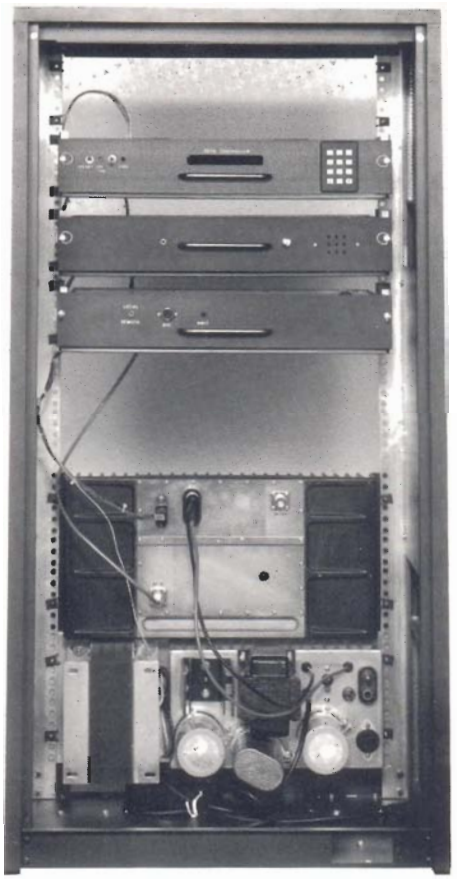
EFJohnson®

CR1010 REPEATER 450–512 MHz SERVICE MANUAL



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CR1010 REPEATER
450–512 MHz
SERVICE MANUAL

450–512 MHz, 117V AC
100 Watts RF Output
Part No. 242–1010–1xx

The E.F. Johnson Company designs and manufactures two–way radio equipment to serve a wide variety of communications needs. Johnson produces equipment for the mobile telephone and land mobile radio services which include business, industrial, government, public safety, and personal users. In addition, Johnson designs and manufactures electronic components used in communications equipment and other electronic devices.

LAND MOBILE PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from your product supplier or from the E.F. Johnson Company, 299 Johnson Avenue, Box 1249, Waseca, MN 56093–0514. Phone (507) 835–6222.

WARNING

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by E. F. Johnson could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

DO NOT allow the antenna to come close to or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

DO NOT operate the radio near electrical blasting caps or in an explosive atmosphere.

DO NOT operate the radio unless all the radio frequency connectors are secure and any open connectors are properly terminated.

DO NOT allow children to operate transmitter equipped radio equipment.

SAFETY INFORMATION

Proper operation of this radio will result in user exposure below the Occupational Safety and Health Act and Federal Communication Commission limits.

The information in this document is subject to change without notice.

This manual includes revisions through October 1995.

REVISIONS LOG

Page

4–6 Revised Figure 4–3, Transmitter Block Diagram to include A180 DC Voltage Control
6–2 Revised Section 6.2 and 6.3 to include A180 DC Voltage Control alignment.
6–3 Revised Figure 6–3, Transmitter Alignment Points Diagram to include A180
7–1 Add A180 to Exciter Drawer parts list.
7–6 Added A180 parts list
7–11 Added A403 PA Rear Connect Assembly
8–10 Added A180 to Exciter Component Layout
8–11 Revised Exciter Schematic to include A180 DC Voltage Control
8–14 Revised Logic drawer component layout to include R995 zero ohm jumper from R990 (+5V) to U732, pin 16 (Vcc).
8–19 Added A180 DC Voltage Control board component layout
8–19 Added A180 DC Voltage Control Board schematic

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SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual includes installation, circuit description, servicing, and alignment information for the Johnson CR1010 UHF Repeater, Part Number 242-1010-116/126.

1.2 DESCRIPTION

The Johnson CR1010 is a UHF-FM repeater that operates in the 450-512 MHz frequency range. It is completely solid state and the transmitter is rated at 100W (450-488 MHz) or 90W (488-512 MHz) RF power output continuous duty. The output from the duplexer (if used) is approximately 75W (450-488 MHz) or 68W (488-512 MHz).

The repeater is modular in design for ease of service. There are separate assemblies for a logic, receiver, exciter, power amplifier, and power supply sections.

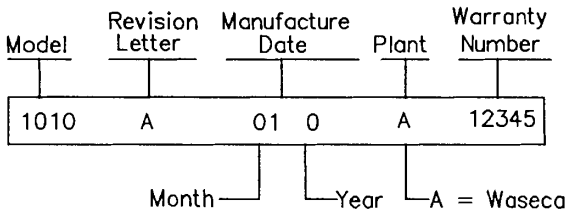
When used in the community repeater configuration, the Logic Drawer controller is capable of decoding any of 38 CTCSS tones (field programmable) and up to 16 CDCSS codes. The controller also allows transmitting different CTCSS tones than received. Refer to Section 3 for programming information.

The CR1010 standard settings are:
3.5 second Hang Time
3.0 minute Time-Out Timer
0.25 second Key Delay

The repeater functions as an open repeater when 0040 Call Guard® is assigned. At the end of each DCG transmission the repeater sends a Digital Call Guard turn-off code. The repeater does not invert the Digital Call Guard signal and does not encode Call Guard signal when keyed with the local microphone.

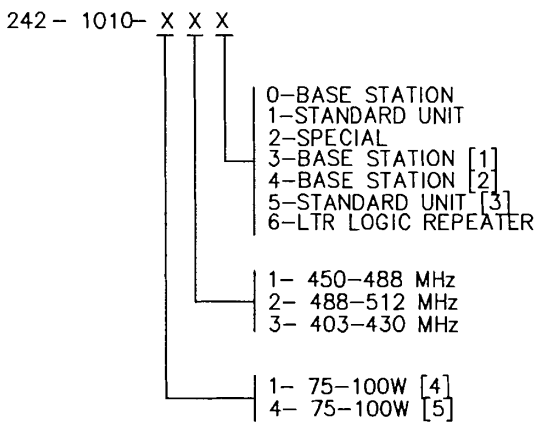
1.3 REPEATER IDENTIFICATION

The serial number is printed on an adhesive backed cloth attached to the inside of the cabinet. The following table shows an identification breakdown of an identification number.



1.4 JOHNSON CR1010 MODELS

The following breakdown shows the part number scheme used for the Johnson CR1010 models.



[1] WITH SECOND RECEIVER OPTION
[2] WITH REPEATER OPTION
[3] WITH EXTERNAL CWID OPTION
[4] 1 CHANNEL REPEATER
[5] WITH MULTI-CHANNEL BASE STATION

1.5 ACCESSORIES

Refer to Table 1-1 for a listing of CR1010 repeater accessories/options and their part numbers.

TABLE 1-1
ACCESSORIES/OPTIONS

DESCRIPTION	PART NUMBER
Transmit 2 PPM TCXO [1]	518-24xx-xxx 518-25xx-xxx
Receive 2 PPM TCXO [1]	518-54xx-xxx 518-55xx-xxx
CW Identifier PROM	544-9050-010
External CWID Kit	250-1010-740
Heavy Duty Microphone	250-0740-200
Outdoor Cabinet	023-4061-001
PA DC Power Substitution Box	023-1010-280
Duplexer	532-4001-004

[1] The last six digits are determined by the frequency in MHz.

1.5.1 EXTERNAL CW IDENTIFIER

The CWID is a separate PC board option that provides automatic international Morse Code station call sign identification by superimposing coded audio onto the transmit modulation. If voice communication is in process, the ID is not transmitted until the repeater unkeys. If the ID is being transmitted, the repeater can be accessed and the voice communication will be heard over the ID.

U701 is included in the kit to upgrade the software if necessary. Revision 208 or later software is required with the CWID.

The PROM can be factory programmed or with the PROM Programmer II, Part No. 250-3020-200.

1.5.2 REPEATER CABINETS

The standard 30-inch cabinet does not have additional room for accessories. The 43- or 60-inch cabinets are used when accessories such as a duplexer is installed. The outdoor cabinet consists of three panels which install around the indoor cabinet to make it weather resistant.

1.5.3 MICROPHONE

This is a high-impedance microphone used for repeater testing. The repeater does not encode Call Guard signal when keyed by the microphone.

1.6 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the Warranty Department, E.F. Johnson Company, 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. This information may also be requested by phone from the Warranty Department. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6970.

1.7 FACTORY CUSTOMER SERVICE

The Customer Service Department of the E.F. Johnson Company provides customer assistance on technical problems and the availability of local and factory repair facilities. Customer Service hours are 7:30 a.m. - 4:30 p.m. Central Time, Monday - Friday. There is also a 24-hour emergency technical support telephone number. From within the continental United States, the Customer Service Department can be reached at this toll-free number:

1-800-328-3911

When your call is answered at the E.F. Johnson Company, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist you. When you enter a first number of "1" or "2", another number is requested to further categorize the type of information you need. You may also enter the 4-digit extension number of the person that you want to reach if you know what it is.

FAX Machine - Sales	(507) 835-6485
FAX Machine - Cust Serv	(507) 835-6969

If you are calling from outside the continental United States, the Customer Service telephone numbers are as follows:

Customer Service Department – (507) 835-6911
Customer Service FAX Machine – (507) 835-6969

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

E.F. Johnson Company
Customer Service Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.8 FACTORY RETURNS

Repair service is normally available through local authorized E.F. Johnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Field Service Department before returning equipment. A service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary. If using the toll-free number in the preceding section, enter "2".

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling the repair lab (see Section 1.7) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Then include a form in the shipping container with each unit. Your phone number and contact name are very important because there are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, use a PO number or some other reference number on your paperwork. These numbers are referenced on the repair order and it makes it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. They require RA numbers for exchange units or if they want to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

1.9 REPLACEMENT PARTS

E.F. Johnson replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number and then enter "1" as described in Section 1.7. When ordering, please supply the part number and quantity of each part ordered. E.F. Johnson dealers also need to give their account number.

If there is uncertainty about the part number, include the designator (C112, for example) and the model number of the equipment the part is from (refer to Section 1.3).

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.7.

E.F. Johnson Company
Service Parts Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

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CR1010 SPECIFICATIONS

The following are general specifications intended for use in testing and servicing this repeater. For current advertised specifications, refer to the Marketing Specifications sheet. Specifications are subject to change without notice.

GENERAL

Frequency Range	450–512 MHz
Channels	1
Transmit/Receive Separation	5 MHz
Channel Spacing	25 kHz
Dimensions	43"H x 22"W x 15"D
Microphone	Optional HD for local operation and test
Power Source	115V AC/230V AC
Battery Drain	2.5A maximum standby, 30A maximum transmit
FCC Compliance	Parts 15, 21, 74, 90 and 95(A)
Duty Cycle	Continuous
Circuit Protection	35A circuit breaker (system) 7A fuse (exciter)

RECEIVER

Sensitivity	0.35 µV (12 dB SINAD)
Selectivity	−90 dB
Squelch Sensitivity	0.25 µV
Modulation Acceptance	±7.5 kHz
Spurious	−100 dB
Image Rejection	−85 dB
Intermodulation	−80 dB
Audio Power Output	0.5 Watt (local)
Hum and Noise	−60 dB (squelched)
Channel Spread	1 MHz maximum
Frequency Stability	±2 PPM −22°F to +140°F
Input Impedance	50 Ohms (nominal)
Speaker Impedance	8 Ohms

TRANSMITTER

RF Power Output	90 Watts
DC Input Power (finals)	200 Watts
Spurious and Harmonic Emissions	−75 dBc
Modulation	16K0F3E: ±5 kHz at 77°F/100% at 1 kHz
FM Hum and Noise	−55 dB minimum
Frequency Stability	±2 PPM −20°F to +140°F
Audio distortion	2% at 1 kHz (±3 kHz deviation)
Channel Spread	3 MHz (5 MHz with 1 dB power degradation)
Load Impedance	50 Ohms

SECTION 2
INSTALLATION

2.1 INTRODUCTION

Although this equipment is carefully aligned at the factory, shipment can upset some of the adjustments so pre-installation testing is recommended. Complete the tests listed in the "Performance Tests", Sections 6.5 and 6.4.

Site preparation and antenna installation is not within the scope of this manual. Refer to the "Dealer Guide To Site Preparation", Part No. 004-8000-100, for preliminary installation requirements. Factory installation of repeaters is available. Contact your sales representative for more information.

Refer to Section 3 for repeater programming and operating information.

2.2 115/230V AC OPERATION

CAUTION

Do not connect the power supply to AC power until an antenna or dummy load has been connected to the antenna jack. The transmitter may momentarily key and damage to the power amplifier could result.

The same power supply can be used for 115 or 230V AC power sources. If the power supply needs to be converted to operate on the other power source, rewire the transformer and change fuse F1 as shown on the schematic and wiring diagrams in the back of this manual. However, if a change between 50 and 60 Hz power sources is necessary, a different transformer is required.

2.3 INSTALLATION

1. Install the antenna coaxial cable through the access holes in the front or back baseplates of the repeater cabinet. Connect the cable to the duplexer or to the transmitter and receiver, depending on the type of installation. Connect the power supply to AC power.

NOTE: Because most repeater installations require several hundred feet of coaxial cable, it is very important that the cable be a high quality product. Failure to use a high quality cable may result in large power losses and poor repeater performance.

2. Set drawer front panel controls as follows:

   LOGIC - Set the ON/OFF LINE switch to "On Line" (green LED on). The Call Guard Level controls are factory set or adjusted during alignment.

   EXCITER - LOCAL/REMOTE SWITCH to "Remote". The Transmit Audio Level controls are factory set or adjusted curing alignment.

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SECTION 3
OPERATION AND PROGRAMMING

3.1 REPEATER OPERATION

The CR1010 repeater has several standard operating functions. The following functions are always available:

Function	Section
On/Off Line Switch	3.2
Power Indicator	3.3
Transmit Indicator	3.4
Manual Rest Switch	3.5
Local/Remote Switch	3.6
Local Volume Control	3.7
Audio Test Jack	3.8
Call Guard Squelch	3.10
Power Failure Alarm	3.11
Optional Functions	
CW Identifier	3.12

Refer to the indicated section for additional information of the particular function listed. A photo showing the various front-panel controls and indicators is located in Figure 4-1.

3.2 ON/OFF LINE SWITCH

For normal repeater operation, this switch is placed in the "On Line" position and the green LED is on. The switch is placed in the "Off Line" position to disable the Logic drawer repeater functions for repeater programming and the green LED is off.

3.3 POWER INDICATOR

Indicates that power is applied to the logic drawer.

3.4 TRANSMIT INDICATOR

Located on the front panel of the Exciter drawer, this LED indicates when the transmit enable signal is being produced by the control logic. It also indicates when the Local PTT is activated.

3.5 MANUAL RESET SWITCH

Resets the microcontroller U701 to read the programming information from the beginning of the program. This occurs automatically when power is applied to the Logic drawer and when system supply or AC power failure returns to normal.

3.6 LOCAL/REMOTE SWITCH

Normally in the Remote position, this switch directs the received audio to the transmit audio circuitry and the PTT line to the controller logic.

When placed in the Local position, the local microphone audio is placed on the transmit audio input and the PTT line is controlled by the local microphone PTT switch.

3.7 LOCAL VOLUME CONTROL

Turning this control clockwise past the detent disables logic control of the squelch and adjusts the local speaker volume level. Then if a carrier is present, the audio signal is heard from the local speaker and fed to the Exciter. The normal operating position for this control is fully counterclockwise to the "off" position. Make sure it is returned to this position when testing is complete.

3.8 AUDIO TEST JACK

Miniature phone jack used to monitor the receive audio signal. Any receive signal, including noise, can be monitored at this jack because it is located before the squelch gates.

3.9 OPEN REPEATER OPERATION

The CR1010 repeater operates as an open repeater when 0040 Call Guard code is programmed. When the repeater is keyed with the local microphone, a Call Guard signal is not encoded.

3.10 CALL GUARD SQUELCH

3.10.1 TRANSMIT TONE CALL GUARD SQUELCH

U706 contains 32-bytes of data, which along with an R-2R ladder network and 5-bit counter U705, is used to generate a step approximated sine wave. The microcontroller EPROM is programmed with two digits (see Table 3-1) assigned to the tone Call Guard frequencies.

3.10.2 TRANSMIT DIGITAL CALL GUARD SQUELCH

U701 is programmed with three digit codes assigned to the digital Call Guard codes (see Table 3-1). These codes are sent directly out of U701 noninverted. The turn-off code is always sent after each transmission.

3.10.3 RECEIVE TONE/DIGITAL CALL GUARD SQUELCH

U701 is programmed with two or three digit numbers assigned to the tone/digital Call Guard frequencies or codes. U701 interprets whether the incoming tone/code is valid and if so, opens the receive squelch circuit and keys the transmitter.

NOTE: When tone and digital Call Guard squelch are used together, it is not recommended to use tone frequencies 127.3 Hz (19), 131.8 Hz (20), 136.5 Hz (21), or 141.3 Hz (22) because of their close proximity to the digital Call Guard turn-off frequency of 134.0 Hz.

3.11 POWER FAILURE ALARM

When the repeater is functioning on standby power, during an AC power loss, three-800 Hz tones are superimposed on the transmit audio. AC voltage from the power supply is connected to the logic controller AC sense circuitry.

3.12 CW IDENTIFIER

U726 is a blank PROM which is user programmed to a unique CWID. The PROM Programmer II programs the PROM. Refer to manual Part No. 002-3020-205 for program information.

3.13 REPEATER PROGRAMMING

3.13.1 INTRODUCTION

The digital processing section consists of the Logic board, front panel display board and rear connector board. The Logic drawer front panel contains a keypad, S701 and four 7-segment displays for Call Guard squelch programming. Receive and retransmit Call Guard codes are entered into the microcontroller's RAM from the front panel keypad. The On/Off Line switch disables the Logic drawer repeater functions, enters programming mode and turns the green LED indicator off. The red LED indicator is always on when power is applied to the Logic drawer. To begin initial programming enter CLEAR 99 to delete any test Call Guard programming before attempting to program Call Guard codes.

3.13.2 SOFTWARE DESCRIPTION

Two types of software are now available for the CR1010 Repeater. Logic drawers without external CWID use U701, Part No. 023-9998-104 (V2.09). Logic Drawers with external CWID use U701, Part No. 023-9998-107 (V2.10).

The logic is controlled by microcontroller U701, clocked at 12 MHz. All program memory is in the onboard 4k EPROM. Peripheral chip U702 provides I/O port expansion, 256 bytes of external RAM, and an external timer. U702 has a NiCad battery backup to provide nonvolatile memory. There are also two PROMs, one for CWID and one for Transmit Tone Call Guard Step Approximated Sinewave.

3.14 PROGRAMMING FUNCTION KEYS

The contents of the Call Guard memory is verified or changed by using the front panel keyboard and display. To begin programming set On/Off Line switch to Off Line and the green LED will go off. Certain keys have special functions as follows:

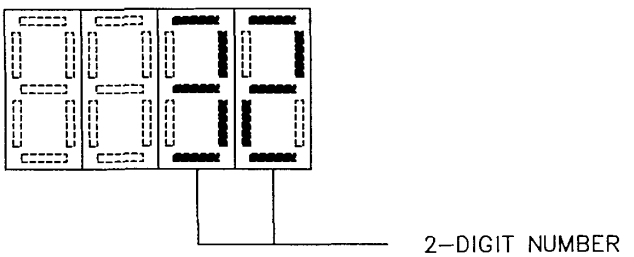
Key	Function
**	Enters the programming mode.
##	Exits the programming mode.
###	Entered during programming exits programming mode.
*	**Before** Call Guard code is entered indicates Tone Call Guard Squelch.
*	**After** Call Guard code is entered indicates LOAD code in memory.
#	**Before** Call Guard Code is entered indicates Digital Call Guard squelch.
#	**After** Call Guard code is entered indicates DELETE code in memory.
11	Scrolls Tone Call Guard code entered. Enter * to advance to next code. Enter # to back up to last code. Enter 11 to Exit scroll mode.
22	Scrolls Digital Call Guard codes entered. Enter * to advance to next code. Enter # to back up to last code. Enter 22 to Exit scroll mode.
....	In Scroll mode this indicates an end-of-list. When programming this indicates error.
99	Clears all Tone and Digital Call Guard codes.
Manual Reset Switch	Resets microcontroller U701.

3.15 TONE CALL GUARD SQUELCH

Press ** to enter programming mode.

Press * for Tone Call Guard mode.

Enter 2-digit Tone Call Guard number (see Table 3-1).



Press * to load code in memory.

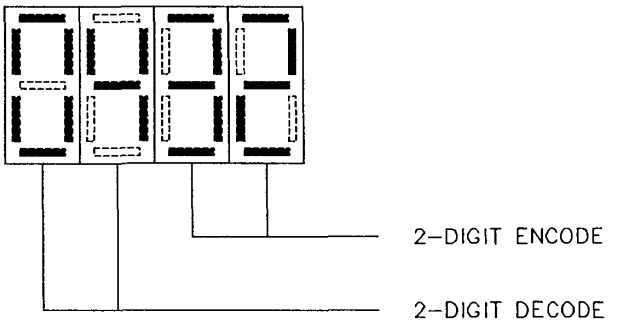
NOTE: When tone and digital Call Guard squelch are used together, it is not recommended to use tone frequencies 127.3 Hz (19), 131.8 Hz (20), 136.5 Hz (21), or 141.3 Hz (22) because of their close proximity to the digital Call Guard turn-off frequency of 134.0 Hz.

3.16 TYPE-A TONE CALL GUARD SQUELCH

Press ** to enter programming mode.

Press * for Tone Call Guard mode.

Enter 2-digit number for Decode first, then enter 2-digit number for Encode (see Table 3-1).



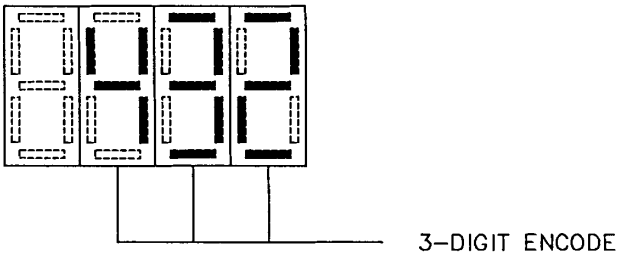
Press * to load code in memory.

3.17 DIGITAL CALL GUARD SQUELCH

Press ** to enter programming mode.

Press # for Digital Call Guard mode.

Enter 3-digit number (see Table 3-1).



Press * to load code in memory.

3.18 DELETE CALL GUARD NUMBER FROM MEMORY

Press ** to enter programming mode.

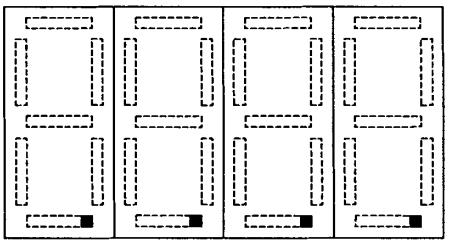
Press * for Tone Call Guard mode.
Press # for Digital Call Guard mode.

Enter Call Guard number to be deleted.

Press # to delete Call Guard number from memory.

3.19 PROGRAMMING ERROR

If during programming Error is indicated



proceed as follows:

Press ### to Exit programming mode.

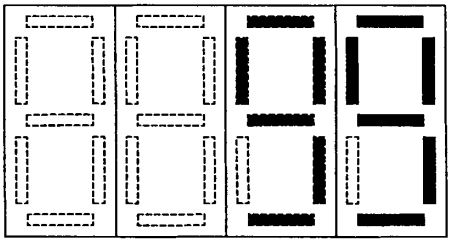
Press 11 (Scroll) to check all TCG numbers.

Press 22 (Scroll) to check all DCG numbers.

Press ** to enter programming mode and continue.

If an error message continues to appear:

Depress Manual Reset Switch.
Enter 99 to clear all TCG and DCG numbers.



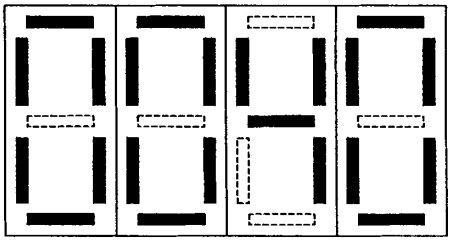
Verify correct numbers (see Table 3-1).
Re-enter all TCG and DCG numbers.

If an error message continues to appear, more than a programming error could be the cause.

3.20 OPEN REPEATER OPERATION

Press ** to enter programming mode.

Enter 0040.



Press * to load into memory.

3.21 TO DISABLE PROGRAMMING/SCROLL FUNCTIONS

Return On/Off Line switch to "On Line" position to disable programming and return to repeater functions. The On Line LED will turn on.

TABLE 3–1
CALL GUARD TONES/CODES

Call Guard Tones									
CODE	FREQ	CODE	FREQ	CODE	FREQ	CODE	FREQ	CODE	FREQ
00	0.0	08	88.5	16	114.8	24	151.4	32	203.5
01	67.0	09	91.5	17	118.8	25	156.7	33	210.7
02	71.9	10	94.8	18	123.0	26	162.2	34*	218.1
03	74.4	11	97.4	19	127.3	27	167.9	35*	225.7
04	77.0	12	100.0	20	131.8	28	173.8	36*	233.6
05	79.7	13	103.5	21	136.5	29	179.9	37*	241.8
06	82.5	14	107.2	22	141.3	30	186.2	38*	250.3
07	85.4	15	110.9	23	146.2	31	192.8		
Recommended Digital Call Guard Codes									
023	065	131	172	261	346	431	532	654	743
025	071	132	174	263	351	432	546	662	754
026	072	134	205	265	364	445	565	664	
031	073	143	223	271	365	464	606	703	
032	074	152	226	306	371	465	612	712	
043	114	155	243	311	411	466	624	723	
047	115	156	244	315	412	503	627	731	
051	116	162	245	331	413	506	631	732	
054	125	165	251	343	423	516	632	734	

* Not recommended for use.

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SECTION 4
CIRCUIT DESCRIPTION

4.1 INTRODUCTION

The CR1010 repeater is completely solid state, modular in construction with drawers mounted to a standard 19 inch rack panel. Figure 4-1 shows repeater assembly locations. Exciter and receiver drawers are mounted on slide rails that slide out and tilt down for ease of servicing. The 100 watt solid state power amplifier and 35 amp power supply are mounted to the rack panels. The repeater is housed in a 43 inch cabinet with an outdoor cabinet optional.

The repeater operates on a continuous duty cycle between 450 to 512 MHz. The power supply requires either 115 or 230 V AC at 50 or 60 Hz.

The incoming signal is fed from the duplexer receive section to the receiver. A portion of the Logic Drawer processes receiver audio output and turns on the exciter. The exciter RF output is coupled to the power amplifier, optional duplexer and antenna.

4.2 RECEIVER

Refer to the block diagram Figure 4-2, and Receiver schematic diagram Figure 8-10.

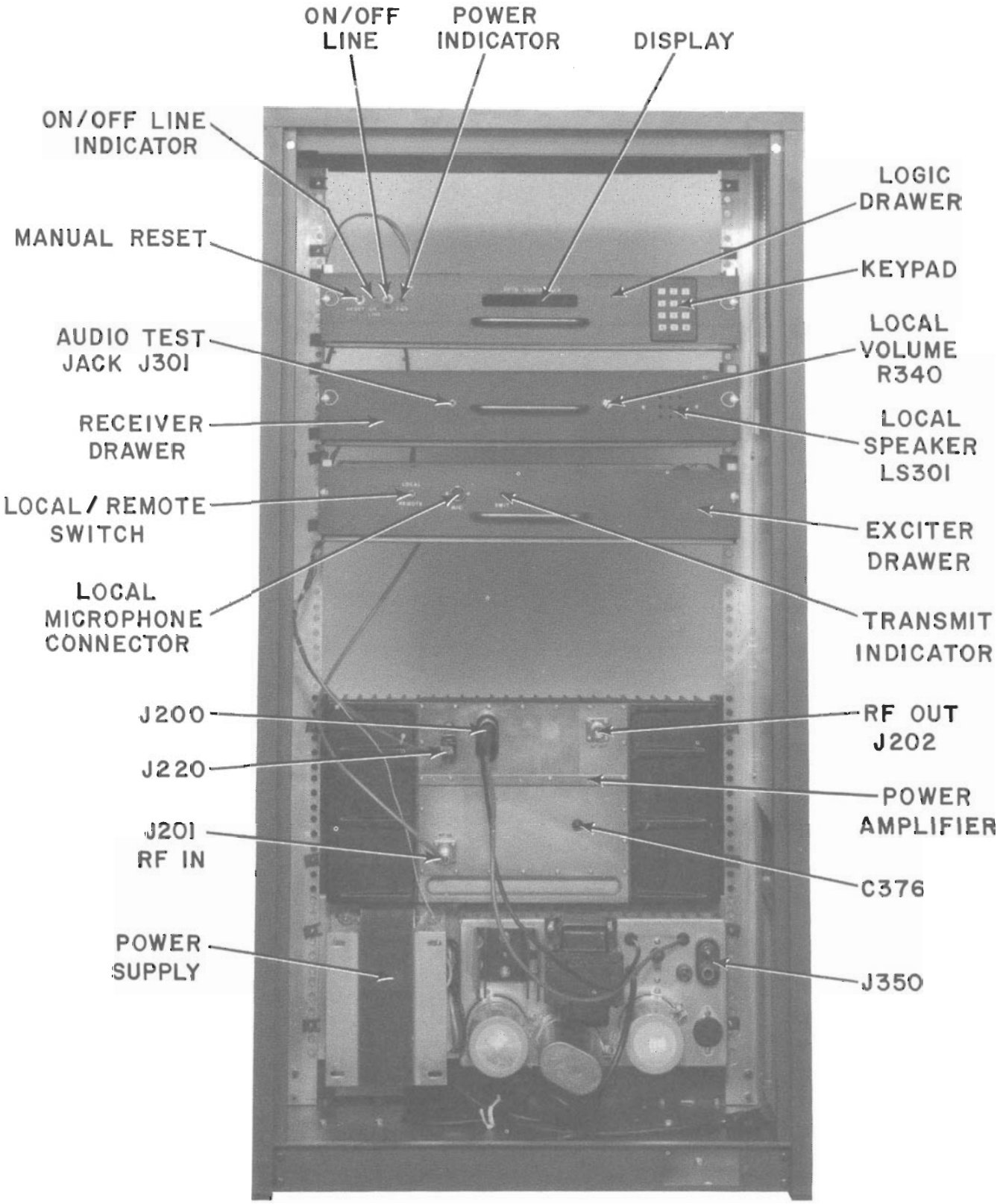
4.2.1 DC POWER SUPPLY

The Power Amplifier supplies 13.6V DC to the receiver at J560, pin 7. The receive 13.6V DC line supplies power to 9V regulators U301, U307 and first mixer Q101. Regulated 9V DC is supplied to the rest of the receiver with R325 and R326 dividing the 9V DC source to a 4.5V DC reference voltage for U302, U303, U304 and U308. The source supply for U201 is provided by 6.8V zener CR305 .

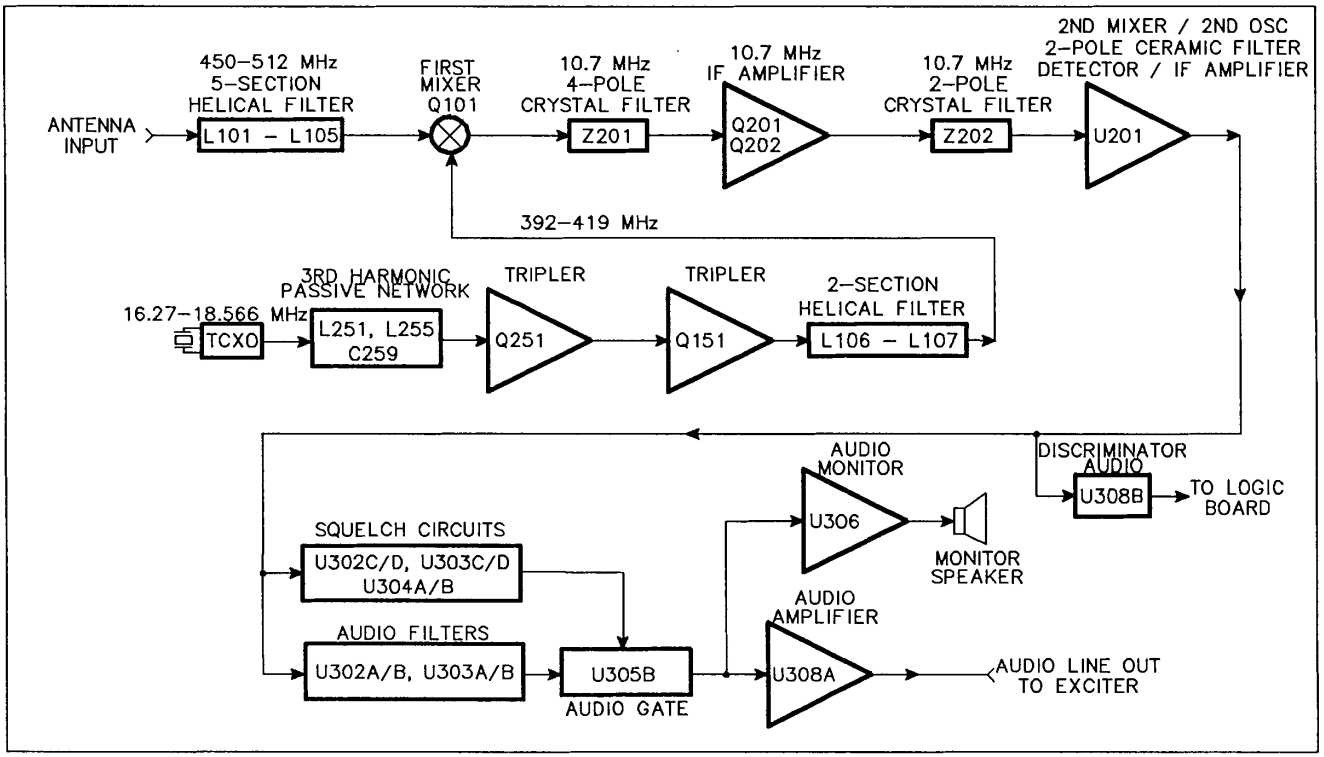
4.2.2 HELICAL FILTER, FIRST MIXER (Q101)

The incoming on-channel signal is coupled through a 5-section helical resonator preselector filter consisting of L101-L105. This bandpass filter provides front-end selectivity and prevents the injection signal from being coupled back to the receiving antenna.

The receive signal is applied to the gate of first mixer Q101, an N-channel J-FET. The first oscillator injection signal is applied to the source of Q101 and mixed with the receive signal to produce a first IF of 10.7 MHz. Low side injection is used, so the injection frequency is 10.7 MHz below the receive frequency.



CR1010 REPEATER
FIGURE 4–1



RECEIVER BLOCK DIAGRAM
FIGURE 4–2

4.2.3 TCXO (Y254), TRIPLER (L251)

Y254 is a temperature compensated crystal oscillator (TCXO) that gives the receiver a frequency stability of ±2 PPM (±0.0002%) from -22°F to +140°F. The TCXO is housed in a shielded, plug–in assembly and has an output of between 16.270 to 18.566 MHz. The oscillator is adjusted exactly on frequency by variable capacitor C705, accessible through an opening in the shield. To ensure the oscillator frequency stays within tolerance at temperature extremes, the frequency should be set at the calibrated ambient temperature reference of 77°F.

TCXO, Y254 is not field repairable because a factory recalibration must be performed whenever a component is changed. Recalibration is required because new components may have slightly different characteristics that may cause oscillator frequency to go out of tolerance.

The TCXO output on pin 5 is fed to the junction of L251/L256 and tuned to the third harmonic by L251, L256, and C259. C260 couples the tuned circuit output to the base of tripler Q251. L252 and C261 also tune to the third harmonic of the TCXO output. C262 and C263 provide impedance matching to the base of Q251. A small RF signal is coupled by C264 to CR251, where it is rectified and filtered to provide a voltage at TP255 for tuning purposes.

4.2.4 TRIPLERS (Q251, Q151)

The output on the collector of Q251 is tuned to the third harmonic of the input by L253 and C267. C268 couples the output from Q251 to the base of tripler Q151. L254, C269 and C151 tune to the output of Q251 and match the input impedance of Q151. A small RF signal is coupled by C270 to CR252, where it is rectified and filtered to provide a voltage at TP256 for tuning purposes.

The output of Q151 is coupled to a two-stage helical bandpass filter consisting of L106 and L107. The filter is tuned to the third harmonic of Q151's input. The filter output is 10.7 MHz below the on-channel receive signal and fed to the source of mixer Q101. The crystal frequency is determined by the following formula:

$$\text{Channel frequency} = \frac{\text{Crystal freq} - 10.7}{27}$$

4.2.5 10.7 MHz CRYSTAL FILTERS AND AMPLIFIER (Z201, Z202, Q201, Q202)

The first mixer output is fed to T201 on the receiver board. T201, C102 and C104 form a resonant circuit tuned for 10.7 MHz. C203 couples the 10.7 MHz signal to Z201A and L201/C204 match the input impedance to Z201A.

Crystal filter Z201 has a center frequency of 10.7 MHz and a bandwidth of 13 kHz at the 6 dB points. Output of Z201B is coupled to IF amplifiers, Q201 and Q202 by C207 and matched by C208 and L202.

Cascode IF amplifier, Q201 and Q202 provides a high gain with low noise and good stability. This series-connected amplifier pair has Q201 sensitive to input voltages and Q202 sensitive to current variations in Q201. The amplified signal output from the drain of Q201 drives the emitter of Q202. The base of Q202 is grounded for an AC signal with bypass capacitors C225/C210 and L203 is an RF choke.

The output of IF amplifier Q202 is coupled to Z202 through C212. L204 and C213 match the input to Z202. Z202 is a two-pole 10.7 MHz crystal filter similar to Z201. The output of Z202 is matched by L205. The mixer input U201, pin 16 is designed to impedance match with the typical value of a crystal filter, approximately 3.3 k ohm.

4.2.6 MIXER, LIMITER/DETECTOR (U201)

U201 contains second mixer, limiter, detector and audio amplifier. The 10.7 MHz first IF frequency is mixed with the 11.155 MHz signal produced by crystal Y201 and the internal oscillator.

The 455 kHz output of the internal double balanced mixer is on U201, pin 3 and filtered by ceramic filter Z203 to attenuate wideband noise in the 455 kHz signal. The 455 kHz signal is then applied to the limiter/amplifier stage in U201 where the limiter clips off noise riding on the 455 kHz signal. C221 and C222 decouple the 455 kHz signal.

From the limiter stage, the signal is fed to the quadrature detector. An external phase-shift network connected to pin 8 shifts the phase of one of the detector inputs 90° at 455 kHz (the other inputs are unshifted in phase). When modulation occurs, the IF signal frequency changes at an audio rate as does the phase of the shifted input. The detector, which has no output with a 90° phase shift, converts this phase shift into an audio signal. T209 is tuned to provide maximum undistorted detector output. From the detector the audio signal is applied to an amplifier stage and fed out of U201 on pin 9. The audio signal (voice frequencies and high-frequency noise) on pin 9 is fed to the squelch and audio filters.

4.2.7 SQUELCH (U302C/D, U303C/D, U304A/B)

The squelch circuit senses the noise level in the detector output signal and uses it as a received signal strength indication (RSSI) to control squelch gate U305B. The amount of noise in the detector output signal is inversely proportional to RSSI. The noise level is maximum when no on-frequency signal is being received and when an on-frequency signal is received, the noise level decreases in proportion to the signal strength. The received signal, including audio, Call Guard signal and noise, is applied to U302C, a high-pass filter. U302C attenuates audio and Call Guard, and passes noise frequencies above 30 kHz through C324 to amplifier U302D. The gain of U302D is adjusted by potentiometer R317 and sets the squelch threshold level.

The noise signal from U302D is coupled by C325 to amplifier U303C. The gain of U303C is temperature variable by RT301 in the feedback loop and RT302 in the input circuit. To compensate for circuit changes due to temperature variations, the thermistors increase the output level as the ambient temperature increases or decreases. The noise signal is then coupled to a bridge rectifier formed by CR301-CR304. When the bridge input goes positive, CR302 and CR303 conduct and charge C327

through R323 and C328 through R321. U303D, pin 3 goes positive and pin 2 goes negative to produce a positive pulse on output pin 1. When the bridge input goes negative, CR301 and CR304 conduct and charge the same capacitors. After charging, C328 discharges through R322 and C327 discharges through R324 to smooth the output waveform. U303D is configured as a differential amplifier to the voltage difference between pins 2 and 3 and the ratio of R321 and R322 determines the gain.

The rectified and amplified noise pulses from U303D are connected to Schmitt trigger U304A. When the level on pin 2 exceeds the bias level on pin 3, the output level drops to near zero volts. More current flows through R327 that causes the level on pin 3 to decrease. This adds hysteresis to the triggering level to prevent squelching and unsquelching with small changes in RSSI.

The fast squelch output of U304A is fed to J560, pin 4 and to logic drawer fast squelch input on J780, pin 19. The output of U304A also discharges C332 through R329. When the received signal strength is low, output of U304A is near zero volts and C332 discharges. When the level on U304B pin 5 drops below the reference level on pin 6, output on pin 7 goes low. Gate U305B opens and interrupts the receive audio signal. R330 and R331 provide additional hysteresis to the triggering level. This stage has an attack and release time of approximately 100 milliseconds to prevent audio chopping with a weak signal.

4.2.8 AUDIO FILTERING, AUDIO GATING, AUDIO AMPLIFIER (U302A/B, U303A/B)

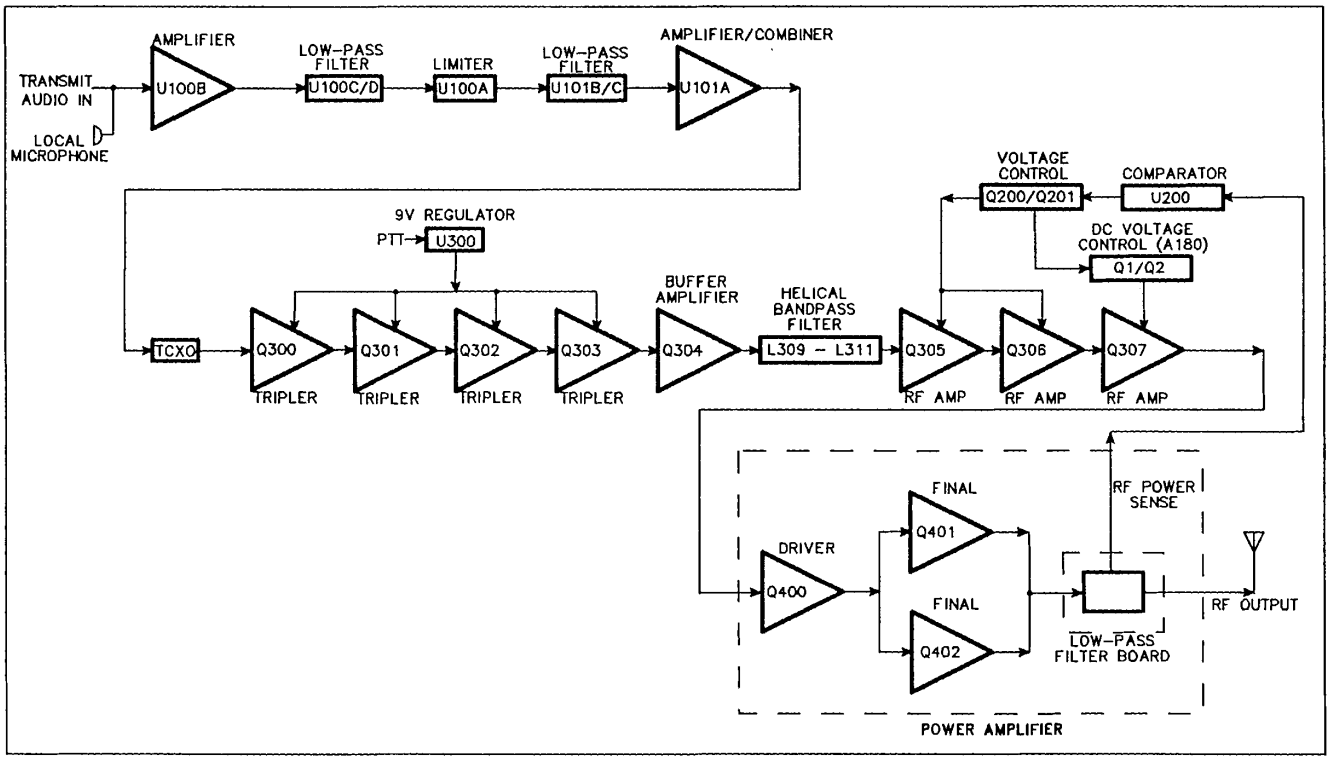
The audio processing circuit filters and gates the receive audio signal before it is fed to the local audio amplifier and transmitter. U302A is a low pass filter that attenuates frequencies above 3 kHz. This filtering is performed by R304, R305, R306, C310, C311 and U302A.

