

# 2235A

## PORTABLE OSCILLOSCOPE INSTRUCTION

**WARNING**

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

***Please Check for  
CHANGE INFORMATION at  
the Rear of This Manual***

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## INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first two digits designate the country of manufacture. The last five digits of the serial number are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000 Tektronix, Inc., Beaverton, Oregon, U.S.A.

HK00000 Tektronix, Inc., Hong Kong

G100000 Tektronix Guernsey, Ltd., Channel Islands

E200000 Tektronix United Kingdom, Ltd., Marlow

J300000 Sony/Tektronix, Japan

H700000 Tektronix Holland, NV, Heerenveen,  
The Netherlands

Certificate of the Manufacturer/Importer

We hereby certify that the 2235A OSCILLOSCOPE AND  
ALL INSTALLED OPTIONS

complies with the RF Interference Suppression requirements of Amtsbl.-Vfg 1046/1984.

The German Postal Service was notified that the equipment is being marketed.

The German Postal Service has the right to re-test the series and to verify that it complies.

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Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß der/die/das 2235A OSCILLOSCOPE AND  
ALL INSTALLED OPTIONS

in Übereinstimmung mit den Bestimmungen der Amtsblatt-Verfügung 1046/1984 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhalten der Bestimmungen eingeräumt.

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NOTICE to the user/operator:

The German Postal Service requires that systems assembled by the operator/user of this instrument must also comply with Postal Regulation, Vfg. 1046/1984, Par. 2, Sect. 1.

HINWEIS für den Benutzer/Betreiber:

Die vom Betreiber zusammengestellte Anlage, innerhalb derer dies Gerät eingesetzt wird, muß ebenfalls den Voraussetzungen nach Par. 2, Ziff. 1 der Vfg. 1046/1984 genügen.

NOTICE to the user/operator:

The German Postal Service requires that this equipment, when used in a test setup, may only be operated if the requirements of Postal Regulation, Vfg. 1046/1984, Par. 2, Sect. 1.7.1 are complied with.

HINWEIS für den Benutzer/Betreiber:

Dies Gerät darf in Meßaufbauten nur betrieben werden, wenn die Voraussetzungen des Par. 2, Ziff. 1.7.1 der Vfg. 1046/1984 eingehalten werden.



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# OPERATORS SAFETY SUMMARY

*The safety information in this summary is for operating personnel. Warnings and cautions will also be found throughout the manual where they apply.*

## Terms in This Manual

**CAUTION** statements identify conditions or practices that could result in damage to the equipment or other property.

**WARNING** statements identify conditions or practices that could result in personal injury or loss of life.

## Terms as Marked on Equipment

**CAUTION** indicates a personal injury hazard not immediately accessible as one reads the markings, or a hazard to property, including the equipment itself.

**DANGER** indicates a personal injury hazard immediately accessible as one reads the marking.

## Symbols in This Manual



This symbol indicates where applicable cautionary or other information is to be found. For maximum input voltage see Table 1-1.

## Symbols as Marked on Equipment



**DANGER**—High voltage.



Protective ground (earth) terminal.



**ATTENTION**—Refer to manual.

## Power Source

This product is intended to operate from a power source that does not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

## Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before making any connections to the product input or output terminals. A protective ground connection, by way of the grounding conductor in the power cord, is essential for safe operation.

## Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts, including knobs and controls that may appear to be insulating, can render an electric shock.

## Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see Figure 2-2.

## Use the Proper Fuse

To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your product.

## Do Not Operate in an Explosive Atmosphere

To avoid explosion, do not operate this instrument in an explosive atmosphere.

## Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

# SERVICING SAFETY SUMMARY

*FOR QUALIFIED SERVICE PERSONNEL ONLY*

*Refer also to the preceding Operators Safety Summary*

## **Do Not Service Alone**

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

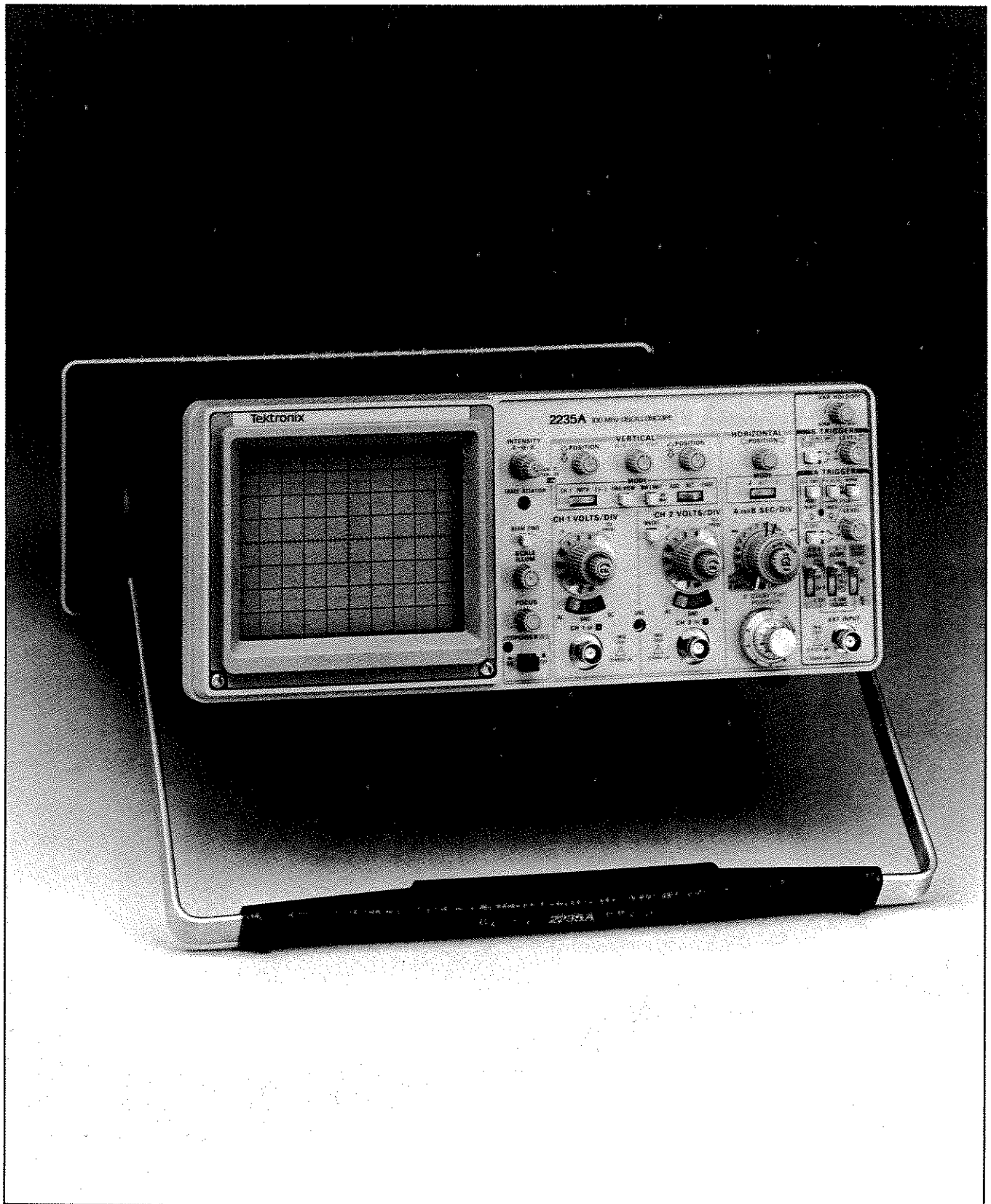
## **Use Care When Servicing With Power On**

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

## **Power Source**

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding connector in the power cord is essential for safe operation.



The 2235A Oscilloscope.

7683-12

# SPECIFICATION

## INTRODUCTION

The TEKTRONIX 2235A Oscilloscope is a rugged, lightweight, dual-channel, 100 MHz instrument that features a bright, sharply defined trace on an 80- by 100-mm cathode-ray tube (crt). Its vertical system supplies calibrated deflection factors from 2 mV per division to 5 V per division. Trigger circuits enable stable triggering over the full bandwidth of the vertical system. The horizontal system provides calibrated sweep speeds from 0.5 s per division to 50 ns per division along with delayed-sweep features. A X10 magnifier circuit extends the maximum sweep speed to 5 ns per division when the A and B SEC/DIV switch is set to 0.05  $\mu$ s per division.

## ACCESSORIES

The instrument is shipped with the following standard accessories:

- 1 Instruction manual
- 2 10X Probes with accessories
- 1 Power cord
- 1 Power cord clamp
- 1 Flat washer
- 1 Self-tapping screw
- 1 Fuse

For part numbers and further information about both standard and optional accessories, refer to the Accessories page at the back of this manual. Your Tektronix representative, local Tektronix Field Office, or Tektronix product catalog can also provide accessories information.

## PERFORMANCE CONDITIONS

The following electrical characteristics (Table 1-1) are valid for the 2235A when it has been adjusted at an ambient temperature between +20°C and +30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0°C and +50°C (unless otherwise noted).

Items listed in the Performance Requirements column are verifiable qualitative or quantitative limits that define the measurement capabilities of the instrument.

Environmental characteristics are given in Table 1-2. The 2235A meets the requirements of MIL-T-28800C, paragraphs 4.5.5.1.3, 4.5.5.1.4, and 4.5.5.1.2.2 for Type III, Class 5 equipment, except where noted otherwise.

Physical characteristics of the instrument are listed in Table 1-3.

Table 1-1  
Electrical Characteristics

| Characteristics                          | Performance Requirements                                                                                                                  |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>VERTICAL DEFLECTION SYSTEM</b>        |                                                                                                                                           |
| Deflection Factor                        |                                                                                                                                           |
| Range                                    | 2 mV per division to 5 V per division in a 1-2-5 sequence.                                                                                |
| Accuracy                                 |                                                                                                                                           |
| +15°C to +35°                            | ±2%.                                                                                                                                      |
| 0°C to +50°C                             | ±3%. <sup>a</sup>                                                                                                                         |
|                                          | For 5 mV per division to 5 V per division VOLTS/DIV switch settings, the gain is set at a VOLTS/DIV switch setting of 10 mV per division. |
|                                          | 2 mV per division gain is set with the VOLTS/DIV switch set to 2 mV per division.                                                         |
| Range of VOLTS/DIV Variable Control      | Continuously variable between settings. Increases deflection factor by at least 2.5 to 1.                                                 |
| Step Response                            |                                                                                                                                           |
| Rise Time                                |                                                                                                                                           |
| +10°C to +35°                            |                                                                                                                                           |
| 5 mV per Division to<br>5 V per Division | 3.5 ns or less. <sup>a</sup>                                                                                                              |
| 2 mV per Division                        | 3.9 ns or less. <sup>a</sup>                                                                                                              |
| +35°C to +50°                            |                                                                                                                                           |
| 5 mV per Division to<br>5 V per Division | 3.9 ns or less. <sup>a</sup>                                                                                                              |
| 2 mV per Division                        | 4.4 ns or less. <sup>a</sup>                                                                                                              |
|                                          | Rise time is calculated from the formula: $\frac{0.35}{\text{Bandwidth (-3 dB)}}$                                                         |
| Bandwidth (-3 dB)                        |                                                                                                                                           |
| +0°C to +35°                             |                                                                                                                                           |
| 5 mV per Division to<br>5 V per Division | Dc to at least 100 MHz.                                                                                                                   |
| 2 mV per Division                        | Dc to at least 90 MHz.                                                                                                                    |

<sup>a</sup> Performance Requirement not checked in Service Manual.

Table 1-1 (cont)

| Characteristics                                                                                                | Performance Requirements                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bandwidth (–3 dB) (cont)                                                                                       |                                                                                                                                                                                                                                                                              |
| +35°C to +50°                                                                                                  |                                                                                                                                                                                                                                                                              |
| 5 mV per Division to<br>5 V per Division                                                                       | Dc to at least 90 MHz. <sup>a</sup>                                                                                                                                                                                                                                          |
| 2 mV per Division                                                                                              | Dc to at least 80 MHz. <sup>a</sup>                                                                                                                                                                                                                                          |
|                                                                                                                | Measured with a vertically centered 6-division reference signal from a 50 $\Omega$ source driving a 50 $\Omega$ coaxial cable that is terminated in 50 $\Omega$ , both at the input connector and at the probe input, with the VOLTS/DIV Variable control in the CAL detent. |
| AC Coupled Lower Limit                                                                                         | 10 Hz or less at –3 dB. <sup>a</sup>                                                                                                                                                                                                                                         |
| Bandwidth Limiter                                                                                              | Upper limits (–3 dB) bandpass at 20 MHz $\pm$ 10%.                                                                                                                                                                                                                           |
| AC Coupled Lower<br>Cutoff Frequency                                                                           | 10 Hz or less at –3 dB. <sup>a</sup>                                                                                                                                                                                                                                         |
| Chop Mode Switching Rate                                                                                       | 500 kHz $\pm$ 30%. <sup>a</sup>                                                                                                                                                                                                                                              |
| Input Characteristics                                                                                          |                                                                                                                                                                                                                                                                              |
| Resistance                                                                                                     | 1 M $\Omega$ $\pm$ 2%. <sup>a</sup>                                                                                                                                                                                                                                          |
| Capacitance                                                                                                    | 20 pF $\pm$ 2 pF. <sup>a</sup>                                                                                                                                                                                                                                               |
| Maximum Safe Input Voltage  | See Figure 1-1 for derating curve.                                                                                                                                                                                                                                           |
| DC Coupled                                                                                                     | 400 V (dc + peak ac) or 800 V ac p-p to 10 kHz or less. <sup>a</sup>                                                                                                                                                                                                         |
| AC Coupled                                                                                                     | 400 V (dc + peak ac) or 800 V ac p-p to 10 kHz or less. <sup>a</sup>                                                                                                                                                                                                         |
| Common-Mode Rejection Ratio (CMRR)                                                                             | At least 10 to 1 at 50 MHz.<br><br>Checked at 10 mV per division for common-mode signals of 6 divisions or less with VOLTS/DIV Variable control adjusted for best CMRR at 50 kHz.                                                                                            |
| Input Current                                                                                                  | 1 nA or less (0.5 division or less trace shift when switching between DC and GND input coupling with the VOLTS/DIV switch at 2 mV per division). <sup>a</sup>                                                                                                                |
| Trace Shift with Volts/Div Switch Rotation                                                                     | 0.75 division or less. <sup>a</sup><br><br>VOLTS/DIV Variable control in CAL detent.                                                                                                                                                                                         |
| Trace Shift as VOLTS/DIV<br>Variable Control is Rotated                                                        | 1.0 division or less. <sup>a</sup>                                                                                                                                                                                                                                           |
| Trace Shift with Invert                                                                                        | 1.5 division or less. <sup>a</sup>                                                                                                                                                                                                                                           |
| Channel Isolation                                                                                              | Greater than 100 to 1 at 50 MHz.                                                                                                                                                                                                                                             |
| POSITION Control Range                                                                                         | At least $\pm$ 11 division from graticule center.                                                                                                                                                                                                                            |

<sup>a</sup> Performance Requirement not checked in Service Manual.

Table 1-1 (cont)

| Characteristics                                                                                           | Performance Requirements                                                                                              |                       |         |
|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------|---------|
| TRIGGER SYSTEM                                                                                            |                                                                                                                       |                       |         |
| A TRIGGER Sensitivity                                                                                     |                                                                                                                       |                       |         |
| P-P AUTO/TV and NORM Modes (A TRIG BW switch in FULL position)                                            | 10 MHz                                                                                                                | 60 MHz                | 100 MHz |
| Internal                                                                                                  | 0.35 div                                                                                                              | 1.0 div               | 1.5 div |
| External                                                                                                  | 35 mV                                                                                                                 | 120 mV                | 150 mV  |
|                                                                                                           | External trigger signal from a 50 Ω source driving a 50 Ω coaxial cable terminated in 50 Ω at the input connector.    |                       |         |
| HF REJ                                                                                                    | Reduces trigger signal amplitude at high frequencies by about 20 dB with rolloff beginning 40 kHz ± 25%. <sup>a</sup> |                       |         |
| LF REJ                                                                                                    | Attenuates signals below 40 kHz (−3 dB point at 40 kHz ± 25%). <sup>a</sup>                                           |                       |         |
| Lowest Usable Frequency in P-P AUTO Mode                                                                  | 20 Hz with 1.0 division internal or 100 mV external. <sup>a</sup>                                                     |                       |         |
| TV LINE (Sync Amplitude)                                                                                  | Internal <sup>a</sup>                                                                                                 | External <sup>a</sup> |         |
|                                                                                                           | 0.35 div                                                                                                              | 35 mV p-p             |         |
| TV FIELD Mode                                                                                             | ≥1 division of composite sync. <sup>a</sup>                                                                           |                       |         |
| B TRIGGER Sensitivity (Internal Only)                                                                     | 10 MHz                                                                                                                | 60 MHz                | 100 MHz |
|                                                                                                           | 0.35 div                                                                                                              | 1.0 div               | 1.5 div |
| EXT INPUT                                                                                                 |                                                                                                                       |                       |         |
| Maximum Input Voltage  | 400 V (dc + peak ac) or 800 V ac p-p at 10 kHz or less. <sup>a</sup><br>See Figure 1-1 for derating curve.            |                       |         |
| Input Resistance                                                                                          | 1 MΩ ± 2%. <sup>a</sup>                                                                                               |                       |         |
| Input Capacitance                                                                                         | 20 pF ± 2.5 pF. <sup>a</sup>                                                                                          |                       |         |
| AC Coupled Lower Cutoff                                                                                   | 10 Hz or less at lower −3 dB point. <sup>a</sup>                                                                      |                       |         |
| Offset                                                                                                    | 25 mV or less.                                                                                                        |                       |         |
| LEVEL Control Range                                                                                       |                                                                                                                       |                       |         |
| A TRIGGER (NORM)                                                                                          |                                                                                                                       |                       |         |
| INT                                                                                                       | Can be set to any point of the trace that can be displayed. <sup>a</sup>                                              |                       |         |
| EXT, DC                                                                                                   | At least ± 1.6 V, 3.2 V p-p.                                                                                          |                       |         |
| EXT, DC ÷ 10                                                                                              | At least ± 16 V, 32 V p-p. <sup>a</sup>                                                                               |                       |         |
| B TRIGGER (Internal)                                                                                      | Can be set to any point of the trace that can be displayed. <sup>a</sup>                                              |                       |         |
| VAR HOLDOFF Control                                                                                       | Increases A Sweep holdoff time by at least a factor of 10. <sup>a</sup>                                               |                       |         |

<sup>a</sup> Performance Requirement not checked in Service Manual.

Table 1-1 (cont)

| Characteristics                                                | Performance Requirements                                                                                                                                                                      |           |
|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| LEVEL Control Range (cont)                                     |                                                                                                                                                                                               |           |
| Trigger View System                                            |                                                                                                                                                                                               |           |
| Deflection Factor                                              |                                                                                                                                                                                               |           |
| Internal                                                       | Same as vertical.                                                                                                                                                                             |           |
| External                                                       |                                                                                                                                                                                               |           |
| AC and DC                                                      | 100 mV per division.                                                                                                                                                                          |           |
| DC ÷ 10                                                        | 1 V per division.                                                                                                                                                                             |           |
| Accuracy                                                       | ± 20%.                                                                                                                                                                                        |           |
| Delay Difference Between EXT INPUT and Either Vertical Channel | Less than 3.0 ns. <sup>a</sup>                                                                                                                                                                |           |
| HORIZONTAL DEFLECTION SYSTEM                                   |                                                                                                                                                                                               |           |
| Sweep Rate                                                     |                                                                                                                                                                                               |           |
| Calibrated Range                                               |                                                                                                                                                                                               |           |
| A Sweep                                                        | 0.5 s per division to 0.05 μs per division in a 1–2–5 sequence of 22 steps. X10 magnifier extends maximum sweep speed to 5 ns per division.                                                   |           |
| B Sweep                                                        | 50 ms per division to 0.05 μs per division in a 1–2–5 sequence of 19 steps. X10 magnifier extends maximum sweep speed to 5 ns per division.                                                   |           |
| Accuracy                                                       | Unmagnified                                                                                                                                                                                   | Magnified |
| + 10°C to + 35°C                                               | ± 2%                                                                                                                                                                                          | ± 3%      |
| 0°C to + 50°C                                                  | ± 3%                                                                                                                                                                                          | ± 4%      |
|                                                                | Sweep accuracy applies over the center 8 divisions. Exclude the first 25 ns of the sweep for the X10 magnified sweep speeds and anything beyond the 100th magnified division.                 |           |
| POSITION Control Range                                         | Start of sweep to 10th division will position past the center vertical graticule line in X1 or 100th division in X10.                                                                         |           |
| Sweep Linearity                                                | ± 5%.                                                                                                                                                                                         |           |
|                                                                | Linearity measured over any 2 of the center 8 divisions. With magnifier in X10, exclude the first 25 ns and anything past the 100th division of the X10 magnified sweeps.                     |           |
| Variable Control Range                                         | Continuously variable between calibrated settings of the SEC/DIV control. Extends the A and the B Sweep speeds by at least a factor of 2.5 times over the calibrated SEC/DIV switch settings. |           |
| Sweep Length                                                   | Greater than 10 division.                                                                                                                                                                     |           |

<sup>a</sup> Performance Requirement not checked in Service Manual.

Table 1-1 (cont)

| Characteristics                                   | Performance Requirements                                                                                                                                                                                                                                                                 |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A/B SWP SEP Range                                 | $\pm 3.5$ divisions or greater.                                                                                                                                                                                                                                                          |
| Delay Time                                        | Applies to $0.5 \mu\text{s}$ per division and slower.<br>Delay time is functional but not calibrated at A sweep speeds above $0.5 \mu\text{s}$ per division.                                                                                                                             |
| Dial Control Range                                | $< 0.5 + 300 \text{ ns}$ to $> 10$ divisions.                                                                                                                                                                                                                                            |
| Jitter                                            | One part or less in 20,000 (0.005%) of the maximum available delay time.                                                                                                                                                                                                                 |
| Differential Time Measurement Accuracy            |                                                                                                                                                                                                                                                                                          |
| $+15^{\circ}\text{C}$ to $+35^{\circ}\text{C}$    | $\pm 1\% + 0.01$ major dial division.                                                                                                                                                                                                                                                    |
| $0^{\circ}\text{C}$ to $+50^{\circ}\text{C}$      | $\pm 2\% + 0.01$ major dial division. <sup>a</sup><br>Exclude delayed operation when A and B SEC/DIV knobs are locked together at any sweep speed or when A SEC/DIV switch is faster than $0.5 \mu\text{s}$ per division. Accuracy applies over the B DELAY TIME POSITION control range. |
| <b>X-Y OPERATION (X1 MAGNIFICATION)</b>           |                                                                                                                                                                                                                                                                                          |
| Deflection Factors                                | Same as Vertical Deflection System with the VOLTS/DIV Variable controls in CAL detent positions.                                                                                                                                                                                         |
| Accuracy                                          |                                                                                                                                                                                                                                                                                          |
| X-Axis                                            |                                                                                                                                                                                                                                                                                          |
| $+15^{\circ}\text{C}$ to $35^{\circ}\text{C}$     | $\pm 3\%$ .                                                                                                                                                                                                                                                                              |
| $0^{\circ}\text{C}$ to $+50^{\circ}\text{C}$      | $\pm 4\%$ . <sup>a</sup><br>Measured with a dc-coupled, 5-division reference signal.                                                                                                                                                                                                     |
| Y-Axis                                            | Same as Vertical Deflection System. <sup>a</sup>                                                                                                                                                                                                                                         |
| Bandwidth (-3 dB)                                 |                                                                                                                                                                                                                                                                                          |
| X-Axis                                            | Dc to a least 2.5 MHz.                                                                                                                                                                                                                                                                   |
| Y-Axis                                            | Same as Vertical Deflection System. <sup>a</sup>                                                                                                                                                                                                                                         |
| Phase Difference Between X- and Y-Axis Amplifiers | $\pm 3^{\circ}$ from dc to 150 kHz.<br>Vertical Input coupling set to DC.                                                                                                                                                                                                                |

<sup>a</sup> Performance Requirement not checked in Service Manual.

Table 1-1 (cont)

| Characteristics                     | Performance Requirements                                                                                                |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>PROBE ADJUST</b>                 |                                                                                                                         |
| Output Voltage of PROBE ADJUST Jack | 0.5 V $\pm$ 2%.                                                                                                         |
| Repetition Rate                     | 1 kHz $\pm$ 5%. <sup>a</sup>                                                                                            |
| <b>Z-AXIS INPUT</b>                 |                                                                                                                         |
| Sensitivity                         | 5 V causes noticeable modulation. Positive-going input decreases intensity.<br>Usable: frequency range is dc to 20 MHz. |
| Maximum Safe Input Voltage          | 30 V (dc + peak ac) or 30 VC p-p ac at 1 kHz or less. <sup>a</sup>                                                      |
| Input resistance                    | 10 k $\Omega$ $\pm$ 10%. <sup>a</sup>                                                                                   |
| <b>POWER SOURCE</b>                 |                                                                                                                         |
| Line Voltage Ranges                 | 90 V to 250 V. <sup>a</sup>                                                                                             |
| Line Frequency                      | 48 Hz to 440 Hz. <sup>a</sup>                                                                                           |
| Maximum Power Consumption           | 75 W (130 VA). <sup>a</sup>                                                                                             |
| Line Fuse                           | 1.25 A, 250 V, slow-blow.                                                                                               |
| <b>CATHODE-RAY TUBE</b>             |                                                                                                                         |
| Display Area                        | 80 by 100 mm. <sup>a</sup>                                                                                              |
| Standard Phosphor                   | P31. <sup>a</sup>                                                                                                       |
| Nominal Accelerating Voltage        | 14 kV. <sup>a</sup>                                                                                                     |

<sup>a</sup> Performance Requirement not checked in Service Manual.

**Table 1-2**  
**Environmental Characteristics**

| Characteristics                                           | Description                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environmental Requirements                                | Instrument meets or exceeds the environmental requirements of MIL-T-28800D for Type III, Class 5, Style D equipment as described below.                                                                                                                                                                                                                    |
| Temperature                                               |                                                                                                                                                                                                                                                                                                                                                            |
| Operating                                                 | 0°C to +50°C (+32°F to +122°F).                                                                                                                                                                                                                                                                                                                            |
| Nonoperating                                              | -40°C to +71°C (-40°F to +160°F). Tested to MIL-T-28800D paragraphs 4.5.5.1.3 and 4.5.5.1.4, except in 4.5.5.1.3 steps 4 and 5 (0°C operating test) are performed ahead of step 2 (-40°C nonoperating test). Equipment shall remain off upon return to room ambient during step 6. Excessive condensation shall be removed before operating during step 7. |
| Altitude                                                  |                                                                                                                                                                                                                                                                                                                                                            |
| Operating                                                 | To 4,570 m (15,000 ft). Maximum operating temperature decreased 1°C per 1,000 ft above 5,000 ft.                                                                                                                                                                                                                                                           |
| Nonoperating                                              | To 15,240 m (50,000 ft).<br>Exceeds requirements of MIL-T-28800D paragraph 4.5.5.2.                                                                                                                                                                                                                                                                        |
| Humidity (Operating and Nonoperating)                     | 5 cycles (120 hours) referenced to MIL-T-28800D paragraph 4.5.5.1.2.2 for Type III, Class 5 instruments. Operating and non-operating at 95% +0° to -5% relative humidity. Operating at +30°C and +50°C for all modes of operation. Non-operating at +30°C to +60°C.                                                                                        |
| Radiated and Conducted Emission Requirements Per VDE 0871 | Meets Class B.                                                                                                                                                                                                                                                                                                                                             |
| Electrostatic Discharge                                   | Withstands discharge of up to 20 kV. Test performed with probe containing a 500 pF capacitor with 1 K $\Omega$ series resistance charged to the test voltage.<br><br>Conforms to Tektronix Standard 062-2862-00.                                                                                                                                           |
| Vibration (Operating)                                     | 15 minutes along each of 3 major axis at a total displacement of 0.015 inch p-p (2.4 g's at 55Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in 1-minute sweeps. Hold for 10 minutes at 55 Hz in each of the 3 major axis. All major resonances must be above 55 Hz.<br><br>Meets requirements of MIL-T-28800D, paragraph 4.5.5.3.1.               |
| Bench Handling Test (cabinet on and cabinet off)          | Each edge lifted four inches and allowed to free fall onto a solid wooden bench surface.<br><br>Meets requirements of MIL-T-28800D, paragraph 4.5.5.4.3.                                                                                                                                                                                                   |
| Shock (Operating and Non-operating)                       | 30 g's, half-sine, 11-ms duration, 3 shocks per axis each direction, for a total of 18 shocks.<br><br>Meets requirements of MIL-T-28800D, paragraph 4.5.5.4.1, except limited to 30 g's.                                                                                                                                                                   |

Table 1-2 (cont)

| Characteristics         | Description                                                                                                                                                                                                      |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Transportation          |                                                                                                                                                                                                                  |
| Packaged Vibration Test | Meets the limits of the National Safe Transit Association test procedure 1A-B-1; excursion of 1 inch p-p at 4.63 Hz (1.1 g) for 30 minutes on the bottom and 30 minutes on the side (for a total of 60 minutes). |
| Package Drop Test       | Meets the limits of the National Safe Transit Association test procedure 1A-B-2; 10 drops of 36 inches.                                                                                                          |

**Table 1-3**  
**Physical Characteristics**

| Characteristics          | Description        |
|--------------------------|--------------------|
| Weight                   |                    |
| With Accessories         | 9.1 kg (20.0 lb).  |
| Without Accessories      | 6.1 kg (13.5 lb).  |
| Domestic Shipping Weight | 10.9 kg (24.1 lb). |
| Height                   |                    |
| With Pouch (Empty)       | 150 mm (5.9 in).   |
| Without Pouch            | 137 mm (5.4 in).   |
| Width                    |                    |
| With Handle              | 360 mm (14.2 in).  |
| Without Handle           | 328 mm (12.9 in).  |
| Depth                    |                    |
| With Front Cover         | 445 mm (17.5 in).  |
| Without Front Cover      | 440 mm (17.3 in).  |
| With Handle Extended     | 511 mm (20.1 in).  |

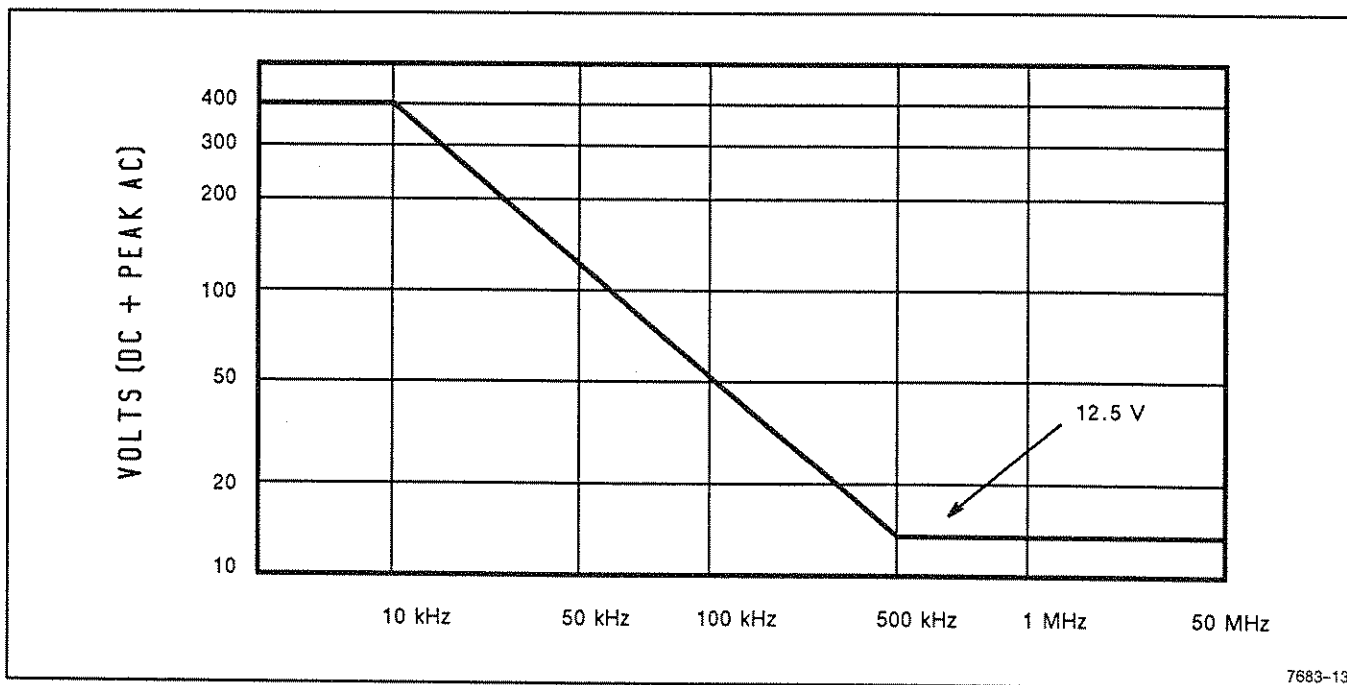
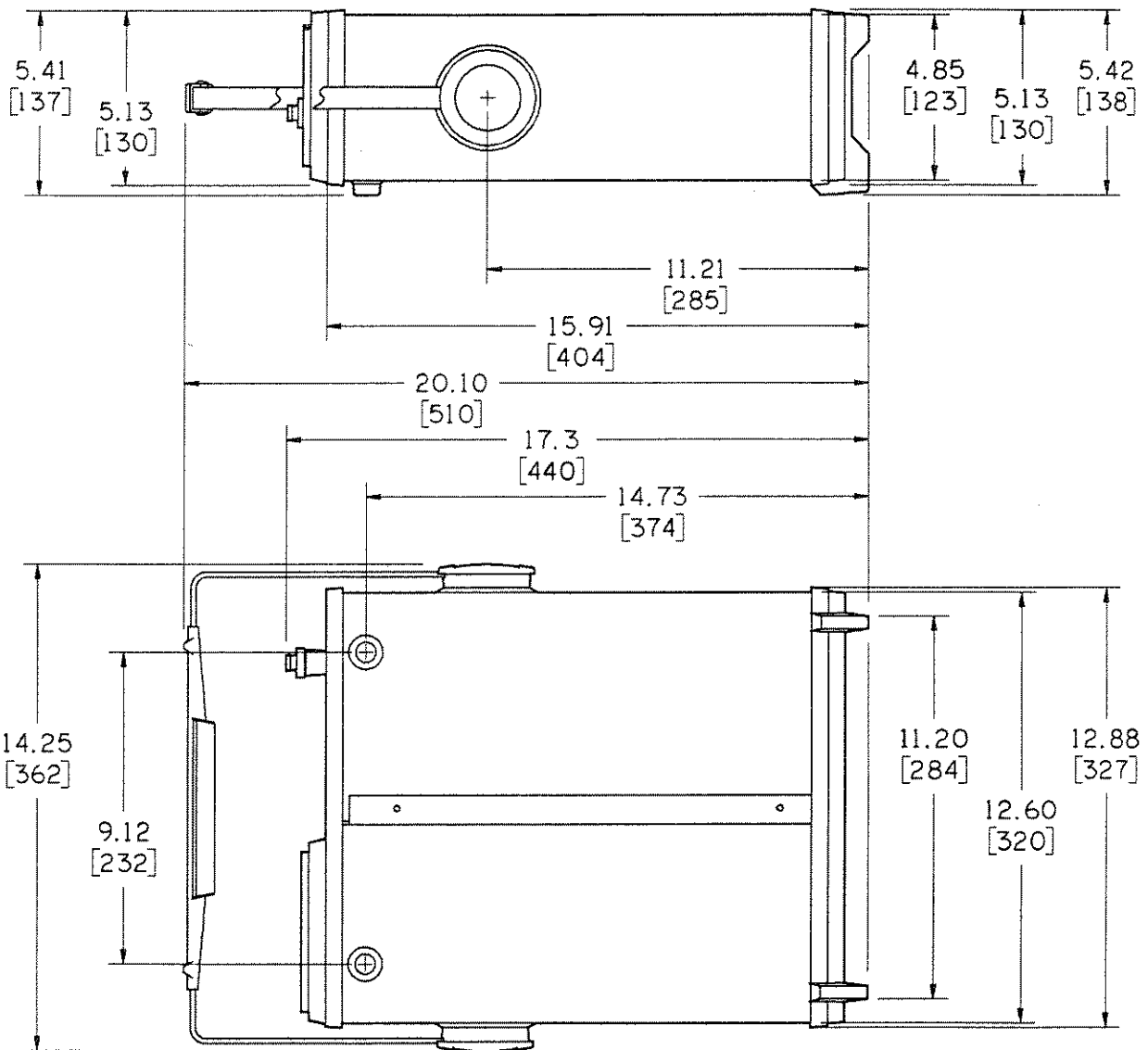


Figure 1-1. Maximum voltage versus frequency derating curve for the CH 1 OR X, CH 2 OR Y, and EXT INPUT OR Z connectors.



Dimensions are in inches [mm]

4735-40

Figure 1-2. Physical dimensions of the 2235A Oscilloscope.



# OPERATING INSTRUCTIONS

## PREPARATION FOR USE

### SAFETY

Refer to the Operators Safety Summary at the front of this manual for power source, grounding, and other safety considerations pertaining to the use of this instrument. Before connecting the instrument to a power source, carefully read the following about line voltages, power cords, and fuses.

### LINE VOLTAGE

The instrument is capable of continuous operation using input voltages that range from 90 V to 250 V nominal at frequencies from 48 Hz to 440 Hz.

### POWER CORD

A detachable three-wire power cord with a three-contact plug is provided with each instrument to permit connection to both the power source and protective ground. The plug protective-ground contact connects (through the protective-ground conductor) to the accessible metal parts of the instrument. For electrical-shock protection, insert this plug only into a power outlet that has a securely grounded protective-ground contact. To secure the power cord to the instrument, use the power cord clamp as illustrated in Figure 2-1.

The instrument is shipped with the required power cord as ordered by the customer. Available power-cord information is illustrated in Figure 2-2, and part numbers are listed in Section 10 at the back of this manual. Contact your Tektronix representative or local Tektronix Field Office for additional power-cord information.

### LINE FUSE

The instrument fuse holder is located on the rear panel (see Figure 2-1) and contains the line fuse. The following procedure can be used to verify that the proper fuse is installed or to install a replacement fuse.

1. Unplug the power cord from the power-input source (if applicable).

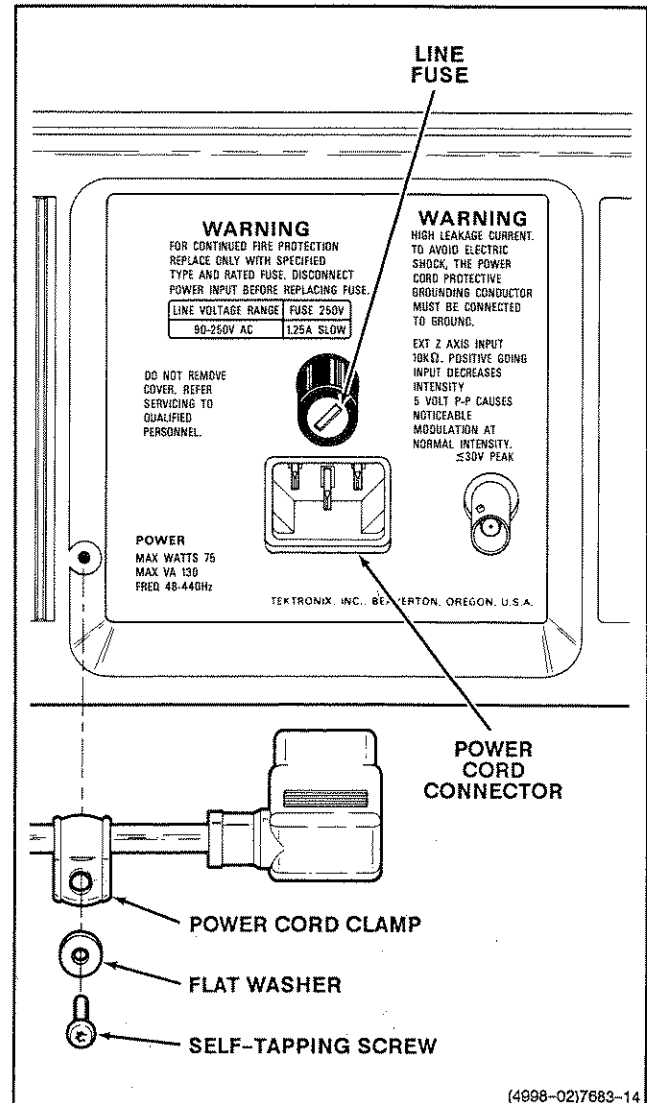
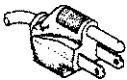
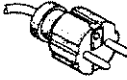


Figure 2-1. Securing the detachable power cord to the instrument.

2. Press in and slightly rotate the fuse-holder cap counterclockwise to release it.
3. Pull the cap (with the attached fuse inside) out of the fuse holder.

4. Verify proper fuse value (1.25 A, 250 V, slow blow).
5. Reinstall the fuse (or replacement fuse) and the fuse-holder cap.

| Plug Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Option       | Power Cord/<br>Plug Type  | Line<br>Voltage | Reference<br>Standards <sup>b</sup>              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------|-----------------|--------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | U.S.<br>Std. | U.S.<br>120V              | 120V            | ANSI C73.11<br>NEMA 5-15-P<br>IEC 83<br>UL 198.6 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A1           | EURO<br>220V              | 220V            | CEE(7),<br>II, IV, VII<br>IEC 83<br>IEC 127      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A2           | UK <sup>a</sup><br>240V   | 240V            | BS 1363<br>IEC 83<br>IEC 127                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A3           | Australian<br>240V        | 240V            | AS C112<br>IEC 127                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A4           | North<br>American<br>240V | 240V            | ANSI C73.20<br>NEMA 6-15-P<br>IEC 83<br>UL 198.6 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A5           | Switzerland<br>220V       | 220V            | SEV<br>IEC 127                                   |
| <sup>a</sup> A 6A, type C fuse is also installed inside the plug of the Option A2 power cord.<br><sup>b</sup> Reference Standards Abbreviations:<br>ANSI—American National Standards Institute<br>AS—Standards Association of Australia<br>BS—British Standards Institution<br>CEE—International Commission on Rules for the Approval of Electrical Equipment<br>IEC—International Electrotechnical Commission<br>NEMA—National Electrical Manufacturer's Association<br>SEV—Schweizerischer Elektrotechnischer Verein<br>UL—Underwriters Laboratories Inc. |              |                           |                 |                                                  |

7683-15

Figure 2-2. Optional power cords.

## INSTRUMENT COOLING

Always maintain adequate instrument cooling. The ventilation holes on both sides of the instrument cabinet and on the rear panel must remain free of obstruction.

## INSTRUMENT REPACKAGING

To ship an instrument, it is recommended that it be packaged in the original manner. The carton and packaging material in which the instrument was shipped should be saved and used for this purpose. The Accessory Pouch should be removed by a qualified service person before being shipped in the original carton.

If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions and having a carton test strength of at least 275 pounds.
2. If the instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: owner of the instrument (with address), the name of a person who can be contacted, complete instrument type and serial number, and a description of the service required.
3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and prevent entry of packing materials into the instrument.
4. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.
5. Seal the carton with shipping tape or with an industrial stapler.
6. Mark the address of the Tektronix Service Center and the return address on the carton in one or more prominent locations.

# CONTROLS, CONNECTORS AND INDICATORS

## DISPLAY AND POWER

Refer to Figure 2-3 for location of items 1 through 8.

- ① **Internal Graticule**—Eliminates parallax viewing error between trace and graticule lines. Rise-time amplitude and measurement points are indicated at the left edge of the graticule.
- ② **POWER Switch**—Turns instrument power on and off. Press in for ON; press again for OFF.
- ③ **Power Indicator**—An LED that illuminates when the instrument is operating.
- ④ **FOCUS Control**—Adjusts for optimum display definition.
- ⑤ **SCALE ILLUM Control**—Adjusts the light level of the graticule illumination.
- ⑥ **BEAM FIND Switch**—When held in, compresses the display to within the graticule area and provides a visible viewing intensity to aid in locating off-screen displays.
- ⑦ **TRACE ROTATION Control**—Screwdriver adjustment used to align the crt trace with horizontal graticule lines.
- ⑧ **A and B INTENSITY Controls**—Determines the brightness of the A and B Sweep traces.

## VERTICAL

Refer to Figure 2-4 for location of items 9 through 18.

- ⑨ **CH 1 VOLTS/DIV and CH 2 VOLTS/DIV Switches**—Used to select the vertical deflection factor in a 1-2-5 sequence. To obtain a calibrated deflection factor, the VOLTS/DIV Variable control must be in the calibrated (CAL) detent (fully clockwise).

**1X**—Indicates the deflection factor selected when using either a 1X probe or a coaxial cable.

**10X PROBE**—Indicates the deflection factor selected when using a 10X probe.

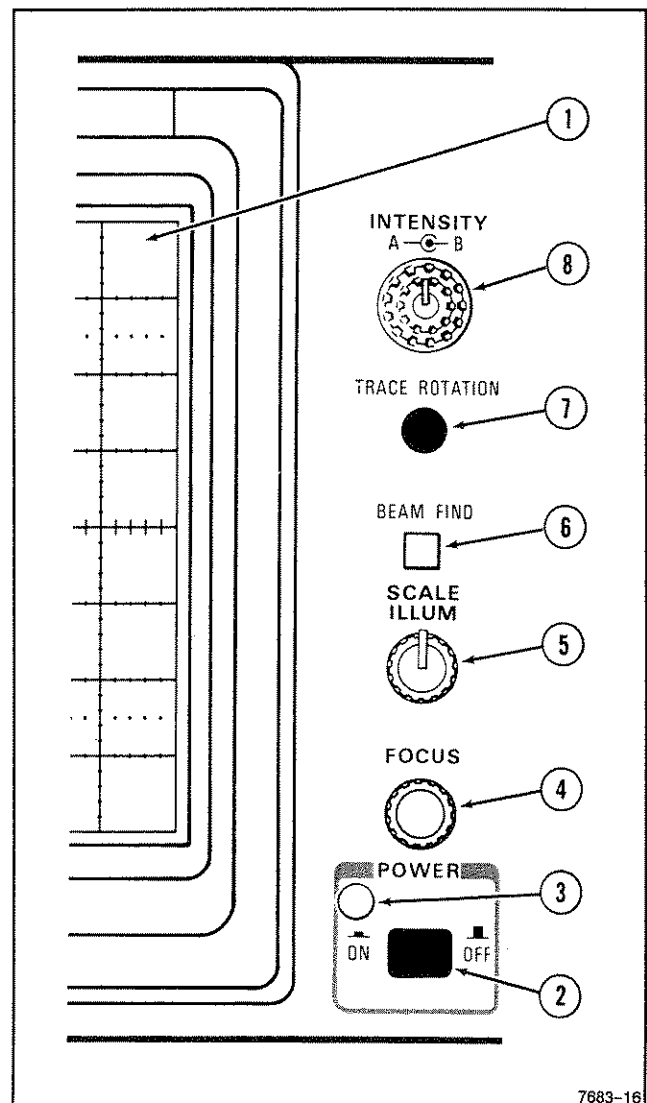


Figure 2-3. Power and display controls and indicator.

