WARNING

THIS MANUAL CONTAINS SERVICING INSTRUCTIONS THAT ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CALLED OUT IN THE OPERATORS MANUAL UNLESS QUALIFIED TO DO SO.

TEKTRONIX®

400
MEDICAL RECORDER

(Serial No. B020000 and up)

WITH OPTIONS

SERVICE

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

Serial Number _____

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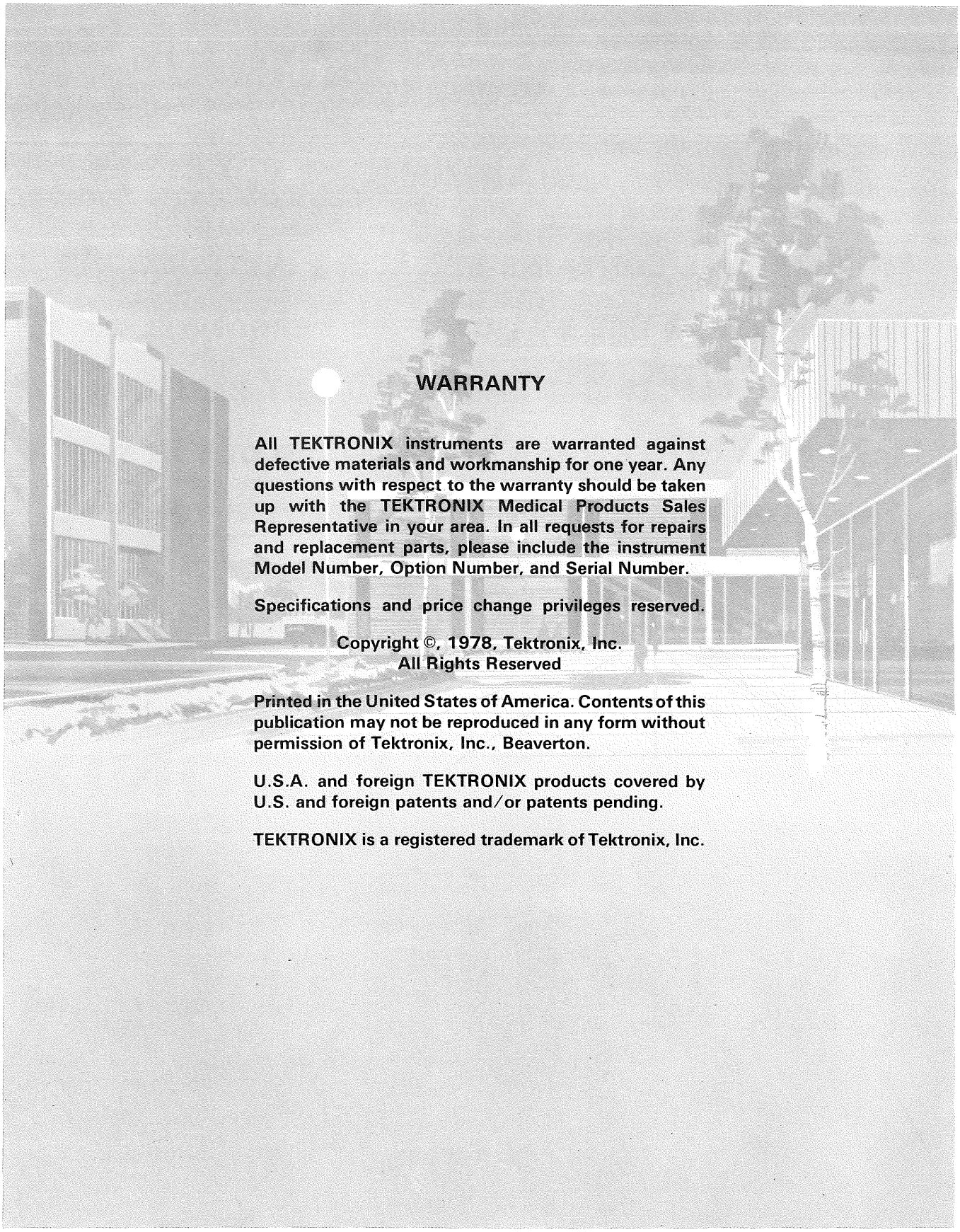

WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with the TEKTRONIX Medical Products Sales Representative in your area. In all requests for repairs and replacement parts, please include the instrument Model Number, Option Number, and Serial Number.

Specifications and price change privileges reserved.

U.S.A. and foreign TEKTRONIX products covered by U.S. and foreign patents and/or patents pending.

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LIST OF ILLUSTRATIONS

The illustrations in Section 7-1 are located near their associated diagrams on the foldout pages.

LIST OF TABLES

SAFETY INFORMATION

This manual contains safety information which you as the user must follow to ensure safe operation of the Monitor/Recorder unit. Refer to the appropriate manual for safety information on the specific monitor used with your Recorder. WARNING information is intended to protect the patient and the operator, and CAUTION information is intended to protect the instrument. The following general safety precautions, which do not appear elsewhere in this publication, must be applied during all phases of operation and maintenance.

WARNING

Use Only With Tektronix Model 408, 412, 413, or 414 Monitor

Do not operate this Recorder in conjunction with any monitor other than those for which it was specifically designed (the Tektronix Model 408, 412, 413, or 414 Monitors). To do so could result in unsafe operation of the Monitor/Recorder unit. Only a Tektronix Field Service Center or other qualified service personnel should mate the Recorder to the Monitor unit.

Do Not Operate Monitor/Recorder in an Explosive Atmosphere

Do not operate the Monitor/Recorder unit in the presence of flammable gases or anesthetics. Explosion can result from operation in such an environment. Safety document NFPA 56A, Standard for the Use of Inhalation Anesthetics, paragraphs 24114(c) and 24032, states that with the appropriate precautions, portable electronic equipment may safely be operated at five feet (or more) above the floor in anesthetic locations.

Use AC Outlet with Protective-Ground Contact

The Monitor/Recorder unit is compatible with isolated power systems as used in operating rooms. In non-isolated power systems, this Monitor/Recorder unit is intended to be operated from a single-phase, earth-referenced power source having one current-carrying conductor (the neutral or grounded conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the line (or ungrounded) conductor has over-current (fuse) protection within the unit.

The unit has a three-wire (18-gauge, SJT grade) power cord and is normally supplied with a three-terminal polarized plug (Hospital Grade) for connection to the power source and protective ground. The ground (earth) terminal of the plug is directly connected to the frame of the Monitor/Recorder unit. For electric-shock protection, insert this plug only in a mating 'Hospital Grade' power outlet with a protective-ground contact. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric-shock hazard.

Inspect the power cord periodically for fraying or other damage. Do not operate the Monitor/Recorder unit from an ac power source if the power cord or plug is damaged.

Use Only Safe Methods of Interconnection

To ensure protection against electric shock from the Monitor/Recorder cabinet whenever auxiliary, line-operated equipment is electrically connected to the unit, the Monitor/Recorder unit must be properly grounded. When the monitor is connected to other line-operated equipment, battery operation should be avoided. If it cannot be avoided, the unit must be grounded using the terminal provided on the rear panel of the monitor. It is extremely important that equipment interconnections are made in accordance with NFPA 76B-T, Tentative Standard for the Safe Use of Electricity in Patient Care Areas of Health Care Facilities, section 3038, 'Signal Transmission Between Appliances'.

Do Not Remove Instrument Covers

High voltage is present inside the monitor. To avoid electric-shock hazard, operating personnel must not remove the protective instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

Do Not Touch Writing Stylus

Do not touch the writing stylus during Recorder operation because the stylus becomes very hot and may cause burns.

CAUTION

Protect the Monitor/Recorder From Foreign Material

Do not insert any object (such as hand, tool, etc.), or allow any foreign material to fall into the opening in the front of the Recorder, as this can cause damage to the electronic components of the unit.

Monitor Mounting Adapter

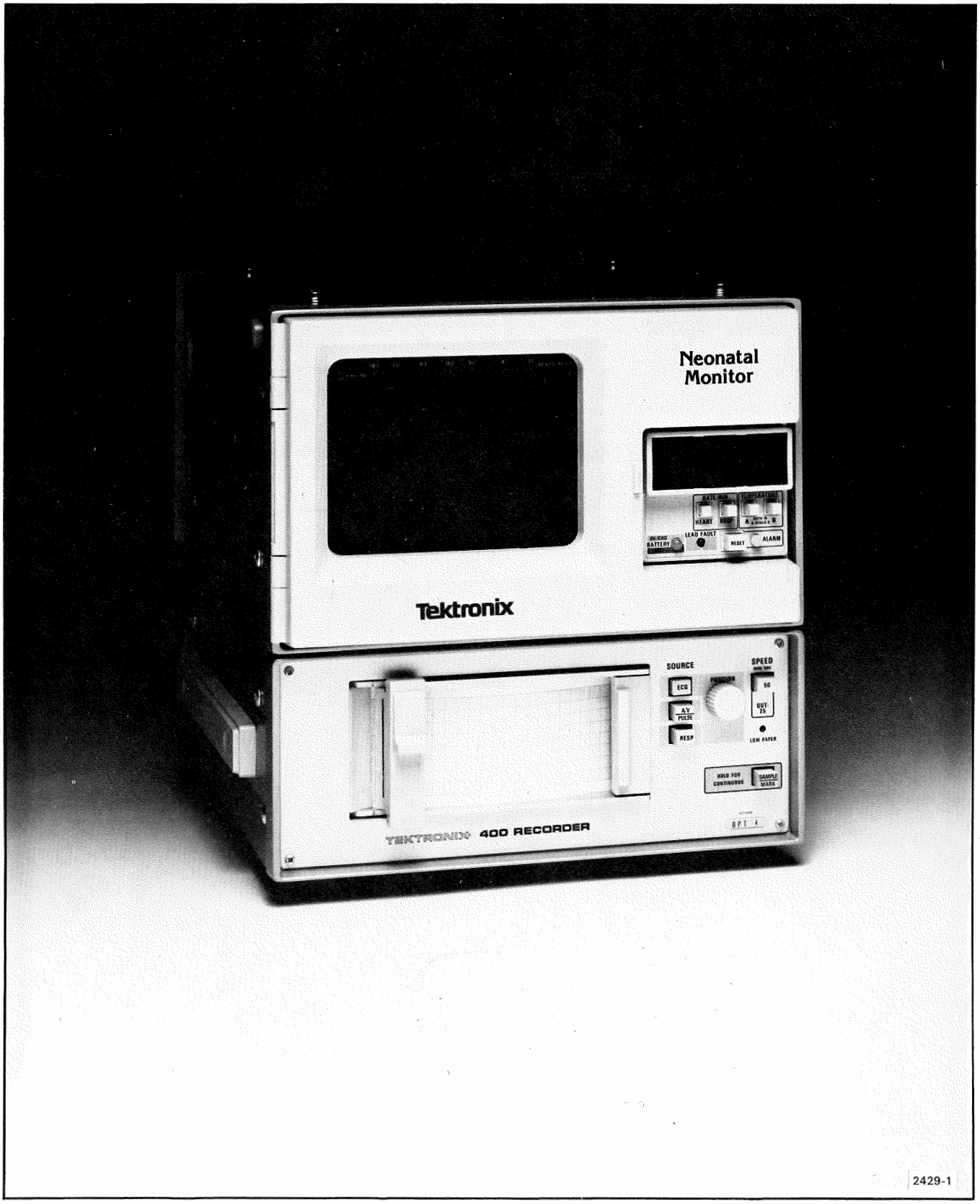
When a Monitor/Recorder is attached to a pole or other support, a plastic support block must be in place on the side of the Recorder under the monitor mounting adapter. This support block, attached to the Recorder at the time of manufacture, provides proper mechanical alignment for the mounting adapter. The Monitor/Recorder mounting fixture design intends that the monitor mounting adapter be used ONLY with the support block installed on the Recorder. See mounting instructions in General Information Section.

Additional safety information can be found in the following documents:

(1) Canadian Standards Association C22.2, No. 125, Electro-Medical Equipment, 1973.

(2) National Fire Protection Association:
NFPA 56A, Standard for the Use of Inhalation Anesthetics, 1973.
NFPA 70, National Electrical Code (Article 517), 1975.
NFPA 76B-T, Tentative Standard for the Safe Use of Electricity in Patient Care Areas of Health Care Facilities, 1973.

(3) Underwriters' Laboratories, Inc:
U.L. 544, Standard for Safety, Medical and Dental Equipment, 1974.



400 OPTION 4 Recorder with 413 Monitor.

GENERAL INFORMATION

DESCRIPTION

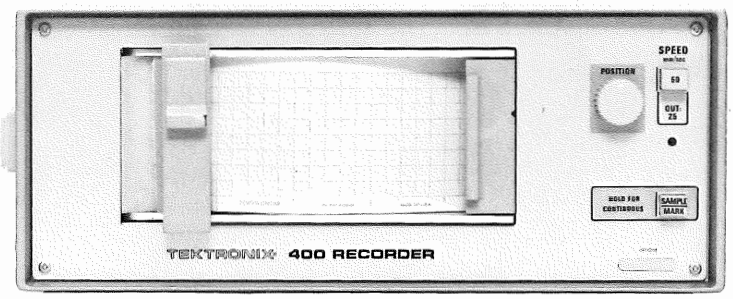
The 400 Recorder is a strip chart recorder (direct writer) which attaches directly to a Tektronix Patient Monitor. Five versions of the 400 Recorder are available (Standard, Option 1, Option 2, and Option 3) to match the capabilities of the 408, 412, and 414 Series Patient Monitors, and Option 4, to match the 413 Series Patient Monitors. Although each model of Recorder is designed to complement a particular monitor's capabilities, any Recorder model can be used on any of the above series monitors with certain feature limitations. To optimize feature matching, refer to Figure 1-1 for the recommended Monitor/Recorder combinations.

The chart Recorder produces permanent paper-strip copies of monitored data. All Recorder models provide single-channel waveform writing of selected patient parameters at two selectable chart speeds. The Recorder display is always one half the amplitude of the monitor display. In addition, the Option 2, 3, and 4 Recorders also provide an alpha-numeric printout, with every record cycle, of patient vital signs and elapsed time. (This feature is effective only in conjunction with the 413 & 414 Series Monitors.)

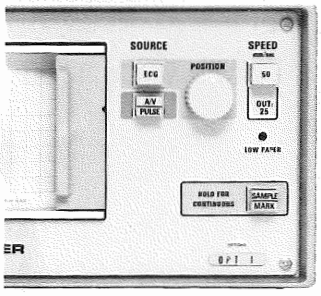
Record cycles of 14-second duration (or 28-second duration for the Option 3 Recorder) can be initiated manually or automatically. The automatic record cycles can be initiated at nominal 15-minute intervals and upon monitor alarm.

Waveform writing is accomplished by a thermal stylus (uses no ink) on heat-sensitive paper. A stylus heat control is provided for adjustment of copy darkness.

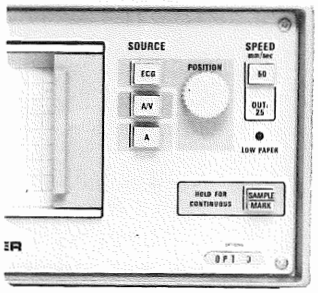
Recorder-equipped monitors are single-unit portable instruments, requiring no separate power or external interconnect wiring. Recorders operate directly from the monitor's internal battery pack and add only about 8 pounds to the monitor package.



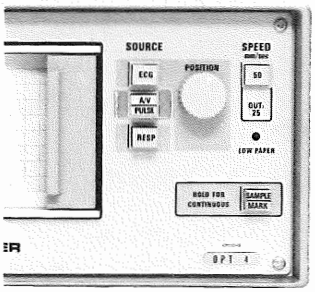
400 STANDARD RECORDER



OPTION 1 & 2



OPTION 3



OPTION 4

RECOMMENDED MONITOR/RECORDER COMBINATIONS

Recorder Model	Recommended Monitor
Standard	408
Option 1	412
Option 2	414, 414 Opt 20 (MOD XA)
Option 3	414 Opt 21 (MOD FA)
Option 4	413, 413 Opt 20

Figure 1-1. Recorder models and recommended Monitor/Recorder combinations.

SPECIFICATIONS

The electrical specifications in Table 1-1 apply when the following conditions are met: (1) The recorder must have been mated to an appropriate Tektronix monitor (see Fig. 1-1), (2) the instrument must have been adjusted at an ambient temperature between +20 and +30 degrees C (+68 and +86 degrees F), and (3) the instrument must be operating in an ambient temperature between 0 and +50 degrees C (+32 and +122 degrees F).

NOTE

The recorder obtains its operating power from the monitor battery pack even when the monitor is connected to the ac power line. Batteries presently used in monitors accept less than a complete charge at ambient temperatures above +25 degrees C. Therefore, available monitor and recorder run time is reduced in ambient temperatures above +25 degrees C.

TABLE 1-1
Electrical

Characteristics	Performance Requirement	Supplemental Information
STANDARD RECORDER		
Direct Writer	Moving hot stylus on thermally-reactive moving paper.	Trace density adjustable by STYLUS HEAT control (rear panel).
Chart Paper	50 mm wide, with 40 mm grid (5 mm major divisions).	3 inch maximum diameter roll (about 190 ft. long). Ten-roll box, Tektronix Part 006-2408-00 recommended.
Chart Speeds	25 or 50 mm/second ±5%.	Selected by front-panel pushbutton.
ECG		
Sensitivity	10 mm/mV, ±10%, with monitor ECG SIZE control set at 20 mm/mV.	10 mm/V, ±5%, at recorder input.
Frequency Response		
Monitors with monitoring bandwidth		
10 mm Pen Deflection	≤0.2 to ≥35 Hz (–3 dB).	
40 mm Pen Deflection	≤0.2 to ≥30 Hz (–3 dB).	
Monitors with Diagnostic bandwidth		
10 mm Pen Deflection	≤0.05 to ≥60 Hz (–3 dB).	
40 mm Pen Deflection	≤0.05 to ≥55 Hz (–3 dB).	
Baseline Positioning	Adjustable ≥1.5 cm above and below chart centerline.	Adjusted by front-panel POSITION control.
Linearity	A signal producing a 5 mm deflection near the center of the chart produces a deflection of 5 mm, ±5%, at any other position within the chart grid area.	Linearity accuracy must not be added to sensitivity accuracy.
Power Source	Monitor battery pack.	Each 14 seconds of recorder operation reduces the available monitor battery operating time by about 45 seconds. See Note at beginning of Specifications Section.

TABLE 1-1 (CONT.)

Electrical

Characteristics	Performance Requirement	Supplemental Information
Record Sample Activation		
Manual	14-second, ± 1.4 second, sample manually started by SAMPLE/MARK pushbutton or by remote contact closure connected to the rear-panel REMOTE SAMPLE/MARK jack.	Records continuously as long as SAMPLE/MARK pushbutton is held in or remote contacts remain closed, plus 14 seconds after release.
Timed Interval	Rear-panel pushbutton allows recorder to initiate a record sample every 15 minutes, ±2 minutes.	Other time intervals can be selected by P136. See Figure 1-7.
Alarm	Rear-panel pushbutton causes a 14 second record sample to be taken automatically when the monitor indicates an alarm.	
Identification Mark	5 mm (–2, +4 mm), 40 ms (±15 ms) rectangular pulse.	Pulse rises above trace when SAMPLE/MARK pushbutton is pressed while recorder is running.

OPTION 1 RECORDER

Specifications for Option 1 Recorder are same as those for Standard Recorder plus the following:

Pressure/Pulse		Selected by SOURCE pushbutton switch marked A/V/PULSE. A=Arterial, V=Venous.
Pressure Sensitivity		
414 412	Pen Deflection:	
250 (250)	5 mm per 50 (50) mmHg, ±5%	
150 (125)	5 mm per 30 (25) mmHg, ±5%	
25 (50)	5 mm per 5 (10) mmHg, ±5%.	
Frequency Response		
Pressure		Dc to about 20 Hz.
Pulse		0.1 Hz to about 20 Hz.
Baseline Positioning	A zero volt pressure signal applied to monitor produces a trace 5 mm, ±1 mm, above bottom line of chart.	

OPTION 2 RECORDER

Specifications for Option 2 Recorders are same as those for Standard and Option 1 Recorders, plus the following:

Alpha-numeric Printout		Elapsed time, heart rate, blood pressure, temperature, and respiration printed along top margin of chart. When the monitor determines that a parameter is overranging, the recorder prints asterisks in place of the parameter. Parameters printed vary according to monitor type.

TABLE 1-1 (CONT.)
Electrical

Characteristics	Performance Requirement	Supplemental Information
Elapsed Time (ET)	Prints out in hours and minutes to 9:59, then repeats. Accurate to ±1 minute in 10 hours. Timing begins from zero when the first sample is taken following monitor turn-on.	
Heart Rate (RATE)	Prints out in beats/minute. Accurate to ±3 bpm at 60 and ±5 bpm at 250 of monitor input.	Derived from ECG, pressure or pulse channel as determined by monitor.
Blood Pressure (BP A/V)[1]	Prints out in millimeters of mercury (mmHg). Accurate to ±5 mmHg of monitor input.	Prints systolic, diastolic and mean pressure values. A minus sign is printed for negative pressure values.
Temperature (TEMP A and/or TEMP B)	Prints out in ° C or ° F as specified by monitor. Accurate to ±0.3° C or ±0.5° F over a range of +5° to +45° C or 41° to 113° F for instrument ambient temperature between +15° and +35° C. Accuracy is ±0.5° C or ±0.9° F over same range for instrument ambient temperature between 0° and +50° C.	With Yellow Springs Instrument Co. Series 700 probes. Temperature printout is eliminated when temperature probe is disconnected. Printout range, –5° to +45° C or +23° to +113° F.
Respiration (RESP)	Prints out in breaths per minute. Accurate to ±3 bpm at 30 and ±5 at 120 of input to monitor.	Monitor derives respiration from its ECG channel.
Alarm	Prints out the word ALARM at the end of print sequence when monitor is in an alarm state.	
Overrange	When monitor determines that a parameter is in overrange, the recorder prints asterisks in place of parameter values.	
Deviation from Monitor Readout	±5 counts maximum.[2]	

OPTION 3 RECORDER

Specifications for Option 3 Recorders are same as those for Standard, Option 1, and Option 2 Recorders, plus the following:

Record Sample Time	28, ±2.8 seconds, or until printout complete. Printout starts 14, ±1.4 seconds after sample is initiated.	Set at P182 on Run Control board.
Blood Pressure (BPA)	Prints out in millimeters of mercury (mmHg). Accurate to ±5 mmHg of monitor input. Pressure value settles to ±3 counts of final reading, 10 seconds after a pressure change occurs.	Prints systolic, diastolic and mean pressure values for Channel A and then Channel A/V. Printout is eliminated if pressure transducer is disconnected from monitor. A minus sign is printed for negative pressure values.

[1] The pressure channel of single pressure 414 Monitors (414, 414 GA, etc.) is always on, except in PULSE mode. When no pressure transducer is connected to the monitor, the pressure channel "floats" causing the recorder to print invalid blood pressure values.

[2] With instrument operating in an ambient temperature range of +15°C to +35°C.

TABLE 1-1 (CONT.)
Electrical

Characteristics	Performance Requirement	Supplemental Information

OPTION 4 RECORDER

Specifications for Option 4 Recorders are same as those for Standard, Option 1, and Option 2 Recorders, plus the following:

Respiration		
Sensitivity	1 ohm change in input to monitor produces a 10 mm (±2.5 mm) pen deflection, with monitor Respiration Size control set to calibrated position.	Monitor derives respiration signal from a changing ac impedance between LA and RA ECG leads. See monitor manual.
Frequency Response (–3 dB)	0.1 Hz or less, to at least 4 Hz.	

TABLE 1-2
Environmental Characteristics

Characteristics	Performance Requirement
Ambient Temperature	
Operating	0 to +50 degrees C (+32 to +122 degrees F). See battery-capacity note at beginning of Specifications section.
Non-operating	–40 to +60 degrees C (–40 to +140 degrees F).
Altitude	To 15,000 feet.

TABLE 1-3
Physical Characteristics

Characteristics	Description
Weight	
Standard and Option 1	7.5 lb (3.4 kg).
Option 2, 4	8.5 lb (3.86 kg.)
Option 3	8.6 lb (3.9 kg.)
Height	
Recorder with Feet	4.06 inches (10.3 cm).
Monitor/Recorder with Feet	10 inches (25.6 cm).
Width	9 inches (23.1 cm).
Depth (including cord wraps and knob protrusions).	11.7 inches (29.8 cm).

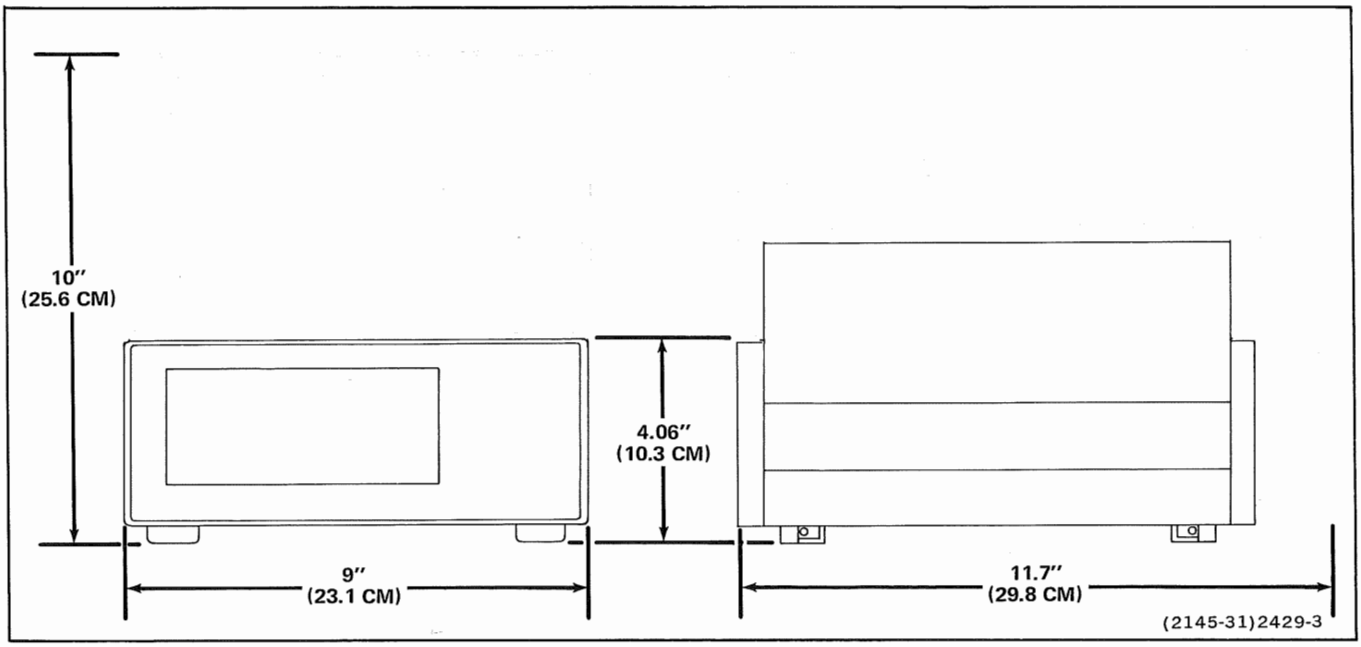


Figure 1-2. Dimensional outline drawing.

MOUNTING INFORMATION

The following accessories are available for mounting the Monitor/Recorder unit on a pole.

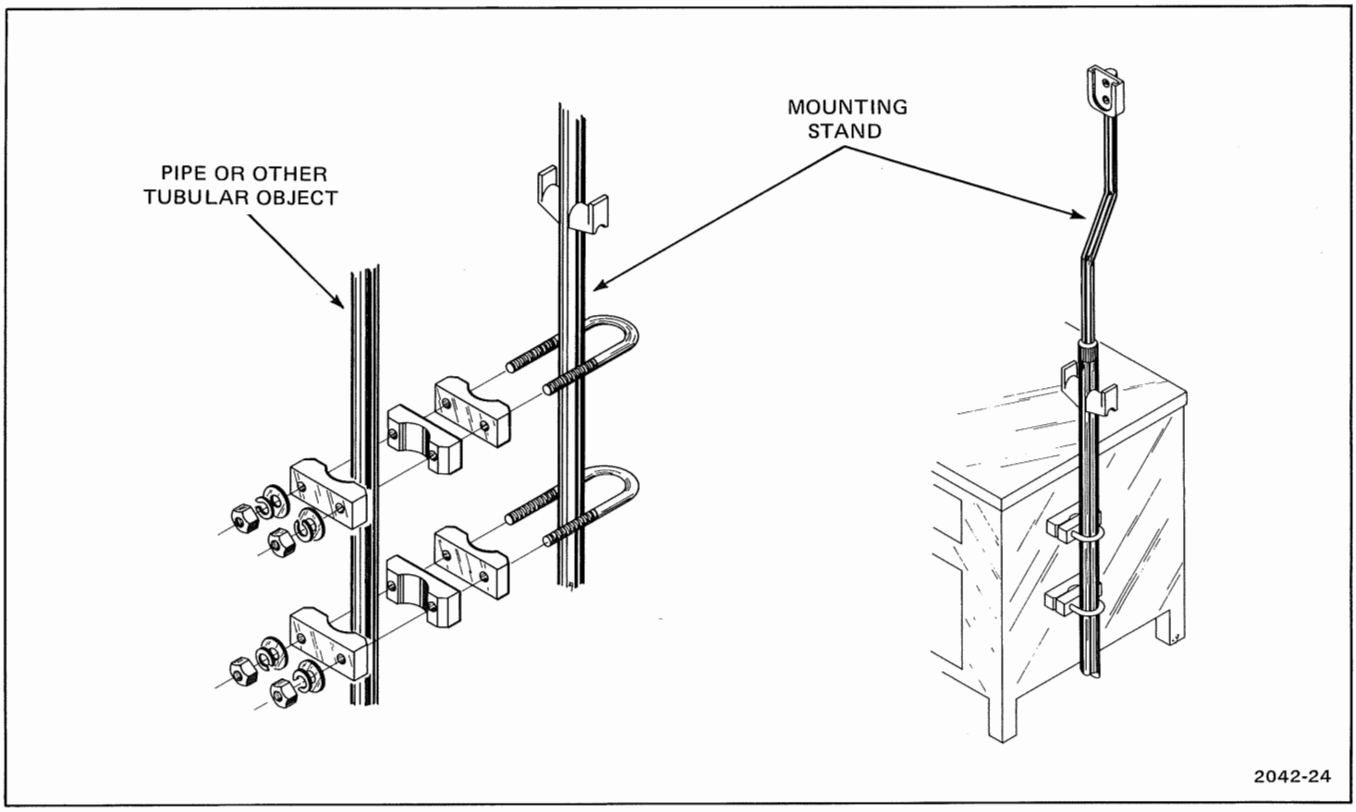


Figure 1-3. Installing mounting stand to tubular object (pipe) or cabinet side.

MOUNTING KIT

Includes Mounting Stand to mount Monitor/Recorder at five-foot level. Attaches to vertical pipes or surfaces of anesthesia machines or similar devices.

Tektronix Part 016-0110-00

MOUNTING BRACKET

Attaches to top of Mounting Stand. Mates with Mounting Fixture below.

Tektronix Part 407-1767-00

MOUNTING ADAPTER

Attaches to monitor. Mates with Mounting Bracket above. (Included with monitor as a standard accessory.)

Tektronix Part 014-0054-00

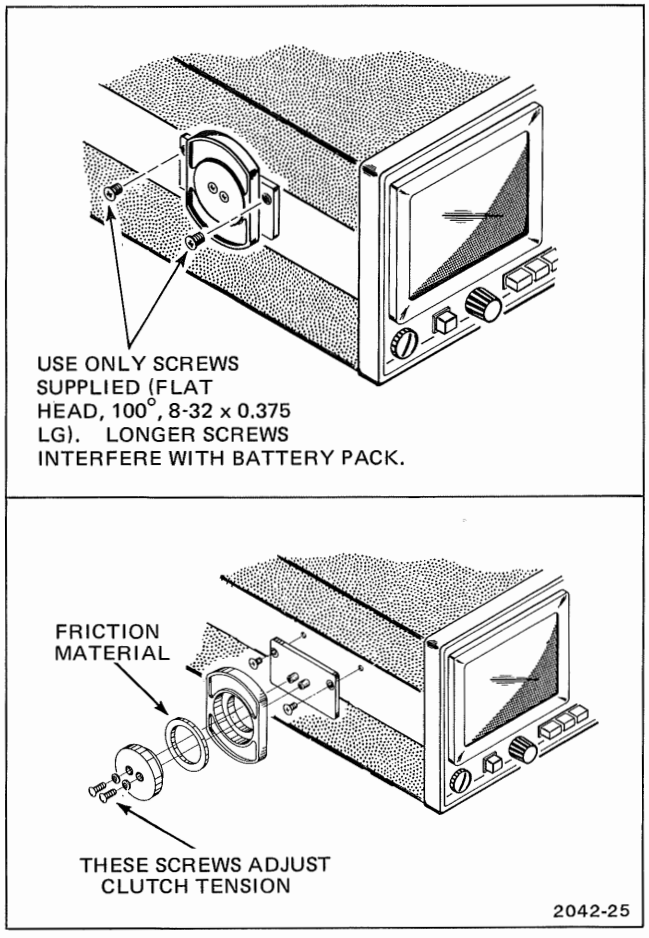


Figure 1-4. Installing mounting adapter to Monitor/Recorder unit.

RECORDER SUPPORT BLOCK

Attaches to recorder. Provides proper mechanical alignment for the mounting adapter. (Attached to recorder at factory.)

Tektronix Part 391-0147-00

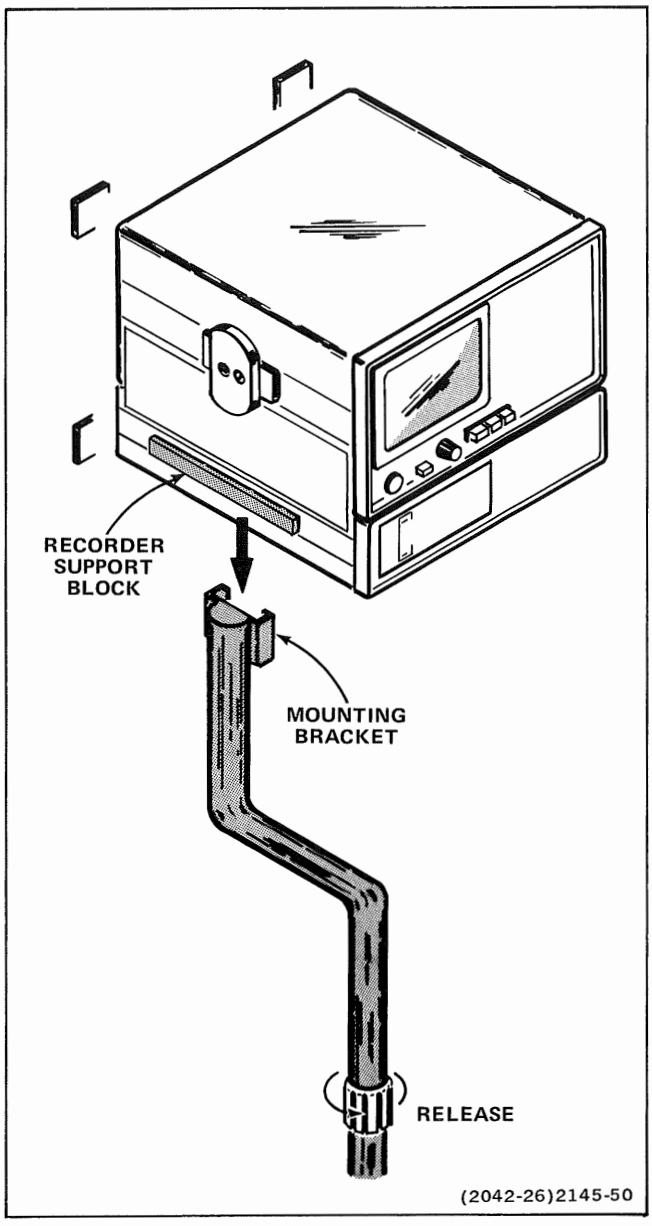


Figure 1-5. Mounting Monitor/Recorder to mounting stand.

SUPPLEMENTAL INFORMATION

RUN CONTROL PROGRAMMABLE FUNCTIONS

Each model of recorder is shipped from the factory with the Run Control circuitry pre-programmed to operate optimally for its intended use. Table 1-4 shows how each recorder model is set at the factory. Figure 1-7 shows what run-control functions are available and how to make a change if desired.

BATTERY DRAIN

Figure 1-6 is a curve showing typical current taken from the monitor battery during recorder operation.

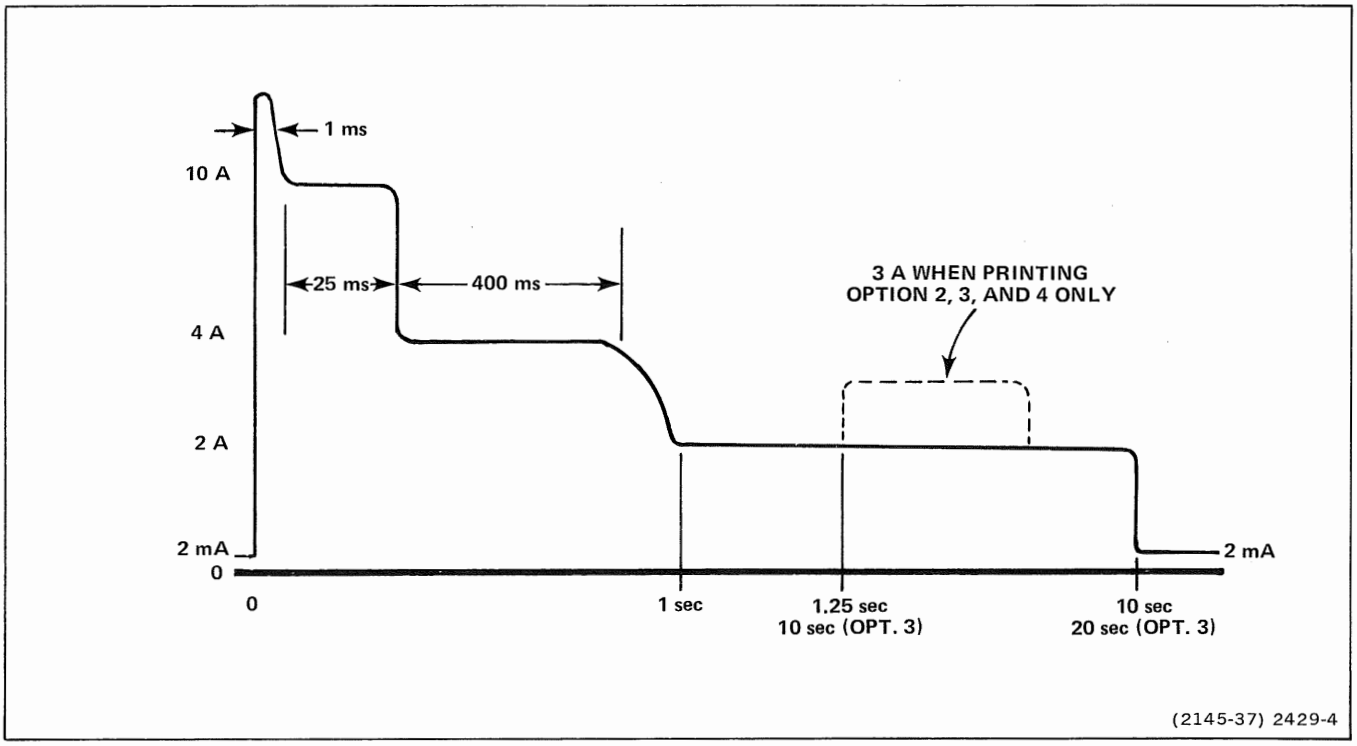


Figure 1-6. Typical battery drain.

TABLE 1-4

Factory Programmed Run-Control Functions

	Run Timer			Automatic Sample Interval Timer				
Recorder Model	Run Time	Print Delay	P182 Jumpers	Interval	P136 Jumpers	Waveform Printed At Selected Chart Speed	Alpha-Numerics Printed at Selected Chart Speed	P203 Jumpers
Standard	14 sec	NA	Pins 1-2 & 5-7	15 min	Pins 3-7	X	NA	Pins 1-2
Option 1	14 sec	NA	Pins 1-2 & 5-7	15 min	Pins 3-7	X	NA	Pins 1-2
Options 2, 4	14 sec	1.75 sec	Pins 1-2 & 5-7	15 min	Pins 3-7	X	X	Pins 1-2
Option 3	28 sec	14 sec	Pins 1-5 & 6-7	15 min	Pins 3-7	X	X	Pins 1-2

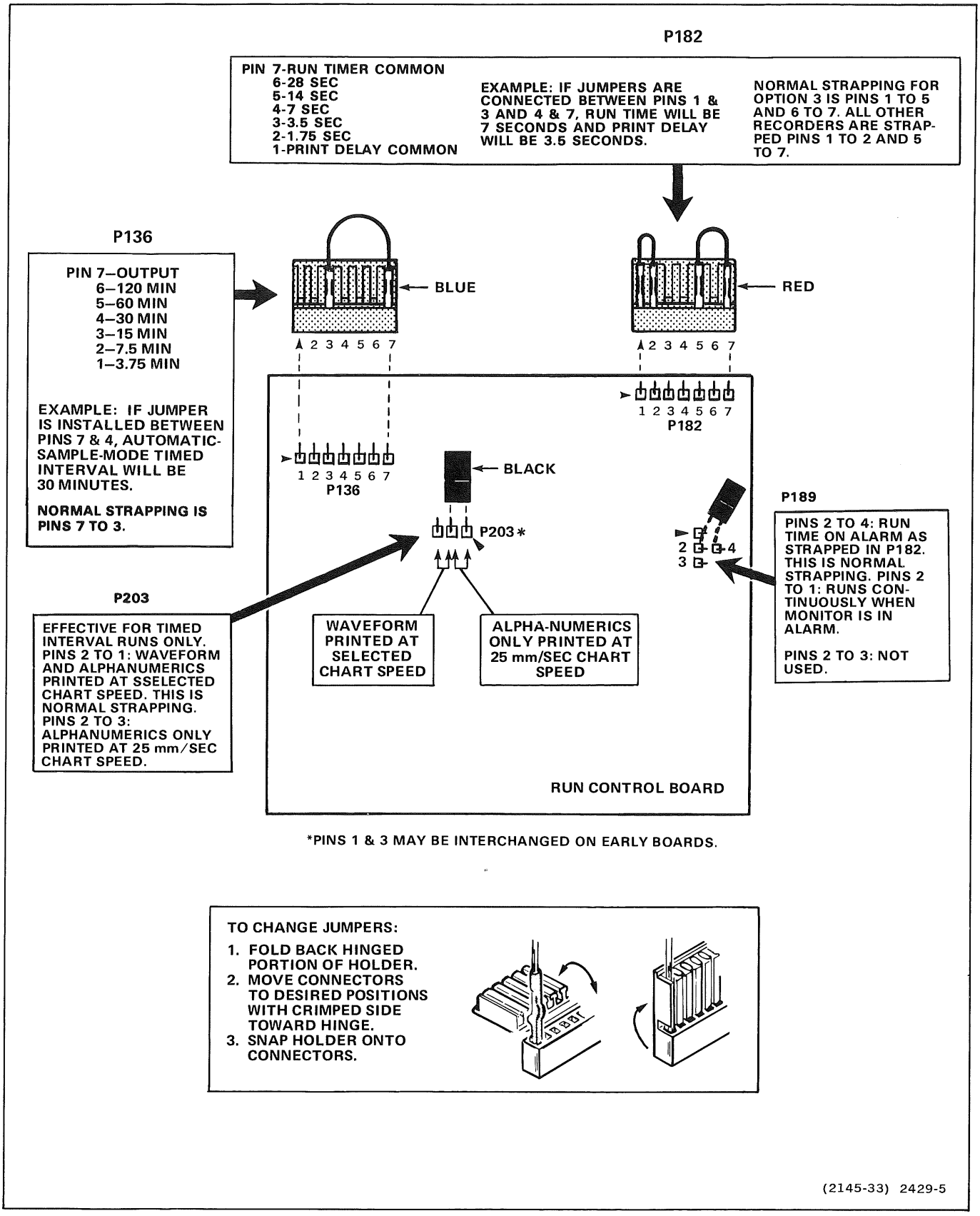


Figure 1-7. Programming Run Control circuit.

408/412/414 MONITOR/RECORDER ADAPTER KIT INSTALLATION

NOTE

It is intended that this kit be installed only by Tektronix Service personnel.

INTRODUCTION

To join a 400 Series Recorder to any Tektronix 408, 412, or 414 Monitor, the following items must be at hand:

1. A 408, 412, or 414 Monitor.

2. A 400 Recorder.

3. An 016-0498-00 Adapter Kit, which contains sufficient electrical and mechanical parts to connect any option recorder to a 408, 412, or 414 monitor. This kit is shipped with all recorders except the Option 4.

4. A monitor battery pack manufactured subsequent to summer 1976. These packs have heavy cell interconnects, a fusing arrangement, and a special connector which provides power to the recorder. If needed, this battery pack must be ordered separately.

Battery-Pack Ordering Information

All monitors mated to alpha-numeric printing recorders (Options 2, 3, 4) must have F-cell battery packs for satisfactory operation. D-cell packs, although not recommended, can be used in a monitor mated to Standard or Option 1 recorders. However the result is about 50% less operating time. Select the appropriate battery pack from the list below.

To replace	with	Order Tektronix Part No.
D-cells	D-cells	119-0441-01
D-cells	F-cells	040-0710-01
F-cells	F-cells	119-0443-01
F-cells	D-cells	Not recommended

Figure 1-8 shows a typical 408, 412, or Monitor/Recorder installation. These steps summarize the installation procedure.

1. A -01 battery pack is installed in the monitor (providing it doesn't already have a battery pack, or its pack does not have provision for recorder operation).

NOTE

If a new battery pack is to be installed, the resistor which determines battery charging current may need to be replaced. Instructions and the proper resistor are packaged with each new battery pack.

2. A Manifold Board is installed in the monitor. This is the interconnection point between various monitor models and the recorder.

3. The necessary cables are connected from the monitor internal circuitry to the Manifold Board.

4. A multi-conductor ribbon cable is connected between the Manifold Board and the Recorder.

5. The monitor and recorder are joined mechanically and tested.

INSTALLATION INSTRUCTIONS

A. Monitor Preparation

NOTE

Check off each step as you complete it.

1. Check contents of Adapter Kit. Check that you have all the components before beginning. See Figure 1-9.

2. Obtain a Service Manual for your monitor. You will have to refer to it later in these instructions.

3. Prepare Monitor.

   a. Disconnect monitor from ac power source.

   b. Remove top cover. Remove two screws on each side. Lift up left side of cover, make sure it has cleared the ECG LEAD CHECK terminals, and remove cover from the monitor.

   c. Remove bottom cover. Remove two screws on each side and pull cover straight off.

   d. Unplug the battery cable connector P711 from the main board. You will be instructed to reconnect it in a later step.

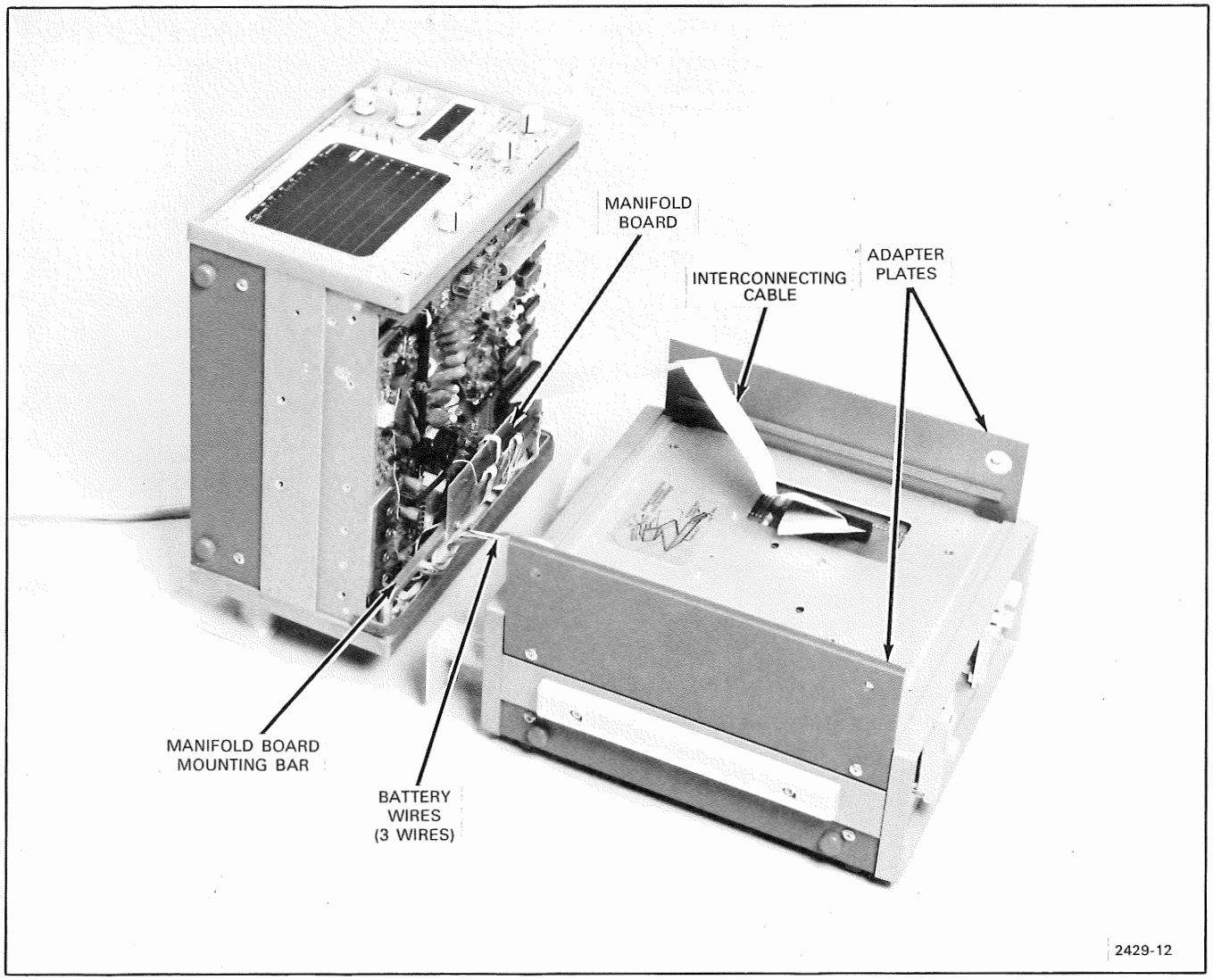


Figure 1-8. Typical 408, 412, or 414 Monitor/Recorder adapter kit installation.

CAUTION

Do not short cells. Nickel-cadmium cells are capable of delivering high currents which can cause wire insulation to melt.

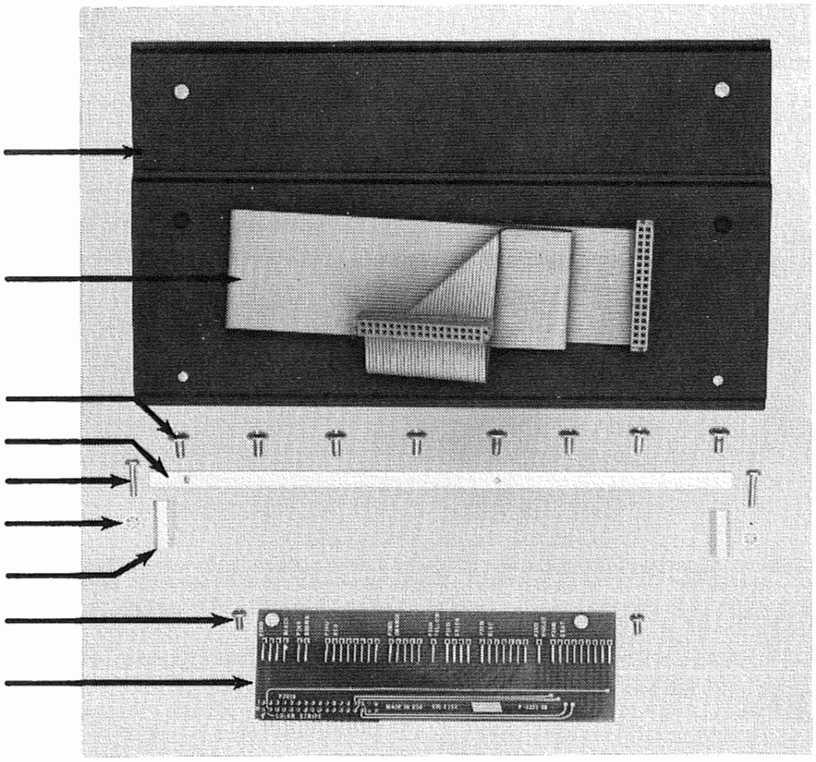
4. If necessary, replace battery pack with new one which has been adapted for recorder use. See list of battery packs in the introductory portion of these instructions. Do not connect either the recorder or monitor battery connector until instructed to do so.

CAUTION

Most of the monitor and recorder circuits can be damaged by the discharge of static electricity into them. The damage may not become apparent for several months. Before proceeding, review and adhere to the Recommended Handling Rules on page 4-8.

5. Install white-violet wire (with violet connector) on main board. See Figure 1-10 for 414 Monitors or Figure 1-11 for 408 and 412 Monitors.

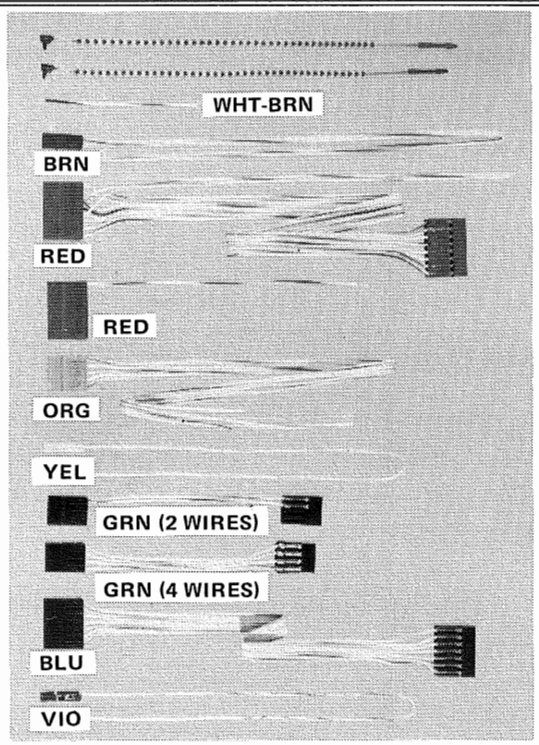
TEKTRONIX PART NO.	QUANTITY
386-3601-00	2
175-1984-00	1
211-0542-00	8
381-0379-00	1
211-0014-00	2
210-0004-00	2
129-0123-00	2
211-0008-00	2
670-4754-00	1



ABOVE COMPONENTS FOR 408, 412, 414 MONITORS

TEKTRONIX PART NO.	QUANTITY	408	412-735C	412	414	414 FA
006-0531-00	2				●	●
2"—#26 INSULATED WIRE	1					●
175-1986-00	1			●	●	
175-1968-00	1					●
195-0187-00	1				●	
175-1969-00	1				●	●
195-0169-00	1	●	●	●	●	●
175-1965-00	1	●				●
175-1966-00	1		●	●	●	
175-1970-00	1				●	●
195-0171-00	1	●	●	●	●	●

SELECT THESE COMPONENTS FOR YOUR PARTICULAR MONITOR



(2145-1) 2429-67

Figure 1-9. 016-0498-00 Monitor/Recorder Adapter Kit contents.

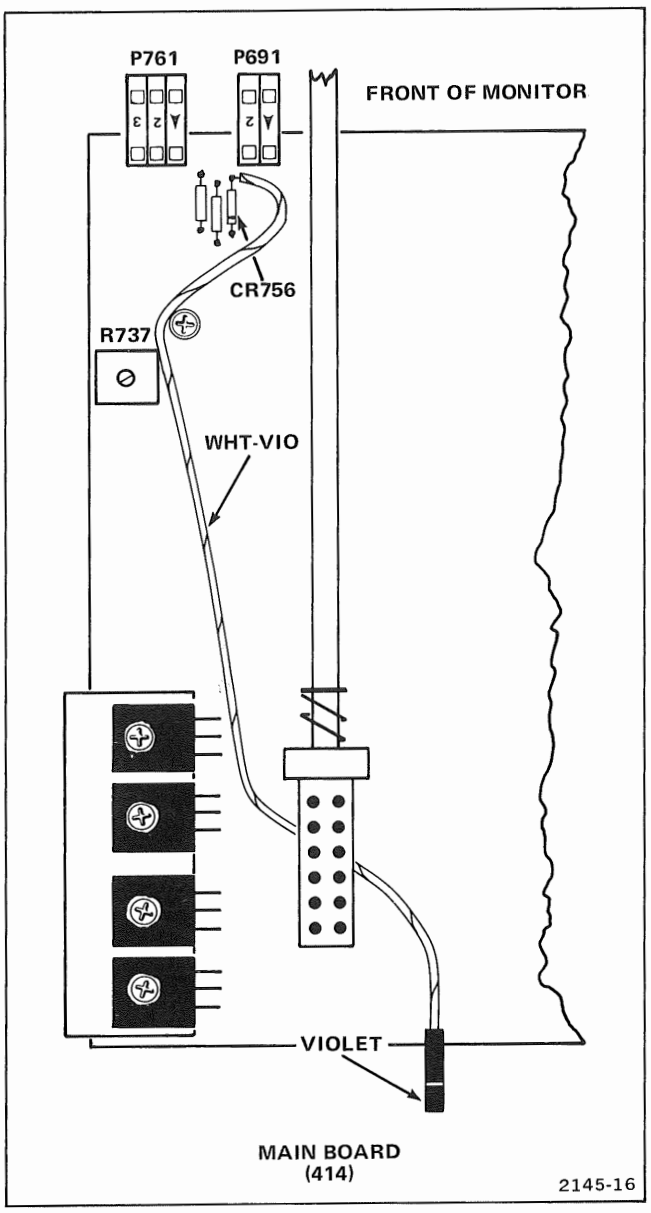


Figure 1-10. Installing wire to 414 Main Board.

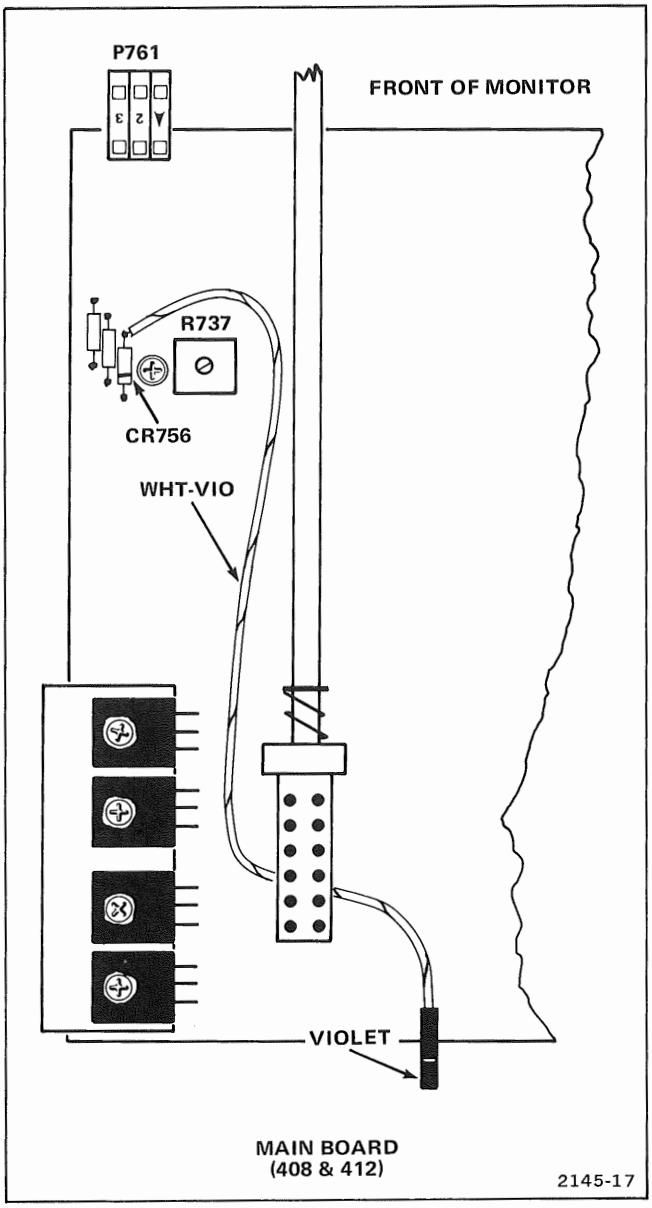


Figure 1-11. Installing wire to 408 and 412 Main Board.

6. Bend down pins on P605, P692, P693, and P702 and install Manifold Board mounting bar as shown in Figure 1-12.

7. Remove ECG board. Refer to Maintenance section in monitor Service Manual for removal instructions.

8. Install white-yellow wire on ECG board as shown in Figure 1-13.

NOTE

The remaining instructions are divided by monitor type. To complete installation of the Adapter Kit, select one of the following sections; B–408; C–412 MOD 735C; D–412; E–414; F–414 Option 21 (MOD FA); G–414 Option 20 (MOD XA).

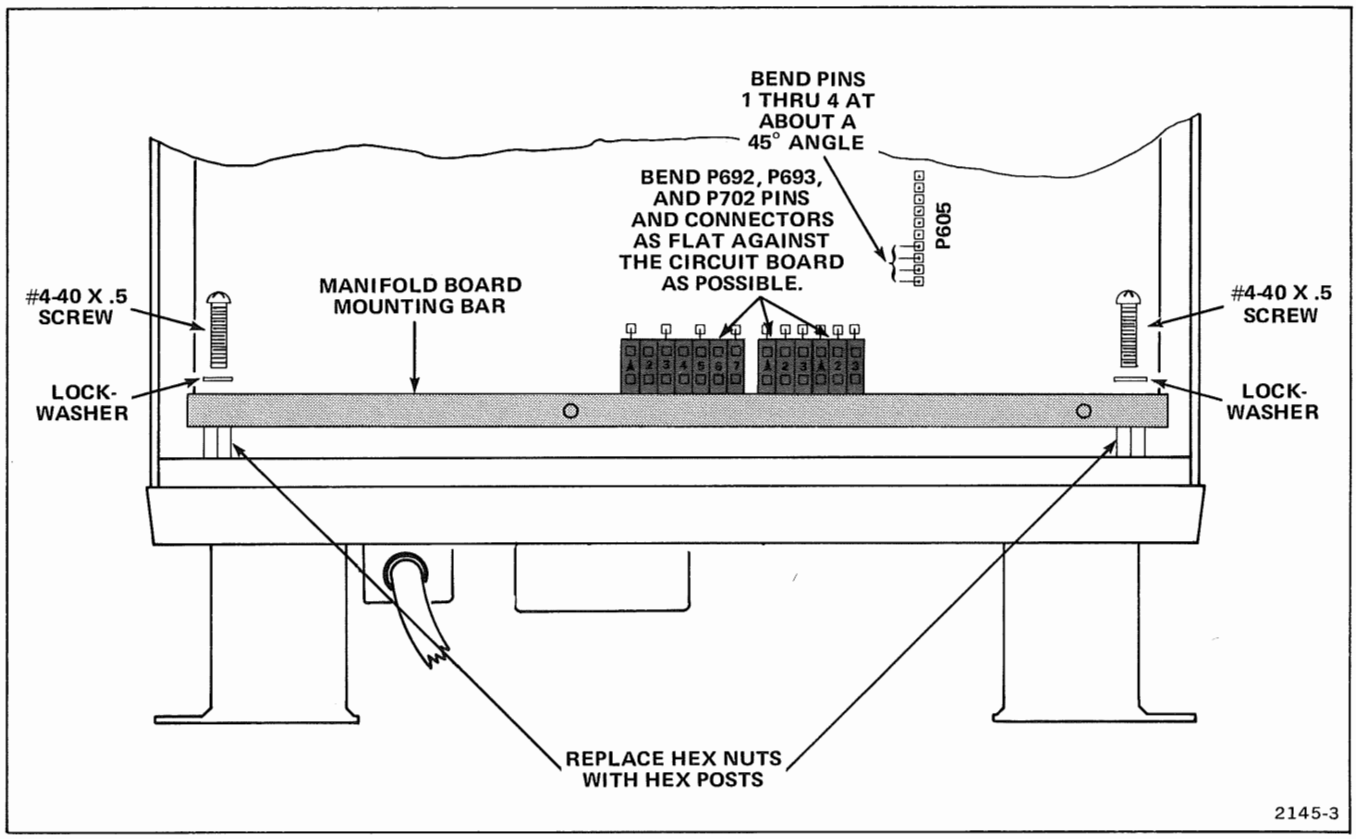


Figure 1-12. Installing Manifold Board mounting bar.

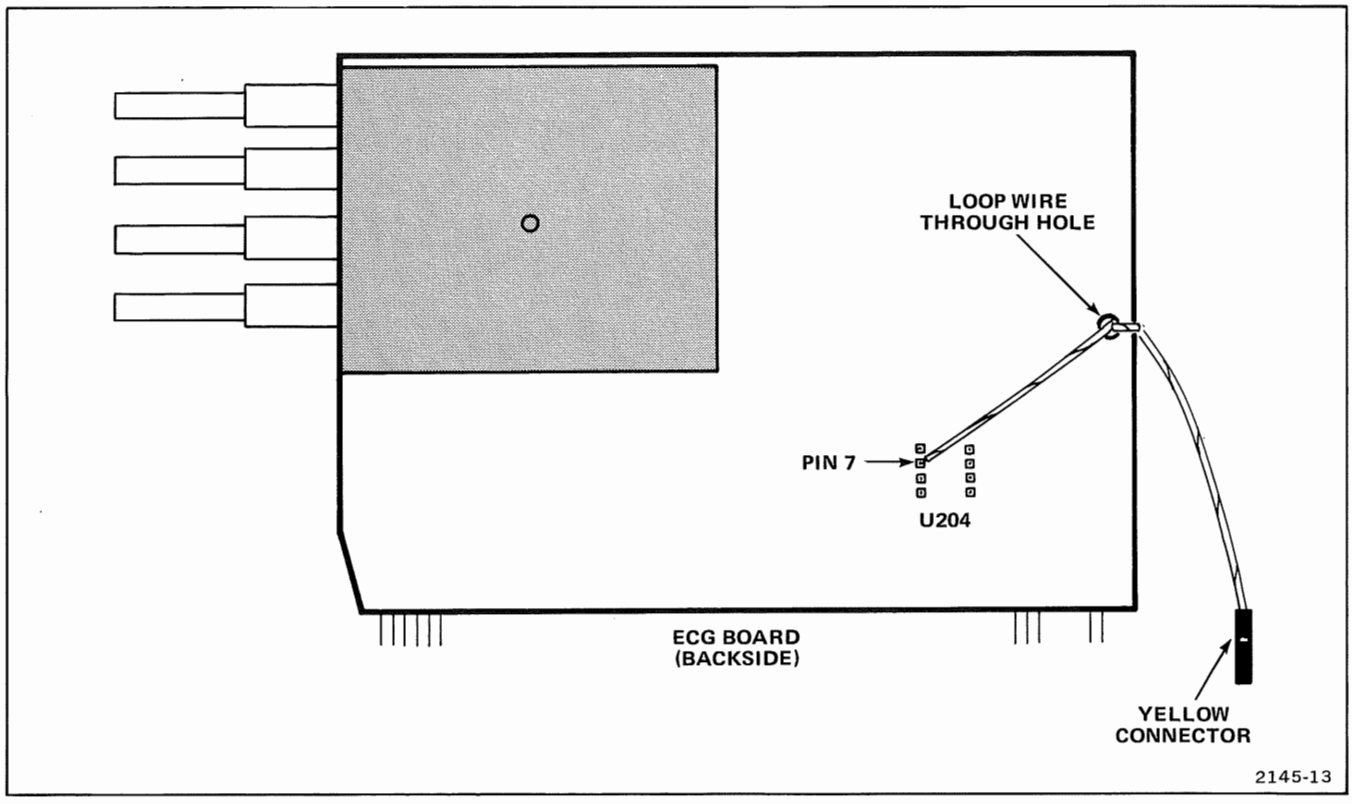


Figure 1-13. Installing wire to ECG Board.

B. 408 Monitors

NOTE

Refer to the Maintenance section of the monitor Service Manual for board removal and installation procedures.

1. Install ECG board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

2. Connect two-wire cable with green connector to P605; install Manifold Board and connect remaining cables. See Figure 1-14.

3. Mount recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

C. 412 Mod 735C Monitors

NOTE

Refer to the Maintenance section of the monitor Service Manual for board removal and installation procedures.

1. Install ECG board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

2. Connect four-wire cable with green connector to P605; install Manifold Board and connect remaining cables. See Figure 1-15.

3. Mount recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

D. 412 Monitors

NOTE

Refer to the Maintenance section of the monitor Service Manual for board removal and installation procedures.

1. Remove Pressure/Pulse Board.

2. Install 2-wire cable (with brown connector) on Pressure/Pulse Board as shown in Figure 1-16.

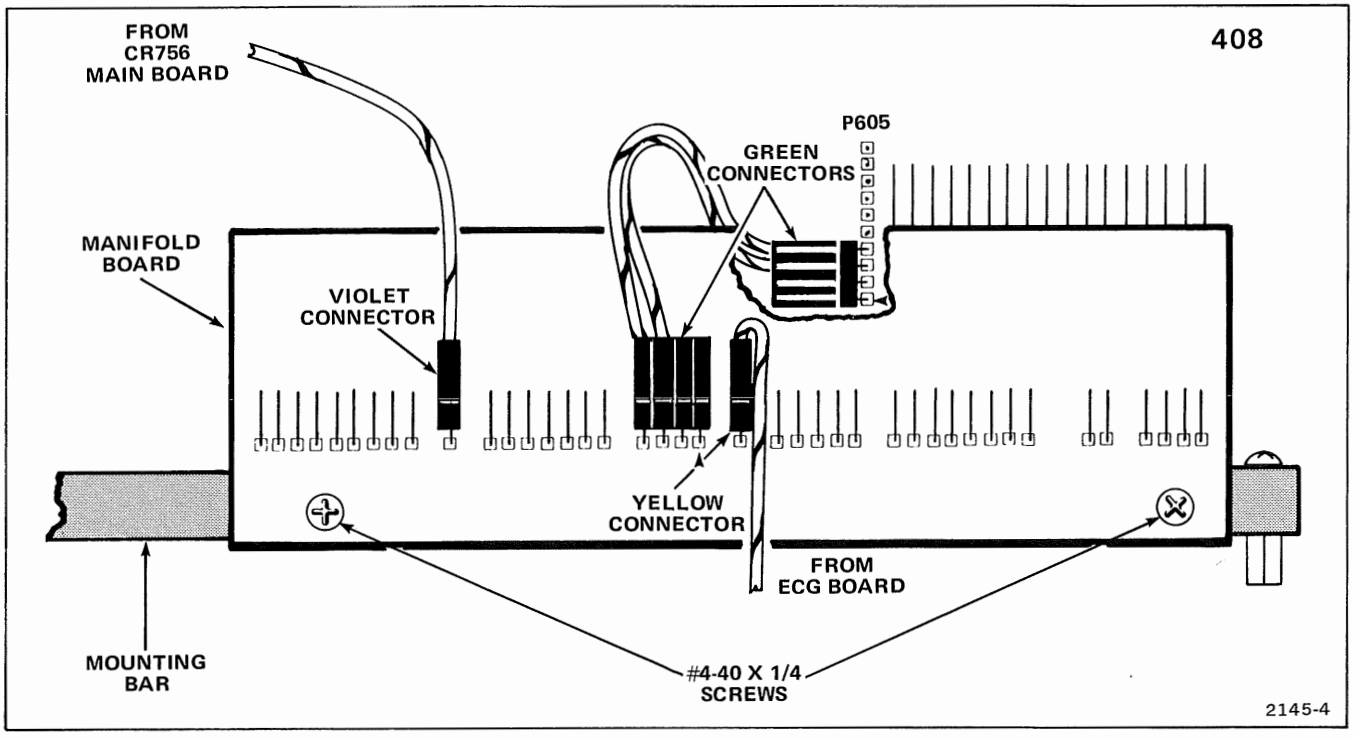


Figure 1-14. Installing Manifold Board and connecting cable in 408.

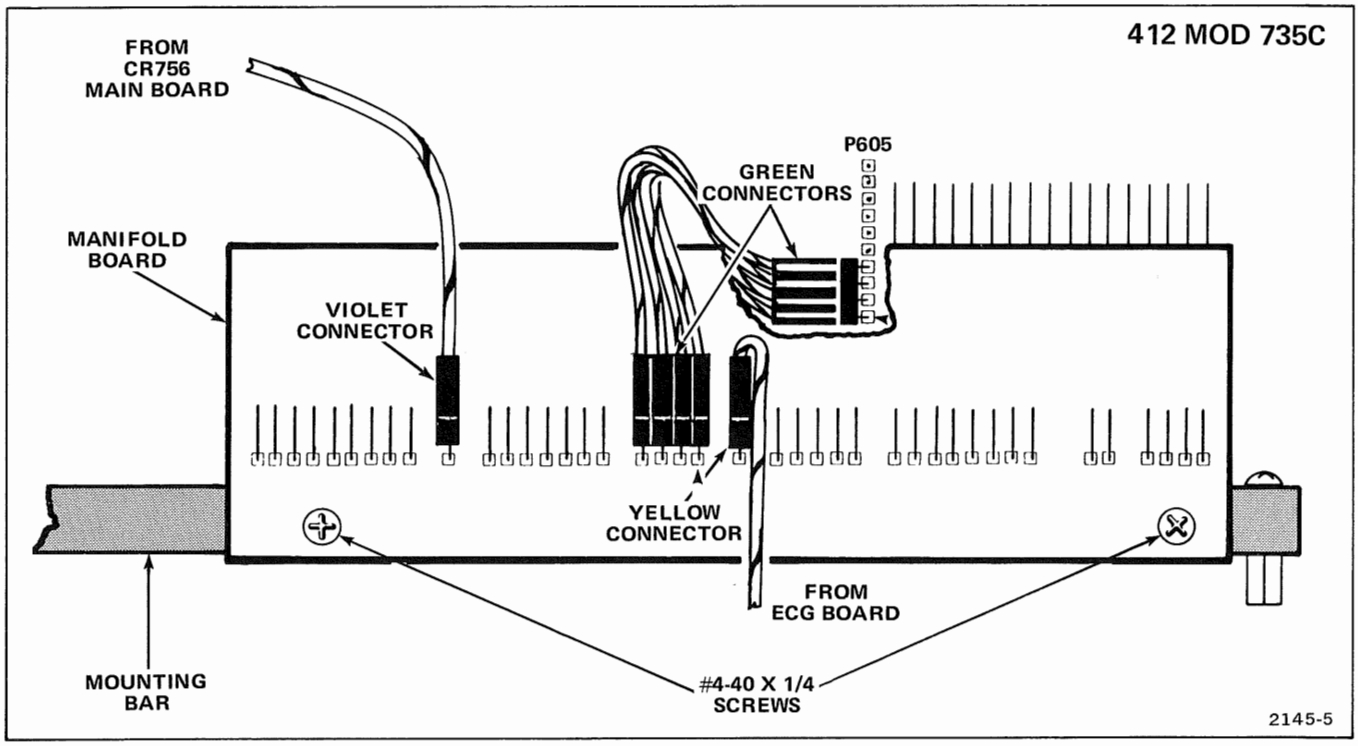


Figure 1-15. Installing Manifold Board and connecting cables in 412 735C.

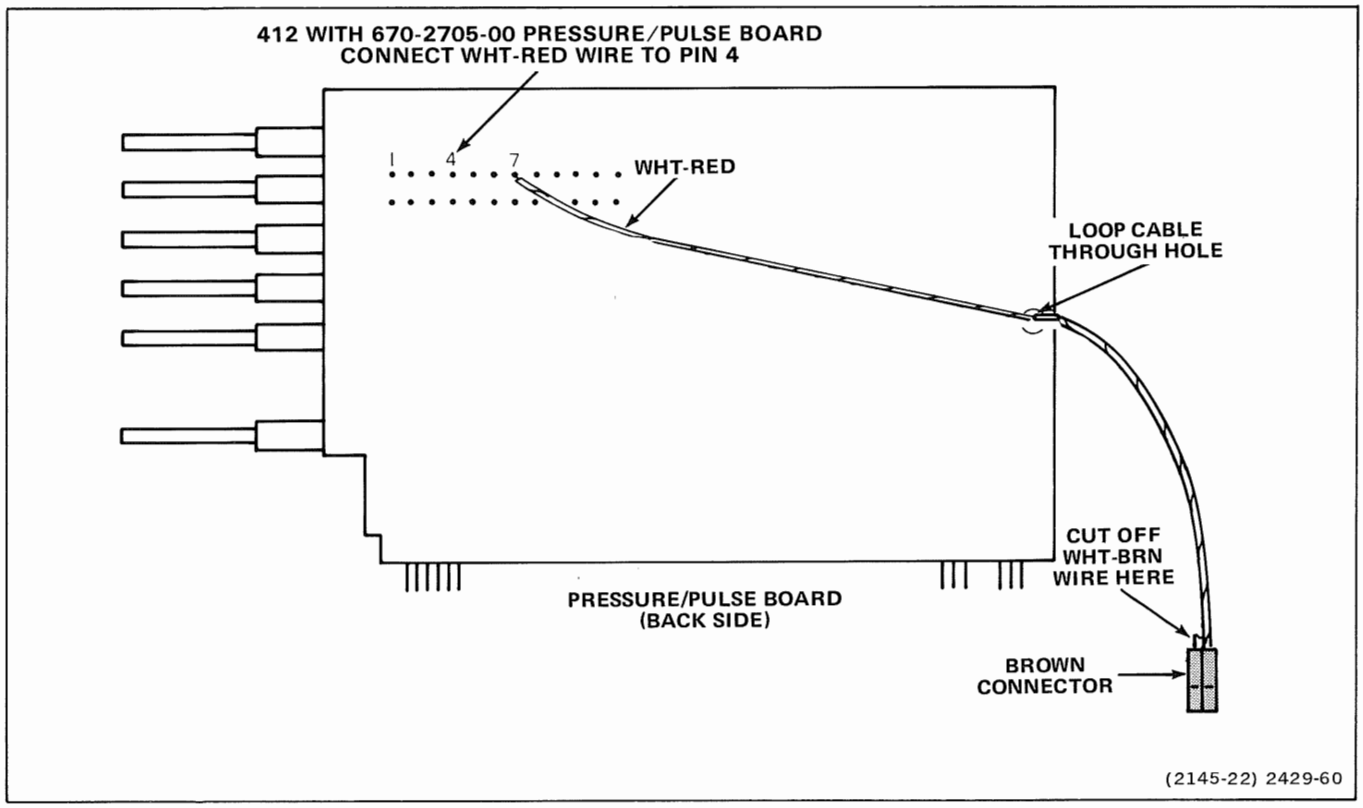


Figure 1-16. Installing 2-wire cable to 412 Pressure/Pulse Board.

3. Install Pressure/Pulse Board. Dress added cable down the inside of rear panel and between the rear frame casting and the added Manifold Board mounting bar.

4. Install ECG board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

5. Connect four-wire cable with green connector to P605, install Manifold Board and connect remaining cables. See Figure 1-17.

6. Mount recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

E. 414 Monitors

NOTE

Refer to Maintenance section of Monitor Manual for board removal and installation procedures.

1. Remove Readout Conditioner Board.

2. Remove Pressure/Pulse Board.

3. Install 5-wire cable (with orange connector) to Readout Conditioner Board as as shown in Figure 1-18.

4. Install 2-wire cable (with brown connector) on Pressure/Pulse Board as shown in Figure 1-19.

5. Install ECG Board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

6. Install Readout Conditioner Board. Dress added 5-conductor cable down inside of rear panel and between the rear frame casting and the added Manifold Board mounting bar.

7. Install Pressure/Pulse Board. Dress added cable down inside rear panel and between the rear frame casting and the added Manifold Board mounting bar.

8. Plug the 7-conductor cable (with blue connectors) onto the Readout Conditioner Board pins marked P1075. Dress this cable down the inside of the rear panel and between the rear frame casting and the Manifold Board mounting bar.

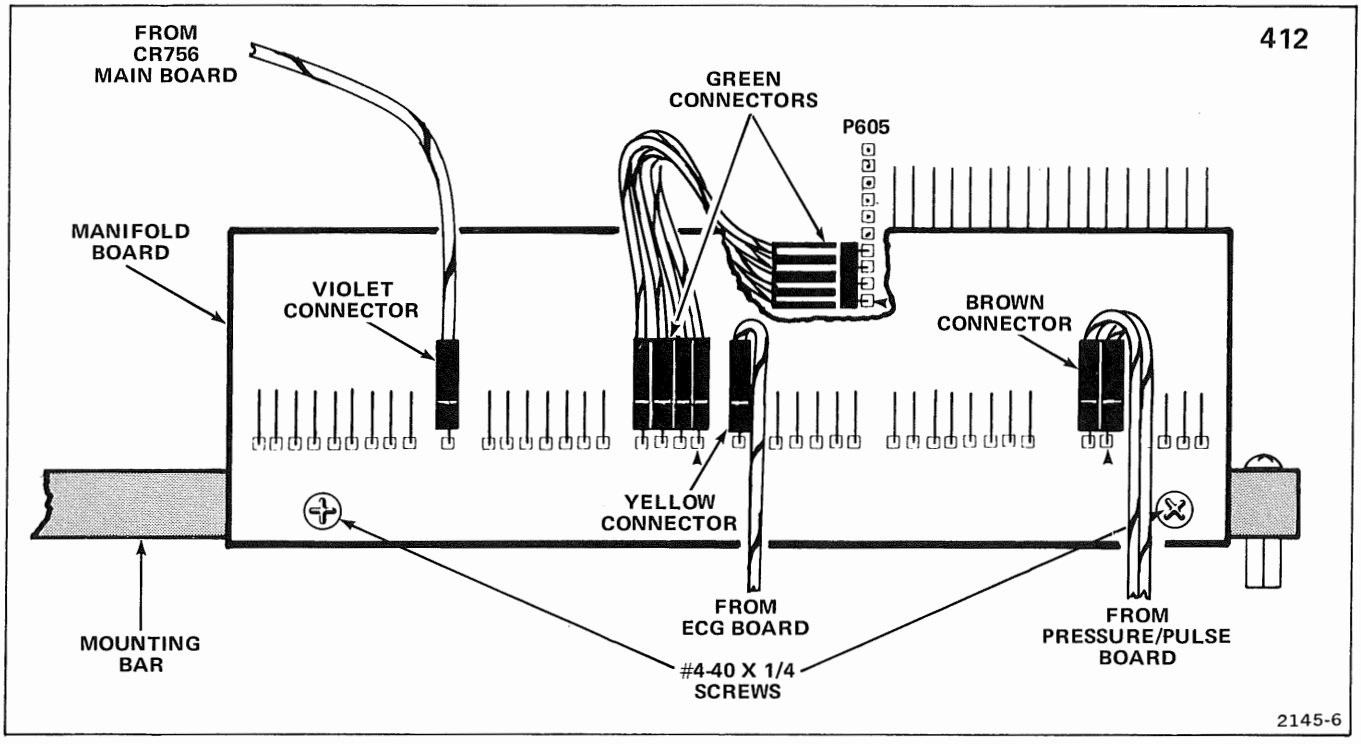


Figure 1-17. Installing Manifold Board and connecting cables in 412.