The Call Guard signal at the output of U302A is coupled through C309 to J560, pin 6. The Call Guard signal is then passed through the wire harness to J780, pin 5 on the logic drawer.

The audio and Call Guard signal from U302A is connected to a high pass filter that removes the Call Guard signal so it is not heard in the speaker. As configured in this circuit, U302B and U303A act as large inductors and together with C312, C313, C314, C316, C318 and C319 form a filter that passes only frequencies above 300 Hz. The audio is then connected to U303B which provides 6 dB per octave de-emphasis. High audio frequency roll-off is produced by C320 and R313 in the feedback loop of U303B. The filtered audio output of U303B is coupled through C347 to J560, pin 8 and audio test jack J301 on the front panel.

Filtered audio is then gated through audio gating circuits U305A/B. Normally U305A is closed, due to the 9 volt supply on pin 6 through 10k ohm resistor R332, so audio from U305A, pin 8 is passed directly to U305B, pin 10. U305B is controlled by the noise activated squelch circuit (U302C/D, U303C/D, U304A/B). U305B is opened whenever received signal strength drops below a preset level. With audio present in the receiver, U305B is closed allowing audio to pass from pin 10 to pin 11. Therefore, receive audio goes from U305B, pin 11 to U308A, pin 2 and C343. Audio level output of U308A, pin 1 is adjusted by R341 and coupled by C348 to J560, pin 12 and the exciter J160, pin 1. Receive audio is coupled by C343 to local volume control, R340 and U306, pin 3. U306 is a Class B audio amplifier that produces 0.5W into 8 ohms.

As mentioned, the noise squelch circuit controls gate U305B. If the output is low, U305B opens and audio cannot pass. Receive audio can also be squelched by gate U305A. The control input to U305A is tied to 9V and the logic drawer squelch enable signal through U305C. Normally U305C and U305A are closed (9V supply through 10k ohm resistors on the control lines R333 and R332 respectively). When the logic squelch enable signal through U305C is low, U305A disables the receive audio. During normal operation, local audio is disabled when the local volume control, R340 is turned counterclockwise and grounds the input on U306, pin 3. If the local audio control is turned off past the click, its switch closes and places a ground on the control input of U305C, pin 13, opens the gate and inhibits the logic squelch enable signal. This is useful during testing as it does not allow the logic to squelch receive audio on J560, pin 12.



TRANSMITTER BLOCK DIAGRAM
FIGURE 4-3

4.3 TRANSMITTER

Refer to the exciter block diagram Figure 4-3 and the exciter schematic diagram Figure 8-12.

4.3.1 INTRODUCTION

The exciter multiplies the TCXO frequency of 16.270 to 18.566 MHz to the transmit channel frequency and provides amplification to a power amplifier output of 100W. The transmit carrier is modulated in the exciter by either receive audio or local microphone audio.

4.3.2 LOCAL MICROPHONE (A140) AND LOGIC PTT LINE (J160, PIN 10)

When the local microphone is keyed, the PTT line places a low on the base of Q207. Q207 connects the 9V supply from U300, pin 5 to enable the exciter frequency multiplier chain. Local microphone audio is coupled by C100 to the input of amplifier U100B, pin 5, biased at 4.5V by resistive divider R120/R121. The gain of U100B is determined by R101, R104 and the impedance of R103/C102 and R102/C101. A peaking network formed by R102/C101 and R103/C102 provides more amplification of audio frequencies. In the repeater mode, logic PTT on J160, pin 10 enables the exciter and R100 and C100 couples receiver audio to U100B, pin 5.

4.3.3 HIGH PASS FILTER, LIMITER, SPLATTER FILTER, SUMMING AMPLIFIER (U100, U101A-C)

Amplified receive audio from U100B is connected to high pass filters U100C and U100D. These stages attenuate frequencies below 300 Hz to prevent interference in the data band and R109/C107 provide pre-emphasis to the transmit audio signal. The limiter circuit consists of amplifier U100A and diode bridge precision limiter circuit CR104-CR107, that sets maximum transmitter deviation. The amplification of U100A is determined by the ratio of R111 and the impedance of R109 and C107.

With normal audio levels bridge output follows the input however, when a high level audio signal is present the bridge opens and limits output signal to a maximum level. Bridge bias, set by R112, R113,

R114 and R111, determines the limit point at which the bridge opens. When the bridge opens, R111 no longer controls amplifier gain and the amplifier attempts to run open loop. With the output on U100A, pin 8 not limited, CR102 and CR103 conduct to prevent amplifier saturation and minimum distortion when the bridge comes out of limiting. CR100, CR101 and R110 are used to drain excess bias from the amplifier input.

From the limiter, audio signal is connected to the inverting input of amplifier U101C, pin 9 through R114. The gain of U101C is set by R115 and R114 at approximately five. Output signal is applied across R116 that sets transmitter deviation.

U101B is a splatter filter that attenuates frequencies above 3 kHz. These frequencies are generated if limiting occurs and are attenuated to prevent adjacent channel interference. Filtered signal from U101B, pin 7 is connected to one input of summing amplifier U101A, pin 2. Transmit digital data from the logic drawer J780, pin 7 to J160, pin 4 is connected through R125 to the other input of summing amplifier U101A, pin 3. R124 and R122 determine the gain of U101A. R125 and R126 determine the input level to pin 3 and the output signal is the sum of the input signals. The combined audio/data output signal from U101A is connected to pin 1 of the TCXO to modulate the transmit frequency.

4.3.4 TCXO AND TRIPLER (Q300)

The temperature compensated crystal oscillator (TCXO) plugged into J400 gives the transceiver a frequency stability of ±2 PPM (±0.0002%) from −22°F to +140°F. The TCXO is housed in a shielded, plug-in assembly with an output of between 16.270 to 18.566 MHz. The oscillator can be adjusted exactly on frequency by tuning a variable capacitor, accessible through an opening in the shield. To ensure the oscillator frequency stays within tolerance at temperature extremes, the oscillator frequency should be set at the calibration reference ambient temperature of 77°F.

The TCXO is not field repairable because a factory recalibration must be performed whenever a component is changed. Recalibration is required because new components may have slightly different characteristics that may cause oscillator frequency to go out of tolerance.

From TCXO J400, pin 5, the TCXO frequency (16.270 to 18.566 MHz) is coupled through C304 to the base of tripler Q300. A TCXO bias return path is established by L317. The output of Q300 is tuned to the third harmonic of the input by L300, C308, L302, C309, L303, C310 and C311. The output frequency of Q300 ranges between 56.25–64.00 MHz. A sample of this signal is coupled through C315 and rectified by CR300 to provide a DC indication at test point J301.

4.3.5 FIRST, SECOND, THIRD DOUBLERS AND BUFFER/AMPLIFIER (Q301–Q304)

The tripler output is connected to a series of three doublers: Q301, Q302 and Q303. Frequency doubler outputs are tuned by T300/L304, T301/L305 and L306 respectively. Rectifier diodes CR301 and CR302 provide a DC indication of the first and second doubler outputs. Third doubler output is coupled by C339 to the base of amplifier Q304. The output of Q304 is coupled from the collector through a high-pass filter consisting of C345, L308 and C347 to a three section variable tuned helical bandpass filter L309, L310 and L311. The bandpass filter passes frequencies between 450–512 MHz.

4.3.6 450–512 MHz RF AMPLIFIERS (Q305, Q306 AND Q307)

There are three stages of on-frequency amplification following the helical filter. Power output from C348 is applied to the base of amplifier Q305. Collector voltage for Q305 and Q306 is supplied by the power control circuit that raises or lowers the drive into amplifier Q307 to change the power amplifier output as required. The 5W to 18W output of Q307 is connected to a back panel mounted BNC connector and cabled to the power amplifier.

4.3.7 POWER AMPLIFIER (Q400, Q401, Q402)

Driver Q400 provides additional amplification needed to drive the final amplifiers. A section of microstrip matches the impedance of the 50 ohm coaxial cable input and C408 couples the input to another section of microstrip that matches the input impedance of Q400. L400/R400 form a low frequency filter to prevent self oscillation and L401 provides base bias from the RF input signal. DC power is taken directly from positive power jack J400 and fed through L402 to the collector of Q400.

Output of Q400 is matched by a section of microstrip and coupled to a 50 ohm section of microstrip by C413. L408 is a quarter wave coaxial cable that feeds two sections of microstrip at the final amplifier inputs.

Q401 and Q402 make up the push-pull final amplifier. Two sections of 25 ohm microstrip match the inputs and provide the 180° out-of-phase signals to drive the amplifier. To prevent self oscillation, low frequencies are removed from the input of Q401 by L403/R401 and Q402 by L407/R402. L405 and L408 provide base bias from the RF input. The 180° out of phase output is combined and matched to a 50 ohm output impedance by four sections of microstrip. C423 is a variable capacitor, adjusted to provide maximum power output.

The signal is coupled by L409, a quarter wave section of coaxial cable, to a 50 ohm microstrip. Coaxial cable connects the amplifier output to a low-pass filter board. This filter, formed by C500-C503 and L500, removes spurs occurring above the frequency band. From the filter, the 100W signal is coupled by another 50 ohm coaxial cable to antenna jack A402.

4.3.8 POWER CONTROL (U200, Q200, Q201)

The power sense circuitry is contained on the low-pass filter board in the power amplifier and on the exciter board. The transmitter power output is controlled by two inputs which are; power amplifier RF output and ambient temperature. If the power amplifier temperature becomes excessive, the temperature sense circuit cuts back power output to protect the transistors from damage.

An RF power level sample is coupled from the filter input by R498/R499 and rectified by CR501, R501 and RT500. Thermistor RT500 compensates for changes in diode characteristics caused by temperature changes. The rectified voltage is filtered and coupled to the exciter through J220, pin 7 to J160, pin 8.

RT200 provides temperature compensation and causes the DC level on U200, pin 2 to increase with an increase in temperature and vice versa. Various capacitors, such as C505, C507, C201 and C205, filter noise from the DC input. The level on amplifier U200, pin 2 controls the power output level.

The resistive circuit formed by R203 and R204 adjusts the power output level from 5W to 18W. The amplification of U200 is controlled by the ratio of R207 and R208. When the level on U200, pin 2 increases, the level on U200, pin 6 decreases and Q200/Q201 conduct less and cut back current to Q305 and Q306. Power output from Q305/Q306 and the stages that follow decreases until a balanced condition exists in the circuit. When the power output decreases, the level on U200, pin 2 decreases and the opposite occurs to increase power output.

4.4 REPEATER LOGIC DRAWER

4.4.1 INTRODUCTION

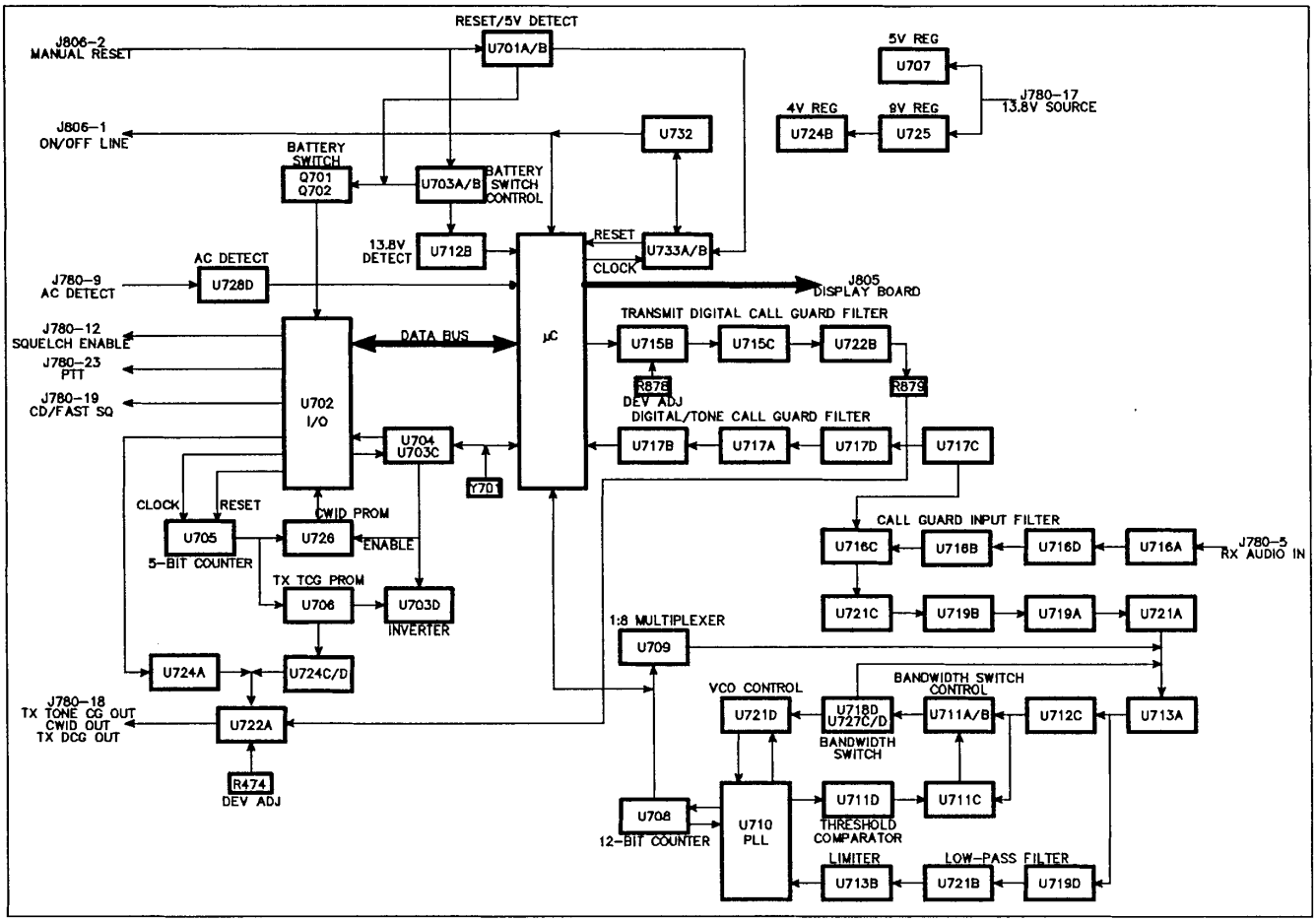
The CR1010 repeater logic assembly provides the supervisory functions for the repeater. The logic controller block diagram in Figure 4-4 contains three interconnecting sections: Digital Processing, Signal Processing and Power Sources. The operating speed of U701 is 12 MHz set by the frequency of crystal Y701. Peripheral chip, U702 also derives its 3 MHz clock frequency from Y701 through a buffer and frequency divider U704.

The remainder of the logic circuitry consists of the System Low Voltage Detector/Reset, AC Detection circuit, 9V and 5V Regulators and 4V reference, Transmit/Receive Digital/Tone Call Guard filters, and Phase-Lock Loop.

4.4.2 PROGRAM MEMORY

U701 and U702 contain all program memory. U701 stores memory in a 4k onboard EPROM. U702 is a peripheral chip that provides I/O port expansion, 256 bytes of external RAM, external timer and a NiCad battery back up for nonvolatile memory. U726 is a blank PROM for a unique CWID that can be user programmed or ordered factory programmed (see Section 3.12).

The front panel keypad programs U701 with tone and digital Call Guard codes (see Table 3-1). The digital Call Guard signal comes directly from U701. The transmit tone Call Guard signal generated by 5-bit counter U705, U706 and a resistor ladder network provide a step approximated sine wave. The 2-digit tone Call Guard code determines the frequency U701 programs into the programmable clock on U702.



LOGIC CONTROLLER BLOCK DIAGRAM
FIGURE 4-4

4.4.3 INPUT FILTER (U716A-C)

The input filter consists of input buffer U716A, bandpass filters U716D/B and buffer U716C. The input on J780, pin 5 is from the receive J101, pin 1. This filter passes frequencies from 67-250 Hz so only Call Guard frequencies are passed to the next stage. The filtered Call Guard signal is fed to low-pass filters U721C/U719B for additional attenuation of frequencies above 250 Hz. Limiter U719A produces a square wave output to amplifier U721A. U721A amplifies the filtered signal to the loop filter through bilateral switch U718D. The combined 3 dB points of both filter stages provide a very sharp roll-off from 250-300 Hz that attenuates all voice from the 67-250 Hz Call Guard frequency band for proper operation of the phase-locked loop (PLL) bandpass filter.

4.4.4 TONE CALL GUARD FILTER (U719, U721, U713A/B, U712C, U711, U718D, U727C/D, U708, U709, U710)

The Call Guard filter is a phase-locked loop (U710) that creates a self-tuning bandpass filter that locks onto the strongest input frequency. The TCXO output of U710, pin 4 and 12-bit binary counter U708 provide the clock for U709. 1:8 multiplexer, U709 is used as a commutating bandpass filter, clocked 8-times faster than the VCO frequency to consecutively switch to each of 8-outputs with equal valued capacitors to ground. The output capacitors are coupled to either R713 if U718D is closed or R714 if U718D is open. U719D is closed when VCO is out-of-lock.

The square wave output of U709, pin 3 is the filtered VCO frequency and goes through high impedance buffer U713A. The signal on U713A, pin 1 takes two paths, one is to 250 Hz low-pass filterU719D, and limiter U721B. The square wave output of buffer U713B is applied to U710, pin 14 and phase compared with the divided-by-8 VCO output on U710, pin 3. Phase comparator output on U710, pin 13 is used to drive loop filter U721D. When the VCO is locked, the pulses are much wider, U721D changes the VCO control voltage that adjusts the VCO output frequency accordingly

Both U721D and U709 are adaptive, meaning, when a tone Call Guard signal is not present, the PLL is out-of-lock and the filter bandwidths are wide for fast acquisition time. When a tone Call Guard signal is present, the loop approaches lock and the bandwidths are narrow to make the PLL less susceptible to noise.

The second path from U713A, pin 1 is to full-wave rectifier CR704/CR703. The tone Call Guard square wave pulse on U713A, pin 1 is rectified to give a constant DC voltage on U719C, pin 8. If a Call Guard signal is present for more than 50 ms, U719C, pin 8 has time to charge C721 through R735 and raise pin 8 above the reference on pin 9. The reference on U712C, pin 9 is set by adaptive bandwidth control R736. When U712C, pin 8 is higher than pin 9, the output on pin 14 is low. This low is passed to U711A, pin 1 and U711C, pin 9. U711A/B create a flip-flop that controls bilateral switches U727C/D and U718D. Without a Call Guard signal present, the control pins of the gates are high to provide a wide bandwidth. When the gates open, R713/R729/R727 are removed from the circuit to narrow the bandwidth and filter out noise.

The output of U712C, pin 14 and U710, pin 1 control the output of the flip-flop. Without a tone Call Guard signal present, U712C, pin 14 and U711A, pin 1 are high, and the output on pin 3 goes low. With U711A, pin 1 high, U711C, pin 9 is also high. When the PLL is out-of-lock, the signal on U710, pin 1 has low pulses that are wider than when the PLL is locked. With U711D, pin 13 grounded, U711D is configured as an inverter. With low pulses on U710, pin 1, C722 does not charge through R738 and U711D, pin 12 is low, so the output on U712D, pin 11 is high to charge C723 and hold U711C, pin 8 high. With pin 8 high and pin 9 high, the output on pin 10 is low. The low on U711A, pin 3 is tied to U711B, pin 5. With U711B, pin 5/6 low, the output on U711A, pin 4 is high and the flip-flop is latched. The control pins of U727C/D and U718D are then high and the switches are closed to provide a wide bandwidth.

With a tone Call Guard signal present, C721 charges, U712C, pin 14, U711A, pin 1 and U711C, pin 9 are low. When the PLL is locked, the pulse output of U710, pin 1 is wide high pulses and narrow low pulses. With wider high pulses, C722 charges through R738 and U711D, pin 12 is high and the output on pin 11 is low. This low reverse biases CR705, and C723 does not charge through R740. With U711C, pins 8/9 low, the output on U711C, pin 10 is high. When U711B, pin 6 is high the output of U711C, pin 4 is low and the flip-flop changes states. With U711A, pins 1/2 low, U711A, pin 3 goes high and the flip-flop is latched. The control pins of U727C/D and U718D are then low, the switches open and R713, R729 and R727 are removed from the circuit to narrow the bandwidth and filter out noise. When the signal on U701, pin 12 is compared to the input signal on pin 10 and the programmed tone code, U701 accepts the tone and tells U702 to unsquelch the receiver.

When a digital Call Guard signal is received, U701 samples the pulse width and recognizes the signal as digital. The PLL will not lock on a digital signal and the microcontroller ignores the loop filter output.

4.4.5 DIGITAL/TONE CALL GUARD FILTER (717C/D) DC RESTORATION (U717A)

The digital/tone Call Guard filter U717C/D is a low-pass filter with a cut-off frequency of 250 Hz. The output of U717D is fed to U717A, a DC restoration circuit. The output pulses from the DC restoration circuit are passed to voltage divider R868/R869 and U701, pin 10. The microcontroller samples the pulse width of the filtered Call Guard signal to determine if a tone or digital Call Guard signal has been received. If a digital signal is sent, U701 detects it and the PLL output is ignored. If a tone is sent, the PLL locks on and a signal is present on the input of U701, pin 12. The PLL input is compared to the filtered Call Guard signal input and the programmed tone code.

When a valid Call Guard signal is detected, U701 tells U702 to unsquelch the receiver and J780, pin 12 goes low.

4.4.6 TRANSMIT DIGITAL CALL GUARD FILTER (U715B/C, U722A)

When a signal is received, the receive audio is coupled to the Logic drawer on J780, pin 5. If the Call Guard signal is valid, U701 disables the squelch with a low on J780, pin 12, enables the transmitter with a low on PTT line J780, pin 23, and sends the transmit digital Call Guard code programmed.

The transmit digital Call Guard filter is a 134 Hz low-pass filter for the signal generated by microcontroller U701, pin 11. The signal is amplified by U715B with stage gain determined by the ratio of R878 to R877. R878 sets the digital Call Guard signal deviation. Filter stages U715C and U722B attenuate high order harmonics and retain as much signal integrity as possible.

The output of U722A, pin 1 to J780, pin 18 is sent to J401, pin 10 of the Exciter drawer to be transmitted.

4.4.7 TRANSMIT TONE CALL GUARD FILTER (U723C/D)

The transmit tone Call Guard signal is a digitally synthesized sine wave created by a programmable clock output from U702, pin 6 to 5-bit counter U705. The outputs of U705 are connected to the inputs of PROM U706. U702, pin 36 provides a high to inverter U703D and disabled CWID PROM U726. The high on U703D, pins 12/13 produce a low output to enable U706.

The Call Guard PROM is factory programmed to provide outputs in voltage steps that produce an approximated sine wave. The resistor network, R763 through R779, provides 32-voltage levels that increase and decrease from a reference to create a stepped sine wave. The Call Guard code entered into U701 determines the frequency of the programmable clock in U702. The sine wave created by U706 and the resistor network is passed to C724 at an amplitude of approximately 0.8V P-P.

The transmit tone Call Guard filter U724C/D is a 334 Hz low-pass filter that attenuates harmonics created by the digitally synthesized sine wave form U706. This filter is flat below 250 Hz to give constant tone Call Guard amplitude, regardless of frequency.

The filter output is coupled from the junction of R758/R746 to R747 that adjusts the transmitted tone Call Guard deviations to ±600 Hz. The tone Call Guard signal is connected to amplifier U722A, pin 2 and the output on U722A, pin 1 is passed from J780, pin 18 to Exciter drawer J401, pin 10 and transmitted.

4.4.8 TRANSMIT CWID FILTER (U724A)

The CWID PROM is programmed with the PROM Programmer II, refer to manual Part No. 002-3020-205 for programming instructions.

The CWID circuit consists of 5-bit counter U705 and PROM U726. U701 programs the clock in U702 for the CWID code speed and places a low output on U702, pin 36 to enable U726 and disable U706. The input to U726 is then clocked to produce the programmed CWID code on the output pin 12. The CWID is sent to U702, pin 5 that places the 800 Hz square wave code on pin 34. The signal is then coupled to the transmit CWID filter.

The transmit CWID filter U724A is a 750 Hz bandpass filter cascaded with a 60 Hz low-pass filter. The filter attenuates harmonics and slows the attack time of the 800 Hz square wave CWID output. The filter output is coupled from the junction of R758/R746 to transmit Call Guard signal deviation adjust R747. The CWID signal is connected to amplifier U722A, pin 2 and the output on pin 1 is passed from J780, pin 18 to Exciter drawer J401, pin 10 and transmitted.

4.4.9 REPEATER AC POWER SENSE CIRCUITRY (U728D)

There are two power sense circuits. One is an AC detection circuit which monitors the AC line and verifies the correct operation of the main power supply. The other circuit senses the system voltage.

The AC detection circuit provides a logic high to U701, pin 24 if AC power fails. The AC voltage from the power supply is on J780, pin 9, coupled through C756 and rectified by CR712/CR713. The rectified AC is filtered by C757 and connected to the inverting input of level detector U728D. This voltage on U728D, pin 10 is greater than the 2.7V bias voltage, set by CR716, on U728, pin 11. Therefore, the output of U728D, pin 13 is low when AC power is sensed. This low level is connected to microcontroller U701, pin 24.

When AC power fails and battery backup is used, the voltage level at U728D, pin 10 becomes less than pin 11. This causes the output at U728D, pin 13 and U701, pin 24 to increase. U701 senses the voltage change and programs U702 to send three 800 Hz tones out pin 34 to the CWID filter and J780, pin 18 to J401, pin 10 to be transmitted each time the repeater is accessed.

4.4.10 SYSTEM VOLTAGE DETECTION (U712B, U703A/B, Q701, Q702)

The system voltage detection circuit provides a high input to U701, pin 28 when the Logic board system voltage drops below approximately 10.5V. Normally, U712B, pin 6 is higher than the reference on U712B, pin 7, and the output on U712B, pin 1 is low. The low on U701, pin 28 tells the microcontroller the voltage levels are normal. U703A/B are configured as a flip-flop. The low on U703A, pin 5 causes U703B, pin 6 to go high. This high is tied to U703A, pin 2, with U703A, pin 1 tied high by the manual reset front panel switch, the output on U703A, pin 3 is low. The low on U703A, pin 3 is connected to the anode of CR726 and reverse biases the diode.

The base of Q701 is normally low to provide bias to the base of Q702 through CR715. Q702 applies a low to U702, pin 8 to enable U702, and provides current flow through R759 to forward bias CR717 to supply voltage for U702, pin 40 and trickle charge BT701.

If the system supply falls below 10.5V, U712B, pin 6 is lower than the 5V reference on U712B, pin 7 and the output on U712B, pin 1 (normally low) goes high. This high is connected to U701, pin 28 to indicate that the system supply is low and U701 shuts down. The high on U712B, pin 1 is also tied to U703B, pin 5. With U703B, pin 5 high, U703B, pin 6 goes low and U703A, pin 2 is low. The output on U703A, pin 3 goes high and places a high on U703B, pin 4 to latch the flip-flop. The high on U703A, pin 3 forward biases CR726 and places a high on the base of Q701. With a high on the base, Q701 turns off and places a low on the base of Q702, and Q702 turns off. Without a ground through R759, CR717 reverse biases and BT701 supplies voltage to U702, pin 40 to maintain the memory.

If the 5V supply falls below approximately 4.5V, U728B, pin 8 will be higher than U728B, pin 9 and the output on U728B, pin 14 goes low. This low causes U728A, pin 6 to be lower than U728A, pin 7 and the output on U728A, pin 1 goes high to reset U701 and disable U702. The high on U728A, pin 1 forward biases CR714 to turn off Q701/Q702 that reverse biases CR717 and allows BT701 to power the memory of U702. Normally, CR717 is forward biased when Q701/Q702 are turned on to provide power to U702 and trickle charges BT701.

4.4.11 WATCHDOG TIMER (U732, U733)

On power up, U728A, pin 7 is higher than pin 6 until C746 charges. During the charge time U728A, pin 1 is high to reset U701 through U733B, and maintain a high on U732, pin 2 so the watchdog time does not clock out and try to reset U701. When C746 has charged, U728A, pin 6 is higher than U728A, pin 7 and the output on U728A, pin 1 goes low. Clock pulses from U701, pin 13 reset the watchdog timer through U733A. If these pulses are not present, both inputs to U733A are low and the watchdog timer times out and places a high on U733B, pin 9 to reset U701.

4.4.12 MANUAL RESET (S702)

Manual reset on J806, pin 2 is connected to front panel switch S702. When the switch is enabled, a low is applied to U728A, pin 6 and U703A, pin 1. This low resets the flip-flop to its normal state, a low on U703A, pin 3. The momentary low from the switch also is applied to U728B, pin 6 that causes U728B, pin 7 to be higher than U728B, pin 6 and output on U728B, pin 1 goes high to reset U701, pin 9 through U733B.

4.4.13 U701 OUTPUT PIN DESCRIPTION

P0.0–P0.7 (Pins 32–39)
Programming outputs to U702 address lines U701/U702 data lines.

P1.0–P1.7 (Pins 1–8)
Programming inputs from front panel keypad S701. Display/keyboard data lines.

P2.0 (Pin 21)
Low battery shutdown input.

P2.1 (Pin 22)
Output to Q704. High disables U718 and removes C759 from digital Call Guard filter to narrow the passband.

P2.2 (Pin 23)
Input from On/Off Line front panel switch S703 to J806, pin 1. Off Line is low and turns off watchdog timer to reset U701.

P2.3 (Pin 24)
Input from repeater AC power sense circuit. Activates the power fail alarm output of U702 with three 800 Hz tones when repeater is accessed and AC power is not present and battery backup is used.

P2.4–P2.6 (Pins 25, 26, 27)
Not used in repeater.

P2.7 (Pin 28)
Input from repeater system supply low voltage sense circuit. Normally low, goes high when system supply falls below 10.5V. Tells U701 that DC voltage is low and to shutdown.

P3.0 (pin 10)
Input from digital Call Guard filter that senses if incoming Call Guard signal is tone or digital by sensing the pulse width of the signal.

P3.1 (Pin 11)

Digital Call Guard output to transmit digital Call Guard filter. Output is on J780, pin 18 to J401, pin 10 of the Exciter.

P3.2 (Pin 12)
Input from receive tone Call Guard PLL filter.

P3.3 (Pin 13)
Output clock pulses to watchdog timer. If pulses are not present U732 resets U701.

P3.4 (Pin 14)
Output to J805, pin 3 on front panel. Error indicator to front panel display.

P3.5 (Pin 15)
Output to U702, pin 7 IO/$\overline{\text{MEM}}$ port. Memory is active low.

P3.6 (Pin 16)
Output to U702, pin 10 $\overline{\text{WR}}$ port, active low.

P3.7 (Pin 17)
Output to U702, pin 9 RD port, active low.

RESET (Pin 9)
Reset input from front panel manual reset switch S702. Reset is normally low, goes high during power up and when system supply or AC power fail returns to normal. Also goes high when reset switch is enabled.

Xtal 2 (Pin 18)
Input from 12 MHz clock Y701.

Xtal 1 (Pin 19)
Y701 ground.

4.4.14 U702 OUTPUT PIN DESCRIPTION

AD0–AD7 (Pins 12–19)
Address input from U701 for programming RAM memory.

PA0–PA3 (Pins 21–24)
Not used in repeater.

PA4 (Pin 25)
Squelch enable output to receiver. J780, pin 12 to J101, pin 14. Squelch enable is active low.

PA5 (Pin 26)
Push-to-talk output to exciter. J780, pin 23 to J401, pin 3. PTT is active low.

PA6–7, PB0–4 (Pins 27–33)
Not used in repeater.

PB5 (Pin 34)
Output to exciter audio J780, pin 18 to J401, pin 10. Sends the CWID code and AC power fail signals to Exciter.

PB6 (Pin 35)
Repeater reset output to counter U705.

PB7 (Pin 36)
Chip select output. A high output selects PROM U706 and a low selects CWID PROM U726.

PC0–PC3 (Pins 1, 37–39)
Not used in repeater.

PC4 (Pin 2)
Output to receiver on J780, pin 19 to J101, pin 5. Sends carrier detect fast squelch to receiver.

PC5 (Pin 5)
CWID code input from PROM U726.

IO/$\overline{\text{MEM}}$ (Pin 7)
Memory input/output port from U701, pin 15. Memory is active low.

WR (Pin 10)
Active low write input from U701, pin 16.

RD (Pin 9)
Active low read input from U701, pin 17.

Timer In (Pin 3)
Clock input from U704, pin 10.

Timer Out (Pin 6)
Programmable clock output to U705, pin 10. This clock rate is programmed by U701 for CWID code speed and transmit tone Call Guard frequency.

CE (Pin 8)
Active low chip enable input. Normally low this pin is pulled high when U701 is reset to prevent programming errors. BT701 maintains voltage on the memory while system supply is low or when U701 is in reset.

4.5 POWER SUPPLY

This power supply has a continuous current rating of 35 amperes. Versions are available for 110/230V AC 50/60 Hz power sources. A ferro-resonant type transformer is used in this power supply that provides a stable AC output voltage with varying load conditions. Therefore, a series pass stage is not needed to regulate the output voltage. This transformer has a split primary which can be wired for either 115V AC or 230V AC inputs. However, different transformers are used for 50 Hz and 60 Hz inputs.

4.5.1 TRANSFORMER (T1), FILTER (C1, L1, C2, C3)

With a nominal 115V AC input, the primaries of T1 are wired in parallel; with a nominal 230V AC input, they are wired in series. Fuse F1 must be 7A with a 115V AC input and 5A with a 230V AC input.

CR3 and CR4 provide full-wave rectification of the 17 volt output signal from the secondary of the transformer. Filtering of the DC signal is provided by C1, L1, C3 and C2. Resistor R1 provides some loading on the transformer and also discharges C1 and C3 when AC power is turned off.

4.5.2 LOADING TRANSISTOR (Q1)

The purpose of Q1 is to provide loading during times when only minimal loading is present on the output of the power supply. The transformer requires some loading at all times to prevent the output voltage from rising excessively. The base of Q1 is maintained at approximately 14V by zener diodes CR1 and CR2 and resistor R2. With a PN junction drop of 0.7V across the base and emitter, Q1 turns on when the emitter voltage is approximately 14.7V or greater. CR7 controls the maximum current following through Q1, and R3 provides base current limiting.

SECTION 5
SERVICING

5.1 GENERAL

5.1.1 PERIODIC CHECKS

Heavy duty cycles and the number of users that depend on the repeater make it especially important that regular preventive maintenance be performed. Checks should include; receiver sensitivity, SINAD, and transmitter frequency, deviation and power output. The repeater should be checked monthly during the first six months of operation and quarterly thereafter.

5.1.2 VISUAL INSPECTION

Always give the repeater a visual inspection before attempting to isolate a problem. Check for; loose, broken or pinched wires, overheated or discolored components and cold solder joints. A defective solder joint may have excess solder, too little solder or a dull, uneven coloring.

5.1.3 SCHEMATICS AND COMPONENT LAYOUTS

Schematic diagrams and component layouts for all PC boards are located in Section 8. The component layouts allow quick location and identification of components and test points.

5.1.4 PARTS LIST

A replacement parts list with component part numbers is located in the back of this manual. Parts are listed alphabetically according to designator, starting with the lowest number, and are separated into sections identified by headings in boldface type.

Semiconductor devices used in the repeater are selected to meet specific parameters and are listed with E. F. Johnson part numbers. To obtain maximum repeater performance, always replace defective semiconductors with the same type parts.

5.1.5 SERVICE AND ALIGNMENT TOOLS

Only common service and alignment tools are required to service the repeater. Use a low power soldering iron (60 watts or less) to prevent component damage from overheating and use rosin core solder containing 60% tin and 40% lead. To remove solder when replacing a defective component, use a desoldering aid such as braided solder wick, bulb or plunger type suction tool.

Common straight, pointed and hex tipped alignment tools are used for adjustments. A kit containing all the alignment tools needed to adjust Johnson equipment is available from the Johnson Customer Service Department. This kit (Part No. 115-0410-001) contains seven alignment tools plus two ceramic replacement tips (Replacement Parts Price Book).

5.1.6 DRAWER REMOVAL

The drawers used in this repeater can be pulled out and tilted down for servicing or they can be easily removed. Before removing a drawer or other subassemblies, turn off power and unplug all cables (note where each is attached). To remove the drawer, slide it out until the guide pins line up with the drawer, slide it out until the guide pins line up with the holes in the side rails and then lift it up and out of the cabinet. Each drawer has a top and bottom cover that can be removed for servicing. To remove the power amplifier or power supply, remove the mounting screws from the back of the cabinet mounting rail.

5.2 INTEGRATED CIRCUIT SERVICING

5.2.1 CMOS HANDLING PRECAUTIONS

Some of the integrated circuits used in this repeater are CMOS devices. CMOS integrated circuits can be identified by a part number of 544-3x1x-xxx. Since these devices have very high open circuit impedance, they are particularly susceptible to damage from static discharges. Damaging static charges may be present even if static arcs are not observed. When handling these devices, observe the following precautions:

1. Before touching the equipment or a CMOS device, discharge any built-up static charge on your body by touching a good earth ground.

2. Ground all test equipment and make sure the soldering iron tip is grounded. Connect ground leads before connecting test probes.

3. Leave the CMOS device in its conductive shipping packaging until it is inserted in the PC board.

   Once the device is installed in the PC board, it is protected by internal diode protection circuits, so the chance of static damage is somewhat reduced. A service bench protection kit, Part No. 299-0026-001, can be ordered from the Service Parts Department. This kit eliminates static build-up on the body and includes a conductive mat, wrist strap, and a grounding strap with a 1M ohm resistor.

5.2.2 SERVICING TECHNIQUES

A good starting point when servicing integrated circuits is to measure steady state DC voltages. Operational amplifiers which function as buffers or amplifiers usually have a DC voltage on the input and output that is half the supply voltage. Others which function as comparators may have an output voltage that is near the supply voltage or 0 volts, depending on which input is higher.

The steady state DC voltages of logic gates such as AND or OR gates can also be measured with a voltmeter. Check the output level produced by each input combination. Troubleshooting operating digital circuits, i.e. microprocessors, is difficult because of the dynamic operation of these devices.

Table 5-1 shows the approximate logic levels for CMOS and TTL integrated circuits.

5.3 TRANSISTOR AND CHIP CAPACITOR SERVICING

5.3.1 REPLACING TRANSISTORS SOLDERED TO MICROSTRIP

Use the following procedure to replace transistors that are soldered directly to PC board microstrip such as those on the power amplifier board.

REMOVAL

Remove the defective transistor and all excess solder on the microstrip. Clean the mounting surface with alcohol or another solvent that does not leave a residue. Do not apply solvent to chip capacitors because it may cause dielectric breakdown and affect the value.

TABLE 5-1
APPROXIMATE LOGIC LEVELS

	Input Level		Output Level	
Device	**Logic Low (Max)**	**Logic High (Min)**	**Logic Low (Max)**	**Logic High (Min)**
CMOS				
5V supply	1.5V	3.5V	0.05V	4.95V
10V supply	3.0V	7.0V	0.05V	9.95V
ECL	3.5V	3.9V	3.4V	4.0V

TINNING

Lightly tin the underside of each transistor lead with solder. Do not allow a thick build-up of solder since this could cause case separation when the transistor is tightened (when applicable).

MOUNTING

Check to make sure that the transistor mounting surface is clean and then apply a thin coat of silicon heatsink compound. Insert the transistor and tighten it securely (when applicable).

Solder the transistor using a generous amount of solder to provide good contact between the entire transistor tab and the microstrip. Check that no solder bridges are present.

5.3.2 REPLACING CHIP COMPONENTS

Chip components are the very small block-like components. These components should not be reused because the unsoldering process may remove part of the end metalization and prevent proper reflow of solder onto the end. When installing a chip component, it is recommended that only solder containing 2% silver be used. Silver solder minimizes leaching of the end metalization during and after installation. Refer to the Surface Mounted Device Handbook, Part No. 001-0576-002. Install chip components as follows:

1. Remove the chip component using a soldering iron on each end or a soldering iron tip that heats both ends simultaneously.

2. Coat the ends of the new component with rosin flux. Place the component in position and melt the solder so that it flows onto the ends of the component (do not directly touch the component with the soldering iron tip). If the solder does not flow onto the entire end of the component, the component should be discarded.

5.4 REPEATER TEST CONTROLS

Since the repeater is logic controlled, a specific data message must be received for the transmitter to key and the receive audio to be enabled. However, controls are provided on the logic, receiver, and exciter drawers to enable functions for testing.

5.4.1 REMOTE/LOCAL

Normally in the Remote position, this switch directs the received audio to the transmit audio circuitry and the PTT line to the controller logic.

When placed in the Local position, the local microphone audio is placed on the transmit audio input and the PTT line is controlled by the local microphone PTT switch.

5.4.2 ON/OFF LINE

For normal operation, this switch is placed in the "ON LINE" position and the green LED is on. The switch is placed in the "Off Line" position to disable repeater functions for programming.

5.4.3 AUDIO TEST

Receiver drawer jack used for monitoring the receive audio signal. A signal is present regardless of the logic and noise squelch signal because this jack is located before the audio gating circuitry.

5.4.4 LOCAL VOLUME

When the receive drawer switch is turned clockwise from the "OFF" position, the logic control of the receive audio gating is disabled and increases the volume level. Then whenever a carrier is detected, receive audio is fed to the exciter and also heard from the front-panel speaker.

5.4.5 LOCAL MICROPHONE

When a microphone is plugged into this jack it can be used to key the transmitter and transmit an audio signal. However, the Call Guard signal is not enabled.

5.5 LOCALIZING PROBLEM TO A DEFECTIVE ASSEMBLY

5.5.1 INTRODUCTION

A problem with the repeater can usually be isolated fairly quickly to a main subassembly such as the receiver or exciter drawer. The following checks can be used to verify operation of the re-

ceiver and transmitter. Before proceeding with these checks, make sure all the cables on the rear panel connectors are in place and that the power supply output voltage is approximately 14V.

Refer to the troubleshooting flowchart Figure 5-3 or to the following information to determine if the receiver is working properly.

5.5.2 VERIFYING RECEIVER OPERATION

1. Set Logic drawer Local/Remote switch to LOCAL.

2. Set an RF signal generator to the receive channel frequency at an output level of 0.5 μV, modulated with 1 kHz at ±5 kHz deviation.

3. Disconnect the coaxial cable from the back panel of the receiver drawer. Connect the generator to the jack.

4. Adjust the LOCAL VOL control clockwise and a tone should be heard from the speaker.

5. If a tone is not heard when the generator is connected to the antenna jack see Section 5.6.

6. Measure receiver outputs on rear panel connector J560. If the receiver is operating properly, signals should be as follows:

   Pins 5 and 12 (Rx audio out) 0.5V RMS

   Pin 3 (Squelch Enable) < 4.5V DC unsquelched
   > 0.5V DC squelched

   Change the generator modulation to a frequency from 60-250 Hz at ±600 Hz deviation

   Pin 6 (Call Guard audio) 0.5V RMS

5.5.3 VERIFYING TRANSMITTER OPERATION

Refer to Figure 5-2 or the following information to determine transmitter operation.

