTS is used, set TERM IN—OUT switch to OUT.

(11) At the data station telephone set, remove the handset from the cradle. Enter talk mode by depressing TALK button. Now depress DATA button.

Requirement: As the data set goes through the answer sequence, the answer tone (2021 Hz) is generated for approximately 2 seconds. During these 2 seconds, the meter on the 914-type DTS indicates the value given in ANSWER TONE 1 column of Table B for each of the compromise equalizer options.

The previous step should be repeated until an accurate reading can be recorded.

(12) On the 914-type DTS, move switch S1 (RS) to ON.

Requirement: The meter indicates the value given in DATA 1 column of Table B for each of the compromise equalizer options.

(13) Move switch S1 to OFF.

Requirement: The meter indicates the value given in the 600 Hz 1 column of Table B for each of the compromise equalizer options.

(14) On the data set, install the -7 dBm transmit level option (S1A DOWN; S1B DOWN; S1C UP; S2A DOWN).

(15) At the data station telephone set, remove handset from cradle and enter talk mode by depressing TALK button. Now depress DATA button.

Requirement: As the data set goes through the answer sequence, the answer tone (2021 Hz) is generated for approximately 2 seconds. During these 2 seconds, the meter on the DTS indicates the value given in ANSWER TONE 2 column of Table B for each compromise equalizer option.

(16) The previous step should be repeated until an accurate reading can be recorded.

(17) Move switch S1 to ON.

Requirement: The meter indicates the value given in DATA 2 column of Table B for each compromise equalizer option.

(18) Move switch S1 to OFF. Move RANGE SWITCH to -10 dB if necessary (see Table B).

Requirement: The meter indicates the value given in the 600 Hz 2 column of Table B for each compromise equalizer option.

(19) Terminate the call by moving switch S3 (DTR) on DTS to OFF. Move FUNCTION switch to OFF. Disconnect meter INPUT terminals from the telephone line.

(20) End of test. Return all equipment to pretest condition.

J. CA-CF Interval Test

5.21 The CA-CF interval test measures the length of time it takes for CF to turn on after a request-to-send signal is given. The test also checks that the received line signal propagates through the receiver analog circuitry and checks receiver clocks and certain interface signals. The only test equipment required is a 914-type DTS and the 3300-ohm (yellow) pin or equivalent circuit as described in 1.04 and 1.05.

5.22 Perform the following procedure.

(1) Connect data set to 914-type DTS as shown in Fig. 5. Set BIT RATE switch to 2000.

(2) Depress AL button on data set.

(3) Apply power to data set and then to the 914-type DTS.

(4) Insert red programming pins into matrix at TP1-4 and TP2-8.

(5) Insert yellow resistor pin into matrix at S1-9 or 3300-ohm resistor as described in 1.05 across 9 and 4 of the interface selector switches.

(6) If 914C DTS is used, set TEST SET MODE to INTERVAL, and START A ONLY—A or B switch to START A ONLY. If 914B is used, set TEST SET MODE switch to TRMT SER.

(7) Move switch S1 (RS) to OFF and reset the counter to 0.

(8) Move switch S1 to ON and read the CA-CF interval on the counter.

Requirement: 46.0 to 56.0 ms

(9) To remeasure CA-CF interval, move S1 to OFF and reset counter. When S1 is set to ON, the CA-CF interval will appear on the counter.

(10) End of test. Return all equipment to pretest condition.

K. Analog Loop-Back Test Using a Pseudo-Random Word

5.23 The analog loop-back test checks that random data can be transmitted through the data set without errors. The received signal is compared with the transmitted signal and any errors are recorded by the 914-type DTS. The test equipment required for this test is a 914C DTS or a 903-type DTS and a 914B DTS. When using the 903-914B DTS combination, a 63-bit word is used. When using a 914C DTS, a 511-bit word is used.

5.24 Perform the following procedure.

(1) Connect equipment as shown in Fig. 6.

(2) Depress AL button on data set.

(3) Apply power to data set and then to the DTSs.

(4) On 914-type DTS, move S1 (RS) to ON and reset counter by depressing RESET button. If a 903-type DTS is used, momentarily depress START button.

Requirement: On the 914-type DTS, the DS1 (RS), DS2 (CS), and DS3 (COD) lamps are lighted. Lamps DS4 (SD) and DS5 (RD) are dimly lighted. The counter is not counting.

(5) To verify that the equipment is connected properly and that the counter is functioning, remove programming pin from crosspoint RD-3.

Requirement: On the 914-type DTS, the error counter counts rapidly and shortly afterward the NO DATA and OVERFLOW lamps light.

(6) Reinsert programming pin into crosspoint RD-3 and reset counter.

Requirement: On the 914-type DTS, the error counter stops counting and the NO DATA and OVERFLOW lamps extinguish.

(7) Conduct a 10-minute error run and record number of errors.

Requirement: No errors recorded.

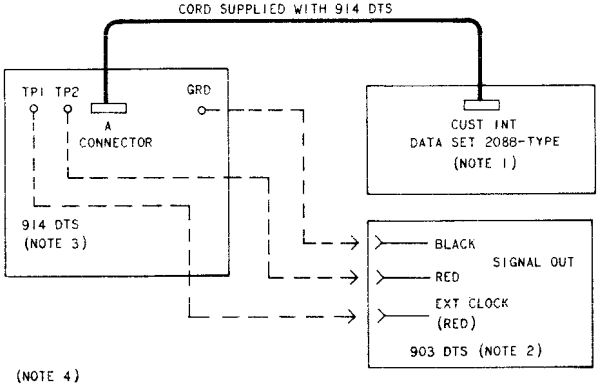
(8) End of test. Return all equipment to normal operating condition.

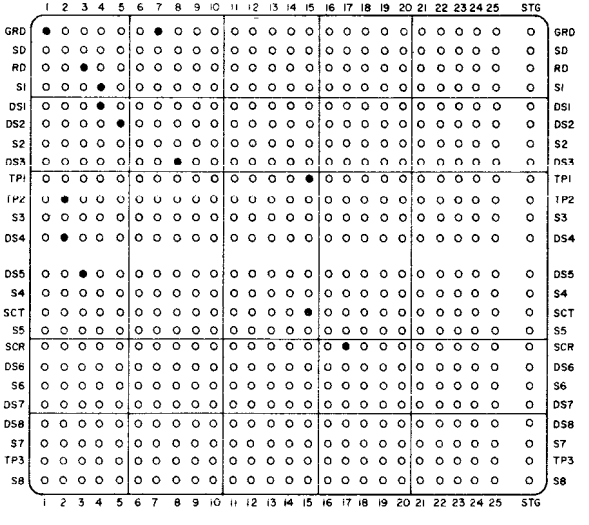
L. End-to-End Test Using a Pseudo-Random Word

5.25 The end-to-end test should be made only when it is necessary to identify facility troubles which the data set has been occasionally experiencing over a period of time. The test is made using two data stations remote from each other or a DTC and a station. The test consists of transmitting random data (63-bit or 511-bit words formed into 1000-bit blocks) and establishing a block error rate. If the 511-bit word is available, it should be used, as it provides a more critical test. Two 914-type DTSs, one at the transmitting end and one at the receiving end, are required.

5.26 Perform the following procedure.

STEP	TRANSMIT	RECEIVE
1	Establish test connections and set switches as shown in Fig. 6. ***Note:*** Information regarding the setup for the 903-type DTS may be disregarded.	Establish test connections and set switches as shown in Fig. 6.





NOTES:

1. VERIFY THE FOLLOWING OPTIONS ARE INSTALLED:

OPTION	SETTING
TRANSMITTER INTERNALLY TIMED	S3C DOWN
CC OFF IN AL MODE	S3A DOWN
COMPROMISE EQUALIZER IN	S2C UP (208B-L1) S2B UP (208B-L1A OR -L1B) S2C UP

2. IF 903 AND 914B DTS ARE USED, CONNECT 903 AS SHOWN AND SET THE FOLLOWING 903 CONTROLS.

CONTROL	SETTING
BIT RATE	EXT CLOCK
TRIGGER	(-) NEGATIVE
RANDOM-DOT	RANDOM

3. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER (914C) RCV SER (914B)
BIT RATE(S)	EXT +
COUNTER	16WL (63 BIT WORD) 2WL (511 BIT WORD)
FUNCTION	OFF
SIGNAL LEVEL	±4V
SAMPLE WIDTH	0.5μF
WORD SYNC	AUTO
S1-S8	OFF
WORD LENGTH(S)	63 OR 511

4. IF 914C IS USED REMOVE PINS FROM TP1-15 AND TP2-2. INSERT PIN IN SD-2.

Fig. 6—Analog Loop-Back and End-to-End Test Setup

STEP	TRANSMIT	RECEIVE
	Note: Information regarding the setup for the 903-type DTS may be disregarded.	
2	Remove programming pins from TP1-15, TP2-2, and RD-3.	Remove programming pins from TP1-15 and TP2-2.
3	Insert programming pin at SD-2, S3-20, and DS6-20.	Insert programming pin at S3-20 and DS6-20.
4	Set TEST SET MODE to SER (914C) or TRMT SER (914B).	Set COUNTER switch to BLOCK ERRORS 16 WL, (63-bit word) or 2 WL (511-bit word).
5	Apply power to the data set and then to the 914-type DTS.	Apply power to the data set and then to the 914-type DTS.
6	Call the receiving end to coordinate test procedure.	Coordinate test procedure with transmitting end.
7	On the 914 DTS, move switch S3 (DTR) to ON.	On the 914 DTS, move switch S3 (DTR) to ON.
8	Go to data mode.	Go to data mode.
9	Set S1 (RS) to ON.	Reset counter.
10	To verify equipment is operating properly, set switch S1 (RS) to OFF.	Counter should count at least once and shortly thereafter the NO DATA lamp should illuminate.
11	Set switch S1 (RS) to ON.	Reset counter. The NO DATA lamp should extinguish.
12	Conduct 10-minute error run.	Counter should record less than 30 counts (less than 30 block errors).
13	At end of 10-minute interval, go to talk mode. If test is required in other direction, set up as receiving station.	At end of 10-minute interval, go to talk mode and give results. If test is required in other direction, set up as transmitting station.
14	End of test. Return equipment to normal operating condition.	End of test. Return equipment to normal operating condition.

M. ▶Remote Start-up Test (Remote DS 208B-L1B Only)◀

5.27 ▶This test uses a 914-type DTS to check start-up of both far-end and near-end data sets. The far-end set must be a DS 208B-L1B; the near-end set may be any DS 208B-type. The RS switch on the near-end 914-type DTS is used to initiate transmission of blocks of data to the far-end set, which is in RT mode. Start-up errors made at the far end will cause SPACE signals to be returned to the near-end data set. A lamp at the RD input to the 914-type DTS will indicate the error status of the far-end data set. MARK signals (no errors) will cause the RD lamp on the near-end data set to remain extinguished. SPACE signals (one or more errors) will cause the RD lamp on the near-end data set to illuminate. If the RD lamp illuminates as a result of one operation of the RS switch, it is counted as one error. Errors

made in the start-up of the near-end receiver are displayed as actual error counts on the 914-type DTS.

Note: This test requires a 914-type DTS and a test person knowledgeable in using the DTS at the near end only.

5.28 Perform the test as follows:

(1) Connect equipment as shown in Fig. 7.

(2) Condition the 914-type DTS as shown in Fig. 8.

(3) Have attendant at far end place data set in RT mode.

(4) Call the far end, check for auto answer, and go to data mode at the near end (switch S8 must be ***on***).

(5) Operate switch S1 (RS) to ***on*** for at least 2 seconds to send blocks of steady MARK to far end (switch S2 ***off***). Data set under test samples RD lead for 1.25 seconds (6000 bits), beginning on a positive transition of COD.

(6) Operate switch RS to ***off*** to receive 2-second MARK (no errors) or SPACE (one or more errors) from far end. [MARK = RD (DS3) lamp extinguished; SPACE = RD (DS3) lamp lighted for 2 seconds].

(7) There are three possible conditions to monitor at the 914-type DTS during the test interval (ie, the 2 seconds after RS is turned ***off***).

(a) A steady SPACE sent back from the far-end data set (RD lamp illuminated on 914-type DTS and CO lamp illuminated on near-end data set) means that the far-end data set has made one block error.

(b) A steady MARK sent back from the far-end data set (RD lamp on data set extinguished and counter on 914-type DTS not counting) means that both data sets are performing satisfactorily.

(c) A steady MARK returned from the far-end data set (RD lamp extinguished on near-end data set), and counter on 914-type DTS not counting means that the near-end set is making start-up errors.

(8) The counter on the 914-type DTS may register a few counts (hits) on the RD lead upon turning ***off*** the RS switch. These counts are not start-up errors and should be ignored. Allow sufficient time between repetitions of the test to permit clearing the counter on the 914-type DTS.

(9) Repeat steps (5) and (6) 19 times, producing a total of 20 blocks.

Requirement: No more than 1 error in 20 blocks of data.

(10) If more than 1 block in 20 is reported in error from the far-end data set, repeat steps (5) and (6) 100 times to send 100 blocks of data.

Requirement: No more than 6 errors in 100 blocks of data.

(11) Errors may be forced by quickly operating and releasing the SD switch within 1.25 seconds after the RS switch is turned ***on***. The far-end receiver should detect the error and return a 2-second block of steady SPACE. If the SD switch remains ***on*** for more than 2 seconds after RS is turned ***on***, the far-end data set will go on-hook and auto answer will be inhibited. This procedure may be used to end the test.◀

N. ▶Analog Loop Start-up Test (DS 208B-L1B Only)◀

5.29 ▶This test uses a 914-type DTS to check start-up of a DS 208B-L1B. The RS switch on the 914-type DTS is used to initiate the transmission of blocks of data through the data set, which is placed in AL mode. Start-up errors will cause the counter on the 914-type DTS to register one count for each block of data in which one or more errors is made.

5.30 Perform the test as follows:

(1) Connect equipment and condition the 914-type DTS as shown in Fig. 8.

(2) Place the data set in analog loop made by pressing the AL switch.

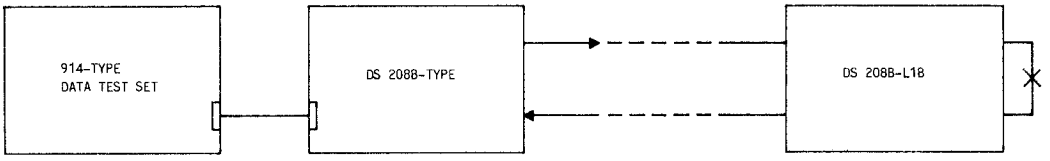
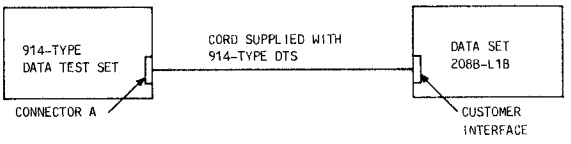


Fig. 7—Remote Start-up Test Setup



914 DTS MATRIX

COLOR OF PIN	VERTICAL	HORIZONTAL	OBSERVE OR CONTROL
RED	2	S2	SD
RED	4	S1	RS
YELLOW (3KΩ)	9	S1	CONTACT BOUNCE
RED	8	DS6	OBSERVE CO
WHITE (DIODE)	3	TP1	CHECK ERRORS
YELLOW (3KΩ)	17	TP1	
RED	19	TP1	
RED	19	SCR	
RED	3	DC3	OBSERVE RD
RED	20	S8	OTR
RED	7	GRD	

914 DTS CONTROLS

TEST SET MODE - SER OR RCV SER
BIT RATE - EXT +
COUNTER - INTERNAL X 1

Fig. 8—Test Setup Using 914-Type DTS

(3) Zero the counter on the 914-type DTS by depressing the RESET switch.

(4) Operate S1 (RS) switch on 914-type DTS to ***on*** for at least 2 seconds to send blocks of steady MARK (S2 ***off***).

Requirement: NO CLOCK and NO DATA lamps on the 914-type DTS are illuminated. Counter does not indicate any counts.

(5) Operate switch S1 (RS) to ***off*** to terminate start-up interval test. The counter on the 914-type DTS may register a few counts (hits on the RD lead at turnoff) which should be ignored.

(6) Zero the counter on the 914-type DTS and repeat steps (4) and (5) 19 times, to send a total of 20 blocks of data.

Requirement: Zero errors on the counter during the start-up interval.

If 1 error is made in 20 blocks, repeat steps (4) and (5) 100 times.

Requirement: No more than 6 errors on the counter in 100 blocks of data (6000 bit blocks).◀

O. ▶End-to-End Start-up Test◀

5.31 ▶This test checks the start-up interval of any DS 208B-type at either end. A 914-type DTS and test personnel knowledgeable in using the DTS are required at both ends.

5.32 Perform the test as follows:

(1) Connect test equipment as shown in Fig. 9.

(2) Condition the 914-type DTS at each end according to the direction of test as shown in Fig. 9. (The basic condition of the 914-type DTS is the same as shown in Fig. 8.)

(3) By prearrangement with the far-end test person, establish a procedure whereby the near-end test person will initiate a data start periodically. The far-end test person should observe the 914-type DTS at each start interval and reset the counter between intervals.

(4) Place data set at each end in DATA mode.

(5) ***Near-End Test Person:*** Operate S1 (RS) to ***on*** for an estimated 1 second to send one block of steady MARK to far end (S2 is ***off***). (One second is equivalent to one 4800-bit block.)

Far-End Test Person: Observe counter on 914-type DTS when CO lamp illuminates (indicating carrier is present). Errors during start-up will cause the counter on the 914-type DTS to register.

Requirement: Zero errors on the counter during start-up interval.

(6) ***Near-End Test Person:*** Operate S1 (RS) to ***off***.

Far-End Test Person: Observe that CO lamp extinguishes. Reset counter on 914-type DTS if necessary. Hits on the counter that occur when RS is turned ***off*** are not counted as errors.

(7) ***Far-End Test Person:*** After 5 seconds (to permit counter reset at far end), repeat steps (5) and (6) until 20 one-second blocks of data have been sent (ie, 20 ***on*** and ***off*** operations of the RS switch). After a prearranged number of tests (or time interval), return to talk mode to discuss test results.

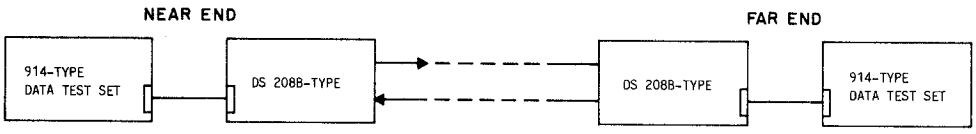
Far-End Test Person: After a prearranged number of tests (or time interval) return to talk mode and discuss test results.

(8) If more than one error is observed in 20 blocks, repeat steps (5) and (6) 100 times. There shall be no more than 5 errors in 100 blocks of data (approximately 4800 bits per block).

(9) If desired, the test can be reversed (Fig. 9). Perform steps (4) through (7) with the far-end sending data and the near-end receiving data and observing the counter on the 914-type DTS.◀

6. GROUND NOISE TEST

6.01 If the data set and business machine are not at the same ground potential, errors may be caused by a potential difference between



TO TEST FAR-END START-UP:
(NO SWITCHES DEPRESSED ON
EITHER DATA SET EXCEPT
"50" SWITCH)

NEAR - END DTS

S1 - ON FOR 2 SECONDS
- OFF FOR 2 SECONDS
S2 - OFF (SEND MARKS)
S8 - ON

FAR - END DTS

S1 - OFF
S2 - EITHER
S8 - ON
MODE - SER OR RCV SER
BIT RATE - EXT +
COUNTER - INTERVAL X 1
MATRIX - PER FIG 8

TO TEST NEAR - END START - UP:
REVERSE ABOVE CONDITIONS

Fig. 9—End-to-End Start-up Test Setup

data set ground and business machine ground. To detect the presence of noise potentials, a test should be made using the 6H impulse counter.

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

6.02 The 6H impulse counter is connected and the test is performed as follows:

(1) Use a 2W6A test cord or equivalent (310 plug on one end, alligator clips connected to tip and ring on the other end). Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the business machine. This test assumes that protective ground from the business machine appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1A and connect the other clip to switch 1B. Verify that power is applied to data set and business machine.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord from 1A and 1B and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

6.03 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of test, disconnect test equipment and restore the data set to pretest condition.

DATA SET 208B-TYPE
TRANSMITTER-RECEIVER
TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 208B-type. Test procedures using the 914-type DTS and the self-test capabilities of DS 208B-type are contained in Section 592-030-500. These procedures are to be used when testing DS 208B-type on an initial installation or during a maintenance visit.

1.02 This section is reissued to add coverage for Version 2 of the 921A DTS. Since this reissue is a general revision, arrows normally used to indicate changes have been omitted.

A. Test Capabilities

1.03 Test circuitry built into DS 208B-type permits the following self tests to be performed: lamp, analog loopback, end-to-end, and end-to-end start-up. Additional tests require the use of external test equipment such as the 921A DTS.

1.04 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

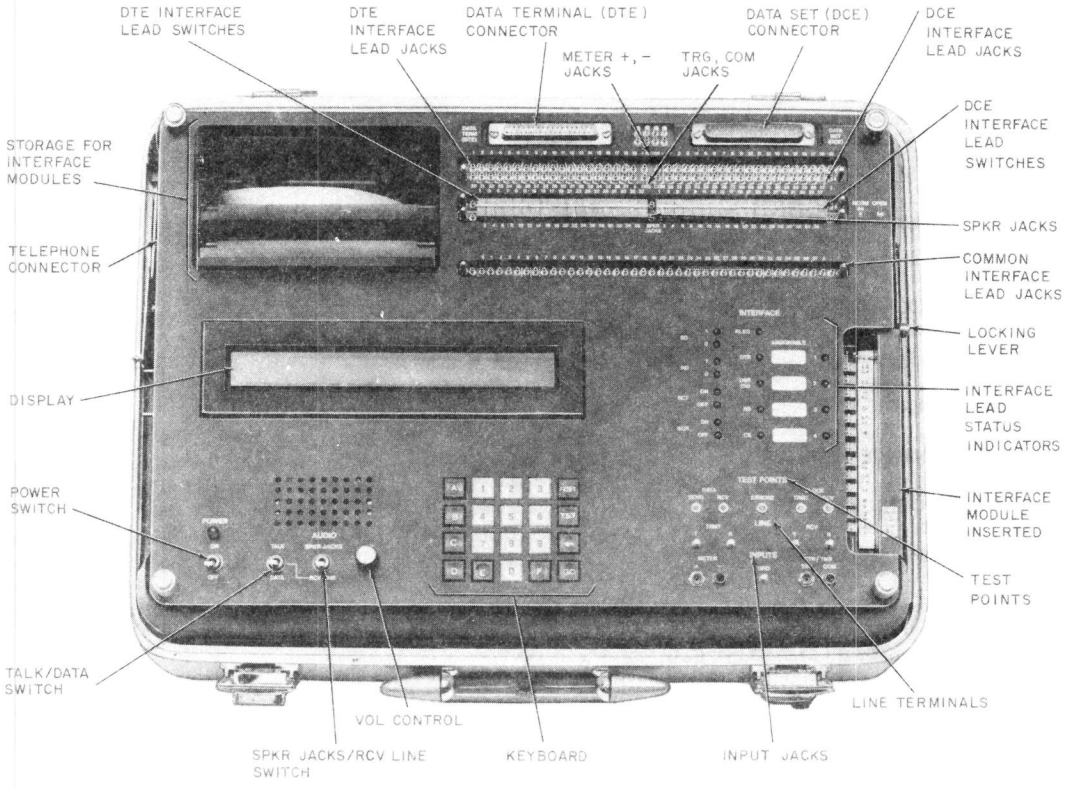


Fig. 1—921A Data Test Set

B. Self Tests

Lamp Test

1.05 The lamp test (LP) nonlocking switch, when depressed, lights the TR, MR, RS, CS, CO, and ER lamps to verify proper operation of these lamps. The LP switch can be depressed at any time, as it does not affect normal data set operation. On DS 208B-L1B, when the AL and ST switches are depressed, the LP switch circuit is reconfigured to introduce errors (spaces) for test purposes.

Analog Loopback Self Test

1.06 This test is initiated by depressing the analog loopback (AL) and self-test (ST) locking switches. Depressing the AL switch connects the data set transmitter to the data set receiver through an internal pad. Depressing the ST switch turns ***on*** the internal request-to-send (CA) lead, transmits a steady mark on the internal send-data (BA) lead, and conditions the ER lamp to indicate received errors. On DS 208B-L1B, depressing the LP switch causes steady spaces to be sent.

End-to-End Self Test

1.07 This test is initiated, after a call connection has been established, by depressing the ST locking switch at the transmitting end and the ST and RO (receive only) locking switches at the receiving end and then transferring to the data mode. This conditions the transmitting end to transmit steady marks. The ER lamp at the receiving end indicates any errors made in

transmission. The direction of transmission can be reversed by releasing the RO switch at the receiving end (which now becomes the transmitting end) and depressing the RO switch at the transmitting end (which now becomes the receiving end). On DS 208B-L1B, depressing the LP switch causes steady spaces to be sent.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence (Fig. 2) provides a method of verifying that the installation is satisfactory. Before proceeding with the tests, verify that the local loop meets the requirements specified in Section 314-205-501.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed when clearing a trouble report and during a maintenance visit to the data station.

3.02 When a trouble report is received, a test center is responsible for isolating the trouble to the data station or the transmission facility. The procedure for doing this is shown in Fig. 3.

3.03 If the trouble seems to be in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests at the data station. The following equipment should be taken on a trouble visit:

- 921A DTS
- Maintenance Kit

3.04 The maintenance kits consist of replacement circuit packs for DS 208-type. Circuit packs in the maintenance kits not used in DS 208B-type are used to support DS 208A-type. The available maintenance kits are as follows.

- D-180497 for DS 208B-L1
- D-180657 for DS 208B-L1 or -L1A
- D-180718 for DS 208B-L1, -L1A, or -L1B

3.05 The sequence in which tests are to be performed by the telco employee at the data station is shown in Fig. 4. If the trouble is isolated to the data set, the repair test procedures in paragraphs 4.29 and 4.30 are to be performed to isolate the trouble to a circuit pack in the data set.

3.06 If a circuit pack is replaced, tag the defective circuit pack with a description of the trouble and carefully pack the circuit pack in the shipping carton supplied with the maintenance kit. Mark

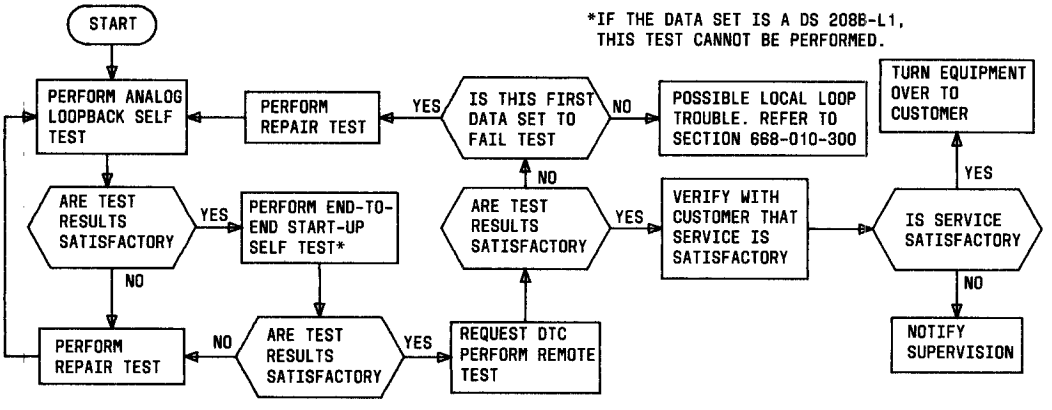


Fig. 2—Installation Test Sequence

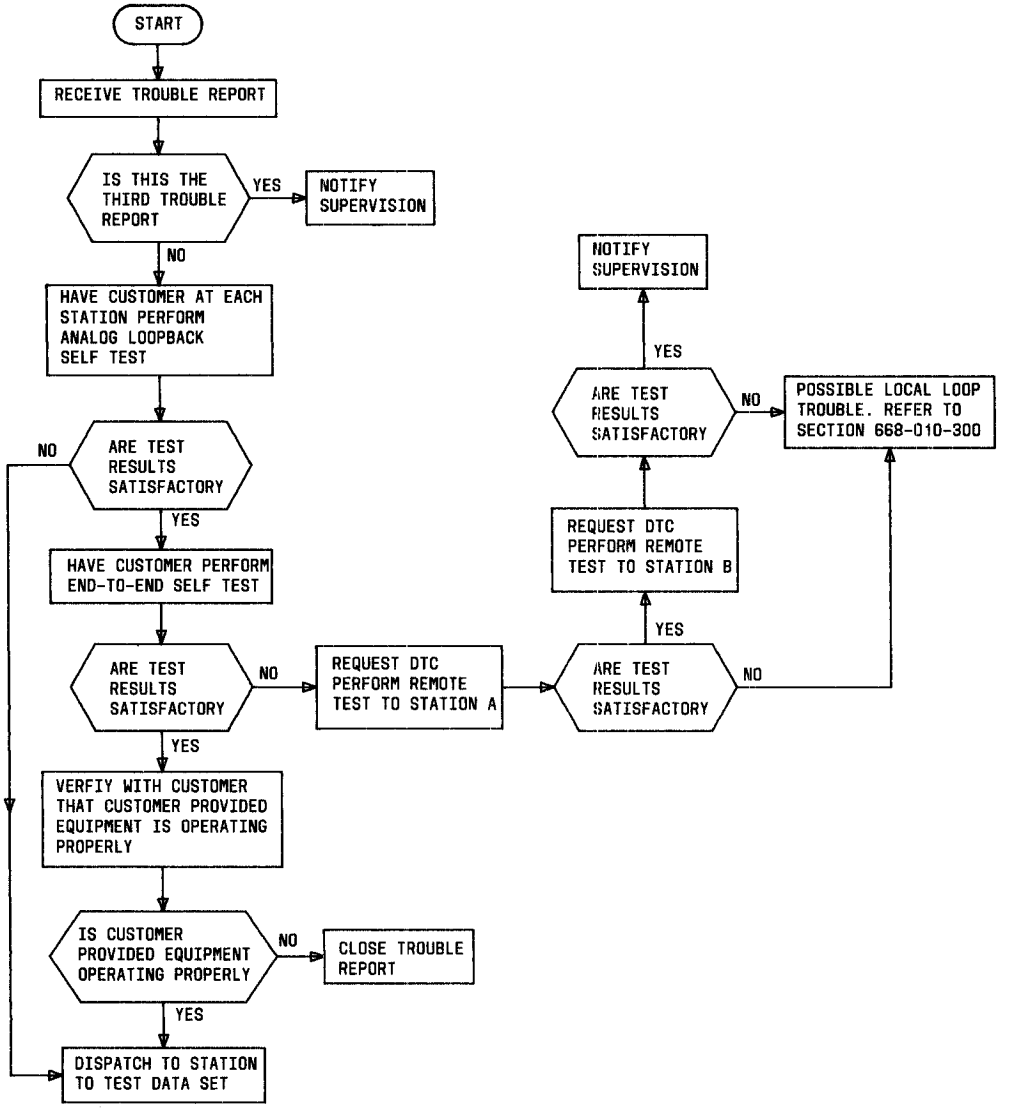


Fig. 3—Clearing Trouble Report

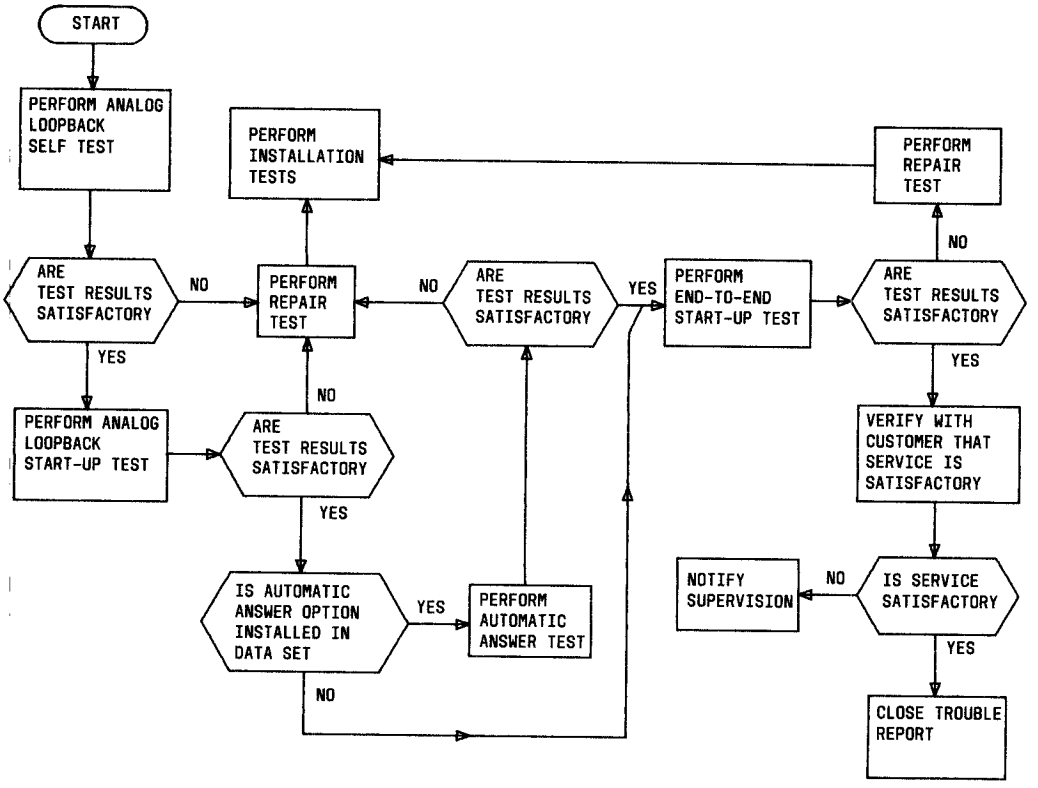


Fig. 4—Maintenance Test Sequence

the carton with the data set code, circuit pack code, and date of manufacture. For example:

Data set 208B

HG11 IV 75

Send the properly packed and marked carton to the telco supplies operation group and notify that group in the normal manner that a replacement circuit pack is needed. The telco supplies operation group will place a requisition for a replacement circuit pack with the local Western Electric service center which will expedite the requisition to the Montgomery (ILL) merchandise organization to ensure its receipt within 24 hours. The Montgomery merchandise organization will ship the circuit pack (via fastest method) directly to the designated telco location within 24 hours after receiving the requisition.

3.07 If the trouble persists after the tests have been completed, proceed as follows.

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that customer-provided equipment (CPE) has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

A. Analog Loopback Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked.

4.03 Perform the test as follows.

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress LP switch on data set.

Requirement: All lamps are lighted.

(3) Depress AL and ST switches on data set.

Requirements: ON, RS, CS, and CO lamps are lighted. ER and MR lamps are off. On DS 208B-L1 and -L1A, TR lamp may be lighted or off, depending on state of CD lead. On DS 208B-L1B, TR lamp is extinguished.

Note: ER lamp goes off immediately. If ER lamp is lighted or blinks, data set has failed analog loopback self test.

(4) Depress LP switch on data set (DS 208B-L1B).

Requirements: ER lamp lights. TR and MR lamps remain off.

(5) Release ST and AL switches on data set.

B. End-to-End Self Test

4.04 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked.

4.05 Perform the test as follows.

(1) Call far-end data set and arrange to conduct an end-to-end self test.

(2) Request ST switch on far-end data set be depressed, and far-end data set be transferred to data mode by depressing DATA button on associated telephone set.

Requirements: ON, RS, CS, and ER lamps on far-end data set are lighted. On DS 208B-L1 and -L1A, MR and CO lamps are off. TR lamp may be lighted or off, depending on state of CD lead. On DS 208B-L1B, TR and MR lamps are lighted.

(3) Depress ST and RO switches on near-end data set, and then transfer to data mode by depressing DATA button on associated telephone set.

Requirements: ON and CO lamps on near-end data set are lighted. RS, CS, MR, and ER lamps are off. On DS 208B-L1 and -L1A, TR lamp may be lighted or off, depending on state of CD lead. On DS 208B-L1B, TR and MR lamps are lighted.

(4) Observe ER lamp on near-end data set for ten 1-minute periods.

Requirement: ER lamp does not blink more than an average of three blinks per 1-minute period.

(5) At a prearranged time, have LP switch on far-end data set (DS 208B-L1B only) depressed.

Requirements: ER lamp lights on near-end data set. TR and MR lamps remain off at far-end data set.

(6) After a prearranged time, return to talk mode to discuss results of test. If test failed, terminate call, place a second call to involve a different connecting path, and repeat test.

(7) Request ST switch on far-end data set be released.

(8) Release RO and ST switches on near-end data set.

C. End-to-End Start-Up Self Test (DS 208B-L1A or -L1B)

4.06 This test checks start-up performance with the 4-dB and 8-dB slope compromise equalizers.

4.07 Perform the test as follows.

(1) Call far-end data set and arrange to conduct an end-to-end start-up self test. (Far-end data set should be one customer will normally call or receive calls from.)

(2) Request ST switch on far-end data set be depressed, and far-end data set be transferred to data mode by depressing DATA button on associated telephone set.

Requirements: ON, RS, CS, and ER lamps on far-end data set are lighted. On DS 208B-L1 and -L1A, MR and CO lamps are off. TR lamp may be lighted or off, depending on state of CD lead. On DS 208B-L1B, TR and MR lamps are lighted.

(3) Depress ST and RO switches on near-end data set, and then transfer to data mode by depressing DATA button on associated telephone set.

Requirements: ON and CO lamps on near-end data set are lighted. On DS 208B-L1 and -L1A, RS, CS, MR, and ER lamps are off. TR lamp may be lighted or off, depending on state of CD lead. On DS 208B-L1B, TR and MR lamps are lighted.

(4) Install 4-dB slope compromise equalizer option (S2B up; S2C up) in near-end data set.

(5) Request RO switch on far-end data set be depressed and released at 5-second intervals for 1 minute.

Requirements: On near-end data set, CO lamp lights and ER lamp goes off at same time. ER lamp does not flicker.

(6) If ER lamp flickers more than twice during 1-minute period, install 8-dB slope compromise equalizer option (S2B down; S2C up) in near-end data set and repeat Step (5).

(7) Install 4-dB slope compromise equalizer option (S2B up; S2C up) in near-end data set, unless 8-dB slope compromise equalizer option produced at least three fewer flickers of ER lamp.

(8) Request ST switch on far-end data set be released.

(9) Release RO and ST switches on near-end data set.

D. Remote Test

4.08 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

4.09 Perform the test as follows.

(1) Contact test center and request a remote test.

(2) When directed by test center, depress RT switch and then depress "50" switch (if not already depressed).

(3) Test center performs remote test.

(4) When directed by test center, release RT switch and then release "50" switch if it was depressed in Step (2).

E. Initial Test Setup for 921A DTS

4.10 Perform the initial test setup for the 921A DTS when used to test DS 208B-type as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter	

STEP	ACTION	VERIFICATION
	cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	Enter 71. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 71
12	Press GO.	Display reads— BIT RATE:
13	Enter 48.	Display reads— BIT RATE: 48

STEP	ACTION	VERIFICATION
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

F. Power Supply Test

4.11 This test measures the +12, +5, and -12 volt supply voltages at the customer interface.

4.12 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Enter 12.	Display reads— TEST SEQ: 12
3	Connect jumper wire from DCE interface lead jack 7 to - METER jack.	
4	Connect jumper wire from DCE interface lead jack 9 to + METER jack.	
5	Press GO.	Display reads voltage present on jack 9. ***Requirement:*** +11.0 to +13.0 volts.
6	Move jumper wire from jack 9 to jack 10.	Display reads voltage present on jack 10. ***Requirement:*** -11.0 to -13.0 volts.
7	Move jumper wire from jack 10 to jack 25.	Display reads voltage present on jack 25. ***Requirement:*** +4.5 to +5.5 volts.
8	Remove jumper wires from DCE interface lead and METER jacks.	

G. Automatic Answer Test

4.13 This test verifies that the data set will automatically answer a call, go to the data mode, and end the call.

4.14 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed. ***Note:*** Ensure that automatic answer option (S3B down) is installed in data set.	Display reads— TEST SEQ:
2	On DTS, enter 40.	Display reads— TEST SEQ: 40
3	Press GO.	Display reads— WAITING FOR RI
4	Place a call to data set from any convenient telephone set.	Display reads— RINGING (during ringing period—ring indicator lead ***on***). ASSIGNABLE 1 indicator follows ring indicator lead. After 3 complete ringing cycles, DTR indicator lights (data terminal ready lead ***on***). After several seconds, DSR indicator lights (data set ready lead ***on***). Display then reads— ANSWERED After several more seconds, DTR indicator goes off (data terminal ready lead ***off***). Then DSR indicator immediately goes off (data set ready lead ***off***). ***Requirement:*** Display reads (briefly)— TEST PASSED

H. CA-CB (RS-CS) Interval Test

4.15 This test measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) lead turns ***on.***

4.16 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Ensure that "50" switch on data set is depressed (50 ms CA-CB interval) and that transmitter internally timed option (S3C down) is installed.	
3	Depress AL switch on data set.	
4	On DTS, enter 30.	Display reads— TEST SEQ: 30

STEP	ACTION	VERIFICATION
5	Press GO.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** 48 to 52 ms.
	Note: To repeat test, press A.	
6	Release "50" switch on data set (150 ms CA-CB interval).	
7	Press A. ***Note:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** DS 208B-L1—140 to 180 ms DS 208B-L1A—140 to 180 ms DS 208B-L1B—148 to 152 ms
8	Depress "50" switch on data set (50 ms CA-CB interval).	
9	Release AL switch on data set.	

I. Transmitter Output Test

4.17 This test measures the frequency of the 2021-Hz answer tone and 600-Hz idle tone. Relative levels of data and 600-Hz tone are also measured.

4.18 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Ensure that following options are installed in data set. Compromise equalizer in For DS 208B-L1, S2C up For DS 208B-L1A or -L1B, S2B down and S2C up (8-dB slope) or S2B up and S2C up (4-dB slope) CC (DSR) ***off*** in analog loop mode (S3A down) Automatic answer (S3B down) Transmitter internally timed (S3C down)	

STEP	ACTION	VERIFICATION
	-3 dBm transmit level (S1A down; S1B up; S1C up; S2A down).	
3	Ensure that all switches on data set except "50" switch are in released (out) position. "50" switch may be depressed (in) or released (out).	
4	Connect data set to DTS using telephone interface cable and adapter cord provided with DTS. ***Note:*** The telephone interface cable is equipped with two 9-pin connectors. The 6-inch adapter cord is euipped with a 9-pin connector and a double-faced, 25-pin connector. Connect interface cable from 9-pin telephone connector on left side of DTS to 9-pin connector on adapter cord. Insert double-faced, 25-pin connector on adapter cord between telephone line connector on data set and telephone line cord.	
5	On front of DTS: (a) Connect meter leads from LINE—TRMT terminals T and R to INPUTS—METER jacks + and -. (b) Connect jumper wires from SPKR JACKS to METER jacks + and - located above SPKR JACKS. Also connect jumper wires from TRG and COM jacks to METER jacks + and -. (c) Set TALK/DATA switch to DATA. (d) Set SPKR JACKS/RCV LINE switch to SPKR JACKS.	
6	Enter 36.	Display reads— TEST SEQ: 36 RS=? (0 OR 1)
7	Enter 0.	Display reads— TEST SEQ: 36 RS=0 (0 OR 1)
8	Enter 37.	Display reads— :37 DTR=? (0 OR 1)
9	Enter 1.	Display reads— :37 DTR=1 (0 OR 1)

STEP	ACTION	VERIFICATION
10	Enter 11.	Display reads— :11 R=? 1=135 6=600 9=900 0=N
11	Enter 9.	Display reads (briefly)— :11 R=9 1=135 6=600 9=900 0=N Display then reads— :
12	Enter 18.	Display reads— :18
13	Press GO.	Display reads (briefly)— TEST COMPLETE
14	Place a call to data set from any convenient telephone set. ***Note 1:*** VOL control adjusts speaker volume. ***Note 2:*** The 921A DTS will not measure the answer tone level accurately because of the short duration of the tone and therefore audible verification of the presence of this tone must suffice. Data and 600-Hz levels are also difficult to measure accurately because of the variable impedance of a telephone line connected to the data set. The difference between the data level and the 600-Hz level should be in the order of 7 to 9 dB as shown in Table A. The levels of Table A are calculated levels established in a laboratory under ideal conditions of line termination.	Ringing is heard on DTS speaker followed by answer tone sequence (1 second of silence, 2 seconds of 2021-Hz answer tone, and then continuous 600-Hz tone). Display reads 600-Hz 1 level. Typical display reads— 409. MV AC [-7.31 DBM (900 OHMS)] ***Requirement:*** DBM value displayed must be within limits specified for 600 Hz 1 level in Table A.
15	Depress ST switch on data set.	Display reads data 1 level. Typical display reads— 734. MV AC [-2.25 DBM (900 OHMS)] ***Requirement:*** DBM value displayed must be within limits specified for data 1 level in Table A.
16	On data set, install -7 dBm transmit level option (S1A down; S1B down; S1C up; S2A down).	Display reads data 2 level. Typical display reads— 460. MV AC [-6.29 DBM (900 OHMS)] ***Requirement:*** DBM value displayed must be within limits specified for data 2 level in Table A.

STEP	ACTION	VERIFICATION

TABLE A

TRANSMIT LEVELS

(ALL READINGS IN dBm WITH RESPECT TO 900Ω)*

DATA SET	COMPROMISE EQUALIZER OPTION	ANSWER TONE 1	DATA 1	600 Hz 1	ANSWER TONE 2	DATA 2	600 Hz 2
208B-L1	IN (S2C up)	−1.2 (±2 dB)	−1.2 (±2 dB)	−8.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−12.2 (±2 dB)
208B-L1A 208B-L1B	8-dB SLOPE (S2B down; S2C up)	−1.2 (±2 dB)	−1.2 (±2 dB)	−10.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−14.2 (±2 dB)
208B-L1A 208B-L1B	4-dB SLOPE (S2B up; S2C up)	−1.2 (±2 dB)	−1.2 (±2 dB)	−8.2 (±2 dB)	−5.2 (±2 dB)	−5.2 (±2 dB)	−12.2 (±2 dB)

*Note that data levels and answer tone levels are independent of compromise equalizer options; whereas, 600-Hz levels are about 7 dB lower than data levels.

17	Release ST switch on data set.	Display reads 600-Hz 2 level. Typical display reads— 260. MV AC [-11.26 DBM (900 OHMS)] ***Requirement:*** DBM value displayed must be within limits specified for 600-Hz 2 level in Table A.
18	Press GO.	Display reads (briefly)— TEST INTERRUPTED Typical display then reads— FREQ=0600 HZ
19	At telephone set associated with data set, remove handset from cradle and depress TALK button (if not already depressed). Then depress DATA button. Replace handset on cradle.	Display reads 2 or 3 frequencies for a short period among which is answer tone frequency. Typical display reads (briefly)— FREQ=2021 HZ ***Requirement:*** 2020 to 2022 Hz. Display then reads idle tone frequency. Typical display reads— FREQ=0600 HZ ***Requirement:*** 599 to 601 Hz.

STEP	ACTION	VERIFICATION
20	Disconnect meter leads, jumper wires, telephone interface cable, and adapter cord.	
21	Restore data set to pretest condition.	

J. Transmitter Clock Test

4.19 This test measures the frequency of the transmitter clock signal, DB (SCT), on the transmitter signal element timing lead.

4.20 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Ensure that following options are installed in data set: Compromise equalizer in For DS 208B-L1, S2C up For DS 208B-L1A or -L1B, S2B down and S2C up (8-dB slope) or S2B up and S2C up (4-dB slope) CC (DSR) ***off*** in analog loop mode (S3A down) Manual answer (S3B up) Transmitter internally timed (S3C down) -3 dBm transmit level (S1A down; S1B up; S1C up; S2A down).	
3	Ensure that all switches on data set except "50" switch are in released (out) position. "50" switch may be depressed (in) or released (out).	
4	On DTS, enter 47 48 17 47.	Display reads— TEST SEQ: 47 48 17 47
5	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??

STEP	ACTION	VERIFICATION
6	Enter 04 03.	Display reads (briefly)— SW CONN: X=04 Y=03 Display then reads— SW CONN: X=?? Y=??
7	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads transmitter clock frequency in hertz. ***Requirement:*** 4799 to 4801 Hz.
8	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
9	Restore data set to pretest condition.	

K. CA-CF (RS-COD) Interval Test

4.21 This test measures the interval between CA (request-to-send) and CF (carrier on).

4.22 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Depress AL switch on data set.	
3	On DTS, enter 31.	Display reads— TEST SEQ: 31
4	Press GO.	Display reads RS-RLSD (CA-CF) interval in milliseconds.

STEP	ACTION	VERIFICATION
	Note: To repeat test, press A.	***Requirement:*** 46.0 to 56.0 ms.
5	Release AL switch on data set.	

L. Analog Loopback Start-Up Test

4.23 This test checks the ability of the data set to begin error-free transmission.

4.24 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Depress AL switch on data set.	
3	On DTS, enter 67.	Display reads— TEST SEQ: 67
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
6	Enter 2.	Display reads— PRESS A TO START
7	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A — Restart test. C — Clear display. D — Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
8	At end of about 1 minute, press D.	***Requirement:*** Zero count on ERR and * displays.

STEP	ACTION	VERIFICATION
9	Release AL switch on data set.	

M. End-to-End Start-Up Test

4.25 This test checks the ability of both data sets to begin error-free transmission. In this test, one end is arbitrarily selected as the controlling station. This station has operating control of the test.

4.26 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-up test. ***Note:*** Procedure at controlled station must be performed first.	
At controlled station, perform Steps 2 through 7.		
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 68.	Display reads— TEST SEQ: 68
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	Enter 2.	Display reads— PRESS A TO START
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
7	Press A. ***Note:*** When A is pressed in Step 14, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 After A is pressed at controlling station, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block. All displays stop counting when D is pressed at controlling station. ***Requirements:*** Count of less than 2 on ERR display and zero count on * display.

STEP	ACTION	VERIFICATION
	At controlling station, perform Steps 8 through 15.	
8	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
9	Enter 67.	Display reads— TEST SEQ: 67
10	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
11	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
12	Enter 2.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A — Restart test. C — Clear display. D — Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 ***Note:*** From this point, BLK RCVD display counts number of blocks received. ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
15	At end of about 1 minute, press D.	***Requirement:*** Count of less than 2 on ERR display and zero count on * display.

N. End-to-End Block Error Test

4.27 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. This test is also used to select the best slope compromise equalizer option. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

4.28 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange an end-to-end block error test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads— 511 BIT ERROR TEST
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— 511 BIT ERROR TEST
At receiving station, perform Steps 7 through 19.		
7	Ensure that 4-dB slope compromise equalizer option (S2B up; S2C up) is installed in data set.	
8	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
9	Enter 54.	Display reads— TEST SEQ: 54
10	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
11	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
12	Enter 2.	Display reads— ????? BITS IN A BLOCK
13	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
14	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
15	Enter 0600.	Display reads (briefly)— 0600 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 ***Note:*** From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 30. Record block errors.

Note: To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only.

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.

STEP	ACTION	VERIFICATION
	C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	
16	Install 8-dB slope compromise equalizer option (S2B down; S2C up) in data set.	
17	On DTS, press TST and repeat Steps 9 through 15.	
18	If 8-dB slope compromise equalizer option produced fewer block errors than 4-dB slope compromise equalizer option, leave 8-dB option installed in data set.	
19	If 4-dB slope compromise equalizer option produced the same or fewer block errors than 8-dB slope compromise equalizer option, install 4-dB option (S2B up; S2C up) in data set.	
20	Perform the end-to-end block error test in the opposite direction. The receiving station now becomes the transmitting station.	

O. Repair Test

4.29 This test provides a method for isolating a data set trouble to a single circuit pack (CP). Table B lists the individual tests in the sequence in which they are to be performed, and also lists the associated CPs that might be defective if the test fails.

4.30 If the data set fails a test listed in Table B, proceed as follows.

(1) Refer to list of CPs associated with test that failed.

(2) Replace first CP in list and repeat test.

(3) If data set still fails test, restore original CP in data set.

(4) Continue replacing, testing, and restoring CPs in sequence in which they are listed until data set passes test. The last CP replaced is cause of trouble.

Note: If CP HG19, HG24, or HG25 is replaced, install correct options before proceeding.

(5) If all CPs have been replaced and cause of trouble has not been found, notify supervision.

TABLE B

REPAIR PROCEDURES

TEST	CP REPLACEMENT SEQUENCE		
	DS 208B-L1	DS 208B-L1A	DS 208B-L1B
Automatic Answer	HG18 HG19 HG22 HG16 or HG16B HG5 HG21	HG18B HG24 HG22 HG16 or HG16B HG5 HG21	HG25 HG22 HG16B HG26 HG21
CA-CB (RS-CS) Interval	HG6 HG20 HG5 HG19 HG21 HG22	HG6 HG20 HG5 HG24 HG21 HG22	HG26 HG20 HG25 HG21 HG22
Transmitter Output	HG19 HG18 HG16 or HG16B HG22 HG5	HG24 HG18B HG16 or HG16B HG22 HG5	HG25 HG16B HG22 HG26
Transmitter Clock	HG21 HG5 HG18	HG21 HG5 HG18B	HG21 HG26
CA-CF (RS-COD) Interval	HG20 HG4 HG22 HG14 or HG14B HG18 HG16 or HG16B HG2 HG19	HG20 HG4 HG22 HG14 or HG14B HG18B HG16 or HG16B HG2 HG24	HG20 HG4 HG22 HG14B HG25 HG16B HG2
Analog Loopback Start-Up	HG19 HG18 HG4 HG20 HG3 HG17 HG21 HG2 HG14 or HG14B HG22 HG15 or HG15B HG12 (No. 1) HG12 (No. 2) HG13 HG11 HG16 or HG16B HG5 HG6	HG24 HG18B HG4 HG20 HG3 HG17 HG21 HG2 HG14 or HG14B HG22 HG15 or HG15B HG12 (No. 1) HG12 (No. 2) HG13 HG11 HG16 or HG16B HG5 HG6	HG25 HG4 HG20 HG3 HG26 HG21 HG2 HG14B HG22 HG15B HG12 (No. 1) HG12 (No. 2) HG13 HG11 HG16B

5. REFERENCES

5.01 Additional information concerning the testing of DS 208B-type is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-205-501	Data Systems—DATAPHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
592-030-500	Data Set 208B-Type—Transmitter-Receiver—Test Procedures Using 914-Type Data Test Set
592-030-100	Data Set 208B-Type—Transmitter-Receiver—Description and Operation
592-030-150	Data Set 208B-Type—Transmitter-Receiver—Supplementary Information
592-030-200	Data Set 208B-Type—Transmitter-Receiver—Installation and Connections

5.02 Detailed information concerning DS 208B-type is contained in CD- and SD-1D242-01.

DATA SET 209A-L1
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional descriptions as well as operating procedures for data set (DS) 209A-L1. Other than a brief description of interface signals and customer options, information pertaining to the customer-provided equipment (CPE) is not given. Detailed information pertaining to DS 209A-L1 is contained in Section 592-032-150.

1.02 This section is reissued to incorporate information previously contained in Section 592-032-101. The detailed functional description and data set option information previously contained in this section are now included in Section 592-032-150. Since this reissue constitutes a general revision, arrows ordinarily used to denote changes have been omitted.

1.03 The following is a technical specification summary for DS 209A-L1.

Data Rate: Multiples of 2400 bps up to maximum of 9600 bps

Operation: Synchronous, binary, serial

Channel Requirements: 3002-type 4-wire PL with high performance data conditioning (D1-type); no C-type conditioning required

Interface Voltages: Per EIA Standard RS-232-C

Transmitter Output Level: 0 dBm

Receiver Input Level: -16 dBm ± 7 dBm

Line Impedance: 600 ohms

Operating Mode: Duplex or half duplex

Timing: Internal or external.

1.04 The data set contains a multiplexing capability which provides data channels in multiples of 2400 bps up to 9600 bps as follows:

- One 9600-bps channel
- One 7200-bps and one 2400-bps channel (72/24)
- Two 4800-bps channels (48/48)
- One 4800-bps channel and two 2400-bps channels (48/24/24)
- Four 2400-bps channels (24/24/24/24).

These channels can interface with CPE or can be extended with DSs 201C-type, 208A-type, or 209A-L1.

1.05 DS 209A-L1 has the capability of operating in DDD backup. The data set will reduce maximum operating speed in DDD backup from 9600 bps to 4800 bps as determined by the DBU1 lead from the data auxiliary set. In DDD backup, the data set contains a multiplexing capability which provides data channels as follows:

- One 4800-bps channel
- Two 2400-bps channels.

These channels can interface with CPE or can be extended with DSs 201C- or 208A-type. The automatic reduction of maximum operating speed can be overridden by modification of the telephone interface cable as described in Section 592-032-200.

1.06 Due to the multiplexing capability provided by DS 209A-L1, many different system applications are possible. Some typical applications are as follows:

- Point-to-Point—Data is exchanged between two points at the rate of 9600 bps.
- Point-to-Point Multiplexing—Up to four data channels as described in 1.04 are provided using only one voicegrade facility. For this application, the CPE must be located within 50 feet of the data set 209A-L1.
- Many-Point Multiplexing—Functionally, this arrangement is similar to point-to-point multiplexing, except the CPE may be located an arbitrary distance from DS 209A-L1. DSs 201C-type, 208A-type, or 209A-L1 (7200 bps) are used to provide the extended distance from CPE to DS 209A-L1.
- One-to-Many Multiplexing—This arrangement provides operation with a single CPE port at one location and multiple CPE ports at the remote location. For example, one CPE port may supply 9600 bps, time-division, multiplexed data to a DS 209A-L1 for transmission to a remote DS 209A-L1. The remote DS 209A-L1 will demultiplex the received 9600-bps data into two channels of 4800 bps.
- Digital Data System Subrate Off-Net Extension Service—Access to the synchronous DDS is provided in remote areas not served directly by the DDS. Data set 209A-L1 can be used to connect the customer to the nearest DDS hub office.

1.07 When DS 209A-L1 is used in a multiplex system, idle (unused) ports are permitted to be unterminated. For example, a point-to-point multiplexing system may use only three of the available channels, while the fourth channel is idle and unterminated.

2. DESCRIPTION

PHYSICAL DESCRIPTION

2.01 DS 209A-L1 (Fig. 1) consists of a transmitter, receiver, and control circuits which are mounted on 19 KD-type plug-in circuit packs. The exterior of the data set consists of front and rear molded black plastic faceplates mounted on an extruded aluminum housing with a brushed finish. The overall dimensions of the data set are approximately 20-1/2 inches across the front, 5 inches high, and 13-1/2 inches deep. The weight is approximately 42 pounds.

2.02 The data set is primarily intended for desk top mounting, but with the addition of D-180556 mounting brackets, it may be mounted in a 23-inch rack.

2.03 The data set will operate in an environment of 20 to 95 percent relative humidity from 40 to 75°F, or 20 to 40 percent relative humidity from 75 to 120°F. For intermediate temperatures, the maximum allowable relative humidity can be determined using a linear interpolation between these limits.

2.04 The data set is provided with four customer interface connectors, a TEL interface connector, and a power cord connector located at the rear of the set, as shown in Fig. 2. Customer interface connectors 1, 2, 3, and 4 are KS-19087-L2 and provide the digital interface leads for interface with CPE or extension data sets. The CPE must be equipped with a cable terminated in a Cinch or Cannon DB-19604-432 plug wired in accordance with Table A. The TEL interface connector is a KS-19088-L2 and provides the interface for connection to the 4-wire PL channel. The TEST connector,

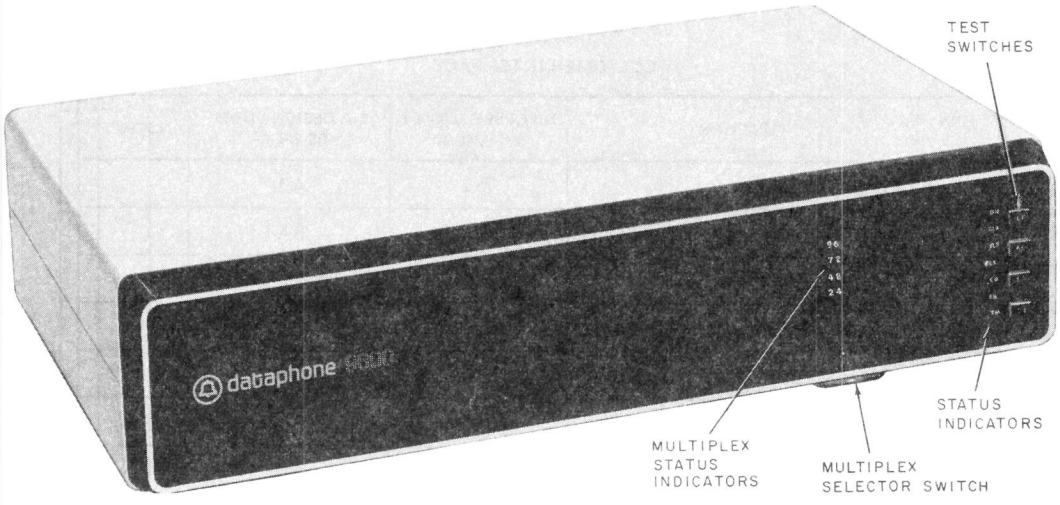


Fig. 1—Data Set 209A-L1—Front View

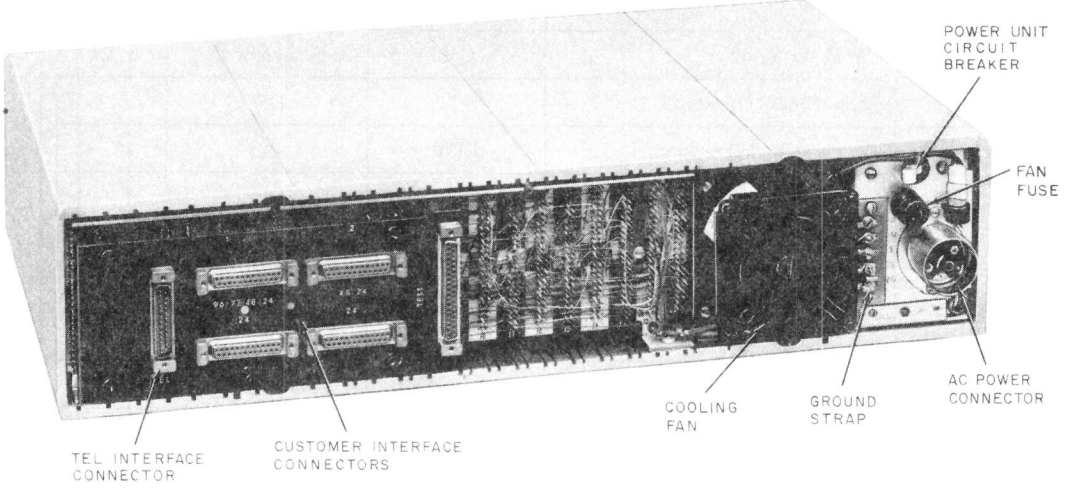


Fig. 2—Data Set 209A-L1 With Faceplate Removed—Rear View

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET 209A-L1 MNEMONIC	EIA DESIGNATION (RS-232-C)	NOTES
1	Frame Ground	FG	AA	
2	Send Data	SD	BA	
3	Receive Data	RD	BB	
4	Request to Send	RS	CA	
5	Clear to Send	CS	CB	
6	Data Set Ready	DSR	CC	
7	Signal Ground	SG	AB	
8	Carrier On Delayed	COD	CF	
9	+12	CI9 (+12V)	Reserved for Data Set Testing	1
10	—12V	CI10 (—12V)	Reserved for Data Set Testing	1
11	Equalizer Mode	QM	Unassigned	1, 2
15	Serial Clock Transmit	SCT	DB	
16	Divided Clock Transmit	DCT	SBB	3
17	Serial Clock Receive	SCR	DD	
18	Divided Clock Receive	DCR	Unassigned	1, 2
21	Signal Quality Detector	COV	CG	
24	Serial Clock Transmitter External	SCTE	DA	
25	+5V	CI25 (+5V)	Unassigned	1, 2

Note 1: Available only at customer interface 1.