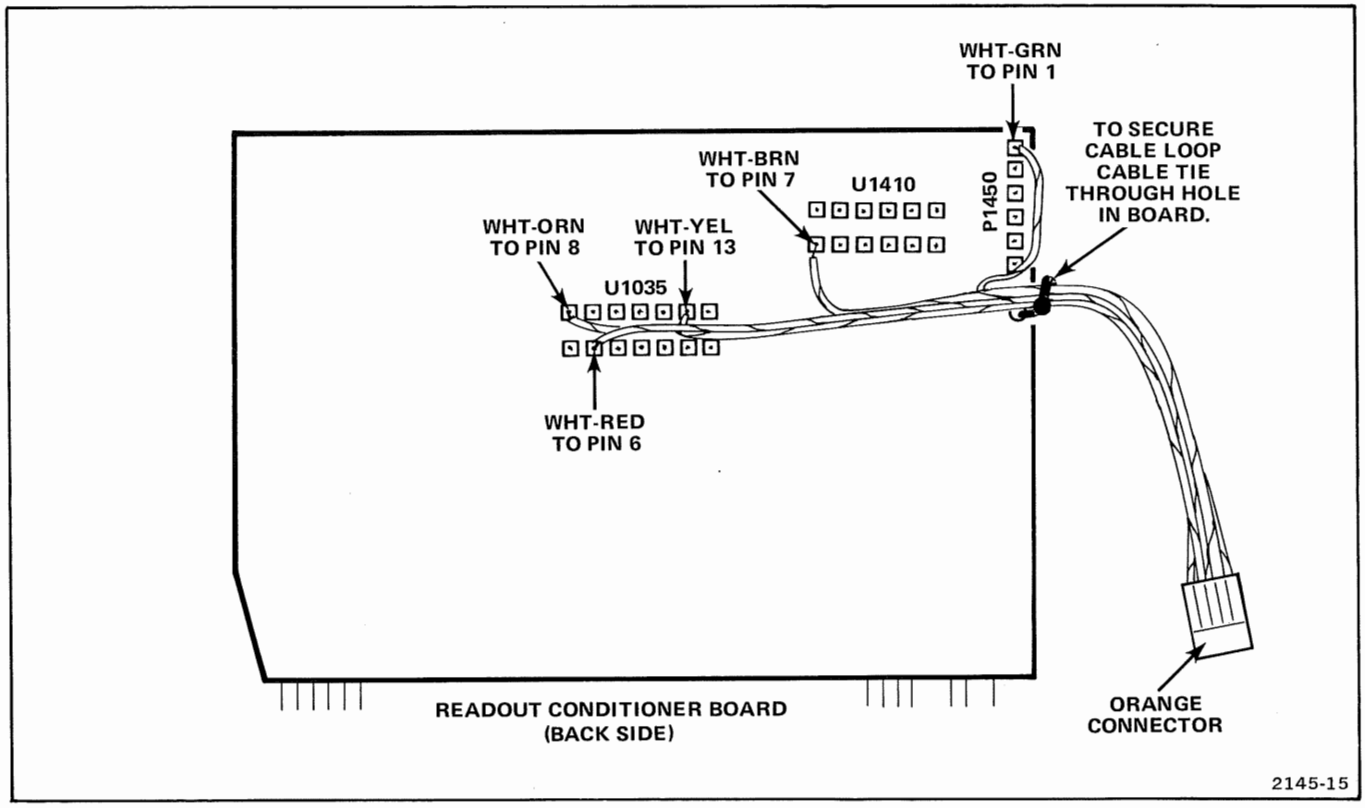


Figure 1-18. Installing 5-wire cable to 414 Readout Conditioner Board.

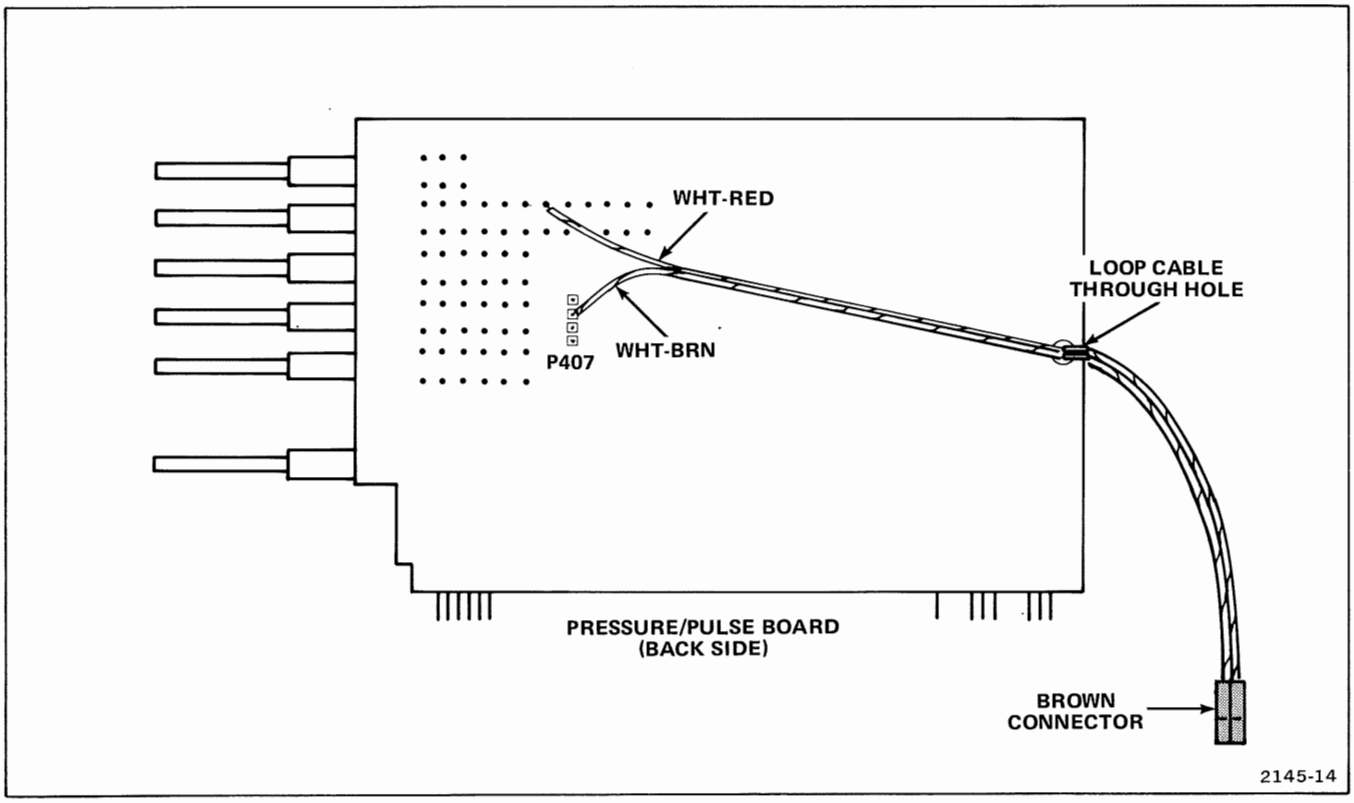


Figure 1-19. Installing 2-wire cable to 414 Pressure/Pulse Board.

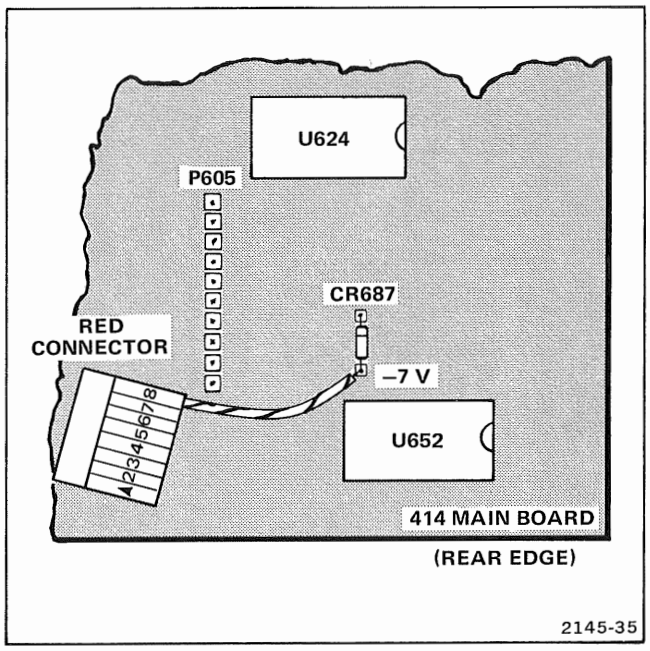


Figure 1-20. Connecting white-red wire to –7 V on 414 Main Board.

9. Connect single wire from 8-conductor red holder to the anode of CR687 as shown in Figure 1-20.

10. Connect four-wire cable with green connector to P605, install Manifold Board and connect remaining cables. See Figure 1-21.

11. Mount recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

F. 414 Option 21 (Mod FA) Monitors

NOTE

Refer to Maintenance section of Monitor Manual for board removal and installation procedures.

1. Remove Readout Conditioner Board.

2. Install 5-wire cable (with orange connector) to Readout Conditioner Board as shown in Figure 1-22.

3. For 414 FA Monitors Serial Numbers B010100-B041281: Add a short length of insulated wire (from kit) to the back side of the Dual-Pressure Board between pin 1 of P3006 and pin 8 of U3090, see Figure 1-23. Note that it can be done without removing the Dual-Pressure Board.

4. Plug the 7-conductor cable (with blue connectors) on to the Readout Conditioner Board pins marked P1075. Dress this cable down the inside of the rear panel and between the rear frame casting and the Manifold Board mounting bar. Be sure to match triangle on plug with the one on the board.

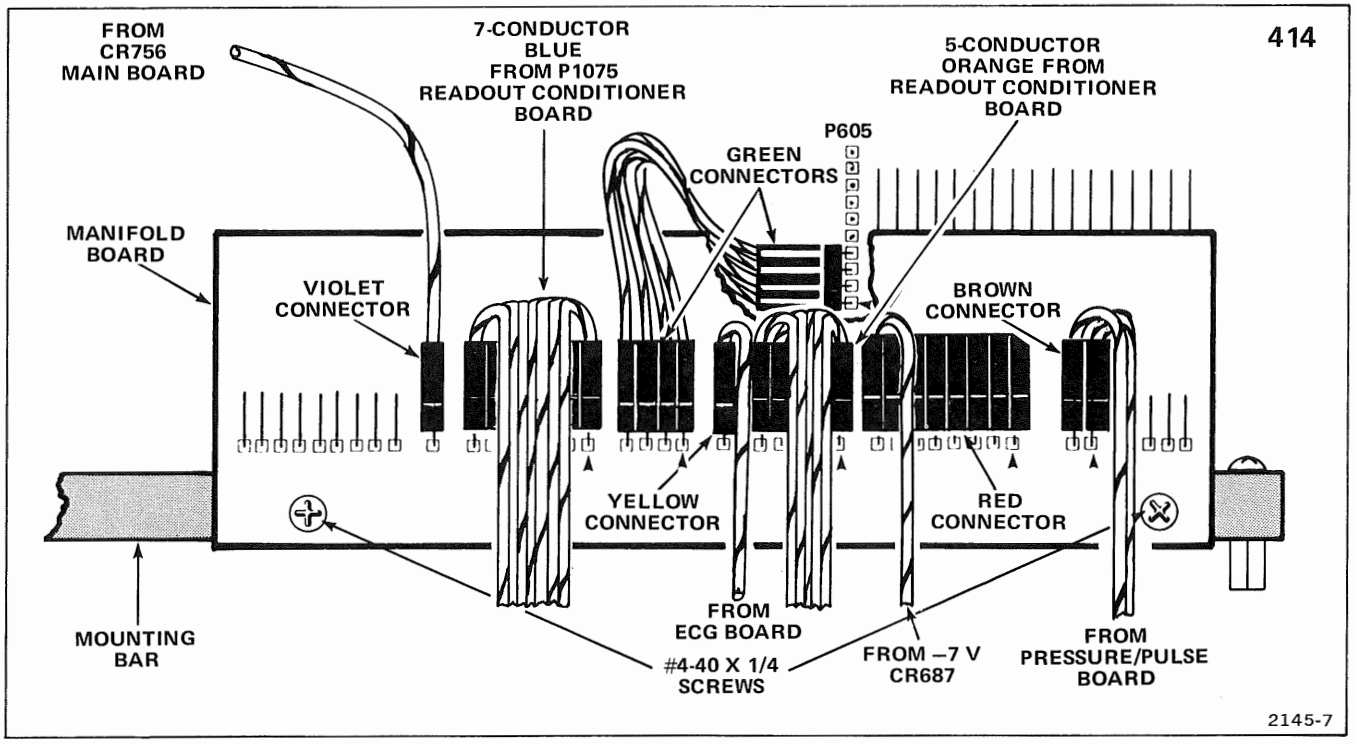


Figure 1-21. Installing Manifold Board and connecting cables to 414.

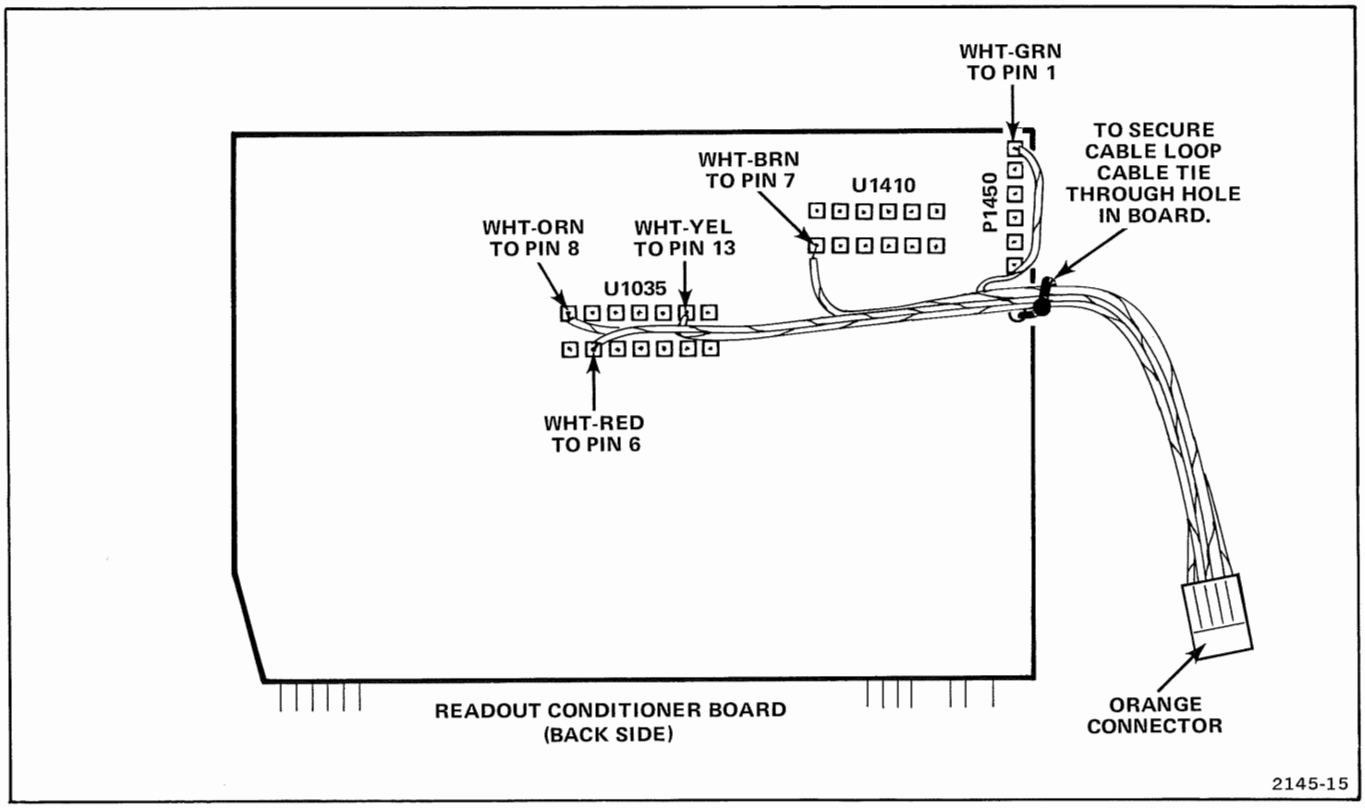


Figure 1-22. Installing 5-wire cable to 414 Option 21 (MOD FA) Readout Conditioner Board.

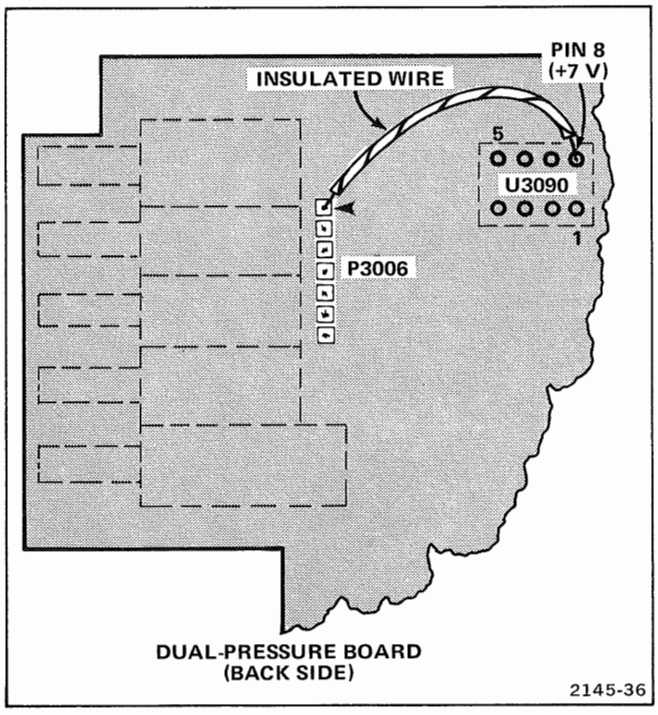


Figure 1-23. Adding wire to 414FA Dual-Pressure Board.

5. Install Readout Conditioner Board. Dress added 5-conductor cable down inside of rear panel and between the rear frame casting and the added Manifold Board mounting bar.

6. Install ECG board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

7. Unplug P3006 (may be P3090 in some earlier monitors) from Dual-Pressure board.

8. Remove four screws holding mounting plate with three phone jacks to rear panel.

9. Pull phonejack mounting plate out away from rear panel.

10. Pull the two P3006 cable wires through opening between phone jack mounting plate and rear panel. These two wires will be replaced in a later step.

11. Take 8-conductor cable (with red connectors) from kit. Plug end of cable, which does not have extra wires attached, to P3006 on Dual-Pressure board. Be sure to match triangle on plug with one on board. Dress this cable horizontally to rear panel, down inside of rear panel and between rear frame casting and added Manifold Board mounting bar.

12. Dress white-blue and white-yellow wires, connected to free end (P2414 end) of cable, to PRESSURE OUTPUT phone jack (J3025).

13. Unsolder and replace respectively white-brown and white-red wires on PRESSURE OUTPUT jack with white-yellow and white-blue wires. (P2412-4 connects via white-yellow wire to tip contact and P2412-6 connects via white-blue wire to ring contact.) Discard 2-wire cable with white-brown and white-red wires.

14. Carefully dress wires on phone jacks into rear panel opening. Fasten mounting plate to rear panel using four screws previously removed.

15. Connect two-wire cable with green connector to P605, install Manifold Board and connect remaining cables. See Figure 1-24.

16. Mount Recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

G. 414 Option 20 (MOD XA) Monitors

NOTE

Refer to Maintenance section of Monitor Manual for board removal and installation procedures.

1. Remove Readout Conditioner board.

2. Install 5-wire cable (with orange connector) to Readout board Conditioner Board as shown in Figure 1-25.

3. Install ECG Board. Dress white-yellow wire down the inside of rear panel and between rear frame casting and the added Manifold Board mounting bar.

4. Install Readout Conditioner Board. Dress added 5-conductor cable down inside of rear panel and between the rear frame casting and the added Manifold Board mounting bar.

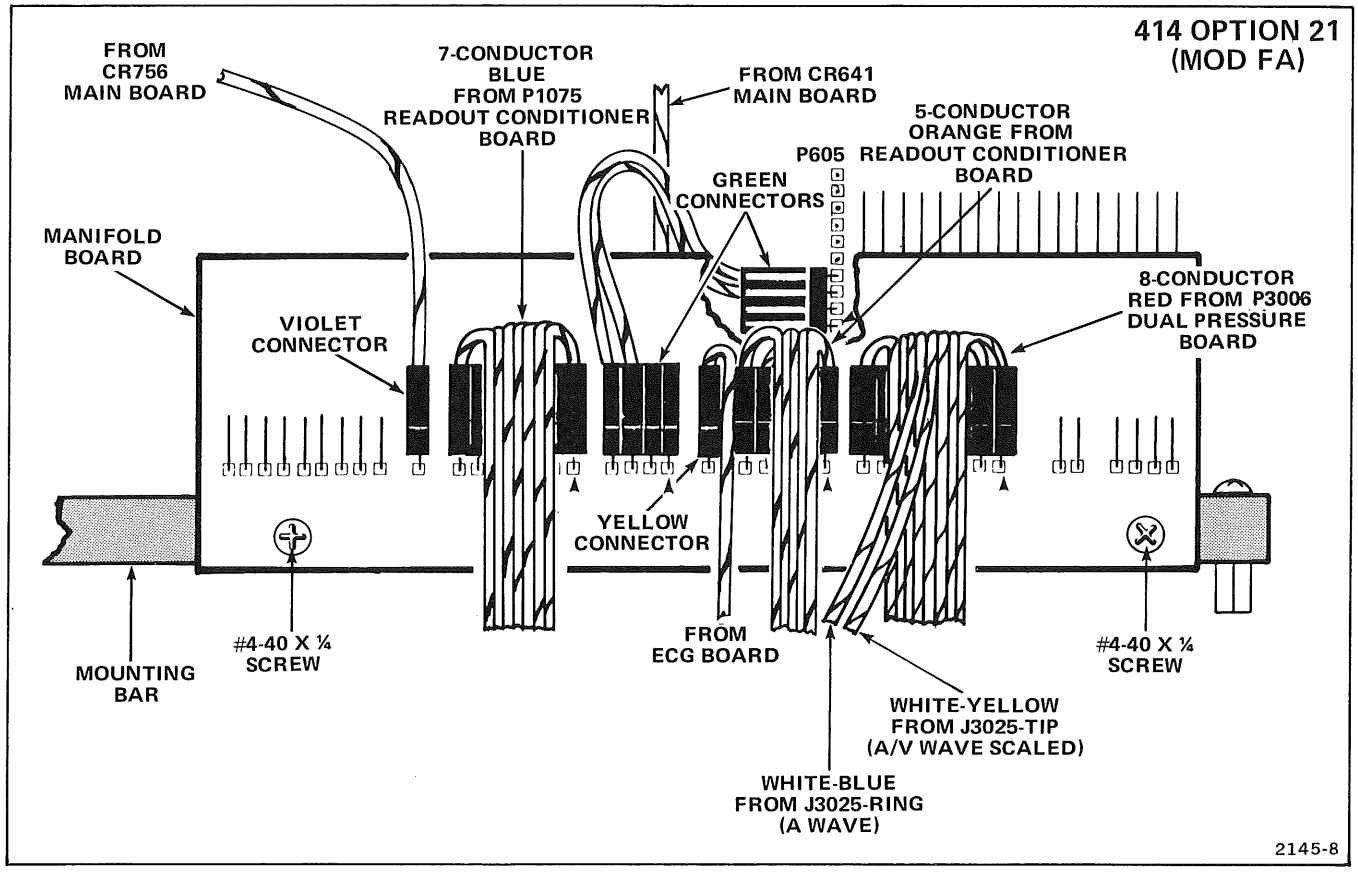


Figure 1-24. Installing Manifold Board and connecting cables in 414 Option 21 (MOD FA).

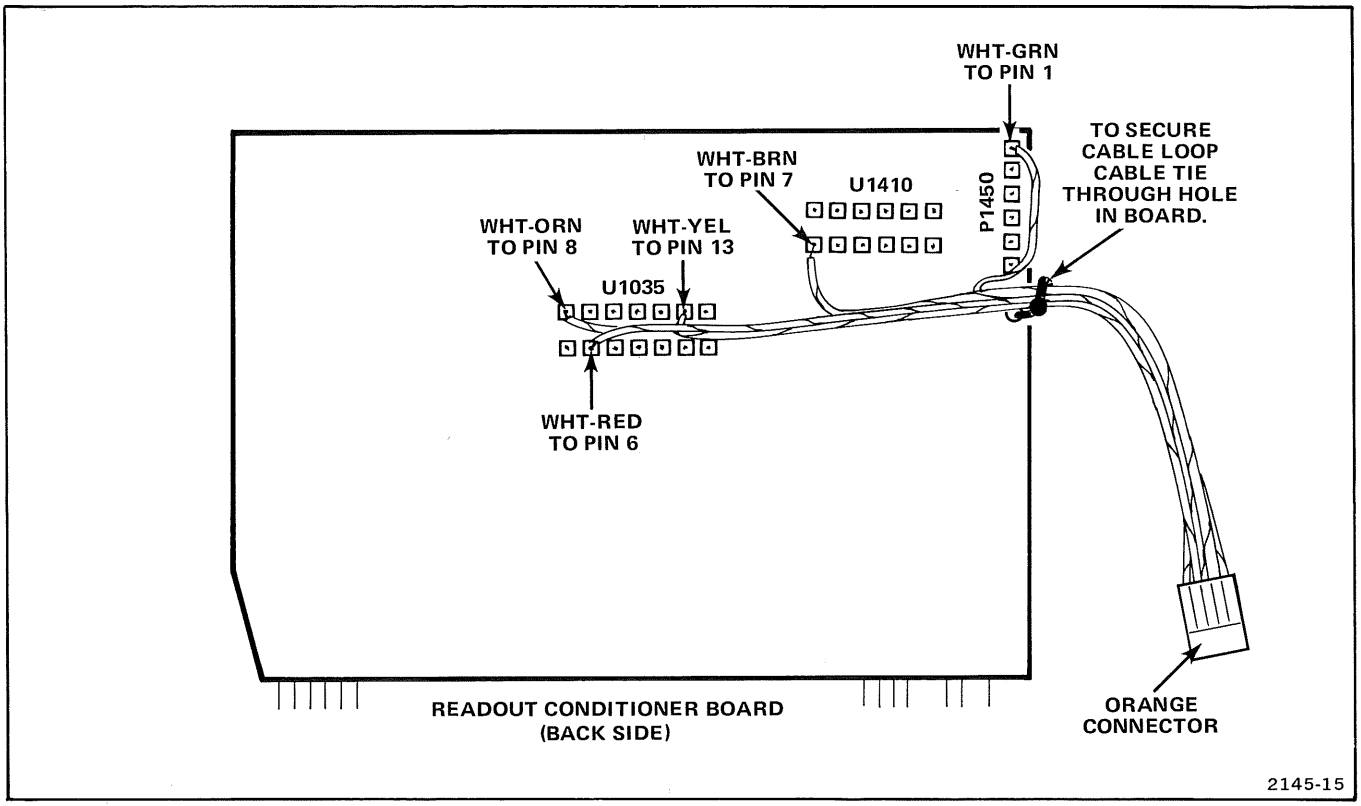


Figure 1-25. Installing 5-wire cable to 414 Option 20 (MOD XA) Readout Conditioner Board.

5. Plug the 7-conductor cable (with blue connectors) onto the Readout Conditioner Board pins marked P1075. Dress this cable down the inside of the rear panel and between the rear frame casting and the Manifold Board mounting bar.

6. Connect four-wire cable with green connector to P605, install Manifold Board and connect remaining cables. See Figure 1-26.

7. Mount recorder to monitor and check calibration of monitor. Refer to Recorder Mounting and Checkout at the end of this installation procedure.

H. Recorder Mounting and Checkout

CAUTION

Make sure monitor power is off and battery plug, P711 is disconnected.

1. Remove two lower cord-wrap feet from monitor and mount on recorder using threaded mounting holes provided.

2. Install adapter plates on recorder. See Figure 1-8. The small ribs go toward the recorder and the large ribs toward the monitor.

3. Install the interconnecting ribbon cable (from kit) between J2200 of the recorder and P2400 on the monitor's Manifold Board. The illustration on the recorder adjacent to J2200 shows proper cable folding and the color stripe locations. If the monitor is equipped with a Digital Readout Module (Option 7 or 8) connect existing interconnecting ribbon cable to P2400. In this case, the one from the kit will not be used.

4. Route the recorder's power cable between the Manifold Board mounting bar and the monitor rear casting, near the end of the mounting bar above the power transistors, so that the power cable can be pulled into the vicinity of the monitor's battery pack.

5. Connect the monitor's battery plug P711 to the monitor main board.

6. Carefully fit the recorder to the monitor. Dress the interconnecting ribbon cable and pull the recorder's power cable into the monitor cavity.

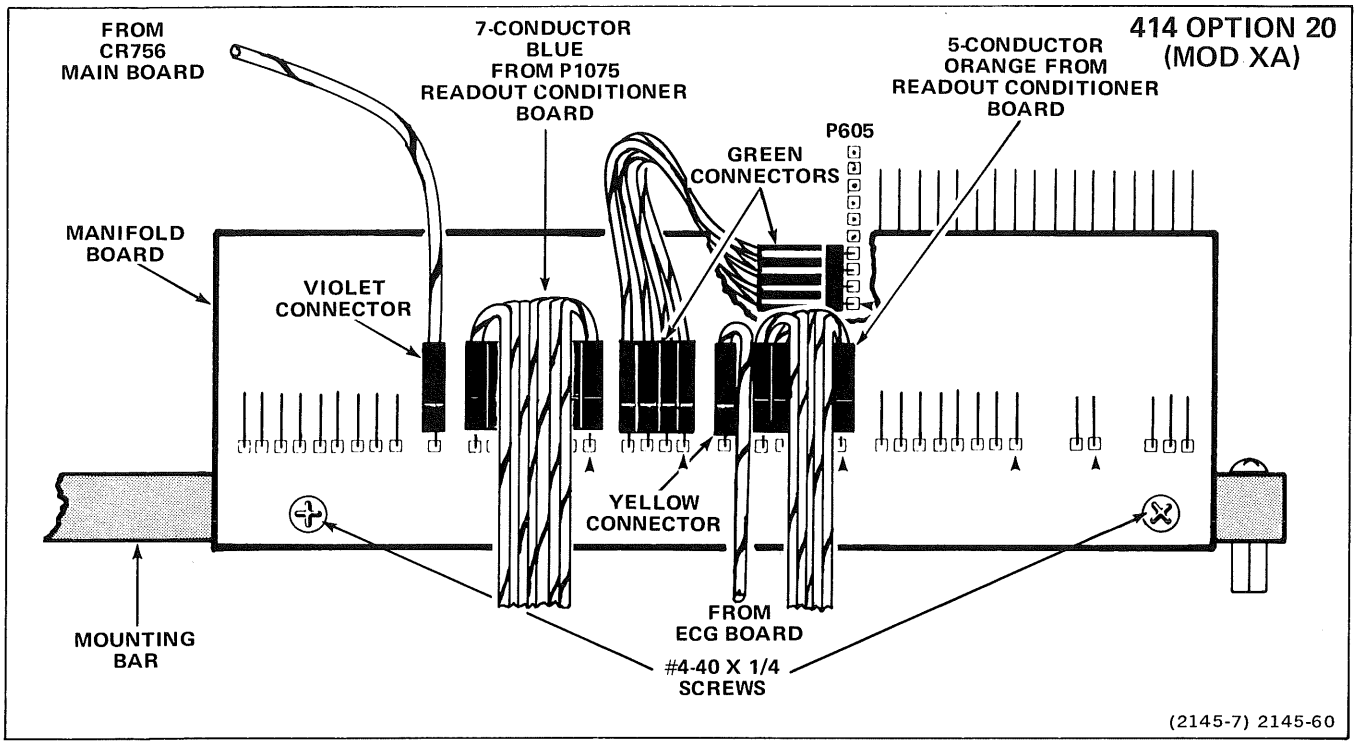


Figure 1-26. Installing Manifold Board and connecting cables in 414 Option 20 (MOD XA).

7. Connect the recorder's power cable to the mating connector on the side of the battery pack.

8. Wires and cables in the vicinity of the ECG input shield and cable (414, Opt. 21 (MOD FA) in particular) should be tied together with a plastic cable tie and dressed away from the ECG input shield and cable.

9. Replace the top cover on the monitor.

10. A plastic support block is attached to the side of the recorder under the monitor's mounting adapter position. If a mounting adapter is installed on the monitor, this support block must be in place. The support block provides proper mechanical alignment for the mounting adapter when the Monitor/Recorder is attached to a pole or other support.

WARNING

The Monitor/Recorder mounting fixture design intends that the monitor mounting adapter be used only with a support block on the Recorder.

11. Install recorder paper. See Operating Information section.

12. Check that recorder operates. Refer to Operating Information section, "How to Start Recorder".

13. Check monitor calibration and make isolation leakage check. Refer to Monitor Service Manual.

413 MONITOR/RECORDER ADAPTER KIT INSTALLATION

NOTE

It is intended that this kit be installed only by Tektronix Service personnel.

INTRODUCTION

To join a 400 Option 4 Recorder to the Tektronix 413 Monitor, the following items must be at hand:

1. 413 Monitor.

2. A 400 Option 4 Recorder. Other recorder models can be used with the 413 with limited capabilities. See Operating Information Section.

3. An 016-0638-00 Adapter Kit, which contains the electrical and mechanical parts to connect the Option 4 Recorder to a 413 Monitor. This kit is shipped with the Option 4 Recorder.

4. A monitor battery pack manufactured subsequent to summer 1976. These packs have heavy cell interconnects, a fusing arrangement, and a special connector which provides power to the recorder. If needed, this battery pack must be ordered separately.

Battery-Pack Ordering Information

All monitors mated to alpha-numeric printing recorders (Option 2, 3, & 4) must have F-cell battery packs for satisfactory operation. D-cell packs, although not recommended, can be used in a monitor mated to Standard or Option 1 recorders. However the result is about 50% less operating time. Select the appropriate battery pack from the list below.

To replace	with	Order Tektronix Part No.
D-cells	D-cells	119-0441-01
D-cells	F-cells	040-0710-01
F-cells	F-cells	119-0443-01
F-cells	D-cells	Not recommended

Figure 1-27 shows the 413 Monitor/Recorder installation. These steps summarize the installation procedure.

1. A -01 battery pack is installed in the monitor (providing it doesn't already have a battery pack, or its pack does not have provision for recorder operation).

NOTE

If a new battery pack is to be installed, the resistor which determines battery charging current may need to be replaced. Instructions and the proper resistor are packaged with each new battery pack.

2. A multi-conductor ribbon cable is connected between the Monitor and the Recorder.

3. The recorder power cable is connected to a plug on the monitor battery pack.

4. The monitor and recorder are joined mechanically and tested.

INSTALLATION INSTRUCTIONS

A. Monitor Preparation

NOTE

Check off each step as you complete it.

1. Check contents of Adapter Kit. Check that you have all the components before beginning. See Figure 1-28.

2. Obtain a Service Manual for your monitor. You will have to refer to it later in these instructions.

3. Prepare Monitor as follows:

   a. Disconnect monitor from ac power source.

   b. Remove top cover. Remove two screws on each side. Lift up left side of cover, make sure it has cleared the ECG LEAD CHECK terminals, and remove cover from the monitor.

   c. Remove bottom cover. Remove two screws on each side and pull cover straight off.

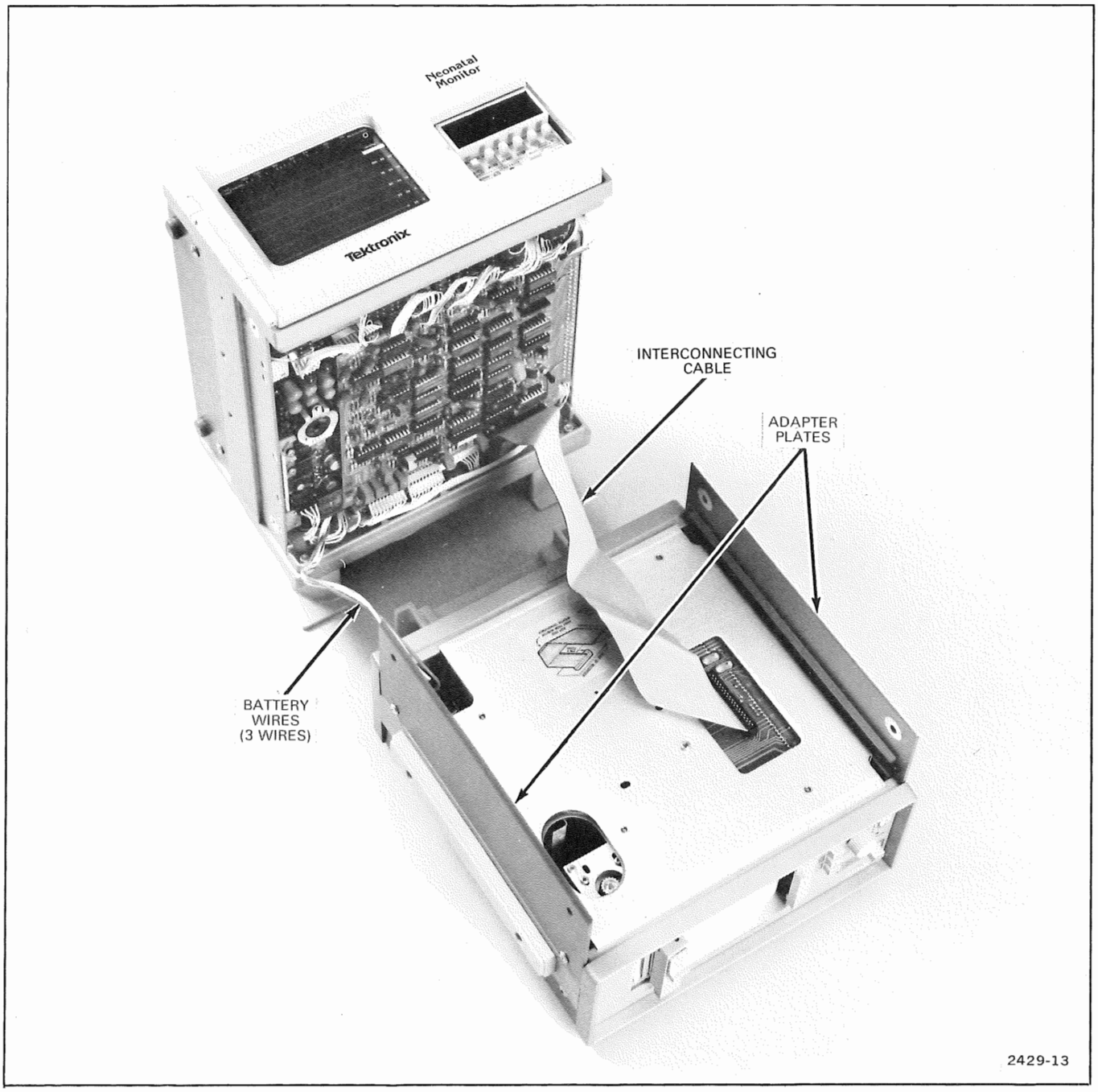


Figure 1-27. 413 Monitor/Option 4 Recorder adapter kit installation.

d. Unplug the battery cable connector P1982 from the main board. You will be instructed to reconnect it in a later step.

CAUTION

Do not short cells. Nickel-cadmium cells are capable of delivering high currents which can cause wire insulation to melt.

4. If necessary, replace battery pack with new one which has been adapted for recorder use. See list of battery packs in the introductory portion of these instructions. Do not connect either the recorder or monitor battery connector until instructed to do so.

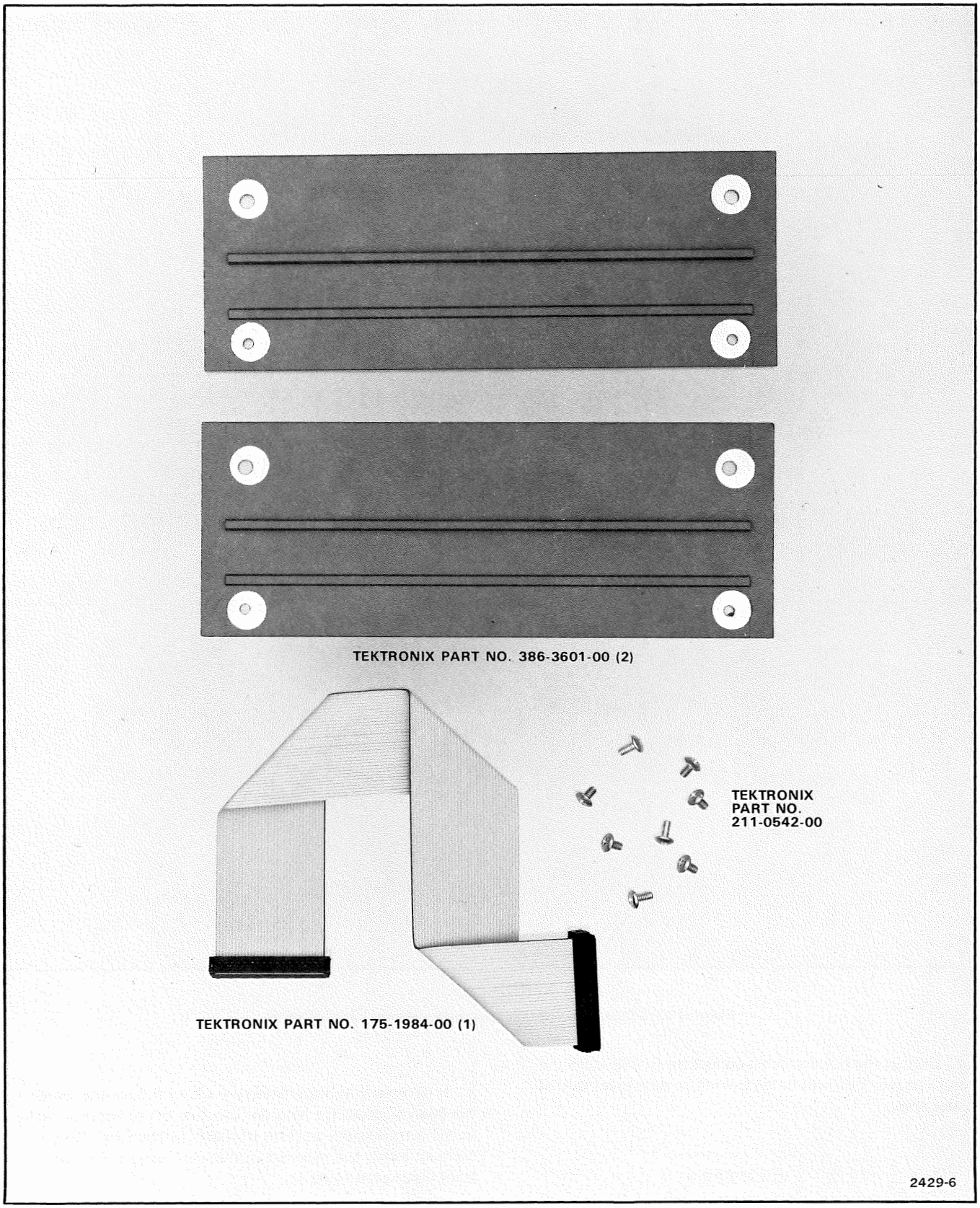


Figure 1-28. Contents of the 016-0638-00 monitor/recorder Adapter Kit.

B. Recorder Mounting and Checkout

CAUTION

Make sure monitor power is off and battery plug, P1982 is disconnected.

1. Install adapter plates on recorder. See Figure 1-27. The small ribs go toward the recorder and the large ribs toward the monitor.

2. Install the interconnecting ribbon cable (from kit) between J2200 of the recorder and P2400 on the monitor's Conditioner Board. The illustration on the recorder adjacent to J2200 shows proper cable folding and the color stripe locations. If the monitor is equipped with a Digital Readout Module (Option 6), connect existing interconnecting ribbon cable to P2400. In this case the cable from the kit will not be used.

3. Route the recorder's power cable between the monitor's main board and the monitor rear casting, near the power transistors, so that the power cable can be pulled into the vicinity of the monitor's battery pack.

4. Connect the monitor's battery plug P1982 to the monitor main board.

5. Carefully fit the recorder to the monitor. Dress the interconnecting ribbon cable and pull the recorder's power cable into the monitor cavity.

6. Connect the recorder's power cable to the mating connector on the side of the battery pack.

7. Replace the top cover on the monitor.

8. A plastic support block is attached to the side of the recorder under the monitor's mounting adapter position. If a mounting adapter is installed on the monitor, this support block must be in place. The support block provides proper mechanical alignment for the mounting adapter when the Monitor/Recorder is attached to a pole or other support.

WARNING

The Monitor/Recorder mounting fixture design intends that the monitor mounting adapter be used only with a support block on the Recorder.

9. Install recorder paper. See Operating Information section.

10. Check that recorder operates. Refer to Operating Information section, "How to Start Recorder".

11. Check monitor calibration and make isolation leakage check. Refer to Monitor Service Manual.

OPERATING INFORMATION

HOW TO LOAD PAPER

1. Open paper carriage by pushing Latch to the left as shown in Figure 2-1.
2. Remove empty spool.
3. Place paper roll on spindle.
4. Unroll about 6" of paper and route around rollers at point A.
5. Close paper carriage.
6. Press Tension Gate button down to open gate.
7. Place unrolled paper behind opened Tension Gate (point B) and snap gate back into position.
8. Pull on end of paper to remove slack.

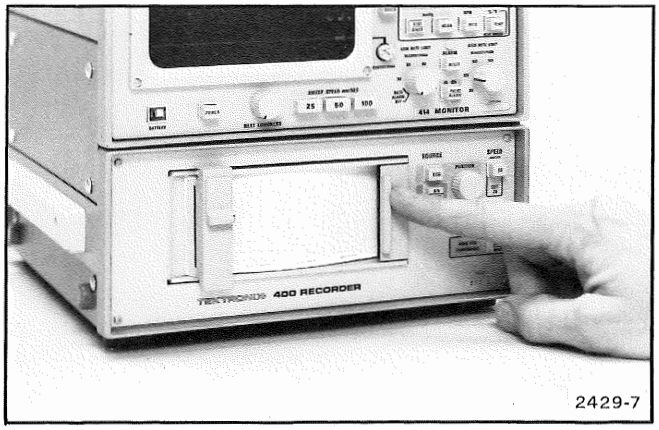


Figure 2-1. Opening paper carriage.

NOTE

The writing stylus will not heat and the paper drive will not operate when the paper carriage is pulled out.

PAPER GRID FORMAT

The chart-paper grid is divided into 8, one-half centimeter, major divisions. These half-centimeter divisions correspond directly to the one-centimeter divisions on the monitor screen. Thus, the Recorder display amplitude is always one half that of the corresponding monitor display.

The vertical lines extended into the lower chart margin can be used to indicate time intervals. With Recorder SPEED set to 25 mm/sec, each lower-margin division equals 1 second; with SPEED set to 50 mm/sec, each lower-margin division equals 0.5 second.

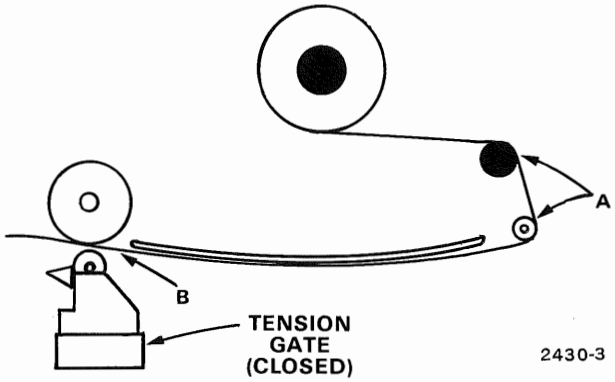


Figure 2-2. Proper routing of paper roll on Recorder carriage.

PAPER USAGE RATE

Typically, a three-inch diameter paper roll contains about 60 meters (190 ft.) of chart paper. A chart speed of 25 millimeters/second allows approximately 170 fourteen-second record cycles per roll of paper, or 85 fourteen-second record cycles per roll at a chart speed of 50 millimeters/second.

HOW TO ORDER PAPER

Two rolls of recording paper are supplied with the Recorder. You can obtain additional rolls through the TEKTRONIX Medical Products Sales Representative in your area. The paper is available only in 10-roll boxes. Order Tektronix Part 006-2408-00.

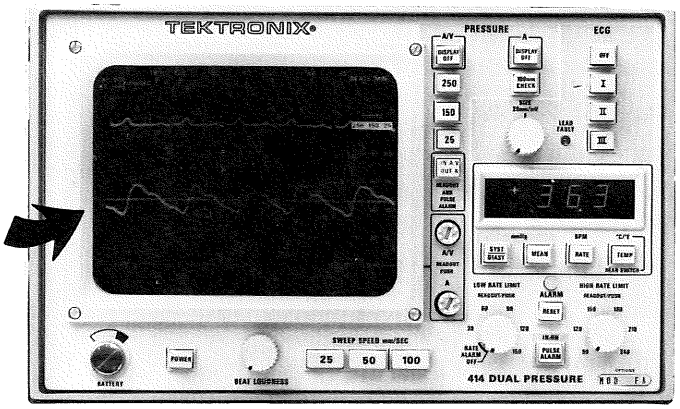
NOTE

The Recorder is specifically designed for use with Tektronix Part 006-2408-00 paper. Other types of paper have coatings which may result in recordings of inferior quality and which may clog the print head mechanism in the Option 2, 3, and 4 Recorders.

HOW TO START RECORDER

Manual Start

1. OBTAIN MONITOR DISPLAY



2. SELECT WAVEFORM SOURCE
(Except on standard model)

3. PUSH SAMPLE/MARK BUTTON
(Recorder will run one cycle and stop.)

NOTE: *Adjust STYLUS HEAT control (rear panel) for visible trace. If this control is set for maximum darkness, fine details may be lost and monitor/recorder battery operating time will be reduced.*

2429-9

Figure 2-3. How to start recorder.

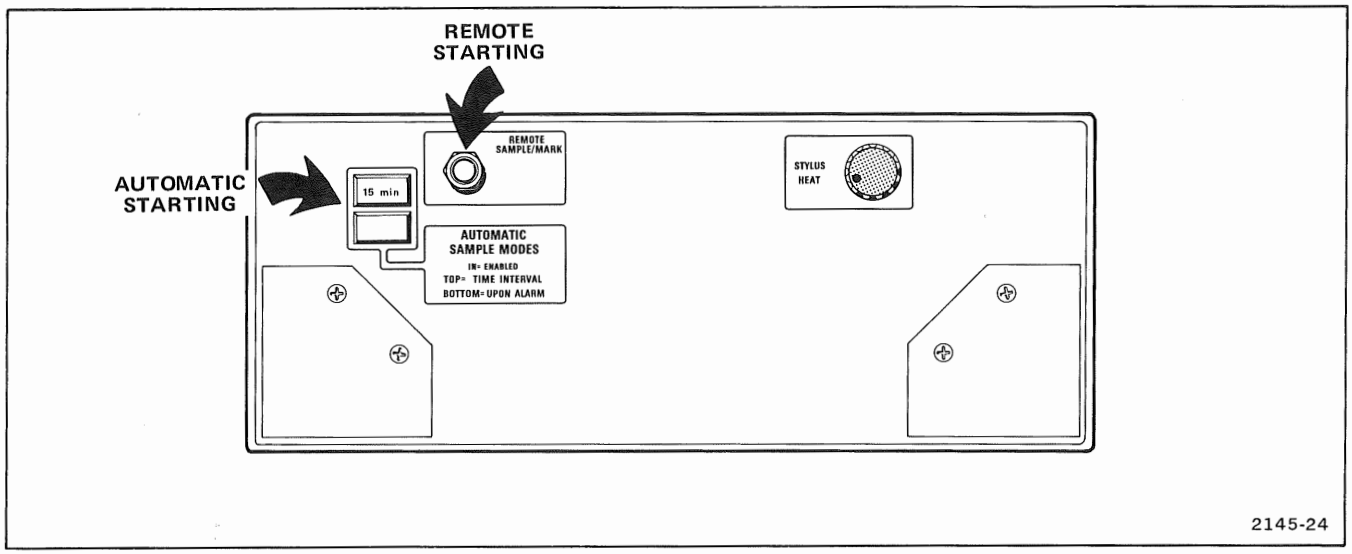


Figure 2-4. Remote and automatic sample modes.

REMOTE AND AUTOMATIC STARTING (FIG. 2-4)

Automatic

For automatic starting every 15 minutes—push upper (15 MIN) pushbutton.

For automatic starting upon monitor alarm—push lower pushbutton.

(See "Functions of Controls, Connectors, and Indicators" for more detailed information.)

Remote

To remotely start recorder, connect external switch circuit through phone plug to the REMOTE SAMPLE/MARK jack.

Short tip to barrel (ground) to start recorder. (Duplicates front-panel SAMPLE MARK function).

HOW TO READ PRESSURE RECORDINGS

Pressure scales on monitor are related to horizontal chart lines as shown in Figure 2-5.

Alpha-Numeric Printing

The Option 2, 3, and 4 Recorders provide alpha-numeric printing of elapsed time and selected patient parameters when used as shown in Table 2-1. The alpha-numeric values are printed along the top margin of the chart paper. Any function which is in overrange during the print cycle will be indicated by the printing of asterisks in place of the numeric value. Following are basic definitions of each alpha-numeric value. Table 2-1 shows the alpha-numeric information available for different combinations of the Recorder/Monitor units.

ET—Elapsed time is printed out in hours and minutes. Each time the monitor's power is turned on, the elapsed-time clock of the Recorder is set to 0:00 and held there until the Recorder begins a record/print cycle. The clock will automatically start the first time a record/print cycle occurs. It counts to 9:59, then repeats. To reset the clock (start from zero): Monitor power must be turned off and then on, and a record/print cycle must be initiated.

RATE=—Heart rate is printed in beats/minute. The rate is derived from the ECG or pressure/pulse signals as determined by the monitor.

NOTE

In general, the blood pressure, temperature, and respiration parameters will be eliminated from the printout if their corresponding probes are disconnected or if their corresponding channels are turned off. See Table 2-1.

BP A= and BP A/V=—Arterial (A) and/or Arterial Venous (A/V). Blood pressure printed in mmHg (millimeters of mercury). Systolic/diastolic and (mean) pressure values are printed for single- or dual-pressure channel monitors. BP A pressure is printed only in Option 3 recorders.

TEMP A= and TEMP B=—Body temperature is printed in °C or °F as determined by a switch on the monitor's rear panel. (When both temperature channels are printed, they are printed in the same temperature scale.) An apostrophe is used to indicate degrees.

RESP=—Respiration rate is printed in breaths/minute.

ALARM—This word appears at the end of the print sequence if the record/print cycle was initiated by an alarm, or if the monitor indicates an alarm when the record/print cycle reaches the final entry.

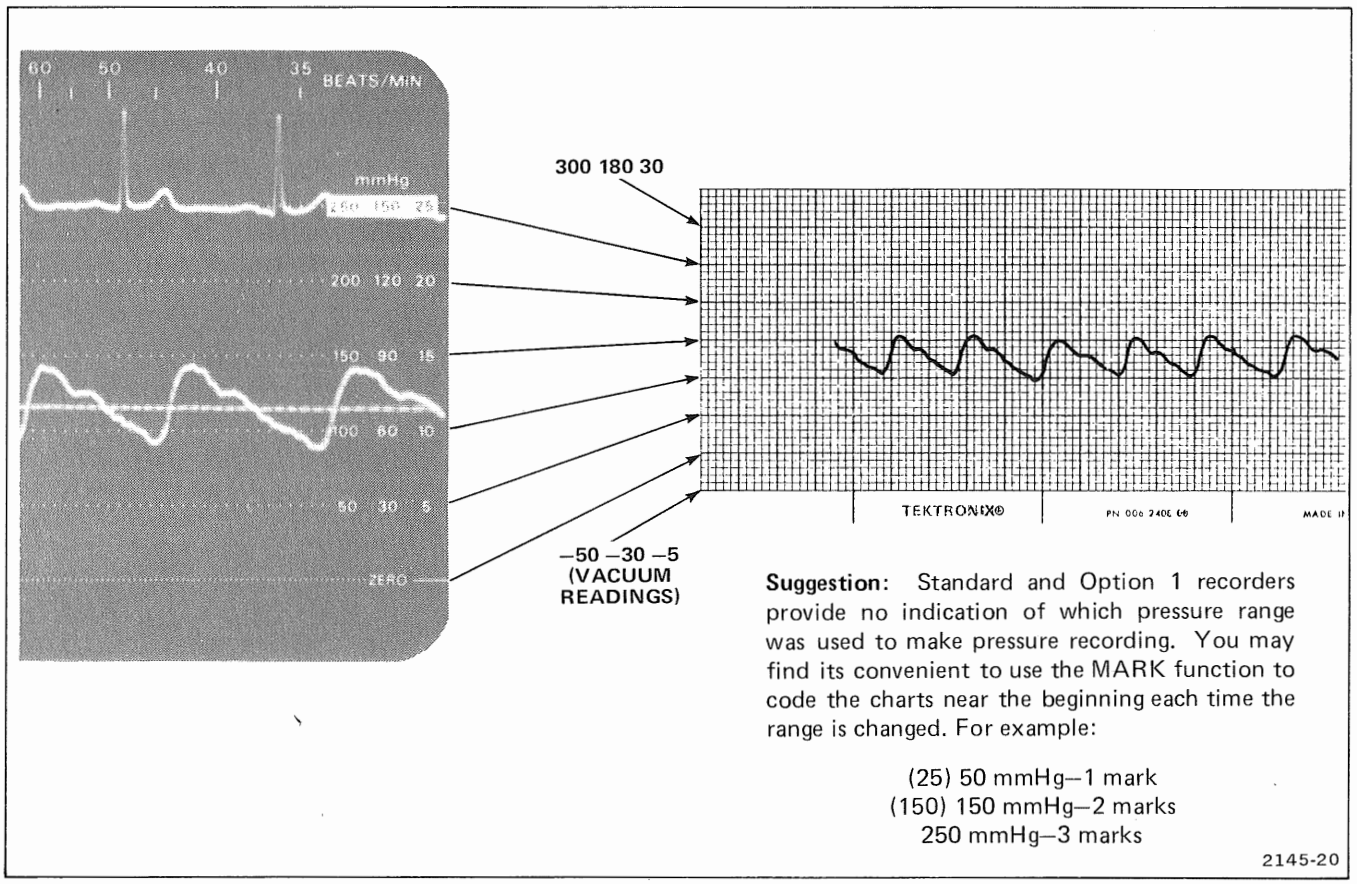


Figure 2-5. Reading pressure recordings.

TABLE 2-1
Alpha-Numerics Available with Various Monitor/Recorder Units

		ET	RATE=	BP A=[1]	BP A/V=	TEMP A=[2]	TEMP B=[2]	RESP=[3]	ALARM[5]
Options 2 and 4 Recorder with:	414	√	√		√[4,7]	√			√
	413	√	√		√[1,4]	√	√	√	√
	413 OPT 20	√	√			√	√	√	√
	414 OPT 21 (MOD FA)	√	√		√[6]	√			√
Option 3 Recorder with:	414	√	√		√[4,7]	√			√
	413	√	√		√[1,4]	√	√	√	√
	413 OPT 20	√	√			√	√	√	√
	414 OPT 21 (MOD FA)	√	√	√	√[1]	√			√

[1] Printout eliminated if pressure transducer is disconnected from monitor.
[2] Printout eliminated if temperature probe is disconnected from monitor.
[3] Printout eliminated if monitor's ECG or RESP channel is switched off.
[4] Printout eliminated when monitor's PULSE channel is selected.
[5] Printed only when monitor indicates an alarm.
[6] The Option 2 and 4 Recorders are not totally compatible with the 414 Option 21 (Mod FA) monitor. The BP A parameter is not printed. The BP A/V parameter is printed (except when pressure transducer is disconnected from the monitor) but the printed numerical value will be either of the A or A/V channel depending on the setting of the monitor READOUT pushbutton (in=A, out=A/V).
[7] Printout not eliminated if pressure transducer is disconnected from monitor.

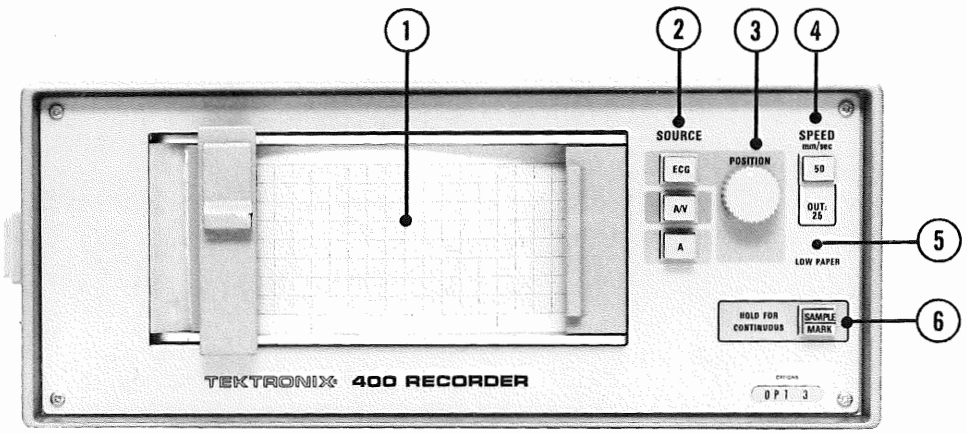


Figure 2-6. Front-panel controls and indicators.

FUNCTIONS OF CONTROLS, CONNECTORS, & INDICATORS

Front Panel (Fig. 2-6)

(1) **CHART**—The chart-paper grid is divided into 8, one-half centimeter, major divisions. These half-centimeter divisions correspond directly to the one-centimeter divisions on the monitor display screen. Thus, the recorder display is always one half the corresponding monitor display amplitude. Alpha-numeric information is printed along the top margin of the chart in the Option 2, 3, and 4 Recorders.

(2) **SOURCE**—(Omitted on Standard Recorder.) Selects analog waveforms to be recorded. When ECG is selected, the recorder display is one half the amplitude of the monitor display, and the monitor's display amplitude is determined by the monitor's ECG SIZE control.

When A/V/PULSE is selected (Options 2 and 4 only), either arterial/venous pressure or pulse waveforms are recorded as determined within the monitor unit. The baseline reference for the pressure waveform is set one-half centimeter (one major division) from the bottom grid line of the chart.

When A/V is selected (Option 3 Recorder with 414 Option 21 (MOD FA) Monitor only), the arterial/venous pressure waveform is recorded.

When the A pressure channel is selected (Option 3 Recorder with 414 Option 21 (MOD FA) Monitor only), the arterial pressure waveform is recorded.

When RESP is selected (Option 4 Recorder with 413 Monitor only), the respiration waveform is recorded.

(3) **ECG POSITION**—Allows Recorder ECG waveform baseline to be positioned ±1.5 centimeters around the chart center.

(4) **SPEED**—Selects chart speed. Speed is 25 millimeters/second with the pushbutton out and 50 millimeters/second with pushbutton depressed.

(5) **LOW PAPER**—Lights to indicate that only a small amount of paper remains. This is a rough indication.

(6) **SAMPLE/MARK**—This multi-function control allows the Recorder to be started manually and provides a convenient means of coding the chart. If the Recorder is not running, pushing this pushbutton momentarily will initiate a record cycle of 14-second duration (28-second record/print cycle for the Option 3 Recorder). If the Recorder is not running and this pushbutton is pressed and held in for more than the record cycle duration, the Recorder will start, run continuously, and will stop running one record cycle after the pushbutton is released.

If the SAMPLE/MARK pushbutton is pushed while the record cycle is in progress, an approximate +½-centimeter, 40-millisecond step will be marked on the written waveform.

On the Option 2, 3, and 4 Recorders, if the SAMPLE/MARK pushbutton is pushed while a record cycle is in progress and after the alpha-numeric print cycle has ended, the step is marked on the written waveform and a new alpha-numeric print cycle is initiated. The Recorder continues to record until the new alpha-numeric print cycle is completed.

Rear Panel (Fig. 2-7)

(7) **AUTOMATIC SAMPLE MODES**—On the Standard and Option 2 Recorders, two pushbuttons allow the record cycle to be initiated automatically every 15 minutes or upon monitor alarm. Both modes can be used at the same time if desired. These modes do not affect operation of other sample modes.

TIME INTERVAL—When the top (15 MIN) pushbutton is depressed, a record cycle is initiated every 15 minutes.

UPON ALARM—Standard and Option 1 Recorders: When the bottom pushbutton is depressed, a record cycle is initiated whenever the monitor indicates an alarm.

Option 2, 3, and 4 Recorders: When the bottom pushbutton is depressed, a record and a print cycle are initiated whenever the monitor indicates an alarm. The word ALARM will be printed at the end of the Print sequence.

(8) **REMOTE SAMPLE/MARK**—Provides a means to remotely initiate record and print cycles. Connect external switch circuit through phone plug. Short tip contact to barrel (ground) to start Recorder. This duplicates the front-panel SAMPLE/MARK function.

(9) **STYLUS HEAT**—Controls trace density.

POWER

The Recorder obtains power directly from the monitor battery, even when the monitor is operating from the ac power line. Although some power is supplied by the internal battery charger, the battery can become discharged if the Recorder is operated continuously or excessively.

Monitor battery charge, and thus recorder power, can be maintained if the monitor is connected to the ac power line and the frequency of record/print cycles is kept within certain limits. Variations between Monitor/Recorder models and monitor functions being used will affect the maximum number of record/print cycles which can be taken per hour. For example, if a Standard or Option 1 Recorder is set to automatically run a 14-second record cycle every 15 minutes, about 17 more record cycles (total of 21) can be run in one hour. (This is equivalent to a total of 5 minutes per hour of run time with the monitor operating on ac power.)

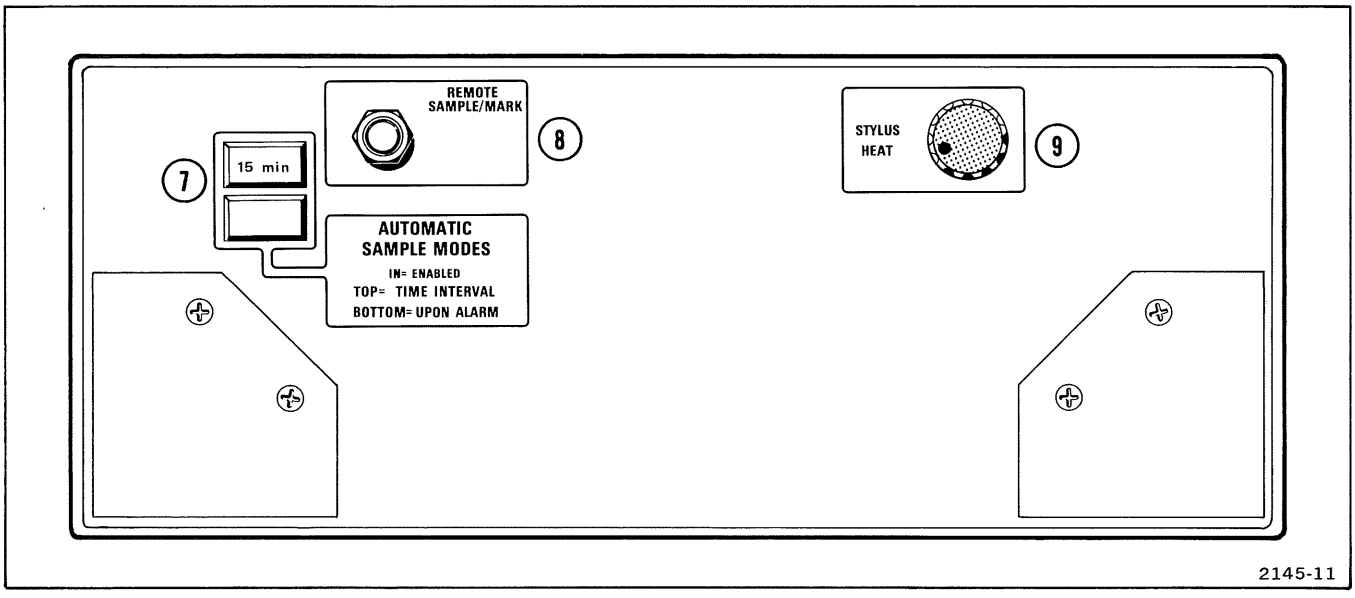


Figure 2-7. Rear-panel controls and indicators.

When taking 14-second record/print cycles on the Option 2 or 4 Recorder, about 10 cycles can be taken in one hour without diminishing the battery charge. About five 28-second record/print cycles can be run in one hour on the Option 3 Recorder if the battery charge is to be fully maintained.

When the Monitor/Recorder unit is not connected to the ac power line, battery operating time normally expected for the monitor alone will be reduced in direct proportion to the accumulated recorder running time. Total operating time will be reduced about 45 seconds for each 14-second record cycle of the standard and Option 1 Recorders. A record/print cycle in the Option 2, 3, and 4 Recorders will reduce operating time by about 1.5 minutes.

Note About Battery Fuse:

If the Recorder will not run and the monitor will not operate on battery, the fuse located inside the monitor battery pack may have blown. Have the Monitor/Recorder unit checked by a qualified service person. When the battery fuse is blown, the monitor will still operate on ac power, however, the recorder will not run.

THEORY OF OPERATION

Most recorder circuitry is located on plug-in circuit boards which are plugged into a large Motherboard, mounted on the upper part of the recorder. See Figure 3-1.

All recorders have three plug-in boards in addition to the Motherboard: Run Control, Pen Amplifier, and Power Supply. Option 2, 3, and 4 recorders have 6 or 7 additional plug-in boards: A/V Buffer (Option 2, 4 only), A/V Conditioner (Option 3 only), A Conditioner (Option 3 only), DVM Analog, DVM Digital, Print Control 1, Print Control 2, and Print Drive.

Recorder power is supplied directly from the monitor battery pack through a separate battery cable.

Signals from the monitor enter the recorder via the monitor/recorder interconnecting cable. The Monitor/Recorder Signal Interconnections diagrams at the back of this manual show a detailed breakdown of signals used by various monitor/recorder combinations.

Illustrations are provided as necessary throughout this section to aid understanding of circuit operation. A detailed schematic diagram of each circuit is located in the Diagrams section at the back of this manual. Shaded boxes surround individual circuits on the schematics.

RUN CONTROL BOARD ◇1

Circuit Functions

The Run Control board provides the following:

1. Start Power pulses to the Power Supply board to initiate run cycles. Start Power pulses are gated in three different ways: (1) By the SAMPLE/MARK pushbutton (or through the REMOTE SAMPLE/MARK jack, (2) by the 15-minute interval timer in the Run Control circuit, or (3) upon alarm indicated by monitor.

2. Stop Power pulse which shuts down the power supply to end the run cycle. The Stop Power pulse is produced by the ending of the 14-second (28-second, Option 3) Run-Timer interval or by the ending of the print cycle, whichever occurs last.

3. 40 millisecond Mark pulse to mark the analog display. Each time the SAMPLE/MARK function is activated, a Mark pulse is produced. However, a mark will not appear on the display at the beginning of a run cycle due to warm-up time of the writing stylus.

4. Chart Speed 50/$\overline{25}$ logic signal, which sets the chart drive motor for the speed set on the front panel (50 mm/SEC, HI or 25mm/SEC, LO).

5. Start Print pulse to the Print Control 1 board to start the alpha-numeric printing. In the Option 2 and 4 recorders, the alpha-numeric printing is delayed by 1.75 seconds to allow time for the writing stylus to heat and start writing the analog display. In the Option 3 recorder, printing is delayed by 14 seconds to allow time for Systolic/Diastolic/Mean Conditioners to settle.

Circuit Operation

The Run Control circuit controls the starting, stopping, and timing of recorder run cycles. A run cycle is initiated when one of three logic signals into the Start Gate circuit goes HI: (1) from the Sample/Mark Input Conditioner, (2) from the Automatic Sample Interval Timer, or (3) from the Alarm Interface.

The output of the Start Gate circuit provides positive-going pulses which start the power supply inverter. Once the power supply has come up to operating voltage, the Run Detector circuit prevents output of additional pulses from the Start Gate circuit.

The Run Timer circuit controls the time duration of the run cycle and the print delay. When the recorder is shipped from the factory, Standard and Options 1, 2, and 4 recorders are set for 14 seconds run time and Option 3 for 28 seconds. Several time durations are available by changing connections on P182 (see Section 1). The Run Timer is reset to zero when one of three logic signals into U126B

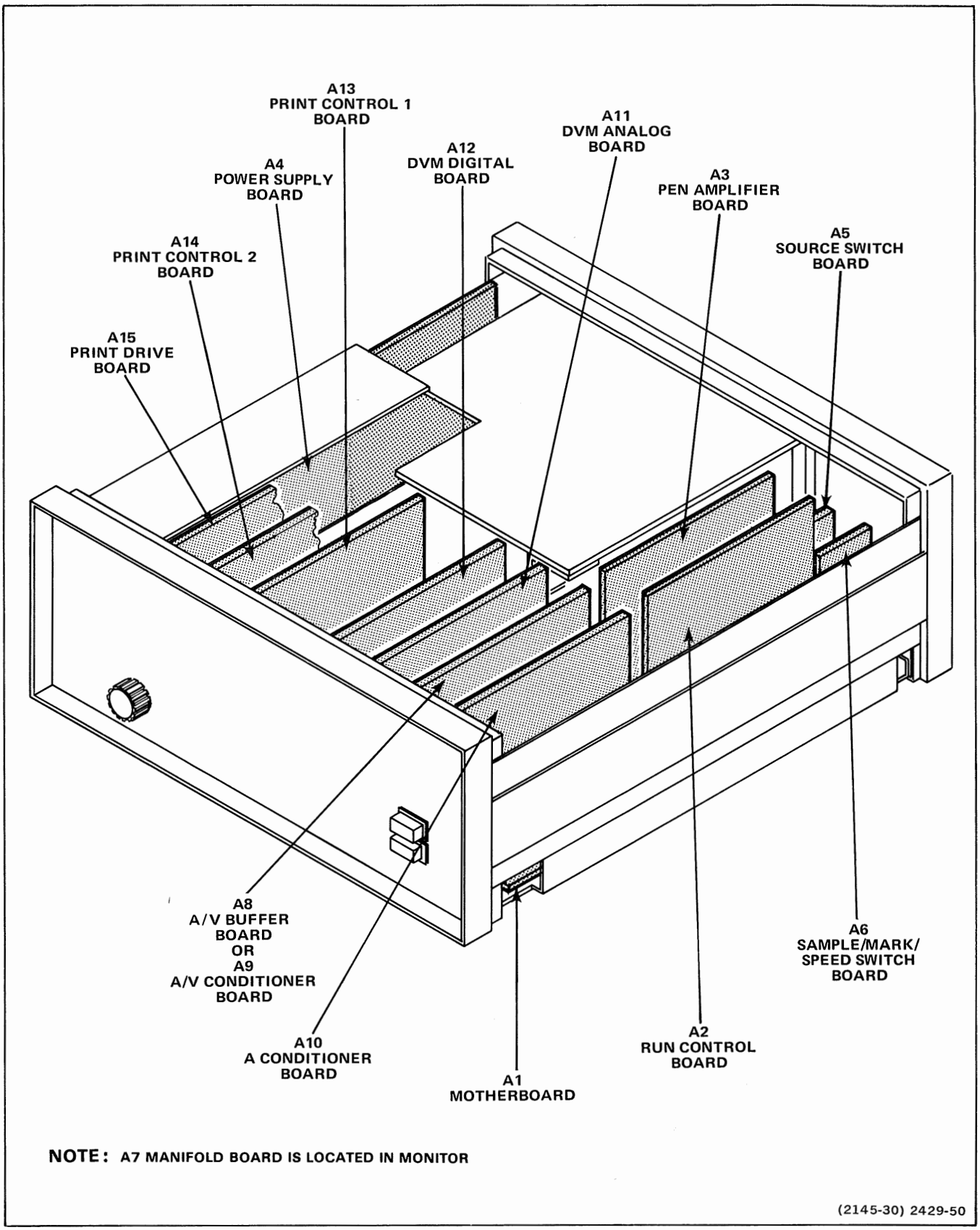


Figure 3-1. Location of circuit boards within the Recorder.

goes HI: (1) from the Run Detector circuit, when the run cycle is ended and power supply voltage is down, (2) from the Alarm Interface circuit when monitor indicates an alarm condition or (3) from the Stop Controller circuit when the run time and print cycle (Options 2, 3, and 4) are ended and SAMPLE/MARK pushbutton is held in.

A Stop Power pulse from the output of the Stop Controller circuit turns off the power supply when three conditions exist: (1) the Run Detector is indicating that the recorder is running, (2) the Run Timer has counted up to 14 seconds (28 seconds, Option 3), and (3) the print cycle (Options 2, 3, and 4) has ended.

START POWER. The power supply is turned on and a run cycle begins when Start Power pulses appear at pin 9 of U126A. See Figure 3-2. Start Power pulses are produced when any one of the U126C inputs (pin 11, 12, or 13) goes HI.

When either the SAMPLE/MARK pushbutton is pressed or the REMOTE SAMPLE/MARK switch circuit is closed, the base of Q115 is grounded. This causes pin 10 of U118B to go HI and produce a positive-going 40 ms pulse at pin 5 of U118B and pin 12 of U126C.

If S110A (TIME INTERVAL, 15 MIN) is closed, the output from the free-running Automatic Sample Interval Timer U130 clocks pin 3 of U138A HI at the 15-minute interval. This causes pin 1 of U138A and pin 13 of U126A to go HI.

If S110B (UPON ALARM) is closed, an alarm logic signal from the monitor will cause pin 12 of U156D to go HI and produce a positive-going 50 ms pulse at pin 13 of U118A and pin 11 of U126C.

When any U126C input goes HI pin 8 of U126A goes LO. Since the power supply is off, pin 2 of U126A is also LO and 1165 Hz signal at pin 1 is gated to the output. The Start Power pulses at pin 9 of U126A start the power supply inverter. When the −11.9 voltage appears at the emitter of Q124, pin 2 of U126A goes HI and shuts off the Start Power pulses. The power supply stays on until turned off by the Stop Power pulse.

STOP POWER. The power supply is shut off and the run cycle ended by a HI (Stop Power) at pin 6 of U150B. See Figure 3-3. Pin 6 of U150B remains LO until all three inputs to U150A are LO at the same time: (1) when the recorder is running, pin 8 is LO, (2) as the run time is ended, pin 1 goes LO, (3) pin 2 is always LO for standard and Option 1 recorders and goes LO on Option 2, 3, and 4 recorders when the printing cycle is ended.

U140A is used specifically to reset the Run Timer and restart a print cycle (Options 2, 3, and 4) when the SAMPLE/MARK pushbutton is held in until both time and print are complete, then released. When the recorder is running and the run time has not ended, pin 9 of U150A is LO and pin 11 of U152D is HI. This holds U140A in a reset position. When the run time ends and the print cycle is complete, pin 9 of U150A goes HI and pin 11 of U152D goes LO. If the SAMPLE/MARK pushbutton was held in during this time, a Stop Power pulse will not occur and the recorder will continue to run due to the HI at pin 4 of U150B. The recorder will continue to run and display analog information as long as the SAMPLE/MARK pushbutton is held in. As soon as the SAMPLE/MARK pushbutton is released, pin 3 of U140A is clocked HI causing the HI at pin 5 of U140A to be transferred to pin 1 of U140A. This resets U145A and U180 through U126B and U125A, starting a new timing cycle and a new print cycle (Option 2, 3, and 4). C142 and R142 delay pin 4 of U150B going LO for 100 μs after the SAMPLE/MARK pushbutton is released. This allows time for U145A to be reset and cause pin 9 of U150A to go LO, thus preventing the Stop Power pulse and allowing the recorder to run for another 14 or 28 seconds.

START PRINT (OPTIONS 2, 3, AND 4). A LO at the collector of Q188 initiates a print cycle. See Figure 3-4. A $\overline{\text{Start Print}}$ pulse is produced when pin 10 of U140B is LO and pin 11 goes HI. Approximately 1.75 seconds (Options 2, 3, and 4)) or 14 seconds (Option 3) after the Run Timer (U180) is started, pin 11 of U145B is clocked HI. Thus, pin 11 of U140B is clocked HI and the collector of Q188 goes LO ($\overline{\text{Start Print}}$). As the print cycle begins, the Print Busy signal is returned from the Print Control 1 circuit which resets U140B and causes Q188 collector to return HI.

The purpose of the 1.75 sec. print delay is to allow time for the writing stylus to heat and start writing the analog waveform before printing begins. (In Option 3 recorders, the print delay is 14 seconds to allow time for the Systolic/Diastolic/Mean Conditioners to settle.)