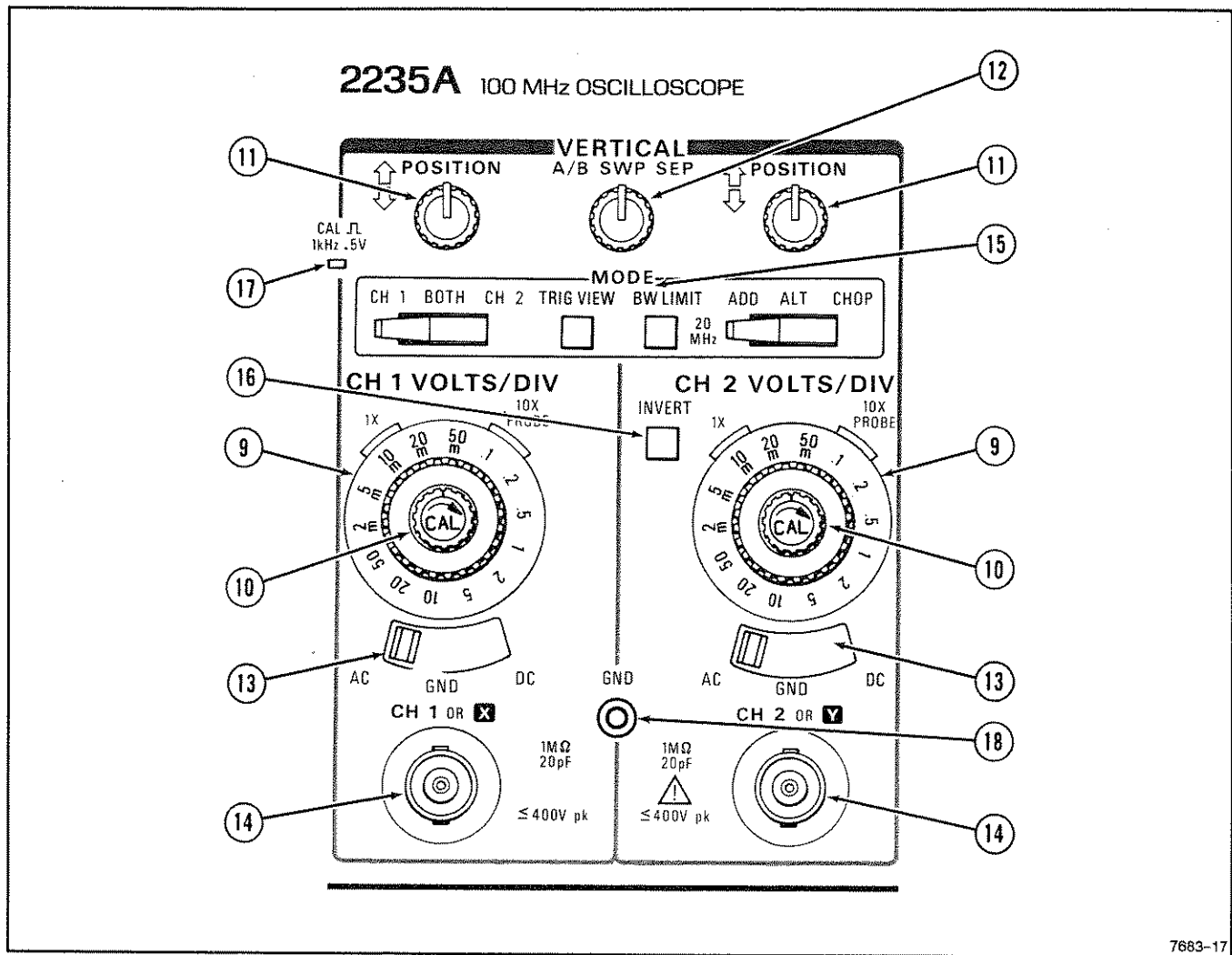


Figure 2-4. Vertical controls, connectors, and indicators.

- ⑩ **VOLTS/DIV Variable Controls**—When rotated counterclockwise out of their calibrated detent positions, these controls provide continuously variable, uncalibrated deflection factors between the calibrated settings of the VOLTS/DIV switches.
- ⑪ **POSITION Controls**—Used to vertically position the display on the crt. When the SEC/DIV switch is set to X-Y, the Channel 2 POSITION control moves the display vertically (Y-axis), and the Horizontal POSITION control moves the display horizontally (X-axis).
- ⑫ **A/B SWP SEP**—Vertically positions the B Sweep trace with respect to the A Sweep when ALT Horizontal MODE is selected.
- ⑬ **Input Coupling AC-GND-DC Switches**—Three-position switches that select the method of coupling the input signals to the instrument deflection system.
- AC**—Input signal is capacitively coupled to the vertical amplifier. The dc component of the input signal is blocked. Low-frequency limit (–3 dB point) is about 10 Hz.

**GND**—The input of the vertical amplifier is grounded to provide a zero (ground) reference-voltage display (does not ground the input signal). This switch position allows precharging the input coupling capacitor.

**DC**—All frequency components of the input signal are coupled to the vertical deflection systems.

- ⑭ **CH 1 OR X and CH 2 OR Y Input Connectors**—Provide for application of external signals to the instrument deflection system or for an X-Y display. In the X-Y mode (SEC/DIV switch set to X-Y), the signal connected to the CH 1 OR X input connector provides horizontal deflection (X-axis), and the signal connected to the CH 2 OR Y input connector provides vertical deflection (Y-axis).

- ⑮ **Vertical MODE Switches**—Two three-position switches and two button switches are used to select the mode of operation for the vertical amplifier system.

**CH 1**—Selects only the Channel 1 input signal for display.

**BOTH**—Selects both Channel 1 and Channel 2 input signals for display. The CH 1-BOTH-CH 2 switch must be in the BOTH position for either ADD, ALT, or CHOP operation.

**CH 2**—Selects only the Channel 2 input signal for display.

**ADD**—Displays the algebraic sum of the Channel 1 and Channel 2 input signals.

**ALT**—Alternately displays Channel 1 and Channel 2 input signals. The alternation occurs during retrace at the end of each sweep. This mode is useful for viewing both input signals at sweep speeds from 0.05  $\mu$ s per division to 0.2 ms per division.

**CHOP**—The display switches between the Channel 1 and Channel 2 input signals during the sweep. The switching rate is about 500 kHz. This mode is useful for viewing both Channel 1 and Channel 2 input signals at sweep speeds from 0.5 ms per division to 0.5 s per division.

**BW LIMIT**—Limits the bandwidth of the vertical deflection system and the A Trigger system to about 20 MHz when the button is pressed in. Button must be pressed in a second time to release it and regain full 100-MHz bandwidth operation. Provides a method for reducing interference from high-frequency signals when viewing low-frequency signals.

**TRIG VIEW**—Press and hold the button in to display a sample of the signal present in the A Trigger amplifier (for all A & B SOURCE switch settings). All other signals displays are removed while the TRIG VIEW button is held in.

- ⑯ **INVERT Switch**—Inverts the Channel 2 display when button is pressed in. Button must be pressed in a second time to release it and regain a non-inverted display.

- ⑰ **CAL  Connector**—Provides an 0.5 V, negative-going square-wave voltage at 1 kHz for compensating voltage probes and checking the operation of the oscilloscope's vertical system. It is not intended to verify the accuracy of the vertical and the horizontal deflection systems

- ⑱ **GND Connector**—Provides direct connection to the instrument chassis ground.

## HORIZONTAL

Refer to Figure 2-5 for location of items 19 through 25.

- ⑲ **A and B SEC/DIV Switches**—Used to select the sweep speeds for the A and B Sweep generators in a 1-2-5 sequence. To obtain calibrated sweep speeds, the A and B SEC/DIV Variable control must be in the calibrated detent (fully clockwise).

**A SEC/DIV**—The calibrated sweep seed is shown between the two the two black lines on the clear plastic skirt. This switch also selects the delay time for delayed-sweep operation when used in conjunction with the B DELAY TIME POSITION control.

**B SEC/DIV**—The B Sweep is set by pulling out the DLY'D SWEEP KNOB and rotating it clockwise to a setting opposite the white line scribed on the knob. The B Sweep circuit is used only for delayed-sweep operation.

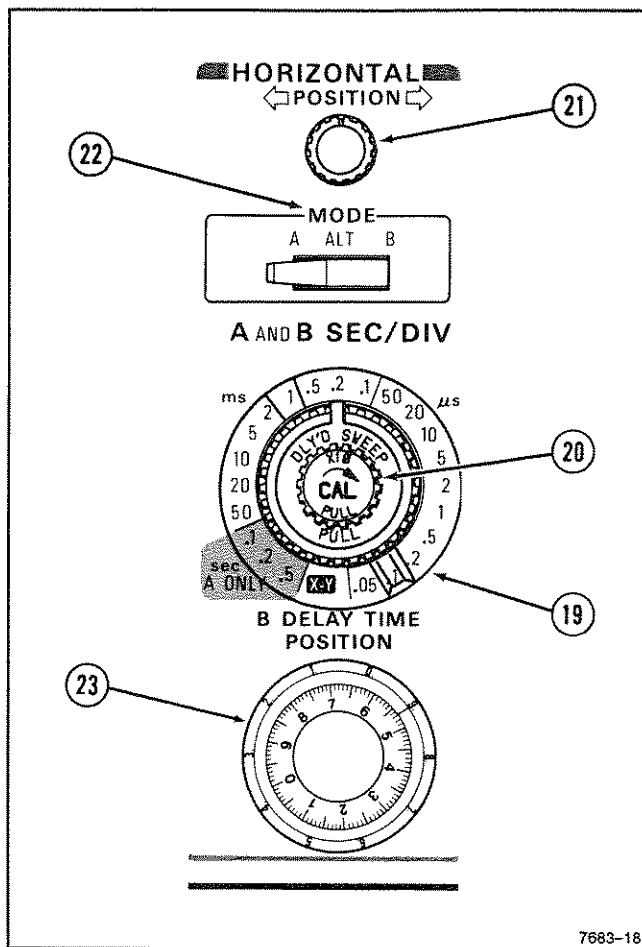


Figure 2-5. Horizontal controls and indicator.

- 20 **A and B SEC/DIV Variable Control and X0 Magnifier Switch**—Provides continuously variable, uncalibrated A Sweep speeds to at least 2.5 times the calibrated setting. It extends the slowest sweep speed to at least 1.25 s per division.

To expand the crt display by a factor of 10, pull out the X10 Magnifier control (SEC/DIV Variable control knob). The display portion of the sweep will be 10 times faster than the A and B SEC/DIV switch settings. This allows a maximum sweep speed of 5 ns per division. Push in the SEC/DIV Variable knob to regain the X1 (normal) sweep speed.

- 21 **POSITION Control**—Horizontally positions the A Sweep display, B Sweep display, and X-axis in X-Y mode.

- 22 **Horizontal MODE Switch**—Determines the mode of operation for the horizontal deflection system.

**A**—Horizontal deflection is provided by the A Sweep generator at a sweep speed determined by the A SEC/DIV switch setting.

**ALT**—Alternates the horizontal displays between the A Sweep (with an intensified zone) and the B Delayed Sweep. The A Sweep speed is determined by the setting of the A SEC/DIV switch. The B Sweep speed and the length of the intensified zone on the A Sweep are both determined by the B SEC/DIV switch setting.

**B**—Horizontal deflection is provided by the B Sweep generator at a sweep speed determined by the B SEC/DIV switch setting. The start of the B Sweep is delayed from the start of the A Sweep by a time determined by the settings of both the A SEC/DIV switch and the B DELAY TIME POSITION control.

- 23 **B DELAY TIME POSITION Control**—Selects the amount of delay time between the start of the A sweep and the start of the B Sweep. Delay time is variable from 0.5 times to 10 times the A SEC/DIV switch setting.

## TRIGGER

Refer to Figure 2-6 for location of items 24 through 34.

- 24 **A TRIGGER Mode Switches**—Determine the A Sweep triggering mode.

**NORM**—Sweep is initiated when an adequate trigger signal is applied. In the absence of a trigger signal, no baseline trace will be present.

**P-P AUTO/TV LINE**—Permits triggering on trigger signals having adequate amplitude and a repetition rate of about 20 Hz or faster. In the absence of a proper trigger signal, an autotrigger is generated, and the sweep free runs. The range of the A TRIGGER LEVEL control is restricted to the peak-to-peak range of the trigger signal. P-P AUTO is the usual trigger mode selection to obtain stable displays of TV Line information.

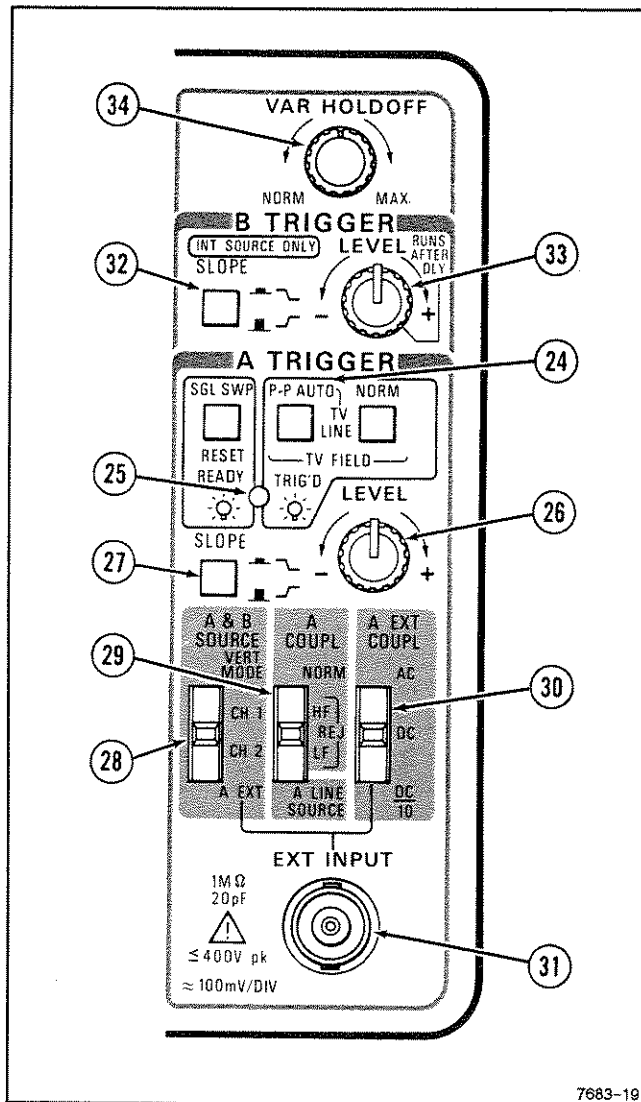


Figure 2-6. Trigger controls, connector, and indicator.

**TV FIELD**—Permits stable triggering on a television field (vertical sync) signal when the P-P AUTO and the NORM Trigger buttons are pressed in together. In the absence of an adequate trigger signal, the sweep free-runs. The instrument otherwise behaves as in P-P AUTO.

**SGL SWP**—Arms the A Trigger circuit for a single-sweep display. Triggering requirements are the same as in NORM trigger mode, except only one sweep is displayed for each trigger signal. After the completion of a triggered sweep, pressing in the SGL SWP button rearms the trigger circuitry to accept the next triggering event. This mode is useful for displaying and photographing either nonrepetitive signals or

signals that cause unstable conventional displays (e.g., signals that vary in amplitude, shape, or time).

- (25) **RESET/READY Indicator**—A dual-function LED indicator. In P-P AUTO and NORM Trigger modes, the LED is turned on when triggering occurs. In SGL SWP Trigger mode, the LED turns on when the A Trigger circuit is armed, awaiting a triggering event, and turns off again after the single sweep event occurs.
- (26) **A TRIGGER LEVEL Control**—Selects the voltage level on the A Trigger signal that produces triggering.
- (27) **A TRIGGER SLOPE Switch**—Selects either the positive slope (button out) or negative slope (button in) of the trigger signal to start the A Sweep.
- (28) **A & B SOURCE Switch**—Selects the source of the internal trigger signal for both the A and the B Trigger Generator circuits. Also selects internal trigger as the A Trigger source.

**VERT MODE**—Trigger signal is obtained alternately from the Channel 1 and Channel 2 input signals in ALT Vertical MODE. In the CHOP or ADD Vertical MODE the trigger signal is the sum of the Channel 1 and Channel 2 input signals. See Table 2-1 for VERT MODE trigger source.

**CH 1**—The signal applied to the CH 1 OR X input connector is the source of the trigger signal.

**CH 2**—The signal applied to the CH 2 OR Y input connector is the source of the trigger signal. The polarity CH 2 Trigger signal may be inverted by the Channel 2 INVERT switch so the displayed slope agrees with the Trigger SLOPE switch.

**A EXT**—Signals applied to the EXT INPUT connector are routed to the A Trigger circuit.

- (29) **A COUPL Switch**—Selects the method of coupling the input trigger signal to the A Trigger circuit.

**NORM**—All frequency components of the trigger signals are coupled to the A Trigger circuit.

**HF REJ**—Attenuates the high-frequency triggering signal components above 40 kHz of the trigger signal.

Table 2-1  
Vertical MODE Trigger Source

| VERT MODE     | Trigger Source                                                                                                                                                                                                   |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CH 1          | CH 1 OR X input signal.                                                                                                                                                                                          |
| CH 2          | CH 2 OR Y input signal.                                                                                                                                                                                          |
| BOTH and ADD  | Algebraic sum of CH 1 OR X and CH 2 OR Y input signals.                                                                                                                                                          |
| BOTH and CHOP | Algebraic sum of CH 1 OR X and CH 2 OR Y input signals.                                                                                                                                                          |
| BOTH and ALT  | Alternates between Channel 1 and Channel 2 on every other sweep (i.e., CH 1 OR X input signal triggers the sweep that displays Channel 1, and CH 2 OR Y input signal triggers the sweep that displays Channel 2. |

**LF REJ**—Attenuates low-frequency triggering signal components below 40 kHz of the trigger signal.

**A LINE SOURCE**—Routes a sample of the ac power source waveform to the A Trigger circuit.

- ③① **A EXT COUPL Switch**—Selects the method of coupling the external signal applied to the EXT INPUT connector to the A Trigger circuit.

**AC**—Input signal is capacitively coupled, and blocks the dc component of the signal.

**DC**—Couples dc and all frequency components of the external trigger signal.

**DC/10**—Attenuates the external signal by a factor of 10. Couples dc and all frequency components of the external trigger signal.

- ③② **EXT INPUT Connector**—Provides for connection of external signals to the A Trigger circuit.
- ③③ **B TRIGGER SLOPE Switch**—Selects either the positive slope (button out) or the negative slope (button in) of the B Trigger signal (internal source only) that starts the B sweep.
- ③④ **B TRIGGER LEVEL Control**—Selects the amplitude point on the B Trigger signal where triggering

occurs in triggerable after delay mode. The fully clockwise position of the B TRIGGER LEVEL Control selects the runs after delay mode of operation for the B Trigger circuitry. Out of the cw position, B Sweep is triggerable after the delay time.

- ③⑤ **VAR HOLDOFF Control**—Varies the holdoff time over a 10 to 1 range. Variable Holdoff starts at the end of the A Sweep. This control improves the ability to trigger on aperiodic signals (such as complex digital waveforms).

## REAR PANEL

Refer to Figure 2-7 for location of item 35.

- ③⑤ **EXT Z-AXIS Connector**—Provides a means of connecting external signals to the Z-Axis amplifier to intensity modulate the crt. Applied signals do not affect display waveshape. Signals with fast rise times and fall times provide the best intensity change, and a 5 V p-p signal will produce noticeable modulation. The Z-axis signals must be time-related to the display to obtain a stable presentation on the crt.

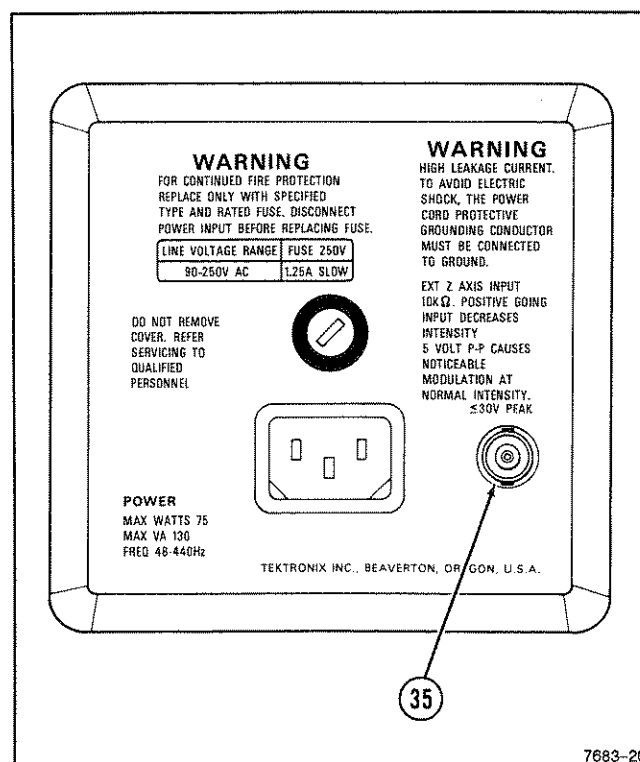


Figure 2-7. Rear-panel connector.

## OPERATING CONSIDERATIONS

### GRATICULE

The graticule is internally marked on the faceplate of the crt to enable accurate measurements without parallax error (see Figure 2-8). It is marked with eight vertical and ten horizontal major divisions. Each major division is divided into five subdivisions. The vertical deflection factors and horizontal timing are calibrated to the graticule so that accurate measurements can be made directly from the crt. Also, percentage markers for the measurement of rise and fall times are located on the left side of the graticule.

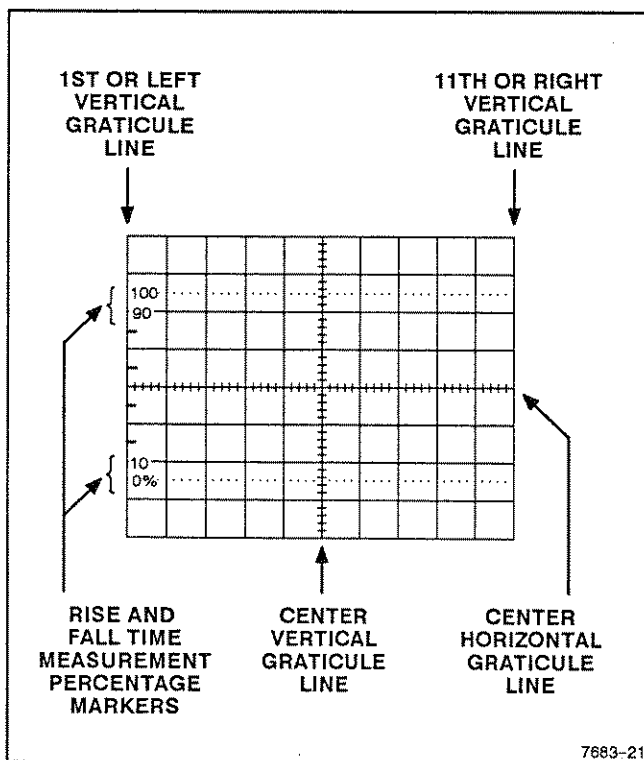


Figure 2-8. Graticule measurement markings.

### GROUNDING

The most reliable signal measurements are made when this instrument and the unit under test are connected by a common reference (ground lead), in addition to the signal lead or probe. The probe's ground lead provides the

best grounding method for signal interconnection and ensures the maximum amount of signal-lead shielding in the probe cable. A separate ground lead can also be connected from the unit under test to the oscilloscope GND connector located on the front panel.

### SIGNAL CONNECTIONS

Generally, probes offer the most convenient means of connecting an input signal to the instrument. They are shielded to prevent pickup of electromagnetic interference, and the supplied 10X probe offers a high input impedance that minimizes circuit loading. This allows the circuit under test to operate with a minimum of change from its normal condition as measurements are being made.

Coaxial cables may also be used to connect signals to the input connectors, but they may have considerable effect on the accuracy of a displayed waveform. To maintain the original frequency characteristics of an applied signal, only high-quality, low-loss coaxial cables should be used. Coaxial cables should be terminated at both ends in their characteristic impedance. If this is not possible, use suitable impedance-matching devices.

### INPUT COUPLING CAPACITOR PRECHARGING

When the Input Coupling switch is set to GND, the input signal is connected to ground through the input coupling capacitor in series with a 1 M $\Omega$  resistor to form a precharging network. This network allows the input coupling capacitor to charge to the average dc-voltage level of the signal applied to the probe. Thus any large voltage transients that may accidentally be generated will not be applied to the amplifier input when the Input Coupling switch is moved from GND to AC. The precharging network also provides a measure of protection to the external circuitry by reducing the current levels that can be drawn from the external circuitry during capacitor charging.

The following procedure should be used whenever the probe tip is connected to a signal source having a

different dc level than that previously applied, especially if the dc-level difference is more than 10 times the VOLTS/DIV switch setting:

1. Set the Input Coupling switch to GND.
2. Insert the probe tip into the oscilloscope GND connector and wait several seconds for the input coupling capacitor to discharge.
3. Connect the probe tip to the signal source and wait several seconds for the input coupling capacitor to charge.
4. Set the Input Coupling switch to AC. The display will remain on the screen, and the ac component of the signal can be measured in the normal manner.

# OPERATOR'S CHECKS AND ADJUSTMENTS

## INTRODUCTION

To verify the operation and accuracy of this instrument before making measurements, perform the following check and adjustment procedures. Adjustments beyond the scope of Operator's Adjustments are in the Adjustment Procedure Section 6 of this manual.

Before proceeding with these instructions, refer to Preparation for Use in this section for first-time start-up considerations.

Verify that the POWER switch is OFF (button out). Then plug the power cord into the power-source outlet.

## BASELINE TRACE

First, obtain a baseline trace using the following procedure.

1. Preset the instrument front-panel controls as follows:

### Display

|                   |                         |
|-------------------|-------------------------|
| A and B INTENSITY | Fully counter-clockwise |
| FOCUS             | Midrange                |

### Vertical (Both Channels)

|                    |                  |
|--------------------|------------------|
| POSITION           | Midrange         |
| A/B SWP SEP        | Midrange         |
| MODE               | CH 1             |
| BW LIMIT           | Off (button out) |
| VOLTS/DIV          | 10 mV            |
| VOLTS/DIV Variable | CAL detent       |
| INVERT             | Off (button out) |
| Input Coupling     | AC               |

### Horizontal

|                       |                         |
|-----------------------|-------------------------|
| POSITION              | Midrange                |
| MODE                  | A                       |
| A and B SEC/DIV       | 0.5 ms                  |
| SEC/DIV Variable      | CAL detent              |
| X10 Magnifier         | Off (knob in)           |
| B DELAY TIME POSITION | Fully counter-clockwise |

## B TRIGGER

|       |                                        |
|-------|----------------------------------------|
| SLOPE | Positive<br>(button out)               |
| LEVEL | RUNS AFTER<br>DLY (fully<br>clockwise) |

## A TRIGGER

|              |                          |
|--------------|--------------------------|
| VAR HOLDOFF  | NORM                     |
| Mode         | P-P AUTO                 |
| SLOPE        | Positive<br>(button out) |
| LEVEL        | Midrange                 |
| A & B SOURCE | VERT MODE                |
| A COUPL      | NORM                     |
| A EXT COUPL  | AC                       |

2. Press in the POWER switch button (ON) and allow the instrument to warm up (20 minutes is recommended for maximum accuracy).
3. Adjust the A INTENSITY control for desired display brightness.
4. Adjust the Vertical and Horizontal POSITION controls as needed to center the trace on the screen.

## TRACE ROTATION

Normally, the resulting trace will be parallel to the center horizontal graticule line, and the Trace Rotation adjustment would not be required. If adjustment is needed, perform the following procedure:

1. Preset instrument controls and obtain a baseline trace.
2. Use the Channel 1 POSITION control to move the baseline trace to the center horizontal graticule line.
3. If the resulting trace is not parallel to the center horizontal graticule line, use a small, flat-bladed screwdriver to adjust the TRACE ROTATION control and align the trace with the center horizontal graticule line.

## PROBE COMPENSATION

Misadjustment of probe compensation is one of the source of measurement error. Most attenuator probes are equipped with a compensation adjustment. To ensure optimum measurement accuracy, always compensate the oscilloscope probes before making measurements. Probe compensation is accomplished as follows:

1. Preset instrument controls and obtain a baseline trace.
2. Connect the two 10X probes (supplied with the instrument) to the CH 1 and CH 2 input connectors.
3. Connect the Channel 1 probe to the CAL output connector.
4. Use the the Channel 1 POSITION control to vertically center the the 5-division display. Adjust the A TRIGGER LEVEL control to obtain a stable display.
5. Check the waveform display for overshoot and rolloff (see Figure 2-9). If necessary adjust the probe compensation for flat tops on the waveforms. Refer to the instructions supplied with probe for details of compensation adjustment.
6. Disconnect the Channel 1 probe from the CAL connector.
7. Connect the Channel 2 probe to the CAL connector.

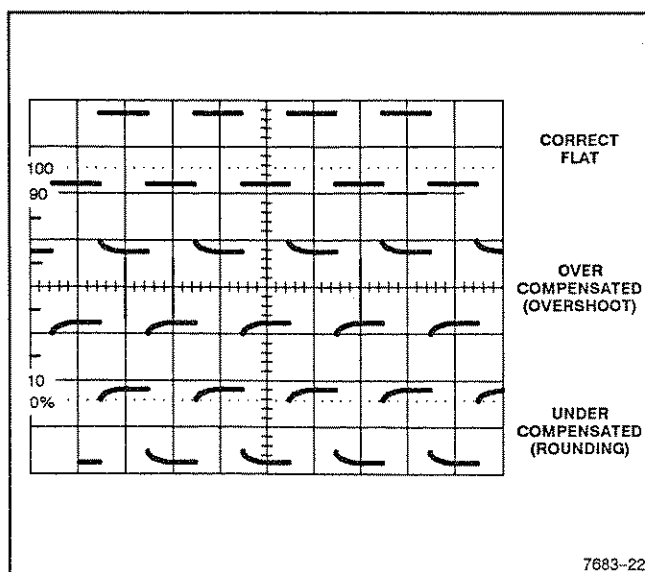


Figure 2-9. Probe compensation.

8. Set the Vertical MODE to CH 2 and vertically center the 5-division display using the Channel 2 POSITION control.
9. Check the waveform display for overshoot and rolloff (see Figure 2-9). If necessary adjust the probe compensation for flat tops on the waveforms. Refer to the instructions supplied with probe for details of compensation adjustment.

## VERTICAL DEFLECTION CHECK

The CAL signal can be used as a convenient way of checking the instrument vertical deflection system with the following checks:

1. Preset the instrument controls and obtain a baseline trace.
2. Connect the two 10X probes (supplied with the instrument) to the CH 1 and CH 2 input connectors.
3. Set both VOLTS/DIV switches to 0.1 V 10X PROBE setting and set both Input Coupling switches to DC.
4. Select CH 1 Vertical MODE and connect the Channel 1 probe to the CAL connector.
5. Using the 1 kHz CAL squarewave signal as the input, obtain a 5-division display of the signal.
6. Set the A SEC/DIV switch to display several cycles of the CAL signal. Use the Channel 1 POSITION control to vertically center the display.
7. Check for a vertical display amplitude of approximately 5 divisions.
8. Select CH 2 Vertical MODE and connect the Channel 2 probe to the CAL connector.
9. Use the Channel 2 POSITION control to vertically center the display and repeat step 7 for the Channel 2 probe.
10. Disconnect the probes from the instrument.

# BASIC APPLICATIONS

## INTRODUCTION

The information in this part is designed to enhance operator understanding and to assist in developing efficient techniques for making specific measurements. Recommended methods for making basic measurements with your instrument are described in the procedures contained in this section.

When a procedure first calls for presetting instrument controls and obtaining a baseline trace, refer to the Operator's Checks and Adjustments part in this section and perform steps 1 through 4 under Baseline Trace.

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## VOLTAGE MEASUREMENTS

### Peak-to-Peak Voltage

To make a peak-to-peak voltage measurement, use the following procedure:

#### NOTE

*This procedure may also be used to make voltage measurements between any two points on the waveform.*

1. Preset instrument controls and obtain a baseline trace.
2. Apply the ac signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Set the appropriate VOLTS/DIV switch to display about five divisions of the waveform, ensuring that the VOLTS/DIV Variable control is in the CAL detent.
4. Adjust the A TRIGGER LEVEL control to obtain a stable display.
5. Set the A SEC/DIV switch to a position that displays several cycles of the waveform.
6. Vertically position the display so that the negative peak of the waveform coincides with one of the horizontal graticule lines (see Figure 2-10, Point A).
7. Horizontally position the display so that one of the positive peaks coincides with the center vertical graticule line (see Figure 2-10, Point B).
8. Measure the vertical deflection from peak to peak (see Figure 2-10, Point A to Point B).

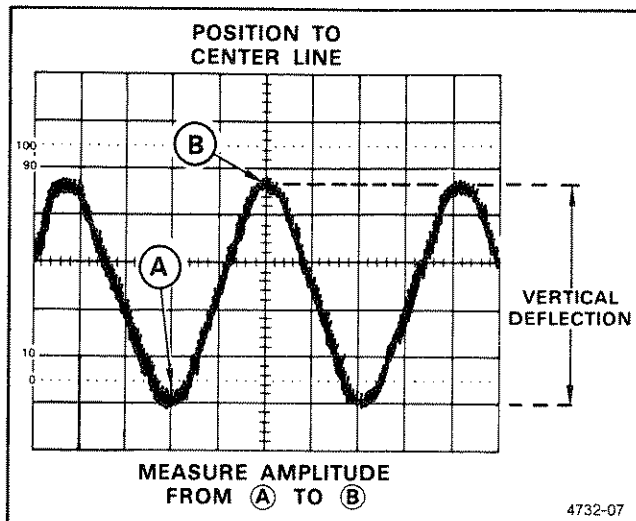


Figure 2-10. Peak-to-peak waveform voltage.

#### NOTE

*If the amplitude measurement is critical or if the trace is thick (as a result of hum or noise on the signal), a more accurate value can be obtained by measuring from the top of a peak to the top of a valley. This will eliminate trace thickness from the measurement.*

9. Calculate the peak-to-peak voltage, using the following formula:

$$\text{Volts (p-p)} = \text{vertical deflection (divisions)} \times \begin{matrix} \text{VOLTS/DIV} \\ \text{switch setting} \\ \text{indicated by 1X} \\ \text{(or 10X PROBE when} \\ \text{10X probe is used)} \end{matrix}$$

EXAMPLE: The measured peak-to-peak vertical deflection is 4.6 divisions (see Figure 2-10) using a 10X attenuator probe with the VOLTS/DIV switch set to 5 V (at 10X PROBE setting).

Substituting the given values:

$$\text{Volts (p-p)} = 4.6 \text{ div} \times 5 \text{ V/div} = 23 \text{ V.}$$

### Instantaneous Voltage

To measure instantaneous voltage level at a given point on a waveform, referred to ground, use the following procedure:

1. Preset instrument controls and obtain a baseline trace.
2. Apply the signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Verify that the VOLTS/DIV Variable control is in the CAL detent and set the Input Coupling switch to GND.
4. Vertically position the baseline trace to the center horizontal graticule line. This establishes the ground reference location.

#### NOTE

*If measurements are to be made relative to a voltage level other than ground, set the Input Coupling switch to DC and apply the reference voltage to the input connector. Then position the trace to the reference (horizontal graticule) line.*

5. Set the Input Coupling switch to DC. Points on the waveform above the ground reference location are positive. Those points below are negative.

#### NOTE

*When using Channel 2, ensure that the Invert mode is not selected (INVERT button out).*

6. If necessary, repeat Step 4 using a different reference line which allows the waveform in Step 5 to be displayed on screen.
7. Adjust the A TRIGGER LEVEL control to obtain a stable display.
8. Set the A SEC/DIV switch to a position that displays several cycles of the signal.
9. Measure the divisions of vertical deflection between the ground reference line and the point on the waveform at which the level is to be determined (see Figure 2-11).

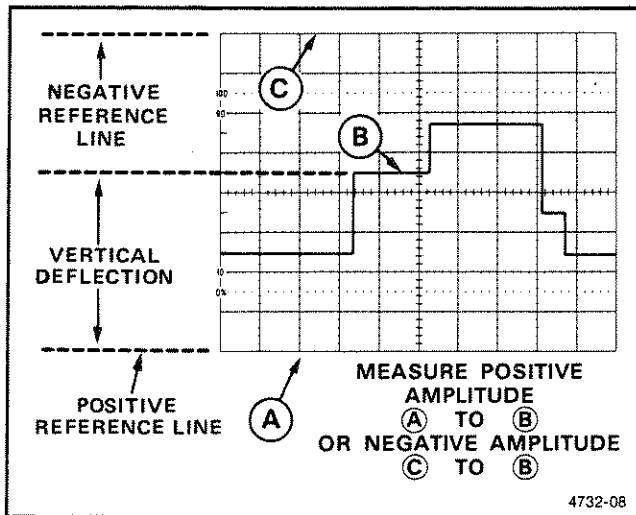


Figure 2-11. Instantaneous voltage measurement.

10. Calculate the instantaneous voltage, using the following formula:

$$\text{Instantaneous Voltage} = \text{vertical deflection (divisions)} \times \text{polarity (+ or -)} \times \text{VOLTS/DIV switch setting indicated by 1X (or 10X PROBE when 10X probe is used)}$$

EXAMPLE: The measured vertical deflection from the reference line is 4.5 divisions (see Figure 2-11), the waveform point is above the reference line, a 10X attenuator probe is being used, and the VOLTS/DIV switch is set to 2 V (at 10X PROBE setting).

Substituting the given values:

$$\text{Instantaneous Voltage} = 4.5 \text{ div} \times (+1) \times 2 \text{ V/div} = 9.0 \text{ V.}$$

### Algebraic Addition

With the Vertical MODE switches set to BOTH and ADD, the waveform displayed is the algebraic sum of the signals applied to the Channel 1 and Channel 2 inputs (CH 1 + CH 2). If the Channel 2 INVERT mode is selected (INVERT button in), the waveform displayed is the difference between the signals applied to the Channel 1 and Channel 2 inputs (CH 1 - CH 2). When both vertical channels are set to the same voltage settings, the deflection factor is equal to that indicated by either VOLTS/DIV switch.

The following general precautions should be observed when using the ADD mode.

- Do not exceed the input voltage rating of the oscilloscope.
- Do not apply signals that exceed the equivalent of about eight times the VOLTS/DIV switch settings, since large voltages may distort the display. For example, with a VOLTS/DIV switch setting of 0.5 V, the voltage applied to that channel should not exceed about 4 volts.
- Use Channel 1 and Channel 2 POSITION control settings which most nearly position the signal on each channel to midscreen, when viewed in either CH 1 or CH 2 Vertical MODE. This ensures the greatest dynamic range for ADD mode operation.
- To attain similar response from each channel, set both the Channel 1 and Channel 2 Input Coupling switches to the same position.

### Common-Mode Rejection

The following procedure shows how to eliminate unwanted ac input-power frequency components. Similar methods could be used either to eliminate other unwanted frequency components or to provide a dc offset.

- Preset instrument controls and obtain a baseline trace.
- Apply the signal containing the unwanted line-frequency components to the CH 1 input connector.
- Apply a line-frequency signal to the CH 2 input connector. To maximize cancellation, the signal applied to Channel 2 must be in phase with the unwanted line-frequency component on the Channel 1 input.
- Select BOTH and CHOP Vertical MODE and set both VOLTS/DIV switches to produce displays of approximately 4 or 5 divisions in amplitude.
- Adjust the CH 2 VOLTS/DIV switch and CH 2 VOLTS/DIV Variable controls so that the Channel 2 display signal is approximately the same amplitude as the undesired portion of the Channel 1 display (see Figure 2-12A).

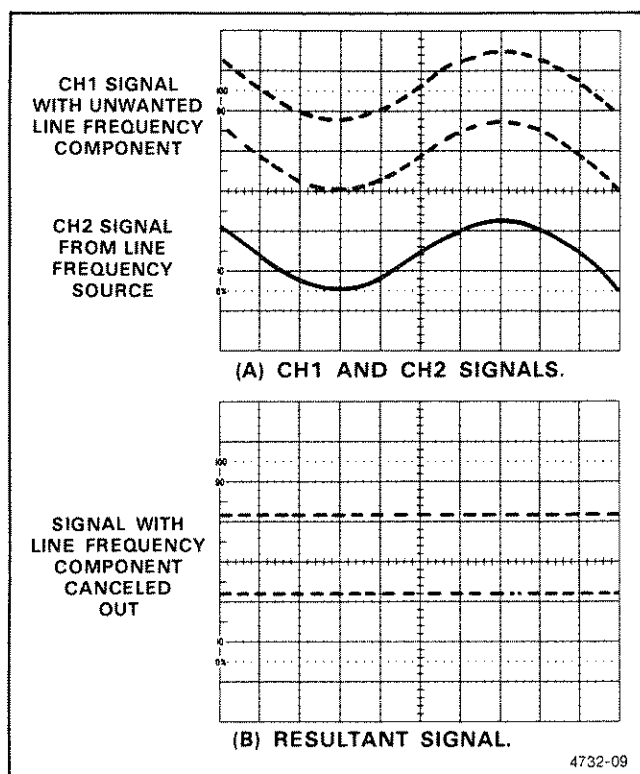


Figure 2-12. Common-mode rejection.

6. Select ADD Vertical MODE and press the INVERT button to invert the Channel 2 display. Slightly readjust the CH 2 VOLTS/DIV Variable control for maximum cancellation of the undesired signal component (see Figure 2-12B).

### Amplitude Comparison (Ratio)

In some applications it may be necessary to establish a set of deflection factors other than those indicated by the VOLTS/DIV switch settings. This is useful for comparing unknown signals to a reference signal of known amplitude. To accomplish this, a reference signal of known amplitude is first set to an exact number of vertical divisions by adjusting the VOLTS/DIV switch and the Variable control. Unknown signals can then be quickly and accurately compared with the reference signal without disturbing the setting of the VOLTS/DIV Variable control. This procedure is as follows:

1. Preset instrument controls and obtain a baseline trace.
2. Apply the reference signal to either vertical channel input and set the Vertical MODE switch to display the channel used.

3. Set the amplitude of the reference signal to five vertical divisions by adjusting the VOLTS/DIV switch and Variable control.
4. Disconnect the reference signal and apply the unknown signal to be measured to the same channel input. Adjust the vertical position of the waveform so that its bottom edge just touches the 0% line on the screen.
5. Horizontally position the waveform so that its top-most features cross the center vertical graticule line (see Figure 2-13).
6. Read the percent ratio directly from the graduations of the center graticule line, referring to the 0% and 100% percentage marks on the left edge of the graticule (1 minor division equals 4% for a 5-division display).

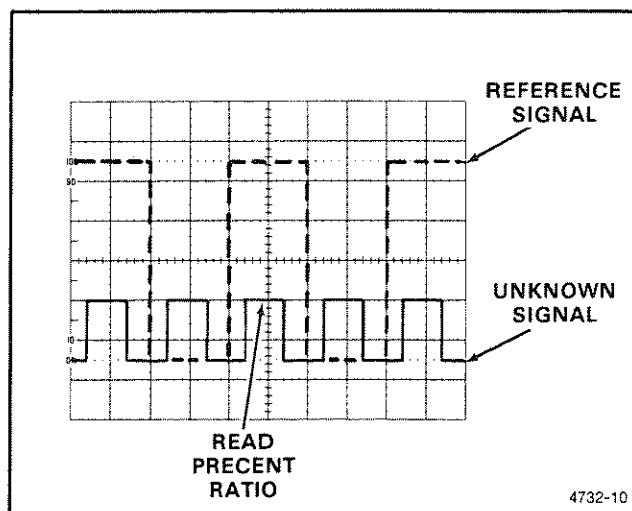


Figure 2-13. Voltage ratios.

## NONDELAYED TIME MEASUREMENTS

### Time Duration

To measure time between two points on a waveform, use the following procedure.

1. Preset instrument controls and obtain a baseline trace.
2. Apply the signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Adjust the A TRIGGER LEVEL control to obtain a stable display.

- Set the A SEC/DIV switch to display one complete period of the waveform. Ensure that the SEC/DIV Variable control is in the CAL detent.
- Position the display to place the time-measurement points on the center horizontal graticule line (see Figure 2-14).

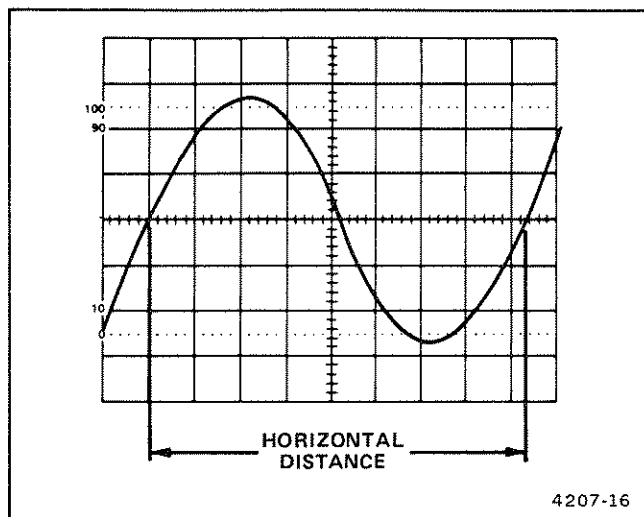


Figure 2-14. Time duration.

- Measure the horizontal distance between the time-measurement points.
- Calculate time duration using the following formula:

$$\text{Time Duration} = \frac{\text{horizontal distance (division)} \times \text{A SEC/DIV switch setting}}{\text{magnification factor}}$$

EXAMPLE: The distance between the time measurement points is 8.3 divisions (see Figure 2-15), and the A SEC/DIV switch is set to 2 ms per division. The X10 Magnifier is off (knob in).

Substituting the given values:

$$\text{Time Duration} = \frac{8.3 \text{ div} \times 2 \text{ ms/div}}{1} = 16.6 \text{ ms}$$

## Frequency

The frequency of a recurrent signal can be determined from its time-duration measurement as follows:

- Measure the time duration of one waveform cycle using the preceding Time Duration measurement procedure.

- Calculate the reciprocal of the time-duration value to determine the frequency of the waveform.

EXAMPLE: The signal in Figure 2-15 has a time duration of 16.6 ms.

Calculating the reciprocal of time duration:

$$\text{Frequency} = \frac{1}{\text{time duration}} = \frac{1}{16.6 \text{ ms}} = 60 \text{ Hz}$$

## Rise Time

Rise-time measurements use the same methods as time duration, except that the measurements are made between the 10% and 90% points of the low-to-high transition of the selected waveform (see Figure 2-15). Fall time is measured between the 90% and 10% points of the high-to-low transition of the waveform.