Note 2: These pins are unassigned by RS-232-C. DS 209A-L1 provides these functions to the leads of connector 1 only. Refer to 2.15.

Note 3: DS 209A-L1 provides a DCT signal on this pin of connector 1 only. RS-232-C assigns SBB to this pin. Refer to 2.15.

which is accessible by removing the rear faceplate, is a KS-19087-L3 and provides manufacturing testing capability, as well as connection for the 156A test set. The power cord connector is a twist-lock type to accept the KS-14532-L24 cord provided with the data set.

2.05 Data set power is provided by the internally mounted 112A power unit, which provides +12, −12, and +5 volts. The power unit requires an input of 105 to 130 volts ac power at 57 to 63 Hz. Power consumption is approximately 95 watts (324.2 BTU/hr).

2.06 The data set power unit is protected by a circuit breaker mounted on the backplane inside the rear faceplate. In addition, the power unit is protected by a self-resetting thermal switch to prevent overheating. The data set cooling fan is protected by a fuse which is also mounted on the backplane. Locations of the circuit breaker and fan fuse are shown in Fig. 2.

2.07 The multiplex selector switch which extends through the bottom of the data set is accessible from the front of the data set (Fig. 1). The switch is a 6-position continuous rotary-type which selects the multiplex mode of operation and illuminates the respective multiplex status indicator. Each of five switch positions selects a unique multiplexing mode (see Table B). The sixth position is used only for manufacturing testing.

2.08 Current factory models of DS 209A-L1 are equipped with a guard to prevent inadvertent operation of the multiplex selector switch. Earlier production models can be equipped with a guard at telco expense. Refer to Section 592-032-200 for ordering and installation information.

2.09 The multiplex status indicators consist of four light-emitting diodes (LEDs) which are visible through translucent designations located on the data set front faceplate. These LEDs indicate the position of the multiplex selector switch as follows:

- 96—This indicator is lighted when the data set is capable of operating with one channel at 9600 bps.
- 72—This indicator is lighted when the data set is capable of operating with one channel at 7200 bps and one channel at 2400 bps.

TABLE B

LIGHTED MULTIPLEX STATUS INDICATORS

MULTIPLEX SWITCH POSITION	MULTIPLEX STATUS INDICATORS		INTERFACE CONNECTOR			
	PL AND 9600-BPS DDD OPERATION	4800-BPS DDD BACKUP OPERATION	1	2	3	4
1	96	48	96*	—	—	—
2	72 & 24	24	72†	24	—	—
3	48	24	48†	48†	—	—
4	48 & 24	24	48†	24	24‡	—
5	24	24	24	24	24‡	24‡
6	None	None	—	—	—	—

* Operates at 4800 bps when DBU1 telephone interface lead is closed.
† Operates at 2400 bps when DBU1 telephone interface lead is closed.
‡ Not operational when DBU1 telephone interface lead is closed.

- 48—This indicator is lighted when the data set is capable of operating with two channels at 4800 bps or one channel at 4800 bps, and two channels at 2400 bps.

- 24—This indicator is lighted when the data set is capable of operating with one channel at 7200 bps and one channel at 2400 bps; or one channel at 4800 bps and two channels at 2400 bps; or with four channels at 2400 bps.

2.10 Data set 209A-L1 is equipped with seven status indicators which monitor the power unit and certain interface leads. The status indicators are LEDs which are visible through translucent designations located on the data set front faceplate. Data set status indicators are as follows:

ON—This indicator is lighted when the power cord is plugged into a 105- to 130-volt ac, 57- to 63-Hz source.

MR—This indicator monitors the status of the data-set-ready (CC) leads and is lighted whenever the CC leads are in the ***on*** condition. When a data auxiliary set (DAS) is used (option YI) and is in the test mode, or when the data set is in the self-test (ST) or digital loop-back (DL) test mode, the MR indicator is off. When the data set is in the analog loop-back (AL) mode, the MR indicator is off except when the DSR-on-in-AL-mode option (YM) is used.

RS—This indicator monitors the status of the request-to-send (CA) signal. In normal operation, this indicator is lighted whenever one or more of the active CA leads are in the ***on*** condition. When the data set is optioned for continuous request-to-send (option XI), the RS indicator is continuously lighted.

CS—This indicator monitors the condition of the clear-to-send (CB) leads and is lighted whenever one or more of the active CB leads are in the ***on*** condition. This indicates that the data set is ready and will transmit the data present on the corresponding send data (BA) leads.

CO—This indicator monitors the condition of the carrier-on (CF) signal and is lighted whenever the CF leads are in the ***on*** condition. This indicates that the receiver has detected a signal on the line which is within the data band.

ER—In the data mode this indicator monitors the condition of the equalizer mode (QM) interface lead of connector 1. The ER indicator is lighted whenever the CO indicator is off. When the CO indicator is lighted, the ER indicator is lighted, provided the QM interface lead is in the ***off*** condition. This indicates marginal performance of the data set due to either excessive channel impairments or a faulty data set, and that the automatic adaptive equalizer is in need of retraining. Data received on the received data (BB) lead during this period is not valid. When the ST switch is depressed, the ER indicator is conditioned to light for approximately 100 ms when each bit error is received.

TM—This indicator is lighted when any of the test switches (LP, AL, ST, DL) are depressed.

2.11 Data set 209A-L1 is provided with four test switches which are accessible through the front faceplate. The switches are depress-to-operate and depress-to-release type with the exception of the LP (lamp test) switch, which is nonlocking. Test switch functions are as follows:

LP (Lamp Test)—This switch, when depressed, lights ***all*** status indicators (LEDs) with the exception of the ON indicator (which should be lighted whenever power is applied to the data set). Depressing this switch does not affect data set operation.

AL (Analog Loop-Back)—This switch, when depressed, loops back the transmitter to the receiver through an internal attenuator on the line side. This permits testing of the local data set with self-contained test circuitry or with external test equipment through the customer interfaces. Depressing the AL switch lights the TM indicator and disables the slaved transmit timing option (WI). The automatic retrain option is invoked. Unless the DSR-on-in-AL-mode option (YM) is installed, the MR indicator goes off and the data set ready (CC) leads turn ***off***.

ST (Self Test)—This switch, when depressed, conditions the data set to transmit steady marks. The request-to-send (CA) lead is held ***on*** by this switch. The ER indicator blinks in response to the occurrence of error signals (spaces) on any of the receive data (BB) leads. Depressing the ST switch lights the TM indicator, disables the slaved transmitter timing option and the external timing option, extinguishes the MR indicator, and turns the CC leads ***off***.

DL (Digital Loop-Back)—This switch, when depressed, causes a loop-back at the data set customer interface. Received data (BB) leads are connected to transmitted data (BA) leads; serial clock receive (DD) leads are connected to the serial clock transmit external (DA) leads; and the signal quality detector (CG) lead is connected to the request-to-send (CA) lead of connector 1. These interface leads are disconnected from the customer interface while the data set functions as a regenerator. This permits testing of the transmission facilities and both data sets. When the DL and ST switches are depressed jointly, the voltage at quality monitor 1 test point is applied to the send data (BA) leads. This facilitates compromise equalization of the data channel from a remote data set location.

Note: The DL and AL test switches should not be operated simultaneously.

FUNCTIONAL DESCRIPTION

2.12 This part contains information pertaining to the data set test modes, interface leads, and options. Refer to Section 592-032-150 for a detailed functional description of the data set.

A. Test Modes

2.13 DS 209A-L1 provides three test modes which enable the customer or telco employee to test the data set in analog loop-back, digital loop-back, and end-to-end test modes.

- ***Analog Loop-Back:*** The purpose of this test is to check the local data set by using any one of the following methods: duplex CPE, data set self-test feature, or a 914-type DTS.

If the CPE requires that an <u>on</u> condition be present on the CC lead, the DSR-on-in-AL-mode option must be enabled.

This test mode is entered by depressing the AL test switch, which disconnects the data set from the telephone line and loops the transmitter output back to the receiver through an internal pad. In this test mode, the ON, RS, CS, CO, and ER indicators operate as in the normal data mode. The MR indicator is off unless the DSR-on-in-AL-mode option is enabled, and the TM indicator is lighted. A self test of the data set without the use of additional test equipment can be initiated by depressing the AL switch and then the ST switch. The ST switch turns the CA lead ***on***, turns the CC lead ***off***, and conditions the BA lead to transmit steady marks. A received space represents an error, resulting in momentary illumination of the ER indicator.

- ***Digital Loop-Back:*** The purpose of this test is to check, from one location, both data sets (local and remote) in conjunction with the transmission facility. This test can be performed with duplex CPE, the data set self-test feature, or a 914-type DTS. The test mode is entered by depressing the DL switch at the remote data set, which causes the remote data set to function as a regenerator. Test data from the CPE or the 914-type DTS can be transmitted by the local data set over the facility to the remote data set, looped back, and retransmitted to the local data set. A self test of the data channel without the use of additional equipment can be initiated by depressing the DL switch of the remote data set and then the ST switch of the local data set. Test data in the form of steady marks is transmitted by the local data set, looped back at the customer interface of the remote data set and retransmitted to the local data set. A received space represents an error, resulting in momentary illumination of the ER indicator at the local data set. The total error count (blinks of the ER indicator at the local data set) is a cumulative total of errors detected at the remote data set and errors detected at the local data set.

- ***End-to-End:*** The purpose of this test is to check the end-to-end performance of the data channel by using any of the following methods: duplex CPE, data set self-test feature, or a 914-type DTS. Test data is transmitted through the customer interfaces of both local and remote data sets. An end-to-end test utilizing the data set self-test feature can be initiated by depressing the ST switches of both data sets to condition them to transmit steady marks. A received space represents an error in one direction of transmission only and is shown by momentary illumination of the ER indicator at the receiving data set. The ON, RS, CS, CO, and TM indicators are lighted, while the ER and MR indicators are off.

B. Customer Interface

2.14 The customer interface is accessible through the four connectors (1, 2, 3, and 4) located at the rear of the data set. The connector pin numbers and the corresponding lead designations are given in Table A. For a detailed description of the interface leads, refer to Section 592-032-150. With the following exceptions, the interfaces are identical, independent, and functionally the same:

- Divided clock receive (DCR), divided clock transmit (SBB), and equalizer mode (QM) interface leads are provided only to customer connector 1.

- Test voltages +12V, −12V, and +5V are present at connector 1 only.

- The serial clock transmit external (DA) interface lead of connector 1 is the only DA signal which can be used to externally time the data set.

2.15 The four interfaces of DS 209A-L1 conform to the EIA Standard RS-232-C with the following exceptions. The exceptions occur only on connector 1, which provides four signals not defined in EIA RS-232-C.

(a) On pin 11, no assignment is given in EIA Standard RS-232-C. DS 209A-L1 has provided the equalizer mode (QM) signal on this lead.

(b) On pin 16, EIA Standard RS-232-C calls for secondary received data (SBB) if the data set is equipped with secondary channel. DS 209A-L1 has provided the divided clock transmit signal on this lead.

(c) On pin 18, no assignment is given in EIA Standard RS-232-C. DS 209A-L1 has provided the divided clock receive (DCR) signal on this lead.

(d) On pin 25, no assignment is given in EIA Standard RS-232-C. DS 209A-L1 has provided +5 volts (to connector 1 only) for data set testing by telco personnel.

C. Telephone Line Interface

2.16 The telephone interface is accessible through the TEL connector (Fig. 2) at the rear of the data set. The connector pin numbers and the corresponding lead designations are given in Table C.

D. Customer Options

2.17 DS 209A-L1 is provided with a number of features which may be requested as options by the customer. A detailed description of these options is given in Sections 592-032-150 and 592-032-200. All options, with the exception of the ground option, are added and removed by switches shown in Fig. 3 and Table D. Options installed in the data set should be identified on the option label which is attached to the front of the power unit.

E. Telco Options

2.18 In addition to the customer options, DS 209A-L1 provides the following options for selection by the telco employee.

- DAS 828- or 829-type used

- 1-second holdover

- Automatic equalizer retraining

- Compromise equalizer.

TABLE C

TELEPHONE LINE INTERFACE

PIN NO.	DESCRIPTION
2	—12 volts dc
3	+5 volts dc
6	DBU1
7	Data tip 1 (DT1) } Transmit Pair
8	Data ring 1 (DR1) } Transmit Pair
9	Data tip (DT) } Receive Pair
10	Data ring (DR) } Receive Pair
11	TEK6 } CC Lead Control from DAS
13	TEK5 } CC Lead Control from DAS
14	DBU2—With DBU1 provides DDD backup control
20	+12 volts dc

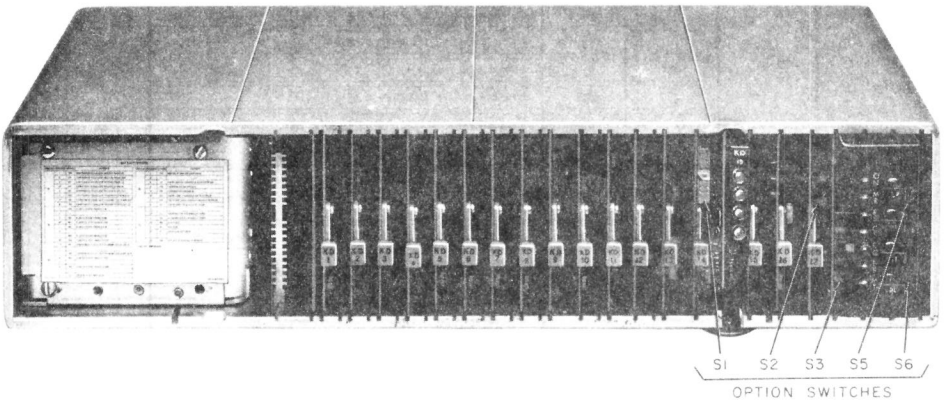


Fig. 3—Data Set 209A-L1 With Faceplate Removed—Front View

TABLE D

DATA SET 209A-L1 OPTIONS

SWITCH	STRAP* POSITION	OPTION	FEATURE
S1	1	WM	Compromise Equalizer Receive Phase HI
	2	WN	Compromise Equalizer Receive Phase OUT
	3	WO	Compromise Equalizer Receive Phase LO
	4	WK†	Compromise Equalizer Receive Slope IN
	5	WL†	Compromise Equalizer Receive Slope OUT
	6	WR	Compromise Equalizer Transmitter Phase HI
	7	WS	Compromise Equalizer Transmitter Phase OUT
	8	WT	Compromise Equalizer Transmitter Phase LO
S2	1	WA	Elastic Store Enable 1 IN
	2	—	Not Used
	3	WC	Elastic Store Enable 2 IN
	4	WF	Elastic Store Enable 3 OUT
	5	WE	Elastic Store Enable 3 IN
	6	—	Not Used
	7	WG	Elastic Store Enable 4 IN
	8	WH	Elastic Store Enable 4 OUT
S3	1	WP‡	Compromise Equalizer Transmitter Slope IN
	2	—	Not Used
	3	WQ‡	Compromise Equalizer Transmitter Slope OUT
	4	WB	Elastic Store Enable 1 OUT
	5	—	Not Used
	6	WD	Elastic Store Enable 2 OUT
	7	—	Not Used
	8	YJ	DAS 828- or 829-Type Not Used
S4	11	YM	DSR-ON-in-Analog-Loop Mode
	2	—	Not Used
	3	XF	4-Wire Switched Carrier and Auto. Retrain
	4	YW	1-Second Holdover OUT
	5	YX	1-Second Holdover IN
	6	XG	4-Wire Cont. Carrier and Auto. Retrain
	7	XH	4-Wire Switched Carrier No Auto. Retrain
	8	XI	4-Wire Cont. RS and Auto. Retrain
S5	1	—	Not Used
	2	YC	Internal Timing
	3	YD	External Timing
	4	WJ	Slave OUT
	5	WI	Slave IN
	6	YI	DAS 828- or 829-Type Used
	7	—	Not Used
	8	YN	DSR-OFF-in-Analog-Loop Mode

* The option switch is numbered from top to bottom with the number 1 strap position at the top.

† Option WK or WL must be installed.

‡ Option WP or WQ must be installed.

3. OPERATION

3.01 Attendant operation of DS 209A-L1 is limited to the four test switches, the multiplex selector switch, and observation of the status indicators. The data set is in data mode under the following conditions:

- All test switches are in the ***out*** position.
- ON and MR status indicators are lighted.
- The multiplex selector switch is in the proper position and the respective multiplex status indicator is lighted.

3.02 The data set is in the test mode when any one of the test switches is depressed and the TM status indicator is lighted. Refer to Section 592-032-500 for detailed information concerning the use of these test switches.

- Momentarily depress the LP switch to light the status indicators for test purposes.
- Depress the AL switch to initiate an analog loop-back test.
- Depress the DL switch to initiate a digital loop-back test.
- Depress the ST switch on the local data set and have the DL switch on the remote data set depressed to initiate a self test independent of external test equipment.

4. REFERENCES

4.01 Documents listed in this part contain information pertaining to DS 209A-L1.

4.02 The following BSPs are listed for reference.

SECTION	TITLE
167-440-203	112A Power Unit—Identification, Installation, and Connection
314-919-100	Digital Data System—Subrate Off-Net Extension Arrangement—Description
590-002-115	9600-Bits Per Second (BPS) Multiplexing Service Using Data Set 209A-L1—Reference Guide
Data Set 209A-L1—Transmitter-Receiver	
592-032-180	Summarizing Specification
592-032-200	Installation and Connections
592-032-300	Maintenance
592-032-500	Test Procedures
666-511-504	Test of Data Services Provided by Data Set 209A-L1 From a Private Line Test Room
999-100-143	How to Operate Manual
Data Auxiliary Set 828A	
598-080-100	Description and Operation
Data Auxiliary Set 829-Type—Channel Interface Units	
598-082-100	Description
Data Auxiliary Set 829-Type—Supplementary Functions	
598-082-101	Description
598-082-102	Installation and Connections

4.03 Detailed information pertaining to DS 209A-L1 is contained in CD- and SD-1D249-01.

DATA SET 209A-L1

TRANSMITTER-RECEIVER

INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the installation and connection of data set (DS) 209A-L1 for point-to-point, point-to-point multiplexing, and digital data system off-net service. Information is included pertaining to the installation and connection of DS 209A-L1 for the following multiplex systems:

- Point-to-point multiplexing
- Many-point multiplexing
- One-to-many multiplexing.

A description of the various systems using DS 209A-L1 is provided in Section 592-032-100. Additional information required when installing DS 201C, 208A-L1A, or 209A-L1 (at 7200 bps) for extended service is included in this section.

1.02 This section is reissued to incorporate information previously contained in Section 592-032-101. Data set option descriptions have been removed from Section 592-032-100 and included in this section. This issue contains connections to provide alternate switched network backup using data auxiliary sets (DAS) 829- or 828A-type and 828C. Since this issue constitutes a general revision, arrows which are ordinarily used to denote changes have been omitted.

1.03 DS 209A-L1 should be installed in conformance with existing installation practices. Refer to the section entitled Data Sets—General Installation and Connection Information (590-020-200). DAS 828- or 829-types are recommended for use with DS 209A-L1.

1.04 The data set operates in an environment of 20 to 95 percent relative humidity from 40 to 75°F, or 20 to 40 percent relative humidity from 75 to 120°F.

1.05 It is preferred that the data set be installed apart from the customer-provided equipment (CPE) on a nearby desk, table, stand, or in a Bell System-provided equipment cabinet. DS 209A-L1 must be located near the CPE, for the interface cord supplied by the customer must not exceed 50 feet in length [to limit stray capacitance and to conform to Electronic Industries Association (EIA) standards]. To minimize inductive interference to data signals on the telephone (data) line, the line should ***not*** be carried in the same run as cable between the data set and CPE or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type-SK (shielded) station wire between the data set and the cable distribution terminal or building entrance. Ground the shield at one end only, preferably at the distribution panel.

1.06 DS 209A-L1 requires an ac outlet to accept the 3-prong plug on the KS-14532-L24 power cord. To prevent the data set from being turned off accidentally, the outlet should not be under control of a switch.

1.07 Four 25-pin KS-19087-L2 connectors are provided at the rear of the data set for connection to customer interfaces which conform to the electrical characteristics of EIA Standard RS-232-C. These connectors are designed to mate with a customer-provided Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood and wired in accordance with Table A. Connection between the data set and DAS 829- or 828-type is made with an M8K cord which comes with the data set.

1.08 Removal of the front faceplate is required for access to the option switch panel and to the circuit packs (CPs). This faceplate can be removed by gently squeezing it at top and bottom and pulling forward. To replace the faceplate, position it properly, gently squeeze at top and bottom, and push into place.

1.09 In order to gain access to the CPs, remove the front faceplate and CP locking bar. Each CP can be removed by pulling forward on the plastic tab. To replace the CP, align it in the proper slot and push gently into place. The locking bar should be reinstalled before replacing the faceplate.

1.10 Current factory models of DS 209A-L1 are equipped with a guard to prevent inadvertant operation of the multiplex selector switch. Earlier production models can be equipped with a guard at telco expense by ordering:

___ Guard(s) Com. Code 841-571-706.

The guard can be installed on the data set housing using Dow-Corning 732 RTV adhesive, or equivalent. Clean both surfaces with alcohol before applying adhesive, and locate the guard approximately 5/16-inch from the front edge of the data set housing.

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DS 209A-L1 MNEMONIC	EIA DESIGNATION (RS-232-C)	NOTES
1	Frame Ground	FG	AA	
2	Send Data	SD	BA	
3	Receive Data	RD	BB	
4	Request to Send	RS	CA	
5	Clear to Send	CS	CB	
6	Data Set Ready	DSR	CC	
7	Signal Ground	SG	AB	
8	Carrier on Delayed	COD	CF	
9	+12V	CI9 (+12V)	Reserved for Data Set Testing	1
10	−12V	CI10 (−12V)	Reserved for Data Set Testing	1
11	Equalizer Mode	QM	Unassigned	1, 2
15	Serial Clock Transmit	SCT	DB	
16	Divided Clock Transmit	DCT	SBB	3
17	Serial Clock Receive	SCR	DD	
18	Divided Clock Receive	DCR	Unassigned	1, 2
21	Signal Quality Detector	COV	CG	
24	Serial Clock Transmitter External	SCTE	DA	
25	+5V	CI25 (+5V)	Unassigned	1, 2

Note 1: Available only at customer interface 1.

Note 2: These pins are unassigned by RS-232-C. DS 209A-L1 provides these functions to the leads of connector 1 only.

Note 3: DS 209A-L1 provides a DCT signal on this pin of connector 1 only. RS-232-C assigns SBB to this pin.

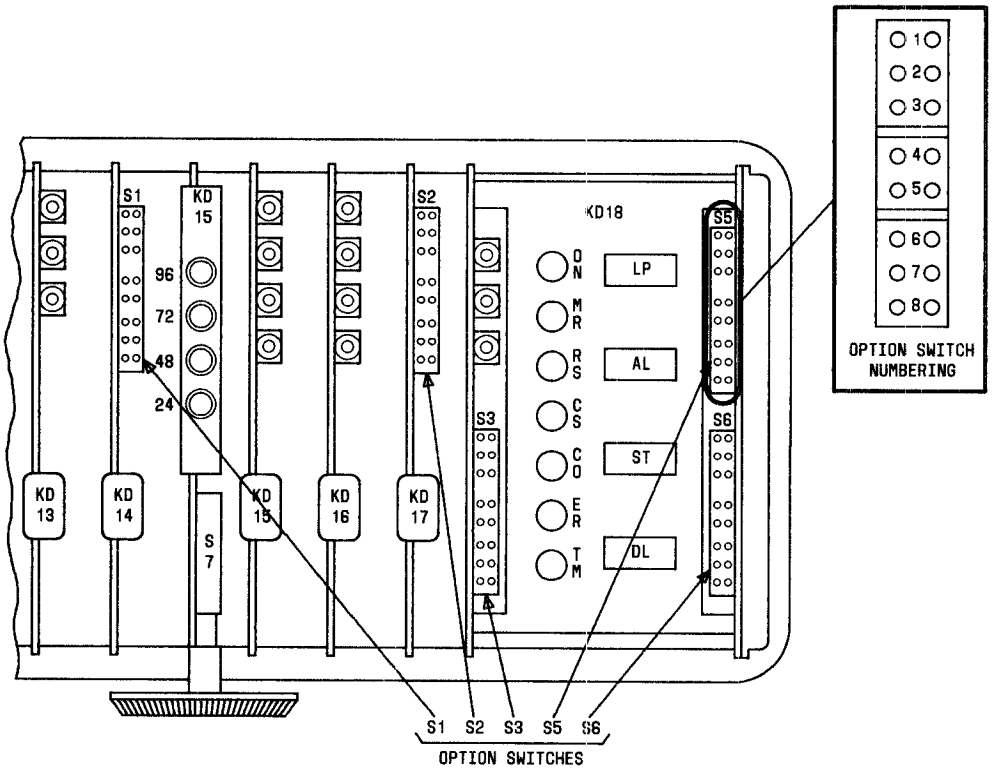


Fig. 1 — Location of Option Switches (Sheet 1 of 2)

USOC DECSN	OPTION DESIG	FEATURE	REMOVE JACK		INSTALL JACK		PROVIDE
			SWITCH	POSITION	SWITCH	POSITION	
D7	WA	ELASTIC STORE ENABLE 1 IN	S3	4	S2	1	ONE PER STATION
D8	WB*	ELASTIC STORE ENABLE 1 OUT	S2	1	S3	4	
D7	WC	ELASTIC STORE ENABLE 2 IN	S3	6	S2	3	ONE PER STATION
D8	WD*	ELASTIC STORE ENABLE 2 OUT	S2	3	S3	6	
D7	WE	ELASTIC STORE ENABLE 3 IN	S2	4	S2	5	ONE PER STATION
D8	WF*	ELASTIC STORE ENABLE 3 OUT	S2	5	S2	4	
D7	WG	ELASTIC STORE ENABLE 4 IN	S2	8	S2	7	ONE PER STATION
D8	WH	ELASTIC STORE ENABLE 4 OUT	S2	7	S2	8	
C5	WI	SLAVE IN	S6	4	S6	5	ONE PER STATION
C6	WJ*	SLAVE OUT	S6	5	S6	4	
	WK*	COMPROMISE EQUALIZER RECEIVE SLOPE IN	S1	5	S1	4	ONE PER STATION
	WL	COMPROMISE EQUALIZER RECEIVE SLOPE OUT	S1	4	S1	5	
	WM	COMPROMISE EQUALIZER RECEIVE PHASE HI	S1	2 OR 3	S1	1	ONE PER STATION
	WN*	COMPROMISE EQUALIZER RECEIVE PHASE OUT	S1	1 OR 3	S1	2	
	WO	COMPROMISE EQUALIZER RECEIVE PHASE LO	S1	1 OR 2	S1	3	
	WP*	COMPROMISE EQUALIZER TRMTR SLOPE IN	S3	3	S3	1	ONE PER STATION
	WQ	COMPROMISE EQUALIZER TRMTR SLOPE OUT	S3	1	S3	3	
	WR	COMPROMISE EQUALIZER TRMTR PHASE HI	S1	7 OR 8	S1	6	ONE PER STATION
	WS*	COMPROMISE EQUALIZER TRMTR PHASE OUT	S1	6 OR 8	S1	7	
	WT	COMPROMISE EQUALIZER TRMTR PHASE LO	S1	6 OR 7	S1	8	
E10	XF	4W SWITCHED CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	6 OR 7 OR 8	S5	3	ONE PER STATION
F11,E9	XG*	4W CONTINUOUS CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	3 OR 7 OR 8	S5	6	
E10	XH	4W SWITCHED CARRIER (SWITCHED RS) AND NO AUTO RETRAIN	S5	3 OR 6 OR 8	S5	7	
F12,E1	XI	4W CONTINUOUS CARRIER (CONTINUOUS RS) AND AUTO RETRAIN	S5	3 OR 6 OR 7	S5	8	
A1	YC*	INTERNAL TIMING	S6	3	S6	2	ONE PER STATION
A2	YD	EXTERNAL TIMING	S6	2	S6	3	
	YI*	DAS 828- OR 829-TYPE USED	S3	8	S6	6	ONE PER STATION
	YJ	DAS 828- OR 829-TYPE NOT USED	S6	6	S3	8	
B3	YM	DSR ON IN ANALOG LOOP MODE	S6	8	S5	1	ONE PER STATION
B4	YN*	DSR OFF IN ANALOG LOOP MODE	S5	1	S6	8	
	YW	1-SECOND HOLDOVER OUT	S5	5	S5	4	ONE PER STATION
	YX*	1-SECOND HOLDOVER IN	S5	4	S5	5	

* FACTORY INSTALLED.

Fig. 1 — Location of Option Switches (Sheet 2 of 2)

2. OPTIONS

2.01 DS 209A-L1 is provided with a number of features by options which can be installed prior to placing the data set in service. The options to be installed in the data set should be specified on the service order. All options, with the exception of the ground option, are installed and removed with the switches shown in Fig. 1. Factory-installed options are indicated in Fig. 1 by an asterisk (*). Options installed in the data set should be identified on the option label attached to the front of the power unit. Recommended data set options for system applications are shown in Figs. 2, 3, and 4.

A. Customer Options

2.02 ***Internal or External Timing:***

- With internal timing, the data set provides serial clock to the customer on the DB lead.
- With external timing, the customer provides serial clock to the data set on the DA lead of connector 1 only. This clock must be 2400, 4800, 7200, or 9600 Hz, depending upon the multiplexing arrangement, and must be stable to $\pm 2.5 \times 10^{-7}$ (± 25 ppm). On data sets with external timing, the DB signal is present and is phase-locked to the clock from the customer on the DA lead. If the elastic store enable 1 in option is used, external timing by the customer cannot be used.

2.03 ***Data Set Ready (CC) ON in AL Mode:*** When the data set is in the analog loop-back test mode, the CC interface lead is normally ***off.*** Enabling this option permits the CC lead to remain ***off*** when the AL switch is depressed. This enables some duplex CPE to perform a loop-back test through the data set.

2.04 ***Slave:*** When the slave option is installed in DS 209A-L1, the recovered symbol clock of the receiver is internally connected to DA and the transmitter is timed from the receiver. This option is recommended for use in many-point and one-to-many multiplexing systems.

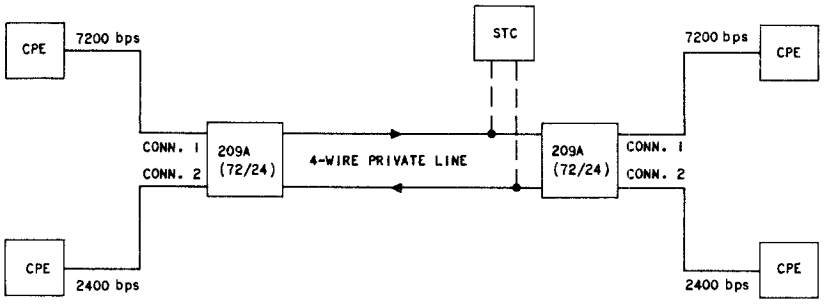
2.05 ***Elastic Store Enable:*** There are four elastic stores, one associated with each of the four interface connectors. The elastic store options compensate for timing phase differences between the BA and DB leads of DS 209A-L1 and the BB and DD leads of the extension data sets (201C/208A/209A). This option is recommended when DS 209A-L1 is installed in one-to-many or many-point multiplexing systems.

2.06 ***Carrier Control:***

- With the switched carrier and switched request-to-send option, the data set transmitter is under control of the CA lead. The data set transmitter turns off within 3.5 ms after CA turns ***off.*** The CA-CB delay for switched carrier can vary between 8 and 200 ms, depending on CPE control of the CA lead and the 150-ms retraining sequence induced by option XF.
- With the continuous carrier and switched request-to-send option, the transmitter remains on continually and transmits MARK signals when CA is ***off.*** Each customer interface has a CA-CB delay of 8 ms. Continuous carrier operation (either XG or XI) is recommended for all system applications.
- With the continuous carrier and continuous request-to-send option (XI), request-to-send is held ***on*** internally, and the transmitter remains on continuously and transmits MARK signals to maintain synchronization. The CB lead is ***on*** continuously except during an auto retrain sequence.

Only one of the four carrier control options (XF, XG, XH, XI) should be installed per data set.

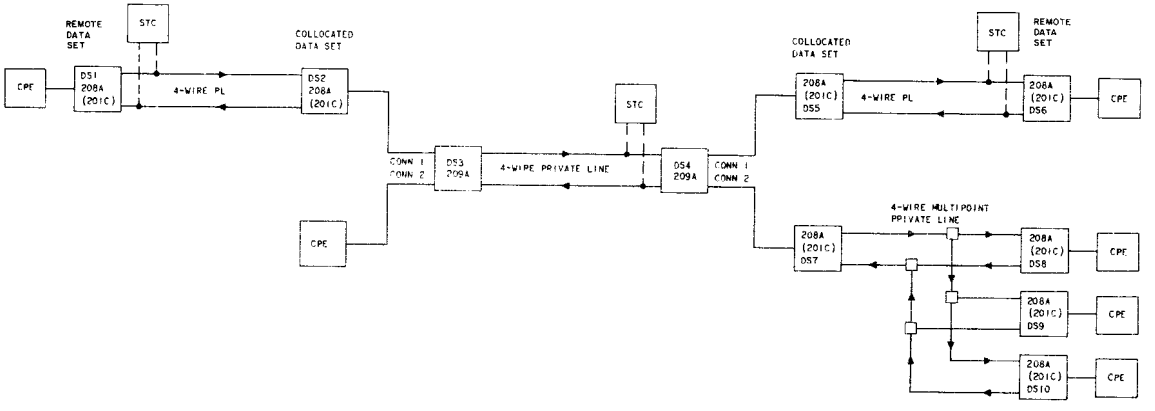
2.07 ***Ground Option:*** When this option is installed, frame ground (AA) is strapped to signal ground (AB). This option is normally installed but can be disconnected by the installer if the customer specifies a different grounding arrangement.



SELECT	DATA SET 209A OPTIONS	SELECT
* 72/24, 48/48, 48/24/24, OR 4-24	MULTIPLEX OPTION	* 72/24, 48/48, 48/24/24, OR 4-24
INTERNAL	TRANSMITTER TIMING	INTERNAL
CONTINUOUS	CARRIER CONTROL	CONTINUOUS
PER CPEs	REQUEST-TO-SEND CONTROL	PER CPEs
ALL DISABLED †	ELASTIC STORES	ALL DISABLED †
NOT PROVIDED †	SLAVED TIMING	NOT PROVIDED †
PER CPEs	DATA SET READY CONDITION IN AL MODE	PER CPEs
PER CPEs OR LOCAL PRACTICE	GROUNDING	PER CPEs OR LOCAL PRACTICE
IN	1-SECOND HOLDOVER	IN

* THE MULTIPLEX OPTION MUST BE THE SAME FOR BOTH DATA SETS.
† REQUIRED OPTION.

Fig. 2—Typical Options for Point-to-Point or Point-to-Point Multiplex Systems



(REMOTE) SELECT	DATA SET 208A OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(COLLOCATED) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
CONTINUOUS	CARRIER CONTROL	SWITCHED *
0 OR 8 MS PER CPE	REQUEST TO SEND OPERATION	SWITCHED *
IN	1-SECOND HOLDOVER	IN
NOT USED *	NEW SYNC	NOT USED *
CC ON OR CC OFF PER CPE	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE *
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB *

(REMOTE) SELECT	DATA SET 201C OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(COLLOCATED) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
CONTINUOUS	CARRIER CONTROL	SWITCHED *
0 OR 7 MS PER CPE	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	7 MS *
NOT USED *	NEW SYNC	NOT USED *
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB *

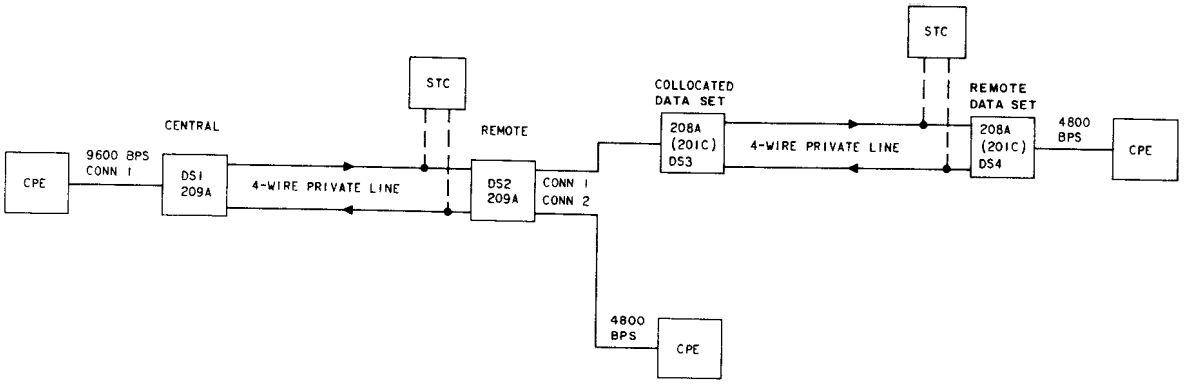
SELECT	DATA SET 209A OPTIONS	SELECT
ANY BUT 96 (48/48 FOR EXAMPLE SHOWN)	MULTIPLEX OPTION	ANY BUT 96 (48/48 FOR EXAMPLE SHOWN)
INTERNAL *	TRANSMITTER TIMING	INTERNAL *
CONTINUOUS *	CARRIER CONTROL	CONTINUOUS *
CONTINUOUS †	REQUEST-TO-SEND CONTROL	CONTINUOUS †
1 IN 2-4 OUT (FOR EXAMPLE SHOWN)	ELASTIC STORES *	1 & 2 IN 3 & 4 OUT (FOR EXAMPLE SHOWN)
OUT IN	SLAVED TIMING ‡ *	IN OUT
PER CPE AT POLLING CENTRAL (FOR EXAMPLE SHOWN)	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE *
AA CONNECTED TO AB *	GROUNDING	AA CONNECTED TO AB *
IN	1-SECOND HOLDOVER	IN

† NOT REQUIRED EXCEPT FOR MULTIPOINT
‡ SLAVE TIMING IS USED IN ONE 209A OR THE OTHER, BUT NOT BOTH.
* REQUIRED

(COLLOCATED) SELECT	DATA SET 208A OPTIONS ON MULTIPOINT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	SWITCHED *
SWITCHED *	REQUEST TO SEND OPERATION	SWITCHED *
OUT *	1-SECOND HOLDOVER	IN *
NOT USED *	NEW SYNC	NOT USED *
CC OFF IN AL TEST MODE *	DATA SET READY (CC) CONDITION IN AL TEST MODE	CC ON OR CC OFF PER CPE
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE

(COLLOCATED) SELECT	DATA SET 201C OPTIONS ON MULTIPOINT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	SWITCHED *
7 MS *	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	7 MS *
NOT USED *	NEW SYNC	NOT USED *
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE

Fig. 3—Typical Options for Many-Point Multiplex System



(CENTRAL) SELECT	DATA SET 209A OPTIONS	(REMOTE) SELECT
96 *	MULTIPLEX OPTION	ANY MULTIPLEX OPTION
INTERNAL *	TRANSMITTER TIMING	INTERNAL *
CONTINUOUS	CARRIER CONTROL	CONTINUOUS *
PER CPE	REQUEST TO SEND CONTROL	CONTINUOUS WITH EXTEN CHANNEL (CONT OR SWITCHED W/O EXTEN CHANNEL)
ALL OUT *	ELASTIC STORES	1 IN * 2-4 OUT * (FOR EXAMPLE SHOWN)
OUT	SLAVED TIMING † ‡	IN (WITH EXTENSION CHANNEL) OUT (WITHOUT EXTENSION CHANNEL)
PER CPE	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB * (ONLY IF USED WITH EXTENSION)
IN	1-SECOND HOLDOVER	IN

* REQUIRED
† REQUIRED WHEN AT LEAST ONE EXTENSION IS USED
‡ SLAVE TIMING IS USED IN ONE 209A OR THE OTHER, BUT NOT BOTH

WHEN AN EXTENSION CHANNEL IS USED, OPTIONS MUST BE SELECTED IN THE COLLOCATED AND REMOTE DATA SETS (EITHER 208A OR 201C).

(COLLOCATED) SELECT	DATA SET 208A OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	CONTINUOUS
SWITCHED *	REQUEST-TO-SEND OPERATION	0 OR 8 MS PER CPE
IN	1-SECOND HOLDOVER	IN
NOT USED *	NEW SYNC	NOT USED *
CC OFF IN AL TEST MODE *	DATA SET READY (CC) CONDITION IN AL TEST MODE	CC ON OR CC OFF PER CPE
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE
(COLLOCATED) SELECT	DATA SET 201C OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	CONTINUOUS
7 MS *	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	0 OR 7 MS PER CPE
NOT USED *	NEW SYNC	NOT USED *
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE

Fig. 4—Typical Options for One-to-Many Multiplex System

B. Telco Options

2.08 In addition to the customer options, DS 209A-L1 provides the following options for selection by the telco employee.

2.09 ***DAS 828- or 829-Type Used:*** This option is installed when these DASs are used as terminations for the data channel. In normal operation, the DAS provides a contact closure between pins 11 and 13 of the telephone interface. Facility loop-back or alternate voice operation of the DAS opens this circuit and causes CC to turn ***off*** when this option is installed in DS 209A-L1. When this option is not installed, the CC lead indicates only the status of DS 209A-L1.

2.10 ***1-Second Holdover:*** With this option installed, the CF lead remains ***on*** for 1 second after loss of line signal. This allows the receiver to maintain synchronization and equalization with the distant-end transmitter for up to 1 second in the absence of a received line signal. This option is recommended when the distant-end DS 209A-L1 is optioned for continuous carrier.

2.11 ***Automatic Equalizer Retraining:*** With this option, the data set automatically resynchronizes and restarts the automatic equalizer when the received signal quality degrades to approximately 1 bit error in 100 bits of data. Duplex operation of the data channel is required to achieve automatic retraining. The retrain sequence causes CB and CF to turn ***off*** on the data set which requires reequalization, while only CB turns ***off*** on the distant-end data set. During retrain the ***off*** state on any one of these leads is maintained for not more than 200 ms. The total time for auto retrain is less than 240 ms, excluding channel propagation delay time. This option is required in either continuous carrier or continuous request-to-send operation. It is recommended in switched carrier operation, but not required.

2.12 ***Compromise Equalizer:*** There are five transmitter equalizer settings and five receiver equalizer settings available. Fixed amplitude and delay equalization are selected by these settings. The proper equalizer setting depends on the characteristics of the transmission facility and is determined for each installation by minimizing a voltage magnitude at two signal quality test points during installation. Final equalizer setting must result in a test voltage of less than −2 volts. Option WP ***or*** WQ must be installed to permit the data set transmitter to function properly. Likewise, option WK ***or*** WL must be installed to allow the data set receiver to function.

2.13 When the data set is installed, it should be checked to verify that the correct options (per the service order) are connected before requesting a loop-back test from the serving test center (STC).

2.14 Option strapping switches S1 and S2 are located on KD14 and KD17 CPs, respectively. Option strapping switches S3, S5, and S6 are located on KD18 CP. Each switch is divided into eight sections, numbered 1 through 8 from top to bottom. Options are installed or removed by inserting or removing shorting jacks on the option switches in accordance with Fig. 1. The data set is shipped with spare shorting jacks attached to the front of the data set heat sink.

2.15 The data set is supplied from the factory with a strap at the bottom of the power supply terminal strip, which is located at the rear of the data set. This strap connects frame ground to signal ground and can be disconnected during installation if the customer specifically requests a different grounding arrangement. To disconnect the strap, loosen the screws, pull back on the strap until the connection is broken, and tighten the strap under the frame ground (FG) screw.

3. CONNECTIONS

3.01 This part contains the information for connecting DS 209A-L1 to DAS 829-type or to DAS 828A-L1 and 828C. For further information pertaining to these data auxiliary sets, refer to Part 6.

3.02 Refer to Fig. 5 and 6 for connections between DS 209A-L1 and DAS 829-type. The data-only connection is shown in Fig. 5 and the data/voice connection is shown in Fig. 6. Additional information pertaining to DAS 829-type is contained in Sections 598-082-100 and 598-082-101.

3.03 Refer to Fig. 7 and 8 for connections between DS 209A-L1 and DAS 828A-type. The data-only connection is shown in Fig. 7 and the data/voice connection is shown in Fig. 8. For further information pertaining to DAS 828A-type, refer to Sections 598-080-100 and 598-080-101.

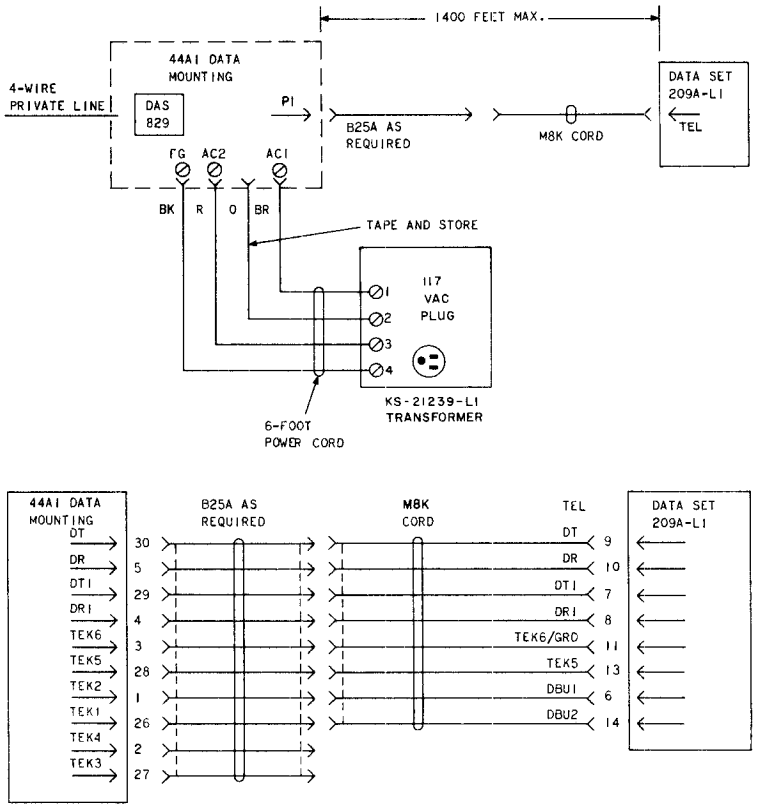


Fig. 5—Block and Connection Diagram for Data Set 209A-l.1 Using DAS 829-Type—Data Only

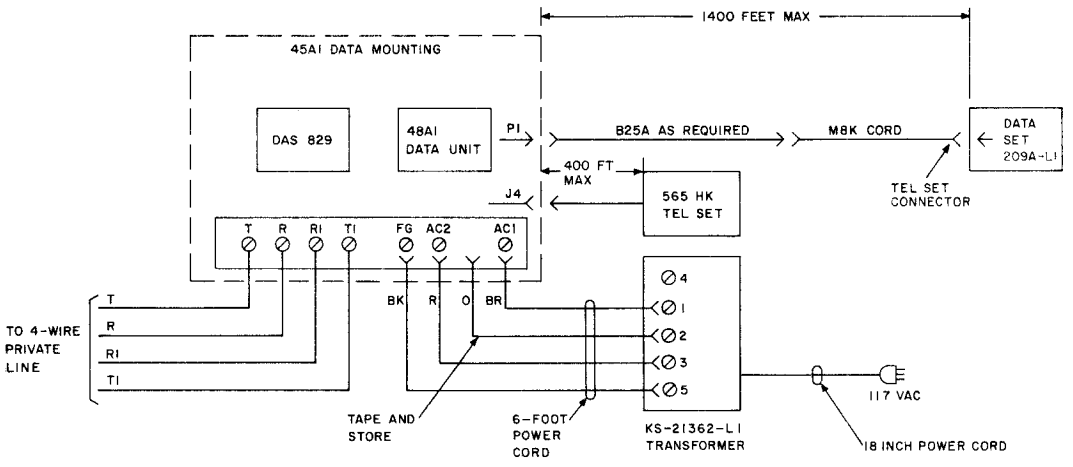


Fig. 6—Block Diagram for Data Set 209A-L1 Using DAS 829-Type—Data/Voice

3.04 Connection for DAS 829-type to provide alternate switched network backup is shown in Fig. 9. The 48A1 data unit is required only when alternate voice is to be provided.

3.05 Connections for DAS 828C to provide alternate switched network backup are shown in Fig. 10 and 11. The connection for data-only is shown in Fig. 10, while the connection for data/voice is shown in Fig. 11. Additional installer wiring as shown is required to provide a dial backup indication to the DS 209A-L1.

3.06 DS 209A-L1 should always be installed at 9600-bps dial backup capability. If external control of the data set transmission rate is desired by the customer, the 6017AL key must be installed as shown in Fig. 12. When in the dial backup mode, the data set operates at 9600 bps if the switch is open and at 4800 bps if the switch is closed.

3.07 When DS 209A-L1 is installed in a multiplex system using extension data sets (201C/208A/209A), one-half speed dial backup operation may inhibit some extension data sets from operating correctly.

3.08 If DS 209A-L1 is to be installed without a DAS, connection to the locally engineered termination equipment may be accomplished by using a D-25D-61 cord and a 66E3 connector block. Refer to Fig. 13.

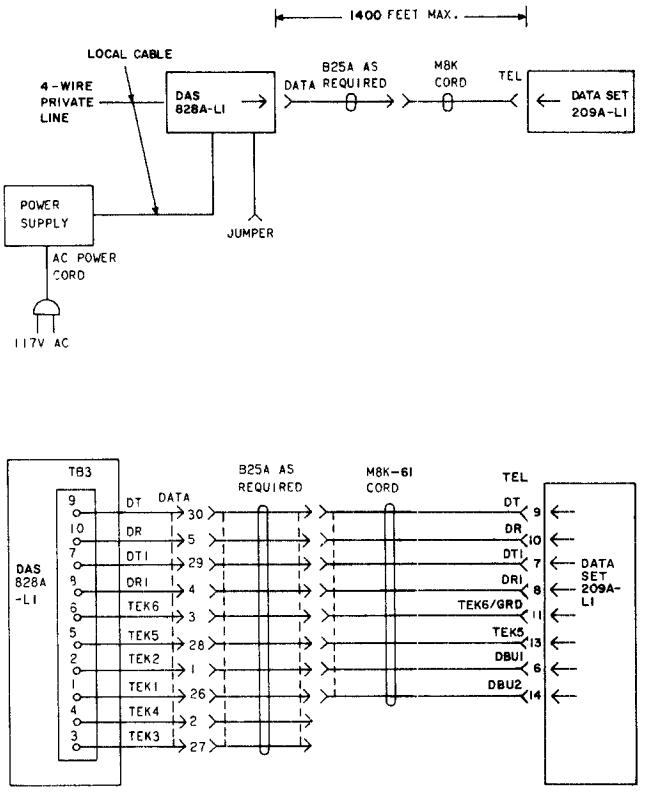


Fig. 7—Block and Connection Diagram for Data Set 209A-L1 Using DAS 828A-L1—Data Only

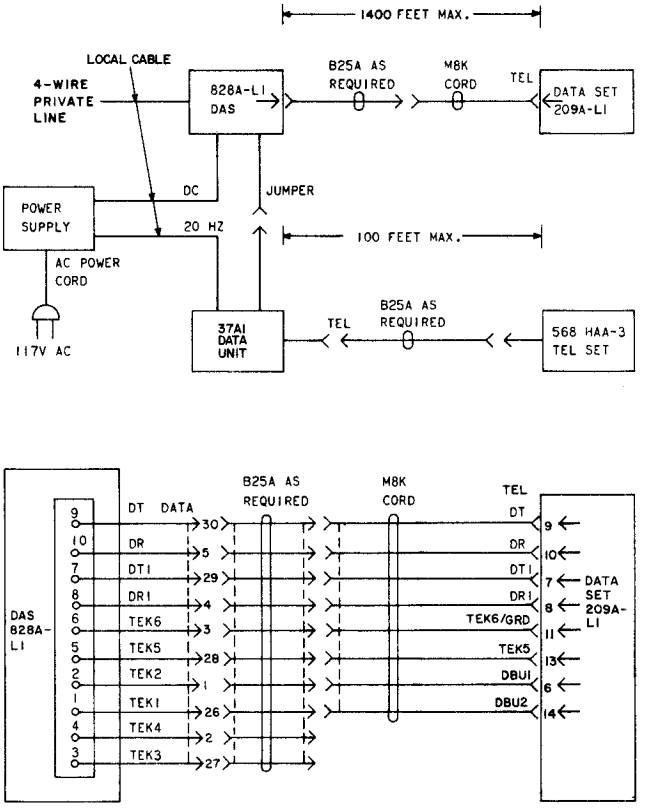


Fig. 8—Block and Connection Diagram for Data Set 209A-l1 Using DAS 828A-l1—Data/Voice

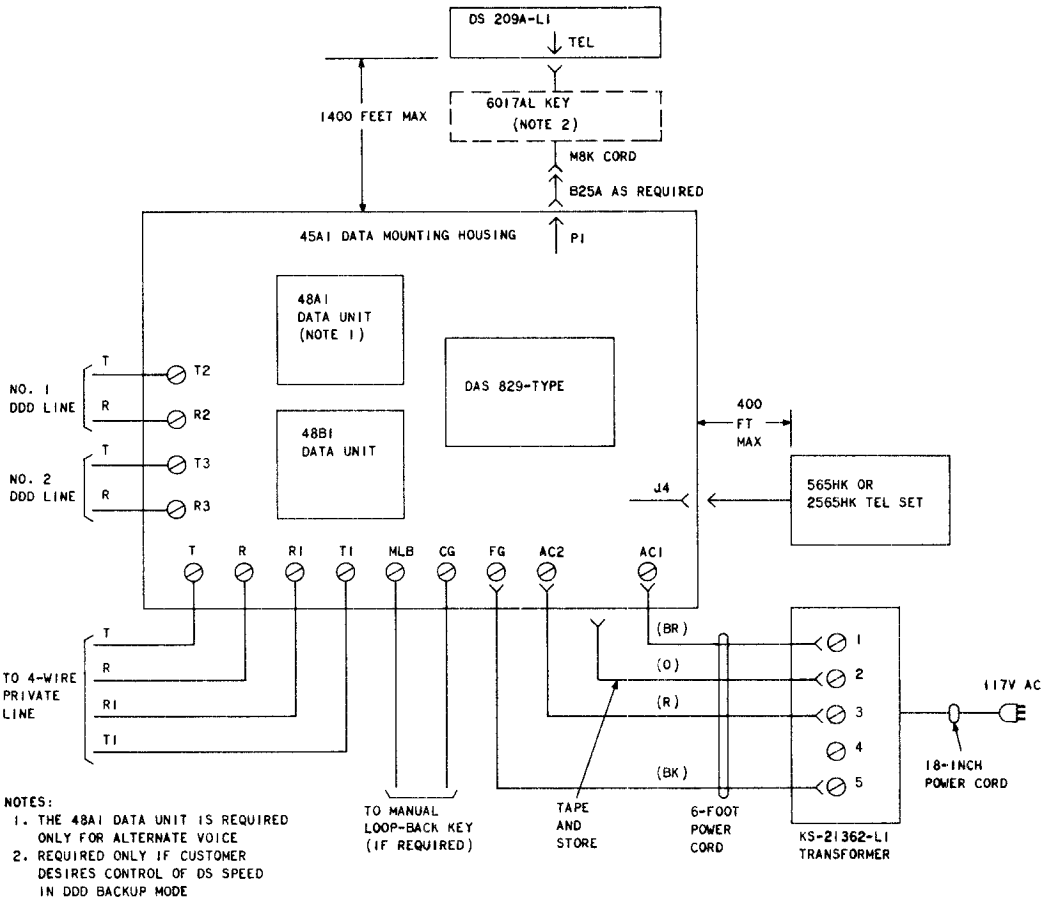


Fig. 9—Data Set 209A-L1 Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 829-Type

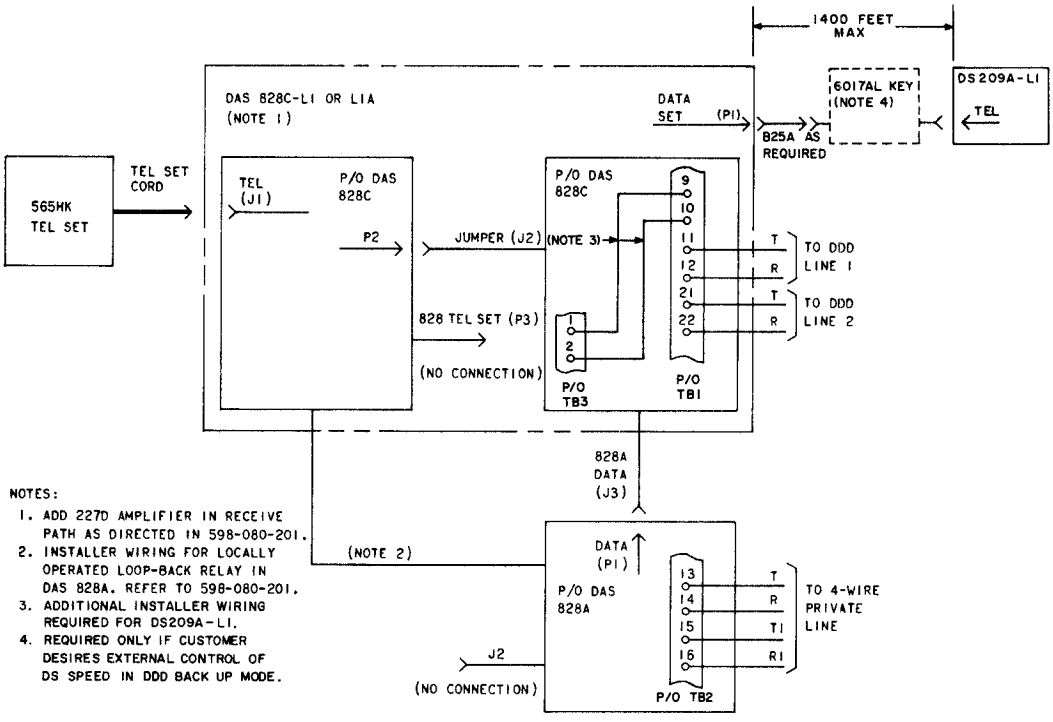


Fig. 10—Data Set 209A-L1 Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 828A-Type and 828C—Data Only

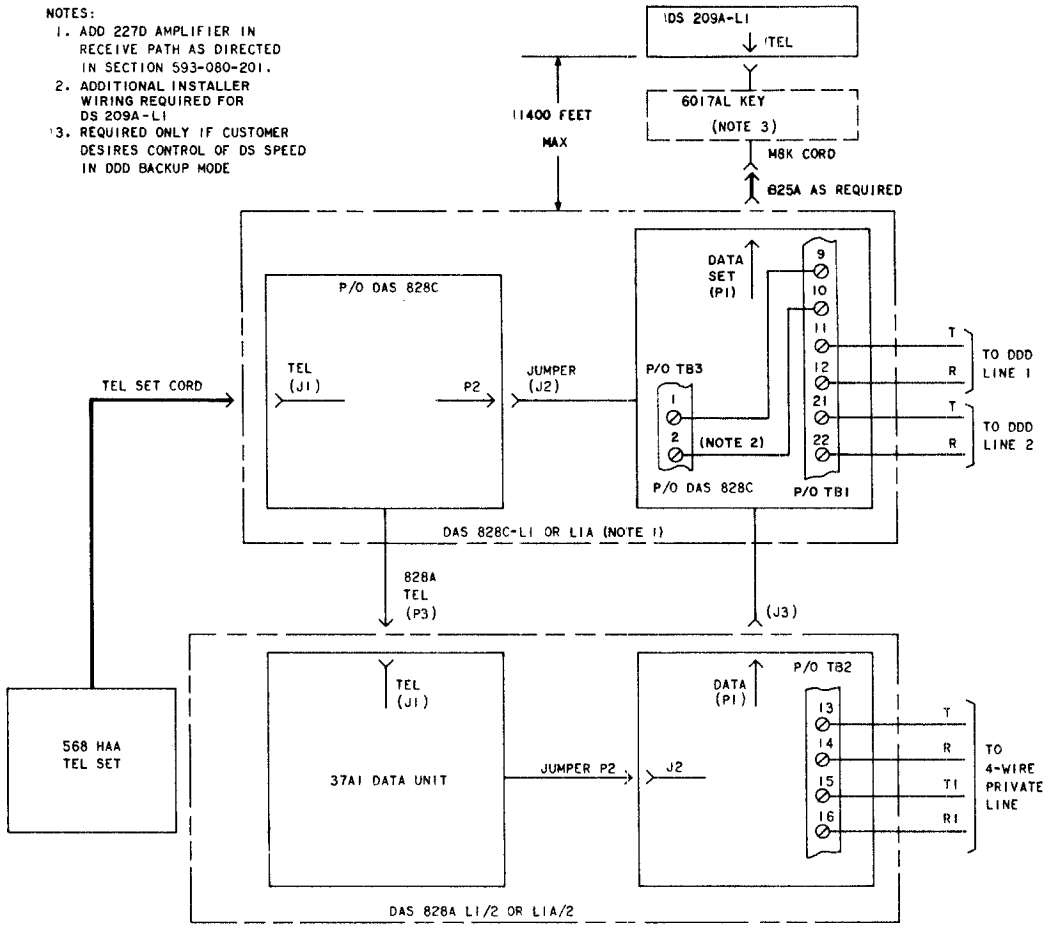
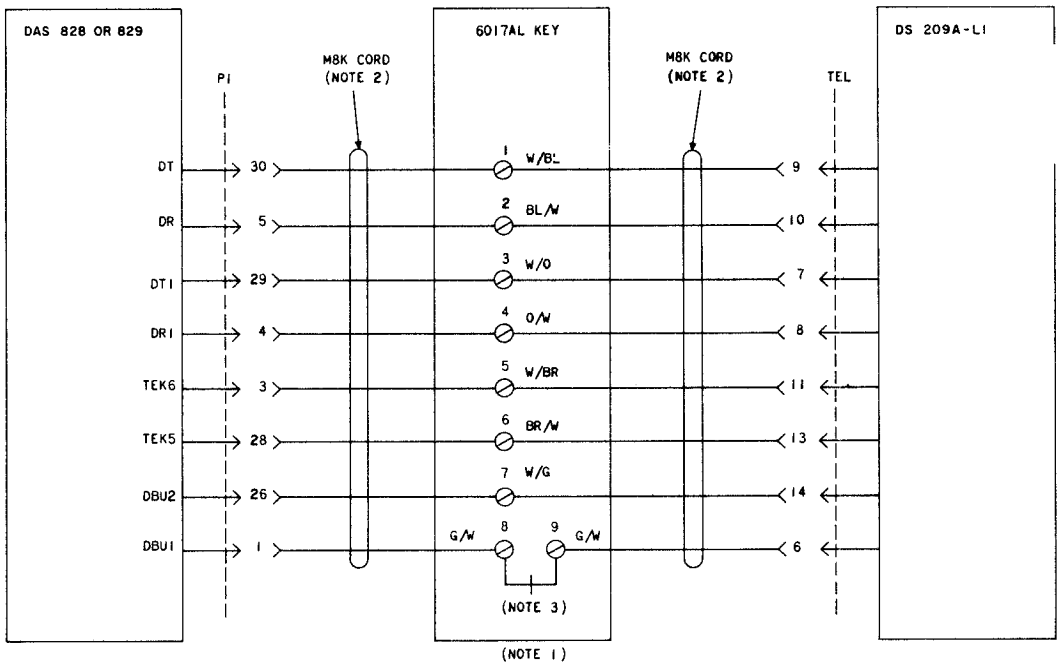


Fig. 11—Data Set 209A-L1 Used on 4-Wire Private Line With Alternate DDD Backup Using DAS 828A-Type and 828C—Data/Voice



NOTES:
1. LOCATE FOR CUSTOMER CONVENIENCE.
2. CUT THE M8K CORD AND CONNECT TO THE 6017AL KEY AS SHOWN.
3. BREAK CONTACT MUST BE WIRED TO TERMINALS 8 AND 9.