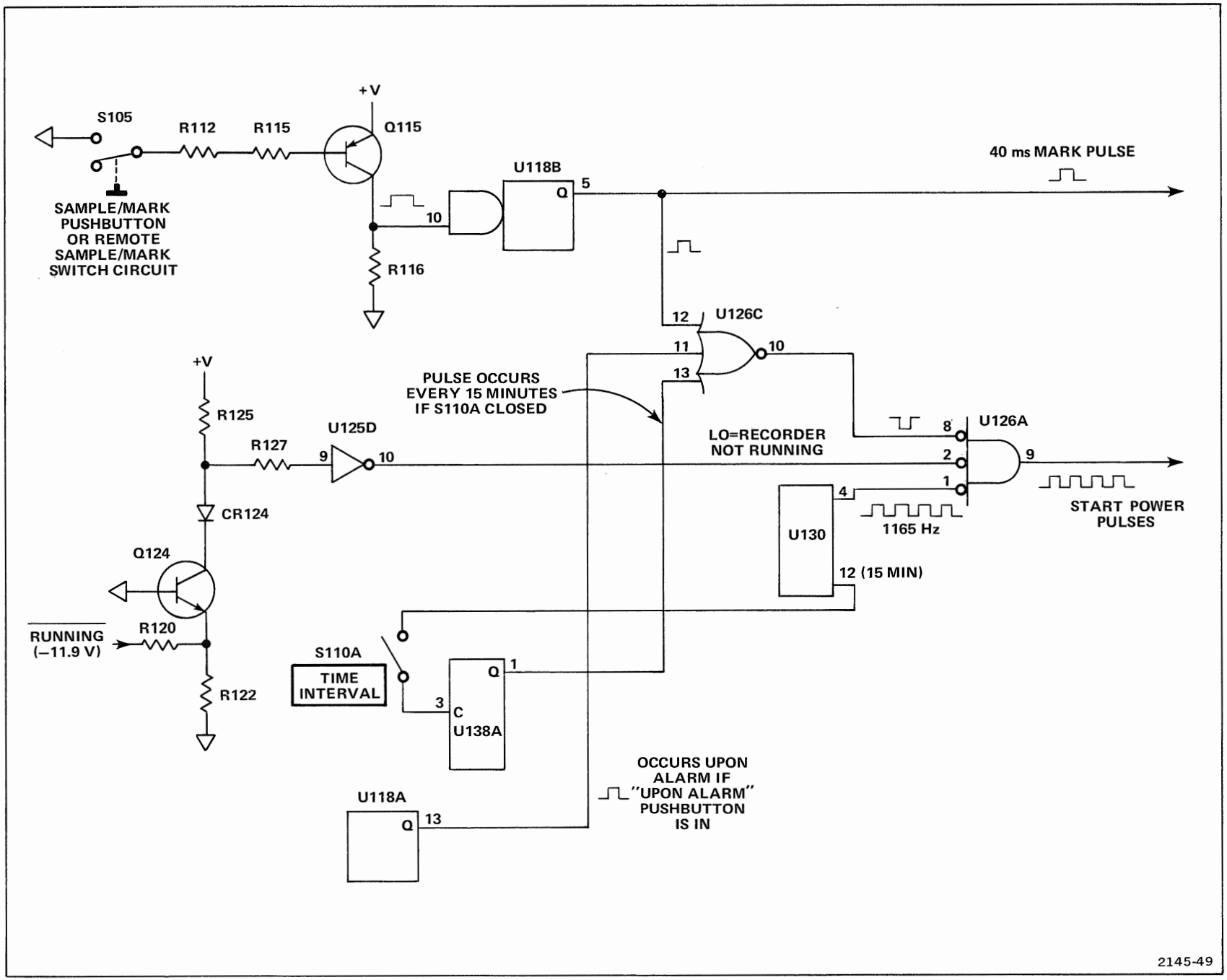


Figure 3-2. Start Power circuit operation.

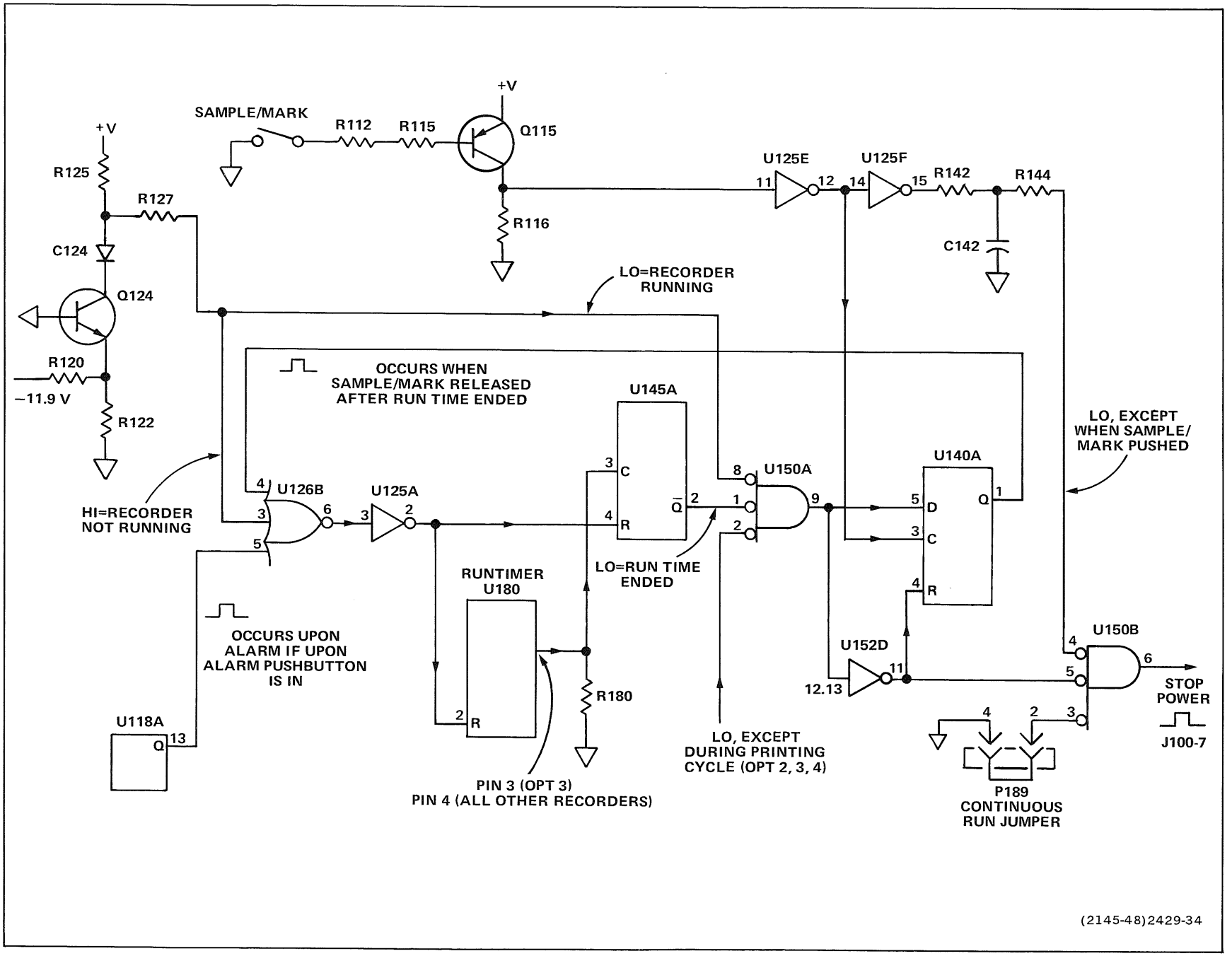


Figure 3-3. Stop Power circuit operation.

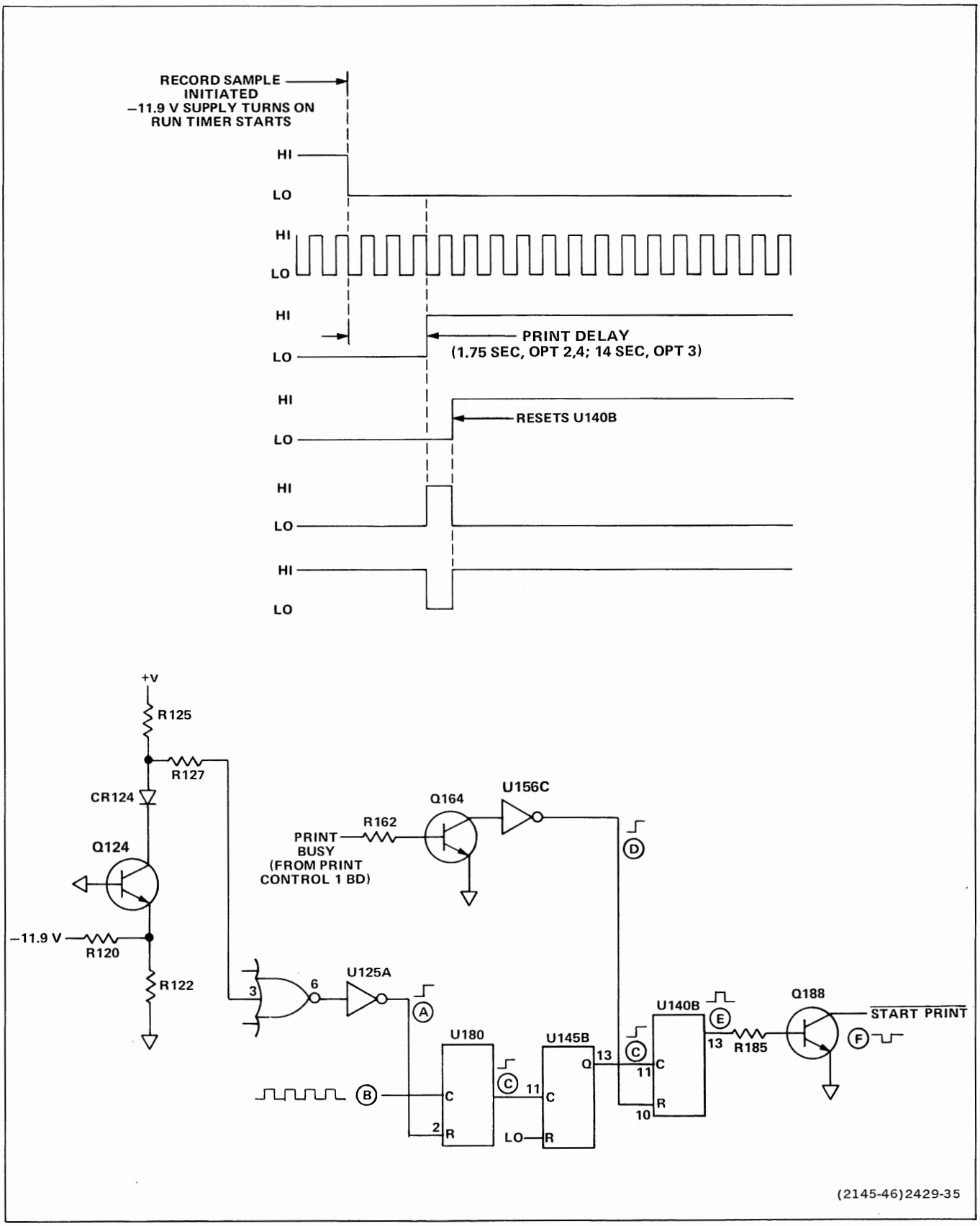


Figure 3-4. $\overline{\text{Start Print}}$ initiated by any record sample mode which has started the recorder.

The print cycle will start without delay when the SAMPLE/MARK pushbutton is held in and released after both run time and print cycle have ended. See Figure 3-5.

This action produces a HI at pin 8 of U145B which sets this flip-flop causing pin 11 of U140B to be clocked HI as above to produce the $\overline{\text{Start Print}}$ pulse at the collector of Q188.

If the SAMPLE/MARK pushbutton is pushed after the print cycle is ended, but before the run time is ended, a new print cycle will be triggered as follows (see Fig. 3-6): Pins 12 and 13 of U150C are LO, pin 12 of U118B (one-shot multivibrator) produces a $\overline{\text{Mark}}$ (LO) pulse at pin 11 of U150C and a HI pulse at pin 8 of U140B. Thus, producing the $\overline{\text{Start Print}}$ pulse at the collector of Q188 as above.

If the monitor produces an Alarm signal after the print cycle is ended, but before the run time is ended, a new print cycle will be triggered as follows (see Fig. 3-6): the Alarm signal passes through U156D to fire U118A (50 ms one shot). The output of the one shot causes Q188 to turn on and produce the $\overline{\text{Start Print}}$ signal for 50 ms.

TIMER-INITIATED PRINT ONLY MODE (OPTIONS 2, 3, AND 4). A low power mode is provided to conserve battery power on timer-initiated runs. Moving the P203 jumper to pins 1 and 2 enables this circuit. The result is alphanumerics only on the chart paper (the waveform recording circuits are disabled) and a chart speed of 25 mm/second regardless of the setting of the front panel SPEED button. U138B pin 9 is connected HI through R302. As the Interval Timer initiates a record sample, pin 11 of U138B is clocked HI, causing pin 13 to go HI to produce a Print Only signal to disable the Pen Amplifier. At the same time, pin 12 goes LO causing the Chart Speed logic signal to go LO and set the chart speed to 25 mm/SEC.

Whenever a Timer-Initiated Run is interrupted by an Alarm or Sample/Mark command, pin 10 of U138B goes HI and resets U138B. This causes pin 13 to go LO and pin 12 to go HI. The analog display begins and chart speed is set to front panel setting.

RUN-CYCLE TIMING RELATIONSHIP. Figures 3-7, 3-8, and 3-9 show timing relationships of three run-cycle modes: normal, in-process-interrupted-by-alarm, and continuous.

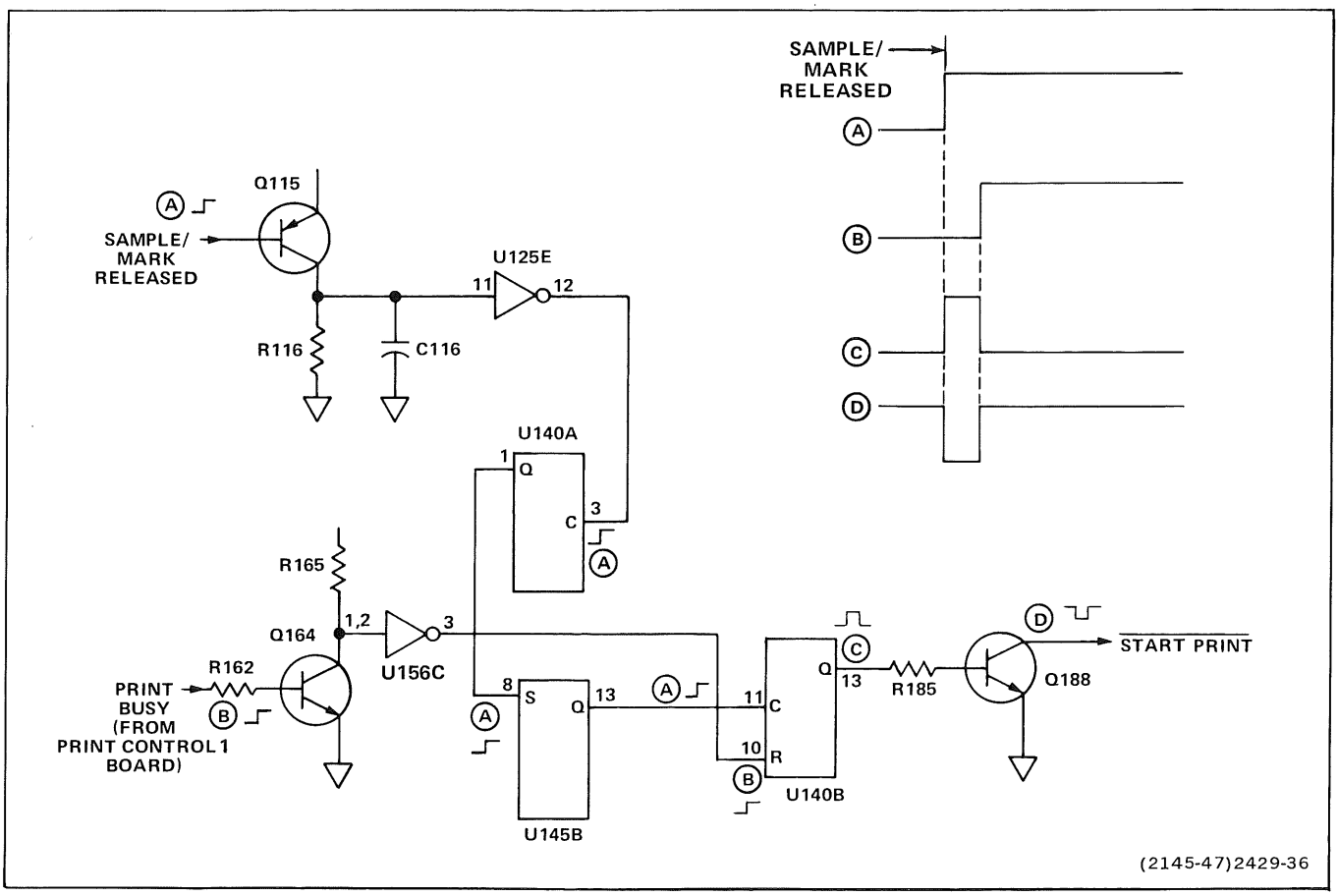


Figure 3-5. $\overline{\text{Start Print}}$ initiated by SAMPLE/MARK being held in then released after run time and print cycle have ended.

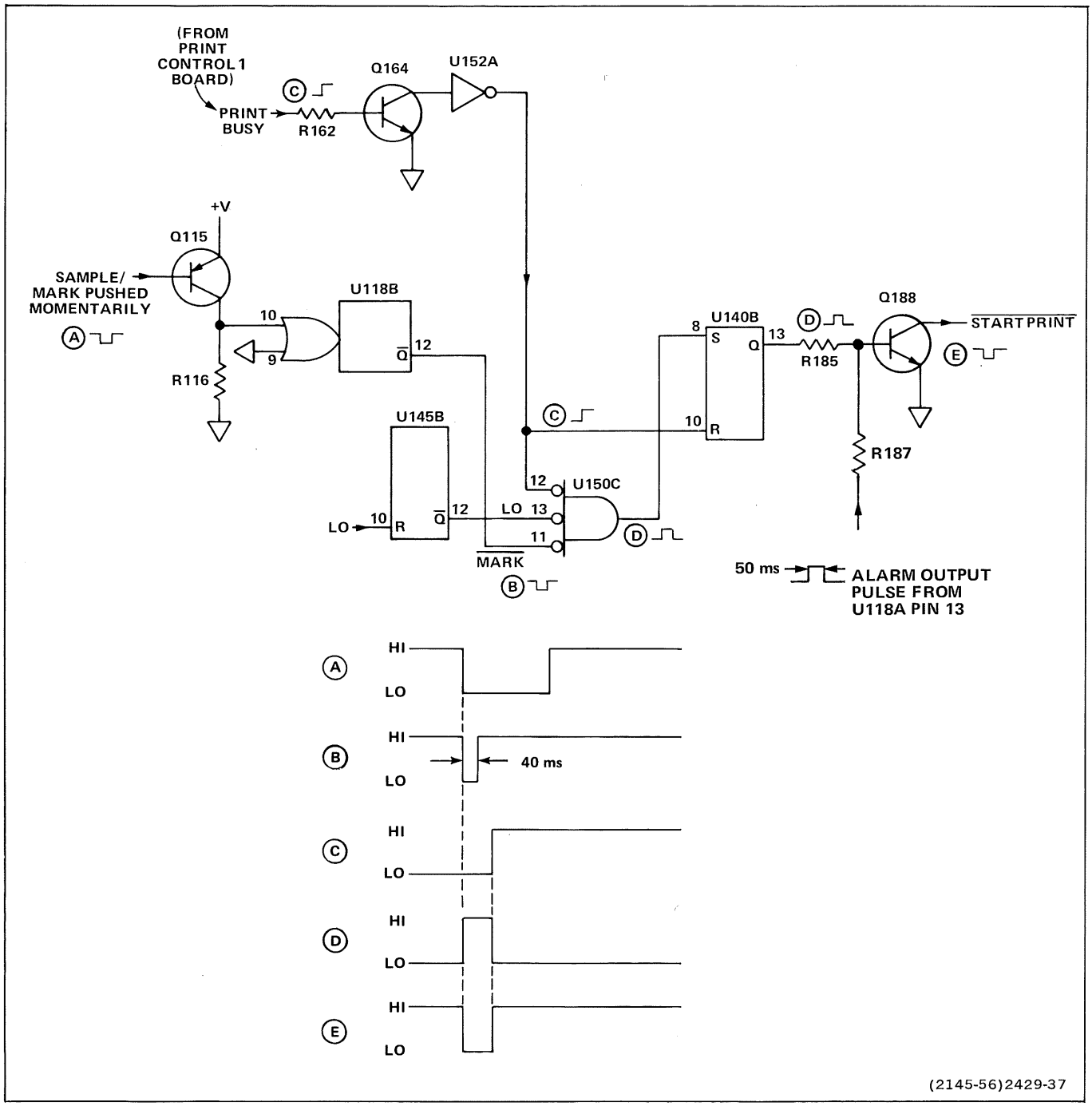


Figure 3-6. Start Print initiated by pushing SAMPLE/MARK after print ends but before run time ends.

PEN AMPLIFIER BOARD ◇2

Circuit Functions

The Pen Amplifier board accomplishes the following:

1. Amplifies ECG or Pressure signals to drive the writing stylus.

2. Provides baseline positioning for ECG waveforms.

3. Provides baseline positioning of pressure waveforms as determined by Pressure/Pulse signal from monitor (except Standard recorder).

4. Disables pen drive upon Print Only command from Run Control board. This command can be strapped in Option 2, 3, and 4 recorders to occur during a timer-initiated run.

5. Uses Mark signal from Run Control board to produce a 40 ms, 0.5 cm high pulse on the displaying waveform.

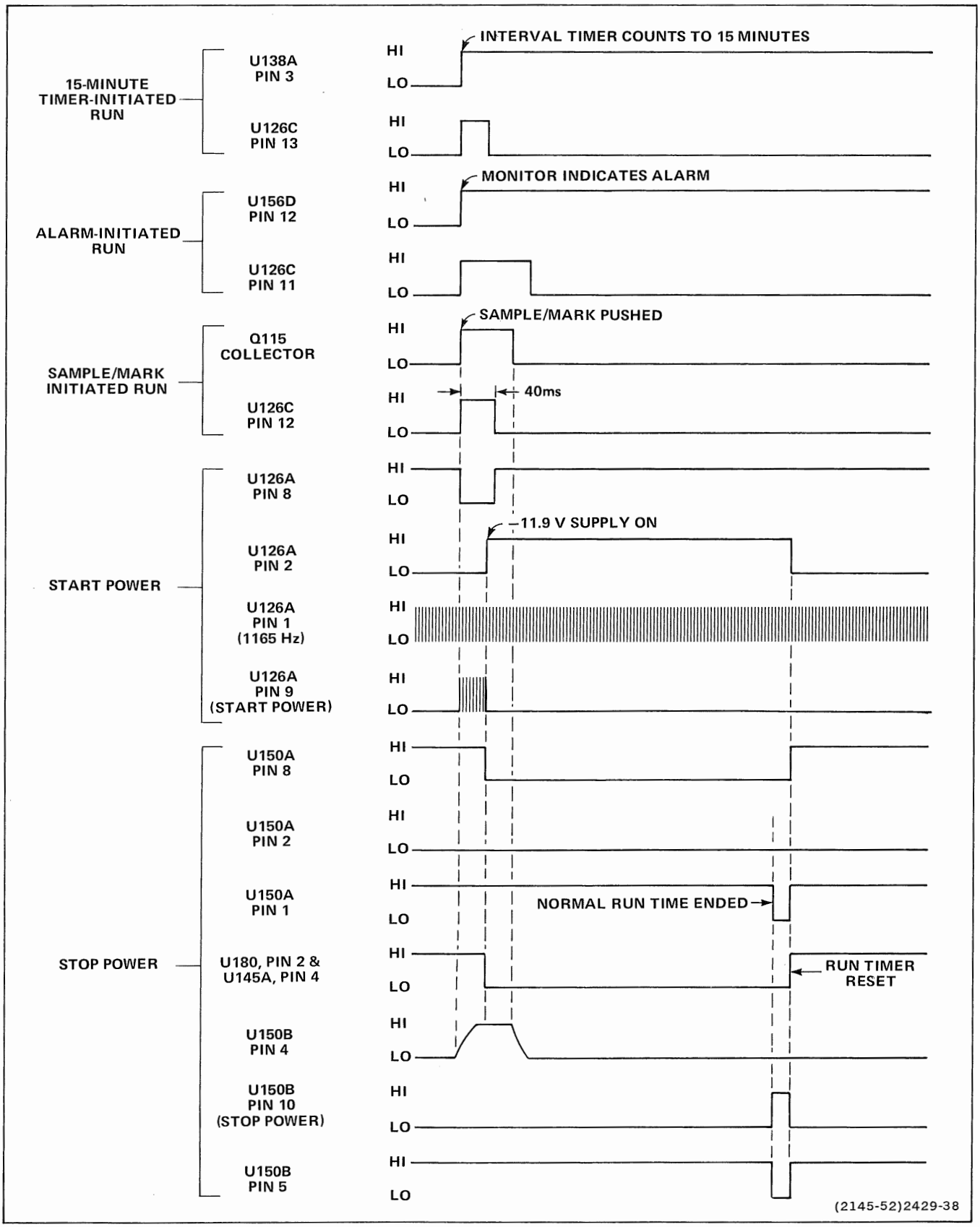


Figure 3-7. Timing diagram for normal run cycle.

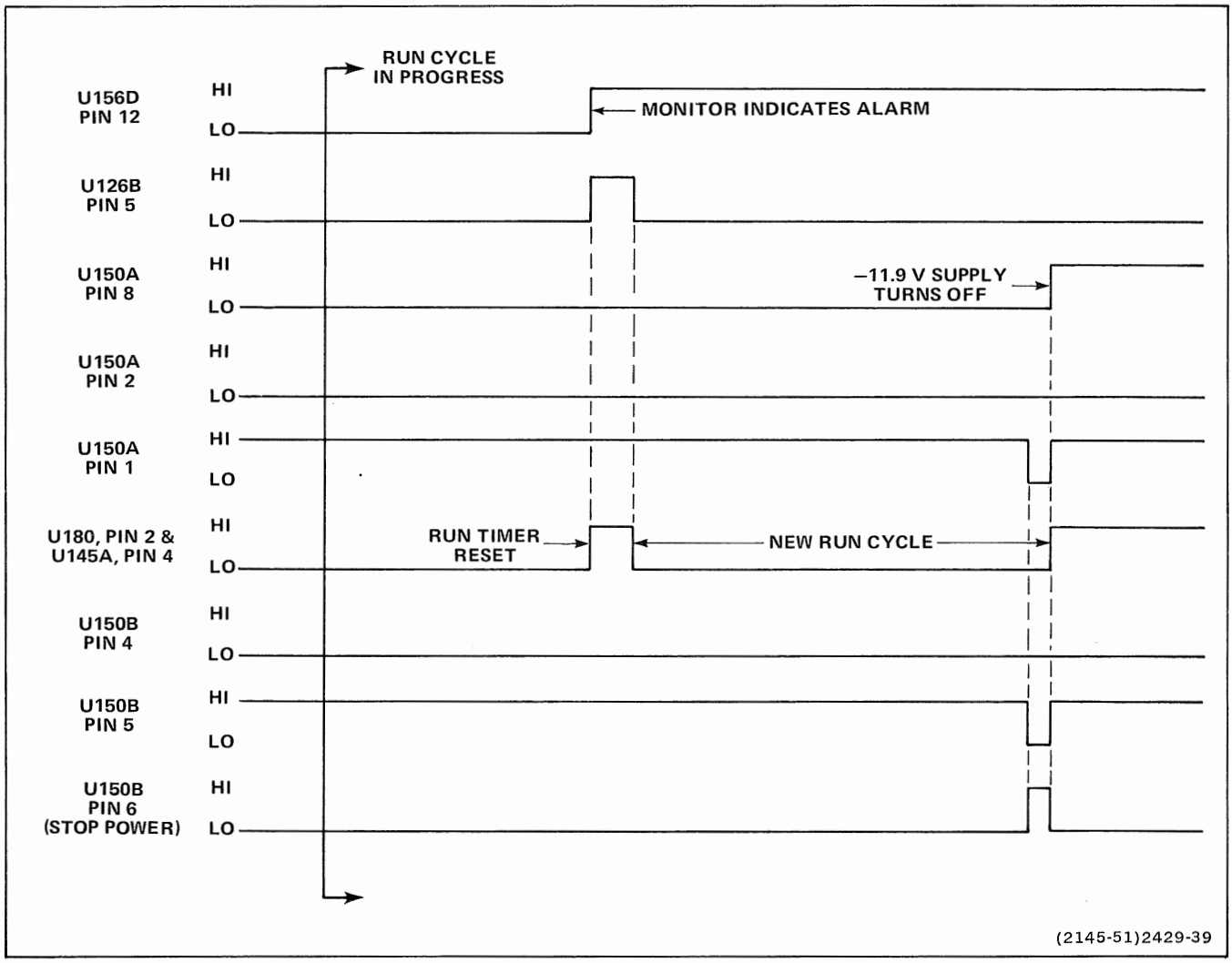


Figure 3-8. Timing diagram for in-process run cycle interrupted by an alarm.

Circuit Operation

ECG signals to be displayed on the recorder paper enter the ECG Inverter/Buffer. The signal is inverted and sent to the Input Buffer and Swing Limiter circuit. It goes either directly through a jumper at P314, pins 4 and 5 on Standard recorders or through the SOURCE switch on Option 1, 2, and 3 when selected by the ECG pushbutton.

Pressure signals by the SOURCE switch enter the Input Buffer and Swing Limiter circuit.

ECG positioning is accomplished by POSITION control R340 which controls the + input of the Input Buffer. In the Option 1, 2, 3, and 4 recorders, the Pressure Baseline Shifter circuit sets the zero pressure baseline 1/2 centimeter above the bottom chart line when the Pressure/$\overline{\text{Pulse}}$ line from the monitor is HI. When the line is LO, indicating Pulse mode, the pulse waveform is centered on the chart.

An inverted signal (Select Pulse/$\overline{\text{Pressure}}$ from the Baseline Shifter circuit is used by Option 2, 3, and 4 recorders to control the alpha-numeric printing of the pressure parameters.

Buffered ECG or pressure signals are sent to the Pen Motor Driver circuit. The pen motor drives the heated writing stylus to display the waveform on heat-sensitive paper.

When the Print Only line from the Run Control board goes HI (Run Control circuit programmed to the omit writing of analog waveform during Timer-Initiated Run), the Print Only switch causes the writing stylus to be centered. At the same time it sends a $\overline{\text{Disable Stylus Heat}}$ signal to the power supply which turns off the stylus heat.

ECG INVERTER/BUFFER. ECG signals from the monitor enter the (−) input of U322 (unity gain amplifier). The signal is inverted and sent to the (−) input of U330; via the SOURCE switch (except Standard recorders) and P314.

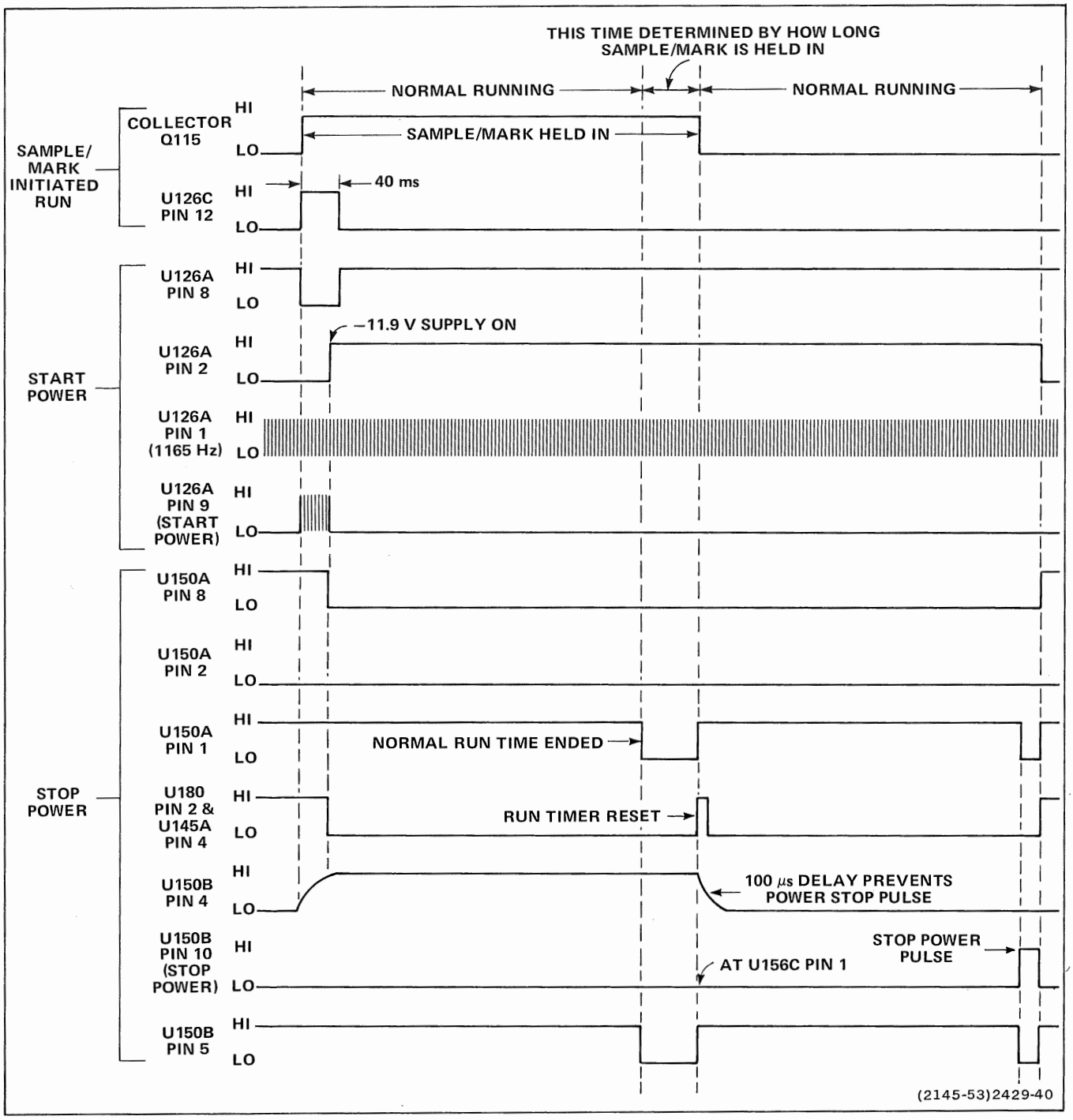


Figure 3-9. Timing diagram for continuous-run cycle, initiated by SAMPLE/MARK button.

INPUT BUFFER AND SWING LIMITER. U330 is an inverting buffer stage. Q332 and Q335 are voltage swing limiters. Q332 limits the negative voltage swing to about −2.5 volts and Q335 limits the positive voltage swing to about +2.5 volts. The differential balance of U330 is critical. R325 is included to match the 750 Ω average setting of the R352 Pressure Zero Position control.

PRESSURE BASELINE SHIFTER. When Pressure/$\overline{\text{Pulse}}$ line into the base of Q346 is HI, indicating pressure mode, Q346 and Q344 are tuned on. This allows the Pressure Zero Position control, R352, to set the level at the (+) input of U330 to some plus voltage, thus setting the zero baseline of the pressure waveform. In the pulse mode, both Q346 and Q344 are turned off and the (+) input of U330 goes to

ground to set the pulse waveform baseline to the center of the chart.

INPUT BUFFER AND SWING LIMITER. U330 is an inverting buffer stage. Q332 and Q335 are voltage swing limiters. Q332 limits the negative voltage swing to about −2.5 volts and Q335 limits the positive voltage swing to about +2.5 volts.

PEN MOTOR AND DRIVER. A positive-going signal at TP388 causes current to be drawn from the −16 volt unregulated supply through R376. This turns on Q378, causing the Pen Motor B389 to move the writing stylus in the negative direction. Similarly, a negative-going signal at TP338 causes Q372 to turn on and the Pen Motor to move the writing stylus in the positive direction.

Feedback is via the Gain adjustment R375 and is primarily dependent on the Pen Motor current which is detected across R381. A Damping adjustment R380 picks off a small fraction of the ac signal and sums it with the main feedback signal. This adjustment is effective with fast-rise signals to compensate for the inductive characteristics of the Pen Motor.

PRINT ONLY SWITCH. This circuit is useful only in the Option 2, 3, and 4 recorders. When the Print Only line goes HI at the base of Q356, Q358 turns on and grounds the minus input of U366 through R381, shorting out the signal to the Pen Motor. An inverted Print Only signal, $\overline{\text{Disable Stylus Heat}}$, is produced when Q356 is turned on. This signal is sent to the Power Supply board to shut off the stylus heater.

A CONDITIONER BOARD ◈3 (OPTION 3 ONLY)

Circuit Functions

The A Conditioner board accomplishes the following:

1. Provides systolic and diastolic pressure values from the monitor A-Wave signal. Systolic and Diastolic Conditioners sample and hold the peak values of systolic and diastolic pressures. The filtered output provides a dc level (for each pressure) that is directly related to the average systolic or diastolic pressure level measured by the pressure transducer.

2. Filters the A-Wave signal from the monitor to produce a voltage representative of the mean value of the pressure signal.

3. Selects (through a multiplexer) either A/V-Systolic, Diastolic, Mean signals from the A/V-Conditioner board or A-Systolic, Diastolic, and Mean signals from this board.

4. Derives a logic overrange signal from the monitor A-Wave signal.

5. Selects (through a multiplexer) either the A or the A/V overrange and skip signals for use by the printing circuits.

Circuit Operation

A INPUT BUFFER. The A Input Buffer circuit provides buffering between the A-Wave signal and the Systolic, Diastolic, and Mean Conditioners. CR442, CR443, and R442 make up a negative pressure limiter. All of the filters in the pressure conditioner circuits use polarized tantalum capacitors (ground reference). The negative pressure circuit prevents excessive reverse voltage on these capacitors.

A SYSTOLIC/DIASTOLIC CONDITIONER. The Systolic/Diastolic Conditioner is a sampling circuit, followed by a two-pole filter. This circuit determines the peak and valley values of the pressure waveform, and through the sampling and filter system, converts these pressure values to voltage levels to be read by the DVM.

U420A and D are trigger circuits that tell when to take the sample. Switches U412A and C are the sample and hold switches and C414 and C434 are the final storage capacitors that provide signal to the filter.

When the incoming pressure signal (from pin 6 of U444) is rising, pin 3 of U420A rises. The rise at pin 3 causes pin 1 to rise. CR421 conducts and charges C420 to the value of the rising signal.

During this period of rising input signal, since pin 5 of U420B is HI, pin 7 goes HI and switch U412A closes. Thus, the rising signal at pin 3 of U410A (voltage follower) charges C412 to the input level.

As long as the input pressure signal is rising, pin 14 of U420D is LO, pin 8 of U420C is LO, and switches U412B and C are open.

At the peak of the rise (systolic), C412 is now charged to that peak level (a sample is taken).

Now, when the pressure signal starts to fall, pin 1 of U420A goes LO, because pin 2 is held at the highest level by C420 while pin 3 falls. Diode CR421 turns off, pin 7 of U420B goes LO, opening switches U412A and D. The sample is now stored in C412. Since there is no R associated with C412 (except leakage current in U410B), C412 holds the highest value of the pressure signal.

As the pressure falls, pin 12 of U420D falls, pin 14 of U420D falls, CR427 turns on, and C425 charges toward the pressure signal level. As pin 14 of U420D falls, pin 8 of U420C goes HI, closing switches U412C and B. C432 now charges toward the pressure input signal level via U410D. At the same time, since U412B is now closed, the voltage on C412 is transferred to C414 and the systolic sample is fed to the two-pole filter U415C and associated circuitry.

Since U412 is open, the diastolic sample is not connected to the two-pole filter, U415D and associated circuitry.

When the input pressure signal reaches the lowest value C432 is charged to that value.

As the input pressure now starts to rise, pin 14 of U420D goes HI because pin 13 is held to the lower level by C425 while pin 12 rises. Diode CR427 turns off, pin 8 of U420C goes LO, switch U412C and B open, and the diastolic sample is now the voltage on C432. At the start of the input pressure rise, pin 1 of U420A again goes HI, pin 7 of U420B goes HI, switch U412D closes, the voltage on C432 is transferred to C434, and the diastolic sample is fed to the two-pole filter U415D and associated circuitry. U412A again closes and a new cycle starts.

A OVERRANGE DETECTOR. The A Overrange Detector consists of U460A, B and associated circuitry. The detector is a pair of comparators that compare the incoming pressure levels (dc) to fixed voltages set by the dividers R460-R461 and R465-R476. The pressure signal is a direct pressure, not attenuated. The comparison level is such that a HI overrange signal is produced if the A-pressure signal causes the display to be off the chart.

SYSTOLIC/DIASTOLIC/MEAN MULTIPLEXER. The Systolic/Diastolic/Mean Multiplexer U450 selects the Systolic, Diastolic, and Mean pressure signals from either the A or A/V pressure channels. A HI on pin 1 of U490 selects the A pressure levels from conditioner circuits on this board. A LO selects the A/V pressure levels from the conditioner circuits from the A/V Conditioner board. The selected Systolic, Diastolic, and Mean signals are sent to the Analog Multiplexer U830 on the DVM Analog board. These are then multiplexed with the other DVM signals from the monitor and processed for printout as required by the Print Control circuits.

PRESSURE-SKIP/OVERRANGE MULTIPLEXER. The Pressure-Skip/Overrange Multiplexer U490 selects skip and overrange signals from either the A or A/V pressure channels. A HI on pin 1 of U490 selects the A Overrange signal at pin 6 of the Skip A signal at pin 3. When pin 1 is LO the A/V Overrange and Skip A/V signals are selected.

The selected pressure-skip and overrange signals are sent to the Overrange Multiplexer on the Print Drive board to be multiplexed with the other skip and overrange signals from the monitor.

Output from the two-pole filters is fed to multiplexer U450 to be selected as required by the Print Control circuit via the Select A/ $\overline{A/V}$ logic signal.

The circuit responds to the peak and valley values (systolic and Diastolic) while rejecting normal dicrotic notch level changes.

The discharge rates of C420 (systolic) and C425 (diastolic) are such that the systolic and diastolic switching points are shown in Figure 3-10.

Resistors R420 and R425 ensure that whenever there is no pulsatile pressure (systolic minus diastolic = 0), all levels decay to the static incoming pressure value.

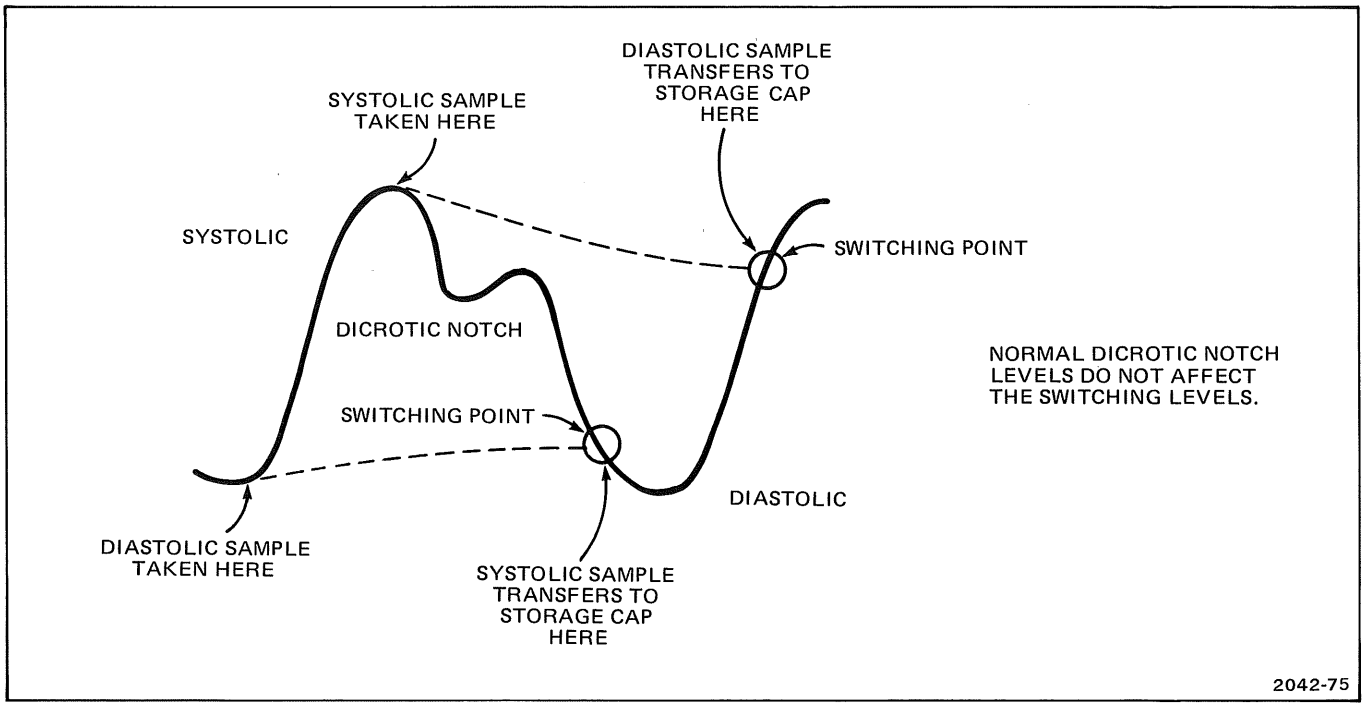


Figure 3-10. Systolic/Diastolic switching points.

A MEAN CONDITIONER. The A Mean Conditioner circuit is a four-pole passive filter consisting of U448A, U448B, and associated components.

The four-pole filter is designed to provide an accurate mean value of the A pressure signal while holding ripple to 1 mmHg, or less.

U448A provides the impedance matching between the second and third poles of the filter. U448B provides the low impedance to drive the A Mean input at pin 3 of the Systolic/Diastolic/Mean multiplexer U450.

A/V BUFFER BOARD ◈4 (OPTION 2 ONLY)

Circuit Functions

The A/V Buffer circuit accomplishes the following:

1. Provides non-inverting buffer stages for systolic, diastolic, and mean pressure signals from the monitor. These signals are sent to the DVM Analog board and provide values for the pressure printout.

2. Conditions the °F/$\overline{°C}$ logic signal from the monitor. The signal is inverted, the logic levels are changed and it is sent to the Print Control 1 board to printout either °C or °F as set by the switch on the monitor rear panel.

3. Converts logic levels of the A/V Overrange signal from the monitor for use in recorder circuitry.

4. Provides a pressure skip logic signal to omit pressure printout when pulse is selected at the monitor.

Circuit Operation

PRESSURE-SKIP LOGIC. The Pressure-Skip Logic circuit is made up of U610A, B, C, D, and associated circuitry. As long as either the Select Pulse/ $\overline{\text{Press}}$ signal from the Pen Amplifier board or the Skip A/V signal from the monitor is HI, the Skip A/V (1) signal at pin 3 of U610A will be HI. This causes the BP A/V printout to be omitted from the alpha-numeric printing sequence.

If both pin 8 and pin 9 of U610C are LO, pin 5 will be LO. This allows a LO on the Select A/ $\overline{\text{A/V}}$ line from the Print Control 1 circuit to enable (cause pin 3 of U610A to go LO) the BP A/V printout.

A/V OVERRANGE CONDITIONER. The A/V Overrange Conditioner converts logic levels of the A/V Overrange signal from the monitor to 0 volts (LO) and +4.9 volts (HI) to match logic levels required by recorder circuitry. The A/V OVRNG (1) signal goes to J400 pin 11, through a jumper to pin 10 and becomes the Pressure Overrange signal which is sent to the Overrange Multiplexer U1925 on the Print Drive board.

°C/°F LOGIC CONDITIONER. The °C/°F Logic Conditioner circuit Q620, Q625, and associated components inverts and changes the approximate 0 volts (LO) and +1.76 volts (HI) °F/$\overline{°C}$ logic signal from the monitor to about +0.6 volts (LO) and +4.9 volts (HI) to match recorder circuitry. The °C/$\overline{°F}$ signal is then sent to Conditional Load Multiplexer U1490 on the Print Control 1 board.

A/V-SYSTOLIC/DIASTOLIC/MEAN BUFFERS. U634A, B, and C are non-inverting buffers for the Mean, Diastolic, and Systolic DVM signals, respectively, from the monitor. These signals are sent to U830 on the DVM Analog board to be multiplexed with the other DVM signals from the monitor, at the appropriate time.

A/V CONDITIONER BOARD ◈5 (OPTION 3 ONLY)

Circuit Functions

The A/V Conditioner board accomplishes the following:

1. Provides a pressure skip logic signal to omit A/V pressure printout when the A/V pressure transducer is disconnected.

2. Conditions the °F/$\overline{°C}$ logic signal from the monitor. The signal is inverted, the logic levels are changed and it is sent to the Print Control 1 board to printout either °C or °F as set by the switch on the monitor rear panel.

3. Provides systolic and diastolic pressure values from the monitor A/V Wave Scaled signal. Systolic and Diastolic Conditioner sample and hold the peak values of systolic and diastolic pressures. The filtered output provides a dc level (for each pressure) that is directly related to the average systolic or diastolic pressure level measured by the pressure transducer.

4. Filters the A/V Wave Scaled signal from the monitor to produce a voltage representative of the mean value of the pressure signal.

5. Provides a logic overrange signal from the monitor A/V Wave signal.

Circuit Operation

A/V PRESSURE-SKIP LOGIC. The A/V Pressure-Skip Logic circuit is made up of U710 A, B, and associated circuitry. As long as either the Select Pulse/$\overline{Press}$ signal from the Pen Amplifier board or the Skip A/V signal from the monitor is HI, the Skip A/V (1) signal at pin 4 of U710B will be HI. This causes the BP A/V printout to be omitted from the alpha-numeric printing sequence.

If both pin 1 and pin 2 of U710A are LO, pin 4 of U710B will be LO and BP A/V will be printed out.

°C/°F LOGIC CONDITIONER. The °C/°F Logic Conditioner circuit Q620 and Q625 and associated components inverts and changes the approximate 0 volts (LO) and +1.76 volts (HI) °F/$\overline{°C}$ logic signal from the monitor to about +0.6 volts (LO) and +4.9 volts (HI) to match the recorder circuitry. The °C/°F signal is then sent to Conditional Load Multiplexer U1490 on the Print Control 1 board.

A/V INPUT BUFFER. The A/V Input Buffer circuit provides buffering between the A/V Wave Scaled signal and the Systolic, Diastolic, and Mean Conditioners. CR752, CR753, and R752 make up a negative pressure limiter. All of the filters in the pressure conditioner circuits use polarized tantalum capacitors (ground reference). The negative pressure circuit prevents excessive reverse voltage on these capacitors.

A/V SYSTOLIC/DIASTOLIC CONDITIONER. The Systolic/Diastolic Conditioner is a sampling circuit, followed by a two-pole filter. This circuit determines the peak and valley values of the pressure waveform, and through the sampling and filter system, converts these pressure values to voltage levels to be read by the DVM Analog circuit.

U730A and D are trigger circuits that tell when to take the sample. Switches U722A and C are the sample and hold switches and C724 and C744 are the final storage capacitors that provide signal to the filter.

When the incoming pressure signal (from pin 6 of U754) is rising, pin 3 of U730A rises. The rise at pin 3 causes pin 1 to rise. CR731 conducts and charges C730 to the value of the rising signal.

During this period of rising input signal, since pin 5 of U730B is HI, pin 7 goes HI and switch U722A closes. Thus, the rising signal at pin 3 of U720A (voltage follower) charges C722 to the input level.

As long as the input pressure signal is rising, pin 14 of U730D is LO, pin 8 of U730C is LO, and switches U722B and C are open.

At the peak of the rise (systolic), C722 is now charged to that peak level (a sample is taken).

Now, when the pressure signal starts to fall, pin 1 of U730A goes LO, because pin 2 is held at the highest level by C730 while pin 3 falls. Diode CR731 turns off, pin 7 of U730B goes LO, opening switches U722A and D. The sample is now stored in C722. Since there is no R associated with C722 (except leakage current in U720B), C722 holds the highest value of the pressure signal.

As the pressure falls, pin 12 of U730D falls, pin 14 of U730D falls, CR737 turns on and C735 charges toward the pressure signal level. As pin 14 of U730D falls, pin 8 of U730C goes HI, closing switches U722C and B. C742 now charges toward the pressure input signal level via U720D. At the same time, since U722B is now closed, the voltage on C722 is transferred to C724 and the systolic sample is fed to the two-pole filter U725C and associated circuitry. Since U722D is open, the diastolic sample is not connected to the two-pole filter, U752D and associated circuitry.

When input pressure signal reaches the lowest value, C742 is charged to that value.

As the input pressure now starts to rise, pin 14 of U730D goes HI because pin 13 is held to the lower level by C735 while pin 12 rises. Diode CR737 turns off, pin 8 of U730 goes LO, switch U722C and B open and the diastolic sample is now the voltage on C742.

At the start of the input pressure rise, pin 1 of U730A again goes HI, pin 7 of U730B goes HI, switch U722D closes, the voltage on C742 is transferred to C744 and the diastolic sample is fed to the two-pole filter U725D and associated circuitry.

U722A again closes and a new cycle starts.

Output from the two-pole filters is fed to multiplexer U450 on the A Conditioner board to be selected as required by the Print Control circuit via the Select A/ $\overline{A/V}$ logic signal.

The circuit responds to the peak and valley values (systolic and diastolic) while rejecting normal dicrotic notch level changes.

The discharge rates of C730 (systolic) and C735 (diastolic) are such that the systolic and diastolic switching points are as shown in Figure 3-10.

Resistors R730 and R735 ensure that whenever there is no pulsatile pressure (systolic minus diastolic = 0), all levels decay to the static incoming pressure value.

A/V MEAN CONDITIONER. The A/V Mean Conditioner circuit is a four-pole passive filter consisting of U758A, U758B, and associated components.

The four-pole filter is designed to provide an accurate mean value of the A/V pressure signal while holding the ripple to 1 mmHg, or less.

U758A provides the low impedance matching between the second and third poles of the filter. U758B provides the low impedance to drive the A Mean input at pin 3 of the Systolic/Diastolic/Mean Multiplexer U450.

A/V OVERRANGE DETECTOR. The A/V Overrange Detector consists of U770A, B and associated circuitry. The detector is a pair of comparators that compare the incoming pressure levels (dc) to fixed voltages set by the dividers R770-R771 and R775-R776. The pressure signal is direct pressure, not attenuated. The comparison level is such that a HI overrange signal is produced if the A/V pressure signal causes the display to be off the chart.

DVM ANALOG ◇6◇ AND DVM DIGITAL ◇7◇

The DVM Analog circuit is shown on schematic 6 and the DVM Digital circuit is shown on schematic 7; both schematics 6 and 7 are located in the Diagrams and Circuit Board Illustrations section of this manual. The circuitry on the DVM Analog and DVM Digital Boards (see schematics 6 and 7) comprise an analog to digital converter (A/D). References to the term A/D in the following discussion imply that A/D circuitry is located on both schematic 6 and 7.

Circuit Function

The DVM Analog and DVM Digital circuitry (see schematics 6 and 7) accomplishes the following:

1. Patient vital signs (systolic, diastolic, etc.) are applied to the DVM Analog board as analog signals. Each analog signal is then converted to a 3 1/2 digit binary-coded-decimal (BCD) format. The BCD output is then the equivalent numerical value of the patient's vital signs and is used to drive the 400 Recorder printout unit.

2. Provides the polarity switching to apply a positive polarity to the DVM Integrator input (regardless of input polarity).

3. A clock provides elapsed time values and sequencing signals to the print function.

The A/D Converter and associated circuits are under master control of the Print Control circuits (see schematics 8 and 9) and will, upon command:

1. Select the patient vital sign that is to be converted.

2. Perform a single A/D conversion and hold the result.

3. Sequentially deliver each BCD digit at the appropriate time (beginning with the most significant digit) and provide the sign value.

Circuit Operation

The A/D converter is designed around a pair of IC's: U810 (DVM Integrator stage) and U1065 (DVM Control stage), see Diagram 6 and 7 respectively. Basically the A/D converter is an integrator and a counter. The A/D converter develops a current proportional to the unknown input voltage. This current is integrated by the DVM Integrator stage. The DVM Integrator stage is then switched to an internal reference current, of opposite polarity to the current produced by the input voltage, which causes the DVM Integrator stage to run back down, see Figure 3-11. The ramp produced by the unknown current is allowed to run up for exactly 1000 counts, before being switched to the reference current. To provide ramp run-up, even though the unknown voltage is zero, a fixed offset current is added to the unknown current. To compensate for this added offset current, the down ramp count is delayed by 100 counts (the equivalent of the fixed offset current on the up ramp). The number of counts back down (after the 100-count delay) gives the value of the unknown current, and therefore the unknown voltage. The remaining circuits of the A/D converter include the Analog Data Multiplexer, Polarity Switch, DVM Integrator, DVM Control, 30 Millivolt Comparator, Clock Oscillator, Binary Divider, Clock Register, Sign Latch and Digital Latch stages; these stages are outlined with shaded areas on Diagrams 6 and 7.

CLOCK OSCILLATOR. The Clock Oscillator stage develops the 32.768 kHz signal. Crystal (Y901) is the frequency determining element and integrated circuits U907B and C provide amplification to sustain the oscillations. Amplifier U924D provides isolation for the 32.768 kHz output signal.

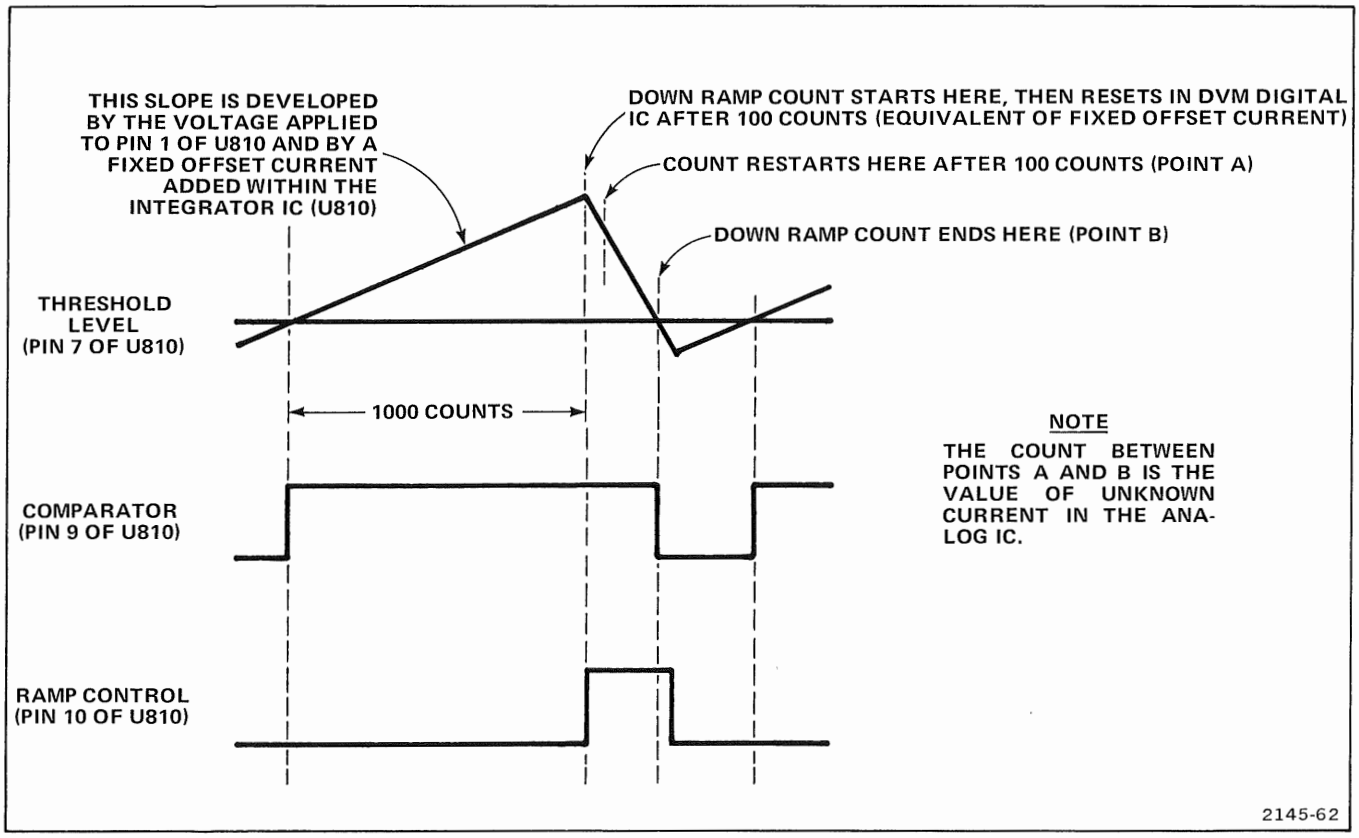


Figure 3-11. Basic A/D dual-slope waveform.

BINARY DIVIDER. The Binary Divider stage divides the 32.768 kHz Clock Oscillator signal down to 128 Hz, 64 Hz, 2 Hz, and 1/60 Hz (1 pulse/minute) signals. These signals are provided at pins 28, 29, 30 and 27 of J800, respectively. The 128 Hz, 64 Hz, and 2 Hz signals are developed by U906 from the 32.768 kHz clock signal, while U909 and U907 (A and B) develop the 1/60 Hz (1 pulse/minute) signal from the 2 Hz signal developed by U906. The 1 pulse/minute output from pin 3 of U909 is developed by dividing the 2 Hz signal 120 times (the division would be 128 times except for the addition of one count for every fifteenth input pulse to U909). This is accomplished by feeding the pulse that occurs on pin 6 of U909 back to the input pin 1 of U906 through C913, R912, U907D and U907A.

The Clock Reset signal, at pin 21 of J800, initiates the Binary Divider stage. When the power to the instrument is turned on, the +V supply connected to R921 sets the output of the RS flip-flop, pin 4 of U924A, HI. This HI is applied to the reset input of U906 (on pin 11) and U909 (on pin 2) to inhibit both U906 and U909 until the +4.9 V supply is activated. The +4.9 V supply is at zero volts until activated, then the output of the RS flip-flop goes LO which activates U906 and U909, and U1015 the Clock Register stage (schematic 6).

ANALOG DATA MULTIPLEXER. The Analog Data Multiplexer stage (see schematic 6) couples any of the 8 input signals, applied to U830 (through pins 7-14 of J800) to the input of the Polarity Switch stage (pin 2 of U845). Logic levels applied to pins 9, 10, and 11 of U830 determine which one of the 8 input signals are selected to pass through U830. Table 3-1 shows the output signal of the Analog Data Multiplexer stage with different combinations of logic levels applied to pins 11, 10, and 9 of U830.

TABLE 3-1

Input/Output Combinations of U830

Selected Output (Pin 3 of U830)	SP2 (Pin 9 of U830)	SP1 (Pin 10 of U830)	SP0 (Pin 11 of U830)
RATE	0	0	0
SYST	0	0	1
DIAST	0	1	0
MEAN	0	1	1
TEMP A	1	0	0
TEMP B	1	0	1
RESP	1	1	0
AUX (DVM)	1	1	1

POLARITY SWITCH. The purpose of the Polarity Switch stage is to provide a positive signal level to the Analog Data Multiplexer, regardless of actual signal polarity. The Polarity Switch stage monitors the output signal from the Analog Data Multiplexer stage (pin 3 of U830); when the signal at pin 3 of U830 is positive, the signal is coupled through the polarity switch to the input of the DVM Integrator stage (pin 1 of U810) with no change in polarity, however, if the signal from pin 3 of U830 is negative the Polarity Switch stage inverts the signal so that a positive signal is applied to the DVM Integrator stage.

The operation of the Polarity Switch stage is as follows: When the signal applied to the Polarity Switch is negative, U845 inverts the signal before applying the signal to pins 1 and 2 of U847A. The output of U847A (pin 3) is LO and the output of U847B (pin 4) is HI; these two signals control the conducting paths within U849A, B, C, and D. A HI applied to pins 5 and 6 of U849 (B and C) internally switches U849B to electrically connect together pins 4 to 3 of U849B and also, pins 8 to 9 of U849C. Thus, the negative signal from pin 3 of U830 is coupled through U849B from pin 4 to pin 3 and then through U853 to the inverting input of U861. The negative signal is inverted by U861 and applied to the input of the DVM Integrator stage as a positive signal (on pin 1 of U810).

DVM INTEGRATOR AND DVM CONTROL. The DVM Integrator stage is shown on schematic 6 and the DVM Control stage is shown on schematic 7. During the following discussion refer to both schematic 6 and 7 in the Diagrams and Circuit Board Illustrations section of this manual.

The DVM Integrator stage converts the voltage applied to pin 1 of U810 (from the Polarity Switch stage) into a current that charges C871 resulting in a positive-going ramp, at pin 7 of U810. The rate-of-rise of this ramp increases (as well as the charge on C871) as the applied voltage increases (becomes more positive) on pin 1 of U810. The ramp (see Fig. 3-11) is allowed to run for 1000 counts by the DVM Control stage (see schematic 7). After the 1000-count interval, the DVM Control stage initiates a positive Ramp Control signal that is applied to the DVM Integrator stage (pin 10 of U810). The Ramp Control signal first causes U810 to disconnect the current used to charge C871 (to produce the positive-going ramp), and then connects a known internally-produced reference current of opposite polarity to discharge C871. As the reference current causes C871 to discharge, pin 7 of U810 produces a negative-going ramp (see Fig. 3-11). When the negative-going ramp approaches zero volts, a comparator within U810 divelops a negative-going Comparator signal on pin 9 of U810. The negative-going Comparator signal is applied to the DVM Control stage (at pin 5 of U1065) to transfer the accumulated count within U1065 to the output (pins 11, 12, 13, and 14, of U1065). (The count

accumulated in the DVM Control stage represents the time required for the reference current to discharge C871.) Therefore, the time between the positive-going Ramp Control signal (see Fig. 3-11) and the negative-going Comparator signal is proportional to the amplitude of the input voltage applied to pin 1 of U810. This information is then sent to the Digital Latch stage from pins 14, 13, 12, and 11, of U1065.

30 MILLIVOLT COMPARATOR. The DVM Control stage makes use of the $< \overline{30\ mV}$ signal to eliminate erroneous DVM readings, around zero. The erroneous DVM readings are due to the inherent 100-count offset characteristics of the DVM Integrator IC, U810. (If the input to the integrator goes slightly negative before the polarity switch actuates, the DVM display jumps from 000 to 099 if not prevented by the 30 mV Comparator.)

The logic level signal, $< \overline{30\ mV}$, is developed by the 30-Millivolt Comparator stage when the voltage from the Polarity Switch stage drops below 30 millivolts. The resistive divider network of R866 and R867 determines the comparison voltage on pin 3 of U869. When the voltage applied to U869 (pin 2) drops below the voltage on pin 3, the output of U869 (pin 6) goes positive. U847C inverts the positive signal and R873, CR873, and CR874 limits it to approximately ground and the +V logic level.

CLOCK REGISTER. The Clock Register stage provides an elapsed-time keeping function. This stage accumulates the amount of time the monitor has been operating, to provide a tape printout of the elapsed operating time. Starting when the first recording is initiated the 1/60 Hz (1 pulse/min) signal (developed by the Binary Divider stage on schematic 6) provides the input to Clock Register stage. The 3-decade counter, U1015, provides a BCD output (on pins 5, 6, 7, and 9) which represents the amount of time in hours and minutes that has elapsed since the Clock Register stage began operation. After reaching the maximum displayed elapse time of 9:59 (9 hours; 59 minutes) the display register resets to 0:00 and then continues counting.

The 3 decade counter, U1015, will count from zero to 1000; however, any counts that occur from 6 through 9 (in the 10's column) are not allowed. Thus, if a count of 60 in the minutes register of U1015 is detected, the count is rapidly advanced (within 1.5 milliseconds) by 40 counts to display (N+1):00 (where N was the previous hour displayed). If the 2- and 4-BCD digit outputs (pins 6 and 7 of U1015) are HI when digit 1 is selected (pin 1 of U1015 LO), the 32.768 kHz signal is applied to the input of U1015 in order to advance the counter from 0:59 to 1.00. This is accomplished when U1021C allows the 32.768 kHz signal to pass through U1012A and through U1021D to the clock input (pin 12 of U1015). U1019 counts the number of 32.768 kHz cycles that are applied to the 3-decade counter (U1015). After 40 cycles occur, U1019 pulls pin 9 of U1021C HI to disconnect the 32.768 kHz signal. Then, the 1/60 Hz signal continues to provide the clock input for the 3-decade counter.

SIGN LATCH. The purpose of the Sign Latch stage is to sample and hold the Sign of the input signal while the respective digital data is latched for display. The Sign signal (on pin 20 of J1000) may fluctuate (determined by patient's vital sign signals) therefore, when the Comparator signal goes HI on the clock input of U1018B (pin 11), the level on the data input (pin 9) is clocked through to the output (pin 13) and is latched there until print out of current data is complete.

DIGITAL LATCH. The BCD output of the Digital Latch stage is the numerical equivalent of the patient's vital signs being processed by the A/D converter, or the elapsed time between the patient's vital signs as recorded by the Clock Register stage. Information from the DVM Control stage and the Clock Register stage is transferred to the Digital Latch stage, one digit at a time. The DVM/$\overline{\text{CLK}}$ signal determines whether information from the Clock Register stage or the DVM Control stage is available at the output on pins 7, 8, 9, and 10 of J1000. The DVM/$\overline{\text{CLK}}$ signal is applied directly to pin 3 of U1035A and indirectly to pin 15 of U1035B through U1024A: When the DVM/$\overline{\text{CLK}}$ signal is HI pins 11, 9, 7, and 5 of U1035A are active and pins 17, 19, 21, and 23 are inactive (open circuit).

Pins 2 and 14 are strobe inputs for the Digital Latch stage, to enter information into the latches within U1035A and B. The Strobe is generated in the Clock Register for pin 2 of U1035A and in the DVM Control stage for pin 14 of U1035B. Logic levels applied to pins 11 and 12 of J1000 by the Print Control circuit determines which digit (in BCD form) is latched into the Digital Latch stage.

PRINT CONTROL 1 BOARD ◇8◇
PRINT CONTROL 2 BOARD ◇9◇
PRINT DRIVE BOARD ◇10◇

Circuit Functions

The Print Control 1, Print Control 2, and Print Drive boards contain the circuitry to address and drive the hot-dot Print Head which prints out a sequence of alpha-numeric characters along the top edge of the moving chart paper.

The Print Control 1 board accomplishes the following:

1. Initiates an alpha-numeric printing sequence upon receipt of a Start Print logic signal from the Run Control board.

2. Provides parameter word load addresses and load commands to the Word-to-Character PROMs on the Print Control 2 board.

3. Receives End-of-Word (EOW) logic signal from the Print Control 2 board to advance Word Address PROMs to the next load address.

4. Receives Skip logic signal from the Print Drive board to skip to the next parameter in the printing sequence when a parameter is not to be printed.

5. Provides a Print Busy logic signal to the Print Drive board to keep the printing circuit operating, and to the Run Control board to prevent the recorder from turning off until the printing sequence is complete.

6. Provides data to the DVM Analog and Print Drive boards to select the appropriate parameter (rate, systolic pressure, etc.) for DVM value, skip, and overrange.

The Print Control 2 board accomplishes the following:

1. Provides ASCII coded data of parameter names and DVM and clock values to the Dot ROM on the Print Drive board upon receipt of the appropriate word address and load command from the Print Control 1 board.

2. Provides EOW (End-of-Word) signal to Print Control 1 board to advance Word address PROMs to the next load address.

3. Receives Overrange signal from the Print Drive board to address the Word-to-Character PROMs for a series of 3 asterisks when a parameter value is in overrange.

4. Receives BCD data of clock or DVM values to be printed out from the DVM Digital board. Commands from the Word-to-Character PROMs to the DVM Digital board select the most significant to the least significant DVM or clock digits.

The Print Drive board accomplishes the following:

1. Receives Print Busy command from Print Control 1 board to start the Column Sequencer at the beginning of a print sequence.

2. Provides drive to the hot-dot Print Head via the Dot ROM upon receipt of ASCII coded data from Print Control 2 board.

3. Receives Print Speed 25/$\overline{50}$ signal to set Column Sequencer clock rate to 64 Hz for 25 mm/SEC chart speed or 128 Hz for 50 mm/SEC.

4. Provides EOC (End-of-Character) signal to Print Control 2 board to advance Word-to-Character PROMs to the next character or digit address.

5. Provides skip and overrange logic signals of the selected parameter. Select-Parameter logic signals from the Print Control 1 board control the selection of the skip and over-range signals from the monitor or the A Conditioner board via two multiplexers.

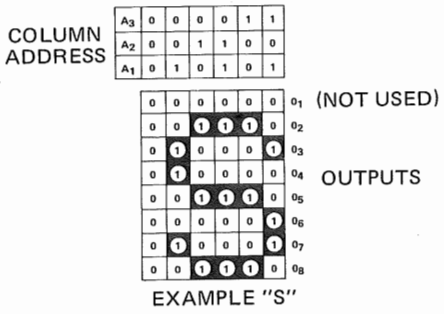
Circuit Operation

Refer to the Print Control/Drive Block Diagram in the Diagrams and Circuit Board Illustrations section.

The Print Head consists of 7 vertically-aligned heat elements (dots). As the chart paper moves under the Print Head, the Dot ROM decides which of these heat elements will be heated to darken the paper and produce the desired character or digit.

As an example of how the Dot ROM heats the Print Head elements to produce a character see Figure 3-12 which shows the print sequence for the letter S. As the letter begins to be printed out, the Column Sequencer selects the first column to the left; nothing is printed in this column but is left blank to provide spacing between characters. In the meantime, the ASCII coded address for the letter S will have been fed into the Dot ROM. The Column Sequencer then selects the next column and the Dot ROM causes dots 3, 4, and 7 to be heated. The Column Sequencer then selects the next column and the Dot ROM causes dots 2, 5, and 8 to be heated. This process continues until the complete letter S has been printed. At the end of the 6th column, the Column Sequencer resets and the Dot ROM again produces a blank column as the next ASCII coded character is fed to the Dot ROM.

The column sequence rate has to be changed when chart speed is changed. The Print Speed 25/$\overline{50}$ signal from the Run Control board is fed into the Print Speed Logic circuit which controls the column sequence rate and dot intensity. The Column Sequencer is stepped at a 64 Hz rate at the 25 mm/SEC speed and 128 Hz at the 50 mm/SEC speed.



CHARACTER ADDRESS

ASCII CHARACTER	A_4	A_5	A_6	A_7	A_8	A_9
	1	1	0	0	1	0

CHARACTER		@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
CHARACTER ADDRESS	A_4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	A_5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	A_6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	A_7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	A_8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A_9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CHARACTER		P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	—
CHARACTER ADDRESS	A_4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	A_5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	A_6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	A_7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	A_8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	A_9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CHARACTER		Blank	!	"	#	$	%	&	'	(	)	*	+	,	—	.	/
CHARACTER ADDRESS	A_4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	A_5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	A_6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	A_7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	A_8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A_9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

CHARACTER		Ø	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
CHARACTER ADDRESS	A_4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	A_5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	A_6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	A_7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	A_8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	A_9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

NOTE: Undefined (column) addresses result in "1" level high outputs.

2145-54

Figure 3-12. ASCII character code.

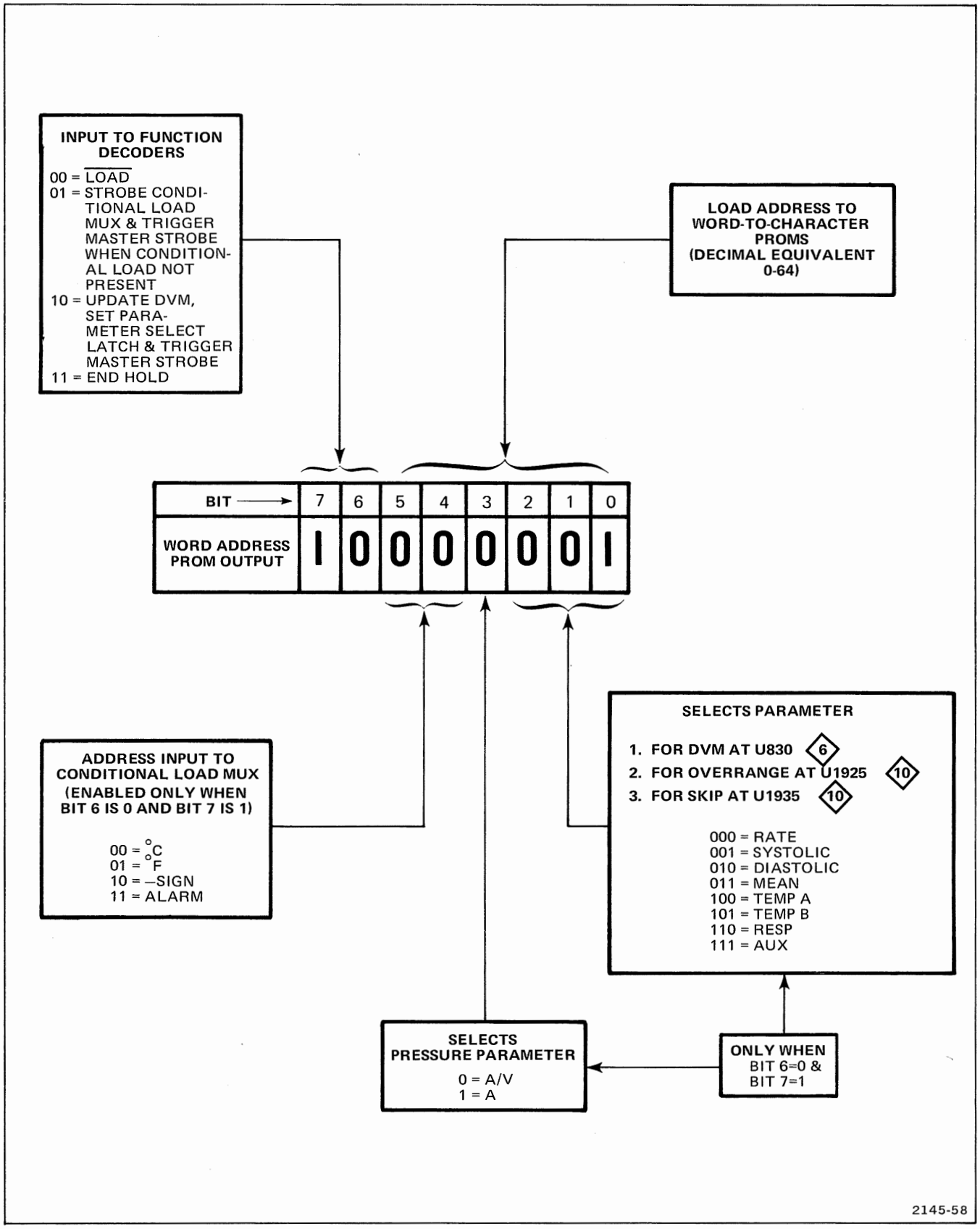


Figure 3-13. Interpreting Word Address PROMs addresses.

TABLE 3-2
Word Address PROMs Contents

	Word Address Counter Output (Decimal)	Word Address PROMs Output (Binary)	Decimal Value to Word-to-Character PROMs	Action
U1460	0	00 001 111	15	Load "ET (clock value)"
	1	00 101 000	40	Load "space space"
	2	10 000 000	---	Update DVM (rate)
	3	00 010 110	22	Load "RATE=(DVM value)"
	4	00 101 000	40	Load "space space"
	5	10 001 001	---	Update DVM (BP A Systolic)
	6	00 011 110	30	Load "BP A"
	7	00 100 100	36	Load "="
	8	01 100 111	7[1]	Conditional Load "—"
	9	00 011 011	27	Load "DVM value (BP A Systolic)"
	10	10 001 010	---	Update DVM (BP A Diastolic)
	11	00 111 101	61	Load "space / space"
	12	01 100 111	7[1]	Conditional Load "—"
	13	00 011 011	27	Load "DVM value (BP A Diastolic)"
	14	10 001 011	---	Update DVM (BP A Mean)
	15	00 101 001	41	Load "space"
	16	00 100 101	37	Load "space ("
	17	01 100 111	7[1]	Conditional Load "—"
	18	00 011 011	27	Load "DVM value (BP A Mean)"
	19	00 100 111	39	Load ") space space"
	20	10 000 001	---	Update DVM (BP A/V Systolic)
	21	00 011 110	30	Load "BP A"
	22	00 100 010	34	Load "/ V="
	23	01 100 111	7[1]	Conditional Load "—"
	24	00 011 011	27	Load "DVM value (BP A Systolic)"
	25	10 000 010	---	Update DVM (BP A/V Diastolic)
	26	00 111 101	61	Load "space / space"
	27	01 100 111	7[1]	Conditional Load "—"
	28	00 011 011	27	Load "DVM value (BP A Diastolic)"
	29	10 000 011	---	Update DVM (BP A/V Mean)
	30	00 101 001	41	Load "space"
	31	00 100 101	37	Load "space ("
U1450	32	01 100 111	7[1]	Conditional Load "—"
	33	00 011 011	27	Load "DVM value (BP A Mean)"
	34	00 100 111	39	Load ") space space"
	35	10 000 100	---	Update DVM (TEMP A)
	36	00 101 010	42	Load "TEMP space"
	37	00 101 111	47	Load "A="
	38	01 100 111	7[1]	Conditional Load "—"
	39	00 110 011	51	Load "DVM value (TEMP A)"
	40	01 000 011	3[1]	Conditional Load " 'C "
	41	01 010 101	5[1]	Conditional Load " 'F "
	42	00 101 000	40	Load "space space"
	43	10 000 101	---	Update DVM (TEMP B)
	44	00 101 010	42	Load "TEMP space"
	45	00 110 001	49	Load "B="
	46	01 100 111	7[1]	Conditional Load "—"
	47	00 110 011	51	Load DVM value (TEMP B)
	48	01 000 011	3[1]	Conditional Load " 'C "
	49	01 010 101	5[1]	Conditional Load " 'F "
	50	00 101 000	40	Load "space space"
	51	10 000 110	---	Update DVM (RESP)
	52	00 111 000	56	Load "RESP="
	53	00 011 011	27	Load "DVM value (RESP)"
	54	00 101 000	40	Load "space space"
	55	10 000 000	---	Update DVM (RATE)
	56	01 111 000	8[1]	Conditional Load "ALARM"
	57	11 111 111	---	End Hold
	58	11 111 111	---	spare
	59	11 111 111	---	spare
	60	11 111 111	---	spare
	61	11 111 111	---	spare
	62	11 111 111	---	spare
	63	11 111 111	---	spare

[1] Decimal values of the Conditional Load addresses are always less than 16 because bits 4 and 5 are used to select the conditional input to the Conditional Load Multiplexer U1490. See Figure 3-13 and the Conditional Load Multiplexer discussion.

The alpha-numeric printing sequence is started by the Start Print pulse into the Print Latch from the Run Control circuit. The Print Latch is initialized when the monitor is first turned on. This clears the Word Address Counter and the Parameter Select Latch. The Start Print pulse switches the Print Latch and generates Print Busy which starts the Column Sequencer counter. The Print Busy signal also goes to the Run Control circuit to prevent the chart from stopping until the print sequence is complete. When the Print Latch cleared the Word Address Counter, its output went to zero which is the first address into the Word Address PROMs. The Word Address PROMs produce an 8-bit binary address. See Figure 3-13 and Table 3-2 to interpret the Word Address PROMs addresses.

As Start Print switches, the Print Latch 2 strobe pulses are generated by the Master Strobes; one strobe pulse is delayed 1 μs from the start of the other. These strobe pulses enable the Function Decoders, where one of four functions is selected—Load, Update DVM, Condition Load, or End Print Sequence. The function selected is determined by bits 6 and 7 from the Word Address PROMs as shown in Figure 3-13.

Assume that Load has been selected. The Load pulse causes bits 0-5 from the Word Address PROMs to be loaded into the Character Sequencer. The binary data now loaded into the Character Sequencer addresses the Word-to-Character PROMs.