1. Connect a wattmeter and 50 ohm dummy load with a power rating of 100W or greater to the RF output jack of the power amplifier. Connect a microphone to the LOCAL MIC jack on the exciter drawer.

2. Key the transmitter and power output should be approximately 100W. If the power output is correct, proceed to step 4. If no power output is produced see Section 5.8.

3. Connect the wattmeter and dummy load to the exciter RF output jack J100. Key the transmitter and power output should be approximately 5W to 18W. If the exciter power output is correct and no power output was produced by the power amplifier, the power amplifier is probably defective. Proceed to Step 4. If the exciter power output is not correct, the exciter drawer is probably defective (see Section 5.7).

4. Check modulation by speaking into the microphone while monitoring the output signal with a communications monitor. Voice modulation should be approximately ±3 kHz. If modulation is incorrect the exciter drawer is probably defective.

5.6 RECEIVE TROUBLESHOOTING

1. Set an RF signal generator to the receive frequency with an output of 0.5 μV, modulated with 1 kHz at ±5 kHz deviation.

2. Connect the generator to the receiver antenna jack J500.

3. Adjust the LOCAL VOL control to hear a 1 kHz tone at the local speaker.

4. Measure receiver output on rear panel connector J560. If the receiver is operating properly, signals should be as follows:

   J560
   Pins 5 and 12 (RxA output) 0.5V RMS
   Pin 3 (Sq EN) < 4.5V DC unsquelched
   > 0.5V DC squelched

5.7 TRANSMIT TROUBLESHOOTING

To isolate an exciter problem to a defective section, start by checking the DC voltages shown below. If this does not indicate a problem, measure the DC, AC, and RF voltages shown on the schematic diagram to locate the defect.

5.7.1 EXCITER DC VOLTAGES

With a suitable antenna load connected to the RF output jack, key the transmitter by placing the Local/Remote switch on the logic drawer in the "Local" position and pressing the PTT switch of the local microphone. The following voltages should be present:

TCXO pin 3 = 9V
U300 pin 4 = 13.8V

5.8 POWER AMPLIFIER TROUBLESHOOTING

1. If the power amplifier is not producing approximately 100W of output power, make sure the exciter drawer is producing the proper drive to the power amplifier (approximately 5W to 18W).

2. Check that 13.8V is applied to all points that should have power.

3. The drive to finals Q401 and Q402 can be measured. Remove the coaxial cable attached to the 50 ohm microstrip from the driver and attach a coaxial cable to a wattmeter to this point. Power at this point should be 40W to 50W. Replace the coaxial cable.

WARNING

DO NOT TOUCH POWER AMPLIFIER COMPONENTS WHILE TRANSMITTING BECAUSE RF BURNS MAY RESULT.

4. A transistor that is producing power should be warm to the touch. After transmitting for a short time, unkey the transmitter and make sure Q401 and Q402 are warm.

5.9 LOGIC DRAWER TROUBLESHOOTING

If a problem is suspected with the logic board, check the DC and AC voltages and waveforms shown on the schematic diagram. Also refer to the circuit description to determine some of the input and output signals that should be present on the microprocessor pins.

If this does not localize the problem and a defective microprocessor is suspected, the simplest thing to do may be to replace the microprocessor and see if the problem is corrected. Specialized test equipment and an understanding of the software is usually necessary to thoroughly troubleshoot the microprocessor.

5.10 CHECKING RECEIVE DESENSITIZATION

5.10.1 INTRODUCTION

Receiver desensitization is the loss of receiver sensitivity caused by high level off-frequency signals that are applied to the receiver. Some possible causes of desensitization are improperly tuned combining equipment or a transmitter generating excessive spurious radiation. The following test measures desensitization and helps locate its source.

5.10.2 CAPACITIVE COUPLER

A capacitive coupler can be used to connect a signal generator to the antenna cable. This coupler should provide 50-60 dB of isolation to adequately protect the generator from high-level RF present on the cable. Use a coupler such as a Bird Model 4275 or fabricate one from a coaxial "T" connector. To do this, remove the pin from one of the side terminals of the connector and shorten it until the required isolation is obtained.

5.10.3 TEST PROCEDURE

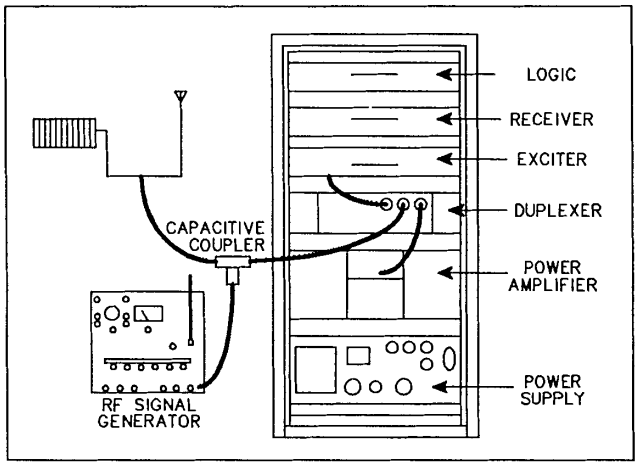
1. Connect the test setup shown in Figure 5-1. The coupler should be inserted in the cable between the receive antenna and repeater or combining equipment.

2. Set the signal generator to the receive channel frequency with an unmodulated output. Connect the generator to the coupler. The repeater transmitter should be unkeyed.

3. Monitor the AC voltage at the AUDIO TEST jack on the receiver drawer. With no generator output signal, note the meter reading to establish the 0 dB reference.

4. Increase the unmodulated generator output to obtain a 15 dB decrease in the meter reading.

5. Key the repeater transmitter by pressing the PTT switch on the local microphone. Less than 2 dB quieting degradation should result.



RECEIVER DESENSE TEST SETUP
FIGURE 5–1

5.10.4 LOCALIZING CAUSE OF DESENSITIZATION

ANTENNA

Substitute a 50 ohm dummy load for the transmit antenna and repeat the test. If the result is normal, the antenna or feedline may be defective.

DUPLEXER OR COMBINING EQUIPMENT

Connect the signal generator to the receiver antenna jack and connect a 50 ohm dummy load to the RF output jack of the power amplifier. Repeat the test and if the result is normal, the duplexer or combining equipment may be improperly tuned or defective.

TRANSMITTER

If the preceding test still resulted in abnormal desensitization, the transmitter may be emitting excessive spurious radiation.

5.11 DETERMINING EFFECTIVE SENSITIVITY

If the repeater is operating in a congested area where many high–level RF signals are present, the effective sensitivity may be less than that obtained using the standard bench check procedure. To determine the effective sensitivity of the repeater, perform the following test.

1. Check the quieting sensitivity of the receiver using the standard bench check procedure detailed in the "Performance Tests" in Section 6.5. Perform the test with the antenna combining equipment (if used) and record the results.

2. Connect the test setup shown in Figure 5–1 using the capacitive coupler as described in Sections 5.10.2 and 5.10.3. Check the sensitivity using a 50 ohm dummy load connected to the capacitive coupler and record the results (transmitter may be keyed or unkeyed).

3. Connect the antenna to the coupler and check the sensitivity with no on–channel signal present. Record the results.

4. Determine the effective sensitivity using the following formula:

Eff. Sens. = Bench X (Antenna ÷ 50Ω load)

EXAMPLE:

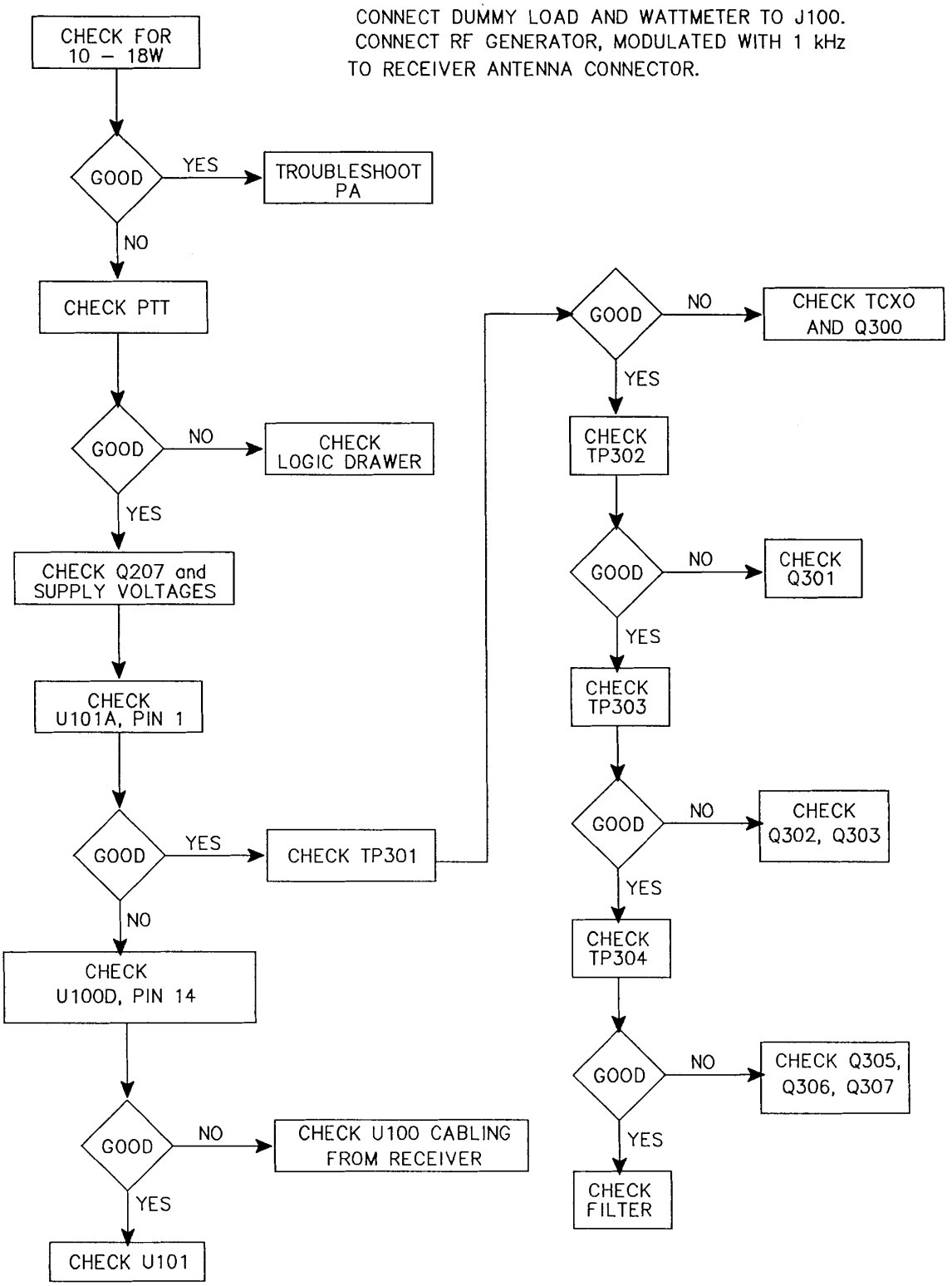
Bench Check Sensitivity = 0.4 μV (20 dB Quieting)

Sensitivity with 50Ω load = 400 μV (20 dB Quieting)

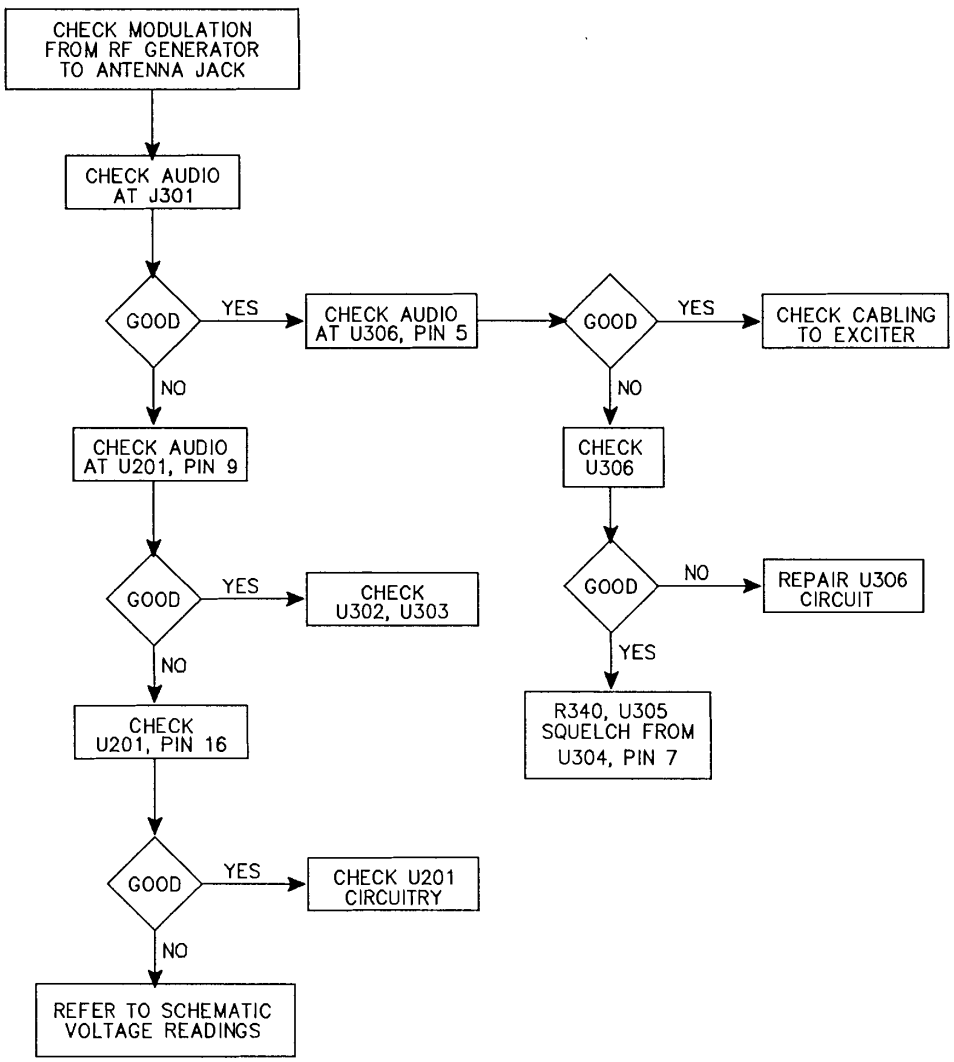
Antenna Sensitivity = 4000 μV (20 dB Quieting)

Effective Sensitivity = 0.4 X (4000 ÷ 400)

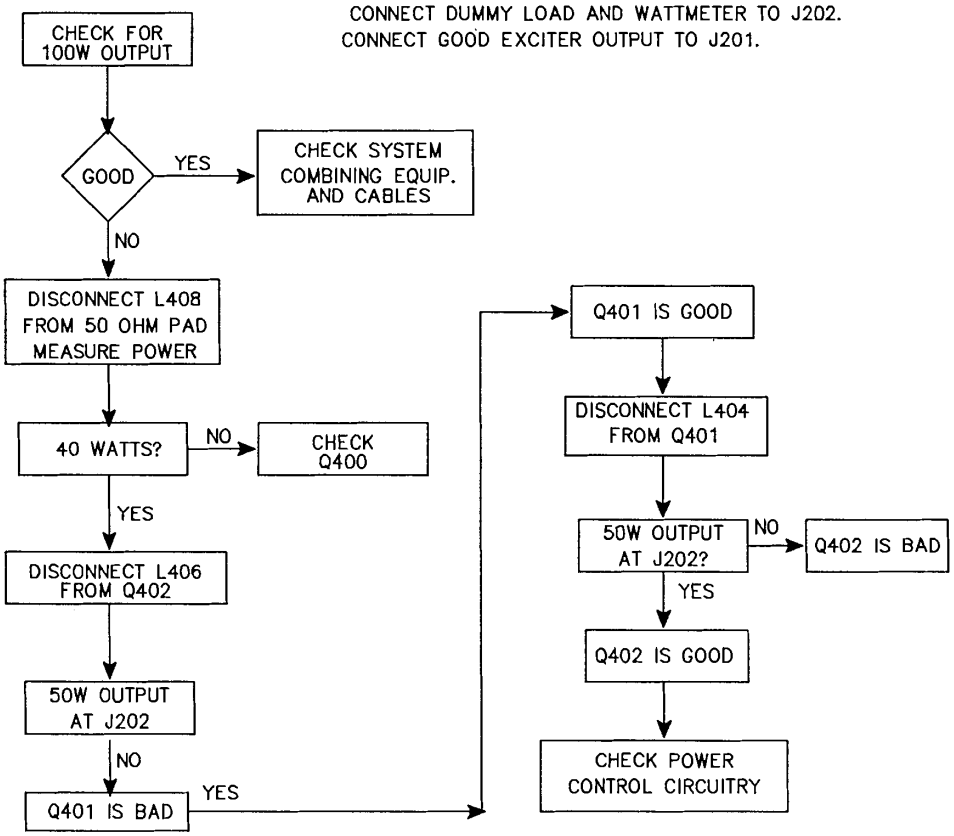
Effective Sensitivity = 4 μV



TRANSMITTER TROUBLESHOOTING FLOWCHART
FIGURE 5–2



RECEIVER TROUBLESHOOTING FLOWCHART
FIGURE 5–3



POWER AMPLIFIER TROUBLESHOOTING FLOWCHART
FIGURE 5–4

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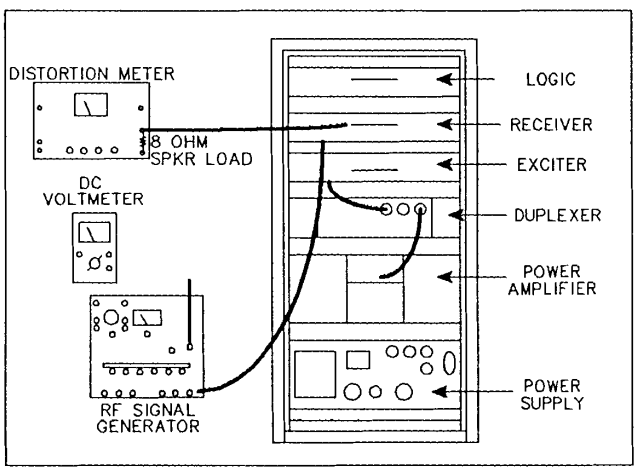
SECTION 6
ALIGNMENT PROCEDURE AND PERFORMANCE TESTS

6.1 RECEIVER DRAWER ALIGNMENT

Refer to Figure 6-1 and Receiver Alignment Points Diagram Figure 6-5.

6.1.1 FIRST, SECOND AND THIRD TRIPLER ADJUSTMENT

1. Install TCXO in J254.
2. Connect DC voltmeter to TP255.
3. Tune L251 and L252 for maximum DC voltage (typically 0.2V DC).
4. Alternately retune L251 and L252 until a peak is achieved.
5. Connect DC voltmeter to TP256.
6. Tune L253 and L254 for maximum DC voltage (typically 0.3V DC).
7. Alternately retune L253 and L254 until a peak is achieved.



RECEIVER TEST SETUP
FIGURE 6-1

6.1.2 IF AND FRONT END ALIGNMENT

1. Turn on the local volume control and using the local speaker as the monitor, set squelch control R317 to threshold.
2. Connect an RF generator to J205 and set to channel frequency modulated with 1 kHz at ±3 kHz deviation.
3. Connect a SINADDER to audio test jack J301.
4. Increase the level sufficiently to "force" a signal through the front-end helical filter.
5. Tune L101-L107 and T201 in sequence for the best 12 dB SINAD while continuously decreasing the RF level as succeeding stages are tuned.
6. Using an appropriate RF frequency measuring instrument, measure and set the correct frequency of the first injection chain by adjusting the tuning capacitor located at the top of the TCXO. (Lightly couple with a probe through the hole in the top of L107 helical cavity. The frequency measured will be 10.7 MHz below the on-channel frequency.)
7. Raise generator RF output level 60 dB above level for best 12 dB SINAD sensitivity.
8. Tune T202 for maximum audio at J301. Measure distortion of audio output at J301 and tune L202 and L204 for minimum audio distortion (distortion should be < 1.5%).
9. Set audio output level to 0.7V RMS at J560, pins 5/12 by adjusting R341.
10. Readjust squelch control R317 to threshold.
11. Decrease RF generator output to 12 dB SINAD sensitivity and carefully readjust L101-L107 and T201 for best 12 dB SINAD sensitivity (typically 1 dB better at the high end of the frequency range than at the low end).
12. Readjust the squelch. Unsquelch the receiver and connect a SINADDER to the Audio Test Jack J301. Increase modulated signal generator input for 6-7 dB SINAD. Monitor local audio and set squelch control R317 for threshold.

6.1.3 ADAPTIVE BANDWIDTH CONTROL LEVEL ADJUST

1. Connect an open receiver generating noise to J701, pin 5 of the Logic board.
2. Adjust R736 until U712, pin 14 is constantly switching from high to low. (Duty cycle is approximately 75% high, 25% low.)

6.2 TRANSMITTER ALIGNMENT

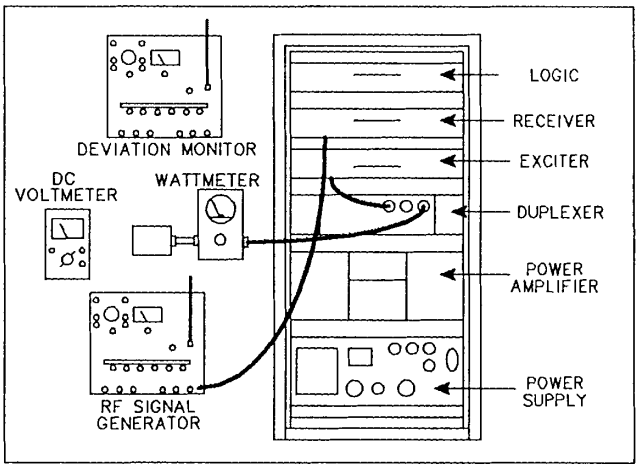
Refer to Transmitter Test Setup Figure 6-2 and Transmitter Alignment Point Diagram 6-3.

6.2.1 EXCITER

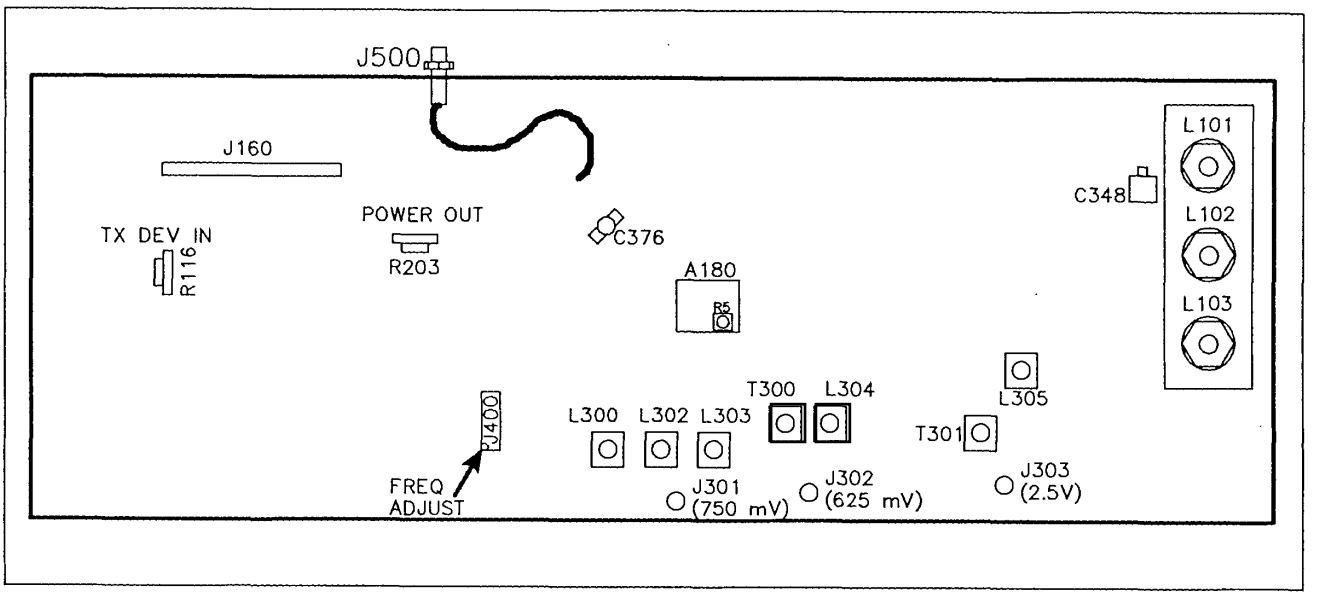
1. Disconnect coax from PA input port J201 and connect to a wattmeter with a 25W element terminated with a dummy load.
2. Install TCXO in J400.
3. Connect DC voltmeter to J301.
4. Key transmitter, tune L300, L302 and L303 for maximum voltage (typically 750 mV).
5. Connect DC voltmeter to J302.
6. Tune T300 and L304 for maximum voltage (typically 625 mV).
7. Connect DC voltmeter to J303.
8. Tune T301 and L305 for maximum voltage (typically 2.5V).
9. Preset helical screws flush with casting.
10. Monitor helical output filter at C348 with an RF voltmeter. Back each helical screw out of the casting one turn at a time, in sequence until power is obtained.
11. Tune helicals for maximum power out.
12. Tune C376 for maximum power out.
13. Retune T301 and L305 for maximum power out (typically 22W)
14. Adjust DC Voltage Control Pot R5 (A180) for 18W.
15. Connect 1V DC to J160, pin 8.
16. Adjust R203 for 10W RF output (range is typically 5-18W). C376 can be repeaked for maximum RF output into a 50 ohm load only.
17. Reconnect coax to PA input port J201.

6.3 POWER AMPLIFIER

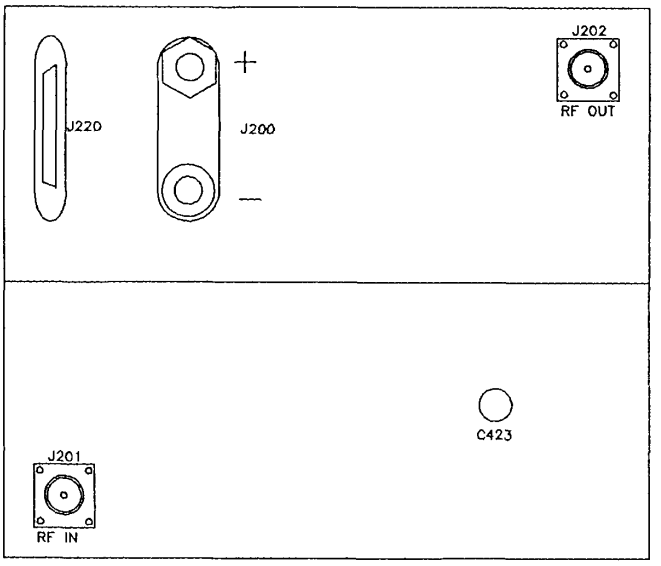
1. Connect a wattmeter (250W) and a 50 ohm dummy load to J202 of the power amplifier.
2. Preset R203 for maximum.
3. Key transmitter and set R5 (A180) for 115W (450-488 MHz) or 100W (488-512 MHz)
4. Tune C423 in the PA for maximum power out and minimum current drain to PA. Readjust R203 if needed.
5. Reset R5 (A180) for 115W (450-488 MHz) or 100W (488-512 MHz).
6. Adjust R203 for 100W (450-488 MHz) or 90W (488-512 MHz).
7. Monitor the output frequency. Set on frequency with the tuning capacitor in the TCXO.



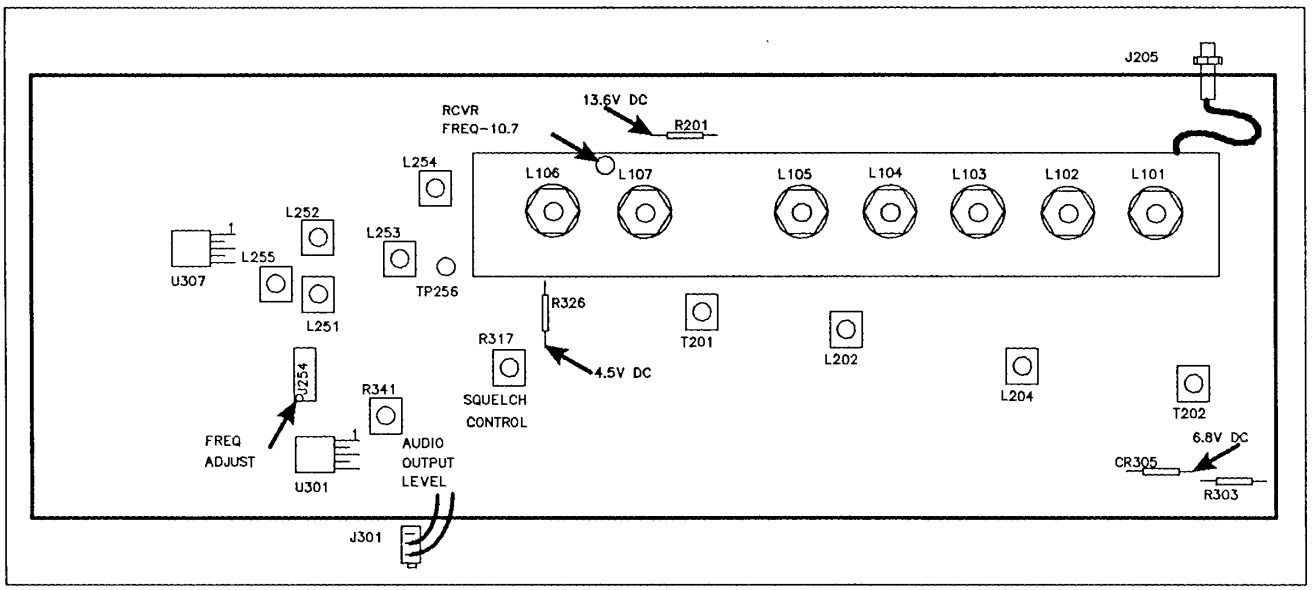
TRANSMITTER TEST SETUP
FIGURE 6-2



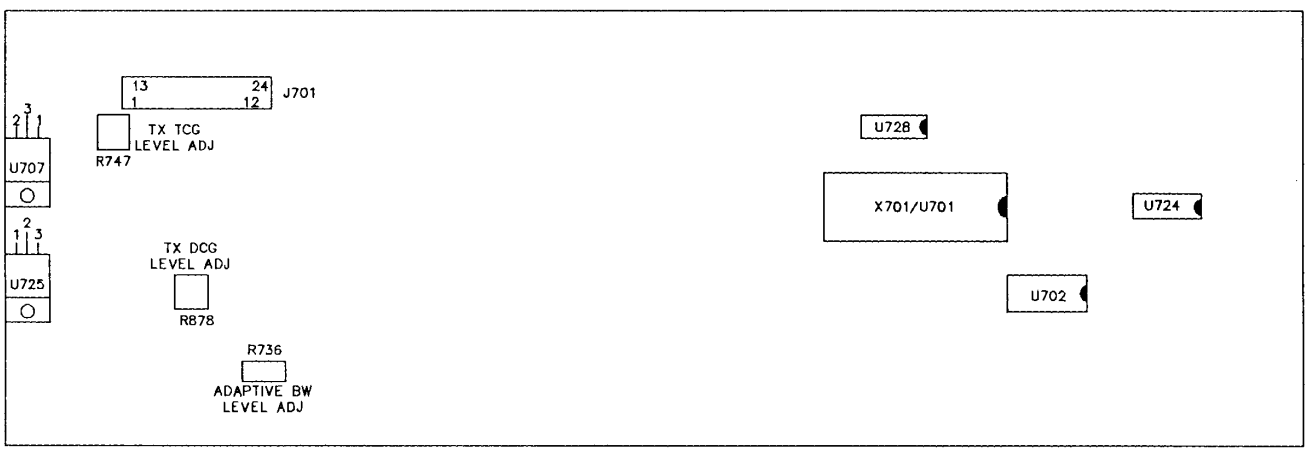
TRANSMITTER ALIGNMENT POINTS DIAGRAM
FIGURE 6–3



PA ALIGNMENT POINTS DIAGRAM
FIGURE 6–4



RECEIVER ALIGNMENT POINTS DIAGRAM
FIGURE 6–5



LOGIC DRAWER ALIGNMENT POINTS DIAGRAM
FIGURE 6–6

6.4 TRANSMITTER PERFORMANCE TESTS

6.4.1 TRANSMITTER DEVIATION

1. Set R116 to mid-range.
2. Connect RF generator at J205 and set to channel frequency with 1 kHz modulation at ±4 kHz deviation.
3. Monitor transmit frequency and set transmit deviation to ±4 kHz deviation with R116.

6.4.2 TRANSMIT CALL GUARD DEVIATION

1. Enter programming mode with keypad.
2. Enter *1818* for 123.0 Hz Tone Call Guard code.
3. Enter #251* for Digital Call Guard code.
4. Enter ### to Exit programming mode.
5. Set RF generator to 123.0 Hz modulated with ±600 Hz deviation.
6. Adjust R747 (Logic drawer) for ±600 Hz Tone Call Guard deviation.
7. Replace the 123.0 Hz tone with Digital Call Guard code 251.
8. Adjust R878 (Logic Drawer) for ±600 Hz Digital Call Guard deviation.

6.5 RECEIVER PERFORMANCE TEST

6.5.1 SENSITIVITY

1. Connect an RF generator to J205 and connect a SINADDER and oscilloscope to J301.
2. Set generator to receive frequency modulated with 1 kHz at ±3 kHz deviation.
3. Set generator output to 0.35 µV. The SINADDER should indicate 12 dB or greater.

6.5.2 AUDIO DISTORTION

1. Connect an RF generator to J205 and connect a SINADDER to J301.
2. Set generator to receive frequency modulated with 1 kHz at ±3 kHz deviation.
3. Increase generator level until a clear signal is produced on the oscilloscope (approximately 100 µV).
4. The audio distortion should be less than 1.5%. Adjust T202 slightly to achieve minimum distortion.

6.5.3 LOCAL AUDIO

1. Connect an AC voltmeter across the local speaker LS301.
2. Turn the local audio on and set the local volume R340 fully clockwise.
3. The AC voltmeter should indicate 2V RMS minimum.

6.6 POWER SUPPLY PERFORMANCE TEST

6.6.1 VOLTAGE REGULATOR TEST

1. Apply 13.6V DC to J701, pin 17.
2. U707, pin 2 should measure +5V ±4%.
3. U725, pin 2 should measure +10V ±4%.
4. U724, pin 7 should measure +5V ±4%.

6.6.2 AC SUPPLY SENSE TEST

1. Remove U701 and connect a 10k ohm resistor from X701, pin 24 to +5V DC.
2. Apply a 60 Hz, 10V RMS signal at J701, pin 9.
3. X701, pin 24 should measure less than 0.7V DC.

4. Remove the signal

5. X701, pin 24 should measure > +4.5V DC.

6.6.3 POWER SUPPLY SENSE TEST

1. Remove U701 and connect a 10k ohm resistor from X701, pin 28 to +5V DC.

2. Reduce voltage at J710, pin 17 to 11.5V DC.

3. X701, pin 28 should measure <0.7V DC.

4. Reduce voltage at J701, pin 17 to 10V DC.

5. X701, pin 28 should measure > +4.5V DC.

6.6.4 RESET CIRCUIT TEST

1. Reduce voltage at J701, pin 17 until the voltage at U707, pin 2 is 4.75V DC.

2. U728, pin 1 should measure <0.7V DC.

3. Ground the cathode of CR714.

4. U702, pin 8 should measure <0.7V DC.

5. Remove ground at CR714 and reduce voltage at J701, pin 17 until voltage at U707, pin 2 is +4.6V DC.

6. U728, pin 1 should measure > +4V DC.
U702, pin 8 should measure > +3.5V DC.

SECTION 7
PARTS LIST

CR1010 REPEATER
PART NO. 242-1010-111 (450-488 MHz)
242-1010-121 (488-512 MHz)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 000	Exciter (450-488 MHz)	023-1010-120
A 000	Exciter (488-512 MHz)	023-1010-122
A 000	Logic drawer top cover assem	023-1010-198
A 000	100 watt power amplifier	023-1010-200
A 000	35A power supply 60 Hz	023-1010-350
A 000	Wire harness	023-1010-400
A 000	BNC-N RG-400 cable	023-1010-460
A 000	Receiver (450-488 MHz)	023-1010-531
A 000	Receiver (488-512 MHz)	023-1010-532
A 000	Logic drawer	023-1010-700
A 000	43 inch cabinet	023-3824-004
A 000	Slide assembly	023-4406-701
CH000	Top and bottom covers	017-2197-041
HW000	Backing plate	013-1479-001
HW000	#10 U-type speed nut ZPS	560-1810-002
HW000	3/16 inch cable clamp	572-0001-002
HW000	Adhesive mount cable clamp	572-0009-002
HW000	4-40 x .250 panhead phil TT	575-0604-008
HW000	6-32 5/16 inch panhead TT	575-0606-010
HW000	#10 panhead phil CPS	575-3610-032
HW000	#4 washer NPB	596-2404-009
HW000	#10 flat washer	596-9112-016
MP000	Exciter top cover (exciter)	017-2205-140
MP000	Anti-skid pad	018-1117-001
MP000	Clip for 1/4 turn drwr fastener	537-4003-001
MP000	Flexible grommet	574-0001-025
U 701	Internal CWID V2.09	023-9998-104
U 701	External CWID V2.10	023-9998-107
Y 000	2 PPM Transmit TCXO	518-24xx-xxx
Y 000	2 PPM Receive TCXO	518-54xx-xxx

EXCITER DRAWER
PART NO. 023-1010-120 (450-488 MHz)
023-1010-122 (488-512 MHz)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 002	Local/Remote switch assembly	023-1010-135
A 003	Microphone connector assem	023-1010-140
A 004	Transmit LED assembly	023-1010-150
A 005	Rear connector assembly	023-1010-160
A 006	RF output cable assembly	023-1010-170
A 013	Back panel assembly	023-1010-196
A 180	Exciter voltage control assem	023-1010-180
C 100	.1 µF ±5% 63V poly	510-1033-104
C 101	.0068 µF ±5% 63V poly	510-1033-682
C 102	.1 µF ±5% 63V poly	510-1033-104
C 103	.01 µF ±5% 63V poly	510-1033-103
C 104	.01 µF ±5% 63V poly	510-1033-103
C 105	.01 µF ±5% 63V poly	510-1033-103
C 106	.01 µF ±5% 63V poly	510-1033-103
C 107	.0047 µF ±5% 63V poly	510-1033-472
C 108	470 pF ±10% Y5P ax cerm	510-3527-471
C 109	.0047 µF ±5% 63V poly	510-1033-472
C 110	.001 µF ±5% 63V poly	510-1033-102
C 111	2.2 µF ±20% 35V dip	510-2245-229
C 112	6.8 µF ±20% 35V dip	510-2245-689
C 113	100 pF ±5% P350 ax cerm	510-3512-101
C 114	.1 µF ±5% 63V poly	510-1033-104
C 119	.1 µF ±5% 63V poly	510-1033-104
C 200	33 pF ±5% NPO ax cerm	510-3514-330
C 201	100 pF ±5% P350 ax cerm	510-3512-101
C 202	.001 µF ±30% Y5P ax cerm	510-3527-102
C 203	33 pF ±5% NPO ax cerm	510-3514-330
C 204	6.8 µF ±20% 35V dip	510-2245-689
C 205	33 pF ±5% NPO ax cerm	510-3514-330
C 206	100 pF ±5% P350 ax cerm	510-3512-101
C 207	120 pF ±5% P350 ax cerm	510-3512-121
C 208	.047 µF ±20% 16V Y5S disc	510-3210-473
C 209	.001 µF ±30% Y5P ax cerm	510-3527-102
C 210	120 pF ±5% P350 ax cerm	510-3512-121
C 211	.047 µF ±20% 16V Y5S disc	510-3210-473
C 212	.001 µF ±30% Y5P ax cerm	510-3527-102
C 213	33 pF ±5% NPO ax cerm	510-3514-330
C 214	.001 µF ±30% Y5P ax cerm	510-3527-102
C 215	33 pF ±5% NPO ax cerm	510-3514-330
C 300	270 pF ±10% Y5P ax cerm	510-3527-271

PARTS LIST [Continued]

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 301	270 pF ±10% Y5P ax cerm	510-3527-271
C 302	47 pF ±5% NPO ax cerm	510-3514-470
C 303	.1 µF ±5% 63V poly	510-1033-104
C 304	.01 µF ±30% Y5R ax cerm	510-3528-103
C 305	.01 µF ±30% Y5R ax cerm	510-3528-103
C 306	.001 µF ±30% Y5P ax cerm	510-3527-102
C 307	.01 µF ±30% Y5R ax cerm	510-3528-103
C 308	22 pF ±5% NPO ax cerm	510-3514-220
C 309	1.5 pF ±20% P350 ax cerm	510-3512-159
C 310	27 pF ±5% NPO ax cerm	510-3514-270
C 311	1.5 pF ±20% P350 ax cerm	510-3512-159
C 312	33 pF ±5% NPO ax cerm	510-3514-330
C 313	33 pF ±5% NPO ax cerm	510-3514-330
C 314	.01 µF ±30% Y5R ax cerm	510-3528-103
C 315	4.7 pF ±10% NPO ax cerm	510-3514-479
C 316	470 pF ±10% Y5P ax cerm	510-3527-471
C 317	.001 µF ±30% Y5P ax cerm	510-3527-102
C 318	.001 µF ±30% Y5P ax cerm	510-3527-102
C 319	12 pF ±5% NPO ax cerm	510-3514-120
C 320	2.7 pF ±10% P350 ax cerm	510-3512-279
C 321	27 pF ±5% NPO ax cerm	510-3514-270
C 322	16 pF ±5% NPO ax cerm	510-3514-160
C 323	.01 µF ±30% Y5R ax cerm	510-3528-103
C 324	2.2 pF ±10% NPO ax cerm	510-3514-229
C 325	100 pF ±5% P350 ax cerm	510-3512-101
C 326	100 µF 16V axial low temp	510-4316-101
C 327	100 pF ±5% P350 ax cerm	510-3512-101
C 328	5.6 pF ±10% NPO ax cerm	510-3514-569
C 329	1 pF ±20% P350 ax cerm	510-3512-109
C 330	12 pF ±5% NPO ax cerm	510-3514-120
C 331	12 pF ±5% NPO ax cerm	510-3514-120
C 332	16 pF ±5% NPO ax cerm	510-3514-160
C 333	47 pF ±5% NPO ax cerm	510-3514-470
C 334	2.2 pF ±10% NPO ax cerm	510-3514-229
C 335	470 pF ±10% Y5P ax cerm	510-3527-471
C 336	.33 pF ±5% 500V comp	510-9502-338
C 337	.01 µF ±30% Y5R ax cerm	510-3528-103
C 338	100 pF ±5% P350 ax cerm	510-3512-101
C 339	3.9 pF ±10% P350 ax cerm	510-3512-399
C 340	.01 µF ±30% Y5R ax cerm	510-3528-103
C 341	33 pF ±5% NPO ax cerm	510-3514-330
C 342	.01 µF ±30% Y5R ax cerm	510-3528-103
C 343	.001 µF ±30% Y5P ax cerm	510-3527-102
C 344	6.8 µF ±20% 35V dip	510-2245-689
C 345	24 pF ±5% NPO ax cerm	510-3514-240
C 346	16 pF ±5% NPO ax cerm	510-3514-160
C 347	4.7 pF ±10% NPO ax cerm	510-3514-479
C 348	33 pF 250V mini mica	510-0020-330
C 349	27 pF 250V mini mica (450-488 MHz)	510-0020-270
C 349	43 pF 250V mini mica (488-512 MHz)	510-0020-430
C 350	68 pF 250V mini mica	510-0020-680
C 351	.1 µF ±5% 63V poly	510-1033-104
C 352	.001 µF ±30% Y5P ax cerm	510-3527-102
C 353	33 pF ±5% NPO ax cerm	510-3514-330
C 354	6.8 µF ±20% 35V dip	510-2245-689
C 355	470 pF ±10% Y5P ax cerm	510-3527-471
C 356	15 pF 250V mini mica (450-488 MHz)	510-0020-150
C 356	36 pF 250V mini mica (488-512 MHz)	510-0020-360
C 357	36 pF 250V mini mica	510-0020-360
C 358	72 pF 100V mica self align	510-0028-720
C 359	22 pF 250V mini mica	510-0020-220
C 360	18 pF 250V mini mica	510-0020-180
C 361	39 pF 250V mini mica	510-0020-390
C 363	11 pF 250V mini mica (450-488 MHz)	510-0020-110
C 363	13 pF 250V mini mica (488-512 MHz)	510-0020-130
C 364	72 pF 100V mica self align	510-0028-720
C 366	.001 µF ±30% Y5P ax cerm	510-3527-102
C 367	.1 µF ±5% 63V poly	510-1033-104
C 368	6.8 µF ±20% 35V dip	510-2245-689
C 369	33 pF ±5% NPO ax cerm	510-3514-330
C 370	.001 µF ±30% Y5P ax cerm	510-3527-102
C 371	.01 µF ±30% Y5R ax cerm	510-3528-103
C 372	72 pF 100V mica self align	510-0028-720
C 373	6.8 µF ±20% 35V dip	510-2245-689
C 374	39 pF 250V mini mica	510-0020-390
C 376	1.9-15.7 pF air var	187-0109-175
C 377	.001 µF ±30% Y5P ax cerm	510-3527-102
C 378	33 pF ±5% NPO ax cerm	510-3514-330
C 379	33 pF ±5% NPO ax cerm	510-3514-330
C 380	6.8 µF ±20% 35V dip	510-2245-689
C 381	.1 µF ±5% 63V poly	510-1033-104
C 382	2.2 µF ±20% 35V dip	510-2245-229
C 383	.001 µF ±30% Y5P ax cerm	510-3527-102
C 384	47 µF ±20% 20V dipped	510-2044-470
C 385	100 pF ±5% P350 ax cerm (488-512 MHz)	510-3512-101
C 399	.1 µF ±20% 25V Z5U axial	510-3546-104
CR100	Si diode 1N4448	523-1500-883
CR101	Si diode 1N4448	523-1500-883
CR102	2.4 volt 1W zener	523-2505-249