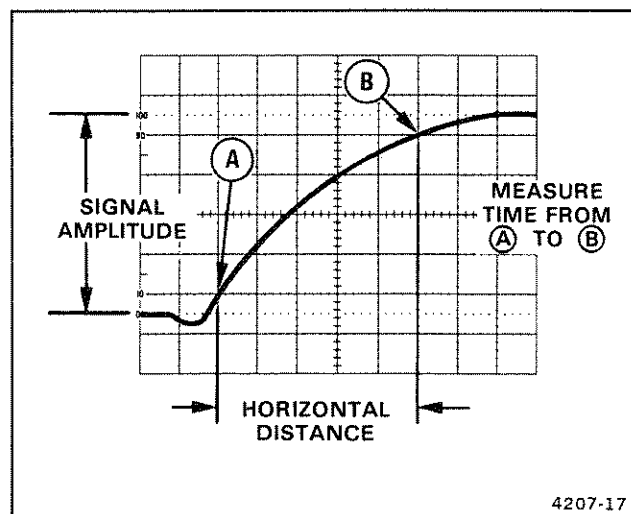


Figure 2-15. Rise time.

- Preset instrument controls and obtain a baseline trace. Ensure that the BW LIMIT is off (button out).
- Apply a signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
- Set the appropriate VOLTS/DIV switch and variable control for an exact 5-division display.
- Vertically position the trace so that the bottom of the waveform touches the 0% graticule line and the top of the waveform touches the 100% graticule line.
- Horizontally position the display so the 10% point on the waveform intersects the second vertical graticule line.

- Measure the horizontal distance between the 10% and 90% points (between Points A and B of Figure 2-16) and calculate the time duration using the following formula:

$$\text{Rise Time} = \frac{\text{horizontal distance (divisions)} \times \text{A SEC/DIV switch setting}}{\text{magnification factor}}$$

Example: The horizontal distance between the 10% and 90% points is 5 divisions, and the A SEC/DIV switch is set to 1  $\mu\text{s}$  per division. A magnification factor of 1 is used.

Substituting the given values in the formula:

$$\text{Rise Time} = \frac{5 \text{ div} \times 1 \mu\text{s/div}}{1} = 5 \mu\text{s}$$

### Time Difference Between Pulses on Time-Related Signals

The calibrated sweep speed and dual-trace features of this instrument allow measurement of the time difference between two separate time-related events. To measure time difference, use the following procedure:

- Preset instrument controls and obtain a baseline trace, then set the A & B SOURCE switch to CH 1.
- Set both Input Coupling switches to the same position, depending on the type of input coupling desired.
- Using either probes or cables with equal time delays, connect a known reference signal to the Channel 1 input and the comparison signal to the Channel 2 input.
- Set both VOLTS/DIV switches for 4- or 5-division displays.
- Select BOTH Vertical MODE; then select either ALT or CHOP, depending on the frequency of input signals.
- If the two signals are of opposite polarity, press INVERT button to invert the Channel 2 display (signals may be of opposite polarity due to 180° phase difference).
- Adjust the A TRIGGER LEVEL control for a stable display.

- Set the A SEC/DIV switch to a sweep speed which provides three or more divisions of horizontal separation between the reference points on the two displays. Center each of the displays vertically (see Figure 2-16)

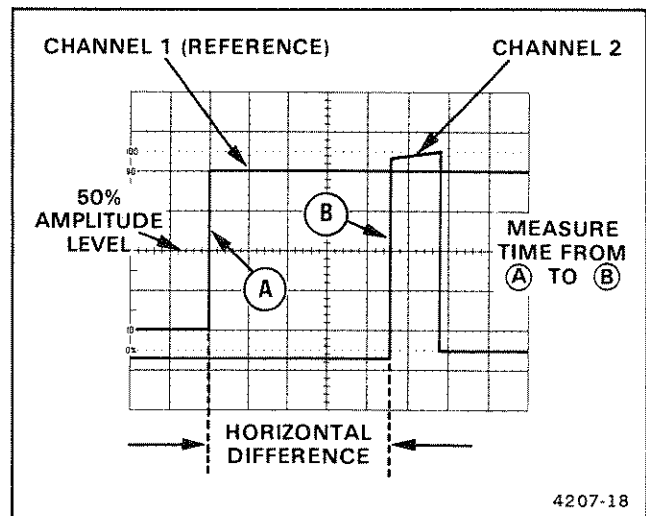


Figure 2-16. Time difference between pulses on time-related signals.

- Measure the horizontal difference between the two signal reference points and calculate the time difference using the following formula:

$$\text{Time Difference} = \frac{\text{A SEC/DIV switch setting} \times \text{horizontal difference (divisions)}}{\text{magnification factor}}$$

EXAMPLE: The A SEC/DIV switch is set to 50  $\mu\text{s}$  per division, the X10 Magnifier is on (button out) and the horizontal difference between waveform measurement points is 4.5 divisions.

Substituting the given values in the formula:

$$\text{Time Difference} = \frac{50 \mu\text{s/div} \times 4.5 \text{ div}}{10} = 22.5 \mu\text{s}$$

### Phase Difference

In a similar manner to Time Difference Between Two Time-Related Pulses, phase comparison between two signals of the same frequency can be made using the dual-trace feature of the instrument. This method of phase difference measurement can be used up to the

frequency limit of the vertical deflection system. To make a phase comparison, use the following procedure:

1. Preset instrument controls and obtain a baseline trace, then set the A & B SOURCE switch to CH 1.
2. Set both Input Coupling switches to the same position, depending on the type of input coupling desired.
3. Using either probes or cables with equal time delays, connect a known reference signal to the Channel 1 input and the unknown signal to the Channel 2 input.
4. Select BOTH Vertical MODE; then select either ALT or CHOP, depending on the frequency of input signals. The reference signal should precede the comparison signal in time.
5. If the two signals are of opposite polarity, press INVERT button to invert the Channel 2 display.
6. Set both VOLTS/DIV switches and both Variable controls so the displays are equal in amplitude.
7. Adjust the A TRIGGER LEVEL control for a stable display.
8. Set the A SEC/DIV switch to a sweep speed which displays about one full cycle of the reference waveform.
9. Position the displays and adjust the SEC/DIV Variable control so that one reference-signal cycle occupies exactly 8 horizontal divisions at the 50% rise-time points (see Figure 2-18). Each division of the graticule now represents  $45^\circ$  of the cycle ( $360^\circ \div 8$  divisions), and the horizontal calibration can be stated as  $45^\circ$  per division.
10. Measure the horizontal difference between corresponding points on the waveforms at a convenient horizontal graticule line and calculate the phase difference using the following formula:

$$\text{Phase Difference} = \text{horizontal difference (divisions)} \times \text{horizontal calibration (deg/div)}$$

Example: The horizontal difference is 0.6 division with a graticule calibration of  $45^\circ$  per division, as shown in Figure 2-17.

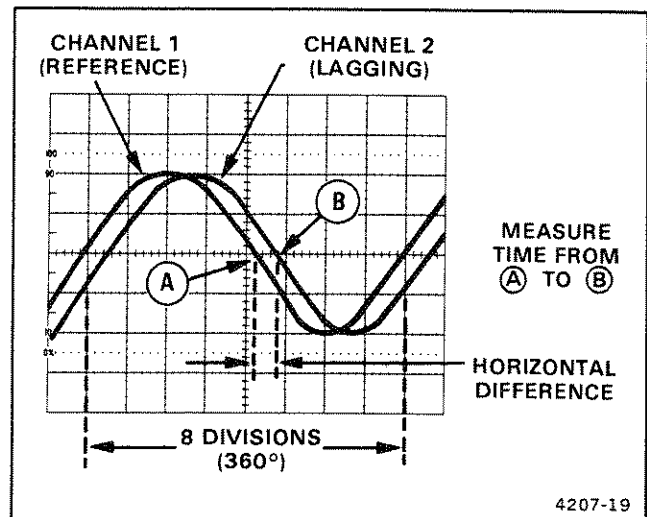


Figure 2-17. Phase difference.

Substituting the given values into the phase difference formula:

$$\text{Phase difference} = 0.6 \text{ div} \times 45^\circ/\text{div} = 27^\circ$$

More accurate phase measurements can be made by using the X10 Magnifier function to increase the sweep speed without changing the SEC/DIV Variable control setting.

EXAMPLE: If the sweep speed were increased 10 times with the magnifier (X10 Magnifier knob out), the magnified horizontal calibration would be  $45^\circ/\text{division}$  divided by 10 (or  $4.5^\circ/\text{division}$ ). Figure 2-18 shows the same signals illustrated in Figure 2-17, but magnifying the displays results in a horizontal difference of 6 divisions between the two signals.

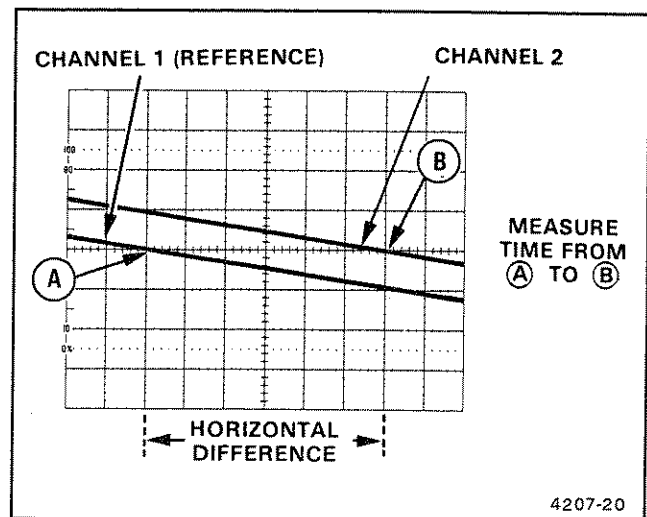


Figure 2-18. High-resolution phase difference.

Substituting the given values in the phase difference formula:

$$\text{Phase difference} = 6 \text{ div} \times 4.5^\circ/\text{div} = 27^\circ$$

## TELEVISION DISPLAYS

### TV Line Signal

The following procedure is used to display a TV Line signal.

1. Preset instrument controls and set A TRIGGER Mode to P-P AUTO/TV LINE.
2. Apply the TV signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Set the appropriate VOLTS/DIV switch to display 1 division or more of composite video signal.
4. Set the A SEC/DIV switch to 10  $\mu$ s.
5. For positive-going TV signal sync pulses, set the A TRIGGER SLOPE switch to positive (button out); for negative-going TV signal sync pulses, set the A TRIGGER SLOPE switch to negative (button in).

#### NOTE

*To examine a TV Line signal in more detail, either the X10 Magnifier or the Delayed-Sweep Magnification feature may be used.*

### TV Field Signal

The television feature of this instrument can also be used to display TV Field signals.

1. Preset instrument controls and obtain a baseline trace.
2. Select TV FIELD A TRIGGER mode (push both P-P AUTO and NORM buttons in) and set the A SEC/DIV switch to 2 ms.
3. To display a TV field, connect the TV signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
4. Set the appropriate VOLTS/DIV switch to display 1 division or more of composite video signal.

5. For positive-going TV signal sync pulses, set the A TRIGGER SLOPE switch to positive (button out); for negative-going TV signal sync pulses, set the A TRIGGER SLOPE switch to negative (button in).
6. To change the TV field that is displayed, momentarily interrupt the trigger signal by setting the Input Coupling switch to GND and then back to DC or AC until the desired field is displayed.

#### NOTE

*To examine a TV Field signal in more detail, either the X10 Magnifier or the Delayed-Sweep Magnification feature may be used.*

7. To display a selected horizontal line, first trigger the sweep on a vertical (field) sync pulse, then use the Magnified Sweep Runs After Delay procedure in this part (steps 5 and 6) to magnify the selected horizontal line for a closer examination. This procedure is useful for examining Vertical Interval Test Signals (VITS).
8. To display either Field 1 or Field 2 individually, connect the TV signal to both CH 1 and CH 2 input connectors and select BOTH and ALT Vertical MODE.
9. Set the A SEC/DIV switch to 0.5 ms or faster sweep speed (displays less than one full field). This will synchronize Channel 1 display to one field and Channel 2 to the other field.

## DELAYED-SWEEP MAGNIFICATION

The delayed-sweep feature of this instrument can be used to provide higher apparent magnification than is provided by the X10 Magnifier switch. Apparent magnification occurs as a result of displaying a selected portion of the A trace at a faster sweep speed (B Sweep speed). The A SEC/DIV switch setting determines how often the B trace will be displayed. Since the B Sweep can occur only once for each A Sweep, the A Sweep time duration determines the time interval between succeeding B Sweeps.

The intensified zone is an indication of both the location and length of the B Sweep interval within the A Sweep interval. Positioning of the intensified zone (i.e., setting the amount of time between start of the A Sweep and start of the B Sweep) is accomplished with the B DELAY TIME POSITION control. With either ALT or B Horizontal MODE selected and B TRIGGER LEVEL control set fully

clockwise (RUNS AFTER DLY), the B DELAY TIME POSITION control provides continuously variable positioning of the start of the B Sweep. The range of this control is sufficient to place the B Sweep interval at most any location within the A Sweep interval. When ALT Horizontal MODE is selected, the B SEC/DIV switch setting determines the B Sweep speed and concurrently sets the length of the intensified zone on the A trace.

Using delayed-sweep magnification may produce a display with some slight horizontal movement (pulse jitter). Pulse jitter includes not only the inherent uncertainty of triggering the delayed sweep at exactly the same trigger point each time, but also jitter that may be present in the input signal. If pulse jitter needs to be measured, use the Pulse Jitter Time Measurement procedure which follows the discussion of Magnified Sweep Runs After Delay.

### Magnified Sweep Runs After Delay

The following procedure explains how to operate the B Sweep in a nontriggered mode and to determine the resulting apparent magnification factor.

1. Preset instrument controls and obtain a baseline trace.
2. Apply the signal to either vertical channel input connector and set the Vertical MODE switch to display the channel used.
3. Set the appropriate VOLTS/DIV switch to produce a display of approximately 2 or 3 divisions in amplitude and center the display.
4. Set the A SEC/DIV switch to a sweep speed which displays at least one complete waveform cycle.
5. Select ALT Horizontal MODE. Adjust both the appropriate channel POSITION control and the A/B SWP SEP control to display the A trace above the B trace.
6. Adjust the B DELAY TIME POSITION control to position the start of the intensified zone to the portion of the display to be magnified (see Figure 2-19).
7. Set the B SEC/DIV switch to a setting which intensifies the full portion of the A trace to be magnified. The intensified zone will be displayed as the B trace (see Figure 2-19). The B Horizontal MODE may also be used to magnify the intensified portion of the A Sweep.
8. The apparent sweep magnification can be calculated from the following formula:

$$\text{Apparent Delayed Sweep Magnification} = \frac{\text{A SEC/DIV switch setting}}{\text{B SEC/DIV switch setting}}$$

EXAMPLE: Determine the apparent magnification of a display with an A SEC/DIV switch setting of 0.1 ms per division and a B SEC/DIV switch setting of 1  $\mu$ s per division.

Substituting the given values:

$$\text{Apparent Magnification} = \frac{1 \times 10^{-4} \text{ s}}{1 \times 10^{-6} \text{ s}} = 10^2 = 100$$

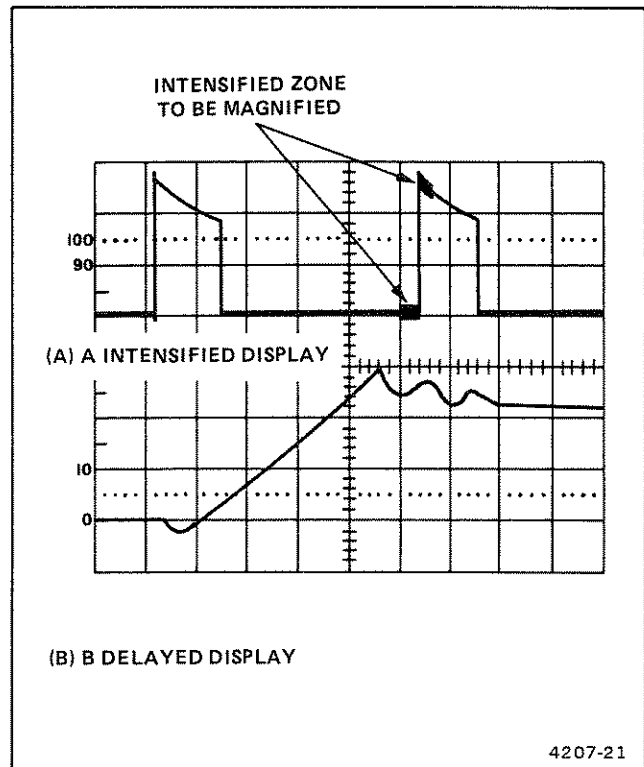


Figure 2-19. Delayed-sweep magnification.

## Pulse Jitter Time Measurement

To measure pulse jitter time:

1. Perform steps 1 through 7 of the preceding Magnified Sweep Runs After Delay procedure.
2. Referring to Figure 2-20, measure the difference between Point C and Point D in divisions and calculate the pulse jitter time using the following formula:

$$\begin{array}{rcl} \text{Pulse Jitter Time} & = & \text{Horizontal difference (divisions)} \times \text{B SEC/DIV switch setting} \end{array}$$

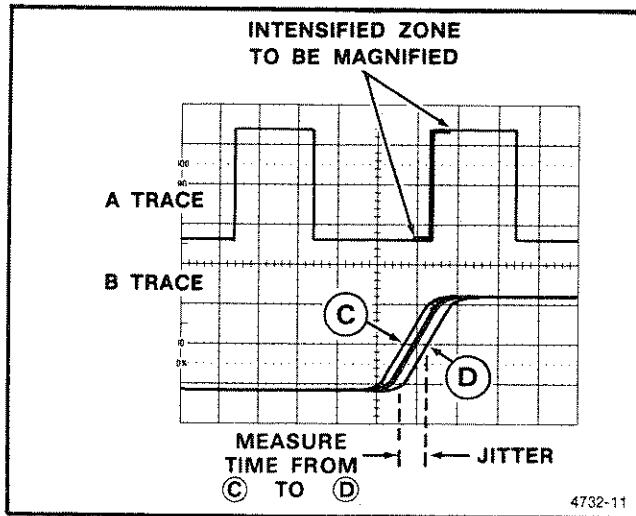


Figure 2-20. Pulse jitter.

## Triggered Magnified Sweep

The following procedure explains how to operate the B Sweep in a triggered mode and to determine the resulting apparent magnification factor. Operating the B Sweep in a triggered mode provides a more stable display, since the delayed display is triggered at the same point each time.

1. Perform steps 1 through 7 of the preceding Magnified Sweep Runs After Delay procedure.
2. Adjust the B TRIGGER LEVEL control so the intensified zone on the A trace is stable.

### NOTE

*The intensified zone seen in the ALT Horizontal MODE display will move from trigger point to trigger point as the B DELAY TIME POSITION control is rotated.*

3. The apparent magnification factor can be calculated from the formula shown in step 8 of the Magnified Sweep Runs After Delay procedure.

## DELAYED-SWEEP TIME MEASUREMENTS

Operating this instrument with the Horizontal MODE set to either ALT or B will permit time measurements to be made with a greater degree of accuracy than attained with Horizontal MODE set to A. The following procedures describe how these measurements are accomplished.

### Time Difference on Single Waveform

To measure time between two points on a waveform, use the following procedure.

1. Preset instrument controls and obtain a baseline trace.
2. Apply the signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Set the appropriate VOLTS/DIV switch to produce a display of approximately 2 or 3 divisions in amplitude.
4. Set the A SEC/DIV switch to display the measurement points of interest on the waveform. Ensure that the SEC/DIV Variable control is in the CAL detent.
5. Select ALT Horizontal MODE and adjust both the appropriate vertical POSITION control and A/B SWP SEP control to display the A trace above the B trace (see Figure 2-21).
6. Set the B SEC/DIV switch to the fastest sweep speed that provides a usable (visible) intensified zone.
7. Adjust the B DELAY TIME POSITION control to move the intensified zone to the leading edge on the first point of interest (on the A trace); then fine adjust until the selected portion (on the B trace) is centered at any convenient vertical graticule line (see Figure 2-21).
8. Record the B DELAY POSITION dial setting.

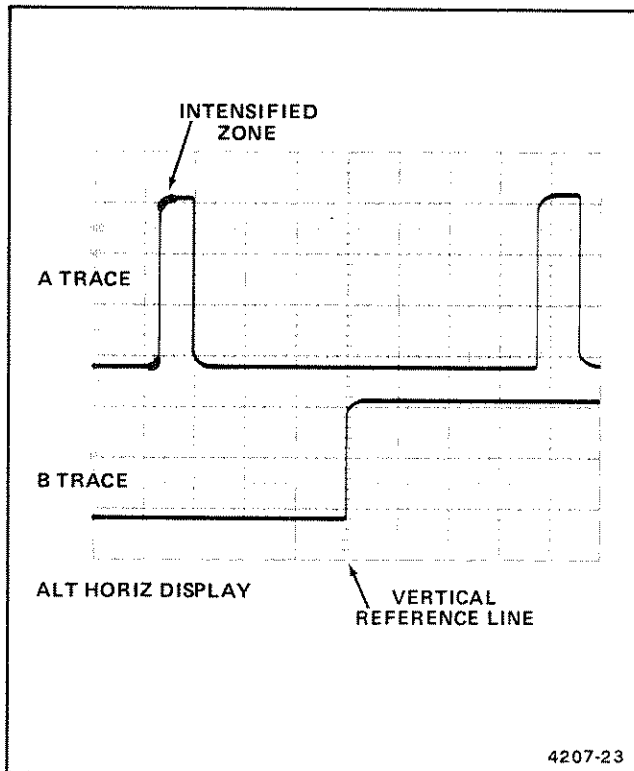


Figure 2-21. Time difference on single waveform.

9. Adjust the B DELAY POSITION control clockwise to move the intensified zone to the leading edge of the second point of interest (on the A trace); then fine adjust until the rising portion (on the B trace) is centered at the same convenient vertical graticule used in preceding step 7.
10. Record the B DELAY TIME POSITION control dial setting.
11. Calculate the time difference between repetitive pulses using the following formula.

$$\text{Time Difference (Duration)} = \left( \begin{array}{c} \text{second} \\ \text{dial} \\ \text{setting} \end{array} - \begin{array}{c} \text{first} \\ \text{dial} \\ \text{setting} \end{array} \right) \left( \begin{array}{c} \text{A SEC/DIV} \\ \text{switch} \\ \text{setting} \end{array} \right)$$

EXAMPLE: With the A SEC/DIV switch set to 0.02 ms per division, the first B DELAY TIME POSITION dial setting is 1.20 and the second B DELAY TIME POSITION dial setting is 9.53 (see Figure 2-22).

Substituting the given values in the time difference formula:

$$\text{Time Difference} = (9.53 - 1.20)(0.2 \text{ ms/div}) = 1.666 \text{ ms}$$

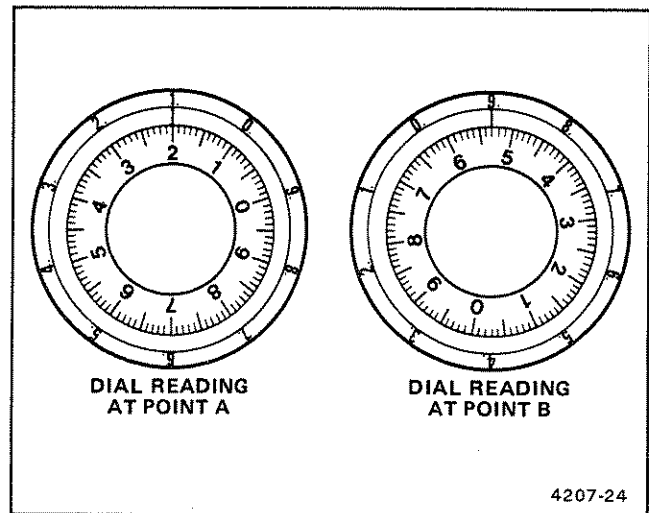


Figure 2-22. DELAY TIME POSITION control settings.

## Rise Time

Rise-time measurements use the same methods as Time Difference on Single Waveform, except that the measurements are made between the 10% and 90% points of the low-to-high transition of the selected waveform. Fall time is measured between the 90% and 10% points of the high-to-low transition of the waveform.

1. Preset instrument controls and obtain a baseline trace.
2. Apply a signal to either vertical-channel input connector and set the Vertical MODE switch to display the channel used.
3. Set the appropriate VOLTS/DIV switch and variable control for an exact 5-division display.
4. Vertically position the trace so that the bottom of the waveform touches the 0% graticule line and the top of the waveform touches the 100% graticule line.
5. Set the A SEC/DIV switch so one transition of interest is displayed. Ensure that the SEC/DIV Variable control is in the CAL detent.
6. Select ALT Horizontal MODE and adjust the B DELAY TIME POSITION control to intensify the transition of interest on A Sweep. Set the B SEC/DIV switch to spread the portion of the A display being measured as much as possible on the B Sweep.

7. Select the B Horizontal MODE. Adjust the B DELAY TIME POSITION control until the display intersects the 10% point at the center vertical graticule line (see Figure 2-23, Point A).
8. Record the B DELAY TIME POSITION control dial setting.
9. Adjust the B DELAY TIME POSITION control until the display intersects the 90% point at the center vertical graticule line (see Figure 2-23, Point B).

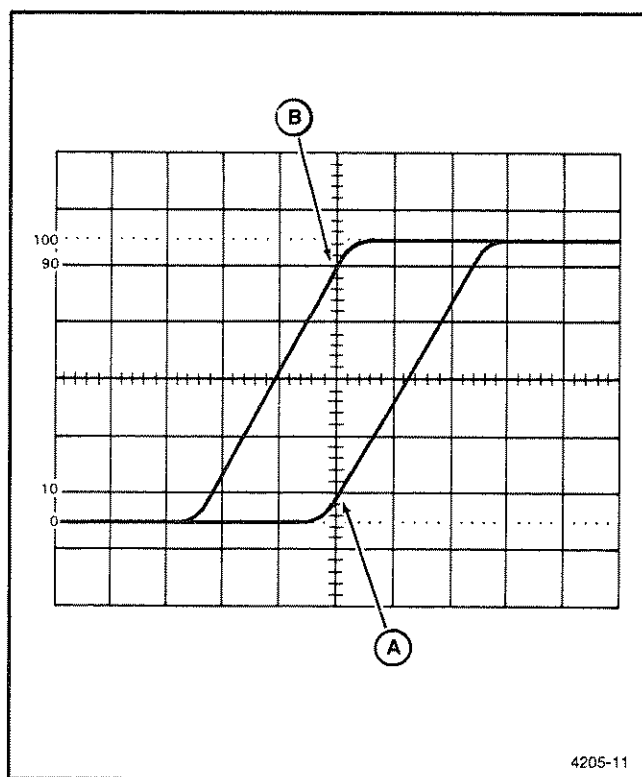


Figure 2-23. Rise time, differential time method.

10. Record the B DELAY TIME POSITION control dial setting.
11. Calculate rise time using the same formula listed in the Time Difference on Single Waveform measurement procedure.

EXAMPLE: With the A SEC/DIV switch set to  $1 \mu\text{s}$  per division, the first B DELAY TIME POSITION dial setting (Point A) is 2.50 and the second B DELAY TIME POSITION dial setting (Point B) is 7.50.

Substituting the given values in the time difference formula:

$$\text{Rise Time} = (7.50 - 2.50)(1 \mu\text{s}/\text{div}) = 5 \mu\text{s}$$

### Time Difference Between Two Pulses on Two Time-Related Signals

1. Preset instrument controls and obtain a baseline trace. Set the A & B SOURCE switch to CH 1 and the Vertical MODE switches to BOTH and ALT.
2. Using probes or cables having equal time delays, apply the reference signal to the Channel 1 input and apply the comparison signal to the Channel 2 input.
3. Set the appropriate VOLTS/DIV switch to produce a display of approximately 2 or 3 divisions in amplitude.
4. Set the A SEC/DIV switch to display the measurement points of interest within the graticule area.
5. Select ALT Horizontal MODE and CH 1 Vertical MODE. Adjust both the Channel 1 POSITION control and the A/B SWP SEP control so that the A trace is displayed above the B trace.
6. Rotate the B DELAY TIME POSITION control to move the intensified zone to the appropriate edge of the reference signal (on the A trace); then fine adjust until the edge of the reference signal (on the B trace) is centered at any convenient vertical graticule line (see Figure 2-24, Part A).
7. Record the B DELAY TIME POSITION control dial setting.
8. Select CH 2 Vertical MODE and adjust both the Channel 2 POSITION control and the A/B SWP SEP control as necessary to display the A trace above the B trace.
9. Rotate the B DELAY TIME POSITION control to move the intensified zone to the appropriate edge of the comparison signal (on the A trace); then fine adjust until the edge of the comparison signal is at the same vertical reference point as used in preceding step 6 (see Figure 2-24, Part B). Do not change the setting of the Horizontal POSITION control.
10. Record the B DELAY TIME POSITION control dial setting.

11. Calculate the time difference between the reference signal (Channel 1) and comparison signal (Channel 2) as in the preceding Time Difference on Single Waveform measurement procedure.

EXAMPLE: With the A SEC/DIV switch set to  $50\ \mu\text{s}$  per division, the dial reading for the reference pulse

(Channel 1) is 2.60 and the dial reading for the comparison pulse (Channel 2) is 7.10.

Substituting the given values into the time-difference formula:

$$\text{Time Difference} = (7.10 - 2.60)(50\ \mu\text{s}/\text{div}) = 225\ \mu\text{s}$$

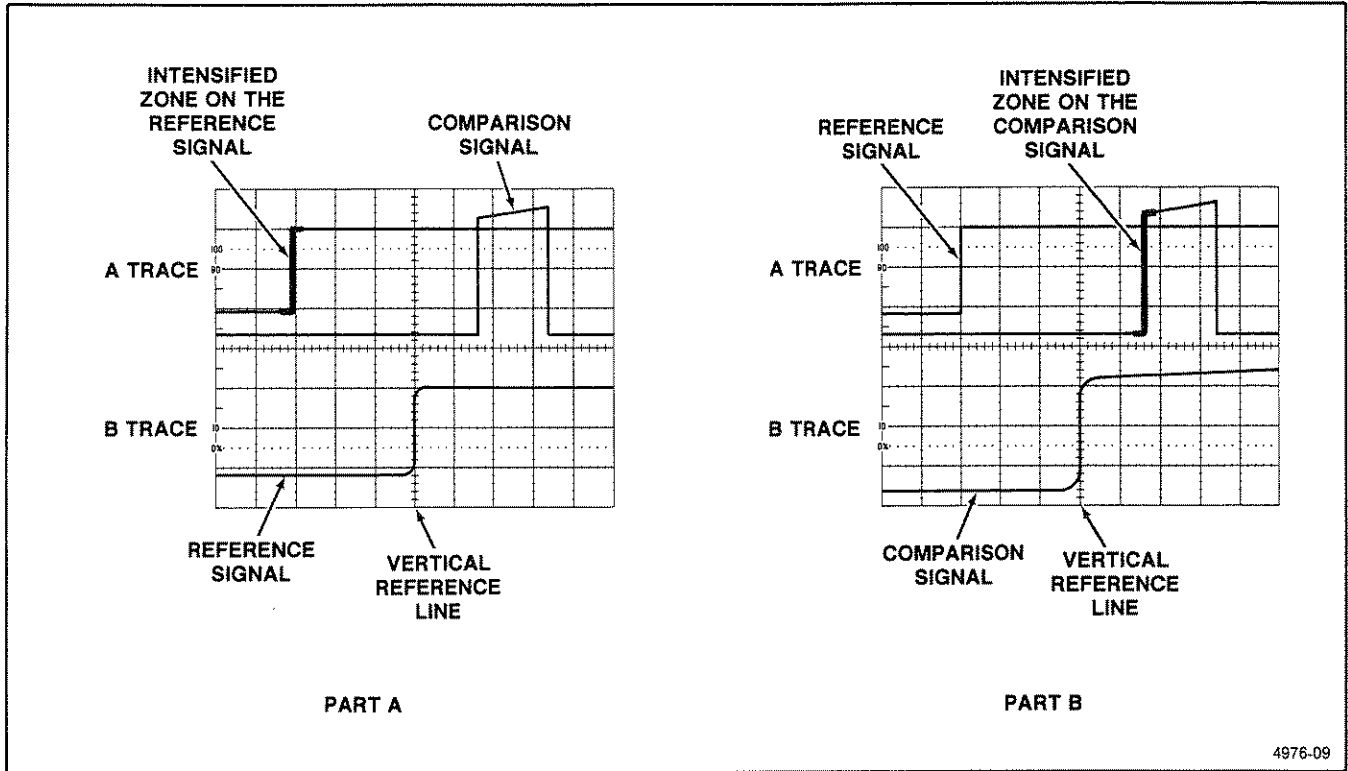


Figure 2-24. Time difference between two pulses on two time-related signals.



## **WARNING**

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.



# THEORY OF OPERATION

## INTRODUCTION

### SECTION ORGANIZATION

This section of the manual contains a general summary of instrument functions followed by a detailed description of each major circuit. Detailed block diagram and schematic diagrams are located in the tabbed Diagrams section at the back of this manual. They are used to show the interconnections between parts of the circuitry, to indicate circuit components, and to identify interrelationships with the front-panel controls.

The schematic diagram number associated with each description is identified in the text and is shown on the block diagrams. For best understanding of the circuit being described, refer to the appropriate schematic diagram and the two block diagrams.

### INTEGRATED CIRCUIT DESCRIPTIONS

#### Digital Logic Conventions

Digital logic circuits perform many functions within the instrument. Functions and operation of the logic circuits

are represented by logic symbology and terminology. Most logic functions are described using the positive-logic convention. Positive logic is a system of notation whereby the more positive of two levels is the TRUE (or 1) state; the more negative level is the FALSE (or 0) state. In this logic description the TRUE state is referred to as HI, and the FALSE state is referred to as LO. The specific voltages which constitute a HI or a LO state vary between specific devices. For specific device characteristics, refer to the manufacturer's data book.

#### Linear Devices

The functioning of individual linear circuit devices in this section use waveforms or other techniques such as voltage measurement and simplified diagrams to illustrate their operation.

## GENERAL DESCRIPTION

### NOTE

*When reading this general circuit description of the 2235A Oscilloscope, refer to the detailed block diagram (Figure 9-4) located in the Diagrams section of this manual. In Figure 9-4, the numbered diamond symbol in each major block refers to the appropriate schematic diagram number.*

Signals to be displayed on the crt are applied to either the CH 1 input connector or the CH 2 input connector. These signals may be directly (DC) coupled to the Attenuator circuit or ac (AC) coupled through an input-coupling capacitor. The input signals may also be disconnected from the oscilloscope circuitry and the input attenuator grounded by setting the coupling switch to the ground (GND) position.

The output signal from the Attenuator circuit is applied to the Vertical Preamplifier for further amplification. Additionally, the Channel 2 Attenuator can invert the Channel 2 display on the crt. Trigger Pickoff Amplifiers in each channel supply an internal trigger signal from either or both channels to the Internal Trigger Amplifier.

Input signals are selected for display by the Channel Switching circuit under control of the front-panel Vertical MODE switches. The output signal from the Channel Switching circuit is applied to a Diode Gate circuit to enable either the vertical or trigger view signal to drive the Delay Line Driver stage. This stage converts a current input to a voltage output and provides an impedance match for the Delay Line. The Delay Line produces approximately 90 ns of delay in the vertical signal. This allows the Horizontal circuitry time to start the sweep so the operator can see the signal that triggered the sweep.

Final amplification of the vertical signal is performed by the Vertical Output Amplifier. This amplifier supplies the signal levels necessary for vertical deflection of the electron beam in the crt. The upper frequency response of the amplifier can be reduced by enabling the Bandwidth Limit circuitry. For locating the position of off-screen displays, the dynamic range of the amplifier can be limited with the Beam Find circuitry. This circuitry also intensifies the trace and limits horizontal deflection.

The A/B Sweep Separation circuitry supplies a dc-offset current to the Vertical Output Amplifier which vertically

positions the B trace with respect to the A trace when Alt Horizontal Mode is selected.

The A Trigger circuitry uses either an Internal Trigger signal, an External Trigger signal, or a Line Trigger signal obtained from the ac power line to develop the gate signal for the A Sweep Generator. The B Trigger circuitry uses only the Internal Trigger signal to gate the B Sweep Generator. A P-P Auto Trigger circuit ensures that the range of the A TRIGGER LEVEL control tracks the peak-to-peak amplitude of the trigger signal when either the P-P Auto or TV Field trigger mode is selected. This allows triggering on most signals without needing to adjust the A TRIGGER LEVEL control. In Norm mode, the A TRIGGER LEVEL control must be adjusted for the correct trigger signal level before a sweep can be generated. When the TRIG VIEW switch is activated, the signal appearing at the input of the A Trigger circuit is applied to the Delay Line Driver and displayed on the crt.

A TV Field sync circuit provides stable triggering on television vertical-sync pulses. Triggering at the television line rate is accomplished when either P-P Auto or Norm mode is selected.

The A Sweep Logic circuit controls sweep generation and Z-Axis unblanking for the A Sweep display. When the A Trigger Mode switches are set to either P-P AUTO or TV FIELD and no trigger signal is present, the Auto Baseline circuit causes the Sweep Logic circuit to produce a sweep for reference purposes. In the NORM setting, the Auto Baseline circuit is disabled and sweeps are inhibited until a trigger event occurs. This is useful for triggering on low-repetition-rate signals. The SGL SWP setting enables only one sweep to be generated after being reset. Following the single sweep, the A Trigger circuit is disabled until the SGL SWP button is pressed again.

The A Sweep Logic circuit controls the operation of the A Miller Sweep Generator circuit. The Sweep circuit produces a linear sweep output with a ramp time that is controlled by the A SEC/DIV switch. The sweep signal is applied to the Horizontal Preamplifier for initial amplification and then to the Horizontal Output Amplifier to drive the crt horizontal deflection plates.

The Horizontal Preamplifier gain is increased by a factor of 10 when the X10 Magnifier is used. Horizontal positioning of the display is accomplished in the Horizontal Preamplifier circuit.

In the X-Y mode of operation, the Channel 1 signal from the Internal Trigger circuitry passes through the X-Y Amplifier to the Horizontal Preamplifier. In this operating mode, the Channel 1 Internal Trigger signal supplies the horizontal deflection to the crt, and the Miller Sweep circuit is disabled to inhibit sweep generation.

The Alternate B Sweep circuitry controls the Alt and B Horizontal mode displays and includes the B Miller Sweep Generator and B Sweep Logic circuitry. In addition to providing the B Sweep sawtooth waveform, signals are generated which control the display switching between the A and B displays.

The intensity levels of both the A and B Sweeps are set by the front-panel A and B INTENSITY controls. These controls, along with signals from the A and B Sweep Logic circuits, determine the drive level to the Z-Axis Amplifier.

The Z-Axis drive from both the A Sweep Logic circuit and the Alternate B Sweep circuit is applied to the Z-Axis Amplifier. The output signal from the Z-Axis Amplifier circuit sets the crt intensity. When using Chop Vertical mode, a blanking signal from the Chop Oscillator circuit

blanks the crt display while switching between the vertical channels.

The Dc Restorer circuit applies the output voltage of the Z-Axis Amplifier between the cathode and grid of the crt. High dc potentials on these elements prohibit direct coupling to the crt.

The Power Supply provides the necessary operating voltages for the instrument. Operating potentials are obtained from a circuit composed of the Preregulator, Inverter and Transformer, and Rectifiers and Filters. The Preregulator produces approximately +43 V dc from the ac power line which is used to drive the 20 kHz Inverter stage. The transformer secondary windings provide various ac levels that are rectified and filtered to produce the operating voltages. A high voltage multiplier circuit produces the accelerating, focus, and cathode potentials required by the crt.

A front-panel CAL output is provided for use in adjusting probe compensation and for checking vertical deflection accuracy. The voltage at the CAL connector is a negative-going square wave that has a peak-to-peak amplitude of 0.5 V and a repetition rate of 1 kHz.

## DETAILED CIRCUIT DESCRIPTION

### VERTICAL ATTENUATORS

The Channel 1 and Channel 2 Attenuator circuits, shown on Diagram 1, are identical with the exception of the additional Invert circuitry in the Channel 2 Paraphase Amplifier. Therefore, only the Channel 1 Attenuator will be described and the Invert circuitry of Channel 2 will be discussed separately.

The Attenuator circuit (see Figure 3-1) provides control of input coupling, vertical deflection factor, and variable volts-per-division gain. Input signals for crt vertical deflection may be connected to the CH 1 and the CH 2 input connectors. In the X-Y mode of operation, the signal applied to the CH 1 OR X connector provides horizontal (X-Axis) deflection for the display, and the signal applied to the CH 2 OR Y connector provides the vertical (Y-Axis) deflection for the display.

### Input Coupling

The signal applied to the CH 1 input connector can be ac coupled, dc coupled, or disconnected from the input of the High Impedance Input Attenuator circuit. Signals applied to the CH 1 input connector are routed through resistor R1 to Input Coupling switch S1. When S1 is set for dc coupling, the Channel 1 signal is applied directly to the input of the High-Impedance Attenuator stage. When ac coupled, the input signal passes through dc-blocking capacitor C2. The blocking capacitor prevents the dc component of the input signal from being applied to the Attenuator circuit. When switched into the signal

path, attenuators AT1 and AT2 attenuate the input signal by factors of 100 and 10 respectively. When S1 is set to GND, the direct signal path is opened and the input of the Buffer Amplifier is connected to ground. This provides a ground reference without the need to disconnect the applied signal from the input connector. The coupling capacitor precharges through R2 to prevent large trace shifts when switching from GND to AC.

### Buffer Amplifier and Gain Switching Network

The Buffer Amplifier presents a high-impedance, low-capacitance load to the signal from the High-Impedance Attenuator and a low output impedance to the Gain Switching Network. A dual-path amplifier is used to combine high-dc stability with high-speed performance.

In the slow path, the input signal is applied to both the gate of source-follower Q13 and the inverting input of U10 through the divider network composed of R3 and R5. Transistor Q13 and emitter-follower Q18 isolate the input signal from the loading of the Gain Switching Network. The divider network at the output of the amplifier (R46, R47, and R48) is connected to the other input of U10. Amplifier U10 compares the two divider voltages and changes the conduction level of current-source transistor Q15 to correct for any error at the source of Q13. Capacitor C10 limits the bandwidth of U10 so that the slow path responds only to frequencies below 100 kHz.

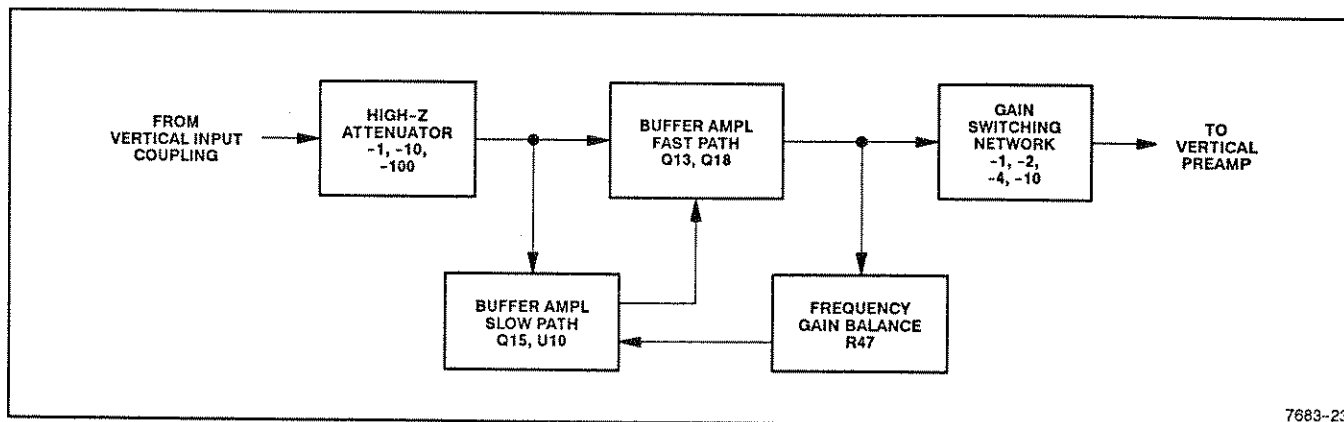


Figure 3-1. Block diagram of the Vertical Attenuators.

In the fast path, input signals are coupled through R6, C6, Q13, and Q18 to the circuit output. By adjusting R47, the gain in both paths is matched. Input offset voltage compensation for U10 is provided by R10 to eliminate trace shifts when switching between Volts/Div settings.

The Gain Switching Network divides down the Buffer Amplifier output signal for application to the Paraphase Amplifier and has an output impedance of 75 ohms for all Volts/Div switch settings. The particular Volts/Div switch setting will determine which contacts of S10 are closed and therefore whether the Paraphase Amplifier will receive a  $\div 1$ ,  $\div 2$ ,  $\div 4$ , or  $\div 10$  signal.

### Paraphase Amplifier

The Paraphase Amplifier converts the single-ended signal from the Gain Switching Network into a differential signal for application to the Vertical Preamplifier. Included in the circuitry is switching that provides extra gain for the 2 mV position of the VOLTS/DIV switch, adjustments for amplifier dc balance, and circuitry for the Variable Volts/Div function. Additionally, the Channel 2 Paraphase Amplifier contains circuitry to invert the Channel 2 display.

The signal from the Gain Switching Network is applied to the base of one input transistor in U30. The other input transistor is biased by the divider network composed of R30, R31, and R33 to a level that will produce a null between the outputs of U30 (no trace shift on the crt screen) when the VOLTS/DIV control is switched between 5 mV and 2 mV. The input transistors buffer the signal voltages and drive the input differential pair. Emitter current for the differential input pair is supplied by R21, R22, R23, and R25, with R29 serving as the gain-setting resistor between the two emitters. In the 2 mV position, amplifier gain is increased by closing contact 15 of S10 to shunt R29 with R26.

The collector current through the differential input pair serves as emitter current for the two differential output transistor pairs. Base bias voltages for the two output pairs are generated by the current through the diodes at pins 7 and 14, and are controlled by R39 and the network composed of R41, R42, and variable gain control R43. Monolithic IC U30 has matched transistor characteristics, so the ratio of currents in the two diodes determines the current ratios in the output transistor pairs. As VOLTS/DIV Variable potentiometer R43 is rotated from the calibrated to uncalibrated position, the conduction level of the transistors connected to R35 will increase. Since the transistor pair outputs are cross-wired, this increased conduction will subtract from the

signal produced by the transistors connected to R38 and the overall gain of the amplifier will decrease. Potentiometer R25 adjusts the balance of the amplifier so there is minimal dc trace shift as the VOLTS/DIV Variable control is rotated.

Incorporated in the Channel 2 Paraphase Amplifier is circuitry to invert the polarity of the Channel 2 signal. Diodes CR85 and CR88 will route current from R91 and R92 to the output pair not connected to R89 through INVERT switch S90. When the switch is out, the transistor pairs in U80 are biased as they are in U30 and there is no trace inversion. For the IN position of S90, connections to the bases of the output transistor pairs are reversed to produce an inverted Channel 2 trace. Potentiometer R75 is adjusted so that there is minimal dc trace shift as the INVERT button is changed between the IN and OUT positions.

### VERTICAL PREAMPLIFIERS

The Vertical Preamplifier, shown on Diagram 2, utilizes differential signal current from the Paraphase Amplifier to produce differential output current to drive the Delay Line Driver. Internal trigger signals for the Trigger circuitry are picked-off and channel selection for the crt display is controlled by the Channel Switch circuitry.