The Word-to-Character PROMs produces an 8-bit binary output. Certain bits from the Word-to-Character PROMs provide various commands. See Figure 3-14 and Table 3-3 to interpret the Word-to-Character PROMs output addresses. As an example, look at bit 6 (Digit/Char). If it's a 1, DVM or clock digits will be selected from the DVM Digital circuit; if it's a 0, ASCII characters are selected from the Word-to-Character PROMs. Let's assume that bit 6 is a 0 and characters are selected. In this case, bits 0-3 from the Word-to-Character PROMs pass through the Character/Digit Multiplexer to the Dot ROM. Bits 0-3 along with bits 4-5 which go directly to the Dot ROM, make up the 6-bit ASCII code that addresses the Dot ROM to print out the character as previously discussed. At the end of count 5 (column 6), the Column Sequencer is reset and the EOC (end-of-character) signal is produced. The EOC signal goes to the Character Sequencer, advances it to the next count, and addresses the Word-to-Character PROMs for the next character or digit.

Assume now that ET (for elapsed time) has just been printed and that the Word-to-Character PROMs is calling for a digit. See Table 3-3 Input Address "18". Bit 6 will be a 1, causing the Character/Digit Select Multiplexer to select BCD digits from the DVM Digit circuit. See Figure 3-14. Since this is to be a clock digit, bit 2 is a 0. Bits 0-1 go to a multiplexer in the DVM Digital circuit and select the most significant to the least significant digit, one at a time. The first clock digit to be selected is hours. The BCD value for hours goes through the Character/Digit Select Multiplexer to the Dot ROM. The digit is then printed out in the same manner as the character, described previously.

Then the EOC signal is produced which steps the Column Sequencer to the next address, causing the Word-to-Character PROMs to call for a colon (:). Since this is a character, bit 6 will be a 0 and the ASCII code for colon will be sent from the Word-to-Character PROMs through the Character/Digit Select Multiplexer to the Dot ROM. When the colon is printed the EOC signal is produced and the Character Sequencer is stepped to the next address causing the Word-to-Character PROMs to call for clock digit, minutes (tens). When the minutes (tens) is printed, the EOC signal steps the Character Sequencer to the next address and the Word-to-Character PROMs call for clock digits, minutes (units). The clock minutes (units) digit is printed and the EOC signal is produced.

However, since this is the last print out in this particular sequence, bit 7 is a 1 to indicate end of word (EOW). When both inputs to U1656D are HI (EOC and bit 7 both 1) the EOW signal is sent to the Master Strobes circuit and steps the Word Address Counter to the next count. This causes the Word Address PROMs to produce its next address.

Let's assume that the next address from the Word Address PROMs included a conditional load command (that is, bit 6 is 1 and bit 7 is 0). See Figure 3-13. The Conditional Load Strobe pulse out of the Function Decoders strobes the Conditional Load Multiplexer to test for conditional loading of one of four conditions selected by bits 4 and 5. The four conditions are °C, °F, – sign, and print "alarm". If the condition selected by bits 4 and 5 is present and producing a HI (or 1) at the input to the Conditional Load Multiplexer, a Cond Load pulse will be generated and the address from the Word Address PROMs will be loaded into the Character Sequencer. The conditional character or word will be printed in the manner described before. If the condition tested is false, no load takes place, and a Master Strobe pulse is generated to advance the Word Address Counter.

When the Word Address Counter has stepped the Word Address PROMs through their complete program, the next address contains ones at bits 6 and 7 which causes the Function Decoders to produce the End Print Sequence pulse which resets the Print Latch. This terminates Print Busy, stops the Column Sequencer, and allows the Run Control circuit to take control of chart operation. When the Print Latch is reset the Word Counter, Parameter Select Latch, and Column Sequencer are cleared and the print sequence is terminated.

If the Word Address PROMs call for a blood pressure reading, then bit 3 is sent through the Parameter Select Latch to the A Conditioner or A/V Buffer circuits to select values from either A or A/V pressure channels. Bits 0-2 (SP 0-2), in the meantime, select systolic, diastolic or mean pressure values via the Analog Data Multiplexer in the DVM Analog circuit. As required, bits 0-2 select any of the other parameter values for input to the DVM.

Bits 0-2 also go to the Skip and Overrange Multiplexers on the Print Drive circuit to check for the presence of a skip or overrange condition. If a skip signal is present (i.e., transducer unplugged) a series of 32 kHz pulses are produced which trigger the Master Strobes. This advances the Word Address PROMs to the next address before the unused parameter can be printed. This process continues until a parameter is addressed that is not to be skipped, which removes the skip signal.

When a parameter value to be printed out is in overrange, the $\overline{\text{Overrange Enable}}$ pulse enables the Overrange Multiplexer to produce an Overrange pulse. The Overrange pulse clears the Character Sequencers to zero which causes the Word-to-Character PROMs to be addressed for a series of 3 asterisks. See Table 3-3.

When a DVM digit is a leading zero which is not to be printed out, bit 3 from the Word-to-Character PROMs is a 0. See Figure 3-14. This causes the Zero Blanking Logic circuit to send a pulse to the Character Sequencer and advance the Word-to-Character PROMs to the next digit, thus skipping that zero. If the zero is to be printed, then bit 3 (Zero Blanking Disable) will be a 1.

PRINT LATCH. Print Latch U1410A and B is an RS flip-flop. It is initialized at the beginning of a run cycle when the +4.9 V supply turns on, setting pin 6 LO and pin 9 HI. Then pin 9 goes HI, U1440 and U1480 are cleared, and their outputs go to 0.

When the $\overline{\text{Print Start}}$ (LO) pulse comes into U1410B pins 3 and 4, the Print Busy (HI) is produced at pin 6. Pin 9 of U1410A goes LO, which removes the clear from U1440 and triggers Master Strobe U1420B. The LO at pin 9 of U1410A also is inverted by U1427D and removes the clear from the Parameter Latch U1480.

MASTER STROBES. U1420A and U1420B are monostable multivibrators which produce 1 μs pulses to clock the Word Address Counter and enable Function Decoders U1425A and B. U1420B is triggered initially by the LO at pin 9 from the Print Latch at the beginning of the print sequence. This enables the Function Decoder U1425B which loads the first address from the Word Address PROMs U1450/U1460 into the Character Sequencers U1620/U1640.

At the end of the first "word" sequence, EOW (End-of-Word) pulse triggers U1420A, producing a LO 1 μs pulse. This pulse advances U1440B at the end (or positive-going edge) of the 1 μs pulse. The delayed output of U1420B then enables U1425B. This delay allows the U1450/U1460 output address time to "settle" before being loaded into the Character Sequencers. Master Strobe U1420A is triggered also by the Skip pulses from the Skip Multiplexer U1935 when a parameter is to be skipped.

WORD ADDRESS COUNTER. Word Address Counter U1440 is a 7-stage binary counter which steps the Word Address PROMs U1450/U1460 through their programmed series of addresses. Note that on counts 0 through 31, pin 4 of U1440 is a 0 (LO) which enables the lower PROM U1460 and inhibits the upper PROM U1450 through U1427A. On counts 32 through 57, pin 4 of U1440 is a 1 (HI) which enables U1450 and inhibits U1460.

WORD ADDRESS PROMS. Word Address PROMs U1450/U1460 are programmable-read-only-memory devices. They contain a pre-programmed sequence of output addresses which address the Word-to-Character PROMs U1620/U1640. See Table 3-2. See Figure 3-13 for interpreting Word Address PROMs output addresses.

U1450/U1460 are sequenced through their addresses by Word Address Counter U1440. The output address on the 57th count has ones in both bits 6 and 7. This causes Function Decoder U1425A to produce a LO at pin 7 to reset the Print Latch U1410A and B, and end the print sequence.

FUNCTION DECODERS. Function Decoders U1425A, B is a dual binary to 1 of 4 decoder. Bits 6 and 7 from U1450/U1460 are decoded to produce the following control signals: $\overline{\text{Load}}$ (pin 12), $\overline{\text{Conditional Load}}$ (pin 11), Update DVM (pin 10) and End Hold (pin 7). See Figure 3-13.

PARAMETER SELECT LATCH. Parameter Select Latch U1480 is a hex D flip-flop of which 4 inputs are used. U1480 is cleared when the monitor is first turned on and the Print Latch is initialized. A HI on pin 1 removes the clear at the beginning of a print sequence. Then, when the first address from U1460 occurs where bit 6 is a 0 and bit 7 is a 1 (producing Update DVM pulse), U1480 is clocked and bits 0-3 from U1460 are latched to the Q outputs.

Bits 0-2 (pins 12, 10, & 7) select the parameter for the DVM value (at U830), overrange (at U1925) and skip (at U1935). See Figure 3-13 and Table 3-2.

Bit 3 (pin 15) goes to the A/V Buffer (Option 2 and 4) or A Conditioner (Option 3) circuits to select the A or A/V pressure channel for addresses which update DVM pressure values. It also selects A or A/V Pressure Overrange and/or Skip Pressure signals to the Skip and Overrange Multiplexer.

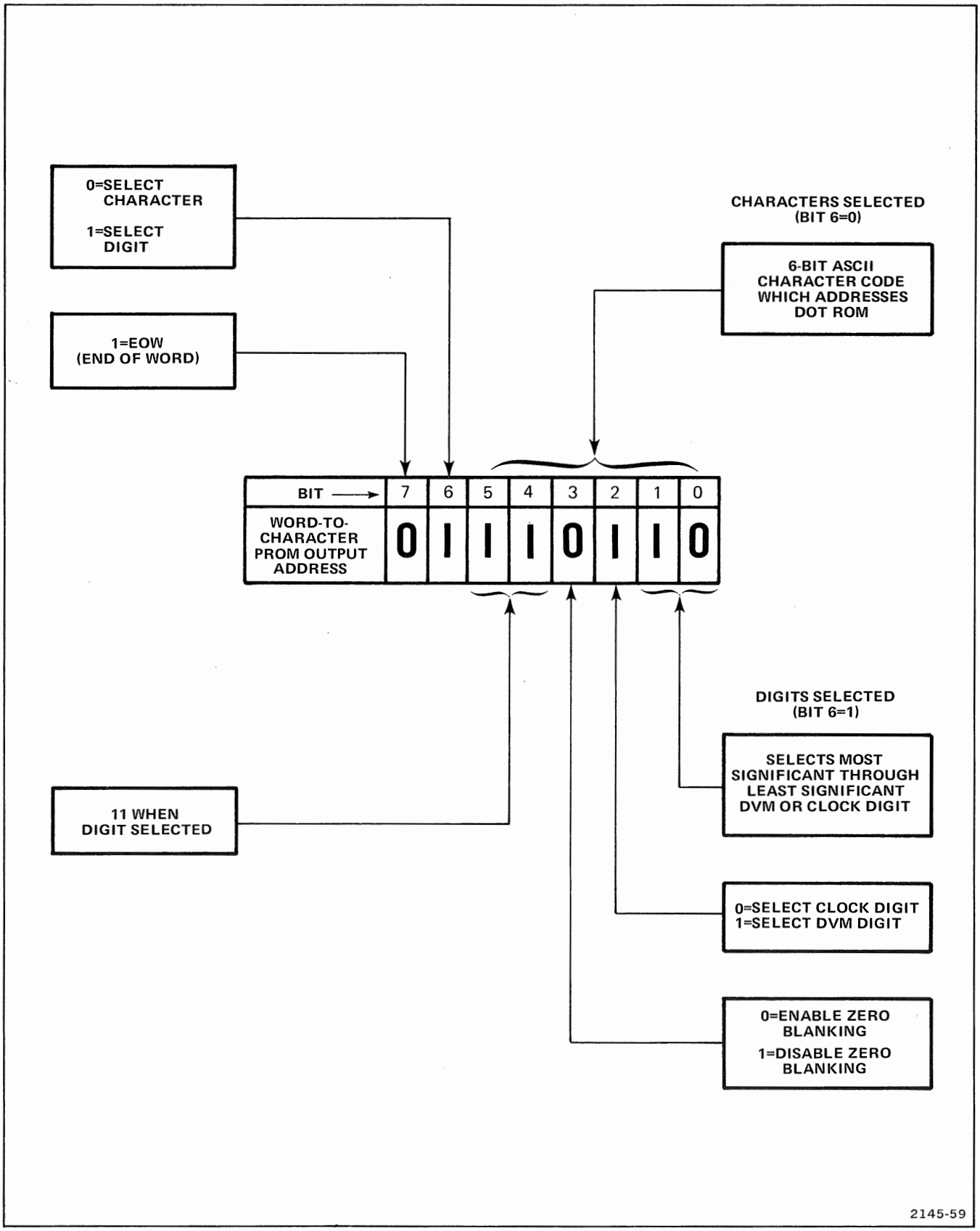


Figure 3-14. Interpreting Word-to-Character PROMs addresses.

TABLE 3-3
Word-to-Character PROMs Contents

	Decimal Value From U1450/U1460	Word-to-Character PROMs Contents	Character or Digit Printed
U1641	0	00 101 010	*
	1	00 101 010	*
	2	10 101 010	* (end)
	3	00 100 111	' (degrees)
	4	10 000 011	C (end)
	5	00 100 111	' (degrees)
	6	10 000 110	F (end)
	7	10 101 101	— (end)
	8	00 000 001	A
	9	00 001 100	L
	10	00 000 001	A
	11	00 010 010	R
	12	10 001 101	M (end)
	13	11 111 111	spare
	14	11 111 111	spare
	15	00 000 101	E
	16	00 010 100	T
	17	00 100 000	space
	18	01 111 010	clock digit (hours)
	19	00 111 010	:
	20	01 111 001	clock digit (tens minutes)
	21	11 111 000	clock digit (units minutes) (end)
	22	00 010 010	R
	23	00 000 001	A
	24	00 010 100	T
	25	00 000 101	E
	26	00 111 101	=
	27	01 110 110	DVM digit (2)
	28	01 110 101	DVM digit (1)
	29	11 111 100	DVM digit (0) (end)
	30	00 000 010	B
	31	00 010 000	P
U1621	32	00 100 000	space
	33	10 000 001	A (end)
	34	00 101 111	/
	35	00 010 110	V
	36	10 111 101	= (end)
	37	00 100 000	space
	38	10 101 000	((end)
	39	00 101 001	)
	40	00 100 000	space
	41	10 100 000	space (end)
	42	00 010 100	T
	43	00 000 101	E
	44	00 001 101	M
	45	00 010 000	P
	46	10 100 000	space (end)
	47	00 000 001	A
	48	10 111 101	= (end)
	49	00 000 010	B
	50	10 111 101	= (end)
	51	01 110 111	DVM digit (3)
	52	01 110 110	DVM digit (2)
	53	01 111 101	DVM digit (1)
	54	00 101 110	.
	55	11 111 100	DVM digit (0) (end)
	56	00 010 010	R
	57	00 000 101	E
	58	00 010 011	S
	59	00 010 000	P
	60	10 111 101	= (end)
	61	00 100 000	space
	62	00 101 111	/
	63	10 100 000	space (end)

CONDITIONAL LOAD MULTIPLEXER. Conditional Load Multiplexer U1490 is used for loading the addresses of the following four conditions °C, °F, —sign, or Print "Alarm". When bit 6 is a 1 and bit 7 is a 0, from U1450/U1460, a 1 μs Conditional Load pulse from the Function Decoder strobes pin 7 of U1490. Then depending on bits 4 and 5 (see Fig. 3-13) one of the four conditions is tested for conditional load. For instance, if both bits 4 and 5 are zeros, °C is being tested for conditional load. Then if the temperature value just printed was in °C, pin 4 of U1490 will be HI and a 1 μs Conditional Load pulse will be produced at pin 6. This pulse causes the address for °C ('C) from U1450/U1460 to be loaded into the Character Sequencers U1620/U1640.

The Conditional Load pulse also goes to pin 3 of U1420A and holds it in the reset position so that it is not triggered and U1440 is not advanced to the next address.

On the other hand if the temperature value were in °F, pin 4 of U1490 would be LO causing pin 6 to remain HI. The Conditional Load pulse would not be produced and U1420A would be triggered at the end (negative-going edge) of the 1 μs pulse at pin 1 of U1420A. This would cause U1440 to advance U1450/U1460 to the next address to test for conditional loading of °F (bit 4=1, bit 5=0). Pin 3 of U1490 would be LO and the Conditional Load pulse at pin 6 would cause the address for °F ('F) to be loaded into the Character Sequencers U1620/U1640.

Note that since bits 4 and 5 are used for conditional load commands, only bits 0-3 are used for conditional load addresses into the Character Sequencers. The Conditional Load pulse through U1632A and U1633B clears U1620 causing both pins 2 and 3 to go LO, inhibiting U1621 and enabling U1641. Thus, output addresses for conditional load characters are contained only in U1641 and only in the first 16 addresses. See Table 3-3.

CHARACTER SEQUENCERS. Character Sequencers U1620/U1640 are 4-bit up decade counters (presettable counters). These counters are loaded (preset) by the address from the Word Address PROMs U1450/U1460 and clocked at the ending of the 1 μs EOC (end-of-character) pulse at pin 5 of U1640. The preset count from U1620/U1640 is the address of the first character of a sequence (in some cases there is only one character in a sequence). U1620/U1640 counts up with each EOC pulse when bit 7 from the Word-to-Character PROMs address is a 1 (end-of-word-EOW) which triggers Master Strobe U1420A at the next EOC and advances U1450/U1460 to the next load address. Note that U1640 is clocked by the ending of EOC while EOW occurs at the beginning of EOC (at U1656D). U1640 is clocked past the end of the sequence, but will be reloaded by the next load address from U1450/U1460 due to the delay in the Master Strobes.

WORD-TO-CHARACTER PROMS. Word-to-Character PROMs U1621/U1641 are programmable-read-only-memory devices. They contain ASCII coded data and other commands which cause a sequence of individual characters or digits to be printed via the Dot ROM U1850. See Table 3-3.

U1621 and U1641 are sequenced through their addresses by Character Sequencers U1620/U1640. Note that when Character Sequencers U1620/U1640 output addresses have decimal equivalents of 0 to 31, pin 2 of U1620 is a 0 (LO) which enables U1641 and inhibits U1621. When addresses are 32 to 63, pin 2 of U1620 is a 1 (HI), U1641 is inhibited and U1621 is enabled. See Figure 3-14 for interpreting Word-to-Character PROMs output addresses.

CHARACTER/DIGIT SELECT MULTIPLEXER. Character/Digit Select Multiplexer U1610 selects ASCII coded data from the Word-to-Character PROMs for printing characters or BCD data from the DVM Digital circuit for printing digits. The selection is made by bit 6 from U1621/U1641 into pin 1 of U1610. When bit 6 is a 0, U1610 will select the ASCII coded data for a character and when bit 6 is a 1, BCD data will be selected for a digit. See Figure 3-14.

DVM/CLOCK DECODER. The DVM/Clock logic signal at the collector of Q1633 is sent to the DVM Digital circuit to select either DVM or clock BCD digits for input to U1610. When a digit is selected (bit 6=1), pin 2 of U1633A is LO and the DVM/Clock signal follows bit 2 (0=clock, 1=DVM) at pin 1 of U1633A. When a character is being selected (bit 6=0) pin 2 of U1633A is HI to ensure that the DVM/Clock signal remains HI and does not follow bit 2 which is now used as part of the character code. See Figure 3-14.

OVERRANGE ENABLE LOGIC. When Word Address PROMs U1450/U1460 indicate DVM Update (bit 6=0 and bit 7=1), U1663B pin 13 (Update Inhibit) is set HI, and pin 12 is set LO. These outputs of U1663B remain in this state until the DVM digits are to be printed (when a 1 μs DVM Digit pulse is produced at pin 10 of U1633C). Since pin 9 of U1633C went LO when pin 12 of U1663B was set LO, an Overrange Enable pulse is produced at pin 8. The Overrange Enable pulse enables the Overrange Multiplexer U1925 once at the start of a DVM digit sequence. U1925 then produces an Overrange pulse when the value for the parameter selected by the Parameter Select Latch is in overrange. The positive-going edge of the DVM Digit pulse at pin 13 of U1632F clocks U1663B at pin 11 causing the Update Inhibit to be LO and prevent further DVM updating while digits are being printed.

ZERO BLANKING LOGIC. When the DVM is indicating a zero (that is not to be printed) a 1 μs pulse is produced at pin 5 of U1673B which advances the Character Sequencers

U1620/U1640 to the next address. If the zero is to be printed, then U1673B is inhibited by a LO at pin 11.

The Update DVM pulse into pin 6 of U1663A sets pin 1 HI releasing the reset signal from U1673B. When a non-zero DVM digit is to be printed, (indicated by DVM Digit pulse at pin 13 of U1632F and a LO at pin 13 of U1661B), a 1 μs pulse is produced at pin 1 of U1661A. U1663A is clocked on the positive-going edge of the pulse at pin 3. U1663A pin 1 goes LO, and U1673B is held in reset and cannot produce the blank zero pulse at pin 5. U1663A stays in this state for the remainder of the DVM digit sequence.

If the DVM digit is a zero (pin 13 of U1661B is HI), U1663A is not clocked, pin 1 remains HI and the Blank Zero pulse is produced by U1673B. When a leading zero is to be printed (as in 0.2), bit 3 from the Word-to-Character PROMs is HI (1). A 1 μs Disable Zero Blanking pulse is produced at pin 11 of U1633D, pin 1 of U1663A is reset LO and U1673B does not produce the Blank Zero pulse.

When a parameter is in overrange, an overrange pulse is produced at pin 12 of U1633D to reset U1663A. This prevents the Character Sequencer from being advanced by a blank Zero pulse before an asterisk is printed.

U1673B is clocked on the negative-going edge of the 1 μs pulse from U1673A. This provides a 1 μs delay which allows time for U1663A to be clocked or reset.

OVERRANGE MULTIPLEXER. The Overrange Multiplexer U1925 provides a 1 μs Overrange pulse when the parameter selected is in overrange. The Overrange pulse goes to the Print Control 2 circuit, clears Character Sequencers U1620 and U1640, and causes a series of 3 asterisks to be printed.

One of 6 parameters into U1925 is first selected at inputs A, B, and C by bits 0-2 (SP 0-2), from the Parameter Select Latch, then strobed by the 1 μs Overrange Enable pulse from the Overrange Enable Logic circuit on the Print Control 2 Board. If the DVM value the parameter selected is in overrange, that input to U1925 is held HI and a 1 μs Overrange pulse is produced at pin 5. On the other hand when the parameter is not in overrange, the input is held LO and no Overrange pulse is produced.

SKIP MULTIPLEXER. Skip Multiplexer U1935 produces a burst of 32.768 kHz pulses when the parameter selected is to be skipped. The burst of pulses trigger the Master Strobe U1420A (Print Control 1 circuit) which advances the Word Address PROMs to the next parameter.

SP 0-2 from the Parameter Select Latch into inputs A, B, and C of U1935 select one of the six parameters (see truth table on schematic). When the parameter selected is to be skipped, its input to U1935 is HI and output Y at pin 5 goes HI. Q1945 is turned on and the 32.768 kHz Skip pulses appear at the collector. Resistors R1931A through E connect U1935 inputs to +4.9 V so that the parameters not available from the monitor in use will be skipped. Since Rate is never to be skipped, input D0 (pin 4) is held LO (ground).

DOT ROM AND DRIVERS. U1850 is a 64 X 6 X 8 Static Character Generator. It provides drive to the Print Head heat elements to produce characters and digits within a standard 5 X 7 dot matrix. The Dot ROM is addressed by 6-bit ASCII coded data from the Word-to-Character PROMs. See Figure 3-12. Output from U1850 turns on the appropriate Darlington driver transistors (Q1852 through Q1858) as U1850 is enabled at pin 1 for about 8 ms (25 mm/SEC) or about 7.6 ms (50 mm/SEC).

COLUMN SEQUENCER. U1895 is a binary counter that sequences the Dot ROM to produce the individual columns of each character. It is clocked either at 64 Hz (25 mm/SEC or 128 Hz (50 mm/SEC).

The counter counts from 0 to 5. At the end of count 5, U1897B pin 4 goes LO and clears U1895 back to zero and sends an EOC (end-of-character) pulse to the Character Sequencer U1640 pin 5. U1895 continues to count 0 to 5 until the end of the print sequence when Print Busy goes LO (at pin 13 of U1897D) and clears U1895. U1895 remains cleared until another print sequence begins and Print Busy again goes HI at pin 13 of U1897D.

PRINT SPEED LOGIC. U1830 is a timer which is triggered at 64 Hz or 128 Hz depending on chart speed. The output of the timer at pin 3 is a rectangular pulse which enables the Dot ROM. The time duration of this pulse determines how long the Print Head heat elements stay on, thus the intensity of the printed character dots. The duration of this pulse is determined by C1817 and the current at pins 6 and 7. As U1830 is triggered, C1817 begins to charge with current through either the 25 mm Intensity adjustment R1810, or the 50 mm Intensity adjustment R1815. As soon as the threshold is reached, the leading edge of the pulse is produced at pin 3. When the charge on C1817 reaches −4.9 V and starts to discharge a second threshold is reached which terminates the pulse.

If the chart speed is set for 25 mm/SEC, the Print Speed 25/$\overline{50}$ line into Q1805 is HI, Q1810 is turned on and R1810 determines the pulse width. When the chart speed is set for 50 mm/SEC, Q1815 is turned on and R1815 determines the pulse width. Using the same Print 25/$\overline{50}$

signal, logic gates U1825A, B, C, and D select 64 Hz or 128 Hz for the trigger rate for U1830.

PRINT HEAD VOLTAGE REGULATOR. Q1833, Q1837, Q1839, and associated circuitry make up a voltage regulator that provides a regulated 13 volts to the Print Head heat elements. The regulated voltage is necessary to control dot density since current supplied to the heat elements can vary up to about 3 A, depending on how many Darlington driver transistors (Q1852 through Q1858) are turned on at a time. Incandescent bulb, DS1837 is used to protect Q1839 from excessive current.

POWER SUPPLY BOARD ◈11◈

Circuit Functions

The Power Supply board accomplishes the following:

1. Converts battery power to provide +4.9 V, −4.9 V, and −11.9 V regulated supply voltages and +16 V, −16 V unregulated supply voltages. The power is turned on and off by Start Power and Stop Power signals from the Run Control circuit.

2. Supplies power to operate the Chart Drive Motor. Two motor speeds are selectable by the Chart Speed 50/$\overline{25}$ logic signal from the Run Control circuit.

3. Supplies power to the Stylus Heater. The $\overline{\text{Disable Stylus Heat}}$ signal from the Run Control circuit turns off the Stylus Heater supply when the Run Control circuit is programmed for Print Only mode (Option 2 and 3).

4. Detects low battery voltage (and monitor off signal from the monitor) to disable the power supply.

5. Provides +V to the Run Control board to allow it to start the recorder, when the monitor is on and the monitor battery has sufficient charge to operate the recorder. +V is also used to run the elapsed time clock in Option 2, 3, and 4 Recorders.

Circuit Operation

The main recorder power comes directly from the monitor battery pack. A small amount of additional current (approximately 700 mA) is supplied by the monitor battery charger when the monitor ac power cord is plugged in. However this is not sufficient current to run the recorder when the batteries are discharged. Battery power is always connected to the Power Inverter, Stop Power Control, and Low Battery/Monitor On circuits even when the monitor is off.

Whenever the monitor is on and the battery has sufficient charge, the +V Supply will be on. The +V Supply provides standby power to the timing and control circuits on the Power Supply board, Run Control board, DVM Analog board, and DVM Digital board. This voltage keeps these circuits in operation while waiting for a record-sample command. When the monitor is turned off or the battery gets low, the Low Batt/$\overline{\text{Monitor On}}$ signal from the monitor goes HI and shuts down the +V Supply.

START POWER AND STOP POWER CONTROL. The Power Inverter is started when Start Power pulses from the Run Control board turn on Q2122 and Q2126 which connects +V to one of the T2135 windings. The Power Inverter is turned off when the Power Stop signal (HI), from the Run Control board, turns on Q2166, Q2172, and Q2175 causing the T2135 winding to be shorted out (grounded) through CR2176 and Q2175.

OVERCURRENT DETECTOR. The Overcurrent Detector circuit detects an over-current condition at T2180 and sends a HI signal through R2165 to the input of the Power Stop Control circuit to shut off the Power Inverter.

CHART DRIVE MOTOR SUPPLY. A separate regulated Chart-Drive-Motor Supply circuit provides power to run the Chart-Drive Motor. Chart speeds of 25 and 50 mm/second are selected by the Chart Speed 50/$\overline{25}$ signal from the Run Control board (HI=50 mm/second, LO=25 mm/second). U2007A combines the requested chart speed signal with an actual chart speed feedback signal (back-emf) to produce the required chart drive. U2007D amplifies this signal. As the supply current required by U2007 (positive supply voltage on pin 4) is proportional to the required chart drive current, a portion of this supply current is obtained as base drive for the Q2011 power amplifier transistor. Q2009 and R2011 current limits the Q2011 power amplifier to roughly 220 mA maximum motor drive current.

CHART DRIVE MOTOR SPEED CONTROL. Motor speed control is accomplished by periodically removing motor drive current, sampling the motor-generated "back-emf", and regulating drive current accordingly. The ratio of drive-to-sample periods is about 9:1. The chart drive motor turns about 3208 rpm to produce a 50 mm/second chart speed, and about 1604 rpm for a 25 mm/second speed.

U2007C is an oscillator with a frequency of about 60 Hz. When its output is low, the U2032B switch is open to allow U2007A to cause U2007D to drive the chart drive motor at the speed requested by the CHART SPEED 50/$\overline{25}$ signal from the Run Control board.

When the oscillator output goes HI,

1. The U2032B switch is closed. This shuts off the U2007D driver, removing drive current from the chart drive motor. Momentum forces the motor to coast. As the motor armature is rotating in a field produced by a permanent magnet, a current is generated. This current (back-emf) is coupled from the brush assembly to the Chart Drive Motor Supply circuits.

2. After a short delay provided by C2027 and associated resistors, the U2032A switch is closed. This places a portion of the "back-emf" on C2032.

When the oscillator output goes LO, the switches open and the motor is again driven. If the motor is running under speed, the "back-emf" voltage is stored in the U2032A-C2032 sample-and-hold circuit will be LO. U2007B will place a LO voltage on the minus input of the U2007A amplifier to cause it to drive harder to increase the motor speed. Conversely, an overspeed motor will cause U2007A to reduce the motor drive current. The chart drive motor does not slow perceptibly during the sample time.

The voltage waveform across the motor is shown in Figure 3-15. The voltages are approximate, depending on frictional and inductive losses in the recorder. Actual motor speed is determined by the 25 and 50 mm/second adjustments on the Power Supply board.

STYLUS HEATER SUPPLY. The Stylus Heater Supply provides current from the +16 V unregulated supply to the Stylus Heater. For approximately one second, during recorder turn-on, the −16 V Supply is connected to the Stylus Heater circuit through R2055 and Q2056 to provide extra current for fast warm up. The extra current is limited to approximately 500 mA by R2055 and Q2054.

+4.9 V, −4.9 V, AND −11.9 V SUPPLIES. The +4.9 V, −4.9 V, and −11.9 V Supplies are electronically regulated. The −11.9 V Supply is zener-diode-referenced and adjustable. The +4.9 V and −4.9 V Supplies are referenced to the −11.9 V Supply.

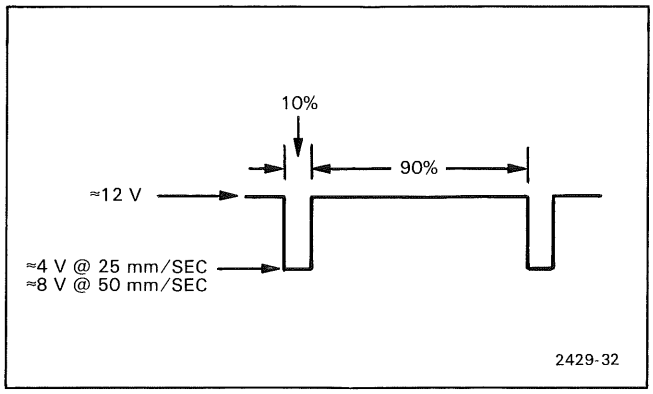


Figure 3-15. Chart drive motor voltage waveform.

+V SUPPLY. When the Low Batt/ $\overline{\text{Monitor On}}$ signal from the monitor is LO (−7 V, indicating monitor is on) and the recorder is not running, Q2154 and Q2156 will be saturated. Thus the +V Supply voltage will be derived from the +Batt voltage. When a record sample is initiated, the supply voltages come up. +6 V at the anode of CR2153 pulls up on the base of Q2156, turning it off. This cuts off the +Batt voltage to the +V Supply, while Q2138 saturates and connects the +4.9 V supply to the +V Supply.

If the Low Batt/ $\overline{\text{Monitor On}}$ signal goes HI (+7 V, indicating a low battery condition), a positive-going pulse into the base of Q2166 (through C2165, CR2161, and R2164) turns off the Power Inverter, if operating. Also Q2154 turns off and Q2156 turns off or, is prevented from turning on until the Low Batt/ $\overline{\text{Monitor On}}$ signal goes LO.

When the monitor is off, Q2156 is off, and the +V Supply is off. When the +V Supply is shorted or attempts to draw excessive current, lamp DS2157 lights to prevent component damage due to high battery current capability. The lamp has a positive temperature coefficient so that as current through it increases, its resistance increases to effectively limit current into the +V loads.

MAINTENANCE

This section of the manual contains information for performing preventive maintenance, troubleshooting, and corrective maintenance for the 400 Recorders.

PREVENTIVE MAINTENANCE

Preventive maintenance, when performed on a regular basis, can prevent instrument breakdown and may improve the reliability of the instrument. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is preceding electrical adjustment of the instrument. Table 4-1 is a suggested routine preventive-maintenance schedule for Monitor/Recorders in continuous use. Obvious defects should be corrected immediately.

TABLE 4-1
Routine Maintenance Schedule

Maintenance Performance	After 1 Month	After 6 Months
Inspect removable cables and wires.	X	
Inspect power cord and plug.	X	
Safety Inspection.		X
Adjustment.		X
Clean exterior.		As Required.
Clean chart platen and drive roller.		As Required.

CABINET REMOVAL

WARNING

To avoid electric-shock hazard, disconnect ac power to the Monitor and turn the Monitor off before removing the covers.

Access to most components in the Recorder can be gained by removing the bottom cover. To remove the bottom cover, remove the two screws on each side of the cover, then lift the cover straight off of the Recorder.

NOTE

The procedures for gaining access to A1–Motherboard, A4–Power Supply board, and A7–Manifold board, are given under Component Removal and Replacement later in this section.

To remove the side adapter plates, remove the four screws securing each plate to the chassis. Then lift the Recorder and remove the plates.

CLEANING

The Recorder should be cleaned as often as operating conditions require. The cabinet covers provide protection against dust in the interior of the instrument.

Exterior

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small brush. The brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. This solution can also be used to clean the chart platen and drive roller. Abrasive cleaners should not be used.

Interior

Cleaning the interior of the instrument should only be occassionally necessary. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (approximately 5 lb/in^2). Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces, or for cleaning more delicate circuit components.

CAUTION

To prevent damage from electrical arcing, circuit boards and components must be dry before applying power to the instrument.

VISUAL INSPECTION

The Recorder should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged or improperly installed circuit boards and heat-damaged parts. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

CAUTION

Recorders that have been dropped or otherwise abused, should be checked by qualified service personnel to verify all safety features.

SEMICONDUCTOR CHECKS

Periodic checks of semiconductors are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on semiconductors are given under Troubleshooting later in this section.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting your Recorder. Information contained in other sections of this manual should be used in conjunction with the following data to aid in locating a defective component. An understanding of the circuit operation is helpful in locating troubles. See Section 3, Theory of Operation, for this information.

TROUBLESHOOTING AIDS

Diagrams

Complete schematic diagrams are given on the foldout pages in Section 7, Diagrams and Circuit Board Illustrations. The component number and electrical value of each component in this instrument are shown on these diagrams. (See the first page of the Diagrams and Circuit Board Illustrations section for definitions of the reference designators and symbols used to identify components in this instrument.) Important voltages and idealized waveforms are also shown on the diagrams. The portions of circuits mounted on circuit boards are enclosed with heavy solid black lines.

Circuit Board Illustrations

A circuit board illustration is shown in conjunction with each circuit diagram. These are located on the back of the pull-out page opposite the associated circuit diagram. Each circuit component and waveform test point shown on the circuit diagram is identified on the circuit board illustration by its circuit number. Circuit number locations are identified with a grid-index system.

Adjustment and Test Point Locations

To aid in locating test points and adjustable components called out in the Performance Check and Adjustment procedure, an Adjustment and Test Point Locations foldout page is provided in Section 7, Diagrams and Circuit Board Illustrations.

Component Value Identification

Values of capacitors, diodes, and resistors used in this instrument are identified by direct numerical values or by a color-code scheme. Figure 4-1 shows the color-code and numerical-value schemes used.

Semiconductor Lead Configurations

Typical semiconductor lead configurations are shown in Figure 4-3 later in this section. Before handling semiconductors or boards containing semiconductors, see the special handling note in this section under Component Removal and Replacement, Semiconductors.

Signal Routing Diagrams

Signal Routing Diagrams are given on pullout pages at the rear of this manual. They show the routing of signals from the monitor through the interconnecting cable to the appropriate Recorder circuits.

Truth Tables

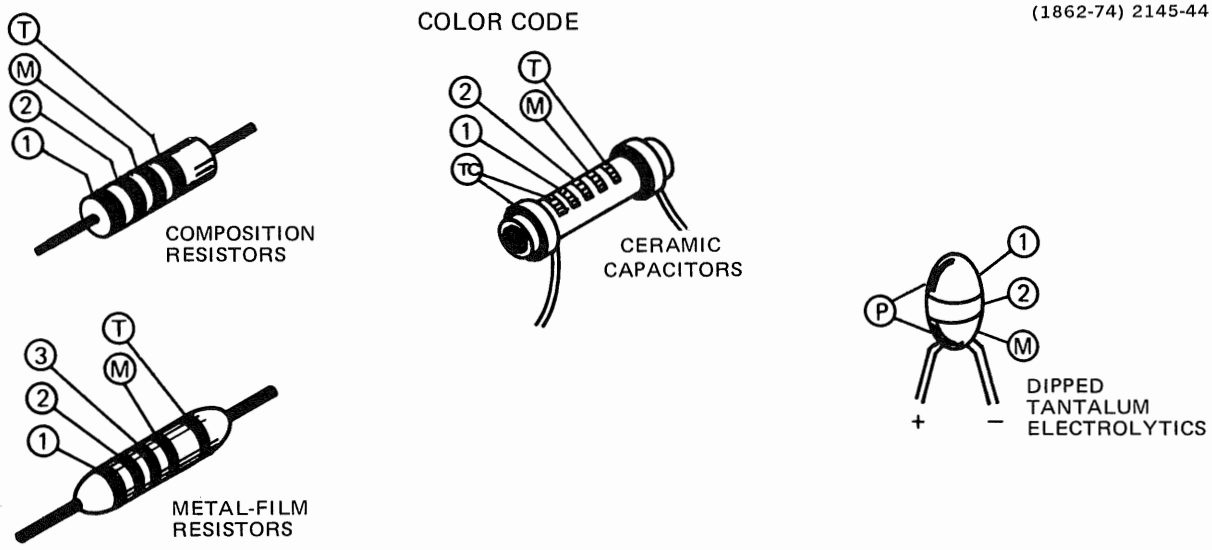
Truth tables are given on pullout pages in the Diagrams and Circuit Board Illustrations section of this manual. These truth tables give the logic state outputs for specified inputs to the various integrated circuits used in the 400 Recorder.

Servicing Extender Set

Servicing Extender Set, Tektronix Part 020-0258-00, is available to aid in troubleshooting. It provides an extender board and cables necessary to operate the Recorder with any of the plug-in circuit boards extended, or with the print module removed.

COLOR CODE

(1862-74) 2145-44



① ② and ③ - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS. Ⓜ - MULTIPLIER Ⓣ - TOLERANCE; Ⓣ AND/OR Ⓒ COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS; Ⓒ - TEMPERATURE COEFFICIENT. Ⓟ - POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER (OHMS)	TOLERANCE	MULTIPLIER (pF)	TOLERANCE		
					OVER 10pF	UNDER 10pF	
BLACK	0	1	–––	1	±20%	± 2pF	4VDC
BROWN	1	10	±1%	10	±1%	±0.1pF	6VDC
RED	2	10^2 or 100	±2%	10^2or 100	±2%	–––	10VDC
ORANGE	3	10^3or 1 K	±3%	10^3 or 1000	±3%	–––	15VDC
YELLOW	4	10^4 or 10K	±4%	10^4 or 10,000	+100% –0%	–––	20VDC
GREEN	5	10^5 or 100 K	±1/2%	10^5or 100,000	±5%	±0.5pF	25VDC
BLUE	6	10^6 or 1 M	±1/4%	10^6 or 1,000,000	–––	–––	35VDC
VIOLET	7	–––	±1/10%	10^7 or 10,000,000	–––	–––	50VDC
GRAY	8	–––	–––	10^{-2} or 0.01	+80% –20%	±0.25pF	–––
WHITE	9	–––	–––	10^{-1} or 0.1	±10%	±1pF	3VDC
GOLD	–––	10^{-1} or 0.1	±5%	–––	–––	–––	–––
SILVER	–––	10^{-2} or 0.01	±10%	–––	–––	–––	–––
NONE	–––	–––	±20%	–––	±10%	±1pF	–––

Figure 4-1. Color code for resistors and capacitors.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in the Recorder are given here.

SERVICE RECORD

It is advisable to keep a detailed service record, since the Monitor/Recorder and its accessories are involved with patient care and safety. Include information such as Monitor/Recorder types and serial numbers, failures, symptoms, routine maintenance performed, and the date.

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before ordering or purchasing replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument. All replacement parts should be direct replacements unless you know that a different component will not adversely affect instrument performance.

Special Parts

Some components of the Recorder are manufactured or selected by Tektronix, Inc. to meet specific performance requirements. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.

2. Instrument serial number.

3. A description of the part (if electrical, include the circuit number).

4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

Disconnect the Monitor from the power source, turn the Monitor off, and unplug the battery pack plug (P2130) before soldering. (See Fig. 4-5 later in this section, for location of P2130.) This procedure disables the + V supply which continuously powers certain portions of the recorder.

Use ordinary 60/40 solder and a 15 watt pencil-type soldering iron for most soldering in this instrument. If higher-wattage soldering irons are used to remove large surface components, be careful not to apply so much heat that the etched circuit wiring separates from the base material. Excessive heat can also cause serious damage to multi-layer circuit boards.

CAUTION

Several of the circuit boards in the 400 Recorders are multi-layer type boards with conductive paths laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to these center conductors. The following boards in the 400 Recorders are multi-layer: A1—Motherboard, A2—Run Control, A4—Power Supply, A10— A Conditioner, A11—DVM Analog, A12—DVM Digital, A13—Print Control 1, A14—Print Control 2, and A15—Print Drive board.

COMPONENT REMOVAL AND REPLACEMENT

WARNING

Disconnect the monitor from the power source and unplug the battery pack plug (P2130) before replacing components.

CAUTION

To prevent semiconductor static-discharge, connect yourself to the recorder with an anti-static strap before removing or replacing components. See Recommended Handling Rules on page 4-8.

Instrument Disassembly

Use the exploded drawings at the rear of this manual as a guide for disassembly. Observe all cautions and warnings found in this section and on the instrument.

Pushbuttons

Remove pushbuttons by pulling straight off with your fingers or with pliers that are protected with cloth or tape. Install pushbuttons by pressing them onto the shaft extensions.

Interconnecting Cables and Terminal Connectors

Interconnecting cable assemblies used in the Recorder consist of multiple-conductor cable with machine-installed terminal connectors, mounted in plastic holders.

The plastic holders, except on the battery cable, can be replaced easily. However, if the cable is defective, such as a wire broken loose from the terminal connector, it is often advisable to replace the complete cable assembly.

If the terminal connectors come loose from the plastic holder, they can be reinstalled as shown in Figure 4-2. When reinstalling connectors on board pins, be sure to match the triangle on the connector holder with the triangle on the circuit board for proper orientation.

Semiconductors

CAUTION

See semiconductor Recommended Handling Rules on page 4-8.

Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of this instrument. When semiconductors are replaced, check the operation of that part of the instrument which may be affected.

CAUTION

To avoid component damage, power must be turned off before removing or replacing semiconductors.

Replacement devices should be of the original type or a direct replacement. Figure 4-3 shows the lead configurations of the semiconductor devices used in this instrument. When replacing, check the manufacturer's basing diagram for correct basing. Semiconductors that have heat radiators use silicone grease to increase heat transfer. Replace silicone grease when replacing these semiconductors.

WARNING

Handle silicone grease with care. Avoid getting the silicone grease in your eyes. Wash hands thoroughly after use.

An extracting tool should be used to remove integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part 003-0619-00. If an extracting tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. To prevent damage to the pins, avoid having one end of the integrated circuit disengage from the socket before the other.

Interconnecting Circuit-Board Pins

A circuit-board pin replacement kit, including necessary tools, instructions, and replacement pins with attached spare ferrules, is available from Tektronix, Inc. Order Tektronix Part 040-0542-00. Replacement of circuit-board pins on multi-layer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

CAUTION

Replace circuit-board pins on multi-layer boards with extreme caution. See Soldering Techniques for identification of multi-layer boards in this instrument.

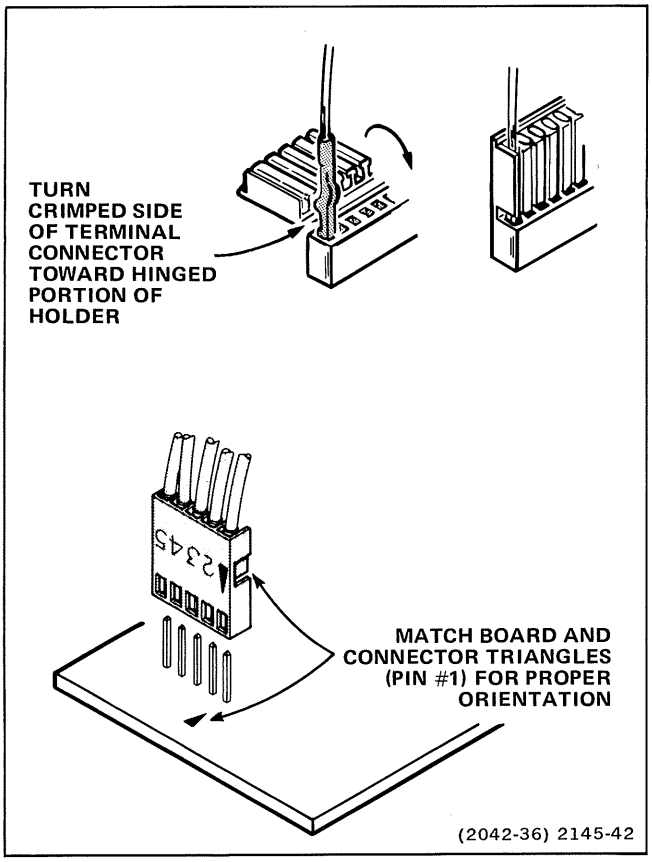


Figure 4-2. Installation and orientation of terminal connectors.

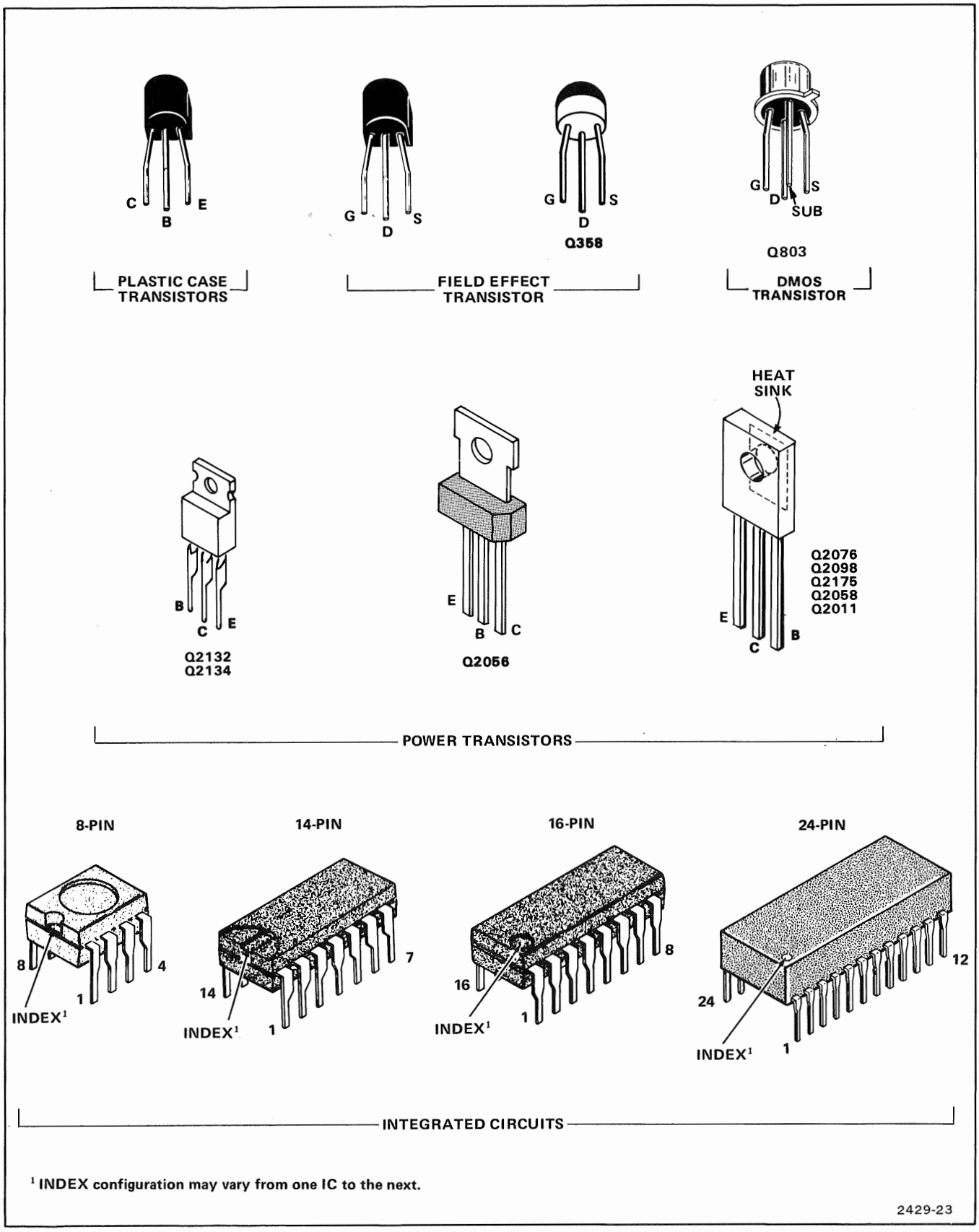


Figure 4-3. Semiconductor lead configurations.

YOU ARE DESTRUCTIVE **STATIC DISCHARGE** CAN DAMAGE COMPONENTS

FACT: BOTH **MOS** AND **BIPOLAR** INTEGRATED CIRCUITS CAN BE DAMAGED BY DISCHARGE OF STATIC ELECTRICITY.

FACT: BOTH **DIGITAL** AND **LINEAR** I.C.'S CAN BE DAMAGED.

FACT: I.C.'S CAN BE DAMAGED WHEN THEY ARE **IN THE CIRCUIT** AS WELL AS WHEN THEY ARE NOT.

FACT: DAMAGE MAY **NOT** BE **APPARENT FOR SEVERAL MONTHS.**

RECOMMENDED HANDLING RULES

STORING AND TRANSPORTING

Don't *remove semiconductors or boards containing semiconductors from original antistatic container until needed.*

Don't *place semiconductors or boards containing semiconductors on or in plastic containers, styrofoam or other nonconductive material. Use material specifically treated for antistatic qualities.*

INSTALLING

Do *discharge static charge from your body. Connect yourself to ground through 100 kΩ while handling circuits or semiconductors.*

Do *use grounded soldering iron and test equipment.*

Do *turn the instrument power off before removing or inserting semiconductors.*

Do *use a grounded conductive bench top when working on boards or instruments containing semiconductors. If not available, use uncoated cardboard as a substitute.*

Don't *slide semiconductors or boards containing semiconductors across any surface.*

Don't *touch semiconductor leads unless necessary.*

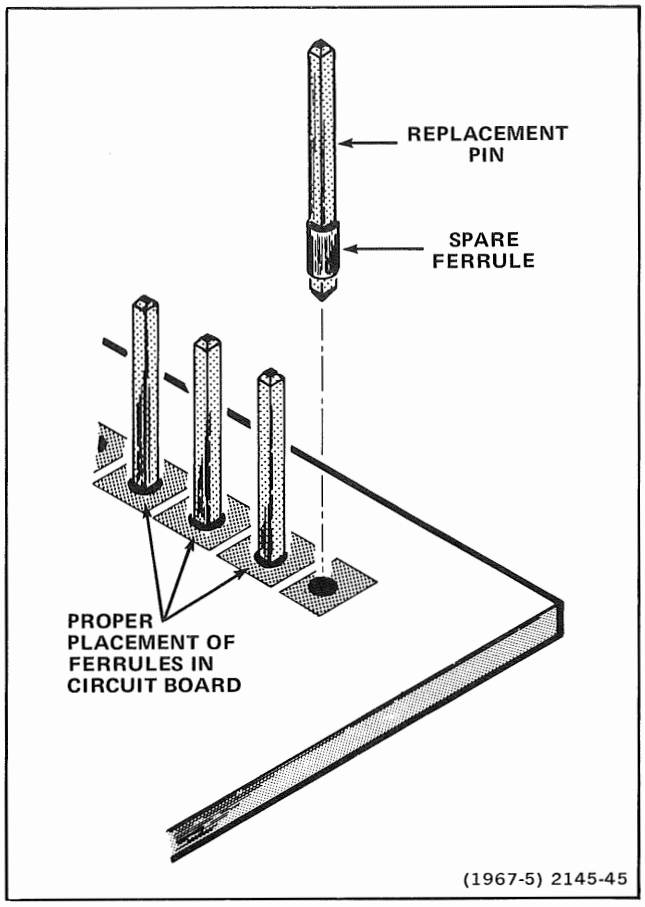


Figure 4-4. Exploded-view of circuit-board pin and ferrule.

To replace a damaged pin, first disconnect any pin connectors. Then unsolder (see Soldering Techniques) the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Fig. 4-4) in the hole if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin, with attached spare ferrule, into the hole. Position the replacement pin in the same manner as the original pin had been. Solder the pin to the circuit board on each side of the circuit board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

Circuit Boards

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers are given in the Replaceable Electrical Parts list for completely wired boards.

WARNING

To avoid electric-shock hazard or possible instrument damage when removing or replacing circuit boards, always disconnect the Monitor from the power source and disconnect P2130 from the battery pack assembly. (See Fig. 4-5.)

CAUTION

To prevent instrument damage when installing boards, be sure to align the outside pins on the Motherboard with the outer receptacles on the plug-in boards. Also be sure to match triangles on the terminal connectors with those on the boards.

Access to most of the boards in your Recorder can be gained by removing the bottom cover. Table 4-2 gives the circuit boards in each Recorder model; Figure 4-6 shows the location of circuit boards within the Recorder.

TABLE 4-2
Circuit Boards Installed in Your Recorder

Circuit Boards	400 Recorder Models			
	Standard	Option 1	Options 2 & 4	Option 3
A1—Motherboard	X	X	X	X
A2—Run Control	X	X	X	X
A3—Pen Amplifier	X	X	X	X
A4—Power Supply	X	X	X	X
A5—Source Switch		X	X	X
A6—Sample/Mark Speed Switch	X	X	X	X
A7—Manifold[1]	X	X	X	X
A8—A/V Buffer			X	
A9—A/V Conditioner				X
A10—A Conditioner				X
A11—DVM Analog			X	X
A12—DVM Digital			X	X
A13—Print Control 1			X	X
A14—Print Control 2			X	X
A15—Print Drive			X	X
A16—Print Head Assembly			X	X

[1] **Added to the 408, 412, and 414 Monitors during recorder installation. Not used with 413 Monitor.**

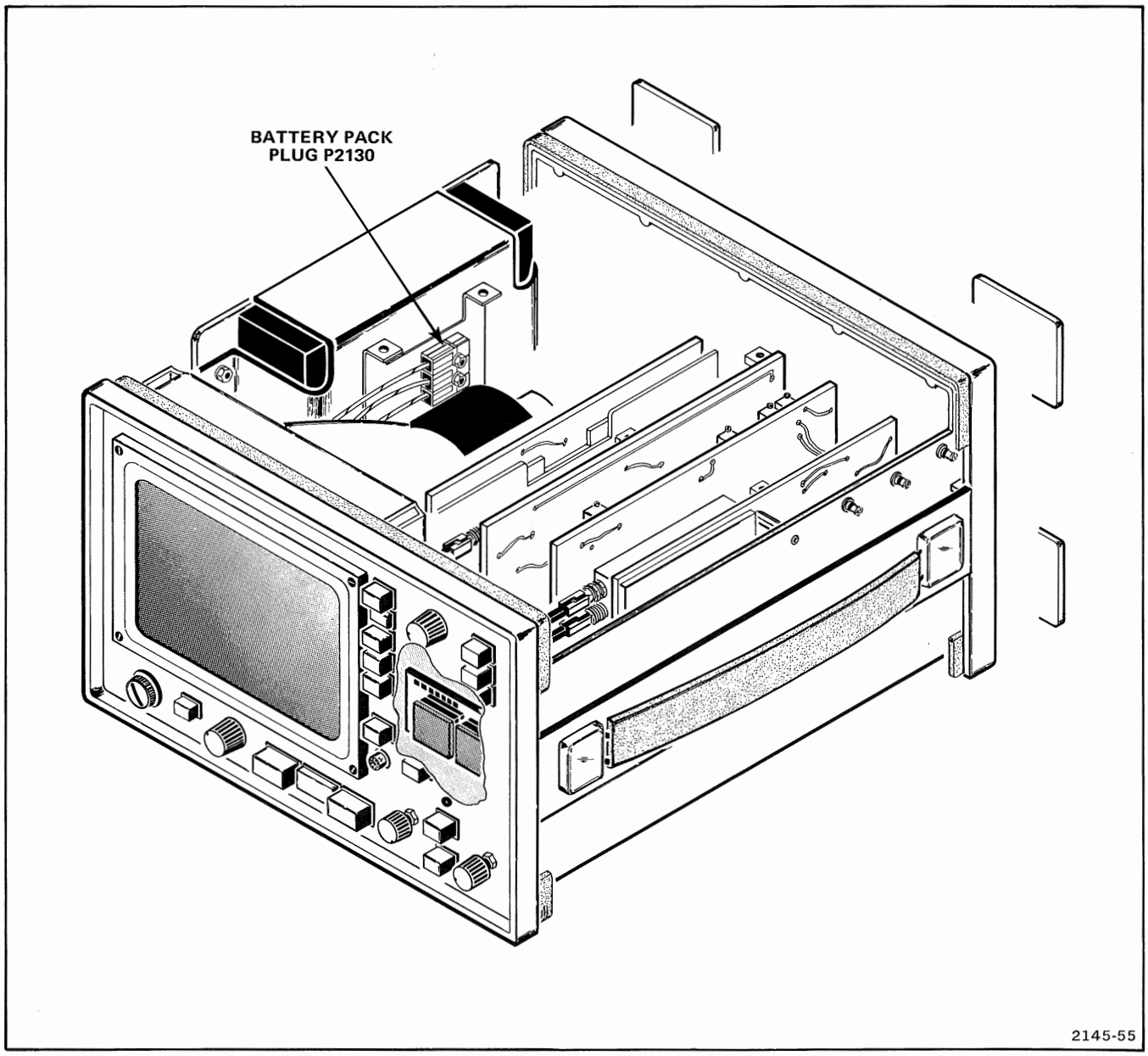


Figure 4-5. Location of battery pack plug P2130 in the Monitor.

A2—RUN CONTROL, A8—A/V BUFFER, A9—A/V CONDITIONER, A10—A CONDITIONER, A11—DVM ANALOG, A12—DVM DIGITAL, A13—PRINT CONTROL 1, AND A14—PRINT CONTROL 2 BOARDS. Remove and replace these circuit boards as follows:

1. Remove the top cover from the Monitor, then disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

2. Remove the bottom cover from the Recorder using the procedure given earlier under Cabinet Removal.

3. Disconnect any terminal connectors located on the board.

4. Pull the board straight up to unplug it from the Motherboard.

5. To replace one of these boards, align the board edges with the slotted board guides. Gently press the board against the Motherboard. Be sure that all pins and sockets are properly mated.

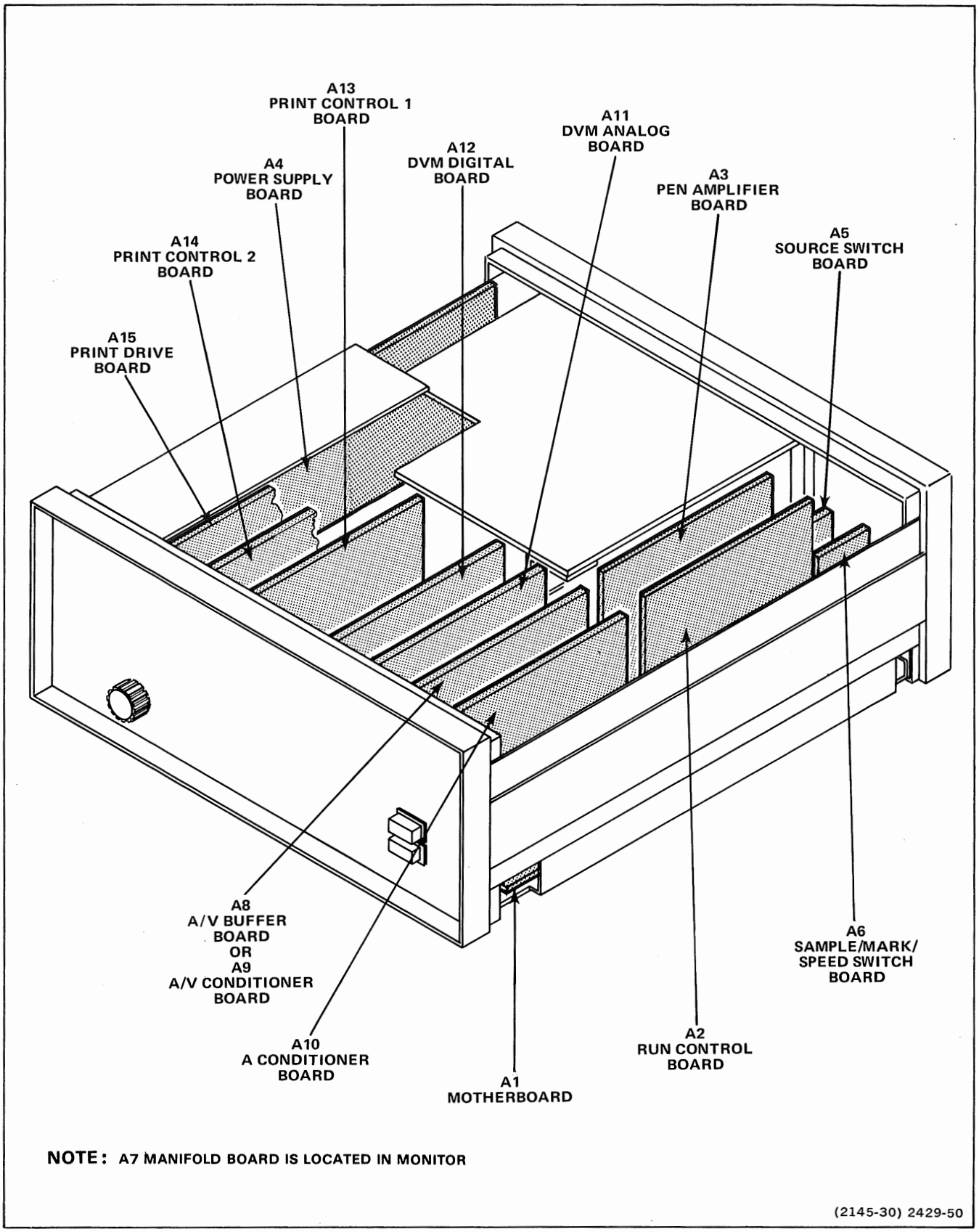


Figure 4-6. Location of circuit boards within the Recorder.

A3—PEN AMPLIFIER BOARD. Remove and replace the Pen Amplifier circuit board as follows:

1. Remove the top cover from the Monitor and disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

2. Remove the bottom cover from the Recorder using the procedure given earlier under Cabinet Removal.

3. Rotate the front panel ECG POSITION control as necessary to loosen the two set screws holding the shaft coupler to the potentiometer.

4. Move the ECG POSITION knob, shaft, and coupler assembly away from the Pen Amplifier board.

5. Lift the board straight out of the Recorder.

6. To replace the board, first align the board edges with the slotted board guides. Gently press the board against the Motherboard. Be sure that all pins and sockets are properly mated.

7. Reposition the ECG POSITION knob, shaft, and coupler assembly as in step 3 above. Tighten the setscrews.

A4—POWER SUPPLY BOARD. Remove and replace the Power Supply circuit board as follows:

1. Remove the top cover from the Monitor and disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

NOTE

Before removing the Power Supply board, study the dress of the attached power cable through the monitor. Attempt to similarly redress the cable after board replacement.

2. Remove the Recorder's bottom cover and side adapter plates.

3. Remove the 3 screws securing the power-supply adjustments access cover to the chassis side rail. See Figure 4-7.

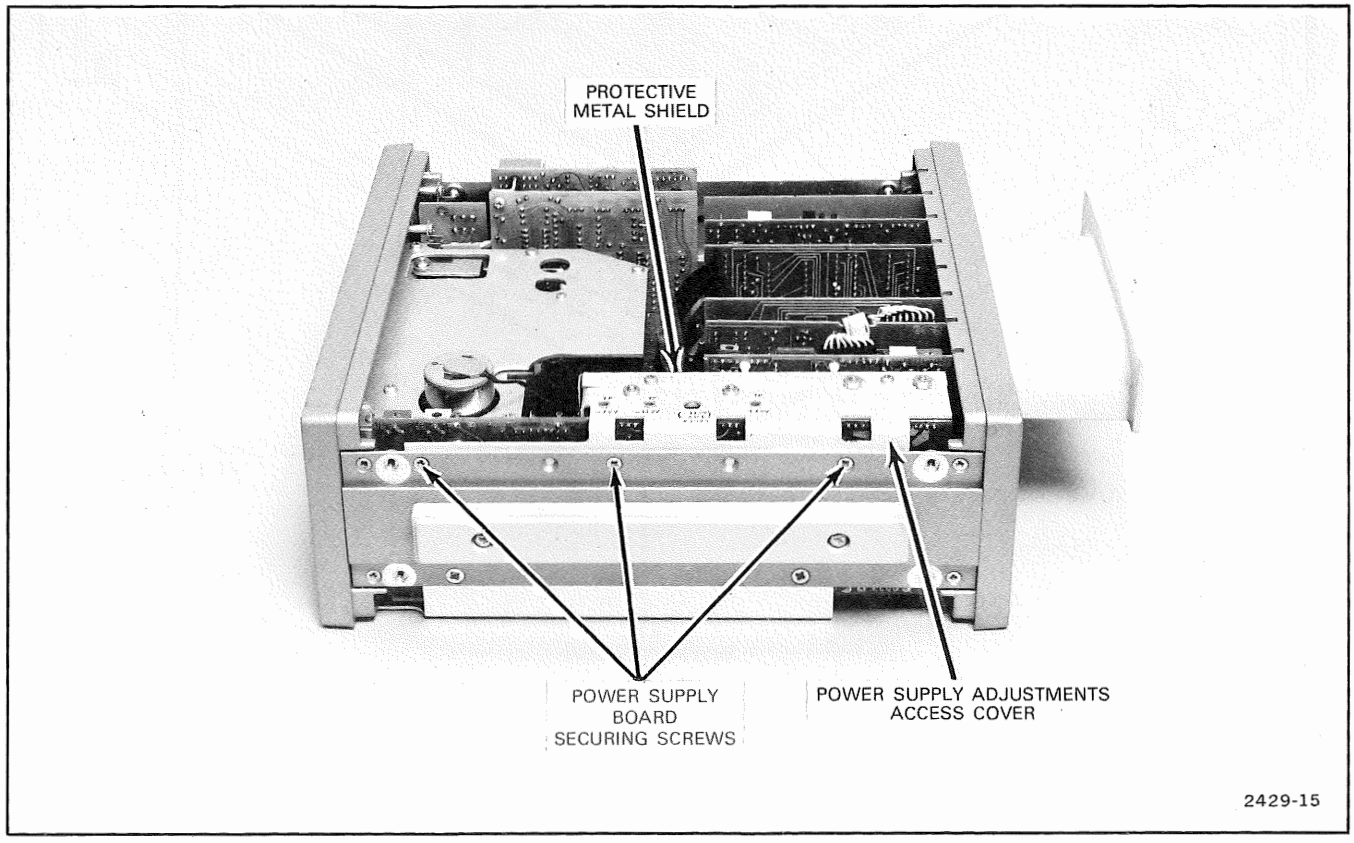


Figure 4-7. Location of screws securing A4—Power Supply circuit board.

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4. Lift the power-supply adjustments access cover, with attached circuit board, straight up to unplug the board from the Motherboard. Carefully guide the power-supply cable through the Monitor and Recorder as the board is removed from the instrument.

5. To replace the Power Supply board, first remove the two screws securing the protective metal shield to the power supply adjustments access cover (see Fig. 4-7) and remove the shield.

6. Thread the power-supply cable through the recorder. Then align the interconnecting board pins with their sockets and gently press the circuit board against the Motherboard.

7. Secure the power-supply adjustments access cover to the chassis and replace the protective metal shield.

8. Redress the power-supply cable through the Monitor as originally positioned.

9. Reconnect battery pack plug P2130 and replace all cabinet covers.

A15—PRINT DRIVE BOARD. Remove and replace the Print Drive circuit board as follows:

1. Remove the top cover from the Monitor, then disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

2. Remove the bottom cover from the Recorder using the procedure given earlier under Cabinet Removal.

3. Disconnect the interconnecting cable which comes from the Print Control 2 board.

4. Unplug the Print Head Flex Cable from the connector on the front edge of the Print Drive circuit board.

5. Pull the board straight up to unplug it from the Motherboard.

6. To replace the board, first carefully reconnect the Print Head Flex Cable to the connector on the front edge of the board.

NOTE

Insure that the Print Head Flex Cable is flat (edges not folded over, etc.) and the etched contact fingers are properly aligned with the contacts in the connector on the Print Drive board.

7. Align the board edges with the slotted board guides. Gently press the board against the Motherboard. Be sure that all pins and sockets are properly mated. Refer to Figure 4-8 for correct dress of the Print Head Flex cable.

8. Reconnect the interconnecting cable. Route it through the notch in the Print Control 2 board and dress it as shown in Figure 4-8.

A7—MANIFOLD BOARD (LOCATED IN 408, 412, 414 MONITORS). Remove and replace the Manifold circuit board as follows:

1. Remove the Monitor's top cover, then disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

2. Remove the side adapter plates and carefully lift the Recorder from the Monitor.

3. Disconnect P711 in the Monitor. (Refer to the appropriate Instruction Manual for the location of P711 in your monitor.) P711 connects battery power to the monitor.

4. Disconnect P2400 and all other interconnecting cables from the Manifold board.

5. Remove the 2 screws securing the board to the mounting bar and lift the board from the Monitor.

6. To replace the board, reverse the removal procedure. The Manifold board is marked with the terminal connector colors to aid in cable replacement.

A1—MOTHERBOARD. Remove and replace the Motherboard as follows:

1. Remove the top cover from the Monitor and disconnect P2130 (see Fig. 4-5) from the battery pack assembly.

2. Remove the bottom cover and side adapter plates from the Recorder. Disconnect P2200 from the bottom of the Motherboard.

3. Remove all circuit boards from the Motherboard.

4. Remove the knob from the rear-panel STYLUS HEAT control.

5. Disconnect all interconnecting cables from the Motherboard.

6. Remove the 2 screws from each side rail which secure the chassis pan to the side rails.

7. Remove the screw on the bottom of the Recorder securing the chassis pan to the print module.

8. Slide the Motherboard with attached chassis pan toward the front panel, and away from the chassis, in order to free the STYLUS HEAT control from the rear panel. Remove the Motherboard and attached chassis pan from the Recorder.

NOTE

Retain the cylindrical spacer which is installed between the chassis pan and the Recorder module. It was secured by the screw removed in step 7.

9. Remove the 4 screws securing the Motherboard to the chassis pan.

10. Replace the Motherboard by reversing the removal procedure. Ensure that the cylindrical spacer is correctly located between the Recorder module and the chassis pan.

A5—SOURCE SWITCH BOARD. Remove and replace the Source Switch circuit board as follows:

1. Rotate the front-panel ECG POSITION control as necessary to loosen the set screws holding the shaft coupler to the potentiometer. Pull the ECG POSITION knob, shaft and coupler away from the Pen Amplifier board.

2. Unplug five multiconductor cables from the Motherboard. Unplug the Print-Head Flex Cable from the Print Drive board.

3. Remove the screw which holds the print module to the chassis pan.

4. Remove the four screws holding the Recorder frame side rails to the front-panel subcasting.

5. Slide the subcasting, complete with print module and switch assemblies, away from the Recorder.

NOTE

Retain the cylindrical spacer which is installed between the chassis pan and the Recorder module.

6. Remove the front-panel SOURCE pushbuttons.

7. Remove the 2 screws securing the SOURCH switch assembly to the chassis-mounted studs.

8. Move the board away from the front panel to free the SOURCE switch, then remove the board from the Recorder.

9. To replace the board, reverse the removal procedure.

A6—SAMPLE/MARK SPEED SWITCH BOARD. Remove and replace the Sample/Mark Speed Switch circuit board as follows:

1. Perform the first five steps for removing the A5—Source Switch board.

2. Remove the front-panel SAMPLE/MARK and SPEED pushbuttons following the procedure given under Push-buttons earlier in this section.

3. Remove the 2 screws securing the switch assembly to the chassis-mounted studs.

4. Move the board toward the rear panel to free the switches, then remove the board from the Recorder.

5. To replace the board, reverse the removal procedure.

Strip Chart Recorder Module

Remove the entire module as follows: See CAUTION note under Pen Motor Replacement.

1. Remove the top cover from the monitor and disconnect the battery cable (P2130, see Fig. 4-5) from the battery pack assembly.

2. Remove the bottom cover and side adapter plates from the recorder. Disconnect the interconnecting cable (P2200) from the bottom of the Motherboard.

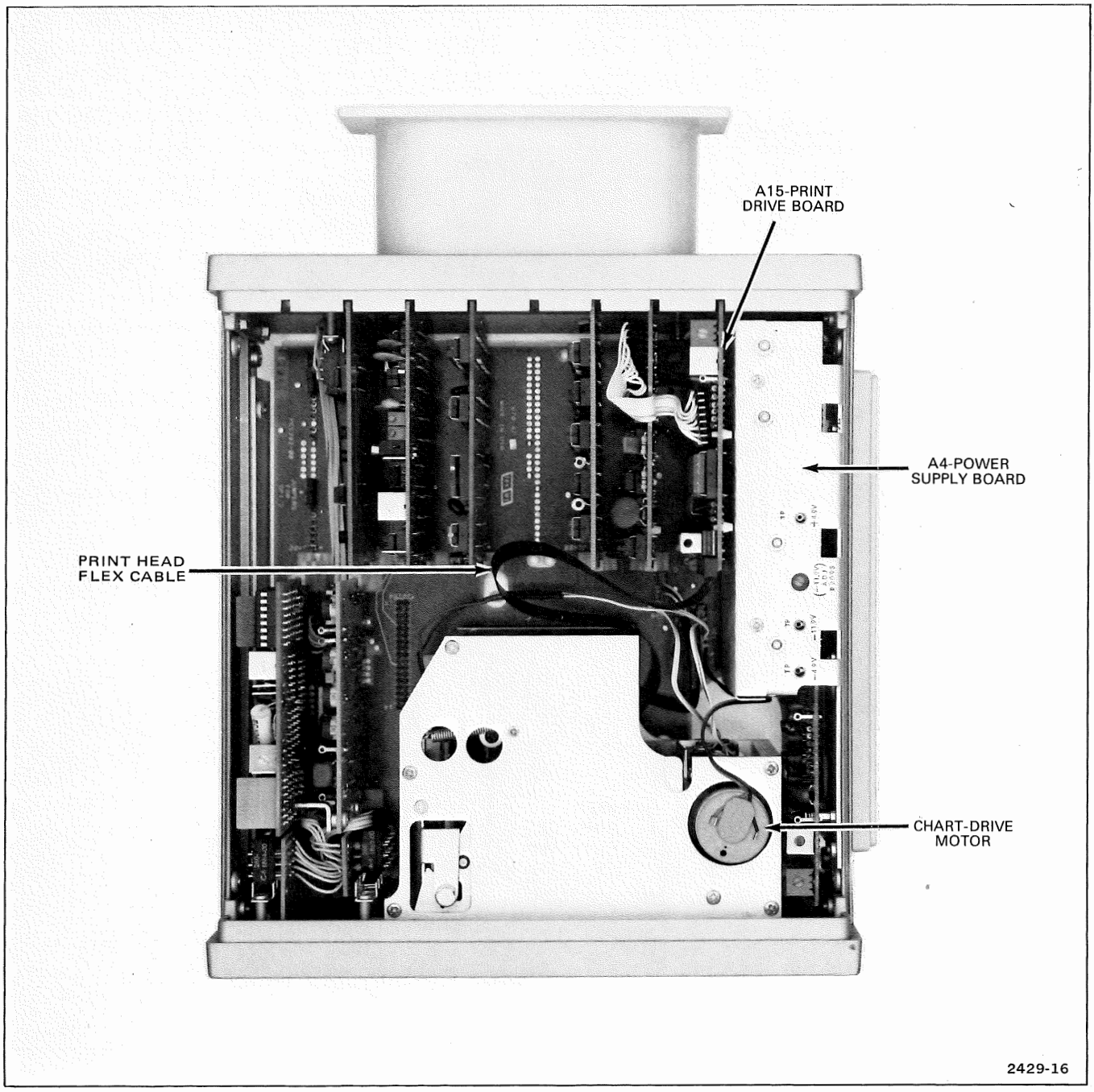

Figure 4-8. Proper dress of the Print Head Flex Cable.

3. Remove the POSITION knob, the tension gate, and the 4 screws in the corners of the front panel. Remove the front panel.

4. Disconnect the three cables leading to the module.

5. Remove the screw securing the module to the top of the Recorder chassis pan (the screw is adjacent to P2200). Remove the 4 screws securing the module to the front panel casting.

6. Carefully lift the module from the Recorder. Retain the cylinderical spacer which is between the chassis pan and the module.

7. To replace the module, reverse the removal procedure. For best contact alignment, unplug the Print Drive board prior to connecting the Print Head Flex Cable to it. Refer to Figure 4-8 for correct dress of the Print Head Flex Cable and Print Drive board-to-Print Control 2 board interconnecting cable. If the screw-head slots are damaged replace screws to allow easy removal in the future.

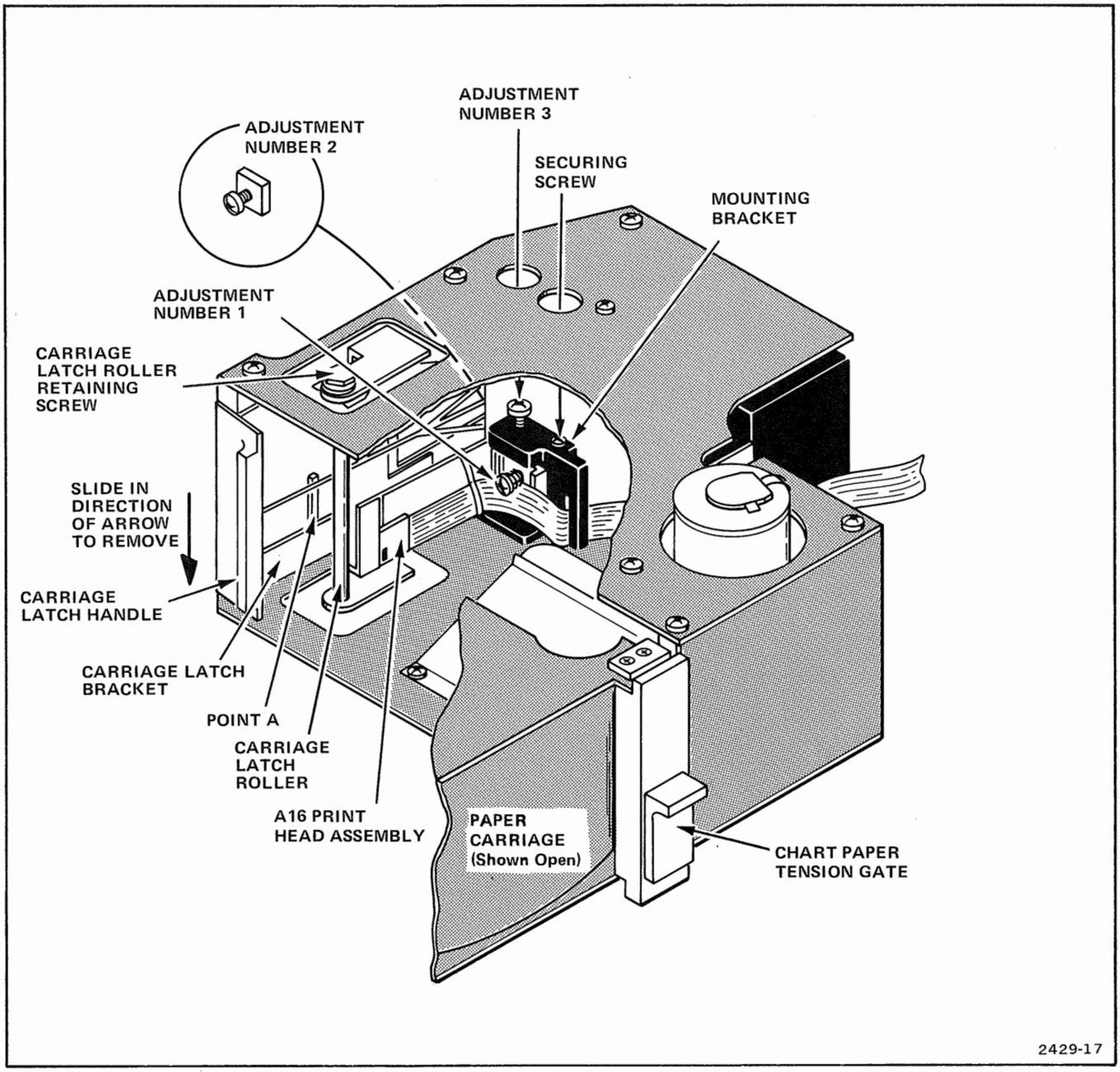

Figure 4-9. Location of securing screws and tension-adjusting screw for the Print Head Assembly.

PRINT HEAD ASSEMBLY (A16)

Remove the A16 Print Head Assembly as follows: (Refer to Fig. 4-9).