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CR103	2.4 volt 1W zener	523-2505-249
CR104	Si diode 1N4448	523-1500-883
CR105	Si diode 1N4448	523-1500-883
CR106	Si diode 1N4448	523-1500-883
CR107	Si diode 1N4448	523-1500-883
CR108	5.1 ±5% 1W zener	523-2503-519
CR200	12V ±5% 1W zener	523-2503-120
CR300	Si diode 1N4448	523-1500-883
CR301	Si diode 1N4448	523-1500-883
CR302	HC diode 1N5711	523-1500-014
EP001	TO-39 spacer	574-9001-001
EP002	.03 teflon tubing	058-0053-510
EP200	Ferrite bead	517-2502-007
EP201	Ferrite bead	517-2502-007
EP202	Ferrite bead	517-2502-007
EP300	Ferrite bead	517-2502-007
EP301	Ferrite bead	517-2502-007
EP302	.14 x .13 ferrite bead	517-2002-001
EP304	.14 x .13 ferrite bead	517-2002-001
EP305	Ferrite bead	517-2502-007
EP306	3/8 in. coil shield	578-0002-001
EP307	3/8 in. coil shield	578-0002-001
EP308	3/8 in. coil shield	578-0002-001
EP309	3/8 in. coil shield	578-0002-001
EP310	3/8 in. coil shield	578-0002-001
EP311	3/8 in. coil shield	578-0002-001
EP312	3/8 in. coil shield	578-0002-001
EP313	TO-92 transistor shield	578-0004-001
EP332	Ferrite bead	517-2502-007
EP333	.138 x .241 ferrite bead (488-512 MHz)	517-2002-002
EP334	.138 x .241 ferrite bead (488-512 MHz)	517-2002-002
EP399	3/16 heat shrink tubing	042-0241-554
HW001	6-32 ph taptite 1/4	575-0606-008
HW002	Nut 4-40 x .094 NPB	560-2104-008
HW003	4-40 mach panhead ZPS phil	575-1604-010
HW004	6-32 phil taptite 5/16	575-0606-010
HW005	Nut 8-32 x .094 NPB	560-2108-008
HW010	#4 shakeproof washer	596-1104-008
HW011	Screw 8-32 panhead CPS phil	575-0608-012
HW012	#8 flathead phil BZPS TT	575-9079-010
HW013	Lockwasher int 10 x .032 NPB	596-2110-012
HW014	Nut 10-32 x .375 CPS	560-1110-012
HW015	Socket LED panel mount	550-0006-100
HW016	6-32 mach panhead ZPS phil	575-1606-016
HW309	Nut tension lock CPS	560-1810-022
HW310	Set screw 10-32 hex NPB	575-9059-032
HW311	Nut 6-32 x .078 NPB	560-2106-008
HW312	6-32 panhead taptite 5/16	575-0606-010
HW313	Lockwasher int 6 x .018 NPB	596-2106-009
HW314	4-40 mach panhead ZPS phil	575-1604-008
J 301	Red tip jack, vert .080	105-2202-201
J 302	Red tip jack, vert .080	105-2202-201
J 303	Red tip jack, vert .080	105-2202-201
J 400	5-pin male connector	515-9031-035
L 300	.22-.37 µH inductor violet	542-1006-117
L 302	.22-.37 µH inductor violet	542-1006-117
L 303	.22-.37 µH inductor violet	542-1006-117
L 304	RF choke space wound brown	542-1012-111
L 305	RF choke space wound violet	542-1012-113
L 306	1.5 T coil 26 AWG	542-0001-015
L 307	3.5 T coil 26 AWG	542-0001-035
L 308	RF choke	542-3006-002
L 309	4.25T helical inductor w/tap (450-488 MHz)	016-1929-107
L 309	4T helical inductor w/tap (488-512 MHz)	016-1929-105
L 310	4.25T helical inductor (450-488 MHz)	016-1929-106
L 310	4T helical inductor (488-512 MHz)	016-1929-107
L 311	4.25T helical inductor w/tap (450-488 MHz)	016-1929-107
L 309	4T helical inductor w/tap (488-512 MHz)	016-1929-105
L 312	2.5T ferrite choke	517-2005-005
L 313	2.5T ferrite choke	517-2005-005
L 314	UHF RF choke	023-3462-002
L 315	2.5T ferrite choke	517-2005-005
L 316	UHF RF choke	023-3462-002
L 317	6.8 µH ±10% RF choke	542-3504-689
MP001	Knob .625 long	032-0767-021
MP008	1/4 turn fastener bail type	537-4001-101
MP009	Retainer for MP8	537-4002-001
MP011	Front panel	014-0771-071
MP012	Handle	017-2139-202
MP014	Drawer rail, left	017-2197-031
MP015	Guide pin	013-1627-001
MP016	Drawer-rail, right	017-2197-032
MP018	Drawer right side	014-0783-045
MP019	Heat pipe	014-0771-105
MP020	Heat sink	014-0771-100

PARTS LIST [Continued]

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
MP300	Casting	015-0901-020
MP301	Heat sink TO-39-5	539-0002-024
MP302	Heat sink TO-220 solder tab	539-0009-100
MP303	Heat sink support	017-2207-005
PC300	PC Board	035-1010-100
Q 200	Si NPN gen purp 2N3904	576-0003-058
Q 201	Si PNP 80V 7A TO-220	576-0002-021
Q 207	Si PNP 80V 7A TO-220	576-0002-021
Q 300	Si NPN VHF/UHF amp/osc	576-0003-051
Q 301	Si NPN VHF/UHF amp/osc	576-0003-051
Q 302	Si NPN MRF-571	576-0003-062
Q 303	Si NPN MRF-571	576-0003-062
Q 304	NPN med pwr RF MRF-581	576-0003-063
Q 305	2W 512 MHz TO-39	576-0004-085
Q 306	5W NPN UHF stud mount	576-0004-094
Q 307	20W UHF amp	576-0004-062
R 099	10k ohm ±5% 1/4W CF	569-0513-103
R 100	270k ohm ±5% 1/4W CF	569-0513-274
R 101	220k ohm ±5% 1/4W CF	569-0513-224
R 102	6800 ohm ±5% 1/4W CF	569-0513-682
R 103	15k ohm ±5% 1/4W CF	569-0513-153
R 104	56k ohm ±5% 1/4W CF	569-0513-563
R 105	82k ohm ±5% 1/4W CF	569-0513-823
R 106	39k ohm ±5% 1/4W CF	569-0513-393
R 107	150k ohm ±5% 1/4W CF	569-0513-154
R 108	22k ohm ±5% 1/4W CF	569-0513-223
R 109	3.3k ohm ±5% 1/4W CF	569-0513-332
R 110	10k ohm ±5% 1/4W CF	569-0513-103
R 111	100k ohm ±5% 1/4W CF	569-0513-104
R 112	150k ohm ±5% 1/4W CF	569-0513-154
R 113	150k ohm ±5% 1/4W CF	569-0513-154
R 114	22k ohm ±5% 1/4W CF	569-0513-223
R 115	100k ohm ±5% 1/4W CF	569-0513-104
R 116	10k ohm 1/8W PC trim pot	562-0004-103
R 117	68k ohm ±5% 1/4W CF	569-0513-683
R 118	10k ohm ±5% 1/4W CF	569-0513-103
R 119	68k ohm ±5% 1/4W CF	569-0513-683
R 120	10k ohm ±5% 1/4W CF	569-0513-103
R 121	10k ohm ±5% 1/4W CF	569-0513-103
R 122	27k ohm ±5% 1/4W CF	569-0513-273
R 123	180k ohm ±5% 1/4W CF	569-0513-184
R 124	82k ohm ±5% 1/4W CF	569-0513-823
R 125	82k ohm ±5% 1/4W CF	569-0513-823
R 126	82k ohm ±5% 1/4W CF	569-0513-823
R 128	1k ohm ±5% 1/4W CF	569-0513-102
R 163	Zero ohm resistor	569-0500-001
R 164	Zero ohm resistor	569-0500-001
R 170	100k ohm ±5% 1/4W CF	569-0513-104
R 200	1k ohm ±5% 1/4W CF	569-0513-102
R 201	12k ohm ±5% 1/4W CF	569-0513-123
R 203	50k ohm 1/8 W PC trim pot	562-0004-503
R 204	5.6k ohm ±5% 1/4W CF	569-0513-562
R 205	12.1k ohm ±1% 1/8W MF	569-0520-409
R 206	1.1k ohm ±1% 1/8W MF	569-0520-305
R 207	100k ohm ±5% 1/4W CF	569-0513-104
R 208	470k ohm ±5% 1/4W CF	569-0513-474
R 209	10k ohm ±5% 1/4W CF	569-0513-103
R 210	33 ohm ±10% 1/2W CC	569-1504-330
R 211	47k ohm ±5% 1/4W CF	569-0513-473
R 212	1k ohm ±5% 1/4W CF	569-0513-102
R 213	680 ohm ±5% 1/4W CF	569-0513-681
R 300	1k ohm ±5% 1/4W CF	569-0513-102
R 301	1k ohm ±5% 1/4W CF	569-0513-102
R 302	1k ohm ±5% 1/4W CF	569-0513-102
R 303	470 ohm ±5% 1/4W CF	569-0513-471
R 304	5.1k ohm ±5% 1/4W CF	569-0513-512
R 305	10 ohm ±5% 1/4W CF	569-0513-100
R 306	110 ohm ±5% 1/4W CF	569-0513-111
R 307	110 ohm ±5% 1/4W CF	569-0513-111
R 308	4.3k ohm ±5% 1/4W CF	569-0513-432
R 309	1k ohm ±5% 1/4W CF	569-0513-102
R 310	100 ohm ±5% 1/4W CF	569-0513-101
R 311	10k ohm ±5% 1/4W CF	569-0513-103
R 312	10k ohm ±5% 1/4W CF	569-0513-103
R 313	22 ohm ±5% 1/4W CF	569-0513-220
R 314	4.7k ohm ±5% 1/4W CF	569-0513-472
R 315	680 ohm ±5% 1/4W CF	569-0513-681
R 316	110 ohm ±5% 1/4W CF	569-0513-111
R 317	4.7k ohm ±5% 1/4W CF	569-0513-472
R 318	820 ohm ±5% 1/4W CF	569-0513-821
R 319	110 ohm ±5% 1/4W CF	569-0513-111
R 320	10k ohm ±5% 1/4W CF	569-0513-103
R 321	1k ohm ±5% 1/4W CF	569-0513-102
R 322	3.6k ohm ±5% 1/4W CF	569-0513-362
R 323	22 ohm ±5% 1/4W CF	569-0513-220
R 324	47 ohm ±5% 1/4W CF	569-0513-470
R 325	22 ohm ±5% 1/4W CF	569-0513-220
R 326	680 ohm ±5% 1/4W CF	569-0513-681
R 327	47 ohm ±5% 1/4W CF	569-0513-470
R 328	10 ohm ±5% 1/4W CF	569-0513-100
R 329	100 ohm ±5% 1/4W CF	569-0513-101
R 330	6800 ohm ±5% 1/4W CF	569-0513-682
R 331	22 ohm ±5% 1/4W CF	569-0513-220
R 333	56 ohm ±5% 1/4W CF	569-0513-560
R 399	100 ohm ±5% 1/4W CF	569-0513-101

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 400	470 ohm ±5% 1/4W CF	569-0513-471
RT200	Thermistor	569-3001-001
T 300	RF transformer valox green	592-5022-109
T 301	RF transformer valox violet	592-5022-110
U 100	Quad Op/Amp 3303	545-2020-003
U 101	Quad Op/Amp 3303	545-2020-003
U 200	Op/Amp CA3160S	544-2018-001
U 300	Adj reg TO-220 LM2931T	544-2003-043

LOCAL/REMOTE SWITCH
PART NO. 023-1010-135

EP135	3/32 heat shrink tubing	042-0241-552
EP136	3/32 heat shrink tubing	042-0241-552
EP137	3/32 heat shrink tubing	042-0241-552
EP138	3/32 heat shrink tubing	042-0241-552
ML135	4" cable tie, nylon	574-9008-004
S 135	Switch	583-2036-007
W 135	26 AWG wire	597-7032-609
W 136	26 AWG wire	597-7032-609
W 137	26 AWG wire	597-7032-609
W 138	26 AWG wire	597-7032-609

MICROPHONE CONNECTOR
PART NO. 023-1010-140

A 140	Microphone connector	117-5205-102
EP140	3/32 heat shrink tubing	042-0241-552
EP141	3/32 heat shrink tubing	042-0241-552
EP142	3/32 heat shrink tubing	042-0241-552
W 141	22 AWG prebonded	597-7032-209
W 142	22 AWG prebonded	597-7032-209
W 143	22 AWG prebonded	597-7032-209

TRANSMIT LED
PART NO. 023-1010-150

CR400	Red LED T 1 3/4 pkg	549-4001-001
EP400	3/32 heat shrink tubing	042-0241-552
HW400	Socket LED panel mount	550-0006-100
W 400	22 AWG prebonded	597-7032-209
W 401	22 AWG prebonded	597-7032-209

EXCITER REAR CONNECTOR
PART NO. 023-1010-160

C 161	470 pF ±5% NPO 1206 chip	510-3602-471
C 162	470 pF ±5% NPO 1206 chip	510-3602-471
C 164	470 pF ±5% NPO 1206 chip	510-3602-471
C 165	470 pF ±5% NPO 1206 chip	510-3602-471
C 166	470 pF ±5% NPO 1206 chip	510-3602-471
C 167	470 pF ±5% NPO 1206 chip	510-3602-471
C 168	470 pF ±5% NPO 1206 chip	510-3602-471
C 170	470 pF ±5% NPO 1206 chip	510-3602-471
EP160	.138 x .241 ferrite bead	517-2002-002
EP161	.03 Teflon tubing	058-0053-510
EP162	.03 Teflon tubing	058-0053-510
PC160	PC board connector filter	035-1010-110
F 160	7 A axial fuse	534-0009-070
HW160	PC mount baillock hdwr kit	537-9055-006
J 160	Ribbon rcpt 14-pin str PC	515-7141-101
W 161	22 AWG prebonded	597-7032-209
W 162	22 AWG prebonded	597-7032-209
W 163	22 AWG prebonded	597-7032-209
W 164	22 AWG prebonded	597-7032-209
W 165	22 AWG prebonded	597-7032-209
W 166	22 AWG prebonded	597-7032-209
W 168	22 AWG prebonded	597-7032-209
W 170	22 AWG prebonded	597-7032-209

RF OUTPUT CABLE
PART NO. 023-1010-170

EP170	1/4 heat shrink tubing	042-0241-555
J 170	Connector BNC panel mount	515-3006-004
W 170	Double shielded RG-316/U	597-3002-011

PARTS LIST [Continued]

EXCITER VOLTAGE CONTROL
PART NO. 023-1010-180

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 001	.01 µF ±10% X7R chip	510-3606-103
C 002	47 µF 16V SMD tantalum	510-2625-470
C 003	47 µF 16V SMD tantalum	510-2625-470
CR001	4.7V zener diode SOT-23	523-2016-479
HW003	4-40 machin panhead ZPS	575-1604-008
HW010	#4 shakeproof washer	596-1104-008
MP001	1/4" hex brass M/F spacer	312-7473-008
P 001	3-pin single row post header	515-9031-473
PC001	PC board	035-1010-180
Q 001	Si PNP low noise SOT-23	576-0003-657
Q 002	Si NPN low noise SOT-23	576-0003-658
R 001	1.8k ohm ±5% 1206 SMD	569-0115-182
R 002	1k ohm ±5% 1206 SMD	569-0115-102
R 003	1.8k ohm ±5% 1206 SMD	569-0115-182
R 004	3.3k ohm ±5% 1206 SMD	569-0115-332
R 005	5k ohm single turn trimmer	562-0112-502
R 006	1k ohm ±5% 1206 SMD	569-0115-102
R 007	1.3k ohm ±5% 1206 SMD	569-0115-132
R 008	1.3k ohm ±5% 1206 SMD	569-0115-132

LOGIC DRAWER
PART NO. 023-1010-700

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 702	Rear connector assembly	023-1010-780
A 704	Display front panel assembly	023-1010-779
A 705	CWID assembly	023-1010-740
A 711	Drawer back panel assembly	023-1010-193
BT701	3.6V 100 mAH NiCad PC mt	503-0005-002
C 701	.018 µF ±5% 63V polyester	510-1033-183
C 702	.0018 µF ±5% 63V polyester	510-1033-182
C 073	.039 µF ±5% 63V polyester	510-1033-393
C 704	.001 µF ±5% 63V polyester	510-1033-102
C 705	.082 µF ±5% 63V polyester	510-1033-823
C 706	.22 µF ±5% 63V polyester	510-1033-224
C 707	.22 µF ±5% 63V polyester	510-1033-224
C 708	.22 µF ±5% 63V polyester	510-1033-224
C 709	.22 µF ±5% 63V polyester	510-1033-224
C 710	.22 µF ±5% 63V polyester	510-1033-224
C 711	.22 µF ±5% 63V polyester	510-1033-224
C 712	.22 µF ±5% 63V polyester	510-1033-224
C 713	.22 µF ±5% 63V polyester	510-1033-224
C 714	.033 µF ±5% 63V polyester	510-1033-333
C 715	.0056 µF ±5% 63V polyester	510-1033-562
C 716	.68 µF ±10% 100V polyester	510-1031-684
C 717	.01 µF ±5% 63V polyester	510-1033-103
C 719	1 µF ±10% 100V polyester	510-1031-105
C 720	1 µF ±10% 35V submin	510-2575-109
C 721	1 µF ±10% 35V submin	510-2575-109
C 722	.022 µF ±5% 63V polyester	510-1033-223
C 723	1 µF ±10% 35V submin	510-2575-109
C 724	6.8 µF ±20% 35V dipped	510-2245-689
C 725	.015 µF ±5% 63V polyester	510-1033-153
C 726	.0056 µF ±5% 63V polyester	510-1033-562
C 727	.039 µF ±5% 63V polyester	510-1033-393
C 728	.0022 µF ±5% 63V polyester	510-1033-222
C 729	.018 µF ±5% 63V polyester	510-1033-183
C 730	.039 µF ±5% 63V polyester	510-1033-393
C 731	.001 µF ±5% 63V polyester	510-1033-102
C 732	.082 µF ±5% 63V polyester	510-1033-823
C 733	15 µF +10% 15V submin	510-2073-150
C 735	15 pF ±5% N750 axial ceram	510-3521-150
C 736	62 pF ±5% N750 axial ceram	510-3521-620
C 737	62 pF ±5% N750 axial ceram	510-3521-620
C 738	.1 µF axial ceramic	510-3554-104
C 739	.1 µF axial ceramic	510-3554-104
C 741	.1 µF axial ceramic	510-3554-104
C 742	.1 µF axial ceramic	510-3554-104
C 743	.33 µF ±5% 63V polyester	510-1033-334
C 744	470 µF 16V radial low temp	510-4216-471
C 745	.01 µF ±5% 63V polyester	510-1033-103
C 746	.001 µF ±5% NPO axial	510-3541-102
C 747	1 µF ±10% 100V polyester	510-1031-105
C 748	100 µF 16V radial low temp	510-4216-101
C 749	1 µF ±10% 35V submin	510-2575-109
C 750	1 µF ±10% 35V submin	510-2575-109
C 751	.0047 µF ±5% 63V polyester	510-1033-472
C 752	.0047 µF ±5% 63V polyester	510-1033-472
C 753	.1 µF axial ceramic	510-3554-104
C 754	6.8 µF ±20% 35V dipped	510-2245-689
C 756	1 µF ±10% 35V submin	510-2575-109
C 757	1 µF ±10% 35V submin	510-2575-109
C 758	.0018 µF ±5% 63V polyester	510-1033-182
C 759	.0027 µF ±5% 63V polyester	510-1033-272
C 760	.33 µF ±5% 63V polyester	510-1033-334
C 761	.1 µF axial ceramic	510-3554-104

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 771	.1 µF ±5% 63V polyester	510-1033-104
C 772	.1 µF ±5% 63V polyester	510-1033-104
C 773	.1 µF axial ceramic	510-3554-104
C 774	.1 µF axial ceramic	510-3554-104
C 775	.01 µF ±5% 63V polyester	510-1033-103
C 776	.01 µF ±5% 63V polyester	510-1033-103
C 777	.033 µF ±5% 63V polyester	510-1033-333
C 778	.0047 µF ±5% 63V polyester	510-1033-472
C 783	.022 µF ±5% 63V polyester	510-1033-223
C 784	.01 µF ±5% 63V polyester	510-1033-103
C 785	.047 µF ±5% 63V polyester	510-1033-473
C 786	.0068 µF ±5% 63V polyester	510-1033-682
C 787	.1 µF axial ceramic	510-3554-104
C 789	.01 µF ±5% 63V polyester	510-1033-103
C 790	.1 µF axial ceramic	510-3554-104
C 941	100 pF ±5% N750 axial ceram	510-3521-101
C 942	10 µF 25V radial aluminum	510-4125-100
C 950	1 µF ±10% 35V submin	510-2575-109
CR701	Si diode 1N4448	523-1500-883
CR702	Si diode 1N4448	523-1500-883
CR703	Si diode 1N4448	523-1500-883
CR704	Si diode 1N4448	523-1500-883
CR705	Si diode 1N4448	523-1500-883
CR706	Si diode 1N4448	523-1500-883
CR707	Si diode 1N4448	523-1500-883
CR708	Si diode 1N4448	523-1500-883
CR709	Si diode 1N4448	523-1500-883
CR711	Si diode 1N4448	523-1500-883
CR712	Si diode 1N4448	523-1500-883
CR713	Si diode 1N4448	523-1500-883
CR714	Si diode 1N4448	523-1500-883
CR715	Si diode 1N4448	523-1500-883
CR716	2.7V 400 mW zener	523-2505-279
CR717	Si diode 1N4448	523-1500-883
CR726	Si diode 1N4448	523-1500-883
EP701	Crystal pin insulator	018-1080-001
EP701	Terminal block	586-2004-005
EP702	Thermal-film washer TO-220	574-5005-005
HW013	4-40 pan head ZPS philips	575-1604-010
HW703	8-32 pan head CPS philips	575-0608-012
HW704	8-32 pan head CPS philips	575-0608-012
HW705	8-32 flat head BZPS taptite	575-6208-010
HW706	6-32 pan head 1/4" taptite	575-0606-008
HW707	4-40 pan head ZPS philips	575-1604-008
HW708	Slip hinge, male NPB	537-9051-003
HW709	4-40 pan head CPS philips	575-0604-016
HW710	4-40 pan head philips	575-0604-010
HW712	#4 x .046 shoulder washer	596-4504-008
MP703	Drawer side	014-0771-110
MP704	Drawer right side	014-0783-045
MP705	Drawer rail, right side	017-2197-032
MP706	Guide pin	013-1627-001
MP708	Drawer rail, left side	017-2197-031
MP713	Connector cover	017-2205-150
MP715	Flexible grommet	574-0001-025
MP716	Flexible grommet	574-0001-025
MP717	1/4" hex brass M/F spacer	312-7473-032
NP001	Label "Repeater Logic"	559-9001-226
P 805	14-pin straight header	515-9031-392
P 806	4-pin PC mt wafer	515-9031-103
PC701	PC board	035-1010-700
Q 701	Si PNP 50 MHz amp TO-92	576-0003-017
Q 702	NPN gen purp 2N3904	576-0003-058
Q 704	NPN gen purp 2N3904	576-0003-058
R 701	10k ohm ±5% 1/4W CF	569-0513-103
R 702	10k ohm ±5% 1/4W CF	569-0513-103
R 703	127k ohm ±1% 1/8W MF	569-0520-511
R 704	127k ohm ±1% 1/8W MF	569-0520-511
R 705	127k ohm ±1% 1/8W MF	569-0520-511
R 706	82.5k ohm ±1% 1/8W MF	569-0520-489
R 708	82.5k ohm ±1% 1/8W MF	569-0520-489
R 709	10k ohm ±5% 1/4W CF	569-0513-103
R 710	390k ohm ±5% 1/4W CF	569-0513-394
R 711	10k ohm ±5% 1/4W CF	569-0513-103
R 712	27k ohm ±5% 1/4W CF	569-0513-273
R 713	2.2k ohm ±5% 1/4W CF	569-0513-222
R 714	18k ohm ±5% 1/4W CF	569-0513-183
R 715	1.82k ohm ±1% 1/8W MF	569-0520-326
R 716	2.67k ohm ±1% 1/8W MF	569-0520-342
R 717	301 ohm ±1% 1/8W MF	569-0520-247
R 718	37.4k ohm ±1% 1/8W MF	569-0520-456
R 719	75k ohm ±1% 1/8W MF	569-0520-485
R 720	24.9k ohm ±1% 1/8W MF	569-0520-439
R 721	4.7k ohm ±5% 1/4W MF	569-0513-472
R 722	4.7k ohm ±5% 1/4W MF	569-0513-472
R 723	390k ohm ±5% 1/4W CF	569-0513-394
R 724	100k ohm ±5% 1/4W CF	569-0513-104
R 725	1k ohm ±5% 1/4W CF	569-0513-102
R 726	226k ohm ±1% 1/8W MF	569-0520-535

PARTS LIST [Continued]

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 727	2.15k ohm ±1% 1/8W MF	569-0520-333
R 728	158k ohm ±1% 1/8W MF	569-0520-520
R 729	15.8k ohm ±1% 1/8W MF	569-0520-420
R 730	10k ohm ±5% 1/4W CF	569-0513-103
R 731	10.7k ohm ±1% 1/8W MF	569-0520-404
R 732	390k ohm ±5% 1/4W CF	569-0513-394
R 733	9.31k ohm ±1% 1/8W MF	569-0520-394
R 734	20k ohm ±1% 1/8W MF	569-0520-430
R 735	51k ohm ±5% 1/4W CF	569-0513-513
R 736	20k ohm trim pot	562-0110-203
R 737	3k ohm ±5% 1/4W CF	569-0513-302
R 738	100k ohm ±5% 1/4W CF	569-0513-104
R 739	1k ohm ±5% 1/4W CF	569-0513-102
R 740	100k ohm ±5% 1/4W CF	569-0513-104
R 741	51k ohm ±5% 1/4W CF	569-0513-513
R 742	51k ohm ±5% 1/4W CF	569-0513-513
R 743	51k ohm ±5% 1/4W CF	569-0513-513
R 744	51k ohm ±5% 1/4W CF	569-0513-513
R 745	51k ohm ±5% 1/4W CF	569-0513-513
R 746	1k ohm ±1% 1/8W MF	569-0520-301
R 747	100k ohm single turn cer trim	562-0112-104
R 748	127k ohm ±1% 1/8W MF	569-0520-511
R 749	127k ohm ±1% 1/8W MF	569-0520-511
R 750	121k ohm ±1% 1/8W MF	569-0520-509
R 751	82.5k ohm ±1% 1/8W MF	569-0520-489
R 752	82.5k ohm ±1% 1/8W MF	569-0520-489
R 753	1M ohm ±1% 1/8W MF	569-0520-601
R 754	100k ohm ±5% 1/4W CF	569-0513-104
R 755	100k ohm ±5% 1/4W CF	569-0513-104
R 756	680k ohm ±5% 1/4W CF	569-0513-684
R 757	10M ohm ±5% 1/4W CF	569-0513-106
R 758	1k ohm ±1% 1/8W MF	569-0520-301
R 759	10k ohm ±5% 1/4W CF	569-0513-103
R 760	10k ohm ±5% 1/4W CF	569-0513-103
R 761	10k ohm ±5% 1/4W CF	569-0513-103
R 762	10k ohm ±5% 1/4W CF	569-0513-103
R 763	150k ohm ±1% 1/8W MF	569-0520-518
R 764	150k ohm ±1% 1/8W MF	569-0520-518
R 765	150k ohm ±1% 1/8W MF	569-0520-518
R 766	150k ohm ±1% 1/8W MF	569-0520-518
R 767	150k ohm ±1% 1/8W MF	569-0520-518
R 768	150k ohm ±1% 1/8W MF	569-0520-518
R 769	150k ohm ±1% 1/8W MF	569-0520-518
R 770	150k ohm ±1% 1/8W MF	569-0520-518
R 771	150k ohm ±1% 1/8W MF	569-0520-518
R 772	150k ohm ±1% 1/8W MF	569-0520-518
R 773	75k ohm ±1% 1/8W MF	569-0520-485
R 774	75k ohm ±1% 1/8W MF	569-0520-485
R 775	75k ohm ±1% 1/8W MF	569-0520-485
R 776	75k ohm ±1% 1/8W MF	569-0520-485
R 777	75k ohm ±1% 1/8W MF	569-0520-485
R 778	75k ohm ±1% 1/8W MF	569-0520-485
R 779	75k ohm ±1% 1/8W MF	569-0520-485
R 780	10k ohm ±5% 1/4W CF	569-0513-103
R 781	100 ohm ±5% 1/4W CF	569-0513-101
R 782	10k ohm ±5% 1/4W CF	569-0513-103
R 783	10k ohm ±1% 1/8W MF	569-0520-401
R 784	8.25k ohm ±1% 1/8W MF	569-0520-389
R 785	68k ohm ±5% 1/4W CF	569-0513-683
R 786	4.3k ohm ±5% 1/4W CF	569-0513-432
R 787	6.98k ohm ±1% 1/8W MF	569-0520-382
R 788	10k ohm ±1% 1/8W MF	569-0520-401
R 789	1k ohm ±5% 1/4W CF	569-0513-102
R 790	100 ohm ±5% 1/4W CF	569-0513-101
R 791	10k ohm ±5% 1/4W CF	569-0513-103
R 792	10k ohm ±5% 1/4W CF	569-0513-103
R 793	10k ohm ±5% 1/4W CF	569-0513-103
R 794	432k ohm ±1% 1/8W MF	569-0520-562
R 795	100k ohm ±5% 1/4W CF	569-0513-104
R 796	10k ohm ±5% 1/4W CF	569-0513-103
R 797	100k ohm ±5% 1/4W CF	569-0513-104
R 798	10k ohm ±1% 1/8W MF	569-0520-401
R 799	1k ohm ±5% 1/4W CF	569-0513-102
R 800	68k ohm ±5% 1/4W CF	569-0513-683
R 801	100k ohm ±5% 1/4W CF	569-0513-104
R 803	10k ohm ±5% 1/4W CF	569-0513-103
R 862	10k ohm ±5% 1/4W CF	569-0513-103
R 863	7.5k ohm ±5% 1/4W CF	569-0513-752
R 864	10k ohm ±5% 1/4W CF	569-0513-103
R 866	61.9k ohm ±1% 1/8W MF	569-0520-477
R 867	61.9k ohm ±1% 1/8W MF	569-0520-477
R 868	1k ohm ±5% 1/4W CF	569-0513-102
R 869	1k ohm ±5% 1/4W CF	569-0513-102
R 870	47.5k ohm ±1% 1/8W MF	569-0520-466
R 871	47.5k ohm ±1% 1/8W MF	569-0520-466
R 875	10k ohm ±5% 1/4W CF	569-0513-103
R 876	10k ohm ±5% 1/4W CF	569-0513-103
R 877	270k ohm ±5% 1/4W CF	569-0513-274
R 878	50k ohm single turn cer trim	562-0112-503
R 880	10k ohm ±5% 1/4W CF	569-0513-103
R 881	100k ohm ±5% 1/4W CF	569-0513-104
R 882	100k ohm ±5% 1/4W CF	569-0513-104
R 883	47k ohm ±5% 1/4W CF	569-0513-473
R 886	56k ohm ±5% 1/4W CF	569-0513-563
R 887	56k ohm ±5% 1/4W CF	569-0513-563
R 890	10k ohm ±5% 1/4W CF	569-0513-103
R 891	13k ohm ±5% 1/4W CF	569-0513-133
R 892	10k ohm ±5% 1/4W CF	569-0513-103

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 893	10k ohm ±5% 1/4W CF	569-0513-103
R 894	100k ohm ±5% 1/4W CF	569-0513-104
R 988	100k ohm ±5% 1/4W CF	569-0513-104
R 989	100k ohm ±5% 1/4W CF	569-0513-104
R 990	10k ohm ±5% 1/4W CF	569-0513-103
R 991	100k ohm ±5% 1/4W CF	569-0513-104
R 992	100k ohm ±5% 1/4W CF	569-0513-104
R 998	10k ohm ±5% 1/4W CF	569-0513-103
R 999	10k ohm ±5% 1/4W CF	569-0513-103
RN701	100k ohm 9-resistor SIP	569-6000-002
RN702	100k ohm 9-resistor SIP	569-6000-002
RN703	100k ohm 9-resistor SIP	569-6000-002
RN704	100k ohm 9-resistor SIP	569-6000-002
U 702	CMOS RAM I/O tmr 81C55	544-5001-111
U 703	Quad 2-input NAND 74HC00	544-3764-000
U 704	Ripple counter 74HC393	544-3764-393
U 705	12-bit binary counter 4040B	544-3014-040
U 706	32 x 8 PROM 825123/883C	544-9050-002
U 707	+5V regulator 7805 TO-220	544-2003-016
U 708	12-bit binary counter 4040B	544-3014-040
U 709	8-chnl analog mux/demux	544-3014-051
U 710	Phase lock loop	544-3014-046
U 711	Quad 2-input NOR 4001	544-3014-001
U 712	Quad comparator LM2901	544-2025-001
U 713	J-FET op amp TL082CP	544-2018-003
U 715	Quad op amp 3303	544-2020-003
U 716	Quad op amp 3303	544-2020-003
U 717	Quad op amp 3303	544-2020-003
U 718	Quad analog switch 4066	544-3014-066
U 719	Quad op amp 3303	544-2020-003
U 720	Hex buffer 74C906	544-3714-906
U 721	Quad op amp 3303	544-2020-003
U 722	Dual op amp 3358	544-2019-001
U 724	Quad op amp 3303	544-2020-003
U 725	Pos adj regulator LM317T	544-2003-027
U 727	Quad analog switch 4016	544-3014-016
U 728	Quad comparator LM2901	544-2025-001
U 730	Hex buffer 74C906	544-3714-906
U 731	Hex buffer 74C906	544-3714-906
U 732	Multivibrator 74HC123	544-3764-123
U 733	Quad 2-input OR 74HC32	544-3764-032
X 701	40-pin IC socket	515-5008-019
X 706	16-pin IC socket	515-5008-013
Y 701	µP crystal 12 MHz	521-0012-000

LOGIC DRAWER
DISPLAY HEAD ASSEMBLY
PART NO. 023-1010-779

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 705	Keyboard display cable assem	023-1010-776
A 706	Switch 4-cond cable assembly	023-1010-777
CR704	Green LED	549-4001-003
CR705	Amber LED	549-4001-005
DS701	Red LED 7-segment display	549-4002-001
DS702	Red LED 7-segment display	549-4002-001
DS703	Red LED 7-segment display	549-4002-001
DS704	Red LED 7-segment display	549-4002-001
MP050	Wear washer, black plastic	574-9019-050
MP702	Front panel	014-0771-080
MP707	Drawer handle	017-2139-202
MP709	1/4 turn fastener bail type	537-4001-001
MP710	Retainer for MP709	537-4002-001
MP711	Insulator	018-1055-002
MP712	Display bracket	017-2205-145
Q 701	Si NPN gen purp TO-92	576-0003-053
R 701	10k ohm ±5% 1/4W CF	569-0513-103
R 702	10k ohm ±5% 1/4W CF	569-0513-103
R 703	10k ohm ±5% 1/4W CF	569-0513-103
R 704	10k ohm ±5% 1/4W CF	569-0513-103
R 708	10k ohm ±5% 1/4W CF	569-0513-103
R 709	10k ohm ±5% 1/4W CF	569-0513-103
R 710	10k ohm ±5% 1/4W CF	569-0513-103
R 711	10k ohm ±5% 1/4W CF	569-0513-103
R 712	10k ohm ±5% 1/4W CF	569-0513-103
R 713	1.5k ohm ±5% 1/4W CF	569-0513-152
R 715	560 ohm ±5% 1/4W CF	569-0513-561
R 716	560 ohm ±5% 1/4W CF	569-0513-561
R 717	560 ohm ±5% 1/4W CF	569-0513-561
R 718	560 ohm ±5% 1/4W CF	569-0513-561
R 719	560 ohm ±5% 1/4W CF	569-0513-561
R 720	560 ohm ±5% 1/4W CF	569-0513-561
R 721	560 ohm ±5% 1/4W CF	569-0513-561
R 722	560 ohm ±5% 1/4W CF	569-0513-561
R 723	560 ohm ±5% 1/4W CF	569-0513-561
R 724	560 ohm ±5% 1/4W CF	569-0513-561
R 725	560 ohm ±5% 1/4W CF	569-0513-561
R 726	560 ohm ±5% 1/4W CF	569-0513-561
R 727	560 ohm ±5% 1/4W CF	569-0513-561
R 728	560 ohm ±5% 1/4W CF	569-0513-561

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 729	560 ohm ±5% 1/4W CF	569-0513-561
R 730	560 ohm ±5% 1/4W CF	569-0513-561
R 731	560 ohm ±5% 1/4W CF	569-0513-561
R 732	560 ohm ±5% 1/4W CF	569-0513-561
R 733	560 ohm ±5% 1/4W CF	569-0513-561
R 734	560 ohm ±5% 1/4W CF	569-0513-561
R 735	560 ohm ±5% 1/4W CF	569-0513-561
R 736	560 ohm ±5% 1/4W CF	569-0513-561
R 737	560 ohm ±5% 1/4W CF	569-0513-561
R 738	560 ohm ±5% 1/4W CF	569-0513-561
R 739	560 ohm ±5% 1/4W CF	569-0513-561
R 740	560 ohm ±5% 1/4W CF	569-0513-561
R 741	560 ohm ±5% 1/4W CF	569-0513-561
R 742	560 ohm ±5% 1/4W CF	569-0513-561
R 743	560 ohm ±5% 1/4W CF	569-0513-561
R 745	560 ohm ±5% 1/4W CF	569-0513-561
R 746	560 ohm ±5% 1/4W CF	569-0513-561
S 701	Keyboard	583-9501-002
S 702	On-None-Mom toggle switch	583-0006-010
S 703	SPST miniature toggle switch	583-0006-006
U 701	Decoder driver 14511	544-3014-511
U 702	Decoder driver 14511	544-3014-511
U 703	Decoder driver 14511	544-3014-511
U 704	1 of 8 decoder/mux 74HC138	544-3764-138
U 705	Decoder driver 14511	544-3014-511
U 706	Quad analog switch 4066	544-3014-066
X 703	Single row conn PC mt	515-7010-207

100 WATT POWER AMPLIFIER
PART NO. 023-1010-200

A 400	Filter power pick off assembly	023-1010-300
A 402	100W PA RF cable assembly	023-1010-230
A 403	Rear connector assembly	023-1010-210
C 400	10 pF ±5% N750 ax cerm	510-3521-100
C 401	220 pF ±10% Y5P ax cerm	510-3527-221
C 402	33 pF ±5% 50 V NPO disc	510-3213-330
C 403	.1 µF ±10% Y5R 50V submin	510-3109-104
C 404	47 µF 25V radial alum	510-4125-470
C 406	4 pF 25 V mini mica	510-0019-409
C 407	5 pF 250V mini mica	510-0019-509
C 408	39 pF 250V mini mica	510-0019-390
C 409	33 pF 250V mini mica	510-0019-330
C 410	33 pF 250V mini mica	510-0019-330
C 411	39 pF 250V mini mica	510-0019-390
C 412	39 pF 250V mini mica	510-0019-390
C 413	39 pF 250V mini mica	510-0019-390
C 414	12 pF 250V mini mica	510-0019-120
C 415	8 pF 250V mini mica	510-0019-809
C 416	4 pF 250V mini mica	510-0019-409
C 417	47 pF 250V mini mica	510-0019-470
C 418	43 pF 250V mini mica	510-0019-430
C 419	43 pF 250V mini mica	510-0019-430
C 420	43 pF 250V mini mica	510-0019-430
C 421	43 pF 250V mini mica	510-0019-430
C 422	47 pF 250V mini mica	510-0019-470
C 423	1.7-11 pF air variable	187-0106-175
C 424	33 pF ±5% 50V NPO disc	510-3213-330
C 425	.1 µF ±10% Y5R 50V submin	510-3109-104
C 426	47 µF 25V radial alum	510-4125-470
C 428	10 pF ±5% N750 ax cerm	510-3521-100
C 429	220 pF ±10% Y5P ax cerm	510-3527-221
C 430	47 pF 250V mini mica	510-0019-470
C 431	43 pF 250V mini mica	510-0019-430
C 432	43 pF 250V mini mica	510-0019-430
C 433	43 pF 250V mini mica	510-0019-430
C 434	43 pF 250V mini mica	510-0019-430
C 435	47 pF 250V mini mica	510-0019-470
C 436	4 pF 250V mini mica	510-0019-409
C 437	4 pF 250V mini mica	510-0019-409
C 440	1000 pF ±20% 1kV feedthru	510-3149-102
C 441	1000 pF ±20% 1kV feedthru	510-3149-102
C 450	4 pF 250V mini mica	510-0019-409
	6 pF 250V mini mica	510-0019-609
C 451	4 pF 250V mini mica	510-0019-409
	6 pF 250V mini mica	510-0019-609
EP400	.375 x .375 ferrite bead	517-2002-003
EP401	.14 x 0.13 ferrite bead	517-2002-001
EP402	.14 x 0.13 ferrite bead	517-2002-001
EP403	.14 x 0.13 ferrite bead	517-2002-001
EP404	.375 x .375 ferrite bead	517-2002-003
EP405	Connector shield	032-0576-001
EP406	Terminal	016-0104-004
EP407	Terminal	016-0104-003
HW400	Lockwshr int 3/8 x .018 NPB	596-2138-018
HW401	Nut hex 1/4-28 x .109 NPB	560-9040-012
HW402	Nut hex 3/8-32 x 094 NPB	560-9062-016
HW403	Washer flat 1/4 x .040 NPB	596-2414-016
HW404	TT 4-40 x .250 panhead phil	575-0604-008
HW405	Washers 1/4-.315 x 1/2	596-4514-020
HW406	No. 4 shakeproof washer	596-1104-008