Common-base transistors Q102 and Q103 convert differential current from the Paraphase Amplifier into level-shifted voltages that drive the bases of the input transistors of U130 and the Internal Trigger circuitry. Emitter current for the differential input pair is supplied by Q114 and Q115. POSITION control R112 adjusts the base voltages through U120A and B to provide position information. The collector current of the differential input pair of U130 serves as emitter current for two differential output pairs. One of the collectors of each output pair is grounded and the other provides output drive to the Delay Line Driver. The base voltages of the transistors with grounded collectors are held at ground potential by R136. The base voltages of the other transistors are controlled by the Channel Switch and Trigger View circuitry.

When Channel 1 is selected to drive the Delay Line Driver, the Q output of U540A is HI. The transistors with the ungrounded collectors will then be forward-biased and the Channel 1 signal will be conducted through to the Delay Line Driver. If Channel 1 is not selected, then the Q output of U540A is LO. The transistors with the ungrounded collectors are then reverse-biased and the output signals will be conducted to ground by the other transistor pair. The gain of the Preamplifier is set by adjusting R145 to determine how much signal current will be shunted between the two differential outputs.

When TRIG VIEW push button S200 is pressed in,  $-8.6\text{ V}$  is applied to R138 and R188 to turn off the transistors in U130 and U180 with ungrounded collectors. Both Channel 1 and Channel 2 output signals are then conducted to ground. Zener diode VR200 turns on and CR200 and CR201 become reverse biased. TriggerView transistors Q440 and Q441 are then coupled to the Delay Line Driver through forward-biased diodes CR202 and CR203. The crt trace will then be a display of the A Trigger signal.

## CHANNEL SWITCH AND VERTICAL OUTPUT

The Channel Switch circuitry, shown on Diagram 2, utilizes the front-panel Vertical MODE switches to select the crt display format. See Figure 3-2 for a block diagram of the circuit.

When any display mode other than X-Y is selected, the XY1 line connected to S550 is LO (through the saturated Q550 transistor). Vertical MODE switches S545 and S550 control the connection between the XY1 line and the PR and CL inputs of U540A to obtain the various display formats described below.

**CHANNEL 1 DISPLAY ONLY.** The CH 1 position of S550 applies a LO to the PR input of U540A while the CL input

is held HI by R550, pin 7 (Diagram 4). This will produce a HI and a LO on the Q and  $\bar{Q}$  outputs respectively, and the Channel 1 Preamplifier signal will drive the Delay Line Driver as described in the Vertical Preamplifier section. The Channel 2 Preamplifier will be disabled.

**CHANNEL 2 DISPLAY ONLY.** The CH 2 position of S550 holds the CL input of U540A LO through CR538 and the PR input is held HI by R550, pin 8. The outputs will then be Q LO and  $\bar{Q}$  HI to enable the Channel 2 Preamplifier signal to drive the Delay Line Driver while the Channel 1 Preamplifier is disabled.

To display the ADD, ALT, or CHOP formats, S550 must be in the BOTH position to provide a LO signal to S545.

**ADD DISPLAY.** In the ADD position of S545, both the PR and CL inputs of U540A are held LO by CR537 and CR540. The Q and  $\bar{Q}$  outputs are then both HI and signal currents from the Channel 1 and Channel 2 Preamplifiers add together to drive the Delay Line Driver.

**CHOP DISPLAY.** In the CHOP position, the CHOP\_EN(L) line is held LO, keeping the Q output of U540B HI. This enables multivibrator U537D to run at a frequency that is determined by R544, R545, and C545. The output of U537C, the inverted output of the multivibrator, is used to drive U537A and U537B.

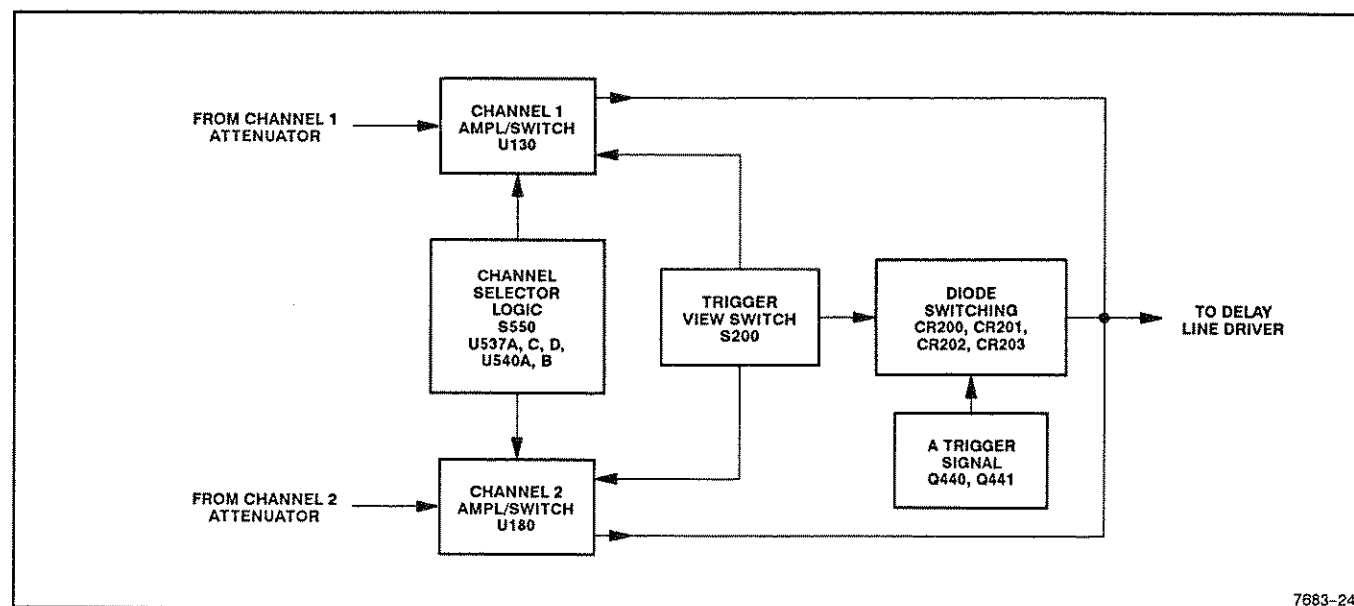


Figure 3-2. Block diagram of the Channel Switching circuitry.

Coupling capacitor C547 and resistors R547 and R548 form a differentiating circuit that produces positive- and negative-going, short-duration pulses. These pulses are inverted by U537B to generate the CHOP\_BLANK signal utilized by the Z-Axis Amplifier.

The ALT\_SYNC signal applied to one input of U537A is HI except during Holdoff. This allows the output of U537C to be inverted by U537A which drives the clock input of U540A. Since the  $\bar{Q}$  output of U540A is connected back to the D input and both the PR and CL inputs are HI, the outputs of U540A will toggle with each clock input. The Delay Line Driver will then be driven alternately by the Channel 1 and Channel 2 Preamplifiers at a rate determined by multivibrator U537D.

**ALTERNATE DISPLAY.** In the ALT position, the CHOP\_EN(L) line is held HI and multivibrator U537D is disabled. The output of U537C will be HI and the CHOP\_BLANK signal from U537B will be LO. Input signals to U537A will be HI from U537C and the ALT\_SYNC signal from the Holdoff circuitry in the A Sweep Generator. The output of U537A will then be the inverted ALT\_SYNC signal which clocks U540A. This causes the outputs of U540A to toggle at the end of each sweep so that the Channel 1 and Channel 2 Preamplifier signals will alternately drive the Delay Line Driver.

### Delay Line Driver

The Delay Line Driver, shown on Diagram 3, converts the signal current from the Vertical Preamplifiers or the Trigger View circuitry into a signal voltage for input to the Delay Line. Transistors Q202, Q203, Q206, and Q207 form a differential shunt-feedback amplifier with the gain controlled by R216 and R217. Amplifier compensation is provided by C210 and R210 and output common-mode dc stabilization by U225. Should the voltage at the junction of R222 and R223 deviate from zero, U225 will sink or source base current to Q202 and Q203 through R202 and R203. This will return the outputs of the Delay Line Driver to an average dc value of zero volts. Delay Line DL9210 provides a vertical signal delay of about 90 ns so that the Sweep Generator has sufficient time to start a sweep before the vertical signal that triggered the sweep reaches the crt deflection plates. This permits viewing the leading edge of the internal signal that originated the trigger pulse.

### Vertical Output Amplifier

The Vertical Output Amplifier provides final amplification of the input signals for application to the vertical deflection plates of the crt. Signals from the Delay Line are

applied to a differential amplifier composed of Q230 and Q231 with low- and high-frequency compensation provided by the RC networks connected between the emitters. Overall gain is set by R233 with temperature compensation provided by RT236. The output stage of the amplifier utilizes two series-connected transistor pairs, Q254–Q256 and Q255–Q257, that convert the collector currents of Q230 and Q231 to proportional output voltages. Resistors R256, R258, R257, and R259 serve as feedback elements and also as divider networks so that each transistor in a pair drops half the final output voltage. The amplifier output signals are applied to the vertical deflection plates of the crt to produce deflection of the crt beam.

BW LIMIT switch S226, C228 and C229, and a diode bridge consisting of CR226, CR227, CR228, and CR229, are utilized to reduce the bandwidth of the amplifier if desired. With the bandwidth limit off, R226 is grounded and the nonconducting diode bridge isolates C228 and C229. With bandwidth limit on, R226 is connected to the +8.6 V supply and the diode bridge conducts. The two capacitors are no longer isolated and will attenuate high-frequency signals.

BEAM FIND switch S390 (Diagram 10) changes output-amplifier biasing to limit the voltage swing at the crt plates. This keeps the vertical trace within the graticule area for locating off-screen traces. With the switch in the normal out position, the -8.6 V supply provides emitter current to the amplifier output stage through R261. When the BEAM FIND switch is in, the direct -8.6 V supply to R261 is removed and emitter current is now supplied through R261 and R262 in series. This reduces the amount of available emitter current and limits the amplifier dynamic range.

### A/B Sweep Separation Circuit

The circuit composed of Q283, Q284, Q285, and associated components provides a means of vertically positioning the B trace with respect to the A trace during Alt Horizontal Mode displays. During the B Sweep interval, the SEP(L) signal from the Alternate Display Switching circuit is LO and Q283 is biased off. This allows A/B SWP SEP potentiometer R280 to affect the bias on one side of a differential current source composed of Q284 and Q285. This supplies a dc offset current to the Vertical Output Amplifier and changes the position of the B trace on the crt screen.

During the A Sweep interval, the SEP(L) signal is HI and Q283 is turned on. The base voltages of Q284 and Q285 are then the same, and equal current is supplied to both sides of the Vertical Output Amplifier so that no offset of the A trace occurs.

## TRIGGER AMPLIFIERS AND SWITCHING

The Trigger Amplifiers, shown on Diagram 4, provide signals to the Trigger Generator circuit from either the Vertical Preamplifiers, the EXT INPUT connector, or the power line. The A & B SOURCE switch selects either Channel 1, Channel 2, a composite of both, or, for A-Trigger, the EXT INPUT as the trigger source. The A COUPL switch offers a means of accepting or rejecting certain components of the trigger signals that are coupled to the A Trigger Generator and also selects line trigger.

### Trigger Switching

Logic levels used to select the desired trigger mode are generated by programmed array logic (PAL), U555, depending on input signals from A & B SOURCE switch S555, A COUPL switch S392 and the two Vertical MODE switches S545 and S550 (+XY & U540). For the discussion below, the appropriate levels to implement the function will be mentioned, but if greater detail is desired, the inputs to U555 for the various switch settings are shown in Table 3-1 and the logic equations for the output levels are shown in Table 3-2.

### Internal Trigger

Signals from the Vertical Preamplifiers drive the Internal Trigger Amplifier with channel selection determined by the Vertical and Horizontal MODE switches.

Trigger pickoff from the Preamplifiers is accomplished by Q302 and Q303 for Channel 1 and Q327 and Q328 for Channel 2. The circuitry associated with Channel 2 is the same as that for Channel 1 except that it does not have a trigger offset adjustment.

Signals from the Channel 1 Preamplifier are applied to Q302 and Q303. These emitter-follower transistors each drive one input transistor in U310, and the collectors of the U310 input transistors in turn supply emitter current to two current-steering transistors. The compensation and biasing network connected to the emitters of the input transistors in U310 is fixed for Channel 2 but not for Channel 1. Potentiometer R309 adjusts the emitter bias levels of the two input transistors so that dc offsets between channels can be matched.

The base bias voltages of one transistor in each output differential amplifier pair is fixed by the divider network composed of R321 and R322. The other base voltage is controlled by the CH1\_TR(L) from line U555. When the CH1\_TR(L) signal is HI, the transistors in each output pair

with the collectors connected together are biased on and the other transistors are off. The collector signal currents are equal in magnitude but opposite in polarity and signal cancellation occurs. If the CH1\_TR(L) signal is LO, the other transistors in each pair will be biased on and an output signal will be developed across R314 and R315 to drive the Internal Trigger Amplifier.

Internal trigger sources are chosen by the A & B SOURCE switch with the A COUPL switch set to a position other than A LINE SOURCE. This causes a HI output on U555, pin 14, and a LO on pins 12 and 13, turning Q392 and Q399 ON, which reverse biases CR393 and CR399 to prevent external trigger signals or the line trigger signal from reaching the A Trigger Generator. Signals from the Internal Trigger Amplifier are passed to the A Trigger Generator through CR372, which is forward-biased because Q369 is OFF.

**Table 3-1**  
**Front Panel Trigger Switch Setting**  
**to PAL Input Decoding**

| SWITCH<br>SETTINGS | PAL (U555) INPUTS |   |  |         |   |  |
|--------------------|-------------------|---|--|---------|---|--|
|                    | XY MODE           |   |  | XY MODE |   |  |
| A & B SOURCE       | A                 | B |  | A       | B |  |
| VERT MODE          | 1                 | 1 |  | 1       | 1 |  |
| CH 1               | 0                 | 1 |  | 1       | 1 |  |
| CH 2               | 1                 | 0 |  | 1       | 1 |  |
| A EXT              | 0                 | 0 |  | 1       | 1 |  |

| A COUPLING    | C | D |  | C | D |  |
|---------------|---|---|--|---|---|--|
| NORM          | 1 | 1 |  | 1 | 1 |  |
| HF REJ        | 0 | 1 |  | 0 | 1 |  |
| LF REJ        | 1 | 0 |  | 1 | 0 |  |
| A LINE SOURCE | 0 | 0 |  | 0 | 1 |  |

| VERTICAL MODE | E    | F | G | E | F | G |   |
|---------------|------|---|---|---|---|---|---|
| CH 1          | 1    | 1 | 0 | 0 | 0 | 1 |   |
| CH 2          | 1    | 0 | 1 | 0 | 0 | 1 |   |
| BOTH          | ADD  | 1 | 0 | 0 | 0 | 1 |   |
|               | ALT  | 0 | 1 | 1 | 0 | 0 | 1 |
|               | CHOP | 1 | 1 | 1 | 0 | 0 | 1 |

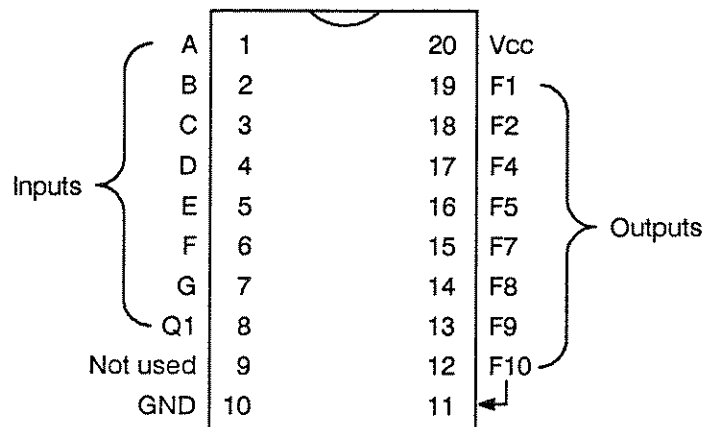
Input Q (Pin 8 of U555) is supplied by U565C.

Table 3-2  
PAL Logic Implementation

Use the following equations with the input values from Table 3-1 to determine the value of the PAL outputs for different switch settings.

| PAL OUTPUT                       | DEFINING EQUATION                                                                                                                                                          | PIN NUMBER |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| F1 = $\overline{\text{CH 1 TR}}$ | $= \overline{\text{AEGQ}} + \overline{\text{AEFG}} + \overline{\text{BG}} + \overline{\text{AEFG}} + \overline{\text{AEFQ}} + \overline{\text{BE}} + \overline{\text{BF}}$ | 19         |
| F2 = $\overline{\text{CH 2 TR}}$ | $= \overline{\text{BFGQ}} + \overline{\text{BEQ}} + \overline{\text{BEF}} + \overline{\text{BEFG}} + \overline{\text{A}}$                                                  | 18         |
| F4 = $\overline{\text{VALT}}$    | $= \overline{\text{EF}}$                                                                                                                                                   | 17         |
| F5 = $\overline{\text{LF REJ}}$  | $= \overline{\text{CD}}$                                                                                                                                                   | 16         |
| F7 = XY                          | $= \overline{\text{BEF}}$                                                                                                                                                  | 15         |
| F8 = INT                         | $= \text{BD} + \text{AD} + \text{BC} + \text{AC}$                                                                                                                          | 14         |
| F9 = EXT                         | $= \overline{\text{ABD}} + \overline{\text{ABC}}$                                                                                                                          | 13         |
| F10 = LINE                       | $= \overline{\text{CDF}} + \overline{\text{CDE}} + \overline{\text{BCD}}$                                                                                                  | 12         |

### 2235A U555 Pin Assignment



**CHANNEL 1.** For triggering from Channel 1, the A & B SOURCE switch is set to CH 1. The output at U555, pin 19, will then be LO and the Channel 1 signal path through U310 will be enabled. The Channel 2 signal path is disabled by U555, pin 18, being HI.

**CHANNEL 2.** For triggering from Channel 2, the A & B SOURCE switch is set to CH 2. U555, pin 18, is LO and will enable the Channel 2 signal path through U335 while the HI output at U555, pin 19, will disable the Channel 1 path.

**Vertical MODE.** When the A & B SOURCE switch is set to VERT MODE, trigger source selection is determined by the two Vertical MODE switches, S545 and S550 (Diagram 2).

When Channel 1 is selected (Vertical MODE switches set to CH 1), CH1\_TR(L) from U555, pin 19, is LO and pin 18 is HI and the Channel 1 signal will be selected.

When Channel 2 is selected (Vertical MODE switches set to CH 2), logic levels at pins 18 and 19 of U555 are LO and HI, respectively, and the Channel 2 signal is used.

When the Vertical MODE switches are set to BOTH-ALT, input at U565B, pin 3, is LO causing the output to be HI, which in turn enables a signal path through U565C. The CH2\_VERT signal from U540A, pin 6 (Diagram 2), is inverted and applied to U555. Since this signal toggles with each sweep, the logic levels at pins 18 and 19 of U555 change at the same time, alternately selecting the trigger source to follow the displayed channel.

In the ADD Vertical MODE position, inputs at pins 6 and 7 of U555 are LO which causes output pins 18 and 19 to also be LO. Both Channel 1 and Channel 2 signal paths will be enabled and their output current will be summed at the inputs of the Internal Trigger Amplifier to produce the internal trigger signal.

The CHOP Vertical MODE position results in a HI on all three inputs to U565B, and this sets the output, CHOP\_EN(L) LO. Pins 18 and 19 of U555 are again both LO, and the signal to the Internal Trigger Amplifier will be the same as for the ADD mode.

### Internal Trigger Amplifier

The Internal Trigger Amplifier converts the differential trigger signals from the Vertical Preamplifiers into a single-ended signal that drives the X-Axis Amplifier and the A and B Trigger Generators.

Signal current is applied to the emitters of U350D and U350E. The collector current of U350D is converted to a voltage across feedback resistor R357. The opposite-phase collector current of U350E causes a voltage drop across R359 which adds to the voltage at the collector of U350C. This voltage appears at the base of U350A which buffers and level shifts the signal back to 0 V. The emitter signal of U350A drives the X-Axis Amplifier, the B Trigger Generator, and the base of U350B. The emitter signal of U350B in turn drives the A Trigger Generator whenever CR372 is forward biased.

### A External Trigger Amplifier

The A External Trigger Amplifier buffers signals applied to the EXT INPUT connector to drive the A Trigger Generator. Input signal coupling is determined by A EXT COUPL switch S380 which selects AC, DC, or  $\frac{DC}{10}$  coupling.

When S380 is in the AC position, the input signal is ac-coupled through C376. In the DC position, the input signal is connected directly to the amplifier. The  $\frac{DC}{10}$  position attenuates the input signal by a factor of 10 through the compensated divider composed of R377, C377, R378, R371, R379, C379, R380, C380, R381, and C381.

The signal is then applied to the gate of Q382A. This source-follower drives emitter-follower transistor Q384 which lowers the amplifier output impedance. The two FETs are a matched pair, and since the gate and source of Q382B are connected together, Q382B will supply source current for Q382A such that there will be no voltage drop across the gate-source junction of Q382A. Q381 is connected as a protection-diode and clamps the signal at the gate of Q382A to about -9 V. The amplifier output will drive the A Trigger Generator through forward-biased CR393 whenever the A & B SOURCE switch is set to A EXT (except for LINE). When the A & B SOURCE switch is not set to A EXT, the base-emitter junction of Q384 will be reverse biased and the amplifier will be disabled.

### Line Trigger Amplifier

The Line Trigger Amplifier supplies a line-frequency trigger to the A Trigger Generator when the A COUPL switch is in the A LINE SOURCE position.

Transformer T390 in the Power Supply (diagram 9) provides a line-frequency signal through R397 to Q397. Diode CR399 is forward biased when S392 is in the A LINE SOURCE position, and the emitter signals of Q397 will drive the A Trigger Generator.

## A Trigger Bandwidth

With the A COUPL switch in NORM position, the base of Q409 is pulled to ground by Q374. LF\_REJ from U555 is HI, turning off Q400 (Diagram 5). Output of Q400 is then low, turning on Q402, which supplies emitter current to Q405, turning it on. With Q402 turned on, Q405 acts as an emitter follower which drives the trigger input of U460 and the peak detectors. The voltage at the collector of Q400 is low enough to keep Q406 and CR406 turned off. Therefore, the only signal path is through Q405 to the peak detectors, which passes all frequency components of the trigger signal.

In the HF REJ mode of trigger coupling, Q374 is turned off by S392, turning on Q409 which bypasses high-frequency components of the trigger signal to ground, resulting in the attenuation of frequencies above approximately 40 kHz. Bias conditions on Q402, Q405, and Q406 (Diagram 5) remain the same as in the NORM setting.

In the LF REJ mode of trigger coupling, Q409 is turned off, disconnecting C409 from ground. The LF\_REJ line is now LO, turning on Q400. This turns off Q402, which in turn, turns off Q405 and CR405. The only signal path is through Q406 to the trigger peak detectors. Transistor Q406 and CR406 are turned on by current supplied through R406. Capacitor C410 and R410 form a high-pass filter, resulting in the attenuation of frequencies below approximately 40 kHz.

## A TRIGGER GENERATOR

The A Trigger Generator, shown on Diagram 5, supplies trigger signals to the A Sweep Generator. Included in the A Trigger Generator circuit are the P-P Auto Trigger, A Trigger Level comparator and Schmitt Trigger, and TV Triggering circuitry.

### A Trigger Level Circuit

The A Trigger Level Circuit establishes voltages at the ends of the A TRIGGER LEVEL potentiometer as a function of the A TRIGGER push button selection and trigger signals selected by the A & B SOURCE switch.

In the P-P Auto and TV Field modes, Q413 is off and CR414 and CR415 are reverse biased. Trigger signals selected by the A & B SOURCE switch are applied to peak detectors consisting of Q420-Q422 and Q421-Q423. These peak detectors track dc levels and have a high voltage transfer efficiency. The positive- and negative-peak signal levels stored by C414 and C415

are near the peak levels of the trigger signal. Amplifiers U426A and U426B are configured as voltage followers with transistors Q428 and Q429 in the feedback loops. These transistors thermally compensate for Q420 and Q421 and level shift the amplifier outputs back to the original dc levels of the input trigger signals. The output of U426A will be the positive peak voltage of the input trigger signal and the output of U426B will be the negative peak voltage. Potentiometers R434 and R435 adjust for dc offsets in the trigger circuitry. In the Norm mode, +8.6 V is applied to the junction of R411 and R414. Diode CR414 is forward biased and Q413 is turned on, which forward biases CR415. Input transistors Q420 and Q421 are then biased off and no trigger signals will reach the A Trigger Level circuit. The inputs and outputs of U426A and U426B will then be fixed voltages and independent of trigger-signal amplitude.

### A Trigger Level Comparator and Schmitt Trigger

Integrated circuit U460 contains the Trigger level comparator and Schmitt Trigger circuitry. The output voltage of the A Trigger amplifier is applied to U460, pin 4. The other input to the comparator is the wiper voltage on the A TRIGGER LEVEL control, applied to pin 2 of U460 through zero-offset buffer Q446 and Q450. The resistor R452 and the voltage at pin 5 of U460 set the emitter current for the comparator.

The Trigger Slope is determined by the relative voltages on U460, pins 7 and 8. If pin 8 is at a higher level than pin 7, the plus output of U460 will change to a HI state when a positive-going input signal crosses the threshold at pin 2 of U460. With pin 8 more negative than pin 7, the Schmitt fires on a negative-going input. The voltage at pin 7 is fixed, while that at pin 8 is selected by the A TRIGGER SLOPE switch S460 through R459, R461, and R462.

The sensitivity of the Schmitt Trigger is controlled by the current at pin 9. The setting of R479 determines the circuit hysteresis.

The outputs of the Schmitt Trigger are at pins 10 and 12 of U460. The outputs are at ECL levels and are from emitter followers internal to U460. Collector voltage to U460 is supplied through pins 11 and 14. When TV Field is not selected, the TV\_TRIG\_ENABLE line connected to CR476 and R473 is LO. Transistors Q473 and Q474 are biased off which also biases Q487 off. Resistor R476 biases CR467 and CR477 on and the + Out Trigger signal from pin 10 of U460 passes through the diodes to U506-6 of the A Sweep Generator.

## TV Trigger Circuit

When TV FIELD is selected, the TV\_TRIG\_ENABLE line is HI. This disconnects the high-speed trigger path by reverse-biasing CR467 and CR477. Setting the A Trigger Level threshold near the center of the horizontal sync-pulse swing causes the trigger IC U460 to output a pulse-train that corresponds to the sync-pulses of the TV signal. This pulse-train is filtered by R467, R468, C467, R469, R470, and C469, and applied to the bases of Q473 and Q474. Normally, the duty cycle of the horizontal sync-pulses is low, and the filtered average voltages of the pulse-train bias Q473 off and Q474 on. This causes Q487 to conduct, providing a LO to the sweep generator. When the TV-Vertical-Sync block occurs, the duty cycle of the horizontal sync-pulses increases, and the filtered average voltages of the pulse-train bias Q473 on and Q474 off, turning off Q487 and providing a positive-going signal to U506, pin 6, to initiate a sweep.

## A SWEEP GENERATOR AND LOGIC

The A Sweep Generator and Logic circuitry, shown on Diagram 6, produces a linear voltage ramp that is amplified by the Horizontal Amplifier to provide horizontal deflection of the crt beam. The Sweep Generator circuits also produce signals that are used to generate correct timing of the crt unblanking and intensity levels used for viewing the display. See Figure 3-3 for the block diagram of the A Sweep Generator and Logic circuitry.

The Sweep Logic circuitry controls the holdoff time, starts the sweep upon reception of a trigger signal, and terminates the sweep at the proper sweep level. When using P-P Auto or TV Field triggering, the Sweep Logic circuitry will cause the Sweep Generator to free run,

producing a baseline trace if a trigger signal is not received within a predetermined time period.

## A Miller Sweep Generator

The A Miller Sweep Generator produces a linear voltage ramp that drives the Horizontal Amplifier. It produces this ramp by maintaining a constant current through timing capacitors to obtain a linearly increasing voltage.

Field-effect transistors Q704A and Q704B are matched devices with Q704B sourcing current for Q704A. Since the gate and source of Q704B are connected together, the source current of Q704A will be of a magnitude such that there is no voltage drop across its gate-source junction.

When the sweep is not running, Q701 is biased on to hold the timing capacitors in a discharged state. The low impedance of Q701 in the feedback path holds the Miller Sweep output near ground potential. The voltage across Q701, in addition to the base-emitter voltage of Q706, prevents saturation of the output device.

A sweep ramp is initiated when Q576 is biased off. This will bias off Q701 and the timing capacitors can charge at a rate determined by timing resistors R701 and R702 and the position of A & B SEC/DIV switch S701. One end of timing resistor R701 is connected to the wiper of R721 and the other end is connected to the input of the Miller integrator. Due to feedback from the circuit output through the timing capacitors, the integrator input voltage remains fixed and establishes a constant voltage across the timing resistors. This constant voltage, which produces a constant current through the timing capacitors, results in a linearly increasing voltage at the output of the A Miller Sweep circuit.

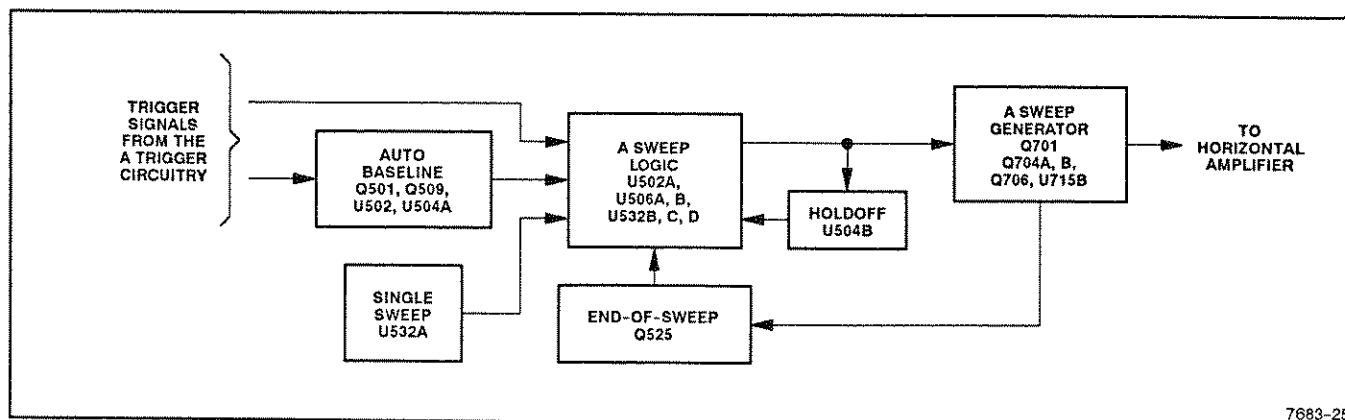


Figure 3-3. Block diagram of the A Sweep Generator and Logic circuitry.

When the output reaches approximately 12 V, the Sweep Logic circuitry will initiate the holdoff period in which Q701 is turned on and the A Sweep Generator is reset. This holdoff period is necessary so that the timing capacitors can be fully discharged before another sweep starts. Capacitors C702 and C703 are always in the charging circuit and are used for high sweep speeds. Capacitor C701A in series with C701B are used for medium sweep speeds, and C701B is used for slow sweep speeds.

The Sec/Div Variable circuitry utilizes an operational amplifier to maintain a constant reference voltage at one end of R721 independent of the circuit load. The voltage applied to the timing resistors varies with the rotational position of R721, the SEC/DIV Variable control. A fixed dc voltage is applied to the noninverting input of the operational amplifier and feedback resistors R717 and R718 establish approximately double that voltage at the anode of VR720.

### A Sweep Logic

The A Sweep Logic circuitry controls sweep generation, as a function of incoming trigger signals and the A Trigger mode selected.

Incoming trigger signals from the output of U460 will clock U502, a one-shot multivibrator, and cause the Q output to go from LO to HI. If another trigger signal is not received by U502 within a time period determined by the time constant of R506 and C501, the Q output will return LO. Whenever trigger signals are being received, the  $\bar{Q}$  output of U502 will bias on Q509 and illuminate TRIG'D LED DS518. The output state of U502 is used in the Auto Baseline circuit described in the P-P AUTO and TV FIELD section.

**NORM.** When NORM Trigger mode is selected, input pin 12 of U532D is held HI by S401B, causing the gate output to also be HI. The output of U532C will then be LO and U506A will not be held reset. Input pin 4 of U532A is held HI by S401C, causing the output to be LO which places a LO on the D input of U506A. Trigger signals received at the clock input of U506A will then clock this LO to the Q output.

During the previous holdoff period, U506A had been set by U532B so that the  $\bar{Q}$  output went LO. This biased on Q576 and the A Miller Sweep was prevented from running. Whenever U506A is clocked following holdoff by a trigger signal, the LO on the D input will be transferred to the Q output and the  $\bar{Q}$  output will go HI. This will bias off Q576 and the A Miller Sweep will generate the sweep ramp as described in the A Miller Sweep Generator

section. When the ramp voltage is about 12 V, Q525 will be biased on. The output of U532B will change from LO to HI, setting U506A and biasing on Q576. With Q576 conducting, holdoff one-shot U504B will be triggered and the A Miller Sweep Generator will be reset to turn off Q525.

With U504B triggered, the  $\bar{Q}$  output changes from HI to LO and will stay LO for a time duration determined by the Var Holdoff circuitry and the A SEC/DIV switch position. VAR HOLDOFF potentiometer R521 determines the amount of charging current available to charge C518, C519, or C520 at pin 15 to the threshold voltage level on pin 14. During the time the  $\bar{Q}$  is LO, the set input of U506A is held HI so that no trigger pulses can initiate a new sweep. When pin 15 of U504B reaches the threshold voltage on pin 14, the  $\bar{Q}$  output goes HI to end the holdoff period and release U506A from the set condition. The circuit is then enabled to generate another sweep once a trigger signal is again applied to the clock input of U506A.

**P-P AUTO and TV FIELD.** When P-P AUTO or TV FIELD is selected, the Auto Baseline configuration is enabled. Pin 12 of U532D is held LO by R569 and the output will follow the signal provided by the Q output of U502. If trigger signals are being received by U502, the output of U532D will be HI and cause the output of U532C to be LO. Flip-flop U506A will respond to trigger signals as described in the NORM section. If trigger signals are not being received by U502, the output of U532D will be LO. The output of U532C will then be the inverse of the input signal applied to pin 11 so that U506A will be reset when holdoff ends, causing a sweep to be generated. With no new trigger pulses being applied to the circuitry, U506A will be continuously set and then reset in this manner to generate sweeps.

**SGL SWP.** In the single sweep mode, both the P-P AUTO and NORM buttons are out. This results in a LO at the output of U532C so that U506A is not held reset. A LO is also on input pin 4 of U532A.

During the previous holdoff period, U532B had reset U506B to cause the Q output to be LO. The D input of U506A will therefore be HI and clock signals to the gate will keep the Q output LO and the sweep disabled. When the SGL SWP button is pushed in, the  $\bar{Q}$  output of U504A will go LO for a time period determined by the time constant of R504 and C504 and then return HI. This HI will then clock through the HI on the D input of U506B to the Q output. Consequently, the output of U532A will go LO and CR514 will be reverse biased to bias on Q511 and light the READY LED. The next trigger pulse applied to the clock input of U506A will then initiate a sweep as described previously. At the end of the sweep, U506B

will again be reset, causing the TRIG'D LED to go out and place a HI on the D input of U506A. A new sweep will not be initiated until the SGL SWP button is again pushed.

**X-Y.** In the X-Y mode of operation, the XY2(L) line is LO which holds the input of U523B LO through CR518. The output of U532B will hold U506A set and no sweeps can be initiated.

## ALTERNATE B SWEEP

The Alternate B Sweep circuitry, shown on Diagram 7, produces a linear voltage ramp that is amplified by the Horizontal Amplifier to provide the B Sweep horizontal deflection on the crt. The Alternate B Sweep circuitry also produces the sweep-switching signals that control the display of the A and B Sweeps, and the gate signals used by the Intensity and Z-Axis circuits to establish the crt unblanking and intensity levels needed for producing both the A Intensified and B Sweep displays.

The B Sweep ramp is enabled by the B Sweep Logic circuit either immediately after the end of the established delay time (Runs After Delay) or upon receipt of the first trigger signal after the delay time has elapsed. This delay time is a function of the B Delay Time Position Comparator circuit and the A Sweep.

## B Miller Sweep Generator

The B Miller Sweep Generator is composed of Q709, Q710A, Q710B, Q712, and associated timing components. This circuit produces the B Sweep and functions in the same manner as the A Miller Sweep Generator; see the A Miller Sweep Generator section for a description of circuitry operation. The output at the collector of Q712 drives the Horizontal Amplifier and Q643.

## B Trigger Level Comparator and Schmitt Trigger

The B Trigger Level Comparator and Schmitt Trigger are contained in U605. This circuit determines both the trigger level and slope at which the B triggering signal is produced. It functions in the same manner as the A Trigger Level Comparator and Schmitt Trigger with the exclusion of the TV trigger circuitry. See the A Trigger Level Comparator and Schmitt Trigger section for a description of circuit operation. The + OUT terminal of U605 is directly

connected to the clock input of U670A to initiate the B Sweep when the B trigger is utilized.

## Runs After Delay

The Runs After Delay circuit allows the B Sweep Logic to generate a B Sweep independently of any B Trigger signals. In the Runs After Delay mode, B TRIGGER LEVEL control R602 is rotated fully clockwise. This biases off Q637 and places a LO on the collector. Inverter U660D will then have a HI output with resistor R640 providing positive feedback. This HI output reverse biases CR626, so the state of U670A is determined by the level at U660F pin 12.

If the B TRIGGER LEVEL control is not fully clockwise, Q637 is biased on and the B Sweep is in the triggered mode. The output of U660D will be LO which keeps the S input of U670A LO, preventing the flip flop from being set by the output of U660F.

Operation of the B Sweep Logic circuitry under both of these conditions is described in the B Sweep Logic discussion.

## B Delay Time Position Comparator

The B Delay Time Position Comparator circuit compares the amplitude of the A Sweep sawtooth output voltage to the dc voltage level set by B DELAY TIME POSITION potentiometer R9644. The output of the comparator is used to initiate a B Sweep and to control the B Z-Axis Logic circuit switching.

The inputs to the comparator, U655, are the wiper voltage of R9644 and the A Sweep voltage from the divider network composed of R651, R652, and R653. Input voltage ranges to the comparator are determined by VR645 and R646 for the noninverting input and by R652 for the inverting input. Delay Start potentiometer R646 is adjusted in conjunction with potentiometer R652 to set the B DELAY TIME POSITION dial calibration.

The output of the comparator is enabled or disabled by the strobe signal connected to pin 6. When the A\_ONLY(L) signal is HI, the comparator is enabled. When the A\_ONLY(L) signal is LO, the output of the comparator is a high impedance and therefore a HI is present on pin 9 of U680C.

## B Sweep Logic

The B Sweep Logic circuitry utilizes signals from the associated B Sweep circuitry to generate control signals

for both the B Miller Sweep and the B Z-Axis Switching Logic circuits.

In the Runs After Delay mode CR626 is reverse-biased, and a LO is placed on the D input of U670A. During the previous holdoff period, U680D pin 13 strobed LO. The output of the flip-flop composed of U680C and U680D went HI and the output of U660F went LO. This placed a LO on the S input of U670A and a HI on the R input, causing the flip-flop to be reset. The LO on pin 2 and HI on pin 3 of U670A are converted to TTL levels by Q630 and Q631. The resulting HI on the collector of Q630 turns Q709 on, preventing the B Miller Sweep from running. Once the A Sweep voltage at U655, pin 3, exceeds the voltage at pin 2, the comparator output will go LO. The U680C-U680D flip-flop will change output states and cause U670A to be set. Q709 is shut off and the B Miller Sweep Generator will produce a linear ramp. This also sets the output of U665D LO to unblank the trace. If the B Sweep ramp voltage reaches about 12 V, sweep-end comparator Q643 will turn on and cause the output of U665D to go HI. The B Miller Sweep Generator will continue to run, but the trace will be blanked because the B\_GATE(L) line is HI which reverse biases CR817. Once the ramp is at approximately 13 V, VR712 will conduct and prevent the voltage from increasing further.

The B Sweep Generator will be reset for another sweep by one of two means. If the A Sweep doesn't end before the B Sweep, the Generator will not be reset until the ALT\_SYNC line goes from HI to LO to change the U680C-U680D flip-flop output states. The R input of U670A goes HI causing the collector of Q630 to be HI, resetting the B Sweep Generator. Depending on the settings of the A AND B SEC/DIV switches, the A Sweep may end before the B Sweep. If this occurs, the ALT\_SYNC line will go LO at the end of the A Sweep and cause an immediate resetting of the Generator. In either case, a new sweep will be initiated the next time the A Sweep voltage at U655, pin 3, exceeds the voltage at pin 2.

When not in the Runs After Delay mode, the output of U660D is LO, a HI is placed on the D input of U670A, and the circuitry connected to U660F operates as described above. When the output of U660F goes HI, U660A no longer holds U670A reset, allowing the Q output to be clocked HI by the first B trigger signal from U605. The collector of Q630 will go LO initiating a B Sweep.

### Alternate Display Switching Logic

The Alternate Display Switching Logic circuitry controls both the Horizontal Amplifier sweep switching and the B Z-Axis Logic switching.

Horizontal MODE switch S648 selects the input logic levels that are applied to the circuitry. In the A Horizontal Mode, the R input of U670B is held HI through Q670, and the S input is LO. This holds U670B reset. The LO on pin 15 and HI on pin 14 result in the A\_DISP line at the collector of Q684 being HI, which allows only the A Sweep to be passed to the Horizontal Amplifier. In the B Horizontal mode, U670B is held set, allowing only the B Sweep to reach the Horizontal Amplifier.

With S648 set to ALT, and for all settings of the Vertical MODE switches except BOTH-ALT, the VALT2(L) signal applied to U660E is HI while the S and R inputs of U670B are both LO. The LO output of U660E causes the output of U680B to be HI, and whenever the ALT\_SYNC signal applied to pin 1 of U680A goes LO, the gate output will change from LO to HI and clock U670B. The outputs of U670B will toggle with each ALT\_SYNC signal transition to alternately enable the A and B Sweeps to reach the Horizontal Amplifier. Whenever the B Sweep is selected for display, the collector of Q687 is HI, and this level is applied to U665C, pin 10. Pin 9 is also HI, so the SEP(L) signal from U665C will be LO to enable the A/B Sweep Separation circuitry.

When the CH 1-BOTH-CH 2 Vertical MODE switch is set to BOTH, the ADD-ALT-CHOP switch becomes functional. In the ALT Vertical MODE position the VALT2(L) signal is LO, the HALT signal is HI, and the CH1\_SELECTED signal is a TTL square wave that switches states at the end of the A Sweep. Input pin 4 of U680B will be HI and the gate output will be the inverse of the CH1\_SELECTED signal. This output signal is NANDed with the ALT\_SYNC signal by U680A to clock U670B. Whenever the ALT\_SYNC signal goes LO at the end of a sweep and the CH1\_SELECTED signal switches from LO to HI, U670B will be clocked. Since only positive transitions on the clock input will cause the flip-flop to change output states, two A Sweeps are required to cause the flip-flop output levels to switch. With this switching arrangement, the crt will first display the two A Intensified Sweeps and then the two Alternate B Sweeps.

### B Z-Axis Logic

The B Z-Axis Logic circuitry switches signal current levels to drive the Z-Axis Amplifier for both the B and the A Intensified Sweep displays. The current supplied is summed with the other signal inputs on the Z-Drive line.

When the Horizontal MODE switch is in the ALT position, pin 5 of U665B is HI. The outputs of U670B and the B\_GATE(L) signal from the output of U665D together with the INTENSITY controls determine the intensity of the A and B Sweeps.

When the A Sweep is displayed, the collector of Q682 is LO and that of Q683 is HI. CR687 is turned on, reverse biasing CR817, preventing Z-axis drive current from flowing through the diode. With CR684 reverse biased, additional Z-axis drive current to intensify the A Sweep will be supplied whenever CR685 is biased off. Since input pin 5 of U665B is HI, the gate output and therefore the conductive state of CR685 is determined by the B\_GATE(L) signal through U660C. Whenever the B Sweep is running, the output of U665D will be LO. This will cause the output of U665B to also be LO and CR685 will be biased off. If the B Sweep is not running, the output of U665B will be HI and CR685 will be biased on. This will bias off CR816 and the A Sweep will not be intensified.

If U670B is set to display the B Sweep (Q HI and  $\bar{Q}$  LO), CR684 will be biased on, reverse biasing CR816 to prevent Z-axis drive through that diode. With CR687 off, the B Sweep will be displayed if CR680 is also reverse biased. Whenever the B Sweep is running, the output of U665D will be LO. Diode CR680 will then be reverse biased and Z-Axis drive current will flow through CR817. If the B Sweep is not running, the output of U665D is HI, forward biasing CR680 and therefore reverse biasing

CR817. No Z-Axis drive current can then flow through CR817.

## HORIZONTAL

The Horizontal Amplifier circuit, shown on Diagram 8, provides the output signals that drive the horizontal crt deflection plates. Signals applied to the Horizontal Preamplifier can come from either the A or the B Miller Sweep Generator (for sweep deflection) or from the XY Amplifier (when X-Y display mode is selected). Sweep switching is under control of the Alternate Display Switching Logic circuit. See Figure 3-4 for the block diagram of the Horizontal Amplifier.

The Horizontal POSITION control, X10 Magnifier circuitry, and the horizontal portion of the Beam Find circuitry are also contained in the Horizontal Amplifier circuit.

### Horizontal Preamplifier

The Horizontal Preamplifier selects display modes and amplifies input signals for application to the Horizontal Output Amplifier.

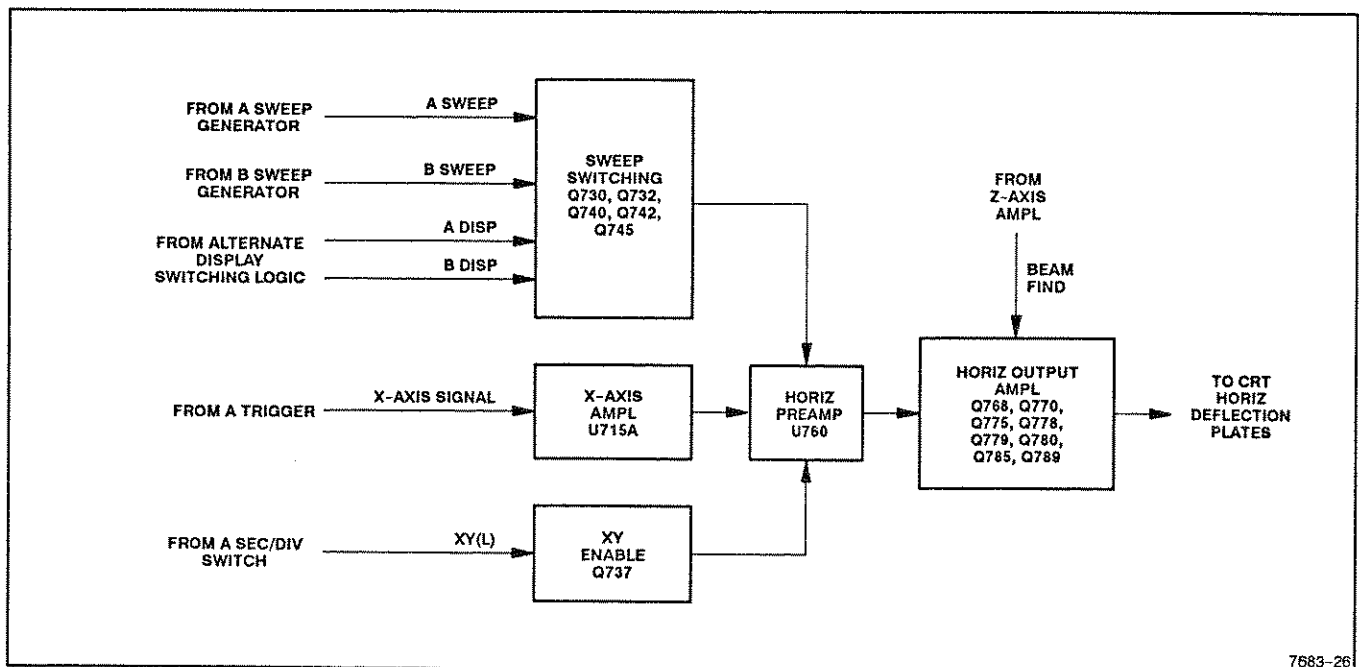


Figure 3-4. Block diagram of the Horizontal Amplifier.