Fig. 12—Data Set 209A-L1 Bit Rate Control Wiring Using a 6017AL Key

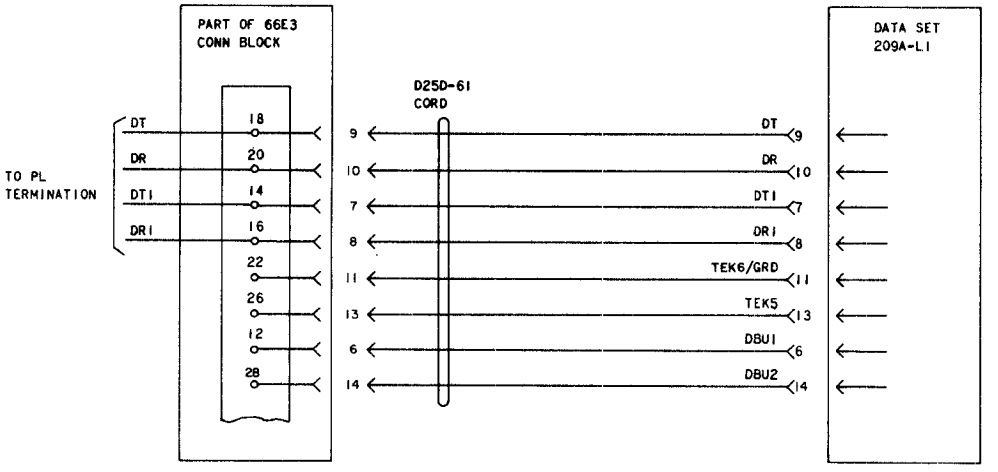


Fig. 13—Data Set 209A-L1 Connections to Locally Engineered Private Line Terminations Without DAS 828- or 829-Type

4. MULTIPLE INSTALLATIONS

4.01 There are two ways in which DS 209A-L1 can be installed in multiple installations.

(a) Three data sets can be stacked vertically.

(b) With suitable mounting brackets (D-180556), the data sets (including faceplates) can be mounted in a 23-inch rack mounting. The small right angle mounting flange can be assembled to the mounting bracket as shown in Fig. 14. If an adjustment to the depth at which the data set is positioned in the rack mounting is required, the small right angle mounting flange can be assembled to the mounting bracket by using the additional holes.

4.02 When DS 209A-L1 are used with the mounting brackets, it is possible to mount the data sets in KS-20018 Bell System-provided equipment cabinets. Cabinets in which DS 209A-L1 are to be mounted must have a perforated rear cover and a translucent front cover. Two Bell System cabinets meet these requirements. The KS-20018-L11A cabinet provides mounting for three DS 209A-L1 and one 46A1 data mounting for DAS 829-type. The KS-20018-L15A cabinet provides mounting for eight DS 209A-L1 and one 46A1 data mounting. Both cabinets must be positioned at least 6 inches from the nearest obstacle to allow free air flow.

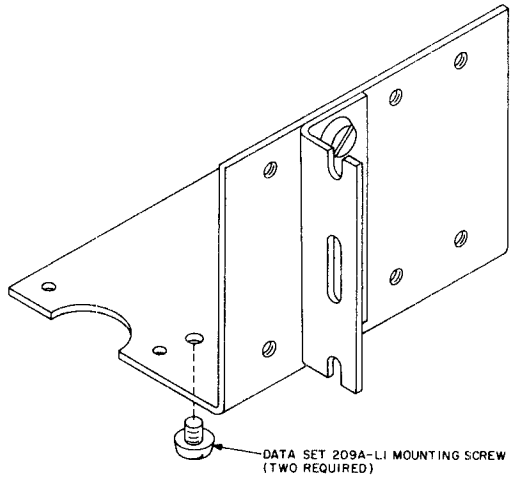


Fig. 14—Data Set 209A-L1 Mounting Bracket (D-180556)

4.03 If the data sets are to be mounted on nonperforated shelves within a cabinet, the front cover of the cabinet must be removed. If the D-180556 mounting brackets are used, the front cover of the cabinet can be retained.

4.04 When installing a multiple installation consisting of a maximum of eight data sets 209A-L1, it may be desirable to concentrate the 8-lead telephone interfaces into a single 50-pin connector. The KS-21253-L1 adapter provides this concentration. The adapter contains eight male 50-pin plugs and one female 50-pin connector. The M8K cord is used to interconnect the data sets and the adapter.

4.05 The DAS 828- and 829-types may also be concentrated in much the same manner by using the KS-21253-L2 adapter. This adapter contains eight female 50-pin connectors and one male 50-pin plug.

4.06 The two line interface adapters (KS-21253-L1 and -L2) can be interconnected by the appropriate length of B25A cable as required. This method of interconnection makes use of the unassigned conductors in a B25A cable. This permits the use of one B25A cable to interconnect a maximum of eight data sets 209A-L1 with a maximum of eight DAS 828- or 829-type.

4.07 When installing a multiple installation consisting of a maximum of 23 DS 209A-L1 equipped with dial backup capability, the 8-lead telephone interface can be concentrated by using two KS-21233-L4 adapters. Refer to Section 598-082-202 for additional information.

5. INSTALLATION PROCEDURES

5.01 After local equipment has been installed, do not turn the system over for customer use until the complete system has been installed and tested end-to-end. Some multiplex systems involve equipment installation at remote locations and require coordination by the STC before the system becomes operational.

A. Point-to-Point, Point-to-Point Multiplexing, and Digital Data System Off-Net

5.02 Call the STC and verify that the 4-wire private line (PL) channel [equipped with high-performance data conditioning (D1)] to be used with DS 209A-L1 meets the requirements given in Sections 314-410-105 and 314-410-500. Requirements specified for the high-performance data conditioning (D1) must be met to ensure that the tests recommended below will adequately test the data channel. Connections for the basic data station configurations are shown in Fig. 5 through 11. Install the DAS 828A-L1 or 829-type in accordance with Section 598-080-200 or 598-082-200, respectively.

5.03 Refer to Fig. 1 for the locations and positions of the data set option switches which provide the options specified on the service order. The first data set installed must have the compromise equalizer slope option IN and the compromise equalizer phase option OUT for both the transmitter and receiver.

Caution: Remove and discard the foam packing material located inside the data set front faceplate. Also remove and discard the protective covering from the data set housing. If the protective packing materials are not removed before operation, excessive heating will result.

5.04 After the data set has been installed, it must be tested to determine if it is operating properly. Perform the appropriate installation tests specified in the test section (592-032-500). Test equipment required to perform the installation tests consists of 914-type data test set or a KS-14510-L1 VOM (or equivalent).

5.05 Record the options that are installed in the data set in the appropriate blocks of the option label located on the power unit.

5.06 Leave the copy of the DS 209A-L1 How to Operate Manual (999-100-143) with the customer.

B. Many-Point and One-to-Many Multiplex Systems

5.07 The telco engineer responsible for system layout must designate the control STC before either of these systems is installed. If possible, the control STC should have access to the 4-wire channel interconnecting the DSs 209A-L1. The control STC specifies which data set is installed first and also coordinates testing of the multiplex system.

5.08 Typical connection diagrams for many-point and one-to-many multiplex systems are shown in Fig. 15 and 16, respectively. Recommended options to be installed in the data sets are given in Fig. 3 and 4. In multiple installations of DS 209A-L1, the data sets at the same location should be equipped with identical options when possible. This facilitates change-out problems where data sets are patched from one channel to another for maintenance purposes. In these installations, the compromise equalizer adjustment should be determined at the remote data set.

5.09 The M23B cord to CPE is 6 inches long and terminated in a 25-pin connector. This connector is designed to mate with a customer-provided Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-01 hood.

5.10 The M8M cord to the collocated data set is available in 4-foot and 10-foot lengths which are terminated in 25-pin plugs at each end. This cord interchanges the serial clock transmit external (DA) and the serial clock receive (DD) leads, which synchronizes the collocated data set clock to the DS 209A-L1 clock. It also interchanges the send data (BA) and receive data (BB) leads, and the request-to-send (CA) and carrier-on (CF) leads.

5.11 A many-point or one-to-many multiplex system can be divided into three possible categories:

- DS 209A with collocated 201C/208A/209A
- DS 209A without collocated 201C/208A/209A
- Remote extension 201C/208A/209A.

Note: The collocated data sets are the 201C, 208A, or 209A (at 7200 bps) which are at the same location as the 209A.

5.12 ***Data Set 209A With Collocated 201C/208A/209A:*** The installation procedure is as follows:

(1) Install DS 209A-L1 as directed in this section and test as directed in 592-032-500.

(2) Position the multiplex selector switch to the proper multiplex option.

(3) After completing installation tests, connect M8M cord(s) to the appropriate data set 209A-L1 interface connectors.

(4) If collocated 201C/208A/209A sets have already been installed, also connect the M8M cord to these data sets.

(5) If collocated 201C/208A/209A sets have not been installed, they should be installed next. Refer to Part 6 for the appropriate BSP numbers.

Note: The collocated data sets must have the external timing option installed.

(6) After installing the collocated data sets, connect the M8M cord between the 209A and the collocated data sets.

Note: If the collocated 201C/208A data sets are a master (central) for an external multipoint polling system, the new sync not used option must be installed.

5.13 ***DS 209A Without Collocated 201C/208A/209A:*** The installation procedure is as follows:

(1) Install DS 209A-L1 as directed in this section and test as directed in 592-032-500.

(2) Position the multiplex selector switch to the proper multiplex option.

(3) If this is the final data set being installed in the system (including extensions), end-to-end tests must be conducted as specified in Section 592-032-500. Conduct tests through each active port (interface connector).

5.14 ***Remote Extension 201C/208A/209A:*** The installation procedure is as follows:

(1) Install remote extension DS 201C/208A/209A. Refer to Part 6 for the appropriate BSP numbers covering installation procedures for these data sets.

(2) Verify that the remote extension DSs 201C/208A/209A have the external timing option installed.

(3) After completing installation tests, install the M23B cord.

(4) Call the STC to determine if additional end-to-end testing is required. If so, refer to Section 592-032-500.

5.15 Record the options installed in the data set in the appropriate blocks of the option label located on the power unit.

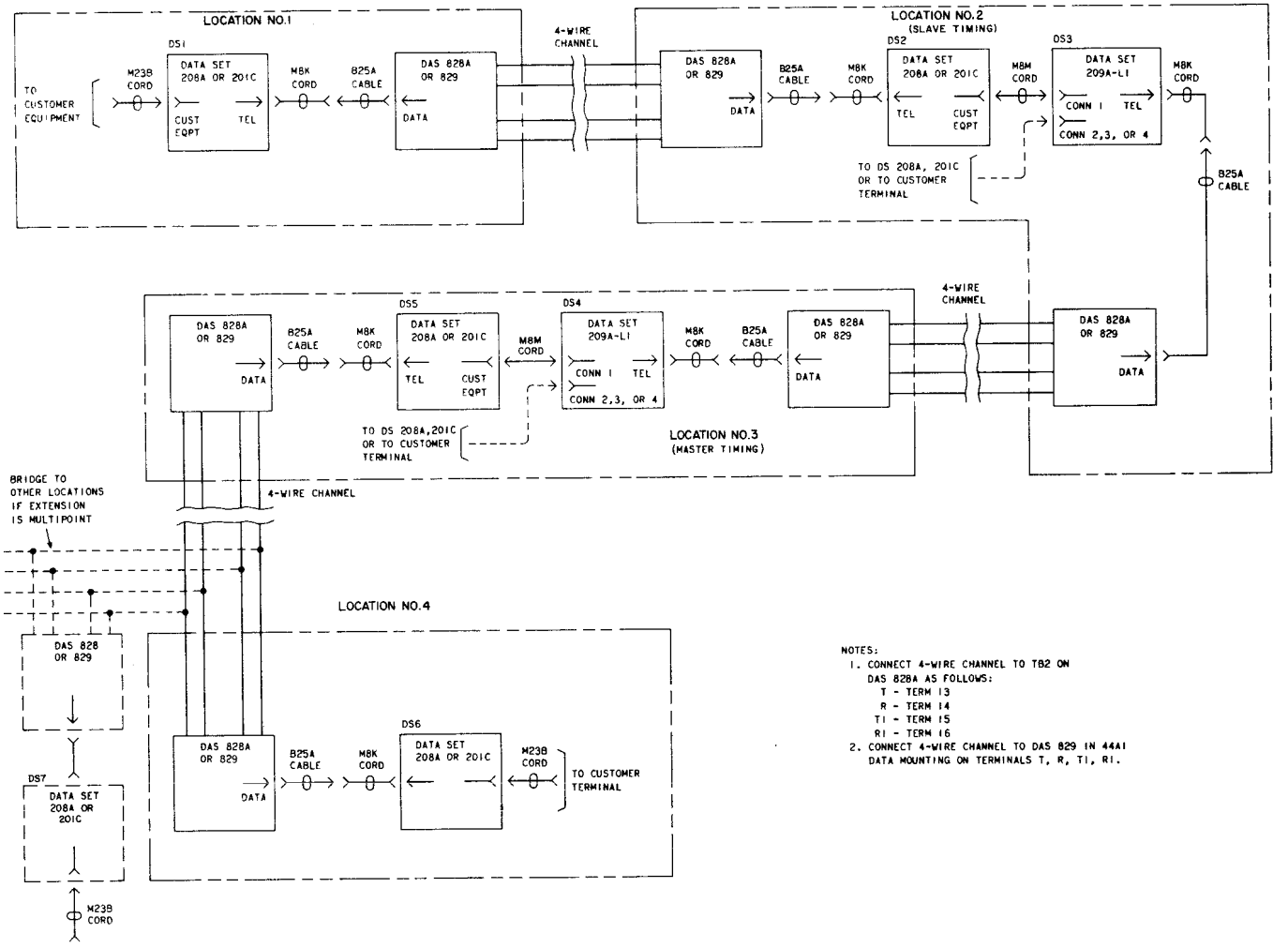
5.16 Leave a copy of the DS 209A-L1 How to Operate Manual (999-100-143) with the customer.

6. REFERENCES

6.01 Refer to the following Bell System Practices which provide information on equipment associated with DS 209A-L1 systems.

SECTION	TITLE
314-410-105	Voice Bandwidth Private Line Data Circuits—High Performance Data Conditioning—Description and Test Requirements
590-020-200	Data Sets—General Installation and Connection Information

SECTION	TITLE
Data Set 208A-Type	
592-027-100	Description and Operation
592-027-200	Installation
592-027-300	Maintenance
592-027-500	Test Procedures
666-511-503	Test of Services Provided By Data Set 208A-Type From a Private Line Test Room
Data Set 201C-Type	
592-029-100	Description and Operation
592-029-200	Installation
592-029-300	Maintenance
592-029-500	Test Procedures
666-511-501	Test of Services Provided By Data Set 201C From a Private Line Test Room
Data Set 209A-L1	
592-032-100	Description and Operation
592-032-150	Supplementary Information
592-032-300	Maintenance
592-032-500	Test Procedures
666-511-504	Test of Data Services Provided By Data Set 209A-L1 From a Private Line Test Room



NOTES:
1. CONNECT 4-WIRE CHANNEL TO TB2 ON DAS 828A AS FOLLOWS:
   T - TERM 13
   R - TERM 14
   TI - TERM 15
   RI - TERM 16
2. CONNECT 4-WIRE CHANNEL TO DAS 829 IN 44A1 DATA MOUNTING ON TERMINALS T, R, TI, RI.

Fig. 15—Typical Many-Point Multiplex System—Connection Diagram

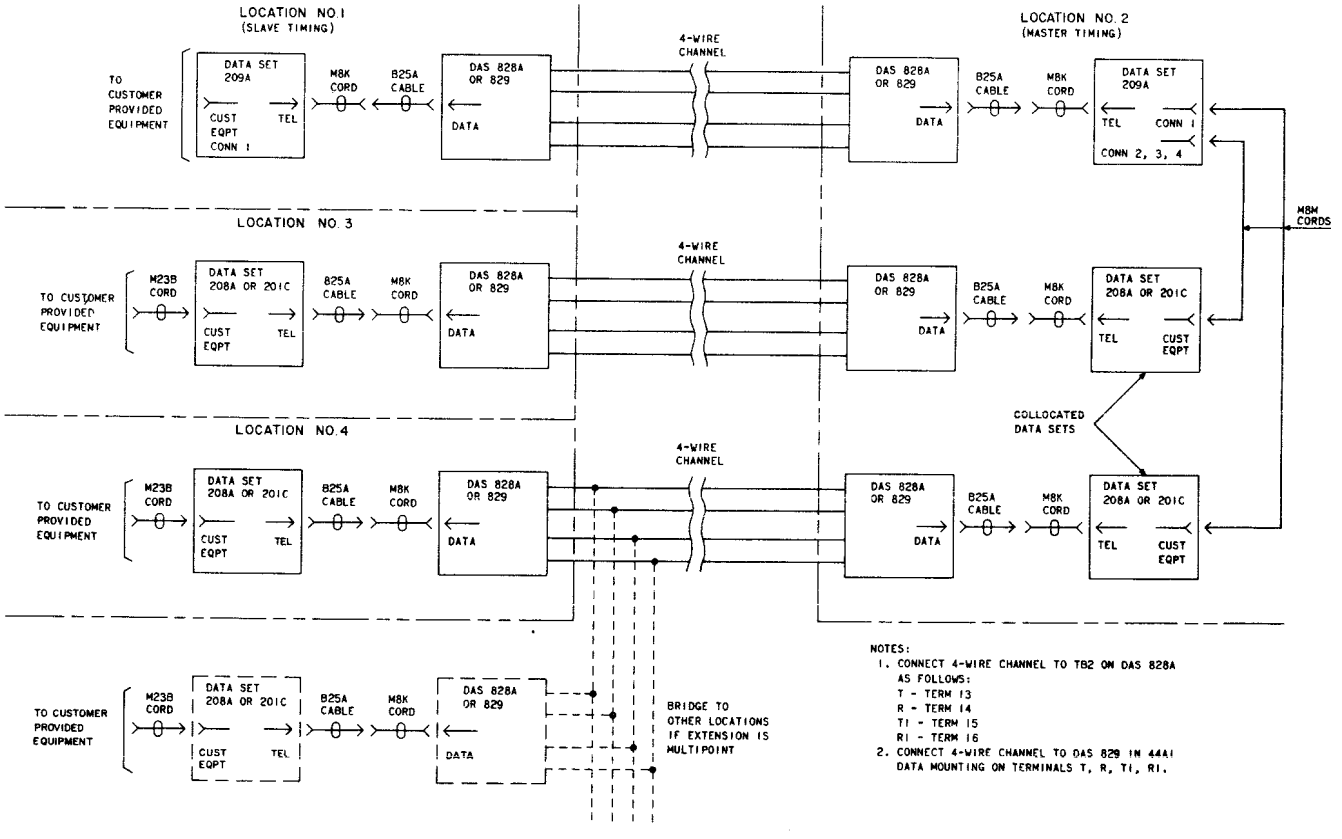


Fig. 16—Typical One-to-Many Multiplex System—Connection Diagram

DATA SET 209A-L1
TRANSMITTER-RECEIVER
MAINTENANCE

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the maintenance of data set (DS) 209A-L1. The objective of this section is to coordinate the efforts of the telephone company (telco) employee with the efforts of the serving test center (STC) in locating and eliminating trouble involving a DS 209A-L1. The control STC, designated by the system engineer, coordinates all maintenance testing.

1.02 This section is reissued to include current information pertaining to DS 209A-L1, and to include DS 209A-L1 multiplex system maintenance procedures previously contained in Section 592-032-301. Since this reissue constitutes a general revision, arrows ordinarily used to denote changes have been omitted.

1.03 Data sets 209A-L1, 208A-L1A, and 201C contain self-test and loop-back test features which aid in locating the source of trouble. However, many of the normal test features do not function properly when these data sets are used in extended multiplex service. Figure 1 shows permissible loop-back tests which can be made without disconnecting data set cords or changing data set options.

Note: DS 208A-L1 does not contain a self-test feature.

1.04 Refer to Part 4 for Bell System Practices which contain information on maintenance and testing for data sets 201C, 208A-type, and 209A-L1. References concerning the maintenance of data auxiliary sets (DASs) 828A-L1 and 829-type are also given in Part 4.

1.05 If dispatch of a craft employee to the location of a suspected defective DS 209A-L1 becomes necessary, the craft employee should take along the following:

- 914C or 914B data test set (DTS)
- 903-type DTS (if 914B DTS is used)
- Maintenance kit (D-180555-L1)

1.06 The maintenance kit consists of the following:

- One carrying case (KS-21363-L1)
- Two diode test pins (white, 840806327) for use with DTS
- Two resistor test pins (yellow, 840806335) for use with DTS
- One set of data set 209A-L1 circuit packs (KD1—KD19)
- Two fan replacement fuses (AGC 1/2)
- Four option shorting jacks

- One of each BSP—592-032-100, -200, -300, and -500
- Three circuit pack (CP) shipping cartons
- One CP shipping carton (large)
- Three option stickers (E-5142).

Note: Maintenance kits should be kept on hand according to the following schedule:

NUMBER OF SETS IN SERVICE IN MAINTENANCE TERRITORY	RECOMMENDED NUMBER OF MAINTENANCE KITS
1 to 9	1
10 to 35	2
36 to 55	3
56 to 80	4
Over 80	Not more than 5 percent of number of sets in service.

1.07 If dispatched to the location of a suspected defective DS 201C or 208A-type used as an extension data set in a multiplex system, the craft employee should take along the following:

- 914C or 914B DTS
- 903-type DTS (if 914B is used)
- Spare DS 201C (if required)
- Maintenance kit D-180468 (for DS 208A-L1) or D-180497 (for DS 208A-L1A) if required.

1.08 The digital loop-back test to the distant end and the analog loop-back test require duplex capability from the DTS. The 914C DTS provides this capability; however, if a 914B DTS is used, a 903-type DTS is required to obtain duplex capability.

1.09 If a CP which contains an option strapping switch is replaced, install the correct options before testing the data set. Refer to Section 592-032-200 for information pertaining to installation of options in DS 209A-L1.

1.10 If CPs are replaced, the defective CPs should be tagged, carefully packed in one of the shipping cartons provided in the maintenance kit (D-180555-L1), and promptly returned to a Western Electric repair center for analysis and repair. ***CPs which fail within one year from the date of manufacture are replaced free of charge under General Engineering Complaint GEC 9400. Refer to Section 010-700-020.***

1.11 When DS 209A-L1 is suspected of being defective, the power supply should first be checked for correct operation. If the ON indicator is extinguished, check for the possibility of the following:

- 105—130 volts ac power not present
- Tripped data set circuit breaker.

If the ON indicator is intermittent, check for the possibility of the following:

- Inoperative data set cooling fan
- Blown fuse in cooling fan fuse mounting
- Excessive ambient room temperature.

1.12 If the cooling fan for DS 209A-L1 is determined to be defective, a replacement cooling fan (KS-21296-L1) can be ordered. Before replacing the cooling fan, check for the possibility of a blown fuse inside the fuse mounting located at the rear of the data set. A spare fuse is located inside the faceplate at the front of the data set.

2. TROUBLE VERIFICATION PROCEDURES

A. Point-to-Point

2.01 When investigating a trouble report, proceed as directed in Fig. 2. Refer to Section 592-032-500 for test procedures applicable to data set 209A-L1.

2.02 If the trouble persists:

(a) Check that the options connected in the data set agree with those called for on the service order.

(b) Check that the multiplex switch is set for correct speed.

(c) Confirm that the customer-provided equipment (CPE) has been tested and checks satisfactorily.

(d) Check for cord and connector defects.

(e) Check for intermittent trouble in the station wiring.

(f) Verify that the data set and CPE are wired to a common ground.

(g) Refer to supervision and the STC for further analysis.

B. Point-to-Point Multiplexing

2.03 When investigating a trouble report on a point-to-point multiplex system, refer to Fig. 3 and 4. Test procedures to be used at the STC are contained in Trial Instruction 405 (Section 666-511-504).

C. Many-Point and One-to-Many Multiplexing

2.04 A typical many-point multiplex system is shown in Fig. 5. A typical one-to-many multiplex system is shown in Fig. 6. The trouble investigation procedures for these systems are shown in Fig. 3, 7, and 8.

2.05 The trouble investigation procedures given are for these typical systems only. Other multiplex systems may require a different approach. However, because of the master/slave timing arrangement, certain restrictions apply.

(a) If trouble is encountered on all multiplex channels, the probable cause is the DS 209A-L1 link.

(b) When performing a digital loop-back test with external test equipment, the test cannot be done from a slave DS 209A-L1 to a master DS 209A-L1 with options as installed. If the slave option is temporarily removed and the slave out option is installed, this test can be performed.

(c) Analog loop-back self test cannot be performed at a remote extension (DS1 and DS6 in Fig. 5, DS4 in Fig. 6) with options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

(d) Digital loop-back self test cannot be performed from a remote extension to a collocated data set (eg, from DS6 to DS5 in Fig. 4) with options as installed. If the internal timing option is temporarily installed at the remote extension, this test can be performed.

2.06 If it becomes necessary to dispatch a craft employee to the defective data station, the craft employee should take along the following:

- Maintenance kit for DS 209A-L1 and 208A-type (if required)
- Spare DS 201C (if required)
- 914C DTS or
- 914B and 903-type DTS.

2.07 Before the STC notifies the customer that service is restored, a digital loop-back test from the STC to each end should be made to verify satisfactory service.

3. MAINTENANCE TESTING CONSIDERATIONS

3.01 DS 201C has an internal word generator under control of the ST switch, which can be used as a self-test feature. DS 208A-L1A and 209A-L1 have self-test features which are valid only if channel continuity has been verified by the STC. If channel continuity has not been verified, external test equipment (914-type DTS) must be used.

3.02 A many-point or one-to-many multiplex system can be divided into three possible categories.

- DS 209A with collocated 201C/208A/209A
- DS 209A without collocated 201C/208A/209A
- Remote extension 201C/208A/209A.

The following is a procedure for maintaining a multiplex system, depending on the part of the system to which the telco employee has been dispatched.

DS 209A With Collocated 201C/208A/209A

3.03 ***Tests from Master 209A:*** The tests should be performed in the following sequence:

(1) Perform analog loop-back self test.

(2) Remove M8M cord if testing with external test equipment (914C DTS or 914B/903 DTS).

Note: Whenever the M8M cord is disconnected from DS 209A and external test equipment is connected, a red matrix pin must be added between row SCT and column 24.

(3) Perform digital loop-back self test or digital loop-back test using external test equipment.

Note: The digital loop-back test using external test equipment cannot be performed if the corresponding (remote) DS 209A has the slave out option (WJ) installed.

(4) Perform end-to-end test using self-test features or external test equipment.

(5) Perform analog loop-back test using external test equipment to distant collocated 201C/208A/209A (eg, between DS3 and DS5 of Fig. 5).

(6) Perform digital loop-back test using external test equipment to distant remote extension 201C/208A/209A (eg, between DS3 and DS6 of Fig. 5).

Note: The distant remote extension 201C/208A must have M23B cord connected.

3.04 ***Tests from Collocated 201C/208A/209A:*** The tests should be performed in the following sequence:

(1) Perform analog loop-back self test.

(2) Disconnect M8M cord from collocated 201C/208A/209A.

(3) Connect external test equipment (914C DTS or 914B/903 DTS).

Note: Whenever the M8M cord is disconnected from DS 201C/208A/209A and external test equipment is connected, a red matrix pin must be added between row S8 and column 24. Switch S8 must be OFF. There must be no other pins in column 24.

(4) Perform digital loop-back test using self test or external test equipment to remote extension.

(5) Perform end-to-end test using self test or external test equipment.

DS 209A Without Collocated 201C/208A/209A

3.05 The tests should be performed in the following sequence:

Note: If the system is a one-to-many multiplex system, set the multiplex selector switch in the same position as the remote DS 209A.

(1) Perform analog loop-back self test.

(2) Perform digital loop-back test using self test or external test equipment (914C DTS or 914B/903 DTS).

Note: The digital loop-back test using external test equipment cannot be performed if the corresponding (remote) data set has the slave out option (WJ) installed.

(3) Perform end-to-end test using self test or external test equipment.

(4) Perform analog loop-back test using external test equipment to distant collocated 201C/208A/209A (eg, between DS1 and DS3 of Fig. 6).

(5) Perform digital loop-back test using external test equipment to distant remote extension (eg, between DS1 and DS4 of Fig. 6).

Note: The distant remote extension 201C/208A must have the M23B cord connected.

(6) Perform end-to-end test using external test equipment. Test must be performed to distant remote extension.

Note: The distant remote extension 201C/208A must have the M23B cord connected.

Remote Extension Data Set 201C/208A/209A

3.06 For the local data set and corresponding collocated data set, the tests should be performed in the following sequence:

Note: In order to perform local analog loop-back tests with external test equipment (914C DTS or 914B/903 DTS), the M23B cord must be disconnected from the local data set. A red matrix pin must be added between row S8 and column 24. Switch S8 must be OFF. There must not be any other pins in column 24.

(1) Perform local analog loop-back test using external test equipment.

(2) Perform digital loop-back test or end-to-end test to distant remote extension using external test equipment (eg, between DS1 and DS6 of Fig. 5).

Note: The M23B cord must be connected to both the local data set and the distant remote (201C/208A) extension.

(3) Perform an analog loop-back test using external test equipment to far-end collocated data sets (eg, between DS1 and DS5 in Fig. 5).

Note: The M23B cord must be connected to the local data set.

4. REFERENCES

4.01 The following documents provide information concerning the data sets used in multiplex systems and DAS 828A- and 829-types.

SECTION	TITLE
010-700-020	General Engineering Complaint GEC-9400—Procedure for Expedited Handling of Certain Initially Defective Apparatus and Equipment
Data Set 208A-Type	
592-027-100	Description and Operation
592-027-200	Installation
592-027-300	Maintenance
592-027-500	Test Procedures
666-511-503	Test of Data Services Provided By Data Set 208A-Type From a Private Line Test Room
Data Set 201C	
592-029-100	Description and Operation
592-029-200	Installation
592-029-300	Maintenance
592-029-500	Test Procedures
666-511-501	Test of Data Services Provided By Data Set 201C From a Private Line Test Room
Data Set 209A-L1	
592-032-100	Description and Operation
592-032-180	Summarizing Specification
592-032-200	Installation
592-032-500	Test Procedures
666-511-504	Test of Data Services Provided by Data Sets 209A-L1 From a Private Line Test Room
999-100-143	How to Operate Manual
Data Auxiliary Sets	
598-080-100	828A—Description and Operation
598-082-100	829-Type—Channel Interface Units—Voiceband Private Line Channels Data Only—Description
598-082-101	829-Type— Supplementary Functions for Voiceband and Private Line Channels (Alternate

SECTION	TITLE
	Voice and Switched Network Backup)— Description
598-082-102	829-Type—Multiple Channel Arrangements (Switched Dial Backup)—Description

4.02 Detailed information pertaining to DS 209A-L1 is contained in CD- and SD-1D249-01.

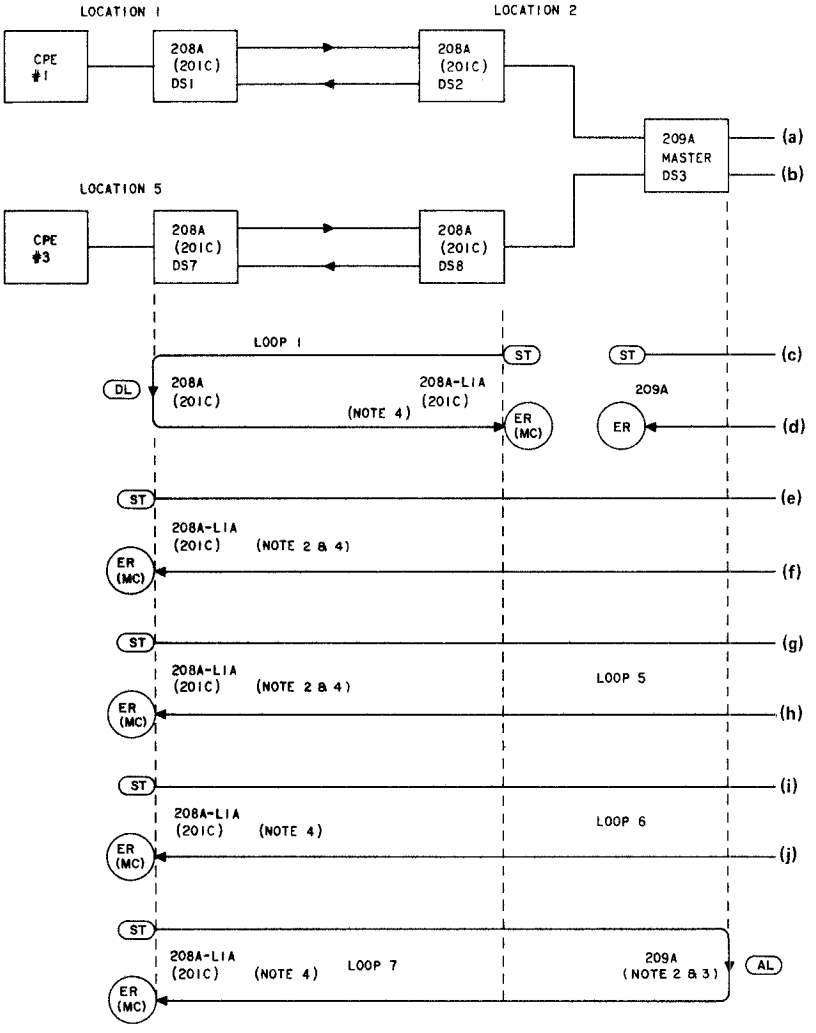
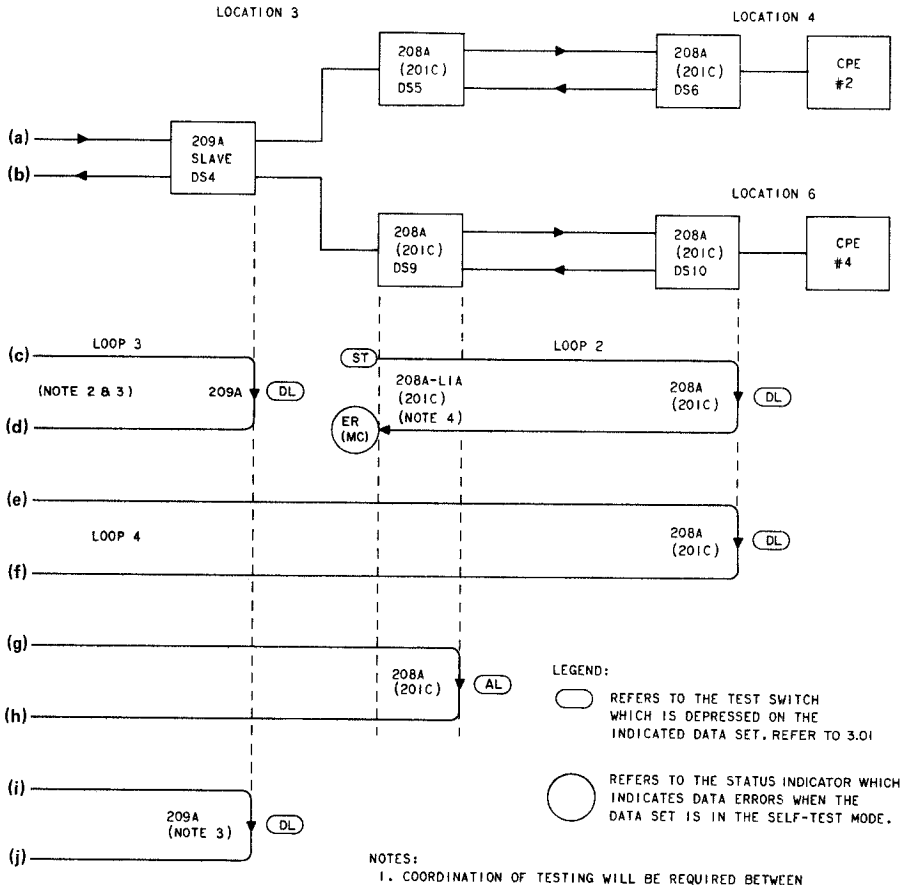


Fig. 1—Permissible Signal Loops When Testing From the Data Set Location (Sheet 1 of 2)



NOTES:

1. COORDINATION OF TESTING WILL BE REQUIRED BETWEEN LOCATIONS UNDER CONTROL OF THE CUSTOMER'S PERSONNEL. A DESIGNATED CONTROL LOCATION SHOULD BE USED.
2. THE PERMISSIBLE SIGNAL LOOPING ARRANGEMENTS SHOWN CAN BE MADE AS SHOWN (LEFT TO RIGHT) OR SYMMETRICALY OPPOSITE TO THAT SHOWN (RIGHT TO LEFT).
3. ANY TESTS USING THE ST, AL, OR DL SWITCHES ON THE DATA SET 209A WILL AFFECT OPERATION ON ALL CONNECTORS AND WILL INTERRUPT NORMAL DATA TRANSMISSION THROUGH THE 209A LINK IN THE SYSTEM.
4. THE DATA SET 208A-L1 HAS NO SELF TEST CAPABILITY. IF THIS DATA SET IS USED, EXTERNAL TEST EQUIPMENT MUST BE PLUGGED INTO THE CUSTOMER INTERFACE OF THAT DATA SET TO GENERATE TEST PATTERNS AND TO CHECK FOR ERRORS.
5. ALL OF THE LOOPS MAY BE RUN WITH THE 914C (914B/903) WITH THE RESTRICTION THAT THE MASTER 209A MAY NOT BE DIGITALLY LOOPED.

Fig. 1—Permissible Signal Loops When Testing From the Data Set Location (Sheet 2 of 2)

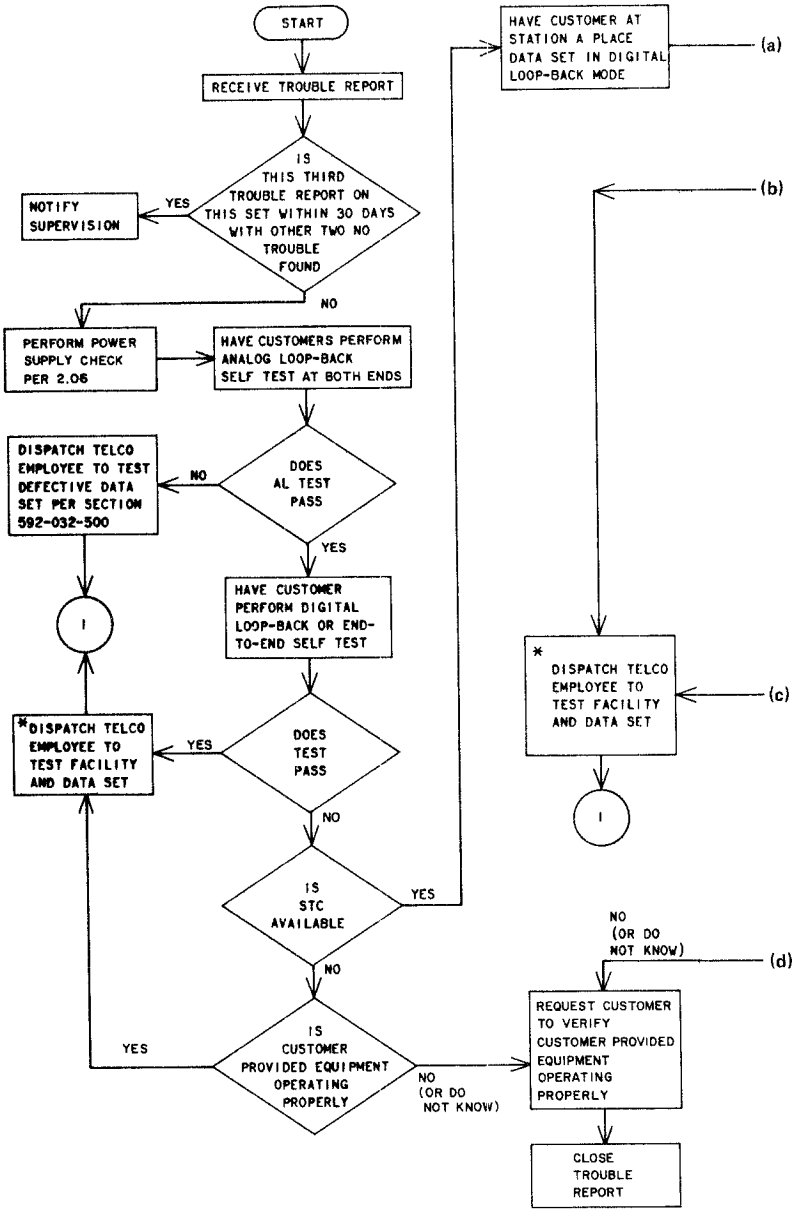


Fig. 2—Point-to-Point Maintenance Flowchart (Sheet 1 of 2)

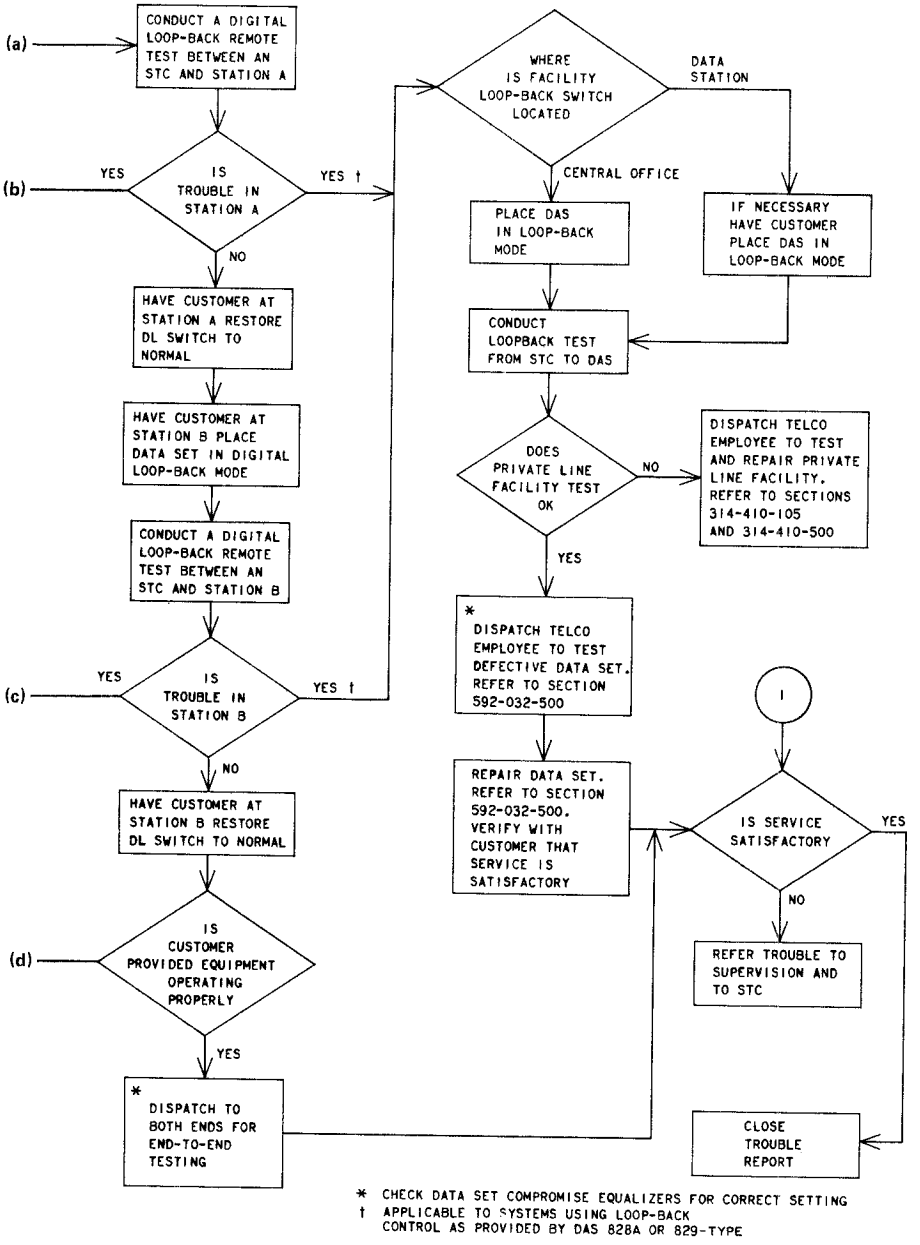


Fig. 2—Point-to-Point Maintenance Flowchart (Sheet 2 of 2)

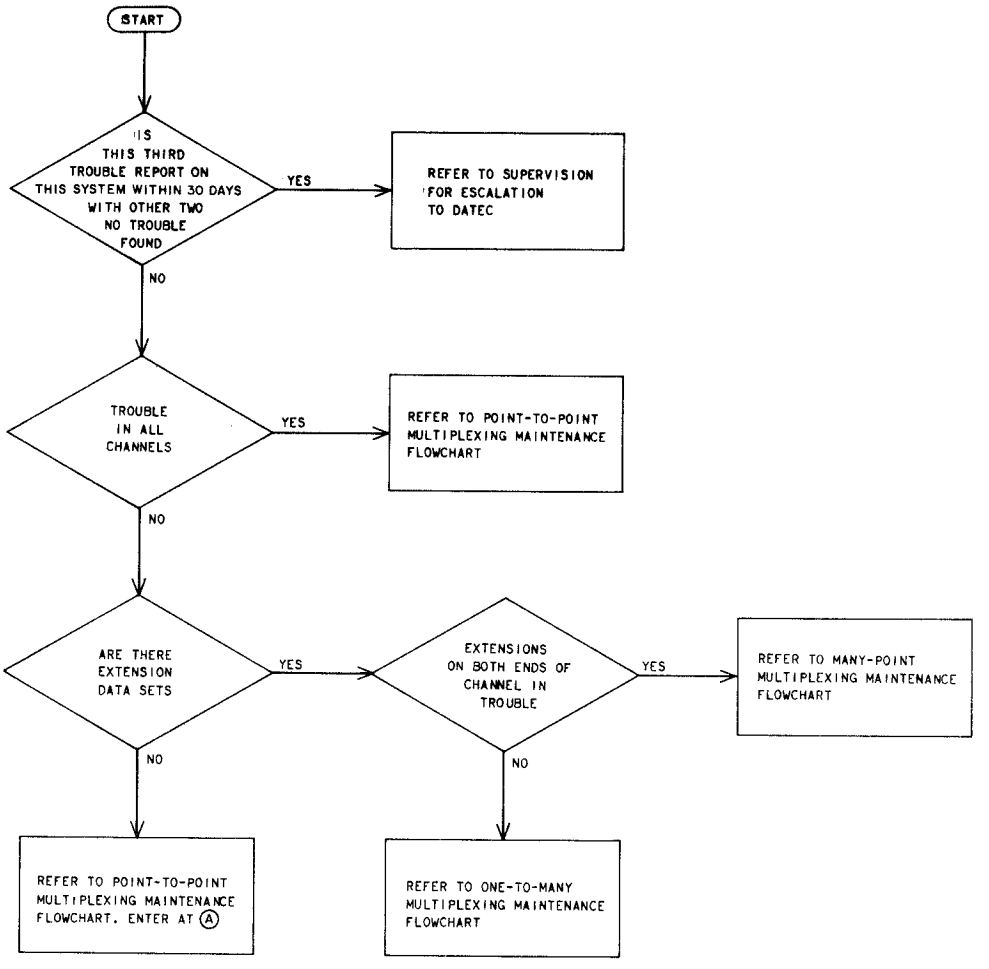


Fig. 3—Maintenance Control Flowchart for Multiplex Systems

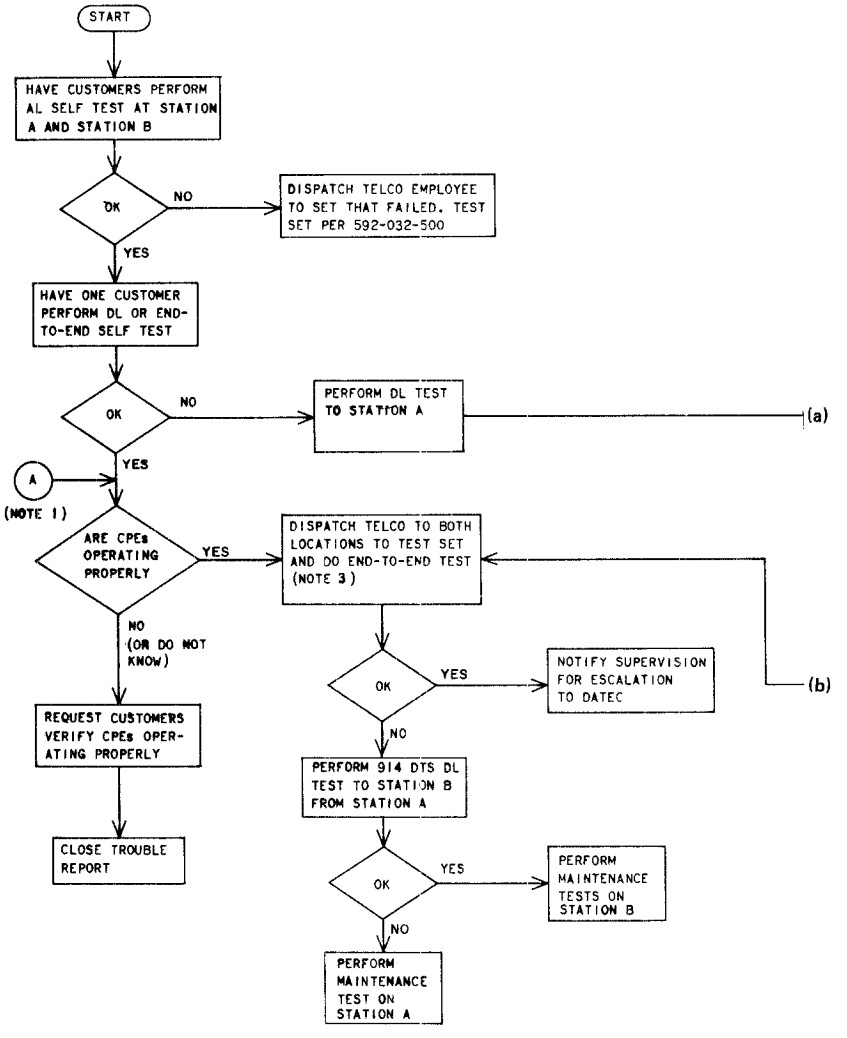


Fig. 4—Point-to-Point Multiplex Maintenance Flowchart (Sheet 1 of 2)

NOTES:
1. IF TROUBLE COMMON TO ALL CHANNELS, BEGIN AT START. IF TROUBLE APPEARS ON ONLY ONE CHANNEL, BEGIN AT (A).
2. APPLICABLE TO SYSTEMS USING LOOPBACK CONTROL AS PROVIDED BY DAS 828 OR 829-TYPE.
3. TEST EACH PORT INDEPENDENTLY USING RANDOM DATA.

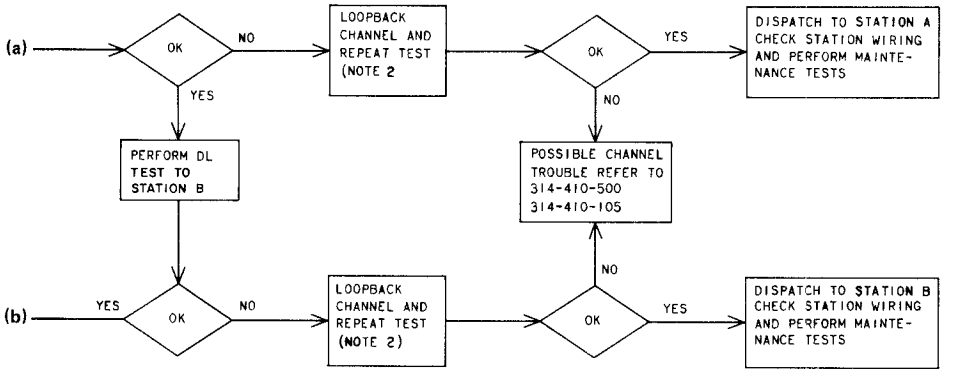
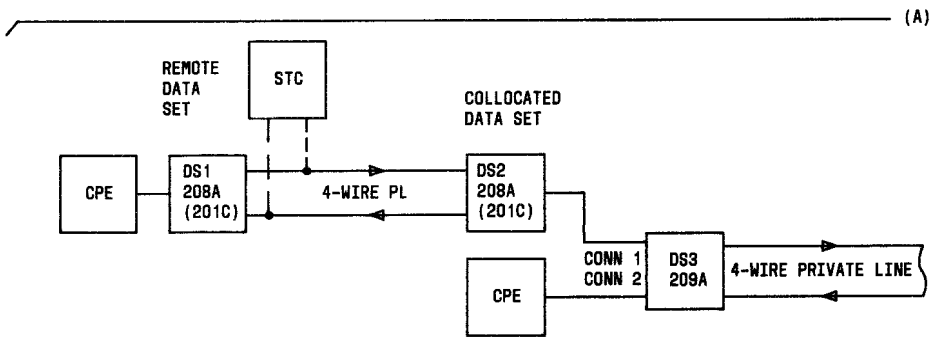


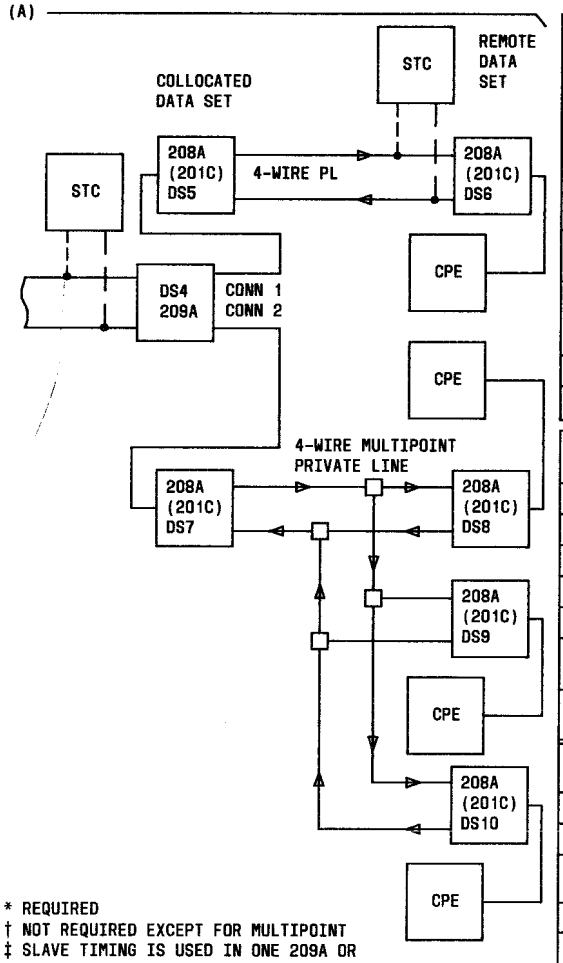
Fig. 4—Point-to-Point Multiplex Maintenance Flowchart (Sheet 2 of 2)



(REMOTE) SELECT	DATA SET 208A OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(COLLOCATED) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
CONTINUOUS	CARRIER CONTROL	SWITCHED *
0 OR 8 MS PER CPE	REQUEST-TO-SEND OPERATION	SWITCHED *
IN	1-SECOND HOLDOVER	IN
NOT USED *	NEW SYNC	NOT USED *
CC ON OR CC OFF PER CPE	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE *
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB *
(REMOTE) SELECT	DATA SET 201C OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(COLLOCATED) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
CONTINUOUS	CARRIER CONTROL	SWITCHED *
0 OR 7 MS PER CPE	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	7 MS *
NOT USED *	NEW SYNC	NOT USED *
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB *

* REQUIRED

Fig. 5—Typical Options, Many-Point Multiplex System (Sheet 1 of 2)

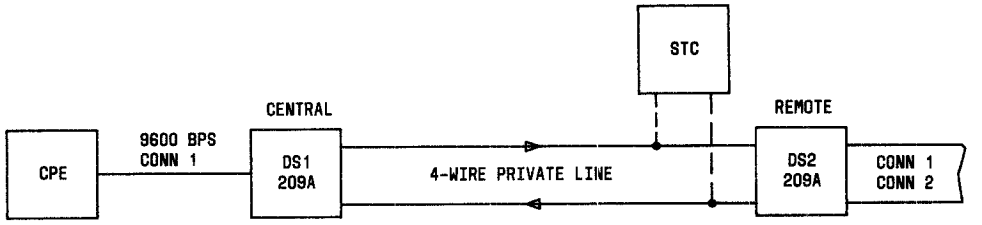


* REQUIRED
† NOT REQUIRED EXCEPT FOR MULTIPOINT
‡ SLAVE TIMING IS USED IN ONE 209A OR THE OTHER, BUT NOT BOTH.