1. Turn off the monitor and disconnect it from the ac power source.

2. Remove the bottom cover from the Recorder. Unplug the Print Head Flex Cable from the A15 Print Drive board.

3. Open the paper carriage and slide the Carriage Latch Handle off the Carriage Latch Bracket.

4. Loosen the Carriage Latch Roller Retaining Screw enough to remove the roller. Do not remove retaining screw.

5. Insert a non-magnetized screwdriver through the access hole and remove the Print Head Assembly Securing Screw and washer. Carefully pull Print Head Assembly out through the front of the Recorder.

Replace the Print Head Assembly as follows: (Refer to Fig. 4-9)

1. Preset adjustments as follows: #1, so that the threaded end of the screw is flush with the surface of the plastic Mounting Bracket; #2, so that the threaded end of the screw protrudes about three threads beyond the far surface of the bracket; #3, so that the threaded end of the screw protrudes about one thread beyond the surface of the bracket.

2. Insert the Print Head Assembly through the front of the Recorder and center the Mounting Bracket on the mounting stud. Be sure that the Carriage Latch Bracket passes through the U-shaped portion of the Print Head Assembly.

3. Replace the Securing Screw and washer. Adjust it until just snug—do not tighten it yet.

4. Replace the Carriage Latch Roller and close Paper Carriage.

5. Remove the Print Drive board.

6. Dress Print Head Flex Cable as shown in Figure 4-8 and carefully plug the end of the cable into the P1850 connector on the A15 Print Drive board. Do not twist flex cable.

NOTE

Make sure that the Print Head Flex Cable is flat (corners not folded over, etc.) and the etched contact fingers are properly aligned when plugging it into the connector on the Print Drive board.

7. Replace the Print Drive board, and reconnect its multiconductor cable from the Print Control 2 board. Dress the cable as shown in Figure 4-8.

To Adjust Print Head:

There are three adjustment screws for properly adjusting the Print Head. There is a certain amount of interaction among the three adjustments.

1. Adjustment #1 sets the pressure of the Print Head against the chart paper. Ideally this adjustment should be set so that characters are printed clearly with the least amount of pressure. Excess pressure can cause rapid print head wear and will reduce battery operating time by loading the chart-drive motor.

2. Adjustment #2 moves the Print Head Assembly in or out to center the hot-dot print head directly over the rubber roller. This adjustment has the effect of increasing or decreasing the contrast of the printed characters. It is possible to set this adjustment to extremes where the hot-dot print head is so far away from the center of the rubber roller that no printing will occur.

3. Adjustment #3 makes the Print Head parallel with the rubber roller. The purpose is to produce dots of equal density between the top and bottom of the printed characters.

WARNING

To prevent possible burns from the writing stylus while making print-head adjustments, set the monitor ECG channel off and the Recorder ECG SOURCE button in. This forces the hot stylus to the bottom of the chart paper.

Two procedures are given for adjusting the Print Head Assembly. The Recommended Procedure requires use of a precision dynamometer (a Type GD-15 dynamometer is available from Jonard Industries Corp.). The Alternative Procedure allows acceptable adjustment to be made when a dynamometer is not readily available.

RECOMMENDED PRINT HEAD ADJUSTMENT PROCEDURE

1. With paper carriage closed, check pressure on Print Head Assembly at point A (Fig. 4-9), using a dynamometer. Pressure should be 100 grams (±25 grams); if not, open paper carriage and rotate Adjustment #1. Clockwise rotation increases pressure while counterclockwise decreases pressure.

2. Connect the monitor to an ac power source and turn on the monitor. Set Recorder chart speed to 25 mm/second.

3. Press the SAMPLE/MARK pushbutton and rotate Adjustment #2 to obtain maximum contrast between the printed characters and the Recorder paper. Moderate screwdriver pressure must be applied to the adjustment screw to achieve optimum adjustment. It is possible that this adjustment may require several turns before printing becomes visible.

4. Press the SAMPLE/MARK pushbutton and rotate Adjustment #3 to obtain equal dot density between the top and bottom of the printed characters.

5. Tighten the Print Head Securing Screw and recheck Print Head pressure (step 1). Recheck for optimum print contrast and equal dot density. If readjustment is necessary, slightly loosen Print Head Securing Screw and repeat steps 3, 4, and 5.

6. Replace Carriage Latch Handle and recorder bottom cover.

ALTERNATIVE PRINT HEAD ADJUSTMENT PROCEDURE

1. Connect the monitor to an ac power source and turn on the monitor. Set the Recorder chart speed to 25 mm/second.

2. Press the SAMPLE/MARK pushbutton and set Adjustment #2 to obtain maximum contrast between the printed characters and the chart paper. Moderate screwdriver pressure must be applied to the adjustment screw to achieve optimum adjustment. It is possible that this adjustment may require several turns before printing becomes visible.

3. Press the SAMPLE/MARK pushbutton and set Adjustment #1 so that the characters are printed faintly.

4. Press the SAMPLE/MARK pushbutton and set Adjustment #3 to obtain equal dot density between the top and bottom of the printed characters.

5. Tighten Print Head Securing Screw. Rotate Adjustment #1 clockwise just far enough to obtain good clear printed characters. Recheck for optimum print contrast and equal dot density. If readjustment is necessary, slightly loosen Print Head Securing Screw and repeat steps 2, 4, and 5.

6. Set Recorder chart speed to 50 mm/second and re-set Adjustment #1 if necessary to obtain good clear printed characters.

NOTE

Rotate Adjustment #1 clockwise only enough to obtain good clear printed characters. Additional rotation increases pressure on the print head, which will shorten its life.

7. Replace Carriage Latch Handle and Recorder bottom cover.

PEN MOTOR

CAUTION

The Pen Motor is a delicate instrument which must be handled carefully to prevent it from being damaged. Only experienced service persons should remove the pen motor from the print module.

In order to maintain optimum performance of the pen motor, note the following considerations:

a. Mechanically rotating the pen motor shaft beyond ±20° will cause demagnetization.

b. Excessive force on any plane of the pen motor shaft will cause damage to the rotor and bearing assemblies.

c. Tampering with any screws on the pen motor case can result in nonlinearity.

d. Mechanical shocks (e.g., dropping the Recorder or print module) may alter the performance of the pen motor.

e. Placing the pen motor on a steel surface, or close to magnets or any strong magnetic field, can change its sensitivity and/or linearity.

f. Using magnetized screwdrivers on or near the pen motor may change the sensitivity of the pen motor, resulting in incorrect recordings.

To Remove Pen Motor:

1. Remove strip-chart Recorder Module from the Recorder. See Strip Chart Recorder Module heading in this section.

2. Loosen set screw in stylus mounting block and pull mounting block with stylus off pen motor shaft.

3. Remove the four screws holding the pen motor in place. Two of these screws hold the stylus stops, which have to be readjusted after installing the pen motor.

4. Remove the pen motor from the strip-chart Recorder Module.

5. Remove the pen motor wire terminal connectors from the gray plastic holder. See Figure 4-2.

To Install Pen Motor:

1. Set pen motor in place on Recorder Module and secure with four screws. The two stylus stops mount under the heads of the two screws nearest the front of the module. See Figure 4-10 for approximate positioning of the stylus stops.

2. Set stylus mounting block with stylus onto pen motor shaft. Do not tighten screw at this time.

3. With chart paper in Recorder, adjust the stylus stops so that the contact point of the stylus is limited to the outer chart lines when the stylus is moved from the top to the bottom of the chart.

4. Position stylus mounting block on pen-motor shaft so that the surface of the mounting block is even with the end of the pen-motor shaft and so that the stylus is in the center of the chart. Tighten set screw in stylus mounting block.

5. Install pen motor wire terminal connectors into the gray P388 plastic holder. Refer to Figure 4-2 and Table 4-3.

TABLE 4-3
P388 Wire Locations

Position	Wire Color	Source
1	White, brown	Low paper switch
2	White, red	Low paper switch
3	Red	Pen motor
4	Yellow	Pen motor
5	Blue	Pen motor
6	White	Pen motor

6. Install strip-chart recorder module in recorder.

7. Adjust stylus tension. See Stylus Tension Adjustment heading in this section.

Stylus Replacement

1. Turn off the Monitor and disconnect it from the ac power source.

2. Remove the bottom cover from the Recorder.

3. Remove the two stylus-wire terminal connectors from P2034 holder (yellow). Refer to Figure 4-2.

4. Open paper carriage.

5. Slide Carriage Latch Handle off Carriage Latch Bracket. See Figure 4-9.

6. Pull out on stylus to release it from the stylus mounting block. See Figure 4-10.

7. Carefully set the new stylus in place on the stylus mounting block and press in about ¼ inch. It may be necessary to slightly bend out rear end of mounting flanges to get stylus started onto the mounting block.

8. Place a screwdriver tip at the location shown in Figure 4-10 and press stylus all the way onto the mounting block.

9. Connect the stylus wire terminal connectors to the yellow P2034 holder. See Figure 4-2 and Table 4-4.

TABLE 4-4
P2034 Wire Locations

Position	Wire Color	Source
1	Red	Chart drive motor +
2	Black	Chart drive motor —
3		Not Used
4		Not Used
5	Black	Stylus sheath
6	Red	Stylus center conductor
7	White-brown	Carriage open switch
8	White-red	Carriage open switch

10. Dress the stylus wires so that they cannot bind in the vicinity of the stylus mounting block.

11. Close paper carriage and adjust stylus tension.

12. Replace Carriage Latch Handle and Recorder bottom cover.

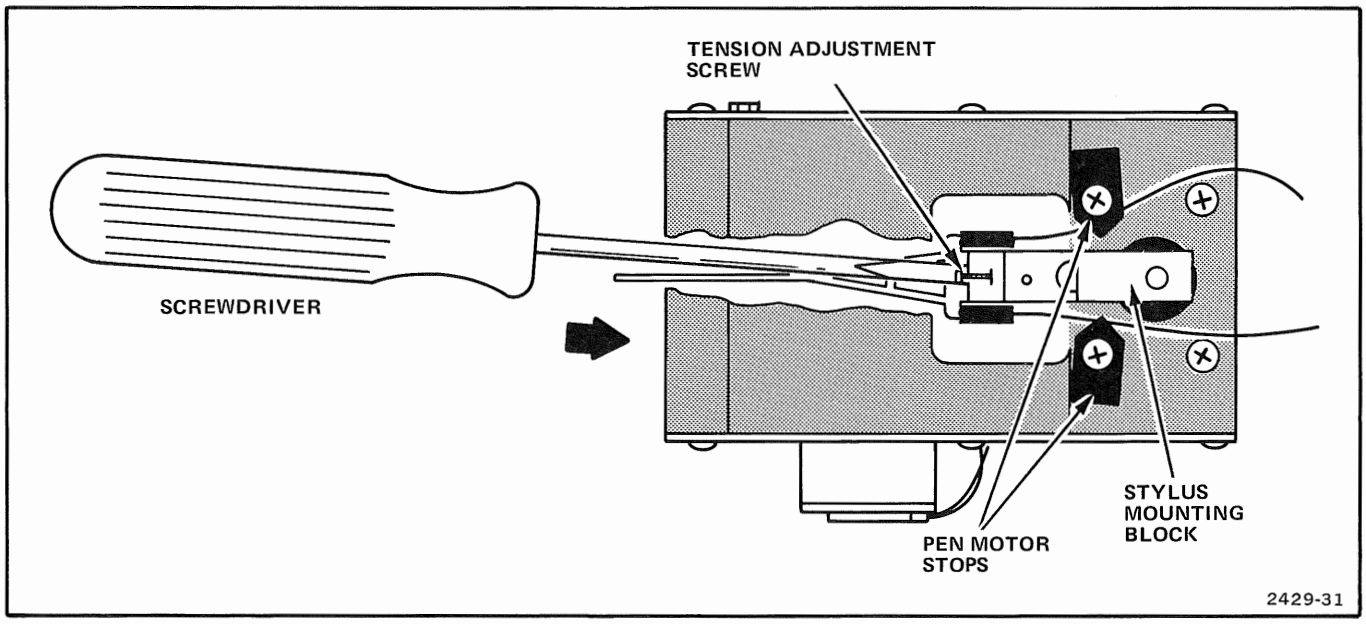

Figure 4-10. Stylus replacement.

STYLUS TENSION ADJUSTMENT. A 1 to 10 gram dynamometer (gram gauge) should be used for accurately setting stylus tension. A precision dynamometer is available from Jonard Industries Corporation. Order Type GR-1.

Two procedures are given below—one is for use with a dynomometer and the other is an alternative procedure to be used when a dynamometer is not available.

Adjusting Stylus Tension Using A Dynamometer.

1. Set STYLUS HEAT Control (rear panel) to about the one o'clock position.

2. Set SOURCE switch (except Standard Recorder) to ECG.

3. With no signal applied to monitor, press SAMPLE/MARK pushbutton to start recorder.

4. Check that a line is written on recorder paper. If not, adjust tension adjusting screw (Fig. 1-10) using adjusting tool shown in Figure 4-11. Rotate the tension adjusting screw about 360^{o} clockwise. Press SAMPLE/MARK pushbutton and check that a line is written.

5. Set red needle on dynamometer to zero. Carefully place tip of dynamometer against the stylus tip. Press SAMPLE/MARK pushbutton. While line is being written, carefully move dynamometer tip against stylus tip until writing is just barely interrupted.

6. Check dynamometer for tension reading of 3-5 grams. If tension is not within these limits adjust stylus tension adjusting screw. Clockwise increases tension and counter-clockwise decreases tension. Rotating the adjusting screw 180^{o} changes the tension by approximately 2 grams.

7. Replace Carriage Latch Handle.

Adjusting Stylus Tension Without A Dynamometer.

1. Set STYLUS HEAT control (rear panel) to about the one o'clock position.

2. Set SOURCE switch (except Standard Recorder) to ECG.

3. With no signal applied to monitor, press SAMPLE/MARK pushbutton to start recorder and check that a line is written on the recorder paper.

4. When Recorder stops, use adjusting tool shown in Figure 4-11 to adjust tension adjusting screw (Fig. 4-10) so that stylus just barely doesn't write. Stylus tension increases

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when adjusting screw is turned clockwise and decreases when turned counterclockwise.

To accomplish this, it is necessary to rotate the screw a little, press the SAMPLE/MARK pushbutton, and check that the stylus just writes faintly. Then turn tension adjusting screw counterclockwise until stylus just barely stops writing.

5. Rotate tension adjusting screw 360° clockwise. This should set the stylus tension somewhere between 3 and 5 grams. Press the SAMPLE/MARK pushbutton and make sure a distinct line is written.

6. Replace Carriage Latch Handle.

Chart Drive Motor

Remove the chart drive motor as follows:

1. Remove the Strip Chart Recorder Module from the Recorder. See Strip Chart Recorder Module heading in this section.

2. Remove the chart drive motor terminal connectors from the yellow plastic holder. See Figure 4-2.

3. Loosen the three screws which secure the motor bracket to the Recorder module frame.

4. Slide the motor bracket as required to remove the three small screws and washers which attach the chart drive motor to the bracket. A magnetic screwdriver is helpful.

5. Slip the chart drive motor out of the Recorder module, leaving the drive belt in place.

6. Remove the drive belt pulley from the chart drive motor shaft.

Replace the Chart Drive Motor as follows:

1. Install the drive belt pulley on the chart drive motor shaft.

2. Slip the chart drive motor into the Recorder module, engaging the drive belt. Rotate the motor so that its wire leads exit toward the power supply −16 V test point when the print module is installed in the Recorder (wire lead routing is not shown correctly in Figs. 4-7 and 4-8).

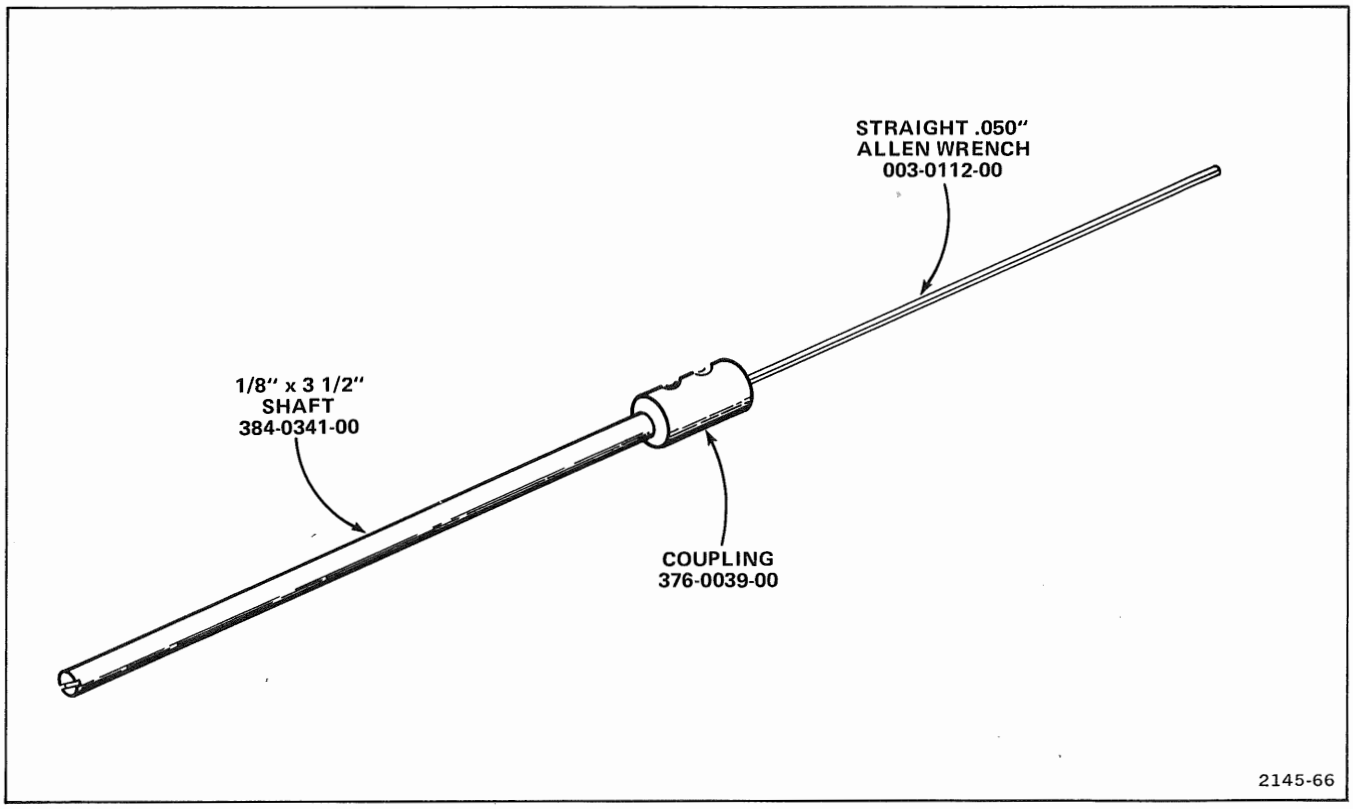

Figure 4-11. Stylus tension adjusting tool.

3. Install the three small screws and washers, moving the motor mounting bracket as required.

4. Tighten the drive belt as follows:

a. Reach into the print module and push the chart drive motor and its mounting bracket as far rearward as possible.

b. Tighten the three screws holding the motor assembly to the module frame.

c. Rotate the rubber chart drive roller by hand in both directions. If the belt slips one or more cogs, it is too loose.

5. Install the chart drive motor terminal connectors in the yellow P2034 holder. See Figure 4-2 and Table 4-4.

6. Replace the Recorder module in the Recorder frame. See Strip Chart Recorder Module heading in this section.

ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of any related circuits. Since the power supplies affect all circuits, adjustment of the entire instrument should be checked if component replacements have been made in these supplies. See Section 5, Calibration, for a complete Adjustment procedure.

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CALIBRATION

INTRODUCTION

Purpose

This procedure is useful for verifying recorder performance and making necessary adjustments. Since the calibration procedure is not intended as a troubleshooting guide, basic recorder operation should be checked before making adjustments. See Functional Check.

Calibration Interval

Recorder performance should be checked and adjustments made every 6 months. Partial or complete recalibration should be performed following some repairs.

Partial Adjustment

It is often desirable to make partial adjustments after replacing components or just to touch up the adjustment of a portion of the recorder between major performance checks.

Most adjustments can be made independently without affecting adjustment of other portions of the recorder. However, if you change the -11.9 Volt adjustment, you should check calibration of the entire recorder.

Test Equipment Required

Table 5-1 lists the test equipment and accessories required to completely recalibrate the Recorder. The specifications given for the test equipment are the minimum necessary for accurate calibration. All test equipment should be correctly calibrated and operating within their specifications.

FUNCTIONAL CHECK

The following procedure will check the basic operation of the 400 recorder. Any improper operation of the recorder should be corrected before making adjustments.

Set:

SPEED (50).....in (50)
SOURCE ECG
(except Std. Recorder)...in
AUTOMATIC SAMPLE
MODES.....Both pushbuttons in

2. Connect monitor to ac power line to help maintain battery charge.

TABLE 5-1

Test Equipment

Description	Minimum Specification	Usage	Examples of Applicable Test Equipment
1. Function Generator	Output, 1 Hz squarewave; Amplitude, 1 to 3 V (offset 0 to +1 V).	Chart speed, and pen amplifier gain, damping, and spike adjustments.	TEKTRONIX FG501 Function Generator.
2. Universal Counter	Measures periods and pulse length; Range, 1 s to 800 μs; Accuracy, within 1%.	Chart speed, 1165 Hz oscillator, run clock, alphanumeric dot intensity adjustments.	TEKTRONIX DC503 Universal Counter.
3. Digital Voltmeter	Resolution, 1 mV in 1130 mV dc; Accuracy, 0.05%. ± 1 count.	-11.9 V reference supply; pen amplifier gain, damping, and spike; DVM sign polarity, full scale gain, and zero offset adjustments.	
4. Temperature Simulation Plugs	Figure 5-2.	DVM calibration.	
5. Calibration Aid		Needed for 413 Monitor.	Tektronix Part 067-0851-00

3. Turn on monitor. Note time and check that recorder starts automatically in about 15 minutes.

In the meantime you can continue with the Functional Check; however keep in mind that if the recorder attempts to start automatically when the chart paper is moving, you will not know if this mode works or not. One suggestion is to stop the Functional Check after about ten minutes and wait for the recorder to start automatically.

4. Obtain display on monitor screen, using ECG LEAD CHECK signal. Use sweep speed of 50.

5. Press SAMPLE/MARK pushbutton and check that recorder produces an ECG LEAD CHECK waveform, one half the amplitude of that displayed on the monitor.

NOTE

Press the SAMPLE/MARK pushbutton as necessary to keep recorder running.

6. While chart is moving:

a. Set mm/SEC pushbutton out (25) and check that chart speed reduces to about one half.

b. Rotate ECG POSTION and check that waveform moves up and down on the paper.

c. Press SAMPLE/MARK pushbutton and check that a 1 minor division wide, 4 minor-division-high pulse is written on the waveform.

d. Slowly rotate STYLUS HEAT (rear panel) and check that waveform darkness varies from light to dark. Set for medium darkness.

e. Allow recorder to be off for 2 minutes, then press SAMPLE/MARK pushbutton and check that waveform starts being written within 5 major divisions.

f. Open paper carriage and check that recorder stops.

7. Remove paper roll, close carriage and check that LOW PAPER light goes on. Replace paper roll.

8. Rotate monitor LOW RATE LIMIT control clockwise to cause an alarm. Check that the recorder starts automatically.

Checks 8, 9, 10, and 11 are for Options 2, 3, and 4 only. See Table 2-1, Operating Information, Section 2 for alphanumerics printed by various monitor/recorder combinations. The table indicates which alphanumerics are eliminated when the corresponding probes or transducers are not connected to the monitor.

9. Connect pressure transducer(s) and temperature probe(s), or simulators, as appropriate to obtain alphanumeric printout.

10. Press SAMPLE/MARK pushbutton and check that alphanumeric printout appears at upper border of chart paper for each monitor parameter specified by Table 2-1.

11. Set the monitor rear-panel ° C/°F switch to °C, press SAMPLE/MARK pushbutton, and check that the alphanumeric printout reads temperature in ° C. Repeat with rear-panel switch in °F position.

12. Rotate the monitor LOW RATE LIMIT CONTROL clockwise to initiate an alarm. Check that the recorder alphanumeric printout indicates ALARM.

PRELIMINARY PROCEDURE FOR ADJUSTMENT

NOTE

The performance of the recorder can be checked at any ambient temperature from 0° to 50° C. Adjustments must be performed at an ambient temperature from +20° to 30°C.

1. Perform Functional Check above.

2. Turn monitor power off, and disconnect from ac power line.

3. Remove bottom cover from recorder. It is held with two screws on each side.

4. Separate recorder and monitor. Remove screws only from recorder side of adapter plates. Don't disconnect interconnecting cables unless instructed to do so by the note below.

NOTE

If the recorder being calibrated is connected to a 413 Neonatal Monitor Calibration Aid 067-0851-00 must be connected between the monitor and the interconnecting cable from the recorder. This Calibration Aid allows external signals to be connected to the recorder during calibration. (The 413 Monitor does not use the Manifold board required by other monitors.) At the conclusion of the Adjustment Procedure, remove the Calibration Aid before reassembling the recorder to the monitor.

5. Connect monitor to ac power line to help maintain battery charge. You should begin calibration procedure with fully charged batteries.

6. Set: SPEED .....in (50)
AUTOMATIC SAMPLE
MODES .....Both pushbuttons out

Refer to Fig. 7-21 (pullout pages) for

TEST POINT AND
ADJUSTMENT LOCATIONS

1. -11.9 VOLT REFERENCE SUPPLY

a. Connect test DVM leads between -11.9 test point and ground (power supply shield).

b. Press SAMPLE/MARK pushbutton to start recorder.

NOTE

Press the SAMPLE/MARK pushbutton as necessary to keep recorder running.

c. **CHECK**—Digital voltmeter reads -11.9 within 35 mV.

d. **ADJUST**—R2095 (-11.9 V) for -11.9 V.

2. 50 mm/SEC CHART SPEED

a. Apply a 3.0 volt peak-to-peak 1 Hz square-wave signal from the Function Generator as follows. See Figure 5-1 for locations of signal inputs.

(1) 408, 412, or 414 Monitor with Standard Recorder:
Unplug the yellow and green connectors (P2414 and P2415) from the Manifold board in the monitor. Connect the function generator output to -ECG Wave input, (P2415-1), and the function generator common to Wave Common input (P2415-3).

(2) 408, 412, or 414 Monitor with Option 1, 2, 3, or 4 Recorder: Unplug the green connector (P2415) from the Manifold board in the monitor. Connect the function generator output to A/V Wave input (P2415-1), and the function generator common to Wave Common input (P2415-3). Press the recorder A/V pushbutton.

(3) 413 with Standard Recorder:
Unplug the -ECG Wave jumper connector from the 500 Recorder Calibration Aid. Connect the function generator output to -ECG Wave (to Recorder) input, and the function generator common to Wave Common input.

(4) 413 Monitor with Option 1, 2, 3, or 4 Recorder: Unplug the A/V Wave jumper connector from the 400 Recorder Calibration Aid. Connect the function generator output to A/V Wave (to Recorder) input, and the function generator common to Wave Common input. Press the recorder A/V-PULSE or A/V pushbutton.

b. Press SAMPLE/MARK pushbutton to start recorder.

c. **CHECK**—One complete square wave period occurs every 10 major divisions (5 cm) within 0.5 minor divisions.

d. **ADJUST**—R2014 (50 mm) for one complete square wave per 10 major divisions.

3. 25 mm/SEC CHART SPEED

a. Set SPEED pushbutton out (25).

b. Press SAMPLE/MARK pushbutton to start recorder.

c. **CHECK**—One complete square wave occurs every 5 major divisions (2.5 cm) within 0.5 minor divisions.

d. **ADJUST**—R2012 (25 mm) for one complete square wave per 5 major divisions.

4. PEN AMPLIFIER GAIN (STANDARD RECORDERS)

a. Press SAMPLE/MARK button to start recorder.

b. Center written square wave on grid with ECG POSITION control (function generator Offset control may require adjustment).

c. **CHECK**—Peak-to-peak amplitude of written square wave is 6 major divisions (3 cm) within 1.5 minor division. Ignore overshoot or undershoot.

d. **ADJUST**—R375 (Gain) for an amplitude of 6 major divisions.

5. PEN AMPLIFIER GAIN (OPTION 1, 2, 3, 4 RECORDERS)

a. Press SAMPLE/MARK button to start recorder.

b. Center written square wave on grid with function generator offset control.

c. **CHECK**—Peak-to-peak amplitude of written square wave is 6 major divisions (3 cm) within 1.5 minor divisions. Ignore overshoot or undershoot.

d. **ADJUST**—R375 (Gain) for an amplitude of 6 major divisions.

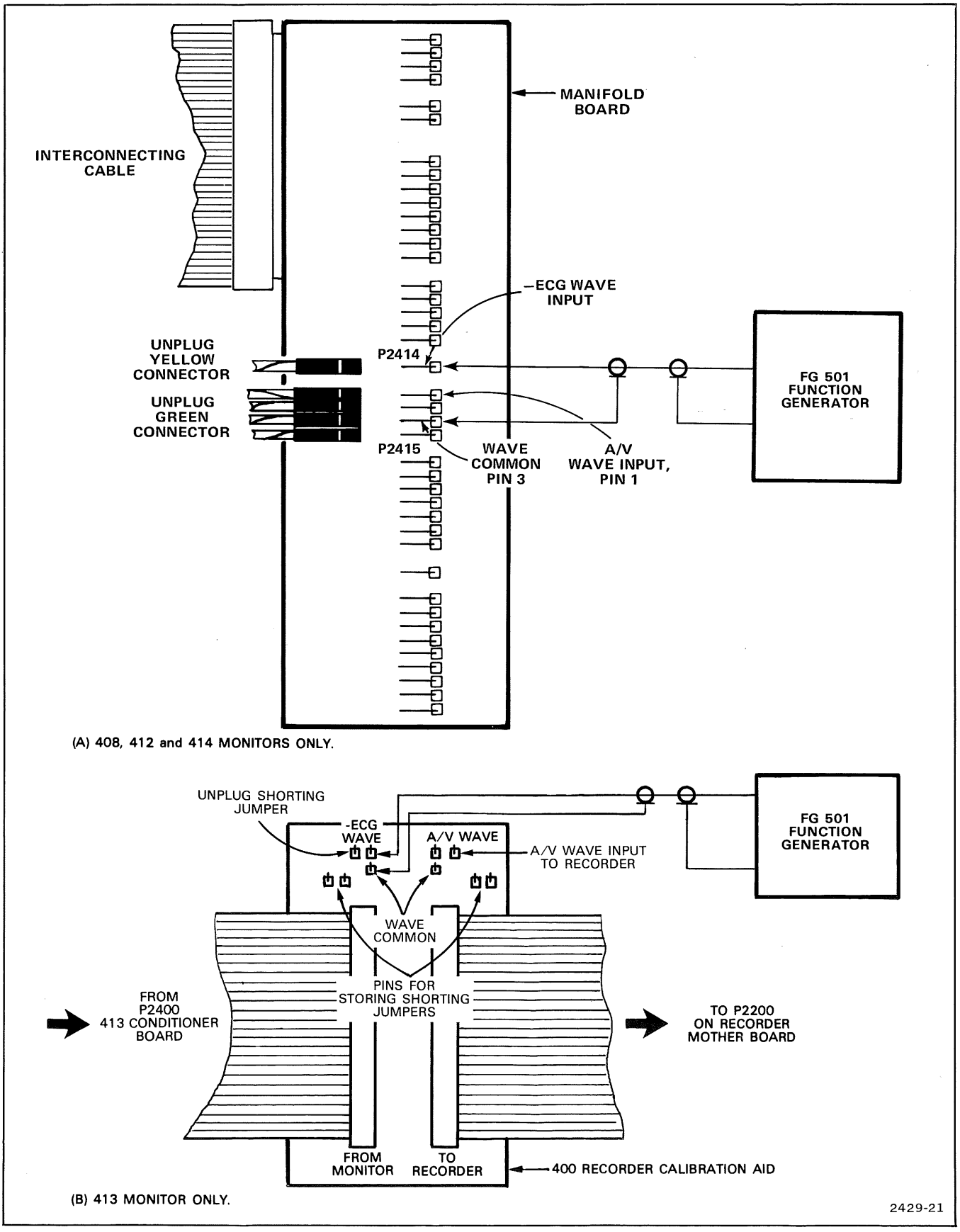


Figure 5-1. Connecting square wave to -ECG wave input.

6. PRESSURE ZERO POSITION (OPTION 1, 2, 3, AND 4 RECORDERS)

a. Press the monitor 250 PRESSURE/PULSE pushbutton.

b. Short together A/V Wave (P2415-1) to Wave Common (P2415-3) on Manifold board or on Calibration Aid. See Figure 5-1.

c. Press SAMPLE/MARK pushbutton.

d. **CHECK**—Zero reference line is written 1 major division up from bottom grid line, within 0.5 minor division.

e. **ADJUST**—R352 (Pressure Zero Position) so that zero reference line is written 1 major division up from bottom grid line.

f. Remove short.

g. Recheck Step 5, Pen Amplifier Gain. Interaction occurs between steps 5 and 6.

7. PEN AMPLIFIER DAMPING AND SPIKE

a. Reduce input signal to about 1 volt peak-to-peak.

b. Press SAMPLE/MARK pushbutton.

c. Center written square wave on grid with function generator offset control.

d. **CHECK**—Written square wave has flat top.

e. **ADJUST**—(Damping) for flat-top square wave.

f. **CHECK**—Written waveform has no overshoot or undershoot.

g. **ADJUST**—R365 (Spike) for no overshoot or undershoot on waveform.

h. **INTERACTION**—Occurs between Damping and Spike adjustments. Repeat Steps d through g as necessary.

i. Disconnect test equipment. Reconnect yellow and green connectors to P2414 and P2415 on Manifold board. (If using Calibration aid, replace shorting jumpers.)

8. 1165 HZ OSCILLATOR

a. Connect universal counter input to TP134 and ground lead to the recorder-module frame.

b. **CHECK**—Waveform period is 858 μs, within 30 μs.

c. **ADJUST**—R134 (1165 Hz Oscillator) for a period of 858 μs.

9. RUN CLOCK

a. Connect universal counter to TP178.

b. **CHECK**—Waveform period if 437.5 ms, within 30 ms.

c. **ADJUST**—R176 for a period of 437.5 ms.

For Standard and Option 1 Recorders, skip to Step 16.

OPTION 2, 3, AND 4 RECORDER ADJUSTMENTS

10. 25 mm/SEC DOT INTENSITY

a. Connect a universal counter to TP1830 on Print Drive board.

b. Set SPEED pushbutton out (25 mm/sec).

c. Press SAMPLE/MARK pushbutton.

d. **CHECK**—Positive-going pulse duration is 8 ms, within 0.2 ms.

e. **ADJUST**—R1810 (25 mm intensity) fully counterclockwise then clockwise for a positive-going pulse of 8 ms.

CAUTION

Do not increase the dot-on time greater than 8 ms. Exceeding this value increases the print head temperature resulting in a substantial reduction in print head life.

11. 50 mm/SEC DOT INTENSITY

a. Press SPEED pushbutton in (50 mm/sec).

b. Press SAMPLE/MARK pushbutton.

c. **CHECK**—Positive-going pulse duration is 7.6 ms +0.1-0.2 ms.

d. **ADJUST**—R1815 (50 mm intensity) fully counterclockwise then clockwise for a positive-going pulse of 7.6 ms duration.

e. Set SPEED pushbutton out (25).

12. DVM SIGN POLARITY

a. Connect test DVM input to TP845 and common to P830 pin 3 on the DVM Analog board. (Pin 3 is towards the front of the recorder.)

b. Move P830 jumper connector from pins 1 & 2 to pins 2 & 3. Note that the test DVM common lead is also connected to pin 3.

c. Press the SAMPLE/MARK pushbutton.

d. **CHECK**—For negative voltage.

e. **ADJUST**—R845 (Sign) so that the voltage at TP845 just changes from positive to negative.

f. Replace P830 jumper connector on pins 1 & 2.

13. DVM FULL SCALE GAIN

a. Connect a 113°F/45°C temperature simulation plug, as described in Figure 5-2, to the monitor TEMPERATURE SENSOR INPUT jack (input A on monitors with multiple temperature capability).

b. Place the monitor °/C°F switch in the °F position.

c. Connect the test DVM input to the TEMP A signal in the monitor/recorder interconnecting ribbon cable, at P2200 pin 9. The test DVM common remains on DVM GND at P830 pin 3.

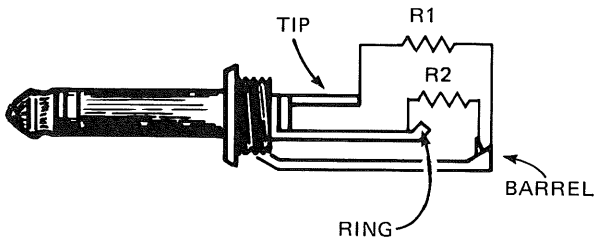
d. Press SAMPLE/MARK pushbutton.

e. **CHECK**—-Tape TEMP A printout reads same value as digital voltmeter within 0.1 degree according to this relationship: 0.1 degree C or F corresponds to 1 mV input to the DVM. For example, if the digital voltmeter indicates 1131 mV, the printout must be in the range 113.0 degrees to 113.2 degrees.

f. **ADJUST**—R306 (Full Scale) so tape readout is within 0.1° of the test DVM readout.

NOTE

It is necessary to understand the accuracy of the digital voltmeter you are using. For example, if its specified accuracy is .1% ±2 counts, then a reading of 1131 mV can ben in error up to about ±2 counts. This error is not acceptable.



°F	°C	R_1 (Ω)	R_2 (Ω)
23	–5	25.40 K	122.1 K
41	5	15.24 K	74.44 K
77	25	6000	30.00 K
113	45	2620	13.28 K
98.6		3610	18.21 K

NOTES:

1. RESISTORS USED FOR THESE PLUGS SHOULD HAVE VALUES WITHIN 0.1% AND HAVE LOW TEMPERATURE COEFFICIENTS.
2. ANY SERIES OR PARALLEL COMBINATION OF QUALITY RESISTORS CAN BE USED TO PRODUCE VALUES OF R1 AND R2.
3. 98.6°F/37°C IS NOT NEEDED FOR ADJUSTMENT PROCEDURE; IT IS GIVEN FOR REFERENCE ONLY.

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Figure 5-2. Temperature Simulation Plugs.

14. DVM ZERO OFFSET

a. Move the P830 jumper connector to pins 2 & 3.

b. Press SAMPLE/MARK pushbutton.

c. **CHECK**—Tape TEMP A printout reads 0.0°F.

d. **ADJUST**—R815 (zero) counterclockwise, until numbers other than zero appear in the TEMP A printout.

e. **ADJUST**—R815 clockwise until 0.0°F just appears in the TEMP A printout. Do not adjust R815 past the setting where 0.0 first appears.

f. **INTERACTION**—Repeat steps 12f and 13d as needed to null out interaction between the DVM Full Scale Gain and Zero Offset adjustments.

Check recorder response to a DVM negative input.

@

g. Replace the 113°F/-5°C plug.

h. Place the monitor °C/°F switch in the °C position.

i. Move the P830 jumper connector to pins 1 & 2.

j. Press SAMPLE/MARK pushbutton.

k. **CHECK**—Tape TEMP A readout corresponds to digital voltmeter reading within 0.2°C. For example, if the digital voltmeter indicates -52 mV, the printout must be in the range -5.0°C to -5.4°C.

l. Remove test DVM leads.

15. CHECK CORRESPONDENCE BETWEEN MONITOR AND RECORDER DVM'S.

The same values should be indicated by the monitor's digital readout, the recorder's printout, and any other digital outputs in the system (such as a Digital Readout Module). Output correspondence is achieved by calibrating in this order: First, calibrate monitor input channels to place standardized signals on the interconnecting ribbon cable. Then, calibrate each DVM to accurately convert and display the standardized signals.

Readout correspondence can be quickly verified as follows:

a. At the monitor's digital readout, depress the TEMP or TEMPERATURE A button.

b. Replace the monitor's temperature simulation plug with a 41°F/5°C temperature simulation plug.

c. Press SAMPLE/MARK pushbutton.

d. Record the values indicated by the monitor digital readout and the recorder tape TEMP A printout.

e. Place the monitor's °C/°F switch in the °F position.

f. Replace the monitor's temperature simulation plug with a 113°F/ 45°C temperature simulation plug.

g. Press SAMPLE/MARK pushbutton.

h. Record the values indicated by the monitor digital readout and the recorder tape TEMP A printout.

i. The difference between the monitor and recorder temperature outputs must not exceed 0.5°. For operator confidence, the difference should be 0.4° or less. If the difference exceeds 0.5° C, the monitor temperature channel, monitor DVM, or recorder DVM are not properly calibrated.

16. REASSEMBLE RECORDER AND MONITOR

a. Turn monitor power off, and disconnect from ac power line.

b. Mount recorder to monitor. Be sure to fold interconnecting cable correctly. See illustration on top of recorder.

c. Install recorder bottom cover.

d. Remove temperature simulation plug from monitor.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000AV	GENERAL SCANNING	150 COOLIDGE AVENUE	WATERTOWN, MA 02172
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORPORATION	3600 SUNSET AVENUE	WAUKEGAN, IL 60085
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	P.O. BOX 600,600 W. JOHN ST.	HICKSVILLE, NY 11802
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50558	ELECTRONIC CONCEPTS, INC.	526 INDUSTRIAL WAY WEST	EATONTOWN, NJ 07724
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75378	CTS KNIGHTS, INC.	400 REIMANN AVE.	SANDWICH, IL 60548
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
87034	ILLUMINATED PRODUCTS INC., A SUB OF OAK INDUSTRIES, INC.	2620 SUSAN ST, PO BOX 11930	SANTA ANA, CA 92711
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET P O BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1[1]	670-4708-00			CKT BOARD ASSY:MOTHER	80009	670-4708-00
A1[2]	670-4709-00			CKT BOARD ASSY:MOTHER	80009	670-4709-00
A2	670-4692-01			CKT BOARD ASSY:RUN CONTROL	80009	670-4692-01
A3	670-4694-00			CKT BOARD ASSY:PEN AMPLIFIER	80009	670-4694-00
A4	670-5354-00			CKT BOARD ASSY:POWER SUPPLY	80009	670-5354-00
A5[3]	670-5333-00			CKT BOARD ASSY:SOURCE SWITCH	80009	670-5333-00
A5[4]	670-4710-00			CKT BOARD ASSY:SOURCE SWITCH	80009	670-4710-00
A5[5]	670-4711-00			CKT BOARD ASSY:SOURCE SWITCH	80009	670-4711-00
A6	670-4712-00			CKT BOARD ASSY:SAMPLE/MARK/SPEED SWITCH	80009	670-4712-00
A7[6]	670-4754-00			CKT BOARD ASSY:MANIFOLD	80009	670-4754-00
A8[7]	670-4696-00			CKT BOARD ASSY:A/V BUFFER	80009	670-4696-00
A9[5]	670-4695-00			CKT BOARD ASSY:A/V CONDITIONER	80009	670-4695-00
A10[5]	670-4697-00			CKT BOARD ASSY: A CONDITIONER/MULTIPLEXER	80009	670-4697-00
A11[2]	670-4698-00			CKT BOARD ASSY:DVM ANALOG	80009	670-4698-00
A12[2]	670-4699-00			CKT BOARD ASSY:DVM DIGITAL	80009	670-4699-00
A13[2]	670-4701-00			CKT BOARD ASSY:PRINT CONTROL 1	80009	670-4701-00
A14[2]	670-4703-00			CKT BOARD ASSY:PRINT CONTROL 2	80009	670-4703-00
A15[2]	670-4706-01			CKT BOARD ASSY:PRINT DRIVE	80009	670-4706-01
B389A	119-0963-01			GALVANOMETER:12V,W/CONNECTORS	80009	119-0963-01
B2034	147-0049-00			MOTOR,DC:5600 RPM,15V,W/CLIPS	80009	147-0049-00
C113	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C116	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C118	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C125	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
C132	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	72982	801-547B821J
C142	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C158	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C168	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C176	285-1130-00			CAP.,FXD,PLSTC:0.22UF,1%,100V	50558	ECT 285-1130-00
C190	283-0065-01			CAP.,FXD,CER DI:0.001UF,5%,100V	80009	283-0065-01
C197	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C332	283-0330-00			CAP.,FXD,CER DI:100PF,5%,50V	72982	8111N068C0G0101J
C335	283-0330-00			CAP.,FXD,CER DI:100PF,5%,50V	72982	8111N068C0G0101J
C338	285-0882-00			CAP.,FXD,PLSTC:0.047UF,10%,100V	56289	LP66A1B473K001
C385	283-0164-00			CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C386	283-0164-00			CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C387	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C388	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C390	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C391	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C395	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C396	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C401[6]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C402[6]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C412[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C414[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C416[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C417[6]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C420[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C425[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C432[6]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3

[1]Standard and Option 1.
[2]Option 2,3 and 4.
[3]Option 4 only.
[4]Option 1,2 and 4.
[5]Option 3 only.
[6]Part of 016-0498-00.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C434[1]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C436[1]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C437[1]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C440[1]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C446[1]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C447[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C450[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C451[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C701[2]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C702[2]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C722[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C724[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C725[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C727[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C730[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C735[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C742[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C744[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C745[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C747[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C750[2]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C756[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C757[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C760[2]	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C761[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C769[2]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C809[3]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C853[3]	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C856[3]	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C863[3]	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C871[3]	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C903[3]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C913[3]	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C921[3]	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C940[3]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C941[3]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C942[3]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1004[3]	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C1022[3]	283-0635-00			CAP.,FXD,MICA D:51PF,1%,100V	00853	D151E510F0
C1079[3]	283-0599-00			CAP.,FXD,MICA D:98PF,5%,500V	00853	D105E980J0
C1091[3]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1408[3]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1420[3]	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C1421[3]	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C1433[3]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1434[3]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1653[3]	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	72982	855-558-Z5V0203Z
C1654[3]	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C1673[3]	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C1674[3]	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C1691[3]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1692[3]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1817[3]	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8131N127X7R0473K

[1]Part of 016-0498-00.
[2]Option 3 only.
[3]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1819[1]	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C1828[1]	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C1830[1]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C1836[1]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C1838[1]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1894[1]	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C1896[1]	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C1949[1]	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C2006	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C2007	283-0164-00			CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C2013	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C2017	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C2020	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	855-558Z5U-103Z
C2025	285-0808-00			CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
C2027	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2032	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2040	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2050	290-0718-00			CAP.,FXD,ELCTLT:22UF,20%,35V	56289	196D226X0035PE3
C2052	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2057	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2058						
C2064	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2078	290-0726-00			CAP.,FXD,ELCTLT:220UF,20%,10V	56289	196D227X0010TE3
C2089	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C2092	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2093	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2096	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2097	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2099	290-0719-00			CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C2125	283-0330-00			CAP.,FXD,CER DI:100PF,5%,50V	72982	8111N068C0G0101J
C2136	283-0164-00			CAP.,FXD,CER DI:2.2UF,20%,25V	72982	8141N037Z5U0225M
C2140	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C2142	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C2145	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C2146	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C2147	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C2157	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2165	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C2168	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2170	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C2175	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2182	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2187	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C2189	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C2191	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
CR115	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR124	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR170	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR173	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR190	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR192	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR345	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

[1]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR421[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR427[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR442[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR443[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR463[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR468[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR483[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR485[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR612[2]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR613[2]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR617[2]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR618[2]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR623[2]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR712[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR713[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR716[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR731[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR737[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR752[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR753[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR773[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR778[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR807[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR819[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR839[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR871[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR873[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR874[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR877[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR878[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR913[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR921[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR931[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR932[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1063[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1094[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1409[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1633[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1823[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1824[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1829[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1913[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1914[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1916[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1917[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1918[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1919[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1921[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1922[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1923[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1924[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1932[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1933[3]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

[1]Option 3 only.
[2]Option 2 and 4 only.
[3]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR1934[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1935[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1936[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1937[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1938[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR1939[1]	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2012	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2025	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2026	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2033	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR2049	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2051	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2056	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR2065	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2140	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR2141	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR2142	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR2143	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J
CR2145	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115A
CR2146	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115A
CR2147	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115A
CR2148	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115A
CR2151	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2160	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2161	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2176	152-0581-00			SEMICOND DEVICE:SILICON,20V,1A	04713	1N5817
CR2182	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2183	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2184	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR2185	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
DS395	150-1031-00			LAMP,LED:RED,20V	53184	XC209R
DS1837[1]	150-0077-00			LAMP,INCAND:14VDC,0.08A	08806	2282D
DS2019	150-1031-00			LAMP,LED:RED,20V	53184	XC209R
DS2157	150-0093-01			LAMP,INCAND:5V,0.06A,0.05MSCP,SEL	87034	9AS15
F1839[1]	159-0114-00			FUSE,CARTRIDGE:1A,125VAC,FAST-BLOW	71400	GFA 1
HR2058[2]						
J104	131-1862-00			JACK,TELEPHONE:	82389	112B
L2034[2]						
L389B[2]						
Q115	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q124	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q140	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q164	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q169	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q188	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q196	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q214	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q332	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q335	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q344	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906

[1]Option 2,3 and 4.
[2]Furnished as a unit with 119-0854-02.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q346	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q356	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q358	151-1066-00			TRANSISTOR:SILICON,FE,P-CHANNEL	80009	151-1066-00
Q372	151-0324-00			TRANSISTOR:SILICON,PNP	80009	151-0324-00
Q378	151-0323-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE521	80009	151-0323-00
Q616[1]	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1078-00
Q620[1]	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q625[1]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q715[2]	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q718[2]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q803[2]	151-1103-00			TRANSISTOR:SILICON,FE,N-CHANNEL	18324	SD210
Q1046[3]	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1633[3]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1805[3]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1810[3]	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1815[3]	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q1833[3]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q1837[3]	151-0435-00			TRANSISTOR:SILICON,PNP	04713	MPS-A65
Q1839[3]	151-0324-00			TRANSISTOR:SILICON,PNP	80009	151-0324-00
Q1852[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1853[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1854[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1855[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1856[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1857[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1858[3]	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q1945[3]	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2009	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2011	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2020	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2029	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2031	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2040	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2046	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2047	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2054	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2056	151-0390-00			TRANSISTOR:SILICON,NPN	80009	151-0390-00
Q2058	151-0324-00			TRANSISTOR:SILICON,PNP	80009	151-0324-00
Q2076	151-0324-00			TRANSISTOR:SILICON,PNP	80009	151-0324-00
Q2085	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2088	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2096	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2098	151-0323-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE521	80009	151-0323-00
Q2122	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2126	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2132	151-0621-00			TRANSISTOR:SILICON,NPN	03508	D44H3
Q2134	151-0621-00			TRANSISTOR:SILICON,NPN	03508	D44H3
Q2154	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2156	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2158	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2166	151-0224-00			TRANSISTOR:SILICON,NPN	07263	2N3904
Q2172	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q2175	151-0323-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE521	80009	151-0323-00

[1]Option 2 and 4 only.
[2]Option 3 only.
[3]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R112	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R113	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R115	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R116	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R118	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R120	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R122	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R125	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R127	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R130	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R132	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	01121	CB3945
R134	311-1242-00			RES.,VAR,NONWIR:200K OHM,10%,0.50W	32997	3386X-T07-204
R137	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R138	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R140	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R142	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R144	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R162	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R163	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R165	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R166	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R167	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R168	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R169	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R172	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R174	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R176	311-1247-00			RES.,VAR,NONWIR:1M OHM,10%,0.5OW	73138	72X-35-0-105K
R177	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R180	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R182	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R185	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R186	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R188	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R189	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R190	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R192	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R194	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R195	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R197	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R202	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R205	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R208	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R210	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R300	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	01121	CB3945
R320	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R322	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R324	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R325	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R327	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R328	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R329	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R330	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R331	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R332	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R335	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	MFF1816G24301F
R336	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R338	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R339	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R340	311-1428-00			RES.,VAR,NONWIR:20K OHM,1W	01121	10M959
R342	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R343	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R345	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R346	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R347	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R350	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R352	311-1563-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91A R1K
R353	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R355	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R356	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R357	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R358	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R361	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R362	315-0434-00			RES.,FXD,CMPSN:430K OHM,5%,0.25W	01121	CB4345
R364	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R365	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R366	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R367	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R370	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R374	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R375	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91A-10001M
R376	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R380	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R381	308-0767-00			RES.,FXD,WW:1.1 OHM,5%,1W	75042	BW20-1R100J
R383	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R384	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R385	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R388	301-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.50W	01121	EB3315
R393	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R415[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R417[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R418[1]	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R420[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R423[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R425[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R428[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R438[1]	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R440[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R442[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R444[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R446[1]	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R447[1]	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R449[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R450[1]	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R451[1]	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R453[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R460[1]	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325

[1]Option 3 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R461[1]	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R463[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R465[1]	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R466[1]	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R468[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R473[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R478[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R480[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R483[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R486[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R610[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R612[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R614[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R615[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R616[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R617[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R618[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R622[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R624[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R630[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R632[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R635[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R640[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R642[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R645[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R650[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R652[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R655[2]	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R710[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R712[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R714[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R716[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R717[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R725[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R727[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R728[1]	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R730[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R733[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R735[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R738[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R745[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R747[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R748[1]	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R750[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R752[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R754[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R756[1]	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R757[1]	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R759[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R760[1]	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R761[1]	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R763[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R769[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

[1]Option 3 only.
[2]Option 2 and 4 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R770[1]	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R771[1]	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R773[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R775[1]	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R776[1]	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R778[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R802[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R803[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R806[2]	311-1319-00			RES.,VAR,NONWIR:10K OHM,10%,0.75W	01121	4SP103
R811[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R812[2]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R815[2]	311-1319-00			RES.,VAR,NONWIR:10K OHM,10%,0.75W	01121	4SP103
R821[2]	321-1289-07			RES.,FXD,FILM:10.1K OHM,0.1%,0.125W	91637	MFF1816C10101B
R822[2]	321-0763-07			RES.,FXD,FILM:1.12K OHM,0.1%,0.125W	91637	MFF1816C11200B
R823[2]	321-1289-07			RES.,FXD,FILM:10.1K OHM,0.1%,0.125W	91637	MFF1816C10101B
R824[2]	321-0763-07			RES.,FXD,FILM:1.12K OHM,0.1%,0.125W	91637	MFF1816C11200B
R825[2]	321-1289-07			RES.,FXD,FILM:10.1K OHM,0.1%,0.125W	91637	MFF1816C10101B
R826[2]	321-0763-07			RES.,FXD,FILM:1.12K OHM,0.1%,0.125W	91637	MFF1816C11200B
R827[2]	321-1289-07			RES.,FXD,FILM:10.1K OHM,0.1%,0.125W	91637	MFF1816C10101B
R828[2]	321-0763-07			RES.,FXD,FILM:1.12K OHM,0.1%,0.125W	91637	MFF1816C11200B
R830[2]	321-1289-07			RES.,FXD,FILM:10.1K OHM,0.1%,0.125W	91637	MFF1816C10101B
R831[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R832[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R833[2]	321-0763-07			RES.,FXD,FILM:1.12K OHM,0.1%,0.125W	91637	MFF1816C11200B
R834[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R835[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R836[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R837[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R838[2]	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R842[2]	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R844[2]	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R845[2]	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72-18-0
R847[2]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R854[2]	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R857[2]	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R859[2]	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R862[2]	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R866[2]	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R867[2]	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R868[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R873[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R877[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R902[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R904[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R912[2]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R913[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R921[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R922[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R929[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R934[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1003[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1004[2]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1006[2]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055

[1]Option 3 only.
[2]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1007[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1022[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1033[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1041[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1046[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1047[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1048[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1051[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1052[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1053[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1054[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1061[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1062[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1063[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1064[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1076[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1079[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1091[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1092[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1096[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1406[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1408[1]	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R1409[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1417[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1418[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1420[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1421[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1452[1]	307-0445-00			RES,NTWK,FXD,FI:4.7K OHM,20%,C9) RES	03888	A3HT07
R1487[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1488[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1489[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1606[1]	307-0549-00			RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	CSP08G01105J
R1617[1]	307-0549-00			RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	CSP08G01105J
R1618[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1619[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1622[1]	307-0445-00			RES,NTWK,FXD,FI:4.7K OHM,20%,C9) RES	03888	A3HT07
R1633[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1634[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1653[1]	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R1654[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1664[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1671[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1673[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1674[1]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1803[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1804[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1805[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1809[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1810[1]	311-1242-00			RES.,VAR,NONWIR:200K OHM,10%,0.50W	32997	3386X-T07-204
R1814[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1815[1]	311-1241-00			RES.,VAR,NONWIR:100K OHM,10%,0.5W	32997	3386X-T07-104
R1817[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1823[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

[1]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1824[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1828[1]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1829[1]	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R1833[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1834[1]	321-0225-00			RES.,FXD,FILM:2.15K OHM,1%,0.125W	91637	MFF1816G21500F
R1836[1]	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1837[1]	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1844[1]	307-0549-00			RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	CSP08G01105J
R1852[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1853[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1854[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1855[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1856[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1857[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1858[1]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1894[1]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1896[1]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1913[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1914[1]	307-0549-00			RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	CSP08G01105J
R1916[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1918[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1921[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1923[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1926[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1927[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1928[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1929[1]	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1931[1]	307-0549-00			RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	CSP08G01105J
R1932[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1934[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1936[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1938[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1943[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1944[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1946[1]	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2002	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2004	311-1241-00			RES.,VAR,NONWIR:100K OHM,10%,0.5W	32997	3386X-T07-104
R2005	311-1240-00			RES.,VAR,NONWIR:25K OHM,10%,0.50W	73138	72X-30-0-253K
R2006	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R2007	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2008	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R2009	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2010	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2011	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R2012	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2013	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2014	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2015	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R2016	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2017	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2019	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2020	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R2021	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

[1]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2022	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2023	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2024	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R2025	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R2026	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2027	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2028	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2029	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2030	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2031	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2032	308-0793-00			RES.,FXD,WW:0.51 OHM,5%,0.50W	75042	BW20-R5100J
R2033	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2034	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R2035	311-1476-00			RES.,VAR,NONWIR:10K OHM,20%,1W	01121	11M085
R2036	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2037	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2042	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2043	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2044	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2048	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2049	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2051	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R2052	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2055	307-0093-00			RES.,FXD,FILM:90.0 OHM,1%,0.125W	91637	MFF1816G90R90F
R2056	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R2057	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R2060	321-0138-00			RES.,FXD,FILM:267 OHM,1%,0.125W	91637	MFF1816G267R0F
R2062	321-1313-08			RES.,FXD,FILM:18K OHM,1%,0.125W	91637	MFF1816D18001F
R2064	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2065	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2067	321-0631-03			RES.,FXD,FILM:12.5K OHM,0.25W,0.125W	91637	MFF1816D12501C
R2068	321-0778-03			RES.,FXD,FILM:5.148K OHM,0.25%,0.125W	91637	MFF1816D51480C
R2070	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R2071	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2073	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2074	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2075	308-0793-00			RES.,FXD,WW:0.51 OHM,5%,0.50W	75042	BW20-R5100J
R2080	321-0780-03			RES.,FXD,FILM:18.96K OHM,0.25%,0.125W	91637	MFF1816D18961C
R2081	321-1330-03			RES.,FXD,FILM:27.1K OHM,0.25%,0.125W	91637	MFF1816D27101C
R2082	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2084	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R2086	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R2090	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R2091	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R2092	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R2094	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R2095	311-1237-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3386X-T07-102
R2096	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R2097	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2098	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2120	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2121	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2124	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2125	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2128	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2151	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R2153	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2159	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2162	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2164	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2165	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2168	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2170	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2172	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R2174	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2175	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2180	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R2182	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2187	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2189	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
S105[1]	260-1864-00			SWITCH,PUSH:2 POLE,2 BTN	71590	2KBM020000-10-40
S110A,B S200[1]	260-1863-00			SWITCH,PUSH:2 POLE,2 BTN	71590	2KBB020000-10
S310[2]	260-1861-00			SWITCH,PUSH:2 POLE,2 BTN	71590	OBD
S310[2,3]	260-1862-00			SWITCH,PUSH:2 POLE,3 BTN	71590	OBD
S394	118-0180-00			SWITCH,SENS:SPDT,10A,125/250VAC	000AV	5107-3101
S590	260-1517-00			SWITCH,PUSH:SPDT,5A,125VAC	01963	E61-50H
S2190	260-1518-00			SWITCH,PUSH:DPDT,5A,125VAC,MONENTARY	80009	260-1518-00
T2130	120-1078-00			TRANSFORMER,RF:TOROID,2 WINDINGS,BIFILAR	80009	120-1078-00
T2135	120-1079-00			XFMR,ASSEMBLY:TOROID,2 WINDINGS	80009	120-1079-00
T2138 T2180[4]	120-1077-00			XFMR,CONVERTER:POT CORE	80009	120-1077-00
U118	156-0750-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	80009	156-0750-00
U125	156-0494-00			MICROCIRCUIT,DI:HEX INVERTER/BUFFER	80009	156-0494-00
U126	156-0575-00			MICROCIRCUIT,DI:3 INPUT NOR GATE	80009	156-0575-00
U130	156-0864-00			MICROCIRCUIT,DI:3 STAGE FREQ DIVIDER	04713	MC14521CP
U138	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U140	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U145	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U150	156-0575-00			MICROCIRCUIT,DI:3 INPUT NOR GATE	80009	156-0575-00
U152	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U156	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-00
U180	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U322	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U330	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U366	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U410[5]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U412[5]	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BL
U415[5]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U420[5]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U444[5]	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U448[5]	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U450[5]	156-0515-00			MICROCIRCUIT,DI:TRIPLE 3-CHAN MUX	80009	156-0515-00
U451[5]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U460[5]	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00

[1]S105 and S200 furnished as a unit.
[2]Option 2 only.
[3]Option 3 and 4.
[4]Furnished as a unit with T2135.
[5]Option 3 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U490[1]	156-0547-00			MICROCIRCUIT,DI:QUAD TOW-INPUT MULTIPLEXER	80009	156-0547-00
U610[2]	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-00
U634[2]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U720[1]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U722[1]	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BL
U725[1]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U730[1]	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U754[1]	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U758[1]	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U770[1]	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U810[3]	156-0751-00			MICROCIRCUIT,LI:ADC SUBSYSTEM	04713	MC1405L
U830[3]	156-0513-00			MICROCIRCUIT,DI:8-CHAN MUX	80009	156-0513-00
U845[3]	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U847[3]	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-00
U849[3]	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BL
U853[3]	156-0512-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM308N
U856[3]	156-0512-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM308N
U861[3]	156-0512-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM308N
U869[3]	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U906[3]	156-0895-00			MICROCIRCUIT,DI:14-BIT BINARYCOUNTER	80009	156-0895-00
U907[3]	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U909[3]	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U924[3]	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-00
U1012[3]	156-0349-01			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0349-01
U1015[3]	156-0896-00			MICROCIRCUIT,DI:3-DIGIT BCD COUNTER	80009	156-0896-00
U1019[3]	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U1021[3]	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U1035[3]	156-0897-00			MICROCIRCUIT,DI:DUAL 4-BIT LATCH	80009	156-0897-00
U1042[3]	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U1065[3]	156-0749-00			MICROCIRCUIT,DI:3.5 DIGIT A/DLOGIC SS	04713	MC14435
U1075[3]	156-0514-00			MICROCIRCUIT,DI:DIFF 4-CHAN MUX	80009	156-0514-00
U1077[3]	156-0767-00			MICROCIRCUIT,DI:HEX GATE	04713	MC14572CL
U1081[3]	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U1091[3]	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U1410[3]	156-0524-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATES	02735	CD4023AE
U1420[3]	156-0750-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	80009	156-0750-00
U1425[3]	156-0898-00			MICROCIRCUIT,DI:DUAL BIN TO 1-OF 4 DCDR	80009	156-0898-00
U1427[3]	156-0767-00			MICROCIRCUIT,DI:HEX GATE	04713	MC14572CL
U1440[3]	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U1450[3]	156-0305-21			MICROCIRCUIT,DI:ROM U1450 PROGRAMMED	80009	156-0305-21
U1460[3]	156-0305-20			MICROCIRCUIT,DI:ROM U1460 PROGRAMMED	80009	156-0305-20
U1480[3]	156-0682-00			MICROCIRCUIT,DI:HEX D FLIP-FLOP	80009	156-0682-00
U1490[3]	156-0869-00			MICROCIRCUIT,DI:8 CHANNEL DGTL MUXER	80009	156-0869-00
U1610[3]	156-0547-00			MICROCIRCUIT,DI:QUAD TOW-INPUT MULTIPLEXER	80009	156-0547-00
U1620[3]	156-0627-00			MICROCIRCUIT,DI:SYN 4-B,UP-DOWN BINARY CTR	80009	156-0627-00
U1621[3]	156-0305-18			MICROCIRCUIT,DI:ROM U1621 PROGRAMMED	80009	156-0305-18
U1632[3]	156-0767-00			MICROCIRCUIT,DI:HEX GATE	04713	MC14572CL
U1633[3]	156-0766-00			MICROCIRCUIT,DI:QUAD 2 INP OR GATE	80009	156-0766-00
U1640[3]	156-0627-00			MICROCIRCUIT,DI:SYN 4-B,UP-DOWN BINARY CTR	80009	156-0627-00
U1641[3]	156-0305-19			MICROCIRCUIT,DI:ROM U1641 PROGRAMMED	80009	156-0305-19
U1653[3]	156-0750-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	80009	156-0750-00
U1656[3]	156-0577-00			MICROCIRCUIT,DI:QUAD 2 INPUT AND GATE	80009	156-0577-00
U1661[3]	156-0754-00			MICROCIRCUIT,DI:DUAL 4-INPUT NOR GATES	02735	CD4002AF

[1]Option 3 only.
[2]Option 2 and 4 only.
[3]Option 2,3 and 4.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1663[1]	156-0366-00			MICROCIRCUIT,LI:DUAL D-TYPE F-F	80009	156-0366-00
U1673[1]	156-0750-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	80009	156-0750-00
U1825[1]	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U1830[1]	156-0402-00			MICROCIRCUIT,DI:TIMER	18324	NE555V
U1850[1]	156-0871-00			MICROCIRCUIT,DI:CHAR GEN,STATIC	80009	156-0871-00
U1895[1]	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U1897[1]	156-0350-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	02735	CD4011AE
U1925[1]	156-0869-00			MICROCIRCUIT,DI:8 CHANNEL DGTL MUXER	80009	156-0869-00
U1935[1]	156-0869-00			MICROCIRCUIT,DI:8 CHANNEL DGTL MUXER	80009	156-0869-00
U2007	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
U2018	156-0071-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	723DC
U2032	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BL
U2063	156-0495-00			MICROCIRCUIT,LI:QUAD OP AMPL,SGL SUPPLY	27014	LM324N
VR2020	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	80009	152-0212-00
VR2050	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	1N961B
VR2090	152-0317-00			SEMICOND DEVICE:ZENER,0.25W,6.2V,5%	81483	1N3497
VR2096	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR2153	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	80009	152-0195-00
Y901	158-0125-00			XTAL UNIT,QTZ:32.768KHZ,0.05%,SERIES	75378	TX-4

[1]Option 2,3 and 4.

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors	=	Values one or greater are in picofarads (pF). Values less than one are in microfarads (μs).
Resistors	=	Ohms (Ω).

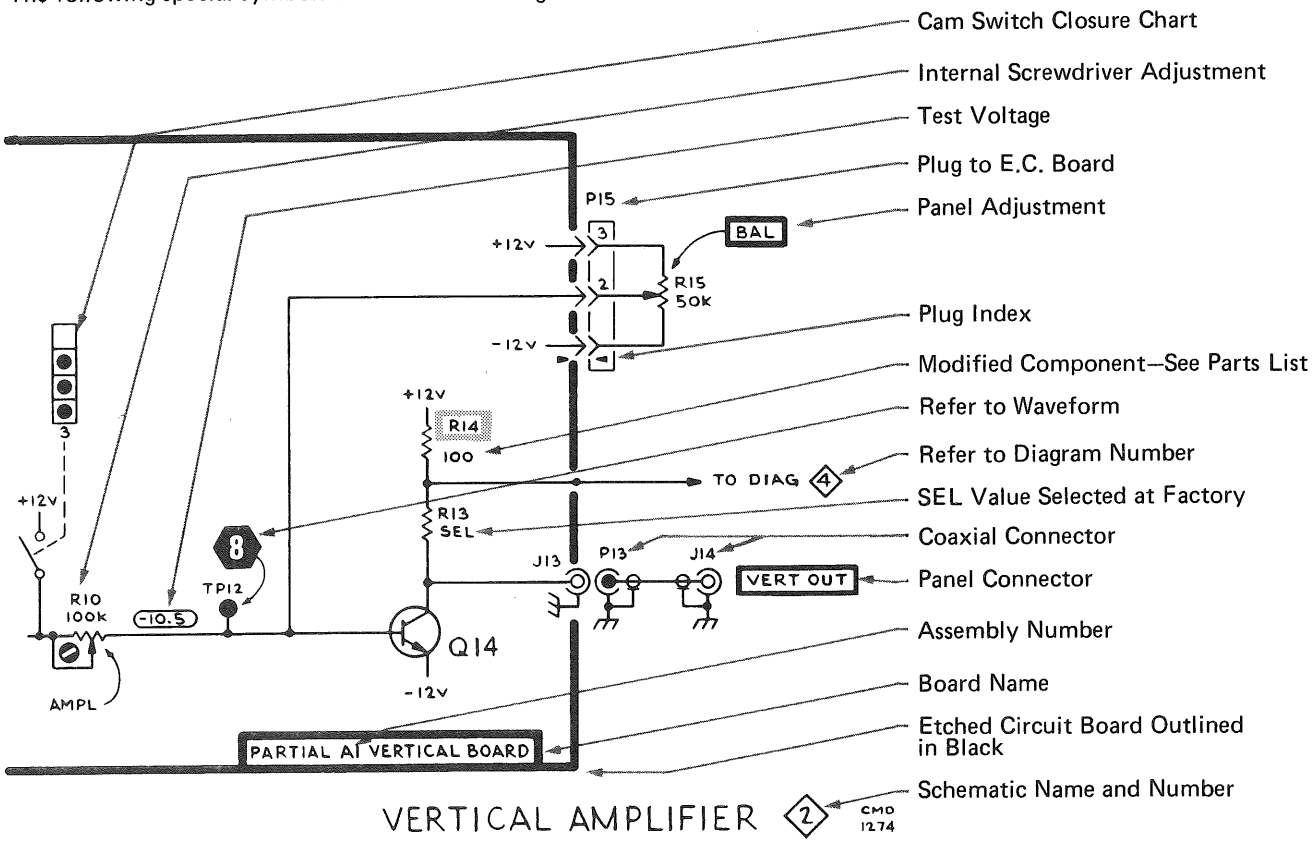
Symbols used on the diagrams are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CB	Circuit breaker
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
E	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
HY	Hybrid circuit
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor or silicon-controlled rectifier
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TC	Thermocouple
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal
Z	Phase shifter

The following special symbols are used on the diagrams:



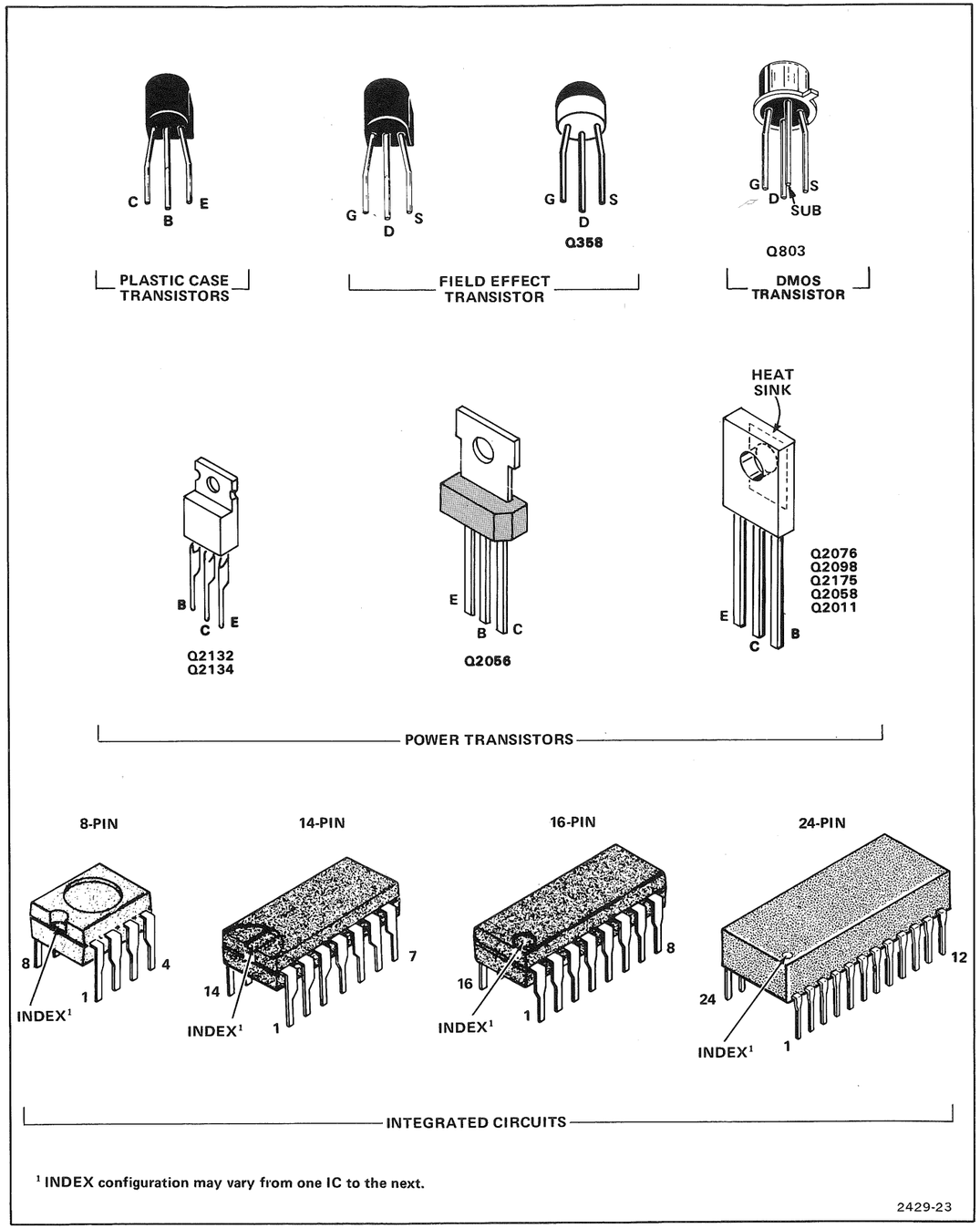


Figure 7-1. Semiconductor Lead configurations.

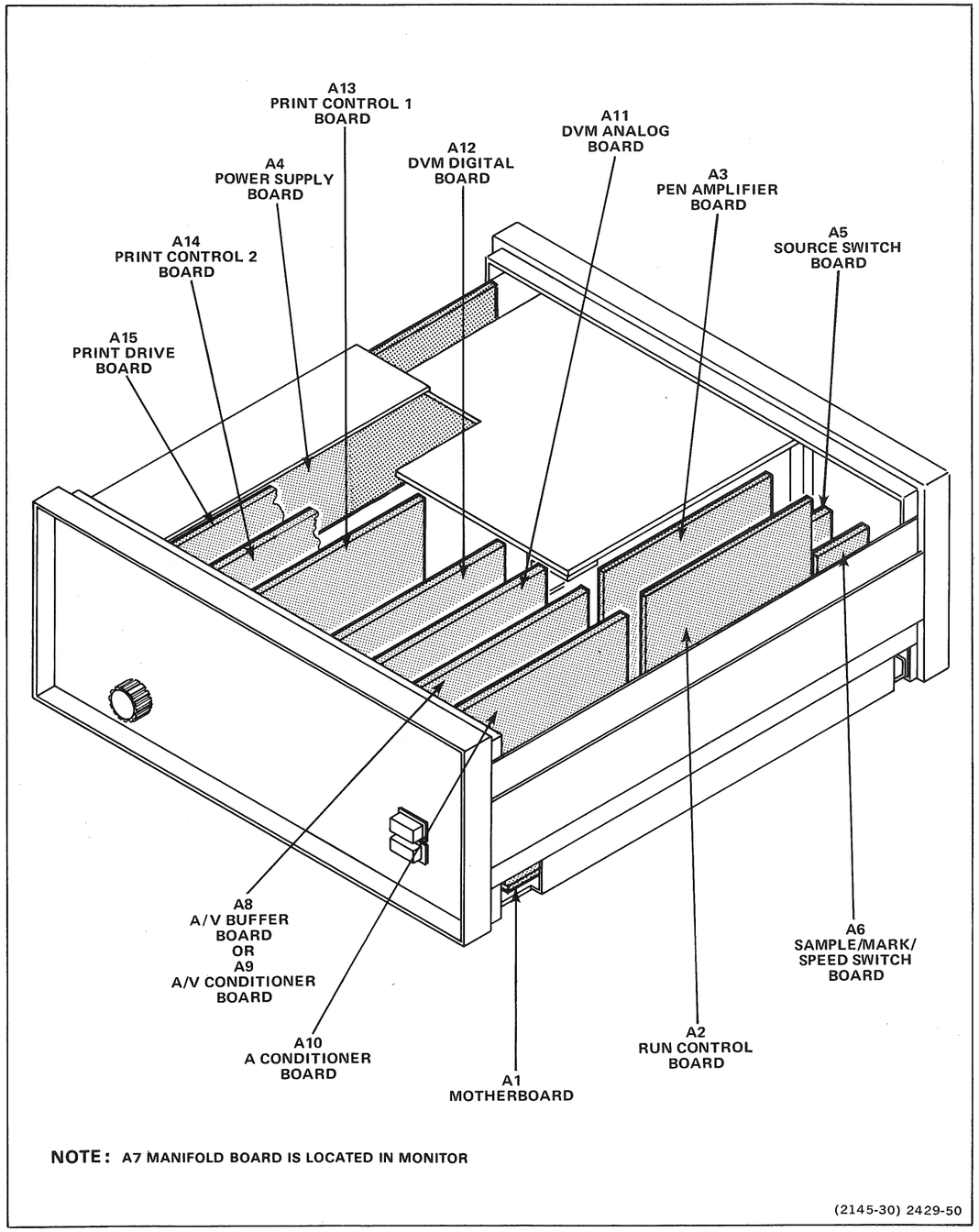


Figure 7-2. Circuit board locations.

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4013 (156-0366-00) DUAL 'D' TYPE FLIP-FLOP (U138, U145, U140, U1091, U1663)

CL▲	D	R	S	Q	$\overline{Q}$	
⌐⌐	0	0	0	0	1	
⌐⌐	1	0	0	1	0	
⌐⌐	X	0	0	Q	$\overline{Q}$	NO CHANGE
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

4051 (156-0513-00) MULTIPLEXER/DEMULTIPLEXER (U830)

INPUT STATES				"ON" CHANNELS
INHIBIT	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

4052 (156-0514-00) DIFFERENTIAL 4-CHANNEL MULTIPLEXER (U1075)

INHIBIT	B	A	"ON" CHANNELS
0	0	0	0x, 0y
0	0	1	1x, 1y
0	1	0	2x, 2y
0	1	1	3x, 3y
1	X	X	NONE

4053 (156-0515-00) TRIPLE 2-CHANNEL MULTIPLEXER (U450)

INPUT STATES				"ON" CHANNELS
INHIBIT	C	B	A	CD4053A
0	0	0	0	cx, bx, ax
0	0	0	1	cx, bx, ay
0	0	1	0	cx, by, ax
0	0	1	1	cx, by, ay
0	1	0	0	cy, bx, ax
0	1	0	1	cy, bx, ay
0	1	1	0	cy, by, ax
0	1	1	1	cy, by, ay
1	X	X	X	NONE

14553 (156-0896-00) THREE-DIGIT BCD COUNTER (U1015)

INPUTS				OUTPUTS
MASTER RESET	CLOCK	DISABLE	LE	
0	⌐⌐	0	0	No Change
0	⌐⌐	0	0	Advance
0	X	1	X	No Change
0	1	⌐⌐	0	Advance
0	1	⌐⌐	0	No Change
0	0	X	X	No Change
0	X	X	⌐⌐	Latched
0	X	X	1	Latched
1	X	X	X	Q0 = Q1 = Q2 = Q3 = 0

14556 (156-0898-00) DUAL BINARY TO 1-OF-4 DECODER/DEMULTIPLEXER (U1425)

INPUTS			OUTPUTS MC14556			
ENABLE	SELECT					
$\overline{E}$	B	A	$\overline{Q}3$	$\overline{Q}2$	$\overline{Q}1$	$\overline{Q}0$
0	0	0	1	1	1	0
0	0	1	1	1	0	1
0	1	0	1	0	1	1
0	1	1	0	1	1	1
1	X	X	1	1	1	1

74C157 (156-0547-00) QUAD 2-INPUT MULTIPLEXER (U490)

ENABLE	SELECT	A	B	OUTPUT Y
1	X	X	X	0
0	0	0	X	0
0	0	1	X	1
0	1	X	0	0
0	1	X	1	1

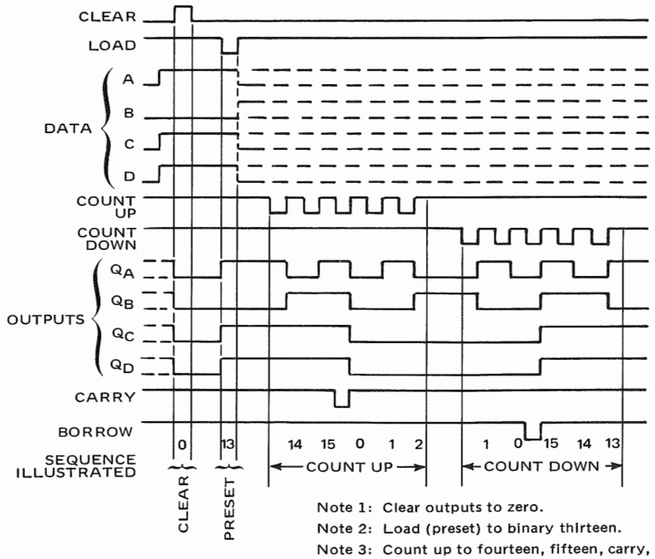
74C174 (156-0682-00) HEX D FLIP-FLOP (U1480)

INPUTS			OUTPUT
CLEAR	CLOCK	D	Q
0	X	X	0
1	⌐⌐	1	1
1	⌐⌐	0	0
1	0	X	Q

74C221 (156-0750-00) DUAL MONSTABLE MULTI-VIBRATOR (U118, U1653, U1673, U1440)

INPUTS			OUTPUTS	
CLEAR	A	B	Q	$\overline{Q}$
0	X	X	0	1
X	1	X	0	1
X	X	0	0	1
1	0	⌐⌐	⊓	⊔
1	⌐⌐	1	⊓	⊔

74C193 (156-0627-00) SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER (U1620, U1640)



Note 1: Clear outputs to zero.
Note 2: Load (preset) to binary thirteen.
Note 3: Count up to fourteen, fifteen, carry, zero, one, and two.
Note 4: Count down to one, zero, borrow, fifteen, fourteen, and thirteen.

Figure 7-3. IC Truth Tables.