The A and B Sweeps, selected by U670B in the Alternate Sweep circuitry, are applied to the bases of Q742 and Q732 respectively through gain potentiometers R740 and R730. The transistors are biased into active or cutoff regions by the control voltage applied at the bases of Q730 and Q740. Switching between the A and B Sweeps occurs within U760, with a negative input at pin 10 or 9 disconnecting the respective sweep from the rest of the amplifier. The Horizontal POSITION control adjusts the crt trace position through pin 14. Output bias current levels are set by R751 at pin 5 and frequency compensation for X-Axis signals is provided by C751 connected to pin 13.

Horizontal X10 Gain is set by the resistor network connected between pins 3 and 6. When the X10 Magnifier is on, S721 is closed and the timing adjustment is made using R754. Magnifier registration is adjusted by R749 so that there is no horizontal trace shift when switching between the X10 Magnifier on and off positions.

### X-Y Amplifier

The X-Y Amplifier amplifies the Channel 1 signal from the Internal Trigger circuitry for application to the Horizontal Preamplifier.

When the X-Y mode is selected, Q737 is biased on to establish a HI on U760, pin 12, so that the A and B Sweeps are disconnected from the Preamplifier outputs. The input voltage from the Horizontal POSITION control at pin 14 is disconnected within U760, but position information is provided through R758 where it is summed with the X-Axis signal from U350, pin 16, (Diagram 4) to drive the inverting input of U715A through R757, R763, and RT763. The output of U715A will then be a function of the X-Axis signal and the Horizontal POSITION control wiper voltage. The X-Axis signal gain is adjusted by R760. The input signal at pin 11 from U715A will be converted to a differential output signal and applied to the Horizontal Output Amplifier.

### Horizontal Output Amplifier

The Horizontal Output Amplifier provides final amplification of the horizontal signal to drive the horizontal crt deflection plates.

Signals from the (+) and (-) sweep outputs of U760 are used to drive two shunt-feedback amplifiers. Due to the feedback, the input impedance of these amplifiers is low. The base voltages of Q768 and Q778 are at nearly the same dc level due to base-emitter voltages of Q770 and Q780.

Transistors Q768, Q770, Q775, and Q779 form a cascode-feedback amplifier for driving the right crt horizontal deflection plate with R775 setting amplifier gain and C775 providing high-frequency compensation. For low-speed signals, Q779 serves as a current source for Q775, and at high sweep rates, the ramp is coupled through C779 to the emitter of Q779. This provides additional pull-up output current to drive the crt at high sweep rates. The amplifier consisting of Q778, Q780, Q785, and Q789 drives the left crt horizontal deflection plate in the same manner as described above with zener diode VR782 level shifting the collector signal of Q780. C774 and R774 adjust the horizontal system response for proper high-speed timing at 5 ns/div.

The BEAM FIND function is implemented when S390 (Diagram 10) is pushed in to disconnect the cathode of CR764 from the -8.6 V supply. The voltage on the cathode of VR764 goes positive, causing CR780 and CR770 to be forward biased. Current from R764 causes the output common-mode voltage of the two shunt-feedback amplifiers to be shifted negative to reduce the available voltage swing at the crt plates. This prevents the trace from being deflected off-screen horizontally.

### Calibrator

The Calibrator circuitry uses a hex inverter digital microcircuit to generate a 0.5V, 1 kHz, negative-going square wave. U985B and U985C are configured as a standard, astable multivibrator. To provide negative feedback and cancel errors caused by variations in the switching thresholds of the gates, U985A and its associated circuitry are added in the feedback loop for U985B. R990 adjusts the operating frequency for 1 kHz. The output voltage of U985D and U985E swings from -8.6 V to ground. R984, R991, and R992 attenuate the output signal with R984 adjusted to provide a 0 to -0.5V amplitude square-wave signal at the CAL output connector. R993, CR986, and CR989 provide protection. U985F supplies a 1kHz reference oscillator signal to the Scale Illumination circuitry on Diagram 10.

### Z-AXIS AMPLIFIER

The Z-Axis Amplifier, shown on Diagram 10, controls the crt intensity level via several input-signal sources. The effect of these input signals is either to increase or decrease trace intensity or to completely blank portions of the display. The Z-Drive signal current as determined by the A and B Z-Axis Switching Logic and the input current from the EXT Z AXIS INPUT connector (if in use) are summed at the emitter of common-base amplifier Q825 and thereby determine the collector current of the

stage. This transistor provides a low-impedance termination for the input signals and isolates the signal sources from following stages of the Z-Axis Amplifier.

Common-base transistor Q829 establishes a constant current through R832. This current is divided between Q825 and Q829 with the portion through Q829 driving the shunt-feedback output amplifier consisting of Q835, Q840, and Q845. The bias level of Q825 therefore determines the amount of emitter current available to Q829. Feedback-resistor R841 establishes the trans-resistance gain which converts the input current to output voltage. Emitter-follower Q835 is dc coupled to Q840, and for low-speed signals Q845 acts as a current source. Fast transitions couple through C845, providing additional current gain through Q845 for fast voltage swings at the output of the amplifier.

External Z-Axis input voltages establish proportional input currents through R822 and R823, and amplifier sensitivity is determined by the transresistance gain of the shunt-feedback amplifier. Diode CR823 protects the Z-Axis Amplifier if excessive signal levels are applied to the EXT Z AXIS INPUT connector.

The intensity of the crt display in the A, B, and Alt Horizontal modes is determined by the INTENSITY controls and associated circuitry. The A INTENSITY potentiometer controls the base voltage of Q804 to determine the amount of emitter current that will flow through the transistor and therefore the level of the Z-Axis signal. Likewise, the B INTENSITY potentiometer will control the base voltage of Q814 and the intensity of the B and Alt Sweep displays.

When only the A Sweep is displayed, Q586 and Q583 are biased off. The current through R818, as set by the A INTENSITY potentiometer, will flow through CR818 and Q825 to fix the voltage level at the Z-Axis Amplifier output. For a B-only display, Q586 is biased on to reverse bias CR818 and prevent A-intensity current from reaching Q825. Current determined by the base voltage of Q814 will flow through CR817 (Diagram 7) to Q825 and determine the B Sweep intensity. For an alternating A and B display, Q586 will be biased off when the A Sweep is displayed. During the portion of the A Sweep in which the B Sweep runs, current from R816 (Diagram 7) is allowed to flow through CR816 by the B Z-Axis Logic circuit to provide an intensified zone.

When CHOP Vertical MODE is selected, the Chop Blank signal is applied to the collector of Q825 through CR824 during the display-switching time. Signal current is shunted away from CR825, and the forward bias of Q829

increases to the blanking level. When blanked, the output of the Z-Axis Amplifier drops to a level that reduces the crt beam current below viewing intensity during the chop-switching transition.

For an X-Y display, CR818, CR817, and CR816 are reverse biased. The XY2(L) signal is LO to reverse bias CR551 and allow current in R820 to flow through CR820. The crt intensity is then controlled by the A INTENSITY potentiometer which sets the current in R820 through Q804.

BEAM FIND switch S390 controls the base bias voltages of Q825 and Q829. When the BEAM FIND button is out, -8.6 V is supplied to a base biasing network. When the button is pushed in, the -8.6 V supply is removed and the voltage at the anode of VR828 rises to about -5.6 V. This turns off Q829 so that the amplifier output voltage is determined by R835 and the voltage at the BEAM FIND switch, as set by other parts of the Beam Find circuitry. The output voltage of Q835 will then be at a fixed level so that the INTENSITY controls and the Z-Drive signal have no control over the crt intensity. A bright trace or dot will then be displayed.

## Dc Restorer

The Dc Restorer circuit produces the crt control-grid bias and couples both dc and ac components of the Z-Axis Amplifier output to the crt control grid. Direct coupling of the Z-Axis Amplifier output to the crt control grid is not employed due to the high potential differences involved. Refer to Figure 3-5 during the following discussion.

Ac drive to the Dc Restorer circuit is obtained from pin 16 of T948. The drive voltage has a peak amplitude of about  $\pm 100V$ , a frequency of about 20 kHz, and is coupled into the Dc Restorer circuit through C853 and R853. The cathode of CR851 is biased by the voltage applied from the wiper of Grid Bias potentiometer R851, and the ac-drive voltage will be clamped whenever the positive peaks reach a level that forward biases CR851.

The Z-Axis Amplifier output voltage, which varies between +10 V and +75 V, is applied to the Dc Restorer at the anode of CR853. The ac-drive voltage will hold CR853 reverse biased until the voltage falls below the Z-Axis Amplifier output voltage level. At that point, CR853 becomes forward biased and clamps the junction of CR851, CR853, and R854 to the Z-Axis output level. Thus, the ac-drive voltage is clamped at two levels to produce a square-wave signal with a positive dc-offset level.

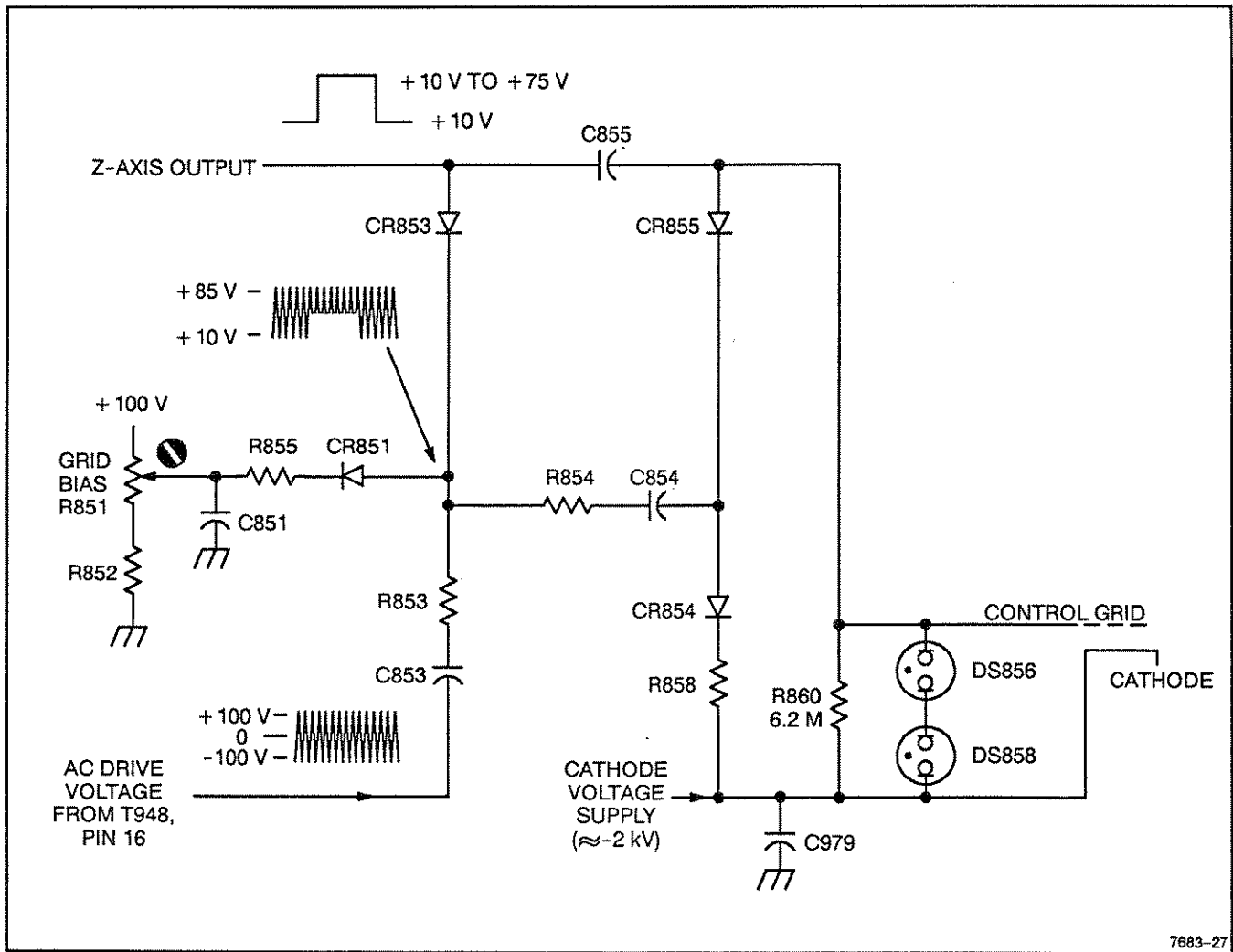


Figure 3-5. Simplified diagram of the Dc Restorer circuitry.

The Dc Restorer is referenced to the  $-2$  kV crt cathode voltage through R858 and CR854. Initially, both C855 and C854 will charge up to a level determined by the difference between the Z-Axis output voltage and the crt cathode voltage. Capacitor C855 charges from the Z-Axis output through R858, CR854, and CR855, to the crt cathode. Capacitor C854 charges through R858, CR854, R854, and CR853 to the crt cathode.

During the positive transitions of the ac drive, from the lower clamped level toward the higher clamped level, the charge on C854 increases due to the rising voltage. The voltage increase across C854 is equal to the amplitude of the positive transition. The negative transition is coupled through C854 to reverse bias CR854 and to forward bias CR855. The increased charge of C854 is then transferred to C855 as C854 discharges toward the

Z-Axis output level. Successive cycles of the ac input to the Dc Restorer will charge C855 to a voltage equal to the initial level plus the amplitude of the clamped square-wave input.

The added charge on C855 determines the control-grid bias voltage. If more charge is added to that already present on C855, the control grid becomes more negative and less crt writing-beam current will flow. Conversely, if less charge is added, the control-grid voltage level will be closer to the cathode-voltage level and more crt writing-beam current flows.

During periods that C854 is charging, the crt control-grid voltage is held constant by the long time-constant discharge path of C855 through R860.

Fast-rise and fast-fall transitions of the Z-Axis output signal are coupled to the crt control grid through C855 to start the crt writing-beam current toward the new intensity level. The Dc Restorer output level then follows the Z-Axis output voltage level to set the new bias voltage for the crt control grid.

Neon lamps DS858 and DS856 protect the crt from excessive grid-to cathode voltage if the potential on either the control grid or the cathode is lost for any reason.

## POWER SUPPLY AND SCALE ILLUMINATION

The Power Supply circuitry converts the ac power-line voltage into the voltages needed for instrument operation. It consists of the Power Input, Preregulator, and Inverter circuits (which drive the primary of the power transformer) and secondary circuits (which produce the necessary supply voltages for the instrument).

### Power Input

The Power Input circuit ( Diagram 9) converts the ac power-line voltage to filtered dc for use by the Preregulator.

POWER switch S901 connects the ac power line through fuse F9001 to the bridge rectifier composed of CR901, CR902, CR903, and CR904. The bridge full-wave rectifies the source voltage, and the output is filtered by C906. Input surge current at the time of instrument power up is limited by thermistor RT901. The thermistor resistance is moderately high when the power is first turned on, but decreases as the input current warms the device. The instrument is protected from large voltage transients by suppressor RV901. Conducted interference originating within the power supply is attenuated by common-mode transformer T901, differential-mode transformer T903, line filter FL9001, and capacitors C900, C902, and C903.

### Preregulator

The Preregulator provides a regulated dc output voltage for use by the Inverter circuitry.

When the instrument is turned on, the voltage developed across C906 will charge C925 through R926. When the voltage has risen to a level high enough that U930 can reliably drive Q9070, U930 will receive operating supply voltage through Q930. This level is set by zener diode

VR925 in the emitter of Q928 and by the voltage divider consisting of R925 and R927. The zener diode will keep Q928 off until the base voltage reaches approximately 6.9 V. Then Q928 will be biased into conduction and the resulting collector current will cause a voltage drop across R929. This voltage drop will bias on Q930, and the positive feedback through R930 will reinforce the turn-on of Q928. Thus Q930 and Q928 will drive each other into saturation very quickly. Once Q930 is on, U930 will begin to function.

Pulse-width modulator U930 controls the output voltage of the Preregulator by regulating the duty cycle of the pulse applied to the gate of Q9070. It utilizes an oscillator with the frequency determined by R919 and C919 (approximately 60 kHz) and with a sawtooth output voltage at pin 5. This sawtooth voltage is compared internally with the output voltage produced by the two error amplifiers. Whenever the sawtooth voltage is greater than the error amplifier output voltage, Q9070 is biased on to supply current to both C940 and the rest of the circuitry. The two error amplifiers maintain a constant output voltage and monitor the output current of the Preregulator. One input of each amplifier is connected through a divider network to the IC internal +5-V reference. The output voltage of the Preregulator is monitored by the voltage divider at pin 2. The voltage drop across R907, produced by the Preregulator output current, is applied to the current limit amplifier at pin 16.

When the instrument is first turned on, the current limit amplifier controls the conduction time of Q9070. While Q9070 is conducting, the output current increases until a sufficiently large voltage drop is developed across R907 to invoke the current-limit mode. The current limit amplifier holds the output current below the current-limit threshold of approximately 1 A. When the voltage across C940 reaches approximately 43 V, the voltage amplifier starts controlling the duty cycle of Q9070 and the Preregulator will not limit current unless there is excessive current demand.

With Q9070 off, C907 charges to the output voltage of the Power Input circuit. When Q9070 turns on, current through the FET will come from the winding connected to pins 1 and 2 of T906 and from C907. Current to C907 is supplied by the winding connected to pins 4 and 5 of T906. When U930 shuts off Q9070, the collapsing magnetic field will raise the voltage at the anode of CR907. This diode then becomes forward biased and passes the currents supplied by C907 and the winding connected to pins 4 and 5 of T906. For this part of the cycle, current to C907 will be supplied by the winding connected to pins 1 and 2 of T906. This process will continue for each period of the oscillator, and the duty cycle controlling the conduction period of Q9070 will be

altered as necessary to maintain 43 V across C940. To shut off Q9070 during each oscillator period, Q908 is used to discharge the gate-drain capacitance. Pin 10 of U930 goes LO, reverse biasing CR908 and turning on Q908 to shut off the FET.

Once the supply is running, power to U930 will be supplied from the winding connected to pins 6 and 7 of T906. Diode CR920 half-wave rectifies the voltage across pins 6 and 7 to keep filter capacitor C925 charged and to maintain supply voltage to U930 through Q930.

Instrument protection from excessive output voltage is supplied by silicon-controlled rectifier Q935. Should the Preregulator output voltage exceed 51 V, zener diode VR935 will conduct, causing Q935 to also conduct. The Preregulator output current will then be shunted through Q935, and the output voltage will very quickly go to zero. With the supply voltage of U930 no longer being provided by the winding connected to pins 6 and 7 of T906, the Preregulator will shut down and Q935 will be reset. The supply will then attempt to power up, but may again shut down if the overvoltage condition is again reached. This sequence continues until the overvoltage condition is corrected.

### Inverter

The Inverter circuit changes the dc voltage from the Preregulator to ac for use by the supplies that are connected to the secondaries of T948.

The output of the Preregulator circuit is applied to the center tap of T948 (shown on Diagram 10). Power-switching transistors Q946 and Q947 alternate conducting current from the Preregulator output through the primary windings of T948. The transistor switching action is controlled by T944, a saturating base-drive transformer.

When the instrument is first turned on, one of the switching transistors will start to conduct and its collector voltage will drop toward the common voltage level. This will induce a positive voltage from the lead of T944 which is connected to the base of the conducting transistor and reinforce conduction. Eventually T944 will saturate, and as the voltage across T944 (and T948) begins to reverse, the conducting transistor will cut off because of the drop in base drive. The other transistor will not start conduction until the voltage on the leads of T944 reverse enough to bias it on. This process will continue, and the saturation time of T944 plus the transistor-switching time will determine the frequency of Inverter operation (typically 20 kHz). After the initial Inverter start up, the switching transistors do not

saturate; they remain in the active region during switching.

Diodes CR946 and CR947 serve as a negative-peak detector to generate a voltage for controlling the output of the error amplifier. Capacitor C943 charges to a voltage equal to the negative peak voltage at the collectors of Q946 and Q947, referenced to the Preregulator input voltage. This voltage level is applied to the divider composed of R937, R938, and R939. The error amplifier, composed of Q938 and Q939, is a differential amplifier that compares the reference voltage of VR943 with the voltage on the wiper of potentiometer R938. The current through Q939 will set the base drive of Q944. This voltage will bias Q946 and Q947 to a level that will maintain the peak-to-peak input voltage of T948. The amplitude of the voltage across the transformer primary winding, and thus that of the secondary voltages of T948, is set by adjusting -8.6 V Adjust potentiometer R938.

At turn on, Q938 is biased off and Q939 is biased on. All the current of the error amplifier will then go through Q939 to bias on Q944. The current through Q944 controls the base drive for Q946 and Q947. Base current provided by base-drive transformer T944 will charge C944 negative with respect to the Inverter circuit floating ground (common) level.

### Crt Supply

High-voltage multiplier U975 (Diagram 10) utilizes the 2-kV winding of T948 to generate 12 kV to drive the crt anode. It also uses an internal half wave rectifier diode to produce -2 kV for the crt cathode. The -2 kV supply is filtered by a low-pass filter composed of C975, C976, R976, R978, and C979. Neon lamp DS870 protects against excessive voltage between the crt heater and crt cathode by conducting if the voltage exceeds approximately 75 V.

### Focus Circuit

Focus voltage is also developed from the -2 kV supply via a voltage divider composed of Q885, R890, and FOCUS potentiometer R893. The focus voltage tracks the A-intensity level through the action of Q885. The emitter voltage of Q804, set by the A INTENSITY control, is applied to the emitter of Q885 through R885. When the emitter voltage of Q804 changes, the current through Q885 changes proportionally and alters the voltage at one end of FOCUS control R893.

### Low-Voltage Supplies

The low-voltage supplies utilize center-tapped secondary windings of T948. The +102 V supply uses CR954

and CR955 for rectification and C954 for filtering. Diodes CR956 and CR957 rectify ac from taps on the 102 V winding, and C956, L956, and C957 filter the output to produce +30 V dc. The diode bridge consisting of CR960, CR961, CR962 and CR963 produces the +8.6 V and -8.6 V supplies. Filtering of the +8.6 V is accomplished by C960, C962, and L960; filtering of the -8.6 V is done by C961, C963, and L961. The +5.2 V supply is produced by CR967, CR970, C968, L968, and C970.

### Scale Illumination

The Scale Illumination circuitry uses a variable pulse width modulator to control the brightness of the scale

illumination lights. A 1 kHz reference oscillator signal is provided by the Calibrator circuit (Diagram 8). This signal is input to U882A, which is an integrator with DC offsets degraded by R887. The output of U882A is a ramp that is coupled to one input of U882B. A voltage level determined by the SCALE ILLUM control, R882, is connected to the other input of U882B. The two voltages are compared by U882B. If the ramp voltage is above the control voltage, Q882 is turned on, turning on lights DS881 and DS882. When the ramp voltage falls below the control voltage, Q882 is biased off, turning off the lights. The width of the pulses at the output of U882B determines the brightness of the lights.

# PERFORMANCE CHECK PROCEDURE

## INTRODUCTION

### PURPOSE

The Performance Check Procedure is used to verify the instrument's Performance Requirements statements listed in Table 1-1. It is the recommended acceptance check procedure for new instruments.

Instrument performance should be checked after every 2000 hours of operation or once each year, if used infrequently. A more frequent interval may be necessary if your instrument is subjected to harsh environments or severe usage. The results of these periodic checks will determine the need for readjustment.

Selected procedures may also be used as preliminary troubleshooting aids or to verify instrument performance after repair or component replacement.

### STRUCTURE

The Performance Check Procedure is structured into four major subsections, each of which can be performed independently to permit checking individual portions of the instrument. At the beginning of each subsection there is an equipment-required list showing only the test equipment necessary for performing the steps in that subsection. In this list, the Item number that follows each piece of equipment corresponds to the Item number listed in Table 4-1.

Also at the beginning of each subsection is a list of all the front-panel control settings required to prepare the instrument for performing Step 1 in that subsection. Each succeeding step within a particular subsection should then be performed, both in the sequence presented and in its entirety, to ensure that control-setting changes will be correct for ensuing steps.

### TEST EQUIPMENT

The test equipment listed in Table 4-1 is a complete list of the equipment required to accomplish both the Performance Check Procedure in this section and the Adjustment Procedure in Section 6. To assure accurate measurements, it is important that test equipment used for making these checks meet or exceed the specifications described in Table 4-1. When considering use

of equipment other than that recommended, utilize the Minimum Specification column to determine whether or not the available test equipment will suffice.

Each procedure in this section is written using the control and connector nomenclature imprinted on the recommended test equipment. When substitute equipment is used, control settings stated in the test setup and in the procedure itself may need to be altered.

Detailed operating instructions for test equipment are not given in this procedure. If more operating information is required, refer to the appropriate test-equipment instruction manual.

### LIMITS AND TOLERANCES

The tolerances given in this procedure are valid for an instrument that is operating in and has been previously calibrated in an ambient temperature between  $+20^{\circ}\text{C}$  and  $+30^{\circ}\text{C}$ . The instrument also must have had at least a 20-minute warm-up period. Refer to Table 1-1 for tolerances applicable to an instrument that is operating outside this temperature range. All tolerances specified are for the instrument only and do not include test-equipment error.

### PREPARATION FOR CHECKS

It is not necessary to remove the instrument cover to accomplish any subsection in the Performance Check Procedure, since all checks are made using operator-accessible front- and rear-panel controls and connectors.

Test equipment items 1 through 10 in Table 4-1 are required to accomplish the complete Performance Check Procedure.

Before performing any procedure in this section, set the POWER switch to ON and allow a 20-minute warm-up period.

The most accurate display adjustments are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and TRIGGER LEVEL controls as needed to view the display.

**Table 4-1**  
**Test Equipment Required**

| Item No. and Description    | Minimum Specification                                                                                                                                                                                                                                                          | Purpose                                                                                           | Examples of Suitable Test Equipment                        |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Calibration Generator       | Standard-amplitude signal levels: 10 mV to 50 V.<br>Accuracy: $\pm 0.3\%$ .<br><br>High-amplitude signal levels: 1 V to 60 V.<br>Repetition rate: 1 kHz.<br><br>Fast-rise signal level: 1 V.<br>Repetition rate: 1 MHz.<br>Rise time: 1 ns or less.<br>Flatness: $\pm 0.5\%$ . | Vertical and horizontal checks and adjustments.                                                   | TEKTRONIX PG 506A Calibration Generator. <sup>a</sup>      |
| Leveled Sine-Wave Generator | Frequency: 250 kHz to above 100 MHz. Output amplitude: variable from 10 mV to 5 V p-p. Output impedance: 50 $\Omega$ . Amplitude accuracy: constant within 3% of reference frequency as output frequency changes.                                                              | Vertical, horizontal, and triggering checks and adjustments. Display adjustment and Z-Axis check. | TEKTRONIX SG 503 Leveled Sine-Wave Generator. <sup>a</sup> |
| Time-Mark Generator         | Marker outputs: 10 ns to 0.5 s. Marker accuracy: $\pm 0.1\%$ . Trigger output: 1 ms to 0.1 $\mu$ s, time-coincident with markers.                                                                                                                                              | Horizontal checks and adjustments. Display adjustment.                                            | TEKTRONIX TG 501 Time-Mark Generator. <sup>a</sup>         |
| Low-Frequency Generator     | Frequency: 1 kHz to 500 kHz. Output amplitude: 300 mV. Output impedance: 600 $\Omega$ . Reference frequency: 1 kHz. Amplitude accuracy: constant within 0.3 dB of reference frequency as output frequency changes.                                                             | Low frequency trigger checks.                                                                     | TEKTRONIX SG 502 Oscillator.                               |
| Cable (2 required)          | Impedance: 50 $\Omega$ .<br>Length: 42 in.<br>Connectors: BNC.                                                                                                                                                                                                                 | Signal interconnection.                                                                           | Tektronix Part Number 012-0057-01.                         |
| Precision Coaxial Cable     | Impedance: 50 $\Omega$ .<br>Length: 42 in.<br>Connectors: BNC.                                                                                                                                                                                                                 | Vertical bandwidth and aberrations checks.                                                        | Tektronix Part Number 012-0482-00.                         |
| Termination (2 required)    | Impedance: 50 $\Omega$ .<br>Connectors: BNC.                                                                                                                                                                                                                                   | Signal termination.                                                                               | Tektronix Part Number 011-0049-01.                         |
| Termination                 | Impedance: 600 $\Omega$ .<br>Connectors: BNC.                                                                                                                                                                                                                                  | Signal termination.                                                                               | Tektronix Part Number 011-0092-00.                         |
| Dual Input Coupler          | Connectors:<br>BNC-Female-to-Dual-BNC-male                                                                                                                                                                                                                                     | Vertical and X-Y checks and adjustments.                                                          | Tektronix Part Number 067-0525-02.                         |

Table 4-1 (cont)

| Item No. and Description                  | Minimum Specification                                                                     | Purpose                                                  | Examples of Suitable Test Equipment                   |
|-------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------|
| 10X Attenuator                            | Ratio: 10X.<br>Impedance: 50 $\Omega$ .<br>Connectors: BNC.                               | Vertical compensation and triggering checks.             | Tektronix Part Number 011-0059-02                     |
| T-Connector                               | Connectors: BNC.                                                                          | Signal Interconnection.                                  | Tektronix Part Number 103-0030-00.                    |
| Adapter                                   | Connectors: Probe Tip to BNC.                                                             | Signal Interconnection.                                  | Tektronix Part Number 013-0084-02.                    |
| Digital Voltmeter                         | Range: 0 to 140 V.<br>Dc voltage accuracy: $\pm 0.15\%$ . 4 1/2-digit display.            | Power supply checks and adjustment. Vertical adjustment. | TEKTRONIX DM 501A Digital Multimeter. <sup>a</sup>    |
| Test Oscilloscope with included 10X Probe | Bandwidth: dc to 10 MHz.<br>Minimum deflection factor: 5 mV/div.<br>Accuracy: $\pm 3\%$ . | Holdoff check and general troubleshooting.               | TEKTRONIX 2213 Oscilloscope.                          |
| DC Voltmeter                              | Range: 0 to 2500 V, calibrated to 1% accuracy at -2000 V.                                 | High-voltage power supply check.                         | Valhalla Model 4500 H.V. Digital Multimeter.          |
| Alignment Tool                            | Length: 1-in shaft.<br>Bit size: 3/32 in.                                                 | Adjust variable capacitors.                              | J.F.D. Electronics Corp. Adjustment Tool Number 5284. |

<sup>a</sup> Requires a TM 500-series power-module mainframe.

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# VERTICAL

## Equipment Required (See Table 4-1):

Calibration Generator  
 Leveled Sine-Wave Generator  
 50- $\Omega$  BNC Coaxial Cable  
 50- $\Omega$  BNC Termination

50- $\Omega$  BNC Precision Coaxial Cable  
 Dual-Input Coupler  
 10X BNC Attenuator

## INITIAL CONTROL SETTINGS

### Vertical (Both Channels)

|                    |                  |
|--------------------|------------------|
| POSITION           | Midrange         |
| INVERT             | Off (button out) |
| MODE               | CH 1             |
| BW LIMIT           | Off (button out) |
| VOLTS/DIV          | 2 mV             |
| VOLTS/DIV Variable | CAL detent       |
| Input Coupling     | DC               |

### Horizontal

|                  |               |
|------------------|---------------|
| POSITION         | Midrange      |
| MODE             | A             |
| A and B SEC/DIV  | 0.2 ms        |
| SEC/DIV Variable | CAL detent    |
| X10 Magnifier    | Off (knob in) |

### A TRIGGER

|              |                          |
|--------------|--------------------------|
| VAR HOLDOFF  | NORM                     |
| Mode         | P-P AUTO                 |
| SLOPE        | Positive<br>(button out) |
| LEVEL        | Midrange                 |
| A & B SOURCE | VERT MODE                |
| A COUPL      | NORM                     |
| A EXT COUPL  | AC                       |

## PROCEDURE STEPS

### 1. Check Deflection Accuracy and Variable Range

- Connect the standard-amplitude generator output via a 50- $\Omega$  cable to the CH 1 input connector.
- Set the generator to produce a 5-division display.

- CHECK—Deflection accuracy is within the limits given in Table 4-2 for each CH 1 VOLTS/DIV switch setting and corresponding standard amplitude signal. When at the 20-mV VOLTS/DIV switch setting, rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise and CHECK that the display decreases to 2 divisions or less. Then return the CH 1 VOLTS/DIV Variable control to the CAL detent and continue with the 50 mV check.
- Move the cable from the CH 1 input connector to the CH 2 input connector. Set the Vertical MODE switch to CH 2.
- Repeat part b using the Channel 2 controls.

**Table 4-2**  
**Deflection Accuracy Limits**

| VOLTS/DIV<br>Switch<br>Setting | Standard<br>Amplitude<br>Signal | Vertical<br>Deflection<br>(Divisions) | Accuracy<br>Limits<br>(Divisions) |
|--------------------------------|---------------------------------|---------------------------------------|-----------------------------------|
| 2 mV                           | 10 mV                           | 5                                     | 4.90 to 5.10                      |
| 5 mV                           | 20 mV                           | 4                                     | 3.92 to 4.08                      |
| 10 mV                          | 50 mV                           | 5                                     | 4.90 to 5.10                      |
| 20 mV                          | 0.1 V                           | 5                                     | 4.90 to 5.10                      |
| 50 mV                          | 0.2 V                           | 4                                     | 3.92 to 4.08                      |
| 0.1 V                          | 0.5 V                           | 5                                     | 4.90 to 5.10                      |
| 0.2 V                          | 1 V                             | 5                                     | 4.90 to 5.10                      |
| 0.5 V                          | 2 V                             | 4                                     | 3.92 to 4.08                      |
| 1 V                            | 5 V                             | 5                                     | 4.90 to 5.10                      |
| 2 V                            | 10 V                            | 5                                     | 4.90 to 5.10                      |
| 5 V                            | 20 V                            | 4                                     | 3.92 to 4.08                      |

**2. Check Position Range**

a. Set:

|                       |       |
|-----------------------|-------|
| VOLTS/DIV (both)      | 10 mV |
| Input Coupling (both) | AC    |

b. Set the generator to produce a 0.2-V standard-amplitude signal.

c. CHECK—The bottom of the waveform can be positioned at least 1 division above the center horizontal graticule line when the Channel 1 POSITION control is rotated fully clockwise, and that the top of the waveform can be positioned one division below the center horizontal graticule line when the Channel 1 POSITION control is rotated fully counter-clockwise.

d. Move the cable from the CH 2 input connector to the CH 1 input connector and set the Vertical MODE switch to CH 1.

e. Repeat part c using the Channel 1 controls.

**3. Check Trigger View Gain**

a. Set:

|                           |            |
|---------------------------|------------|
| Vertical POSITION (both)  | Midrange   |
| VOLTS/DIV (both)          | 0.1 V      |
| VOLTS/DIV Variable (both) | CAL detent |

b. Press and hold in the TRIG VIEW button, vertically center the display with the A TRIGGER LEVEL control.

c. CHECK—Display amplitude is 1.6 to 2.4 divisions while holding in the TRIG VIEW button.

d. Move the cable from the CH 1 input connector to the CH 2 input connector and set the Vertical MODE switch to CH 2.

e. Repeat parts b and c.

f. Move the cable from the CH 2 input connector to the EXT INPUT connector. Set the A &amp; B SOURCE switch to A EXT.

g. Repeat parts b and c.

h. Set the A EXT COUPL switch to DC.

i. Repeat parts b and c.

j. Set the A EXT COUPL switch to  $\frac{DC}{10}$ .

k. Set the generator to produce a 5-V signal.

l. Repeat parts b and c.

m. Disconnect the test equipment from the instrument.

**4. Check Bandwidth**

a. Set:

|                       |                  |
|-----------------------|------------------|
| BW LIMIT              | Off (button out) |
| VOLTS/DIV (both)      | 2 mV             |
| Input Coupling (both) | DC               |
| A SEC/DIV             | 20 $\mu$ s       |

b. Connect the leveled sine-wave generator output via a 50- $\Omega$  precision cable and a 50- $\Omega$  termination to the CH 2 input connector.

c. Set the generator to produce a 50-kHz, 6-division display.

d. CHECK—Display amplitude is 4.2 divisions or greater as the generator output frequency is increased up to the value shown in Table 4-3 for the corresponding VOLTS/DIV switch setting.

e. Repeat parts c and d for all indicated CH 2 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.

f. Move the cable from the CH 2 input connector to the CH 1 input connector. set the Vertical MODE switch to CH 1.

g. Repeat parts c and d for all indicated CH 1 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.

**Table 4-3**  
**Settings for Bandwidth Checks**

| VOLTS/DIV<br>Switch Setting | Generator<br>Output Frequency |
|-----------------------------|-------------------------------|
| 2 mV                        | 90 MHz                        |
| 5 mV                        | 100 MHz                       |

**5. Check Bandwidth Limit Operation**

a. Set:

|                |                |
|----------------|----------------|
| BW LIMIT       | On (button in) |
| CH 1 VOLTS/DIV | 10 mV          |
| A SEC/DIV      | 20 $\mu$ s     |

- b. Set the generator to produce a 50-kHz, 6-division display.
- c. Increase the generator output frequency until the display amplitude decreases to 4.2 divisions.
- d. CHECK—Generator output frequency is between 18 and 22 MHz.
- e. Disconnect the test equipment from the instrument.

#### 6. Check Common-Mode Rejection Ratio

- a. Set:
 

|                  |                  |
|------------------|------------------|
| BW LIMIT         | Off (button out) |
| VOLTS/DIV (both) | 10 mV            |
| INVERT           | On (button in)   |
- b. Connect the leveled sine-wave generator output via a 50- $\Omega$  precision cable, a 50- $\Omega$  termination, and a dual-input coupler to the CH 1 and the CH 2 input connectors.
- c. Set the generator to produce a 50-MHz, 6-division display.
- d. Vertically center the display using the Channel 1 POSITION control. Then set the Vertical MODE switch to CH 2 and vertically center the display using the Channel 2 POSITION control.
- e. Set the Vertical MODE switches to BOTH and ADD.
- f. CHECK—Display amplitude is 0.6 division or less.
- g. If the check in part f meets the requirement, skip to part p. If it does not, continue with part h.
- h. Set the Vertical MODE switch to CH 1.
- i. Set the generator to produce a 50-kHz, 6-division display.
- j. Set the Vertical MODE switch to BOTH.
- k. Adjust the CH 1 or CH 2 VOLTS/DIV Variable control for minimum display amplitude.

- l. Set the Vertical MODE switch to CH 1.
- m. Set the generator to produce a 50-MHz, 6-division display.
- n. Set the Vertical MODE switch to BOTH.
- o. CHECK—Display amplitude is 0.6 division or less.
- p. Disconnect the test equipment from the instrument.

#### 7. Check Channel Isolation

- a. Set:
 

|                           |                  |
|---------------------------|------------------|
| Vertical MODE             | CH 1             |
| CH 1 VOLTS/DIV            | 1 V              |
| CH 2 VOLTS/DIV            | 0.5 V            |
| VOLTS/DIV Variable (both) | CAL detent       |
| INVERT                    | Off (button out) |
| Channel 2 Input Coupling  | GND              |
| A SEC/DIV                 | 0.1 $\mu$ s      |
- b. Connect the leveled sine-wave generator output via a 50- $\Omega$  precision cable and a 50- $\Omega$  termination to the CH 1 input connector.
- c. Set the generator to produce a 50-MHz, 5-division display.
- d. Set the CH 1 VOLTS/DIV switch to 0.5 position.
- e. Set the Vertical MODE switch to CH 2.
- f. CHECK—Display amplitude is 0.1 division or less.
- g. Move the cable from the CH 1 input connector to the CH 2 input connector.
- h. Set:
 

|                          |      |
|--------------------------|------|
| Vertical MODE            | CH 1 |
| Channel 1 Input Coupling | GND  |
| Channel 2 Input Coupling | DC   |
- i. CHECK—Display amplitude is 0.1 division or less.
- j. Disconnect the test equipment from the instrument.

# HORIZONTAL

## Equipment Required (See Table 4-1):

Calibration Generator  
Leveled Sine-Wave Generator  
Time-Mark Generator

Low-Frequency Generator  
50- $\Omega$  Coaxial Cable  
50- $\Omega$  BNC Termination

## INITIAL CONTROL SETTINGS

### Vertical

|                          |                  |
|--------------------------|------------------|
| POSITION                 | Midrange         |
| Vertical MODE            | CH 1             |
| BW LIMIT                 | Off (button out) |
| CH 1 VOLTS/DIV           | 0.5 V            |
| CH 1 VOLTS/DIV Variable  | CAL detent       |
| Channel 1 Input Coupling | AC               |

### Horizontal

|                       |                         |
|-----------------------|-------------------------|
| POSITION              | Midrange                |
| MODE                  | A                       |
| A SEC/DIV             | 0.05 $\mu$ s            |
| SEC/DIV Variable      | CAL detent              |
| X10 Magnifier         | Off (knob in)           |
| B DELAY TIME POSITION | Fully counter-clockwise |

### B TRIGGER

|       |                       |
|-------|-----------------------|
| SLOPE | OUT                   |
| LEVEL | RUNS AFTER            |
|       | DLY (fully clockwise) |

### A TRIGGER

|              |                       |
|--------------|-----------------------|
| VAR HOLDOFF  | NORM                  |
| Mode         | NORM                  |
| SLOPE        | Positive (button out) |
| LEVEL        | Midrange              |
| A & B SOURCE | VERT MODE             |
| A COUPL      | NORM                  |
| A EXT COUPL  | DC                    |

## PROCEDURE STEPS

### 1. Check Timing Accuracy and Linearity

- Connect the time-mark generator output via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 input connector.
- Select 50-ns time markers from the time-mark generator.
- Adjust the A TRIGGER LEVEL control for a stable, triggered display.
- Use the Horizontal POSITION control to align the second time marker with the second vertical graticule line.
- CHECK—Timing accuracy is within 2% (0.16 division at the 10th vertical graticule line), and linearity is within 5% (0.1 division over any 2 of the center 8 divisions).

### NOTE

*For checking the timing accuracy of the A SEC/DIV switch settings from 50 ms to 0.5 s, watch the time marker tips only at the 2nd and 10th vertical graticule lines while adjusting the Horizontal POSITION control.*

- Repeat parts c through e for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 4-4 under the Normal column.

- Set:

|               |               |
|---------------|---------------|
| A SEC/DIV     | 0.05 $\mu$ s  |
| X10 Magnifier | On (knob out) |

**Table 4-4**  
**Settings for Timing Accuracy Checks**

| SEC/DIV<br>Switch<br>Setting | Time-Mark Generator Setting |               |
|------------------------------|-----------------------------|---------------|
|                              | Normal                      | X10 Magnified |
| 0.05 $\mu$ s                 | 50 ns                       | 10 ns         |
| 0.1 $\mu$ s                  | 0.1 $\mu$ s                 | 10 ns         |
| 0.2 $\mu$ s                  | 0.2 $\mu$ s                 | 20 ns         |
| 0.5 $\mu$ s                  | 0.5 $\mu$ s                 | 50 ns         |
| 1 $\mu$ s                    | 1 $\mu$ s                   | 0.1 $\mu$ s   |
| 2 $\mu$ s                    | 2 $\mu$ s                   | 0.2 $\mu$ s   |
| 5 $\mu$ s                    | 5 $\mu$ s                   | 0.5 $\mu$ s   |
| 10 $\mu$ s                   | 10 $\mu$ s                  | 1 $\mu$ s     |
| 20 $\mu$ s                   | 20 $\mu$ s                  | 2 $\mu$ s     |
| 50 $\mu$ s                   | 50 $\mu$ s                  | 5 $\mu$ s     |
| 0.1 ms                       | 0.1 ms                      | 10 $\mu$ s    |
| 0.2 ms                       | 0.2 ms                      | 20 $\mu$ s    |
| 0.5 ms                       | 0.5 ms                      | 50 $\mu$ s    |
| 1 ms                         | 1 ms                        | 0.1 ms        |
| 2 ms                         | 2 ms                        | 0.2 ms        |
| 5 ms                         | 5 ms                        | 0.5 ms        |
| 10 ms                        | 10 ms                       | 1 ms          |
| 20 ms                        | 20 ms                       | 2 ms          |
| 50 ms                        | 50 ms                       | 5 ms          |
| A Sweep Only                 |                             |               |
| 0.1 s                        | 0.1 s                       | 10 ms         |
| 0.2 s                        | 0.2 s                       | 20 ms         |
| 0.5 s                        | 0.5 s                       | 50 ms         |

- h. Select 10-ns time markers from the time-mark generator.
- i. Use the Horizontal POSITION control to align the first time marker that is 25 ns beyond the start of the sweep with the second vertical graticule line.
- j. CHECK—Timing accuracy is within 3% (0.24 division at the 10th vertical graticule line) and linearity is within 5% (0.1 division over any 2 of the center 8 divisions). Exclude any portion of the sweep past the 100th magnified division.

- k. Repeat parts i and j for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 4-4 under the X10 Magnified column.

- l. Set:

|                 |               |
|-----------------|---------------|
| Horizontal MODE | B             |
| A SEC/DIV       | 0.1 $\mu$ s   |
| B SEC/DIV       | 0.05 $\mu$ s  |
| X10 Magnifier   | Off (knob in) |
| A TRIGGER Mode  | P-P AUTO      |

- m. Repeat parts b through k for the B Sweep. Keep the A SEC/DIV switch one setting slower than the B SEC/DIV switch.

## 2. Check Variable Range and Sweep Separation

- a. Set:

|                  |                         |
|------------------|-------------------------|
| Horizontal MODE  | A                       |
| A and B SEC/DIV  | 0.2 ms                  |
| SEC/DIV Variable | Fully counter-clockwise |
| X10 Magnifier    | Off (knob in)           |

- b. Select 0.5-ms time markers from the time-mark generator.
- c. CHECK—Time markers are 1 division or less apart.
- d. Set:

|                          |            |
|--------------------------|------------|
| Channel 1 Input Coupling | GND        |
| SEC/DIV Variable         | CAL detent |
| Horizontal MODE          | ALT        |

- e. Use the Channel 1 POSITION control to set the A Sweep at the center horizontal graticule line.
- f. CHECK—The B Sweep can be positioned more than 3.5 divisions above and below the A Sweep when the A/B SWP SEP control is rotated fully clockwise and counterclockwise respectively.