ANY BUT 96 (48/4/ FOR EXAMPLE SHOWN)	MULTIPLEX OPTION	ANY BUT 96 (48/48 FOR EXAMPLE SHOWN)
INTERNAL *	TRANSMIITER TIMING	INTERNAL *
CONTINUOUS *	CARRIER CONTROL	CONTINUOUS *
CONTINUOUS †	REQUEST-TO-SEND CONTROL	CONTINUOUS †
1 IN 2-4 OUT (FOR EXAMPLE SHOWN)	ELASTIC STORES *	1 & 2 IN 3 & 4 OUT (FOR EXAMPLE SHOWN)
OUT IN	SLAVED TIMING‡ *	IN OUT
PER CPE AT POLLING CENTRAL (FOR EXAMPLE SHOWN)	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE *
AA CONNECTED TO AB *	GROUNDING	AA CONNECTED TO AB *
IN	1-SECOND HOLDOVER	IN

(COLLOCATED) SELECT	DATA SET 208A OPTIONS ON MULTIPOINT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	SWITCHED *
SWITCHED *	REQUEST-TO-SEND OPERATION	SWITCHED *
OUT *	1-SECOND HOLDOVER	IN *
NOT USED *	NEW SYNC	NOT USED *
CC OFF IN AL TEST MODE *	DATA SET READY (CC) CONDITION IN AL TEST MODE	CC ON OR CC OFF PER CPE
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE
(COLLOCATED) SELECT	DATA SET 201C OPTIONS ON MULTIPOINT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	SWITCHED *
7 MS *	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	7 MS *
NOT USED *	NEW SYNC	NOT USED *
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE

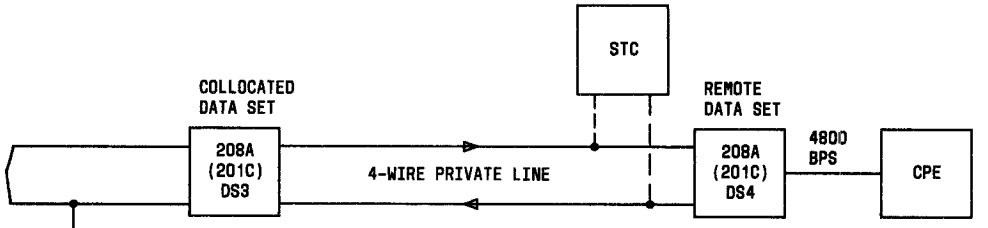
Fig. 5—Typical Options, Many-Point Multiplex System (Sheet 2 of 2)



(CENTRAL) SELECT	DATA SET 209A OPTIONS	(REMOTE) SELECT
96 *	MULTIPLEX OPTION	ANY MULTIPLEX OPTION
INTERNAL *	TRANSMITTER TIMING	INTERNAL *
CONTINUOUS	CARRIER CONTROL	CONTINUOUS *
PER CPE	REQUEST-TO-SEND CONTROL	CONTINUOUS WITH EXTENSION CHANNEL (CONT OR SWITCHED W/O EXTENSION CHANNEL)
ALL OUT *	ELASTIC STORES	1 IN * 2-4 OUT * (FOR EXAMPLE SHOWN)
OUT	SLAVED TIMING † ‡	IN (WITH EXTENSION CHANNEL) OUT (WITHOUT EXTENSION CHANNEL)
PER CPE	DATA SET READY CONDITION IN AL TEST MODE	CC OFF IN AL TEST MODE
PER CPE OR LOCAL PRACTICE	GROUNDING	AA CONNECTED TO AB * (ONLY IF USED WITH EXTENSION)
IN	1-SECOND HOLDOVER	IN

* REQUIRED
† REQUIRED WHEN AT LEAST ONE EXTENSION IS USED
‡ SLAVE TIMING IS USED IN ONE 209A OR THE OTHER, BUT NOT BOTH

Fig. 6—Typical Options, One-to-Many Multiplex System (Sheet 1 of 2)



WHEN AN EXTENSION CHANNEL IS USED, OPTIONS MUST BE SELECTED IN THE COLLOCATED AND REMOTE DATA SETS (EITHER 208A OR 201C).

(COLLOCATED) SELECT	DATA SET 208A OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	CONTINUOUS
SWITCHED *	REQUEST-TO-SEND OPERATION	0 OR 8 MS PER CPE
IN	1-SECOND HOLDOVER	IN
NOT USED *	NEW SYNC	NOT USED *
CC OFF IN AL TEST MODE *	DATA SET READY (CC) CONDITION IN AL TEST MODE	CC ON OR CC OFF PER CPE
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE
(COLLOCATED) SELECT	DATA SET 201C OPTIONS ON PT-TO-PT EXTENSION CHANNEL	(REMOTE) SELECT
EXTERNAL *	TRANSMITTER TIMING	EXTERNAL *
SWITCHED *	CARRIER CONTROL	CONTINUOUS
7 MS *	REQUEST-TO-SEND/CLEAR-TO-SEND DELAY	0 OR 7 MS PER CPE
NOT USED *	NEW SYNC	NOT USED *
AA CONNECTED TO AB *	GROUNDING	PER CPE OR LOCAL PRACTICE

* REQUIRED

Fig. 6—Typical Options, One-to-Many Multiplex System (Sheet 2 of 2)

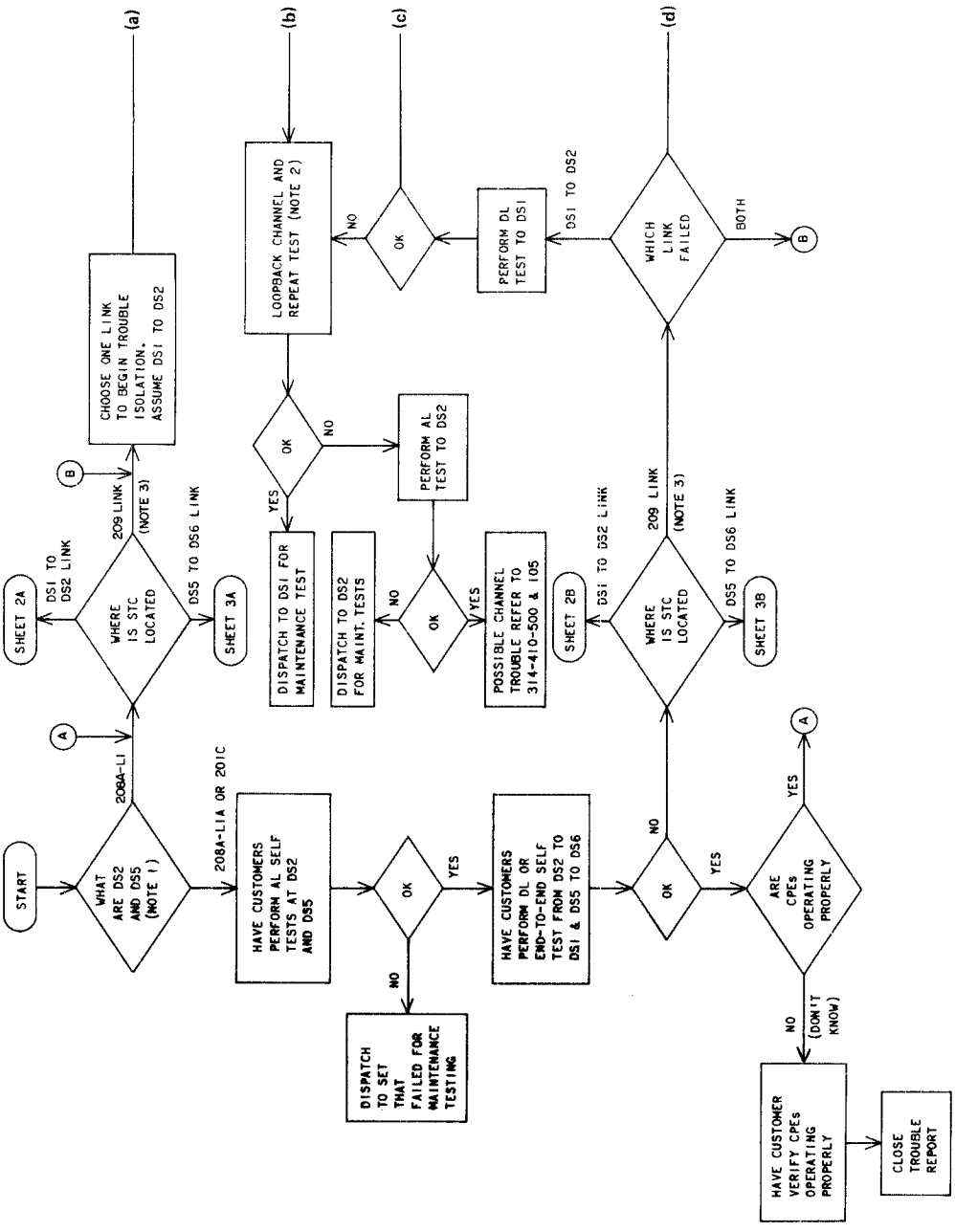


Fig. 7 — Many-Point Multiplex System Maintenance Flowchart (Sheet 1 of 3)

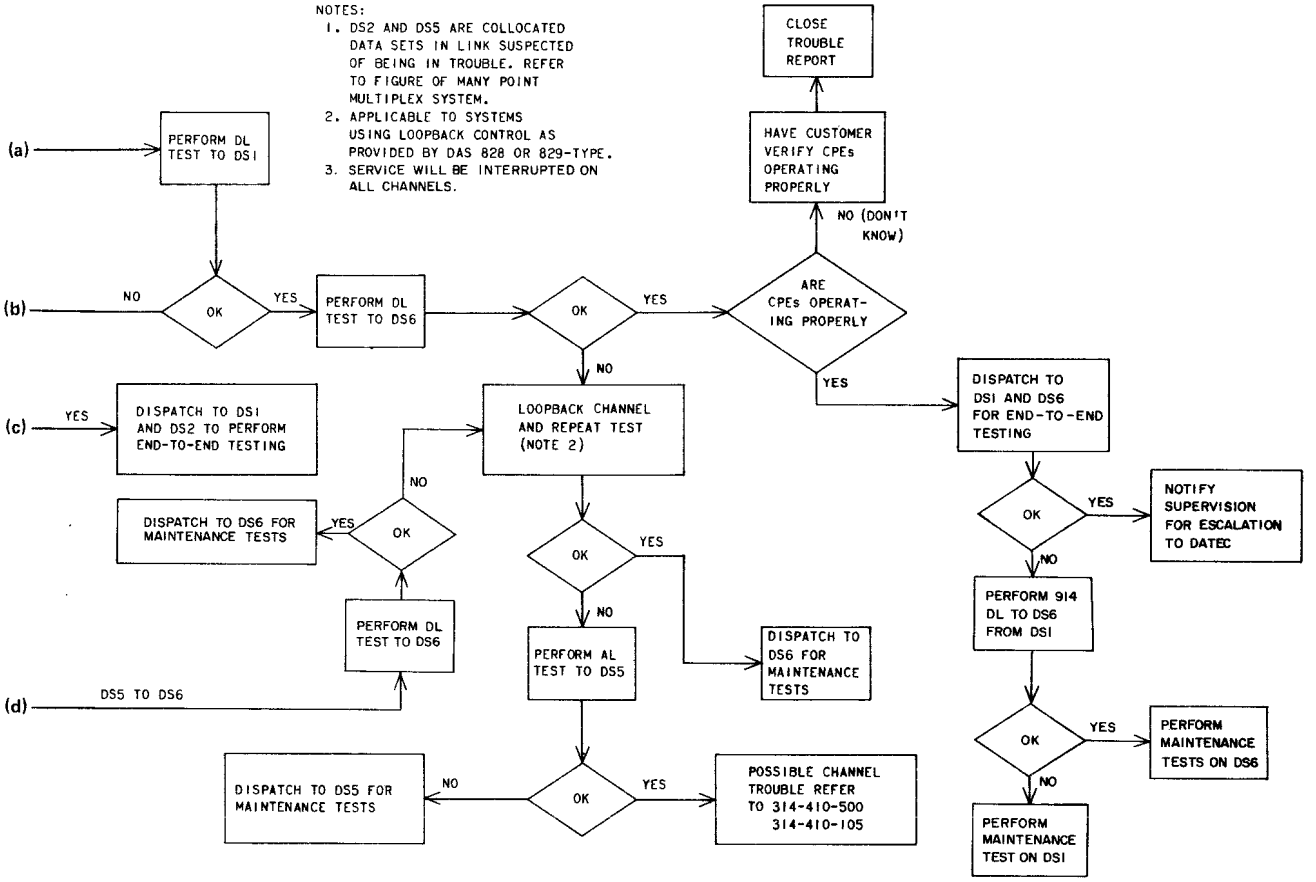


Fig. 7— Many-Point Multiplex System Maintenance Flowchart (Sheet 1.1 of 3)

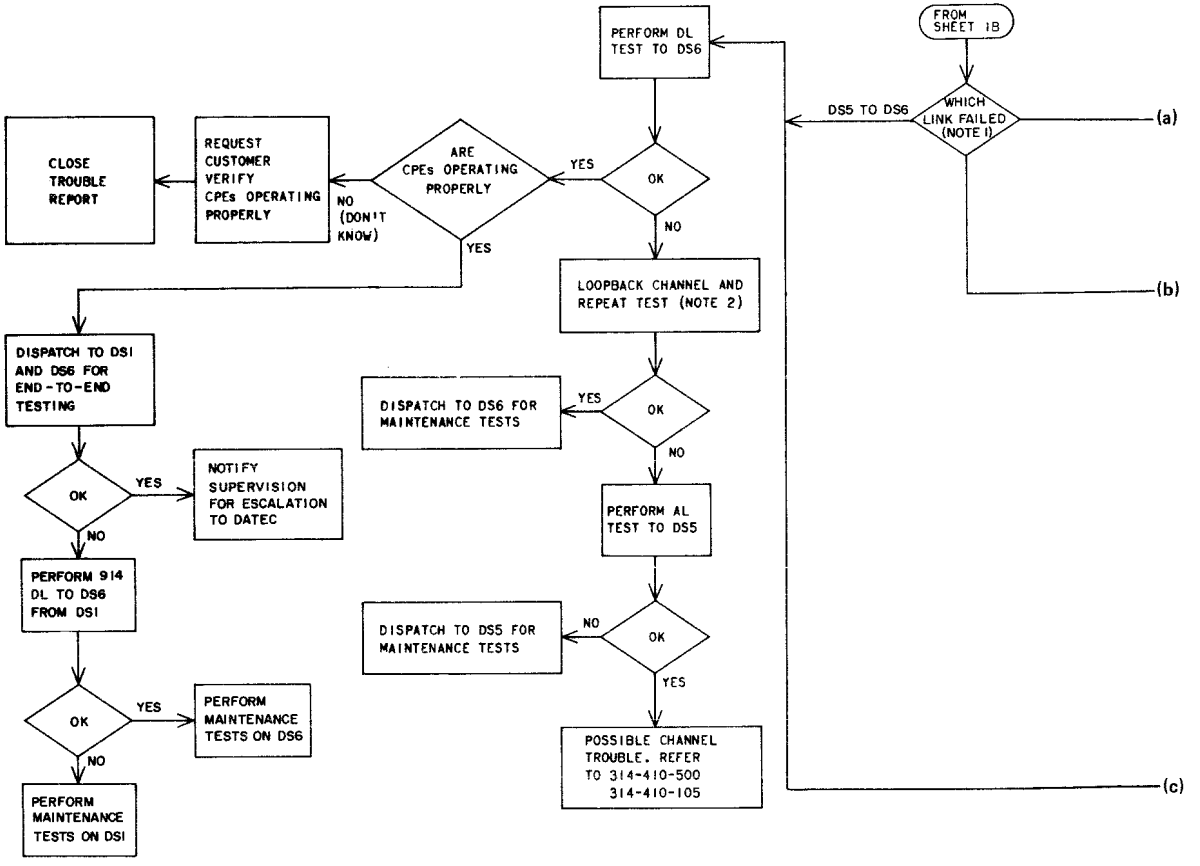


Fig. 7—Many-Point Multiplex System Maintenance Flowchart (Sheet 2 of 3)

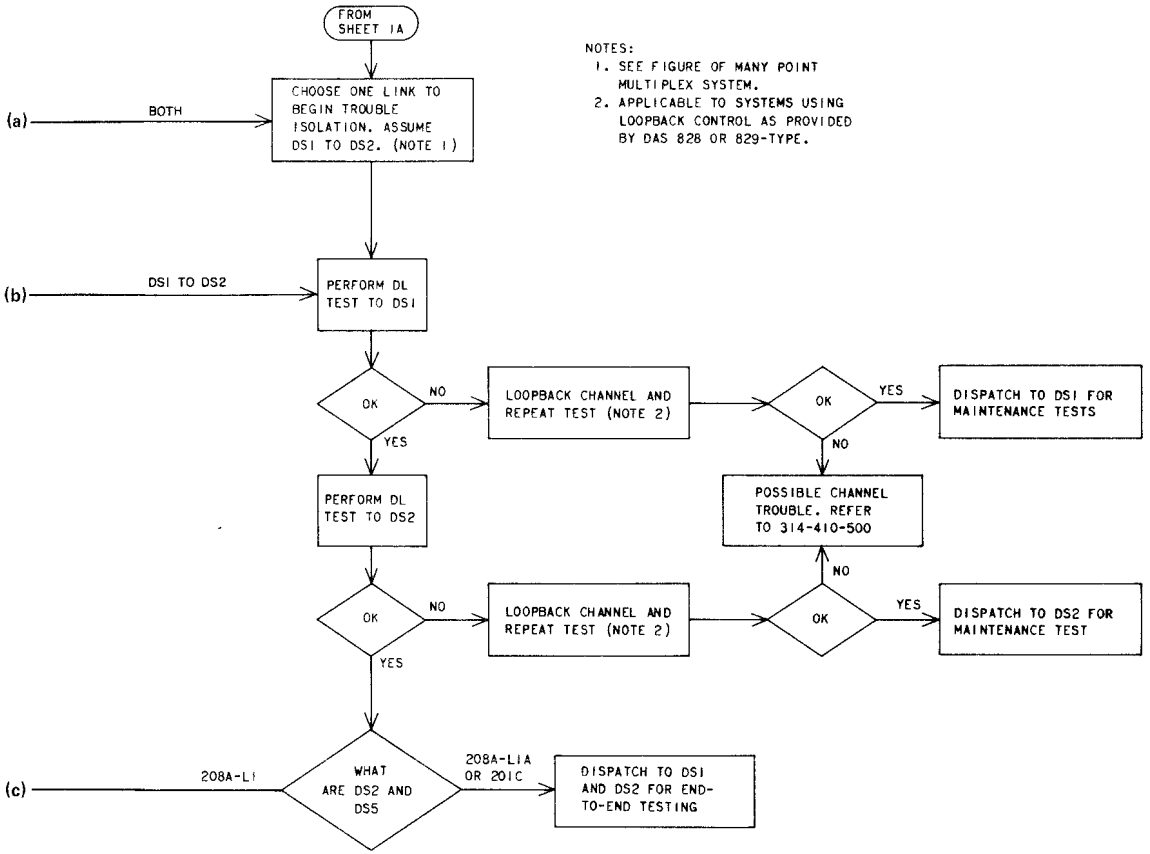


Fig. 7—Many-Point Multiplex System Maintenance Flowchart (Sheet 2.1 of 3)

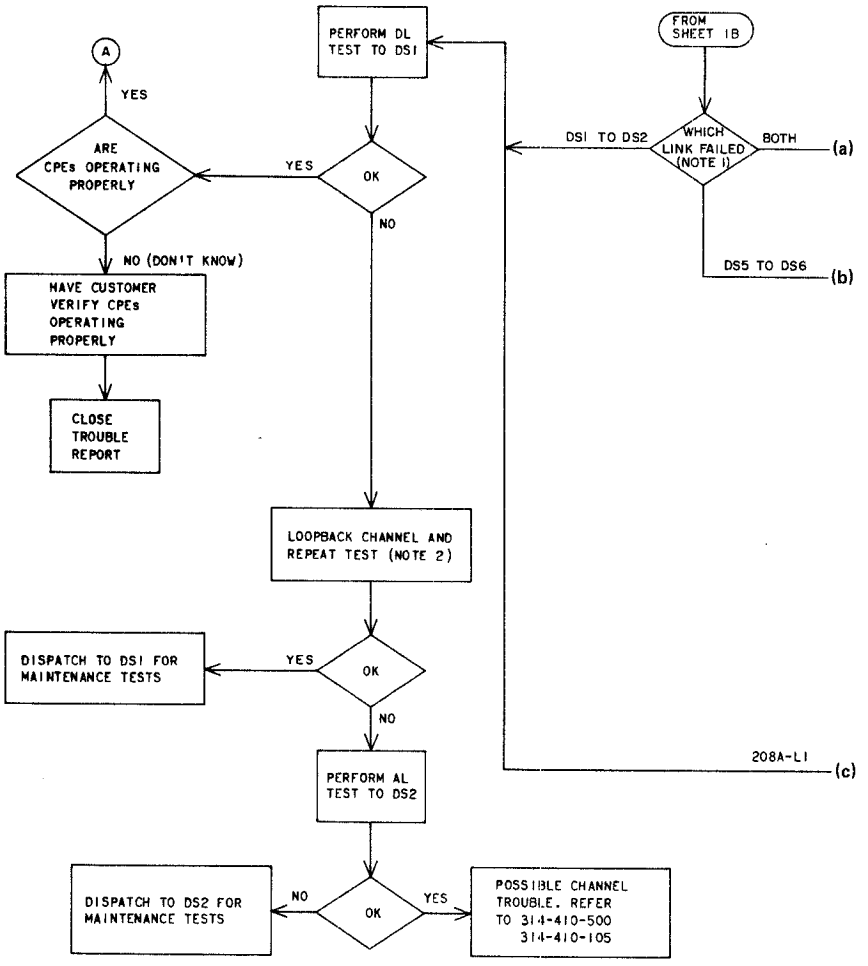


Fig. 7—Many-Point Multiplex System Maintenance Flowchart (Sheet 3 of 3)

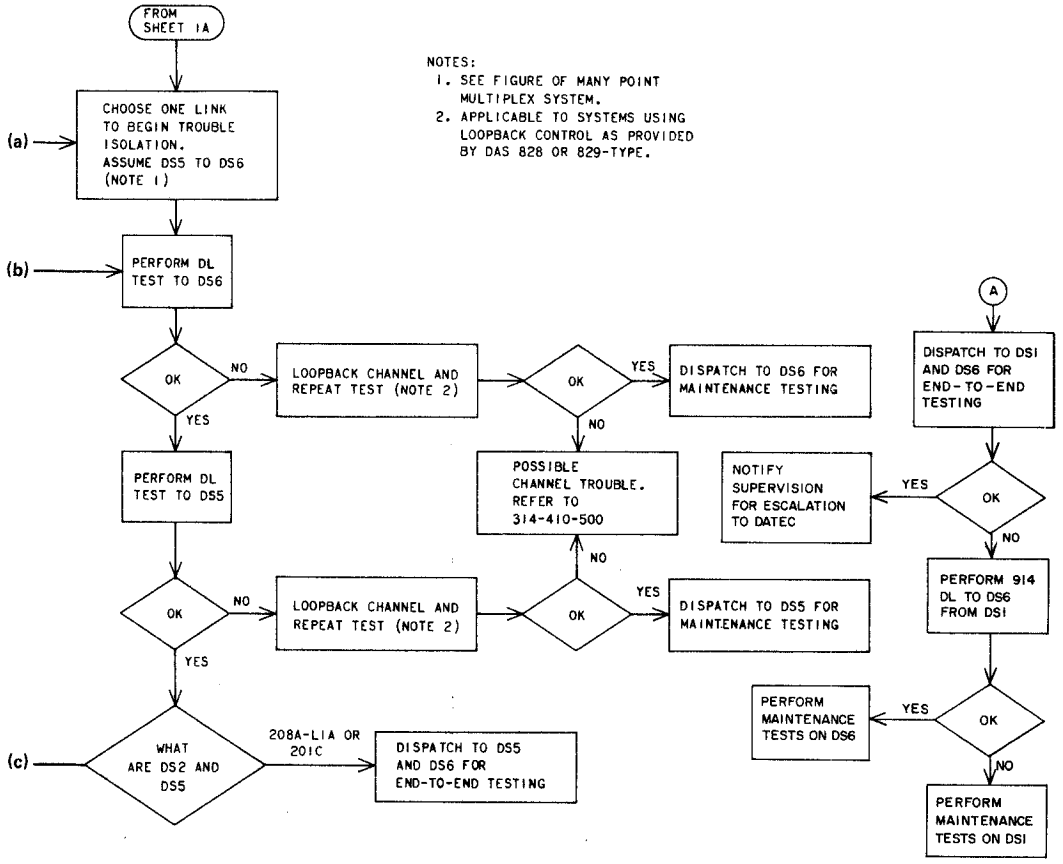


Fig. 7—Many-Point Multiplex System Maintenance Flowchart (Sheet 3.1 of 3)

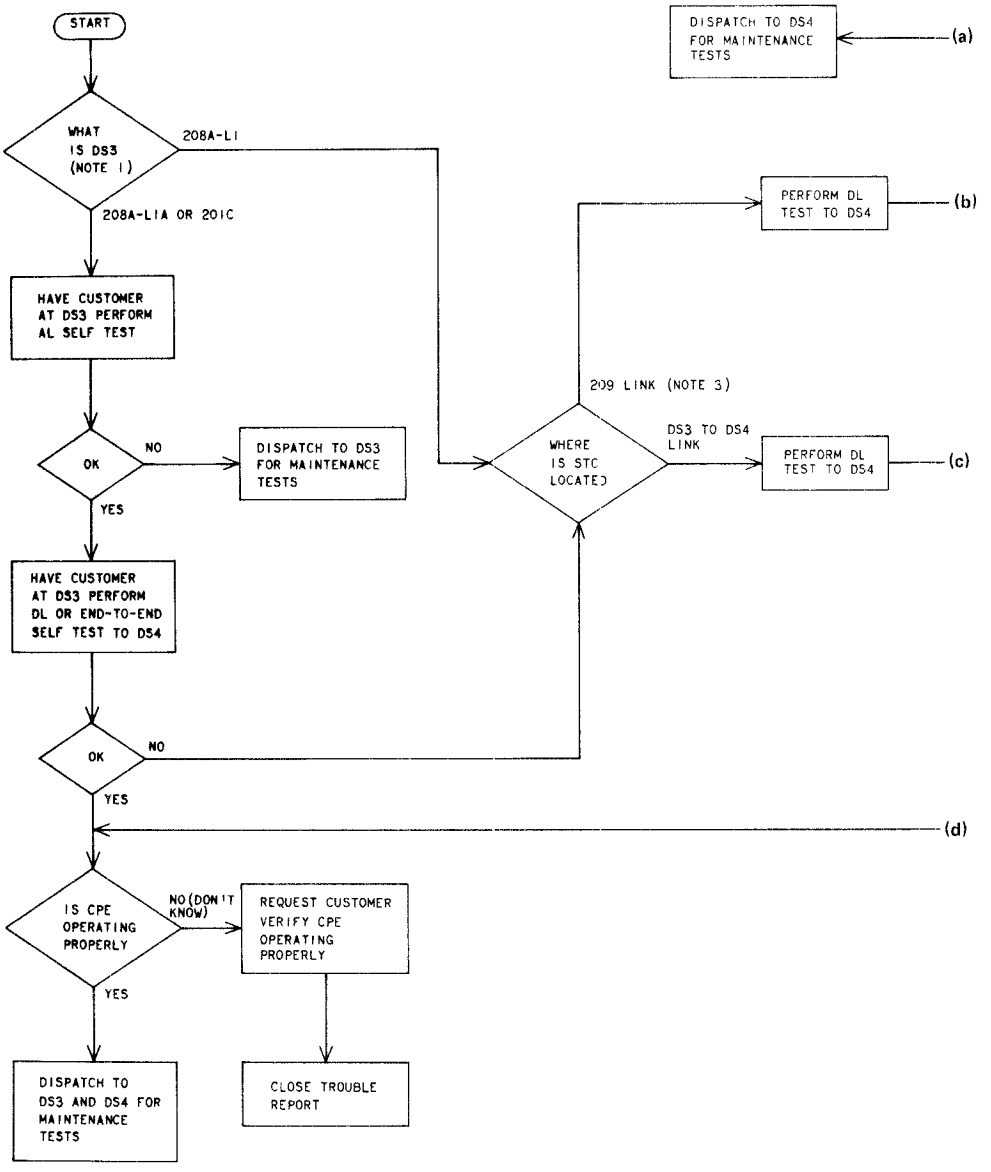
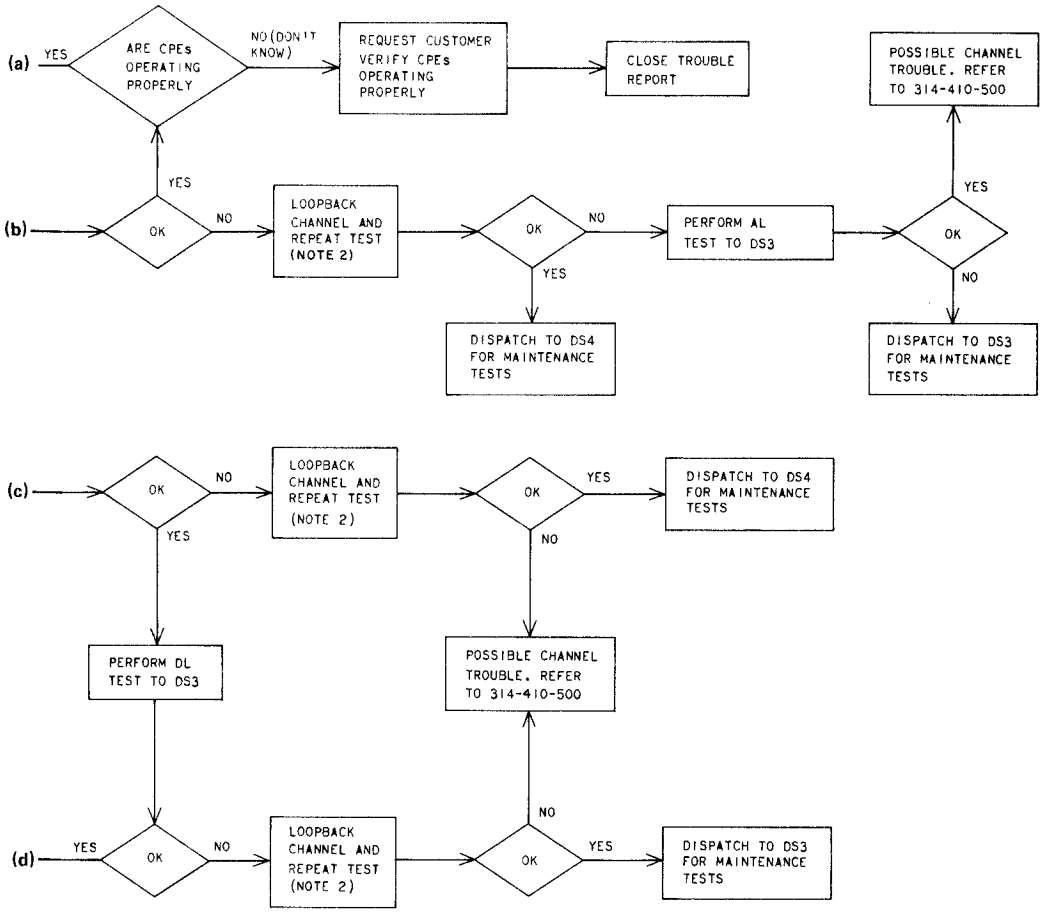


Fig. 8— One-to-Many Multiplex System Maintenance Flowchart (Sheet 1 of 2)



NOTES:
1. REFER TO FIGURE OF ONE-TO-MANY MULTIPLEX SYSTEM FOR LOCATION OF DS3
2. APPLICABLE TO SYSTEMS USING LOOPBACK CONTROL AS PROVIDED BY DAS 828 OR 829
3. SERVICE WILL BE INTERRUPTED ON ALL CHANNELS

Fig. 8—One-to-Many Multiplex System Maintenance Flowchart (Sheet 2 of 2)

DATA SET 209A-L1
TRANSMITTER-RECEIVER
TEST PROCEDURES

1. GENERAL

1.001 This addendum supplements Section 592-032-500, Issue 1.

1.002 This addendum is issued to correct Test A (Start-Up Error Test) which is included in Part 6 (SUPPLEMENTARY TESTS). The following complete test procedure must be used instead of the procedure contained in Section 592-032-500.

2. CHANGES TO SECTION

2.001 On page 23, revise paragraph 6.01 as follows.

6.01 This test consists of switching on the request-to-send (CA) lead and recording any errors that occur immediately after the lead is switched on and the data set turns on the clear-to-send (CB) lead. This test is applicable only when the data set under test is optioned for switched carrier [XF (S5-3) or XH (S5-7)]. When testing a DS 209A-L1 that is installed in a point-to-point multiplexing system, perform the start-up error test using each active customer interface.

2.002 On page 23, revise paragraph 6.02 as follows.

6.02 Perform the following procedure for the start-up error test:

(1) Connect the equipment and set the controls of the 914-type DTS as shown in Fig. 6.

(2) On the 914-type DTS, add pins to the programmable matrix in the following positions:

- Red pins in TP1-20, SCT-15, and SCR-20
- White (diode) pin TP1-3
- Yellow (resistor) pin TP1-17

(3) Position the 914-type DTS TEST SET MODE switch to SER (914C) or RCV SER (914B).

(4) Position the 914-type DTS COUNTER switch to BIT ERRORS.

(5) Position the 914-type DTS BIT RATE switch to EXT+.

(6) Depress the data set AL switch.

(7) Apply power to the data set and then to the 914-type DTS.

(8) At the DTS, verify that S1 (CA) is OFF.

(9) Reset the DTS counter by momentarily depressing the RESET switch.

(10) Position S1 to ON.

Requirement: Zero errors are indicated by the DTS immediately after CA is switched on.

Note: Disregard any transient errors that may occur when S1 is positioned to OFF.

(11) Repeat (10) for a total of five trials.

End of test. Restore the data set to normal operating condition.

DATA SET 209A-L1
TRANSMITTER-RECEIVER
TEST PROCEDURES

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning procedures to be used when testing data set (DS) 209A-L1 on an initial installation or during a maintenance visit. Overall procedures to be followed when investigating the trouble report are outlined in Section 592-032-300. Procedures for testing DS 209A-L1 when installed in a point-to-point, point-to-point multiplexing, and digital data system subrate off-net installations are provided in this section. Also provided in this section are procedures for testing data sets 209A-L1, 208A-type, and 201C-type when installed in a 9600-bits per second (bps) multiplex system. These tests are in addition to tests normally required for installation and maintenance of the data sets.

1.02 This section is reissued to incorporate information previously contained in Section

592-032-501. Since this reissue constitutes a general revision, arrows ordinarily used to denote changes have been omitted.

1.03 This section is divided into seven parts. Part 1, GENERAL, contains general information pertaining to testing DS 209A-L1. Part 2, TEST FACILITIES AVAILABLE, describes the test capabilities of the data set. Part 3, INSTALLATION TESTS, describes the tests necessary to verify an installation. Part 4, MAINTENANCE TESTS, describes the tests to be performed during a trouble visit. Part 5, TEST PROCEDURES, describes and gives a step-by-step procedure for the various tests necessary to install and maintain data set 209A-L1. Part 6, SUPPLEMENTARY TESTS, describes the tests to be performed when normal testing has failed to isolate trouble. Part 7, REFERENCES, provides documentation information pertaining to data sets used in multiplexing systems.

1.04 The analog loop-back test and the digital loop-back test to distant end require duplex capability from the data test set (DTS). The 914C DTS provides this capability; however, if a 914B DTS must be used, a 903-type DTS is required to obtain duplex capability. A 511-bit random word is transmitted when using the 914C DTS and a 63-bit random word is transmitted when using the 914B—903 DTS combination.

1.05 The CA-CB and CG-CF interval tests require the use of a 3300-ohm resistor pin (yellow) to eliminate the effect of contact bounce caused by the 914-type DTS switches. If this pin is not available, a 3000/4000-ohm resistor can be connected from pin 9 to pin 4 on the 914-type interface selector switch panel.

1.06 The test equipment required to perform test procedures given in this section consists of a 914C DTS or a 914B DTS and a 903-type DTS.

2. TEST FACILITIES AVAILABLE

2.01 DS 209A-L1 is tested with a 914-type DTS. The analog loop-back test and end-to-end and remote loop-back tests to either a serving test center (STC) or distant data set can be performed to check for proper status of interface signals and to record data errors.

2.02 Test circuitry built into DS 209A-L1 permits the analog loop-back, end-to-end, and the remote loop-back tests without the use of external test equipment. The compromise equalizer test, which determines the optimum compromise equalizer option setting, is also performed using the data set self-test feature.

A. Self-Test Features

2.03 The self-test features of the data set make use of the pushbutton switches and status indicators located at the front of the data set. For a description of the switches and indicators, refer to Section 592-032-100. Table A depicts the test switch positions and indicators during test and normal operation. The self tests do not test the customer interface circuits.

Status Indicator Test

2.04 The lamp test (LP) switch is a nonlocking switch that, when depressed, illuminates the multiplex and data set status indicators to ensure their proper operation. The LP switch can be depressed at any time since it does not affect normal data operation.

Analog Loop-Back Self Test

2.05 The analog loop-back self-test mode is entered by depressing the analog loop (AL) and self test (ST) locking switches. Depression of the AL switch connects the data set transmitter output to its own receiver input through an attenuation network. Depressing the ST switch forces the internal request to send (CA) ***on***, transmits a steady mark on the data set internal SD lead, and enables the ER indicator to be used to indicate received errors. The analog loop-back self test does not test the telephone interface.

Digital Loop-Back Self Test to Distant End

2.06 In this test the distant-end data set is placed in the digital loop (DL) mode to act as a regenerator. The local data set is placed in the self-test mode by depressing the ST switch. This causes the local transmitter to send steady marks to the distant-end receiver, where the recovered data is looped around to its transmitter at the customer interface of the data set. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is conditioned to indicate any errors made in transmission.

TABLE A

DATA SET 209A-L1 TEST SWITCH POSITIONS AND INDICATOR STATUS

SWITCH OR INDICATOR	NORMAL OPERATION	ANALOG LOOP-BACK SELF TEST	REMOTE LOOP-BACK FROM STC	DIGITAL LOOP-BACK† SELF-TEST TO DISTANT END	END-TO-END SELF TEST		LED INDICATOR TEST
					LOCAL	DISTANT-END DATA SET	
LP Switch							X
AL Switch		X					
ST Switch		X		X	X	X	
DL Switch			X				
ON Indicator	ON	ON	ON	ON	ON	ON	ON
MR Indicator	*Note 1*	OFF	OFF	OFF	OFF	OFF	ON
RS Indicator	*Note 2*	ON	*Note 3*	ON	ON	ON	ON
CS Indicator	*Note 4*	ON	*Note 4*	ON	ON	ON	ON
CO Indicator	*Note 5*	ON	*Note 5*	ON	ON	ON	ON
ER Indicator	*Note 6*	*Note 7*	*Note 8*	*Note 7*	*Note 7*	*Note 7*	ON
TM Indicator	OFF	ON	ON	ON	ON	ON	ON

X = Switch depressed; Blank = Switch not depressed
† = Assumes distant-end data set is in digital loop mode

Note 1: Monitors state of data-set-ready circuit.
Note 2: ON when data is being transmitted.
Note 3: ON when line signal is being transmitted by STC.
Note 4: ON after completion of CA-CB interval (7.5 or 147 ms). Stays ON for completion of data transmission.
Note 5: On when line signal is being received.
Note 6: Indicates state of adaptive equalizer. When on, equalizer is in need of retraining, or when CO is OFF.
Note 7: OFF except when errors occur.
Note 8: ON when CO indicator is off. When CO indicator is on, indicates state of adaptive equalizer. When on, equalizer is in need of retraining.

End-to-End Self Test

2.07 The end-to-end self-test mode is entered by depressing the ST switches at both data sets. This action causes both transmitters to turn on and transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission.

B. Tests Using External Equipment

2.08 A 914C or a 914B and a 903 DTS can be used to perform all tests given in this section that are necessary to install and maintain the data set. By using the 914-type DTS, the customer interface is tested, timing intervals are measured, certain power supply voltages are checked, and actual error runs are performed.

> ***Caution: Certain 914B DTSs are susceptible to power line transients which may cause the fuse in the 914B DTS 5-volt power supply to fail. To avoid this problem, do not unplug the data set while power is applied to the 914B. If the fuse in the 914B DTS 5-volt supply fails, the counter will count continuously and will refuse to reset.***

Analog Loop-Back Test

2.09 This test using a 914-type DTS is functionally the same as the analog loop-back self test. The 914-type DTS provides a more inclusive test of the data set customer interface circuits by transmitting test data through the data set customer interface and not utilizing the DS 209A-L1 internal word generator.

Digital Loop-Back Test

2.10 This test using a 914-type DTS is functionally the same as the digital loop-back self test. The 914-type DTS provides a more inclusive test of the data set interface circuits and the data channel. The digital loop-back mode is entered by depressing the DL switch which permits a remote terminal or an STC to test data transmission on a regenerative basis through the data set by looping around the received data to send data at the customer interface. Also connected at the customer interface are CG to CA and DD to DA leads. These circuits are disconnected at the customer interface so that the local customer-provided equipment (CPE) will not be able to monitor them.

End-to-End Test

2.11 The end-to-end test using a 914-type DTS is functionally the same as the end-to-end self test. The 914-type DTS provides a more inclusive test of both data sets and the connecting facility. One data set can be located in an STC. The end-to-end test consists of transmitting a random word and establishing an error rate at the receiving end.

3. INSTALLATION TESTS

3.01 After DS 209A-L1 has been installed, it must be tested to determine if it is operating properly. The compromise equalizer options must be installed and tested as given in Part 5F.

A. Point-to-Point, Point-to-Point Multiplexing, and Digital Data System Applications

3.02 Refer to Fig. 1 for the sequence of tests to be performed and to Part 5 for test procedures.

B. Many-Point Multiplexing Applications

3.03 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested. A digital loop-back test must be performed on each multiplex channel to its corresponding remote data set. Coordination is required with the control STC to ensure that the remote data set is in the digital loop-back mode and none of the data sets between the remote extensions are in a test mode.

3.04 End-to-end digital loop-back testing of the complete multiplex system can be done from either end with one exception. ***A digital loop-back test (with external test equipment) cannot be performed to a DS 209A which has the slave out option installed.***

End-to-End Digital Loop-Back Testing From a DS 201C-Type Extension

3.05 If the extension data set (at the location originating the test) is a 201C-type, the self-test feature can be used to perform the digital loop-back test to the distant-end data set. (The

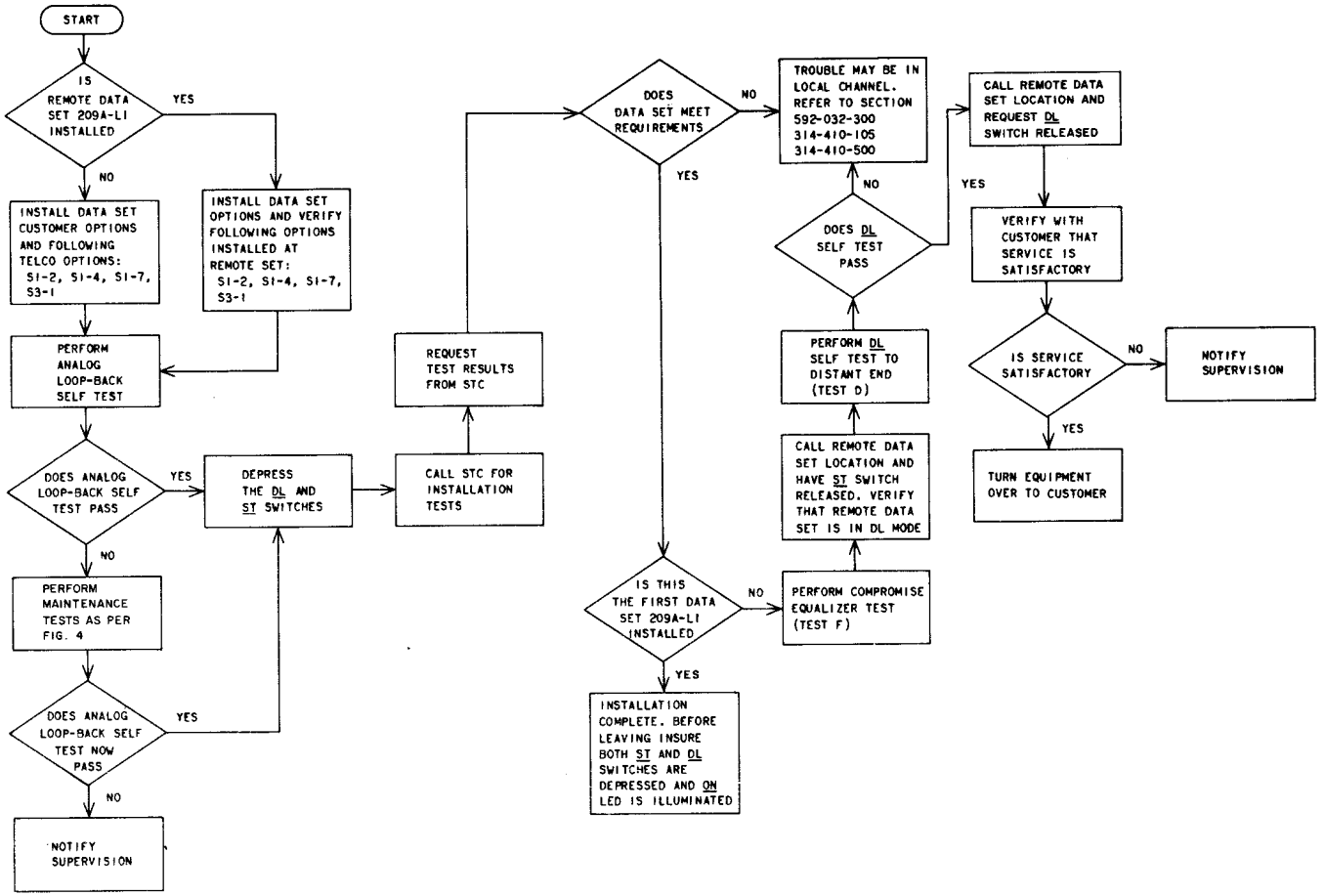


Fig. 1—Installation Testing Flowchart

M23B cord must be connected while this test is being performed.)

(1) Verify that the DL switch is depressed on the distant-end data set.

(2) Depress the ST switch on DS 201C-type. Check that the MC lamp is off and all other lamps are lighted.

(3) Observe the MC lamp for five 1-minute test periods.

Requirement: Error requirements will vary depending on system configuration. Refer to Fig. 2.

(4) If the system does not pass the test, refer to Section 592-032-300.

(5) To return the data set to normal operation, release the ST switch.

(6) Have the distant-end data set released from the digital loop-back mode.

(7) Notify the control STC of the test results.

End-to-End Digital Loop-Back Testing From a DS 209A-L1 or From a DS 208A-Type or 209A-L1 Extension

3.06 This test requires duplex testing capability from the 914-type DTS. If a 914C DTS is not available, a 914B-903 DTS combination will provide duplex capability. If an extension DS 208A-type or 209A-L1 is located at the station originating the test, the M23B cord must be connected while this test is performed. This test verifies that random data can be sent from the local transmitter to the remote receiver, looped back on the digital side to the remote transmitter, and be transmitted back to the local receiver. The received data (BB) lead at the local receiver is then checked for errors.

Note: The self-test feature available on DS 208A-L1A or 209A-L1 must not be used for this digital loop-back test.

3.07 Perform the following procedure for the end-to-end test using the 63- or 511-bit random word. This test consists of transmitting random data and establishing a block error rate. The block size is measured in approximately 1000-bit blocks.

(1) Connect the equipment and set the controls on the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown in Fig. 3.

(2) Verify that the local data set is not in any test mode.

(3) Verify that the distant-end data set is in the digital loop-back mode and all intermediate data sets are not in any test mode.

(4) Apply power to the data set and then to the 914-type DTS.

Requirements: At the local data set if testing DS 209A-L1, the ON, RS, CS, CO, and MR indicators are lighted. The ER and TM indicators are off. At the local data set if testing DS 208A-L1, the ON, RS, CS, and CO indicators are lighted. The ER, AL, and DL indicators are off. At the local data set if testing DS 208A-L1A, the ON, CO, MR, RS, and CS indicators are lighted. The ER indicator is off. At the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM), and DS6 (CG) are lighted. The NO CLOCK and NO DATA lamps are off.

(6) If the 903-type DTS is used, depress and release the START button.

(7) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(8) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: At the 914-type DTS, the error counter counts rapidly, and shortly thereafter the NO DATA lamp lights.

(9) At the 914-type DTS, depress the interface selector switch 3A.

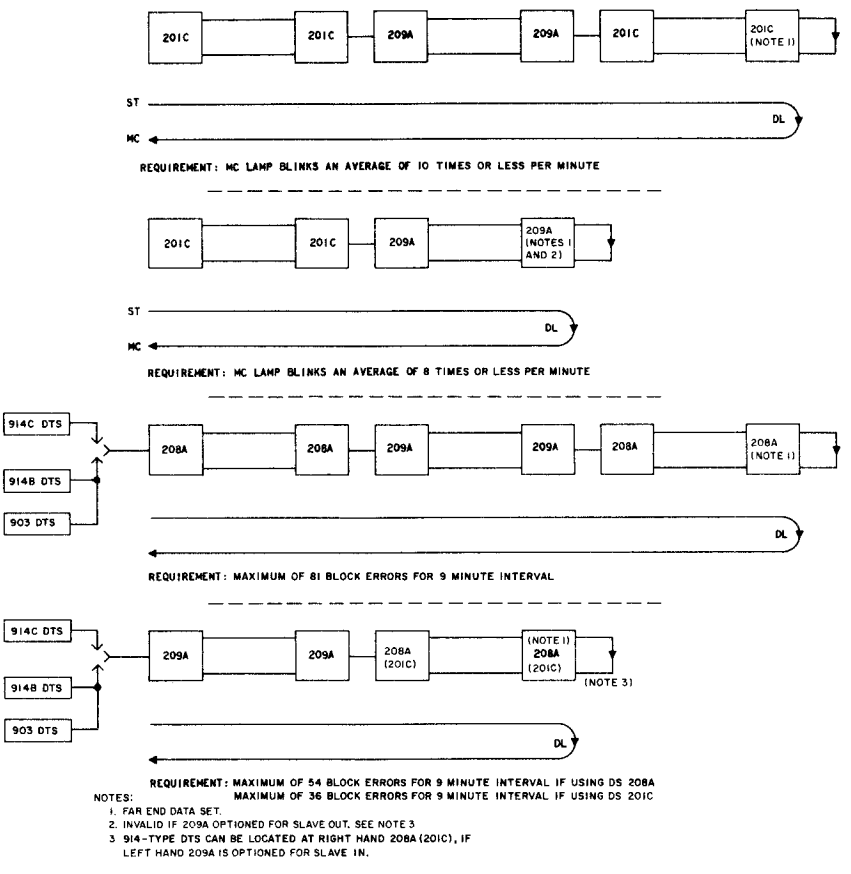


Fig. 2—Installation Test Requirements

(10) Reset the counter to zero by pressing the RESET switch. Perform a 9-minute error run and record the total number of errors.

Requirement: Error requirements will vary depending on system configuration. Refer to Fig. 2.

(11) If the system does not meet requirements, refer to Section 592-032-300.

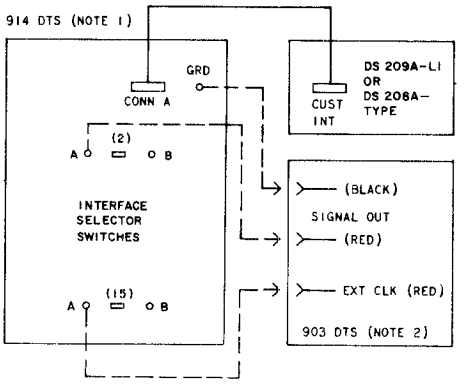
(12) Upon satisfactory completion of the test, disconnect test equipment and restore installation to normal.

(13) Have distant-end data set released from the test mode.

(14) Notify the control STC of the test results.

C. One-to-Many Multiplexing Applications

3.08 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested end-to-end. A digital loop-back test must be performed on each multiplex channel. If the end-to-end testing is originated from the remote extension, refer to Part 3B (many-point multiplexing) for test procedures. If the end-to-end testing is originated from the



NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER(914C DTS)
	RCV SER(914B DTS)
COUNTER	2WL(914C DTS)
	16WL(914B DTS)
RCV BIT RATE	EXT +
RCV WORD LENGTH	511(914C DTS)
	63(914B DTS)
TRANSMIT BIT RATE (914C)	EXT +
TRANSMIT WORD LENGTH (914C)	511
SIG LEV	±4V
SWITCH S1	ON
SWITCH S2	OFF
SAMPLE WIDTH	.5 US
INTERFACE SELECTOR SWITCHES	ALL INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN(FOR 914B-903 COMBINATION 2A AND 15A MUST BE PULLED OUT).
WORD SYNC	AUTO

2. SET SWITCHES ON 903 DTS AS FOLLOWS

SWITCH	SETTING
BIT RATE	EXT CLOCK
TRIGGER	(+) POSITIVE
RANDOM DOT	RANDOM

3. 914 DTS INDICATOR LAMPS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

LAMP	FUNCTION		EIA
DS1	REQUEST TO SEND	(RS)	CA
DS2	CLEAR TO SEND	(CS)	CB
DS3	DATA SET READY	(DSR)	CC
DS4	CARRIER ON	(CO)	CF
DS5	EQUALIZER MODE	(QM)	
DS6	SIGNAL QUALITY DETECTOR	(COV)	CG

4. THIS PIN IS REQUIRED ONLY IF THE DS209A-L1 IS E/W OPTION WA, WC, WE, OR WG.

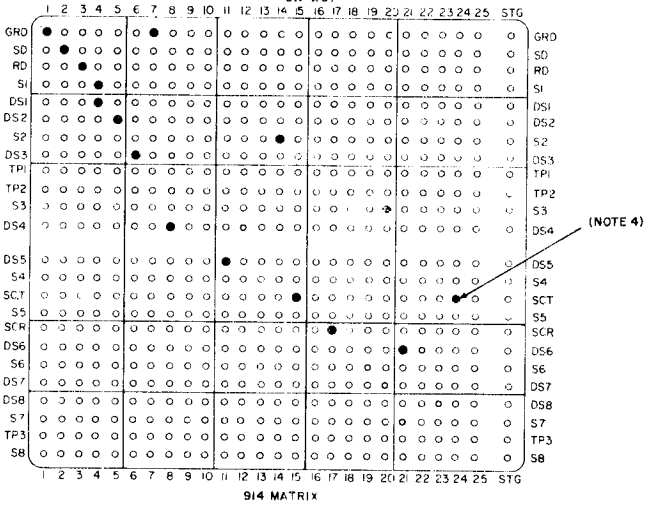


Fig. 3—Test Setup Using 914-Type DTS and 903-Type DTS

DS 209A, the test must be performed from each connector of the DS 209A to each of the remote extension data sets. Coordination is required with the control STC to ensure that the remote extension data set is in the digital loop-back mode and none of the data sets between DS 209A-L1 and the remote extensions are in a test mode. The test is conducted as directed in 3.06 and 3.07 through each interface connector being used. In order to perform this test, the local DS 209A-L1 must have the multiplex selector switch positioned the same as DS 209A-L1. Upon satisfactory completion of this test, restore the multiplex selector switch to the 9600 position.

4. MAINTENANCE TESTS

4.01 The test procedure provides a method of isolating a trouble within the data set to a circuit pack (CP) or group of CPs. It is assumed that the maintenance procedures outlined in Section 592-032-300 have been followed prior to dispatching the telephone company (telco) employee. Refer to Section 314-410-105 for information pertaining to the high-performance data conditioning which must be installed on the basic 3002-type channel used by a DS 209A-L1. If the probable cause of trouble is in the private line (PL) facilities, refer to the section entitled Private Line Data Circuits—Voice Bandwidth Circuits for Miscellaneous Data—Overall Tests and Requirements (314-410-500). If the probable cause of trouble is in data auxiliary set (DAS) 828A, refer to the section entitled Data Auxiliary Set 828A—Maintenance and Test Procedures (598-080-500).

4.02 The overall maintenance test sequence is contained in the flowchart shown in Fig. 4. The maintenance test sequence consists of five basic functional tests:

- Power Supply Test
- CA-CB Interval Test
- CG-CF Interval Test
- Analog Loop-Back Test
- End-to-End Test.

The tests are written such that the flowchart may be entered at any point without performing all preceding tests. The ground noise and start-up error tests are not included in Fig. 4 as maintenance tests. These tests should be performed as required.

4.03 When any test shown in Fig. 4 (with the exception of the power supply test) fails, the following procedure should be performed. A list of CPs used in each test is given. These CPs (in the order of appearance) should be individually replaced with the test being repeated after each CP replacement. If the test fails after a CP is replaced, in order to avoid replacing a CP which may not be defective, the original CP should be reinstalled and the next CP in the list replaced. This procedure should be repeated until all the recommended CPs have been replaced. Removal of ac power is not required while replacing CPs.

4.06 In the unusual instance when the data set is obviously malfunctioning but CP replacements do not clear up the cause of trouble, it is recommended that the problem be referred to supervision according to local instructions.

4.07 Proceed to Fig. 4 to begin the maintenance test sequence.

5. TEST PROCEDURES FOR DATA SET 209A-L1

5.01 This part describes the various test procedures and provides step-by-step procedure for performing the tests.

5.02 If a procedure requires that an option be installed in the set which is not specified on the service order or circuit layout record card, remove the option at the end of the test and verify that all the specified options are installed in the set.

A. Analog Loop-Back Self Test

5.03 The analog loop-back self test is initiated by depressing the AL and ST locking switches located on the data set front. Depression of the AL switch connects the transmitter to the receiver through an attenuation network. Depression of the ST switch turns on the data set internal request- to-send lead, transmits steady marks on the data set internal SD lead, and conditions the ER indicator to be used to indicate errors. Since steady marks were transmitted, any spaces detected by the error circuitry constitute errors. Each bit error lights the ER indicator for approximately 100 ms.

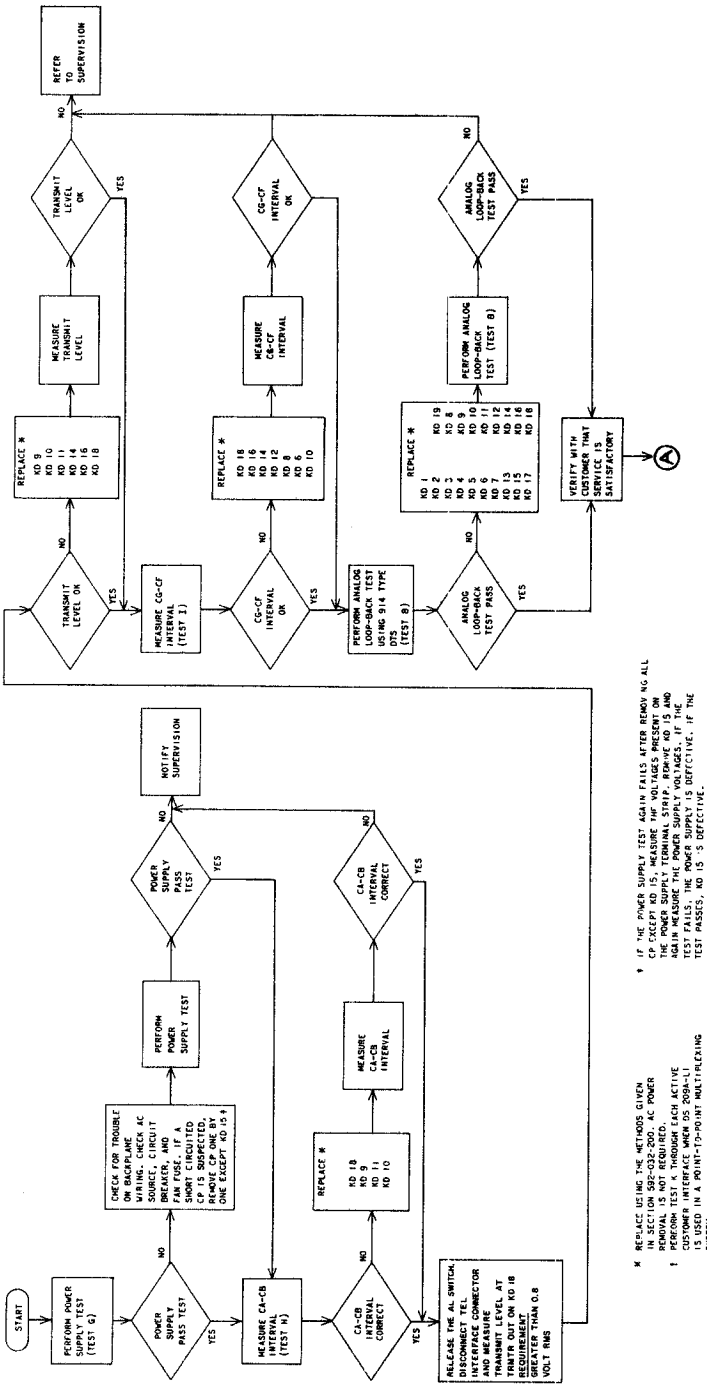


Fig. 4—Maintenance Test Sequence (Sheet 1 of 2)

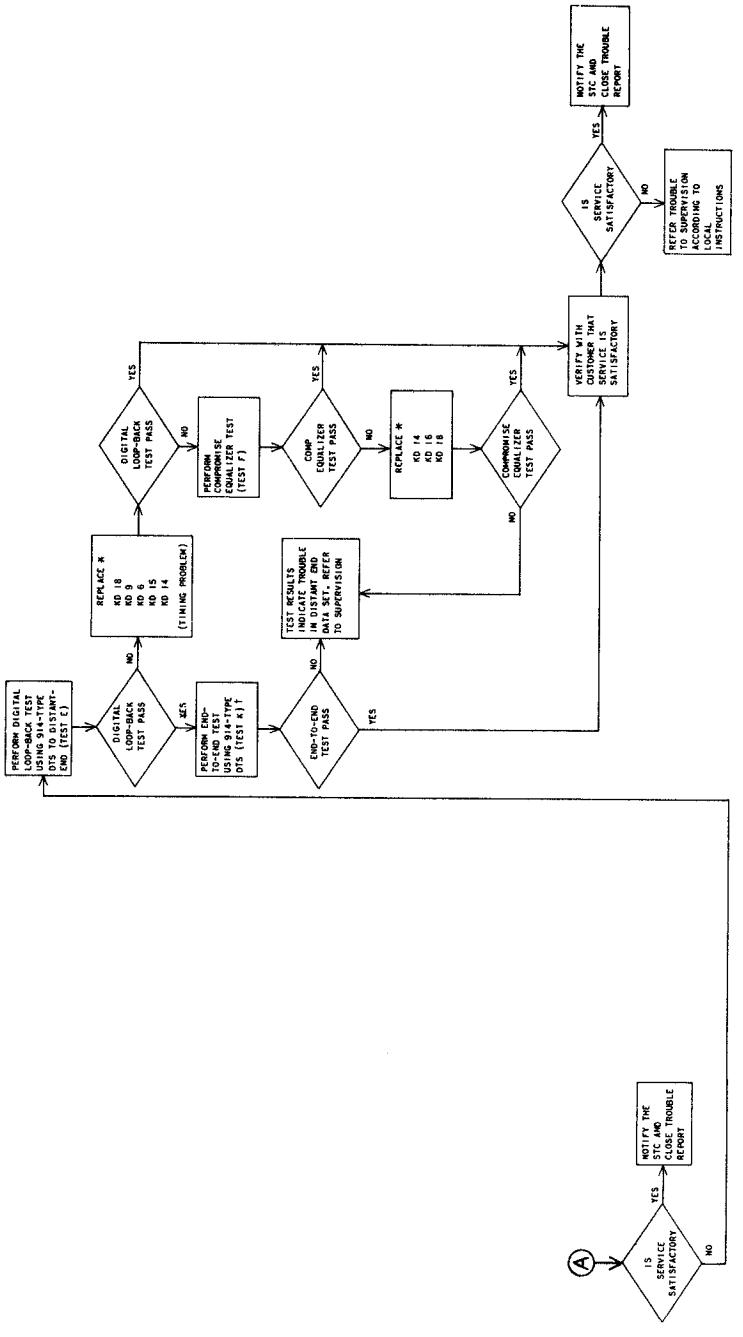


Fig. 4—Maintenance Test Sequence (Sheet 2 of 2)

5.04 Perform the following procedure for the analog loop-back self test.

(1) Apply ac power to the data set.