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
HW407	Screw philips panhead 4-40	575-0604-010
HW408	Flat washer 3/8 x .020 NPB	596-9057-022
J 201	RF input jack (A402)	023-1010-230
J 202	RF output jack (A402)	023-1010-230
J 401	DC power female gnd jack	013-0025-010
L 400	2.5T coil 26 AWG	542-0001-025
L 401	2.5T ferrite choke	517-2005-005
L 402	UHF RF choke	023-3462-002
L 403	2.5T coil 26 AWG	542-0001-025
L 404	UHF RF choke	023-3462-002
L 405	2.5T ferrite choke	517-2005-005
L 406	UHF RF choke	023-3462-002
L 407	2.5T coil 26 AWG	542-0001-025
L 408	1/4 wave transformer	016-1929-130
L 409	1/4 wave transformer	016-1929-130
L 410	2.5T ferrite choke	517-2005-005
MP400	Heat sink	015-0868-130
MP401	Stainless steel spacer	317-7478-028
MP402	Shield insert	017-2081-021
MP403	Shield insert	017-2081-021
MP404	Shield feedthru	017-2197-091
MP405	Filter cover	017-2205-135
MP406	Cover	017-2205-137
P 400	DC power male B+ jack	023-0030-014
PC400	PC board 100 watt PA	035-1010-200
PC500	PC board PA filter	035-1010-300
Q 400	45W UHF amp	576-0004-027
Q 401	55W UHF amp	576-0004-066
Q 402	55W UHF amp	576-0004-066
R 400	15 ohm ±10% 1/2W CC	569-1504-150
R 401	15 ohm ±10% 1/2W CC	569-1504-150
R 402	15 ohm ±10% 1/2W CC	569-1504-150
W 405	Double shielded RG-316/U	597-3002-011

POWER PICK-OFF FILTER
PART NO. 023-1010-300

C 500	7 pF ±5% 350V underwood	510-0016-007
C 501	13 pF ±5% 350V underwood	510-0016-013
C 502	13 pF ±5% 350V underwood	510-0016-013
C 503	7 pF ±5% 350V underwood	510-0016-007
C 505	.001 µF ±20% Y5T axial ceram	510-3529-102
C 506	33 pF ±5% N750 axial ceramic	510-3521-330
C 507	33 pF ±5% N750 axial ceramic	510-3521-330
CR501	Hot carrier diode 1N5711	523-1500-014
EP499	Teflon tubing .03	058-0053-510
EP500	Ferrite bead	517-2502-007
L 500	Low pass filter inductor	016-2212-005
PC500	PC board	035-1010-300
R 498	750k ohm ±5% 1/4W CF	569-0513-754
R 499	750k ohm ±5% 1/4W CF	569-0513-754
R 500	18k ohm ±5% 1/4W CF	569-0513-183
R 501	180 ohm ±5% 1/4W CF	569-0513-181
RT500	500 ohm ±10% disc thermistor	569-3001-005

PA REAR CONNECTOR ASSEMBLY
PART NO. 023-1010-210

C 211	470 pF ±5% NPO 1206 chip	510-3602-471
C 213	470 pF ±5% NPO 1206 chip	510-3602-471
C 215	470 pF ±5% NPO 1206 chip	510-3602-471
C 217	470 pF ±5% NPO 1206 chip	510-3602-471
C 218	470 pF ±5% NPO 1206 chip	510-3602-471
EP210	0.138 x 0.241 ferrite bead	517-2002-002
EP211	Solder terminal	016-0104-003
EP212	Solder terminal	016-0104-004
HW210	Baillock hardware kit	537-9055-006
J 220	14-pin straight ribbon recept	515-7141-101
PC220	PC board	035-1010-110

35A POWER SUPPLY
PART NO. 023-1010-350/110 V AC 60 Hz
023-1010-352/110 V AC 50 Hz
023-1010-354/230 V AC 60 Hz
023-1010-356/230 V AC 50 Hz

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
BK001	Bracket	017-2121-001
C 001	55000 µF aluminum cap	510-4028-002
C 002	.033 µF ±20% 50V Y5U disc	510-3002-333
C 003	55000 µF aluminum cap	510-4028-002
C 004	1000 pF ±20% 1kV feedthru	510-3149-102
C 005	10 µF 660V AC oil fill	510-1014-003
CB001	35 amp 1-pos	534-2006-003
CH001	Chassis 35A	017-1951-015
CR001	6.8V ±5% 1W zener	523-2503-689
CR002	6.8V ±5% 1W zener	523-2503-689
CR003	100V 40A rectifier 1N1184R	523-0019-010
CR004	100V 40A rectifier 1N1184R	523-0019-010
CR007	200V 1A rectifier 1N4003	523-0501-002
CR010	100V 40A rectifier 1N1184R	523-0019-010
EP001	Connector	013-1426-001
EP002	Connector	023-3313-001
EP003	Mica washer 1/4" stud mount	574-5005-008
EP004	Molded handle	032-0362-001
EP005	10/16-14 AWG ring terminal	586-0001-012
EP007	Terminal	016-0104-004
EP008	1/4 ring term 16-14 wire	586-0001-013
EP009	Black varnished tubing	042-0240-500
EP029	2104-10 terminal lug	586-0005-110
EP031	10/8 AWG ring terminal	586-0001-027
EP032	Connector shield	032-0576-001
F 001	Fuse 125V AC 7A SB MDX (110V AC 60 Hz)	534-0001-010
F 001	Fuse 125V 5A SB MDX (230V AC 60 Hz)	534-0001-008
FH001	HKP fuse holder	534-1002-001
HW000	Mounting bracket C1/C3	572-0002-005
HW001	Nut 10-32 x .375 CPS	560-1110-012
HW002	Nut 4-40 x .094 NPB	560-2104-008
HW003	6-32 panhead taptite 1/4 in.	575-0606-008
HW004	Nut 6-32 x .078 NPB	560-2106-008
HW005	9/16 ID rubber grommet	574-0002-004
HW006	Strain relief SV/SVT18	574-0003-002
HW007	8-18 x 5/8 hex ZPS screw	575-9070-020
HW008	10-32 panhead phil NPB	575-2610-020
HW009	10-32 mach panhead ZPS phil	575-1610-036
HW010	Nut 8-32 x .109 NPB	560-2108-010
HW011	Lockwasher int 6 x .018 CPS	596-1106-009
HW012	#10 shakeproof washer	596-1110-012
HW013	Lockwasher int 4 x .015 NPB	596-2104-008
HW014	Washers 1/4-.315 x 1/2	596-4514-020
HW015	Nut hex 1/4-28 x .109 NPB	560-9040-012
HW016	4-40 mach panhead ZPS phil	575-1604-020
HW017	Lockwshr int 1/4 x .025 NPB	596-2114-015
HW018	Rubber grommet	574-0002-014
HW019	Nut 8-32 U-type CPS	560-1808-004
HW020	Backing plate	013-1479-001
HW021	Nut hex 3/8-32 x .094 NPB	560-9062-016
HW022	6-32 mach panhead ZPS phil	575-1606-012
HW023	4-40 mach panhead ZPS phil	575-1604-014
HW024	Base mount cap. bracket	572-0002-012
HW025	Lockwasher int 8 x .020 CPS	596-1108-011
HW026	8-32 mach panhead ZPS phil	575-1608-016
HW027	6-32 mach panhead ZPS phil	575-1606-008
HW032	Nut 4-40 x .063 NPB	560-2104-006
HW033	Plug (230V AC 60 Hz)	537-9001-017
J 001	Jack	013-0025-010
J 002	125V AC recept. w/Ground	515-1006-001
L 001	1 µH filter choke 35A DC	542-5005-012
MP001	Rack panel	017-1828-003
MP002	Heat Sink outer	017-1718-002
MP003	Heat Sink inner	017-1719-003
P 001	Banana plug sub-assembly	023-0030-014
Q 001	Si PNP 80V 7A TO-220	576-0002-021
R 001	33 ohm ±10% 10W WW	569-2010-330
R 002	1k ohm ±10% 1/2W	569-1504-102
R 003	10 ohm ±10% 1/2W CC	569-1504-100
R 004	220k ohm ±10% 1/2W CC	569-1004-224
R 010	5.6 ohm ±10% 10W WW	569-2010-569
T 001	115/230V AC-13.6V DC 35A/60 Hz	592-3501-010
T 001	115/230V AC-13.6V DC 35 A/50 Hz	592-3501-011

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
TB001	Term. strip 3-ins 1-gnd	586-1001-022
TB002	Term. strip 4-ins 1-gnd	586-1001-024
W 006	8 ft AC cord 3-18 black	597-1001-002
	RECEIVER DRAWER	
	PART NO. 023-1010-531	**450-488 MHz**
	023-1010-532	**488-512 MHz**
A 201	RF input shield	023-1010-521
A 202	Mixer shield	023-1010-522
A 203	Tripler shield	023-1010-523
A 205	RF out cable	023-1010-170
A 206	Volume control	023-1010-550
A 208	Back panel	023-1010-190
A 560	Rear connector	023-1010-560
C 101	.001 µF ±20% Y5T ax cerm	510-3529-102
C 102	39 pF ±5% NPO ax cerm	510-3514-390
C 103	.01 µF ±30% Y5R ax cerm	510-3528-103
C 104	51 pF ±5% N750 ax cerm	510-3521-510
C 151	27 pF ±5% NPO 50V submin	510-3113-270
C 152	47 pF ±5% NPO 50V submin	510-3113-470
C 153	47 pF ±5% NPO 50V submin	510-3113-470
C 154	47 pF ±5% NPO 50V submin	510-3113-470
C 155	47 pF ±5% NPO 50V submin	510-3113-470
C 156	3.9 pF ±5% NPO 50V (450-488 MHz)	510-3113-399
C 156	1.5 pF ±5% NPO 50V (488-512 MHz)	510-3113-159
C 201	56 pF ±5% NPO ax cerm	510-3514-560
C 202	.001 µF ±20% Y5T ax cerm	510-3529-102
C 203	5.6 pF ±10% NPO ax cerm	510-3514-569
C 204	12 pF ±5% N150 ax cerm	510-3517-120
C 206	1.5 pF ±5% 50V NPO disc	510-3213-159
C 207	8.2 pF ±10% NPO ax cerm	510-3514-829
C 208	22 pF ±5% N150 ax cerm	510-3517-220
C 209	.01 µF ±30% Y5R ax cerm	510-3528-103
C 210	.01 µF ±30% Y5R ax cerm	510-3528-103
C 211	.01 µF ±30% Y5R ax cerm	510-3528-103
C 212	9.1 pF ±5% 50V NPO disc	510-3213-919
C 213	33 pF ±5% N220 ax cerm	510-3518-330
C 214	.01 µF ±30% Y5R ax cerm	510-3528-103
C 215	43 pF ±5% NPO 50V submin	510-3113-430
C 216	120 pF ±5% NPO 50V submin	510-3113-121
C 217	.01 µF ±30% Y5R ax cerm	510-3528-103
C 218	.1 µF ax cer conf/coat	510-3554-104
C 219	47 µF ±20%15V dipped	510-2243-470
C 220	270 pF ±5% 50V N750 disc	510-3220-271
C 221	.1 µF ax cer conf/coat	510-3554-104
C 222	.1 µF ax cer conf/coat	510-3554-104
C 223	47 µF 10V radial alum	510-4110-470
C 224	2200 pF ±30% Y5R ax cerm	510-3528-222
C 225	56 pF ±5% NPO ax cerm	510-3514-560
C 253	.01 µF ±30% Y5R ax cerm	510-3528-103
C 259	100 pF ±5% NPO ax multl	510-3541-101
C 260	6.8 pF ±10% NPO ax cerm	510-3514-689
C 261	16 pF ±5% NPO ax cerm	510-3514-160
C 262	30 pF ±5% NPO ax cerm	510-3514-300
C 263	82 pF ±5% N750 ax cerm	510-3521-820
C 264	10 pF ±5% NPO ax cerm	510-3514-100
C 265	.001 µF ±20% Y5T ax cerm	510-3529-102
C 266	.001 µF ±20% Y5T ax cerm	510-3529-102
C 267	16 pF ±5% NPO ax cerm	510-3514-160
C 268	1.5 pF ±5% 500V comp	510-9502-159
C 269	10 pF ±5% NPO ax cerm	510-3514-100
C 270	10 pF ±5% NPO ax cerm	510-3514-100
C 271	.001 µF ±20% Y5T ax cerm	510-3529-102
C 272	.001 µF ±20% Y5T ax cerm	510-3529-102
C 301	47 µF ±20% 20V dipped	510-2044-470
C 302	.001 µF ±20% Y5T ax cerm	510-3529-102
C 303	56 pF ±5% NPO ax cerm	510-3514-560
C 304	1 µF ±10% 35V submin	510-2575-109
C 305	47 µF ±20% 15V dipped prep	510-2243-470
C 306	.001 µF ±20% Y5T ax cerm	510-3529-102
C 307	33 pF ±5% NPO ax cerm	510-3514-330
C 308	47 µF 10V radial alum	510-4110-470
C 309	10 µF 25V aluminum	510-4006-002
C 310	.0033 µF ±5% 63V poly	510-1033-332
C 311	470 pF ±5% NPO 50V submin	510-3113-471
C 312	.047 µF ±5% 63V poly	510-1033-473
C 313	.22 µF ±5% 63V poly	510-1033-224
C 314	.33 µF ±5% 63V poly	510-1033-334
C 315	.047 µF ±5% 63V poly	510-1033-473
C 316	.033 µF ±5% 63V poly	510-1033-333
C 317	.047 µF ±5% 63 V poly	510-1033-473
C 318	.15 µF ±5% 63V poly	510-1033-154
C 319	.047 µF ±5% 63V poly	510-1033-473
C 320	.022 µF ±5% 63V poly	510-1033-223
C 321	100 pF ±5% P350 ax cerm	510-3512-101
C 322	100 pF ±5% P350 ax cerm	510-3512-101
C 323	100 pF ±5% P350 ax cerm	510-3512-101
C 324	1200 pF ±5% NPO ax multl	510-3541-122
C 325	.01 µF ±30% Y5R ax cerm	510-3528-103
C 326	.01 µF ±30% Y5R ax cerm	510-3528-103
C 327	.1 µF ax cer conf/coat	510-3554-104
C 328	.1 µF ax cer conf/coat	510-3554-104

PARTS LIST [Continued]

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 329	.01 µF ±30% Y5R ax cerm	510-3528-103
C 330	.1 µF ax cer conf/coat	510-3554-104
C 331	1 µF ±10% 35V submin	510-2575-109
C 332	1 µF ±10% 35V submin	510-2575-109
C 333	1 µF ±10% 35V submin	510-2575-109
C 334	.01 µF ±30% Y5R ax cerm	510-3528-103
C 335	15 µF ±10% 15V submin tube	510-2073-150
C 336	.047 µF ±10% 35V submin	510-2575-477
C 337	.0033 µF ±5% 63V poly	510-1033-332
C 338	.1 µF ax cer conf/coat	510-3554-104
C 339	15 µF ±10% 15V submin tube	510-2073-150
C 340	.1 µF ax cer conf/coat	510-3554-104
C 341	15 µF ±10% 15V submin tube	510-2073-150
C 342	47 µF 10V radial aluminum	510-4110-470
C 343	10 µF 25 V aluminum	510-4006-002
C 344	33 pF ±5% NPO ax cerm	510-3514-330
C 345	220 µF 16V aluminum	510-4116-221
C 346	47 µF 10V radial aluminum	510-4110-470
C 347	10 µF 25V radial aluminum	510-4125-100
C 348	10 µF 25V aluminum	510-4006-002
C 350	1 µF ±10% 35V submin	510-2575-109
C 351	47 µF ±20% 15V dipped	510-2243-470
CH101	Front end casting	015-0901-008
CR251	Si diode 1N4448	523-1500-883
CR252	Si diode 1N4448	523-1500-883
CR301	Si diode 1N4448	523-1500-883
CR302	Si diode 1N4448	523-1500-883
CR303	Si diode 1N4448	523-1500-883
CR304	Si diode 1N4448	523-1500-883
CR305	6.8V ±5% 1W zener	523-2503-689
EP201	Crystal pin insulator	018-1080-002
EP202	Crystal pin insulator	018-1080-002
EP204	Crystal pin insulator	018-1080-002
EP207	Crystal pin insulator	018-1080-002
EP251	3/8 in. coil shield	578-0002-001
EP252	3/8 in. coil shield	578-0002-001
EP253	3/8 in. coil shield	578-0002-001
EP254	3/8 in. coil shield	578-0002-001
EP255	1/4 in. coil shield	578-0003-001
HW101	Helical screw	013-1563-001
HW102	Nut tension lock CPS	560-1810-022
HW103	6-32 panhead taptite 5/16	575-0606-010
HW104	4-40 x .375 panhead phil TT	575-0604-012
HW105	Nut 4-40 x .094 NPB	560-2104-008
HW106	6 x 7/16 flathead CPS phil	575-0606-014
HW203	4-40 mach panhead ZPS phil	575-1604-016
HW204	Nut 4-40 x .063 NPB	560-2104-006
HW205	Lockwasher int 4 x .015 NPB	596-2104-008
HW206	Washer ins 6 x .047 fiber	596-4406-011
HW207	Grill cloth	018-1111-001
HW208	Nut hex 1/4-32 x .094 NPB	560-9043-012
HW209	Lockwshr int 1/4 x .025 NPB	596-2114-013
HW210	Nut 10-32 x .375 CPS	560-1110-012
HW212	#8 flathead phil BZPS TT	575-9079-010
HW213	Lockwasher int 10 x .032 NPB	596-2110-012
HW214	6-32 panhead taptite 5/16	575-0606-010
HW215	4-40 mach panhead ZPS phil	575-1604-008
J 254	5-pin male connector	515-9031-035
J 301	3.6 mm jack enclosed	515-2001-011
L 101	Helical coil w/tap (450-488)	016-1929-101
L 101	4.25T helical coil (488-512)	016-1929-111
L 102	Helical coil (450-488)	016-1929-020
L 102	Coil (488-512)	016-1929-014
L 103	Helical coil (450-488)	016-1929-020
L 103	Coil (488-512)	016-1929-014
L 104	Helical coil (450-488)	016-1929-020
L 104	Coil (488-512)	016-1929-014
L 105	Helical coil w/tap (450-488)	016-1929-102
L 105	4.25T helical coil (488-512)	016-1929-112
L 106	Helical coil w/tap (450-488)	016-1929-102
L 106	4.25T helical coil (488-512)	016-1929-112
L 107	Helical coil w/tap (450-488)	016-1929-103
L 107	4.25T helical (488-512)	016-1929-113
L 108	2.5T coil 26 AWG	542-0001-025
L 151	1.5T coil 26 AWG	542-0001-015
L 202	5-8.6 µH inductor	542-1012-001
L 204	5-8.6 µH inductor	542-1012-001
L 251	.11-.14 inductor valox orange	542-1006-113
L 252	.18-.31 inductor valox blue	542-1006-116
L 253	RF choke valox sp wnd violet	542-1012-113
L 254	.11-.14 inductor valox orange	542-1006-113
L 255	1.5T coil 26 AWG	542-0001-015
LS301	8 ohm mylar 2" speaker	589-1012-007
MP050	Wear washer, black plastic	574-9019-050
MP200	Knob .625 long	032-0767-021
MP201	Guide pin	013-1627-001
MP202	Speaker mounting bracket	017-2197-061
MP203	Drawer front	014-0771-060
MP204	Drawer member side	014-0783-041
MP205	Drawer handle	017-2139-202

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
MP206	Drawer rail, left	017-2197-031
MP207	Drawer rail, right	017-2197-032
MP208	1/4 turn fastener bail type	537-4001-101
MP209	Retainer for MP208	537-4002-001
MP210	Grommet, flexible	574-0001-025
PC200	PC board	035-1010-511
Q 101	J-FET low noise RF TO-92	576-0006-009
Q 151	Si NPN high freq low noise	576-0003-065
Q 201	J-FET low noise RF TO-92	576-0006-014
Q 202	Si NPN VHF/UHF amp/osc	576-0003-051
Q 251	Si NPN VHF/UHF amp/osc	576-0003-051
R 101	2k ohm ±5% 1/4W CF	569-0513-202
R 151	4.7k ohm ±5% 1/8W CF	569-0511-472
R 152	390 ohm ±5% 1/8W CF	569-0511-391
R 153	100 ohm ±1% 1/8W CF	569-0511-101
R 154	100 ohm ±5% 1/8W CF	569-0511-101
R 155	1k ohm ±5% 1/8W CF	569-0511-102
R 201	10 ohm ±5% 1/4W CF	569-0513-100
R 202	5.6k ohm ±5% 1/4W CF	569-0513-562
R 203	39 ohm ±5% 1/4W CF	569-0513-390
R 204	4.7k ohm ±5% 1/4W CF	569-0513-472
R 205	12k ohm ±5% 1/4W CF	569-0513-123
R 206	1k ohm ±5% 1/4W CF	569-0513-102
R 207	100 ohm ±5% 1/4W CF	569-0513-101
R 209	33k ohm ±5% 1/4W CF	569-0513-333
R 210	330 ohm ±5% 1/4W CF	569-0513-331
R 211	100 ohm ±5% 1/4W CF	569-0513-101
R 254	Zero ohm ±5% 1/4W CF	569-0500-001
R 255	2.2k ohm ±5% 1/4W CF	569-0513-222
R 256	1k ohm ±5% 1/4W CF	569-0513-102
R 257	270 ohm ±5% 1/4W CF	569-0513-271
R 258	100 ohm ±5% 1/4W CF	569-0513-101
R 259	100k ohm ±5% 1/4W CF	569-0513-104
R 260	10 ohm ±5% 1/4W CF	569-0513-100
R 261	100k ohm ±5% 1/4W CF	569-0513-104
R 301	1k ohm ±5% 1/4W CF	569-0513-102
R 302	6800 ohm ±5% 1/4W CF	569-0513-682
R 303	82 ohm ±5% 1/4W CF	569-0513-820
R 304	33k ohm ±5% 1/4W CF	569-0513-333
R 305	22k ohm ±5% 1/4W CF	569-0513-223
R 306	68k ohm ±5% 1/4W CF	569-0513-683
R 307	10k ohm ±5% 1/4W CF	569-0513-103
R 308	100 ohm ±5% 1/4W CF	569-0513-101
R 309	1M ohm ±5% 1/4W CF	569-0513-105
R 310	100 ohm ±5% 1/4W CF	569-0513-101
R 311	1M ohm ±5% 1/4W CF	569-0513-105
R 312	10k ohm ±5% 1/4W CF	569-0513-103
R 313	56k ohm ±5% 1/4W CF	569-0513-563
R 314	18k ohm ±5% 1/4W CF	569-0513-183
R 315	150k ohm ±5% 1/4W CF	569-0513-154
R 316	3.3k ohm ±5% 1/4W CF	569-0513-332
R 317	200k ohm trimmer single-turn	562-0112-204
R 318	750 ohm ±5% 1/4W CF	569-0513-751
R 319	5.6k ohm ±5% 1/4W CF	569-0513-562
R 320	24k ohm ±5% 1/4W CF	569-0513-243
R 321	10k ohm ±5% 1/4W CF	569-0513-103
R 322	47k ohm ±5% 1/4W CF	569-0513-473
R 323	10k ohm ±5% 1/4W CF	569-0513-103
R 324	47k ohm ±5% 1/4W CF	569-0513-473
R 325	1k ohm ±5% 1/4W CF	569-0513-102
R 326	1k ohm ±5% 1/4W CF	569-0513-102
R 327	820k ohm ±5% 1/4W CF	569-0513-824
R 328	330k ohm ±5% 1/4W CF	569-0513-334
R 329	100k ohm ±5% 1/4W CF	569-0513-104
R 330	100k ohm ±5% 1/4W CF	569-0513-104
R 331	470k ohm ±5% 1/4W CF	569-0513-474
R 332	10k ohm ±5% 1/4W CF	569-0513-103
R 333	10k ohm ±5% 1/4W CF	569-0513-103
R 334	7.5k ohm ±5% 1/4W CF	569-0513-752
R 335	18 ohm ±5% 1/4W CF	569-0513-180
R 336	2.7 ohm ±5% 1/4W CF	569-0513-279
R 337	39 ohm ±5% 1/4W CF	569-0513-390
R 338	10 ohm ±5% 1/4W CF	569-0513-100
R 339	100k ohm ±5% 1/4W CF	569-0513-104
R 341	50k ohm trimmer single-turn	562-0112-503
R 342	10k ohm ±5% 1/4W CF	569-0513-103
R 343	1k ohm ±5% 1/4W CF	569-0513-102
R 344	6800 ohm ±5% 1/4W CF	569-0513-682
R 350	100k ohm ±5% 1/4W CF	569-0513-104
R 351	100k ohm ±5% 1/4W CF	569-0513-104
R 352	11k ohm ±5% 1/4W CF	569-0513-113
R 353	10k ohm ±5% 1/4W CF	569-0513-103
RT301	Thermistor	569-3001-001
RT302	Thermistor	569-3001-001
T 201	18.75 MHz modular phone	592-5009-023
T 202	7 mm 455 kHz disc coil	592-5022-005
TP255	Red tip jack, vert .080	105-2202-211
TP256	Red tip jack, vert .080	105-2202-211
U 201	Low power FM IF 3361	544-2026-007
U 301	Adj volt reg LM2931T TO-220	544-2003-043
U 302	Quad Op/Amp	545-2020-003

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
U 303	Quad Op/Amp	545-2020-003
U 304	Linear dual Op/Amp 2904	545-2019-003
U 305	Quad analog switch	545-3014-066
U 306	Audio Amp 8-pin TBA820M	544-2006-003
U 307	Adj volt reg LM2931T TO-220	544-2003-043
U 308	Linear dual Op/Amp 2904	545-2019-003
Y 201	11.155 MHz 32 pF HC-18	519-0009-001
Z 201	10.7 MHz 4-pole crystal filter	532-0006-002
Z 202	10.7 MHz 2-pole crystal filter	532-0006-001
Z 203	Ceramic filter 455-15	532-2004-001

INDOOR CABINET
PART NO. 023-3824-004

CH002	Cabinet corner panel (2)	014-0724-011
CH003	Brace plate (2)	016-2123-011
CH004	Side panel (2)	017-1989-011
CH005	Vent (2)	017-1990-011
CH007	Vent (2)	017-1991-011
CH008	Cable, exit plate	016-2109-001
CH009	Cover	016-2110-001
CH010	Floor repeater cabinet	017-1992-011
CH011	Cabinet corner front (2)	014-0723-011
HW001	Black urethane foam	042-0361-320
HW002	Speed nuts (4)	537-0001-002
HW003	Foam strip	042-0361-342
HW004	8-32 ph phl ZNPL blkchr (4)	575-9074-012
HW005	Nut hex 10-32x.078 NPB (17)	560-9027-012
HW006	Nut 8-32 x .125 CPS (4)	560-1108-011
HW007	#10 shakeproof washer (16)	596-1110-012
HW008	Lockwshr int 8 x 020 CPS (4)	596-1108-011
HW009	8-32 panhead CPS phil (8)	575-0608-008
HW010	#10 phil flathead 82 ZPS (4)	575-1210-028
HW011	10-32 mach pnhd ZPS ph (12)	575-1610-032
MP001	Lock cam (2)	537-9007-011
MP002	Rubber bumper (6)	018-0798-009
MP003	Cabinet foot (4)	032-0510-001
MP004	Cabinet door (2)	017-1988-011
NP001	Name plate (2)	015-0848-001
NP002	Overlay logo large (2)	559-2094-001
U 001	Top assembly	023-3711-011

SLIDE ASSEMBLY
PART NO. 023-4406-701

CH001	Drawer support	017-2197-001
MP001	Slide channel left	017-2197-021
MP002	Slide channel right	017-2197-022

OUTDOOR CABINET
PART NO. 023-4061-001

HW001	Scr 8-32 ph slot cps (12)	575-0508-010
MP001	Side (2)	017-2118-001
MP002	Top	017-2117-001

BNC-N RG-400 CABLE
PART NO. 023-1010-460

P 460	BNC coaxial connector	515-3006-001
P 461	Type N plug	515-3010-001
W 460	RG-400 cable	597-3002-008

N-N RG-214 CABLE
PART NO. 023-1010-465

P 465	Connector for RG-214	515-3010-002
P 466	Connector for RG-214	515-3010-002
W 465	RG-214 coax	597-3002-010

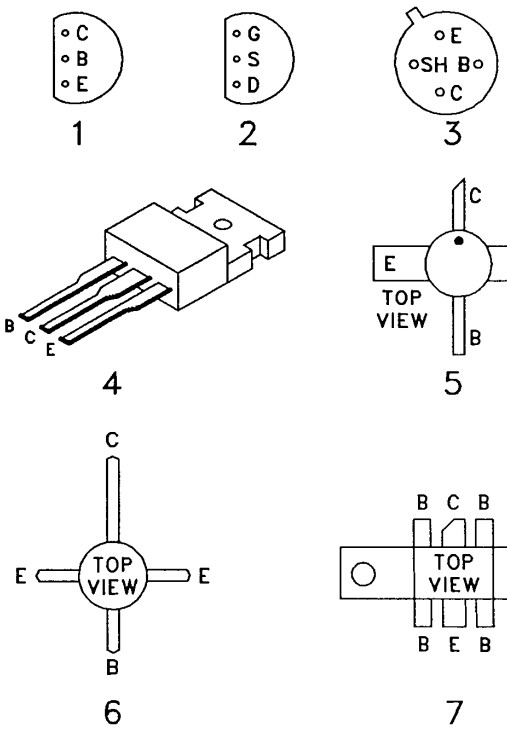
SECTION 8
SCHEMATIC DIAGRAMS AND COMPONENT LAYOUTS

TRANSISTOR AND DIODE BASING REFERENCE TABLE

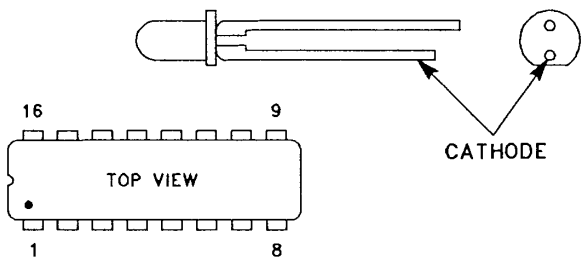
TRANSISTORS

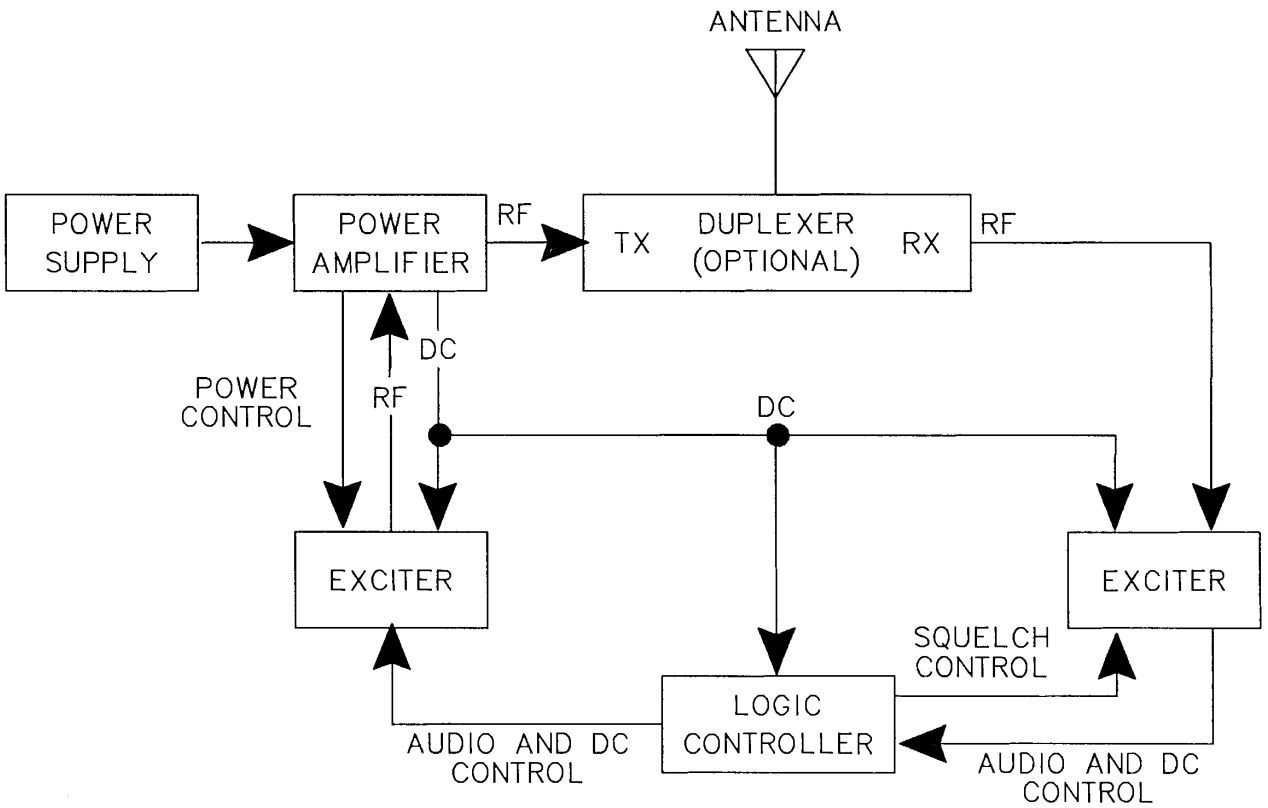
Part Number	Basing Diagram	Identification
576-0002-021	4	
576-0002-046	4	
576-0003-027	3	
576-0003-029	3	
576-0003-032	3	
576-0003-037	3	
576-0003-051	1	
576-0003-052	6	
576-0003-053	1	
576-0003-057	1	
576-0003-063	6	
576-0004-805	7	
576-0004-806	7	
576-0004-807	5	
576-0004-809	7	
576-0006-009	2	
576-0006-014	2	

Number On Schematic

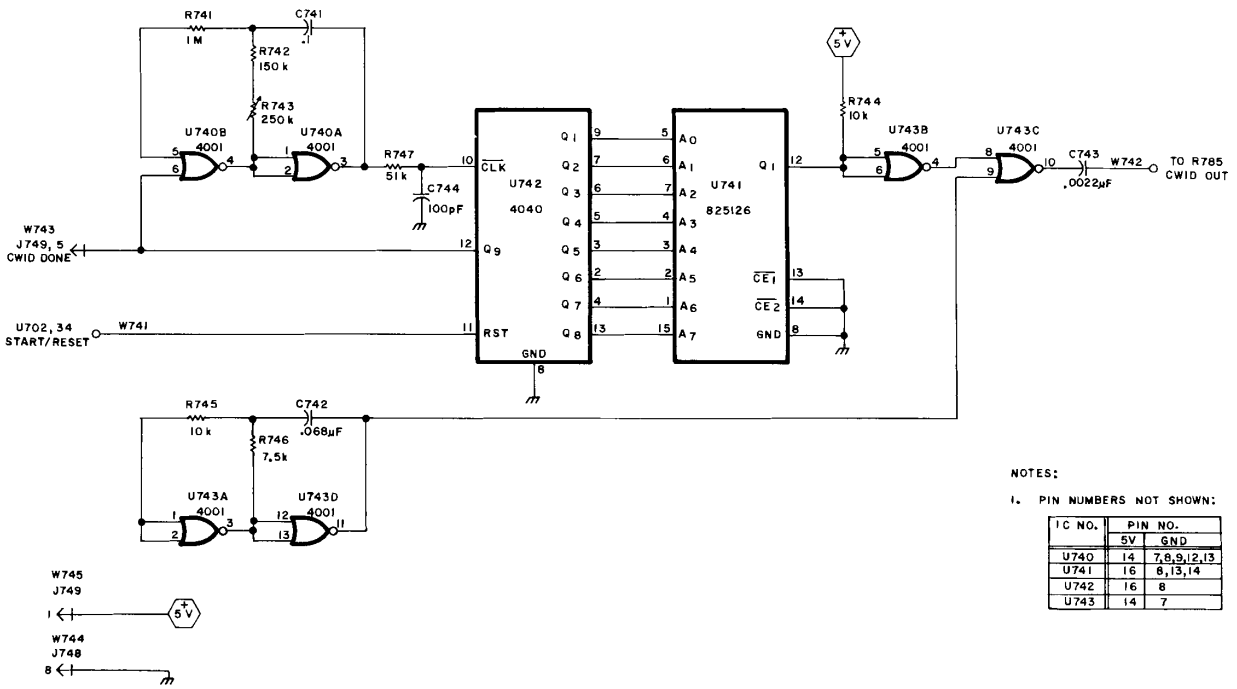


INTEGRATED CIRCUITS AND LEDs
TYPICAL PIN LOCATIONS



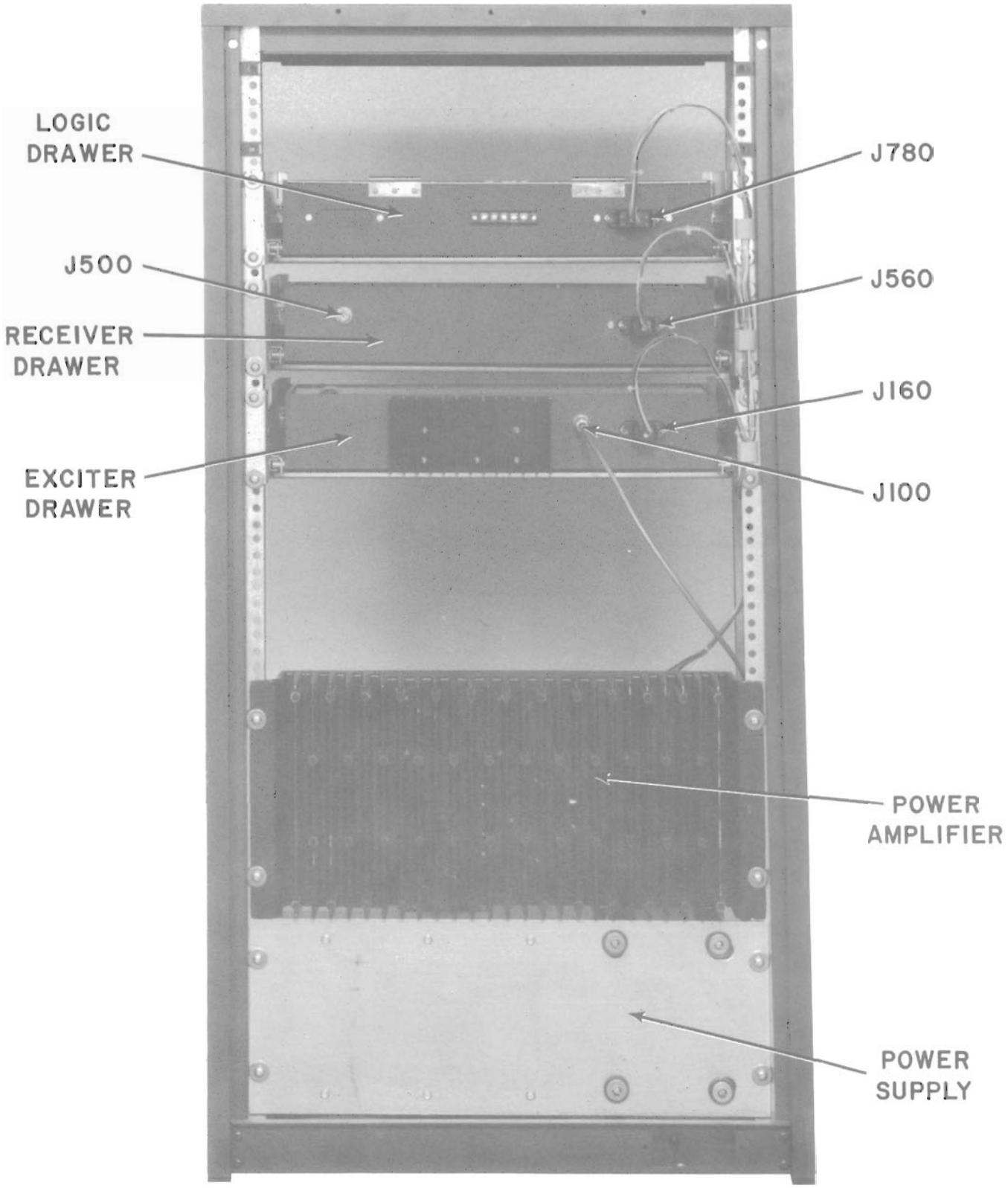


CR1010 BLOCK DIAGRAM
FIGURE 8–1

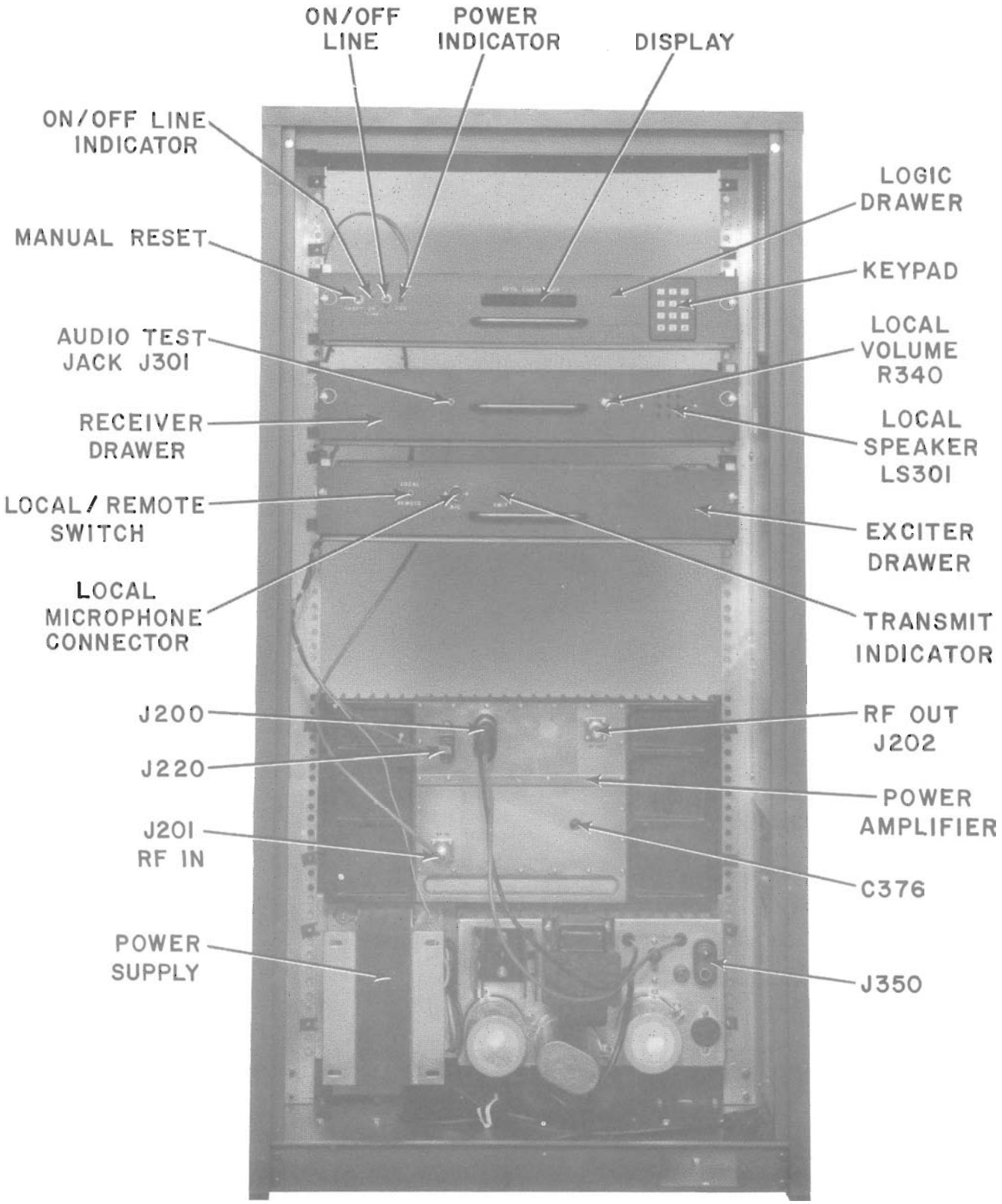


IC NO.	PIN NO.	
	5V	GND
U740	14	7,8,9,12,13
U741	16	8,13,14
U742	16	8
U743	14	7

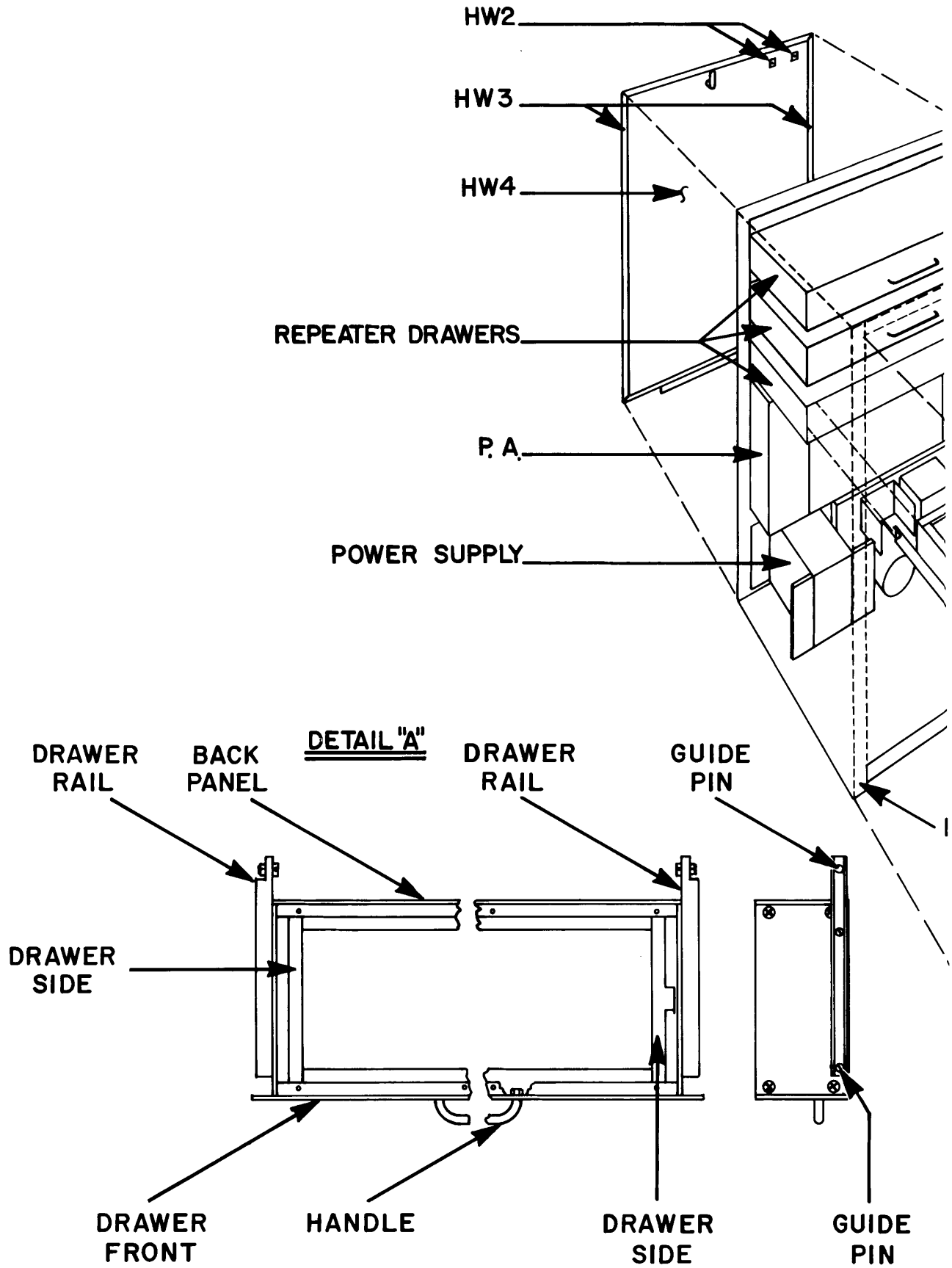
EXTERNAL CWID SCHEMATIC
(SHOWN FOR REFERENCE)