## 3. Check Delay Time Dial Range and Accuracy

- a. Set the B DELAY TIME POSITION dial fully counterclockwise.
- b. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.
- c. CHECK—Intensified portion of the trace starts within 0.5 division of the start of the sweep.

- d. Rotate the B DELAY TIME POSITION control fully clockwise.

- e. CHECK—Intensified portion of the trace is past the 11th vertical graticule line.

- f. Set:

|                       |                         |
|-----------------------|-------------------------|
| A and B SEC/DIV       | 0.5 $\mu$ s             |
| B DELAY TIME POSITION | Fully counter-clockwise |

- g. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.

- h. CHECK—Intensified portion of the trace starts within 1.1 divisions of the start of the sweep.

- i. Repeat parts d and e.

- j. Set:

|                          |              |
|--------------------------|--------------|
| Channel 1 Input Coupling | DC           |
| Horizontal MODE          | B            |
| A SEC/DIV                | 0.5 $\mu$ s  |
| B SEC/DIV                | 0.05 $\mu$ s |
| B DELAY TIME POSITION    | 1.00         |

- k. Select 0.5- $\mu$ s time markers from the time-mark generator.

- l. Adjust the Horizontal POSITION control so that the top of the first fully displayed time marker is aligned with the center vertical graticule line.

- m. Without changing the Horizontal POSITION control setting, set the B DELAY TIME POSITION dial to 9.00. Slightly readjust the B DELAY TIME POSITION dial to align the top of the time marker with the center vertical graticule line.

- n. CHECK—The B DELAY TIME POSITION dial setting is between 8.910 and 9.090.

- o. Repeat parts l through n for the remaining A and B SEC/DIV and time-mark generator setting combinations shown in Table 4-5.

Table 4-5

Settings for Delay Time Accuracy Checks

| A SEC/DIV<br>Switch<br>Setting | B SEC/DIV<br>Switch<br>Setting | Time-Mark<br>Generator<br>Setting |
|--------------------------------|--------------------------------|-----------------------------------|
| 0.5 $\mu$ s                    | 0.05 $\mu$ s                   | 0.5 $\mu$ s                       |
| 5 $\mu$ s                      | 0.5 $\mu$ s                    | 5 $\mu$ s                         |
| 0.5 ms                         | 50 $\mu$ s                     | 0.5 ms                            |
| 5 ms                           | 0.5 ms                         | 5 ms                              |

- p. Set:

|                       |            |
|-----------------------|------------|
| A SEC/DIV             | 0.1 ms     |
| B SEC/DIV             | 10 $\mu$ s |
| B DELAY TIME POSITION | 1.00       |

- q. Select 0.5-ms time markers from the time-mark generator.

- r. Adjust the Horizontal POSITION control so that the rising edge of the displayed time marker is aligned with the center vertical graticule line.

- s. Without changing the Horizontal POSITION control setting, turn the B DELAY TIME POSITION dial clockwise to position the next time marker leading edge to the center vertical graticule line.

- t. CHECK—The B DELAY TIME POSITION dial setting is 0.980 to 1.020 greater than the previous setting.

- u. Set the B DELAY TIME POSITION dial to the exact integer setting.

- v. Repeat parts r through u for each successive time marker up to the marker corresponding to the B DELAY TIME POSITION dial setting of 10.00.

#### 4. Check Delay Jitter

- a. Set:

|                       |             |
|-----------------------|-------------|
| A SEC/DIV             | 0.5 ms      |
| B SEC/DIV             | 0.5 $\mu$ s |
| B DELAY TIME POSITION | 10.00       |

- b. Select 50- $\mu$ s time markers from the time-mark generator.

- c. Rotate the B DELAY TIME POSITION control counterclockwise to position a time marker within

the graticule area for each major dial division and CHECK that the jitter on the leading edge of the time marker does not exceed 0.5 division. Disregard slow drift.

## 5. Check Position Range

### a. Set:

|                 |            |
|-----------------|------------|
| Horizontal MODE | A          |
| A SEC/DIV       | 10 $\mu$ s |

- b. Select 10- $\mu$ s time markers from the time-mark generator.
- c. CHECK—Start of the sweep can be positioned to the right of the center vertical graticule line by rotating the Horizontal POSITION control fully clockwise.
- d. CHECK—The 11th time marker can be positioned to the left of the center vertical graticule line by rotating the Horizontal POSITION control fully counterclockwise.
- e. Select 50- $\mu$ s time markers from the time-mark generator.
- f. Align the 3rd time marker with the center vertical graticule line using the Horizontal POSITION control.
- g. Set the X10 Magnifier knob to On (knob out).
- h. CHECK—Magnified time marker can be positioned to the left of the center vertical graticule line by rotating the Horizontal POSITION control fully counterclockwise.
- i. CHECK—Start of the sweep can be positioned to the right of the center vertical graticule line by rotating the Horizontal POSITION control fully clockwise.
- j. Disconnect the test equipment from the instrument.

## 6. Check X Gain

### a. Set:

|                     |               |
|---------------------|---------------|
| CH 1 VOLTS/DIV      | 10 mV         |
| Horizontal POSITION | Midrange      |
| A SEC/DIV           | X-Y           |
| X10 Magnifier       | Off (knob in) |

- b. Connect the standard-amplitude generator output via a 50- $\Omega$  cable to the CH 1 OR X input connector.

- c. Set the generator to produce a 50-mV signal. Vertically center the trace using the Channel 1 POSITION control.

- d. CHECK—Display is 4.85 to 5.15 horizontal divisions.

- e. Disconnect the test equipment from the instrument.

## 7. Check X-Y Phasing

- a. Connect the output of the low-frequency generator to the CH 1 OR X and CH 2 OR Y input connectors via a 50- $\Omega$  cable and a 50- $\Omega$  termination, and a dual-input coupler.

### b. Set:

|                          |       |
|--------------------------|-------|
| Channel 2 Input Coupling | DC    |
| CH 2 VOLTS/DIV           | 10 mV |

- c. Adjust the leveled sine-wave generator for an 8-division horizontal display at 150 kHz.
- d. Center the display vertically and horizontally with the Horizontal POSITION and Channel 2 POSITION controls.
- e. CHECK—Display for an opening at the center horizontal graticule line of 0.4 division or less.
- f. Disconnect the test equipment from the instrument.

## 8. Check X Bandwidth

- a. Connect the output of the leveled sine-wave generator to the CH 1 OR X input connectors via a 50- $\Omega$  cable and a 50- $\Omega$  termination.
- b. Set the generator to produce a 5-division horizontal display at an output frequency of 50 kHz.
- c. Increase the generator output frequency of 2.5 MHz.
- d. CHECK—Display is at least 3.5 horizontal divisions.
- e. Disconnect the test equipment from the instrument.

## 9. Check Sweep Length

- a. Set the A SEC/DIV control to 0.1 ms and position the start of the sweep at the first vertical graticule line using the Horizontal POSITION control.
- b. CHECK—End of the sweep is to the right of the 11th vertical graticule line.

# TRIGGER

**Equipment Required (See Table 4-1):**

Leveled Sine-Wave Generator  
50-Ω BNC Coaxial Cable

50-Ω BNC Termination

## INITIAL CONTROL SETTINGS

### Vertical (Both Channels)

|                    |                  |
|--------------------|------------------|
| POSITION           | Midrange         |
| INVERT             | Off (button out) |
| MODE               | CH 1             |
| BW LIMIT           | Off (button out) |
| CH 1 VOLTS/DIV     | 5 mV             |
| CH 2 VOLTS/DIV     | 50 mV            |
| VOLTS/DIV Variable | CAL detent       |
| Input Coupling     | DC               |

### Horizontal

|                       |                         |
|-----------------------|-------------------------|
| POSITION              | Midrange                |
| MODE                  | A                       |
| A and B SEC/DIV       | 0.2 μs                  |
| SEC/DIV Variable      | CAL detent              |
| X10 Magnifier         | Off (knob in)           |
| B DELAY TIME POSITION | Fully counter-clockwise |

### B TRIGGER

|       |                          |
|-------|--------------------------|
| SLOPE | Positive<br>(button out) |
| LEVEL | Midrange                 |

### A TRIGGER

|              |                          |
|--------------|--------------------------|
| VAR HOLDOFF  | NORM                     |
| Mode         | P-P AUTO                 |
| SLOPE        | Positive<br>(button out) |
| LEVEL        | Midrange                 |
| A & B SOURCE | VERT MODE                |
| A COUPL      | NORM                     |
| A EXT COUPL  | DC                       |

## PROCEDURE STEPS

### 1. Check Internal A and B Triggering

- Connect the leveled sine-wave generator output via a 50-Ω cable and a 50-Ω termination to the CH 1 input connector.
- Set the generator to produce a 10-MHz, 3.5-division display.
- Set the CH 1 VOLTS/DIV switch to 50 mV.
- CHECK—Stable display can be obtained by adjusting the A TRIGGER LEVEL control for each switch combination given in Table 4-6.

**Table 4-6**  
**Switch Combinations for A Triggering Checks**

| A TRIGGER Mode | A TRIGGER SLOPE |
|----------------|-----------------|
| NORM           | Positive        |
| NORM           | Negative        |
| P-P AUTO       | Negative        |
| P-P AUTO       | Positive        |

- Set the Horizontal MODE switch to B.
- CHECK—Stable display can be obtained by adjusting the B TRIGGER LEVEL control in a position other than the B RUNS AFTER DELAY position for both the Positive and Negative positions of the B TRIGGER SLOPE switch.
- Set:

|                 |      |
|-----------------|------|
| Vertical MODE   | CH 2 |
| A & B SOURCE    | CH 2 |
| Horizontal MODE | A    |

- h. Move the cable from the CH 1 input connector to the CH 2 input connector.

- i. Repeat parts d through f.

- j. Set:

|                 |               |
|-----------------|---------------|
| Horizontal MODE | A             |
| A SEC/DIV       | 0.1 $\mu$ s   |
| X10 Magnifier   | On (knob out) |

- k. Set the generator to produce a 60-MHz, 1.0-division display.

- l. Repeat parts d through f.

- m. Set:

|                 |           |
|-----------------|-----------|
| Vertical MODE   | CH 1      |
| A & B SOURCE    | VERT MODE |
| Horizontal MODE | A         |

- n. Move the cable from the CH 2 input connector to the CH 1 input connector.

- o. Repeat parts d through f.

- p. Set:

|                 |              |
|-----------------|--------------|
| Horizontal MODE | A            |
| A SEC/DIV       | 0.05 $\mu$ s |

- q. Set the generator to produce a 100-MHz, 1.5-division display.

- r. Repeat parts d through f.

- s. Set:

|                 |      |
|-----------------|------|
| Vertical MODE   | CH 2 |
| Horizontal MODE | A    |

- t. Move the cable from the CH 1 input connector to the CH 2 input connector.

- u. Repeat parts d through f.

- v. Disconnect the test equipment from the instrument.

## 2. Check External Triggering

- a. Set:

|                 |               |
|-----------------|---------------|
| Vertical MODE   | CH 1          |
| Horizontal MODE | A             |
| X10 Magnifier   | Off (knob in) |
| A & B SOURCE    | EXT           |

- b. Connect a 35-mV, 10-MHz signal from the leveled sine-wave generator via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the EXT INPUT connector.

- c. Press and hold in the TRIG VIEW button.

- d. CHECK—Stable display can be obtained by adjusting the A TRIGGER LEVEL control for each switch combination given in Table 4-6. Then release the TRIG VIEW button.

- e. Set the generator output voltage to 120 mV and the frequency to 60 MHz. Set the X10 Magnifier to On (knob out).

- f. Repeat parts c and d.

- g. Set the generator output voltage to 150 mV and the frequency to 100 MHz.

- h. Repeat parts c and d.

- i. Disconnect the test equipment from the instrument.

## 3. Check External Trigger Ranges

- a. Set:

|                |               |
|----------------|---------------|
| CH 1 VOLTS/DIV | 0.5 V         |
| A SEC/DIV      | 20 $\mu$ s    |
| X10 Magnifier  | Off (knob in) |
| A TRIGGER Mode | NORM          |

- b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable, a 50- $\Omega$  termination, and a dual-input coupler to both the CH 1 OR X and EXT INPUT connectors.

- c. Set the generator to produce a 50-kHz, 6.4-division display.

- d. CHECK—Display is triggered along the entire positive slope of the waveform as the A TRIGGER LEVEL control is rotated.

- e. CHECK—Display is not triggered (no trace) at either extreme of rotation.

- f. Set the A TRIGGER SLOPE button to Negative (button in).

- g. CHECK—Display is triggered along the entire negative slope of the waveform as the A TRIGGER LEVEL control is rotated.

- h. CHECK—Display is not triggered (no trace) at either extreme of rotation.

**4. Check Single Sweep Operation**

- a. Set the A & B SOURCE switch to VERT MODE.
- b. Adjust the A TRIGGER LEVEL control to obtain a stable display.
- c. Set the Channel 1 Input Coupling switch to GND.
- d. Press in the SGL SWP button. The RESET/READY LED should illuminate and remain on.
- e. Set the Channel 1 Input Coupling switch to DC.

- f. CHECK—RESET/READY LED goes out and a single sweep occurs.

**NOTE**

*The A INTENSITY control may require adjustment to observe the single-sweep trace.*

- g. Press in the SGL SWP button several times.
- h. CHECK—Single-sweep trace occurs, and the RESET/READY LED illuminates briefly every time the SGL SWP button is pressed in and released.
- i. Disconnect the test equipment from the instrument.

# EXTERNAL Z-AXIS AND CALIBRATOR

## Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator  
Two 50- $\Omega$  BNC Coaxial Cables  
50- $\Omega$  BNC Termination

BNC T-Connector  
10X Probe (provided with instrument)

## INITIAL CONTROL SETTINGS

### Vertical

Channel 1 POSITION  
MODE  
BW LIMIT  
CH 1 VOLTS/DIV  
CH 1 VOLTS/DIV Variable  
Input Coupling

Midrange  
CH 1  
On (button in)  
1 V  
CAL detent  
DC

### Horizontal

POSITION  
MODE  
A SEC/DIV  
SEC/DIV Variable  
X10 Magnifier

Midrange  
A  
10  $\mu$ s  
CAL detent  
Off (knob in)

### A TRIGGER

VAR HOLDOFF  
MODE  
SLOPE  
LEVEL  
A & B SOURCE  
A COUPL

NORM  
P-P AUTO  
OUT  
Midrange  
VERT MODE  
NORM

## PROCEDURE STEPS

### 1. Check External Z-Axis Operation

- Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a T-connector to the CH 1 input connector. Then connect a 50- $\Omega$  cable and a 50- $\Omega$  termination from the T-connector to the EXT Z AXIS INPUT connector on the rear panel.
- Set the generator to produce a 5-V, 50-kHz signal.
- CHECK—For noticeable intensity modulation. The positive part of the sine wave should be of lower intensity than the negative part.
- Disconnect the test equipment from the instrument.

### 2. Check Calibrator Amplitude and Frequency

- Set:
 

|                |        |
|----------------|--------|
| CH 1 VOLTS/DIV | 10 mV  |
| A SEC/DIV      | 0.5 ms |
- Connect the 10X Probe to the CH 1 OR X input connector and connect the probe tip to the CAL connector.
- Center the vertical display and, if necessary, adjust the probe compensation for a flat top square-wave display.
- CHECK—For a 5-division display.
- CHECK—For a 5-division period (5-divisions between risetime portions of the display).
- Disconnect the 10X probe from the instrument.



# Adjustment Procedure

## INTRODUCTION

### PURPOSE

The Adjustment Procedure is a set of logically sequenced instructions intended to return the instrument to conformance with the Performance Requirement statements listed in Table 1-1. Adjustments contained in this procedure should only be performed after checks from the Performance Check Procedure (Section 4) have indicated a need for readjustment or after repairs have been made to the instrument.

### STRUCTURE

This procedure is structured into four major subsections, each of which can be performed independently to permit adjustment of individual sections of the instrument. For example, if only the Vertical section fails to meet the Performance Requirements or has had repairs made, it can be readjusted with little or no effect on other sections of the instrument.

The Power Supply section, however, affects all other sections of the instrument. Therefore, if repairs or readjustments have been made that change the absolute value of any of the supply voltages, the entire Adjustment Procedure should be performed.

At the beginning of each subsection is a list of all the front-panel control settings required to prepare the instrument for performing Step 1 in that subsection. Each succeeding step within a subsection should be performed in sequence and in its entirety to ensure that control settings will be correct for ensuing steps. All steps within a subsection should be completed.

### TEST EQUIPMENT

The test equipment listed in Table 4-1 is a complete list of the equipment required to accomplish both the

Performance Check Procedure in section 4 and the Adjustment Procedure in this section. To assure accurate measurements, it is important that test equipment used for making these checks meet or exceed the specifications described in Table 4-1. When considering use of equipment other than that recommended, utilize the Minimum Specification column to determine whether available test equipment will suffice.

Detailed operating instructions for test equipment are not given in this procedure. If more operating information is required, refer to the appropriate test-equipment instruction manual.

### LIMITS AND TOLERANCES

The limits and tolerances stated in this procedure are instrument specifications only if they are listed in the Performance Requirements column of Table 1-1. Tolerances given are applicable only to the instrument undergoing adjustment and so not include test equipment error. Adjustment of the instrument must be accomplished at an ambient temperature between  $+20^{\circ}\text{C}$  and  $+30^{\circ}\text{C}$ , and the instrument must have had a warm-up period of at least 20 minutes.

### ADJUSTMENT INTERACTION

Some adjustments interact with and affect other adjustment settings. Table 5-1 identifies these interaction areas. Refer to this table if a partial procedure is performed or if a circuit requires readjustment due to a component replacement. To use Table 5-1, first find the adjustment that was made (extreme left column). Then move to the right, across the row, until you come to a darkened square. From the darkened square, move up the column to find the interactive adjustment. Check the accuracy and, if necessary, readjust the adjustment.

## PREPARATION FOR ADJUSTMENT

The instrument cabinet must be removed to perform the Adjustment Procedure. See the Cabinet remove and replace instructions located in the Maintenance section of the manual.

All test equipment items listed in Table 4-1 are required to accomplish a complete Adjustment Procedure. At the

beginning of each subsection there is an equipment-required list showing only the test equipment necessary for performing the steps in that subsection.

The most accurate display adjustments are made with a stable, well focused, low-intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and TRIGGER LEVEL controls as needed to view the display.

Table 5-1  
Adjustment Interactions

| REPAIRS MADE         | INTERNAL ADJUSTMENTS AFFECTED |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
|----------------------|-------------------------------|----------------------------|-------------------------|-------------------|-----------------------------------|-----------------------------|---------------------|-------------------------|--------------------------|--------------|-----------------|----------|------------------------|----------------------------|------------|--------|---------------------------------------|
|                      | -8.6 VOLTS                    | GRID BIAS, ASTIG. AND GEOM | ATTENUATOR STEP BALANCE | 2/5 mV DC BALANCE | CH 1 VAR AND CH 2 INVERT BALANCES | MF/LF COMP AND GAIN BALANCE | CH 1 AND CH 2 GAINS | ATTENUATOR COMPENSATION | HF COMP AND CH 2 HF COMP | 2 mV PEAKING | HORIZONTAL GAIN | X10 GAIN | MAGNIFIER REGISTRATION | HIGH SPEED AND 5 ns TIMING | DELAY TIME | X GAIN | INTERNAL AND EXTERNAL TRIGGER OFFSETS |
| POWER SUPPLIES       |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| VERTICAL ATTENUATORS |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| PREAMPS & CHANNEL SW |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| VERTICAL OUTPUT      |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| TRIGGER CIRCUITS     |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| A SWEEP GENERATOR    |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| B SWEEP GENERATOR    |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| HORIZONTAL AMPLIFIER |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |
| CRT                  |                               |                            |                         |                   |                                   |                             |                     |                         |                          |              |                 |          |                        |                            |            |        |                                       |

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# POWER SUPPLY AND CRT DISPLAY

## Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator  
Time-Mark Generator  
50- $\Omega$  BNC Coaxial Cable  
50- $\Omega$  BNC Termination

Digital Voltmeter  
DC Voltmeter  
Alignment Tool

See **ADJUSTMENT LOCATIONS 1**

*at the back of this manual for location of test points and adjustments.*

## INITIAL CONTROL SETTINGS

### Vertical (Both Channels)

|                    |            |
|--------------------|------------|
| POSITION           | Midrange   |
| MODE               | CH 1       |
| VOLTS/DIV          | 5 mV       |
| VOLTS/DIV Variable | CAL detent |
| Input Coupling     | GND        |

### Horizontal

|                  |               |
|------------------|---------------|
| POSITION         | Midrange      |
| MODE             | A             |
| A SEC/DIV        | X-Y           |
| SEC/DIV Variable | CAL detent    |
| X10 Magnifier    | Off (knob in) |

### A TRIGGER

|              |                       |
|--------------|-----------------------|
| VAR HOLDOFF  | NORM                  |
| Mode         | P-P AUTO              |
| SLOPE        | Positive (button out) |
| LEVEL        | Midrange              |
| A & B SOURCE | VERT MODE             |
| A COUPL      | NORM                  |

- Connect the digital voltmeter low lead to chassis ground and connect the volts lead to the -8.6-V supply (TP961).
- CHECK—Voltmeter reading is -8.56 to -8.64 V. If the reading is within these limits, skip to part d.
- ADJUST—The -8.6 V Adjust potentiometer (R938) for a voltmeter reading of -8.6 V.
- CHECK—Voltage levels of the remaining power supplies listed in Table 5-2 are within the specified limits.

**Table 5-2**  
**Power Supply Limits**

| Power Supply | Test Point | Reading (Volts) |
|--------------|------------|-----------------|
| -8.6 V       | W961       | -8.56 to -8.64  |
| +5.2 V       | W968       | +5.04 to +5.35  |
| +8.6 V       | W960       | +8.43 to +8.77  |
| +30 V        | W956       | +29.1 to +30.9  |
| +102 V       | W954       | +99 to +105     |

- Disconnect the test equipment from the instrument.

### 2. Check High-Voltage Supply

**WARNING**

*Instrument must be turned off when removing or replacing the crt cover and cap.*

## PROCEDURE STEPS

### 1. Check/Adjust Power Supply DC Levels (R938)

#### NOTE

*Review the information at the beginning of the Adjustment Procedure before starting this step.*

- a. Remove the crt cover and connect a dc voltmeter capable of measuring at least  $-2500\text{ V}$  between pin 2 of the crt socket and chassis ground. Pin 2 of the crt is negative with respect to the chassis.
- b. CHECK – Voltmeter reading is between  $-1900\text{ V}$  and  $-2100\text{ V}$ .
- c. Disconnect the voltmeter leads and replace the crt cap and cover.

### 3. Adjust CRT Grid Bias (R851)

- a. Connect a  $50\text{-}\Omega$  termination to the EXT Z AXIS INPUT connector located on the rear panel.
- b. Adjust the front-panel FOCUS control to produce a well-defined dot.
- c. Rotate the A INTENSITY control fully counter-clockwise.
- d. ADJUST – Grid Bias (R851) for a visible dot. Then back off the Grid Bias potentiometer until the dot just disappears.
- e. Disconnect the  $50\text{-}\Omega$  termination from the EXT Z AXIS INPUT connector.

### 4. Adjust Astigmatism (R874)

- a. Set:

|                          |                 |
|--------------------------|-----------------|
| A INTENSITY              | Visible display |
| CH 1 VOLTS/DIV           | 5 mV            |
| Channel 1 Input Coupling | DC              |
| A SEC/DIV                | 5 $\mu\text{s}$ |

- b. Connect the leveled sine-wave generator output via a  $50\text{-}\Omega$  cable and a  $50\text{-}\Omega$  termination to the CH 1 input connector.
- c. Set the generator to produce a 50-kHz, 4-division display.
- d. ADJUST – Astig (R874) and the FOCUS control for the best defined waveform.
- e. Disconnect the test equipment from the instrument.

### 5. Adjust Trace Alignment

- a. Position the trace to the center horizontal graticule line.
- b. ADJUST – The TRACE ROTATION control for optimum alignment of the trace with the center horizontal graticule line.

### 6. Adjust Geometry (R870)

- a. Set:

|                |        |
|----------------|--------|
| CH 1 VOLTS/DIV | 50 mV  |
| A SEC/DIV      | 0.1 ms |

- b. Connect 50- $\mu\text{s}$  time markers from the time-mark generator via a  $50\text{-}\Omega$  cable and a  $50\text{-}\Omega$  termination to the CH 1 OR X input connector.
  - c. Adjust the Channel 1 POSITION control to position the baseline part of the display below the bottom horizontal graticule line.
  - d. Adjust the SEC/DIV Variable control for 5 markers per division.
  - e. ADJUST – Geom (R870) for minimum curvature of the time markers at the left and right edges of the graticule.
  - f. Set the Channel 1 Input Coupling switch to GND.
  - g. ADJUST – Geom (R870) for minimum curvature of the baseline trace when positioned at the top and bottom horizontal graticule lines using the Channel 1 POSITION control.
  - h. Set the Channel 1 Input Coupling switch to DC.
  - i. Repeat parts e through h for optimum compromise between the vertical and horizontal displays.
  - j. Disconnect the test equipment from the instrument.
- ### 7. Check Scale Illumination
- a. Rotate the SCALE ILLUM control between the maximum counterclockwise position and the maximum clockwise position.
  - b. CHECK – The scale illumination lights are off in the maximum counterclockwise position. The brightness of the scale illumination lights increases as the SCALE ILLUM control is rotated to the maximum clockwise position.

# VERTICAL

## Equipment Required (See Table 4-1):

|                                          |                                      |
|------------------------------------------|--------------------------------------|
| Calibration Generator                    | Dual-Input Coupler                   |
| Leveled Sine-Wave Generator              | 10X Attenuator                       |
| 50- $\Omega$ BNC Coaxial Cable           | Adapter                              |
| 50- $\Omega$ BNC Precision Coaxial Cable | Alignment Tool                       |
| 50- $\Omega$ BNC Termination             | 10X Probe (included with instrument) |

See **ADJUSTMENT LOCATIONS 1** and **ADJUSTMENT LOCATIONS 2**  
at the back of this manual for locations of test points and adjustments.

## INITIAL CONTROL SETTINGS

### Vertical (Both Channels)

|                    |                  |
|--------------------|------------------|
| POSITION           | Midrange         |
| MODE               | CH 1             |
| BW LIMIT           | Off (button out) |
| INVERT             | Off (knob in)    |
| VOLTS/DIV          | 50 mV            |
| VOLTS/DIV Variable | CAL detent       |
| Input Coupling     | AC               |

### Horizontal

|                  |               |
|------------------|---------------|
| POSITION         | Midrange      |
| MODE             | A             |
| A SEC/DIV        | 0.5 ms        |
| SEC/DIV Variable | CAL detent    |
| X10 Magnifier    | Off (knob in) |

### A TRIGGER

|              |           |
|--------------|-----------|
| VAR HOLDOFF  | NORM      |
| Mode         | P-P AUTO  |
| SLOPE        | OUT       |
| LEVEL        | Midrange  |
| A & B SOURCE | VERT MODE |
| A COUPL      | NORM      |
| A EXT COUPL  | AC        |

## PROCEDURE STEPS

### 1. Adjust Attenuator Step Balance (R10 and R60)

- Position the trace on the center horizontal graticule line using the Channel 1 POSITION control.
- Set the CH 1 VOLTS/DIV switch to 5 mV.
- ADJUST – CH 1 Step Atten Bal (R10) to set the trace on the center horizontal graticule line.
- Set the CH 1 VOLTS/DIV switch to 50 mV.
- Repeat parts a through d until there is no trace shift when changing the CH 1 VOLTS/DIV switch from 50 mV to 5 mV.
- Set the Vertical MODE switch to CH 2.
- Repeat parts a through e for Channel 2, adjusting Ch 2 Step Atten Bal (R60) in part c.

### 2. Adjust 2/5 mV DC Balance (R33 and R83)

- Set the CH 2 VOLTS/DIV switch to 5 mV.
- Position the trace on the center horizontal graticule line using the Channel 2 POSITION control.
- Set the CH 2 VOLTS/DIV switch to 2 mV.
- ADJUST – CH 2 2/5 mV Dc Bal (R83) to set the trace on the center horizontal graticule line.
- Repeat parts a through d until there is no trace shift when changing the CH 2 VOLTS/DIV switch from 5 mV to 2 mV.

- f. Set the Vertical MODE switch to CH 1.
- g. Repeat parts a through e for Channel 1, adjusting CH1 2/5 mV Dc Bal (R33) in part d.

### 3. Adjust Channel 1 Variable Balance (R25)

- a. Set both VOLTS/DIV switches to 10 mV.
- b. Rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise.
- c. Position the trace on the center horizontal graticule line using the Channel 1 POSITION control.
- d. Rotate the CH 1 VOLTS/DIV Variable control clockwise to the CAL detent.
- e. ADJUST—CH1 Var Bal (R25) to set the trace to the center horizontal graticule line.
- f. Repeat parts b through e until there is no trace shift between the fully clockwise and the fully counterclockwise positions of the CH 1 VOLTS/DIV Variable control.
- g. Return the CH 1 VOLTS/DIV Variable control to the CAL detent.
- h. Repeat Steps 2 and 3 for Channel 1 until no further improvement is noted.

### 4. Adjust Channel 2 Invert Balance (R75)

- a. Set the Vertical MODE switch to CH 2.
- b. Position the trace on the center horizontal graticule line using the Channel 2 POSITION control.
- c. Set the INVERT switch to On (button in).
- d. ADJUST—CH2 Invert Bal (R75) to set the trace to the center horizontal graticule line.
- e. Set the INVERT switch to Off (button out).
- f. Repeat parts b through e until there is no trace shift when switching the INVERT switch between the On and Off positions.

#### NOTE

*If the trace shift is less than 1 division when rotating CH 2 VOLTS/DIV Variable control between its clockwise and counterclockwise positions, proceed to step j, otherwise proceed to step g.*

- g. Readjust CH 2 Invert Bal (R75) slightly so that the trace shift is less than one division as the CH 2 VOLTS/DIV Variable control is rotated between fully clockwise and counterclockwise positions.
- h. Set the CH 2 VOLTS/DIV Variable control to the CAL detent.
- i. CHECK—The trace shift is less than 1.5 divisions when the INVERT switch is set from Off (button out) to ON (button in).
- j. Repeat parts b through i until the trace shift requirements for both INVERT and CH 2 VOLTS/DIV Variable are met.
- k. Rotate the CH 2 VOLTS/DIV Variable control clockwise to the CAL detent, and set the INVERT button to OFF (button out).
- l. INTERACTION—Repeat steps 2 and 4 for CH 2 until no further improvement is noted.

### 5. Adjust MF/LF Compensation and Gain Balance (C53, R97, C3, and R47).

#### a. Set:

|                       |                  |
|-----------------------|------------------|
| INVERT                | Off (button out) |
| Vertical MODE         | CH 2             |
| VOLTS/DIV (both)      | 10 mV            |
| Input Coupling (both) | DC               |
| A SEC/DIV             | 20 $\mu$ s       |

- b. Connect the high-amplitude square wave output via a 50- $\Omega$  cable, a 10X attenuator, and a 50- $\Omega$  termination to the CH 2 input connector.
- c. Set the generator to produce a 10-kHz, 5-division display.
- d. Set the top of the display on the center horizontal graticule line using the Channel 2 POSITION control.
- e. ADJUST—CH2 MF/LF Comp (C53) and CH2 MF/LF Gain Bal (R97) for the best front corner and flat top.
- f. Move the cable from the CH 2 input connector to the CH 1 input connector. Set the Vertical MODE switch to CH 1.
- g. Set the top of the display on the center horizontal graticule line using the Channel 1 POSITION control.
- h. ADJUST—CH1 MF/LF Comp (C3) and CH1 MF/LF Gain Bal (R47) for the best front corner and flat top.
- i. Disconnect the test equipment from the instrument.

**6. Adjust Vertical Gain (R145, R195, R76, and R26)**

- a. Connect a 50-mV standard-amplitude signal via a 50- $\Omega$  cable to the CH 1 input connector.
- b. Set the A SEC/DIV switch to 0.2 ms.
- c. ADJUST—CH1 Gain (R145) for an exact 5-division display.
- d. Move the cable from the CH 1 input connector to the CH 2 input connector. Set the Vertical MODE switch to CH 2.
- e. ADJUST—CH2 Gain (R195) for an exact 5-division display.
- f. Change the generator output to 10 mV and set both VOLTS/DIV switches to 2 mV.
- g. ADJUST—Ch2 2mV Gain (R76) for an exact 5-division display.
- h. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the Vertical MODE switch to CH 1.
- i. ADJUST—Ch1 2mV Gain (R26) for an exact 5-division display.
- j. Set both Input Coupling switches to GND.
- k. CHECK—That no trace shift occurs when switching between the 5 mV and 2 mV positions of the CH 1 VOLTS/DIV switch. If trace shift is observed, repeat Step 2 of this procedure.
- l. Set the Vertical MODE switch to CH 2.
- m. CHECK—That no trace shift occurs when switching between the 5 mV and 2 mV positions of the CH 2 VOLTS/DIV switch. If trace shift is observed, repeat Step 2 of this procedure.

**7. Check Deflection Accuracy and Variable Range**

- a. Set:

|                       |      |
|-----------------------|------|
| Vertical MODE         | CH 1 |
| Input Coupling (both) | DC   |

- b. CHECK—Deflection accuracy is within the limits given in Table 5-3 for each CH 1 VOLTS/DIV switch setting and corresponding standard amplitude signal. When at the 20-mV VOLTS/DIV switch setting, rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise and CHECK that the display

decreases to 2 divisions or less. Then return the CH 1 VOLTS/DIV Variable control to the CAL detent and continue with the 50-mV check.

- c. Move the cable from the CH 1 input connector to the CH 2 input connector. Set the Vertical MODE switch to CH 2.
- d. Repeat part b using the Channel 2 controls.
- e. Disconnect the test equipment from the instrument.

**Table 5-3**  
**Deflection Accuracy Limits**

| VOLTS/DIV<br>Switch<br>Setting | Standard<br>Amplitude<br>Signal | Vertical<br>Deflection<br>(Divisions) | Accuracy<br>Limits<br>(Divisions) |
|--------------------------------|---------------------------------|---------------------------------------|-----------------------------------|
| 2 mV                           | 10 mV                           | 5                                     | 4.90 to 5.10                      |
| 5 mV                           | 20 mV                           | 4                                     | 3.92 to 4.08                      |
| 10 mV                          | 50 mV                           | 5                                     | 4.90 to 5.10                      |
| 20 mV                          | 0.1 V                           | 5                                     | 4.90 to 5.10                      |
| 50 mV                          | 0.2 V                           | 4                                     | 3.92 to 4.08                      |
| 0.1 V                          | 0.5 V                           | 5                                     | 4.90 to 5.10                      |
| 0.2 V                          | 1 V                             | 5                                     | 4.90 to 5.10                      |
| 0.5 V                          | 2 V                             | 4                                     | 3.92 to 4.08                      |
| 1 V                            | 5 V                             | 5                                     | 4.90 to 5.10                      |
| 2 V                            | 10 V                            | 5                                     | 4.90 to 5.10                      |
| 5 V                            | 20 V                            | 4                                     | 3.92 to 4.08                      |

**8. Adjust Attenuator Compensation (C7, C12, C11, C5, C4, C62, C61, C55, C54, and C57)**

- a. Set:

|                       |      |
|-----------------------|------|
| Vertical MODE         | CH 1 |
| Input Coupling (both) | DC   |

- b. Connect the high-amplitude square wave output via a 50- $\Omega$  termination, a probe-tip-to-BNC adapter, and the 10X probe to the CH 1 OR X input connector.
- c. Set the generator to produce a 1-kHz, 5-division display and compensate the probe using the probe compensation adjustment (see the probe instruction manual).
- d. Set the CH 1 VOLTS/DIV switch to 10 mV.

- e. Set the generator to produce a 5-division display.

### NOTE

Use Table 5-4 to identify the correct capacitor for each channel adjustment.

**Table 5-4**  
**Attenuator Compensation Adjustments**

| VOLTS/DIV | Adjustment         | Channel 1  | Channel 2  |
|-----------|--------------------|------------|------------|
| 10 mV     | Input C            | C7         | C57        |
| 0.1 V     | LF Comp<br>Input C | C12<br>C11 | C62<br>C61 |
| 1 V       | LF Comp<br>Input C | C5<br>C4   | C55<br>C54 |

- f. ADJUST—The Ch1 1X Attn (C7) capacitor for best front corner.
- g. Set the CH 1 VOLTS/DIV switch to 0.1 V.
- h. Replace the probe and probe-tip-to-BNC adapter with a 50- $\Omega$  cable.
- i. Set the generator to produce a 5-division display.
- j. ADJUST—The Ch1 10X Attn (C12) for best front corner.
- k. Replace the 50- $\Omega$  cable and the 50- $\Omega$  termination with the probe and probe-tip-to-BNC adapter.
- l. Set the generator to produce a 5-division display.
- m. ADJUST—The Ch1 10X Attn (C11) for best flat top.
- n. Repeat parts h through m until no further improvement is noted.
- o. Set the CH 1 VOLTS/DIV switch to 1 V.
- p. Replace the probe and probe-tip-to-BNC adapter with the 50- $\Omega$  cable and 50- $\Omega$  termination.
- q. Set the generator to produce a 5-division display.
- r. ADJUST—The Ch1 100X Attn (C5) for best front corner.
- s. Replace the 50- $\Omega$  cable and 50- $\Omega$  termination with the probe and probe-tip-to-BNC adapter.
- t. Set the generator to produce a 5-division display.

- u. ADJUST—The 100X Attn (C4) for best flat top.
- v. Repeat parts p through u until no further improvement is noted.
- w. Set the Vertical MODE switch to CH 2.
- x. Repeat parts b through v for Channel 2.
- y. Disconnect the test equipment from the instrument.

### 9. Adjust High-Frequency Compensation (C237), Delay Line Compensation (R240 and R241), and Channel 2 High-Frequency Compensation (C180)

- a. Set:

|                       |                  |
|-----------------------|------------------|
| Vertical MODE         | CH 1             |
| BW LIMIT              | Off (button out) |
| VOLTS/DIV (both)      | 10 mV            |
| Input Coupling (both) | DC               |
| A SEC/DIV             | 0.05 $\mu$ s     |
| A & B SOURCE          | VERT MODE        |

- b. Connect the positive-going fast-rise square wave output via a 50- $\Omega$  cable, a 10X attenuator, and a 50- $\Omega$  termination to the CH 1 input connector.
- c. Set the generator to produce a 1-MHz, 5-division display.
- d. Set the top of the display to the center horizontal graticule line using the Channel 1 POSITION control.
- e. ADJUST—HF Comp (C237) for the best front corner with minimum overshoot on the displayed signal.
- f. ADJUST—HF Comp (R240 and R241) for best flat top on the front corner.
- g. Repeat parts e and f until no further improvement is noted.
- h. Move the cable from the CH 1 input connector to the CH 2 input connector and reconnect the 10X attenuator. Set the Vertical MODE switch to CH 2.
- i. Set the generator to produce a 5-division display.
- j. Set the top of the display to the center horizontal graticule line using the Channel 2 POSITION control.

- k. ADJUST—Ch2 HF Comp (C180) for the best front corner with minimum overshoot on the displayed signal.

#### 10. Adjust 2-mV Peaking Compensation (C76 and C26)

- Set both VOLTS/DIV switches to 2 mV.
- Set the generator to produce a 5-division display.
- Set the top of the display to the center horizontal graticule line using the Channel 2 POSITION control.
- ADJUST—Ch2 2mV Peak Comp (C76) for the best front corner with minimum overshoot of the displayed signal.
- Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the Vertical MODE switch to CH 1.
- Repeat parts b through d for Channel 1, adjusting Ch1 2mV Peak Comp (C26) in part d.
- Disconnect the test equipment from the instrument.

#### NOTE

*Install the instrument cabinet for the remaining vertical checks and allow a 20-minute warm-up period before continuing with the Adjustment Procedure. See the Cabinet remove and replace instructions located in the Maintenance section of the manual.*

#### 11. Check Bandwidth

- a. Set:

|                           |                  |
|---------------------------|------------------|
| Vertical POSITION (both)  | Midrange         |
| BW LIMIT                  | Off (button out) |
| VOLTS/DIV (both)          | 2 mV             |
| VOLTS/DIV Variable (both) | CAL detent       |
| Input Coupling (both)     | DC               |
| A SEC/DIV                 | 20 $\mu$ s       |

- Connect the leveled sine-wave generator output via a 50- $\Omega$  precision cable and a 50- $\Omega$  termination to the CH 2 input connector.
- Set the generator to produce a 50-kHz, 6-division display.
- CHECK—Display amplitude is 4.2 divisions or greater as the generator output frequency is increased up to the value shown in Table 5-5 for the corresponding VOLTS/DIV switch setting.

**Table 5-5**  
**Settings for Bandwidth Checks**

| VOLTS/DIV<br>Switch Setting | Generator<br>Output Frequency |
|-----------------------------|-------------------------------|
| 2 mV                        | 90 MHz                        |
| 5 mV to 5 V                 | 100 MHz                       |

- Repeat parts c and d for all indicated CH 1 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.
- Move the cable from the CH 1 input connector to the CH 2 input connector. Set the Vertical MODE switch to CH 2.
- Repeat parts b and c for all indicated CH 2 VOLTS/DIV switch settings, up to the output-voltage upper limit of the sine-wave generator being used.
- Disconnect the test equipment from the instrument.

#### NOTE

*To continue with the Adjustment Procedure, remove the instrument cabinet and allow a 20-minute time period to elapse before continuing with the Adjustment Procedure. See the Cabinet removal instructions located in the Maintenance section of the manual.*

# HORIZONTAL

## Equipment Required (See Table 4-1):

|                             |                              |
|-----------------------------|------------------------------|
| Calibration Generator       | 50- $\Omega$ BNC Termination |
| Leveled Sine-Wave Generator | Dual-Input Coupler           |
| Time-Mark Generator         | Test Oscilloscope            |
| 50- $\Omega$ Coaxial Cable  | Alignment Tool               |

See **ADJUSTMENT LOCATIONS 1**, **ADJUSTMENT LOCATIONS 2**, and **ADJUSTMENT LOCATIONS 3**

at the back of the manual for test points and adjustment locations.

## INITIAL CONTROL SETTINGS

### Vertical

|                          |                  |
|--------------------------|------------------|
| POSITION                 | Midrange         |
| MODE                     | CH 1             |
| BW LIMIT                 | Off (button out) |
| INVERT                   | Off (button out) |
| CH 1 VOLTS/DIV           | 0.5 V            |
| CH 1 VOLTS/DIV Variable  | CAL detent       |
| Channel 1 Input Coupling | DC               |

### Horizontal

|                       |                         |
|-----------------------|-------------------------|
| POSITION              | Midrange                |
| MODE                  | A                       |
| A and B SEC/DIV       | 0.1 ms                  |
| SEC/DIV Variable      | CAL detent              |
| X10 Magnifier         | Off (knob in)           |
| B DELAY TIME POSITION | Fully counter-clockwise |

### B TRIGGER

|       |                                  |
|-------|----------------------------------|
| SLOPE | Positive (button out)            |
| LEVEL | RUNS AFTER DLY (fully clockwise) |

### A TRIGGER

|                  |               |
|------------------|---------------|
| VAR HOLDOFF Mode | NORM P-P AUTO |
|------------------|---------------|

### SLOPE

LEVEL  
A & B SOURCE  
A COUPL  
A EXT COUPL

Positive (button out)

Midrange

~~NORM~~ VERT MODE (7/8/92-REV)  
NORM  
DC

## PROCEDURE STEPS

1. **Adjust Horizontal Amplifier Gain (R740 and R730)**
  - a. Connect 0.1-ms time markers from the time-mark generator via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 input connector.
  - b. Align the first time marker with the first (extreme left) vertical graticule line using the Horizontal POSITION control.
  - c. ADJUST—A Gain (R740) for 1 time marker per division over the center 8 divisions.

### NOTE

When making timing measurements, use as a reference the tips of the time markers positioned at the center horizontal graticule line.

- d. Set the Horizontal MODE switch to B.
- e. ADJUST—B Gain (R730) for 1 time marker per division.

**2. Adjust X10 Horizontal Amplifier Gain (R754)**

a. Set:

|                 |               |
|-----------------|---------------|
| Horizontal MODE | A             |
| X10 Magnifier   | On (knob out) |

- b. Select 10- $\mu$ s time markers from the time-mark generator.
- c. Align the nearest time marker to the first vertical graticule line with the first graticule line.
- d. ADJUST—X10 Gain (R754) for 1 time marker per division.

**3. Adjust Magnifier Registration (R749)**

- a. Set the A SEC/DIV switch to 0.2 ms.
- b. Select 1-ms time markers from the time-mark generator.
- c. Position the middle time marker to the center vertical graticule line using the Horizontal POSITION control.
- d. Set the X10 Magnifier to Off (knob in).
- e. ADJUST—Mag Regis (R749) to position the middle time marker to the center vertical graticule line.
- f. Set the X10 Magnifier to On (knob out) and CHECK for no horizontal shift in the time marker.
- g. Repeat parts c through f until no further improvement is noted.

**4. Adjust Delay Dial Timing (R646 and R652)**

a. Set:

|                       |                                            |
|-----------------------|--------------------------------------------|
| Horizontal MODE       | ALT                                        |
| A SEC/DIV             | 0.1 ms                                     |
| B SEC/DIV             | 1 <del>0</del> $\mu$ s <i>7/8/92 - B2V</i> |
| SEC/DIV Variable      | CAL detent                                 |
| X10 Magnifier         | Off (knob in)                              |
| B DELAY TIME POSITION | 1.00                                       |

- b. Select 0.1-ms time markers from the time-mark generator.
- c. Adjust the A/B SWP SEP control to separate the A and B Sweeps.

d. ADJUST—Delay Start (R646) so that the 2nd A-Sweep time marker is intensified and the B-Sweep time marker's rising edge starts at the beginning of the B Sweep.

e. Set the B DELAY TIME POSITION dial to 9.00.

f. ADJUST—Delay End (R652) so that the 10th A-Sweep time marker is intensified and the B-Sweep time marker's rising edge starts at the beginning of the B Sweep.

g. Set the B DELAY TIME POSITION dial to 1.00.

h. Repeat parts d through g until no further improvement is noted.

**5. Adjust 5  $\mu$ s Timing (C703 and C713)**

a. Set:

|                 |           |
|-----------------|-----------|
| Horizontal MODE | A         |
| A SEC/DIV       | 5 $\mu$ s |

- b. Select 5- $\mu$ s time markers from the time-mark generator.
- c. ADJUST—A Sweep 5- $\mu$ s Timing (C703) for 1 time marker per division over the center 8 divisions.

d. Set:

|                 |            |
|-----------------|------------|
| Horizontal MODE | B          |
| A SEC/DIV       | 10 $\mu$ s |
| B SEC/DIV       | 5 $\mu$ s  |

e. ADJUST—B Sweep 5- $\mu$ s Timing (C713) for 1 time marker per division over the center 8 divisions.

**6. Adjust 5-ns Timing and Linearity (C774)**

a. Set:

|                 |              |
|-----------------|--------------|
| CH 1 VOLTS/DIV  | 0.2 V        |
| Horizontal MODE | A            |
| A SEC/DIV       | 0.05 $\mu$ s |
| A & B SOURCE    | A EXT        |

- b. Connect a 50- $\Omega$  cable and a 50- $\Omega$  termination to the EXT INPUT connector from the time-mark generator.
- c. Select 5-ns time markers from the time-mark generator and set the start of the display on the 1st vertical graticule line.
- d. Set the X10 Magnifier to On (knob out).