(2) Depress and hold the LP switch.

Requirement: All status indicators on the data set are lighted. (See Table A.)

(3) Release the LP switch and depress the AL and then the ST switch.

Requirement: After a brief retraining interval, the ON, RS, CS, CO, and TM indicators are lighted. The ER and MR indicators are off.

Note: If the indicators do not give the above indications, or if the ER indicator continues to flash, the data set has failed the analog loop-back self test.

(4) End of test. Depress, then release the ST and AL switches to restore the data set to normal operating condition.

B. Analog Loop-Back Test Using a 914-Type DTS

5.05 The analog loop-back test using a 914-type DTS is functionally the same as the analog loop-back self test. The 914-type DTS provides a more inclusive test of the data set customer interface circuits by generating test data and not utilizing the DS 209A-L1 internal word generator. This test must be performed using each active customer interface.

5.06 Perform the following procedure for the analog loop-back test using the 63- or 511-bit random word.

(1) Connect the equipment and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown in Fig. 3.

(2) Depress the data set AL switch.

(3) Apply power to the data set and then to the 914-type DTS.

(4) Operate the data set multiplex selector switch to the 9600 bps position.

Requirements: At the data set, the ON, RS, CS, CO, MR, and TM indicators are lighted. The ER indicator is off. At the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM) and DS6 (CB) lamps are lighted. The NO CLOCK and NO DATA lamps are off.

Note: If the DSR on in AL mode option is not installed, the MR indicator and the DS3 (CC) lamp are off.

(5) If the 903-type DTS is used, depress and release the START button.

(6) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(7) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: On the 914-type DTS, the error counter counts rapidly and shortly thereafter the NO DATA lamp is lighted.

(8) On the 914-type DTS, depress the interface selector switch 3A.

(9) Reset the counter to zero by pressing the RESET switch. Perform a 1-minute error run and record the total number of errors.

Requirement: DTS counter registers 0 block errors during a 1-minute error run.

(10) If the data set under test is equipped with 4-wire switched carrier [option XF (S5-3) or XH (S5-7)], position switch S1 of the DTS to OFF.

Requirement: At the data set, the RS, CS, and CO indicators are off. At the DTS, DS1 (CA), DS2 (CB), and DS4 (CF) lamps are off.

(11) End of test. Restore the data set to normal operating condition.

C. Remote Loop-Back Test From STC

5.07 When instructed by the STC, place the data set in the digital loop-back mode by depressing the DL switch and verifying that the MR indicator is off and the TM indicator is lighted. (Refer to Table A.)

5.08 After receiving the test results from the STC, restore the data set to normal operating condition by depressing to release the DL switch and verifying that the MR indicator is lighted.

D. Digital Loop-Back Self Test to Distant End

5.09 When instructed by the STC, this test is performed from the local data set to a distant-end data set. The distant-end data set must be in the digital loop-back mode and should have been previously tested by the STC. The local data set is placed into the self-test mode by depressing the ST locking switch. This turns on the local transmitter and applies steady marks to the data set internal SD lead. The steady marks are transmitted to the distant-end receiver, where the recovered data is looped around to the transmitter on the digital side of the data set. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is used to indicate any errors made in transmission.

5.10 Perform the following procedure:

(1) Verify that the distant-end data set is in the DL mode and the ON indicator is lighted.

(2) Apply power to the local data set.

(3) Depress the self-test (ST) locking switch.

Requirements: The ON, RS, CS, CO, and TM indicators are lighted and the MR indicator is off. Since the ER indicator responds to errors received, it should be off.

(4) Perform a 5-minute error run.

Requirement: Acceptable performance is indicated by a total of 30 or less blinks of the ER indicator.

(5) End of test. Restore both data sets (local and distant-end) to normal operating condition.

E. Digital Loop-back Test Using 914-Type DTS to Distant End

5.11 The distant-end data set must be in the digital loop-back mode and should have been previously tested by the STC. This test verifies that data can be sent from the local transmitter to the remote receiver, looped back on the digital side to the remote transmitter, and be transmitted back to the local receiver. The received data (BB) lead at the local receiver is then checked for errors. This test must be performed using each active customer interface connector.

5.12 Perform the following digital loop-back test to distant end using the 63- or 511-bit random word.

(1) Connect the equipment and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown on Fig. 3.

(2) Verify that options YJ (S3-8) and YN (S6-8) are installed.

(3) If the local data set is equipped with the slave option WI (S6-5), temporarily remove this option and install option WJ (S6-4) before performing the test.

(4) Verify that the distant-end data set is in the digital loop-back mode, with the multiplex selector switch to 9600, and that the ON indicator is lighted.

(5) Apply power to the local data set and then to the 914-type DTS.

(6) Operate the data set multiplex selector switch to the 9600 bps position.

Requirements: At the data set, the ON, RS, CS, CO, and MR indicators are lighted. The ER and TM indicators are off. At the DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM), and DS6 (CG) lamps are lighted. The NO CLOCK and NO DATA lamps are off.

(7) If the 903-type DTS is used, depress and release the START button.

(8) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(9) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: At the 914-type DTS, the error counter counts rapidly and shortly thereafter the NO DATA lamp is lighted.

(10) At the 914-type DTS, depress the interface selector switch 3A.

(11) Reset the counter to zero by pressing the RESET switch. Perform a 5-minute error run and record the total number of errors.

Requirement: Total is less than 30 block errors.

(12) End of test. Restore both data sets (local and remote) to normal operating condition.

F. Compromise Equalizer Test

5.13 This test determines the optimum setting of the compromise equalizer in the local data set. This test must be performed upon initial installation of the local data set after the remote data set has been tested previously by the STC. An analog loop-back self test should be performed prior to performing the compromise equalizer test.

5.14 A VOM or a 914-type DTS is required at the local data set. The dispatch of a telco employee to the distant-end data set location is not required; however, the distant-end data set must have the DL and ST switches depressed. In this test, an effort is made to minimize the negative test voltage at test points located on KD16 CP. The signals at these test points provide an indication of the performance by the data set. Lower magnitude voltages indicate good performance, while higher magnitude voltages represent poorer performance. If the factory-supplied options (WK, WN, WP, WS) result in a voltage indication of −1.25 volts or less, the data channel has adequate equalization for good performance. The complete compromise equalizer test need not be performed under these conditions.

5.15 Perform the following procedure:

(1) Call the STC and verify that options WK(S1-4), WN(S1-2), WP(S3-1), WS(S1-7), XG(S5-6), or XI(S5-8) are installed in the distant-end data set. (Disregard additional options not listed.)

(2) Refer to Fig. 5 and install options WN(S1-2), WK(S1-4), WS(S1-7), XG(S5-6), or XI(S5-8) in the local data set. (Disregard additional options not listed.)

(3) Verify that the distant-end data set is in the digital loop-back mode and that the ST switch is depressed.

(4) Position the multiplex selector switch of the local data set to 2400 bps. (This conditions the ***quality 2 out*** test point on KD16 of the local data set to indicate the quality of the received signal at the distant-end data set.)

(5) Apply power to the local data set.

(6) Depress the ST switch of the local data set. Ignore momentary blinking of the status indicators. The ER indicator is lighted while the ST switch on the distant-end data set is depressed.

All voltage measurements in this test are negative with respect to analog ground. Therefore, the positive (+) terminal must be connected to analog ground to obtain a positive meter indication.

(7) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

Requirement: 1.25 volts or less. If this requirement is met, proceed to (18).

(8) Remove option shorting jack S1-4 and reinstall at S1-5.

(9) Measure the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(10) Install the option shorting jack (either S1-4 or S1-5) which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

Note: Good performance of the data channel is indicated by 0.75 volts dc, while marginal performance is indicated by a test voltage greater than 2.0 volts dc.

(11) Install option WM (S1-1) in the local data set.

(12) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(13) Remove option shorting jack S1-1 and reinstall at S1-3.

(14) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(15) Remove option shorting jack S1-3 and reinstall at S1-2.

(16) Measure the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(17) Install option shorting jack S1-1, S1-2, or S1-3, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

(18) Install option WP (S3-1) in the local data set.

(19) Disconnect the VOM negative test lead from ***quality 1 out*** test point and connect to ***quality 2 out*** test point.

(20) Measure and record the dc voltage at ***quality 2 out*** test point. (Refer to Fig. 5.)

Requirement: 1.25 volts or less. If this requirement is met, the test is concluded. Return both data sets to normal operating conditions.

(21) Remove option shorting jack S3-1 and reinstall at S3-3.

(22) Measure the dc voltage at ***quality 2 out*** test point.

(23) Install either option shorting jack S3-1 or S3-3, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

(24) Install option WR (S1-6) in the local data set.

(25) Measure and record the dc voltage at test point ***quality 2 out.***

(26) Remove option shorting jack S1-6 and reinstall at S1-8.

(27) Measure and record the dc voltage at ***quality 2 out*** test point.

(28) Remove option shorting jack S1-8 and reinstall at S1-7.

(29) Measure the dc voltage at ***quality 2 out*** test point.

(30) Install option shorting jack S1-6, S1-7, or S1-8, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

Requirements: Test voltage at both ***quality 1 out*** and ***quality 2 out*** is less than 2.0 volts dc.

Note: If requirements for the compromise equalizer are not met, a telco employee must be dispatched to the distant-end data set location. This data set must have the options specified in (1) installed in order to perform the compromise equalizer test. If the required options are not installed during the test, repeat the test with the options installed. If the options were installed during the original test or if the second test also fails, refer to the appropriate Bell System Practices for maintenance procedures concerning the facility and DS 209A-L1.

(31) End of test. Return both data sets to normal operating conditions.

G. Power Supply Test

5.16 The power supply test checks that ac voltage appears at the power supply input and then measures the +12, +5, and −12 volt supply voltages

OPTION	FEATURE	REMOVE JACK		INSTALL JACK		PROVIDE
		SWITCH	POSITION	SWITCH	POSITION	
WA	ELASTIC STORE ENABLE 1 IN	S3	4	S2	1	ONE PER STATION
WB *	ELASTIC STORE ENABLE 1 OUT	S2	1	S3	4	
WC	ELASTIC STORE ENABLE 2 IN	S3	6	S2	3	ONE PER STATION
WD *	ELASTIC STORE ENABLE 2 OUT	S2	3	S3	6	
WE	ELASTIC STORE ENABLE 3 IN	S2	4	S2	5	ONE PER STATION
WF *	ELASTIC STORE ENABLE 3 OUT	S2	5	S2	4	
WG	ELASTIC STORE ENABLE 4 IN	S2	8	S2	7	ONE PER STATION
WH	ELASTIC STORE ENABLE 4 OUT	S2	7	S2	8	
WI	SLAVE IN	S6	4	S6	5	ONE PER STATION
WJ *	SLAVE OUT	S6	5	S6	4	
WK *	COMPROMISE EQUALIZER RECEIVE SLOPE IN	S1	5	S1	4	ONE PER STATION
WL	COMPROMISE EQUALIZER RECEIVE SLOPE OUT	S1	4	S1	5	
WM	COMPROMISE EQUALIZER RECEIVE PHASE HI	S1	2 OR 3	S1	1	ONE PER STATION
WN *	COMPROMISE EQUALIZER RECEIVE PHASE OUT	S1	1 OR 3	S1	2	
WO	COMPROMISE EQUALIZER RECEIVE PHASE LO	S1	1 OR 2	S1	3	
WP *	COMPROMISE EQUALIZER TRMTR SLOPE IN	S3	3	S3	1	ONE PER STATION
WQ	COMPROMISE EQUALIZER TRMTR SLOPE OUT	S3	1	S3	3	
WR	COMPROMISE EQUALIZER TRMTR PHASE HI	S1	7 OR 8	S1	6	ONE PER STATION
WS *	COMPROMISE EQUALIZER TRMTR PHASE OUT	S1	6 OR 8	S1	7	
WT	COMPROMISE EQUALIZER TRMTR PHASE LO	S1	6 OR 7	S1	8	
XF	4W SWITCHED CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	6 OR 7 OR 8	S5	3	ONE PER STATION
XG *	4W CONTINUOUS CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	3 OR 7 OR 8	S5	6	
XH	4W SWITCHED CARRIER (SWITCHED RS) AND NO AUTO RETRAIN	S5	3 OR 6 OR 8	S5	7	
XI	4W CONTINUOUS CARRIER (CONTINUOUS RS) AND AUTO RETRAIN	S5	3 OR 6 OR 7	S5	8	
YC *	INTERNAL TIMING	S6	3	S6	2	ONE PER STATION
YD	EXTERNAL TIMING	S6	2	S6	3	
YI *	DAS 828- OR 829- TYPE USED	S3	8	S6	6	ONE PER STATION
YJ	DAS 828- OR 829- TYPE NOT USED	S6	6	S3	8	
YM	DSR ON IN ANALOG LOOP MODE	S6	8	S5	1	ONE PER STATION
YN *	DSR OFF IN ANALOG LOOP MODE	S5	1	S6	8	
YW	1-SECOND HOLDOVER OUT	S5	5	S5	4	ONE PER STATION
YX *	1-SECOND HOLDOVER IN	S5	4	S5	5	

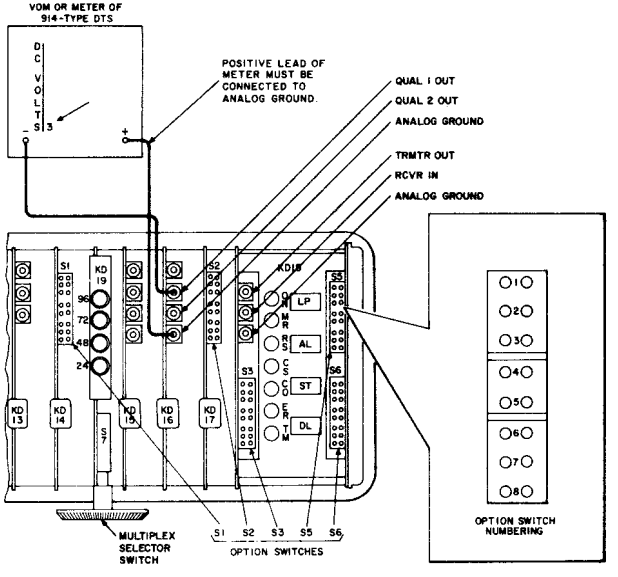


Fig. 5—Compromise Equalizer Test Setup

at the customer interface. The only test equipment required is a 914-type DTS.

5.17 Perform the following procedure:

(1) Connect the data set to the 914-type DTS. The only programming pins required in the matrix are at crosspoints GRD-1 and GRD-7.

(2) Apply power to the data set and then to 914-type DTS.

Requirement: The data set ON indicator lights.

(3) If the ON indicator fails to light or lights momentarily and goes off, check the ac source voltage with a VOM.

Requirement: 105 to 130 volts RMS.

Data set 209A-L1 is equipped with a circuit breaker which will trip under excessive current and thermal conditions. To reset the circuit breaker, operate the switch located inside the rear faceplate. The data set cooling fan is under control of the fuse which is located near the circuit breaker. A replacement fuse (AGC 1/2 ampere) is mounted at the front of the data set power unit, or one may be obtained from the maintenance kit (D-180555-L1). The data set is also provided with a self-resetting thermal overload switch which disconnects the power unit if the power unit temperature rises excessively.

(4) Position the VERTICAL MONITOR switch to 9 and the RANGE switch to 30 DCV.

(5) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI9 lead (pin 9 of customer interface).

Requirement: 11.5 to 12.5 volts.

(6) Position the FUNCTION switch to OFF and the VERTICAL MONITOR switch to 25.

(7) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI25 lead (pin 25 of customer interface).

Requirement: 4.5 to 5.5 volts.

(8) Position the FUNCTION switch to OFF, the VERTICAL MONITOR switch to 10, and the POLARITY switch to REV.

(9) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI10 lead (pin 10 of customer interface).

Requirement: 11.5 to 12.5 volts.

(10) Position the FUNCTION switch to OFF.

(11) End of test. Remove test equipment and return to pretest conditions.

H. CA-CB Interval Test

5.18 The CA-CB interval test checks the 8-ms and 147-ms request-to-send/clear-to-send (CA-CB) intervals. Although requirements are given for the three possible options, the data set under test need not be checked for proper operation of all options. Check only the CA-CB interval provided by the option specified on the service order. This test is required ***only*** when the data set under test is optioned for switched request-to-send [XF (S5-3), XG (S5-6), or XH (S5-7)]. A 914-type DTS and the 3300-ohm (yellow) pin are required.

Note: If the associated DAS is in the facility loop-back mode, the CA-CB interval cannot be measured unless option YM is installed in the data set.

5.19 Perform the following procedure:

(1) Connect the data set to the 914-type DTS and set the controls as shown in Fig. 6.

(2) If a 914C DTS is used, position START switch to A ONLY.

(3) Apply power to the data set and then to the DTS.

(4) Depress the AL switch located on DS 209A-L1.

(5) Position the data set multiplex selector switch to 9600.

(6) On the 914-type DTS, add red pins to the programmable matrix in the following positions: 4-TP1, 5-TP2.

(7) Install option YC (S6-2) and the option specified by the service order [XF (S5-3) or XG (S5-6) or XH (S5-7)] in the data set.

(8) On the 914-type DTS, ensure that switch S1 is OFF. Zero the counter by pressing the RESET switch.

(9) Position switch S1 to ON and record the CA-CB interval on the counter.

Requirements: Option XF—130 to 160 ms
Option XG—6.0 to 9.0 ms
Option XH—130 to 160 ms.

Note: Because the COUNTER switch is set to INTERVAL X-10, the counter indicates 13 to 16 for options XF and XH. Similarly, for option XG the COUNTER switch is set to INTERVAL X.1, resulting in an indication of 60 to 90.

(10) To remeasure the CA-CB interval, position switch S1 to OFF and press the RESET switch. When S1 is moved to ON, the CA-CB interval appears on the counter.

(11) End of test. Restore data set to normal operating condition.

I. CG-CF Interval Test

5.20 In this test the interval between CG (initial detection of carrier) and CF (indication to the customer that the data set is in the proper state to receive data) will be measured. A 914-type DTS and the yellow pin (3300 ohms) are required.

5.21 Perform the following procedures:

(1) Connect the data set to the 914-type DTS and position the controls as shown in Fig. 6.

(2) Install option XF (S5-3) in the data set.

(3) Apply power to the data set and then to the 914-type DTS.

(4) Depress the AL switch located on DS 209A-L1.

(5) Position the data set multiplex selector switch to 9600.

(6) On the 914-type DTS, add red pins to the programmable matrix in the following positions: 21-TP1 and 8-TP2.

(7) Ensure that switch S1 is positioned to OFF. Zero the counter by pressing the RESET switch.

(8) If a 914C DTS is used, position the START switch to A ONLY.

(9) Position switch S1 to ON and read the CG-CF interval on the counter.

Requirement: 120 to 140 ms.

Note: Because the COUNTER switch is set to INTERVAL X10, the counter indicates 12 to 14.

(10) To remeasure the CG-CF interval, position switch S1 to OFF and reset the counter. Position switch S1 to ON and read the CG-CF interval on the counter.

(11) End of test. Restore the data set to normal operating condition.

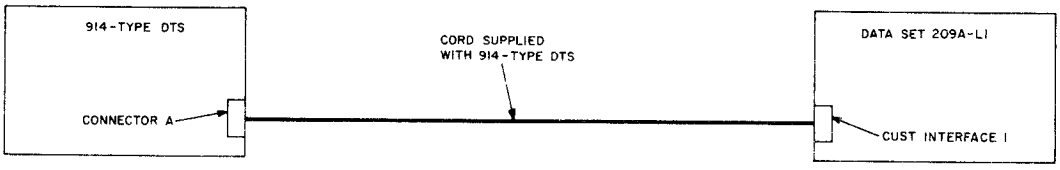
J. End-to-End Self Test

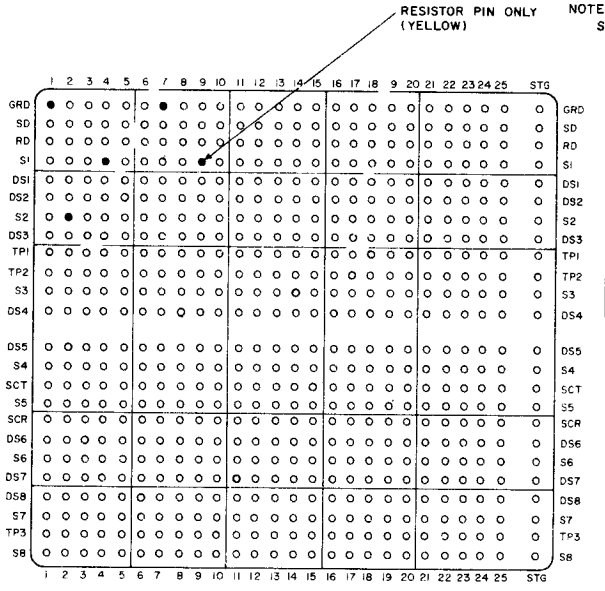
5.22 The performance of the data channel is quickly tested by the end-to-end self test. Depressing the ST switches on both data sets conditions the respective transmitters to transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission. This test checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facility. The customer interface circuits are not tested by the end-to-end self test.

5.23 Perform the following procedure for the end-to-end self test.

(1) Ensure that the data sets are connected to the facility and that ac power is applied.

Requirements: ON and MR indicators are lighted.





NOTE:
SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	INTERVAL (914C); RCV SER(914B)
COUNTER	INTERVAL X10
FUNCTION	OFF
BIT RATE	2000
TPI FIRST	+/OPEN
TP2 FIRST	+/OPEN
SI (CA)	OFF
S2 (BA)	OFF

Fig. 6—Interval Test Setup

(2) Depress the ST switches at each data set.

Requirements: ON, RS, CS, TM, and CO indicators are lighted. MR and ER indicators are off.

(3) Perform a 5-minute error run.

Requirements: Acceptable performance is indicated by a total of 30 or less blinks of the ER indicator.

(4) End of test. Restore both data sets (local and distant-end) to normal operating condition.

K. End-to-End Test Using 914-Type DTS

5.24 The end-to-end test is performed when it is necessary to identify facility troubles, or when the DS 209A-L1 experiences difficulty while multiplexing two or more Electronic Industries Association (EIA) interfaces. This test checks the transmitter and receiver of both data sets and the two directions of transmission by the connecting facility. One DS 209A-L1 can be located in an

STC. A 914-type DTS is required at both ends of the data channel. By using the 914-type DTS, the customer interface is checked and an actual error count is performed.

End-to-End Test (Duplex)

5.25 Perform the following procedure for a duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect a 903-type DTS to a 914B DTS as shown in Fig. 3.

(2) Apply power to the data set and then to the 914-type (903-type) DTS.

(3) Establish voice communications between the data stations and verify that neither of the data sets is in a test mode.

(4) If using a 903-type DTS, depress and release the START switch.

Requirements: At each DS 209A-L1, the ON, MR, RS, CS, and CO indicators are lighted. The ER and TM indicators are off. At each 914-type DTS, the DS1, DS2, DS3, DS4, DS5, and DS6 lamps are lighted.

The attendant at each data station must verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the test must be restarted.

(5) At both data stations, simultaneously depress the DTS RESET and perform a 5-minute error run and record the total errors.

Requirement: Total errors are less than 30 block errors.

(6) As required, repeat the end-to-end test using each active EIA interface when operating in a multiplexing system.

(7) End of test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

End-to-End Test (Half-Duplex)

5.26 Perform the following procedure for a half-duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914-type DTS as shown in Fig. 3.

Note: The 903-type DTS is not required for a half-duplex test.

(2) Apply power to the data set and then to the 914-type DTS.

(3) Establish voice communications between the data stations and verify that neither of the data sets is in a test mode.

(4) On the 914-type DTS at the transmitting end only, position the TEST SET MODE switch to TRMT SER (914B DTS) or SER (914C DTS).

(5) On the 914-type DTS at the receiving end only, position the TEST SET MODE switch to the RCV SER (914B DTS) or SER (914C DTS).

Requirements: At each DS 209A-L1, the ON, MR, RS, CS, and CO indicators are lighted. The ER and TM indicators are off. At each 914-type DTS, the DS1, DS2, DS3, DS4, DS5, and DS6 lamps are lighted.

The attendant at the receiving station should verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the receiving station attendant must contact the transmitting station and agree to retest.

(6) At both data stations, simultaneously depress the DTS RESET and perform a 5-minute error run and record the total errors.

Requirement: Total errors are less than 30 block errors.

(7) At the end of the prearranged time interval, establish voice communication to discuss the test results and agree to repeat the end-to-end test in the opposite direction if necessary. The transmitting data station now would become the receiving data station. Repeat (4) through (6).

(8) As required, repeat the end-to-end test using each active EIA interface when operating in a multiplexing arrangement.

(9) End to test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

6. SUPPLEMENTARY TESTS

A. Start-Up Error Test

6.01 This test consists of switching on the request-to-send (CA) lead and recording any errors that occur immediately after the lead is switched on, and the data set turns on the clear-to-send (CB) lead. This test is applicable only when the data set under test is optioned for switched request-to-send XF (S5-3), XG (S5-6), or XH (S5-7)]. When testing a DS 209A-L1 that is installed in a point-to-point multiplexing system, perform the start-up error test using each active customer interface.

6.02 Perform the following procedure for the start-up error test:

(1) Connect the equipment and set the controls of the 914-type DTS as shown in Fig. 6.

(2) Position the 914-type DTS COUNTER switch to BIT ERRORS.

(3) Position the 914-type DTS BIT RATE switch to EXT+.

(4) Depress the data set AL switch.

(5) Apply power to the data set and then to the 914-type DTS.

(6) At the DTS, verify that S1 (CA) is OFF.

(7) Reset the DTS counter by momentarily depressing the RESET switch.

(8) Position S1 to ON.

Requirement: Zero errors are indicated by the DTS immediately after CA is switched on.

Note: Disregard any transient errors that may occur when S1 is positioned to OFF.

(9) Repeat (8) for a total of five trials.

(10) End of test. Restore the data set to normal operating condition.

B. Ground Noise Test

6.03 If the data set and CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6H impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset level and are separated by approximately 150 ms or more.

6.04 The following test equipment is required to perform the ground noise test:

- 6H impulse counter (or equivalent)
- 914-type DTS
- 2W6A test cord for 6H impulse counter (310 plug on one end, alligator clips connected to tip and ring on the other end).

6.05 For this test, the impulse counter is connected between the grounds of the data set and the CPE. The impulse counter will register when a potential difference of a preset level has developed between the isolated grounds. The 914-type DTS is used only to gain access to the ground interface leads. If the 914-type DTS is not available, any method of gaining access to the interface is acceptable.

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and

Maintenance (103-620-101). If the 6H impulse counter is ***not*** available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

6.06 Perform the following procedure:

(1) Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective ground from the CPE appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1A and connect the other clip to switch 1B. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications by the counter.

(8) Remove clips of the 2W6A cord from 1A and 1B and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications by the counter.

6.07 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

7. REFERENCES

7.01 The following Bell System Practices provide information concernng the data sets used in multiplex systems.

SECTION	TITLE
Data Set 208A-Type	
592-027-100	Description and Operation
592-027-200	Installation
592-027-300	Maintenance
592-027-500	Test Procedures
666-511-503	Test of Services Provided By Data Set 208A-Type From a Private Line Test Room
Data Set 201C-Type	
592-029-100	Description and Operation
592-029-200	Installation
592-029-300	Maintenance
592-029-500	Test Procedures
666-511-501	Test of Services Provided By Data Set 201C From a Private Line Test Room
Data Set 209A-L1	
592-032-100	Description and Operation
592-032-150	Supplementary Information
592-032-200	Installation
592-032-300	Maintenance
666-511-504	Test of Services Provided By Data Set 209A-L1 From a Private Line Test Room

DATA SET 209A-L1

TRANSMITTER-RECEIVER

TEST PROCEDURES USING 921A DATA TEST SET

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CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 209A-L1. Test procedures using the 914-type DTS and the self-test capabilities of DS 209A-L1 are contained in Section 592-032-500. These procedures are to be used when testing DS 209A-L1 on an initial installation or during a maintenance visit. The procedures to be used when investigating a trouble report are contained in Section 592-032-300. Procedures for testing DS

209A-L1 in point-to-point, point-to-point multiplexing, and digital data system subrate off-net installations are provided in this section. Also included in this section are procedures for testing DS 209A-L1, 208A-type, and 201C-type when installed in a 9600 bits-per-second (bps) multiplexing system. These tests are required in addition to tests normally required for installation and maintenance of these data sets.

1.02 This section is reissued to add coverage for Version 2 of the 921A DTS. Since this reissue is a general revision, arrows normally used to indicate changes have been omitted.

1.03 DS 209A-L1 is a synchronous, binary, serial, 9600-bps data set for use on basic 3002-type, 4-wire private line (PL) telephone channels equipped with high-performance data conditioning (HPDC) type D1. C-type conditioning is not required. Refer to Section 314-410-105 for information concerning HPDC type D1. DS 209A-L1 contains a multiplexing capability that provides data channels in multiples of 2400 bps up to 9600 bps as follows.

- One 9600-bps channel
- One 7200-bps channel and one 2400-bps channel
- Two 4800-bps channels
- One 4800-bps channel and two 2400-bps channels
- Four 2400-bps channels.

These channels can interface with customer-provided equipment (CPE) or can be extended with DS 201C-type or DS 208A-type.

A. Test Capabilities

1.04 Test circuitry built into DS 209A-L1 permits the following self tests to be performed: analog loopback, digital loopback, and end-to-end. The test circuitry also facilitates the remote test of the data set from a test center. The analog loopback, digital loopback, and end-to-end tests can also be performed by use of external test equipment such as the 921A DTS.

1.05 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C DTS for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

B. Self Tests

Lamp Test

1.06 The lamp test (LP) nonlocking switch, when depressed, lights the multiplex and data set status indicator lamps to verify proper operation of these lamps. The LP switch can be depressed at any time, since it does not affect normal data set operation.

Analog Loopback Self Test

1.07 This test is initiated by depressing the analog loopback (AL) and self-test (ST) locking switches. Depressing the AL switch connects the data set transmitter to the data set receiver through an attenuation network. Depressing the ST switch turns ***on*** the internal request-to-send (CA) lead, transmits steady marks on the internal send data (BA) lead, and conditions the ER lamp to indicate receiver errors. Since steady marks were transmitted, any spaces detected by the error circuitry constitute errors. Each bit error lights the ER lamp for approximately 100 ms. This test does not check the customer or telephone interface circuits.

Digital Loopback Self Test

1.08 This test is performed from the local data set to a distant-end data set. The distant-end data set must be in the digital loopback mode. The local data set is placed in the self-test mode by depressing the ST locking switch. This turns on the local transmitter and applies steady marks to the internal send data (BA) lead. The steady marks are transmitted to the distant-end receiver, where the recovered data is looped back internally to the distant-end transmitter. The distant-end transmitter now transmits this data back to the local receiver, where the ER lamp indicates any errors made in transmission. The customer interface circuits are not checked.

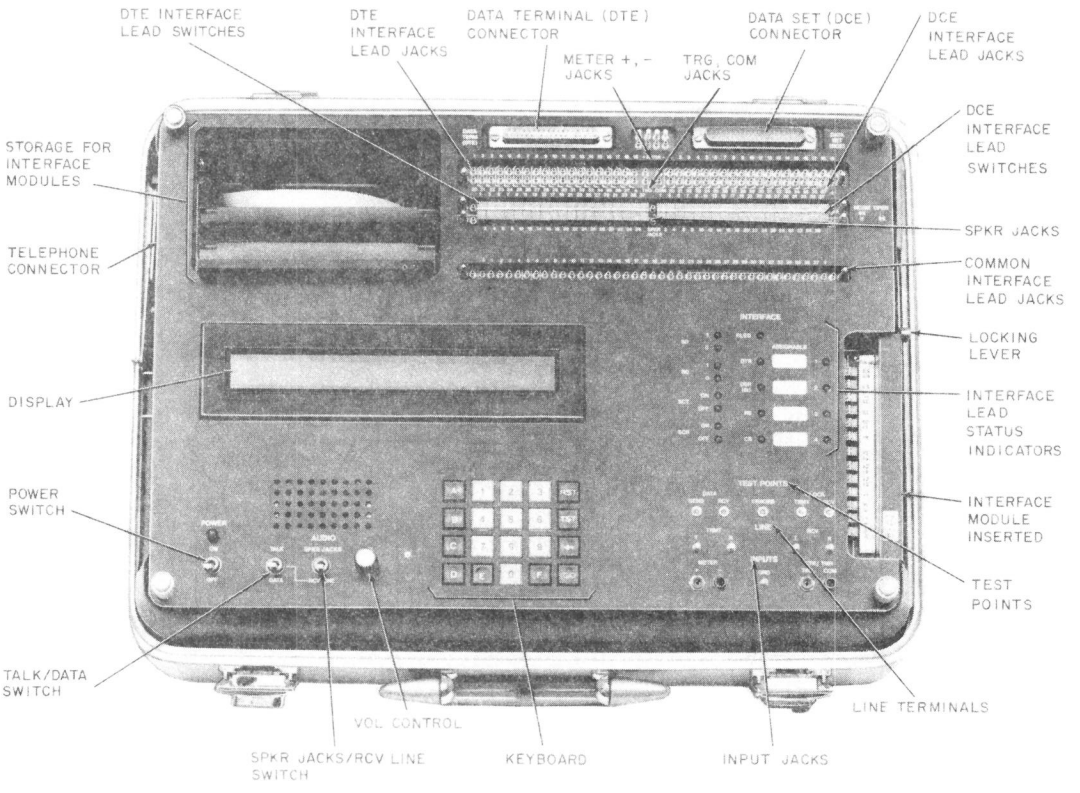


Fig. 1—921A Data Test Set—Front Panel

End-to-End Self Test

1.09 This test is initiated by depressing the ST locking switches on both data sets. This action conditions the respective transmitters to transmit steady marks. At both receivers, the ER lamps indicate any errors made in transmission. This test simultaneously checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facility. The customer interface circuits are not checked.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory. Before proceeding with the tests, verify that the 4-wire private line meets the requirements specified in Section 314-410-500.

A. Point-to-Point, Point-to-Point Multiplexing, and Digital Data System Subrate Off-Net Installations

2.02 Refer to Fig. 2 for the sequence of tests to be performed and to Part 4 for the test procedures.

B. Many-Point Multiplexing Installations

2.03 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested. A digital loopback (DL) test must be performed on each multiplex channel to its corresponding remote data

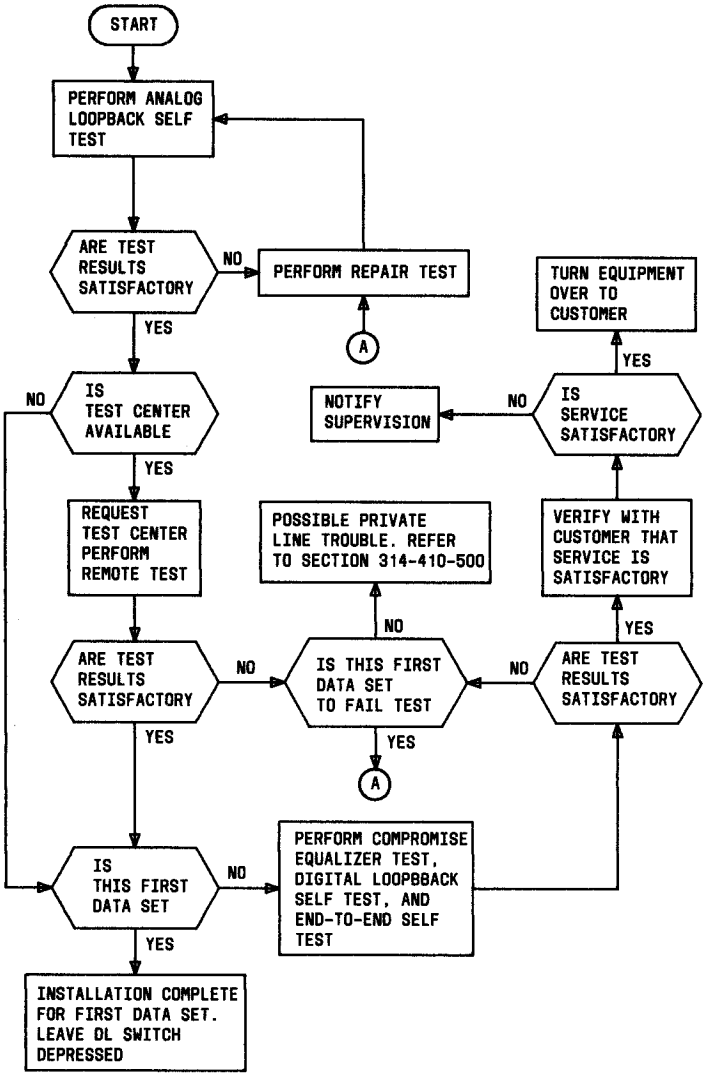


Fig. 2—Installation Test Sequence

set. For this test, the remote data set must be in the DL mode and all of the data sets between the remote extensions must not be in a test mode.

2.04 DL testing of the entire multiplex system can be performed from either end with one exception. ***A DL test (with external test equipment) from a slave DS 209A-L1 cannot be performed to a master DS 209A-L1 because the master DS 209A-L1 cannot be placed in the DL mode.***

Digital Loopback Testing From a DS 201C-Type Extension

2.05 If the extension data set (at the location originating the test) is a DS 201C-type, the self-test feature can be used to perform the digital loopback test to the distant-end data set. (The M23B cord must be connected while this test is being performed.)

2.06 Perform the test as follows.

(1) Contact distant-end data station and have DL switch on data set depressed.

(2) Depress ST switch on DS 201C-type.

Requirements: All lamps are lighted except MC.

(3) Observe MC lamp for five 1-minute periods.

Requirement: Maximum allowable blinks of MC lamp depend on system configuration. Refer to Fig. 3.

(4) If system does not meet requirement, refer to Section 592-032-300.

(5) Release ST switch on DS 201C-type.

(6) Contact distant-end data station and have DL switch on data set released.

Digital Loopback Testing From a DS 208A-Type or DS 209A-L1 Extension

2.07 If an extension DS 208A-type is located at the station originating the test, the M23B cord must be connected while this test is performed. If testing from a DS 209A-L1, the 921A DTS must be located at the master DS 209A-L1. A DL test cannot be performed from a slave DS 209A-L1 to the master DS 209A-L1. If the slave in option (WI) is temporarily removed from the slave DS 209A-L1 and the slave out option (WJ) installed, a DL test can be performed.

Note: The self-test feature available on DS 208A-L1A or DS 209A-L1 must not be used for this DL test.

2.08 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to a 921A DTS, using interface cable and EIA adapter cord provided with DTS. ***Note 1:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set. ***Note 2:*** If testing from a DS 208A-type, an M23B cord must be connected between data set and adapter cord.	

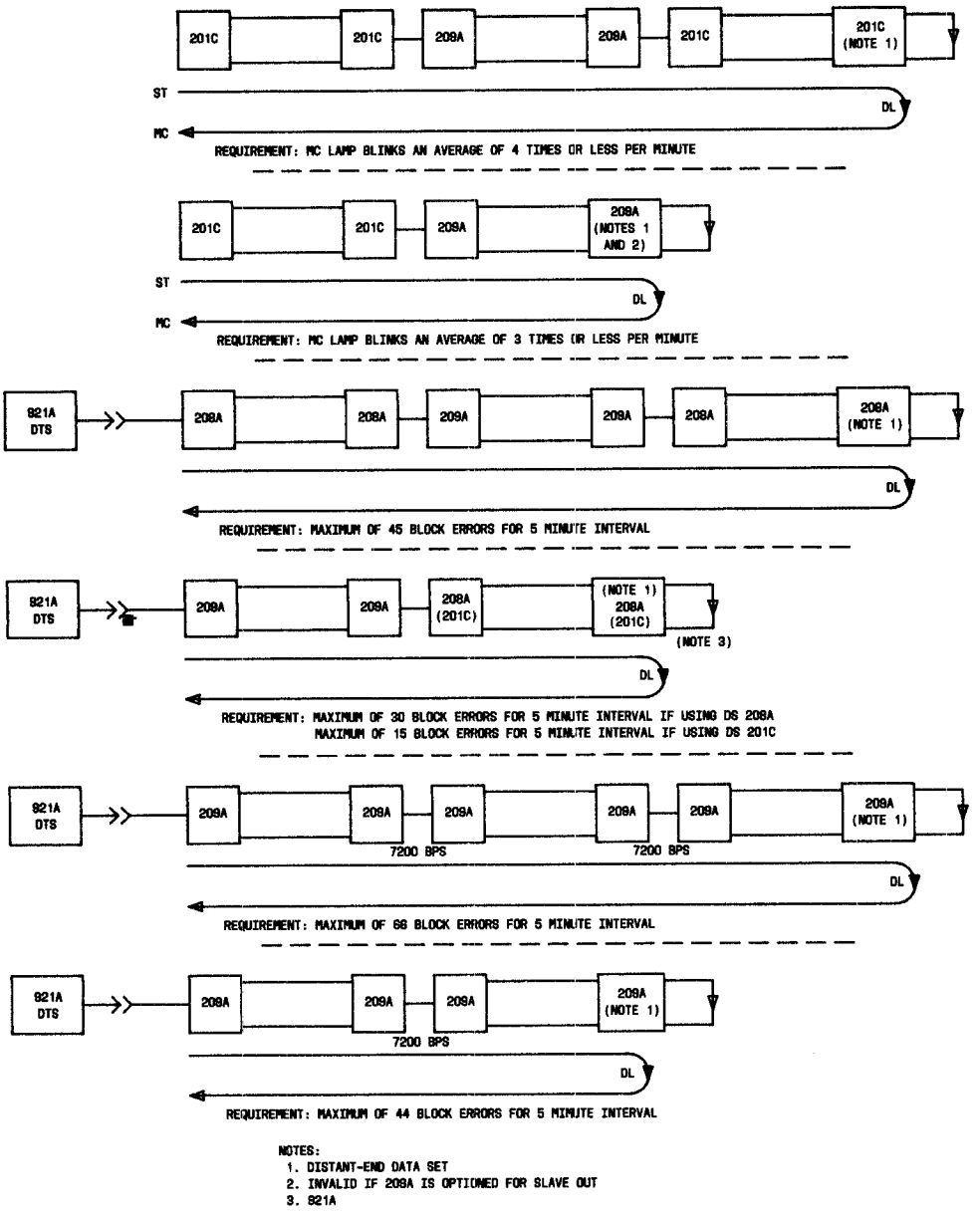


Fig. 3—Loopback and Test Requirements

STEP	ACTION	VERIFICATION
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove the EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	If testing from a DS 208A-type, enter 70 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 70
12	If testing from a DS 209A-type, enter 75.	Display reads— DATA SET: 75
13	Press GO.	Display reads— BIT RATE:
14	If testing from a DS 208A-type, enter 48.	Display reads— BIT RATE: 48
15	If testing from a DS 209A-L1, enter 72.	Display reads— BIT RATE: 72
16	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
17	Contact distant-end data station and have DL switch on data set depressed.	
18	On DTS, enter 55.	Display reads— TEST SEQ: 55
19	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
20	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
21	Enter 2.	Display reads— ????? BITS IN A BLOCK
22	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
23	Enter 0300. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0300 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Error Requirement:*** Maximum allowable block errors depend on system configuration. Refer to Fig. 3. ***Data Set Requirements:*** At local data set if testing DS 208A-L1A— ON, CO, MR, RS, and CS lamps are lighted; ER lamp is off.

STEP	ACTION	VERIFICATION
		At local data set if testing DS 208A-L1—ON, RS, CS, and CO lamps are lighted; ER, AL, and DL lamps are off. At local data set if testing DS 209A-L1—ON, RS, CS, CO, and MR lamps are lighted; ER and TM lamps are off.
24	If system does not meet requirements, refer to Section 592-032-300.	
25	Contact distant-end data station and have DL switch on data set released.	

C. One-to-Many Multiplexing Installations

2.09 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested. A digital loopback (DL) test must be performed on each multiplex channel. When testing is originated from the master DS 209A-L1, the test must be performed from each connector of the DS 209A-L1 to each of the remote extension data sets. DL testing of the individual links comprising the multiplex system can be performed from either end with one exception. ***A DL test (with external test equipment) from a slave DS 209A-L1 cannot be performed to a master DS 209A-L1 because the master DS 209A-L1 cannot be placed in the DL mode.***

2.10 For this test, the remote extension data sets must be in the DL mode and all of the data sets between DS 209A-L1 and the remote extensions must not be in a test mode. In order to conduct the test through each interface connector in use, the local DS 209A-L1 (master) must have the multiplex selector switch positioned the same as the distant-end DS 209A-L1.

2.11 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Contact distant-end DS 209A-L1 station and determine position of multiplex selector switch. Ensure that data set is not in a test mode.	
2	Set multiplex selector switch on local DS 209A-L1 (master) to same position as distant-end DS 209A-L1.	
3	Connect local DS 209A-L1 to a 921A DTS, using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into	

STEP	ACTION	VERIFICATION
	appropriate customer interface connector on data set. Refer to Table A.	
4	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
5	Contact each remote extension data set location and have DL switch on data set depressed.	
6	Apply power to local DS 209A-L1.	ON lamp lights.
7	On front of DTS, set POWER switch to ON.	POWER lamp lights.
8	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
9	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
10	On right side of DTS, ensure that locking lever is in OPEN position.	
11	Insert interface module into slot.	

TABLE A

MULTIPLEX SELECTOR SWITCH POSITIONS AND ACTIVE INTERFACE CONNECTORS

MULTIPLEX SELECTOR SWITCH POSITION	MULTIPLEX STATUS LAMP		INTERFACE CONNECTOR			
	PL AND 9600-BPS DDD OPERATION	4800-BPS DDD BACKUP OPERATION	1	2	3	4
1	96	48	96*	—	—	—
2	72 & 24	24	72†	24	—	—
3	48	24	48†	48†	—	—
4	48 & 24	24	48†	24	24‡	—
5	24	24	24	24	24‡	24‡
6	None	None	—	—	—	—

* Operates at 4800 bps when DBU1 telephone interface lead is closed.
† Operates at 2400 bps when DBU1 telephone interface lead is closed.
‡ Not operational when DBU1 telephone interface lead is closed.

STEP	ACTION	VERIFICATION
12	Move locking lever to CLOSE position.	
13	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
14	If remote extension data set is a DS 201C-type, enter 62 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 62
15	If remote extension data set is a DS 208A-type, enter 70.	Display reads— DATA SET: 70
16	If remote extension data set is a DS 209A-L1, enter 75.	Display reads— DATA SET: 75
17	Press GO.	Display reads— BIT RATE:
18	If remote extension data set is a DS 201C-type, enter 24.	Display reads— BIT RATE: 24
19	If remote extension data set is a DS 208A-type, enter 48.	Display reads— BIT RATE: 48
20	If remote extension data set is a DS 209A-L1, enter 72.	Display reads— BIT RATE: 72
21	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:
22	Enter 55.	Display reads— TEST SEQ: 55
23	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
24	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
25	Enter 2.	Display reads— ????? BITS IN A BLOCK

STEP	ACTION	VERIFICATION
26	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
27	Enter 0300. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads briefly— 0300 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Maximum allowable block errors depend on system configuration. Refer to Fig. 3.
28	If system does not meet requirements, refer to Section 592-032-300.	
29	Contact each remote extension data set location and have DL switch on data set released.	
30	Set multiplex selector switch on local DS 209A-L1 to pretest position.	

3. MAINTENANCE TESTS

3.01 This part provides the sequence (Fig. 4) in which tests are to be performed during a maintenance visit to the data station. This test sequence provides a method of isolating a trouble to the data set or the customer-provided equipment (CPE). It is assumed that the maintenance procedures in Section 592-032-300 have been followed prior to dispatching a telco employee to the data station. If the data set is found to be defective, procedures are provided for isolating the trouble to a circuit pack (CP) in order to repair the data set.

4. TEST PROCEDURES

4.01 This part provides the procedures for the normal installation and maintenance tests.

A. Analog Loopback Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked.

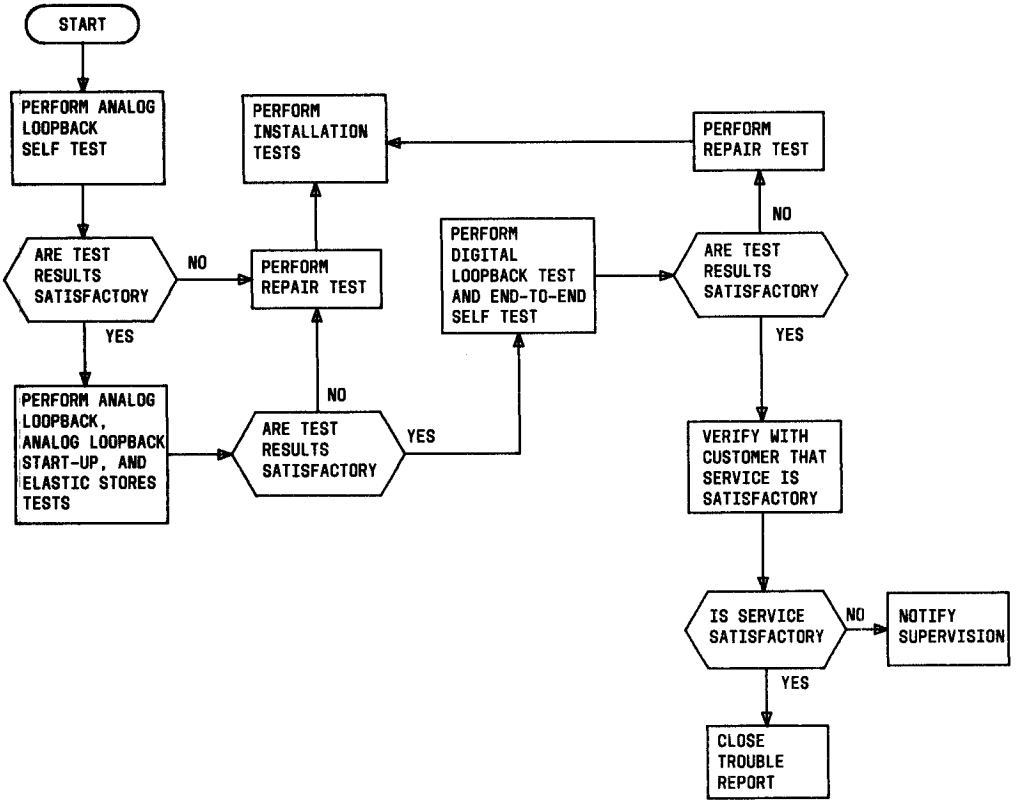


Fig. 4—Maintenance Test Sequence

4.03 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and ST switches on data set.

Requirements: After a brief retraining interval, ON, RS, CS, CO and TM lamps are lighted. ER and MR lamps are off.

Note: ER lamp goes off immediately. If ER lamp is lighted or blinks, data set has failed analog loopback self test.

(3) Observe lamps on data set for at least 30 seconds.

(4) Release ST and AL switches on data set.

B. Digital Loopback Self Test

4.04 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked.

4.05 Perform the test as follows:

(1) Contact distant-end data station and have DL switch on distant-end data set depressed.

(2) Depress ST switch on local data set.

Requirements: ON, RS, CS, CO, and TM lamps are lighted. MR and ER lamps are off.

(3) Observe ER lamp for a 5-minute period.

Requirement: Total blinks of ER lamp are less than 31.

(4) Release ST switch on local data set.

(5) Contact distant-end data station and have DL switch on data set released.

C. End-to-End Self Test

4.06 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are not checked.

4.07 Perform the test as follows.

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that neither data set is transmitting or receiving data.

(3) On both data sets, depress ST switch.

Requirements: On both data sets, ON, RS, CS, TM, and CO lamps are lighted. MR and ER lamps are off.

(4) On both data sets, observe ER lamp for a 5-minute period.

Requirement: On both data sets, total blinks of ER lamp are less than 31.

(5) ON both data sets release ST switch.

D. Remote Test

4.08 This test allows a test center to check the data set transmitter and receiver and the facilities connecting the data set and the test center. The customer interface is not checked.

4.09 Perform the test as follows.

(1) Contact test center and request a remote test.

(2) When directed by test center, depress DL switch on data set.

(3) Test center performs remote test.

(4) When directed by test center, release DL switch on data set.

E. Initial Test Setup for 921A DTS

4.10 Perform the initial test setup for the 921 DTS when used to test DS 209A-L1 as follows.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and EIA adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into appropriate customer interface connector on data set. Refer to Table A.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	

STEP	ACTION	VERIFICATION
3	Apply power to data set.	ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	Enter 75 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 75
12	Press GO.	Display reads— BIT RATE:
13	Enter first two digits of bit rate corresponding to customer interface connector used in Step 1. Refer to Table A.	Display reads— BIT RATE: and digits entered
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:
15	Ensure that multiplex selector switch on data set is set to position corresponding to customer interface connector used in Step 1. Refer to Table A.	On data set corresponding multiplex status lamp lights.

F. Analog Loopback Test

4.11 In this test, an analog loopback block error run is performed. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.12 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Depress AL switch on data set.	
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0060. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Dislay timing remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0060 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.
9	Release AL switch on data set.	

G. Digital Loopback Test

4.13 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interface at the distant data set is not checked. Test data is generated by the 921A DTS and transmitted by the local data set. This data is looped back internally from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.14 If DS 209A-L1 is installed in a many-point or one-to-many multiplex system, a master/slave timing arrangement must be used. When performing a digital loopback test with external test equipment, the test cannot be conducted from a slave DS 209A-L1 to a master DS 209A-L1 with options as installed. If the slave in option (WI) is temporarily removed and the slave out option (WJ) is installed, this test can be performed.

4.15 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	If slave in option (WI) is installed in local data set, remove this option and temporarily install slave out option (WJ).	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Contact distant-end data station and have DL switch on data set depressed. Verify that multiplex selector switch on distant data set is set to same position as multiplex selector switch on local data set.	
4	On DTS, enter 55.	Display reads— TEST SEQ: 55
5	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
6	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
7	Enter 2.	Display reads— ????? BITS IN A BLOCK
8	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS

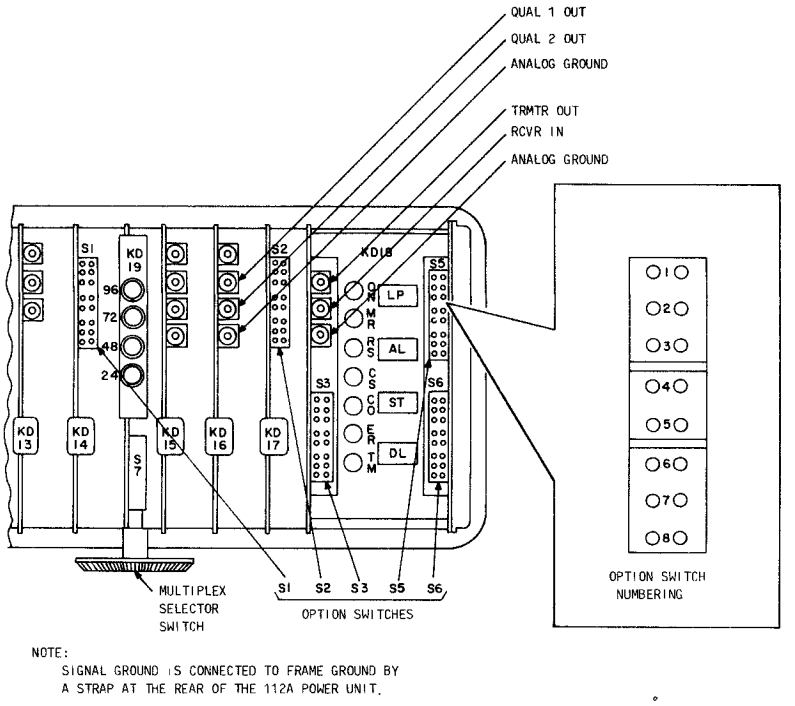
TABLE B

DS 209A-L1 OPTIONS

OPTION	FEATURE	REMOVE JACK		INSTALL JACK		PROVIDE
		SWITCH	POSITION	SWITCH	POSITION	
WA	ELASTIC STORE ENABLE 1 IN	S3	4	S2	1	ONE PER STATION
WB*	ELASTIC STORE ENABLE 1 OUT	S2	1	S3	4	
WC	ELASTIC STORE ENABLE 2 IN	S3	6	S2	3	ONE PER STATION
WD*	ELASTIC STORE ENABLE 2 OUT	S2	3	S3	6	
WE	ELASTIC STORE ENABLE 3 IN	S2	4	S2	5	ONE PER STATION
WF*	ELASTIC STORE ENABLE 3 OUT	S2	5	S2	4	
WG	ELASTIC STORE ENABLE 4 IN	S2	8	S2	7	ONE PER STATION
WH*	ELASTIC STORE ENABLE 4 OUT	S2	7	S2	8	
WI	SLAVE IN	S6	4	S6	5	ONE PER STATION
WJ*	SLAVE OUT	S6	5	S6	4	
WK*	COMPROMISE EQUALIZER RECEIVE SLOPE IN	S1	5	S1	4	ONE PER STATION
WL	COMPROMISE EQUALIZER RECEIVE SLOPE OUT	S1	4	S1	5	
WM	COMPROMISE EQUALIZER RECEIVE PHASE HI	S1	2 or 3	S1	1	
WN*	COMPROMISE EQUALIZER RECEIVE PHASE OUT	S1	1 or 3	S1	2	ONE PER STATION
WO	COMPROMISE EQUALIZER RECEIVE PHASE LO	S1	1 or 2	S1	3	
WP*	COMPROMISE EQUALIZER TRMTR SLOPE IN	S3	3	S3	1	ONE PER STATION
WQ	COMPROMISE EQUALIZER TRMTR SLOPE OUT	S3	1	S3	3	
WR	COMPROMISE EQUALIZER TRMTR PHASE HI	S1	7 or 8	S1	6	
WS*	COMPROMISE EQUALIZER TRMTR PHASE OUT	S1	6 or 8	S1	7	ONE PER STATION
WT	COMPROMISE EQUALIZER TRMTR PHASE LO	S1	6 or 7	S1	8	
XF	4W SWITCHED CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	6 or 7 or 8	S5	3	
XG*	4W CONTINUOUS CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	3 or 7 or 8	S5	6	ONE PER STATION
XH	4W SWITCHED CARRIER (SWITCHED RS) AND NO AUTO RETRAIN	S5	3 or 6 or 8	S5	7	
XI	4W CONTINUOUS CARRIER (CONTINUOUS RS) AND AUTO RETRAIN	S5	3 or 6 or 7	S5	8	
YC*	INTERNAL TIMING	S6	3	S6	2	ONE PER STATION
YD	EXTERNAL TIMING	S6	2	S6	3	
YI*	DAS 828- or 829-TYPE USED	S3	8	S6	6	ONE PER STATION
YJ	DAS 828- or 829-TYPE NOT USED	S6	6	S3	8	
YM	DSR ON IN ANALOG LOOP MODE	S6	8	S5	1	ONE PER STATION
YN*	DSR OFF IN ANALOG LOOP MODE	S5	1	S6	8	
YW	1-SECOND HOLDOVER OUT	S5	5	S5	4	ONE PER STATION
YX*	1-SECOND HOLDOVER IN	S5	4	S5	5	

* FACTORY INSTALLED

STEP	ACTION	VERIFICATION



NOTE:
SIGNAL GROUND IS CONNECTED TO FRAME GROUND BY A STRAP AT THE REAR OF THE 112A POWER UNIT.

Fig. 5—Switch and Test Point Locations

9 Enter 0300.

Note: To perform functions listed below, press associated key.