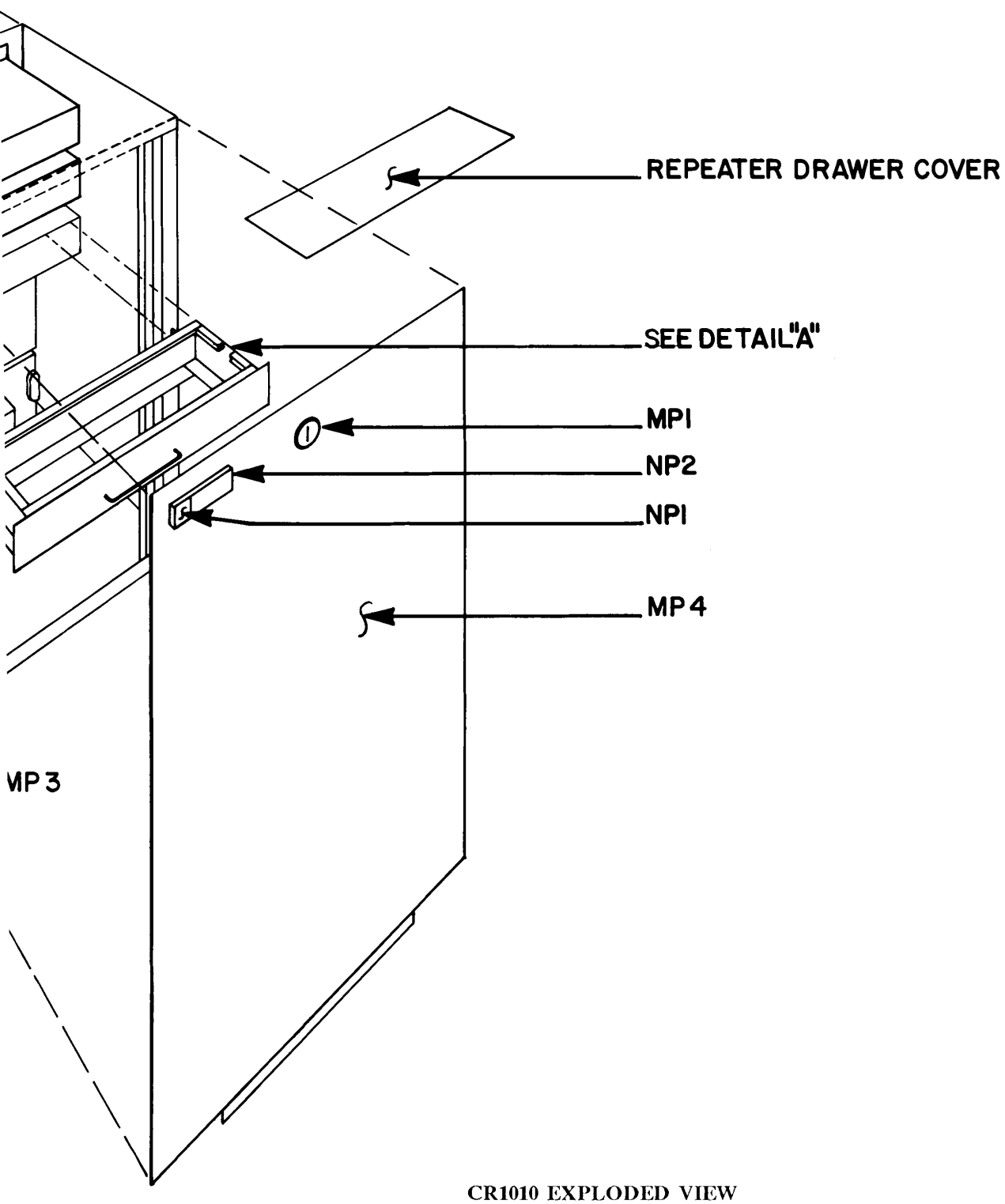
CR1010 BACK VIEW
FIGURE 8–2



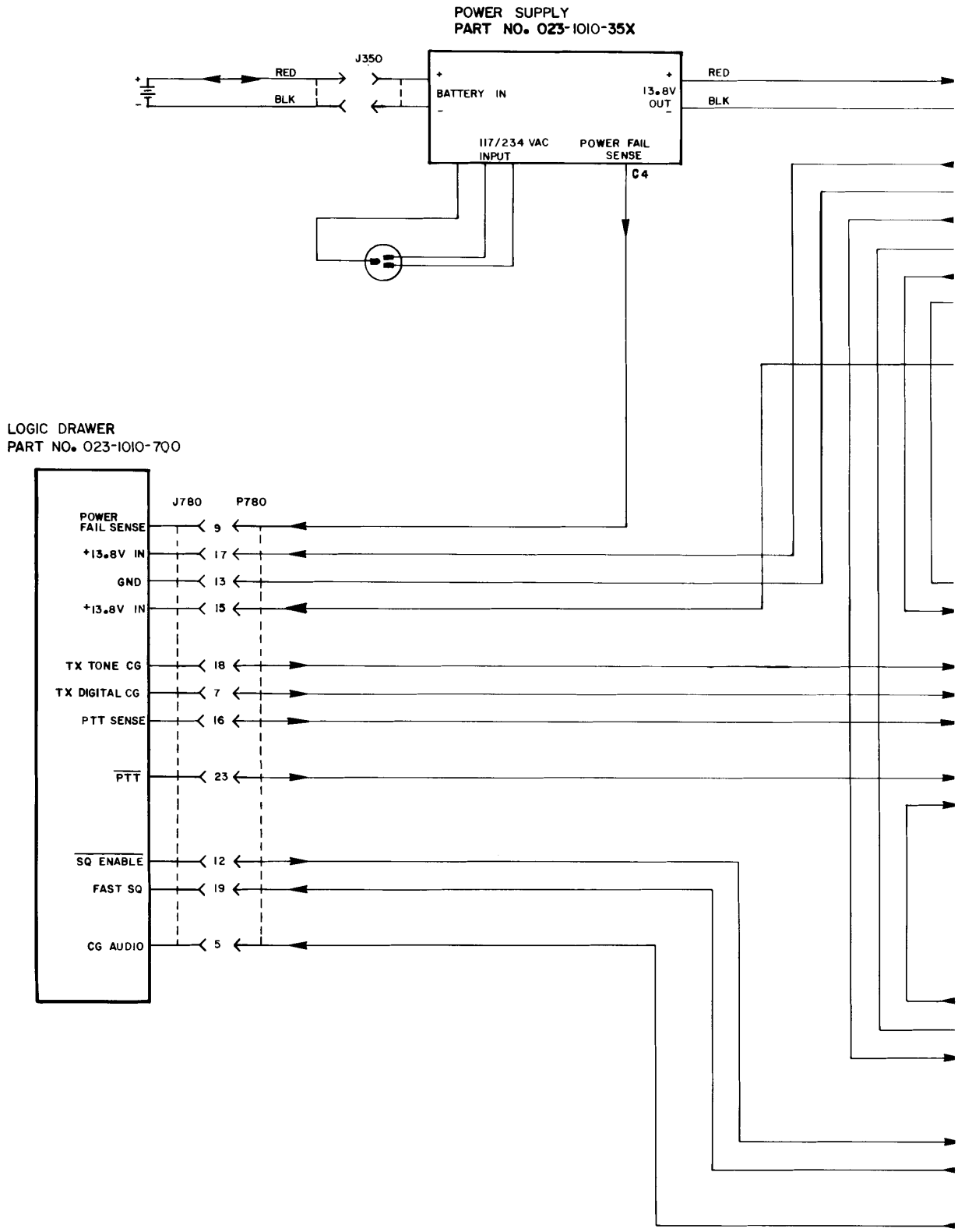
CR1010 FRONT VIEW
FIGURE 8–3

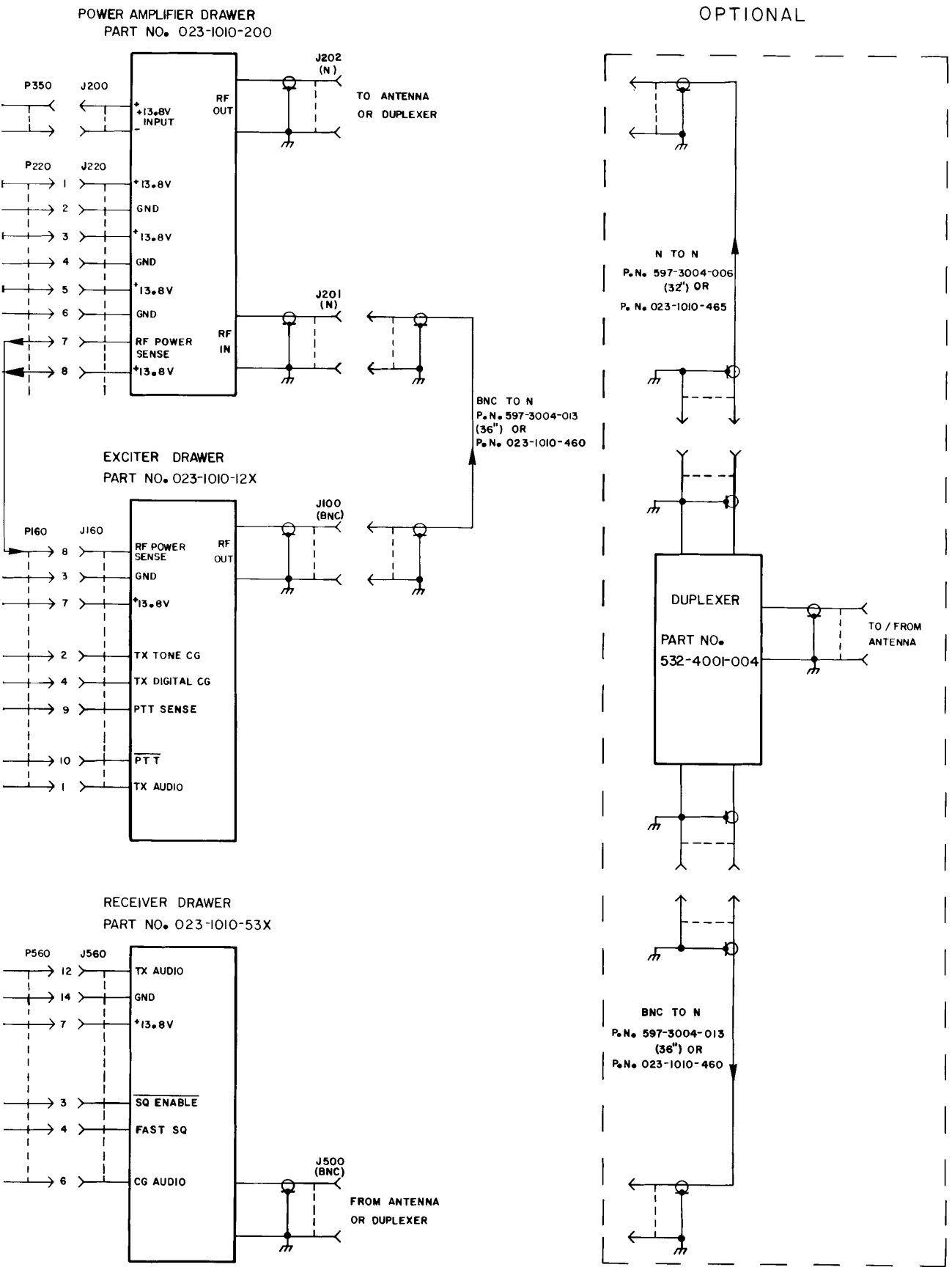

HW2
HW3
HW4
REPEATER DRAWERS
P. A.
POWER SUPPLY
DETAIL "A"
DRAWER RAIL
BACK PANEL
DRAWER RAIL
GUIDE PIN
DRAWER SIDE
DRAWER FRONT
HANDLE
DRAWER SIDE
GUIDE PIN

←FOLDOUT

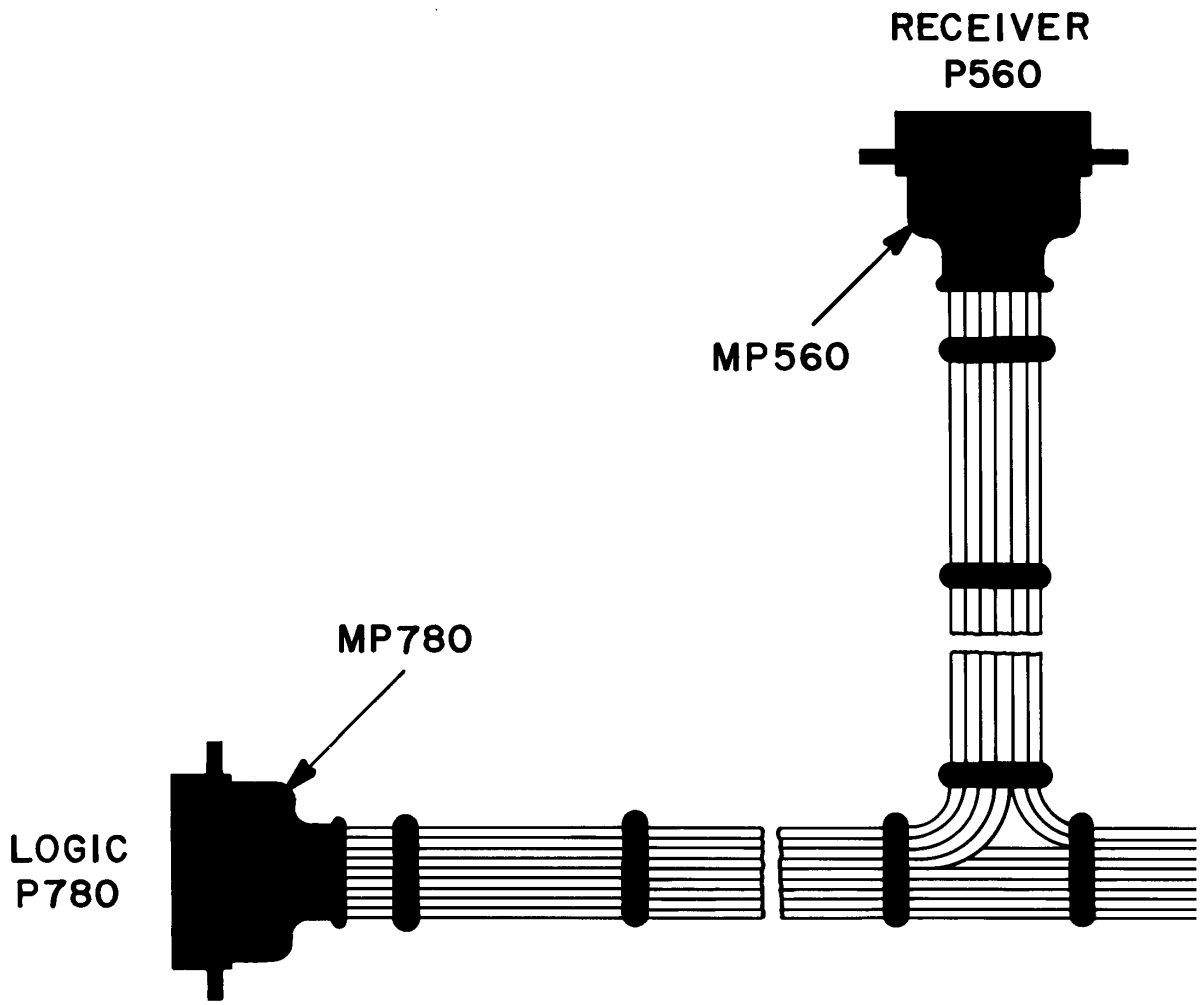


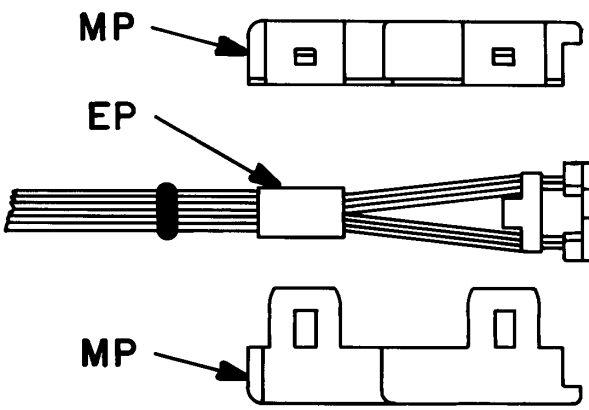
CR1010 EXPLODED VIEW
FIGURE 8–4

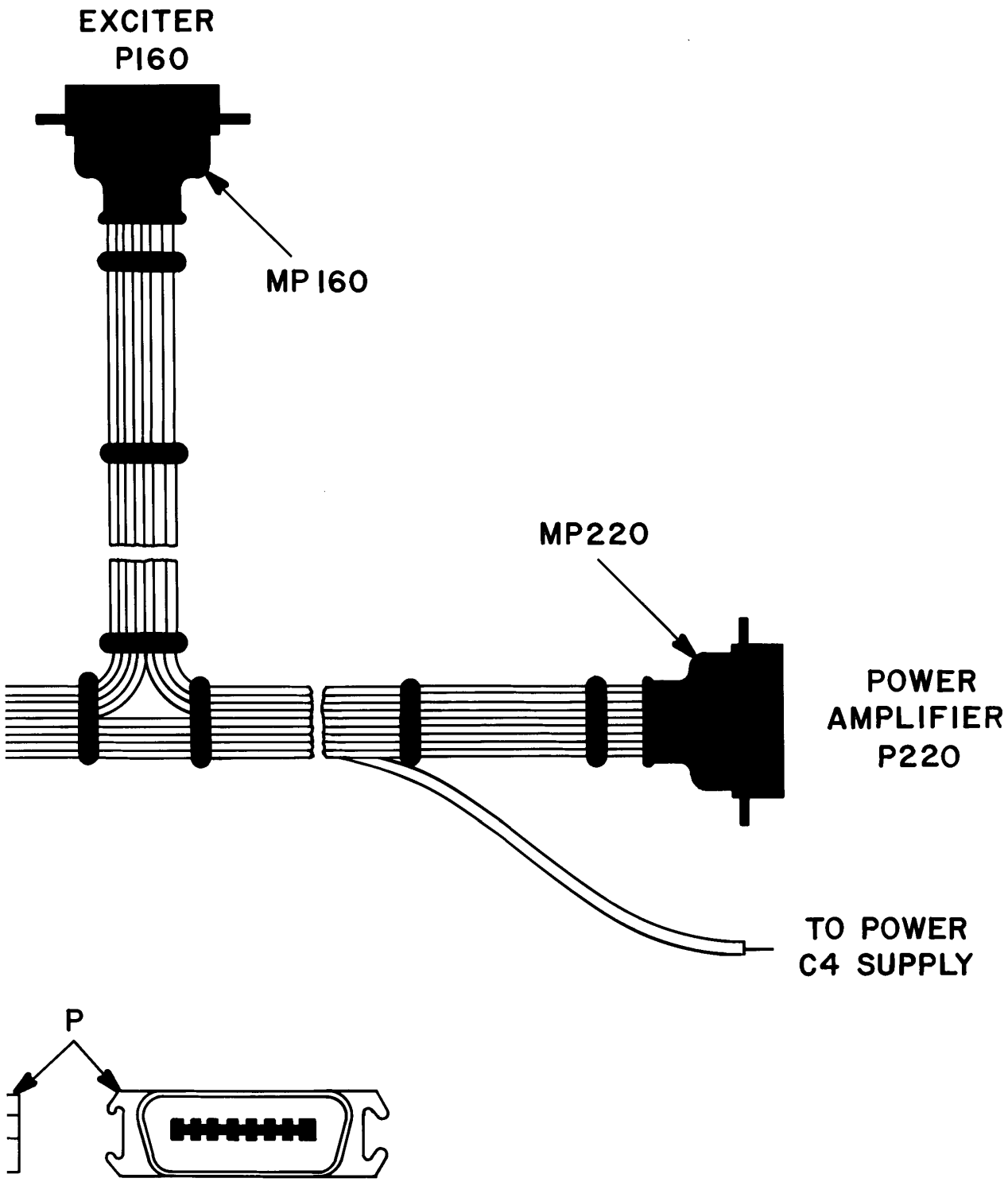

POWER SUPPLY
PART NO. 023-1010-35X
J350
RED
BLK
BATTERY IN
13.8V OUT
RED
BLK
117/234 VAC INPUT
POWER FAIL SENSE
C4
LOGIC DRAWER
PART NO. 023-1010-700
J780
P780
POWER FAIL SENSE
9
+13.8V IN
17
GND
13
+13.8V IN
15
TX TONE CG
18
TX DIGITAL CG
7
PTT SENSE
16
PTT
23
SQ ENABLE
12
FAST SQ
19
CG AUDIO
5



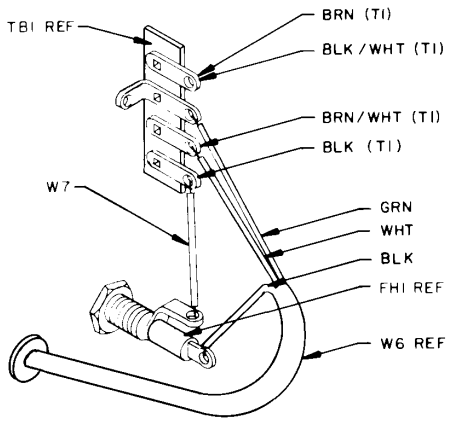
CR1010 INTERCONNECT SCHEMATIC
FIGURE 8–5


RECEIVER
P560
MP560
MP780
LOGIC
P780


MP
EP
MP

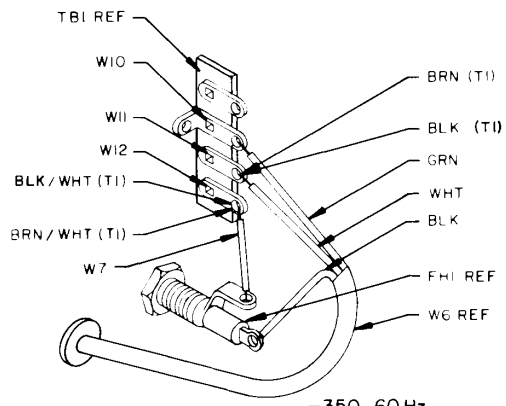


CR1010 REPEATER WIREHARNESS
FIGURE 8–6

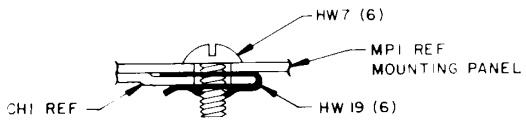


220-230 VAC -354 60Hz -356 50Hz

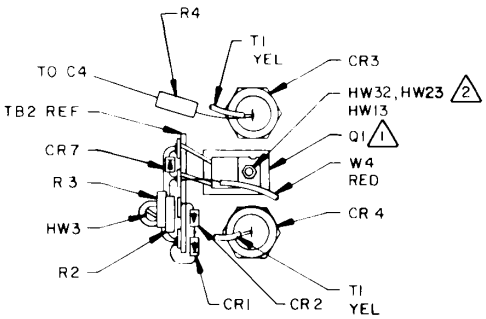
DETAIL G



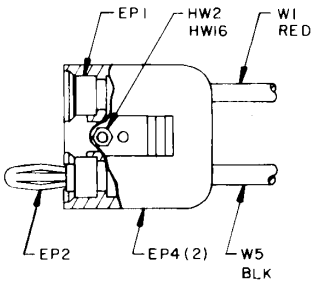
DETAIL F 110-120 VAC -350 60Hz -352 50Hz



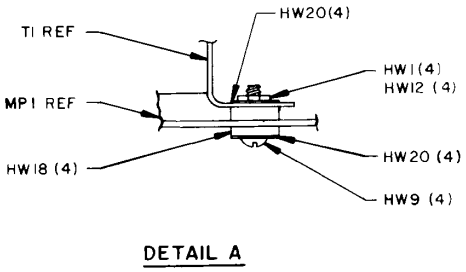
DETAIL D



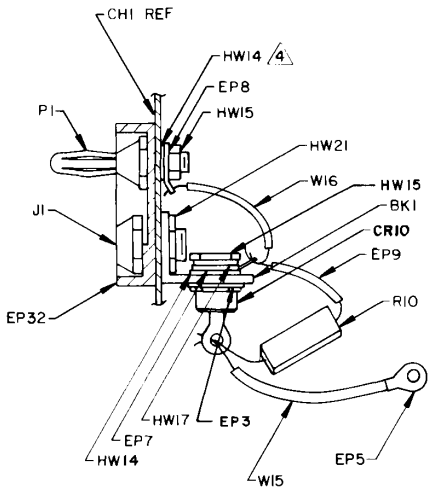
DETAIL E



DETAIL C

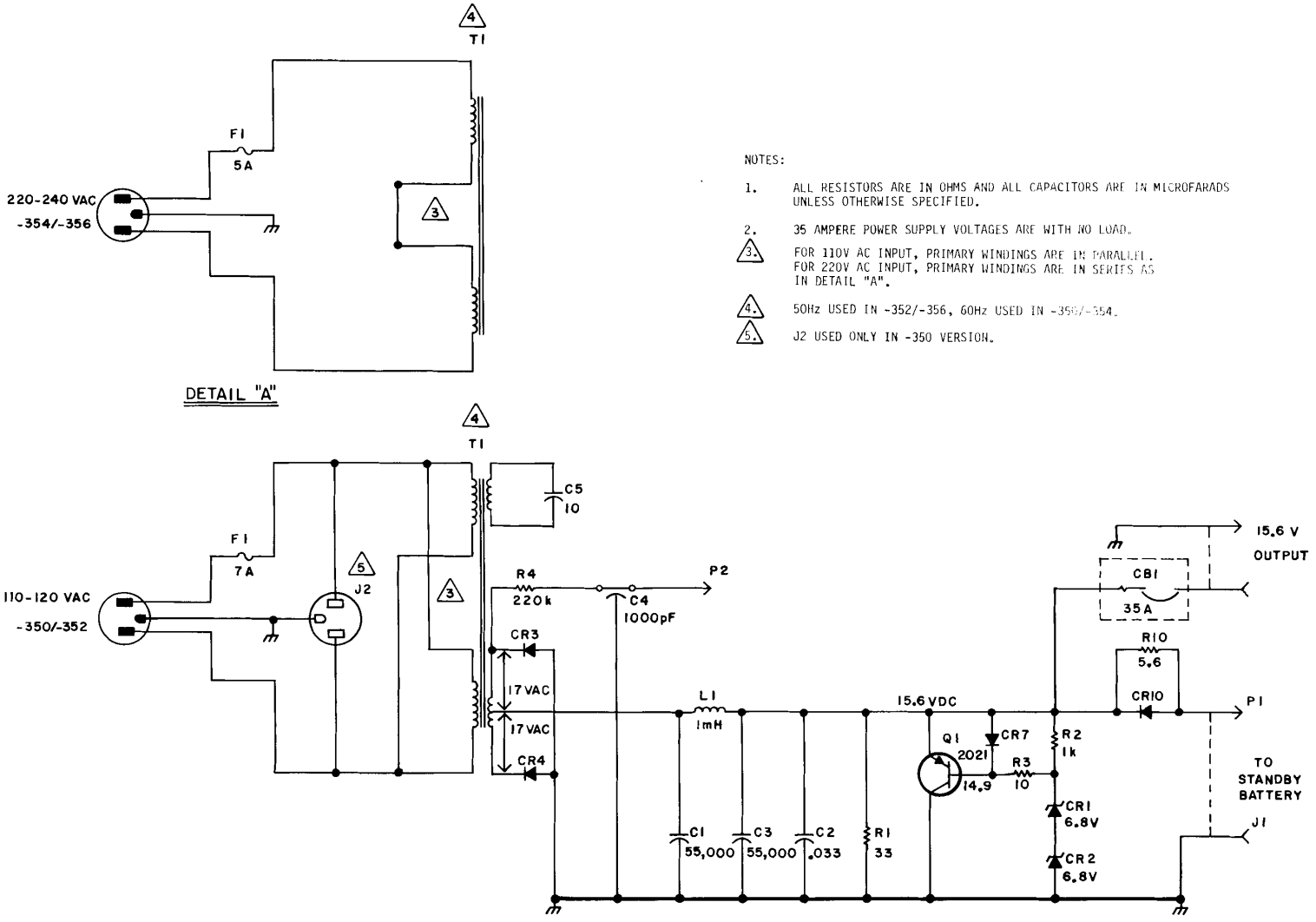


DETAIL A

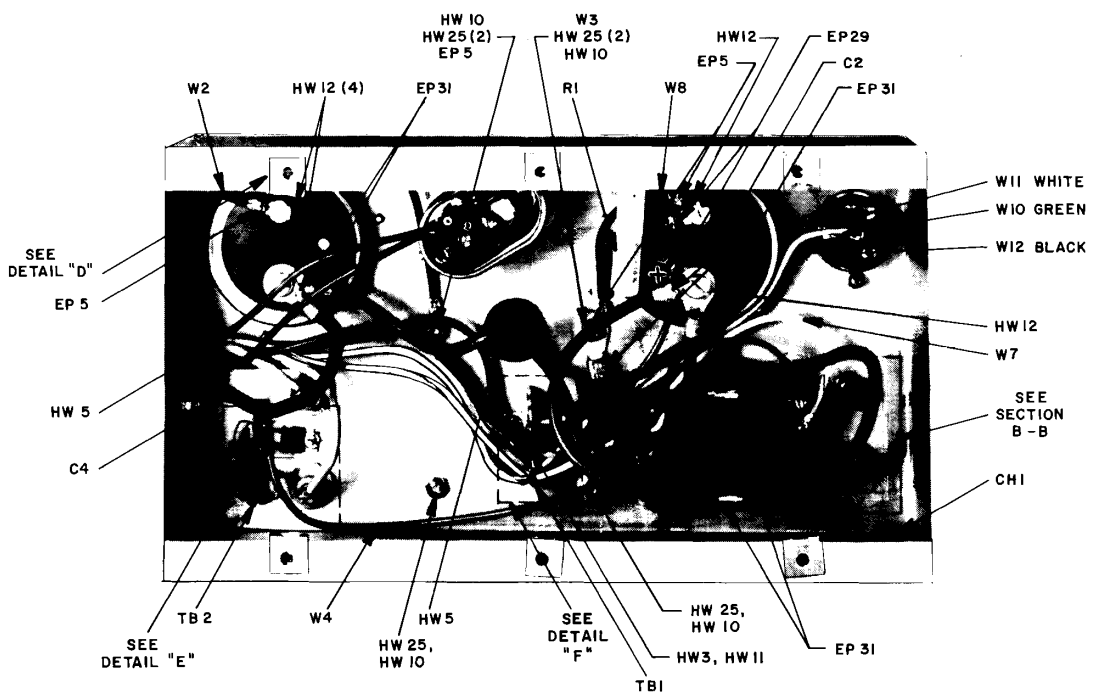


SECTION B-B

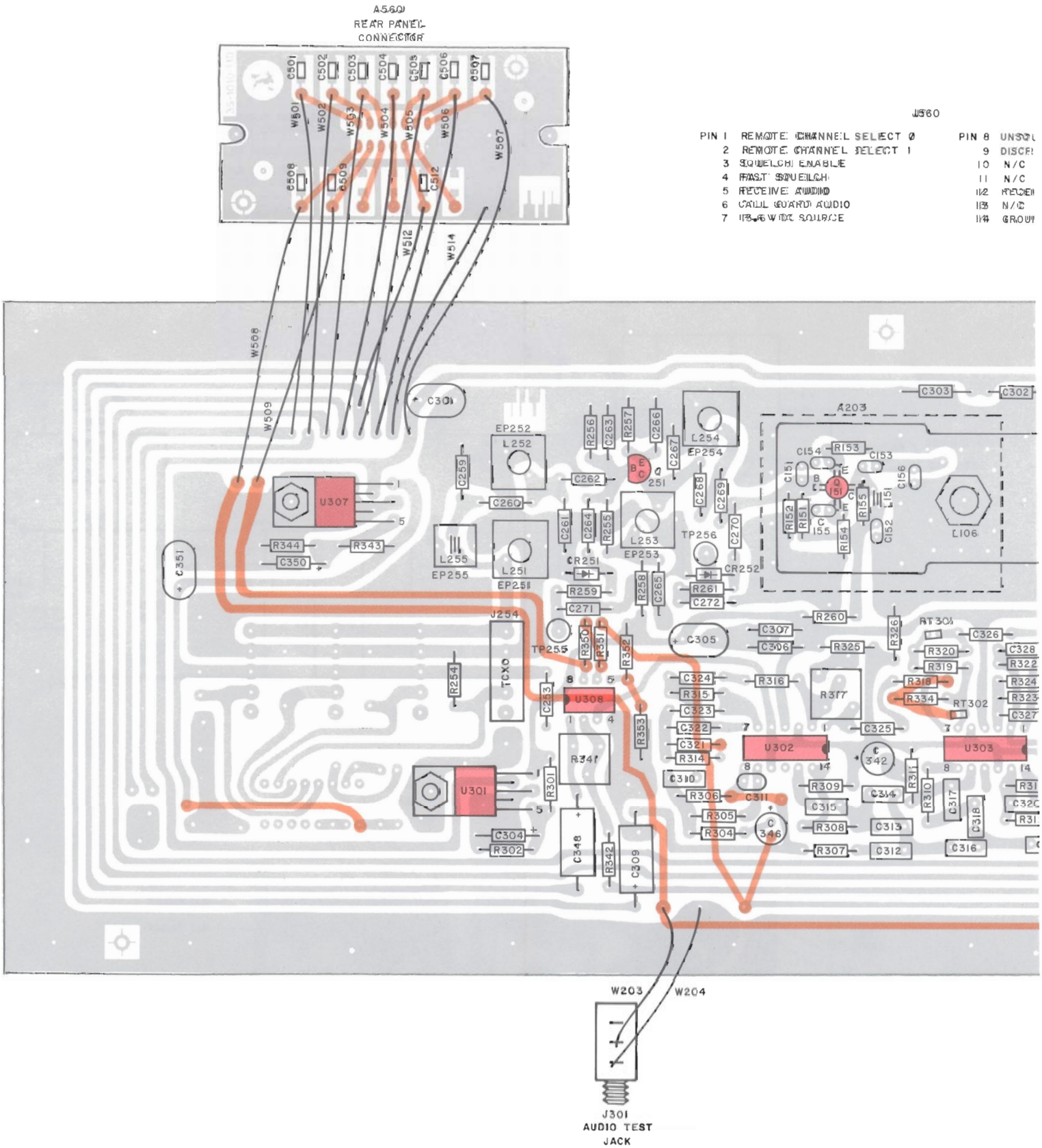
35 AMP POWER SUPPLY WIRING DETAILS
FIGURE 8–7



35 AMP POWER SUPPLY SCHEMATIC
FIGURE 8–8



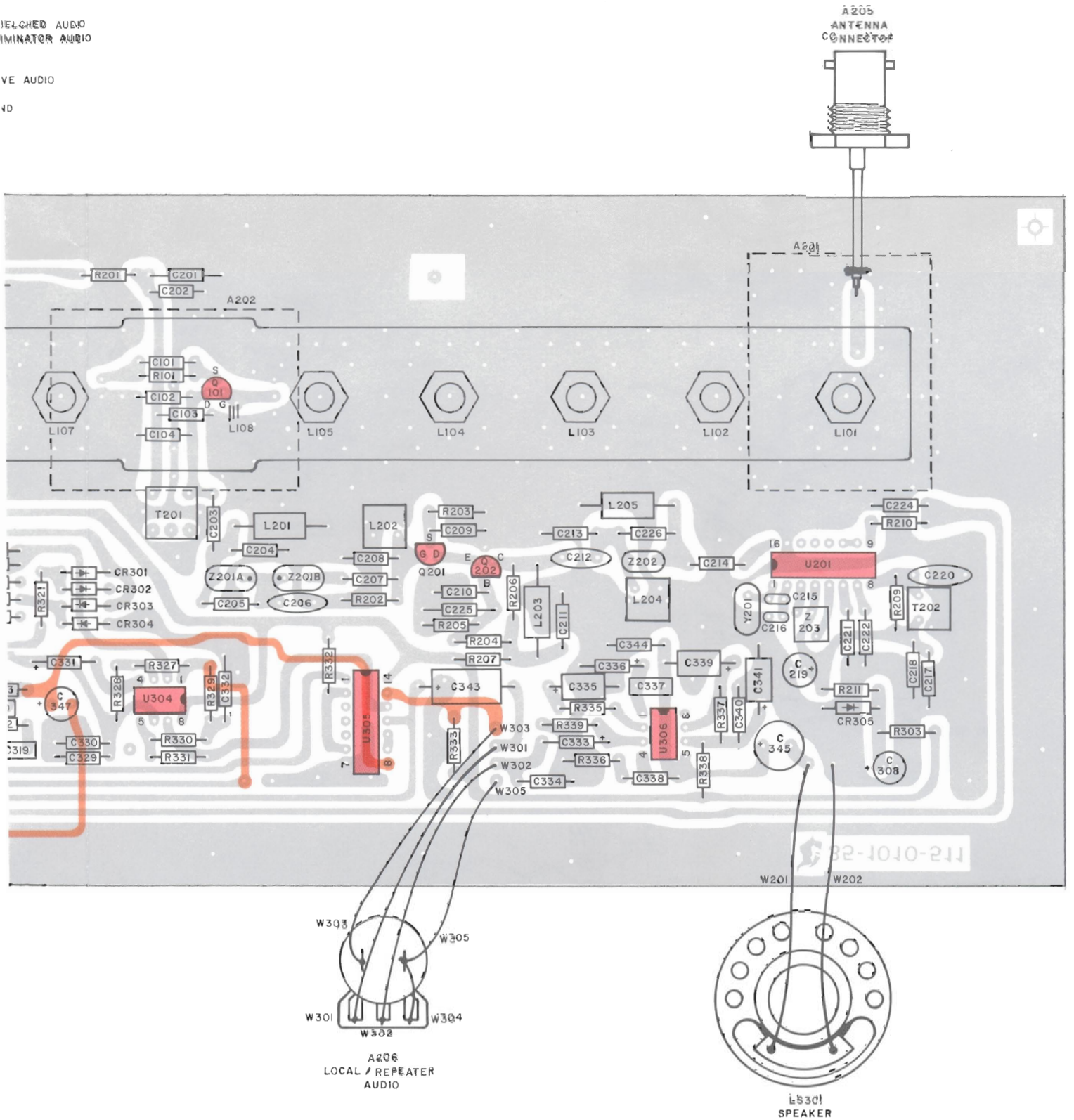
35 AMP POWER SUPPLY
WIRING DIAGRAM


A560
REAR PANEL
CONNECTOR
J560
PIN 1 REMOTE CHANNEL SELECT 0
2 REMOTE CHANNEL SELECT 1
3 SQUELCH ENABLE
4 FAST SQUELCH
5 RECEIVE AUDIO
6 CALL GUARD AUDIO
7 TX MOD SOURCE
PIN 8 UNSOL
9 DISCR
10 N/C
11 N/C
12 RECEI
13 N/C
14 GROUN
W501
W502
W503
W504
W505
W506
W507
W508
W509
W512
W514
C501
C502
C503
C504
C505
C506
C507
C508
C509
C512
C301
C351
U307
R344
R343
C350
L255
EP255
L251
EP251
EP252
L252
C259
C260
C261
C262
C263
C264
R255
R256
R257
C266
C267
L254
EP254
L253
EP253
C268
C269
C270
TP256
CR251
CR252
R258
C265
R259
C271
R261
C272
J254
TCXO
TP255
R350
R351
R352
C253
U308
R254
R353
R341
U301
R301
C304
R302
C348
R342
C309
C305
C307
C306
R260
R325
R326
R316
R315
C324
C323
C322
C321
R314
C310
R306
R305
R304
C311
C346
U302
R309
C315
R308
R307
C342
C314
C313
C312
R311
R310
C317
C318
C316
U303
R317
C325
RT301
R320
R319
R318
R334
RT302
C326
C328
C322
R324
C323
C327
A203
C154
R153
C153
C151
C156
R152
R151
C155
R155
C152
R154
L106
W203
W204
J301
AUDIO TEST
JACK