- e. Align the time markers with the vertical graticule lines using the Horizontal POSITION control.
- f. ADJUST—5-ns Timing (C774) for one time marker per division over the center 8 divisions of the magnified sweep.
- g. CHECK—Time markers between the 2nd and 4th vertical graticule lines should be aligned within 0.05 division. If not, a slight compromise between timing and linearity should be made by readjusting the 5-ns Timing capacitor (C774).
- h. Select 10-ns time markers from the time-mark generator.
- i. Set the A SEC/DIV switch to 0.1  $\mu$ s.
- j. CHECK—Timing accuracy is within 2% (0.16 division at the 10th vertical graticule line). If not, a slight compromise between the 5-ns timing and the 20-ns timing should be made by readjusting the 5-ns Timing capacitor (C774).
- k. Disconnect the 50- $\Omega$  cable and the 50- $\Omega$  termination from the EXT INPUT connector to the time-mark generator.

## 7. Check Timing Accuracy and Linearity

### a. Set:

|                |               |
|----------------|---------------|
| CH 1 VOLTS/DIV | 0.5 V         |
| A SEC/DIV      | 0.05 $\mu$ s  |
| X10 Magnifier  | Off (knob in) |
| A TRIGGER Mode | NORM          |
| A & B SOURCE   | VERT MODE     |

- b. Select 50-ns time markers from the time-marker generator.
- c. Adjust the A TRIGGER LEVEL control for a stable, triggered display.
- d. Use the Horizontal POSITION control to align the second time marker with the second vertical graticule line.
- e. CHECK—Timing accuracy is within 2% (0.16 division at the 10th vertical graticule line), and linearity is within 5% (0.1 division over any 2 of the center 8 divisions).

## NOTE

*For checking the timing accuracy of the A SEC/DIV switch setting from 50 ms to 0.5 s, watch the time marker tips only at the 2nd and 10th vertical graticule lines while adjusting the Horizontal POSITION control.*

- f. Repeat parts c through e for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 5-6 under the Normal column.
- g. Set the X10 Magnifier to On (knob out).
- h. Select 50-ms time markers from the time-mark generator when checking the A Sweep and 5-ms time markers when checking the B Sweep.

**Table 5-6**  
**Settings for Timing Accuracy Checks**

| SEC/DIV<br>Switch<br>Setting | Time-Mark Generator Setting |               |
|------------------------------|-----------------------------|---------------|
|                              | Normal (X1)                 | X10 Magnified |
| 0.05 $\mu$ s                 | 50 ns                       | 10 ns         |
| 0.1 $\mu$ s                  | 0.1 $\mu$ s                 | 10 ns         |
| 0.2 $\mu$ s                  | 0.2 $\mu$ s                 | 20 ns         |
| 0.5 $\mu$ s                  | 0.5 $\mu$ s                 | 50 ns         |
| 1 $\mu$ s                    | 1 $\mu$ s                   | 0.1 $\mu$ s   |
| 2 $\mu$ s                    | 2 $\mu$ s                   | 0.2 $\mu$ s   |
| 5 $\mu$ s                    | 5 $\mu$ s                   | 0.5 $\mu$ s   |
| 10 $\mu$ s                   | 10 $\mu$ s                  | 1 $\mu$ s     |
| 20 $\mu$ s                   | 20 $\mu$ s                  | 2 $\mu$ s     |
| 50 $\mu$ s                   | 50 $\mu$ s                  | 5 $\mu$ s     |
| 0.1 ms                       | 0.1 ms                      | 10 $\mu$ s    |
| 0.2 ms                       | 0.2 ms                      | 20 $\mu$ s    |
| 0.5 ms                       | 0.5 ms                      | 50 $\mu$ s    |
| 1 ms                         | 1 ms                        | 0.1 ms        |
| 2 ms                         | 2 ms                        | 0.2 ms        |
| 5 ms                         | 5 ms                        | 0.5 ms        |
| 10 ms                        | 10 ms                       | 1 ms          |
| 20 ms                        | 20 ms                       | 2 ms          |
| 50 ms                        | 50 ms                       | 5 ms          |
| A Sweep Only                 |                             |               |
| 0.1 s                        | 0.1 s                       | 10 ms         |
| 0.2 s                        | 0.2 s                       | 20 ms         |
| 0.5 s                        | 0.5 s                       | 50 ms         |

- i. Use the Horizontal POSITION control to align the first time marker that is 25 ns beyond the start of the sweep with the second vertical graticule line.
- j. CHECK—Timing accuracy is within 3% (0.24 division at the 10th vertical graticule line), and linearity is within 5% (0.1 division over any 2 of the center 8 divisions). Exclude any portion of the sweep past the 100th magnified division.
- k. Repeat parts i and j for the remaining A SEC/DIV and time-mark generator setting combinations shown in Table 5-6 under the X10 Magnified column.
- l. Set:
 

|                 |               |
|-----------------|---------------|
| Horizontal MODE | B             |
| A SEC/DIV       | 0.1 $\mu$ s   |
| B SEC/DIV       | 0.05 $\mu$ s  |
| X10 Magnifier   | Off (knob in) |
- m. Repeat parts b through k for the B Sweep. Keep the A SEC/DIV switch one setting slower than the B SEC/DIV switch.

### 8. Check Delay Time Dial Range and Accuracy

- a. Set:

|                          |                         |
|--------------------------|-------------------------|
| Channel 1 Input Coupling | GND                     |
| Horizontal MODE          | ALT                     |
| A and B SEC/DIV          | 0.1 ms                  |
| X10 Magnifier            | Off (knob in)           |
| B DELAY TIME POSITION    | Fully counter-clockwise |
| A TRIGGER Mode           | P-P AUTO                |

- b. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.
- c. CHECK—Intensified portion of the trace starts within 0.5 division of the start of the sweep.
- d. Rotate the B DELAY TIME POSITION control fully clockwise.
- e. CHECK—Intensified portion of the trace is past the 11th vertical graticule line.
- f. Set:
 

|                       |                         |
|-----------------------|-------------------------|
| A and B SEC/DIV       | 0.5 $\mu$ s             |
| B DELAY TIME POSITION | Fully counter-clockwise |

- g. Align the start of the A Sweep with the 1st vertical graticule line using the Horizontal POSITION control.
- h. CHECK—Intensified portion of the trace starts within 1.1 divisions of the start of the sweep.
- i. Repeat parts d and e.
- j. Set:
 

|                          |              |
|--------------------------|--------------|
| Channel 1 Input Coupling | DC           |
| Horizontal MODE          | B            |
| A SEC/DIV                | 0.5 $\mu$ s  |
| B SEC/DIV                | 0.05 $\mu$ s |
| B DELAY TIME POSITION    | 1.00         |
- k. Select 0.5- $\mu$ s time markers from the time-mark generator.
- l. Adjust the Horizontal POSITION control so that the top of the first fully displayed time marker is aligned with the center vertical graticule line.
- m. Without changing the Horizontal POSITION control setting, set the B DELAY TIME POSITION dial to 9.00. Slightly readjust the B DELAY TIME POSITION dial to align the top of the time marker with the center vertical graticule line.
- n. CHECK—The B DELAY TIME POSITION dial setting is between 8.910 and 9.090.
- o. Repeat parts l through n for the remaining A and B SEC/DIV and time-mark generator setting combinations shown in Table 5-7.
- p. Set:
 

|                       |             |
|-----------------------|-------------|
| A SEC/DIV             | 5 $\mu$ s   |
| B SEC/DIV             | 0.5 $\mu$ s |
| B DELAY TIME POSITION | 1.00        |

**Table 5-7**  
**Settings for Delay Time Accuracy Checks**

| A SEC/DIV<br>Switch<br>Setting | B SEC/DIV<br>Switch<br>Setting | Time-Mark<br>Generator<br>Setting |
|--------------------------------|--------------------------------|-----------------------------------|
| 0.5 $\mu$ s                    | 0.05 $\mu$ s                   | 0.5 $\mu$ s                       |
| 5 $\mu$ s                      | 0.5 $\mu$ s                    | 5 $\mu$ s                         |
| 0.5 ms                         | 50 $\mu$ s                     | 0.5 $\mu$ s                       |
| 5 ms                           | 0.5 ms                         | 5 ms                              |
| 0.5 s                          | 50 ms                          | 0.5 s                             |

- q. Select 5- $\mu$ s time markers from the time-mark generator.
- r. Adjust the Horizontal POSITION control so that the rising edge of the displayed time marker is aligned with the center vertical graticule line.
- s. Without changing the Horizontal POSITION control setting, turn the B DELAY TIME POSITION dial clockwise to position the next time marker leading edge to the center vertical graticule line.
- t. CHECK—The B DELAY TIME POSITION dial setting is 0.980 to 1.020 greater than the previous setting.
- u. Set the B DELAY TIME POSITION dial to the exact integer setting.
- v. Repeat parts r through u for each successive time marker up to the marker corresponding to the B DELAY TIME POSITION dial setting of 10.00.
- w. Disconnect the test equipment from the instrument.

#### 9. Adjust X Gain (R760)

- a. Set:

|                |       |
|----------------|-------|
| CH 1 VOLTS/DIV | 10 mV |
| A SEC/DIV      | X-Y   |

- b. Connect a 50-mV standard-amplitude signal via a 50- $\Omega$  cable to the CH 1 input connector.
- c. ADJUST—X Gain (R760) for exactly 5-divisions of horizontal deflection.
- d. Disconnect the test equipment from the instrument.

#### 10. Check A-Sweep Holdoff

- a. Set:

|                 |      |
|-----------------|------|
| Horizontal MODE | A    |
| A SEC/DIV       | 1 ms |
| VAR HOLDOFF     | NORM |

- b. Connect the test oscilloscope and its 10X probe tip to the front end of R707 (toward the front panel) which is located on the Timing circuit board.
- c. CHECK—The A-Sweep holdoff is greater than 3 ms but less than 7 ms.
- d. Rotate the VAR HOLDOFF control to the maximum clockwise position (MAX).
- e. CHECK—The A-Sweep holdoff has increased by a factor of 10 or more.
- f. Disconnect the test oscilloscope 10X probe from R707.

# TRIGGER

**Equipment Required (See Table 4-1):**

Leveled Sine-Wave Generator  
50- $\Omega$  BNC Coaxial Cable  
50- $\Omega$  BNC Termination

10X Attenuator  
Alignment Tool

See **ADJUSTMENT LOCATIONS 1**

*at the back of this manual for test points and adjustment locations.*

## INITIAL CONTROL SETTINGS

### Vertical (Both Channels)

|                    |                  |
|--------------------|------------------|
| POSITION           | Midrange         |
| MODE               | BOTH-ALT         |
| BW LIMIT           | Off (button out) |
| INVERT             | Off (button out) |
| VOLTS/DIV          | 50 mV            |
| VOLTS/DIV Variable | CAL detent       |
| Input Coupling     | GND              |

### Horizontal

|                       |                         |
|-----------------------|-------------------------|
| POSITION              | Midrange                |
| MODE                  | A                       |
| A and B SEC/DIV       | 20 $\mu$ s              |
| SEC/DIV Variable      | CAL detent              |
| X10 Magnifier         | Off (knob in)           |
| B DELAY TIME POSITION | Fully counter-clockwise |

### B TRIGGER

|       |                       |
|-------|-----------------------|
| SLOPE | Positive (button out) |
| LEVEL | Midrange              |

### A TRIGGER

|              |                       |
|--------------|-----------------------|
| VAR HOLDOFF  | NORM                  |
| Mode         | P-P AUTO              |
| SLOPE        | Positive (button out) |
| LEVEL        | Midrange              |
| A & B SOURCE | VERT MODE             |
| A COUPL      | NORM                  |
| A EXT COUPL  | DC                    |

## PROCEDURE STEPS

1. **Adjust Internal and External Trigger Offset (R309 and R387))**
  - a. Set the Channel 1 trace and the Channel 2 trace to the center horizontal graticule line using the Channel 1 and Channel 2 POSITION controls.
  - b. Set both Input Coupling switches to DC.
  - c. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable, 10X attenuator, and a 50- $\Omega$  termination to the BNC female connector of the dual-input coupler. Connect the two BNC male connectors of the dual-input coupler to the CH 1 and CH 2 connectors.
  - d. Set the generator to produce a 50 kHz, 4-division display on both channels.
  - e. Rotate the A TRIGGER LEVEL control to the midrange position (equal distance between the + and - positions).
  - f. Vertically center both displays with the Vertical POSITION controls and horizontally position the start of the displays on the 2nd vertical graticule line.
  - g. ADJUST — The Trigger Offset (R309) so that both displays are superimposed and start at the center horizontal graticule line.
  - h. Disconnect the dual-input coupler from the CH 2 input connector and connect it to the EXT INPUT connector.
  - i. Set the generator to produce a 8-division display.
  - j. Set the A & B SOURCE switch to A EXT position.

- k. ADJUST – Ext Off (R387) so that the display triggers (start of the display) at the center horizontal graticule line.

- l. Disconnect the test equipment from the instrument.

## 2. Adjust Trigger Sensitivity (R479 and R627)

- a. Set:

|                       |            |
|-----------------------|------------|
| Vertical MODE         | CH 1       |
| CH 1 VOLTS/DIV        | 0.1 V      |
| Input Coupling (both) | AC         |
| A SEC/DIV             | 10 $\mu$ s |

- b. Connect the leveled sine-wave generator output via a 50- $\Omega$  cable and a 50- $\Omega$  termination to the CH 1 input connector.
- c. Set the generator to produce a 50-kHz, 2.4-division display.
- d. Set the CH 1 VOLTS/DIV switch to 1 V.
- e. ADJUST – The A Trig Sens (R479) while rotating the A TRIGGER LEVEL control slowly so that the A Trigger is just able to be maintained.
- f. Set the Horizontal MODE switch to B.

- g. ADJUST – B Trig Sens (R627) while rotating the B TRIGGER LEVEL control slowly so that the B Trigger is just able to be maintained.

## 3. Adjust P-P Auto Trigger Centering (R434 and R435)

- a. Set:

|                 |                 |
|-----------------|-----------------|
| CH 1 VOLTS/DIV  | 10 mV           |
| Horizontal MODE | A               |
| A TRIGGER SLOPE | OUT             |
| A TRIGGER LEVEL | Fully clockwise |

- b. Set the generator to produce a 50-kHz, 6-division display.
- c. Set the CH 1 VOLTS/DIV switch to 0.1 V.
- d. ADJUST – (+) Auto (R434) so that the vertical display just solidly triggers on the positive peak of the signal.
- e. Set:
- |                 |                         |
|-----------------|-------------------------|
| A TRIGGER SLOPE | IN                      |
| A TRIGGER LEVEL | Fully counter-clockwise |
- f. ADJUST – (–) Auto (R435) so that the display just solidly triggers on the negative peak of the signal.
- g. Disconnect the test equipment from the instrument.

# CALIBRATOR

**Equipment Required (See Table 4-1):**

Calibration Generator  
Time-Mark Generator  
50- $\Omega$  BNC Coaxial Cables

50- $\Omega$  BNC Termination  
10X Probe (provided with instrument)

See **ADJUSTMENT LOCATIONS 1**

*at the back of this manual for test points and adjustment locations.*

## INITIAL CONTROL SETTINGS

### Vertical

|                          |                |
|--------------------------|----------------|
| Channel 1 POSITION       | Midrange       |
| MODE                     | CH 1           |
| BW LIMIT                 | On (button in) |
| CH 1 VOLTS/DIV           | 0.1 V          |
| CH 1 VOLTS/DIV Variable  | CAL detent     |
| Channel 1 Input Coupling | DC             |

### Horizontal

|                  |               |
|------------------|---------------|
| POSITION         | Midrange      |
| MODE             | A             |
| A SEC/DIV        | 0.2 ms        |
| SEC/DIV Variable | CAL detent    |
| X10 Magnifier    | Off (knob in) |

### A TRIGGER

|             |          |
|-------------|----------|
| VAR HOLDOFF | NORM     |
| Mode        | P-P AUTO |
| SLOPE       | OUT      |
| LEVEL       | Midrange |
| A TRIG BW   | FULL     |
| A SOURCE    | INT      |

- b. Set the standard amplitude generator output to 0.5 V.
- c. Adjust the CH 1 VOLTS/DIV Variable control for a waveform amplitude of exactly 8 divisions.
- d. Disconnect the probe tip from the standard amplitude generator and connect it to the CAL connector.
- e. ADJUST—Cal Gain (R984) for a display amplitude of exactly 8 divisions.
- f. Return the CH 1 VOLTS/DIV Variable control to the CAL detent and set CH 1 VOLTS/DIV to 0.1 V (using the 10X PROBE scale factor).
- g. ADJUST—Cal Freq (R990) for an exact 5 division period (5 divisions between risetime portions of the display).

### NOTE

*Greater accuracy of the CAL output frequency can be achieved by comparing the square-wave period to the time markers.*

- h. Set:
 

|                |           |
|----------------|-----------|
| CH 2 VOLTS/DIV | 0.5 V     |
| Vertical MODE  | BOTH, ALT |
| A & B SOURCE   | CH 1      |

## PROCEDURE STEPS

### 1. Adjust Calibrator Amplitude and Frequency (R984 and R990)

- a. Connect the standard amplitude generator output via a probe-tip-to-BNC adapter, and a properly adjusted 10X probe (supplied with the instrument) to the CH 1 connector.
- i. Connect the time-mark generator output to the CH 2 input connector via a 50-ohm cable and a 50- $\Omega$  terminator.
- j. Set the generator to produce 1-ms time markers.
- k. ADJUST—Cal Freq (R990) for the least amount of drift of the displayed time markers.
- l. Disconnect the 10X probe and test equipment from the instrument.

# MAINTENANCE

This section contains information for conducting preventive maintenance, troubleshooting, and corrective maintenance on the instrument. Circuit board removal

procedures are included in the corrective maintenance part of this section.

## STATIC-SENSITIVE COMPONENTS

The following precautions are applicable when performing any maintenance involving internal access to the instrument.



*Static discharge can damage any semiconductor component in this instrument.*

This instrument contains electrical components that are susceptible to damage from static discharge. Table 6-1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

When performing maintenance, observe the following precautions to avoid component damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers or on a metal rail. Label any package that contains static-sensitive components or assemblies.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these components. Servicing static-sensitive components or assemblies should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up components by their bodies, never by their leads.
7. Do not slide the components over any surface.

**Table 6-1**  
**Relative Susceptibility to**  
**Static-Discharge Damage**

| Semiconductor Classes                                                                            | Relative Susceptibility Levels <sup>a</sup> |
|--------------------------------------------------------------------------------------------------|---------------------------------------------|
| MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (Most Sensitive) | 1                                           |
| ECL                                                                                              | 2                                           |
| Schottky signal diodes                                                                           | 3                                           |
| Schottky TTL                                                                                     | 4                                           |
| High-frequency bipolar transistors                                                               | 5                                           |
| JFET                                                                                             | 6                                           |
| Linear microcircuits                                                                             | 7                                           |
| Low-power Schottky TTL                                                                           | 8                                           |
| TTL (Least Sensitive)                                                                            | 9                                           |

<sup>a</sup> Voltage equivalent for levels (voltage discharged from a 100-pf capacitor through resistance of 100  $\Omega$ ):

|                  |                         |
|------------------|-------------------------|
| 1 = 100 to 500 V | 6 = 600 to 800 V        |
| 2 = 200 to 500 V | 7 = 400 to 1000 V (est) |
| 3 = 250 V        | 8 = 900 V               |
| 4 = 500 V        | 9 = 1200 V              |
| 5 = 400 to 600 V |                         |

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only approved antistatic, vacuum-type desoldering tools for component removal.

# PREVENTIVE MAINTENANCE

## INTRODUCTION

Preventive maintenance consists of cleaning, visual inspection, and checking instrument performance. When performed regularly, it may prevent instrument malfunction and enhance instrument reliability. The severity of the environment in which the instrument is used determines the required frequency of maintenance. An appropriate time to accomplish preventive maintenance is just before instrument adjustment.

## GENERAL CARE

The cabinet minimizes accumulation of dust inside the instrument and should normally be in place when operating the oscilloscope. The front cover supplied with the instrument provides both dust and damage protection for the front panel and crt. The front cover should be on whenever the instrument is stored or is being transported.

## INSPECTION AND CLEANING

The instrument should be visually inspected and cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket, preventing efficient heat dissipation. It also provides an electrical conduction

path that could result in instrument failure, especially under high-humidity conditions.



*Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a nonresidue-type cleaner, preferably isopropyl alcohol or a solution of 5% mild detergent with 95% water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

### Exterior

**INSPECTION.** Inspect the external portions of the instrument for damage, wear, and missing parts; use Table 6-2 as a guide. Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Deficiencies found that could cause personal injury or could lead to further damage to the instrument should be repaired immediately.



*To prevent getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.*

Table 6-2  
External Inspection Checklist

| Item                            | Inspect For                                                                                  | Repair Action                                                         |
|---------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Cabinet, Front Panel, and Cover | Cracks, scratches, deformations, and damaged hardware or gaskets.                            | Touch up paint scratches and replace defective components.            |
| Front-panel controls            | Missing, damaged, or loose knobs, buttons, and controls.                                     | Repair or replace missing or defective items.                         |
| Connectors                      | Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.                | Replace defective parts. Clean or wash out dirt.                      |
| Carrying Handle                 | Correct operation.                                                                           | Replace defective parts.                                              |
| Accessories                     | Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors. | Replace damaged or missing items, frayed cables, and defective parts. |

**CLEANING.** Loose dust on the outside of the instrument can be removed with a soft cloth or small soft-bristle brush. The brush is particularly useful for dislodging dirt on and around the controls and connectors. Dirt that remains can be removed with a soft cloth dampened in a mild detergent-and-water solution. Do not use abrasive cleaners. Clean the light filter and the crt face with a soft lint-free cloth dampened with isopropyl alcohol, denatured ethyl alcohol, or a mild detergent-and-water solution.

### Interior

To gain access to internal portions of the instrument for inspection and cleaning, refer to the Removal and Replacement Instructions in the Corrective Maintenance part of this section.

**INSPECTION.** Inspect the internal portions of the instrument for damage and wear, using Table 6-3 as a guide. Deficiencies found should be repaired immediately. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components 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.

If any electrical component is replaced, conduct a Performance Check for the affected circuit and for other closely related circuits (see Section 4). If repair or replacement work is done on any of the power supplies, conduct a complete Performance Check and, if so indicated, an instrument readjustment (see Section 5).

**Table 6-3**  
**Internal Inspection Checklist**

| Item               | Inspect For                                                                                                           | Repair Action                                                                                                                                                                                                                                               |
|--------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Circuit Boards     | Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating. | Clean solder corrosion with an eraser and flush with isopropyl alcohol. Resolder defective connections. Determine cause of burned items and repair. Repair defective circuit runs.                                                                          |
| Resistors          | Burned, cracked, broken, or blistered.                                                                                | Replace defective resistors. Check for cause of burned component and repair as necessary.                                                                                                                                                                   |
| Solder Connections | Cold solder or rosin joints.                                                                                          | Resolder joint and clean with isopropyl alcohol.                                                                                                                                                                                                            |
| Capacitors         | Damaged or leaking cases. Corroded solder on leads or terminals.                                                      | Replace defective capacitors. Clean solder connections and flush with isopropyl alcohol.                                                                                                                                                                    |
| Semiconductors     | Loosely inserted in sockets. Distorted pins.                                                                          | Firmly seat loose semiconductors. Remove devices having distorted pins. Carefully straighten pins (as required to fit the socket) using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break. |
| Wiring and Cables  | Burned, broken, or frayed wiring.                                                                                     | Firmly seat connectors. Repair or replace defective wires or cables.                                                                                                                                                                                        |
| Chassis            | Dents, deformations, and damaged hardware.                                                                            | Straighten, repair, or replace defective hardware.                                                                                                                                                                                                          |

**CAUTION**

*To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the instrument.*

**CLEANING.** To clean the interior, blow off dust with dry, low-pressure air (approximately 9 psi). Remove any remaining dust with a soft brush or a cloth dampened with a solution of mild detergent and water. A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards. If these methods do not remove all the dust or dirt, the instrument may be spray washed using a solution of 5% mild detergent and 95% water as follows:

1. Gain access to the parts to be cleaned by removing easily accessible shields and panels (see Removal and Replacement Instructions).
2. Spray wash dirty parts with the detergent-and-water solution; then use clean water to thoroughly rinse them.
3. Dry all parts with low-pressure air.

**SWITCH CONTACTS.** The VOLTS/DIV and SEC/DIV switches are mounted on circuit boards within the instrument. Care must be exercised to preserve the high-frequency characteristics of these switches. Switch maintenance is seldom necessary, but if required, use this procedure.

1. The VOLTS/DIV switches contain cam-actuated switches.

**CAUTION**

*Most spray-type circuit coolants contain Freon 12 as a propellant. Because many Freons adversely affect switch contacts, do not use spray-type coolants on the switches or attenuators.*

*The only recommended circuit coolants for the VOLT/DIV attenuators are dry ice (CO<sub>2</sub>) and isopropyl alcohol.*

- a. Use only isopropyl alcohol as a cleaning agent for switches, especially in the area of the Vertical Attenuator circuit board. Carbon based solvents will damage the board material.

- b. Apply the alcohol with a small, camel-hair brush. Do not use cotton-tipped applicators, since the cotton tends to snag and possibly damage the switch contacts.

2. The SEC/DIV switch is comprised of rotary-activated contacts.

**CAUTION**

*Use only deionized or distilled water at about 55°C (131°F) to clean the SEC/DIV timing switch. Tap water contains impurities that remain as residual deposits after evaporation.*

- a. Spray hot water into the slots at the top of each switch housing while rotating the switch control knob. Use an atomizing spray device, and spray for only about five seconds.
- b. Dry the switch and circuit board on which it is mounted with dry, low-pressure air.
- c. Bake the switch and circuit board in an oven or drying compartment using dry circulating air at about 75°C (167°F) for 15 minutes to eliminate all moisture.
- d. Spray a very small amount (only about a 1/2 second squirt) of a recommended lubricant, such as No Noise, into the slots at the top of the switch housing.
- e. Rotate the switch control knob about 180° and again spray a very small amount of lubricant into each slot.

## LUBRICATION

Most of the potentiometers used in this instrument are permanently sealed and generally do not require periodic lubrication. All switches, both rotary- and lever-type, are installed with proper lubrication applied where necessary and will rarely require any additional lubrication. A regular periodic lubrication program for the instrument is not recommended.

## SEMICONDUCTOR CHECKS

Periodic checks of the transistors and other semiconductors in the oscilloscope are not recommended. The best check of semiconductor performance is actual operation in the instrument.

## PERIODIC READJUSTMENT

To ensure accurate measurements, check the performance of this instrument every 2000 hours of operation, or if used infrequently, once each year. In addition, replacement of components may necessitate readjustment of the affected circuits.

Complete Performance Check and Adjustment instructions are given in Sections 4 and 5. The Performance Check Procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor problems may be revealed or corrected by readjustment. If only a partial adjustment is performed, see the interaction chart, Table 5-1, for possible adjustment interaction with other circuits.

# TROUBLESHOOTING

## INTRODUCTION

Preventive maintenance performed on a regular basis should reveal most potential problems before an instrument malfunctions. However, should troubleshooting be required, the following information is provided to facilitate location of a fault. In addition, the material presented in the Theory of Operation and Diagrams sections of this manual may be helpful while troubleshooting.

## TROUBLESHOOTING AIDS

### Schematic Diagrams

Complete schematic diagrams are located on tabbed foldout pages in the Diagrams section. Portions of circuitry mounted on each circuit board are enclosed by heavy black lines. The assembly number and name of the circuit are shown near either the top or the bottom edge of the enclosed area.

Component numbers and electrical values of components in this instrument are shown on the schematic diagrams. Refer to the first page of the Diagrams section for the reference designators and symbols used to identify components.

### Circuit Board Illustrations

Circuit board illustrations showing the physical location of each component are provided for use in conjunction with each schematic diagram. Each board illustration is found in the Diagrams section on the back of a foldout page, preceding the first schematic diagram(s) to which it relates. If more than one schematic diagram is associated with a particular circuit board, the board illustration is located on a left-hand page preceding the diagram with which the board is first associated.

Also provided in the Diagrams section is an illustration of the bottom side of the Main circuit board. This illustration aids in troubleshooting by showing the connection pads for the components mounted on the top side of the circuit board. By using this illustration, circuit tracing and probing for voltages and signals that are inaccessible from the top side of the board may be achieved without dismantling portions of the instrument.

Waveform test-point locations are also identified on the circuit board illustration by hexagonal-outlined numbers that correspond to the waveform numbers appearing on both the schematic diagram and the waveform illustration.

### Circuit Board Locations

An illustration depicting the location of a circuit board within the instrument is shown on the foldout page adjacent to the circuit board illustration.

### Circuit Board Interconnections

A circuit board interconnection diagram is provided in the Diagrams section to aid in tracing a signal path or power source between boards. All wire, plug, and jack numbers are shown along with their associated wire or pin numbers.

### Power Distribution

Power Distribution diagram 11 is provided to aid in troubleshooting power-supply problems. This diagram shows the service jumper connections used to remove power from the various circuit boards. Excessive loading on a power supply by a circuit board fault may be isolated by disconnecting the appropriate service jumpers.

## Grid Coordinate System

Each schematic diagram and circuit board illustration has a grid border along its left and top edges. A table located adjacent to each diagram lists the grid coordinates of each component shown on that diagram. To aid in physically locating components on the circuit board, this table also lists the circuit-board grid coordinates of each component.

Adjacent to each circuit board illustration is an alpha-numeric listing of all components mounted on that board. The second column in each listing identifies the schematic diagram in which each component can be found. These component-locator tables are especially useful when more than one schematic diagram is associated with a particular circuit board.

## Troubleshooting Charts

The troubleshooting charts contained in the Diagrams section are to be used as an aid in locating malfunctioning circuitry. To use the charts, begin with the Troubleshooting Guide. This chart will help identify a particular problem area for further troubleshooting.

Note that some troubleshooting-procedure boxes on each chart contain numbers along their lower edges. These numbers identify the applicable schematic diagram(s) to be used when performing the action specified in the box.

Both General and Specific notes may be called out in the troubleshooting-chart boxes. These notes are located on the inner panels of the foldout pages. Specific Notes contain procedures or additional information to be used in performing the particular troubleshooting step called for in that box. General Notes contain information that pertains to the overall troubleshooting procedure.

Some malfunctions, especially those involving multiple simultaneous failures, may require more elaborate troubleshooting approaches with references to circuit descriptions in the Theory of Operation section of this manual.

## Component Color Coding

Information regarding color codes and markings of resistors and capacitors is located on the color-coding illustration (Figure 9-1) at the beginning of the Diagrams section.

**RESISTOR COLOR CODE.** Resistors used in this instrument are carbon-film, composition, or precision metal-film types. They are usually color coded with the EIA color code; however, some metal-film type resistors may have the value printed on the body. The color code is interpreted starting with the stripe nearest to one end of the resistor. Composition resistors have four stripes; these represent two significant digits, a multiplier, and a tolerance value. Metal-film resistors have five stripes representing three significant digits, a multiplier, and a tolerance value.

**CAPACITOR MARKINGS.** Capacitance values of common disc capacitors and small electrolytics are marked on the side of the capacitor body. White ceramic capacitors are color coded in picofarads, using a modified EIA code.

Dipped tantalum capacitors are color coded in microfarads. The color dot indicates both the positive lead and the voltage rating. Since these capacitors are easily destroyed by reversed or excessive voltage, be careful to observe the polarity and voltage rating when replacing them.

**DIODE COLOR CODE.** The cathode end of each glass-encased diode is indicated by either a stripe, a series of stripes, or a dot. For most diodes marked with a series of stripes, the color combination of the stripes identifies three digits of the Tektronix Part Number, using the resistor color-code system. The cathode and anode ends of a metal-encased diode may be identified by the diode symbol marked on its body.

## Semiconductor Lead Configurations

Figure 9-2 in the Diagrams section shows the lead configurations for semiconductor devices used in the instrument. These lead configurations and case styles are typical of those used at completion of the instrument design. Vendor changes and performance improvement changes may result in changes of case styles or lead configurations. If the device in question does not appear to match the configuration shown in Figure 9-2, examine the associated circuitry or consult the semiconductor manufacturer's data sheet.

## Multipin Connectors

Multipin connector orientation is indexed by two triangles; one on the holder and one on the circuit board. Slot numbers are usually molded into the holder. When a connection is made to circuit board pins, ensure that the index on the holder is aligned with the index on the circuit board (see Figure 6-1).

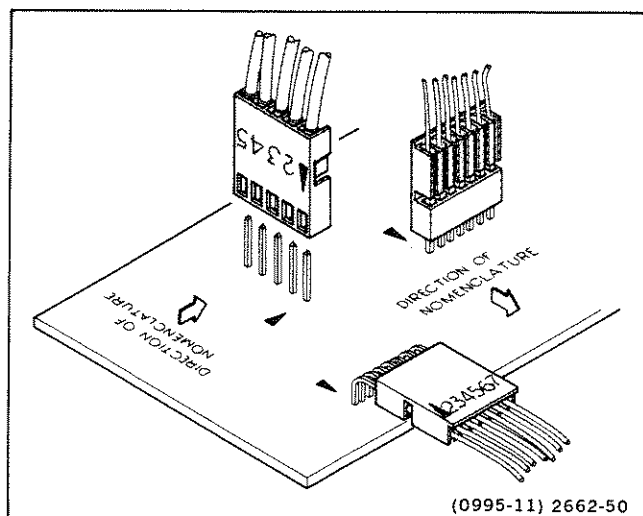


Figure 6-1. Multi-connector holder orientation.

## TROUBLESHOOTING EQUIPMENT

The equipment listed in Table 4-1 of this manual, or equivalent equipment, may be useful when troubleshooting this instrument.

## TROUBLESHOOTING TECHNIQUES

The following procedure is arranged in an order that enables checking simple trouble possibilities before requiring more extensive troubleshooting. The first four steps ensure proper control settings, connections, operation, and adjustment. If the trouble is not located by these checks, the remaining steps will aid in locating the defective component. When the defective component is located, replace it using the appropriate replacement procedure given under Corrective Maintenance in this section.



*Before using any test equipment to make measurements on static-sensitive, current-sensitive, or voltage-sensitive components or assemblies, ensure that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.*

### 1. Check Control Settings

Incorrect control settings can give a false indication of instrument malfunction. If there is any question about the correct function or operation of any control, refer to the Operating Instructions in Section 2 of this manual.

### 2. Check Associated Equipment

Before proceeding, ensure that any equipment used with the instrument is operating correctly. Verify that input signals are properly connected and that the interconnecting cables are not defective. Check the power-input-source voltages.

#### WARNING

*To avoid electrical shock, disconnect the instrument from the power-input source before performing visual inspection.*

### 3. Visual Check

Perform a visual inspection. This check may reveal broken connections or wires, damaged components, semiconductors not firmly mounted, damaged circuit boards, or other clues to the cause of an instrument malfunction.

### 4. Check Instrument Performance and Adjustment

Check the performance of either those circuits where trouble appears to exist or the entire instrument. The apparent trouble may be the result of misadjustment. Complete performance check and adjustment instructions are given in Sections 4 and 5 of this manual.

### 5. Isolate Trouble to a Circuit

To isolate problems to a particular area, use the trouble symptom to help identify the circuit in which the trouble is located. Refer to the troubleshooting charts in the Diagrams section as an aid in locating a faulty circuit.

### 6. Check Power Supplies

#### WARNING

*For safety reasons, an isolation transformer must be connected whenever trouble shooting is done in the Preregulator and Inverter Power Supply sections of the instrument.*

Check the power supplies whenever trouble symptoms appear in more than one circuit. The correct output voltage and ripple for each supply should be measured between the supply test point and chassis ground (see Table 6-4 and associated circuit board illustration). Voltages may be measured with a DMM, while the ripple measurements are accomplished only with an oscilloscope. Before checking power-supply circuitry, set the A INTENSITY control to minimum brightness and the A SEC/DIV switch to X-Y mode.

When measuring ripple, use a 1X probe having a bayonet ground assembly attached to the probe tip to minimize stray pickup. Insert the bayonet assembly signal tip into the first test point indicated in Table 6-4, and touch the bayonet assembly ground tip to the nearest chassis ground. The ripple values listed in Table 6-4 are based on a system limited in bandwidth to 30 kHz (greater bandwidth will result in higher readings).

**Table 6-4**  
**Power Supply Limits and Ripple**

| Power Supply | Test Point | Reading (Volts) | P-P Ripple (mV) |
|--------------|------------|-----------------|-----------------|
| -8.6 V       | W961       | -8.56 to -8.64  | < 1.5           |
| +5.2 V       | W968       | +5.04 to +5.35  | < 3             |
| +8.6 V       | W960       | +8.43 to +8.77  | < 1.5           |
| +30 V        | W956       | +29.1 to +30.9  | < 25            |
| +102 V       | W954       | +99.0 to +105.0 | < 40            |

If the power-supply voltages and ripple are within the ranges listed in Table 6-4, the supply can be assumed to be working correctly. If they are outside the ranges, the supply may be either misadjusted or operating incorrectly. Use the Power Supply and CRT Display section in the Adjustment procedure to adjust the -8.6 V supply.

A defective component elsewhere in the instrument can create the appearance of a power-supply problem and may also affect the operation of other circuits.

## 7. Check Circuit Board Interconnections

After the trouble has been isolated to a particular circuit, again check for loose or broken connections, improperly seated semiconductors, and heat-damaged components.

## 8. Check Voltages and Waveforms

Often the defective component can be located by checking the appropriate voltage or waveform in the circuit. Typical voltages are listed on the schematic diagrams. Waveforms are shown adjacent to the schematics, and waveform test points are indicated on both the schematics and the circuit board illustrations by hexagonal-outlined numbers.

### NOTE

*Voltages and waveforms given on the schematic diagrams are not absolute and may vary slightly between instruments. To establish operating conditions similar to those used to obtain these readings, see the Voltage and Waveform Setup conditions in the Diagrams section for the preliminary equipment setup. Note the recommended test equipment, initial front-panel control settings, and cable-connection instructions. The control-setting changes (from initial setup) required to obtain the given waveforms and voltages are located on the waveform-diagram page.*

### WARNING

*To avoid electric shock, always disconnect the instrument from the ac power source before removing or replacing components.*

## 9. Check Individual Components

The following procedures describe methods of checking individual components. Two-lead components that are soldered in place are most accurately checked by first disconnecting one end from the circuit board. This isolates the measurement from the effects of the surrounding circuitry. See Figure 9-1 for component value identification and Figure 9-2 for typical semiconductor lead configurations.

### CAUTION

*When checking semiconductors, observe the static-sensitivity precautions located at the beginning of this section.*

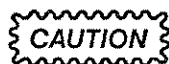
**TRANSISTORS.** A good check of a transistor is actual performance under operating conditions. A transistor can most effectively be checked by substituting a

known-good component. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic-type transistor checker for testing. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

When troubleshooting transistors in the circuit with a voltmeter, measure both the emitter-to-base and emitter-to-collector voltages to determine whether they are consistent with normal circuit voltages. Voltages across a transistor may vary with the type of device and its circuit function.

Some of these voltages are predictable. The emitter-to-base voltage for a conducting silicon transistor will normally range from 0.6 V to 0.8 V. The emitter-to-collector voltage for a saturated transistor is about 0.2 V. Because these values are small, the best way to check them is by connecting a sensitive voltmeter across the junction rather than comparing two voltages taken with respect to ground. If the former method is used, both leads of the voltmeter must be isolated from ground.

If values less than these are obtained, either the device is shorted or no current is flowing in the external circuit. If values exceed the emitter-to-base values given, either the junction is reverse biased or the device is defective. Voltages exceeding those given for typical emitter-to-collector values could indicate either a nonsaturated device operating normally or a defective (open-circuited) transistor. If the device is conducting, voltage will be developed across the resistors in series with it; if open, no voltage will be developed across the resistors unless current is being supplied by a parallel path.

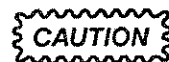


*When checking emitter-to-base junctions, do not use an ohmmeter range that has either a high internal current or voltage. High current or high voltage may damage the transistor. Reverse biasing the emitter-to-base junction with a high current may degrade the transistor's current-transfer ratio (Beta).*

A transistor emitter-to-base junction also can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter set to a range having a low internal source current, such as the R X 1 k $\Omega$  range. The junction resistance should be very high in one direction and much lower when the meter leads are reversed.

When troubleshooting a field-effect transistor (FET), the voltage across its elements can be checked in the same manner as previously described for other transistors. However, remember that in the normal depletion mode of operation, the gate-to-source junction is reverse biased; in the enhanced mode, the junction is forward biased.

**INTEGRATED CIRCUITS.** An integrated circuit (IC) can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is essential when troubleshooting a circuit having an IC. Use care when checking voltages and waveforms around the IC so that adjacent leads are not shorted together. The grabber tip or an IC test clip provides a convenient means of clipping a test probe to an IC.



*When checking a diode, do not use an ohmmeter range that has a high internal current. High current may damage a diode. Checks on diodes can be performed in much the same manner as those on transistor emitter-to-base junctions; use a dynamic tester, such as the TEKTRONIX 576 Curve Tracer.*

**DIODES.** A diode can be checked for either an open or a shorted condition by measuring the resistance between terminals with an ohmmeter set to a range having a low internal source current, such as the R X 1 k $\Omega$  range. The diode resistance should be very high in one direction and much lower when the meter leads are reversed.

Silicon diodes should have 0.6 V to 0.8 V across their junctions when conducting; Schottky diodes about 0.2 V to 0.4 V. Higher readings indicate that they are either reverse biased or defective, depending on polarity.

**RESISTORS.** Check resistors with an ohmmeter. Refer to the Replaceable Electrical Parts list for the tolerances of resistors used in this instrument. A resistor normally does not require replacement unless its measured value varies widely from its specified value and tolerance.

**INDUCTORS.** Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit.

**CAPACITORS.** A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter set to one of the highest ranges. Do not exceed the voltage rating of the capacitor. The resistance reading should be

high after the capacitor is charged to the output voltage of the ohmmeter. An open capacitor can be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

#### **10. Repair and Adjust the Circuit**

If any defective parts are located, follow the replacement procedures given under Corrective Maintenance in this section. After any electrical component has been

replaced, the performance of that circuit and any other closely related circuit should be checked. Since the power supplies affect all circuits, performance of the entire instrument should be checked if work has been done on the power supplies or if the power transformer has been replaced. Readjustment of the affected circuitry may be necessary. Refer to the Performance Check Procedure and Adjustment Procedure, Sections 4 and 5 of this manual and to Table 5-1 (Adjustment Interactions).

# CORRECTIVE MAINTENANCE

## INTRODUCTION

Corrective maintenance consists of component replacement and instrument repair. This part of the manual describes special techniques and procedures required to replace components in this instrument. If it is necessary to ship your instrument to a Tektronix Service Center for repair or service, refer to the Instrument Repackaging in Section 2.

## MAINTENANCE PRECAUTIONS

To reduce the possibility of personal injury or instrument damage, observe the following precautions.

1. Disconnect the instrument from the ac power input source before removing or installing components.
2. Use care not to interconnect instrument grounds which may be at difference potentials (cross grounding).

## OBTAINING REPLACEMENT PARTS

Most electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can usually be obtained from a local commercial source. Before purchasing or ordering a part from a source other than Tektronix, Inc., please check the Replaceable Electrical Parts list for the proper value, rating, tolerance, and description.

### NOTE

*Physical size and shape of a component may affect instrument performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.*

## Special Parts

In addition to the standard electronic components, some special parts are used in the instrument. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. The various manufacturers can be identified by referring to the Cross Index—Manufacturer's Code number to Manufacturer at the beginning of the Replaceable Electrical Parts list. Most of the mechanical parts used in this instrument were 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., be sure to include all of the following information:

1. Instrument type (include all modification and option numbers).
2. Instrument serial number.
3. A description of the part (if electrical, include its full circuit component number).
4. Tektronix part number.

## MAINTENANCE AIDS

The maintenance aids listed in Table 6-5 include items required for performing most of the maintenance procedures on this instrument. Equivalent products may be substituted for the examples given, provided their characteristics are similar.

**Table 6-5**  
**Maintenance Aids**

| Description                          | Specifications                                | Usage                                                   | Example                                                                                                                                                                                                      |
|--------------------------------------|-----------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Soldering Iron                    | 15 to 25 W.                                   | General soldering and unsoldering.                      | Antex Precision Model C.                                                                                                                                                                                     |
| 2. Torx Screwdriver Tips and Handles | Torx tips #T7, #T9, #T10, #T15 and #T20.      | Assembly and disassembly.                               | Tektronix Part Numbers:<br>(#T7) 003-1293-00<br>(#T9) 003-0965-00<br>(#T10) 003-0814-00<br>(#T15) 003-0966-00<br>(#T20) 003-0866-00.<br><br>Torx handles:<br>8 1/2 in. 003-0293-00<br>3 1/2 in. 003-0445-00. |
| 3. Nutdrivers                        | 1/4 inch, 5/16 inch, 1/2 inch, and 9/16 inch. | Assembly and disassembly.                               | Xcelite #8, #10, #16, and #18.                                                                                                                                                                               |
| 4. Open-end Wrench                   | 9/16 inch.                                    | Assembly and disassembly.                               |                                                                                                                                                                                                              |
| 5. Hex Wrenches                      | 0.050 inch and 1/16 inch.                     | Assembly and disassembly.                               | Allen Wrenches.                                                                                                                                                                                              |
| 6. Long-nose Pliers                  |                                               | Component removal and replacement.                      | Diamalloy Model LN 55-3.                                                                                                                                                                                     |
| 7. Diagonal Cutters                  |                                               | Component removal and replacement.                      | Diamalloy Model M554-3.                                                                                                                                                                                      |
| 8. Vacuum Solder Extractor           | No static charge retention.                   | Unsoldering components.                                 | Pace Model PC-10.                                                                                                                                                                                            |
| 9. Lubricant                         | No-Noise.                                     | Switch lubrication.                                     | Tektronix Part Number 006-0442-02.                                                                                                                                                                           |
| 10. Pin-replacement Kit              |                                               | Replace circuit board connector pins.                   | Tektronix Part Number 040-0542-01.                                                                                                                                                                           |
| 11. Isolation Transformer            |                                               | Isolate the instrument from the ac-power-source outlet. | Tektronix Part Number 006-5953-00.                                                                                                                                                                           |
| 12. 1X Probe                         |                                               | Power supply ripple check.                              | TEKTRONIX P6101A Probe (1X).                                                                                                                                                                                 |
| 13. Bayonet Ground Assembly          |                                               | Signal interconnection.                                 | Tektronix Part Number 013-0085-00.                                                                                                                                                                           |
| 14. IC Test Clip                     | 40-lead tester.                               | Testing DIP IC packages.                                | Tektronix Part Number 003-0801-00.                                                                                                                                                                           |
| 15. IC-Removal Tool                  |                                               | Removing DIP IC packages.                               | Augat T114-1.                                                                                                                                                                                                |
| 16. IC Test Clip                     | Reagent grade.                                | Cleaning attenuator and front panel assemblies.         | 2-Isopropanol.                                                                                                                                                                                               |

## INTERCONNECTIONS

Pin connectors are used to connect wires to the interconnecting pins. They are grouped together and mounted in a plastic holder and should be removed, reinstalled, or replaced as a unit. If an individual wire or connector in the assembly is faulty, the entire cable assembly should be replaced. To provide correct orientation of a multipin connector, an index arrow is stamped on the circuit board, and a matching arrow is molded into the plastic housing of the multipin connector. Be sure these arrows are aligned with each other when the multipin connector is reinstalled.