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.
E	Inject 8 errors into data stream.
F	Force out-of-sync condition.

Display reads (briefly)—
0300 SECONDS
Display then reads—
BLK RCVD=0000 ERR=0000
From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A.
At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error.

Requirement: Total blocks in error are less than 30.

STEP	ACTION	VERIFICATION
10	Contact distant-end data station and have DL switch on data set released.	
11	If option WJ was temporarily installed in local data set in Step 1, remove this option and install option WI.	

H. Compromise Equalizer Test

4.16 This test determines the optimum setting of the compromise equalizer in the local data set. This test must be performed upon initial installation of the local data set and after the distant-end data set has been tested. An analog loopback self test of the local data set should be performed prior to performing the compromise equalizer test.

4.17 A VOM or a 921A DTS is required at the local data set and the distant-end data set must have the DL and ST switches depressed. In this test, an effort is made to minimize the negative test voltage at test points located on CP KD16 in the local data set. The voltages at these test points provide an indication of data set performance. Smaller negative voltages indicate better performance, while larger negative voltages represent poorer performance. If the factory-supplied options WK, WN, WP, and WS result in a test voltage of -1.25 volts or less, the data channel has adequate equalization for good performance and the complete compromise equalizer test need not be performed.

4.18 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	Contact distant-end data station and ensure that options WK (S1-4), WN (S1-2), WP (S3-1), WS (S1-7), and XG (S5-6) or XI (S5-8) are installed in distant-end data set.	
2	Have DL and ST switches on distant-end data set depressed.	
3	Ensure that options WK (S1-4), WN (S1-2), WP (S3-1), WS (S1-7), and XG (S5-6) or XI (S5-8) are installed in local data set.	

STEP	ACTION	VERIFICATION
4	Set multiplexer selector switch on local data set to 2400 bps. (This conditions the QUAL 2 OUT test point on KD16 of the local data set to indicate the quality of the received signal at the distant-end data set.)	24 lamp lights.
5	Depress ST switch on local data set. Ignore momentary blinking of status lamps.	
6	If a 921A DTS is used, ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
7	On DTS, enter 12.	Display reads— TEST SEQ: 12
8	Refer to Fig. 5 and connect a meter lead from analog ground test point on data set to INPUTS—METER - jack on DTS. ***Note:*** All voltage measurements in this test are negative with respect to analog ground. Therefore, if a VOM is used instead of the 921A DTS, the positive (+) terminal must be connected to the analog ground test point to obtain a positive meter indication.	
9	Refer to Fig. 5 and connect a meter lead from QUAL 1 OUT test point on data set to INPUTS—METER + jack on DTS.	
10	On DTS, press GO.	From this point, DTS display reads voltage present at QUAL 1 OUT test point.
11	Verify that option shorting jack is installed at S1-4. Record average value of first two digits displayed. ***Note:*** If requirement is met, omit Steps 12 through 17.	***Requirement:*** -1.25 volts or less negative.
12	Remove option shorting jack from S1-4 and install at S1-5. Record average value of first two digits displayed.	
13	Install option shorting jack at location (S1-4 or S1-5) that had average value nearest zero. ***Note:*** Good performance of the data channel is indicated by a test voltage less negative than -0.75 volts, while marginal performance	***Requirement:*** -2.00 volts or less negative.

STEP	ACTION	VERIFICATION
	is indicated by a test voltage more negative than -2.00 volts.	
14	Verify that option shorting jack is installed at S1-2. Record average value of first two digits displayed.	
15	Remove option shorting jack from S1-2 and install at S1-1. Record average value of first two digits displayed.	
16	Remove option shorting jack from S1-1 and install at S1-3. Record average value of first two digits displayed.	
17	Install option shorting jack at location (S1-1, S1-2, or S1-3) that had average value nearest zero.	***Requirement:*** -2.00 volts or less negative.
18	Refer to Fig. 5 and disconnect meter lead from QUAL 1 OUT test point on data set and connect to QUAL 2 OUT test point.	From this point, DTS display reads voltage present at QUAL 2 OUT test point.
19	Verify that option shorting jack is installed at S3-1. Record average value of first two digits displayed.	***Requirement:*** -1.25 volts or less negative.
	Note: If requirement is met, omit Steps 20 through 26.	
20	Remove option shorting jack from S3-1 and install at S3-3. Record average value of first two digits displayed.	
21	Install option shorting jack at location (S3-1 or S3-3) that had average value nearest zero.	***Requirement:*** -2.00 volts or less negative.
22	Verify that option shorting jack is installed at S1-7. Record average value of first two digits displayed.	
23	Remove option shorting jack from S1-7 and install at S1-6. Record average value of first two digits displayed.	
24	Remove option shorting jack from S1-6 and install at S1-8. Record average value of first two digits displayed.	
25	Install option shorting jack at location (S1-6, S1-7, or S1-8) that had average value nearest zero.	***Requirement:*** -2.00 volts or less negative.

STEP	ACTION	VERIFICATION
26	Refer to Fig. 5 and disconnect meter lead from QUAL 2 OUT test point on data set and connect to QUAL 1 OUT test point. Record average value of first two digits displayed.	DTS display reads voltage present at QUAL 1 OUT test point. ***Requirement:*** -2.00 volts or less negative.
27	If option XF (S5-3) or XH (S5-7) was removed from local data set in Step 3, install removed option.	
28	Contact distant-end data station and have DL and ST switches on distant-end data set released.	
29	Ensure that options in distant-end data set are restored to pretest condition.	

I. Power Supply Test

4.19 This test checks that ac voltage appears at the power supply input and then measures the +12, +5, and -12 volt supply voltages at the customer interface.

4.20 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Enter 12.	Display reads— TEST SEQ: 12
3	Connect jumper wire from DCE interface lead jack 7 to - METER jack.	
4	Connect jumper wire from DCE interface lead jack 9 to + METER jack.	
5	On data set, if ON lamp fails to light or lights momentarily and goes off, check ac source voltage with a VOM. ***Note:*** DS 209A-L1 is equipped with a circuit breaker that will trip under excessive current and thermal conditions. To reset circuit breaker, operate switch located inside rear faceplate. The data set cooling fan is under control of a fuse that is located near circuit breaker. A replacement fuse (AGC 1/2 ampere) is mounted at front of data set power unit, or one may be obtained from maintenance kit D-180555-L1. The data set is also provided with a self-resetting thermal overload switch	ON lamp is lighted. ***Requirement:*** 105 to 129 volts RMS.

STEP	ACTION	VERIFICATION
	that disconnects the power unit if the power unit temperature rises excessively.	
6	Press GO.	Display reads voltage present at jack 9. ***Requirement:*** +11.5 to +12.5 volts.
7	Move jumper wire from jack 9 to jack 10.	Display reads voltage present at jack 10. ***Requirement:*** -11.5 to -12.5 volts.
8	Move jumper wire from jack 10 to jack 25.	Display reads voltage present at jack 25. ***Requirement:*** +4.5 to +5.5 volts.
9	Remove jumper wires from DCE interface lead and METER jacks.	

J. CA-CB (RS-CS) Interval Test

4.21 This test measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) lead turns ***on.***

4.22 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads __ TEST SEQ:
2	Depress AL switch on data set.	
3	On DTS, enter 30.	Display reads __ TEST SEQ: 30
4	Press GO. ***Note 1:*** Only the option actually installed in the data set need be tested. Refer to Table B and Fig. 5. ***Note 2:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** Option XF—130 to 160 ms Option XG—6.0 to 9.0 ms Option XH—130 to 160 ms
5	Release AL switch on data set.	

K. CA-CF (RS-COD) and CA-CG (RS-COV) Intervals Test

4.23 In this test the interval between CA (request-to-send) and CF (carrier on) is measured. The interval between CA and CG (signal quality detector) is also measured.

4.24 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	If option XF is not installed in data set, remove option XG, XH, or XI and temporarily install option XF.	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Depress AL switch on data set.	
4	On DTS, enter 31 and 32.	Display reads— TEST SEQ: 31 32
5	Press GO.	Display reads RS-RLSD (CA-CF) interval in milliseconds.
6	Record number indicated on display (for example, 135.0).	
7	Press GO.	Display reads RS-SQD (CA-CG) interval in milliseconds.
8	Subtract number indicated on display from number recorded in Step 6 (for example, 135.0 - 08.00 = 127.0 ms).	***Requirement:*** Result is between 120 and 140 ms.
9	Release AL switch on data set.	
10	If option XF was temporarily installed in data set in Step 1, remove this option and install option removed in Step 1 (XG, XH, or XI).	

L. Transmitter Output Test

4.25 This test measures the output level of the transmitted signal.

4.26 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	If option XG is not installed in data set, remove option XF, XH, or XI and temporarily install option XG.	

STEP	ACTION	VERIFICATION
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads – TEST SEQ:
3	Refer to Fig. 5 and connect a meter lead from analog ground test point on data set to INPUTS—METER - jack on DTS.	
4	Refer to Fig. 5 and connect a meter lead from TRMTR OUT test point on data set to INPUTS—METER + jack on DTS.	
5	Insert a 600-ohm terminating resistor into INPUTS—METER + and - jacks.	
6	Enter 11.	Display reads (briefly)— TEST SEQ: 11 Display then reads— :11R=? 1=135 6=600 9=900 0=N
7	Enter 6.	Display reads (briefly)— :11R=6 1=135 6=600 9=900 0=N Display then reads— :
8	Press GO.	Display reads transmitter output level in mV ac and dBm. ***Requirement:*** More than 750 mV ac.
9	Disconnect meter leads from DTS and data set.	
10	If option XG was temporarily installed in data set in Step 1, remove this option and install option removed in Step 1 (XF, XH, or XI).	

M. End-to-End Block Error Test

4.27 This test checks the transmitter and receiver of both data sets and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

4.28 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test.	

STEP	ACTION	VERIFICATION
	Note: If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations.	
	At both stations, perform Steps 2 through 8.	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	On DTS, enter 55.	Display reads— TEST SEQ: 55.
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0300. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0300 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 30.

N. External Timing Test

4.29 This test checks the external timing of DS 209A-L1 during normal and abnormal operation. This test is required ***only*** if external timing (option YD) is installed in the data set. Refer to Table B and Fig. 5.

4.30 During normal operation with external timing the data set phase locks to the serial clock transmitter external (DA) signal provided by the CPE or a DTS. The phase-locked signal produces the serial clock transmitter (DB) signal that is used to synchronize the transmitted data. The abnormal operation for this test is produced by disconnecting the DA signal provided by the DTS and connecting DA to DB. This causes the transmit phase-lock loop to be shifted to the end of its range. As a result, the serial clock receive (DD) signal cannot synchronize with the looped back transmitted signal and errors are produced.

4.31 Perform the test as follows.

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	Depress AL switch on data set.	
3	For Version 1 DTS, enter 43.	Display reads— TEST SEQ: 43
4	For Version 1 DTS, press GO.	Display reads— BIT RATE:
5	For Version 1 DTS, enter first two digits of bit rate corresponding to customer interface connector used in Step 1 of initial test setup (paragraph 4.10). Refer to Table A.	Display reads (briefly)— BIT RATE: and digits entered Display then reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
8	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
9	Enter 2.	Display reads— ????? BITS IN A BLOCK
10	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS

STEP	ACTION	VERIFICATION
11	Enter 0060. ***Note:*** To perform functions listed below, press associated key. **KEY** **FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0060 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.
12	Set DCE interface lead switch 24 to OPEN.	
13	Connect a jumper wire between DCE interface lead jacks 15 and 24.	
14	Repeat test by pressing A. ***Note:*** When display flashes OSYN, do not press A.	***Requirement:*** Total blocks in error are more than 100.
15	Press GO.	Display reads briefly— TEST INTERRUPTED Display then reads— TEST SEQ:
16	For Version 1 DTS, enter 46.	Display reads— TEST SEQ: 46
17	For Version 1 DTS, press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
18	Remove jumper wire from DCE interface lead jacks.	

O. Elastic Stores Test

4.32 This test checks the elastic stores of DS 209A-L1 during normal and abnormal operation. This test is required ***only*** if an elastic store enable in option (WA, WC, WE, and WG) is installed in the data set. Refer to Table B and Fig. 5. This test should be performed at each customer interface connector associated with an installed elastic store enable in option. The customer interface connectors and the associated elastic store enable in options are: connector 1, option WA; connector 2, option WC; connector 3, option WE; and connector 4, option WG.

4.33 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	If option XI is not installed in data set, remove option XF, XG, or XH and temporarily install option XI.	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Connect a jumper wire between DCE interface lead jacks 15 and 24.	
4	Depress AL switch on data set.	
5	On DTS, enter 55.	Display reads— TEST SEQ: 55
6	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
7	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
8	Enter 2.	Display reads— ????? BITS IN A BLOCK
9	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
10	Enter 0060. *Note:* To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0060 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.

STEP	ACTION	VERIFICATION
11	Remove jumper wire from DCE interface lead jacks 15 and 24.	
12	Repeat test by pressing A. ***Note:*** When display flashes OSYN, do not press A.	***Requirement:*** Total blocks in error are more than 100.
13	Set DCE interface lead switch 4 to OPEN.	
14	Repeat test by pressing A.	***Requirement:*** No blocks in error.
15	Release AL switch on data set.	
16	If option XI was temporarily installed in data set in Step 1, remove this option and install option removed in Step 1 (XF, XG, or XH).	

P. Analog Loopback Start-Up Test

4.34 This test checks the ability of the data set to begin error-free transmission. The data set must be equipped with switched carrier and 1-second holdover out.

4.35 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	If continuous carrier (option XG or XI) is installed in data set, remove this option and temporarily install switched carrier (option XF or XH).	
2	If 1-second holdover in (option YX) is installed in data set, remove this option and temporarily install 1-second holdover out (option YW).	
3	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
4	Depress AL switch on data set.	
5	On DTS, enter 67.	Display reads— TEST SEQ: 67
6	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
7	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR

STEP	ACTION	VERIFICATION
8	Enter 2.	Display reads— PRESS A TO START
9	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
10	At end of about 1 minute, press D.	***Requirement:*** Zero count on ERR and * displays.
11	Release AL switch on data set.	
12	If option YW was temporarily installed in data set in Step 2, remove this option and install option YX.	
13	If option XF or XH was temporarily installed in data set in Step 1, remove this option and install option removed in Step 1 (XG or XI).	

Q. End-to-End Start-Up Test

4.36 This test checks the ability of both data sets to begin error-free transmission. In this test, one end is arbitrarily selected as the controlling station. This station has operating control of the test. The controlled station must be equipped with switched carrier and 1-second holdover out.

4.37 Perform the test as follows.

Note: For option installation and removal information, refer to Table B and Fig. 5.

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-up test.	

STEP	ACTION	VERIFICATION
	Note 1: If continuous carrier (option XG or XI) and/or 1-second holdover in (option YX) are installed in data set at controlled station, temporarily install switched carrier (option XF or XH) and/or 1-second holdover out (option YW).	
	Note 2: Procedure at controlled station must be performed first.	
	At controlled station, perform Steps 2 through 7.	
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	On DTS, enter 68.	Display reads— TEST SEQ: 68
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	If switched carrier (option XF or XH) is installed in data set at controlling station, enter 2. If continuous carrier (option XG or XI) is installed in data set at controlling station, enter 3.	Display reads— PRESS A TO START On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
6	Place data set in data mode.	
7	Press A. ***Note:*** When A is pressed in Step 14, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays.	Display reads— BLK RCVD=0000 ERR=0000 * =0000 After A is depressed at ***controlling*** station, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block. All displays stop counting when D is pressed at ***controlling*** station. ***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
	At controlling station, perform Steps 8 through 15.	
8	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
9	Enter 67.	Display reads— TEST SEQ: 67
10	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
11	If switched carrier (option XF or XH) is installed in data set at controlling station, enter 2. If continuous carrier (option XG or XI) is installed in data set at controlling station, enter 3.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
12	Enter 2.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
15	At end of about 2 minutes, press D. ***Note:*** If option XF or XH and/or option YW were temporarily installed in data set at controlled station, remove these options and install options that were removed (XG or XI and/or YX).	***Requirement:*** Count of less than 2 on ERR display and zero count on * display.

R. Repair Test

4.38 This test provides a method for isolating a data set trouble to a single circuit pack (CP). Table C lists the individual tests in the sequence in which they are to be performed, and also lists the associated CPs that might be defective if the test fails.

4.39 If the data set fails a test listed in Table C, proceed as follows.

(1) Refer to list of CPs associated with test that failed.

(2) Replace first CP in list and repeat test.

(3) If data set still fails test, restore original CP in data set.

(4) Continue replacing, testing, and restoring CPs in sequence in which they are listed until data set passes test. The last CP replaced is cause of trouble.

Note: If CP KD14, KD17, or KD18 is replaced, install correct options before proceeding.

(5) If all CPs have been replaced and cause of trouble has not been found, notify supervision.

TABLE C

REPAIR PROCEDURES

TEST	CP REPLACEMENT SEQUENCE*	TEST	CP REPLACEMENT SEQUENCE*
Power Supply	112A Power Supply †	Analog Loopback Start-Up	KD1 KD2 KD3 KD4 KD5 KD6 KD7 KD13 KD15 KD17 KD19 KD8 KD9 KD10 KD11 KD12 KD14 KD16 KD18
CA-CB (RS-CS) Interval	KD18 KD9 KD11 KD10		
Transmitter Output	KD9 KD10 KD11 KD14 KD16 KD18		
CA-CF (RS-COD) and CA-CG (RS-COV) Intervals	KD18 KD16 KD14 KD12 KD8 KD6 KD10		

* Replace using the methods given in Section 592-032-200. AC power removal is not required.

† If the power supply test again fails after removing all CPs except KD15, measure the voltages present on the power supply terminal strip. Remove KD15 and again measure the power supply voltages. If the test fails, the power supply is defective. If the test passes, KD15 is defective.

5. REFERENCES

5.01 Additional information concerning the testing of DS 209A-L1 is contained in the following publications.

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-410-105	Voice Bandwidth Private Line Data Circuits—High Performance Data Conditioning (HPDC)—Description and Test Requirements
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
592-032-100	Data Set 209A-L1—Transmitter-Receiver—Description and Operation
592-032-200	Data Set 209A-L1—Transmitter-Receiver—Installation and Connections
592-032-300	Data Set 209A-L1—Transmitter-Receiver—Maintenance
592-032-500	Data Set 209A-L1—Transmitter-Receiver—Test Procedures
666-511-504	Test of Data Services Provided by Data Set 209A-L1 From a Private Line Testroom
999-100-143	Data Set 209A-L1—How to Operate Manual

5.02 Detailed information concerning DS 209A-L1 is contained in CD- and SD-1D249-01.

DATA SET 212A-L1A/2A
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional description and operating procedures for data set (DS) 212A. Other than a description of interface signals and customer options, information pertaining to the customer-provided equipment (CPE) is not given.

1.02 This section is reissued to provide BSP coverage for the new version of DS 212A-L1A/2A. The new version provides all the features and options of the older DS 212A and in addition provides additional interface circuits, options, and simplified testing. These features are described as follows:

- Test Voltages—Plus and minus 14 Vdc have been provided on pins 9 and 10 of the customer interface to facilitate data set testing.

- Test Mode (TM) Indication and Make Busy/Analog Loop (CN)—A new customer option enables either pin 25 or pin 18 of the customer interface to control the CN circuit. When CN is optioned for pin 18, the TM circuit can be optionally installed on pin 25. CN on pin 18 and TM on pin 25 would be used to implement an interface which would be compatible with the proposed International Organization for Standardization 25-pin interface.

- Interface Controlled Remote Digital Loop (RL)—When this new customer option is activated, the RL test may be activated through pin 21 of the customer interface.

- Speed Control—This new customer option enables high-speed or low-speed operation of an originating data set to be controlled through pin 23 of the customer interface or with the front panel HS button.

- Terminal ready (TR) indicator is lighted during either digital loopback or self test.

- Self test overrides both high-speed (HS) and remote digital loop (RL) interface leads.

- Slave transmitter timing (option WI) is overridden in analog loopback mode.

1.03 Data set 212A (Fig. 1) provides full-duplex transmission and reception of serial binary data at two distinct bit rates over the switched network. In the low-speed mode, the maximum bit rate is 300 bits per second (bps). In the high-speed mode, operation is synchronous or character-asynchronous at 1200 bps.

1.04 The following is a technical specification summary for DS 212A.

Data Rates:

- Low-Speed—Asynchronous, 0 to 300 bps.

- High-Speed—Character-asynchronous format, 1200 bps (+1.0, -2.5 percent).

- High-Speed—Synchronous format, 1200 bps (±0.01 percent).

Operation:

- Low-Speed—Asynchronous, binary, serial.

- High-Speed—Character-asynchronous or synchronous, binary, serial.

Operating Mode: Full-duplex at all speeds.

Line Requirement: 2-wire switched network.

Line Signals:

- Low-Speed—Frequency shift keyed (FSK).

- High-Speed—Phase shift keyed (PSK).

Data Set Compatibility:

- Low-Speed—Existing 100-type, 300-baud FSK switched network data sets, and DS 212A.

- High-Speed—DS 212A only.

Interface Voltages: Per Electronic Industries Association (EIA) RS-232-C.

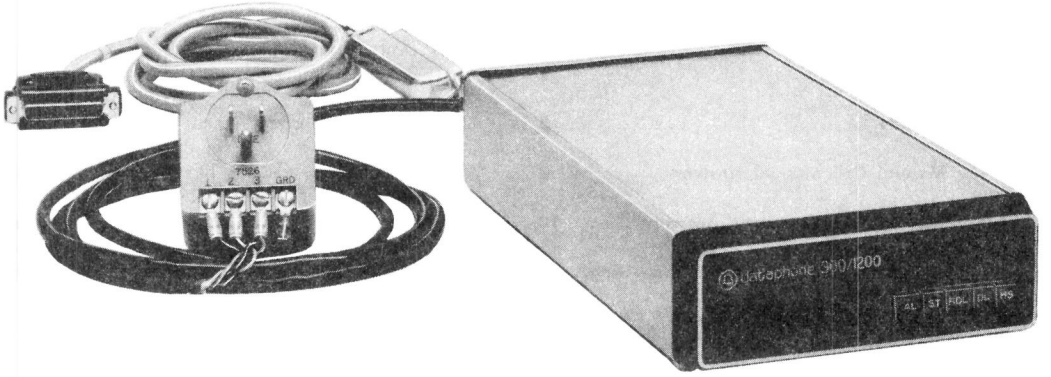


Fig. 1—Front View of DS 212A-L1A/2A

Interface Compatibility: Same as data sets 100-type with additional timing and control functions.

AC Power: 117 volts ±10 percent, 60 Hz ±5 percent. Single data set consumes 9 watts maximum. Power outlet should be a conventional 3-wire type not under switch control.

Environmental Requirements:

- Ambient temperature range from 40 to 120°F.
- Relative humidity from 20 to 95 percent at 75°F or 20 to 40 percent at 120°F with no condensation.

Dimensions of DS 212A-L1A:

- Height: 2.2 inches
- Width: 5.8 inches
- Depth: 10.8 inches.

Weight of DS 212A-L1A/2A: 4 pounds without transformer.

2. PHYSICAL DESCRIPTION

2.01 List code designations have been assigned to DS 212A as follows:

- DS 212A-L1A: Printed circuit pack assembly shown in Fig. 2.
- DS 212A-L1A/2A: Housing assembly, front and rear covers, interface assembly, power cord and transformer, and M13F telephone interface cord. This group of apparatus is coded as the 47D2 data mounting to simplify ordering when needed for field conversion of DS 212A-L1A to DS 212A-L1A/2A.

Orderable codes are DS 212A-L1A and DS 212A-L1A/2A.

DS 212A-L1A

2.02 DS 212A-L1A consists of two printed circuit boards interconnected by a flexible cable. The overall dimensions of the data set circuit board assembly are 5.55 inches wide, 10.40 inches long, and 1.50 inches high. The assembly weighs approximately 1.5 pounds. The circuit board has a faceplate through which are mounted the status indicators and buttons for test and control.

2.03 The status indicators are light emitting diodes (LEDs) which monitor the status of various interface leads and operating modes of the data set. When the data set is installed in the mounting with the covers in place, the LEDs illuminate "dropout" graphics on the front cover. "Dropout" graphics provide for the appearance of the 2-letter abbreviation when the LED is lighted and a continuous black opaque surface when the LED is off.

2.04 The indicators are as follows:

- MB (Make Busy)—This indicator is lighted when the make busy relay is operated. The relay is operated when the analog loop (AL) button is depressed or when the CN (make-busy/analog loop) lead from the CPE is ***on*** and option YE (CN circuit—IN) is installed.
- TR (Terminal Ready)—This indicator is lighted when the CD (data terminal ready) lead from the CPE is ***on,*** or when ST or DL switches are depressed. The TR indicator is also lighted when the data set is remotely commanded to enter the digital loopback mode.
- MR (Modem Ready)—This indicator is normally lighted when the CC (data set ready) lead to the CPE is ***on,*** and is optionally lighted in certain test modes.
- SD (Send Data)—This indicator monitors the BA (transmitted data) lead in both the data mode and the analog loopback mode. The indicator is lighted for space and off for mark.
- RD (Received Data)—This indicator monitors the BB (received data) lead in both the data mode and the analog loopback mode. The indicator is lighted for space and off for mark.
- HS (High-Speed)—This indicator is lighted when the data set is operating at 1200 bps (high-speed) in either the data mode or analog loopback test mode. It is off at all other times.

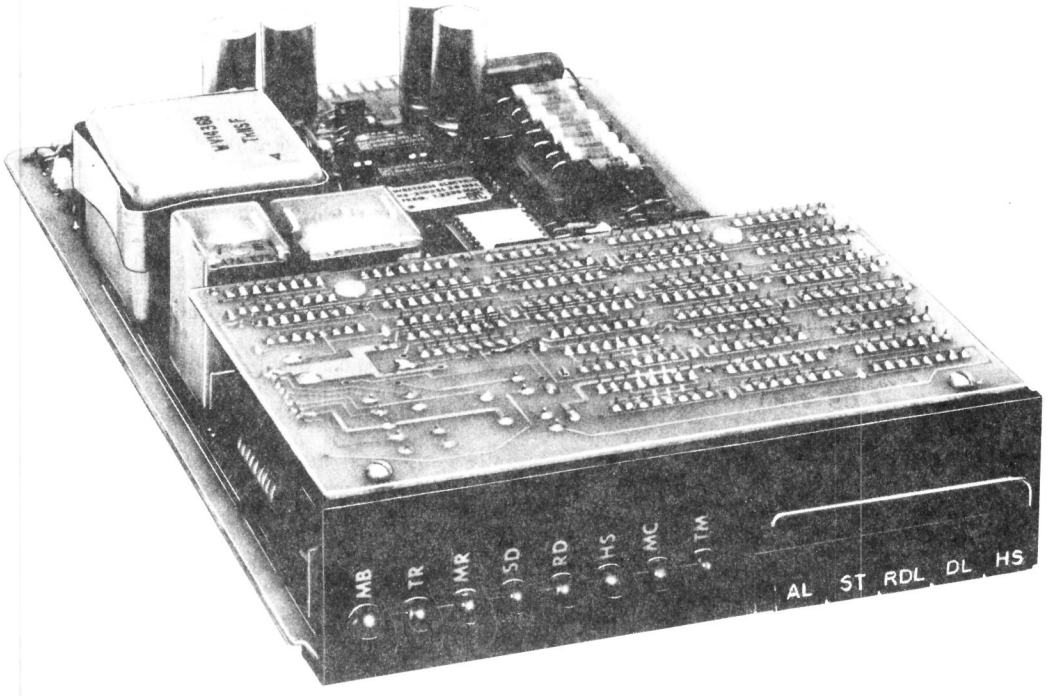


Fig. 2—DS 212A-L1A

- MC (Modem Check)—This indicator is lighted in the idle mode or in the data mode when carrier is not being received. The indicator blinks for 300 ms when an error is detected in any test mode where the ST button is depressed.

- TM (Test Mode)—This indicator is lighted when the data set is in any test mode.

2.05 Five push button switches are provided for control and testing of DS 212A. These switches are mounted in a faceplate in order to be accessible to both customer and telephone company (telco) personnel.

The switch functions are as follows:

- AL (Analog Loopback)—The set will go into the analog loop mode when the switch is depressed and the customer data terminal ready lead (CD) is on. When depressed, the AL switch disables the transmitter timing—slave (option WI). This allows an analog loopback test in the high-speed mode when the slave timing option is installed. It can be used to make the data set loop back to the terminal, or in conjunction with the ST button to give a self-check of the data set independent of customer equipment and telephone line. The make busy relay will be activated and the "TM" indicator lighted. If test mode indication on pin 25 (option XR) is installed, pin 25 goes high.

- ST (Self Test)—The switch is used, in the data mode, or in conjunction with AL to condition the set to transmit a test pattern and examine the received data for errors. With ST depressed it is not necessary to

have CD on. When ST is depressed, the CN (make busy/analog loopback), RL (remote digital loopback), and CH (speed mode selector) circuits are disconnected from the interface and prevented from having any effect on the test state. Speed control of the originate data set is automatically transferred to the front panel HS switch. It is not possible to change the speed mode of the data set once it is in the data mode.

Each error will cause the MC light to blink at least for 300 ms. The "TM" and "TR" indicators are lighted when this switch is depressed.

- RDL (Remote Digital Loopback)—When depressed, the switch causes the far-end data set to loop the data back to the near-end set. It is enabled only in the high-speed data mode. The "TM" indicator will be lighted. If test mode indication on pin 25 (option XR) is installed, pin 25 goes high.

- DL (Digital Loopback)—This switch conditions the set for automatic answer and allows the set to be tested from a remote location. It causes a local digital loop and overrides the customer controlled data terminal ready. The "TM" and "TR" indicators are lighted.

- HS (High-Speed)—This switch will control the speed of an originating station if the CI (customer interface speed select) option is out. When depressed, the switch conditions an originating (calling) data set to operate at 1200 bps. When not depressed, a calling set is conditioned to operate at 0 to 300 bps. It must be depressed prior to going into the data mode if the high speed operation is desired. The speed mode of the answering set is automatically determined by the originating set; therefore, its HS switch position is inconsequential.

2.06 Installer options are accomplished by setting the positions of individual rockers of four multiple section rocker assemblies (Fig. 3), strapping plugs, and a screw switch on the backplane. Refer to Section 592-034-200 for instructions on selecting and installing options.

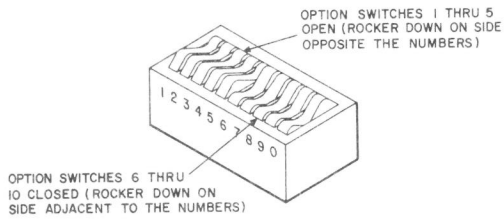


Fig. 3—Option Switch

DS 212A-L1A/2A

2.07 The mounting provided as part of list 2 is extruded aluminum with brushed finish. The front and rear covers are of molded plastic with the reverse side painted black. The circuit pack assembly plugs into an interface assembly (Fig. 4) which mounts in the rear of the mounting.

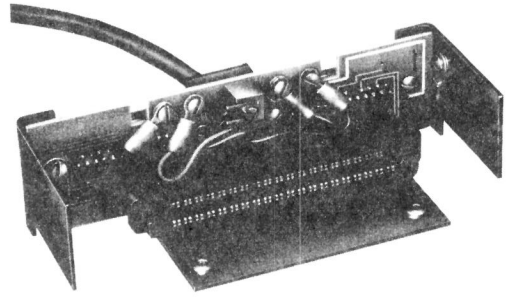


Fig. 4—Interface Assembly (P/O 47D2 Mounting)

2.08 The mounting with data set installed measures 5.8 inches wide, 11.2 inches long, and 2.2 inches high. The weight is approximately 4 pounds.

2.09 The interface assembly has two interface connectors which are accessible through the rear cover. One connector provides a 25-pin interface between the data set and CPE. The other connector provides a 25-pin interface between the data set and telephone equipment via the M13F cord. The interface assembly provides the electrical interconnection from the gold fingers of the data

set circuit board to the two interface connectors and the power transformer.

2.10 Power to the data set is provided by a KS-21239-L5 transformer which plugs into a standard 117 Vac 3-wire grounded outlet. The transformer weighs about 1 pound. This transformer provides 24 Vac and a ground which are brought out on four screw terminals to which the data set power cord is attached.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains information pertaining to the operating modes, test modes, interface leads, and options.

GENERAL OPERATION

3.02 DS 212A simultaneously transmits and receives serial binary data over the voice-grade switched telephone network. This full-duplex operation is achieved by frequency division multiplexing (similar to that used in data sets 100-type). The originating data set transmits in a low frequency band and receives in a high frequency band. The operation of the answering data set is complementary; it receives in the low frequency band and transmits in the high frequency band.

3.03 The data set has three operating formats:

- Asynchronous 0 to 300 bps
- Character asynchronous with the data in 9-bit or 10-bit start-stop character format at 1200 bps (+1, -2.5 percent)
- Synchronous at 1200 bps.

3.04 Character-asynchronous operation occurs when characters arrive at the CPE interface at random intervals. It is not bit asynchronous as is the low-speed mode but gives the appearance of asynchronous operation to the CPE. Each character must consist of an initial (spacing) start bit, 8 (or optionally 7) information bits, and one (marking) stop bit.

3.05 Option switches are provided to select either the synchronous or character-asynchronous data format at 1200 bps. A speed mode—HIGH option is provided which causes the data set to block the transmission and reception of customer data if the data set enters the low-speed mode. When the synchronous format is selected, transmit and receive clocks are provided at the CPE interface.

3.06 Speed selection is performed differently at the originating and answering stations. At the originating station, speed selection is under customer control by use of a pushbutton switch (HS) on the front panel of the data set or through the interface by making pin 23 high if option XJ is installed. At the answering station, speed selection is performed automatically, independent of the speed selection at that end. For the purpose of speed selection and recognition, there is no distinction between 1200-bps synchronous and 1200-bps character-asynchronous operation. The answering station replies at the same speed used at the originating station. During data transmission both stations are at the same speed. Changing speed during the data portion of a call is not possible and should not be attempted.

TEST MODES

3.07 DS 212A is provided with built-in test features which can be used during installation or maintenance. These tests make use of the test buttons and status indicators on the data set. Procedures and requirements for these tests are contained in Section 592-034-500.

A. Analog Loopback

3.08 The purpose of this test is to check the local data set by the use of a full-duplex CPE, data set self-test feature, or 914- or 921-type data test set. This test can be initiated in either of two ways:

(a) The AL switch is pressed and the CD (data terminal ready) lead is ***on.***

(b) The CN (make-busy/analog loop) and the CD (data terminal ready) leads are both ***on*** and option YE (CN circuit—IN) is installed.

3.09 The speed mode of the test is selected by use of either the HS button on the front panel or interface control. DS 212A follows a "handshaking" sequence when entering the analog loopback test mode which resembles the data mode sequence. The speed mode of the test can be changed during the test, in which case, the data

set reinitializes the test sequence in the new speed mode.

3.10 If option ZF (CC indication for analog loop—ON) is installed, the customer interface CC (data set ready) lead is ***on*** whenever the AL switch is depressed or if the CN (make-busy/analog loop) circuit is ***on*** and option YE (CN circuit—IN) is installed. The TM indicator on the front panel is lighted whenever the AL switch is depressed or the CN circuit is ***on*** and option YE is installed.

B. Analog Loopback Self Test

3.11 The test is initiated by depressing both the AL and ST switches. Internal to the data set, an analog loopback is established in the same way as the analog loop test mode except that the customer interface circuits remain ***off.*** DS 212A generates a dotting test pattern which is applied to the transmitter, looped back to the receiver, and applied to an error detection circuit. If the analog loopback self test is being done in the low-speed mode, the error detection circuitry causes the MC indicator to blink if the length of a received data bit is outside the nominal length by 25 percent or more. If DS 212A is in the high-speed mode, the MC indicator blinks if a bit error is detected in the received data.

C. End-to-End Self Test

3.12 This test can be used to check the local data set, the distant data set, and the communication channel. This test is performed by depressing the ST switch at each end, placing a call from one end to the other, and then going to the data mode. Each data set sends the test pattern to the other end. The error-detecting circuitry at each end monitors the received data signal and causes the MC indicator to blink if the distortion threshold is exceeded (low-speed) or if an error is detected (high-speed). The speed mode of this test is controlled by the speed mode at the originating station. CD need not be turned on for this test.

D. Digital Loopback Test

3.13 When DS 212A is placed in the digital loopback mode, it is conditioned to act as a repeater. This test mode can be used to test the data set from the distant end or from a data test center (DTC). The test is performed by placing a call to the data set to be tested. The data set answers automatically and goes to the data mode. When the DL switch is depressed, the DS 212A is conditioned as follows:

Note: Depressing the DL key conditions the data set for automatic answer and internally turns on the TR lead.

- The data set answers automatically independent of options ZH and ZG.
- The CD (data terminal ready) lead is held ***on*** internally and the TR indicator lights.
- Received data is looped back to transmitted data internally.
- Receiver timing is looped back to transmitter timing (in high-speed mode).
- Interface circuits CC (data set ready), CB (clear to send), and CF (received line signal detector) are held ***off.***
- TM indicator lights.

The digital loopback test cannot be done in the 1200-bps mode if the distant (testing end) DS 212A is optioned for transmitter timing—SLAVE (WI).

3.14 If DS 212A is installed in a multiple housing (40A2 or 40A3 data mounting), the data set is transferred to the service line when the DL button is depressed. When the data set is taken out of the DL mode, the data set is transferred back to the normal telephone line.

3.15 When the data set is in the digital loopback mode, it is conditioned to disconnect upon loss of carrier which may occur during the test. Therefore, when the testing end has completed testing and gone out of the data mode, the loss of carrier at the data set under test causes it to disconnect from the line. The data set is taken out of the digital loopback mode by releasing the DL switch.

E. Digital Loopback Self Test

3.16 This test takes advantage of the digital loopback capability of the data set at one end and the self-test (pattern generating and

comparing) capability of the data set at the other end. The test is performed by putting one data set in the DL mode, placing the other data set in the ST mode, placing a call from one end to the other, and then going to the data mode. The MC indicator on the data set which is in the ST mode blinks when data distortion of a single bit exceeds 25 percent (low-speed) or if a received error occurs (high-speed). The data set in the DL mode is conditioned the same as previously described in paragraph 3.13. In the ST mode, the transmitter timing option is forced to the INTERNAL position.

F. Remote Digital Loopback

3.17 DS 212A has the capability to force the distant data set into a digital loopback mode. The test can only be used when the data set is in the high-speed mode. The distant data set must have option ZH (automatic answer—IN) installed and the CD (data terminal ready) interface circuit must be ***on.*** After a call has been placed to the distant data set, this test can be initiated by manually depressing the RDL switch or (provided option XL is installed) through pin 21 of the customer interface on the testing data set.

3.18 The digital loopback takes place at the distant data set only if option YK (receiver responds to digital loop—IN) is installed at that end.

This test cannot be done if the testing DS 212A is equipped with option WI (transmitter timing—SLAVE).

G. Remote Digital Loopback Self Test

3.19 This test takes advantage of the remote digital loopback and self-test capability of the local data set and can be used to test both data sets and the communication channel. The distant data set is placed in the remote digital loopback mode as previously described in paragraph 3.17.

> ***Note:*** The local set can initiate an RDL only via the RDL pushbutton when ST is also depressed.

The local data set is then placed in the self-test mode. The local data set pattern generator is used to send a signal to the distant end, where it is looped back and retransmitted. The error-detecting circuitry causes the MC indicator on the local data set to blink when an error is detected in the received data.

INTERFACE

3.20 The customer interface is accessible through a 25-pin female connector at the rear of the mounting. The pin assignments, lead designations, and lead descriptions are given in Table A.

3.21 The telephone interface is accessible through a 25-pin male connector at the rear of the mounting. The pin assignments, lead designations, and lead descriptions are given in Table B.

OPTIONS

3.22 DS 212A is provided with a number of features or options which may be requested by the user. Some of these features are available as customer options; others are available as telco engineering options.

3.23 Options are installed and removed by means of switches and strapping plugs on the circuit board and by a screw switch on the backplane. Refer to Table C for a summary of data set options. Refer to Section 592-034-200 for a more complete description of the data set options.

4. OPERATION

4.01 A call may be originated either automatically with an automatic calling unit (ACU) or manually with the associated telephone set. Either manual or automatic answer may be used to receive a call; however, when a call is manually answered, manual calling must be used. The call setup procedures are the same for high- or low-speed operation.

A. Manual Call/Manual Answer

4.02 The procedure for manual call/manual answer is as follows:

(a) The calling attendant picks up the telephone handset, depresses the appropriate line key, and after hearing dial tone, dials the number of the distant data station.

TABLE A

CUSTOMER INTERFACE

PIN NO.	EIA DESIG	FUNCTION	SIGNAL ORIGINATED BY CPE OR BY DS
2	BA	Send Data (SD) (Note 1)	CPE
3	BB	Receive Data (RD) (Note 1)	DS
5	CB	Clear-to-Send (CS) (Note 2)	DS
6	CC	Data Set Ready (DSR) (Note 2)	DS
7	AB	Signal Ground (SG)	Ground
8	CF	Received Line Signal Detector (RLSD) (Note 2)	DS
9	—	+P	DS
10	—	—P	DS
12	CI	Speed Indication (CI) (Note 3)	DS
15	DB	Transmit Clock (SCT)	DS
17	DD	Receive Clock (SCR)	DS
18	(CN)	Make Busy/Analog Loop (Optional Pin)	DS
20	CD	Date Terminal Ready (DTR) (Note 2)	CPE
21	RL	Remote Digital Loopback	DS
22	CE	Ring Indicator (RI) (Note 5)	DS
23	CH	Speed Select Originate	DS
24	DA	External Transmit Clock (SCTE)	CPE
25	CN or TM	Make Busy/Analog Loop or Test Mode (Note 4)	CPE

Note 1: Space = +V; Mark = —V

Note 2: ON = +V; OFF = —V

Note 3: High Speed = +V; Low Speed = —V

Note 4: Loopback = +V; Normal Use = —V

Note 5: Ringing = +V; No Ringing = —V

(b) At the called data set, ringing is heard, the CE (ring indicator) circuit turns ***on***, and the appropriate line lamp lights when ringing voltage is applied. The attendant answers the call by depressing the appropriate line key, picking up the handset, and establishing voice contact with the calling attendant.

(c) Both attendants verify that the CD (data terminal ready) circuit is ***on*** (TR lamp on data set lighted). The calling attendant verifies that the proper speed mode has been selected.

(d) To transfer to the data mode, both attendants momentarily depress the nonlocking DATA key on the telephone set so that the line key releases and the line lamp lights. Both attendants place the handset on-hook.

Note: Either attendant can depress the DATA key first. However, if the called data

TABLE B

TELEPHONE AND ACU INTERFACE

PIN NO.	DESIGNATION	FUNCTION
1	L	Telephone set line lamp control from data set
2 3	MB1 MB	Make busy relay contact in data set
4	LG	Ground from data set for telephone set line lamp
5	TD	Talk/data lead from telephone set to data set
7	T	Telephone line tip
8	R	Telephone line ring
12	RD	Data set ring detector contact closure to ground
14	C	Data mode indication contact closure to ground for DAS 801C
16	D1	Data mode contact closure to ground to data set from DAS 801-type
21	T1	Tip of telephone set
22	R1	Ring of telephone set
23 24	A A1	"A" lead control for KTU or ACU applications
25	TDG	Data set ground return for TD control signal

set enters the data mode first, the calling attendant must depress the DATA key within 15 seconds to prevent the called data set from aborting the call.

(e) When the data mode is entered, the line lamp lights, the MR lamp on the data set lights, and the CC (data set ready) circuit turns ***on.***

B. Manual Call/Automatic Answer

4.03 The procedure for manual call/automatic answer is as follows:

(a) The calling attendant picks up the telephone handset, depresses the appropriate line key, and after hearing dial tone, dials the number of the distant data station.

(b) At the called station, the CE (ring indicator) circuit turns ***on,*** and the appropriate line lamp lights when ringing voltage is applied.

(c) If the CD (data terminal ready) circuit is ***on*** and option ZH (automatic answer—IN) is installed, the distant data set answers automatically at the end of the ringing cycle, turns ***on*** the CC (data set ready) circuit, and lights the MR lamp on the data set and the line key lamp on the telephone set.

(d) At the calling station after a 2-second silent interval, the attendant hears the high-pitched answer tone (2225 Hz) transmitted by the distant data set. After verifying that the CD (data terminal ready) circuit is ***on*** and selecting the speed mode, the calling attendant transfers to the data mode by depressing the DATA key on the telephone set until the line key releases and the line lamp lights. The CC (data set ready) circuit turns ***on.***

Note: Transfer to the data mode must take place within 15 seconds after the answer tone begins.

TABLE C

DATA SET 212A OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING											PROVIDE
			S1 SWITCH CONTACTS											
			1	2	3									
Tip, Ring Make Busy	F	IN	X	—	—									One per set
	E*	OUT	O	—	—									
CC Indication for Analog Loop	ZF*	ON	—	—	X									One per set
	ZE	OFF	—	—	O									
			SWITCH CONTACTS											
			S2									S5		
			1	2	3	4	5	6	7	8	9	1	2	
Speed Control	XJ	INTERFACE	O	—	—	—	—	—	—	—	—			One per set
	XK*	HS BUTTON	X	—	—	—	—	—	—	—	—			
Interface Controlled Make Busy/Analog Loop-CN	YE	IN	—	O	—	—	—	—	—	—	—			One per set
	YF*	OUT	—	X	—	—	—	—	—	—	—			
Transmitter Timing	YC*	INTERNAL	—	—	O	O	—	—	—	—	—			One per set
	YD	EXTERNAL	—	—	O	X	—	—	—	—	—			
	WI	SLAVE	—	—	X	O	—	—	—	—	—			
1200-bps Operation	YG*	ASYNC/START-STOP	—	—	—	—	O	—	—	—	—	O	O	One per set
	YH	SYNC	—	—	—	—	X	—	—	—	—	X	X	
Character Length (Use With YG)	YI	9-BIT	—	—	—	—	—	O	—	—	—			One per set
	YJ*	10-BIT	—	—	—	—	—	X	—	—	—			
Receiver Responds to Digital Loop	YK*	IN	—	—	—	—	—	—	O	—	—			One per set
	YL	OUT	—	—	—	—	—	—	X	—	—			
Interface Controlled Remote Digital Loop	XL	IN	—	—	—	—	—	—	—	X	—			One per set
	XM	OUT	—	—	—	—	—	—	—	O	—			
			S3 SWITCH SETTINGS											
			1	2	3	4	5	6	7	8				
Loss of Carrier Disconnect	S*	IN	X	—	—	—	—	—	—	—				One per set
	R	OUT	O	—	—	—	—	—	—	—				
Receive Space Disconnect	V*	IN	—	X	—	—	—	—	—	—				One per set
	Y	OUT	—	O	—	—	—	—	—	—				
CB and CF Indications	A*	COMMON	—	—	X	—	—	—	—	—				One per set
	B	SEPARATE	—	—	O	—	—	—	—	—				
Send Space Disconnect	T*	IN	—	—	—	X	—	—	—	—				One per set
	U	OUT	—	—	—	O	—	—	—	—				
Automatic Answer	ZH*	IN	—	—	—	—	O	—	—	—				One per set
	ZG	OUT	—	—	—	—	X	—	—	—				
Answer Mode Indication	X	CE ON	—	—	—	—	—	X	—	—				One per set
	W*	CE OFF	—	—	—	—	—	O	—	—				
Speed Mode	YO	HIGH	—	—	—	—	—	—	X	—				One per set
	YP*	DUAL	—	—	—	—	—	—	O	—				
Interface Speed Indication - CI	YQ	IN	—	—	—	—	—	—	—	X				One per set
	YR*	OUT	—	—	—	—	—	—	—	O				
			STRAPPING OPTIONS											
CN and TM Assignments	XO*	CN 25, TM NC	INSTALL E1 - E2, E3 - E4											One per set
	XN	CN 18, TM NC	INSTALL E1 - E2, E4 - E5											
	XR	CN 18, TM 25	INSTALL E2 - E3, E4 - E5											
Signal Ground to Frame Connection	Q*	IN	S1 CLOSED											One per 47D2 DM
	P	OUT	S1 OPEN											

X = Contact Closed — = Contact Not Applicable O = Contact Open * = Factory-Provided

(e) The calling attendant places the handset on-hook.

C. Automatic Calling/Automatic Answering

4.04 The procedure for automatic calling and answering is as follows:

(a) An ACU originates the call and detects the answer tone from the distant DS 212A.

(b) Provided the CD (data terminal ready) circuit is ***on,*** the ACU causes the local data set to transfer to the data mode at the beginning of the answer tone.

(c) When transfer is complete, the telephone set line lamp lights and the CC (data set ready) circuit in the data set turns ***on.***

D. Data-to-Talk Transfer

4.05 Transferring the telephone line back to the telephone handset can be accomplished by depressing the line key for the appropriate telephone line and lifting the handset. DS 212A immediately terminates the data mode, which includes removing carrier from the channel. If the distant data set is equipped to disconnect on loss of carrier, this transfer may cause it to disconnect and go on-hook. If the data set is in the answer mode when the transfer to the talk mode is made, it stores this fact internally so a transfer back to the data mode can be made as an answering station.

E. Data Call Termination

4.06 ***DTR Control:*** The local DS 212A enters an irreversible disconnect sequence when the CD (data terminal ready) circuit is turned ***off*** during the data mode for more than 50 ms, unless the data set is in certain test modes. If option U (send space disconnect—OUT) is installed, the CC (data set ready) circuit turns ***off*** 68 ±10 ms after the CD circuit turns ***off.*** If option T (send space disconnect—IN) is installed, then the data set enters the space transmit sequence. The CD circuit can be turned ***on*** any time after the 50 ms required ***off*** interval.

4.07 ***Send Space Disconnect:*** If option T (send space disconnect—IN) is installed, the space transmit sequence is initiated by either of two conditions.

- The CD (data terminal ready) circuit is turned ***off*** for at least 50 ms.

- Option S (loss of carrier disconnect—IN) is installed and the carrier detector is turned ***off*** for at least 307 ms.

When the space transmit sequence begins, the transmit data lead is clamped to the spacing condition and the CF (received line signal detector) circuit is turned ***off.*** After 3.95 ±0.15 seconds have elapsed, DS 212A disconnects from the telephone line and the CC (data set ready) circuit turns ***off.*** The sequence cannot be interrupted by any condition of the CD (data terminal ready) circuit or a restoration of received carrier. It is possible to transfer to the talk mode before the 4-second time interval has elapsed and not lose the telephone connection.

4.08 ***Carrier Fail Disconnect:*** The installation of option S (loss of carrier disconnect—IN) causes DS 212A to terminate a data call when a substantial loss of received carrier is detected. The CC (data set ready) and CB (clear to send) circuits turn ***off*** 433 ±17 ms after the carrier falls below the carrier detector threshold, disconnecting the telephone line. If the carrier is interrupted for less than 175 ms, a disconnect does not occur; if a carrier interrupt lasts for more than 307 ms, a disconnect always occurs. The CF (received line signal detector) circuit turns ***off*** 17 ±7 ms after the loss of carrier, and turns ***on*** 155 ±50 ms after carrier is restored. If DS 212A is put into the digital loop test mode by a remote DS 212A, the loss of carrier disconnect option is forced to the IN condition electronically for the remainder of the data call.

4.09 ***Receive Space Disconnect:*** When option V (receive space disconnect—IN) is installed, DS 212A disconnects the data call when the BB (received data) circuit remains in a spacing condition for 1.6 ±0.15 seconds. At the time of disconnect, the CC (data set ready), CB (clear to send), and CF (received line signal detector) circuits turn ***off*** and the data set goes on-hook. If the remote digital loop feature is activated in DS 212A, the receive space disconnect option is forced to the OUT state internally. At the DS 212A which is put into the digital loop test mode, the option is also forced to the OUT condition. These overrides exist only as long as DS 212A is in the test mode.

4.10 ***Abort Disconnect:*** The abort disconnect feature is not optional, but is always activated when DS 212A is transferred to the data mode as an answering data set. From the time that the CC (data set ready) circuit turns ***on,*** received carrier must be detected within 17.87 ±0.15 seconds or the data set goes on-hook.

4.11 ***Manual Disconnect:*** A manual disconnect can be forced by the attendant by first transferring to the talk mode, then placing the handset on-hook. This method of disconnecting overrides all of the others, and works for either the originating or answering data sets.

5. REFERENCES

5.01 The following Bell System Practices provide additional information concerning DS 212A.

SECTION	TITLE
592-034-200	Data Set 212A Transmitter-Receiver—Installation and Connections
592-034-500	Data Set 212A Transmitter-Receiver—Test Procedures
668-102-5ZZ	Data Test Center 904A/C and 904B/D Test Procedures—Data Set 212A

DATA SET 212A-L1A/2A

TRANSMITTER-RECEIVER

INSTALLATION AND CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section contains information needed to install options and to install and connect a data set (DS) 212A-L1A/2A. The data set should be installed in conformance with the general instructions given in Section 590-010-200. Refer to Section 590-010-202 for installation of multiset arrangements in 40A-type data mountings.

1.02 This section is reissued to provide BSP coverage for the new version of DS 212A-L1A/2A. The new version provides all the features and options of the older DS 212A and in addition provides additional interface circuits, options, and simplified testing. These features are described as follows:

- Test Voltages—Plus and minus 14 Vdc have been provided on pins 9 and 10 of the customer interface to facilitate data set testing.

- Test Mode (TM) Indication and Make Busy/Analog Loop (CN)—A new customer option enables either pin 25 or pin 18 of the customer interface to control the CN circuit. When CN is optioned for pin 18, the TM circuit can be optionally installed on pin 25. CN on pin 18 and TM on pin 25 would be used to implement an interface which would be compatible with the proposed International Organization for Standardization 25-pin interface.

- Interface Controlled Remote Digital Loop (RL)—When this new customer option is activated, the RL test may be activated through pin 21 of the customer interface.

- Speed Control—This new customer option enables high-speed or low-speed operation of an originating data set to be controlled through pin 23 of the customer interface or with the front panel HS button.

1.03 Prior to installing the data set, verify that the overall facilities meet type 2 requirements specified in the section entitled Data Systems—DATAPHONE® Service—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (314-205-501).

1.04 Data set 212A should be located near the customer-provided equipment (CPE) because the interface cord provided by the customer must not exceed 50 feet in length (to reduce stray capacitance and conform to Electronic Industries Association [EIA] standards). To minimize inductive interference to data signals on the telephone (data) line, the line should not be carried in the same run as the cable between the data set and CPE or lines connected to teletypewriter services. If this condition cannot be met, it will be necessary to run the telephone (data) line in type SK (shielded), or equivalent, station wire between the data set and cable distribution terminal or building entrance. Ground the shield at one end only, preferably the distribution terminal end.

1.05 Low voltage alternating current is supplied to the data set by the KS-21239-L5 plug-mounted transformer. The customer must provide a standard 3-wire, grounded 105 to 129V at 57 to 63 Hz, power receptacle that is easily accessible to the data set. The power required is approximately 9 watts.

Caution: If the outlet has a metal cover, do not remove the center screw to mount the transformer. When this screw is removed, it is possible for the metal cover to fall across the prongs of the transformer.

1.06 A 25-pin female connector is provided at the rear of the data set for connection to the CPE. The customer must provide a cord terminated with a Cinch or Cannon DB-19604-432 plug equipped with a DB-51226-1 hood (or equivalent). Data set connections to the CPE are in accordance with Table A.

1.07 A 25-pin male connector is provided at the rear of the data set for connection to telephone company (telco) equipment via the M13F cord. Data set connections to telco equipment are in accordance with Table B.

1.08 To gain access to the circuit packs and option switches, it is necessary to remove the data set from the housing:

(a) Remove the front cover by gently depressing it at the top and rotating it down and out of the housing.

(b) Remove the data set from the housing by pulling on the wire handle on the faceplate.

Note: Figure 1 shows the data set unfolded for locating option switches. Change options without unfolding CM1.

1.09 To reassemble the data set, proceed as follows:

(a) Slide the data set into the housing. Ensure that the data set is completely plugged into the connector in the rear of the housing.

(b) Replace the front cover by hooking the tabs on the bottom of the cover into the detents in the bottom of the housing.

(c) Gently rotate the top of the front cover into the housing until it snaps into place.

1.10 A label (E-6550) and holder (841 788 292) are available for use with DS 212A-L1A to permit identification of the circuit number and trouble call number. The label has a pressure sensitive adhesive which can be used to adhere to the bottom of the front cover. Mount the holder below the center of the front cover and flush with the front edge.

2. OPTIONS

2.01 Before the data set is placed in service, it should be disassembled and checked to make sure proper options are installed. The factory-provided options are designated in Table C.

2.02 Options are installed and removed by means of multiple section rocker assemblies (Fig. 2) strapping plugs and by a screw switch on the backplane (signal ground to frame ground connection). A long screwdriver (6-inch) is needed to operate the screw switch that controls the grounding option. If the appropriate screwdriver is not available, the backplane may be taken out of the housing by removing the two screws on the bottom of the housing.

2.03 Refer to Table C for a summary of data set options.

2.04 ***Tip, Ring Make Busy:*** When option F (IN) is selected, a resistor is connected from tip to ring when the data set is made busy. It is recommended for use on terminate-only lines used behind line hunting equipment.

2.05 ***CC Indication for Analog Loop:*** When option ZF (ON) is selected, the CPE receives a CC (data set ready) ***on*** indication while the data set is in the analog loop mode.

2.06 ***Speed Control:*** When option XJ (interface) is selected, it enables high-speed or low-speed operation of an originating data set to be controlled through pin 23 of the customer's interface. When option XK (HS button) is selected, high-speed or low-speed operation is controlled by the front panel HS button.

2.07 ***Interface Controlled Make Busy/Analog Loop-CN:*** When option YE (IN) is selected,

TABLE A

CUSTOMER INTERFACE

PIN NO.	EIA DESIG	FUNCTION	SIGNAL ORIGINATED BY CPE OR BY DS
2	BA	Send Data (SD) (Note 1)	CPE
3	BB	Receive Data (RD) (Note 1)	DS
5	CB	Clear-to-Send (CS) (Note 2)	DS
6	CC	Data Set Ready (DSR) (Note 2)	DS
7	AB	Signal Ground (SG)	Ground
8	CF	Received Line Signal Detector (RLSD) (Note 2)	DS
9	—	+P	DS
10	—	—P	DS
12	CI	Speed Indication (CI) (Note 3)	DS
15	DB	Transmit Clock (SCT)	DS
17	DD	Receive Clock (SCR)	DS
18	(CN)	Make Busy/Analog Loop (Optional Pin)	DS
20	CD	Date Terminal Ready (DTR) (Note 2)	CPE
21	RL	Remote Digital Loopback	DS
22	CE	Ring Indicator (RI) (Note 5)	DS
23	CH	Speed Select Originate	DS
24	DA	External Transmit Clock (SCTE)	CPE
25	CN or TM	Make Busy/Analog Loop or Test Mode (Note 4)	CPE

Note 1: Space = +V; Mark = —V

Note 2: ON = +V; OFF = —V

Note 3: High Speed = +V; Low Speed = —V

Note 4: Loopback = +V; Normal Use = —V

Note 5: Ringing = +V; No Ringing = —V

the CN (make busy/analog loop) interface lead from the CPE can be used to make the telephone line appear busy; or if the data terminal ready lead is ***on,*** to place the data set in the analog loop test mode.

2.08 ***Transmitter Timing:*** This option must be selected when the data set is to be used in the high-speed mode. The option selects one of three possible sources for the transmitter timing signal. The state of this option does not affect operation in the low-speed mode.

- YC (INTERNAL)—The transmitter clock is derived from a master oscillator within the data set. This option is recommended for 1200-bps character-asynchronous operation.

- YD (EXTERNAL)—The transmitter clock is phase-locked to an external source provided

TABLE B

TELEPHONE AND ACU INTERFACE

PIN NO.	DESIGNATION	FUNCTION
1	L	Telephone set line lamp control from data set
2 3	MB1 MB	Make busy relay contact in data set
4	LG	Ground from data set for telephone set line lamp
5	TD	Talk/data lead from telephone set to data set
7	T	Telephone line tip
8	R	Telephone line ring
12	RD	Data set ring detector contact closure to ground
14	C	Data mode indication contact closure to ground for DAS 801C
16	D1	Data mode contact closure to ground to data set from DAS 801-type
21	T1	Tip of telephone set
22	R1	Ring of telephone set
23 24	A A1	"A" lead control for KTU or ACU applications
25	TDG	Data set ground return for TD control signal

by the CPE on the DA circuit (transmit signal element timing, data terminal equipment source).

- WI (SLAVE)—The transmit clock is phase-locked to the DD (receive clock) interface circuit. This option is provided for possible use with multiplexers or other systems requiring slave timing.

2.09 ***1200-bps Operation:*** When option YG (ASYNC/START-STOP) is selected, the data set operates in the 1200-bps character-asynchronous format. When option YH (SYNC) is selected, the data set operates in the 1200-bps synchronous format. Transmit and receive clocks which are provided for synchronous operation are not provided for character-asynchronous operation. The state of this option must be the same for any pair of DSs 212A-L1A/2A which communicate with each other. The state of this option does not affect operation in the low-speed mode.

Note: When option YH is selected, the 1200-bps transmit and receive clocks are present on the DB (pin 15) and DD (pin 17) circuits at all times, even when the data set is in the low-speed mode.

2.10 ***Character Length:*** A decision must be made on this option whenever option YG (1200-bps operation-ASYNC/START-STOP) is selected. The state of this option does not affect operation in the low-speed mode.

- YI (Character length 9)—When this option is selected, the total number of bits per character (including start and stop bits) must be nine.

- YJ (Character length 10)—When this option is selected, the total number of bits per character (including start and stop bits) must be 10.