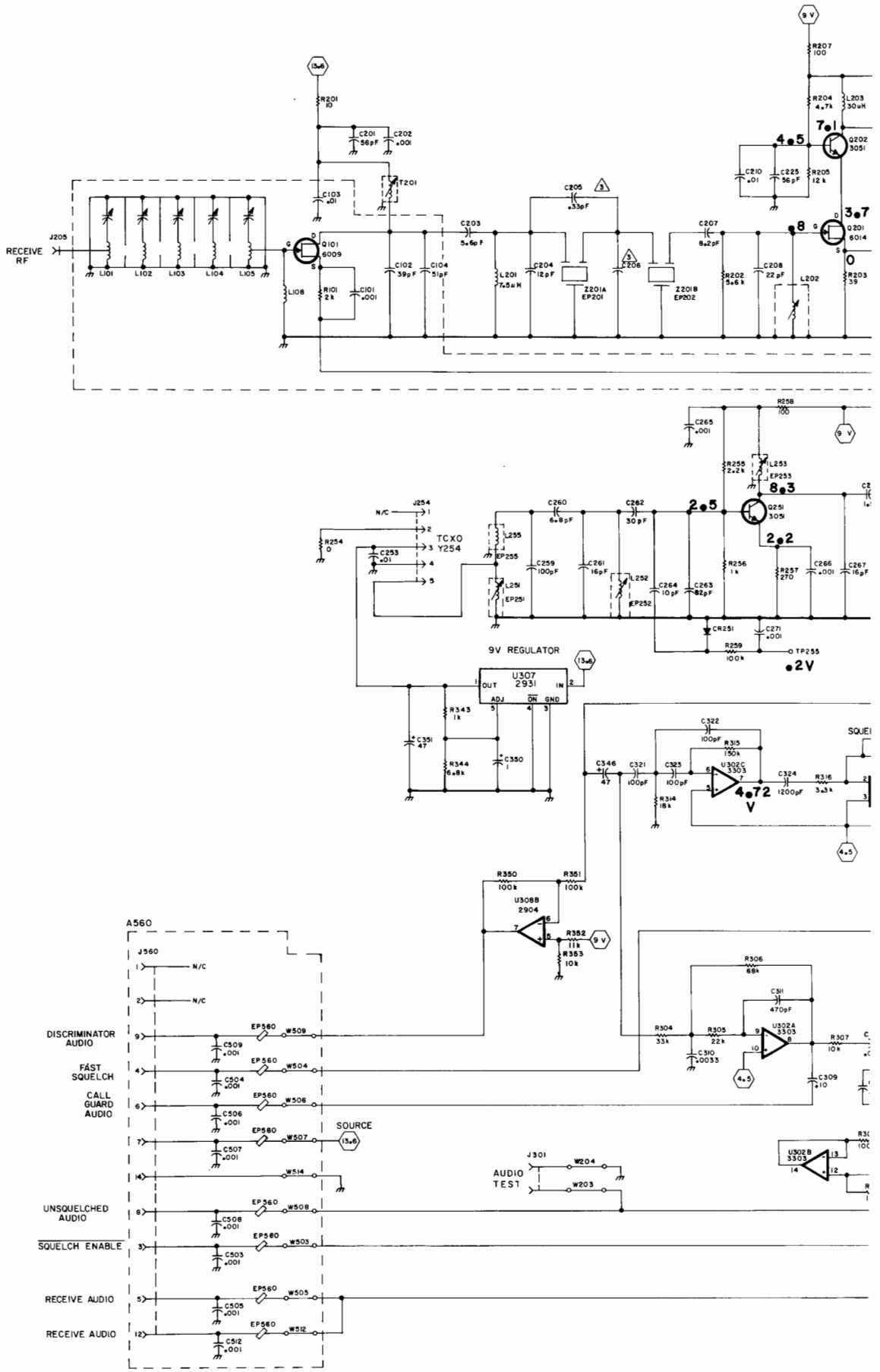
IELCHED AUDIO
IMINATOR AUDIO

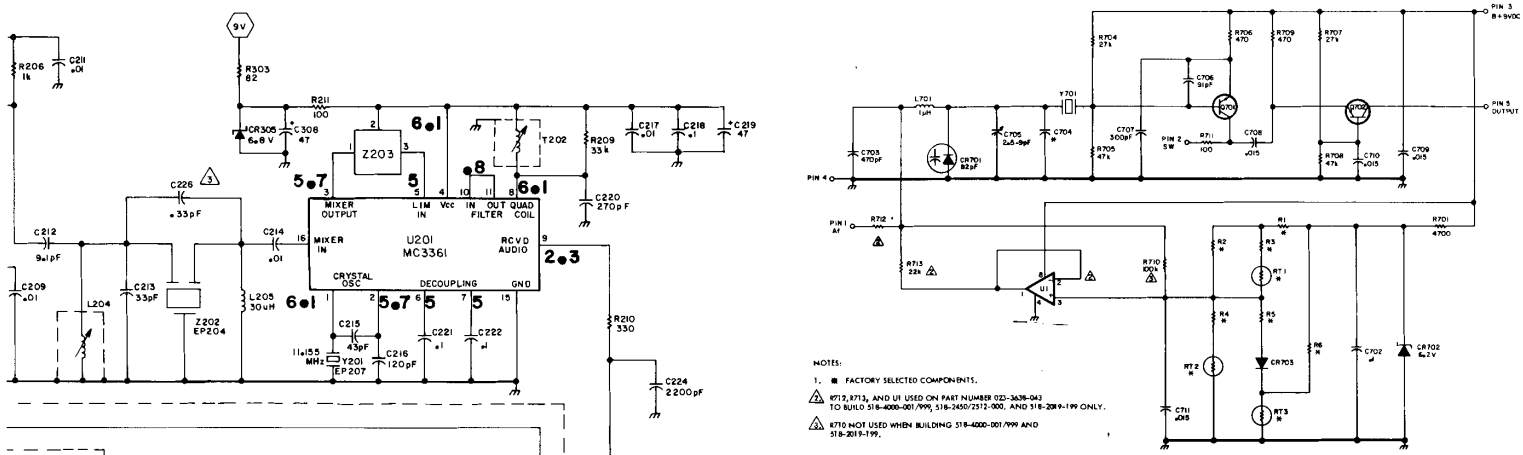
VE AUDIO

ND

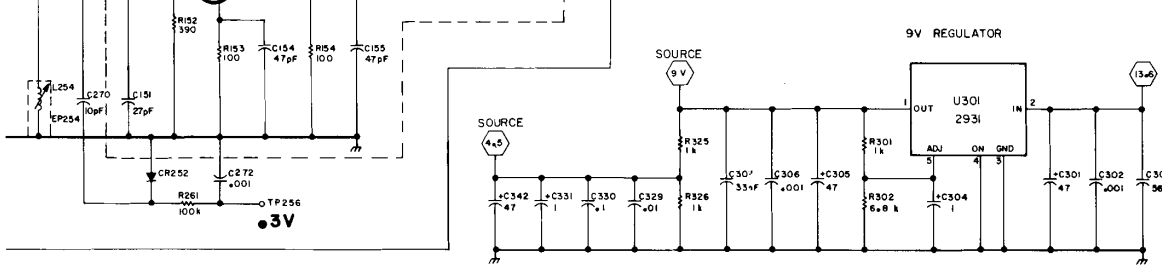


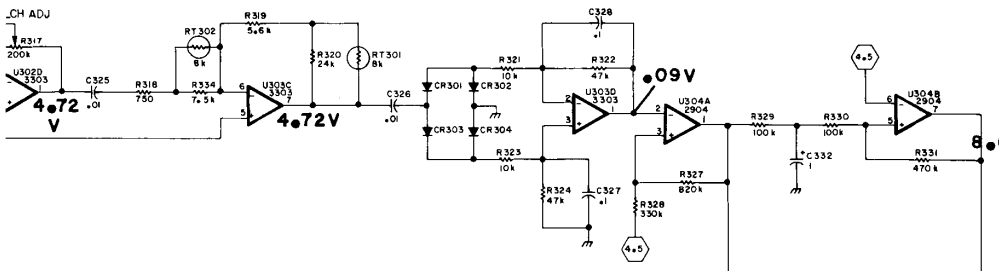
RECEIVER COMPONENT LAYOUT
FIGURE 8–9


RECEIVE RF
J205
L101
L102
L103
L104
L105
L108
Q101 6009
R201 10
C201 56pF
C202 .001
C103 .01
T201
C102 39pF
C104 51pF
C203 5.6pF
L201 7.5nH
C204 12pF
C205 .33pF
Z201A EP201
Z201B EP202
C206
C207 8.2pF
R202 5.6k
C208 22pF
L202
R203 39
R101 2k
C101 .001
R207 100
R204 4.7k
L203 30uH
Q202 3051
C210 .01
C225 56pF
R205 12k
Q201 6014
R208 0
9 V
7.1
4.5
3.7
8
0
J254
N/C
TCXO Y254
R254 0
C253 .01
L255
EP255
L251
EP251
C260 6.8pF
C262 30 pF
C259 100pF
C261 16pF
L252
EP252
C264 10 pF
C263 82pF
2.5
2.2
Q251 3051
R255 2.2k
L253
EP253
R256 1k
R257 270
C266 .001
C267 16pF
R258 100
C265 .001
CR251
C271 .001
R259 100k
TP255
2V
9V REGULATOR
U307 2931
OUT
IN
ADJ
ON
GND
R343 1k
C351 47
R344 6.8k
C350 1
C322 100pF
R315 150k
C346 47
C321 100pF
C323 100pF
U302C 3303
4.72 V
C324 1200pF
R316 3.3k
R314 18k
4.5
R350 100k
R351 100k
U308B 2904
R352 11k
R353 10k
9 V
A560
J560
N/C
N/C
DISCRIMINATOR AUDIO
FAST SQUELCH
CALL GUARD AUDIO
SOURCE
UNSQUELCHED AUDIO
SQUELCH ENABLE
RECEIVE AUDIO
RECEIVE AUDIO
EP560
W509
W504
W506
W507
W514
W508
W503
W505
W512
C509 .001
C504 .001
C506 .001
C507 .001
C508 .001
C503 .001
C505 .001
C512 .001
J301
AUDIO TEST
W204
W203
R306 68k
C311 470pF
R304 33k
R305 22k
U302A 5303
C310 .0033
R307 10k
C309 .10
U302B 5303



TCXO SCHEMATIC
(For Reference Only)



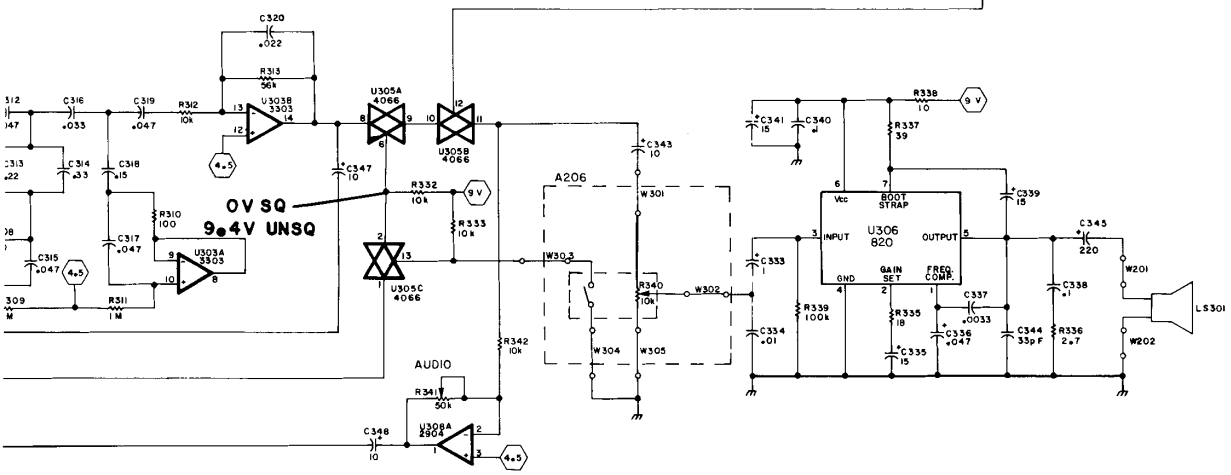


NOTES:

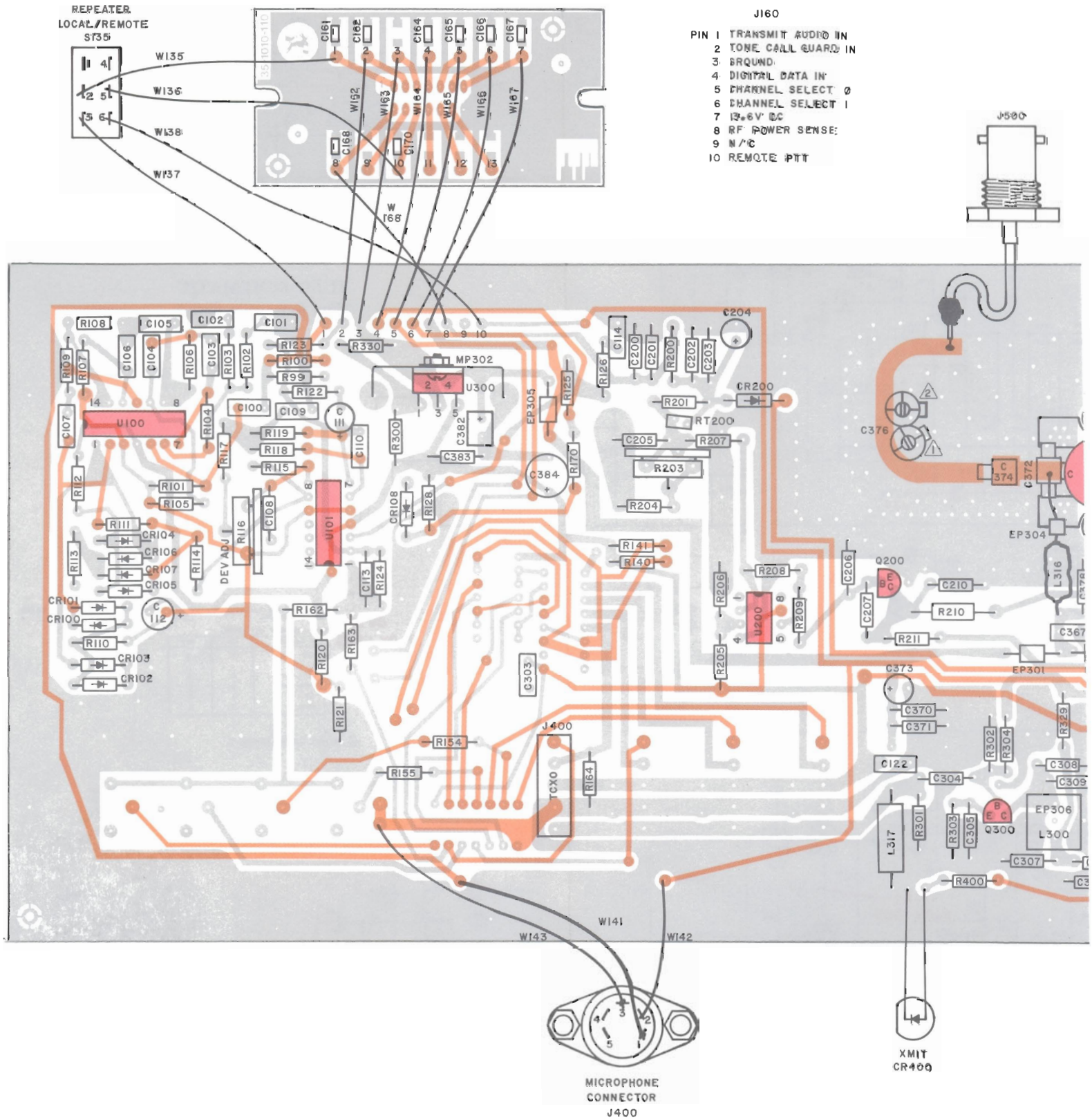
1. ALL CAPACITORS ARE IN MICROFARADS, RESISTORS IN OHMS AND VOLTAGE POSITIVE UNLESS OTHERWISE SPECIFIED.
2. IC PIN CONNECTIONS NOT SHOWN;

IC NUMBER	Vcc	GND
U201	4	15
U302, U303	4	11
U304, U308	8	4
U305	14	7
U308	6	4

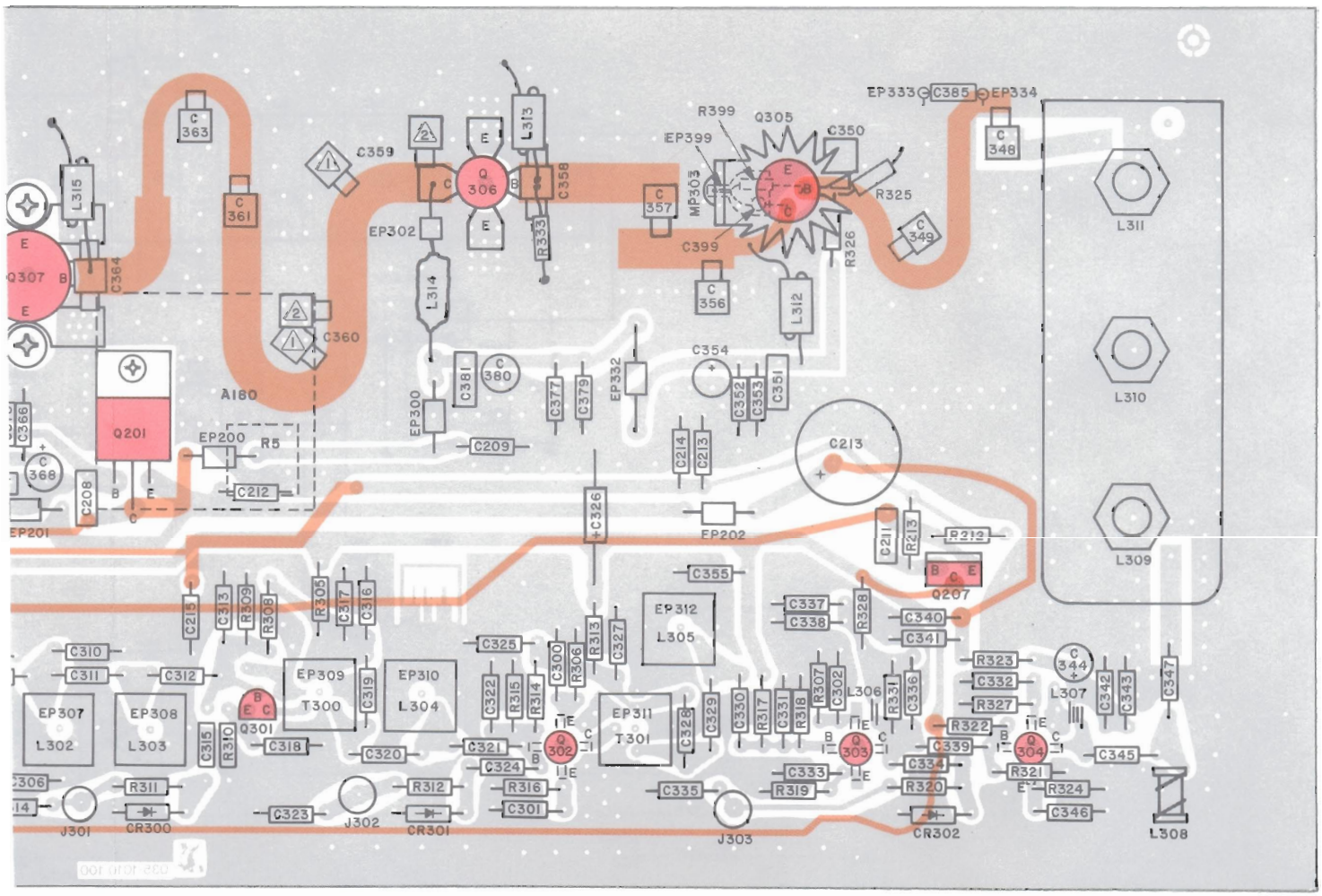
3. FACTORY SELECTED COMPONENT.



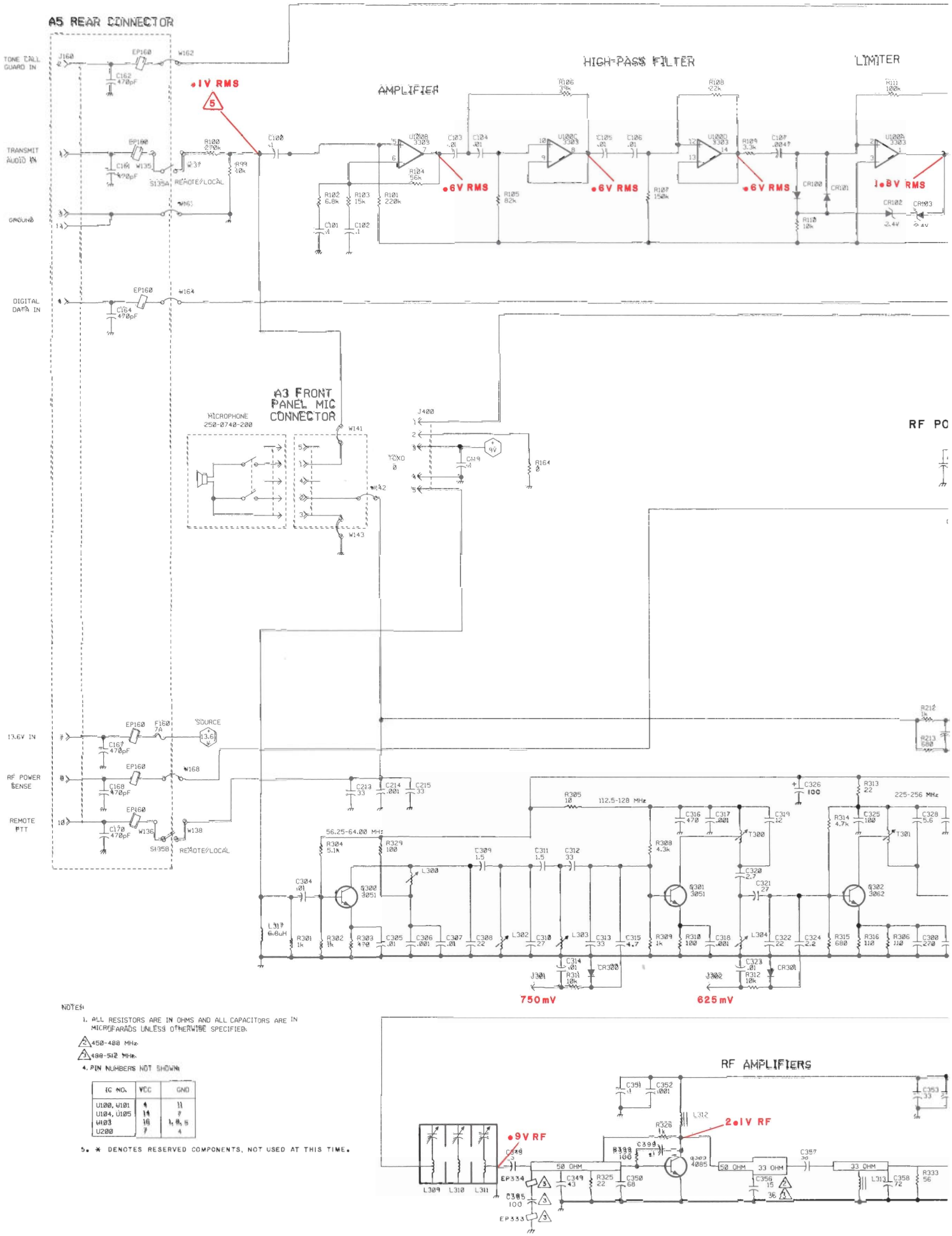
RECEIVER SCHEMATIC
FIGURE 8–10


REPEATER LOCAL/REMOTE S135
W135
W136
W138
W137
W168
J160
PIN 1 TRANSMIT AUDIO IN
2 TONE CALL GUARD IN
3 GROUND
4 DIGITAL DATA IN
5 CHANNEL SELECT 0
6 CHANNEL SELECT 1
7 13.6V DC
8 RF POWER SENSE
9 N/C
10 REMOTE PTT
J500
C376
C374
C372
EP304
L316
C367
EP301
C373
C370
C371
R329
R302
R304
C122
C304
C308
C309
EP306
L300
Q300
L317
R301
R303
C305
C307
R400
XMIT CR400
W141
W143
W142
MICROPHONE CONNECTOR J400
J400
TCXO
R164
R154
R155
C303
R162
R163
R120
R121
C113
R124
DEV ADJ
R116
C108
U101
R111
CR104
CR106
CR107
CR105
CR101
CR100
R110
CR103
CR102
C112
R113
R114
R112
R117
R104
C107
U100
R101
R105
C110
R119
R118
R115
C100
C109
R123
R100
R99
R122
R330
MP302
U300
R300
C382
C383
EP305
C384
R170
R125
CR108
R128
R141
R140
R208
R206
U200
R209
R205
C206
Q200
C210
R210
R211
C207
R204
R203
R207
RT200
CR200
R201
C204
C114
C200
C201
R200
C202
C203
R126
R108
C105
C102
C101
R109
R107
C106
C104
R106
C103
R103
R102

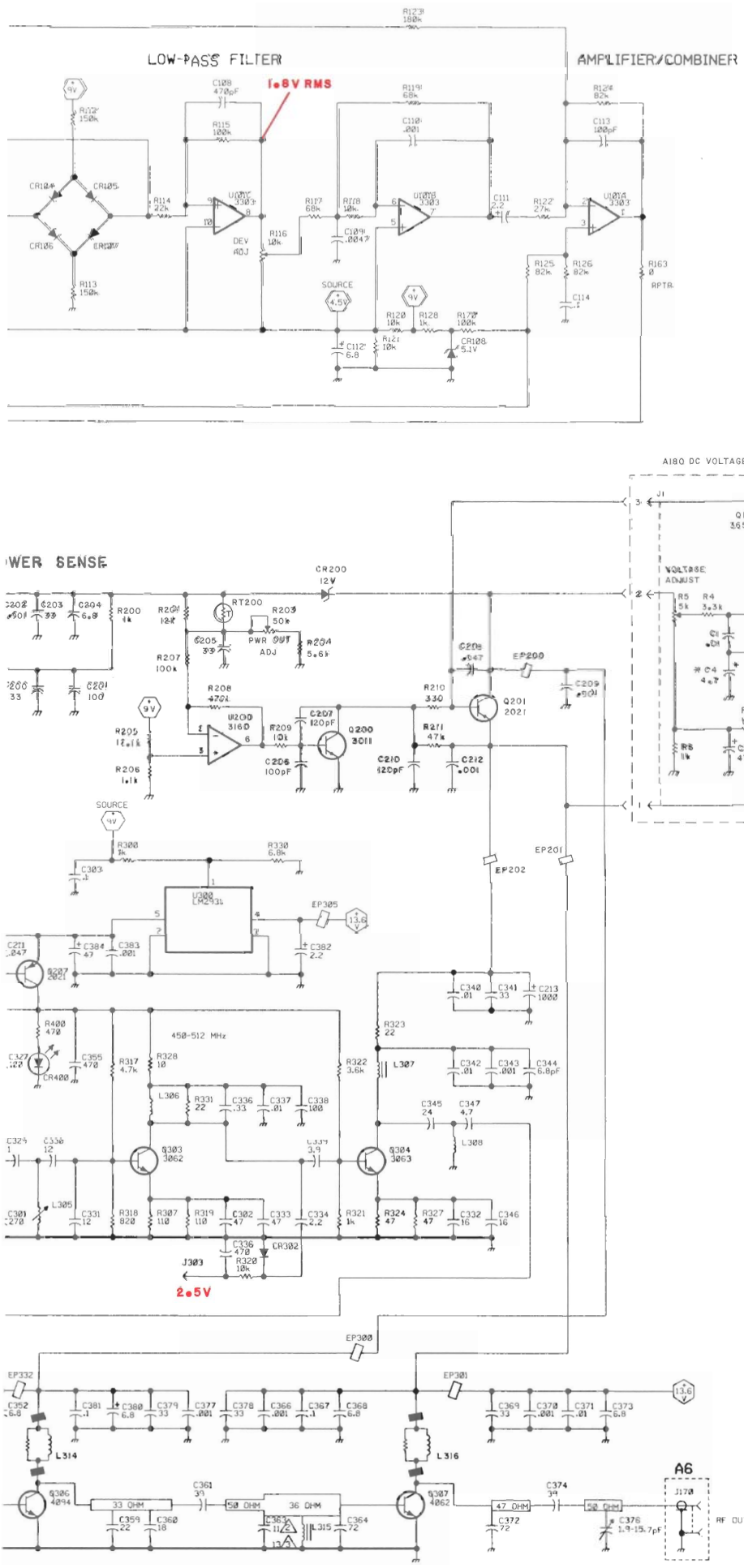
⚠1 = 450 - 488 MHz
⚠2 = 488 - 512 MHz



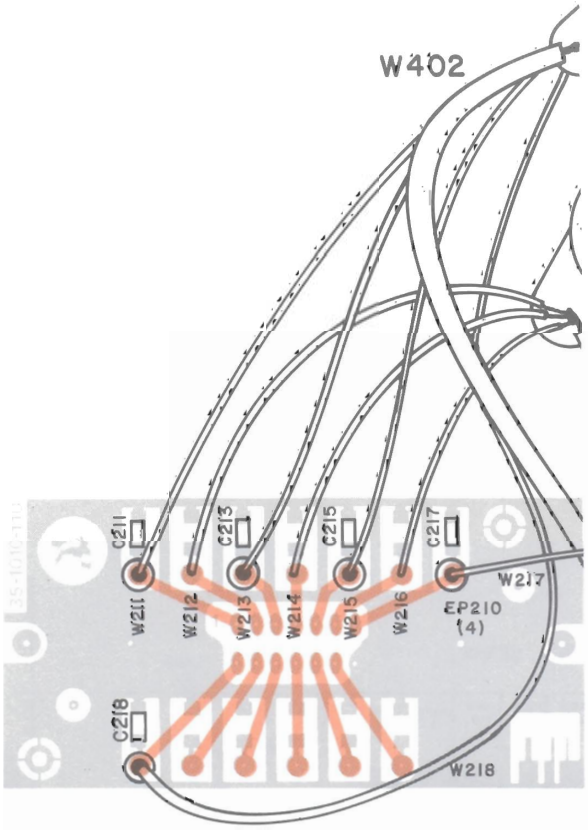
EXCITER COMPONENT LAYOUT
FIGURE 8-11

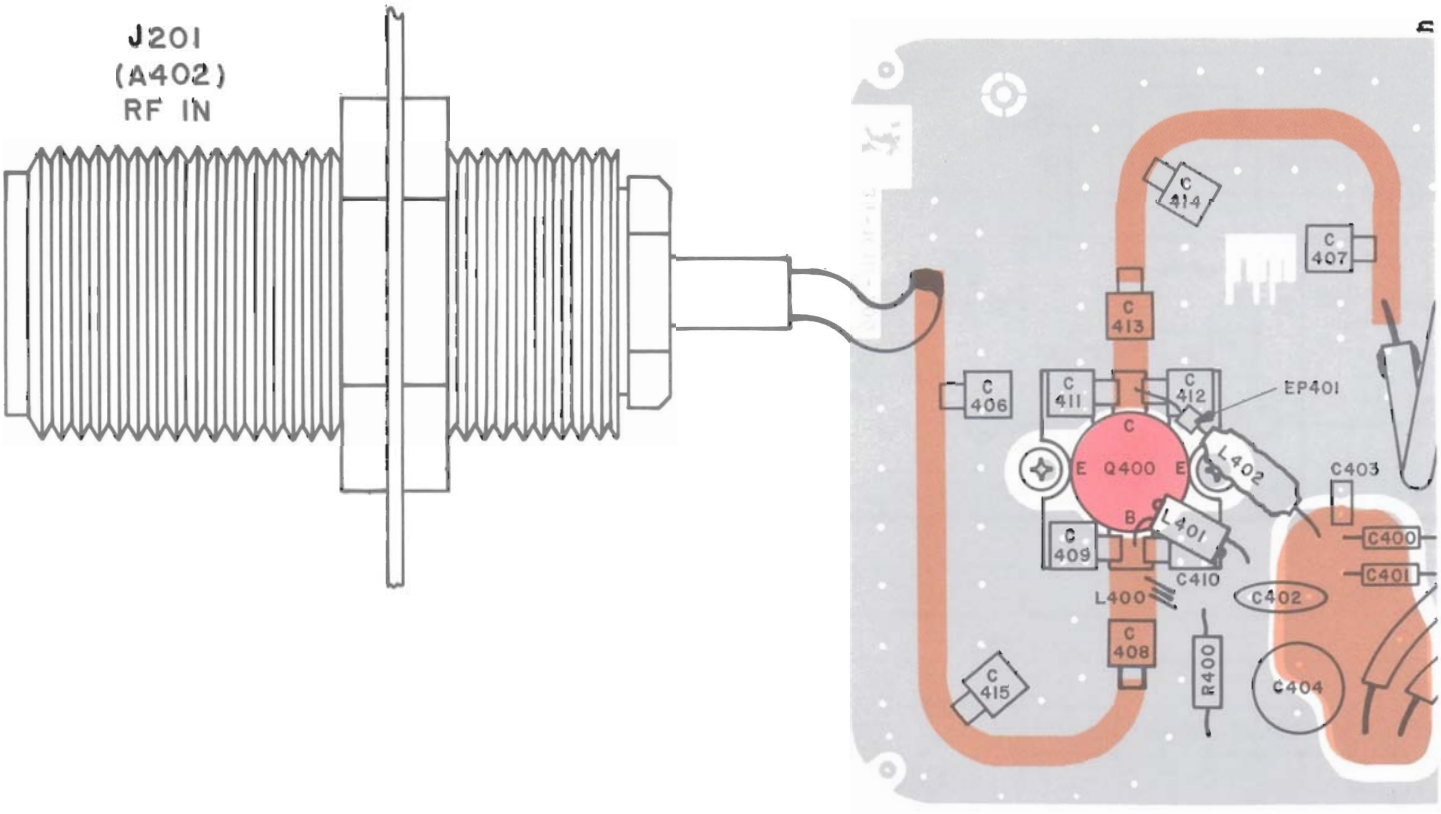


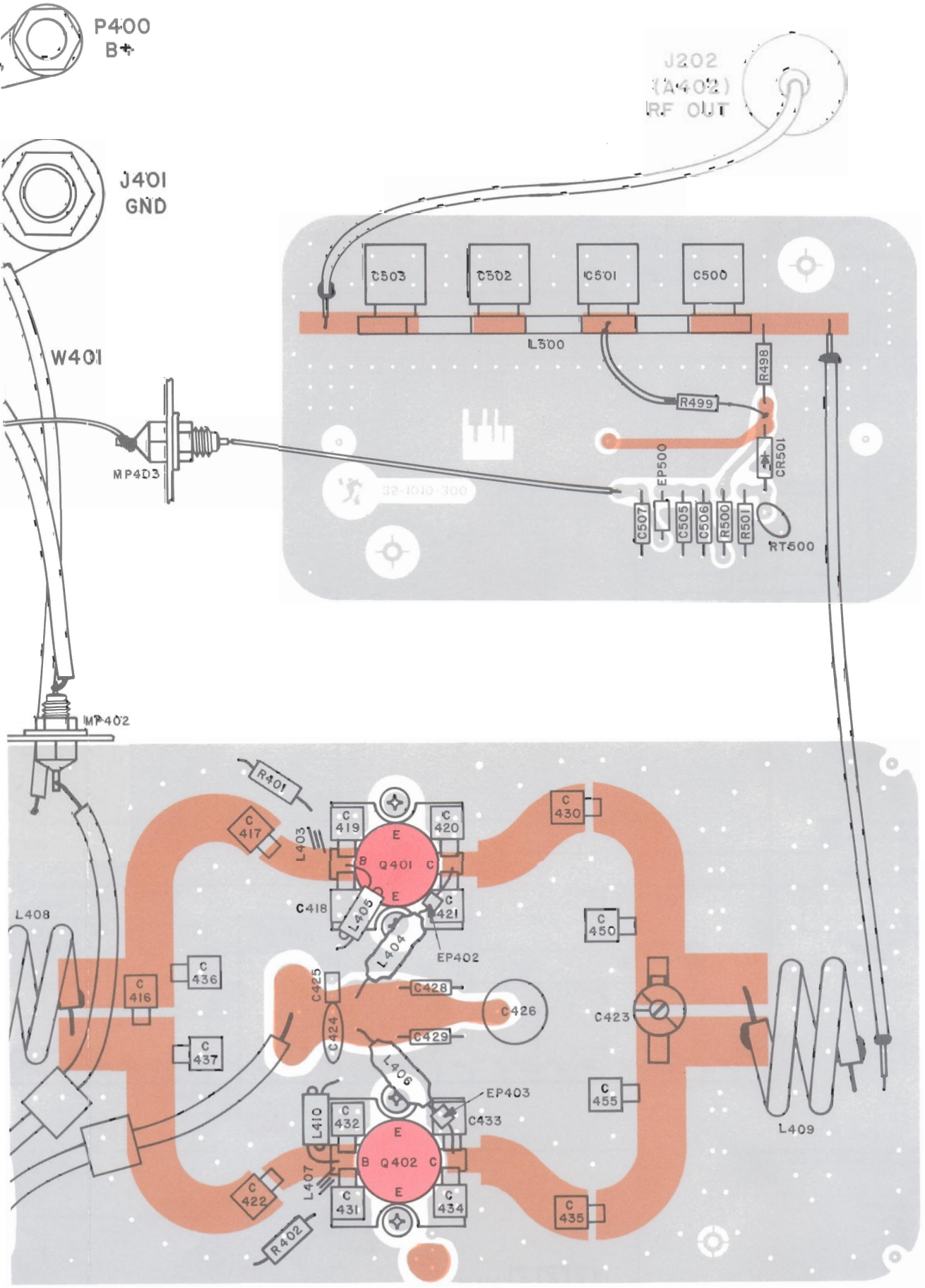
IC NO.	VCC	GND
U100, U101	4	11
U104, U105	14	7
U103	16	1, 8, 5
U200	7	4



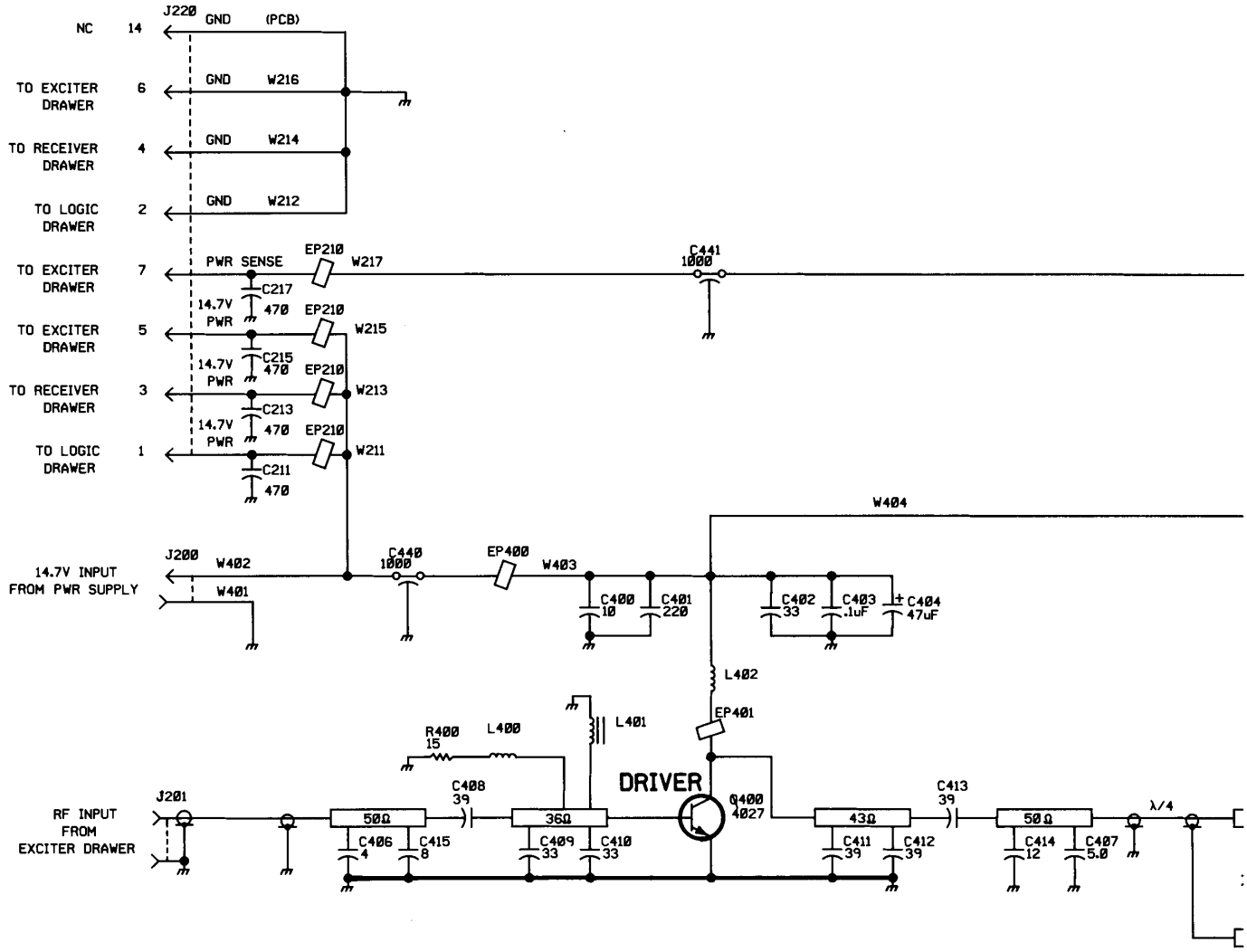
EXCITER SCHEMATIC
FIGURE 8–12


W402
C211
C213
C215
C217
W211
W212
W213
W214
W215
W216
W217
EP210
(4)
C218
W218


J201
(A402)
RF IN
C 414
C 407
C 413
C 406
C 411
C 412
EP401
C
E Q400 E
B
L402
C403
L401
C400
C401
C 409
C410
C402
L400
C 408
R400
C 415
C404