4066 (156-0644-00)
QUAD BILATERAL SWITCH
(U849)

CONTROL	SWITCH
1	closed
0	open

14508 (156-0897-00
DUAL 4-BIT LATCH
(U1035)

MR	ST	Disable	D3	D2	D1	D0	Q3	Q2	Q1	Q0
0	1	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0	0	1
0	1	0	0	0	1	0	0	0	1	0
0	1	0	0	1	0	0	0	1	0	0
0	1	0	1	0	0	0	1	0	0	0
0	0	0	X	X	X	X	Latched			
1	X	0	X	X	X	X	0	0	0	0
X	X	1	X	X	X	X	High Impedance			

74C151 (156-0869-00)
8-CHANNEL DIGITAL MULTIPLEXER
(U1490, U1925, U1935)

INPUTS												OUTPUTS	
C	B	A	STROBE	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	Y	W
X	X	X	1	X	X	X	X	X	X	X	X	0	1
0	0	0	0	0	X	X	X	X	X	X	X	0	1
0	0	0	0	1	X	X	X	X	X	X	X	1	0
0	0	1	0	X	0	X	X	X	X	X	X	0	1
0	0	1	0	X	1	X	X	X	X	X	X	1	0
0	1	0	0	X	X	0	X	X	X	X	X	0	1
0	1	0	0	X	X	1	X	X	X	X	X	1	0
0	1	1	0	X	X	X	0	X	X	X	X	0	1
0	1	1	0	X	X	X	1	X	X	X	X	1	0
1	0	0	0	X	X	X	X	0	X	X	X	0	1
1	0	0	0	X	X	X	X	1	X	X	X	1	0
1	0	1	0	X	X	X	X	X	0	X	X	0	1
1	0	1	0	X	X	X	X	X	1	X	X	1	0
1	1	0	0	X	X	X	X	X	X	0	X	0	1
1	1	0	0	X	X	X	X	X	X	1	X	1	0
1	1	1	0	X	X	X	X	X	X	X	0	0	1
1	1	1	0	X	X	X	X	X	X	X	1	1	0

I.C. TRUTH TABLES

Symbol Definitions

1 High Level

0 Low Level

X Don't Care

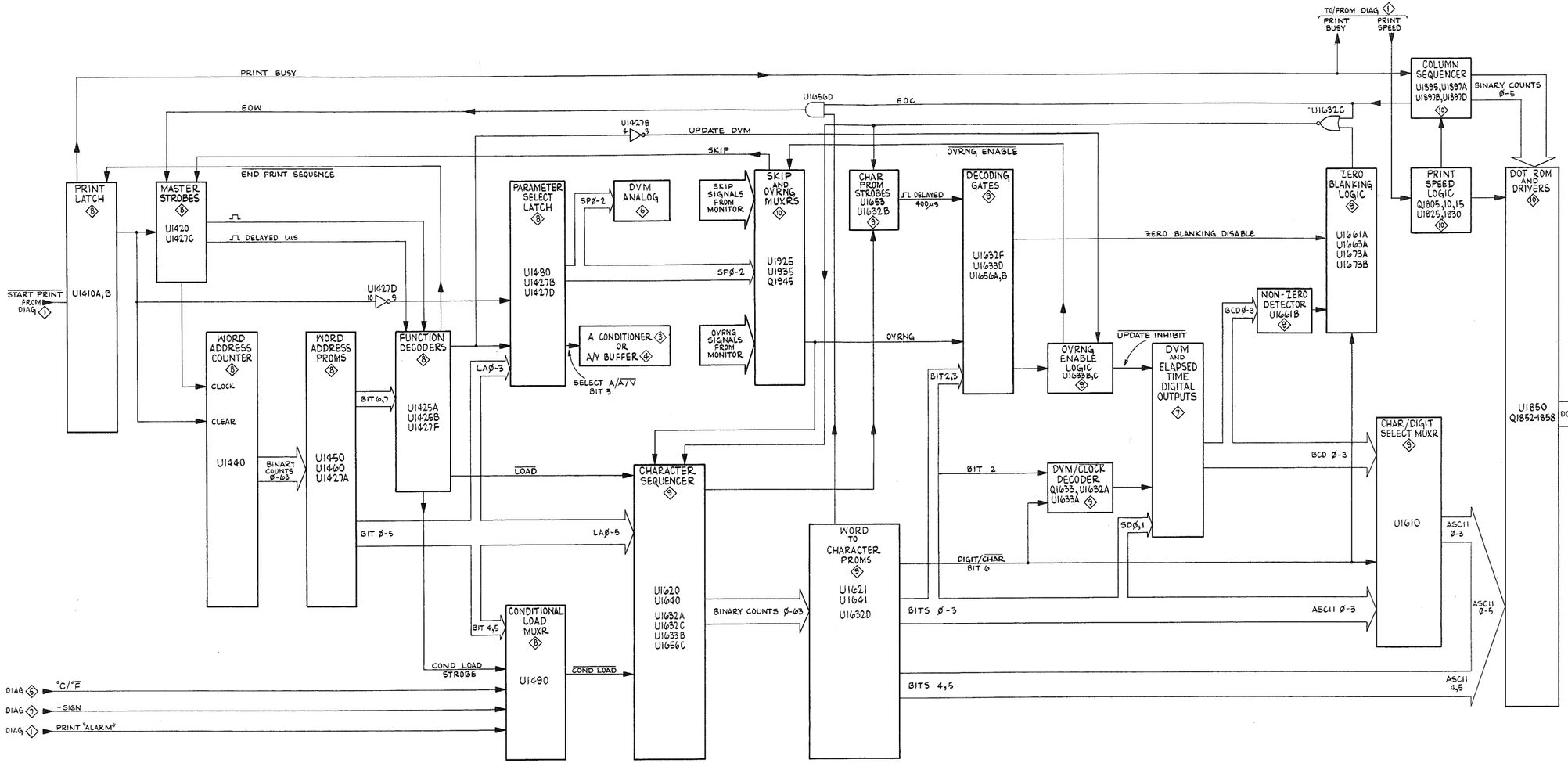
Positive Transition

Negative Transition

CL Clock Level Change

One High Level Pulse

One Low Level Pulse



400 RECORDER
(SN B02000 & UP)

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PRINT CONTROL/DRIVE BLOCK DIAGRAM

PRINT CIRCUIT BLOCK DIAGRAM

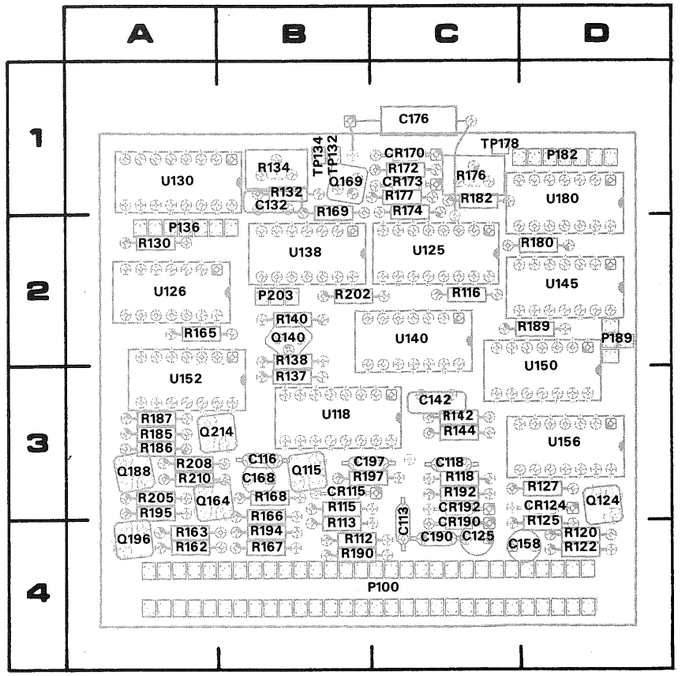
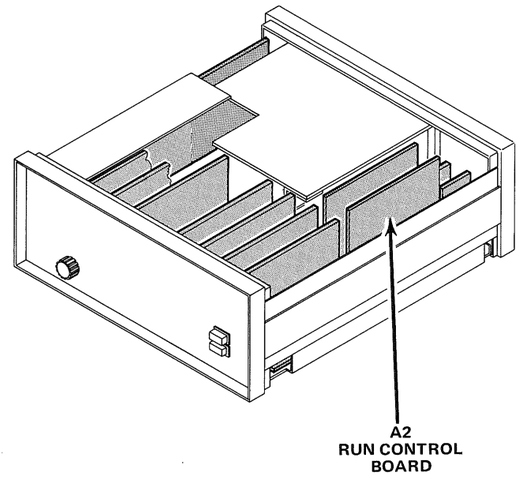
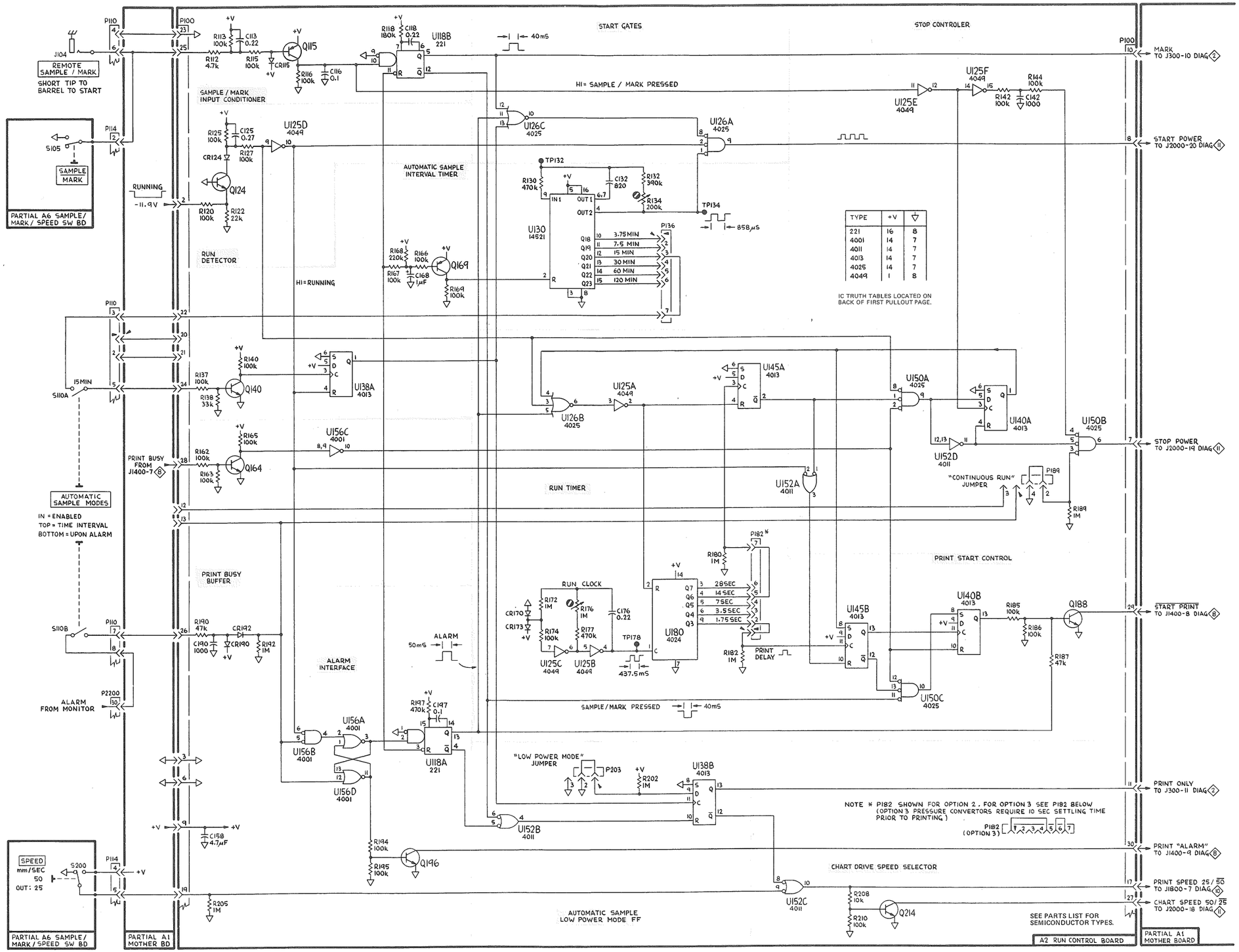


Figure 7-4. A2—Run Control Board Components. 2429-52

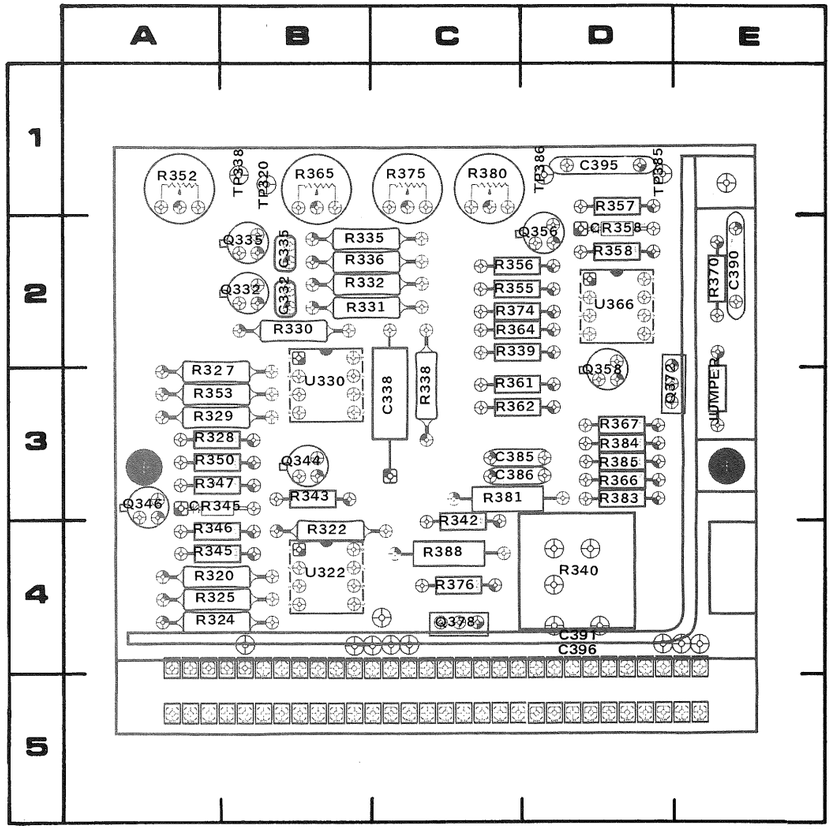
A2—RUN CONTROL BD COMPONENTS

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C113	3C	R112	4B	R189	2D
C116	3B	R113	3B	R190	4B
C118	3C	R115	3B	R192	3C
C125	4C	R116	2C	R194	3B
C132	1B	R118	3C	R195	3A
C142	3C	R120	4D	R197	3B
C158	4D	R122	4D	R202	2B
C168	3B	R125	3D	R205	3A
C176	1C	R127	3D	R208	3A
C190	4C	R130	1A	R210	3A
C197	3B	R132	1B		
		R134	1B	TP132	1B
CR115	3B	R137	2B	TP134	1B
CR124	3D	R138	2B	TP178	1C
CR170	1C	R140	2B		
CR173	1C	R142	3C	U118	3B
CR190	3C	R144	3C	U125	2C
CR192	3C	R162	4A	U126	2A
		R163	3A	U130	1A
P100	4C	R165	2A	U138	2B
P136	1A	R166	3B	U140	2C
P182	1D	R167	4B	U145	2D
P189	2D	R168	3B	U150	2D
P203	2B	R169	1B	U152	2A
		R172	1C	U156	3D
Q115	3B	R174	1C	U180	1D
Q124	3D	R176	1C		
Q140	2B	R177	1C		
Q164	3A	R180	2D		
Q169	1B	R182	1C		
Q188	3A	R185	3A		
Q196	4A	R186	3A		
Q214	3A	R187	3A		




START GATES
STOP CONTROLER
SAMPLE / MARK INPUT CONDITIONER
HI= SAMPLE / MARK PRESSED
AUTOMATIC SAMPLE INTERVAL TIMER
RUN DETECTOR
HI=RUNNING
RUN TIMER
PRINT START CONTROL
PRINT BUSY BUFFER
ALARM INTERFACE
AUTOMATIC SAMPLE LOW POWER MODE FF
CHART DRIVE SPEED SELECTOR
RUN CLOCK
PRINT DELAY
"CONTINUOUS RUN" JUMPER
"LOW POWER MODE" JUMPER
REMOTE SAMPLE / MARK
SHORT TIP TO BARREL TO START
AUTOMATIC SAMPLE MODES
IN = ENABLED
TOP = TIME INTERVAL
BOTTOM = UPON ALARM
ALARM FROM MONITOR
PRINT BUSY FROM J1400-7
RUNNING -11.9V
PARTIAL A6 SAMPLE/ MARK/ SPEED SW BD
PARTIAL A1 MOTHER BD
PARTIAL A1 MOTHER BOARD
A2 RUN CONTROL BOARD
SPEED mm/SEC 50 OUT: 25
MARK TO J300-10 DIAG
START POWER TO J2000-20 DIAG
STOP POWER TO J2000-19 DIAG
START PRINT TO J1400-8 DIAG
PRINT ONLY TO J300-11 DIAG
PRINT "ALARM" TO J1400-9 DIAG
PRINT SPEED 25/50 TO J1800-7 DIAG
CHART SPEED 50/25 TO J2000-18 DIAG
3.75 MIN
7.5 MIN
15 MIN
30 MIN
60 MIN
120 MIN
858µS
40mS
50mS
437.5mS
TYPE | +V | ⏚
221 | 16 | 8
4001 | 14 | 7
4011 | 14 | 7
4013 | 14 | 7
4025 | 14 | 7
4049 | 1 | 8
IC TRUTH TABLES LOCATED ON BACK OF FIRST PULLOUT PAGE.
NOTE * P182 SHOWN FOR OPTION 2 . FOR OPTION 3 SEE P182 BELOW (OPTION 3 PRESSURE CONVERTORS REQUIRE 10 SEC SETTLING TIME PRIOR TO PRINTING)
P182 (OPTION 3)
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

400 (SN B020000 & up)

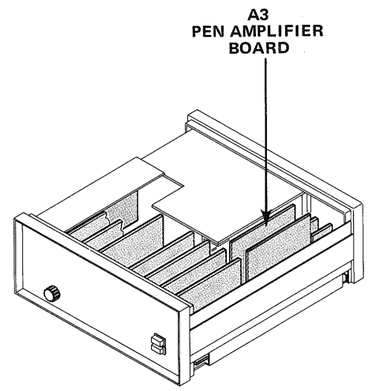


2145-73

Figure 7-6. A3—Pen Amplifier Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C332	2B	R320	4A	R355	2C	TP385	1D
C335	2B	R322	4B	R356	2C	TP386	1D
C338	3C	R324	4A	R357	1D		
C385	3C	R325	4A	R358	2D	U322	4B
C386	3C	R327	2A	R361	3C	U330	3B
C390	2E	R328	3A	R362	3C	U366	2D
C391	4D	R329	3A	R364	2C		
C395	1D	R330	2B	R365	1B		
C396	4D	R331	2B	R366	3D		
		R332	2B	R367	3D		
CR345	3A	R335	2B	R370	2E		
CR358	2D	R336	2B	R374	2C		
		R338	3C	R375	1C		
JUMPER	3E	R339	2C	R376	4C		
		R340	4D	R380	1C		
Q332	2B	R342	4C	R381	3C		
Q335	2B	R343	3B	R383	3D		
Q344	3B	R345	4A	R384	3D		
Q346	3A	R346	4A	R385	3D		
Q356	2D	R347	3A	R388	4C		
Q358	3D	R350	3A				
Q372	3D	R352	1A	TP320	1B		
Q378	4C	R353	3A	TP338	1B		

@



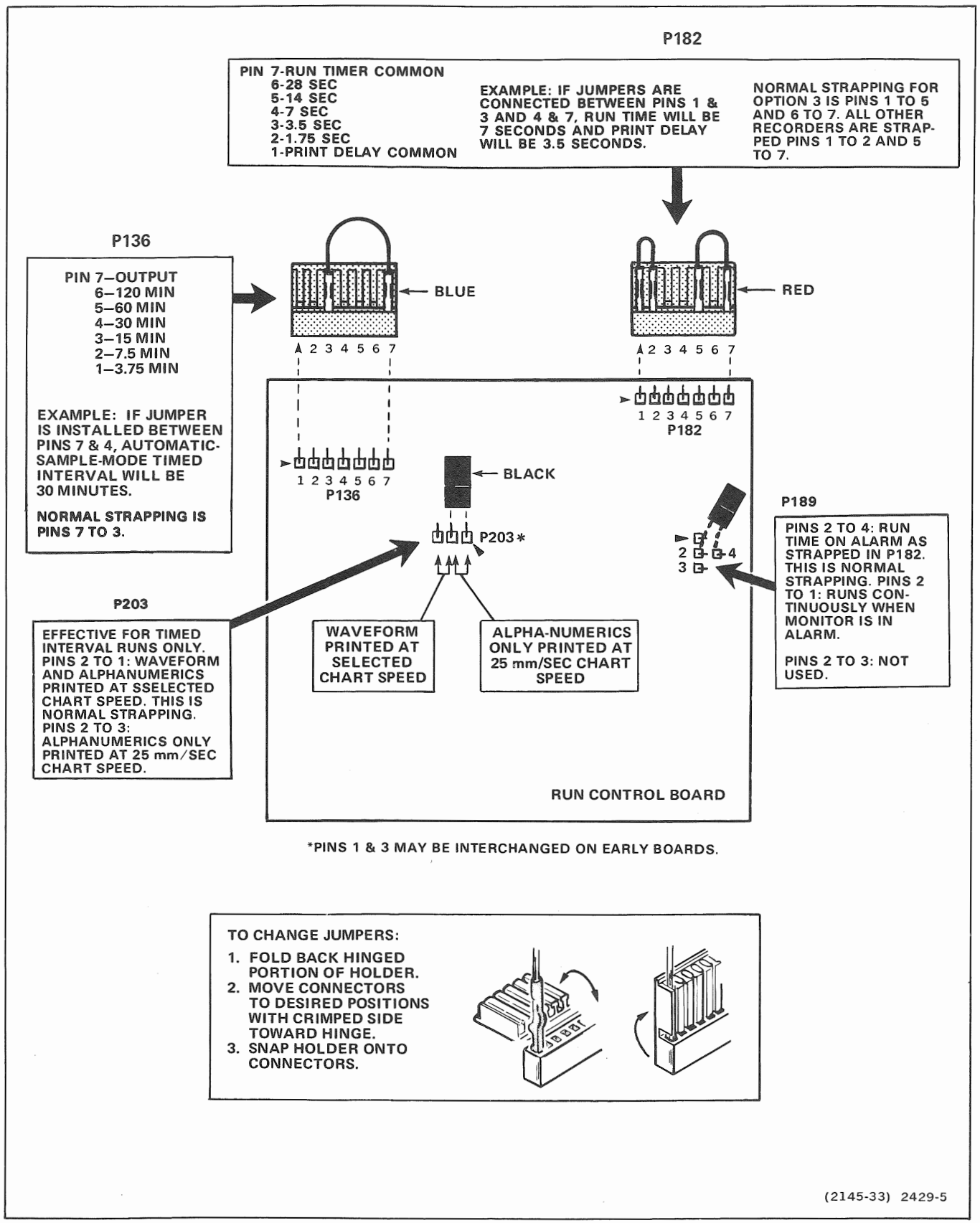
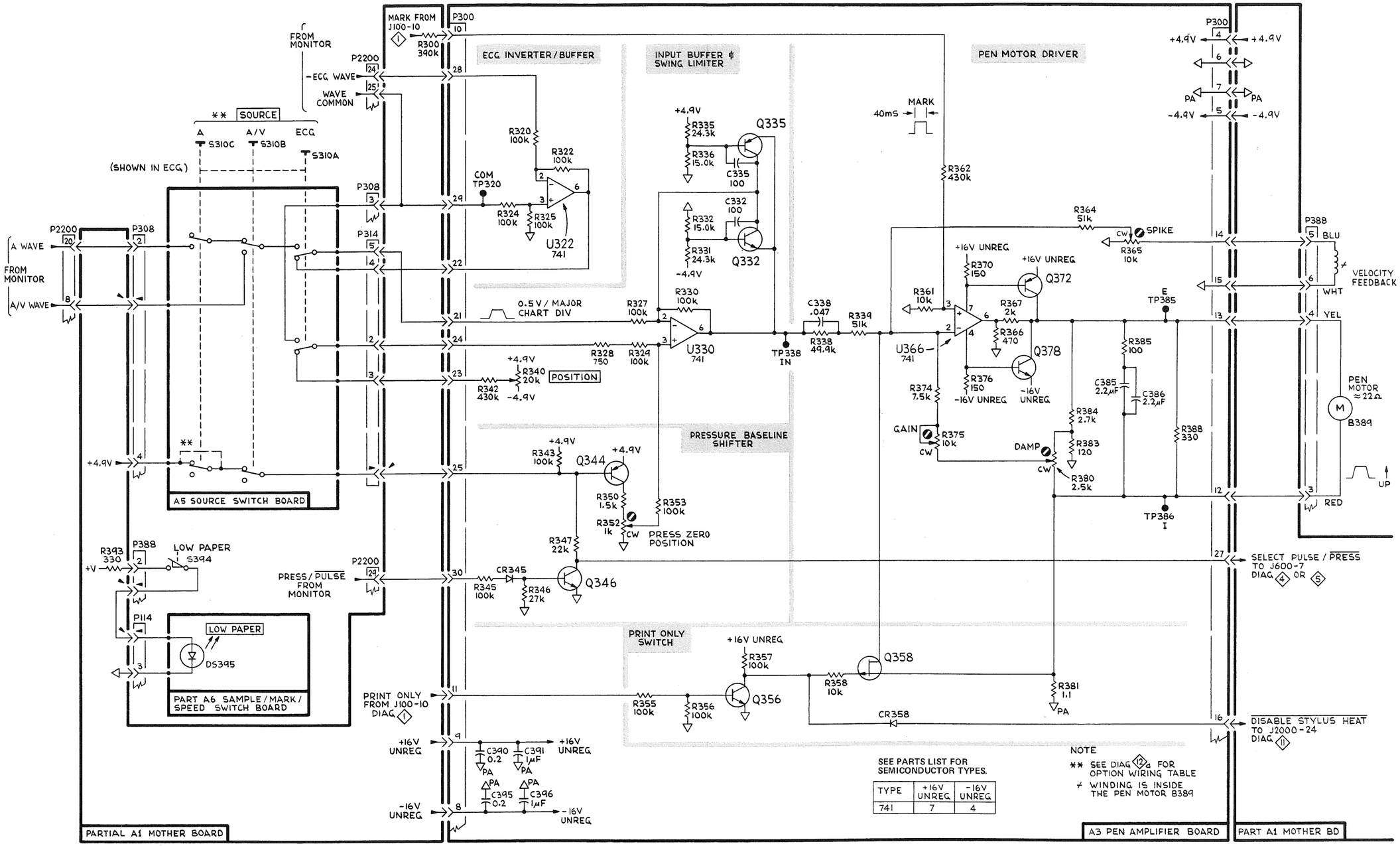


Figure 7-5. Programming Run Control circuit.



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

TYPE	+16V UNREG	-16V UNREG
741	7	4

NOTE

** SEE DIAG 12/a FOR OPTION WIRING TABLE

≠ WINDING IS INSIDE THE PEN MOTOR B389

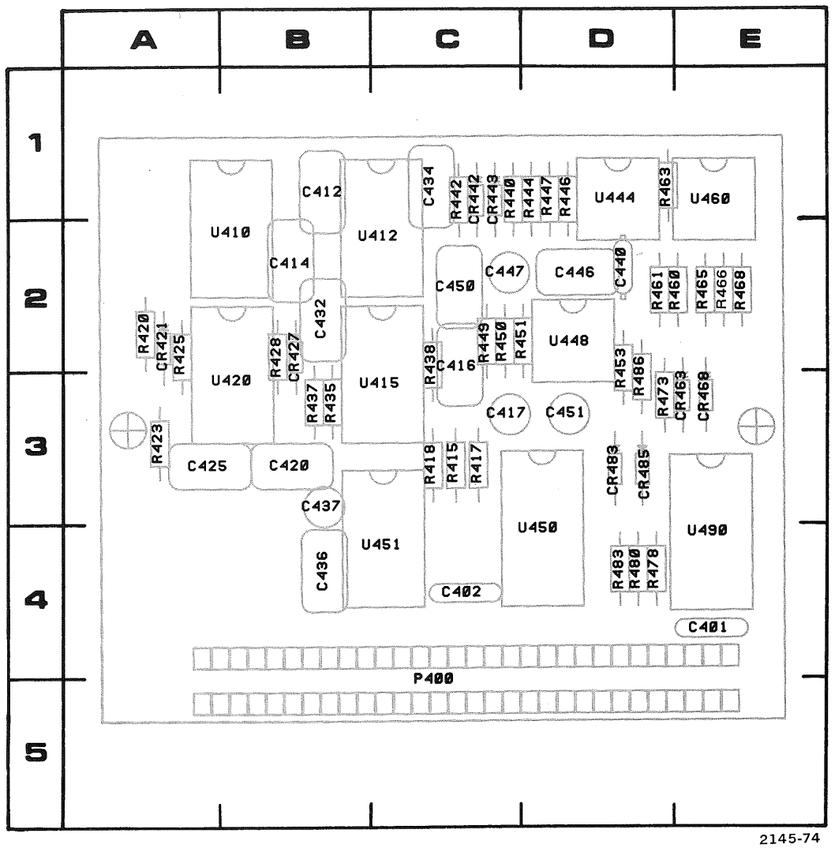
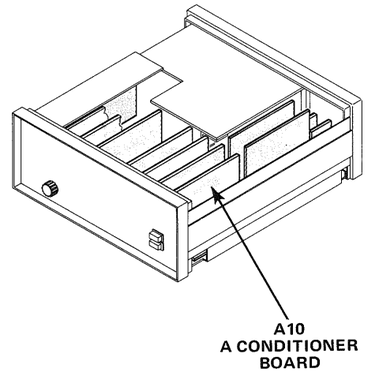
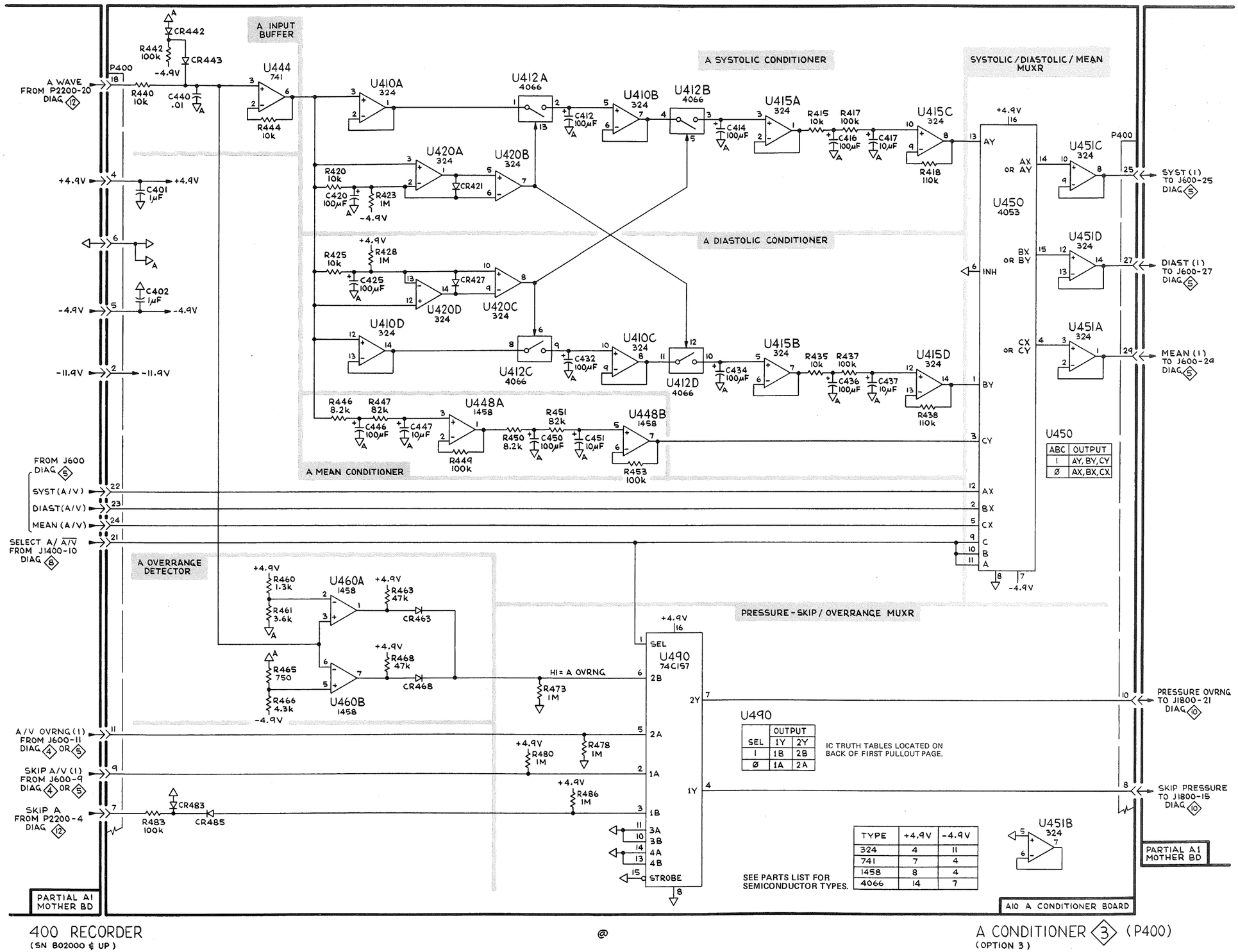


Figure 7-7. A10–A Conditioner Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C401	4E	CR427	2B	R438	2C	R483	4D
C402	4C	CR442	1C	R440	1C	R486	3D
C412	1B	CR443	1C	R442	1C		
C414	2B	CR463	3E	R444	1D	U410	2B
C416	2C	CR468	3E	R446	1D	U412	2C
C417	3C	CR483	3D	R447	1D	U415	3C
C420	3B	CR485	3D	R449	2C	U420	3B
C425	3A			R450	2C	U444	1D
C432	2B	P400	4C	R451	2C	U448	2D
C434	1C			R453	2D	U450	4D
C436	4B	R415	3C	R460	2D	U451	4C
C437	3B	R417	3C	R461	2D	U460	1E
C440	2D	R418	3C	R463	1D	U490	4E
C446	2D	R420	2A	R465	2E		
C447	2C	R423	3A	R466	2E		
C450	2C	R425	2A	R468	2E		
C451	3C	R428	2B	R473	3D		
		R435	3B	R478	4D		
CR421	2A	R437	3B	R480	4D		





400 RECORDER
(SN B02000 & UP)

A CONDITIONER 3 (P400)
(OPTION 3)

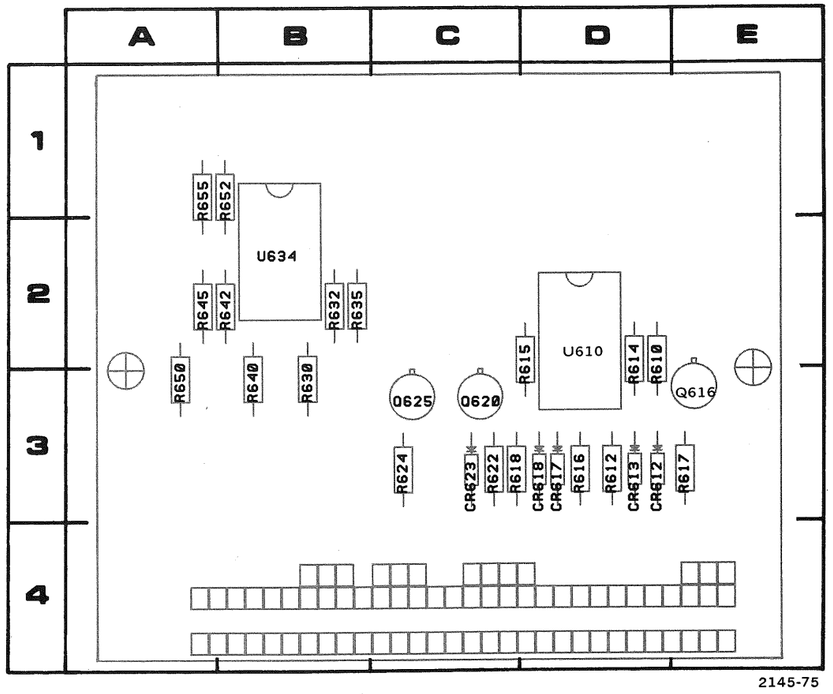
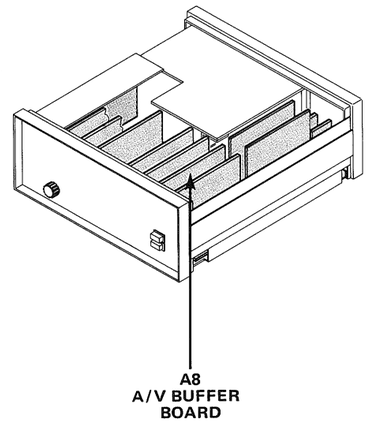
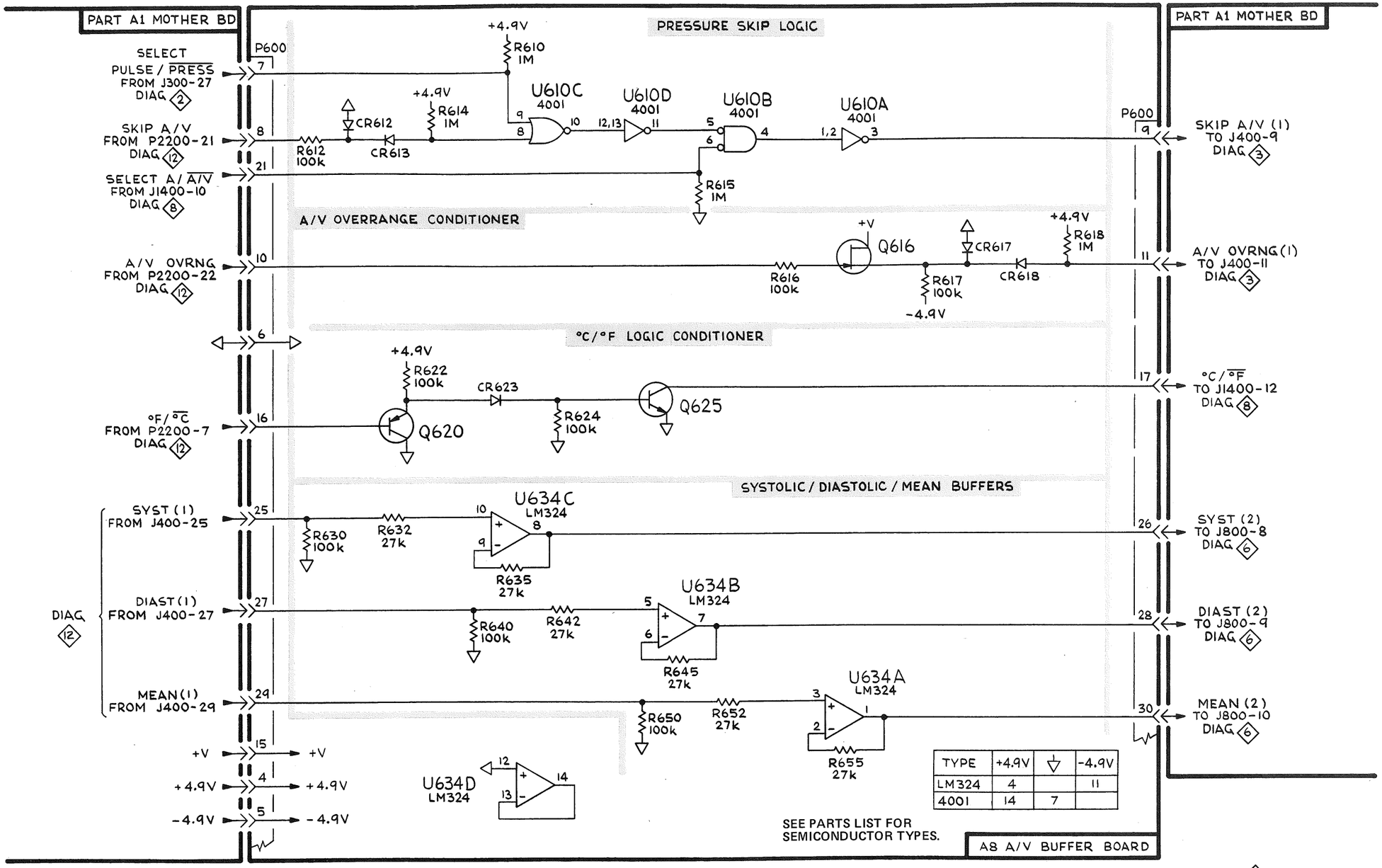


Figure 7-8. A8—A/V Buffer Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD
CR612	3D	R618	3C
CR613	3D	R622	3C
CR617	3D	R624	3C
CR618	3D	R630	3B
CR623	3C	R632	2B
		R635	2B
Q616	3E	R640	3B
Q620	3C	R642	2B
Q625	3C	R645	2A
		R650	3A
R610	2D	R652	1B
R612	3D	R655	1A
R614	2D		
R615	2D	U634	2B
R616	3D	U610	2D
R617	3E		





400 RECORDER
(SN B02000 & UP)

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A/V BUFFER 4 (P600)
(OPTION 2 & 4)

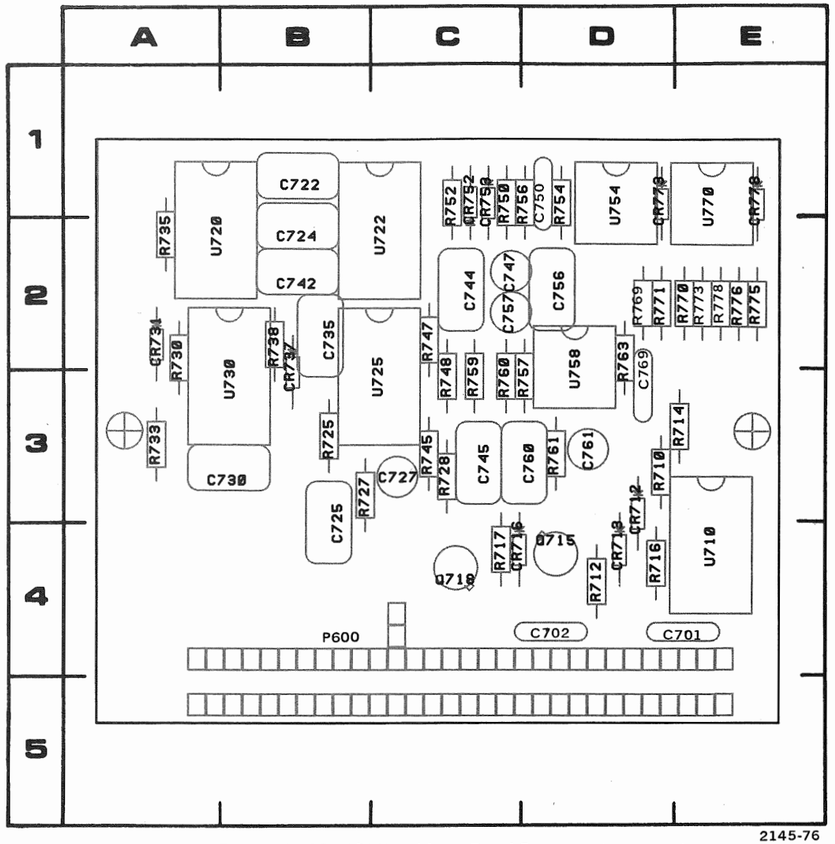
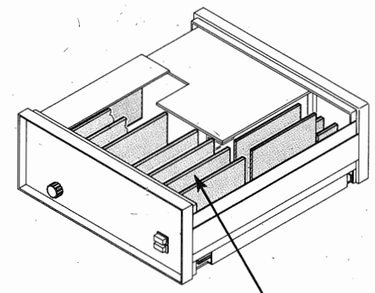
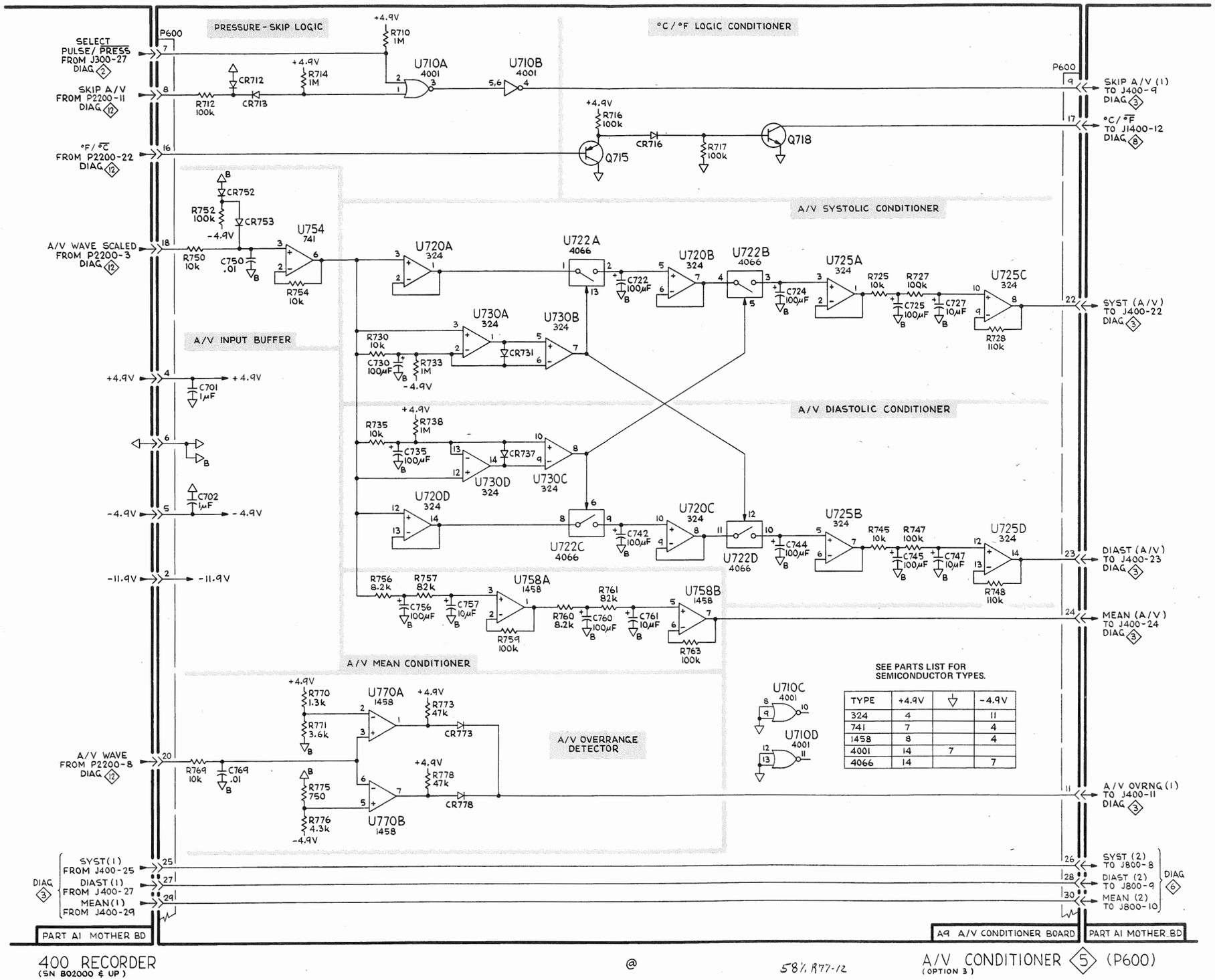


Figure 7-9. A9—A/V Conditioner Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C701	4D	CR773	1D	R759	3C
C702	4C	CR778	1E	R760	3C
C722	1B	P600	4B	R761	3D
C724	2B	Q715	4D	R763	2D
C725	3B	Q718	4C	R763	3D
C727	3C			R769	2D
C730	3B	R710	3D	R770	2E
C735	2B	R712	4D	R771	2D
C742	2B	R714	3E	R773	2E
C744	2C	R716	4D	R775	2E
C745	3C	R717	4C	R776	2E
C747	2C	R725	3B	R778	2E
C750	1D	R727	3B		
C756	2D	R728	3C	U710	4E
C757	2C	R730	2A	U720	2A
C760	3D	R733	3A	U722	2C
C761	3D	R735	2A	U725	2C
C769	3D	R738	2B	U730	2B
		R745	3C	U754	1D
CR712	3D	R747	2C	U758	3D
CR713	4D	R748	3C	U770	1E
CR716	4C	R750	1C		
CR731	2A	R752	1C		
CR737	2B	R754	1D		
CR752	1C	R756	1D		
CR753	1C	R757	3D		





400 RECORDER
(SN B02000 & UP)

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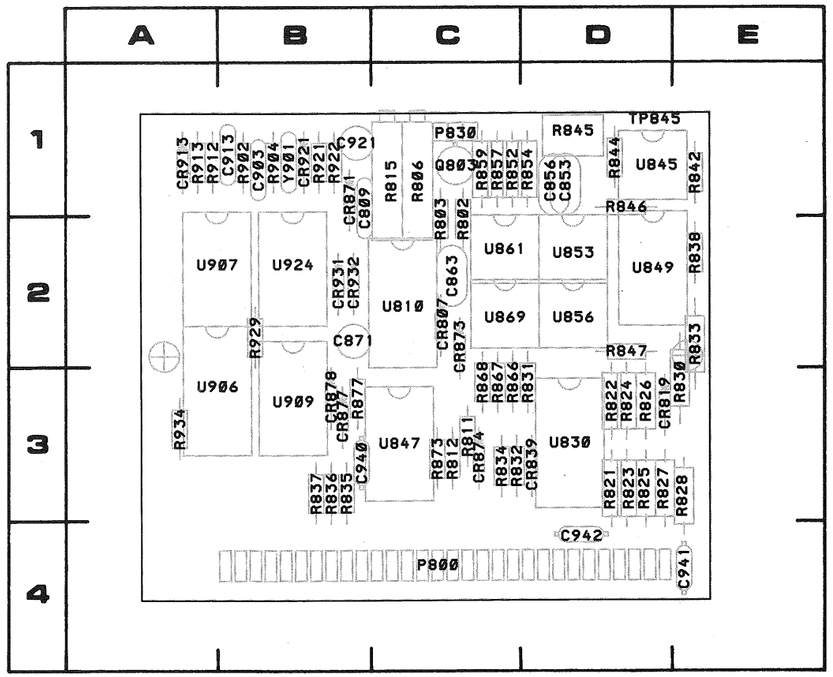
58% R77-12

A/V CONDITIONER 5 (P600)
(OPTION 3)

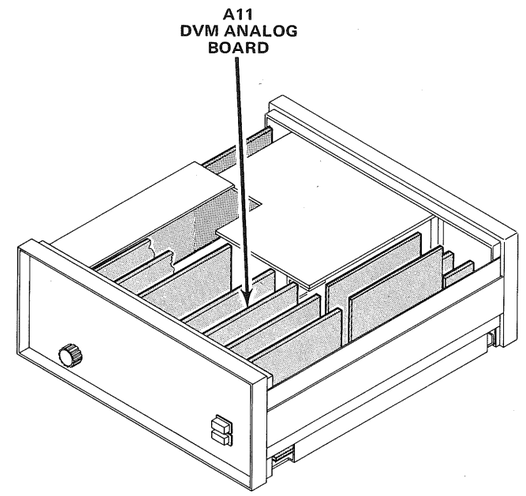


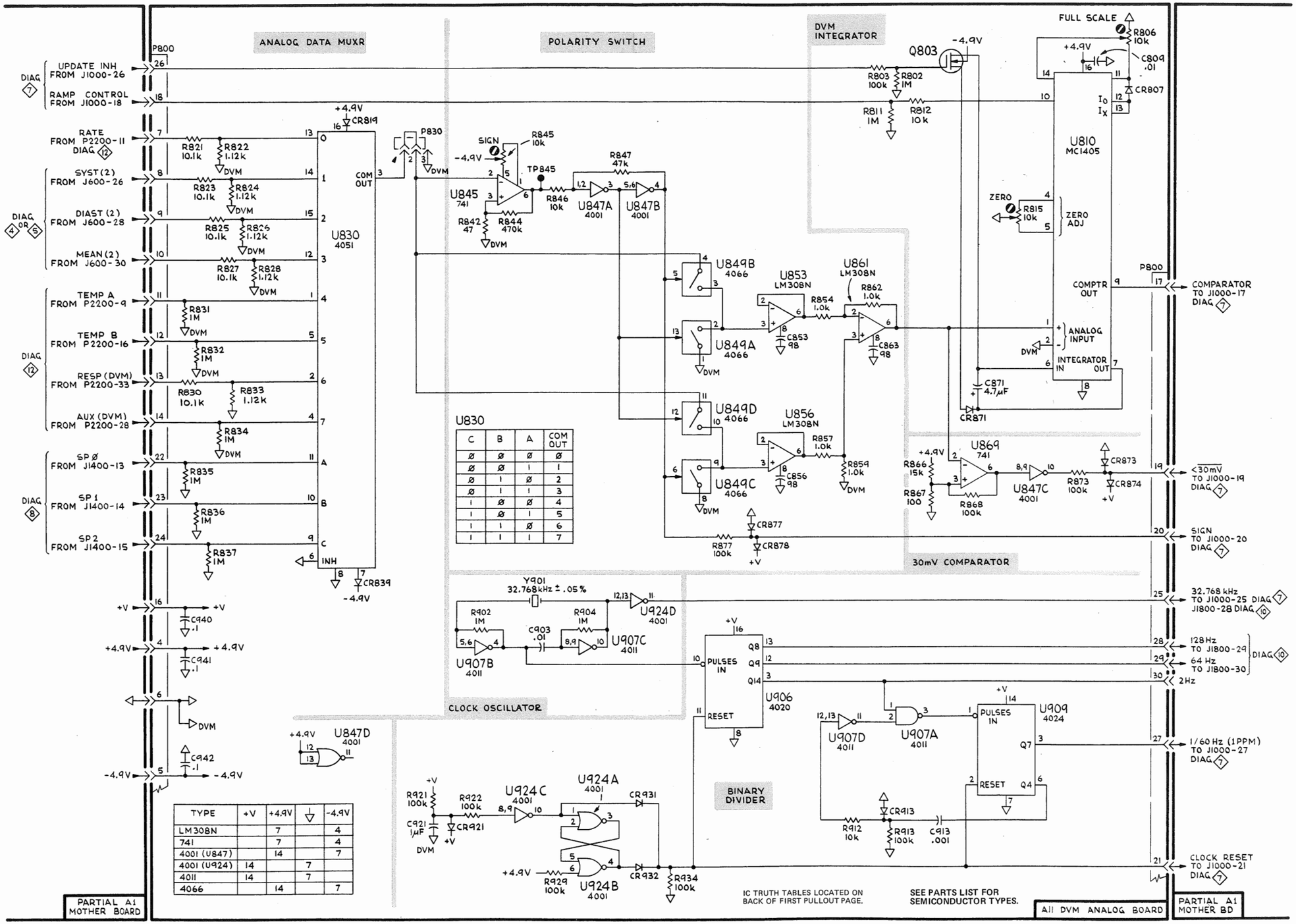
2429-53

Figure 7-10. A11–DVM Analog Board Components.

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C809	2B	P830	1C	R842	1E	U810	2C
C853	1D			R844	1D	U830	3D
C856	1D	Q803	1C	R845	1D	U845	1D
C863	2C			R846	1D	U847	3C
C871	2B	R802	2C	R847	2D	U849	2D
C903	1B	R803	2C	R852	1C	U853	2D
C913	1B	R806	1C	R854	1D	U856	2D
C921	1B	R811	3C	R857	1C	U861	2C
C940	3B	R812	3C	R859	1C	U869	2C
C941	4E	R815	1C	R866	3C	U906	3A
C942	4D	R821	3D	R867	3C	U907	2A
		R822	3D	R868	3C	U909	3B
CR807	2C	R823	3D	R873	3C	U924	2B
CR819	3D	R824	3D	R877	3B		
CR839	3D	R825	3D	R902	1B	Y901	1B
CR871	2B	R826	3D	R904	1B		
CR873	2C	R827	3D	R912	1A		
CR874	3C	R828	3E	R913	1A		
CR877	3B	R830	3E	R921	1B		
CR878	3B	R832	3C	R922	1B		
CR913	1A	R833	2E	R929	2B		
CR921	1B	R834	3C	R934	3A		
CR931	2B	R835	3B				
CR932	2B	R836	3B	TP845	1D		
		R837	3B				
P800	4C	R838	2E				

@





U830

C	B	A	COM OUT
Ø	Ø	Ø	Ø
Ø	Ø	1	1
Ø	1	Ø	2
Ø	1	1	3
1	Ø	Ø	4
1	Ø	1	5
1	1	Ø	6
1	1	1	7

TYPE	+V	+4.9V	⏚	-4.9V
LM308N		7		4
741		7		4
4001 (U847)		14		7
4001 (U924)	14		7	
4011	14		7	
4066		14		7

400 (SN B020000 & up)

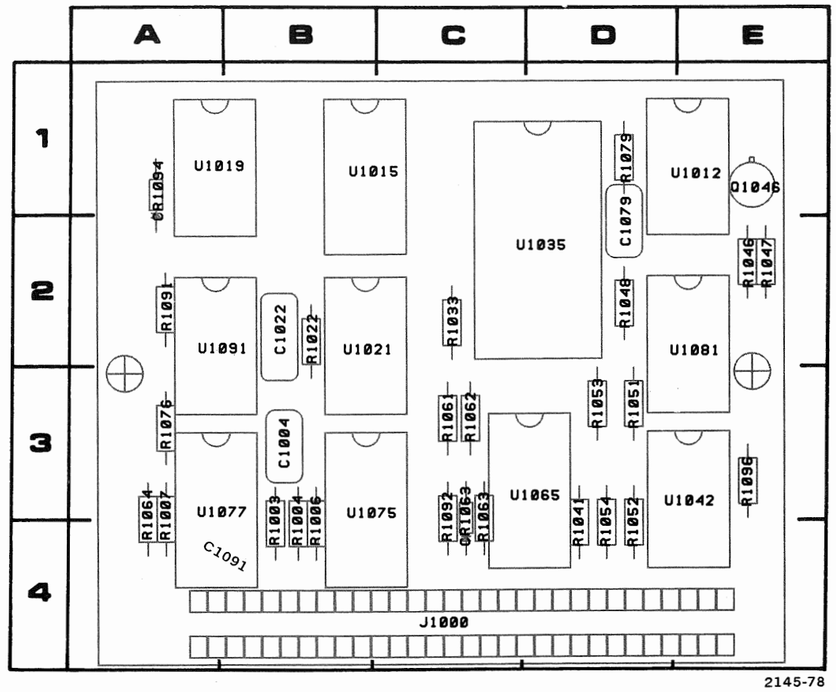
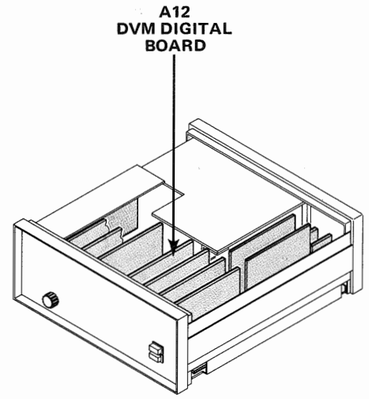
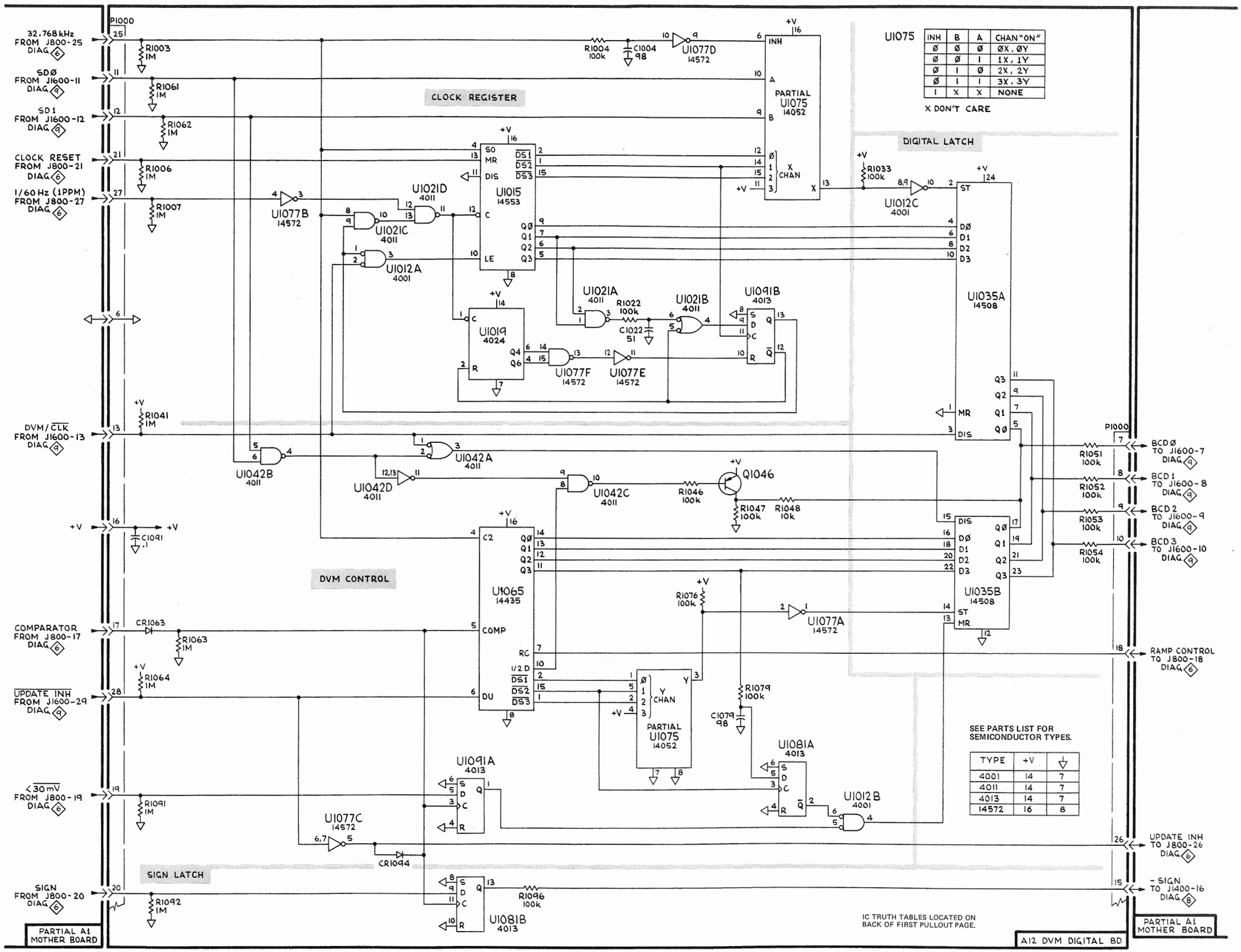


Figure 7-11. A12–DVM Digital Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C1004	3B	R1022	2B	R1091	2A
C1022	2B	R1033	2C	R1092	3C
C1079	2D	R1041	3D	R1096	3E
C1091	4B	R1046	2E		
		R1047	2E	U1012	1E
CR1063	3C	R1048	2D	U1015	1B
CR1094	1A	R1051	3D	U1019	1A
		R1052	3D	U1021	2B
J1000	4C	R1053	3D	U1035	2D
		R1054	3D	U1042	3E
Q1046	1E	R1061	3C	U1065	3D
		R1062	3C	U1075	3B
R1003	3B	R1063	3C	U1077	3A
R1004	3B	R1064	3A	U1081	2E
R1006	3B	R1076	3A	U1091	2A
R1007	3A	R1079	1D		





U1075

INH	B	A	CHAN "ON"
Ø	Ø	Ø	ØX, ØY
Ø	Ø	1	1X, 1Y
Ø	1	Ø	2X, 2Y
Ø	1	1	3X, 3Y
1	X	X	NONE

X DON'T CARE

400 RECORDER
(SN B02000 & UP)

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DVM DIGITAL 7 (P1000)
(OPTION 2, 3 & 4)

400 (SN B020000 & up)

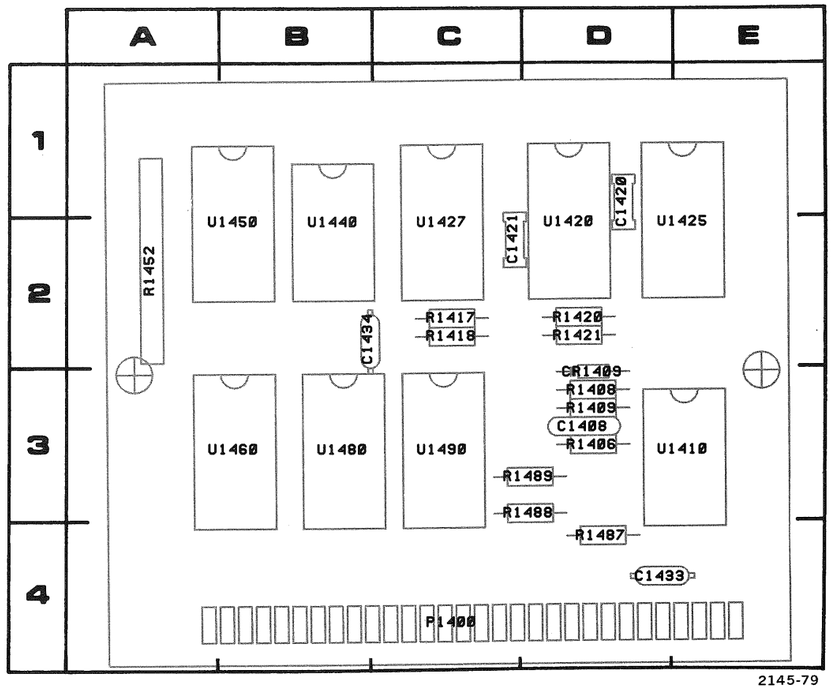
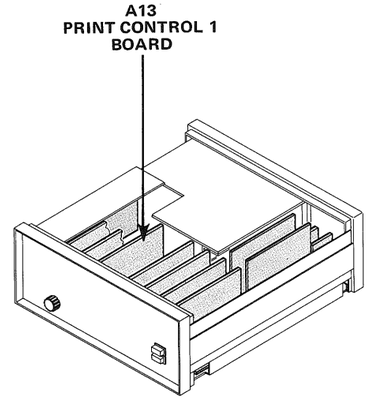
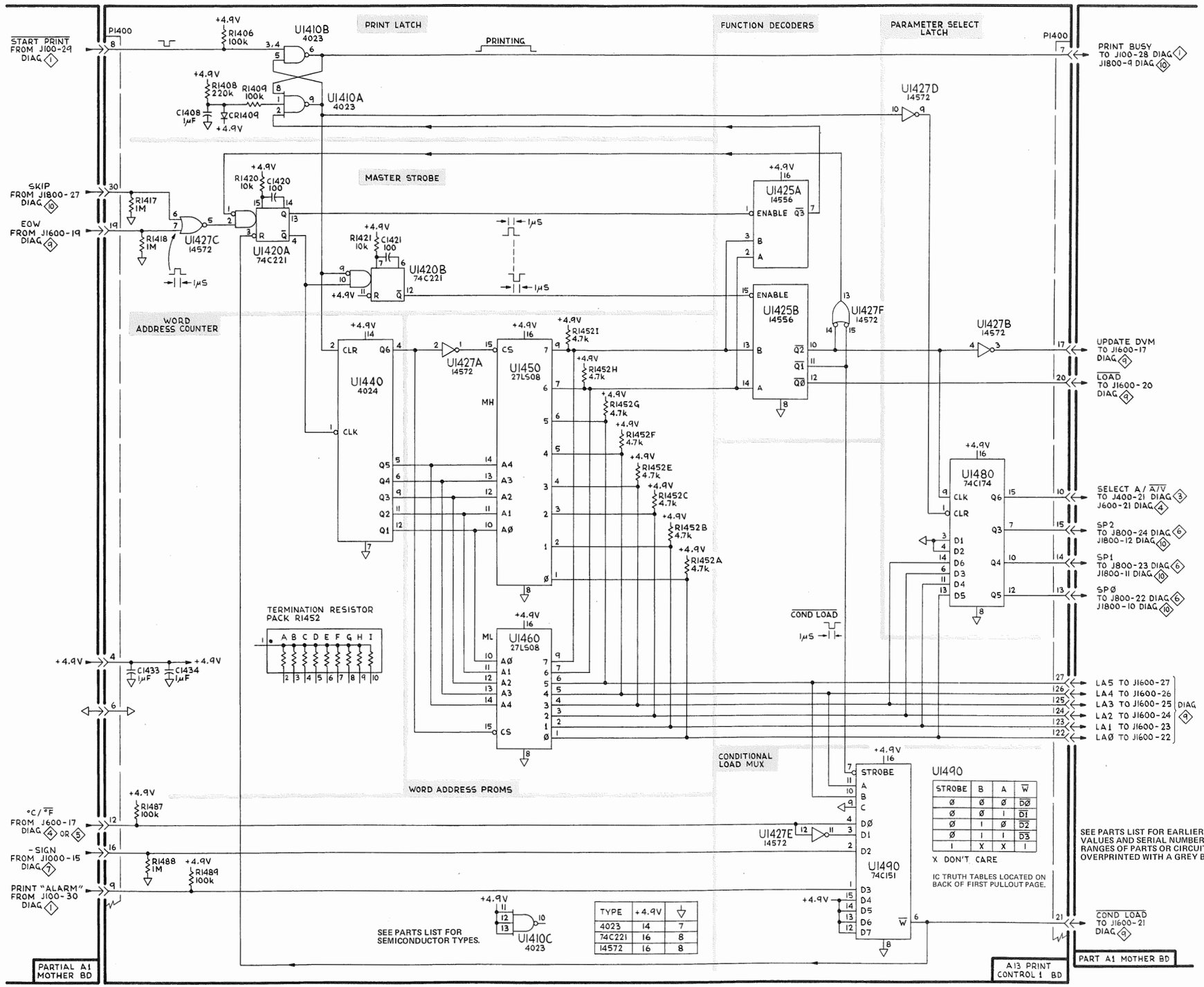


Figure 7-12. A13—Print Control 1 Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD
C1408	3D	R1421	2D
C1420	1D	R1452	2A
C1421	2C	R1487	4D
C1433	4D	R1488	3D
C1434	2B	R1489	3D
CR1409	3D	U1410	3E
		U1420	2D
P1400	4C	U1425	2E
		U1427	2C
R1406	3D	U1440	2B
R1408	3D	U1450	2B
R1409	3D	U1460	3B
R1417	2C	U1480	3B
R1418	2C	U1490	3C
R1420	2D		





400 RECORDER
(SN B02000 & UP)

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PRINT CONTROL 1 ◇8◇ (P1400)
(OPTION 2, 3 & 4)

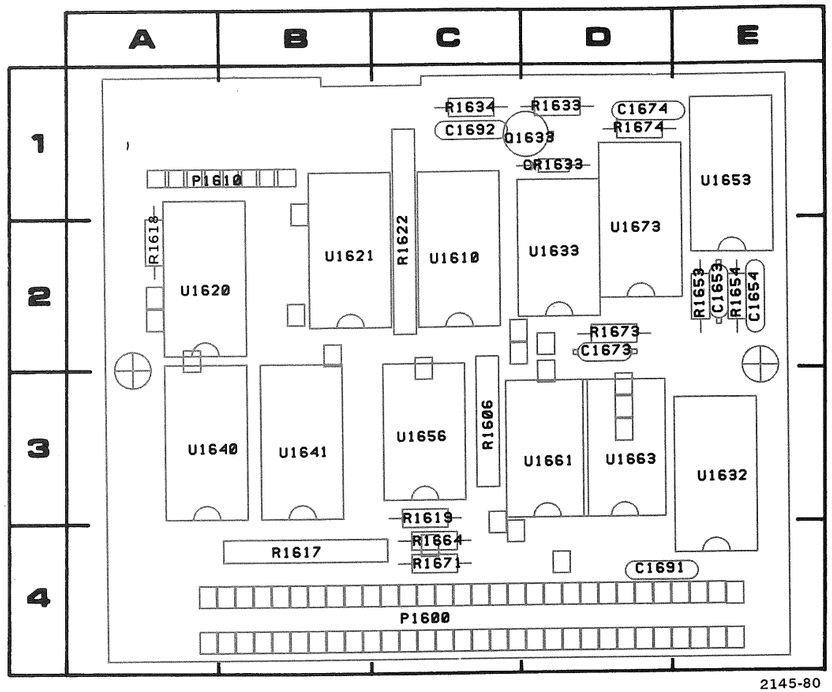
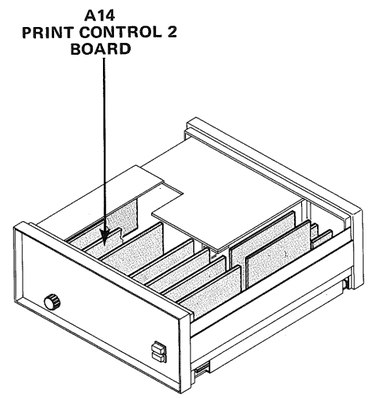


Figure 7-13. A14—Print Control 2 Board Components.

CKT NO	GRID COORD	CKT NO	GRID COORD
C1653	2E	R1634	1C
C1654	2E	R1653	2E
C1673	2D	R1654	2E
C1674	1D	R1664	4C
C1691	4D	R1671	4C
C1692	1C	R1673	2D
		R1674	1D
CR1633	1D		
		U1610	2C
P1600	4C	U1620	2A
P1610	1A	U1621	2B
		U1632	3E
Q1633	1D	U1633	2D
		U1640	3A
R1606	3C	U1641	3B
R1617	4B	U1653	1E
R1618	2A	U1656	3C
R1619	3C	U1661	3D
R1622	2C	U1663	3D
R1633	1D	U1673	2D



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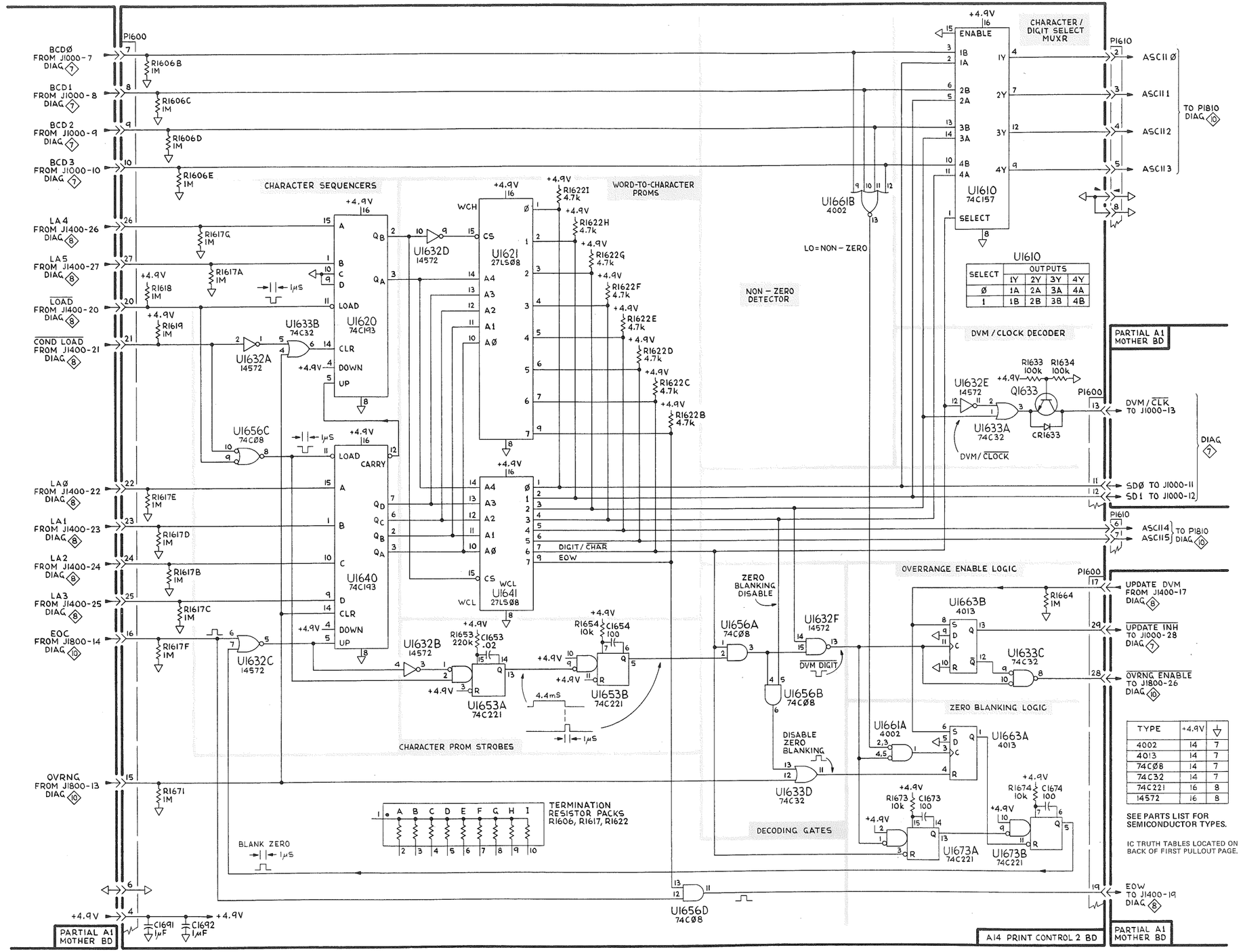

400 RECORDER
(SN B02000 & UP)

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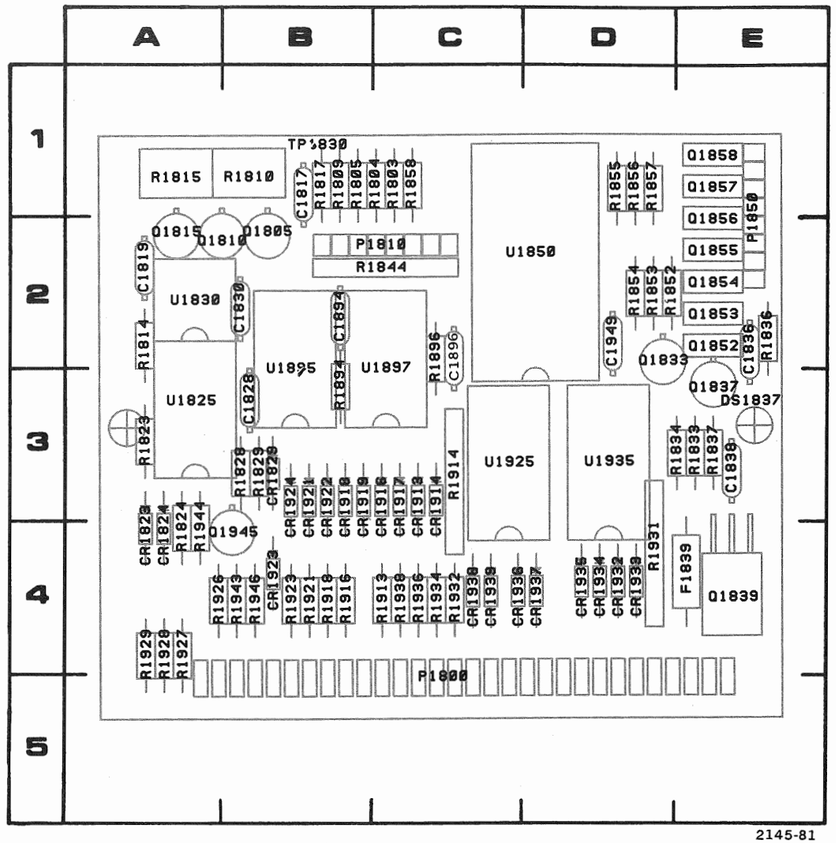
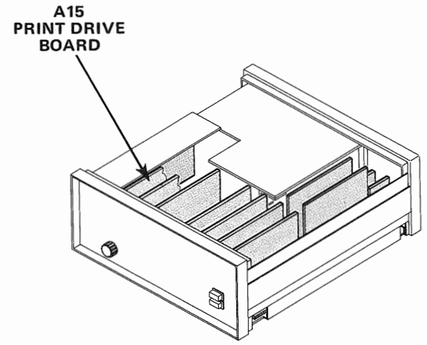
PRINT CONTROL 2 ◇9◇ (P1600)
(OPTION 2, 3 & 4)



2145-81

Figure 7-14. A15—Print Drive Board Components.



CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C1817	1B	CR1932	4D	Q1852	2E	R1836	2E	R1932	4C
C1819	2A	CR1933	4D	Q1853	2E	R1837	3E	R1934	4C
C1828	2B	CR1934	4D	Q1854	2E	R1844	2C	R1936	4C
C1830	2B	CR1935	4D	Q1855	2E	R1852	2D	R1938	4C
C1836	2E	CR1936	4C	Q1856	2E	R1853	2D	R1943	4B
C1838	3E	CR1937	4D	Q1857	1E	R1854	2D	R1944	4A
C1894	2B	CR1938	4C	Q1858	1E	R1855	1D	R1946	4B
C1896	2C	CR1939	4C	Q1945	4B	R1856	1D		
C1949	2D					R1857	1D	TP1830	1B
		DS1837	3E	R1803	1C	R1858	1C		
CR1823	4A			R1804	1C	R1894	3A	U1825	3A
CR1824	4A	F1839	4E	R1805	1B	R1896	2C	U1830	2A
CR1829	3B			R1809	1B	R1913	4C	U1850	2D
CR1913	3C	P1800	5C	R1810	1B	R1914	3C	U1895	2B
CR1914	3C	P1810	2C	R1814	2A	R1916	4B	U1897	2C
CR1916	3C	P1850	2E	R1815	1A	R1918	4B	U1925	3C
CR1917	3C			R1817	1B	R1921	4B	U1935	3D
CR1918	3B	Q1805	2B	R1823	3A	R1923	4B		
CR1919	3B	Q1810	2A	R1824	4A	R1926	4B		
CR1921	3B	Q1815	2A	R1828	2B	R1927	4A		
CR1922	3B	Q1833	2D	R1829	3B	R1928	4A		
CR1923	4B	Q1837	3E	R1833	3E	R1929	4A		
CR1924	3B	Q1839	4E	R1834	3E	R1931	4D		

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PART A1 MOTHER BD

PRINT SPEED LOGIC

PRINT HEAD VOLTAGE REGULATOR

PRINT SPEED 25/50 FROM J100-17 DIAG 1

64 Hz FROM J800-29 DIAG 6

128 Hz FROM J800-28 DIAG 6

FROM P1610 DIAG 9

ASCII Ø

ASCII 1

ASCII 2

ASCII 3

ASCII 4

ASCII 5

DOT ROM & DRIVERS

COLUMN SEQUENCER

PRINT BUSY FROM J1400-7 DIAG 8

OVERRANGE MUXR

RATE OVRNG FROM P2200-6 DIAG 12

PRESS OVRNG FROM J400-10 DIAG 3

TEMP A OVRNG FROM P2200-23

TEMP B OVRNG FROM P2200-14

RESP OVRNG FROM P2200-31

AUX OVRNG FROM P2200-18

DIAG 12

OVRNG ENABLE FROM J1600-23 DIAG 9

SPØ FROM J1400-13

SP 1 FROM J1400-14

SP 2 FROM J1400-15

DIAG 8

SKIP MUXR

SKIP PRESS FROM J400-8 DIAG 3

SKIP TEMP A FROM P2200-5 DIAG 12

SKIP TEMP B FROM P2200-15 DIAG 12

SKIP RESP FROM P2200-32 DIAG 12

SKIP AUX FROM P2200-1 DIAG 12

32.768 kHz FROM J800-25 DIAG 6

PRINT DRIVE (OPTION 2,3 & 4) 10 (P1800)

8mS (25mm/SEC)
7.6mS (50mm/SEC)

U1925, U1935

STROBE	C	B	A	Y
Ø	Ø	Ø	Ø	DØ
Ø	Ø	Ø	1	D1
Ø	Ø	1	Ø	D2
Ø	Ø	1	1	D3
Ø	1	Ø	Ø	D4
Ø	1	Ø	1	D5
Ø	1	1	Ø	D6
Ø	1	1	1	D7
1	X	X	X	Ø

X DON'T CARE

TERMINATION RESISTOR PACKS
R1844, R1914, R1931

TYPE	+4.9V	⏚
4011	14	7

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

IC TRUTH TABLES LOCATED ON BACK OF FIRST PULLOUT PAGE.