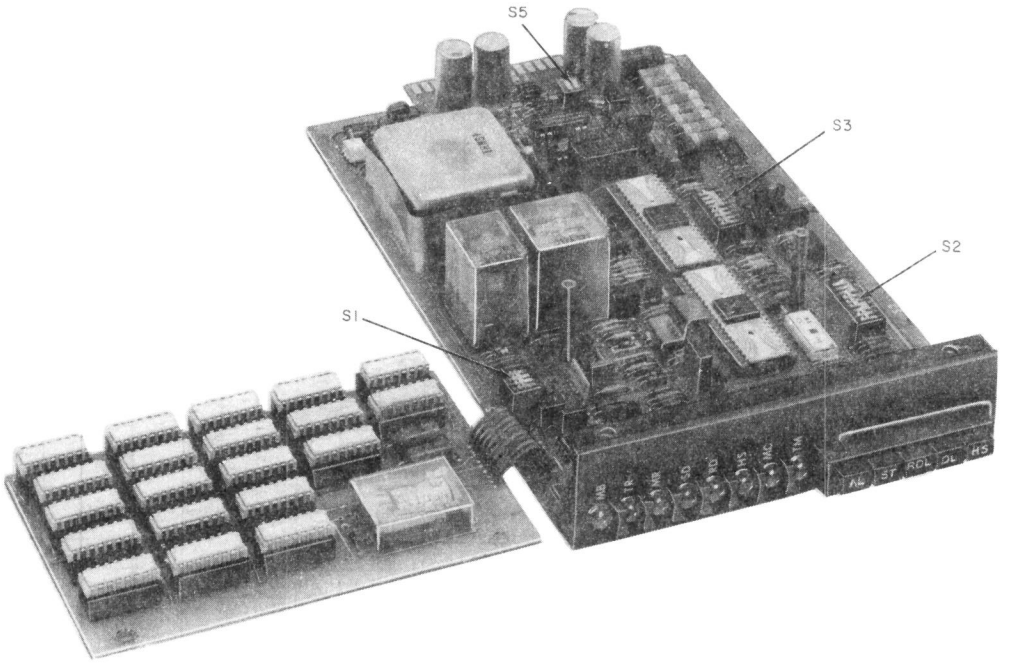


Fig. 1—Data Set Unfolded for Location of Option Switches

The bits between the start and stop bits do not have to conform to any coding system. The setting of this option must be the same for any pair of DSs 212A-L1A/2A which communicate with each other. If option YH (SYNC) is selected, the character length option has no effect on data set operation.

2.11 ***Receiver Responds to Digital Loop:*** This option is active only when the data set is in the high-speed (1200-bps) mode. When option YK (IN) is selected, the data set responds to a request for a digital loop from the distant data station. When option YK (OUT) is selected, the data set cannot be put into the digital loop test mode remotely. This option does not affect the operation of the DL switch on the front panel and does not affect operation in the low-speed mode.

2.12 ***Interface Controlled Remote Digital Loop (RDL):*** When option XL (IN) is selected, a positive voltage on pin 21 will enable the RDL circuitry the same as depressing the RDL button on the front panel. When option XM (OUT) is selected, the RDL circuitry can be enabled only by depressing RDL button on the front panel.

2.13 ***Loss of Carrier Disconnect:*** When option S (IN) is selected, the data set terminates the call if carrier disappears from the line for approximately 350 ms.

2.14 ***Receive Space Disconnect:*** When option V (IN) is selected, the data set terminates the call upon receiving approximately 1.6 seconds of spacing signal.

2.15 ***CB and CE Indications:*** When option A (COMMON) is selected, the CB (clear-to-send) interface lead is forced ***off*** whenever the CF (received line signal detector) lead goes ***off.*** When option B (SEPARATE) is selected, the state of the CF lead has no effect on the state of the CB lead.

TABLE C

DATA SET 212A OPTIONS

FEATURE	OPTION	DESCRIPTION	SWITCH SETTING											PROVIDE
			S1 SWITCH CONTACTS											
			1	2	3									
Tip, Ring Make Busy	F	IN	X	—	—									One per set
	E*	OUT	O	—	—									
CC Indication for Analog Loop	ZF*	ON	—	—	X									One per set
	ZE	OFF	—	—	O									
			SWITCH CONTACTS											
			S2									S5		
			1	2	3	4	5	6	7	8	9	1	2	
Speed Control	XJ	INTERFACE	O	—	—	—	—	—	—	—	X			One per set
	XK*	HS BUTTON	X	—	—	—	—	—	—	—	O			
Interface Controlled Make Busy/Analog Loop-CN	YE	IN	—	O	—	—	—	—	—	—	—			One per set
	YF*	OUT	—	X	—	—	—	—	—	—	—			
Transmitter Timing	YC*	INTERNAL	—	—	O	O	—	—	—	—	—			One per set
	YD	EXTERNAL	—	—	O	X	—	—	—	—	—			
	WI	SLAVE	—	—	X	O	—	—	—	—	—			
1200-bps Operation	YG*	ASYNC/START-STOP	—	—	—	—	O	—	—	—	—	O	O	One per set
	YH	SYNC	—	—	—	—	X	—	—	—	—	X	X	
Character Length (Use With YG)	YI	9-BIT	—	—	—	—	—	O	—	—	—			One per set
	YJ*	10-BIT	—	—	—	—	—	X	—	—	—			
Receiver Responds to Digital Loop	YK*	IN	—	—	—	—	—	—	O	—	—			One per set
	YL	OUT	—	—	—	—	—	—	X	—	—			
Interface Controlled Remote Digital Loop	XL	IN	—	—	—	—	—	—	—	X	—			One per set
	XM	OUT	—	—	—	—	—	—	—	O	—			
			S3 SWITCH SETTINGS											
			1	2	3	4	5	6	7	8				
Loss of Carrier Disconnect	S*	IN	X	—	—	—	—	—	—	—				One per set
	R	OUT	O	—	—	—	—	—	—	—				
Receive Space Disconnect	V*	IN	—	X	—	—	—	—	—	—				One per set
	Y	OUT	—	O	—	—	—	—	—	—				
CB and CF Indications	A*	COMMON	—	—	X	—	—	—	—	—				One per set
	B	SEPARATE	—	—	O	—	—	—	—	—				
Send Space Disconnect	T*	IN	—	—	—	X	—	—	—	—				One per set
	U	OUT	—	—	—	O	—	—	—	—				
Automatic Answer	ZH*	IN	—	—	—	—	O	—	—	—				One per set
	ZG	OUT	—	—	—	—	X	—	—	—				
Answer Mode Indication	X	CE ON	—	—	—	—	—	X	—	—				One per set
	W*	CE OFF	—	—	—	—	—	O	—	—				
Speed Mode	YO	HIGH	—	—	—	—	—	—	X	—				One per set
	YP*	DUAL	—	—	—	—	—	—	O	—				
Interface Speed Indication - CI	YQ	IN	—	—	—	—	—	—	—	X				One per set
	YR*	OUT	—	—	—	—	—	—	—	O				
			STRAPPING OPTIONS											
CN and TM Assignments	XO*	CN 25, TM NC	INSTALL E1 - E2, E3 - E4											One per set
	XN	CN 18, TM NC	INSTALL E1 - E2, E4 - E5											
	XR	CN 18, TM 25	INSTALL E2 - E3, E4 - E5											
Signal Ground to Frame Connection	Q*	IN	S1 CLOSED											One per 47D2 DM
	P	OUT	S1 OPEN											

X = Contact Closed — = Contact Not Applicable O = Contact Open * = Factory-Provided

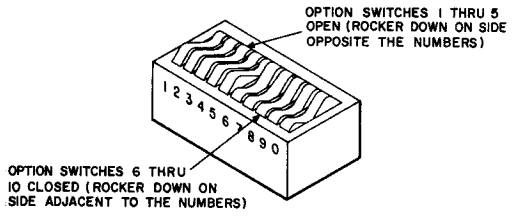


Fig. 2—Details of Option Switch

2.16 ***Send Space Disconnect:*** When option T (IN) is selected, the data set transmits approximately 4 seconds of spacing signal at the end of a data call. This causes the distant data set to disconnect if it is equipped with option V (receive space disconnect—IN).

2.17 ***Automatic Answer:*** If option ZH (IN) is selected, the data set answers a telephone call without manual assistance if the CD (data terminal ready) interface lead is ***on.*** This feature is disabled when the AL switch on the front panel is pressed or when the CN (make-busy/analog loop) interface circuit is ***on*** and option YE (CN circuit—IN) is installed.

2.18 ***Answer Mode Indication:*** This option provides a means whereby the user can determine if the data set answered or originated the call. When option X (ON) is selected, the CE (ring indicator) lead at the answering station remains ***on*** after the call has been answered. This option does not affect normal operation of the CE lead. For the originating data set, the CE circuit remains ***off*** regardless of the state of the option.

2.19 ***Speed Mode:*** If option YO (HIGH) is selected, low-speed operation is prevented because the BB (received data), CB (clear-to-send), and CF (received line signal detector) leads are clamped ***off*** if an attempt is made to operate in the low-speed mode. If option YP (DUAL) is selected, the data set operates normally for both speed modes.

2.20 ***Interface Speed Indication:*** When option YQ (IN) is selected, the data set provides an indication of the data set speed mode on the CI (speed mode indicator) lead. The high-speed mode is indicated by an ***on*** condition on the CI lead. It is ***off*** in the low-speed mode and at all other times. The CI lead is disconnected from the CPE interface when option YR (OUT) is selected.

2.21 ***"CN and TM Assignments":*** This group of options is provided by strapping plugs. They allow the user to configure the customer interface to be compatible with the ISO standard or to be compatible with data set interfaces that use the CN function on pin 25. When option XO is selected, the CN function is assigned to pin 25, but the TM function is not available. When option XN is selected, the CN function is assigned to pin 18, but the TM function is not available. When option XR is selected, the CN function is assigned to pin 18, and the TM function is assigned to pin 25.

> ***Note:*** If analog loop control through the customer interface is required, option YE must be selected.

2.22 ***Signal Ground to Frame Ground Connection:*** When option Q is selected, (signal ground) interface lead is connected to frame ground. This arrangement provides additional margin against longitudinal power line noise. When option P is selected, the AB (signal ground) interface lead is disconnected from the frame ground. Due consideration should be given to possible noise conditions, ground potential differences, safety conditions, local electrical codes, and the data terminal manufacturer's recommendations.

3. INSTALLATION

3.01 The procedure for installing a DS 212A-L1A/2A is as follows:

(1) Unpack the data set and remove the protective covering from the housing.

This is important to prevent damage due to overheating.

(2) Disassemble the data set as directed in paragraph 1.08.

(3) Install the required options called for on the service order. Refer to Table C.

(4) Mark the installed options on the option label (E-6898) and attach it to the bottom of the housing.

(5) Reassemble the data set as directed in paragraph 1.09.

(6) Connect the data set to the telephone line and to power as directed on the appropriate connection diagram.

(7) Perform installation tests as directed in Section 592-034-500.

4. CONNECTIONS

4.01 The data signal power level reaching the serving central office (SCO) should be no greater that -12 dBm. Usually the average loop loss between the SCO and the data set is -3 dB or greater. This -3 dB loop loss combined with the fixed -9 dBm output level of the data set ensures that the signal reaching the SCO is not greater than -12 dBm. In some cases the loop loss is less than -3 dB, and should be padded down. To meet the required power level, it may be necessary to install a pad external to the data set. The necessary pad may be ordered assembled or may be made up in the field and installed in accordance with Fig. 3.

4.02 In the event the actual loop loss is not known, it may be determined as follows.

(1) Dial the central office milliwatt supply or request the local testboard to send 1000-Hz tone at 0 dBm on the loop.

(2) Use a transmission test set with 600-ohm termination to measure the level of the incoming signal. The numerical reading is equal to the loop loss in dB (for example, -6 dBm on the meter is equal to 6 dB loop loss).

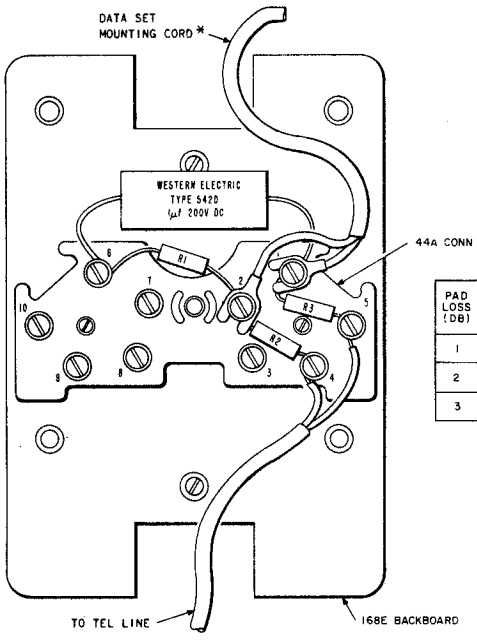
4.03 When the loop loss has been determined, the pad value may be selected as follows:

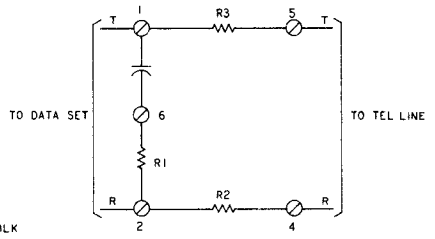
LOOP LOSS	USE
0.0 to 2.0 dB	2-dB pad
2.0 to 3.0 dB	1-dB pad
Greater than 3.0 dB	No pad

4.04 ***DS 212A-L1A/2A Without Automatic Calling Unit (ACU):*** When a single DS 212A-L1A/2A is installed without an ACU, connect cables and connect tip and ring as shown in Fig. 4. Figure 5 provides detailed wiring which may be useful in troubleshooting this arrangement.

4.05 ***DS 212A-L1A/2A With ACU:*** When a single DS 212A-L1A/2A is installed with an ACU, connect cables and connect tip and ring as shown in Fig. 6. Figure 7 provides detailed wiring which may be useful in troubleshooting this arrangement. Figure 8 shows an alternate connection which requires an M15H cord (order separately).

4.06 ***Single Data Set With Shared Telephone Set:*** If DS 212A-L1A/2A shares the telephone set with other DSs 212A or other new family data sets, the connections are made as shown in Fig. 9. To eliminate the need for several 110-Vac outlets, the individual KS-21239-L5 transformers can be plugged into a multiple power outlet strip. A 602-15 Waber Electric power outlet strip accommodates three transformers. A 1A2 power panel accommodates six transformers. A KS-14532-L20 or equivalent cord is required with the 1A2 power panel. Figure 10 shows the KS-21253-L3 adapter used with this arrangement. Figure 11 shows the internal wiring of this adapter, and may be useful in troubleshooting.





PAD LOSS (DB)	RESISTOR VALUE (OHMS)				ORDERING INFORMATION
	R1		R2 AND R3		
1	8200	GRAY RED RED	47	YELLOW VIOLET BLACK	F-58101
2	3900	ORANGE WHITE RED	110	BROWN BROWN BROWN	F-58102
3	2700	RED VIOLET RED	160	BROWN BLUE BROWN	F-58103

NOTES:
1. RESISTORS ARE ALLEN BRADLEY, 1 WATT, 5% TOLERANCE (KS-19151 L1). CAPACITOR IS WESTERN ELECTRIC CO. 542D TYPE, 1UF, 200VDC.
2. A 101C TYPE COVER SHOULD BE USED TO PROTECT THE PAD.
3. THE PAD VALUE SHOULD BE STENCILED ON COVER FOR FUTURE REFERENCE.

* STORE UNUSED CONDUCTORS ON VACANT TERMINALS

Fig. 3—Connections to Insertion Loss Pad

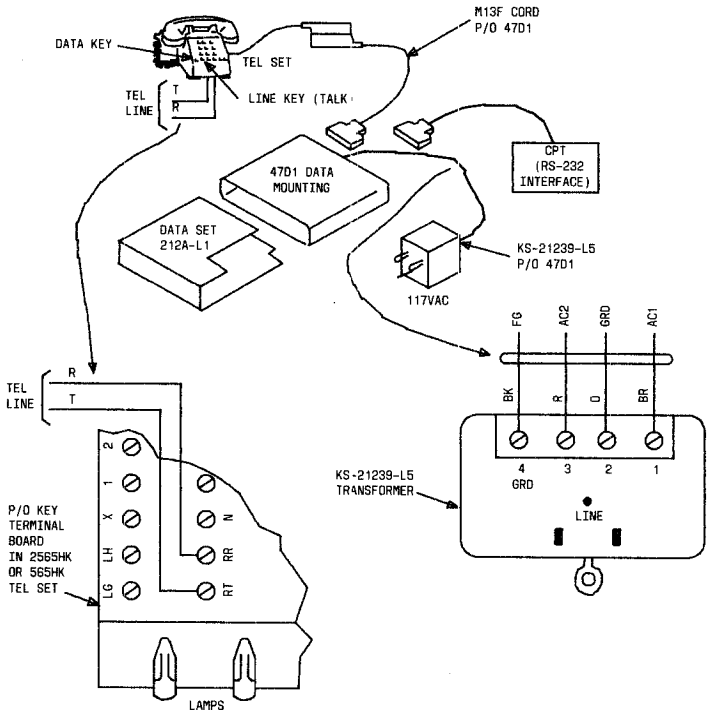


Fig. 4—Installation of DS 212A-L1/2 Without an ACU

5. REFERENCES

5.01 The following Bell System Practices contain additional information which may be useful when installing DS 212A-L1A/2A.

SECTION	TITLE
502-500-120	Telephone Sets—540, 560, 1560, and 2560 Series—Common Installation and Maintenance Information
590-010-202	Data Sets—Station Arrangements for Mixed Data Set Types in 40A2 Data Mounting
592-034-100	Data Set 212A Transmitter-Receiver—Description and Operation
592-034-500	Data Set 212A Transmitter-Receiver—Test Procedure
598-010-011	Data Auxiliary Set 801A5 and 801A6 for Automatic Calling—Description and Operation
598-012-101	Data Auxiliary Sets 801C3 and 801C4—Description and Operation
598-012-102	Data Auxiliary Set 801C-L1/2—Description and Operation

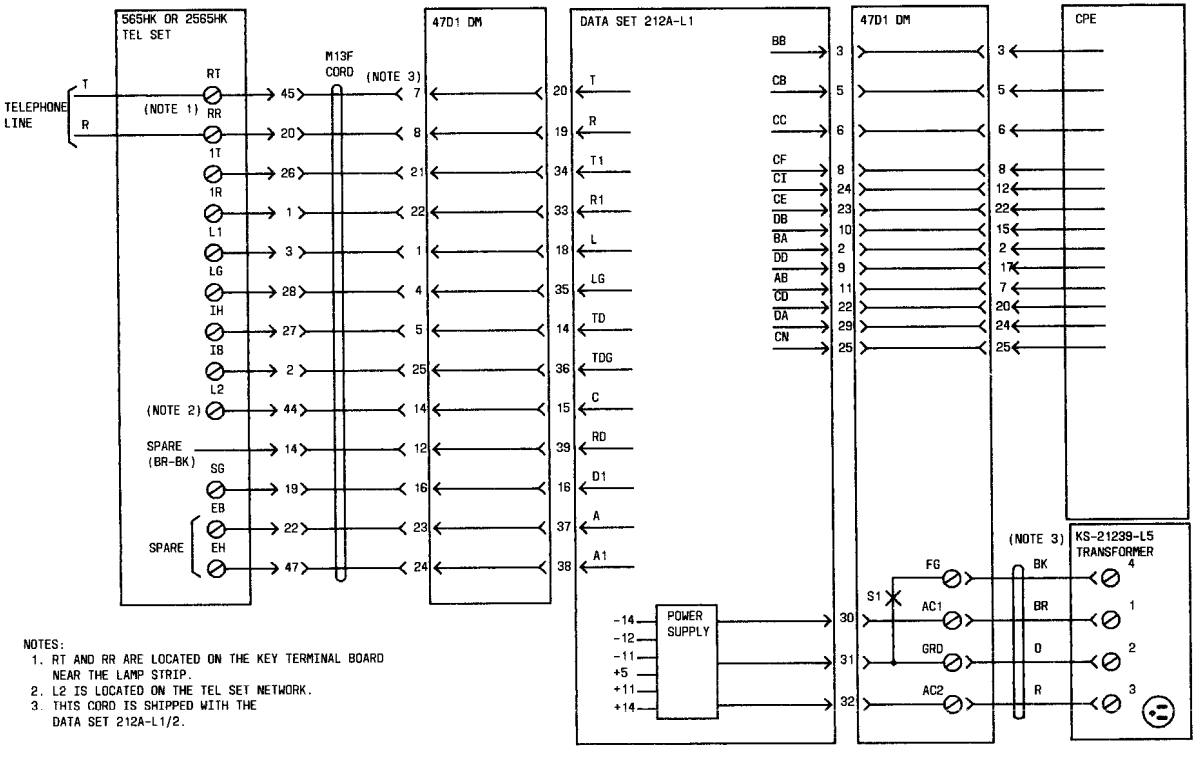


Fig. 5—Connection Wiring for DS 212A-L1/2 Without an ACU

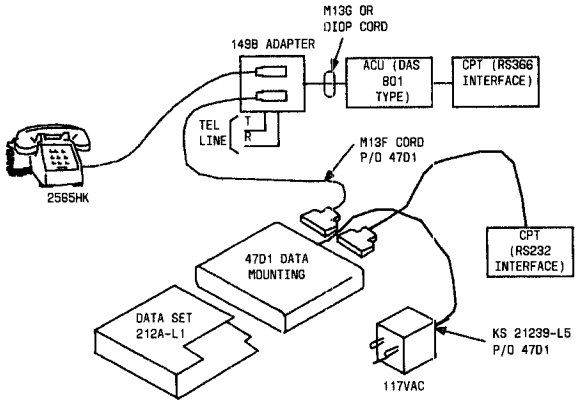


Fig. 6—Installation of DS 212A-L1/2 With an ACU

DAS 801-TYPE ACU OPTIONS

	DAS 801C-L1/2 (BSP 598-012-202)	DAS 801C4 (BSP 598-012-201)	DAS 801A6 (BSP 598-010-201)
REQUIRED	X, T, B, ZG, ZP	X, T, B, ZG, ZB, ZH, ZM, M	X, T, B, ZB, ZF, ZG, M
NOT USED	W, S, E, Q, ZA, ZN	W, S, E, Q, F, ZA, ZC, ZJ, ZK, ZL, N, G, Z	W, S, E, Q, F, ZA, ZC, ZE, N, G, Z
CHOOSE	V OR Y, R OR H, G OR Z, ZU OR ZV, ZW OR ZR OR ZS OR ZT	V OR Y, R OR H, ZD OR A	R OR H, ZD OR A

NOTES:
1. OPTIONS DAS 801 PER ADJACENT TABLE. REFER TO 598-010-201, 598-012-201 OR 598-012-202 FOR INSTALLATION AND REMOVAL OF OPTIONS.
2. DAS 801C-L1/2 IS EQUIPPED WITH AN M13G CORD. DAS 801C4 AND DAS 801A6 ARE EQUIPPED WITH A D10P CORD.
3. IF EITHER DAS 801C-L1/2 OR 801C4 IS USED, THE TELEPHONE LINE MUST BE ARRANGED FOR TOUCH-TONE SERVICE. IF DAS 801A6 IS USED OR IF DAS 801C-L1/2 OR 801C4 HAS OPTION V INSTALLED, THE TELEPHONE LINE MUST BE ARRANGED FOR GROUND-START OPERATION.
4. INSTALLER STRAPS.
5. TERMINAL DESIGNATIONS SHOWN ARE FOR 565HK AND 2565HK TELEPHONE SETS. ADD STRAP IN TELEPHONE SET AS SHOWN. FOR THE 662A1 OR 2662A1 TELEPHONE SET, CONNECT THE INSULATED AND STORED (V-BR) LEAD OF THE D5OK MOUNTING CORD TO TERMINAL 1. NO STRAPPING IS REQUIRED.
6. L2 IS LOCATED ON THE TEL SET NETWORK.
7. THIS CORD AND TRANSFORMER SHIPPED WITH DATA SET 212A-L1/2.

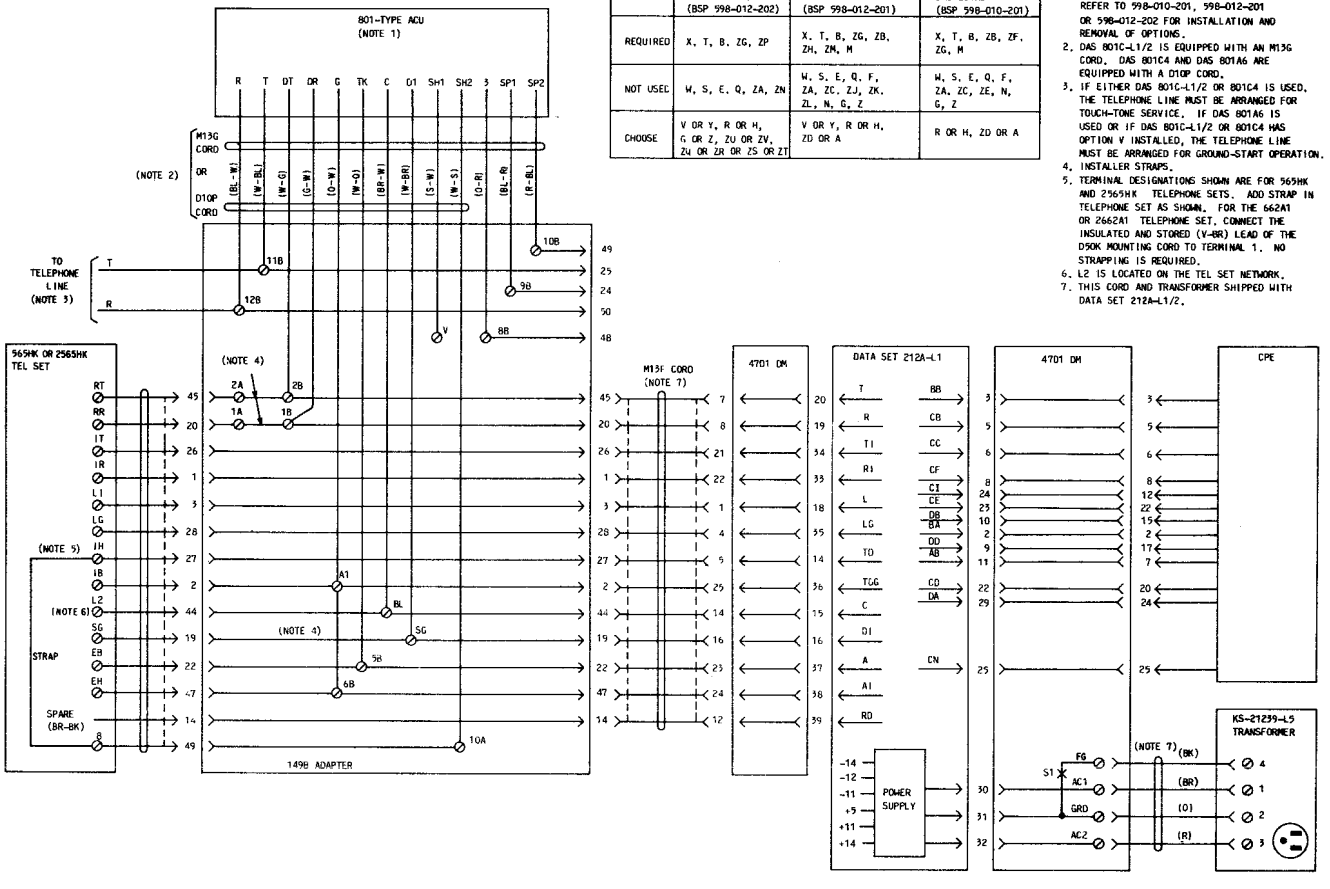


Fig. 7—Connection Wiring for DS 212A-L1/2 With an ACU

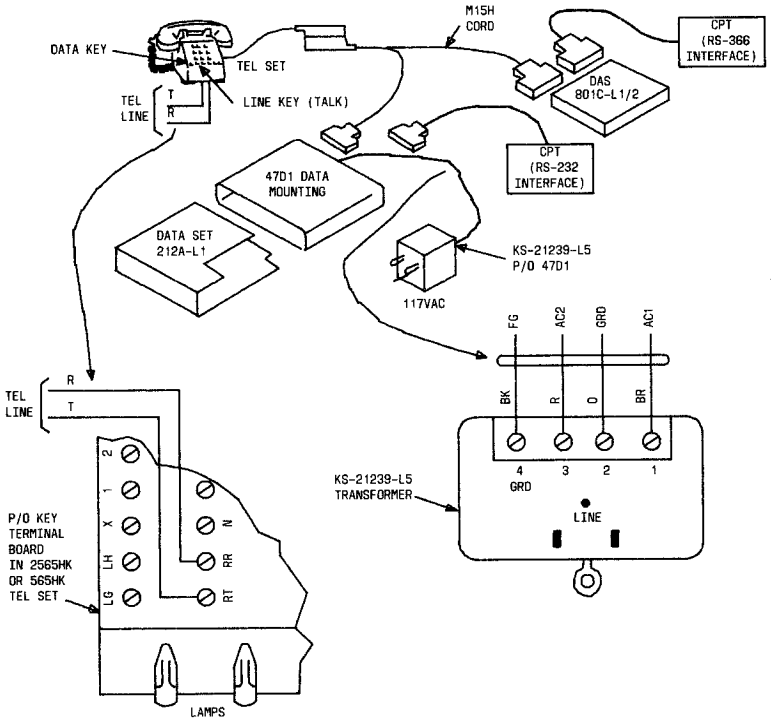


Fig. 8—Alternate Method of Installing DS 212A-L1/2 With 801C-L1/2 ACU

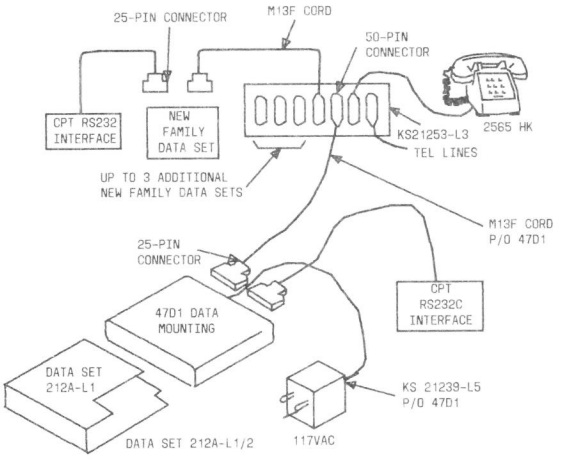


Fig. 9—Single Data Set With Shared Tel Set

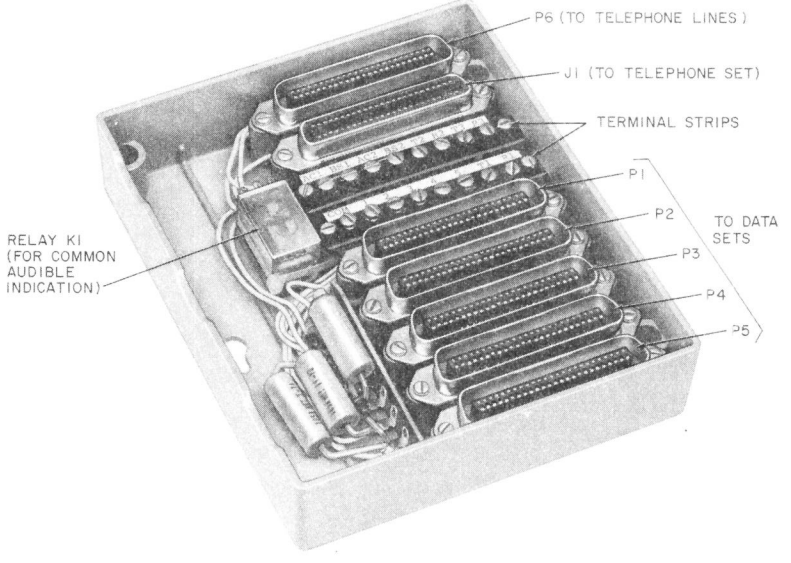


Fig. 10—KS-21253-L3 Adapter With Cover Removed

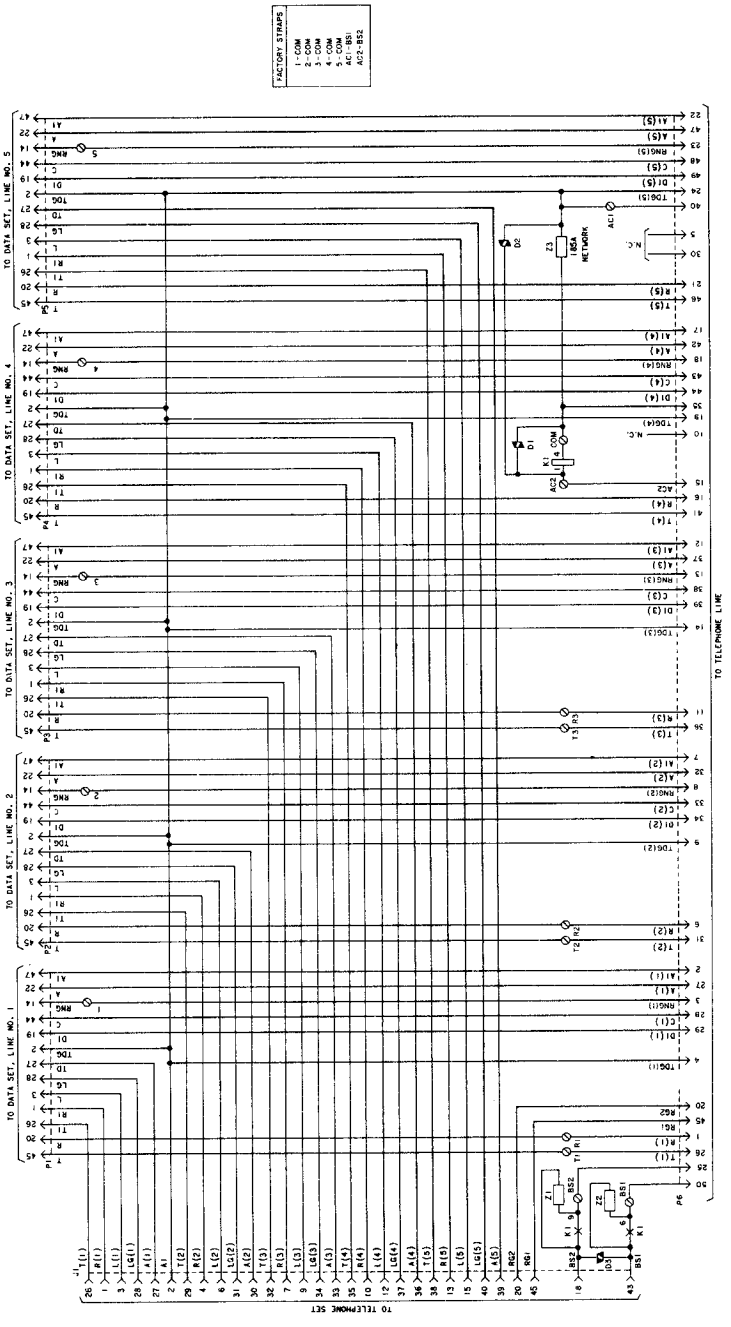


Fig. 11—Internal Wiring of KS-21253-L3 Adapter

DATA SET 212A-L1A/2A

TRANSMITTER-RECEIVER

TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures using the 914-type data test set (DTS) and the self-test capabilities of data set (DS) 212A. These procedures are to be used when testing DS 212A on an initial installation or during a maintenance visit.

1.02 This section is reissued to provide BSP coverage for DS 212A-L1A/2A. Data set 212A-L1A/2A provides all the features and options of DS 212A and has additional interface circuits, options, and simplified testing. These features are described in Sections 592-034-100 and 592-034-200.

A. Test Capabilities

1.03 Test circuitry built into DS 212A permits the following self tests to be performed.

- Analog Loopback Self Test
- Digital Loopback Self Test
- End-to-End Self Test
- Remote Digital Loopback Self Test (High-Speed Mode).

1.04 If a 914-type DTS is used, the analog loopback, digital loopback, and end-to-end tests can be done using pseudorandom data. By use of the 914-type DTS, the customer interface circuits are tested and a more precise indication of bit and block errors can be obtained. The 914-type DTS can also be used to perform a test of the data set automatic answer and interface circuits.

B. Restrictions on Use of Loopback Tests Using 914C DTS

1.05 When DS 212A-L1 is configured to operate in the high-speed mode and the transmitter option (WI) (transmitter timing—SLAVE) is installed,

the analog loopback, digital loopback, and remote digital loopback capabilities cannot be used with external test equipment. This restriction does not apply to DS 212A-L1A. In addition, the remote digital loopback capability cannot be used in the low-speed mode.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a method of verifying that the installation is satisfactory. The self-test features of the data set are used for all installation testing; external equipment is not required.

2.02 Before proceeding with the tests, verify that the local loop meets requirements specified for type 2 Dataphone® lines in Section 314-205-501. Refer to Fig. 1 for the installation test sequence.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed during a maintenance visit. This test sequence provides a method of isolating a trouble to the data set, the transmission facility, or the customer-provided equipment (CPE).

3.02 When a trouble report is received, the DTC is responsible for isolating the trouble to the data set or transmission facility. The procedure for doing this is shown in Fig. 2.

3.03 If it is suspected that the trouble is in the data station equipment, a telco employee must be dispatched to conduct more extensive tests. The following equipment should be taken on a trouble visit:

- Spare DS 212A-L1/2 or DS 212A-L1A/2A
- 914C DTS (for conducting error tests through the interface).

3.04 Refer to Fig. 3 or the sequence in which tests are to be performed by the telco employee at the data station. If the data set is replaced, the defective data set should be tagged with a tag describing the nature of the trouble, carefully packed and returned to a service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists, proceed as follows:

(a) Check that the options installed in the data set agree with those specified on the service order.

(b) Verify that the CPE has been tested and is operating properly.

(c) Check for physical damage to the data station equipment.

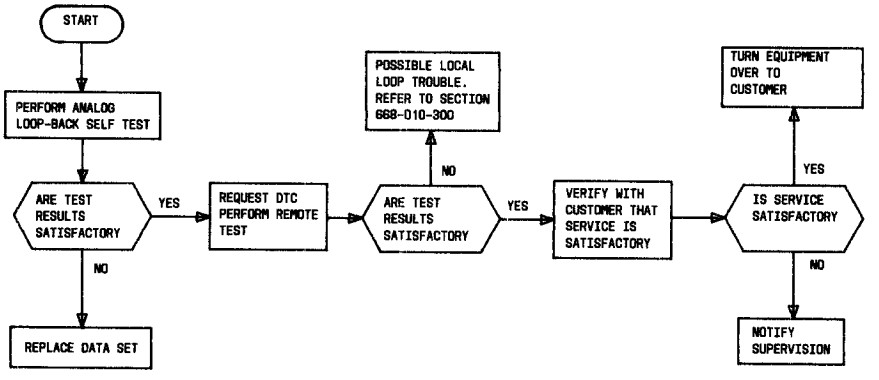


Fig. 1—Installation Test Sequence

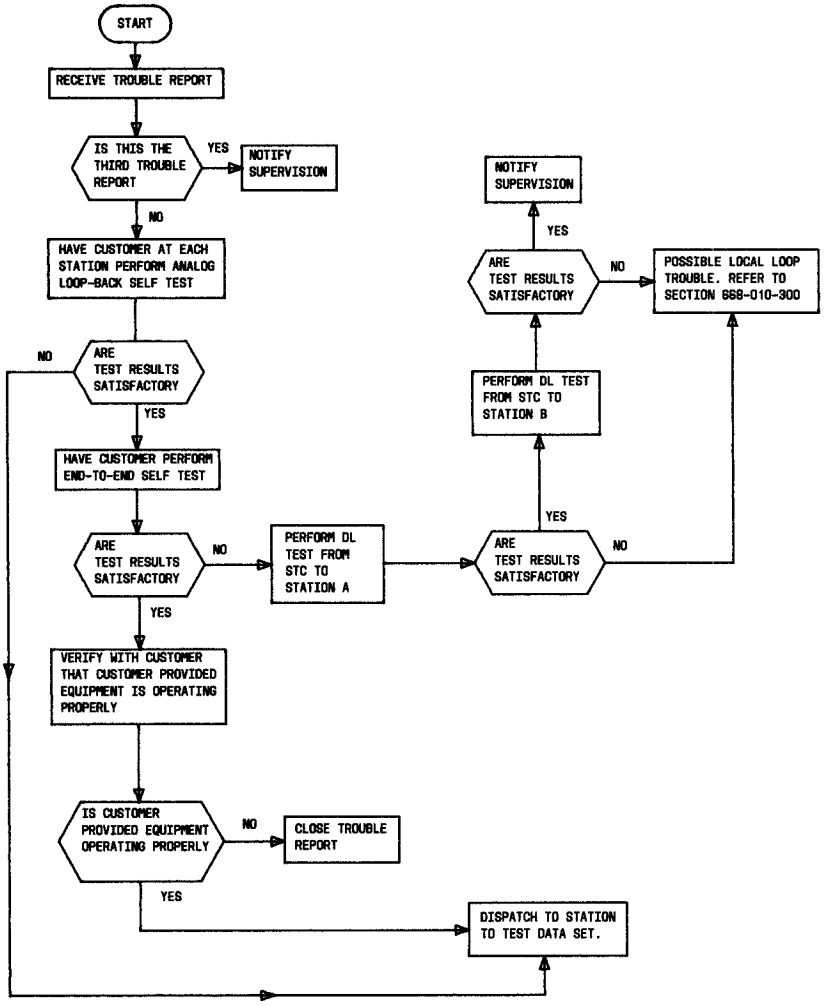


Fig. 2—Clearing Trouble Report

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in the station wiring.

(f) Verify that the data set and CPE are connected to a common ground.

(g) If the trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

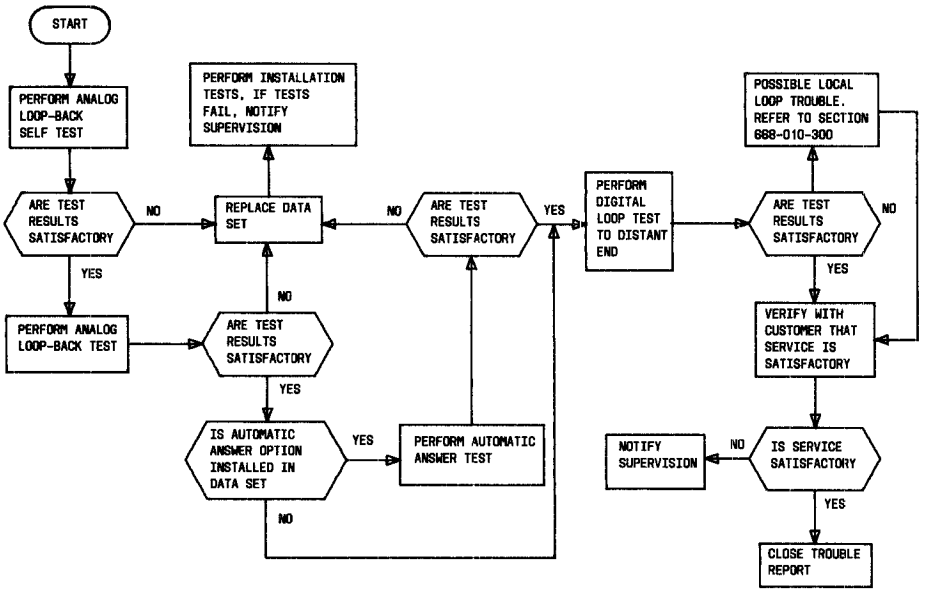


Fig. 3—Maintenance Test Sequence

A. Analog Loopback Self Test

4.02 The analog loopback self test checks the data set transmitter and receiver. The customer interface is not checked. Test data (dotting pattern) generated by the data set is looped from the transmitter output to the receiver input. The received data is compared to the transmitted data. This test can be performed in either the high-speed or low-speed mode. If the data set is operating in the low-speed mode, the MC lamp blinks if the distortion threshold (25 percent) is exceeded. If the data set is operating in the high-speed mode, the MC lamp blinks if a bit error is detected in the received data. The speed is controlled by the HS switch. Perform the test in the speed mode used by the CPE. Perform the test as follows:

(1) Set the speed mode of the test by setting the position of the HS button (IN for high-speed mode).

(2) Press the AL and ST switches on the data set.

Requirement: The MB, TR, and the TM indicators are lighted. The MC indicator goes off after the SD and RD indicators light. Disregard the TR indicator on DS 212A; the TR indicator is either lighted or off depending on the state of the lead from the CPE. The TR indicator is lighted anytime ST or DL is pressed on DS 212A-L1A. The MR lamp is lighted if data set is equipped with option ZF. The HS indicator is either lighted or off, depending on the speed mode of the data set.

(3) Observe the MC indicator for 1 minute.

Requirement: MC indicator does not blink.

(4) Release the AL and ST switches.

B. Digital Loopback Self Test

4.03 This test takes advantage of the digital loopback capability of the data set at one end and the self-test (pattern generating and comparing) capability of the data set at the other end. The test is performed by putting one data

set in the DL mode, placing the other data set in the ST mode, placing a call, and then going to the data mode. The MC indicator on the data set which is in the ST mode blinks when data distortion of a single bit exceeds 25 percent (low-speed) or if a received error occurs (high-speed).

Note: In the low-speed mode, the distant data set may be 103J or 113D.

4.04 Perform this test at the speed mode used most often by the CPE or in the speed mode which is causing difficulty. The speed mode is selected by use of the HS button. The test is performed as follows:

(1) Place a call to the distant end. If the distant data set is already in the DL mode, it will answer automatically.

(2) If the distant data set does not answer automatically, instruct the attendant at the distant end to press the DL switch and go to the data mode.

(3) On the local data set, press the ST switch and go to the data mode. Observe that TR, MR, SD, and RD are lighted.

(4) Observe the MC indicator for 2 minutes.

Requirement:

- Low-Speed—The MC indicator stays off, indicating that both data sets and the line facilities are operating properly. If the MC indicator blinks or remains lighted, the round trip distortion is exceeding 25 percent. Since the distortion in the two directions may be additive, no conclusion about the proper operability of the data sets and the line facility may be drawn.

- High-Speed—Maximum of four blinks

(5) Release the ST switch on the local data set. Call the distant end and have the DL switch released.

C. Remote Digital Loopback Self Test

4.05 This test takes advantage of the remote digital loopback and self-test capabilities of the local data set and can be used to test both data sets and the communication channel in the high-speed mode only. The local data set is placed in the self-test mode by pressing the ST button. ***The distant data set is placed in the remote digital loopback mode by pressing the RDL switch on the local data set.*** The local data set pattern generator is used to send a signal to the distant end, where it is looped back and retransmitted. The error-detecting circuitry causes the MC indicator on the local data set to blink when an error is detected in the received data.

If the distant data set is equipped with option YL (receiver responds to digital loop—OUT) or option ZG (automatic answer—OUT), this test cannot be done.

4.06 The test is performed as follows:

(1) Press the HS, RDL, and ST switches on the local data set and verify that the TM indicator lights.

(2) Dial a call to the distant data set.

(3) When the distant data set has answered, place the local data set in the data mode. MR, SD, RD, and HS indicators light.

(4) Then observe the MC indicator on the local data set for 2 minutes.

Requirement: Maximum of six blinks

Note: If the MC indicator is lighted continuously, this may indicate that the distant data set is not in DL mode.

(5) Release the RDL and ST switches on the local data set. Return the data set to the speed mode used by the CPE.

D. End-to-End Self Test

4.07 This test can be used to check the local data set, the distant data set, and the communication channel. This test is performed by pressing the ST switch at each end, placing a call from one end to the other, and then going to the data mode. Each data set sends the test pattern to the other end. The speed mode of the test is selected at the originating station. The error-detecting

circuitry at each end monitors the received data signal and causes the MC indicator to blink if the distortion threshold (25 percent) is exceeded (low-speed) or if an error is detected (high-speed).

Note: For low-speed testing, the distant end may be a DS 103J or 113D.

4.08 The test is performed as follows:

(1) Call the distant end and arrange to conduct an end-to-end self test. At the originating station, the speed mode is selected by use of the HS button.

(2) Press the ST switch on the front of each data set. Verify that the TM indicator lights.

(3) Go to the data mode at each end MR lights. Verify that the MC indicator goes off after the SD and RD indicators light. Disregard the TR indicator on DS 212A; the TR indicator is lighted or off, depending on the state of the CD lead from the CPE. The TR indicator is lighted anytime ST or DL is pressed on DS 212A-L1A. The HS indicator is lighted or off, depending on the speed mode of the test.

(4) Observe the MC lamp on the front of the data set for 2 minutes.

Requirement:

- Low-Speed—The MC indicator stays off, indicating that both data sets and the line facilities are operating properly. If the MC indicator blinks or remains lighted, the distortion is exceeding 25 percent.

- High-Speed—Maximum of two blinks

(5) At the end of the test, go to the talk mode and then release the ST switch.

E. Analog Loopback Test With 914C DTS

4.09 This test checks the data set interface and transmitter and receiver circuits. Test data is generated by a data test set (DTS) and looped back from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS and errors are indicated on the DTS counter.

4.10 Perform this test in the speed mode used most often by the CPE or in the speed mode which is causing difficulty.

Low-Speed

4.11 Perform the test as follows:

(1) Connect and condition the test equipment as shown in Fig. 4.

(2) Apply power to the data set and then to the test equipment.

(3) Verify that the data set is in the low-speed mode (HS button out) if option XK is installed. Speed selection is automatic when option XJ is installed.

(4) Press the AL button on the data set. Verify that the data set TM indicator lights. On the DTS, verify that DS3 (CF) and then DS1 (CB) light and the NO DATA lamp goes off.

(5) On the 914C DTS, set the FUNCTION switch to PHASE ADJ.

(6) Adjust the PHASE control to zero the meter.

(7) Move the FUNCTION switch to OFF.

(8) Operate the WORD SYNC switch to MAN and release when the counter stops.

(9) Reset the counter on the 914C DTS.

(10) Conduct the test for 1 minute.

Requirement: No errors

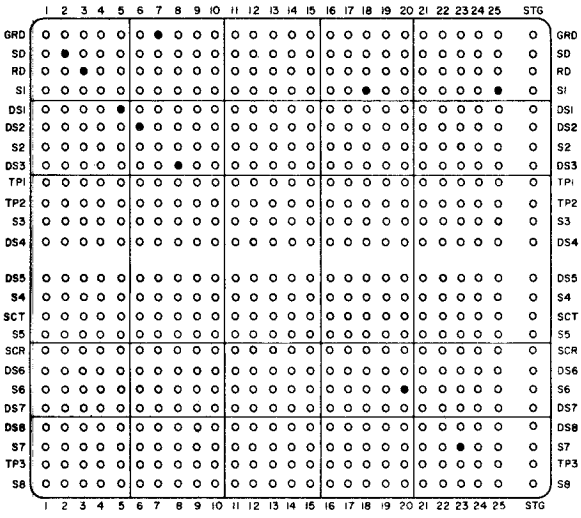
(11) Upon completing the test, disconnect test equipment and restore data set to pretest condition.

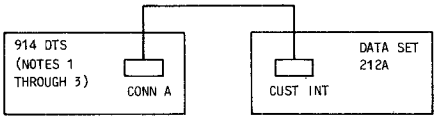
High-Speed

(1) Connect and condition the test equipment as shown in Fig. 5.

(2) Install options YH (1200 bps operation—SYNC) and YC (internal transmitter timing).

(3) Apply power to the data set and then to the DTS.





NOTES:

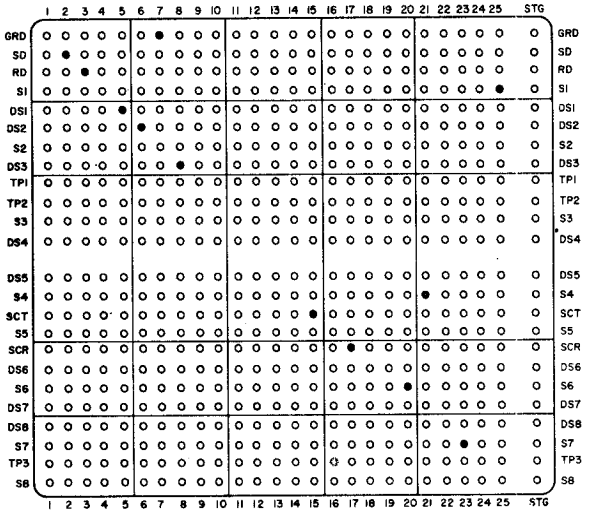
1. SET SWITCHES ON 914 DTS AS FOLLOWS:

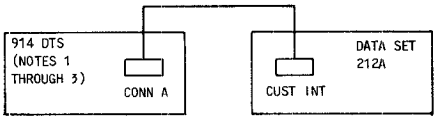
SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER
COUNTER	BIT ERRORS
FUNCTION	OFF
SAMPLE WIDTH	.5US
RCV BIT RATE	300
TRANSMIT BIT RATE	300
RCV WORD LENGTH	63
TRANSMIT WORD LENGTH	63
SIG LEV	±4V
S1	OFF
S6	ON
S7	OFF

2. INSERT RED PROGRAMMING PINS IN 914 DTS MATRIX IN POSITIONS INDICATED ABOVE
3. 914 DTS SWITCHES AND INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

SWTICH	INDICATOR	FUNCTION
	DS1	CLEAR TO SEND (CB)
	DS2	DATA SET READY (CC)
	DS3	RCVD LINE SIGNAL DETECTOR (CF)
S1		MAKE BUSY/ANALOG LOOP (CN)
S6		DATA TERMINAL READY (CD)
S7		SPEED SELECT ORIGINATE

Fig. 4—Analog Loopback, Digital Loopback and End-to-End Test Setup—Low-Speed





NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER
COUNTER	BIT ERRORS
FUNCTION	OFF
SAMPLE WIDTH	.5US
RCV BIT RATE	EXT +
TRANSMIT BIT RATE	EXT +
RCV WORD LENGTH	63
TRANSMIT WORD LENGTH	63
SIG LEV	±4V
S1	OFF
S4	OFF
S6	ON
S7	ON

2. INSERT RED PROGRAMMING PINS IN 914 DTS MATRIX IN POSITIONS INDICATED ABOVE
3. 914 DTS SWITCHES AND INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

SWITCH	INDICATOR	FUNCTION
	DS1	CLEAR TO SEND (CB)
	DS2	DATA SET READY (CC)
	DS3	RCVD LINE SIGNAL DETECTOR (CF)
S1		MAKE BUSY/ANALOG LOOP (CN)
S4		REMOTE DIGITAL LOOPBACK
S6		DATA TERMINAL READY (CD)
S7		SPEED SELECT ORIGINATE

Fig. 5—Analog Loopback, Digital Loopback and End-to-End Test Setup—High-Speed

(4) Press the AL and HS buttons on the data set if option XK is installed. Speed selection is automatic when option XJ is installed. Verify that the data set TM indicator lights. On the DTS, verify that the DS3 (CF) and then the DS1 (CB) indicators light and that the NO DATA indicator goes off.

(5) Operate the WORD SYNC switch to MAN and release when the counter stops.

(6) Reset the counter on the DTS.

(7) Conduct the test for 1 minute.

Requirement: No errors

(8) Upon completing the test, disconnect test equipment and restore the data set to pretest condition. If option YH was installed in (2), restore original option at this time.

F. Digital Loopback Test With 914C DTS

4.12 This test checks the transmitter and receiver of both data sets and the connecting facility. The distant data set can be a 103J or 113D. The customer interface at the distant data set is not checked. Test data is generated by the DTS and transmitted by the local data set. This data is looped back from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and is compared to the original data. Data errors are indicated on the counter of the DTS.

For DS 212A-L1 this test cannot be done in the high-speed mode if option WI (transmitter timing—SLAVE) is installed in the local data set. This restriction does not apply to DS 212A-L1A—option WI is overridden.

4.13 Perform this test at the speed mode used most often by the CPE or in the speed mode which is causing difficulty.

4.14 The DS 212A type has the capability to force the distant data set into a digital loopback mode. The test can only be used when the data set is in the high-speed mode. The remotely activated digital loopback takes place at the distant data set only if options YK (receiver responds to digital loop—IN) and ZH (automatic answer—IN) are installed at that end and the CD (data terminal ready) lead is ***on.***

4.15 Perform the test as follows:

Low-Speed

(1) Connect and condition the test equipment as shown in Fig. 4.

(2) Verify that the data set is in the low-speed mode (HS button out).

(3) Apply power to the data set and then to the DTS.

(4) Request the attendant at the distant end to press the DL switch on the data set.

(5) Dial the distant data set and go to the data mode at the local data set. On the 914C DTS, verify that DS2 lights, then DS3, and then DS1. Verify that the NO DATA lamp goes off.

(6) On the DTS, set the FUNCTION switch to PHASE ADJ.

(7) Adjust the PHASE control to zero the meter.

(8) Move the FUNCTION switch to OFF.

(9) Operate the WORD SYNC switch to MAN and release when the counter stops.

(10) Reset the counter on the 914C DTS.

(11) Conduct the test for 5 minutes.

Requirement: One error or less

(12) Upon completing the test, disconnect test equipment and restore data set to pretest condition.

High-Speed

(1) Connect and condition the test equipment as shown on Fig. 5.

(2) Install option YH (1200-bps operation—SYNC).

(3) Apply power to the data set and to the DTS.

(4) Press the HS button on the data set if option XK is installed. Speed selection is automatic when option XJ is installed.

(5) If the remote digital loop feature is being used (refer to paragraph 4.14), and option XM is installed, press RDL button on the front of the data set. If otpion XL is installed operate S4 on DTS to on. If the remote digital loop feature is not being used, request the attendant at the distant end to press the DL button on the data set.

(6) Dial the distant data set and go to the data mode at the local data set. On the 914C DTS, verify that DS2 lights, then DS3, then DS1. Verify that the NO DATA lamp goes off.

(7) On the DTS, operate the WORD SYNC switch to MAN and release when the counter stops.

(8) Reset the counter on the DTS.

(9) Conduct the test for 5 minutes.

Requirement: Ten errors or less

(10) Upon completing the test, disconnect test equipment and restore data set to pre-test condition. If option YH was added in (2), restore original option at this time.

G. End-to-End Test Using 914C DTS

4.16 The end-to-end test checks the transmitter and receiver of both data sets and the connecting facility. The customer interface at both data sets is also checked. Identical test data is generated by DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated on the DTS counter.

4.17 Perform this test at the speed mode used most often by the CPE. If the CPE is arranged to operate dual mode, perform the test in the speed mode which is causing difficulty.

4.18 Perform the test as follows:

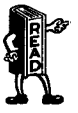
Low-Speed

(1) At both stations, connect and condition the test equipment as shown in Fig. 4.

(2) Apply power to the data set and then to the DTS.

(3) Establish voice communication between data stations and arrange to conduct an end-to-end test.

(4) Go to the data mode at both ends. On the 914C DTS, verify that DS2 lights, then DS3, then DS1.



Verify that the NO DATA indicator on the 914C DTS is off. This indicates that a valid connection has been established. If the NO DATA lamp lights during the test, the test must be restarted.

(5) Move FUNCTION switch to PHASE ADJ.

(6) Adjust the PHASE CONTROL to zero the meter.

(7) Move the FUNCTION switch to OFF.

(8) Operate the WORD SYNC switch to MAN and release when the counter stops.

(9) Reset the counter on the 914C DTS.

(10) Conduct a 15-minute test.

Requirement: 5 errors or less

(11) Upon completing the test, disconnect test equipment and restore data set to pretest condition.

High-Speed

(1) At both data stations, connect and condition the test equipment as shown in Fig. 5.

(2) Install option YH (1200 bps operation—SYNC) at both ends.

(3) Apply power to the data set and then to the DTS.

(4) Press the HS button at the originating end if option XK is installed. Speed selection is automatic when option XJ is installed.

(5) Establish voice communication between data stations and arrange to conduct an end-to-end test.

(6) Go to the data mode at both ends. On the 914C DTS, verify that DS2 lights, then DS3, then DS1.

Verify that the NO DATA indicator on the DTS is off. This indicates that a valid connection has been established. If the NO DATA indicator lights during the test, the test must be restarted.

(7) Operate the WORD SYNC switch to MAN and release when the counter stops.

(8) Reset the counter on the DTS.

(9) Conduct the test for 15 minutes.

Requirement: 18 errors or less

(10) Upon completing the test, disconnect test equipment and restore data set to pre-test condition. If option YH was added in (2), restore the original option at this time.

H. Automatic Answer Test

4.19 This test checks the ability of the data set to answer a call, go to the data mode, and terminate the call. The data set under test must be equipped with option ZH (automatic answer—IN). The test is performed as follows:

(1) Connect and condition the test equipment as shown in Fig. 6 ***except turn off S2.***

(2) Apply power to the data set and then to the DTS.

(3) Place a call to the data set under test.

Requirement: DS5 lights (ring indicator ***on***) during ringing period. DS5 goes off (ring indicator ***off***) during silent period. Data set does ***not*** answer call.

(4) During a silent period of the ring cycle, set S2 to ON (data terminal ready ***on***).

Requirement: At the end of the next ringing cycle, the data set answers the call and DS2 lights (data set ready is ***on***). This indicates that the data set is in the data mode. DS5 (ring indicator) may remain lighted if data set is equipped with option X (answer mode indication CE—ON).

(5) In less than 15 seconds after DS2 lights, move S2 to OFF (data terminal ready ***off***).

Requirement: DS2 goes off (data set ready is ***off***). This indicates that the data set has terminated the call.

(6) Upon completing the test, disconnect test equipment and restore data set to pretest condition.