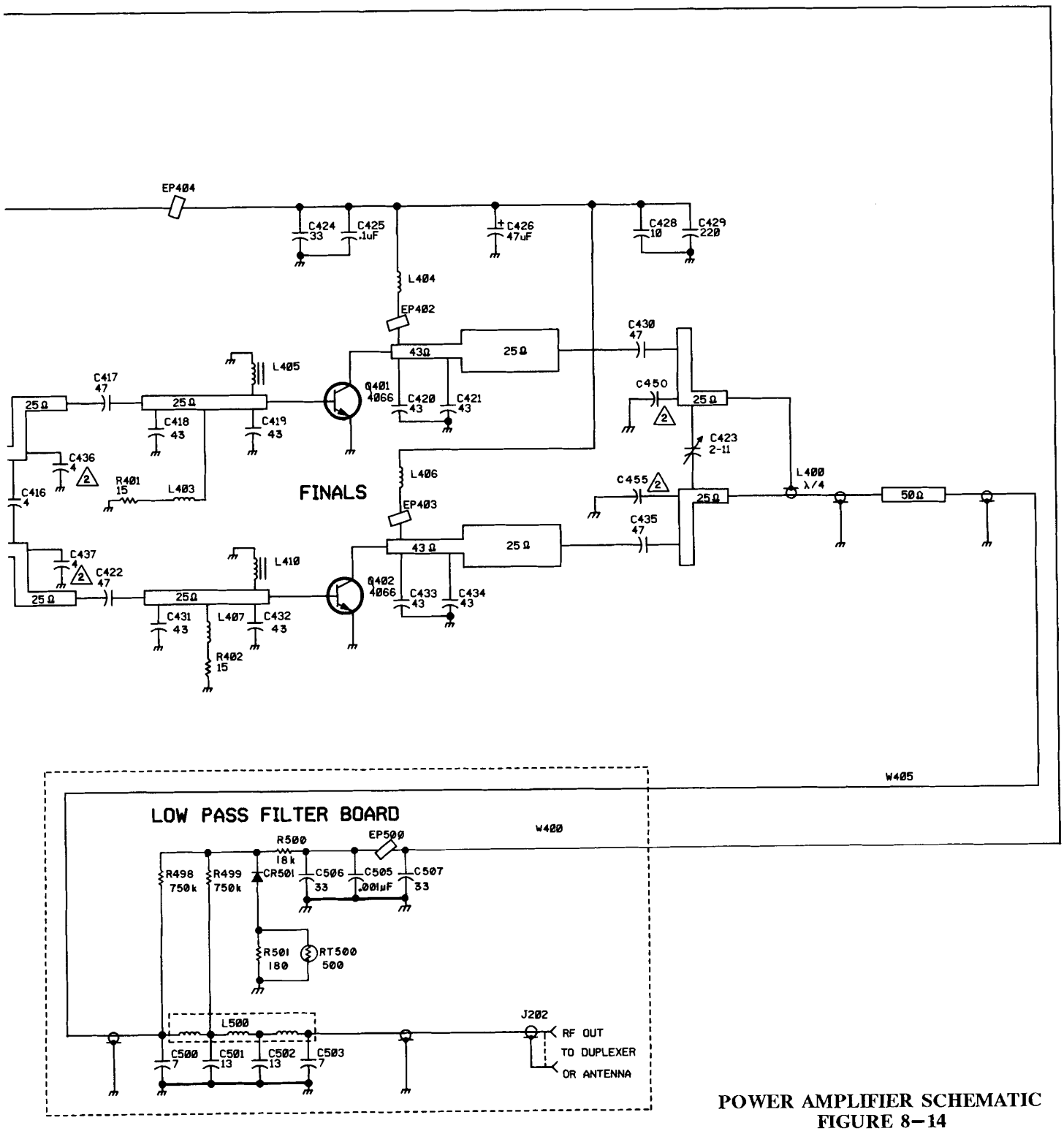
POWER AMPLIFIER COMPONENT LAYOUT
FIGURE 8-13



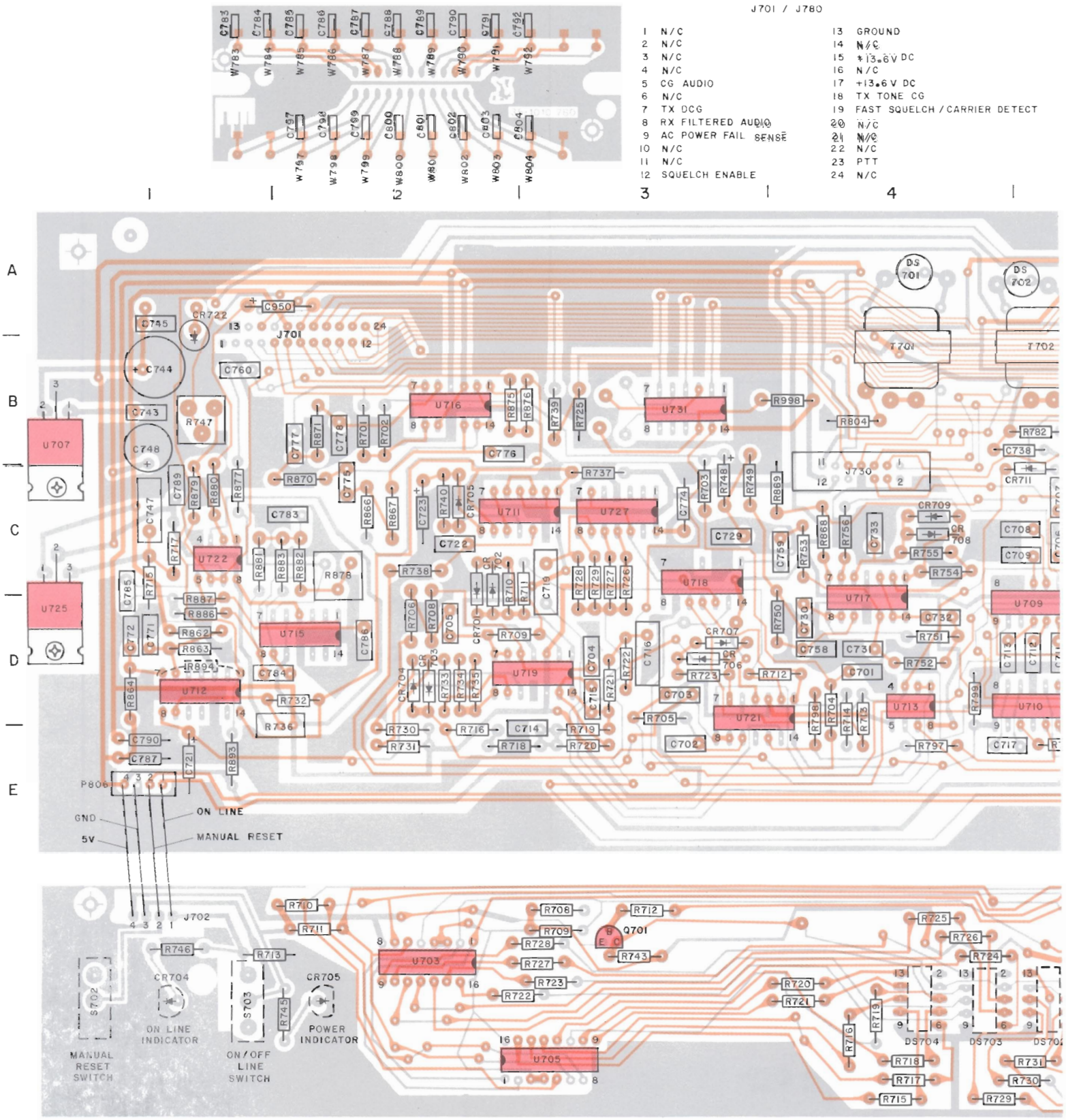
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN PICOFARADS UNLESS OTHERWISE SPECIFIED.

(2) FACTORY SELECTABLE.



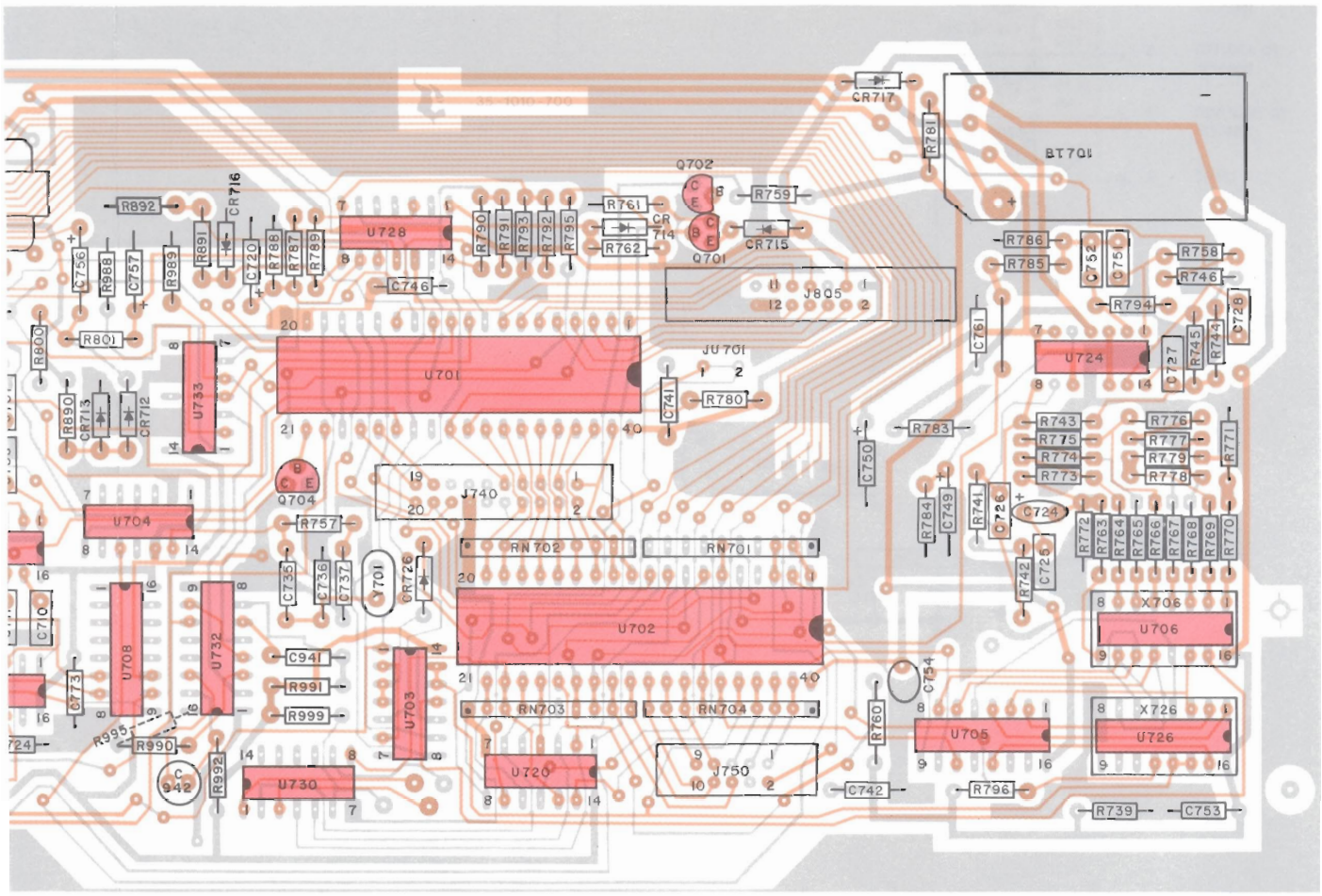
POWER AMPLIFIER SCHEMATIC
FIGURE 8–14

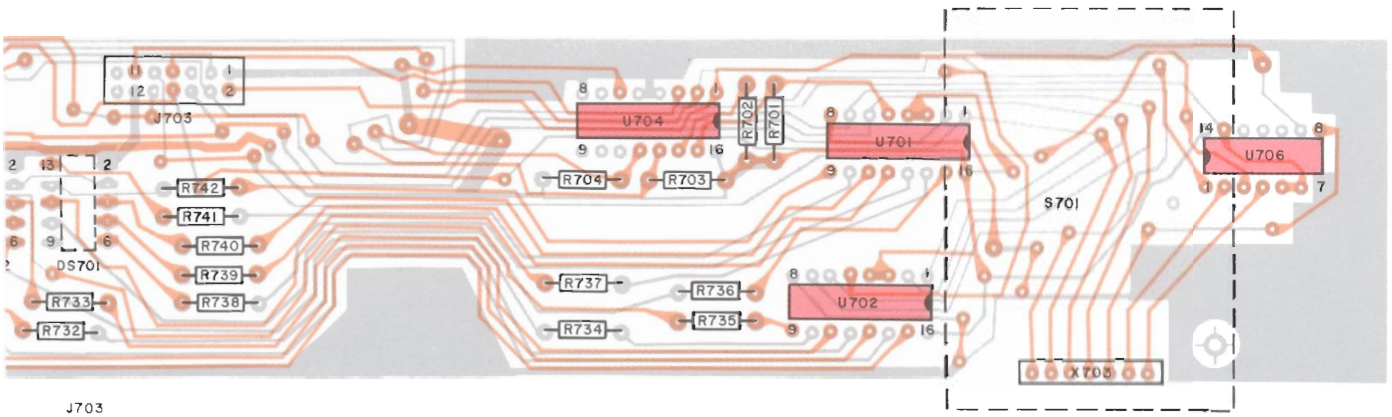

J701 / J780
1 N/C
2 N/C
3 N/C
4 N/C
5 CG AUDIO
6 N/C
7 TX DCG
8 RX FILTERED AUDIO
9 AC POWER FAIL SENSE
10 N/C
11 N/C
12 SQUELCH ENABLE
13 GROUND
14 N/C
15 +13.6V DC
16 N/C
17 +13.6 V DC
18 TX TONE CG
19 FAST SQUELCH / CARRIER DETECT
20 N/C
21 N/C
22 N/C
23 PTT
24 N/C
J701
J730
T701
T702
DS 701
DS 702
P805
GND
5V
ON LINE
MANUAL RESET
J702
MANUAL RESET SWITCH
ON LINE INDICATOR
ON/OFF LINE SWITCH
POWER INDICATOR
DS704
DS703
12 GND
11 COL 2 - LED A
10 ROW 1 - LED E
9 COL 3
8 ROW 2 - LED E
7 KEYBOARD - D

J805

12	GROUND	11	COL 2 / LED A1
10	ROW 1 / LED BCD Ø	9	COL 3
8	ROW 2 / LED BCD 1	7	KEYBOARD / $\overline{\text{DISPLAY}}$
6	ROW 3 / LED BCD 2	5	DECIMAL POINT
4	ROW 4 / LED BCD 3	3	ERROR INDICATOR
2	COL 1 / LED AØ	1	+5V

5 | 6 | 7 | 8

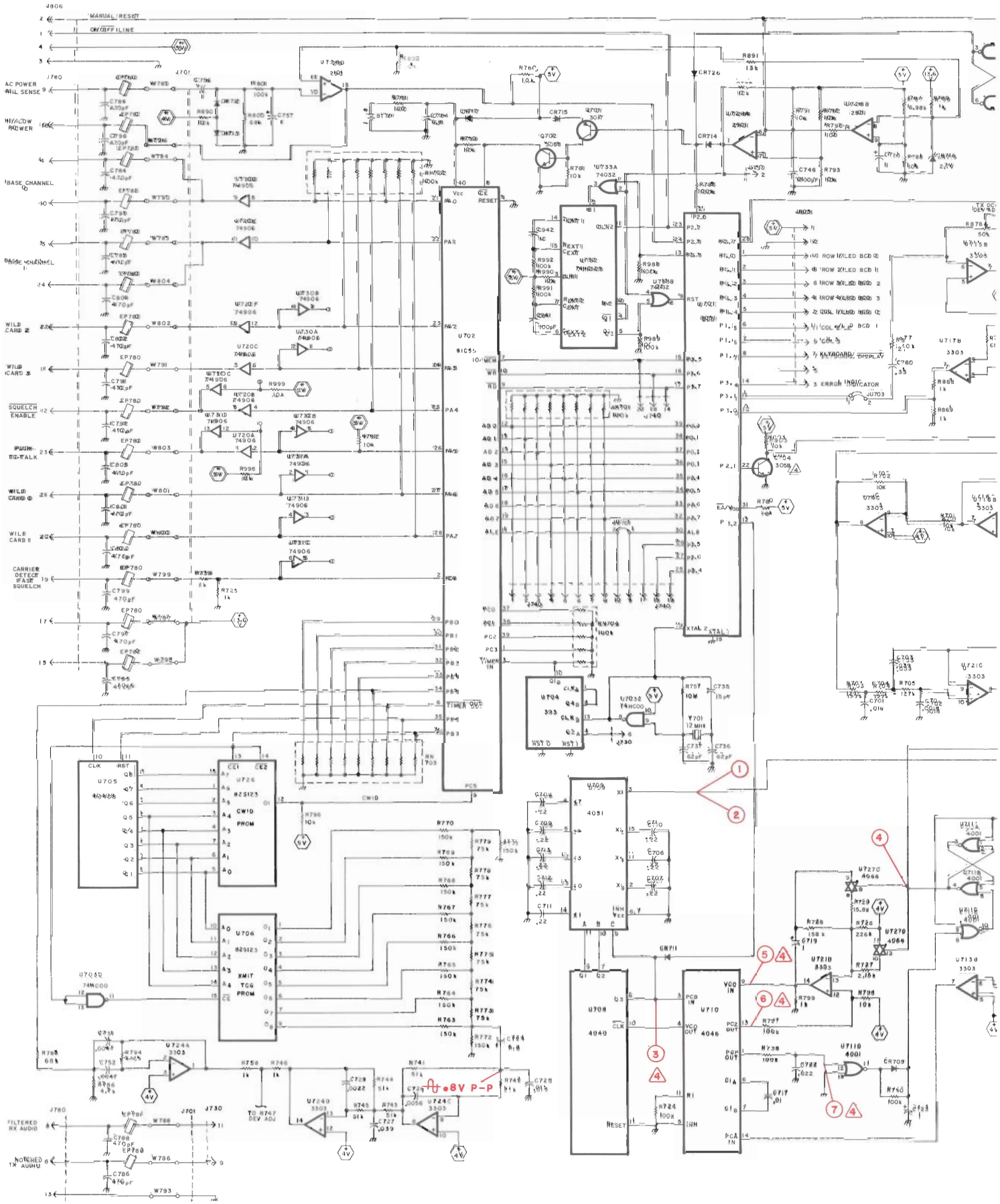


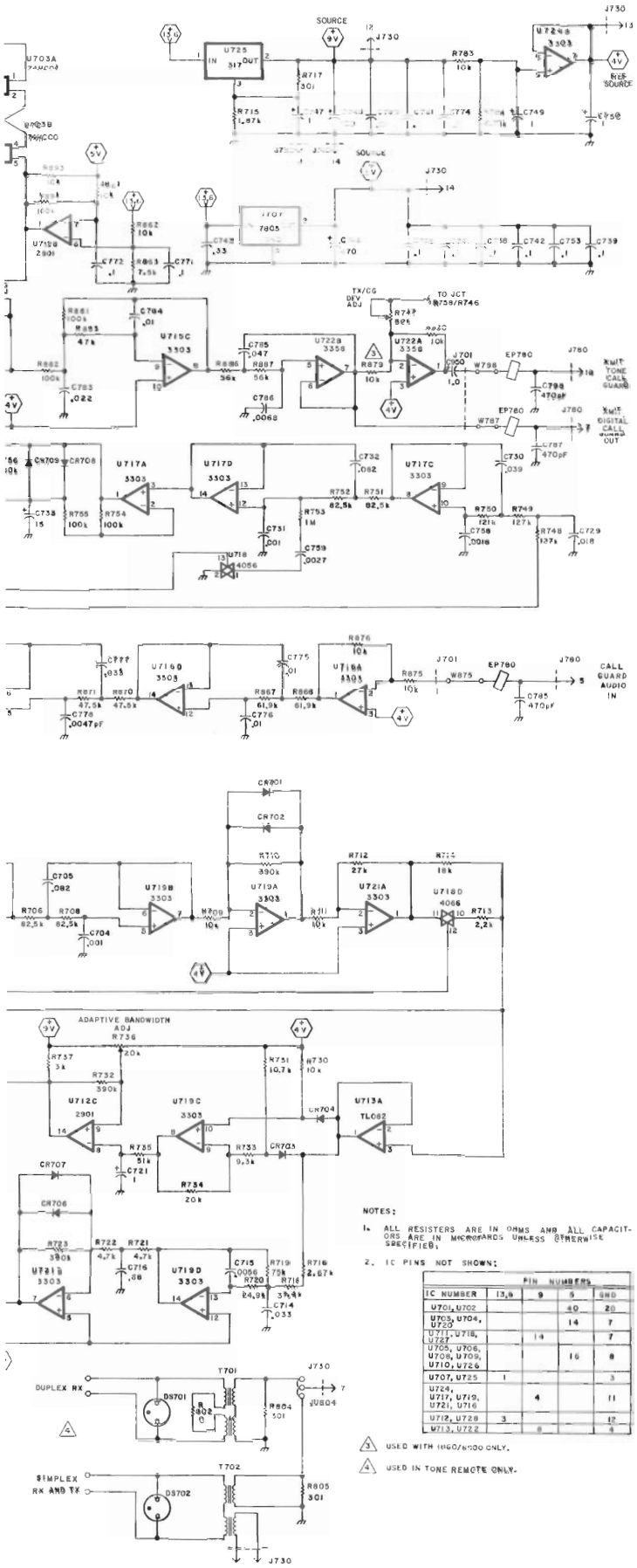


J703

	6	ROW 3 – LED BCD 2
AI	5	N/C
CD Ø	4	ROW 4 – LED BCD 3
	3	ERROR INDICATOR
BCD 1	2	COL 1 – LED AØ
ISPLAY	1	+5V

LOGIC COMPONENT LAYOUT
FIGURE 8–15


MANUAL RESET
ON/OFF LINE
AC POWER FAIL SENSE
HI/LOW POWER
BASE CHANNEL 0
BASE CHANNEL 1
WILD CARD 2
WILD CARD 1
SQUELCH ENABLE
PUSH-TO-TALK
WILD CARD 0
WILD CARD 11
CARRIER DETECT FAST SQUELCH
FILTERED RX AUDIO
NOTCHED TX AUDIO
TO R747 DEV ADJ
.8V P-P
CWID PROM
XMIT TCG PROM
TX DEV ADJ
KEYBOARD/ DISPLAY
ERROR INDICATOR

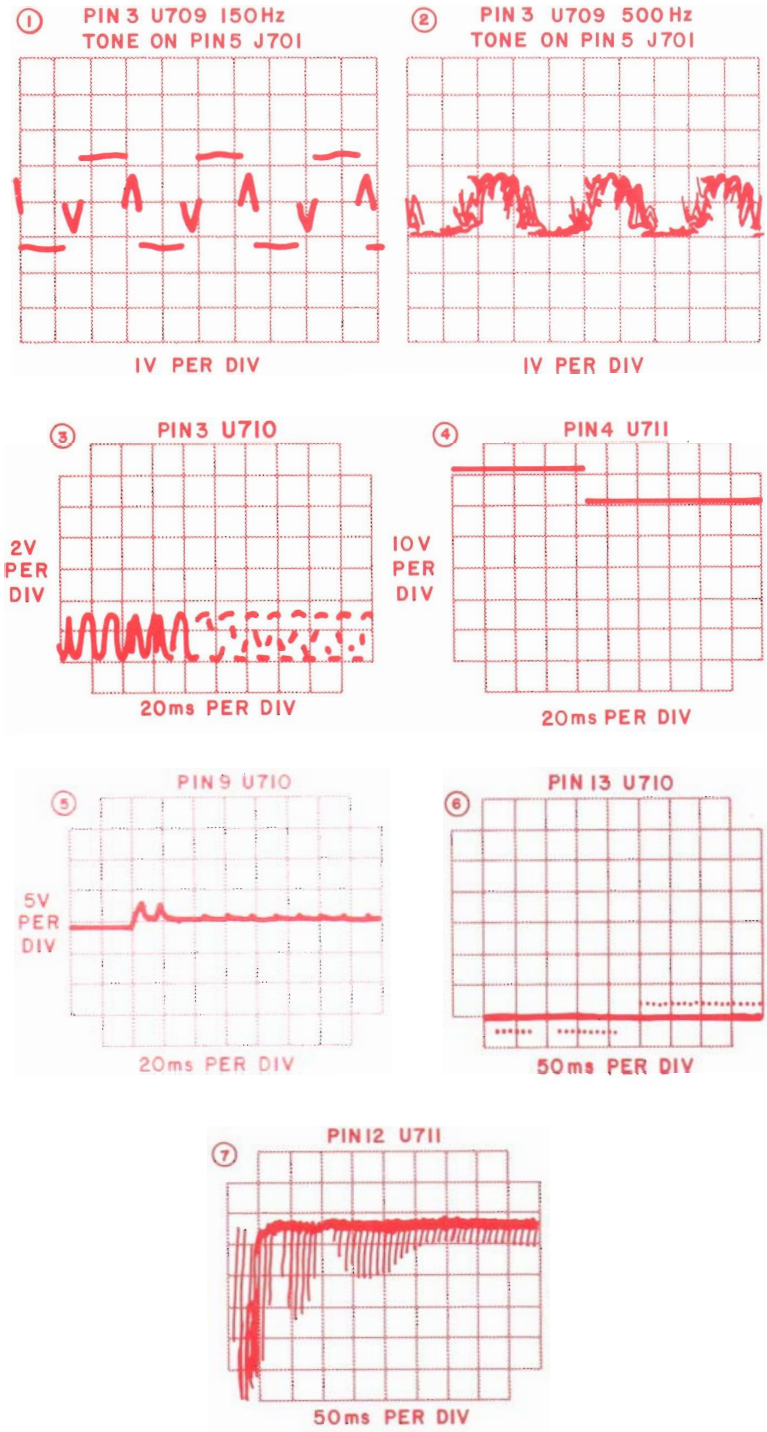


NOTES:

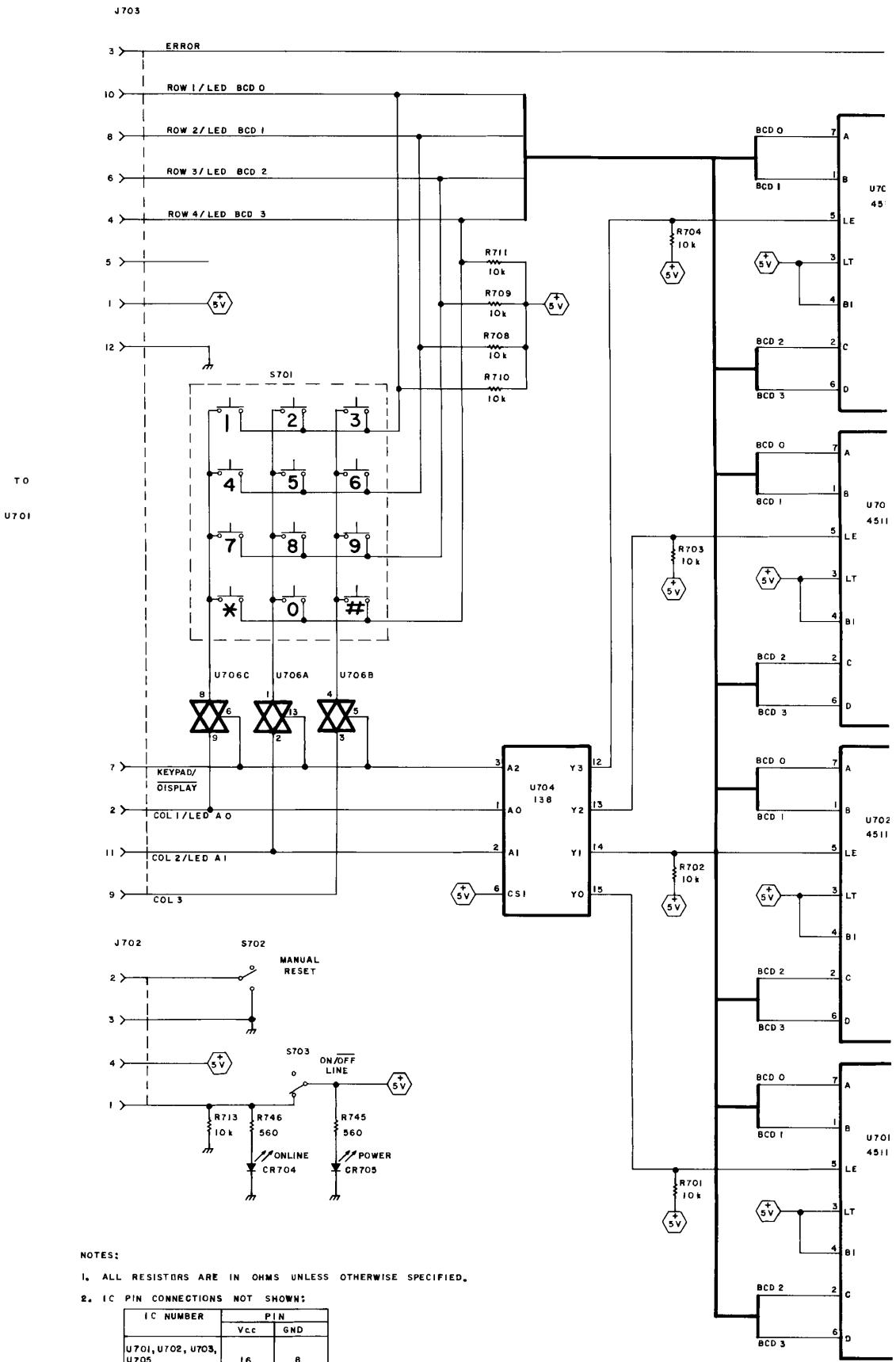
1. ALL RESISTERS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARDS UNLESS OTHERWISE SPECIFIED.
2. IC PINS NOT SHOWN:

IC NUMBER	PIN NUMBERS 13,6	9	5	GND
U701, U702			10	20
U703, U704, U720			14	7
U711, U718, U727		14		7
U705, U706, U708, U709, U710, U726			16	8
U707, U725	1			3
U724, U717, U719, U721, U716		4		11
U712, U728	3			12
U713, U722		8		4

3. USED WITH (1860/8500 ONLY.
4. USED IN TONE REMOTE ONLY.



LOGIC SCHEMATIC
FIGURE 8–16

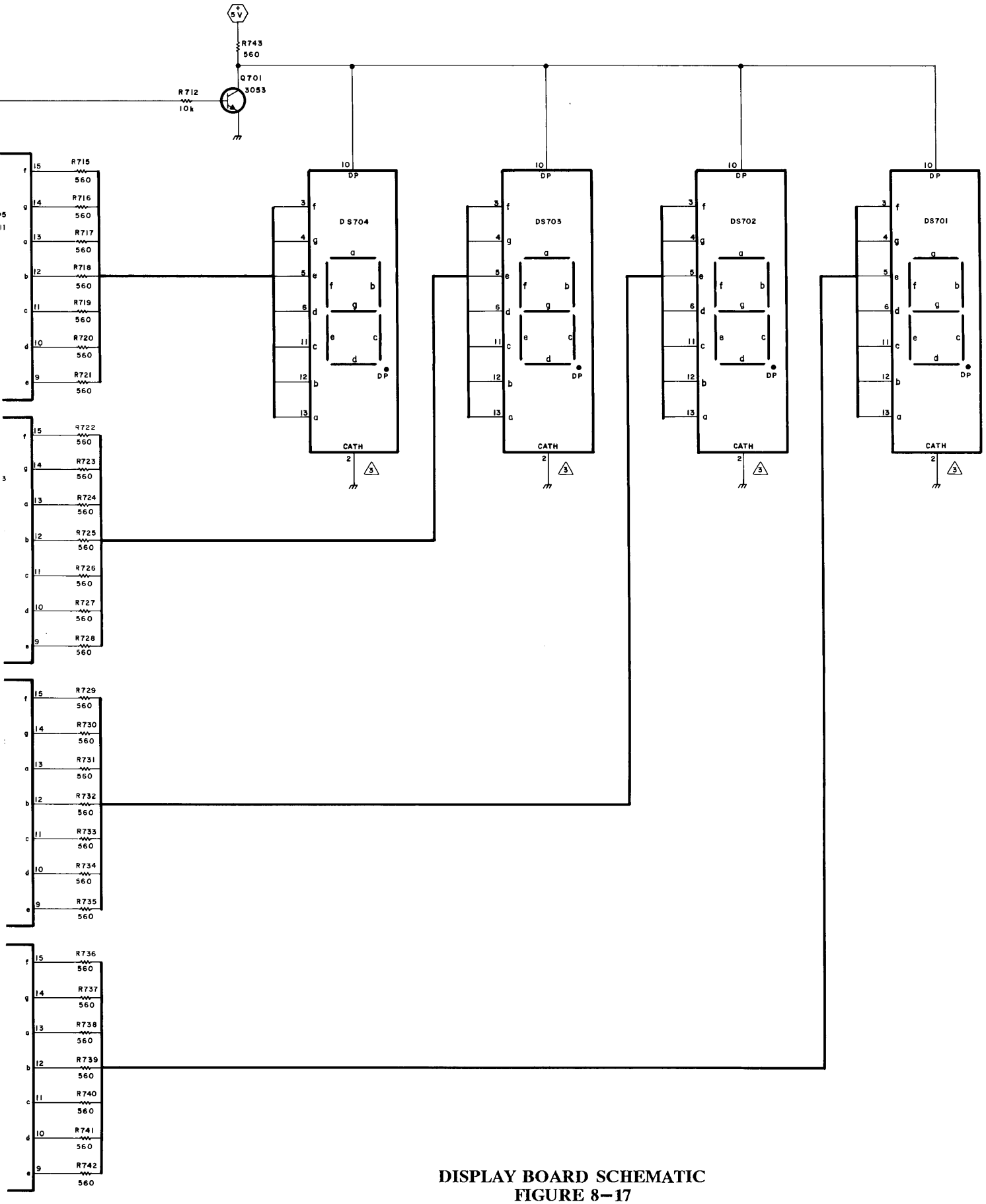


NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. IC PIN CONNECTIONS NOT SHOWN:

IC NUMBER	PIN	
	Vcc	GND
U701, U702, U703, U705	16	8
U704, U706	14	7

3. PINS 2 AND 9 ON DS704, DS703, DS702, AND DS701 ARE CONNECTED INTERNALLY.



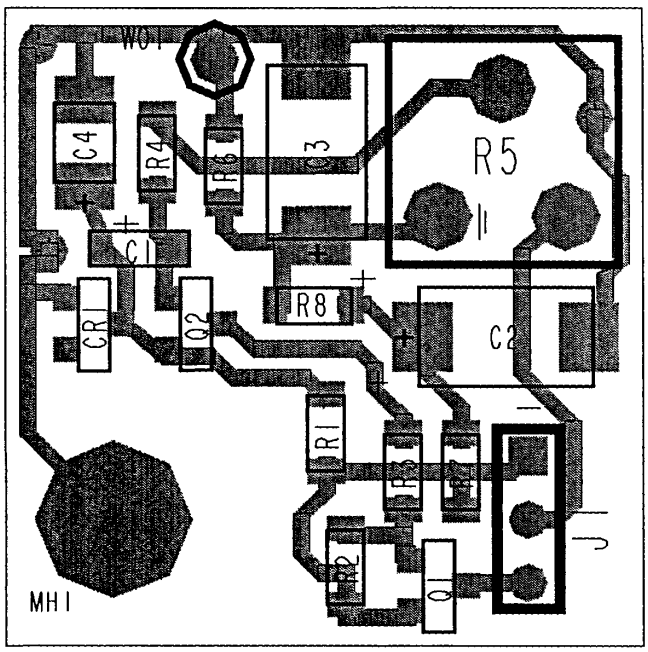
DISPLAY BOARD SCHEMATIC
FIGURE 8–17

The following information is an aid to locating components on the Logic, Display and Rear Connector PC boards. Refer to the grid around the component layout to determine the location of the following components. DIS = Display board, RC = Rear Connector board.

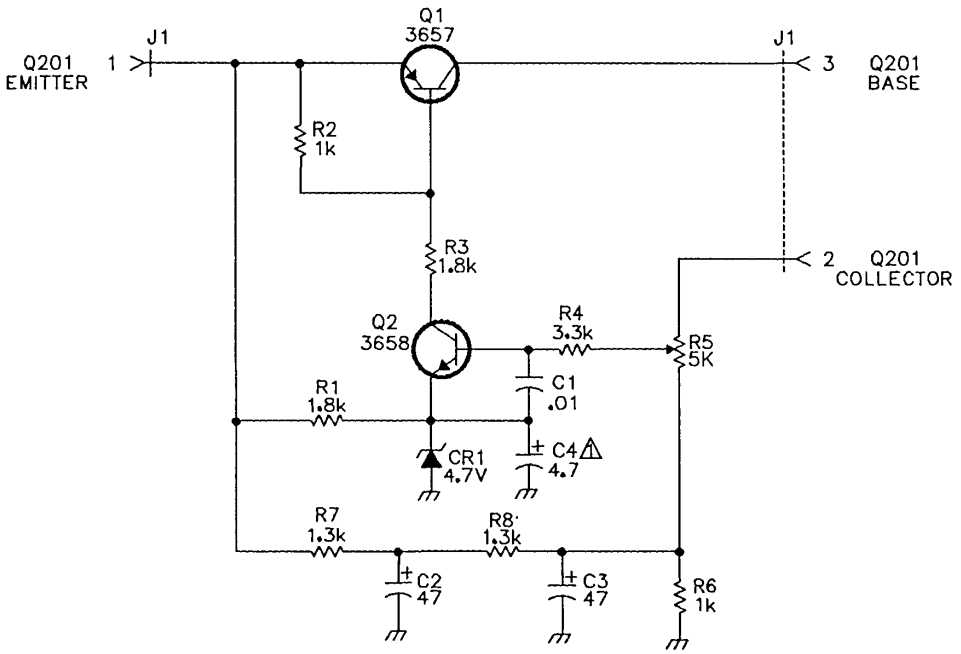
LOGIC CONTROLLER COMPONENT LOCATOR GUIDE

Comp	Loc	Comp	Loc	Comp	Loc	Comp	Loc	Comp	Loc	Comp	Loc
BT701	A8	C 751	B8	CR701	C2	R 708	DIS	R 733	DIS	R 769	C8
C 701	D4	C 752	B8	CR702	C2	R 709	D2	R 734	D2	R 770	C8
C 702	E3	C 753	E8	CR703	D2	R 709	DIS	R 734	DIS	R 771	C8
C 703	D3	C 754	D7	CR704	D2	R 710	C2	R 735	D2	R 772	C8
C 704	D3	C 756	B5	CR704	DIS	R 710	DIS	R 735	DIS	R 773	C8
C 705	D2	C 757	B5	CR705	C2	R 711	C3	R 736	D2	R 774	C8
C 706	C5	C 758	D4	CR705	DIS	R 711	DIS	R 736	DIS	R 775	C8
C 707	C5	C 759	C4	CR706	D3	R 712	DIS	R 737	C3	R 776	C8
C 708	C5	C 760	B1	CR707	D3	R 713	D4	R 737	DIS	R 777	C8
C 709	C5	C 761	B8	CR708	C4	R 713	DIS	R 738	C2	R 778	C8
C 710	D5	C 771	D1	CR709	C4	R 714	D4	R 738	DIS	R 779	C8
C 711	D5	C 772	D1	CR711	C5	R 715	C1	R 739	B3	R 780	C7
C 712	D5	C 773	D5	CR712	C5	R 715	DIS	R 739	DIS	R 781	A7
C 713	D4	C 774	C3	CR713	C5	R 716	E2	R 740	C2	R 782	B5
C 714	E3	C 775	C2	CR714	B7	R 716	DIS	R 740	DIS	R 783	C7
C 715	D3	C 776	B2	CR715	B7	R 717	C1	R 741	C8	R 784	C7
C 716	D3	C 777	B2	CR716	B5	R 717	DIS	R 741	DIS	R 785	B8
C 717	E5	C 778	B2	CR717	A7	R 718	E2	R 742	D8	R 786	B8
C 719	C3	C 783	C2	CR726	D6	R 718	DIS	R 742	DIS	R 787	B6
C 720	B5	C 783	RC	DS701	DIS	R 719	E3	R 743	C8	R 788	B5
C 721	E1	C 784	D2	DS702	DIS	R 719	DIS	R 743	DIS	R 789	B6
C 722	C2	C 784	RC	DS703	DIS	R 720	E3	R 744	B8	R 790	B6
C 723	C2	C 785	C1	DS704	DIS	R 720	DIS	R 745	B8	R 791	B6
C 724	C8	C 785	RC	J 701	A2	R 721	D3	R 745	DIS	R 792	B6
C 725	D8	C 786	D2	J 702	DIS	R 721	DIS	R 746	B8	R 793	B6
C 726	C8	C 786	RC	J 703	DIS	R 722	D3	R 746	DIS	R 794	B8
C 727	B8	C 787	E1	J 730	C4	R 722	DIS	R 747	B1	R 795	B6
C 728	B8	C 787	RC	J 740	C6	R 723	D3	R 748	C3	R 796	E8
C 729	C3	C 788	C1	J 750	E7	R 723	DIS	R 749	C3	R 797	E4
C 730	D4	C 788	RC	J 780	RC	R 724	E5	R 750	D4	R 798	D4
C 731	D4	C 789	C1	JU701	C7	R 724	DIS	R 751	D4	R 799	D4
C 732	D4	C 789	RC	P 805	B7	R 725	B3	R 752	D4	R 800	B5
C 733	C4	C 790	E1	P 806	E1	R 725	DIS	R 753	C4	R 801	B5
C 735	D6	C 790	RC	Q 701	B7	R 726	C3	R 754	C4	R 804	B4
C 736	D6	C 791	RC	Q 701	DIS	R 726	DIS	R 755	C4	R 862	D1
C 737	D6	C 792	RC	Q 702	B7	R 727	C3	R 756	C4	R 863	D1
C 738	B5	C 792	RC	Q 704	C6	R 727	DIS	R 757	C6	R 864	D1
C 739	E8	C 797	RC	R 701	B2	R 728	C3	R 758	B8	R 866	C2
C 741	C7	C 798	RC	R 701	DIS	R 728	DIS	R 759	B7	R 867	C2
C 742	E7	C 799	RC	R 702	B2	R 729	C3	R 760	D7	R 868	C4
C 743	B1	C 800	RC	R 702	DIS	R 729	DIS	R 761	B7	R 869	C4
C 744	B1	C 801	RC	R 703	C3	R 730	E2	R 762	B7	R 870	C2
C 745	A1	C 802	RC	R 703	DIS	R 730	DIS	R 763	C8	R 871	B2
C 746	B6	C 803	RC	R 704	D4	R 731	E2	R 764	C8	R 875	B2
C 747	C1	C 804	RC	R 704	DIS	R 731	DIS	R 765	C8	R 876	B3
C 748	B1	C 941	D6	R 705	D3	R 732	D2	R 766	C8	R 877	C1
C 749	C7	C 942	E5	R 706	D2	R 732	DIS	R 767	C8	R 878	C2
C 750	C7	C 950	A2	R 708	D2	R 733	D2	R 768	C8	R 880	C1

LOGIC CONTROLLER COMPONENT LOCATOR GUIDE (Continued)											
Comp	**Loc**	**Comp**	**Loc**	**Comp**	**Loc**	**Comp**	**Loc**	**Comp**	**Loc**	**Comp**	**Loc**
R 881	C1	R 990	E5	U 701	C6	U 707	B1	U 720	E6	Y 701	D6
R 882	C2	R 991	D6	U 701	DIS	U 708	D5	U 721	D3		
R 883	C2	R 992	E5	U 702	D6	U 709	D5	U 722	C1		
R 886	D1	R 998	B4	U 702	DIS	U 710	D5	U 724	B8		
R 887	D1	R 999	D6	U 703	D6	U 711	C2	U 725	D1		
R 890	C5	RN701	D7	U 703	DIS	U 712	D1	U 726	E8		
R 891	B5	RN702	D6	U 704	C5	U 713	D4	U 727	C3		
R 892	B5	RN703	D6	U 704	DIS	U 715	D2	U 728	B6		
R 893	E1	RN704	D7	U 705	E8	U 716	B2	U 730	B6		
R 894	D1	S 701	DIS	U 705	DIS	U 717	D4	U 731	B3		
R 988	B5	S 702	DIS	U 706	D8	U 718	C3	U 732	D5		
R 989	B5	S 703	DIS	U 706	DIS	U 719	D3	U 733	C5		



DC VOLTAGE CONTROL COMPONENT LAYOUT
FIGURE 8–18



⚠1 NOT USED AT THIS TIME.
⚠2 ALL CAPACITOR VALUES ARE IN MICROFARADS AND RESISTOR VALUES ARE IN OHMS, UNLESS OTHERWISE SPECIFIED.

DC VOLTAGE CONTROL SCHEMATIC
FIGURE 8–19

Part No. 001-1010-104 10-95mwp Printed in U.S.A.