A16 PRINT HEAD ASSEMBLY

A15 PRINT DRIVE BOARD

PART A1 MOTHER BD

400 (SN B020000 & up)

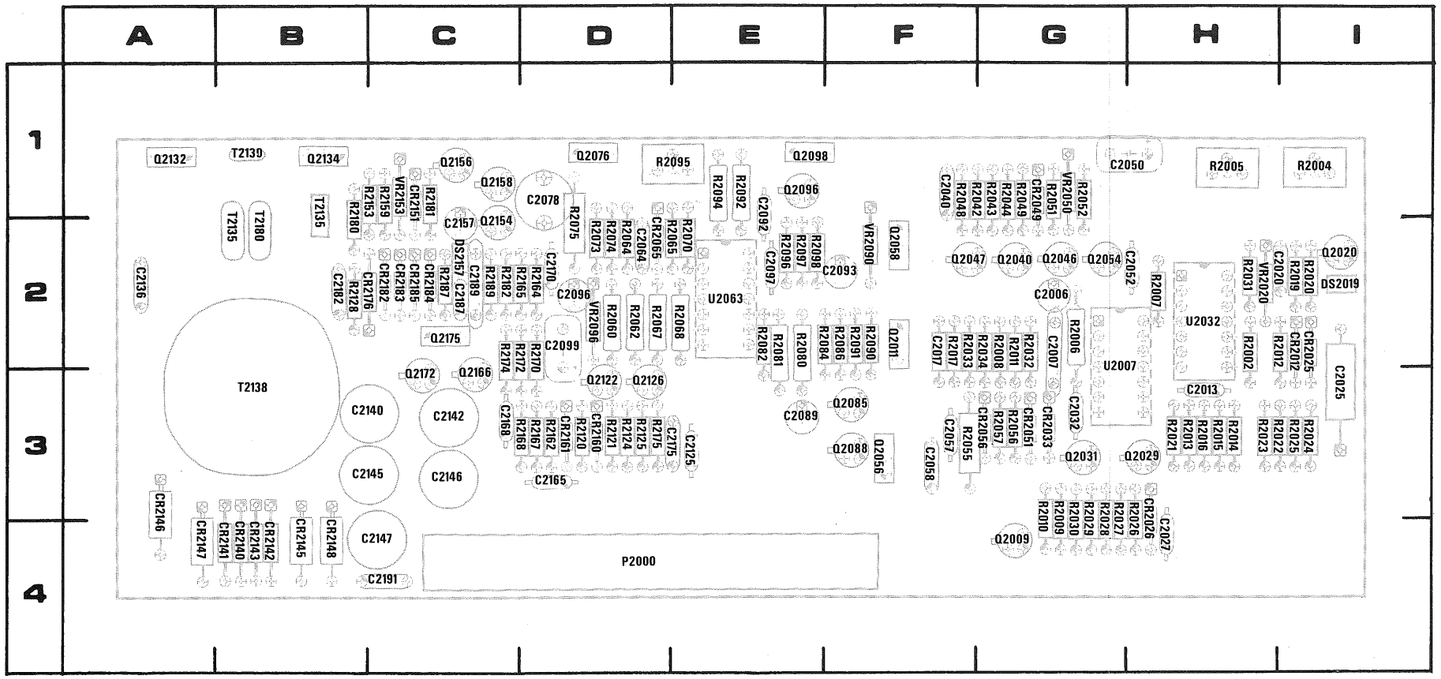
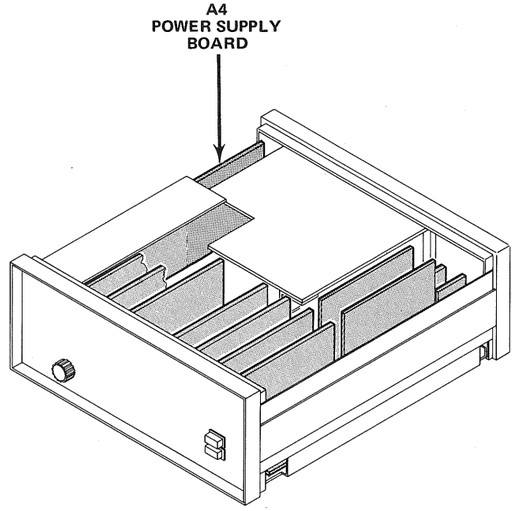


Figure 7-15. A4—Power Supply board component locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C2006	2G	C2182	2B	P2000	
C2007	2G	C2187	2C		
C2013	3H	C2189	2C	Q2009	
C2017	2F	C2191	4C	Q2011	
C2020	2H			Q2020	
C2025	3I	CR2012	2I	Q2029	
C2027	4H	CR2025	2I	Q2031	
C2032	3G	CR2026	4H	Q2040	
C2040	1F	CR2033	3G	Q2046	
C2050	1G	CR2049	1G	Q2047	
C2052	2H	CR2051	3G	Q2054	
C2057	3F	CR2056	3G	Q2056	
C2058	3F	CR2065	2D	Q2058	
C2064	2D	CR2140	4B	Q2076	
C2078	1D	CR2141	4B	Q2085	
C2089	3E	CR2142	4B	Q2088	
C2092	1E	CR2143	4B	Q2096	
C2093	2F	CR2145	4B	Q2098	
C2096	2D	CR2146	3A	Q2122	
C2097	2E	CR2147	4A	Q2126	
C2099	2D	CR2148	4B	Q2132	
C2125	3E	CR2151	1C	Q2134	
C2136	2A	CR2160	3D	Q2154	
C2140	3B	CR2161	3D	Q2156	
C2142	3C	CR2176	2B	Q2158	
C2145	3B	CR2182	2C	Q2166	
C2146	3C	CR2183	2C	Q2172	
C2147	4C	CR2184	2C	Q2175	
C2157	2C	CR2185	2C		
C2165	3D			R2002	
C2168	3C			R2004	
C2170	2D	DS2019	2I	R2005	
C2175	3D	DS2157	2C	R2006	



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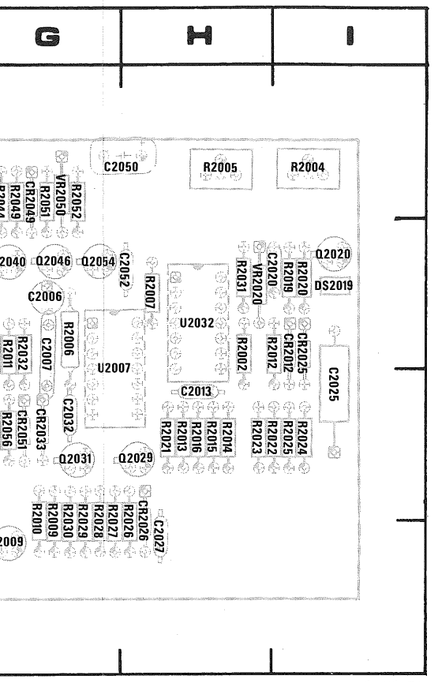
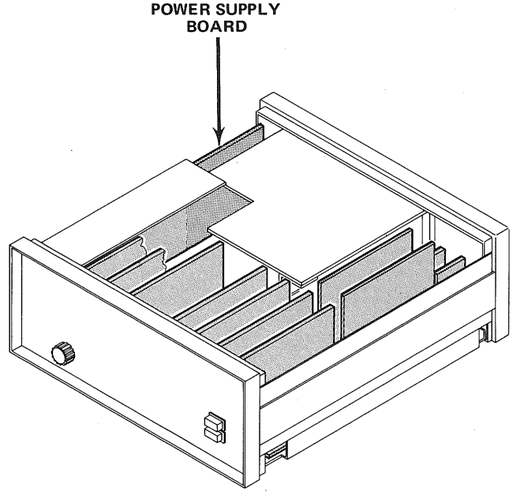
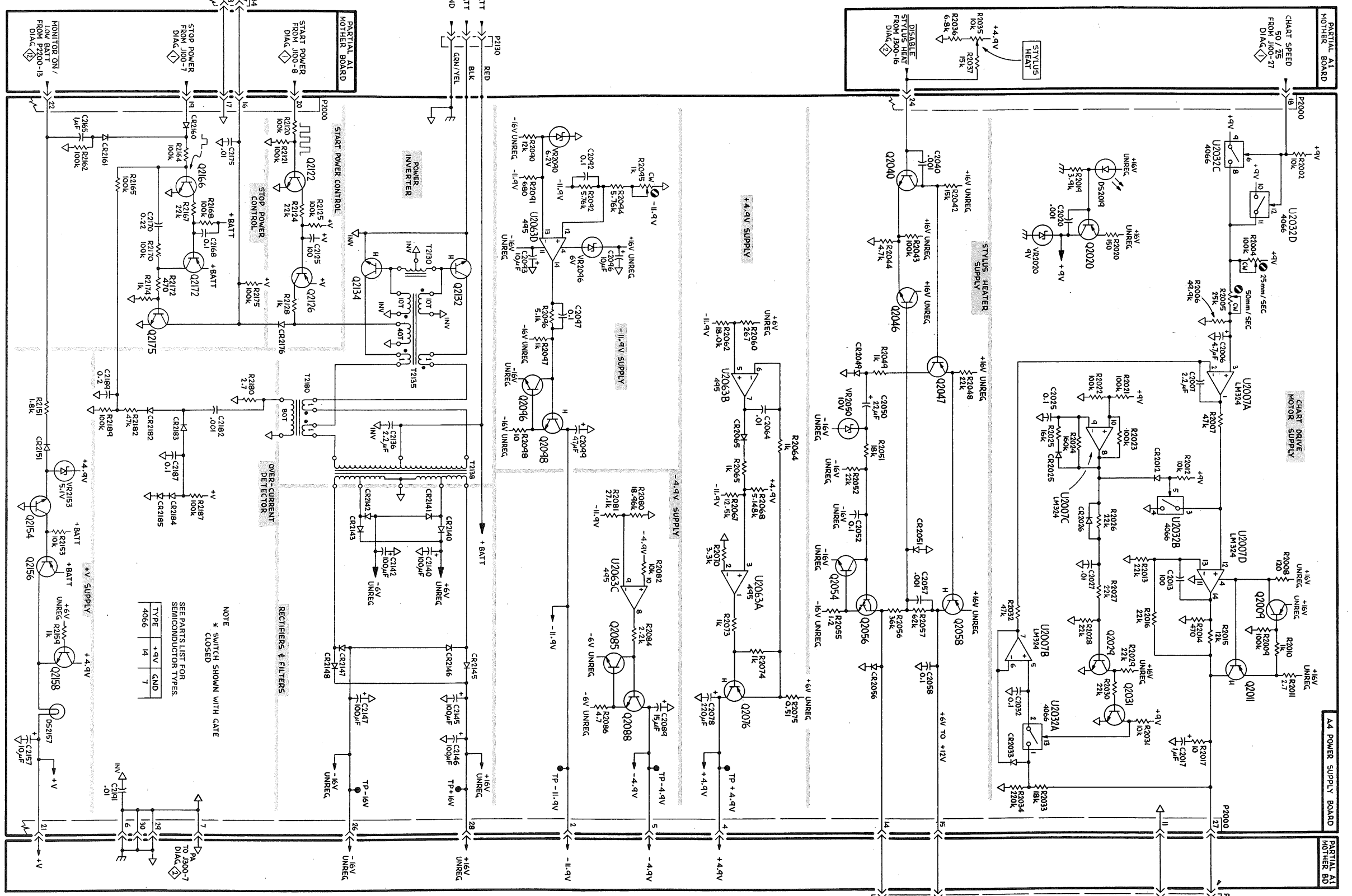


2429-54

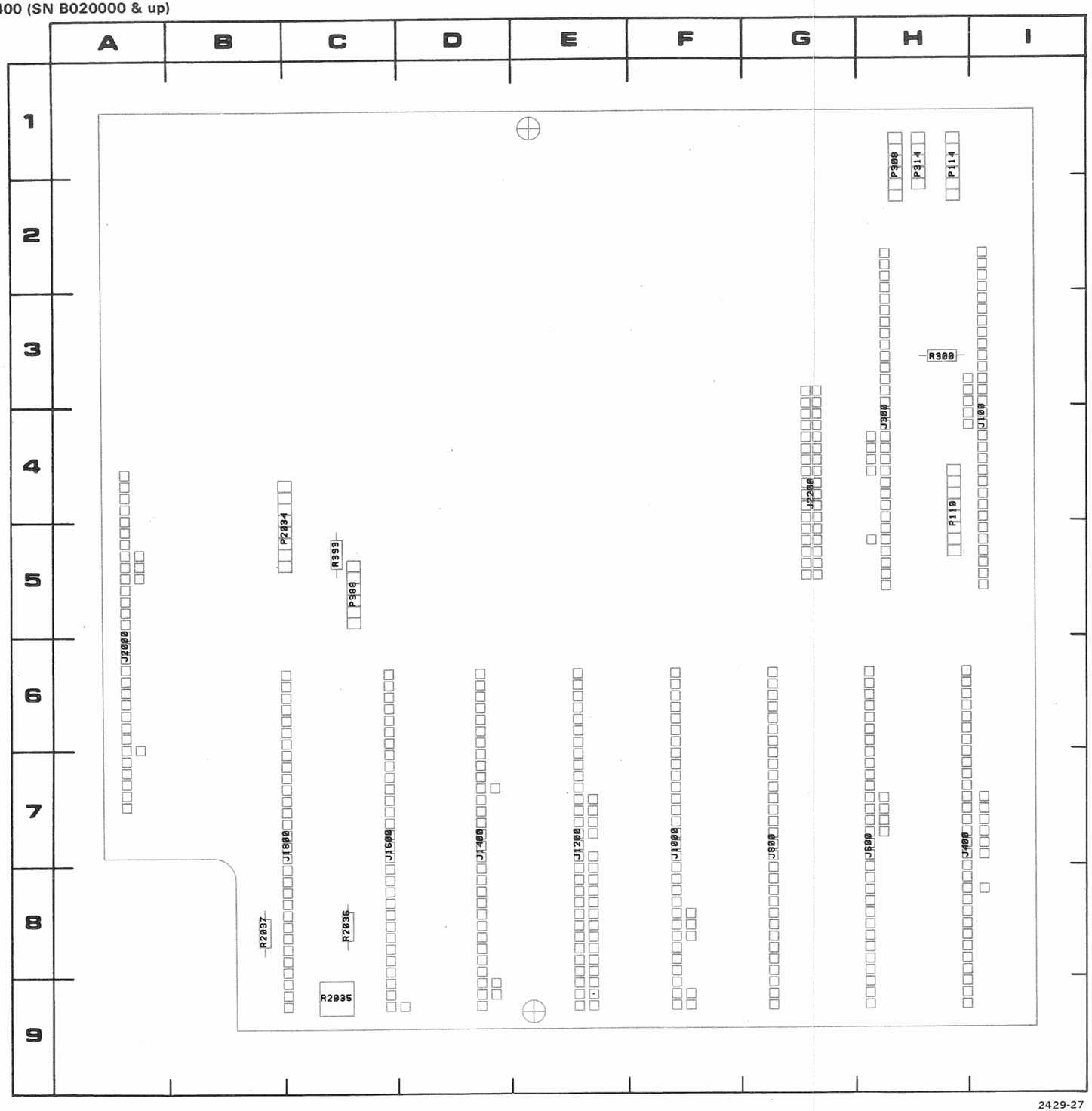


CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C2006	2G	C2182	2B	P2000	4D	R2007	2H	R2052	1G	R2153	1C
C2007	2G	C2187	2C			R2008	2G	R2055	3F	R2159	1C
C2013	3H	C2189	2C	Q2009	4G	R2009	4G	R2056	3G	R2162	3D
C2017	2F	C2191	4C	Q2011	2F	R2010	4G	R2057	3G	R2164	2D
C2020	2H			Q2020	2I	R2011	2G	R2060	2D	R2165	2C
C2025	3I	CR2012	2I	Q2029	3H	R2012	2H	R2062	2D	R2167	3D
C2027	4H	CR2025	2I	Q2031	3G	R2013	3H	R2064	2D	R2168	3D
C2032	3G	CR2026	4H	Q2040	2G	R2014	3H	R2065	2D	R2170	2D
C2040	1F	CR2033	3G	Q2046	2G	R2015	3H	R2076	2D	R2172	2C
C2050	1G	CR2049	1G	Q2047	2F	R2016	3H	R2068	2E	R2174	2C
C2052	2H	CR2051	3G	Q2054	2G	R2017	2F	R2070	2E	R2175	3D
C2057	3F	CR2056	3G	Q2056	3F	R2019	2I	R2073	2D	R2180	1B
C2058	3F	CR2065	2D	Q2058	2F	R2020	2I	R2074	2D	R2182	2C
C2064	2D	CR2140	4B	Q2076	1D	R2021	3H	R2075	2D	R2187	2C
C2078	1D	CR2141	4B	Q2085	3F	R2022	3H	R2080	2E	R2189	2C
C2089	3E	CR2142	4B	Q2088	3F	R2023	3H	R2081	2E		
C2092	1E	CR2143	4B	Q2096	1E	R2024	3I	R2082	2E	T2130	1B
C2093	2F	CR2145	4B	Q2098	1E	R2025	3I	R2084	2E	T2135	1B
C2096	2D	CR2146	3A	Q2122	3D	R2026	4H	R2086	2F	T2138	3B
C2097	2E	CR2147	4A	Q2126	3D	R2027	4G	R2090	2F	T2180	2B
C2099	2D	CR2148	4B	Q2132	1A	R2028	4G	R2091	2F		
C2125	3E	CR2151	1C	Q2134	1B	R2029	4G	R2092	1E	U2007	2G
C2136	2A	CR2160	3D	Q2154	2C	R2030	4G	R2094	1E	U2032	2H
C2140	3B	CR2161	3D	Q2156	1C	R2031	2H	R2095	1D	U2063	2E
C2142	3C	CR2176	2B	Q2158	1C	R2032	2G	R2096	2E		
C2145	3B	CR2182	2C	Q2166	3C	R2033	1F	R2097	2E	VR2020	2H
C2146	3C	CR2183	2C	Q2172	3C	R2034	2G	R2098	2E	VR2050	1G
C2147	4C	CR2184	2C	Q2175	2C	R2042	1F	R2121	3D	VR2090	2F
C2157	2C	CR2185	2C			R2043	1G	R2120	3D	VR2095	2D
C2165	3D			R2002	2H	R2044	1G	R2124	3D	VR2153	1C
C2168	3C			R2004	1I	R2048	1F	R2125	3D		
C2170	2D	DS2019	2I	R2005	1H	R2049	1G	R2128	2B		
C2175	3D	DS2157	2C	R2006	2G	R2051	1G	R2151	1C		

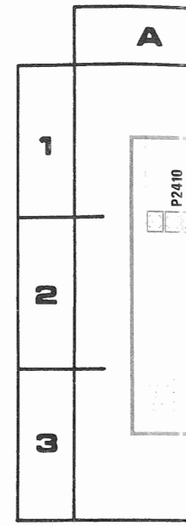

A4 POWER SUPPLY BOARD
PARTIAL A1 MOTHER BD
P2000
P2034
P2130
+ BATT
- BATT
GND
GRN/YEL
BLK
RED
FROM MONITOR
GATE OPEN
S2190
STYLUS HEAT
DISABLE STYLUS HEAT FROM J800-16 DIAG 2
CHART SPEED 50 / 75 FROM J600-27 DIAG 1
START POWER FROM J100-8 DIAG 1
STOP POWER FROM J100-7 DIAG 1
MONITOR ON / LOW BATT FROM P2200-15 DIAG 2
STYLUS HEATER SUPPLY
CHART DRIVE MOTOR SUPPLY
+4.9V SUPPLY
-11.9V SUPPLY
START POWER CONTROL
STOP POWER CONTROL
POWER INVERTER
-4.9V SUPPLY
+5V SUPPLY
OVER-CURRENT DETECTOR
RECTIFIERS & FILTERS
+6V UNREG
+16V UNREG
-16V UNREG
+4.9V
-11.9V
+5V
-4.9V
+ BATT
TP +4.9V
TP -11.9V
TP +16V
TP -16V
+6V TO +12V
TO J800-7 DIAG 2
STYLUS HEATER
HR2058 (45A TYP)
BRN
RED
BLACK
M
B2034
NOTE
* SWITCH SHOWN WITH GATE CLOSED
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
TYPE | +9V | GND
4066 | 14 | 7

400 (SN B020000 & up)

A1– MOTHER & A7–
MANIFOLD BD COMPONENTS



CKT NO	GRID COORD
J100	4I
J300	4H
J400	7H
J600	7H
J800	7G
J1000	7F
J1200	7E
J1400	7D
J1600	7C
J1800	7C
J2000	6A
J2200	4G
P110	4H
P114	1H
P308	1H
P314	1H
P388	5C
P2034	5C
R300	3H
R393	5C
R2035	9C
R2036	8C
R2037	8B



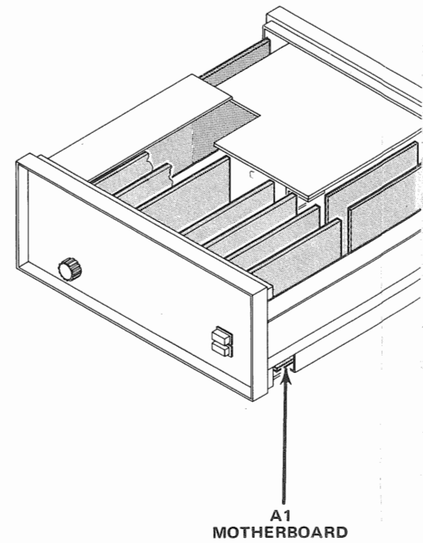
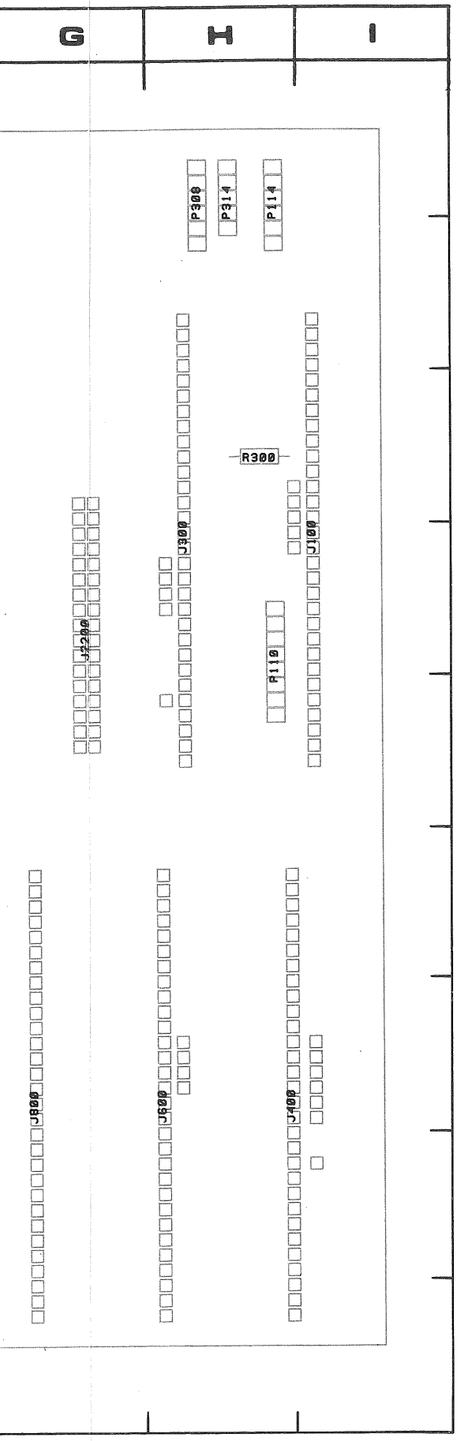


Figure 7-16. A1—Motherboard component locations.

@



CKT NO	GRID COORD
J100	4I
J300	4H
J400	7H
J600	7H
J800	7G
J1000	7F
J1200	7E
J1400	7D
J1600	7C
J1800	7C
J2000	6A
J2200	4G
P110	4H
P114	1H
P308	1H
P314	1H
P388	5C
P2034	5C
R300	3H
R393	5C
R2035	9C
R2036	8C
R2037	8B

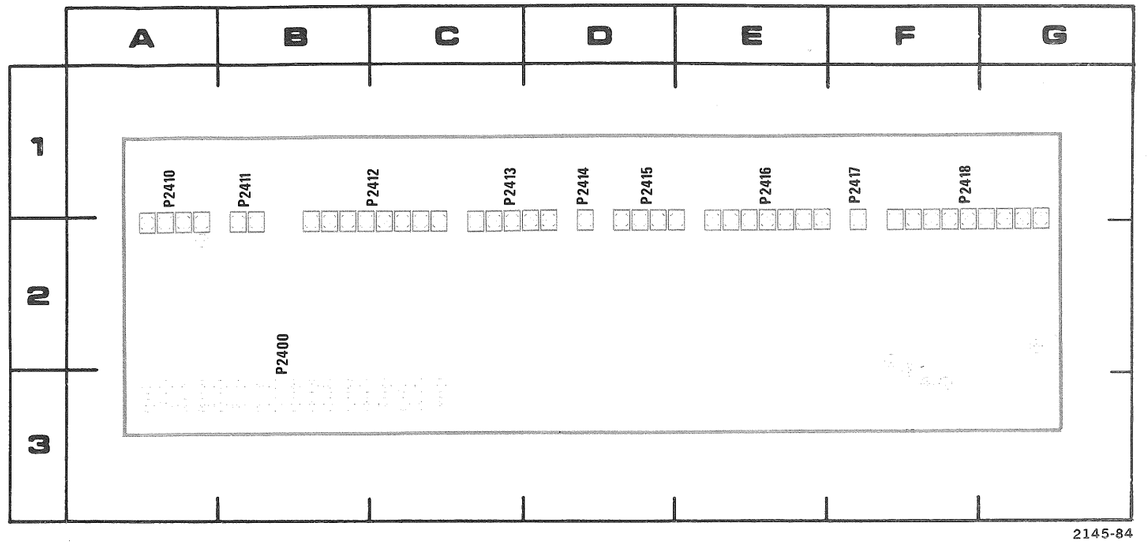
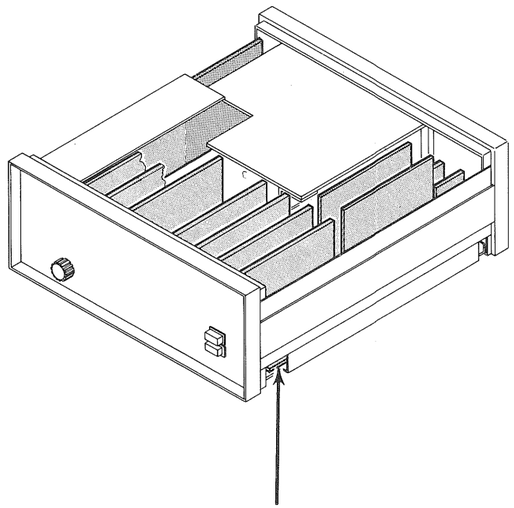


Figure 7-17. A7—Manifold board connector locations.



CKT NO	GRID COORD	CKT NO	GRID COORD
P2400	2B	P2414	1D
P2410	1A	P2415	1D
P2411	1B	P2416	1E
P2412	1C	P2417	1F
P2413	1C	P2418	1F

400 (SN B020000 & up)

MONITOR/RECORDER INTERCONNECTING SIGNAL

P2200	SIGNAL NAME	SIGNAL TYPE		VOLTAGE LIMITS
		DIGITAL	ANALOG	
1	ALARM EXT OUT	X		+7, 0 V
2	ALARM RESET	X		+7, 0 V
3	A/V WAVE SCALED		X	+3, –0.5 V
4	SKIP A	X		±7 V
5	SKIP TEMP A	X		+7 V
6	RATE OVERRANGE	X		±7 V
7	°F/$\overline{°C}$	X		≈1.0/0 V
8	A/V WAVE (PULSE WAVE)		X	+3.5, –0.5 V
9	TEMP A (DVM)		X	+1, 0 V
10	DIAST (DVM)		X	+3, 0 V
11	HEART RATE (DVM)		X	+3, 0 V
12	DVM COMMON	–	–	0 V
13	LOW BATT/$\overline{\text{MONITOR ON}}$	X		±7 V
14	TEMP B OVERRANGE	X		±7 V
15	SKIP TEMP B	X		±7 V
16	TEMP B (DVM)		X	+1, 0 V
17	+7 V	–	–	+7 V
18	A WAVE SCALED		X	+3, –0.5 V
19	RESP WAVE		X	±2 V
20	A WAVE		X	+3.5, –0.5 V
21	SKIP A/V	X		±7 V
22	A/V OVERRANGE	X		±7 V
23	TEMP A OVERRANGE	X		±7 V
24	–ECG WAVE		X	±2 V
25	WAVE COMMON	–	–	0 V
26	SYST (DVM)		X	+3, 0 V
27	MEAN(DVM)		X	+3, 0 V
28	PRESS/PULSE TRIG	X		±7 V
29	PRESS/$\overline{\text{PULSE}}$	X		+7, –3.6 V
30	ALARM	X		±7 V
31	RESP OVERRANGE	X		±7 V
32	SKIP RESP	X		±7 V
33	RESP RATE (DVM)		X	±2 V
34	RESP TRIG	X		±7 V

Battery Leads	Wire Color	Voltage
+BATTERY	Wht-red	5.5 V*
–BATTERY	Wht-brn	0 V
SAFETY EARTH	Grn-yel	0 V

*Depends on battery temperature and charge.

**In early Opt. 2 and 3 recorders, P2200-28 is connected to P2200-33 instead of J800-14.

@

NOTE 1: **

**OPTION WIRING TABLE	
RECORDER	WIRING CHANGES
STANDARD	THE SOURCE SWITCH BOARD IS REMOVED, AND REPLACED BY P308 AND P314 AS SHOWN IN NOTE 1.
OPTION 1 AND OPTION 2	SWITCH S310C IS REMOVED. A STRAP IS INSTALLED TO THE +4.9 V AS SHOWN WITH DOTTED LINE. S310B BECOMES A/V PULSE
OPTION 3	THE SOURCE SWITCH BOARD WIRING CONFIGURATION SHOWN APPLIES TO OPTION 3 ONLY. THE STRAP ACROSS S310C IS REMOVED.
OPTION 4	MOVE WIRE FROM PIN 2, P308 TO PIN 5, P308. THE STRAP ACROSS S310C IS INSTALLED.

MONITOR / RECORDER INTERCONNECTING SIGNALS

** SOURCE (SHOWN IN ECG)

A S310C — A/V S310B — ECG S310A

SEE DIAG 2

AS SOURCE SW BD

WHT — VELOCITY FEEDBACK — BLU — YEL — M B389 PEN MOTOR — RED

SEE DIAG 2

LOW PAPER S394

R393 330 +V

P314 P308 P388

A WAVE FROM P2200-20 (J400-18) — A/V WAVE FROM P2200-8 (J600-20) — WAVE COMMON FROM P2200-25 (J300-24) — +4.9V

POWER SUPPLY J2000 — PRINT DRIVE J1800 — PRINT CONTROL 2 J1600 — PRINT CONTROL 1 J1400 — SPARE J1200 — DVM DIGITAL J1000 — DVM ANALOG J800 — A/V BUFFER OR A/V CONDITIONER J600 — A CONDITIONER J400 — PEN AMPLIFIER J300 — RUN CONTROL J100

SPARE
-11.9V
AUX GND
+4.9V
+4.9V
--4.9V
GND

+4.9V

VPA TO J300-7

PRINT SPEED 25/50 FROM J100-17
+16V UNREG FROM J2000-28
PRINT BUSY FROM J1400-7
SP Ø FROM J1400-13
SP 1 FROM J1400-14
SP 2 FROM J1400-15

BCD Ø FROM J1000-7
BCD 1 FROM J1000-8
BCD 2 FROM J1000-9
BCD 3 FROM J1000-10

START PRINT FROM J100-29
PRINT "ALARM" FROM J100-30

SD Ø TO J1000-11
SD 1 TO J1000-12
DVM / CLK TO J1000-13
SPARE TO J1000-14
- SIGN FROM J1000-15
UPDATE DVM
SPARE
EOW
LOAD
COND LOAD
LA Ø
LA 1
LA 2
LA 3
LA 4
LA 5
OVRNG ENABLE TO J1800-26
UPDATE INH TO J1000-28
SKIP FROM J1800-27

PRINT BUSY TO J100-28, J1800-9
SELECT A/ A/V TO J400-21
SAMPLE+MARK FROM J100-25
*C/ *F FROM J600-17
SP Ø TO J800-22, J1800-10
SP 1 TO J800-23, J1800-11
SP 2 TO J800-24, J1800-12
+V FROM J2000-21

BCD Ø TO J1600-7
BCD 1 TO J1600-8
BCD 2 TO J1600-9
BCD 3 TO J1600-10
SD Ø FROM J1600-11
SD 1 FROM J1600-12
DVM / CLK FROM J1600-13
SPARE FROM J1600-14
- SIGN TO J1400-16
+V FROM J2000-21
COMPARATOR
RAMP CONTROL
< 30mV
SIGN
CLOCK RESET
SP Ø FROM J1400-13
SP 1 FROM J1400-14
SP 2 FROM J1400-15
32.768kHz TO J1800-28
UPDATE INH
1/60Hz (1PPM)
128Hz TO J1800-24
64Hz TO J1800-30
2Hz

SYST (2) FROM J600-26
DIAST (2) FROM J600-28
MEAN (2) FROM J600-30

SELECT PULSE/PRESS FROM J300-27
SKIP A/V (1)
A/V OVRNG (1)
NOTE * FOR OPTION 2 JUMPERS AT J400 CONNECT PINS 8-9, 10-11, 25-26, 27-28, 29-30
+V FROM J2000-21
*C/*F TO J1400-12
A WAVE TO P308-2
WAVE COMMON
A/V WAVE TO P308-1
SELECT A/ A/V
SYST (A/V)
DIAST (A/V)
MEAN (A/V)
SYST (1)
SYST (2) TO J800-8
DIAST (1)
DIAST (2) TO J800-9
MEAN (1)
MEAN (2) TO J800-10
FROM J1400-10

SKIP PRESS TO J1800-15
PRESS OVRNG TO J1800-21

+ INPUT
BUFFERED ECG OUT
ECG POSITION OUT
- INPUT
DISABLE PRESSURE POSITION

VPA FROM J2000-7
-16V UNREG FROM J2000-26
+16V UNREG FROM J2000-28
MARK
R300 390k
PRINT ONLY

DISABLE STYLUS HEAT TO J2000-24

SAMPLE+MARK FROM P114-2
TO J1200-11
SELECT PULSE/PRESS TO J600-7
WAVE COMMON TO P308-3

STOP POWER TO J2000-19
START POWER TO J2000-20
+V FROM J2000-21
SAMPLE+MARK TO J100-25
+V
PRINT SPEED 25/50 TO J1800-7
15 MIN
TIMER COMMON
SAMPLE+MARK
ALARM (1)
CHART SPEED 50/25 TO J2000-18
PRINT BUSY FROM J1400-7
START PRINT TO J1400-8
PRINT "ALARM" TO J1400-9

P114
LOW PAPER
DS345
SEE DIAG 1
SAMPLE MARK
S105
SPEED mm/SEC 50 OUT 25
S200
A6 SAMPLE/MARK/ SPEED SWITCH BD.
15MIN
S110A
J104
REMOTE SAMPLE/MARK
AUTOMATIC SAMPLE MODES
S110B
P110
A1 MOTHER BOARD
SEE DIAG 1

CHART DRIVE MOTOR
P2034
BLK
B2034
M
HR2058 45
STYLUS HEATER
S2140 GATE OPEN
SEE DIAG 1
RED

CHART SPEED 50/25 FROM J100-27
STOP POWER FROM J100-7
START POWER FROM J100-8
+V

STYLUS HEAT
+4.9V
R2035 10k
R2036 6.8k
R2037 15k
DISABLE STYLUS HEAT FROM J300-16
-16V UNREG TO J300-8
+16V UNREG TO J300-9 J1800-8

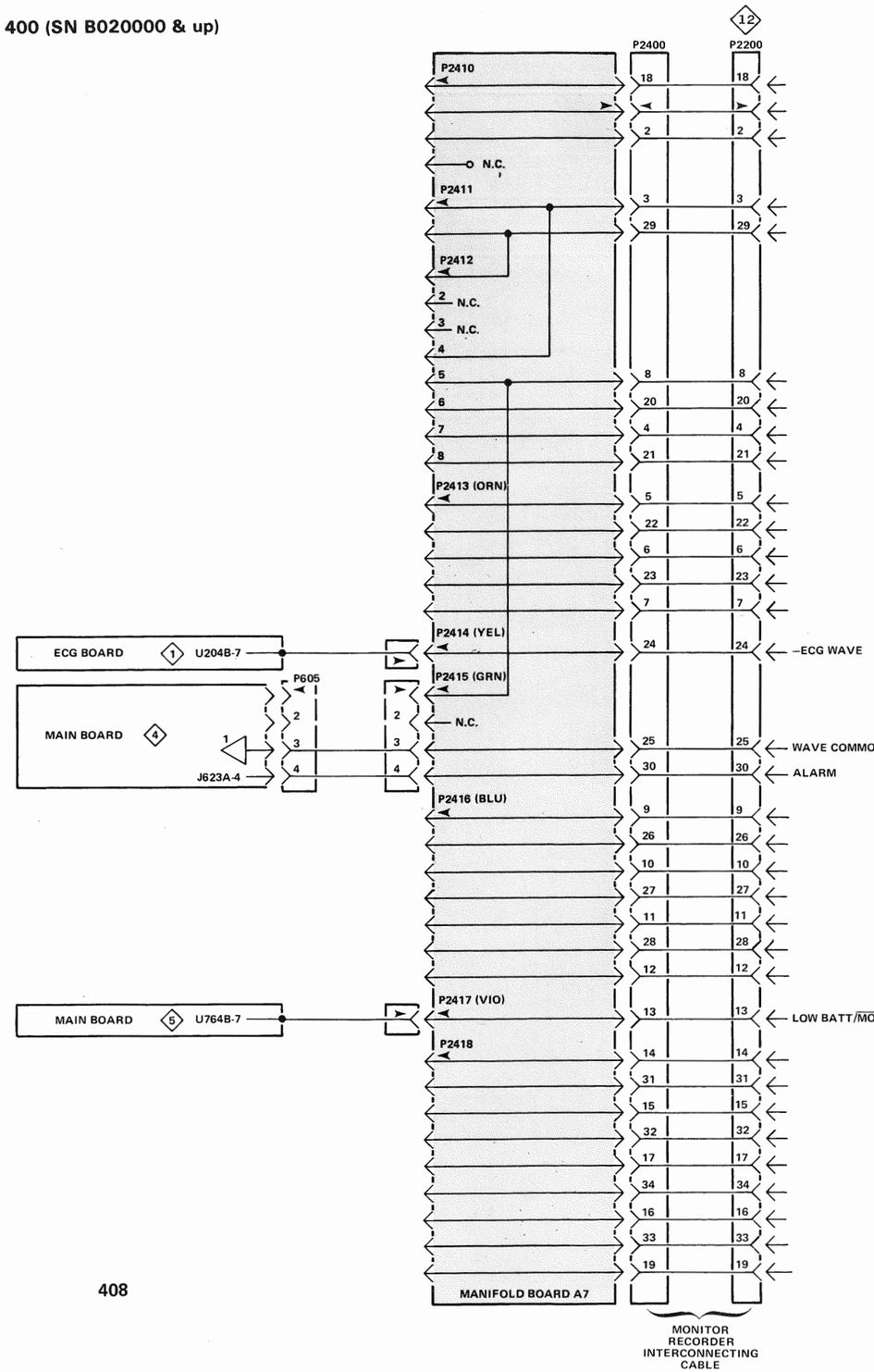
OVRNG
EOC
SKIP PRESS FROM J400-8
PRESS OVRNG FROM J400-10
OVRNG ENABLE FROM J1600-28
SKIP TO J1400-30
32.768kHz FROM J800-25
128Hz FROM J800-28
64Hz FROM J800-29

P2200

LOW BATT / MONITOR ON — SKIP TEMP A — TEMP A OVRNG — TEMP B OVRNG — RESP OVRNG — A WAVE SCALED — NC — RATE OVRNG — ALARM EXT OUT — NC — SKIP RESP — SKIP TEMP B — RESP TRIG — RESP WAVE — +7V — ALARM RESET — UPDATE INH FROM J1600-24 — GND (DVM COM) — PRESS/PULSE TRIG — NC — RESP RATE (DVM) — TEMP B (DVM) — TEMP A (DVM) — HEART RATE (DVM) — SKIP A/V — A/V OVRNG — *F/*C — A/V WAVE SCALED — WAVE COMMON — A/V WAVE (PULSE) — MEAN — DIAST — SYST — A WAVE — SKIP A — - ECG WAVE — PRESS/PULSE — ALARM

MONITOR CONNECTIONS SHOWN IN MONITOR / RECORDER INTERCONNECTIONS
FIGURE 7-18, 7-19, 7-20

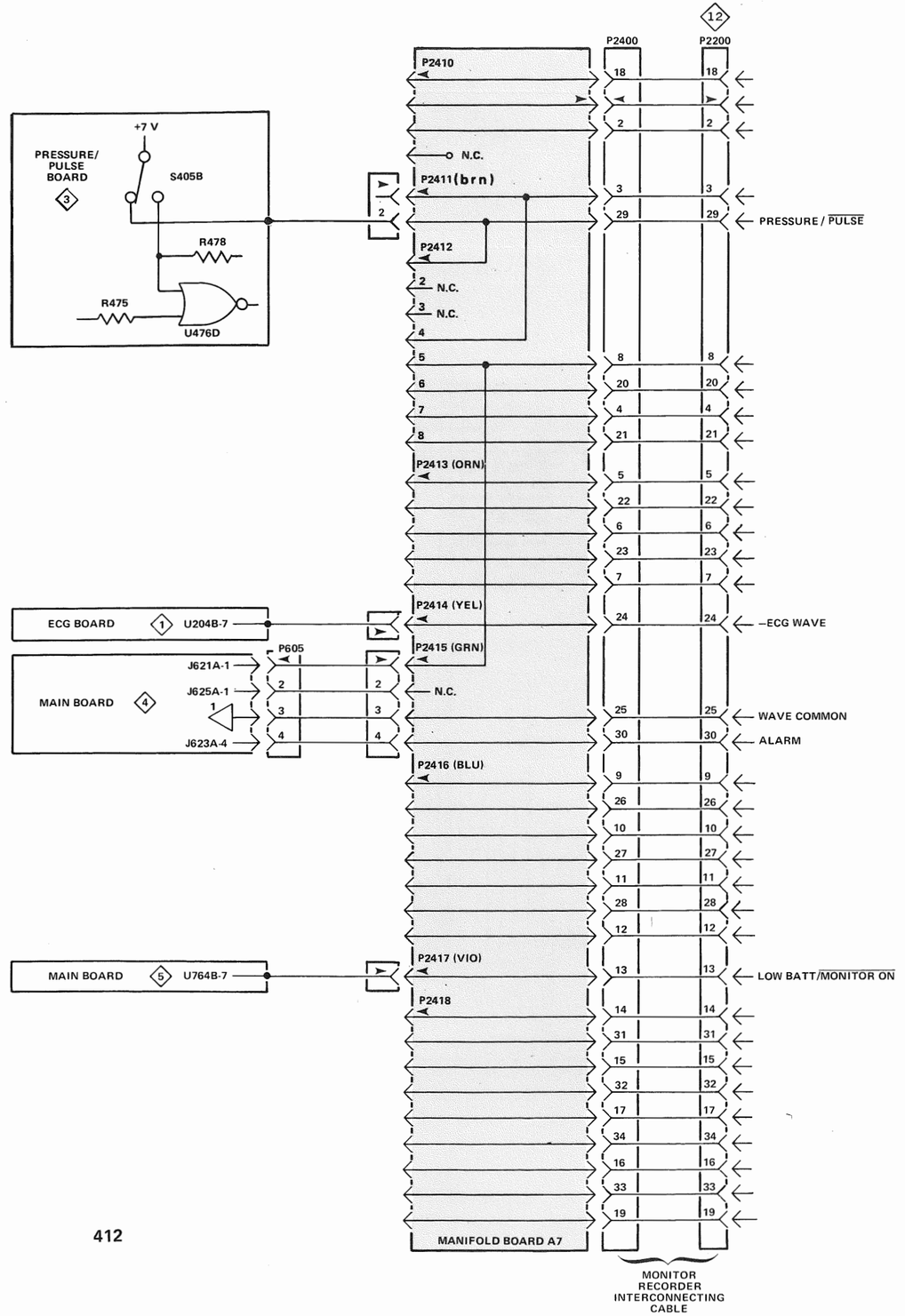
400 (SN B020000 & up)



408

@

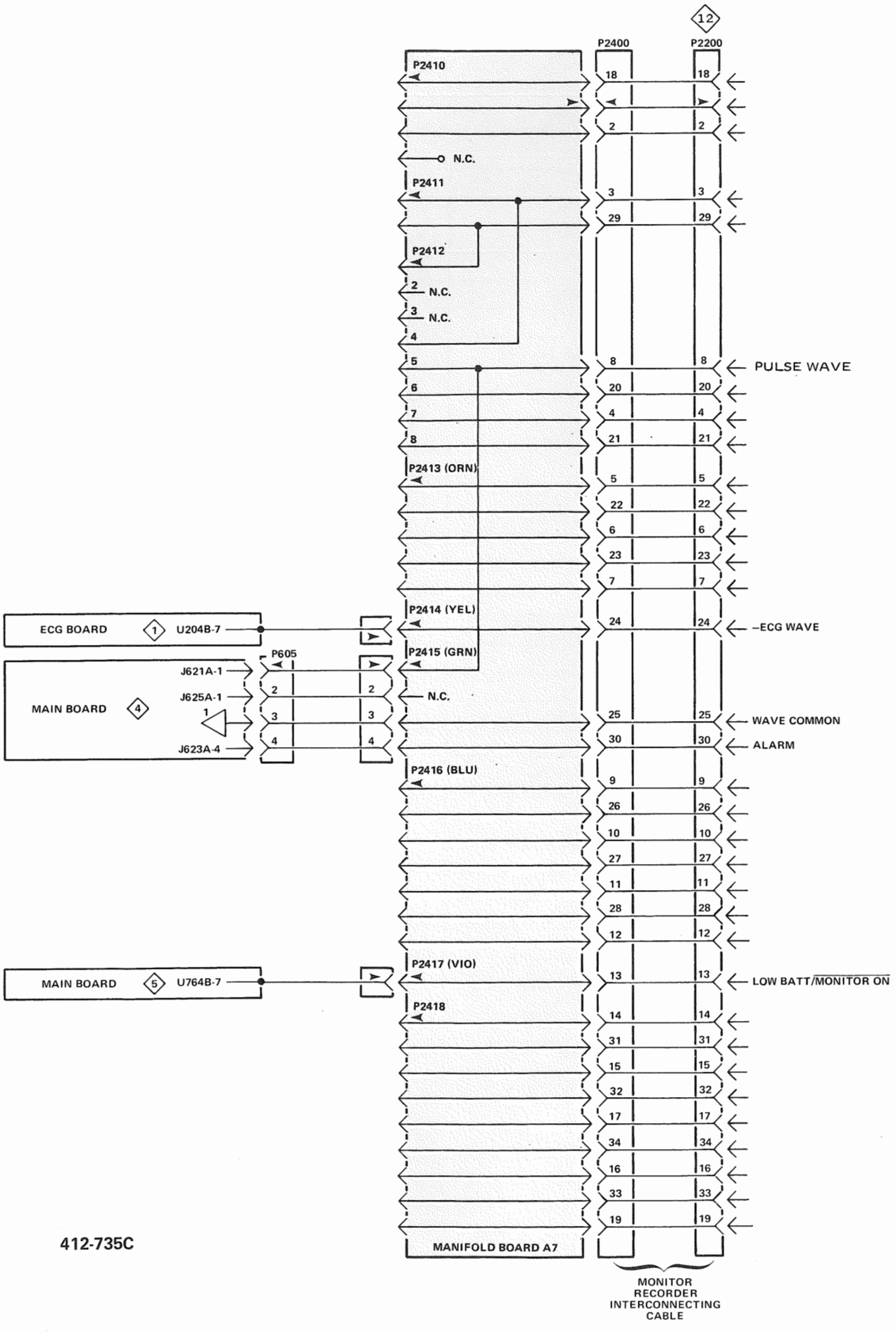
2145-86

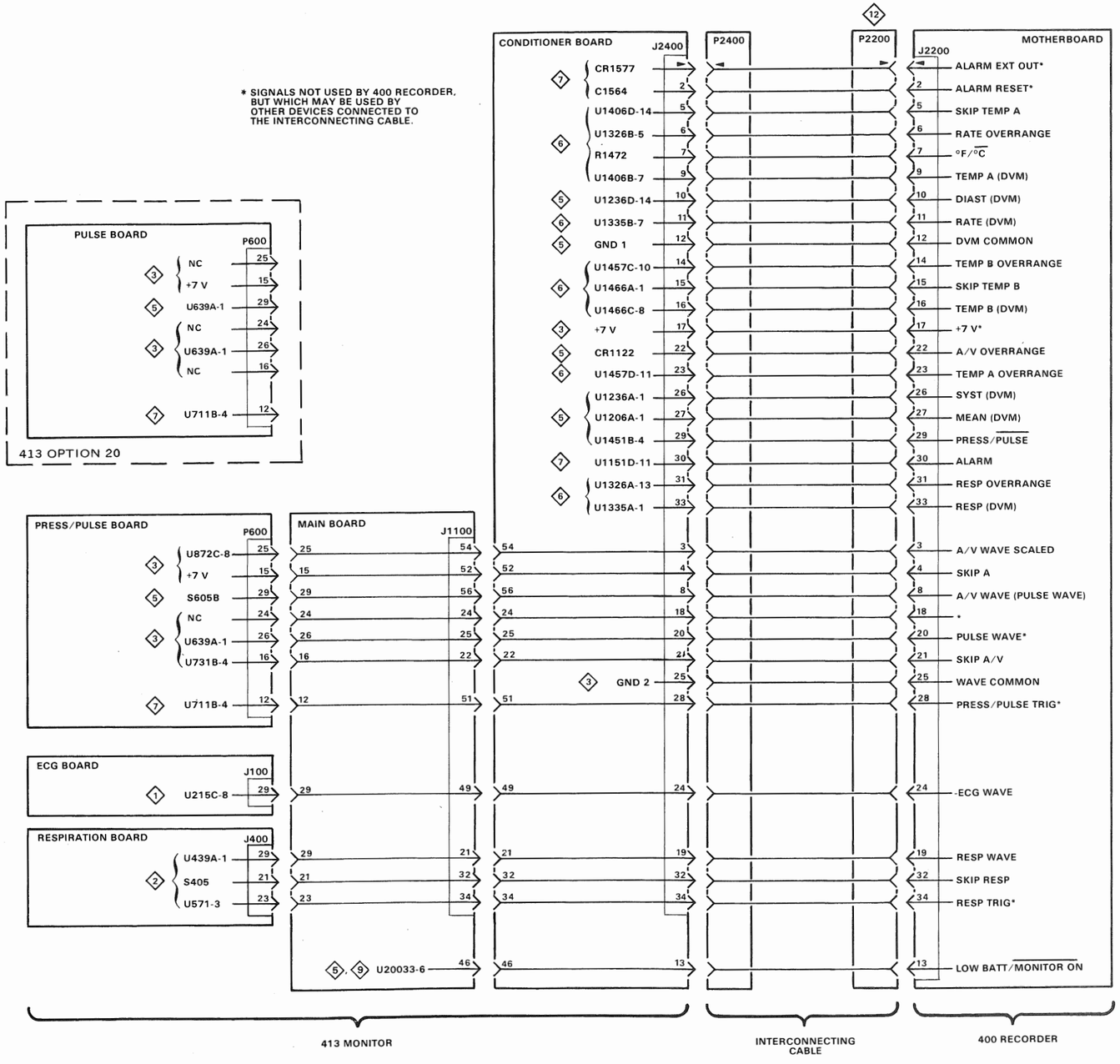


412

Figure 7-18. Monitor/Recorder Signal Interconnections (408, 412, 412-735C).

2145-87

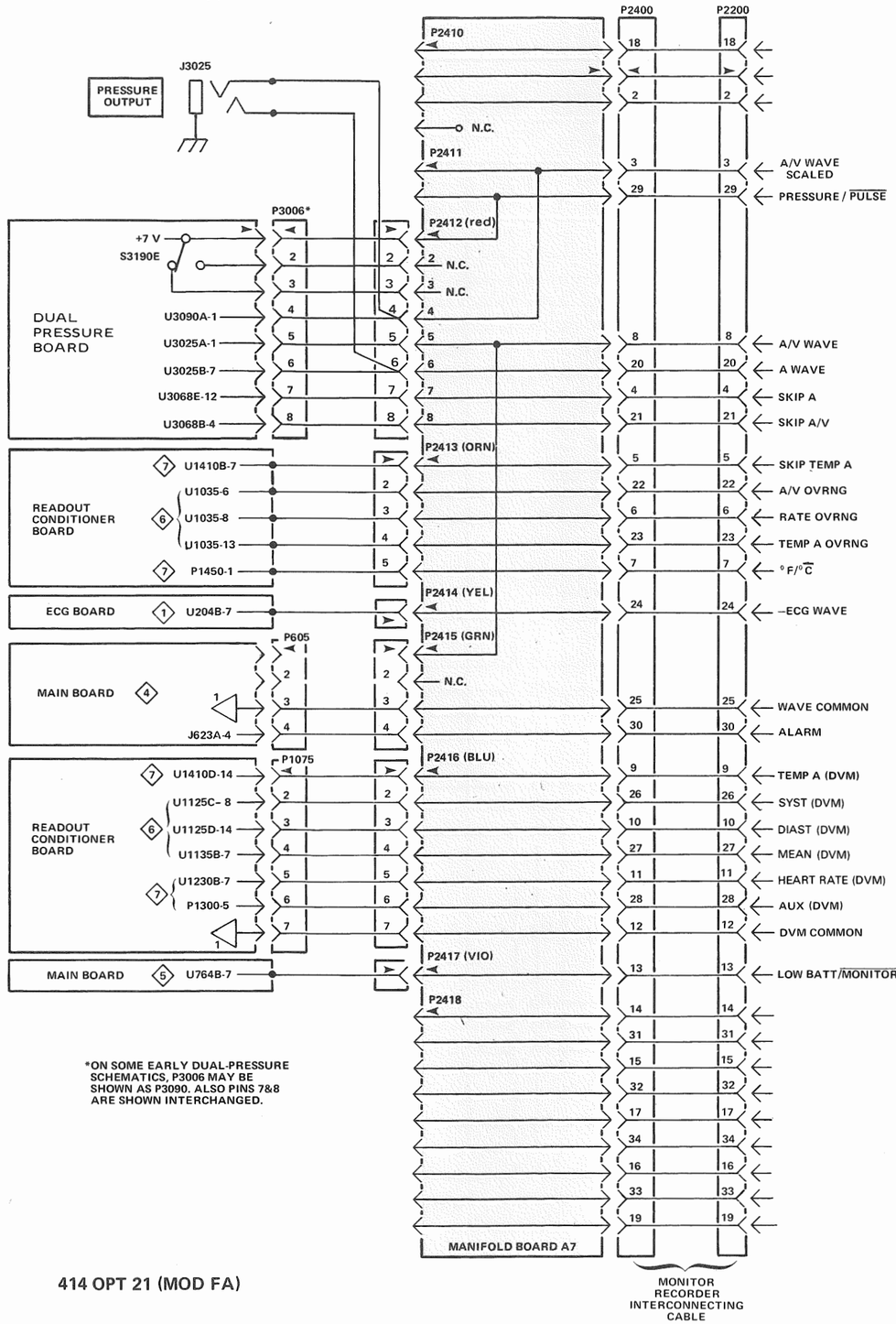

12
P2400
P2200
P2410
18
18
2
2
N.C.
P2411
3
3
29
29
P2412
2 N.C.
3 N.C.
4
5
8
8
PULSE WAVE
6
20
20
7
4
4
8
21
21
P2413 (ORN)
5
5
22
22
6
6
23
23
7
7
P2414 (YEL)
24
24
–ECG WAVE
ECG BOARD
1
U204B-7
P605
P2415 (GRN)
J621A-1
J625A-1
MAIN BOARD
4
1
2
3
4
J623A-4
N.C.
25
25
WAVE COMMON
30
30
ALARM
P2416 (BLU)
9
9
26
26
10
10
27
27
11
11
28
28
12
12
P2417 (VIO)
MAIN BOARD
5
U764B-7
13
13
LOW BATT/MONITOR ON
P2418
14
14
31
31
15
15
32
32
17
17
34
34
16
16
33
33
19
19
MANIFOLD BOARD A7
MONITOR
RECORDER
INTERCONNECTING
CABLE
412-735C
2145-88



413, 413 OPT 20

Figure 7-19. Monitor/Recorder Signal Interconnections (413, 413/OPT 20).

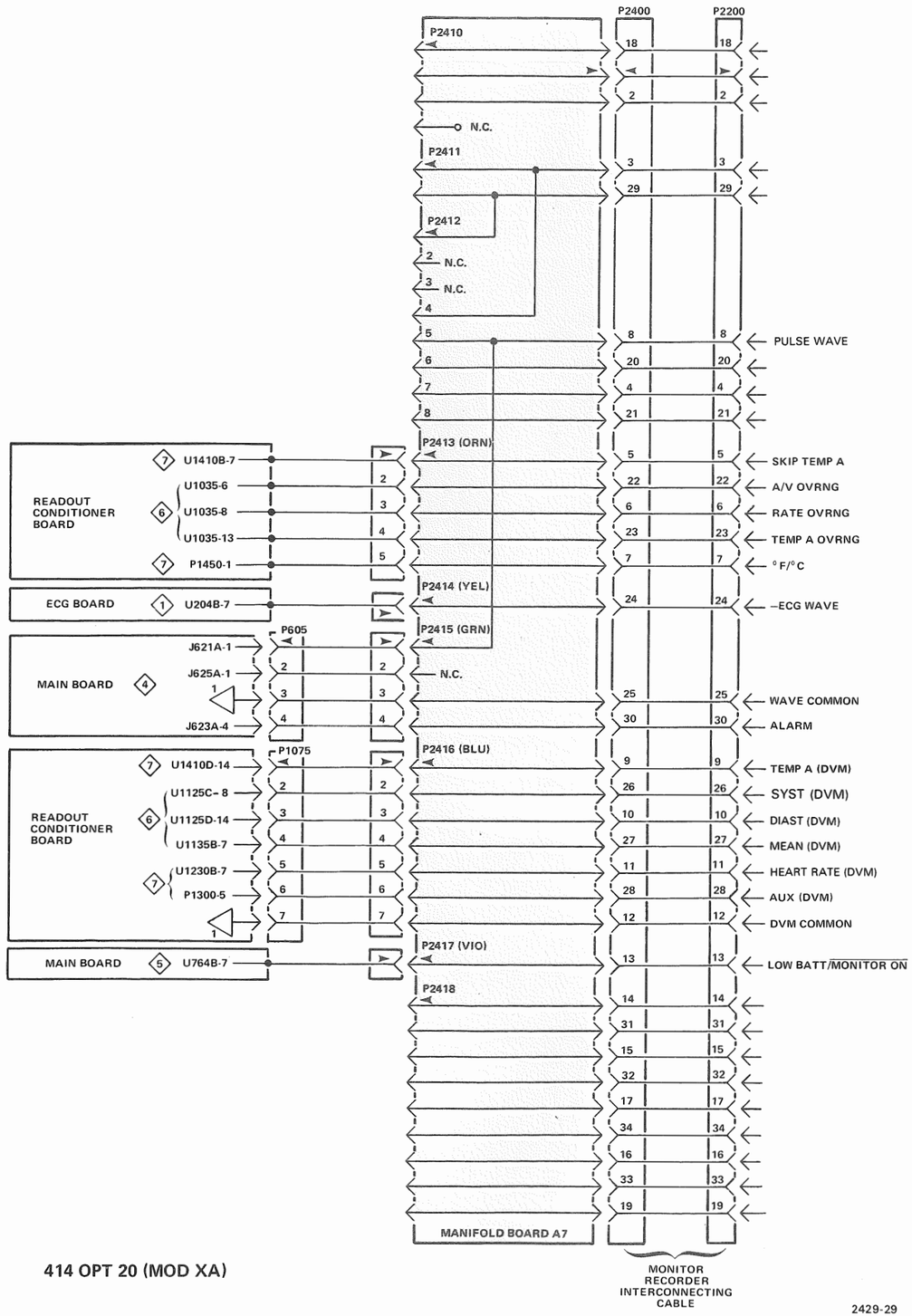
400 (SN B020000 & up)



*ON SOME EARLY DUAL-PRESSURE SCHEMATICS, P3006 MAY BE SHOWN AS P3090. ALSO PINS 7&8 ARE SHOWN INTERCHANGED.

414 OPT 21 (MOD FA)

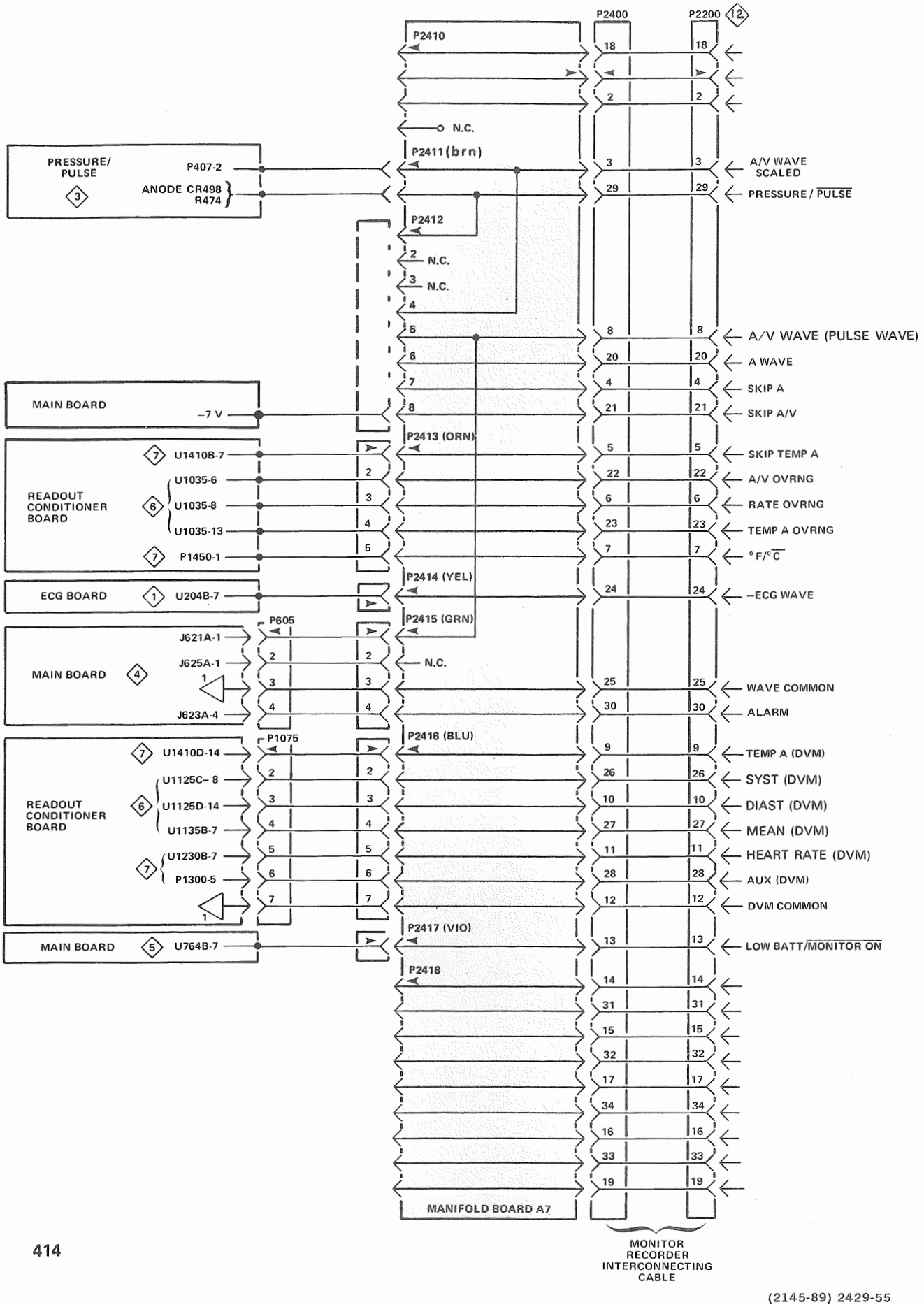
2145-90



414 OPT 20 (MOD XA)

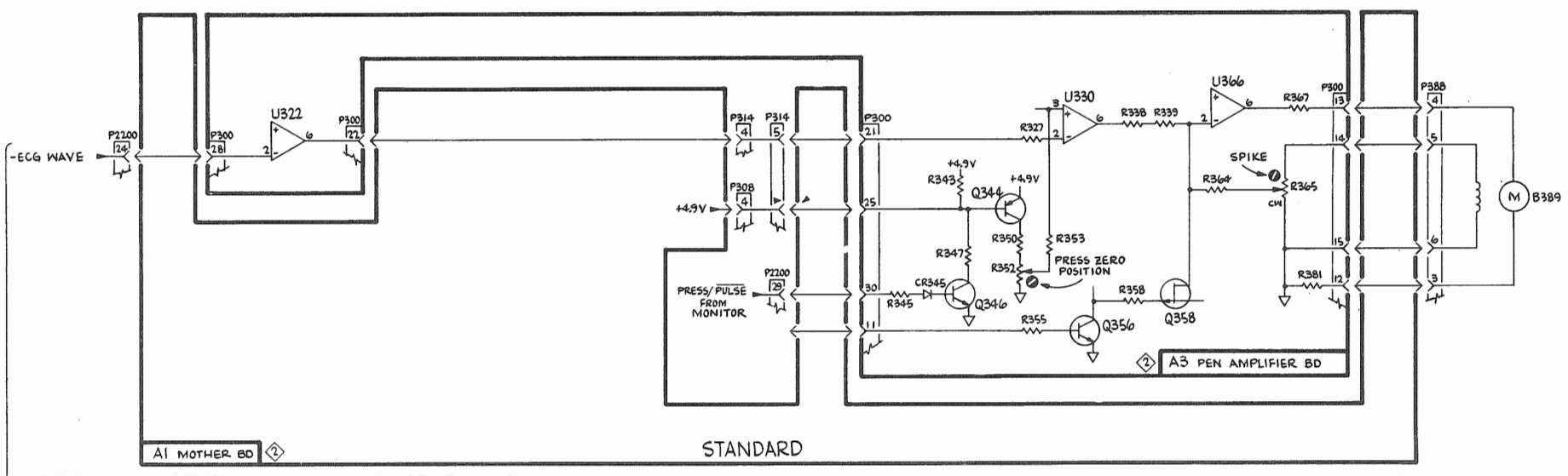
2429-29

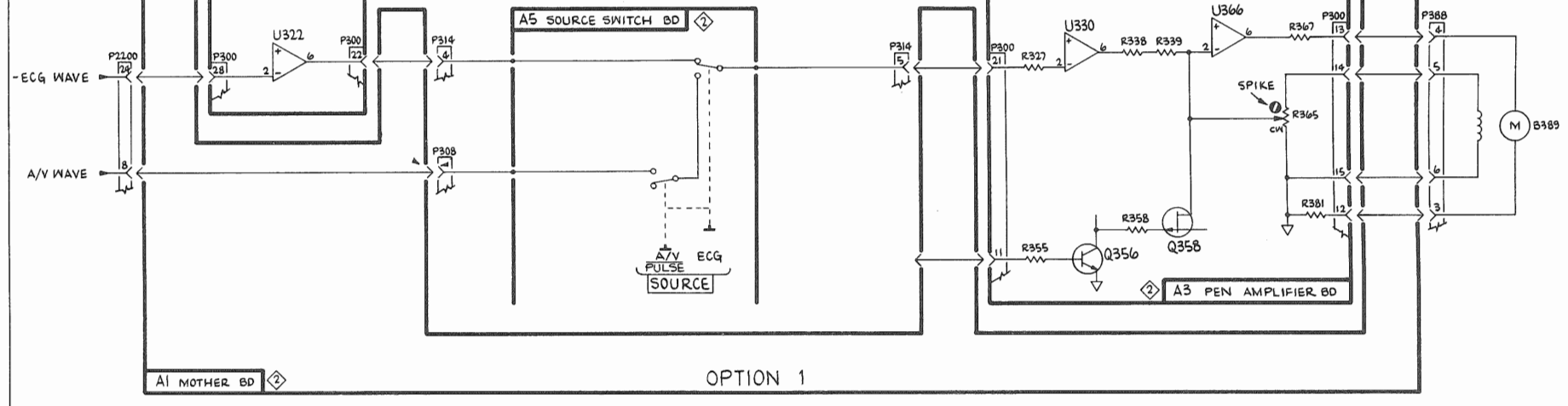
Figure 7-20. Monitor/Recorder Signal Interconnection 414 OPT 21 MOD FA, 414 OPT 20 (MOD XA), 414.