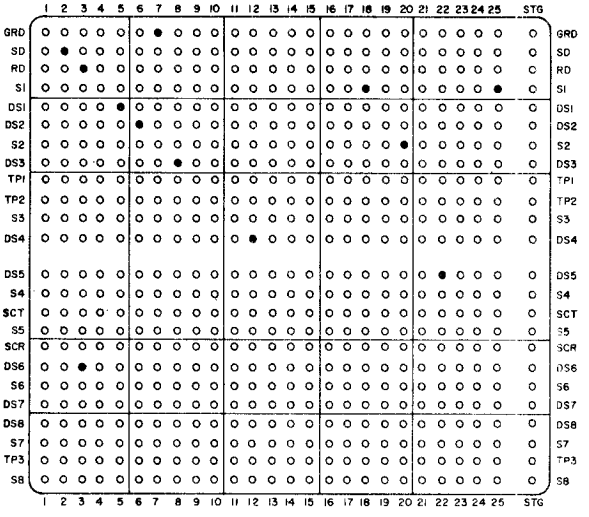
I. Interface Tests

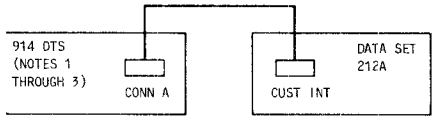
4.20 This test checks the ability of the data set to respond to interface control and to provide indications through the interface. The signals which the data set will respond to and the indications given depend on the options installed. In this test, the DS 212A interface is checked using a 914C DTS. Some of these tests require assistance from the data test center (DTC).

4.21 ***Test of CN Circuit:*** This test checks the ability of the local data set to go into the analog loopback mode under control of the CN interface lead. The data set must be equipped with option YE (CN circuit—IN). Perform the test as follows:

For DS 212A-L1 or DS 212A-L1A with options XO or XN installed, insert red programming pins in both S1-18 and S1-25. For DS 212A-L1A with option XR installed, remove pin from S1-25 and insert pin in DS 4-25.

(1) Connect and condition the test equipment as shown in Fig. 6 ***except S2 must be off.***





NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR	ALL DEPRESSED
FUNCTION	OFF
INTERFACE MODE	VOLTAGE
RCV BIT RATE	300
TRANSMIT BIT RATE	300
S1	OFF
S2	ON

2. INSERT RED PROGRAMMING PINS IN 914 CTS MATRIX IN POSITIONS INDICATED
3. 914 DTS SWITCHES AND INDICATORS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

SWITCH	INDICATOR	FUNCTION
	DS1	CLEAR TO SEND (CB)
	DS2	DATA SET READY (CC)
	DS3	RCVD LINE SIG DETECTOR (CF)
	DS4	SPEED INDICATION (CI)
	DS5	RING INDICATOR (RI)
S1		MAKE BUSY/ANALOG LOOP (CN)
S2		DATA TERMINAL READY (CD)

Fig. 6—Interface Tests

(2) Apply power to the data set and then to the DTS.

(3) Set switch S1 to ON. This turns ***on*** the CN interface lead.

Requirement: Data set MB indicator lights. If the data set is equipped with option ZF (CC indication for analog loop—ON), the MR indicator on the data set and the DS2 indicator on the DTS are lighted.

(4) To verify that the data set is in the analog loopback mode and to verify proper operation of the send data and receive data interface leads, move switch S2 (CD) to ON.

Requirement: On 914C DTS, DS3 lights, then DS1 lights and DS6 (BB) shows received data.

(5) Move S2 to OFF.

Requirement: DS1, DS3, and DS6 (BB) indicators go off.

4.22 ***Test of Receive Space Disconnect Feature:*** This test checks the ability of the data set to disconnect (go on-hook) upon receiving a space signal from the distant data set. The data set must be equipped with option V (receive space disconnect—IN). The test is performed as follows:

(1) Connect and condition the test equipment as shown in Fig. 6.

(2) Apply power to the data set and then to the DTS.

(3) Have the DTC go to the low-speed mode and place a call to the local data set.

(4) If option ZG (automatic answer—OUT) is installed, answer the call, go to the data mode, and place the handset on-hook. Verify that DS2 goes on, followed by DS3 and DS1.

(5) The DTC sends at least 4 seconds of spacing.

Requirement: DS1, DS2, and DS3 indicators go off (data set drops the call).

4.23 ***Test of CB and CF Indications Option:*** When option A (CB and CF indications—COMMON) is selected, the clear-to-send (CB) interface circuit is forced ***off*** whenever the received line signal detector (CF) interface circuit goes ***off.*** This test checks proper operation of this feature. Perform the test as follows:

(1) Connect and condition the test equipment as shown on Fig. 6.

(2) Ensure that option R (loss of carrier disconnect—OUT) is installed in the data set.

(3) Apply power to the data set and then to the DTS.

(4) Have the DTC go to the low-speed mode and place a call to the local data set.

(5) If option ZG (automatic answer—OUT) is installed, answer the call, go to the data mode, and place the handset on-hook. Verify that DS2 goes on, followed by DS3 and DS1.

(6) Have the DTC go from the data mode to the talk mode without dropping the call (or go from TEST to TALK on 904 DTC).

Requirement: DS1 (CB) and DS3 (CF) go off ***at the same time.*** Disregard other indicators.

4.26 ***Test of Speed Mode Option:*** When the data set is equipped with option YO (speed mode—HIGH), the data set will not pass data through the interface when in the low-speed mode. This test checks that low-speed data is blocked at the interface.

(1) Connect and condition the test equipment as shown in Fig. 6.

(2) Press the AL and HS switches on the data set.

Requirement: DS1 and DS3 are lighted. DS6 flickers.

(3) Place the data set in the low-speed mode by releasing the HS button.

Requirement: DS1 (CB), DS3 (CF), and DS6 (BB) go off.

J. Ground Noise Test

4.27 If the data set and CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6-type impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset level and which are separated by approximately 150 ms or more.

4.28 Test equipment required for this test is as follows:

1—6H impulse counter (or equivalent)

1—914-type DTS

1—2W6A test cord for 6H impulse counter (310 plug on one end, alligator clips connected to tip and ring on the other end).

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description Operation, and Maintenance (103-620-100).

4.29 In this test, the impulse counter is connected between the grounds of the data set and the CPE. The counter registers when potential differences of sufficient amplitude have developed between the separated grounds. The 914-type DTS is used to gain access to the ground interface leads. If a 914-type DTS is not available, any suitable method of access (such as 901 test adapter) may be used.

4.30 The 6H impulse counter is connected and the test is performed as follows.

(1) Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective ground from the CPE appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip to the 2W6A cord to switch 1B and the other clip to any clear, bare metal on the data set housing. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

4.31 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

DATA SET 212A

TRANSMITTER-RECEIVER

TEST PROCEDURES USING 921A DATA TEST SET

CONTENTS PAGE

1. GENERAL

1.01 This section contains test procedures to be followed when using a 921A-L1, -L2 (version II or later) data test set (DTS) to test a data set

(DS) 212A. These procedures are to be followed when investigating a trouble report or when needed during an installation. Test procedures using the 914 DTS are described in the section entitled Data Set 212A Transmitter-Receiver—Test Procedures (592-034-500).

1.02 When this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 DS 212A provides full-duplex transmission and reception of serial binary data at two distinct bit rates over the switched network. In the low-speed mode, the maximum bit rate is 300 bits per second (bps). In the high-speed mode, operation is synchronous or character-asynchronous at 1200 bps. Additional information concerning DS 212A is contained in the section entitled Data Set 212A Transmitter-Receiver—Description and Operation (592-034-100).

1.04 The 921A DTS is a portable, general purpose, serial data test set which provides the serial testing capabilities of the 914C DTS and is compatible with the 914C for end-to-end testing. In addition, the 921A DTS is compatible with the 911A and 911NA DTSs for end-to-end start-stop distortion measuring purposes. Additional information concerning the 921A DTS is contained in the section entitled 921A Data Test Set—Description (107-104-100).

1.05 Input to the 921A DTS is made through the 20-button keyboard. The 32-character alphanumeric display provides operator prompting and diagnostic results. Refer to Fig. 1 for the location and nomenclature of connectors, switches, status indicators, input and output jacks, etc, which will be used in the course of testing DS 212A.

2. INSTALLATION TESTS

2.01 After the data set has been installed, it must be tested to determine if it is operating properly. Before proceeding with the test, verify that the local loop meets the requirements specified in the section entitled Data Systems—DATAPHONE® Service—Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange and Remote Exchange Lines (314-205-501).

2.02 Refer to Fig. 2 for the sequence of tests to be performed to verify proper installation. The 921A DTS is not required for installation testing, but may be used if needed.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed during a maintenance visit. This test sequence provides a method of isolating a trouble to the data set, the transmission facility, or the customer-provided equipment (CPE).

3.02 When a trouble report is received, the DTC is responsible for isolating the trouble to the data set or transmission facility. The procedure for doing this is shown in Fig. 3.

3.03 If it is suspected that the trouble is in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests. The following equipment should be taken on a trouble visit:

- Spare DS 212A-L1A/2A
- 921 DTS (for conducting error tests through the interface).

3.04 Refer to Fig. 4 for the sequence in which tests are to be performed by the telco employee at the data station. If the data set is replaced, the defective data set should be tagged with a tag describing the nature of the trouble, carefully packed and returned to a service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists, proceed as follows:

(a) Check that the options installed in the data set agree with those specified on the service order.

(b) Verify that the CPE has been tested and is operating properly.

(c) Check for physical damage to the data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in the station wiring.

(f) Verify that the data set and CPE are connected to a common ground.

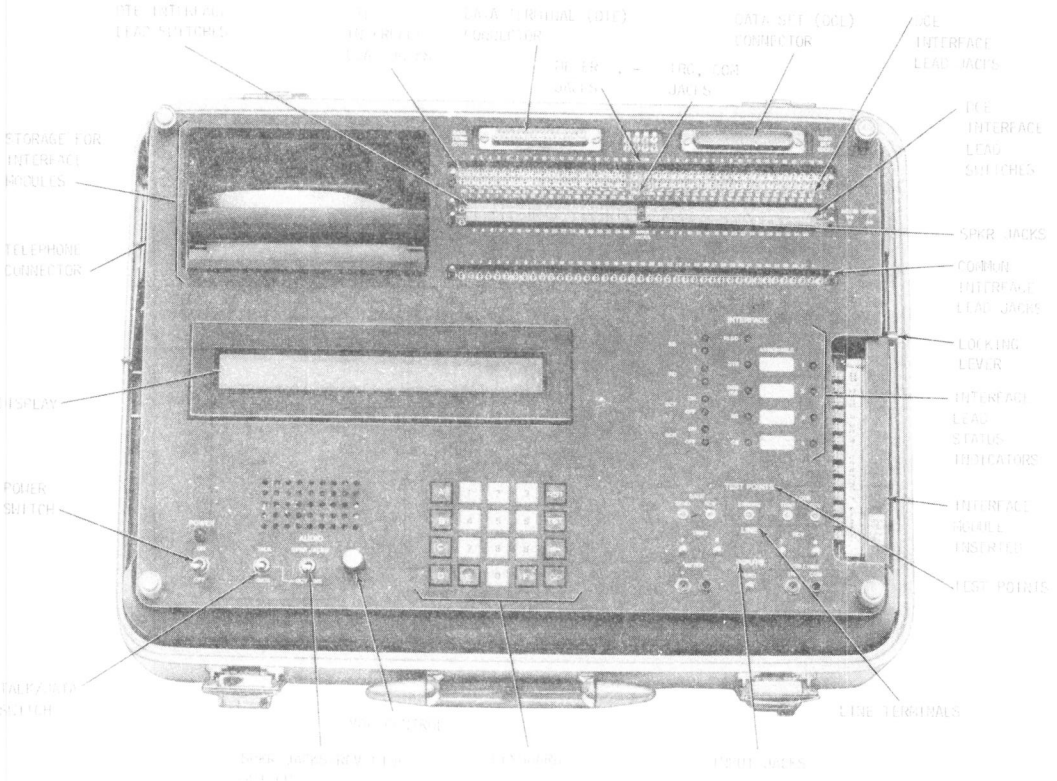


Fig. 1—921A Data Test Set—Front Panel

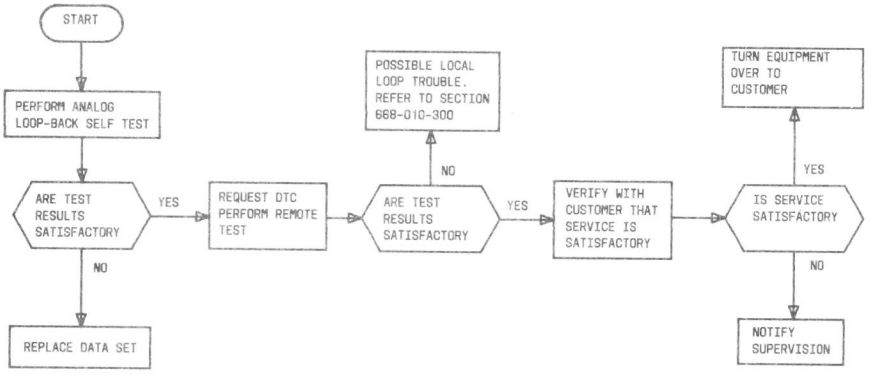


Fig. 2—Installation Test Sequence

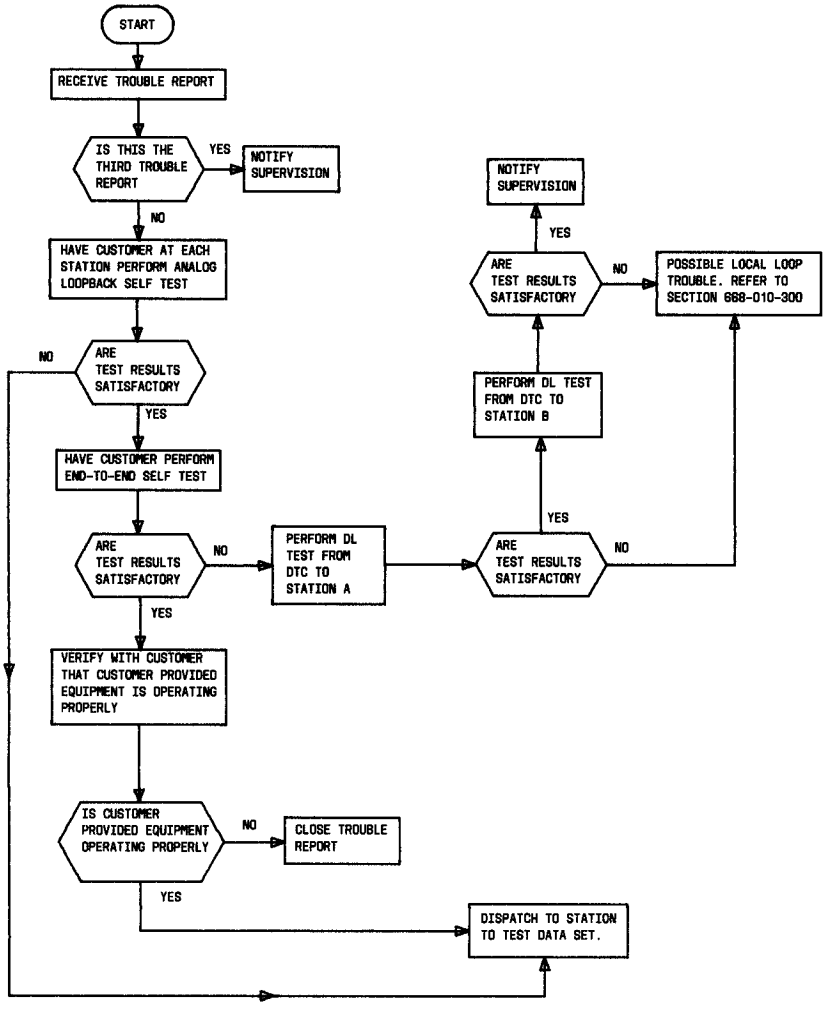


Fig. 3—Clearing Trouble Report

(g) If the trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

TEST CAPABILITIES

4.01 Test circuitry built into DS 212A permits the following self tests to be performed.

- Analog Loopback Self Test
- Digital Loopback Self Test
- End-to-End Self Test
- Remote Digital Loopback Self Test (High-Speed Mode).

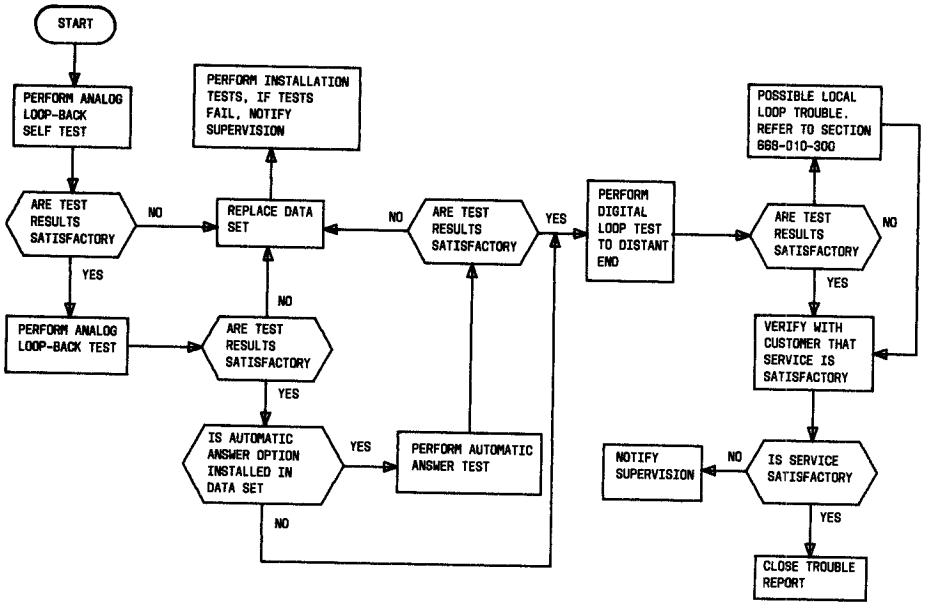


Fig. 4—Maintenance Test Sequence

4.02 If a 921 DTS is used, the analog loopback, digital loopback, and end-to-end tests can be done using pseudorandom data. By use of the 921 DTS, the customer interface circuits are tested and a more precise indication of bit and block errors can be obtained. Start-stop distortion test can be performed for asynchronous operation. The 921 DTS can also be used to perform a test of the data set automatic answer and interface circuits.

A. Analog Loopback Self Test

4.03 The analog loopback self test checks the data set transmitter and receiver (Fig. 5). The customer interface is not checked. Test data (dotting pattern) generated by the data set is looped from the transmitter output to the receiver input. The received data is compared to the transmitted data. This test can be performed in either the high-speed or low-speed mode. If the data set is operating in the low-speed mode, the MC lamp blinks if the distortion threshold (25 percent) is exceeded. If the data set is operating in the high-speed mode, the MC lamp blinks if a bit error is detected in the received data. The speed is controlled by the HS switch and/or interface lead. Perform the test in the speed mode used by the CPE. Perform the test as follows:

(1) Set the speed mode of the test by either setting the position of the HS button (IN for high-speed mode) through the customer interface.

(2) Press the AL and ST switches on the data set.

Requirement: The MB and the TM indicators are lighted. The MC indicator goes off after the SD and RD indicators light. Disregard the TR indicator on DS 212A-L1; the TR indicator is either lighted or off depending on the state of the CD lead from the CPE. The TR indicator is lighted anytime ST or DL is depressed on DS 212A-L1A. The MR lamp is lighted if data set is equipped with option ZF.

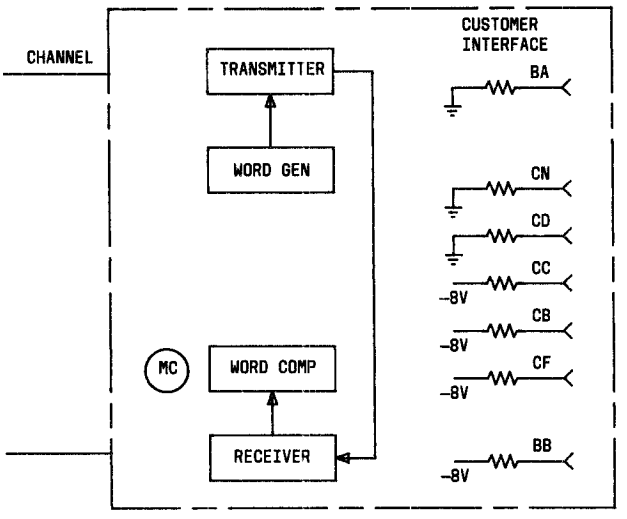


Fig. 5—Analog Loopback Self Test—Simplified Block Diagram

(3) Observe the MC indicator for 1 minute:

Requirement: MC indicator does not blink.

(4) Release the AL and ST switches.

B. Digital Loopback Self Test

4.04 This test takes advantage of the digital loopback capability of the data set at one end and the self-test (pattern generating and comparing) capability of the data set at the other end (Fig. 6). The test is performed by putting one data set in the DL mode, placing the other data set in the ST mode, placing a call, and then going to the data mode. The MC indicator on the data set which is in the ST mode blinks when data distortion of a single bit exceeds 25 percent (low-speed) or if a received error occurs (high-speed).

Note: In the low-speed mode, the distant data set may be 103J, 113C, or 113D.

4.05 Perform this test at the speed mode used most often by the CPE or in the speed mode which is causing difficulty. The speed mode is selected by use of the HS button. The test is performed as follows:

(1) Place a call to the distant end. If the distant data set is already in the DL mode, it will answer automatically.

(2) If the distant data set does not answer automatically, instruct the attendant at the distant end to press the DL switch and go to the data mode.

(3) On the local data set, press the ST switch and go to the data mode.

(4) Observe the MC indicator for 2 minutes.

Requirement:

- Low-Speed—If the MC indicator stays off, both data sets and the line facilities are operating properly. If the MC indicator blinks or remains lighted, the round trip distortion is exceeding 25 percent. Since

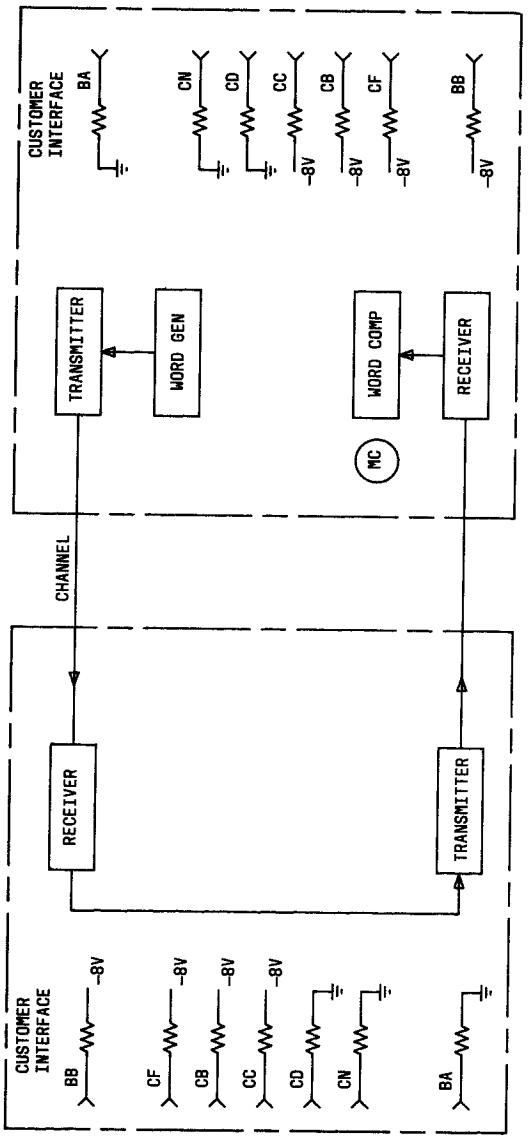


Fig. 6—Digital Loopback—Simplified Block Diagram

the distortion in the two directions may be additive, no conclusion about the proper operability of the data sets and the line facility may be drawn.

- High-Speed—Maximum of six blinks

(5) Release the ST switch on the local data set. Call the distant end and have the DL switch released.

C. Remote Digital Loopback Self Test

4.06 This test takes advantage of the remote digital loopback and self-test capabilities of the local data set and can be used to test both data sets and the communication channel in the high-speed mode only. The local data set is placed in the self-test mode by pressing the ST button. The distant data set is placed in the remote digital loopback mode by pressing the RDL switch on the local data set. The local data set pattern generator is used to send a signal to the distant end, where it is looped back and retransmitted. The error-detecting circuitry causes the MC indicator on the local data set to blink when an error is detected in the received data.

If the distant data set is equipped with option YL (receiver responds to digital loop—OUT) or option ZG (automatic answer—OUT), this test cannot be done.

4.07 The test is performed as follows:

(1) Press the HS, RDL, and ST switches on the local data set and verify that the TM indicator lights.

(2) Dial a call to the distant data set.

(3) When the distant data set has answered, place the local data set in the data mode.

(4) Observe the MC indicator on the local data set for 2 minutes.

Requirement: Maximum of six blinks.

Note: If the MC indicator is lighted continuously, this may indicate that the distant data set is not in DL mode.

(5) Release the RDL and ST switches on the local data set. Return the data set to the speed mode used by the CPE.

D. End-to-End Self Test

4.08 This test can be used to check the local data set, the distant data set, and the communication channel. This test is performed by pressing the ST switch at each end, placing a call from one end to the other, and then going to the data mode. Each data set sends the test pattern to the other end. The speed mode of the test is selected at the originating station. The error-detecting circuitry at each end monitors the received data signal and causes the MC indicator to blink if the distortion threshold (25 percent) is exceeded (low-speed) or if an error is detected (high-speed).

Note: For low-speed testing, the distant end may be a DS 103J, 113C, or 113D.

4.09 The test is performed as follows:

(1) Call the distant end and arrange to conduct an end-to-end self test. At the originating station, the speed mode is selected by use of the HS button.

(2) Press the ST switch on the front of each data set. Verify that the TM indicator lights.

(3) Go to the data mode at each end. Verify that the MC indicator goes off after the SD and RD indicators light. Disregard the TR indicator on DS 212A-L1; the TR indicator is lighted or off, depending on the state of the CD lead from the CPE. The TR indicator is lighted anytime ST or DL is depressed on DS 212A-L1A. The HS indicator is lighted or off, depending on the speed mode of the test.

(4) Observe the MC lamp on the front of the data set for 2 minutes.

Requirement:

- Low-Speed—If the MC indicator stays off, both data sets and the line facilities are operating properly. If the MC indicator blinks or remains lighted, the distortion is exceeding 25 percent.

- High-Speed—Maximum of two blinks

(5) At the end of the test, go to the talk mode and then release the ST switch.

E. Initial Test Setup for 921A DTS

4.10 The initial test setup to test DS 212A using the 921A DTS is as follows:

Ignore lamps on 921 DTS unless specifically designated.

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface and adapter cords provided with DTS. ***Note:*** The interface cord is equipped with a 37-pin connector on each end. The 6-inch adapter cord matches the interface cord to the 25-pin interface connector on the data set.	
2	Connect DTS to a 105-129 Vac 60-Hz power source.	
3	Apply power to data set.	Data set ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp on DTS lights.
5	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
6	Remove Electronic Industries Association (EIA) RS-232-C interface card from storage and ensure that all 25 interface lead switches are in TERM position.	
7	On right side of DTS, ensure that latch is in OPEN position.	
8	Insert interface into slot.	
9	Move latch to CLOSE position.	
10	On front of DTS, ensure that: All 37 DCE interface lead switches are in	

STEP	ACTION	VERIFICATION
	NORM position. AUDIO switch is in RCV LINE position. TALK/DATA switch is in DATA position.	

F. Analog Loopback Test With 921 DTS

4.11 This test checks the data set interface and transmitter and receiver circuits. Test data is generated by a DTS and looped back from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS and errors are indicated on the DTS display.

4.12 Perform this test in the speed mode used most often by the CPE or in the speed mode which is causing difficulty.

AL Low-Speed Bit Error Test

4.13 Condition DS 212A as follows:

(1) Verify that option YP is installed.

(2) Verify that DS 212A is in the low-speed mode (HS button out) if option XK is installed. Speed selection is automatic when option XJ is installed.

(3) Depress the AL button on the data set. If option ZF is installed, verify that MR lamp on data set and DSR on the 921 DTS lights.

4.14 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads: TRANSMITTER=? 1=921 2=914 3=903

STEP	ACTION	VERIFICATION
8	Enter 1.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
9	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
10	Enter 1.	Display reads— ???? SECONDS
11	Enter 0060. ***Note:*** To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0060 seconds Display then reads— OOOO BITS IN ERROR From this point, DTS counts the number of bit errors. If an out-of-sync condition occurs, display flashes OSYN. If this happens, the test must be restarted by pressing A. At the end of the test, the DTS display reads briefly each of the following messages: TEST COMPLETE XXXXX SYNC LOSSES XXXX BITS IN ERROR ***Requirement:*** 0 errors.

AL Low-Speed Start-Stop Distortion

4.15 Condition DS 212A as described in paragraph 4.13.

4.16 Perform test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36

STEP	ACTION	VERIFICATION
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
8	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
9	Enter 2.	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
10	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
11	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER??% (MAX=49%)
12	Enter 08.	Display reads (briefly)— HITS OVER 08% (MAX=49%) Display then reads— ???? SECONDS
13	Enter 0060.	Test begins and runs for 60 seconds. Display reads— PEAK=XX% HITS=XX/08 AWG BIAS=XX%
	Note: To perform functions listed below, press associated key.	

Note: If the peak reading on the display is greater than 08% when the test begins, press

STEP	ACTION	VERIFICATION
	the C key to clear the display readings and allow test to continue. KEY FUNCTION A Repeat test. B Display time remaining in test. C Clear display. D End test.	After 60 seconds, the display cycles through two messages: PEAK=XX% HITS=XX/08 AVG BIAS=XX% and TEST COMPLETE ***Requirement:*** PEAK=08% MAX HITS=00/08 AVG BIAS=01% MAX

AL High-Speed Synchronous Bit Error Test

4.17 Condition data set as follows:

(1) Verify that option YH is installed.

(2) Depress the AL and HS buttons on the data set.

4.18 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 66 on input keyboard.	Display reads— DATA SET: 66
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE: 12
5	Press GO.	Display reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
8	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS

STEP	ACTION	VERIFICATION
9	Enter 1.	Display reads— ???? SECONDS
10	Enter 0060. ***Note 1:*** If sync is lost during the test, the right portion of the display will flash OSYN. If this occurs, the test must be restarted by pressing A. ***Note 2:*** To perform functions listed below, press associated key.	

KEY	FUNCTION	
A	Repeat test.	Display reads (briefly)— 0060 SECONDS Display then reads— 0000 BITS IN ERROR
B	Display time remaining in test.	
C	Clear display.	
D	End test.	After 60 seconds, the display cycles through these messages: TEST COMPLETE; XXXXX SYNC LOSSES; XXXX BITS IN ERROR
E	Inject errors into data stream.	
F	Force out-of-sync condition.	***Requirement:*** Total bits in error are less than 12.

AL High-Speed Asynchronous Start-Stop Distortion Test—10-Bits/Character

4.19 Condition data set as follows:

(1) Verify that options YG and YJ are installed.

(2) Depress AL and HS buttons on the data set.

4.20 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE 12

STEP	ACTION	VERIFICATION
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— BITS/CHAR=? (0=NINE 1=TEN)
8	Enter 1.	Display reads briefly— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads— PARITY=? (0=EVEN, 1=ODD)
9	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
10	Enter 2.	Display reads— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
11	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
12	Enter 2.	Display reads— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— BITS/CHAR=? (0=NINE 1=TEN)
13	Enter 1.	Display reads (briefly)— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads— HITS OVER??% (MAX=49%)
14	Enter 16.	Display reads (briefly)— HITS OVER 16% Display then reads— ???? SECONDS
15	Enter 0060. ***Note:*** To perform functions listed below, press associated key.	Test begins and display then reads— PEAK=XX% HITS=XX/08 AWG BIAS=XX% ***Note:*** If the peak reading exceeds 16% when the test begins, press the C key to clear the display readings and allow the test to continue.

STEP	ACTION		VERIFICATION
	KEY	FUNCTION	
	A	Repeat test.	After 60 seconds, the display reads— TEST COMPLETE; then PEAK=XX% HITS=XX/16 AVG BIAS=XX%
	B	Display time remaining in test.	
	C	Clear display.	
	D	End test.	
	E	Inject errors into data stream.	
	F	Force out-of-sync condition.	***Requirements:*** PEAK=16% MAX HITS=00/16 AVG BIAS=06% MAX

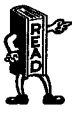
AL High-Speed Asynchronous Start-Stop Distortion Test—9-Bit Word

4.21 The 9-bit word test and requirements are the same as the test and requirements for the 10-bit word described in paragraphs 4.19 and 4.20 with the following changes:

- Install option YI.
- Step 8 enter "0" instead of "1"; the display reads briefly: BITS/CHAR=0 (0=NINE 1=TEN), display then reads TRMT=? (1=MAN 2=CONT).
- Omit Step 9.
- Step 13 enter "0" instead of "1"; the display reads briefly: BITS/CHAR=0 (0=NINE 1=TEN), then reads "HITS OVER??% (MAX 49)".
- Step 14 enter 14 instead of 16; the display reads briefly: HITS OVER 14%, then reads "???? SECONDS".
- Step 15 change requirements to: PEAK=14% MAX, HITS=00/14%, AWG BIAS=06% MAX.

G. Digital Loopback Test With 921 DTS

4.22 This test checks the transmitter and receiver of both data sets and the connecting facility. The distant data set can be a 103J, 113C, or 113D. The customer interface at the distant data set is not checked. Test data is generated by the DTS and transmitted by the local data set. This data is looped back from the receiver output to the transmitter input of the distant data set and retransmitted. The data is received by the local data set and is compared to the original data. Data errors are indicated on the display of the DTS.



This test cannot be done in the high-speed mode if option WI (transmitter timing—SLAVE) is installed in the local data set.

4.23 Perform this test at the speed mode used most often by the CPE or in the speed mode which is causing difficulty.

4.24 DS 212A-type has the capability to force the distant data set into a digital loopback mode. The test can only be used when the data set is in the high-speed mode. The remotely activated digital loopback takes place at the distant data set only if options YK (receiver responds to digital loop—IN) and ZH (automatic answer—IN) are installed at that end and the CD (data terminal ready) lead is ***on.*** If option YE is installed, interface lead CN must be ***off.***

4.25 Make sure the initial test setup using 921 DTS to test DS 212A is followed. Refer to paragraph 4.10.

DL Low-Speed Bit Error Test

4.26 Condition DS 212A as follows:

(1) Verify that DS 212A is in the low-speed mode (HS button out for DS 212A-L1 and either HS button out or interface control for DS 212A-L1A). Speed selection is controlled by interface lead CH (pin 23) going low when option XD is installed. Add strap between 10 and 23 of common interface terminal on DTS.

4.27 Perform test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ: ***Note:*** If the DL low-speed start-stop distortion test is to be performed, also enter 52, 79 at this time.
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
8	Enter 1.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63 Also observe that DTR on 921 DTS lights.
9	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
10	Place call to distant end and request the attendant to depress the DL switch on the data set and go into data mode at both ends.	Verify that RLSD, DSR, and CS on 921 DTS are lighted.
11	Enter 1.	Display reads— ???? SECONDS
12	Enter 0300.	
	Note: To perform functions listed below, press associated key.	

STEP	ACTION	VERIFICATION
	KEY FUNCTION	
	A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0800 SECONDS Display then reads— 0000 BITS IN ERROR From this point, display counts the number of errors. If an out-of-sync condition occurs, display flashes OSYN. If this happens, the test must be restarted by pressing A. At the end of the test, the display indicates: TEST COMPLETE XXXXX SYNC LOSSES XXXX BITS IN ERROR ***Requirement:*** 1 or less bits in error. ***If DL low-speed start-stop distortion test is going to be performed, do not hang up. Press GO, display reads briefly TEST INTERRUPTED: display then reads PARITY=? (0=EVEN, 1=ODD) Skip to Step 9 of paragraph 4.29 and proceed with test.***

DL Low-Speed Start-Stop Distortion

4.28 Condition DS 212A as described in paragraph 4.26.

4.29 Perform test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03

STEP	ACTION	VERIFICATION
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD) Also observe that DTR on 921 DTS lights.
8	Place call to distant end and request the attendant to depress the DL switch on the data set, and go into data mode at both ends.	Verify that RLSD, DSR, and CS on 921 DTS are lighted.
9	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
10	Enter 2.	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
11	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
12	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— HITS OVER??% (MAX=49%)
13	Enter 08.	Display reads (briefly)— HITS OVER 08% (MAX=49%) Display then reads— ???? SECONDS
14	Enter 0060. ***Note:*** To perform functions listed below, press associated key.	Display reads (briefly)— 0060 SECONDS Display then reads— PEAK=XX% HITS=XX/08 AWG BIAS=XX% ***Note:*** Initially if the peak reading is greater than 08%, press C to clear the display readings and allow test to continue.

STEP	ACTION	VERIFICATION
	KEY FUNCTION	
	A Repeat test. B Display time remaining in test. C Clear display. D End test.	After 60 seconds, the display cycles through two messages: PEAK=XX% HITS=XX/00 AVG BIAS=XX% and TEST COMPLETE ***Requirement:*** PEAK=08% MAX HITS=00/08 AVG BIAS=01% MAX

DL High-Speed Asynchronous Start-Stop Distortion Test—10-Bit Word

4.30 Make sure the initial test setup using 921 DTS to test DS 212A is followed. Refer to pargraph 4.10.

4.31 Condition DS 212A as follows:

(1) Verify that options YG and YJ are installed.

(2) Depress HS buttons on the data set. Verify that DS 212A is in the low-speed mode (HS button out for DS 212A-L1 and either HS button out or interface control for DS 212A-L1A) installed. Speed selection is controlled by interface lead CH (pin 23) going low when option XD is installed. Add strap between 10 and 23 of common interface terminal on DTS.

4.32 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE: 12
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— BITS/CHAR=? (0=NINE 1=TEN)
8	Enter 1.	Display reads (briefly)— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads—

STEP	ACTION	VERIFICATION
		PARITY=? (0=EVEN, 1=ODD) Also observe that DTR on 921 DTS lights.
9	Place call to distant end and request the attendant to depress the DL switch on the data set and go into data mode at both ends.	Verify that RLSD, DSR, and CS on 921 DTS are lighted.
10	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
11	Enter 2.	Display reads (briefly)— TRMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
12	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
13	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— BITS/CHAR=? (0=NINE 1=TEN)
14	Enter 1.	Display reads (briefly)— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads— HITS OVER??% (MAX=49%)
15	Enter 16.	Display reads (briefly)— HITS OVER 16% (MAX=49%) Display then reads— ???? SECONDS
16	Enter 0060. ***Note:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads— PEAK=XX% HITS=XX/16 AVG BIAS=XX% ***Note:*** Initially if peak reading greater than 16% appears after entering 0060 seconds, momentarily press C to clear display. ***Requirement:*** PEAK=15% MAX HITS=00/16 AVG BIAS=06% MAX

STEP	ACTION	VERIFICATION
		After 60 seconds have elapsed, display reads— TEST COMPLETE; then PEAK=XX% HITS=XX/16 AVG BIAS=XX%

DL High-Speed Asynchronous Start-Stop Distortion Test—9-Bit Word

4.33 The 9-bit word test and requirements are the same as the test and requirements for the 10-bit word described in paragraphs 4.31 and 4.32 with the following changes:

- Install option YI.
- Step 8 enter "0" instead of "1"; the display reads briefly: BITS/CHAR=0 (0=NINE 1=TEN), then display reads TRMT=? (1=MAN 2=CONT).
- Omit Step 10.
- Step 14 enter "0" instead of "1"; the display reads briefly: BITS/CHAR=0 (0=NINE 1=TEN), display then reads HITS OVER??% (MAX=49%).
- Step 15 enter 14 instead of 16; the display reads briefly: HITS OVER 14% (MAX=49%), display then reads ???? SECONDS.

DL High-Speed Synchronous Bit Error Test

4.34 Condition data set as follows:

(1) Verify that option YH is installed.

(2) Depress the HS buttons on the data set. Verify that DS 212A is in the low-speed mode (HS button out per DS 212A-L1 and either HS button out or interface control for DS 212A-L1A).

4.35 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 66 on input keyboard.	Display reads— DATA SET: 66
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE: 12
5	Press GO.	Display reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads— D=DT Q=SP 1=MK 2=2047 5=511 6=63 Also observe that DTR on 921 DTS lights.

STEP	ACTION	VERIFICATION
8	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
9	Place call to distant end and request the attendant to depress the DL switch on the data set and go into data mode at both ends.	Verify that RLSD, DSR, and CS on 921 DTS are lighted.
10	Enter 1.	Display reads— ???? SECONDS
11	Enter 0300. ***Note 1:*** If sync is lost during the test, the right portion of the display will flash OSYN. If this occurs, the test must be restarted by pressing A. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0300 SECONDS Display then reads— 0000 BITS IN ERROR After 300 seconds have elapsed, display cycles through three messages: TEST COMPLETE; 00000 SYNC LOSSES; 0000 BITS IN ERROR ***Requirement:*** Total errors are less than 12.

H. End-to-End Test Using 921A DTS

4.36 The end-to-end test checks the transmitter and receiver of both data sets and the connecting facility. The customer interface at both data sets is also checked. Identical test data is generated by DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated on the DTS counter.

4.37 Perform this test at the speed mode used most often by the CPE. If the CPE is arranged to operate dual mode, perform the test in the speed mode which is causing difficulty.

ETE Low-Speed Error Test

4.38 Make sure the initial test setup using 921 DTS to test DS 212A is followed. Refer to paragraph 4.10.

4.39 Condition DS 212A as follows:

(1) Verify that option YP is installed at both ends.

(2) Verify that DS 212A is in the low-speed mode (HS button out for DS 212A-L1, and either HS button out or interface control for DS 212A-L1A). Speed selection is controlled by interface lead CH (pin 23) going low when option XD is installed. Add strap between 10 and 23 of common interface terminals on DTS.

4.40 Establish voice communication between data stations and arrange to conduct an end-to-end test. Do not enter data mode until instructed to do so.

4.41 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads— TRANSMITTER=? 1=921 2=914 3=903
8	Enter 1, 2, or 3 to correspond to the type of data test set being used at the distant end.	Display reads (briefly)— TRANSMITTER=1 1=921 2=914 3=903 Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
9	Enter 5. ***Note:*** If distant end data test set is a 903, enter 6 instead of 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
10	Enter 1.	Display reads— ???? SECONDS
11	Discuss with far end the length of the test. Then enter data mode at both ends.	
12	Enter 0900.	

STEP	ACTION	VERIFICATION
	Note: To perform functions listed below, press associated key.	
	KEY **FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— 0000 BITS IN ERROR From this point, display counts the number of errors. If an out-of-sync condition occurs, display flashes OSYN. If this happens, the test must be restarted by pressing A. At the end of the test, the display indicates test completed total errors. TEST COMPLETE XXXXX SYNC LOSSES XXXX BITS IN ERROR ***Requirement:*** 5 errors or less.

ETE Low-Speed Stop-Start Distortion

4.42 Connect and condition the 921 DTS per instructions in paragraph 4.10.

4.43 Condition DS 212A as follows:

(1) Verify that option YP is installed.

(2) Verify that DS 212A is in the low-speed mode (HS button out for DS 212A-L1 and either HS button out or interface control for DS 212A-L1A). Speed selection is controlled by interface lead CH (pin 23) going low when option XD is installed. Add strap between 10 and 23 of common interface terminals on DTS.

4.44 Establish voice communication between the data stations and arrange to conduct an end-to-end test.

4.45 Perform test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03

STEP	ACTION	VERIFICATION
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— PARITY=? (0=EVEN, 1=ODD)
8	Enter 0.	Display reads (briefly)— PARITY=0 (0=EVEN, 1=ODD) then TRMT=? (1=MAN 2=CONT)
9	Enter 2.	Display reads (briefly)— TEMT=2 (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
10	Press GO.	Display reads (briefly)— TEST INTERRUPTED then MODE=? (1=RCV 2=RCV & TRMT)
11	Enter 2.	Display reads (briefly)— MODE=2 (1=RCV 2=RCV & TRMT) HITS OVER??% (MAX=49%)
12	Enter 08.	Display reads (briefly)— HITS OVER 08% (MAX=49%) Display then reads— ???? SECONDS
13	Discuss with far end the length of test. Then enter the data mode at both ends.	
14	Enter 0060. ***Note:*** To perform functions listed below, press associated key.	Display reads— PEAK=XX% HITS=XX/08 AVG BIAS=XX% ***Note:*** Initially if the peak reading exceeds 08%, press the C key to clear reading and allow test to continue.

KEY	FUNCTION
A	Repeat test.
B	Display time remaining in test.
C	Clear display.
D	End test.

After 60 seconds have elapsed, the display cycles through two messages:
PEAK=XX% HITS=XX/08 AVG BIAS=XX%
The display then reads—
TEST COMPLETE

STEP	ACTION	VERIFICATION
		Requirement: PEAK=08% MAX HITS=00/08 AVG BIAS=01% MAX
15	Upon completion of test, disconnect test equipment and restore data set to pretest condition.	

ETE High-Speed Synchronous Bit Error Test

4.46 Condition data set as follows:

(1) Verify that option YH is installed.

(2) Depress the HS buttons on the data set.

4.47 Establish voice communication with the far end and arrange to conduct an end-to-end test.

4.48 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 66 on input keyboard. ***Note:*** To delete a wrong entry on input keyboard during any test, press back space arrow (←).	Display reads— DATA SET: 66
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE: 12
5	Press GO.	Display reads— TEST SEQ:
6	Enter 55.	Display reads— TEST SEQ: 55
7	Press GO.	Display reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
8	Enter 5. ***Note:*** If distant end data test set is a 903, enter 6 instead of 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
9	Enter 1.	Display reads— ???? SECONDS

STEP	ACTION	VERIFICATION
10	Discuss with far end the length of the test. Then enter data mode at both ends.	
11	Enter 0900. ***Note 1:*** If sync is lost during the test, the right portion of the display will flash OSYN. If this occurs, the test must be restarted by pressing A. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0900 SECONDS Display then reads— 0000 BITS IN ERROR After the 900 seconds have elapsed, the display cycles through three messages: TEST COMPLETE; XXXXX SYNC LOSSES; XXXX BITS IN ERROR ***Requirement:*** 18 errors or less.

ETE High-Speed Asynchronous Start-Stop Distortion Test—10-Bit Word

4.49 Connect and condition the 921 DTS per instructions in paragraph 4.10.

4.50 Condition data set as follows:

(1) Verify that options YG and YJ are installed.

(2) Depress the HS button on the data set.

4.51 Establish voice communications between the data stations and arrange to conduct an end-to-end test.

4.52 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36.	Display reads— DATA SET: 36

STEP	ACTION	VERIFICATION
3	Press GO.	Display reads— BIT RATE:
4	Enter 12.	Display reads— BIT RATE: 1200
5	Press GO.	Display reads— TEST SEQ:
6	Enter 52 79.	Display reads— TEST SEQ: 52 79
7	Press GO.	Display reads— BITS/CHAR=? (0=NINE 1=TEN)
8	Enter 1.	Display reads (briefly)— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads— PARITY=? (0=EVEN, 1=ODD)
9	Enter 0.	Display reads— PARITY=0 (0=EVEN, 1=ODD) Display then reads— TRMT=? (1=MAN 2=CONT)
10	Enter 2.	Display reads— TRMT=? (1=MAN 2=CONT) Display then reads— PRESS A TO START ***Note:*** Ignore display "PRESS A TO START"
11	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— MODE=? (1=RCV 2=RCV & TRMT)
12	Enter 2.	Display reads— MODE=2 (1=RCV 2=RCV & TRMT) Display then reads— BITS/CHAR=? (0=NINE 1=TEN)
13	Enter 1.	Display reads briefly— BITS/CHAR=1 (0=NINE 1=TEN) Display then reads— HITS OVER??% (MAX=49%)
14	Enter 16.	HITS OVER 16% (MAX=49%) ???? SECONDS
15	Discuss with far-end length of test, then enter date mode at both ends.	

STEP	ACTION	VERIFICATION
16	ENTER 0060. *Note:* To perform functions listed below, press associated key. **KEY — FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject errors into data stream. F Force out-of-sync condition.	Display reads— PEAK=XX% HITS=XX/16 AVG BIAS=XX% *Note:* Initially if peak reading greater than 16% appears after entering 0060 seconds, momentarily press C to clear display. After 60 seconds have elapsed, the display reads— TEST COMPLETE Display then reads— PEAK=XX% HITS=XX/16 AVG BIAS=XX% ***Requirement:*** PEAK=16% MAX HITS=00/16 AVG BIAS=06% MAX

ETE High-Speed Asynchronous Start-Stop Distortion Test—9-Bit Word

4.53 The 9-bit word test and requirements are the same as the test and requirements for the 10-bit word described in paragraphs 4.19 and 4.20 with the following changes:

- Install option YI in both data sets.
- Step 8 enter "0" instead of "1"; the display reads BITS CHAR=0 (0=NINE 1=TEN).
- Delete Step 9.
- Step 13 enter "0" instead of "1"; the display reads BITS/CHAR=0 (0=NINE 1=TEN).
- Step 14 enter 14 instead of 16; the display reads HITS OVER 14%.

I. Automatic Answer Test

4.54 This test checks the ability of the data set to answer a call, go to the data mode and terminate the call.

4.55 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.56 Verify that option ZH (automatic answer-IN) and option U (send-space disconnect-OUT) are installed in DS 212A.

4.57 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. *Note:* If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36

STEP	ACTION	VERIFICATION
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 40.	Display reads— TEST SEQ: 40
7	Press GO.	Display reads— WAITING FOR RI
8	Have a call made to the data set.	Display reads— RINGING (during ringing period). Assignable L1 follows the RI lead. After 3 or 4 rings, the DTR lead turns on and the DTR indicator lights. After 7 seconds, DSR indicator lights (data set ready lead ***on***). Display then reads— ANSWERED After approximately 2.5 seconds, the DTR indicator goes off (data terminal ready lead ***off***). After 1 more second, DSR indicator goes off (data set ready lead ***off***). ***Requirement:*** If all of the above events occur,the display reads briefly— TEST PASSED followed by TEST COMPLETE. If any of the above events fail to occur, the display reads— TEST FAILED.

J. Interface Test

4.58 This test checks the ability of the data set to respond to interface control and to provide indications through the interface. The signals which the data set will respond to and the indications given depend on the options installed. In this test, the DS 212A interface is checked using a 921 DTS. Some of these tests require assistance from the data test center (DTC).

4.59 ***Test of CN Circuit:*** This test checks the ability of the local data set to go into the analog loop mode under control of the CN interface lead.

4.60 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.61 Verify that option YE (CN circuit-IN) is installed.

4.62 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Connect jumper wires on interface lead jacks: For DS 212A-L1 or DS 212A-L1A with option XO installed—jumper 4 to 25. For DS 212A-L1A with option XN installed—jumper 4 to 18. For DS 212A-L1A with option XR installed—jumper 4 to 18 and 13 to 25.	
2	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs some self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
3	Enter 36 on input keyboard.	Display reads— DATA SET: 36
4	Press GO.	Display reads— BIT RATE:
5	Enter 03.	Display reads— BIT RATE: 03
6	Press GO.	Display reads— TEST SEQ:
7	Enter 47 48 37.	Display reads— TEST SEQ: 47 48 37 Display then reads— :37 DTR=? (0 OR 1)
8	Enter 0.	Display reads— TEST SEQ: DTR=0 (0 OR 1)
9	Enter 38.	Display reads— TEST SEQ: 37 DTR=0 (0 OR 1) 38
10	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
11	Enter 05.	Dislay reads— SW CONN: X=05 Y=??
12	Enter 09.	Display reads (briefly)— SW CONN: X=05 Y=09

STEP	ACTION	VERIFICATION
		Display then reads— SW CONN: X=?? Y=??
13	Enter 16.	Display reads— SW CONN: X=16 Y=??
14	Enter 10.	Display reads (briefly)— SW CONN: X=16 Y=10 Display then reads— SW CONN: X=?? Y=??
15	Enter 11.	Display reads— SW CONN: X=11 Y=??
16	Enter 08.	Display reads (briefly)— SW CONN X=11 Y=08 Display then reads— SW CONN: X=?? Y=??
17	Press GO. ***Note:*** S1 is controlled by input key Number 1; S2 is controlled by input key Number 2; S3 is controlled by input key Number 3. S4 is controlled by input key Number 4.	Display reads— TEST INTERRUPTED CROSS CONNECTIONS MANUALLY SET TEST COMPLETE CROSS CONNECTIONS MANUALLY SET The display then indicates the state of the assigned switches. S1=OFF S2=OFF S3=ON S4=ON
18	Press 1.	Display reads— S1=ON S2=OFF S3=ON S4=ON ***Requirement:*** MB indicator lights on DS 212A.
19	Press 2.	Display reads— S1=ON S2=ON S3=ON S4=ON ***Requirement:*** RLSD lights followed momentarily by CS lighting. ***Note:*** If option XR is installed, observe that assignable L4 indicator lights.

4.63 ***Test of Receive Space Disconnect Feature:*** This test checks the ability of the data set to disconnect (go on-hook) upon receiving a space signal from the distant data set.

4.64 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.65 Verify that option V (receive space disconnect-IN) is installed.

4.66 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 37.	Display reads— TEST SEQ: 37 DTR=? (0 OR 1)
7	Enter 1.	Display reads— TEST SEQ: 37 DTR=1 (0 OR 1)
8	Press GO.	Display reads— TEST SEQ:
9	Place call to DTC. Have the DTC place a call to the local data set; enter low-speed data mode; send approximately 10 seconds of spacing and then send at least 4 seconds of spacing.	
10	Answer the call. If option ZG (automatic answer-OUT) is installed, answer the call, go to the data mode, and place the handset on-hook.	On 921 DTS, verify that DSR indicator lights and shortly thereafter RLSD and CS indicators light.
11	When the DTC sends spacing.	Observe that RD-0 indicator lights and approximately 1-1/2 seconds later RLSD, DSR, and CS go off (data set drops call).

4.67 ***Test of CB and CF Indications Option:*** When option A (CB and CF indications—COMMON) is selected, the clear-to-send (CB) interface circuit is forced ***off*** whenever the received line signal detector (CF) interface circuit goes ***off.*** This test checks proper operation of this feature.

4.68 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.69 Verify that option A (CB and CF indications-COMMON) and option R (loss of carrier disconnect-OUT) are installed.

4.70 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 37.	Display reads— TEST SEQ: 37 DRT=? (0 OR 1)
7	Enter 1.	Display reads— TEST SEQ: 37 DTR=1 (0 OR 1)
8	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
9	Place call to DTC and request the DTC to place a call to the local data set in the low-speed mode.	
10	Answer the call. If option ZG (automatic answer-OUT) is installed, answer the call, go to the data mode, and place the handset on-hook. ***Note:*** The DTC should go to the data mode after receiving answer tone.	On 921 DTS, verify that DSR indicator lights and shortly thereafter RLSD and CS indicators light.
11	Have DTC go into data mode and then from the data mode to the talk mode without dropping the call (or go from TEST to TALK on 904 DTC).	Observe that RLSD and CS indicators go off and DSR remains lighted. Display reads— TEST COMPLETE

4.71 ***Test of Carrier Fail Disconnect Option:*** When option S (loss of carrier disconnect-IN) is selected, the data set terminates the call if carrier disappears from the line for approximately 350 ms.

4.72 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.73 Verify that option S (loss of carrier disconnect-IN) is installed.

4.74 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 37.	Display reads— TEST SEQ: 37 DTR=? (0 OR 1)
7	Enter 1.	Display reads— TEST SEQ: 37 DTR=1 (0 OR 1)
8	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:
9	Place call to DTC and request the DTC to place a call to the local data set in the low-speed mode.	
10	Answer the call. If option ZG (automatic answer-OUT) is installed, answer the call, go to the data mode, and place the handset on-hook. ***Note:*** The DTC should go to the data mode after receiving answer tone.	On 921 DTS, verify that DSR indicator lights and shortly thereafter RLSD and CS indicators light.

STEP	ACTION	VERIFICATION
11	Have DTC go from the data mode to the talk mode without dropping the call (or go from TEST to TALK on 904 DTC).	RLSD and CS indicators go off immediately. DSR indicator goes off in approximately 350 ms or is delayed for approximately 4 seconds if option T is installed.

4.75 ***Test of Speed Mode Option:*** When the data set is equipped with option YO (speed mode-HIGH), the data set will not pass data through the interface when in the low-speed mode. This test checks that low-speed data is blocked at the interface.

4.76 Connect and condition the 921 DTS per the instructions in paragraph 4.10.

4.77 Condition the data set as follows:

(1) Verify that option YO (speed mode-HIGH) is installed.

(2) Depress the AL and HS buttons on the data set.

4.78 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
2	Enter 36 on input keyboard.	Display reads— DATA SET: 36
3	Press GO.	Display reads— BIT RATE:
4	Enter 03.	Display reads— BIT RATE: 03
5	Press GO.	Display reads— TEST SEQ:
6	Enter 53 37.	Display reads— 53 37 DTR=? (0 OR 1)
7	Enter 1.	Display reads (briefly)— 53 37 DRT=1 (0 OR 1) Display then reads— :
8	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
9	Press D.	Display reads— DOTTING BIT ERROR TEST

STEP	ACTION	VERIFICATION
10	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— TEST COMPLETE Display then reads— TEST SEQ: On 921 DTS, verify that indicators RLSD and CS light steadily and both SD and RD are flashing.
11	Release the HS button on DS 212A.	On 921 DTS, verify that indicators RLSD and CS go off and SD continues flashing. RD-1 is ***on*** and RD-0 is ***off.***

4.79 ***Test of Interface Speed Control Option (DS 212A-L1A Only):*** When option XJ (interface) is selected, it enables high-speed or low-speed operation of an originating data set to be controlled through pin 23 of the customer's interface.

4.80 Connect and condition the 921 DTS per instructions in paragraph 4.10.

4.81 Condition the data set as follows:

(1) Verify that option XJ (interface) is installed.

(2) Depress the AL button on the data set.

4.82 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Connect a jumper wire on common interface lead jack between 20 and 23.	
2	Press RST on input keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display indicates version number of DTS (921A VERS #02). DTS then performs certain self tests. If DTS is defective, a TEST FAILED message appears on display. If DTS is satisfactory, display reads— DATA SET:
3	Enter 36 on input keyboard.	Display reads— DATA SET: 36
4	Press GO.	Display reads— BIT RATE:
5	Enter 12.	Display reads— BIT RATE: 12
6	Press GO.	Display reads— TEST SEQ:
7	Enter 47 48 37.	Display reads— :37 DTR=? (0 OR 1)

STEP	ACTION	VERIFICATION
8	Enter 1.	Display reads— TEST SEQ: 37 DTR=1 (0 OR 1)
9	Press GO.	Display reads (briefly)— TEST COMPLETE— Display then reads— SW CONN: X=?? Y=?? Observe that the HS indicator on the data set and assignable LED #1 on DTS are lighted.
10	Enter 10.	Display reads— SW CONN: X=10 Y=??
11	Enter 05.	Display reads (briefly)— SW CONN: X=10 Y=05
12	Press GO.	Display reads (briefly)— TEST INTERRUPTED Display then reads— CROSS CONNECTIONS MANUALLY SET Display then reads— TEST COMPLETE Display then reads— CROSS CONNECTIONS MANUALLY SET Display then reads— TEST SEQ: Observe that the HS indicator and assignable LED #1 go off. Test complete.

K. Ground Noise Test

4.83 ***Signal Ground to Frame Ground Connection:*** When option Q is selected, (signal ground) interface lead is connected to frame ground. This arrangement provides additional margin against longitudinal power line noise. When option P is selected, the AB (signal ground) interface lead is disconnected from the frame ground. Due consideration should be given to possible noise conditions, ground potential differences, safety conditions, local electrical codes, and the data terminal manufacturer's recommendations.

4.84 If the data set and CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6-type impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset level and which are separated by approximately 150 ms or more.

4.85 Test equipment required for this test is as follows:

1—6H impulse counter (or equivalent)

1—921-type DTS

1—2W6A test cord for 6H impulse counter (310 plug on one end, alligator clips connected to tip and ring on the other end).

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and Maintenance (103-620-101). If the 6H impulse counter is not available, a 6A impulse counter

may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

4.86 In this test, the impulse counter is connected between the grounds of the data set and the CPE. The counter registers when potential differences of sufficient amplitude have developed between the separated grounds. The 921 DTS is used to gain access to the ground interface leads. If a 921-type DTS is not available, any suitable method of access (such as 901 test adapter) may be used.

4.87 The 6H impulse counter is connected and the test is performed as follows:

(1) Connect the 921 DTS DCE connector to the customer connector on the data set. Connect the 921 DTS DTE connector to the data set connector on the CPE. This test assumes that protective ground from the CPE appears at the customer interface.

(2) On the 921 DTS, open all interface switches.

(3) Connect one clip to the 2W6A cord to terminal 1 interface lead jack and the other clip to any clear, bare metal on the data set housing. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

(8) Remove clips of 2W6A cord and connect to the terminal on the interface lead jack corresponding to terminal 7 of the CPE interface and terminal 7 of the data set interface.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the minutes control to 15. After the 15-minute test has elapsed, record the number of indications on the counter.

4.88 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

5. REFERENCES

5.01 Additional information concerning the testing of DS 212A is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-205-501	Data Systems—DATAPHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
592-034-100	Data Set 212A—Transmitter-Receiver— Description and Operation
592-034-200	Data Set 212A—Transmitter-Receiver—Installation and Connections
592-034-500	Data Set 212A—Transmitter-Receiver— Test Procedures Using 914-Type Data Test Set
666-511-501	Test of Data Services Provided by Data Set 201C From a Private Line Testroom

SECTION	TITLE
668-010-300	Data Systems—DATAPHONE® Service on Direct Distance Dialing Network—Data Test Center—Trouble Analysis Procedures
999-100-138	Data Set 201C—How to Operate Manual

5.02 Detailed information concerning DS 212A is contained in CD- and SD-1D239-01.