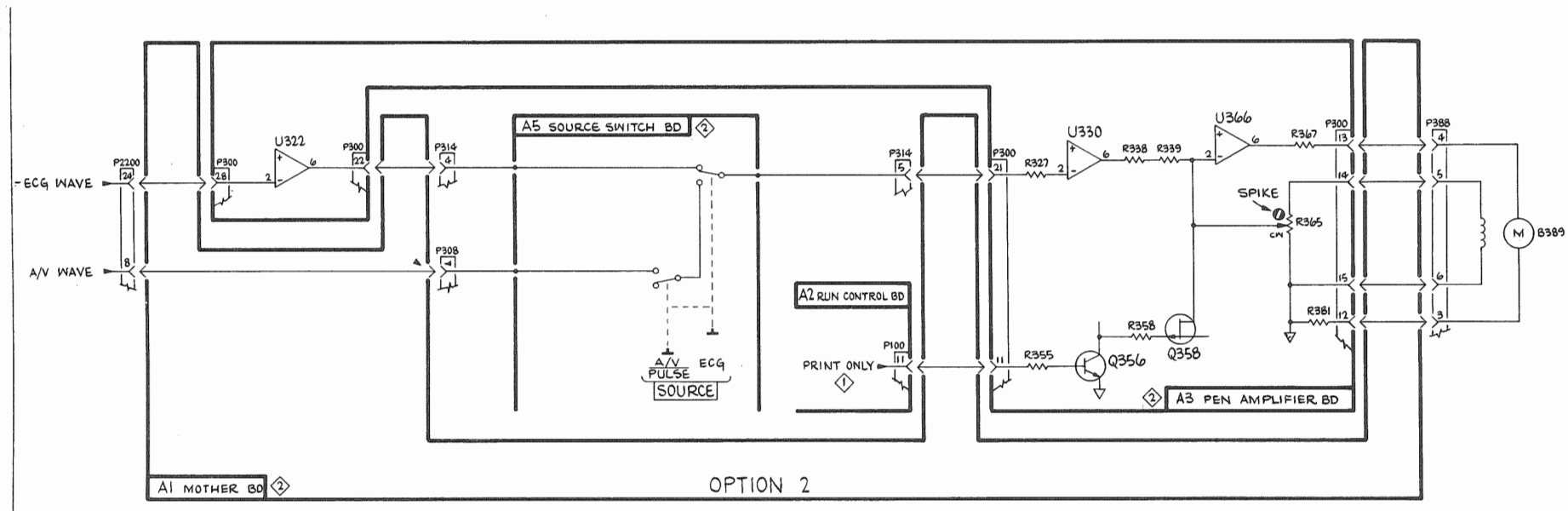
(2145-89) 2429-55

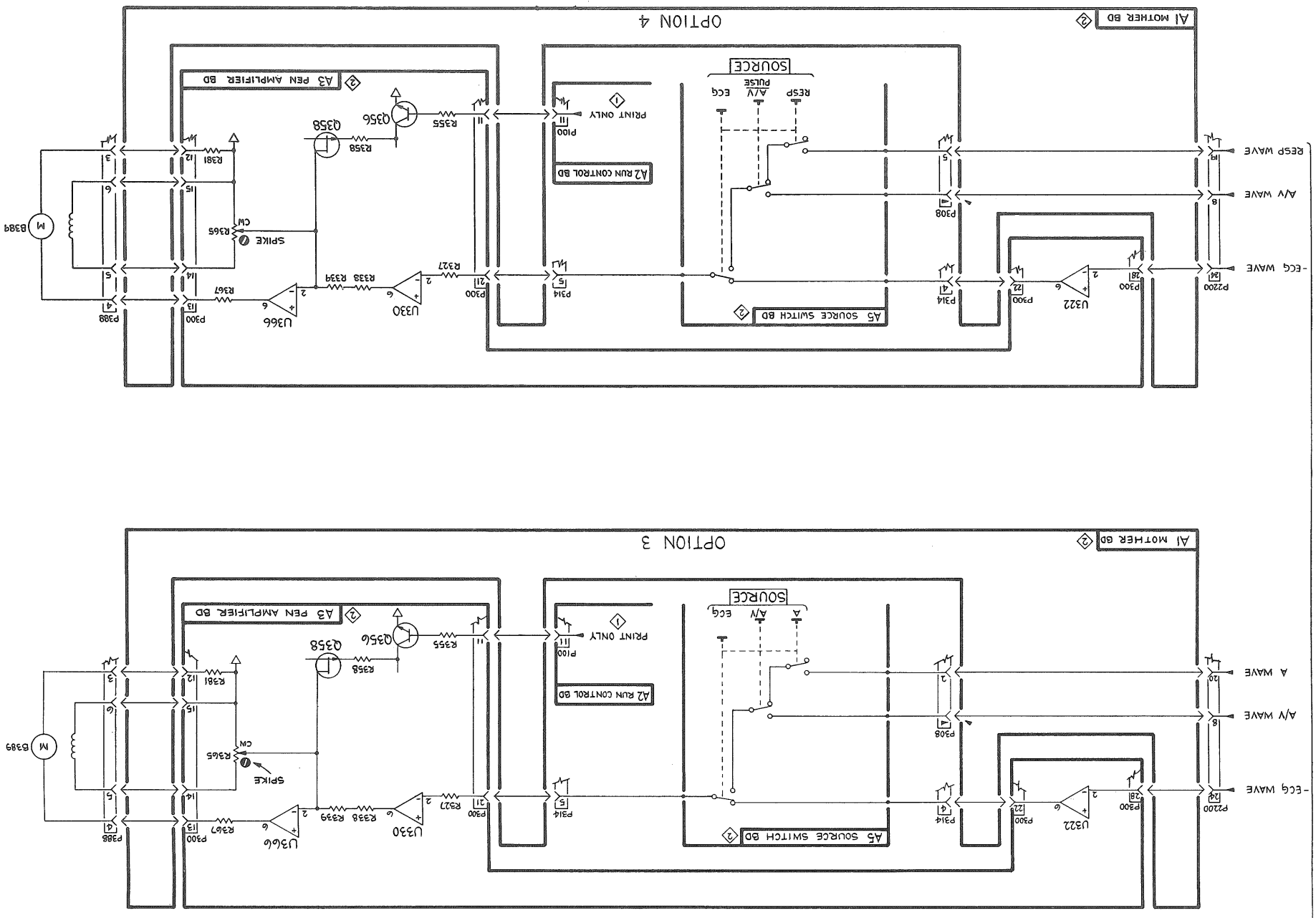
400 RECORDER
(SN 802000 & UP)



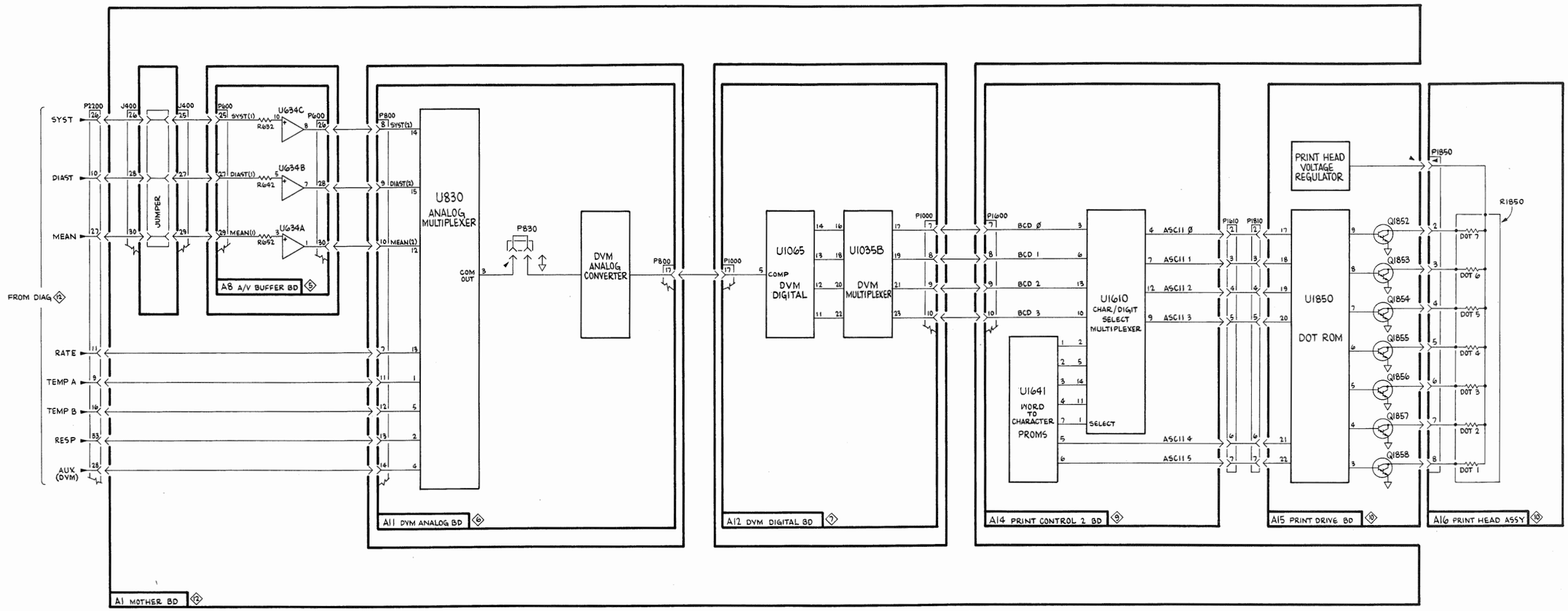


FROM MONITOR





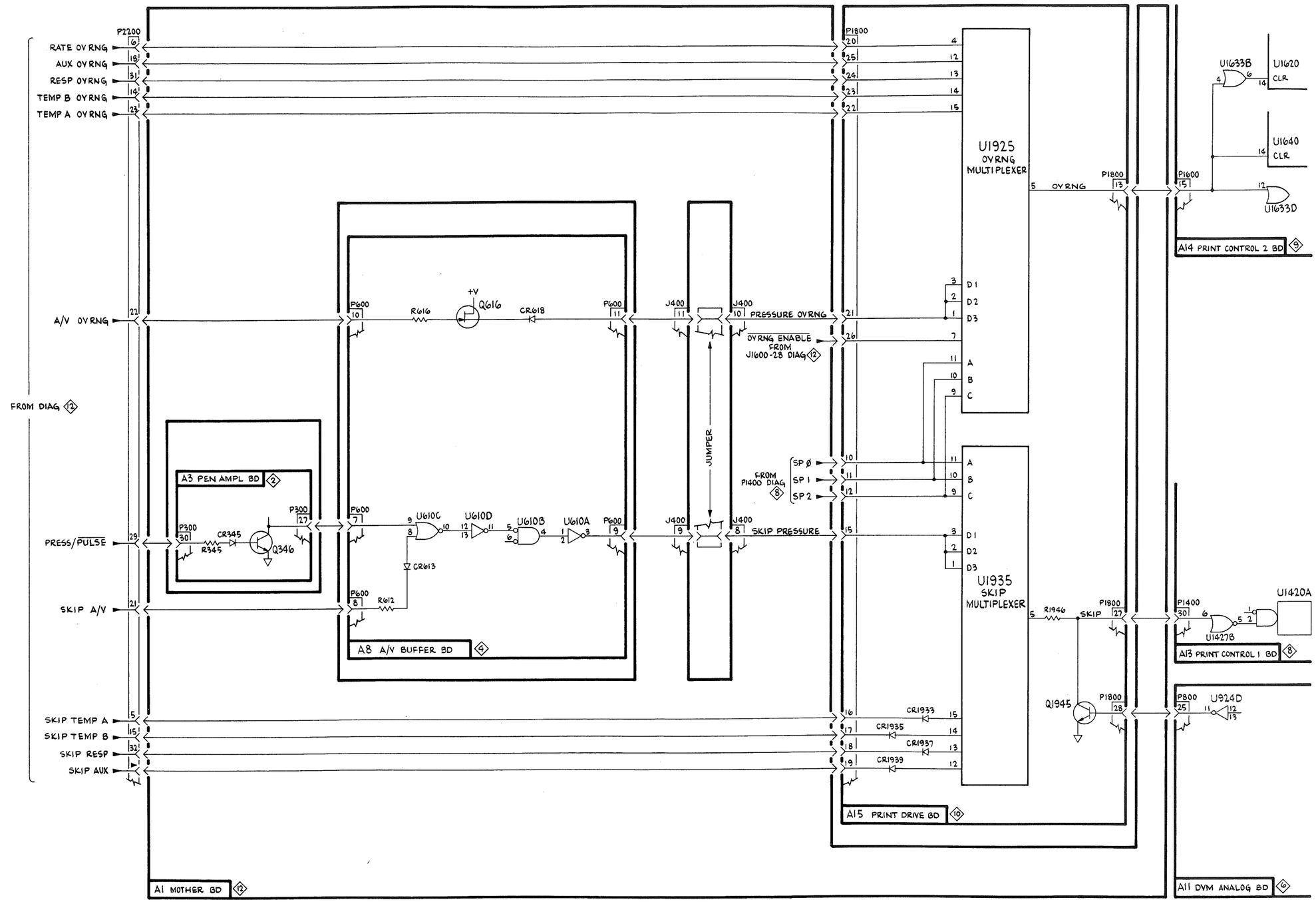
ANALOG SIGNAL ROUTING



400 RECORDER
(SN B02000 & UP)

@

DVM SIGNAL ROUTING
OPTIONS 2 & 4



400 RECORDER
(SN B02000 & UP)

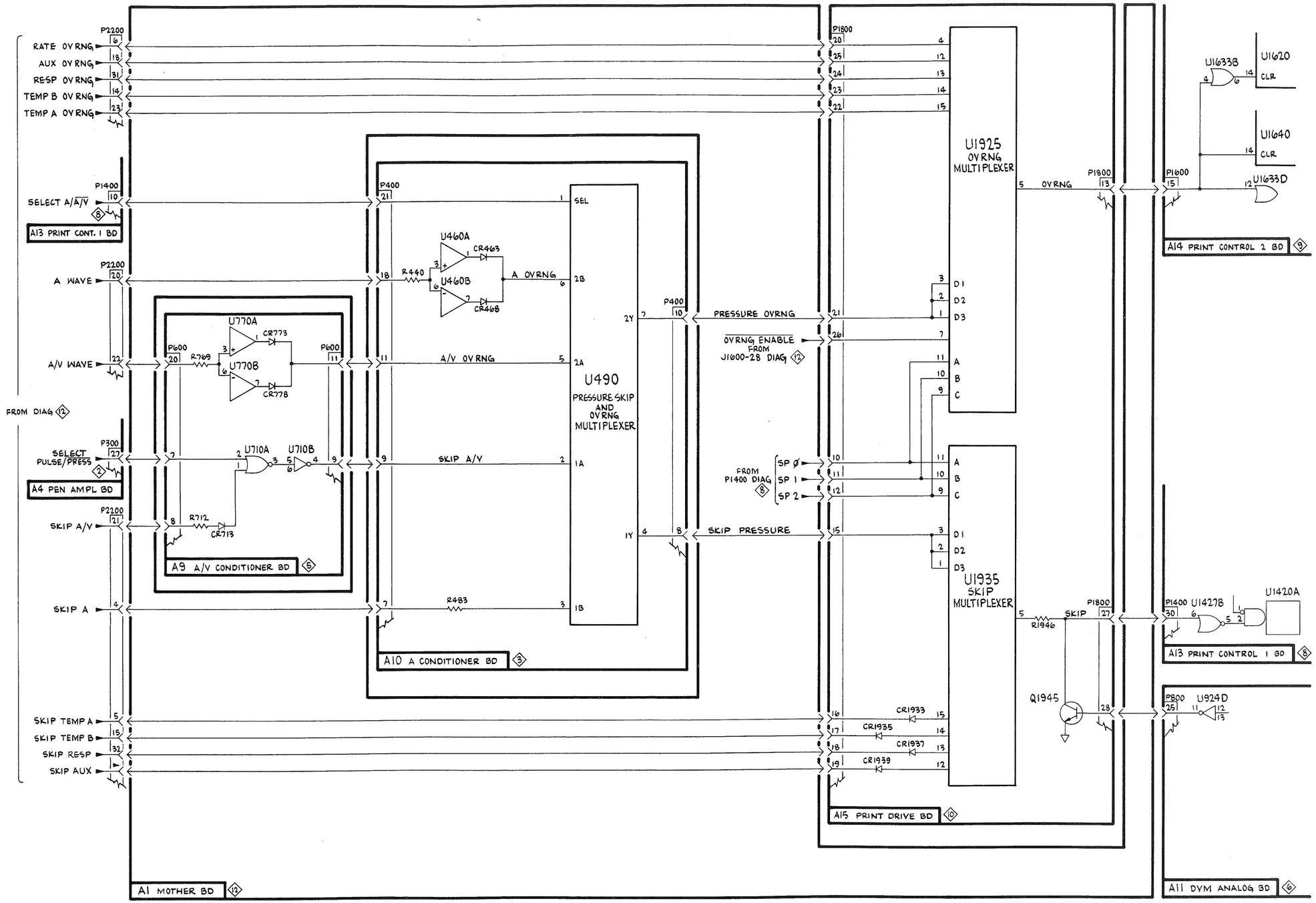
@

SKIP & OVERRANGE SIGNAL ROUTING
OPTIONS 2 & 4

DVM SIGNAL ROUTING
OPTION 3

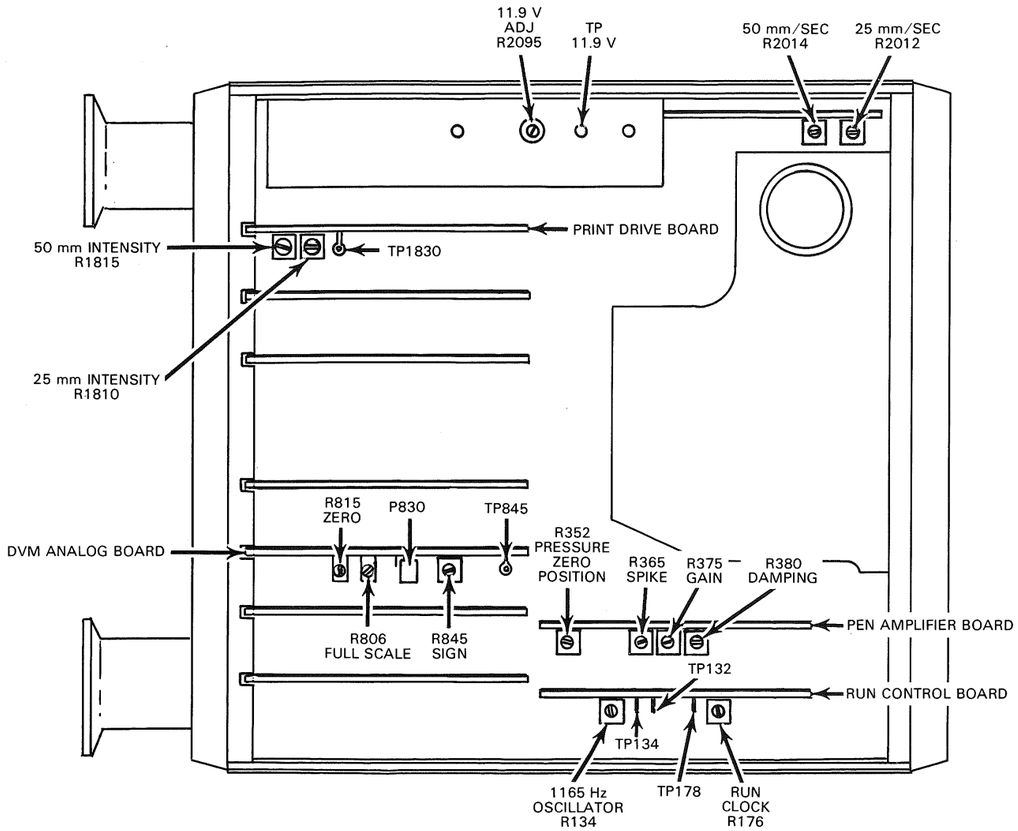
400 RECORDER
(SN B02000 & UP)

@



400 RECORDER
(SN B02000 & UP)

SKIP & OVERRANGE SIGNAL ROUTING
OPTION 3



400 RECORDER BOTTOM VIEW

Figure 7-21. Adjustment and Test-Point Locations.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000AQ	CONNOR SPRING & MFG. COMPANY	1426 SE 6TH	PORTLAND, OREGON 97214
000AV	GENERAL SCANNING	150 COOLIDGE AVENUE	WATERTOWN, MA 02172
000BB	BERQUIST COMPANY	4350 WEST 78TH	MINNEAPOLIS, MN 55435
000CX	N W SPRING AND MANUFACTURING COMPANY	5525 ROSEWOOD STREET	LAKE OSWEGO, OREGON 97034
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02929	NEWARK ELECTRONICS CORPORATION	500 N PULASKI ROAD	CHICAGO, IL 60624
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
07111	PNEUMO DYNAMICS CORPORATION	4800 PRUDENTIAL TOWER	BOSTON, MA 02199
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
20859	MELLOWES CO., THE	125 E. NASH ST.	MILWAUKEE, WI 53212
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22670	G.M. NAMEPLATE, INC.	2040 15TH AVENUE WEST	SEATTLE, WA 98119
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
60619	NASHUA CORPORATION INDUSTRIAL DIVISION	7800 S WOODLAWN AVENUE	CHICAGO, IL 60619
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77969	RUBBERCRAFT CORP. OF CALIF., LTD.	1800 W. 220TH ST.	TORRANCE, CA 90507
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201

STANDARD & OPTION 1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	390-0544-00			1		CAB.,WRAPAROUND:BOTTOM	80009	390-0544-00
						(ATTACHING PARTS)		
-2	211-0565-00			4		SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
						- - - * - - -		
-3	348-0414-00			2		BUMPER,PLASTIC:0.500 DIA	80009	348-0414-00
-4	348-0089-00			4		BUMPER,PLASTIC:BLACK VINYL	80009	348-0089-00
-5	348-0380-01			4		FOOT,CABINET:	80009	348-0380-01
						(ATTACHING PARTS FOR EACH)		
-6	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	253-0164-00			AR		TAPE,PRESS SENS:	60619	OBD
-7	366-1264-00			1		KNOB:	80009	366-1264-00
	213-0153-00			2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-8	366-1557-55			1		PUSH BUTTON:SILVER GRAY,ECG	80009	366-1557-55
-9	366-1557-58			1		PUSH BUTTON:SILVER,GRAY,A/V/PULSE	80009	366-1557-58
-10	366-1557-57			1		PUSH BUTTON:SILVER GRAY,50	80009	366-1557-57
-11	366-1557-56			1		PUSH BUTTON:SILVER GRAY,SAMPLE/MARK	80009	366-1557-56
-12	426-0681-00[1]			2		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
	426-0681-00			2		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-13	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-14	333-2381-00			1		FRONT PANEL:400 STANDARD	80009	333-2381-00
	333-2382-00			1		FRONT PANEL:400 OPT 1/2	80009	333-2382-00
						(ATTACHING PARTS)		
-15	211-0022-00			4		SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-16	334-1418-00[1]			1		PLATE,IDENT:	80009	334-1418-00
-17	426-1331-00			1		FRAME SECT,CAB:RIGHT	80009	426-1331-00
						(ATTACHING PARTS)		
-18	211-0101-00			4		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-19	391-0147-00			1		BLOCK,SUPPORT:MONITOR	80009	391-0147-00
						(ATTACHING PARTS)		
-20	211-0578-00			2		SCREW,MACHINE:6-32 X 0.438 INCH,PNH STL	83385	OBD
-21	426-1332-00			1		FRAME SECT,CAB.:LEFT	80009	426-1332-00
						(ATTACHING PARTS)		
-22	211-0101-00			6		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-23	214-2493-00			1		HT SK PWR SPLY:	80009	214-2493-00
						(ATTACHING PARTS)		
-24	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-25	----- -----			1		CKT BOARD ASSY:POWER SUPPLY SEE(A4 EPL)		
-26	----- -----			2		. TRANSISTOR:(SEE Q2132 & Q2134 EPL)		
						(ATTACHING PARTS FOR EACH)		
-27	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-28	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-29	210-1178-00			1		. WSHR,SHOULDERED:FOR MTG TO-220 TRANSISTOR	49671	DF 137A
-30	342-0202-00			1		. INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
						- - - * - - -		
-31	----- -----			1		. TRANSISTOR:(SEE Q2076 & Q2098 EPL)		
						(ATTACHING PARTS FOR EACH)		
-32	211-0198-00			1		. SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
-33	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-34	342-0363-00			1		. INSULATOR,PLATE:TRANSISTOR,SILCONE RUBBER	000BB	7403-10-50
						- - - * - - -		
-35	361-0853-00			1		. SPACER,HT SINK:POWER SUPPLY	80009	361-0853-00
	----- -----			2		. TRANSISTOR:(SEE Q2011 & Q2058 EPL)		
						(ATTACHING PARTS FOR EACH)		
	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
	342-0202-00			1		. INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
						- - - * - - -		

[1]Option 1 only.

STANDARD & OPTION 1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-36	348-0031-00			3		. GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-37	214-2636-00			1		. HT SK,PWR SPLY:	80009	214-2636-00
-38	129-0368-00			3		. . SPACER,POST:4-40 X 0.25 L,THD THRU,BRS	80009	129-0368-00
-39	210-0569-00			9		. . NUT,PRESMOUNT:4-40 X 0.25 OD,STL	80009	210-0569-00
						(ATTACHING PARTS FOR HEAT SINK)		
-40	211-0116-00			2		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			1		. TRANFORMOR:(SEE T2138 EPL)		
						(ATTACHING PARTS)		
-41	211-0529-00			1		. SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
-42	210-0812-00			2		. WASHER,NONMETAL:#10,FIBER	86445	OBD
						- - - * - - -		
-43	166-0031-00			1		. SPACER,SLEEVE:0.18 ID X 0.25 INCH LONG	80009	166-0031-00
-44	214-0579-00			5		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-45	136-0269-02			3		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-46	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
	198-3385-00			1		. WIRE SET,ELEC:	80009	198-3385-00
-47	131-1965-00			2		. . CONN,PLUG,ELEC:SNAP CATCH,30A,BLACK	02929	OBD
-48	131-1966-00			1		. . CONN,PLUG,ELEC:SNAP CATCH,30A,RED	02929	OBD
-49	384-1112-01			1		EXTENSION SHAFT:1.910 INCH L,EPOXY GLASS	80009	384-1112-01
-50	376-0051-00			1		CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00			4		. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-51	----- -----			1		CKT BOARD ASSY:PEN AMPLIFIER(SEE A3 EPL)		
-52	252-0571-00			FT		. RUB.SPL SHAPED:CHANNEL,0.083 FT LONG	77969	1353
-53	----- -----			2		. TRANSISTOR:(SEE Q372 & Q378 EPL)		
						(ATTACHING PARTS FOR EACH)		
-54	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-55	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-56	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
						- - - * - - -		
-57	214-2495-00			1		. HT SINK,CKT BD:PEN MOTOR AMP	80009	214-2495-00
						(ATTACHING PARTS)		
-58	211-0007-00			2		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-59	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-60	136-0514-00			3		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802
-61	214-0579-00			4		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-62	----- -----			1		. RES NONWIR:(SEE R314 EPL)		
-63	----- -----			1		CKT BOARD ASSY:RUN CONTROL(SEE A2 EPL)		
-64	136-0328-00			17		. SOCKET,PIN TERM:	00779	86282-2
-65	136-0269-00			8		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-66	136-0260-02			3		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-67	131-0589-00			13		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			7		. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-68	131-0993-00			2		. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
	198-3327-00			1		. WIRE SET,ELEC:RUN CONTROL	80009	198-3327-00
-69	352-0165-02			1		. . CONN BODY,PL,EL:7 WIRE RED	80009	352-0165-02
	352-0165-07			1		. . CONN BODY,PL,EL:7 WIRE VIOLET	80009	352-0165-07
-70	131-0707-00			6		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-71	334-3005-00			1		MARKER,IDENT:MARKED DIAGRAM	22670	OBD
-72	386-1635-00			13		SUPPORT,CKT BD:	80009	386-1635-00
-73	337-1349-00			1		SHIELD,ELEC:	80009	337-1349-00
						(ATTACHING PARTS)		
-74	211-0513-00			1		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		
-75	361-0371-00			1		SPACER,SLEEVE:0.388 L X 0.156 ID PLASTIC	80009	361-0371-00
-76	351-0519-00			4		GUIDE CKT BD:LEFT	80009	351-0519-00
-77	----- -----			1		CKT BOARD ASSY:MOTHER(SEE A1 EPL)		
						(ATTACHING PARTS)		
-78	211-0116-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD ASSY INCLUDES:		
-79	131-0608-00			34		. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357

STANDARD & OPTION 1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-80	131-0589-00			115		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-81	----- -----			1		. RES.,NONWIR:(SEE R2035 EPL)		
-82	366-1495-00			1		KNOB:GRAY	80009	366-1495-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-83	358-0301-02			1		BUSHING,SLEEVE:GRAY PLASTIC	80009	358-0301-02
-84	----- -----			1		JACK,TELEPHONE:(SEE J104 EPL)		
						(ATTACHING PARTS)		
-85	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		
-86	366-1161-66			1		PUSH BUTTON:SILVER GRAY,15 MIN	80009	366-1161-66
-87	366-1161-00			1		PUSH BUTTON:GRAY,BLANK	80009	366-1161-00
-88	----- -----			1		SWITCH,PUSH:(SEE S110 EPL)		
						(ATTACHING PARTS)		
-89	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-90	426-0568-00			2		FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-91	333-2212-00			1		PANEL,REAR:400	80009	333-2212-00
						(ATTACHING PARTS)		
-92	213-0055-00			4		SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
	198-3443-00			1		WIRE SET,ELEC:	80009	198-3443-00
	131-0621-00			2		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	75694-006
	352-0198-00			1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0198-00
-93	----- -----[1]			1		CKT BOARD ASSY:SOURCE SW(SEE A5 EPL)		
						(ATTACHING PARTS)		
-94	211-0012-00[1]			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-95	----- -----[1]			1		. SWITCH,PUSH:(SEE S310 EPL)		
-96	361-0384-00[1]			4		. SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	198-3328-00[1]			1		. WIRE SET,ELEC:	80009	198-3328-00
-97	175-0827-00[1]			FT		. . WIRE,ELECTRICAL:4 WIRE RIBBON,0.271 FT L	08261	OBD
-98	175-0828-00[1]			FT		. . WIRE,ELECTRICAL:5 WIRE RIBBON,0.271 FT L	08261	OBD
-99	131-0707-00[1]			9		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-100	352-0163-03[1]			1		. . CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0163-03
-101	352-0164-07[1]			1		. . CONN BODY,PL,EL:6 WIRE VIOLET	80009	352-0164-07
-102	----- -----			1		CKT BOARD ASSY:SAMPLE MARK SPEED SW(SEE A6 EPL)		
						(ATTACHING PARTS)		
-103	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-104	----- -----			1		. SWITCH,PUSH:(SEE S105 EPL)		
-105	361-0411-00			4		. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-106	----- -----			1		. LT EMITTING DIO:(SEE DS2019 EPL)		
	198-3330-00			1		. WIRE SET,ELEC:SAMPLE MARK SPEED SW	80009	198-3330-00
-107	175-0829-00			FT		. . WIRE,ELECTRICAL:6 WIRE RIBBON,0.271 FT L	08261	OBD
-108	131-0707-00			6		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-109	352-0164-03			1		. . CONN BODY,PL,EL:6 WIRE ORANGE	80009	352-0164-03
-110	119-0951-00			1		MODULE:STRIP-CHART RECORDED	80009	119-0951-00
						(ATTACHING PARTS)		
-111	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-112	426-1465-00			1		FRAME,CABINET:FRONT	80009	426-1465-00
	----- -----			-		MODULE INCLUDES:		
-113	105-0767-00			1		. LATCH,HOLDER:	80009	105-0767-00
						(ATTACHING PARTS)		
-114	214-2683-00			1		. PIN,GRVD,HDLS:0.125 DIA X 1.25 L,BRASS	80009	214-2683-00
-115	214-1226-01			1		. SPRING,HLCPS:0.18 OD X 0.44 INCH LONG	80009	214-1226-01
						- - - * - - -		
-116	214-2684-00			1		. HINGE,HOLDER:	80009	214-2684-00
						(ATTACHING PARTS)		
-117	211-0087-01			2		. SCREW,MACHINE:2-56 X 0.188" 82 DEG,FLH,STL	83385	OBD
-118	214-2661-00			1		. PIN,STR,HDLS:0.094 DTA X 0.6 L,BRASS	80009	214-2661-00
						- - - * - - -		

[1]Option 1 only.

STANDARD & OPTION 1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-119	401-0389-00			1		. ROLLER,PAPER DR:0.25 OD X 1.73 L,SST	80009	401-0389-00
-120	407-2048-00			1		. BRACKET,PPR RLR:PLASTIC	80009	407-2048-00
-121	214-1226-01			2		. SPRING,HLCPS:0.18 OD X 0.44 INCH LONG	80009	214-1226-01
-122	352-0498-00			1		. HOLDER,PPR,RLR:	80009	352-0498-00
-123	386-3843-00			1		. PLATE,CARRIAGE:TOP	80009	386-3843-00
						(ATTACHING PARTS)		
-124	213-0012-00			2		. SCREW,MACHINE:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-125	401-0393-00			2		. BEARING,PPR RLR:0.046 ID X 0.115 L,PLASTIC	80009	401-0393-00
-126	401-0387-00			1		. ROLLER,PAPER DR:0.095 OD X 2.107 L,SST	80009	401-0387-00
-127	351-0548-00			1		. GUIDE,PAPER:	80009	351-0548-00
-128	384-1490-00			1		. SHAFT,STRAIGHT:1.75 L X 0.6 OD,PLASTIC	80009	384-1490-00
						(ATTACHING PARTS)		
-129	213-0012-00			1		. SCREW,MACHINE:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-130	386-3842-00			1		. PLATE,CARRIAGE:BOTTOM	80009	386-3842-00
						(ATTACHING PARTS)		
-131	213-0012-00			2		. SCREW,MACHINE:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-132	214-2633-00			1		. PLATEN,PRINTER:	80009	214-2633-00
-133	426-1458-00			1		. FRAME SECT,MDL:LEFT	80009	426-1458-00
						(ATTACHING PARTS)		
-134	213-0267-00			5		. SCR,TPG,THD CTG:4-24 X 0.375 INCH,PNH,STL	83385	OBD
						- - - * - - -		
-135	210-0259-00			1		. TERMINAL,LUG:0.099"ID INT TOOTH,SE	80009	210-0259-00
						(ATTACHING PARTS)		
-136	210-0405-00			1		. NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
	351-0564-00			2		. GUIDE,CARRIAGE:PLASTIC	80009	351-0564-00
-137	426-1464-00			1		. FRAME SECT,MDL:BOTTOM	80009	426-1464-00
						(ATTACHING PARTS)		
-138	211-0008-00			1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-139	211-0022-00			1		. SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
-140	213-0267-00			5		. SCREW,MACHINE:4-40 X 0.375 INCH,PHN,STL	83385	OBD
						- - - * - - -		
-141	210-1035-00			2		. WASHER,SPR TNSN:0.195 ID X 0.006 THK,STL	86928	OBD
-142	401-0394-00			2		. BRG,DOOR LATCH:0.25 OD X 0.21 L,PLASTIC	80009	401-0394-00
-143	214-2655-00			1		. SPRING,HL EXT:0.187 OD X 0.875 L,MUSIC WIRE	83385	OBD
-144	367-0241-00			1		. HANDLE,DOOR LCH:	80009	367-0241-00
-145	401-0388-00			1		. ROLLER,PAPER DR:0.125 OD X 2.052 L,SST	80009	401-0388-00
						(ATTACHING PARTS)		
-146	401-0392-00			2		. BEARING,PPR RLR:0.067 ID X 0.36 L,BRASS	80009	401-0392-00
-147	210-0804-00			2		. WASHER,FLAT:0.17 ID X 0.375 INCH OD,STL	12327	OBD
-148	210-0069-00			2		. WASHER,LOCK:0.168 ID X 0.293 " OD,SPLIT,STL	83385	OBD
						- - - * - - -		
-149	105-0766-00			1		. LATCH,CARRIAGE:	80009	105-0766-00
-150	401-0397-00			1		. HUB,STYLUS:	000AV	2501-1008-1
-151	105-0765-00			2		. STOP,STYLUS:	80009	105-0765-00
						(ATTACHING PARTS FOR EACH)		
-152	211-0513-00			1		. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		
-153	119-0958-00			1		. STYLUS,CHART RE:	000AV	Z814-12V
-154	----- -----			1		. GALVANOMETER:12V,W/CONNECTORS(SEE B389 EPL)		
						(ATTACHING PARTS)		
-155	211-0513-00			2		. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		
-156	426-1459-00			1		. FRAME SECT,MDL:RIGHT	80009	426-1459-00
-157	401-0386-01			1		. ROLLER,PAPER DR:0.625 OD X 2.24 L,PLASTIC	80009	401-0386-01
-158	384-1489-00			1		. SHAFT,STRAIGHT:2.24 L X 0.249 OD	80009	384-1489-00
						(ATTACHING PARTS)		
-159	211-0008-00			1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		

STANDARD & OPTION 1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-160	----- -----			1		. SWITCH,PUSH:(SEE S2190 EPL)		
						(ATTACHING PARTS)		
-161	211-0185-00			2		. SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	OBD
-162	210-0850-00			2		. WASHER,FLAT:0.093 ID X 0.281 INCH OD	12327	OBD
						- - - * - - -		
-163	214-2638-00			1		. SPRING,FLAT:	80009	214-2638-00
-164	----- -----			1		. SWITCH,PUSH:(SEE S394 EPL)		
						(ATTACHING PARTS)		
-165	211-0185-00			2		. SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	OBD
-166	210-0850-00			2		. WASHER,FLAT:0.093 ID X 0.281 INCH OD	12327	OBD
						- - - * - - -		
-167	214-2656-00			1		. BELT,POS DRIVE:0.125 W X 3.59 L,44 TEETH	000AQ	6R6-044012
-168	401-0395-00			1		. SPROCKET WHEEL:0.119 ID X 0.558 OD,AL	80009	401-0395-00
						(ATTACHING PARTS)		
-169	213-0048-00			2		. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
						- - - * - - -		
-170	----- -----			1		. MOTOR,DC:(SEE B2034 EPL)		
						(ATTACHING PARTS)		
-171	211-0125-00			3		. SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL	83385	OBD
-172	210-1024-00			2		. WASHER,FLAT:0.084 ID X 0.018 THK,STL	12327	OBD
						- - - * - - -		
-173	407-2050-00			1		. BRACKET,MOTOR:ALUMINUM	80009	407-2050-00
						(ATTACHING PARTS)		
-174	211-0012-00			3		. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-175	210-0851-00			3		. WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
						- - - * - - -		
-176	214-2637-00			1		. SPRING,FLAT:	80009	214-2637-00
						(ATTACHING PARTS)		
-177	211-0008-00			2		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-178	426-1463-00			1		. FRAME SECT,MDL:TOP	80009	426-1463-00
-179	426-1330-00			1		FRAME,CAB.,REAR:	80009	426-1330-00

FIG. 1 STD & OPTION 1
EXPLODED

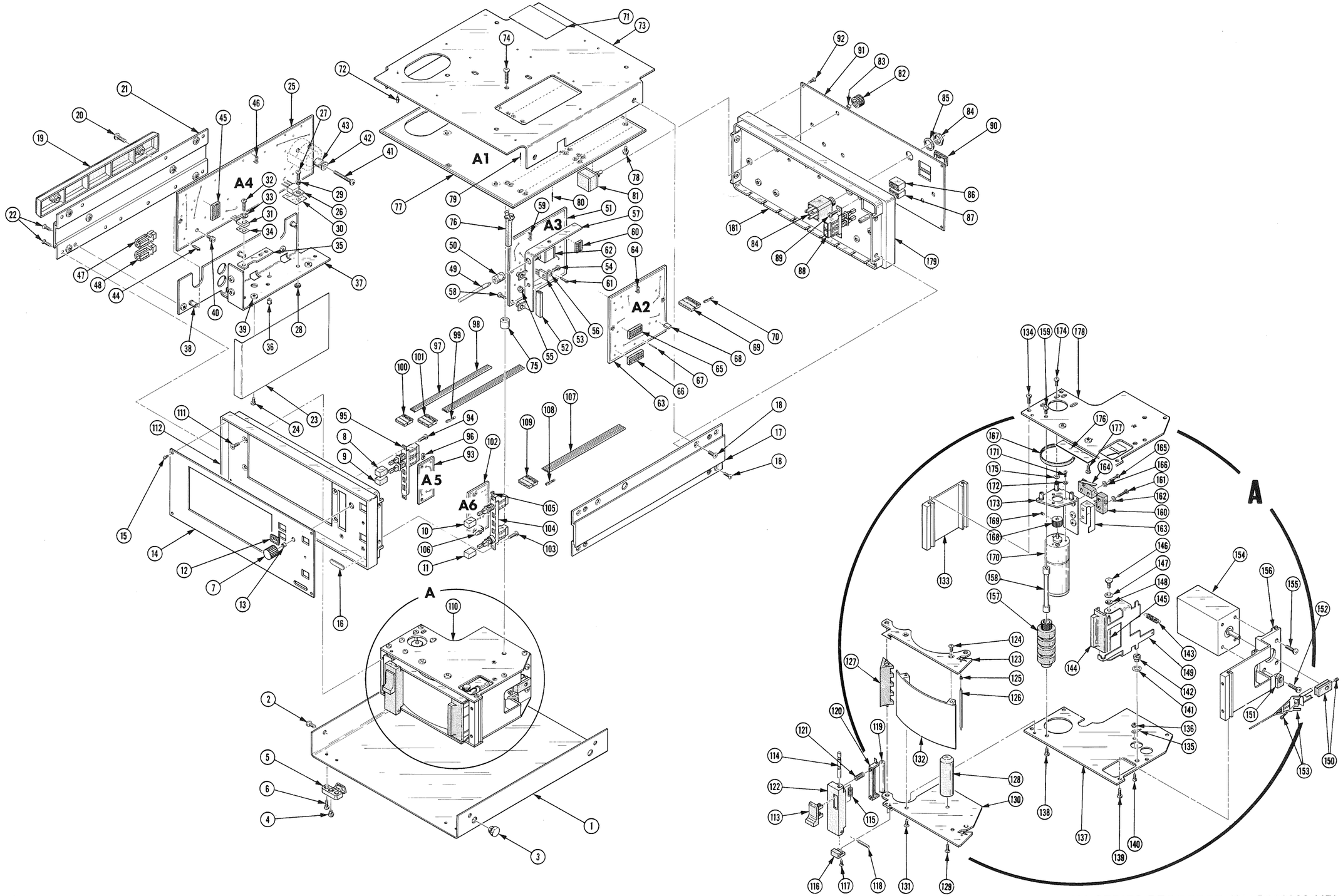
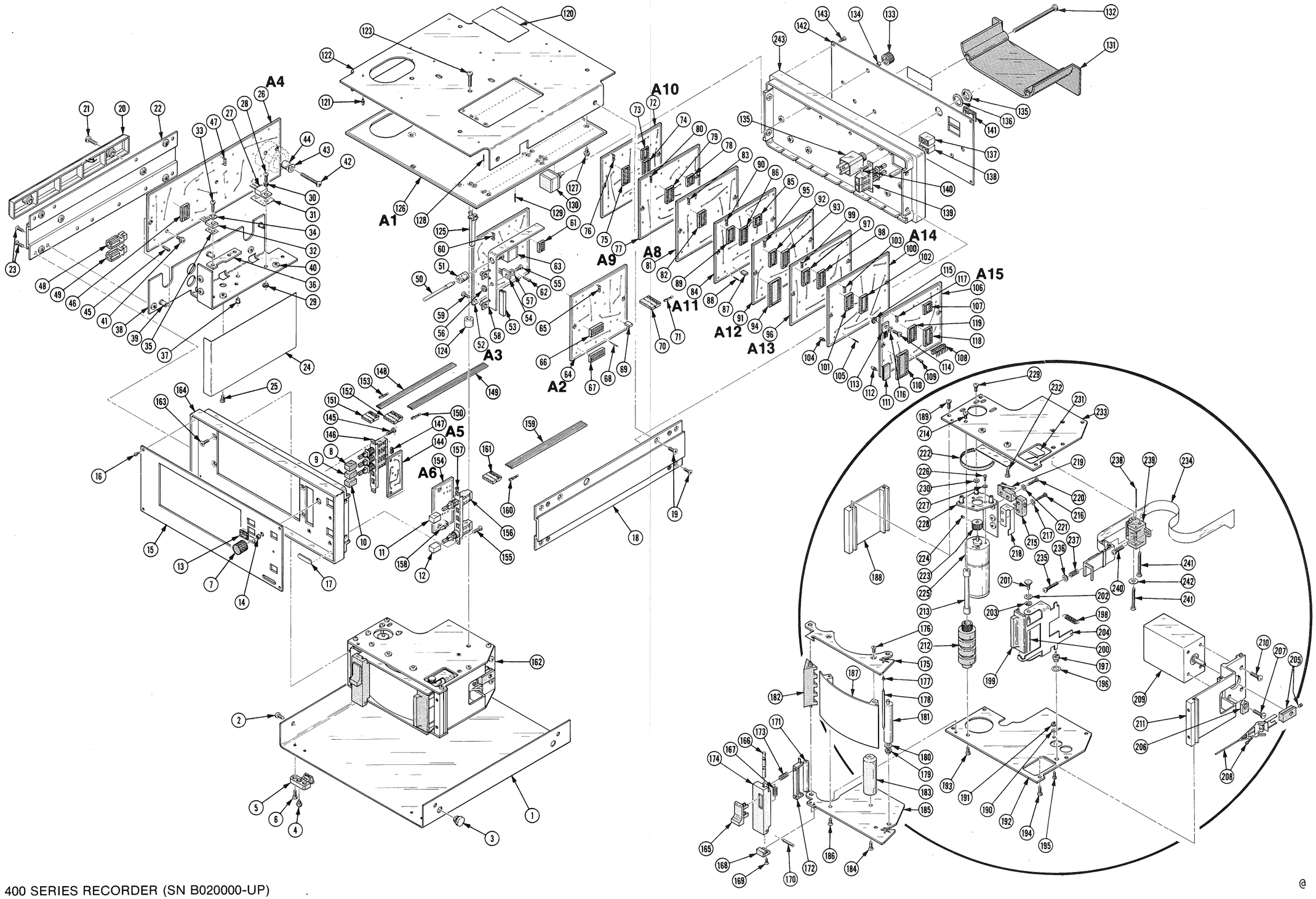


FIG. 2 OPTIONS 2, 3, & 4
EXPLODED



OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	390-0544-00			1		CAB.,WRAPAROUND:BOTTOM	80009	390-0544-00
						(ATTACHING PARTS)		
-2	211-0565-00			4		SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
						- - - * - - -		
-3	348-0414-00			2		BUMPER,PLASTIC:0.500 DIA	80009	348-0414-00
-4	348-0089-00			4		BUMPER,PLASTIC:BLACK VINYL	80009	348-0089-00
-5	348-0380-01			4		FOOT,CABINET:	80009	348-0380-01
						(ATTACHING PARTS FOR EACH)		
-6	211-0008-00			1		SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
	253-0164-00			AR		TAPE,PRESS SENS:	60619	OBD
-7	366-1264-00			1		KNOB:	80009	366-1264-00
	213-0153-00			2		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-8	366-1557-55			1		PUSH BUTTON:SILVER GRAY,ECG	80009	366-1557-55
-9	366-1557-58[1]			1		PUSH BUTTON:SILVER GRAY,A/V/PULSE	80009	366-1557-58
	366-1557-59[2]			1		PUSH BUTTON:SILVER GRAY,A	80009	366-1557-59
-10	366-1557-60			1		PUSH BUTTON:SILVER GRAY,A/V	80009	366-1557-60
	366-1557-80			1		PUSH BUTTON:SILVER GRAY,RESP	80009	366-1557-80
-11	366-1557-57[2]			1		PUSH BUTTON:SILVER GRAY,50	80009	366-1557-57
-12	366-1557-56[3]			1		PUSH BUTTON:SILVER GRAY,SAMPLE/MARK	80009	366-1557-56
-13	426-0681-00[4]			4		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
	426-0681-00[5]			5		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-14	358-0378-00			1		BUSHING,SLEEVE:PRESS MOUNT	80009	358-0378-00
-15	333-2382-00			1		PANEL,FRONT:OPT 1/2	80009	333-2382-00
	333-2383-00			1		PANEL,FRONT:OPT 03		
	333-2384-00			1		PANEL,FRONT:OPT 04		
						(ATTACHING PARTS)		
-14	211-0022-00			6		SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-17	334-1418-00			1		PLATE,IDENT:	80009	334-1418-00
-18	426-1331-00			1		FRAME SECT,CAB:RIGHT	80009	426-1331-00
						(ATTACHING PARTS)		
-19	211-0101-00			4		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-20	391-0147-00			1		BLOCK,SUPPORT:MONITOR	80009	391-0147-00
						(ATTACHING PARTS)		
-21	211-0578-00			2		SCREW,MACHINE:6-32 X 0.438 1NCH,PNH STL	83385	OBD
-22	426-1332-00			1		FRAME SECT,CAB:LEFT	80009	426-1332-00
						(ATTACHING PARTS)		
-23	211-0101-00			6		SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-24	214-2493-00			1		HT SK PWR SPLY:	80009	214-2493-00
						(ATTACHING PARTS)		
-25	211-0007-00			2		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-26	----- -----			1		CKT BOARD ASSY:POWER SUPPLY SEE(A4 EPL)		
-27	----- -----			2		. TRANSISTOR:(SEE Q2132 & Q2134 EPL)		
						(ATTACHING PARTS FOR EACH)		
-28	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-29	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-30	210-1178-00			1		. WSHR,SHOULDERED:FOR MTG TO-220 TRANSISTOR	49671	DF 137A
-31	342-0202-00			1		. INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
						- - - * - - -		
-32	----- -----			1		. TRANSISTOR:(SEE Q2076 & Q2098 EPL)		
						(ATTACHING PARTS FOR EACH)		
-33	211-0198-00			1		. SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
-34	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-35	342-0363-00			1		. INSULATOR,PLATE:TRANSISTOR,SILCONE RUBBER	000BB	7403-10-50
						- - - * - - -		
-36	361-0853-00			1		. SPACER,HT SINK:POWER SUPPLY	80009	361-0853-00

[1]Option 2 and 4 only.
[2]Option 3 only.
[3]Option 4 only.
[4]Option 2 only.
[5]Option 3 and 4 only.

OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-	----- -----			2		. TRANSISTOR:(SEE Q2011 & Q2058 EPL)		
						(ATTACHING PARTS FOR EACH)		
	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
	342-0202-00			1		. INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
						- - - * - - -		
-37	348-0031-00			3		. GROMMET,PLASTIC:0.156 INCH DIA	80009	348-0031-00
-38	214-2636-00			1		. HT SK,PWR SPLY:	80009	214-2636-00
-39	129-0368-00			3		. . SPACER,POST:4-40 X 0.25 L,THD THRU,BRS	80009	129-0368-00
-40	210-0569-00			9		. . NUT,PRESSMOUNT:4-40 X 0.25 OD,STL	80009	210-0569-00
						(ATTACHING PARTS FOR HEAT SINK)		
-41	211-0116-00			2		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			1		. TRANSFORMOR:(SEE T2138 EPL)		
						(ATTACHING PARTS)		
-42	211-0529-00			1		. SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
-43	210-0812-00			2		. WASHER,NONMETAL:#10,FIBER	86445	OBD
						- - - * - - -		
-44	166-0031-00			1		. SPACER,SLEEVE:0.18 ID X 0.25 INCH LONG	80009	166-0031-00
-45	214-0579-00			5		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-46	136-0269-02			3		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-47	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
	198-3385-00			1		. WIRE SET,ELEC:	80009	198-3385-00
-48	131-1965-00			2		. . CONN,PLUG,ELEC:SNAP CATCH,30A,BLACK	02929	OBD
-49	131-1966-00			1		. . CONN,PLUG,ELEC:SNAP CATCH,30A,RED	02929	OBD
-50	384-1112-01			1		EXTENSION SHAFT:1.910 INCH L,EPOXY GLASS	80009	384-1112-01
-51	376-0051-00			1		. CPLG,SHAFT,FLEX:FOR 0.125 INCH DIA SHAFTS	80009	376-0051-00
	213-0022-00			4		. SETSCREW:4-40 X 0.188 INCH,HEX SOC STL	74445	OBD
-52	----- -----			1		CKT BOARD ASSY:PEN AMPLIFIER(SEE A3 EPL)		
-53	252-0571-00			FT		. RUB.SPL SHAPED:CHANNEL,0.083 FT L	77969	1353
-54	----- -----			2		. TRANSISTOR:(SEE Q372 & Q378 EPL)		
						(ATTACHING PARTS FOR EACH)		
-55	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-56	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-57	211-0071-00			1		. SCREW,MACHINE:4-40 X 0.375 1NCH,TRH,STL	83385	OBD
						- - - * - - -		
-58	214-2495-00			1		. HT SINK,CKT BD:PEN MOTOR AMP	80009	214-2495-00
						(ATTACHING PARTS)		
-59	211-0007-00			2		. SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-60	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-61	136-0514-00			3		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802
-62	214-0579-00			4		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-63	----- -----			1		. RES,NONWIR:(SEE R314 EPL)		
-64	----- -----			1		CKT BOARD ASSY:RUN CONTROL(SEE A2 EPL)		
-65	136-0328-00			17		. SOCKET,PIN TERM:	00779	86282-2
-66	136-0269-00			8		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	71785	133-59-02-073
-67	136-0260-02			3		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-68	131-0589-00			17		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0608-00			7		. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-69	131-0993-00			2		. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
	198-3327-00			1		. WIRE SET,ELEC:RUN CONTROL	80009	198-3327-00
-70	352-0165-02			1		. . CONN BODY,PL,EL:7 WIRE RED	80009	352-0165-02
	352-0165-07			1		. . CONN BODY,PL,EL:7 WIRE VIOLET	80009	352-0165-07
-71	131-0707-00			6		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
	131-0993-00			5		. CONNECTOR,RCPT,:	05574	2VH36/1AV3
-72	----- -----			1		CKT BOARD ASSY:A CONDITIONER(SEE A10 EPL)		
-73	136-0514-00			3		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802
-74	136-0269-02			5		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-75	136-0260-00			2		. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
-76	136-0328-03			21		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-77	----- -----			1		CKT BOARD ASSY: AV CONDITIONER(SEE A9 EPL)		
-78	136-0514-00			3		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802

OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-79	136-0269-02			5		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-80	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-81	----- -----			1		CKT BOARD ASSY:AV BUFFER(SEE A8 EPL)		
-82	136-0269-02			2		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-83	136-0328-03			20		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-84	----- -----			1		CKT BOARD ASSY:DVM ANALOG(SEE A11 EPL)		
-85	136-0514-00			5		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802
-86	136-0260-02			3		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-87	131-0993-00			1		. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-88	131-0589-00			4		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-89	136-0269-02			5		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-90	136-0328-03			29		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-91	----- -----			1		CKT BOARD ASSY:DVM DIGITAL(SEE A12 EPL)		
-92	136-0269-02			6		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-93	136-0260-02			4		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-94	136-0578-00			1		. SOCKET,PLUG-IN:24 DIP,LOW PROFILE	01295	C952402
-95	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-96	----- -----			1		CKT BOARD ASSY:PRINT CONTROL(SEE A13 EPL)		
-97	136-0269-02			2		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-98	136-0260-02			7		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-99	136-0328-03			23		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-100	----- -----			1		CKT BOARD ASSY:PRINT CONTROL(SEE A14 EPL)		
-101	136-0269-02			4		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
-102	136-0260-02			8		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-103	136-0328-03			24		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-104	386-1635-00			1		. SUPPORT,CKT BD:	80009	386-1635-00
-105	131-0589-00			8		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-106	----- -----			1		CKT BOARD ASSY:PRINT DRIVE(SEE A15 EPL)		
-107	136-0514-00			1		. SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	73803	C950802
-108	131-1426-00			1		. CONTACT SET,ELE:R ANGLE,0.250L,STRIP OF 36	22526	65524-436
-109	214-0579-00			1		. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-110	136-0578-00			1		. SOCKET,PLUG-IN:24 DIP,LOW PROFILE	01295	C952402
-111	131-1954-00			1		. TERM SET,PIN:30 MALE CONT,R ANGEL	00779	3-87232-0
-112	386-1635-00			2		. SUPPORT,CKT BD:	80009	386-1635-00
-113	----- -----			1		. TRANSISTOR:		
						(ATTACHING PARTS)		
-114	211-0097-00			1		. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-115	210-0586-00			1		. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-116	210-0071-00			1		. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
						- - - * - - -		
-117	136-0328-03			29		. SOCKET,PIN TERM:HORIZ,SQ PIN RCPT	22526	47710
-118	136-0260-02			2		. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C951601
-119	136-0269-02			3		. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C951401
	198-3434-00			1		WIRE SET,ELEC:	80009	198-3434-00
	131-0707-00			16		. CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
	352-0166-00			2		. CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
-120	334-3005-00			1		MARKER,IDENT:MARKED DIAGRAM	22670	OBD
-121	386-1635-00			13		SUPPORT,CKT BD:	80009	386-1635-00
-122	337-1349-00			1		SHIELD,ELEC:	80009	337-1349-00
						(ATTACHING PARTS)		
-123	211-0513-00			1		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		
-124	361-0371-00			1		SPACER,SLEEVE:0.388 L X 0.156 ID PLASTIC	80009	361-0371-00
-125	351-0510-00[1]			10		GUIDE,CKT CARD:	80009	351-0510-00
	351-0510-00[2]			11		GUIDE,CKT CARD:	80009	351-0510-00
-126	----- -----			1		CKT BOARD ASSY:MOTHER(SEE A1 EPL)		
						(ATTACHING PARTS)		
-127	211-0116-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						- - - * - - -		
	----- -----			-		. CKT BOARD INCLUDES:		
-128	131-0608-00			34		. CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL	22526	47357
-129	131-0589-00			115		. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-130	----- -----			1		. RES.,NONWIR:(SEE R2035 EPL)		

[1]Option 2 and 4 only.
[2]Option 3 only.

OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-131	348-0530-00			1		FOOT,CORD WRAP:	80009	348-0530-00
						(ATTACHING PARTS)		
-132	211-0571-00			2		SCREW,MACHINE:6-32 X 2.50 INCHES,PNH,STL	83385	OBD
						- - - * - - -		
-133	366-1495-00			1		KNOB:GRAY	80009	366-1495-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-134	358-0301-02			1		BUSHING,SLEEVE:GRAY PLASTIC	80009	358-0301-02
-135	----- -----			1		JACK,TELEPHONE:(SEE J104 EPL)		
						(ATTACHING PARTS)		
-136	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		
-137	366-1161-66			1		PUSH BUTTON:SILVER GRAY,15 MIN	80009	366-1161-66
-138	366-1161-00			1		PUSH BUTTON:GRAY,BLANK	80009	366-1161-00
-139	----- -----			1		SWITCH,PUSH:(SEE S110 EPL)		
						(ATTACHING PARTS)		
-140	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-141	426-0568-00			2		FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-142	333-2212-00			1		PANEL,REAR:400	80009	333-2212-00
						(ATTACHING PARTS)		
-143	213-0055-00			4		SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
	198-3443-00			1		WIRE SET,ELEC:	80009	198-3443-00
	131-0621-00			2		. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	75694-006
	352-0198-00			1		. CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0198-00
-144	----- -----			-		CKT BOARD ASSY:SOURCE SW(SEE A5 EPL)		
						(ATTACHING PARTS)		
-145	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-146	----- -----			1		SWITCH,PUSH:(SEE S310 EPL)		
-147	361-0384-00[1]			4		. SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0384-00[2]			5		. SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	198-3328-00[1]			1		. WIRE SET,ELEC:	80009	198-3328-00
-148	175-0827-00[1]			FT		. . WIRE,ELECTRICAL:4 WIRE RIBBON,0.271 FT L	08261	OBD
-149	175-0828-00[1]			FT		. . WIRE,ELECTRICAL:5 WIRE RIBBON,0.271 FT L	08261	OBD
-150	131-0707-00[1]			9		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-151	352-0163-03[1]			1		. . CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0163-03
-152	352-0164-07[1]			1		. . CONN BODY,PL,EL:6 WIRE VIOLET	80009	352-0164-07
	198-3723-00[2]			1		. WIRE SET,ELEC:	80009	198-3723-00
-153	131-0707-00[2]			9		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
	175-0827-00[2]			FT		. . WIRE,ELECTRICAL:4 WIRE RIBBON,0.271 FT L	08261	OBD
	175-0828-00[2]			FT		. . WIRE,ELECTRICAL:5 WIRE RIBBON,0.271 FT L	08261	OBD
	352-0163-00[2]			1		. . CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
	352-0164-07[2]			1		. . CONN BODY,PL,EL:6 WIRE VIOLET	80009	352-0164-07
-154	----- -----			1		CKT BOARD ASSY:SAMPLE MARK SPEED SW(SEE A6 EPL)		
						(ATTACHING PARTS)		
-155	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-156	----- -----			1		. SWITCH,PUSH:(SEE S105 EPL)		
-157	361-0411-00			4		. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-158	----- -----			1		. LT EMITTING DIO:(SEE DS2019 EPL)		
	198-3330-00			1		. WIRE SET,ELEC:	80009	198-3330-00
-159	175-0829-00			FT		. . WIRE,ELECTRICAL:6 WIRE RIBBON,0.271 FT L	08261	OBD
-160	131-0707-00			6		. . CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-161	352-0164-03			1		. . CONN BODY,PL,EL:6 WIRE ORANGE	80009	352-0164-03
-162	119-0959-00			1		MODULE:STRIP CHART RCD W/ALPHA NUM	80009	119-0959-00
						(ATTACHING PARTS)		
-163	211-0559-00			1		SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-164	426-1465-00			1		FRAME ,CABINET:FRONT	80009	426-1465-00
	----- -----			-		MODULE INCLUDES:		

[1]Option 2 and 3 only.
[2]Option 4 only.

OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-165	105-0767-00			1		. LATCH,HOLDER:	80009	105-0767-00
						(ATTACHING PARTS)		
-166	214-2683-00			1		. PIN,GRVD,HDLS:0.125 DIA X 1.25 L,BRASS	80009	214-2683-00
-167	214-1226-01			1		. SPRING,HLCPS:0.18 OD X 0.44 INCH LONG	80009	214-1226-01
						- - - * - - -		
-168	214-2684-00			1		. HINGE,HOLDER:	80009	214-2684-00
						(ATTACHING PARTS)		
-169	211-0087-01			2		. SCREW,MACHINE:2-56 X 0.188" 82 DEG,FLH,STL	83385	OBD
-170	214-2661-00			1		. PIN,STR,HDLS:0.094 DTA X 0.6 L,BRASS	80009	214-2661-00
						- - - * - - -		
-171	401-0389-00			1		. ROLLER,PAPER DR:0.25 OD X 1.73 L,SST	80009	401-0389-00
-172	407-2048-00			1		. BRACKET,PPR RLR:PLASTIC	80009	407-2048-00
-173	214-1226-01			2		. SPRING,HLCPS:0.18 OD X 0.44 INCH LONG	80009	214-1226-01
-174	352-0498-00			1		. HOLDER,PPR,RLR:	80009	352-0498-00
-175	386-3843-00			1		. PLATE,CARRIAGE:TOP	80009	386-3843-00
						(ATTACHING PARTS)		
-176	213-0012-00			2		. SCREW,MACHINE:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-177	401-0393-00			2		. BEARING,PPR RLR:0.046 ID X 0.115 L,PLASTIC	80009	401-0393-00
-178	401-0387-00			1		. ROLLER,PAPER DR:0.095 OD X 2.107 L,SST	80009	401-0387-00
-179	401-0396-00			2		. BRG,PR HD RLR:0.126 ID X 0.115 L,PLASTIC	80009	401-0396-00
-180	210-1002-00			2		. WASHER,FLAT:0.125 ID X 0.25 INCH OD,BRS	12327	OBD
-181	401-0390-01			1		. ROLLER,PRINT HD:0.125 OD X 2.2 L,SST	80009	401-0390-01
-182	351-0548-00			1		. GUIDE,PAPER:	80009	351-0548-00
-183	384-1490-00			1		. SHAFT,STRAIGHT:1.75 L X 0.6 OD,PLASTIC	80009	384-1490-00
						(ATTACHING PARTS)		
-184	213-0012-00			1		. SCREW,TPG,TC:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-185	386-3842-00			1		. PLATE,CARRIAGE:BOTTOM	80009	386-3842-00
						(ATTACHING PARTS)		
-186	213-0012-00			2		. SCREW,TPG,TC:4-40 X 0.375 INCH,FLH STL	83385	OBD
						- - - * - - -		
-187	214-2633-00			1		. PLATEN,PRINTER:	80009	214-2633-00
-188	426-1458-00			1		. FRAME SECT,MDL:LEFT	80009	426-1458-00
						(ATTACHING PARTS)		
-189	213-0267-00			5		. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
						- - - * - - -		
-190	210-0259-00			1		. TERMINAL,LUG:0.099"ID INT TOOTH,SE	80009	210-0259-00
						(ATTACHING PARTS)		
-191	210-0405-00			1		. NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
						- - - * - - -		
	351-0564-00			2		. GUIDE,CARRIAGE:PLASTIC	80009	351-0564-00
-192	426-1464-00			1		. FRAME SECT,MDL:BOTTOM	80009	426-1464-00
						(ATTACHING PARTS)		
-193	211-0008-00			1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-194	213-0267-00			5		. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-195	211-0022-00			1		. SCREW,MACHINE:2-56 X 0.188 INCH,PNH STL	83385	OBD
						- - - * - - -		
-196	210-1035-00			2		. WASHER,SPR TNSN;0.195 ID X 0.006 THK,STL		
-197	401-0394-00			2		. BRG,DOOR LATCH:0.25 OD X 0.21 L,PLASTIC	80009	401-0394-00
-198	214-2655-00			1		. SPRING,HL EXT:0.187 OD X 0.875 L,MUSIC WIRE		
-199	367-0241-00			1		. HANDLE,DOOR LCH:	80009	367-0241-00
-200	401-0388-00			1		. ROLLER,PAPER DR:0.125 OD X 2.052 L,SST	80009	401-0388-00
						(ATTACHING PARTS)		
-201	401-0392-00			2		. BEARING,PPR RLR:0.067 ID X 0.36 L,BRASS	80009	401-0392-00
-202	210-0804-00			2		. WASHER,FLAT:0.17 ID X 0.375 INCH OD,STL	12327	OBD
-203	210-0069-00			2		. WASHER,LOCK:0.168 ID X 0.293 " OD,SPLIT,STL	83385	OBD
						- - - * - - -		
-204	105-0766-00			1		. LATCH,CARRIAGE:	80009	105-0766-00
-205	401-0397-00			1		. HUB,STYLUS:		
-206	105-0765-00			2		. STOP,STYLUS:	80009	105-0765-00
						(ATTACHING PARTS FOR EACH)		
-207	211-0513-00			1		. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		

OPTION 2,3 & 4

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-208	119-0958-00			1		. STYLUS,CHART RE:		
-209	----- -----			1		. GALVANOMETER:12V,W/CONNECTORS(SEE B389 EPL)		
						(ATTACHING PARTS)		
-210	211-0513-00			2		. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
						- - - * - - -		
-211	426-1459-00			1		. FRAME SECT,MDL:RIGHT	80009	426-1459-00
-212	401-0386-01			1		. ROLLER,PAPER DR:0.625 OD X 2.24 L,PLASTIC	80009	401-0386-01
-213	384-1489-00			1		. SHAFT,STRAIGHT:2.24 L X 0.249 OD	80009	384-1489-00
						(ATTACHING PARTS)		
-214	211-0008-00			1		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-215	----- -----			1		. SWITCH,PUSH:(SEE S2190 EPL)		
						(ATTACHING PARTS)		
-216	211-0185-00			2		. SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	OBD
-217	210-0850-00			2		. WASHER,FLAT:0.093 ID X 0.281 INCH OD	12327	OBD
						- - - * - - -		
-218	214-2638-00			1		. SPRING,FLAT:	80009	214-2638-00
-219	----- -----			1		. SWITCH,PUSH:(SEE S394 EPL)		
						(ATTACHING PARTS)		
-220	211-0185-00			2		. SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	OBD
-221	210-0850-00			2		. WASHER,FLAT:0.093 ID X 0.281 INCH OD	12327	OBD
						- - - * - - -		
-222	214-2656-00			1		. BELT,POS DRIVE:0.125 W X 3.59 L,44 TEETH		
-223	401-0395-00			1		. SPROCKET WHEEL:0.119 ID X 0.558 OD,AL	80009	401-0395-00
						(ATTACHING PARTS)		
-224	213-0048-00			2		. SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	74445	OBD
						- - - * - - -		
-225	----- -----			1		. MOTOR,DC:(SEE B2034 EPL)		
						(ATTACHING PARTS)		
-226	211-0125-00			3		. SCREW,MACHINE:1-72 X 0.25 INCH,PNH STL	83385	OBD
-227	210-1024-00			3		. WASHER,FLAT:0.084 ID X 0.018 THK,STL		
						- - - * - - -		
-228	407-2050-00			1		. BRACKET,MOTOR:ALUMINUM	80009	407-2050-00
						(ATTACHING PARTS)		
-229	211-0012-00			3		. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-230	210-0851-00			3		. WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
						- - - * - - -		
-231	214-2637-00			1		. SPRING,FLAT:	80009	214-2637-00
						(ATTACHING PARTS)		
-232	211-0008-00			2		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-233	426-1463-00			1		. FRAME SECT,MDL:TOP	80009	426-1463-00
-234	119-0854-02			1		. THRM PRINT HEAD:W/CKT BD,SPRING & SOCKET	80009	119-0854-02
						(ATTACHING PARTS)		
-235	211-0017-00			1		. SCREW,MACHINE:4-40 X 0.750 INCH,PNH STL	83385	OBD
-236	210-0851-00			1		. WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
						- - - * - - -		
-237	214-1352-00			1		. SPRING,HLCPS:0.2 OD X 0.5 L,CLOSED	000CX	OBD
-238	214-2727-00			1		. PIN,STR,HEADED:0.065 DIA X 0.96 L,BRASS	80009	214-2727-00
-239	407-2049-00			1		. BRACKET,LEVER:PRINT HEAD,PLASTIC	80009	407-2049-00
						(ATTACHING PARTS)		
-240	211-0014-00			1		. SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-241	211-0020-00			2		. SCREW,MACHINE:4-40 X 1.125 INCH,PNH STL	83385	OBD
	210-0017-00			1		. WASHER,LOCK:#5 SPLIT,0.035 THK,STL CD PL	20859	OBD
-242	210-0851-00			1		. WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
						- - - * - - -		
-243	426-1330-00			1		FRAME,CAB.,REAR:	80009	426-1330-00

FIG. 3 MOUNTING RECORDER

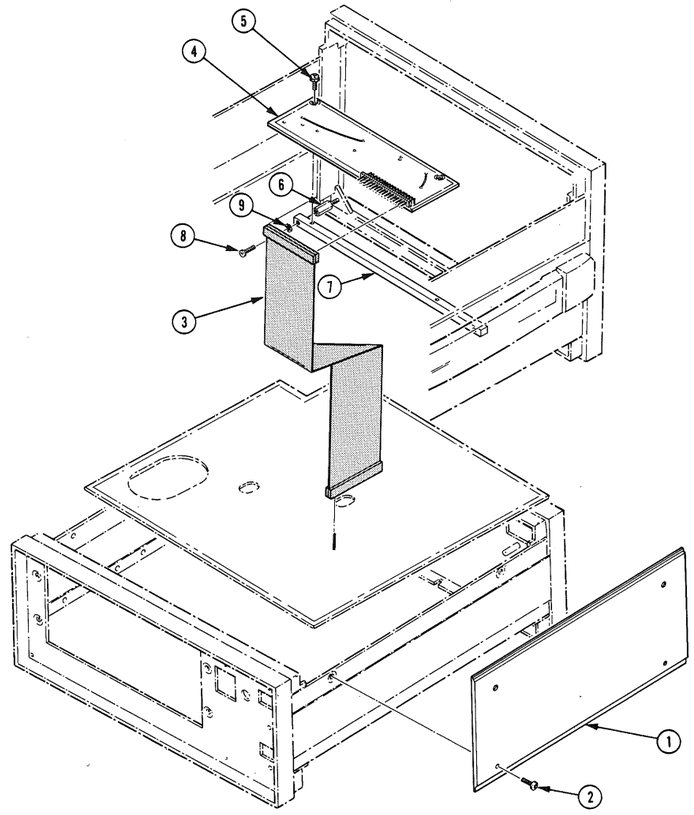


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-	016-0498-00[1]			1		ADPT,RECORDER:	80009	016-0498-00
-1	386-3601-00			1		. PLATE,ADAPTER:RECORDER	80009	386-3601-00
						(ATTACHING PARTS)		
-2	211-0542-00			8		. SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	OBD
						- - - * - - -		
-3	175-1984-00			1		. CA ASSY,SP,ELEC:34,26 AWG,15.0 L	80009	175-1984-00
	175-1965-00			1		. CA ASSY,SP,ELEC:2,26 AWG,3.0 L	80009	175-1965-00
	175-1966-00			1		. CA ASSY,SP,ELEC:4,26 AWG,3.0 L	80009	175-1966-00
	175-1968-00			1		. CA ASSY,SP,ELEC:8,26 AWG,10.5 L	80009	175-1968-00
	175-1969-00			1		. CA ASSY,SP,ELEC:5,26 AWG,11.5 L	80009	175-1969-00
	175-1970-00			1		. CA ASSY,SP,ELEC:7,26 AWG,7.0 L	80009	175-1970-00
	175-1986-00			1		. CA ASSY,SP,ELEC:2,26 AWG,12.0 L	80009	175-1986-00
	195-0169-00			1		. LEAD,ELECTRICAL:1,26 AWG,9.5 L	80009	195-0169-00
	195-0171-00			1		. LEAD,ELECTRICAL:1,26 AWG,9.5 L	80009	195-0171-00
	195-0187-00			1		. LEAD,ELECTRICAL:1,26 AWG,4.0 L	80009	195-0187-00
-4	670-4754-00			1		. CKT BOARD ASSY:MANIFOLD	80009	670-4754-00
						(ATTACHING PARTS)		
-5	211-0008-00			2		. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
						- - - * - - -		
-6	129-0123-00			2		. SPACER,POST:0.688L X 0.25,W/4-40 THD THRU HEX	80009	129-0123-00
-7	381-0379-00			1		. BAR,MOUNTING:CIRCUIT BOARD	80009	381-0379-00
						(ATTACHING PARTS)		
-8	211-0014-00			2		. SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-9	210-0004-00			2		. WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
						- - - * - - -		

[1]Standard, Option 1, 2 & 3 only.

FIG. 4 ACCESSORIES

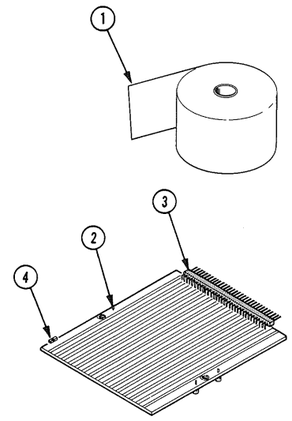


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-1	006-2408-01[1]			1		CHART,RGDG INST:ECG,DUAL TRACE,PKG OF 10	80009	006-2408-01
-2	670-4886-00			1		CKT BOARD ASSY:EXTENDER	80009	670-4886-00
-3	131-1954-00			1		. TERM SET,PIN:30 MALE CONT,R ANGLE	00779	3-87232-0
	016-0638-00			1		ADPTR,RECORDER:400 OPT 04	80009	016-0638-00
	070-2430-00			1		MANUAL,TECH:OPERATORS	80009	070-2430-00
	070-2429-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2429-00

[1]Two rolls shipped with recorder; Available replacement is package of 10 only.

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ±5 V dc Offset. Has ±5 V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; ±10 V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - ±5 V output	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has ±5 V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μs, plus 10 ns sinewave.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μs.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

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MANUAL CHANGE INFORMATION

PRODUCT 400 MEDICAL RECORDER WITH OPTIONS

CHANGE REFERENCE C1/178

DATE 1-17-78

CHANGE:	DESCRIPTION

070-2429-00 Pilot Changes #54 & #55

EFF SN B020000 and up

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

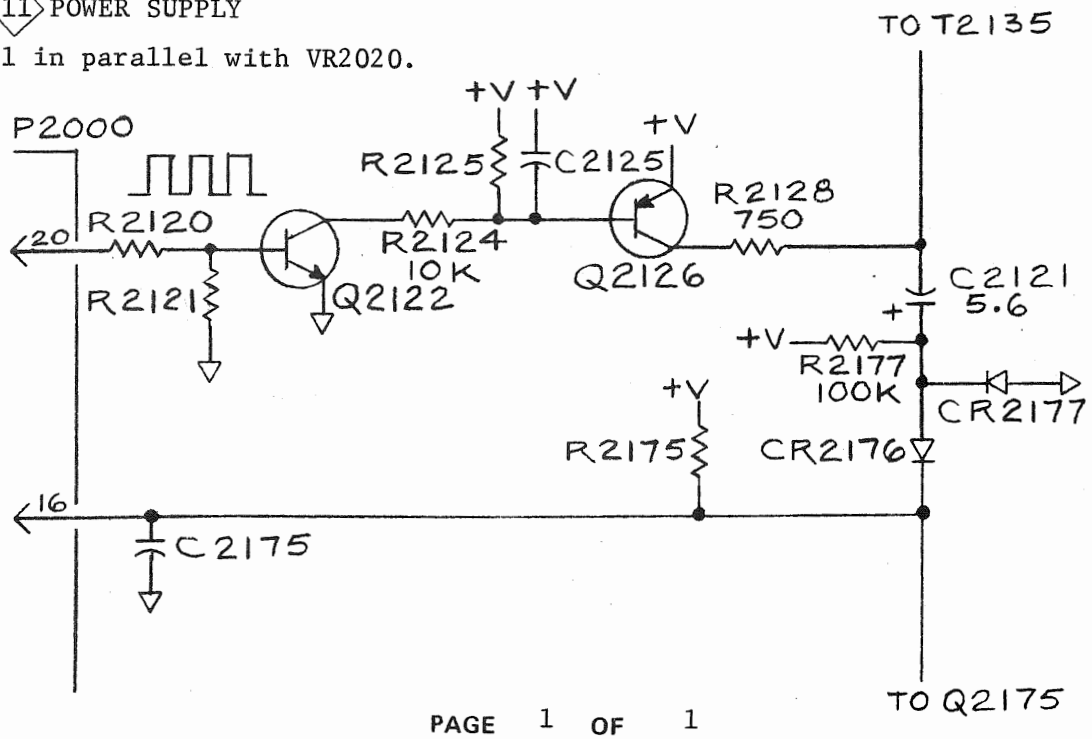
C2006	290-0512-00	CAP.,FXD,ELCTLT:22UF,20%,15V
CR2176	152-0586-00	SEMICOND DEVICE:SILICON,600V,500MA,RGP10J
R2124	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R2128	315-0751-00	RES.,FXD,CMPSN: 750 OHM,5%,0.25W
VR2090	152-0486-00	SEMICOND DEVICE:ZENER,0.25W,6.2V,2%,1N3497

ADD:

C2021	290-0726-00	CAP.,FXD,ELCTLT:220 UF,20%,10V
C2121	290-0415-00	CAP.,FXD,ELCTLT:5.6UF,35V
CR2177	152-0586-00	SEMICOND DEVICE:SILICON,600V,500MA,RGP10J
R2177	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W

DIAGRAM 11 POWER SUPPLY

Add C2021 in parallel with VR2020.



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MANUAL CHANGE INFORMATION

PRODUCT 400
MEDICAL RECORDER

CHANGE REFERENCE C2/378
DATE 3-23-78

CHANGE:	DESCRIPTION

070-2429-00

TEXT CORRECTIONS

Page 1-2 SPECIFICATIONS, TABLE 1-1

CHANGE TO:

Baseline Positioning	Adjustable 1.5 (-0.2,0.5) cm above and below chart centerline.

Page 4-18 To Install Pen Motor:

CHANGE steps 3 and 4 to read:

3. With chart paper in Recorder, adjust the stylus stops so that the contact point of the stylus is limited to 1 to 3 mm beyond the grid area when the stylus is moved from the top to the bottom of the chart.

4. Position the stylus mounting block on the pen-motor shaft so that the surface of the mounting block is even with the end of the pen-motor shaft and so that the stylus is within 1 mm of the center of the chart. Tighten the set screw in the stylus mounting block.

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

R2011	307-0112-00	RES.,FXD,CMPSN:4.3 OHM,5%,0.25W (Pilot Change #56A)
S394	260-1517-00	SWITCH,PUSH:SPDT,5A,125VAC

REMOVE:

S590	260-1517-00	SWITCH,PUSH:SPDT,5A,125VAC

MECHANICAL PARTS LIST CHANGES

Fig. & Index No.		
1-170 & 2-225	(147-0049-00)	MOTOR,DC:ASSEMBLY (B2034)

Consists of the following assemblies:

118-0410-00	MOTOR
118-0411-00	GEARBOX

NOTE

When replacing motor assembly, motor, or gearbox, also order 3 each replacement screws 211-0125-00.

Chart-Drive Gearbox Replacement Instructions

1. Remove chart-drive motor. See Chart Drive Motor removal instructions in the Maintenance section.

2. Loosen the two screws holding the gearbox to the motor.

3. Separate gearbox from the motor.

CHANGE:	DESCRIPTION

4. Slip new gearbox onto the motor and tighten the two screws.

5. Replace the chart-drive motor. See Chart Drive Motor replacement instructions in the Maintenance section.

Fig. &
Index No.

1-113 thru 116

1-118 thru 122

or Also available as an assembly 352-0525-00.

2-165 thru 168

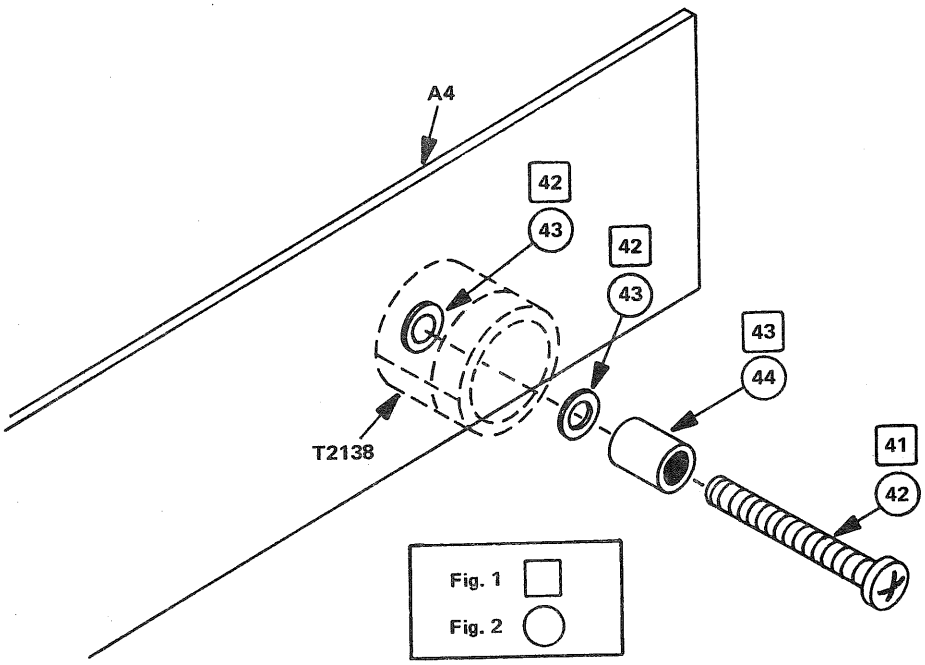
2-170 thru 174

NOTE

When replacing 352-0525-00 or subpart 214-2684-00 order 2 each replacement screws 211-0087-01.

EXPLODED DRAWINGS Fig. 1 and Fig. 2

CORRECT the order of T2138 attaching parts as follows:



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MANUAL CHANGE INFORMATION

PRODUCT 400, 401, 408,412 413 & 414 SERVICE MANUALS

CHANGE REFERENCE C8/378

DATE 3-15-78

CHANGE:	DESCRIPTION

BATTERY USE AND CARE

THIS INFORMATION SUPERSEDES ALL SIMILAR INFORMATION CONTAINED ELSEWHERE IN THIS MANUAL

CONTENTS OF THIS SECTION:

1. BATTERY CHARGING INSTRUCTIONS AND RELATED INFORMATION,
2. INSTRUCTIONS FOR A PERIODIC BATTERY-OPERATING-TIME TEST WHICH THE USER SHOULD PERFORM,
3. A CHART WHICH SHOWS THE BATTERY CHARGING AND OPERATING TIMES APPROPRIATE FOR VARIOUS MONITORS, AND
4. A MAINTENANCE PLAN FOR QUALIFIED SERVICE PERSONNEL.

1. BATTERY CHARGING INSTRUCTIONS

A. 16 HOURS MINIMUM ARE REQUIRED TO RECHARGE A DEPLETED BATTERY. CONNECT THE LINE CORD PLUG TO A "HOSPITAL GRADE" AC OUTLET.

LONGER CHARGING TIME IS REQUIRED UNDER CERTAIN CIRCUMSTANCES. SEE THE TIME CHART ON A LATER PAGE OF THIS SECTION.

B. CHARGE IN A COOL PLACE; PREFERABLY NO WARMER THAN +22°C (≈+72°F).

HIGHER TEMPERATURES PREVENT THE BATTERY FROM ACCEPTING MAXIMUM CHARGE. LONGER CHARGING TIME WILL ONLY PARTIALLY COMPENSATE FOR A HIGH TEMPERATURE. NO CHARGING WILL OCCUR WHEN THE TEMPERATURE EXCEEDS +40°C (+104°F).

MAXIMUM BATTERY OPERATING TIME IS OBTAINED WHEN CHARGING IS DONE WITH THE MONITOR TURNED

OFF AND IN A COOL PLACE. WITH THE MONITOR OFF, THE INTERNAL TEMPERATURE WILL BE LOWER.

C. AVOID EXCESSIVE CHARGING.

IF THE MONITOR IS NOT BEING USED, TURN IT OFF. UNPLUG IT FROM THE AC OUTLET WHEN THE BATTERY IS FULLY CHARGED.

THE BATTERY WILL GRADUALLY DISCHARGE ITSELF OVER A TWO TO SIX MONTH PERIOD AND WILL, THEREFORE, REQUIRE RECHARGING WHEN IT IS AGAIN PLACED INTO USE.

APPLICATIONS, SUCH AS USE IN INTENSIVE CARE, MAY REQUIRE CONTINUOUS USE AND, THEREFORE, WILL REQUIRE THE MONITOR TO BE CONTINUOUSLY CONNECTED TO AN AC OUTLET. WEEKS OR MONTHS OF EXCESSIVE CHARGING RESULT. WHEN NEXT USED ON BATTERY, THE OPERATING TIME MAY BE SIGNIFICANTLY LESS THAN THE LISTED, TYPICAL AMOUNT.

2. BATTERY OPERATING TIME TEST

OCCASIONALLY CHECK OPERATING TIME AS FOLLOWS:

A. CHARGE FULLY. SEE THE TIME CHART ON A LATER PAGE OF THIS SECTION.
B. OPERATE MONITOR ON BATTERY UNTIL AUTOMATIC SHUTDOWN OCCURS.
C. NOTE THE OPERATING TIME.

IF THE OPERATING TIME IS SIGNIFICANTLY LESS THAN LISTED ON THE CHART AND BECOMES, THEREFORE, UNSUITABLE FOR YOUR APPLICATION, REFER THE MONITOR FOR SERVICE.

TEKTRONIX MEDICAL MONITORS
BATTERY CHARGING AND OPERATING TIMES

Monitor Type	Charging Hours @ 20-25°C Ambient			Operating Hours①②	
	D-Cell Battery	F-Cell Battery		D-Cell Battery	F-Cell Battery
	Either Operating Or Not	Not Operating	Fully Operating	Typical	Typical
408 Monitor	16	16	18	3.5	5.6
w/400 Recorder	③	16	20④		5.3④
w/400 Recorder	③	16	26⑤		4.6⑤
412 Monitor	16	16	18	2.5	4.0
w/400 Recorder	③	16	20④		3.8④
w/400 Recorder	③	16	26⑤		3.3⑤
413 Monitor	16	16	18	1.6	2.6
w/400 Recorder	③	16	20④		2.5④
w/400 Recorder	③	16	26⑤		2.3⑤
w/401 DRM	③	16	50		1.9
w/both 400 & 401	③	16	⑦		1.8④
414 Monitor	16	16	18	1.7	2.7
w/400 Recorder	③	16	20④		2.6④
w/400 Recorder	③	16	26⑤		2.4⑤
w/400 Recorder	③	16	22⑥		2.5⑥
w/401 DRM	③	16	50		2.1
w/both 400 & 401	③	16	⑦		2.0④

Footnotes:

1. Operating times listed are for new battery packs which have been charged while the monitor is turned off. For battery packs charged while the monitor was operating, reduce the listed time by about one-third.
2. Operating times listed assume that all monitor capabilities are being used and with typical trace positions and sizes.
3. Combination not recommended.
4. With Recorder producing four 14-second strips per hour.
5. With Recorder producing twenty 14-second strips per hour.
6. With Option 3 Recorder producing four 28-second strips per hour.
7. Monitor can be operating, but either or both the Recorder or DRM must be turned off for charging to take place.

CHANGE:	DESCRIPTION

4. MAINTENANCE

THE FOLLOWING PROCEDURES ARE TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

WHEN A BATTERY PROVIDES SIGNIFICANTLY LESS THAN THE RATED OPERATING TIME, THERE ARE THREE ALTERNATIVES:

A. REPLACE IT WITH A NEW BATTERY, OR
B. ATTEMPT TO REJUVENATE THE BATTERY, OR
C. CONTINUE TO USE THE BATTERY, AS IS.

ATTEMPTED REJUVENATION CARRIES THE RISK THAT ONE OR MORE CELLS MAY BECOME SHORT CIRCUITED INTERNALLY AND MUST THEN BE REPLACED. THIS RISK IS OF LITTLE CONSEQUENCE IF IT HAS ALREADY BEEN DECIDED THAT THE BATTERY CAN NO LONGER BE USED.

REJUVENATION CONSISTS OF:

A. DEEP DISCHARGE
B. RECHARGE
C. DEEP DISCHARGE
D. RECHARGE

THIS PROCEDURE SHOULD CORRECT ANY ACCUMULATED CHARGE IMBALANCE AND REFORM THE CRYSTALLINE STRUCTURE OF THE CELL PLATES. IF ADEQUATE OPERATING TIME IS NOT RESTORED, THE BATTERY SHOULD BE REPLACED.

DEEP DISCHARGE IS ACCOMPLISHED BY CONNECTING A RESISTOR ACROSS THE BATTERY. RESISTOR VALUE SHOULD BE ABOUT TEN OHMS AND THE POWER RATING SHOULD BE AT LEAST FIVE WATTS (TEK PART NO. 308-0399-00). THE RESISTOR WILL GET HOT, SO TAKE APPROPRIATE PRECAUTIONS. THE RESISTOR SHOULD REMAIN CONNECTED UNTIL THE BATTERY VOLTAGE DROPS BELOW ONE VOLT.

CHANGE:	DESCRIPTION

BATTERY RECHARGING CAN, OF COURSE, BE ACCOMPLISHED THROUGH IT'S MONITOR, BUT YOUR MONITORS NEED NOT BE KEPT IN THE MAINTENANCE AREA WHILE THIS REJUVENATION IS PERFORMED. THE MONITOR CAN BE USED ON AC LINE WITHOUT A BATTERY INSTALLED (UNLESS THE MONITOR IS EQUIPPED WITH A 400 RECORDER AND/OR A 401 DIGITAL READOUT MODULE). HOWEVER, THIS MAY BE INCOMPATIBLE WITH THE USER'S NEEDS.

RECHARGING SHOULD BE DONE WITH A RELATIVELY CONSTANT CURRENT SOURCE, NOT A VOLTAGE SOURCE AS WITH LEAD-ACID BATTERIES. THIS CAN BE ACCOMPLISHED BY PUTTING A SUITABLE RESISTOR IN SERIES WITH A POWER SUPPLY. THE PACK VOLTAGE WILL RANGE FROM AS LOW AS 4.6 VOLTS DURING THE LATTER PHASE OF DISCHARGING TO AS HIGH AS 6 VOLTS DURING THE LATTER PHASE OF CHARGING.

THE RECOMMENDED CHARGING CURRENTS FOR THIS PURPOSE ARE:

D-CELLS	250 TO 350 MA	(BATTERY PACK - TEK PART No.: 119-0441-01)
F-CELLS	400 TO 600 MA	(BATTERY PACK - TEK PART No.: 119-0443-01)

THE FOLLOWING IS RECOMMENDED. BUY EXTRA BATTERY PACKS, PERHAPS ONE EXTRA FOR EACH FIVE MONITORS IN USE. IF YOU USE BOTH "D" AND "F" CELL BATTERIES, THEY MUST BE CONSIDERED SEPARATELY. PUT A NEW BATTERY IN THE MONITOR AND RETURN IT FOR USE WHILE THE REJUVENATION PROCEDURE IS PERFORMED. (NOTE: MONITORS EQUIPPED WITH D-CELL PACKS CAN BE CONVERTED TO F-CELL PACKS BY INSTALLING AN F-CELL MOD KIT - TEK PART No.: 040-0710-00).

IT IS SUGGESTED THAT EACH BATTERY PACK BE MARKED WITH AN IDENTIFYING NUMBER AND THAT BATTERY SERVICE RECORDS BE KEPT.

CHANGE:	DESCRIPTION

BATTERY PACKS WHICH FAIL TO REJUVENATE MAY BE REPAIRABLE BY REPLACING THE DEFECTIVE CELL(S). THERE ARE SEVERAL THINGS TO KEEP IN MIND WHEN REPLACING CELLS:

1. REPLACE CELLS WHICH FAIL TO DELIVER AT LEAST 75% OF THEIR LISTED, TYPICAL OPERATING TIME.
2. WHEN A BATTERY PACK HAS BEEN IN SERVICE MORE THAN ONE YEAR, IT IS PROBABLY WISE TO REPLACE ALL OF THE CELLS WHEN THE FIRST BAD CELL IS DETECTED.
3. REPLACEMENT CELLS SHOULD BE OBTAINED FROM TEKTRONIX BECAUSE THESE SPECIAL CELLS ARE DIFFICULT TO OBTAIN OTHERWISE. LOCALLY AVAILABLE CELLS TYPICALLY HAVE LOWER CAPACITY, NARROWER TEMPERATURE RANGE AND CANNOT TOLERATE THE MAGNITUDE OF CHARGING CURRENT PROVIDED BY THE MONITOR.
4. MINIMIZE THE AMOUNT OF HEAT TRANSFERRED FROM SOLDERING IRON TO CELL BODY. BEND THE SOLDER TAB OUTWARD, AWAY FROM THE CELL BODY AND PLACE A HEAT-SINK CLIP BETWEEN THE CELL BODY AND THE SOLDER AREA. NEVER SOLDER DIRECTLY TO THE CELL BODY.