## TRANSISTORS AND INTEGRATED CIRCUITS

Transistors and integrated circuits should not be replaced unless they are actually defective. If removed from their sockets or unsoldered from the circuit board during routine maintenance, return them to their original board locations. Unnecessary replacement or transposing of semiconductor devices may affect the adjustment of the instrument. When a semiconductor is replaced, check the performance of any circuit that may be affected.

Any replacement component should be of the original type or a direct replacement. Bend transistor leads to fit their circuit board holes, and cut the leads to the same length as the original component. See Figure 10-2 for typical lead-configuration illustrations.

To remove socketed dual-in-line packaged (DIP) integrated circuits, pull slowly and evenly on both ends of the device. Avoid disengaging one end of the integrated circuit from the socket before the other, since this may damage the pins.

To remove a soldered DIP IC when it is going to be replaced, clip all the leads of the device and remove the leads from the circuit board one at a time. If the device must be removed intact for possible reinstallation, do not heat adjacent conductors consecutively. Apply heat to pins at alternate sides and ends of the IC as solder is removed. Allow a moment for the circuit board to cool before proceeding to the next pin.

The heat-sink-mounted power supply transistors are insulated from the heat sink. In addition, a heat-sink compound is used to increase heat-transfer capabilities. Reinstall the insulators and replace the heat-sink compound when replacing these transistors. The compound should be applied to both sides of the

insulators and should be applied to the bottom side of the transistor where it comes in contact with the insulator.

### NOTE

*After replacing a power transistor, check that the collector is not shorted to the chassis before applying power to the instrument.*

## SOLDERING TECHNIQUES

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used to remove or replace parts. General soldering techniques, which apply to maintenance of any precision electronic equipment, should be used when working on this instrument.

### WARNING

*To avoid an electric-shock hazard, observe the following precautions before attempting any soldering: turn the instrument off, disconnect it from the ac power source, and allow approximately three minutes for the power-supply capacitors to discharge.*

Use rosin-core wire solder containing 63% tin and 37% lead. Contact your local Tektronix Field Office or representative to obtain the names of approved solder types.

When soldering on circuits boards or small insulated wires, use only a 15-watt to 25-watt, pencil-type soldering iron. A higher wattage soldering iron may cause etched circuit conductors to separate from the board base material and melt the insulation on small wires. Always keep the soldering-iron tip properly tinned to ensure best heat transfer from the iron tip to the solder joint. Apply only enough solder to make a firm joint. After soldering, clean the area around the solder connection with an approved flux-removing solvent (such as isopropyl alcohol) and allow it to air dry.

### CAUTION

*Attempts to unsolder, remove, and resolder leads from the component side of a circuit board may cause damage to the reverse side of the circuit board.*

*The following techniques should be used to replace a component on any of the circuit boards:*

1. Touch the vacuum desoldering tool to the lead at the solder connection. Never place the iron directly on the board; doing so may damage the board.

#### NOTE

*Some components are difficult to remove from the circuit board due to a bend placed in the component leads during machine insertion. The bent leads hold the component in place during a solder-flow manufacturing process that solders all the components at once. To make removal of machine-inserted components easier, straighten the component leads on the reverse side of the circuit board with a small flat-bladed screwdriver or pliers. It may be necessary to remove the circuit board to gain access to the component leads on the reverse side of the circuit board. Circuit-board removal and reinstallation procedures are discussed later in this section.*

2. When removing a multipin component, especially an IC, do not heat adjacent pins consecutively. Apply heat to the pins at alternate sides and ends of the IC as solder is removed. Allow a moment for the circuit board to cool before proceeding to the next pin.



*Excessive heat can cause the etched circuit conductors to separate from the circuit board. Never allow the solder extractor tip to remain at one place on the board for more than three seconds. Solder wick, spring-actuated or squeeze-bulb solder suckers, and heat blocks (for desoldering multipin components) must not be used. Damage caused by poor soldering techniques can void the instrument warranty.*

3. Bend the leads of the replacement component to fit the holes in the circuit board. If the component is replaced while the board is installed in the instrument, cut the leads so they protrude only a small amount through the reverse side of the circuit board. Excess lead length may cause shorting to other conductive parts.
4. Insert the leads into the holes of the board so that the replacement component is positioned the same as

the original component. Most components should be firmly seated against the circuit board.

5. Touch the soldering iron to the connection and apply enough solder to make a firm solder joint. Do not move the component while the solder hardens.
6. Cut off any excess lead protruding through the circuit board (if not clipped to the correct length in step 3).
7. Clean the area around the solder connection with an approved flux-removing solvent. Be careful not to remove any of the printed information from the circuit board.

## REMOVAL AND REPLACEMENT INSTRUCTIONS

The exploded view drawings in the Replaceable Mechanical Parts list (Section 10) may be helpful during the removal and reinstallation of individual sub-assemblies or components. Circuit board and component locations are shown in the Diagrams section.

#### WARNING

*To avoid electric shock, disconnect the instrument from the ac-power source before removing or replacing any component or assembly.*

### Cabinet

To remove the instrument cabinet, perform the following steps:

1. If present, remove the power-cord clamp and securing screw from the rear panel.
2. Disconnect the power cord from the instrument.
3. Remove the screws from the right-rear side, the bottom front of the cabinet, and two screws from the rear panel. Then remove the rear panel.
4. Pull the front panel and attached chassis forward and out of the cabinet.

To reinstall the cabinet, perform the reverse of the preceding steps.



*To ensure that the cabinet is grounded to the instrument chassis, the screw at the right rear side of the cabinet must be tightly secured.*

## Cathode-Ray Tube

Use care when handling a cathode ray tube (crt). Breakage of the crt may cause high velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which may cause it to crack or implode. When storing a crt, either place it in a protective carton or set it face down on a smooth surface in a protected location with a soft mat under the faceplate.

To remove the crt, perform the following steps:

1. Disconnect four deflection-plate wires at the middle of the crt neck, noting locations for reinstallation reference.
2. Unplug the Trace Rotation connector (P9006) from J9006 on the Front Panel circuit board noting location and orientation for reinstallation reference.

## WARNING

*The crt anode lead retains a high-voltage charge after the instrument is turned off. To avoid electrical shock, disconnect the crt anode lead from the High-Voltage Multiplier jack and ground it to the main instrument chassis.*

3. Unplug the crt anode lead connector from the High-Voltage Multiplier jack located on the left front side of Power-Supply shield and discharge it to the chassis.
4. Remove the two front panel screws that fasten the plastic crt frame and a blue implosion shield to the front panel. Remove the crt frame and implosion shield from the instrument.
5. With the rear of the instrument facing you, place the fingers of both hands over the front edge of the front subpanel. Using both thumbs, press forward gently on the crt funnel near the front of the crt. When the crt base pins disengage from the socket, remove the crt

and the crt shield through the instrument front sub-panel. Place the crt in a safe place until it is ready to reinstall. If the plastic crt corner pads fall out, save them for reinstallation.

6. Remove the crt socket cap from the rear of the crt socket for reinstallation.

To reinstall the crt, perform the reverse of the preceding steps. Before replacing the crt, reinstall any plastic crt corner pads that are out of place, insert the crt, crt shield, anode lead, and Trace Rotation leads through the front-panel opening. Ensure all pins are straight and that the indexing keys on the crt base socket and shield are aligned. Ensure that the ground clip makes contact only with the outside of the crt shield.

When pushing the crt base into the socket, verify that the crt base and socket are flush together as viewed from the rear. Ensure that the crt is seated properly in the front panel opening.

## Scale Illum Circuit Board

To remove the Scale Illum circuit board, perform the following steps:

1. Disconnect the scale illum cable from J9882 on the Main circuit board. J9882 is located directly beneath the crt at the front edge of the Main board.
2. Remove the crt frame and implosion shield from the instrument (see step 4 Cathode-Ray Tube removal procedure).
3. Remove the screw holding the Scale Illum circuit board and Light Reflector to the chassis frame (located at the bottom of the crt).
4. Remove the Scale Illum circuit board and Light reflector from the instrument.

To reinstall the Scale Illum circuit board and Light Reflector, perform the reverse of the preceding steps.

## Power-Supply Shields

To remove the power-supply shields, perform the following steps:

### Top Shield

1. Remove the two screws at the front edge of the top shield.

2. Remove the screw that secures the right rear corner of the top shield to the rear of the chassis.
3. Lift the top shield out of the instrument.

To reinstall the top power-supply shield, perform the reverse of the preceding steps.

#### Side Shield

#### WARNING

*The crt anode lead retains a high-voltage charge after the instrument is turned off. To avoid electric shock, disconnect the crt anode lead from the High-Voltage Multiplier jack and ground the lead to the main instrument chassis.*

1. Unplug the crt anode lead from the High-Voltage Multiplier jack and discharge it to the chassis.
2. Remove the top shield as described in above procedure.
3. Remove the screw from the plastic power-supply shield on the bottom side of the Main circuit board.
4. Remove the screw located directly in front of the plastic power-supply shield (at the right side of the instrument).
5. Remove the two screws securing the side shield to the rear of the chassis. (The lower screw is located below the input power connector.)
6. Lift the power-supply side shield from the instrument.

To reinstall the power-supply side shield, perform the reverse of the preceding steps.

#### Lower Shield

1. Perform step 3 of the preceding Side Shield removal procedure.
2. Press inward gently on the rear of the plastic, lower shield on the bottom of the Main board. Slide the shield forward to clear the chassis edge, and remove it.

To reinstall the power-supply lower shield, perform the reverse of the preceding steps.

### Filter Circuit Board

To remove the Filter circuit board, perform the following steps:

1. Remove the three Power-Supply shields (see the Power-Supply Shields removal procedure).
2. Remove the two screws that secure the Line Filter board to the rear chassis.
3. Lift the Line Filter assembly clear of adjacent components and remove the snap-on plastic cover.
4. Unsolder the following wires that connect the Line Filter board to the instrument:
  - a. W9040 (gray-black-yellow) on the Main circuit board.
  - b. W9190 (gray-brown-white) on the Main circuit board.
  - c. The white-gray wire connected to RFI filter, FL9001.
  - d. The gray-brown-black wire connected to the line fuseholder. (Move fuse cover completely off the fuseholder before unsoldering).
5. Lift the Line Filter circuit board out of the instrument.

To reinstall the Line Filter circuit board, perform the reverse of the preceding steps.

### Alt Sweep Circuit Board

To remove the Alt Sweep circuit board, perform the following steps:

1. Unclip the Alt Sweep circuit board from the plastic holder attached to the Power-Supply shield.
2. Pull up and remove the Alt Sweep circuit board from the connectors on the Main circuit board.

To reinstall the Alt Sweep circuit board, perform the reverse of the preceding steps.

### Attenuator Circuit Board

To remove the Attenuator circuit board, perform the following steps:

1. Use a 1/16-inch hexagonal wrench to loosen the set screws on both the CH 1 and the CH 2 VOLTS/DIV Variable knobs and remove the knobs.

2. Set the CH 1 and the CH 2 VOLTS/DIV switches to the same position. Note switch positions for reinstallation reference; then remove the knobs by pulling them straight out from the front panel.
3. Place the instrument on its side and unsolder the resistors from the CH 1 and CH 2 input connectors.
4. Remove the two screws securing the Attenuator circuit board to the subpanel (located underneath the CH 1 and CH 2 input connectors).
5. Disconnect the following plugs from the Attenuator board, noting locations and orientations for reinstallation reference:
  - a. P9200, a 4-wire connector located in the cutout at the rear edge of the top attenuator shield.
  - b. P9991, a 4-wire connector located at the center rear edge of the board.
6. Disconnect the following plugs from the Main circuit board, noting locations and orientations for reinstallation reference:
  - a. P9108, a 3-wire connector located between the crt and the power switch extension shaft (near the center of the board).
  - b. P9103, a 3-wire connector located between the rear of the attenuator assembly and the crt.
7. Loosen the screw at the front edge of the top attenuator shield.
8. Remove the remaining six screws securing the top attenuator shield, noting screw lengths and locations for reinstallation reference.
9. Slide the top attenuator shield to the rear until it clears the screw at the front edge. Lift the shield out of the instrument.
10. Remove the screw in the left rear corner of the Attenuator board that secures the board to the bottom shield assembly.
11. Pull the Attenuator board straight back from the front of the instrument until the switch shafts are clear of the Front Panel board and the two Input Coupling switch shafts (located between the front panel and

the subpanel). Lift the Attenuator board out of the instrument.

To reinstall the Attenuator circuit board, perform the reverse of the preceding steps.

### Timing Circuit Board

To remove the Timing circuit board, perform the following steps.

1. Use a 1/16-inch hexagonal wrench to loosen the set-screw of the SEC/DIV Variable knob. Remove the Variable knob.
2. Lock the A and B SEC/DIV knobs together and note the position for reinstallation reference. Use a 1/16-inch hexagonal wrench to loosen the set screws securing the B SEC/DIV knob; pull off the knob.
3. Use a 1/16-inch Hex-key wrench to loosen two set screws securing the A SEC/DIV dial to the shaft assembly. Remove the dial.
4. Remove the following connectors from the Timing circuit board.
  - a. P9705, an eight-wire connector located at the rear of the Timing circuit board.
  - b. P9700, a 10-wire connector located on the right edge of the Timing circuit board.
  - c. P9201, a 4-wire connector located at the left rear corner of the Timing board.
5. Remove one screw at the rear of the Attenuator circuit board (securing both the Attenuator and the Timing circuit boards to the Bottom shield).
6. Remove the remaining three screws securing the Timing circuit board to the Bottom shield.
7. Pull the Timing board straight back from the front of the instrument until switch shaft is clear of the Front-Panel circuit board. Lift the board out of the instrument.

To reinstall the Timing circuit board, perform the reverse of the preceding steps.

### Bottom Shield, Attenuator, and Timing Circuit Board Module

Removal of the module consisting of the bottom shield and the Attenuator and Timing circuit boards is accomplished by the following steps:

1. Firmly grasp the FOCUS knob and pull straight out from the front panel. Remove the knob/extension shaft assembly from the instrument.
  2. Remove the Alt Sweep circuit board (see Alt Sweep Circuit Board removal procedure).
  3. Perform steps 1 through 6 under the Attenuator Circuit Board removal procedure.
  4. Perform steps 1 through 4 under the Timing Circuit Board removal.
  5. Place the instrument on its side. Remove three screws and one hexagonal post spacer holding the bottom shield to the main circuit board. Set instrument down.
  6. Pull the bottom shield, along with the Attenuator and Timing circuit boards, straight back from the front of the instrument until the switch shafts are clear of the holes in the Front-Panel circuit board. Then lift out the entire assembly through the top of the instrument.
  7. If accessibility to the bottom of either the Attenuator or the Timing circuit board is desired refer to steps 7 through 10 of the Attenuator Circuit Board removal procedure or to steps 5 and 6 of the Timing Circuit Board removal procedure.
2. Remove the knobs from the following control shafts by pulling them straight out from the front panel:
    - a. Channel 1 POSITION.
    - b. A/B SWP SEP.
    - c. Channel 2 POSITION.
    - d. B TRIGGER LEVEL.
    - e. A TRIGGER LEVEL.
    - f. SCALE ILLUM.
  3. Use a 1/16-inch hexagonal wrench to loosen the set screws and remove the following knobs:
    - a. B INTENSITY.
    - b. A INTENSITY.
    - c. HORIZONTAL POSITION.
    - d. VAR HOLDOFF.
  4. Unsolder both the resistor to the EXT INPUT center connector and the wire strap to the EXT INPUT ground lug.
  5. Disconnect the following plugs from the Main circuit board:
    - a. P9884, a 2-wire connector located at the front edge of the board between the crt and power switch extension shaft.
    - b. P2222, an 18-conductor flexible cable located at the front edge of the board.
    - c. P2223, an 18-conductor flexible cable located at the front edge of the board.
  6. Disconnect P9006, a 2-wire connector located at the upper left corner of the Front Panel board.
  7. Remove the four screws that secure the Front Panel circuit board to the front subpanel.
  8. Release the power indicator light-emitting diode (LED) from its holder.
  9. Set all front-panel lever switches to their center positions.
  10. Pull the Front Panel circuit board straight back until the switch shafts clear the front subpanel and lift it out of the instrument.

To reinstall the bottom shield, Attenuator, and Timing circuit board module assembly, perform the reverse of the preceding steps.

### Front Panel Circuit Board

1. Remove the Bottom shield, Attenuator, and Timing circuit-board module (see the preceding removal procedure).

To reinstall the Front Panel circuit board, perform the reverse of the preceding steps.

## Main Circuit Board

All components on the Main circuit board are accessible either directly or by removing the crt, the Bottom shield, Attenuator, Timing circuit-board module, or the Power-Supply shield. Removal of the Main circuit board is required only when it is necessary to replace the board with a new one.

To remove the Main circuit board, perform the following steps:

1. Remove the power-supply shields (see Power Supply Shields removal procedure).
2. Remove the Alt Sweep circuit board (see Alt Sweep Circuit Board removal procedure).
3. Disconnect the following connectors from the Main circuit board, noting locations and orientations for reinstallation reference:
  - a. P9870B, a 4-wire connector (5-wire body) located at the left edge of the board in front of the delay line.
  - b. P9108, a 4-wire connector located near the center of the board between the crt shield and the power-switch extension shaft.
  - c. P9103, a 4-wire connector located between the left rear corner of the attenuator shield and the crt shield.
  - d. P9884, a 2-wire connector located at the front edge of the board between the attenuator shield and the crt.
  - e. P9644, a 3-wire connector located at the right edge of the board to the rear of the Timing circuit board.
  - f. P9882, a 2-wire connector located at the front edge of the board, below the crt (accessible from the bottom side of the instrument).
4. Disconnect P9991, a 4-wire connector located at the center rear edge of the Attenuator circuit board.
5. Disconnect the following connectors from the Timing circuit board:
  - a. P9705, an 8-wire connector located at the rear of the board.
  - b. P9700, a 10-wire connector located at the right side of the board.
6. Disconnect the four deflection leads from the crt neckpins, noting locations and orientations for reinstallation reference.
7. Unsolder the delay-line wires from the Main circuit board, noting wire colors and locations for reinstallation reference. (One end of the delay line is soldered to the component side of the Main board and the other end is soldered to the opposite side.
8. Unsolder the rear-panel EXT Z AXIS connector wire from the Main circuit board.
9. Unsolder the five crt base pin wires (W9870) from the Main board. The wires are located adjacent to the High Voltage Multiplier (U975) in the Power Supply section.
10. Unsolder the following Line Filter wires from the Main circuit board:
  - a. The gray-black-yellow wire from the solder pad labeled W9040.
  - b. The gray-brown-white wire from the solder pad labeled W91090.
11. Remove the FOCUS control knob assembly by pulling it straight out from the front panel.
12. Remove the POWER switch extension-shaft assembly as follows:
  - a. Press in the POWER button to the ON position.
  - b. Insert a scribe (or similar tool) into the notch between the end of the switch shaft and the end of the extension shaft and gently pry the connection apart.
  - c. Push the extension shaft forward, then sideways, to clear the switch shaft.
  - d. Pull the extension shaft back and out of the instrument.
13. Remove the two screws that secure the power-supply transistor heat sink assembly to the right side of the chassis.

14. Turn the instrument bottom side up. Remove the three screws and hexagonal post spacer that secure the Main circuit board to the bottom attenuator shield.
  15. Remove the screw that secures the rear of the Main circuit board to the chassis.
  16. Remove the two screws that secure the edge of the Main circuit board to the chassis (located adjacent to the delay line).
  17. Lift the front of the Main board slightly and disconnect P2222 and P2223 from their sockets (located at the front of the board).
  18. Remove the Main circuit board through the bottom of the instrument chassis.
- To reinstall the Main circuit board, perform the reverse of the preceding steps.

# OPTIONS

There are currently no options for this instrument except the optional power cords previously described in Section 2.



# 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.

### LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

### CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

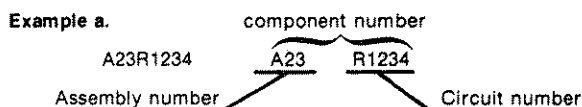
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

### ABBREVIATIONS

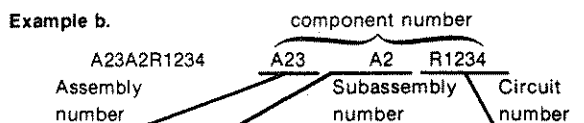
Abbreviations conform to American National Standard Y1.1.

### COMPONENT NUMBER (column one of the Electrical Parts List)

A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:



Read: Resistor 1234 of Assembly 23



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

### TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

### SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

### NAME & DESCRIPTION (column five of the Electrical Parts List)

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.

### MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

### MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

## CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

| Mfr.<br>Code | Manufacturer                                                                                       | Address                                             | City, State, Zip Code          |
|--------------|----------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------|
| 00853        | SANGAMO WESTON INC<br>COMPONENTS DIV                                                               | SANGAMO RD<br>PO BOX 128                            | PICKENS SC 29671-9716          |
| 01121        | ALLEN-BRADLEY CO                                                                                   | 1201 S 2ND ST                                       | MILWAUKEE WI 53204-2410        |
| 02114        | AMPEREX ELECTRONIC CORP<br>FERROXCUBE DIV                                                          | 5083 KINGS HWY                                      | SAUGERTIES NY 12477            |
| 02735        | RCA CORP<br>SOLID STATE DIVISION                                                                   | ROUTE 202                                           | SOMERVILLE NJ 08876            |
| 03508        | GENERAL ELECTRIC CO<br>SEMI-CONDUCTOR PRODUCTS DEPT                                                | W GENESEE ST                                        | AUBURN NY 13021                |
| 04222        | AVX CERAMICS<br>DIV OF AVX CORP                                                                    | 19TH AVE SOUTH<br>P O BOX 867                       | MYRTLE BEACH SC 29577          |
| 04713        | MOTOROLA INC<br>SEMICONDUCTOR PRODUCTS SECTOR                                                      | 5005 E MCDOWELL RD                                  | PHOENIX AZ 85008-4229          |
| 05397        | UNION CARBIDE CORP<br>MATERIALS SYSTEMS DIV                                                        | 11901 MADISON AVE                                   | CLEVELAND OH 44101             |
| 07263        | FAIRCHILD SEMICONDUCTOR CORP<br>NORTH AMERICAN SALES<br>SUB OF SCHLUMBERGER LTD MS 118             | 10400 RIDGEVIEW CT                                  | CUPERTINO CA 95014             |
| 07716        | TRW INC<br>TRW IRC FIXED RESISTORS/BURLINGTON                                                      | 2850 MT PLEASANT AVE                                | BURLINGTON IA 52601            |
| 08806        | GENERAL ELECTRIC CO<br>MINIATURE LAMP PRODUCTS DEPT<br>LIGHTING BUSINESS GROUP                     | NELA PK                                             | CLEVELAND OH 44112             |
| 09023        | CORNELL-DUBILIER ELECTRONICS<br>DIV FEDERAL PACIFIC ELECTRIC CO                                    | 2652 DALRYMPLE ST                                   | SANFORD NC 27330               |
| 12697        | CLAROSTAT MFG CO INC                                                                               | LOWER WASHINGTON ST                                 | DOVER NH 03820                 |
| 12954        | MICROSEMI CORP - SCOTTSDALE                                                                        | 8700 E THOMAS RD<br>P O BOX 1390                    | SCOTTSDALE AZ 85252            |
| 12969        | UNITRODE CORP                                                                                      | 5 FORBES RD                                         | LEXINGTON MA 02173-7305        |
| 14433        | ITT SEMICONDUCTORS DIV                                                                             |                                                     | WEST PALM BEACH FL             |
| 14552        | MICROSEMI CORP                                                                                     | 2830 S FAIRVIEW ST                                  | SANTA ANA CA 92704-5948        |
| 14752        | ELECTRO CUBE INC                                                                                   | 1710 S DEL MAR AVE                                  | SAN GABRIEL CA 91776-3825      |
| 15454        | KETMA<br>RODAN DIVISION                                                                            | 2900 BLUE STAR STREET                               | ANAHEIM CA 92806-2591          |
| 17735        | AT & T TECHNOLOGIES INC<br>SUB OF AMERICAN TELEPHONE AND<br>TELEGRAPH                              | KANSAS CITY WORK<br>777 N BLUE PKY                  | LEES SUMMIT MO 64063-5712      |
| 17856        | SILICONIX INC                                                                                      | 2201 LAURELWOOD RD                                  | SANTA CLARA CA 95054-1516      |
| 19396        | ILLINOIS TOOL WORKS INC<br>PAKTRON DIV                                                             | 1205 MCCONVILLE RD<br>PO BOX 4539                   | LYNCHBURG VA 24502-4535        |
| 19701        | MEPCO/CENTRALAB<br>A NORTH AMERICAN PHILIPS CO<br>MINERAL WELLS AIRPORT                            | PO BOX 760                                          | MINERAL WELLS TX 76067-0760    |
| 20932        | KYOCERA INTERNATIONAL INC                                                                          | 11620 SORRENTO VALLEY RD<br>PO BOX 81543 PLANT NO 1 | SAN DIEGO CA 92121             |
| 22229        | SOLITRON DEVICES INC<br>SEMICONDUCTOR GROUP SAN DIEGO OPERS                                        | 8808 BALBOA AVE                                     | SAN DIEGO CA 92123             |
| 22526        | DU PONT E I DE NEMOURS AND CO INC<br>DU PONT CONNECTOR SYSTEMS<br>DIV MILITARY PRODUCTS GROUP      | 515 FISHING CREEK RD                                | NEW CUMBERLAND PA 17070-3007   |
| 24546        | CORNING GLASS WORKS                                                                                | 550 HIGH ST                                         | BRADFORD PA 16701-3737         |
| 25403        | AMPEREX ELECTRONIC CORP<br>SEMICONDUCTOR SOLID STATE AND ACTIVE<br>DEVICES-ELECTRO OPTICAL DEVICES | GEORGE WASHINGTON HWY                               | SMITHFIELD RI 02917            |
| 27014        | NATIONAL SEMICONDUCTOR CORP                                                                        | 2900 SEMICONDUCTOR DR                               | SANTA CLARA CA 95051-0606      |
| 32997        | BOURNS INC<br>TRIMPOT DIV                                                                          | 1200 COLUMBIA AVE                                   | RIVERSIDE CA 92507-2114        |
| 34899        | FAIR-RITE PRODUCTS CORP                                                                            | 1 COMMERCIAL ROW                                    | WALLKILL NY 12589              |
| 50139        | ALLEN-BRADLEY CO<br>ELECTRONIC COMPONENTS                                                          | 1414 ALLEN BRADLEY DR                               | EL PASO TX 79936               |
| 51406        | MURATA ERIE NORTH AMERICA INC<br>HEADQUARTERS AND GEORGIA OPERATIONS                               | 2200 LAKE PARK DR                                   | SMYRNA GA 30080                |
| 52769        | SPRAGUE-GOODMAN ELECTRONICS INC                                                                    | 134 FULTON AVE                                      | GARDEN CITY PARK NY 11040-5352 |
| 54473        | MATSUSHITA ELECTRIC CORP OF AMERICA                                                                | ONE PANASONIC WAY<br>PO BOX 1501                    | SECAUCUS NJ 07094-2917         |
| 54937        | DEYOUNG MANUFACTURING INC                                                                          | 12920 NE 125TH WAY                                  | KIRKLAND WA 98034-7716         |

## CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

| Mfr.<br>Code | Manufacturer                                                         | Address                                         | City, State, Zip Code      |
|--------------|----------------------------------------------------------------------|-------------------------------------------------|----------------------------|
| 55112        | WESTLAKE CAPACITORS INC                                              | 5334 STERLING CENTER DRIVE                      | WESTLAKE VILLAGE CA 91361  |
| 55680        | NICHICON /AMERICA/ CORP                                              | 927 E STATE PKY                                 | SCHAUMBURG IL 60195-4526   |
| 56289        | SPRAGUE ELECTRIC CO<br>WORLD HEADQUARTERS                            | 92 HAYDEN AVE                                   | LEXINGTON MA 02173-7929    |
| 56845        | DALE ELECTRONICS INC                                                 | 2300 RIVERSIDE BLVD<br>PO BOX 74                | NORFOLK NE 68701-2242      |
| 57668        | ROHM CORP                                                            | 8 WHATNEY<br>PO BOX 19515                       | IRVINE CA 92713            |
| 58361        | QUALITY TECHNOLOGIES CORP                                            | 3400 HILLVIEW AVE                               | PALO ALTO CA 94304-1319    |
| 59821        | MEPCO/CENTRALAB<br>A NORTH AMERICAN PHILIPS CO                       | 7158 MERCHANT AVE                               | EL PASO TX 79915-1207      |
| 64053        | COILTRON INC                                                         | 6755 SW SANDBURG ST                             | TIGARD OR 97223-8008       |
| 71400        | BUSSMANN<br>DIV OF COOPER INDUSTRIES INC                             | 114 OLD STATE RD<br>PO BOX 14460                | ST LOUIS MO 63178          |
| 71744        | CHICAGO MINIATURE LAMP INC                                           | CHEVY CHASE BUSINESS PARK<br>1080 JOHNSON DRIVE | BUFFALO GROVE IL 60089     |
| 73743        | FISCHER SPECIAL MFG CO                                               | 111 INDUSTRIAL RD                               | COLD SPRING KY 41076-9749  |
| 75042        | IRC ELECTRONIC COMPONENTS<br>PHILADELPHIA DIV<br>TRW FIXED RESISTORS | 401 N BROAD ST                                  | PHILADELPHIA PA 19108-1001 |
| 80009        | TEKTRONIX INC                                                        | 14150 SW KARL BRAUN DR<br>PO BOX 500            | BEAVERTON OR 97077-0001    |
| 82104        | STANDARD GRIBSBY INC                                                 | 920 RATHBONE AVE                                | AURORA IL 60507            |
| 91637        | DALE ELECTRONICS INC                                                 | 2064 12TH AVE<br>PO BOX 609                     | COLUMBUS NE 68601-3632     |
| 95348        | GORDOS CORP                                                          | 250 GLENWOOD AVE                                | BLOOMFIELD NJ 07003-2416   |
| D5243        | ROEDERSTEIN E SPEZIALFABRIK FUER<br>KONDENSATOREN GMBH               | LUDMILLA STRASSE 23-25                          | 8300 LANDSHUT GERMANY      |
| TK0510       | PANASONIC COMPANY<br>DIV OF MATSUSHITA ELECTRIC CORP                 | ONE PANASONIC WAY                               | SECAUCUS NJ 07094          |
| TK0900       | UNITED CHEMI-CON INC                                                 | 9801 W HIGGINS<br>SUITE 430                     | ROSEMONT IL 60018-4704     |
| TK1326       | NORTHWEST FOURSLIDE INC                                              | 18224 SW 100TH CT                               | TUALATIN OR 97062          |
| TK1339       | PREM MAGNETICS INC                                                   | 3521 N CHAPEL HILL RD                           | MCHENRY IL 60050           |
| TK1395       | ROEDERSTEIN ELECTRONICS INC                                          | 2100 W FRONT ST                                 | STATESVILLE NC 28677-3651  |
| TK1450       | TOKYO COSMOS ELECTRIC CO LTD                                         | 2-268 SOBUDAI ZAWA                              | KANAGAWA 228 JAPAN         |
| TK1544       | COMPUTER CONNECTIONS                                                 | 30608 SAN ANTONIO ST                            | HAYWARD CA 94544           |
| TK1913       | WIMA<br>THE INTER-TECHNICAL GROUP IND                                | ONE BRIDGE ST<br>PO BOX 23                      | IRVINGTON NY 10533         |
| TK2048       | UNION CARBIDE INC<br>KEMET DIV                                       | 401 PARK PL<br>SUITE 219                        | KIRKLAND WA 98033          |
| TK2058       | TDK CORPORATION OF AMERICA                                           | 2254 N FIRST ST                                 | SAN JOSE CA 95131          |
| U4144        | MURATA ELECTRONICS UK LTD                                            | SOUTHWOOD<br>FARNBOROUGH                        | HANTS ENGLAND              |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description          | Mfr.<br>Code | Mfr. Part No. |
|---------------|-----------------------|--------------------------------------------|-----------------------------|--------------|---------------|
| A1            | 671-1418-00           |                                            | CIRCUIT BD ASSY:MAIN        | 80009        | 671-1418-00   |
| A2            | 671-1423-00           |                                            | CIRCUIT BD ASSY:ATTEN       | 80009        | 671-1423-00   |
| A3            | 671-1415-00           |                                            | CIRCUIT BD ASSY:FRONT PANEL | 80009        | 671-1415-00   |
| A4            | 671-1420-00           |                                            | CIRCUIT BD ASSY:TIMING      | 80009        | 671-1420-00   |
| A5            | 671-1422-00           |                                            | CIRCUIT BD ASSY:ALT SWEEP   | 80009        | 671-1422-00   |
| A6            | 670-7615-01           |                                            | CIRCUIT BD ASSY:EMI FILTER  | 80009        | 670-7615-01   |
| A7            | 671-1463-00           |                                            | CIRCUIT BD ASSY:SCALE ILLUM | 80009        | 671-1463-00   |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective | Discont | Name & Description                  | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|-------------------------------|---------|-------------------------------------|-----------|----------------|
| A1            | 671-1418-00        |                               |         | CIRCUIT BD ASSY:MAIN                | 80009     | 671-1418-00    |
| A1C100        | 283-0853-00        |                               |         | CAP,FXD,CER DI:2.2PF,200V           | TK2048    | C322C22902G5CA |
| A1C114        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C115        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C116        | 281-0775-01        |                               |         | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C120        | 281-0775-01        |                               |         | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C125        | 281-0772-00        |                               |         | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C126        | 281-0767-00        |                               |         | CAP,FXD,CER DI:330PF,20%,100V       | 04222     | MA106C331MAA   |
| A1C127        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C130        | 283-0159-00        |                               |         | CAP,FXD,CER DI:18PF,5%,50V          | 04222     | SR155A180JAA   |
| A1C133        | 281-0785-00        |                               |         | CAP,FXD,CER DI:68PF,10%,100V        | 04222     | MA101A680KAA   |
| A1C150        | 283-0853-00        |                               |         | CAP,FXD,CER DI:2.2PF,200V           | TK2048    | C322C22902G5CA |
| A1C164        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C165        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C175        | 281-0772-00        |                               |         | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C176        | 281-0767-00        |                               |         | CAP,FXD,CER DI:330PF,20%,100V       | 04222     | MA106C331MAA   |
| A1C177        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C180        | 281-0327-00        |                               |         | CAP,VAR,CER DI:4.5-30PF,250VDC      | 52769     | GKU30046       |
| A1C198        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C199        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C200        | 290-0136-00        |                               |         | CAP,FXD,ELCTLT:2.2UF,20%,20V        | 05397     | T322B225M020AS |
| A1C201        | 290-0136-00        |                               |         | CAP,FXD,ELCTLT:2.2UF,20%,20V        | 05397     | T322B225M020AS |
| A1C204        | 281-0811-00        |                               |         | CAP,FXD,CER DI:10PF,10%,100V        | 04222     | MA101A100KAA   |
| A1C210        | 281-0797-00        | B010100                       | B010245 | CAP,FXD,CER DI:15PF,10%,100V        | 04222     | SA106A150KAA   |
| A1C210        | 281-0756-00        | B010246                       |         | CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V  | 04222     | SA102A2R2DAA   |
| A1C215        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C220        | 281-0772-00        |                               |         | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C225        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C226        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C228        | 283-0665-00        |                               |         | CAP,FXD,MICA DI:190PF,1%,100V       | 00853     | D155F191F0     |
| A1C229        | 283-0665-00        |                               |         | CAP,FXD,MICA DI:190PF,1%,100V       | 00853     | D155F191F0     |
| A1C237        | 281-0327-00        |                               |         | CAP,VAR,CER DI:4.5-30PF,250VDC      | 52769     | GKU30046       |
| A1C239        | 281-0776-00        |                               |         | CAP,FXD,CER DI:120PF,5%,100V        | 20932     | 401E0100AD121J |
| A1C240        | 283-0643-00        |                               |         | CAP,FXD,MICA DI:22PF,0.5%,500V      | 00853     | D105E220D0     |
| A1C241        | 281-0777-00        |                               |         | CAP,FXD,CER DI:51PF,5%,100V         | 04222     | MA101A510JAA   |
| A1C242        | 281-0812-00        |                               |         | CAP,FXD,CER DI:1000PF,10%,100V      | 04222     | MA101C102KAA   |
| A1C250        | 281-0768-00        |                               |         | CAP,FXD,CER DI:470PF,20%,100V       | 04222     | MA101A471MAA   |
| A1C251        | 281-0768-00        |                               |         | CAP,FXD,CER DI:470PF,20%,100V       | 04222     | MA101A471MAA   |
| A1C255        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C262        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C274        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C281        | 281-0775-01        |                               |         | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C282        | 281-0767-00        |                               |         | CAP,FXD,CER DI:330PF,20%,100V       | 04222     | MA106C331MAA   |
| A1C292        | 290-0776-00        |                               |         | CAP,FXD,ELCTLT:22UF,+50-20%,10V     | 55680     | ULA1A220TAA    |
| A1C312        | 281-0893-00        |                               |         | CAP,FXD,CER DI:4.7PF,+/-0.5PF,100V  | 04222     | MA101A4R7DAA   |
| A1C337        | 281-0893-00        |                               |         | CAP,FXD,CER DI:4.7PF,+/-0.5PF,100V  | 04222     | MA101A4R7DAA   |
| A1C350        | 281-0756-00        | B010100                       | B010245 | CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V  | 04222     | SA102A2R2DAA   |
| A1C350        | 281-0811-00        | B010246                       |         | CAP,FXD,CER DI:10PF,10%,100V        | 04222     | MA101A100KAA   |
| A1C363        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C381        | 283-0637-00        |                               |         | CAP,FXD,MICA DI:20PF,2.5%,500V      | 00853     | D155E200D0     |
| A1C381        | 283-0637-01        |                               |         | CAP,FXD,MICA DI:20PF,2.5%,500V      | 09023     | CD1A15ED200D03 |
| A1C389        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C390        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C396        | 283-0203-00        |                               |         | CAP,FXD,CER DI:0.47UF,20%,50V       | 04222     | SR305SC474MAA  |
| A1C397        | 281-0773-00        |                               |         | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C402        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C406        | 281-0862-00        |                               |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C409        | 283-0167-00        |                               |         | CAP,FXD,CER DI:0.1UF,10%,100V       | 80009     | 283-0167-00    |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Discont | Name & Description                  | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|---------------------------------------|-------------------------------------|-----------|----------------|
| A1C410        | 283-0051-00        |                                       | CAP,FXD,CER DI:0.0033UF,5%,100V     | 04222     | SR301A332JAA   |
| A1C414        | 290-0246-00        |                                       | CAP,FXD,ELCTLT:3.3UF,10%,15V        | 12954     | D3R3EA15K1     |
| A1C415        | 290-0246-00        |                                       | CAP,FXD,ELCTLT:3.3UF,10%,15V        | 12954     | D3R3EA15K1     |
| A1C418        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C419        | 281-0851-00        |                                       | CAP,FXD,CER DI:180PF,5%,100VDC      | 04222     | MA101A181JAA   |
| A1C420        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C421        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C451        | 281-0772-00        |                                       | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C453        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C459        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C460        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C467        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C469        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C473        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C487        | 281-0785-00        |                                       | CAP,FXD,CER DI:68PF,10%,100V        | 04222     | MA101A680KAA   |
| A1C494        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C499        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C500        | 281-0903-00        |                                       | CAP,FXD,CER DI:3.9PF,100V           | 04222     | MA101A3R9DAA   |
| A1C501        | 290-0246-00        |                                       | CAP,FXD,ELCTLT:3.3UF,10%,15V        | 12954     | D3R3EA15K1     |
| A1C502        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C503        | 281-0775-01        |                                       | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C504        | 290-0246-00        |                                       | CAP,FXD,ELCTLT:3.3UF,10%,15V        | 12954     | D3R3EA15K1     |
| A1C505        | 290-0183-00        |                                       | CAP,FXD,ELCTLT:1UF,10%,35V          | 05397     | T3228105K035AS |
| A1C506        | 281-0772-00        |                                       | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C507        | 290-0776-04        |                                       | CAP,FXD,ELCTLT:22UF,20%,10V,MI      | 80009     | 290-0776-04    |
| A1C517        | 281-0772-00        |                                       | CAP,FXD,CER DI:4700PF,10%,100V      | 04222     | SA101C472KAA   |
| A1C518        | 281-0852-00        |                                       | CAP,FXD,CER DI:1800PF,10%,100VDC    | 04222     | MA101C182KAA   |
| A1C519        | 281-0775-01        |                                       | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C520        | 290-0246-00        |                                       | CAP,FXD,ELCTLT:3.3UF,10%,15V        | 12954     | D3R3EA15K1     |
| A1C525        | 281-0895-00        |                                       | CAP,FXD,CER DI:6.8PF,100WDC         | 04222     | MA101A6R8DAA   |
| A1C527        | 281-0797-00        |                                       | CAP,FXD,CER DI:15PF,10%,100V        | 04222     | SA106A150KAA   |
| A1C529        | 281-0785-00        |                                       | CAP,FXD,CER DI:68PF,10%,100V        | 04222     | MA101A680KAA   |
| A1C531        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C537        | 281-0775-01        |                                       | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C538        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C539        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C540        | 290-0776-04        |                                       | CAP,FXD,ELCTLT:22UF,20%,10V,MI      | 80009     | 290-0776-04    |
| A1C545        | 285-1345-00        |                                       | CAP,FXD,PLASTIC:2200PF,100V,5%      | 55112     | 185(2200PF)    |
| A1C547        | 281-0768-00        |                                       | CAP,FXD,CER DI:470PF,20%,100V       | 04222     | MA101A471MAA   |
| A1C565        | 281-0768-00        |                                       | CAP,FXD,CER DI:470PF,20%,100V       | 04222     | MA101A471MAA   |
| A1C590        | 290-0136-00        |                                       | CAP,FXD,ELCTLT:2.2UF,20%,20V        | 05397     | T3228225M020AS |
| A1C603        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C635        | 281-0826-00        |                                       | CAP,FXD,CER DI:2200PF,10%,100V      | 20932     | 401EM100AD222K |
| A1C646        | 290-0776-00        |                                       | CAP,FXD,ELCTLT:22UF,+50-20%,10V     | 55680     | ULA1A220TAA    |
| A1C647        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C648        | 281-0775-01        |                                       | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C649        | 281-0862-00        |                                       | CAP,FXD,CER DI:0.001UF,+80-20%,100V | 04222     | MA101C10ZMAA   |
| A1C673        | 281-0797-00        |                                       | CAP,FXD,CER DI:15PF,10%,100V        | 04222     | SA106A150KAA   |
| A1C764        | 281-0773-00        |                                       | CAP,FXD,CER DI:0.01UF,10%,100V      | 04222     | MA201C103KAA   |
| A1C771        | 281-0777-00        |                                       | CAP,FXD,CER DI:51PF,5%,100V         | 04222     | MA101A510JAA   |
| A1C774        | 281-0327-00        |                                       | CAP,VAR,CER DI:4.5-30PF,250VDC      | 52769     | GKJ30046       |
| A1C775        | 281-0940-00        |                                       | CAP,FXD,CER DI:1.5PF,+/-0.25PF,100V | 04222     | MA101A1R5CAA   |
| A1C777        | 281-0771-00        |                                       | CAP,FXD,CER DI:2200PF,20%,200V      | 04222     | SA106E222MAA   |
| A1C779        | 285-1101-00        |                                       | CAP,FXD,PLASTIC:0.022UF,10%,200V    | 19396     | 223K02PT485    |
| A1C781        | 281-0777-00        |                                       | CAP,FXD,CER DI:51PF,5%,100V         | 04222     | MA101A510JAA   |
| A1C782        | 281-0775-01        |                                       | CAP,FXD,CER DI:0.1UF,20%,50V        | 04222     | SA105E104MAA   |
| A1C784        | 281-0811-00        |                                       | CAP,FXD,CER DI:10PF,10%,100V        | 04222     | MA101A100KAA   |
| A1C785        | 281-0940-00        |                                       | CAP,FXD,CER DI:1.5PF,+/-0.25PF,100V | 04222     | MA101A1R5CAA   |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                               | Mfr.<br>Code | Mfr. Part No.    |
|---------------|-----------------------|--------------------------------------------|--------------------------------------------------|--------------|------------------|
| A1C787        | 281-0771-00           |                                            | CAP,FXD,CER DI:2200PF,20%,200V                   | 04222        | SA106E222MAA     |
| A1C789        | 285-1101-00           |                                            | CAP,FXD,PLASTIC:0.022UF,10%,200V                 | 19396        | 223K02PT485      |
| A1C796        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C797        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C799        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C824        | 281-0785-00           |                                            | CAP,FXD,CER DI:68PF,10%,100V                     | 04222        | MA101A680KAA     |
| A1C825        | 281-0767-00           |                                            | CAP,FXD,CER DI:330PF,20%,100V                    | 04222        | MA106C331MAA     |
| A1C828        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C832        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C835        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C845        | 281-0771-00           |                                            | CAP,FXD,CER DI:2200PF,20%,200V                   | 04222        | SA106E222MAA     |
| A1C846        | 281-0756-00           |                                            | CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V               | 04222        | SA102A2R2DAA     |
| A1C847        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C849        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C851        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C853        | 281-0767-00           |                                            | CAP,FXD,CER DI:330PF,20%,100V                    | 04222        | MA106C331MAA     |
| A1C854        | 283-0279-00           |                                            | CAP,FXD,CER DI:0.001UF,20%,3000V                 | 51406        | DHR12Y5S102M3KV  |
| A1C855        | 285-1255-00           |                                            | CAP,FXD,PLASTIC:0.01UF,20%,3KV                   | 56289        | 430P582          |
| A1C871        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C873        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C875        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C877        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C881        | 290-0946-00           |                                            | CAP,FXD,ELCTLT:270UF,+100-10%,40V                | 00853        | 301EN271W040B2   |
| A1C882        | 285-1100-00           |                                            | CAP,FXD,PLASTIC:0.022UF,5%,200V                  | 19396        | 223J02PT485      |
| A1C893        | 283-0279-00           |                                            | CAP,FXD,CER DI:0.001UF,20%,3000V                 | 51406        | DHR12Y5S102M3KV  |
| A1C904        | 285-1222-00           |                                            | CAP,FXD,PLASTIC:0.068UF,20%,250V                 | 55112        | 158/.068/M/250/H |
| A1C906        | 290-1206-00           |                                            | CAP,FXD,ELCTLT:270UF,20%,450V                    | TK0900       |                  |
| A1C907        | 285-1177-01           |                                            | CAP,FXD,PLASTIC:1UF,10%,450V                     | 80009        | 285-1177-01      |
| A1C908        | 283-0481-00           |                                            | CAP,FXD,CER DI:220PF,10%,250VAC                  | TK1395       | RK0811           |
| A1C917        | 281-0812-00           |                                            | CAP,FXD,CER DI:1000PF,10%,100V                   | 04222        | MA101C102KAA     |
| A1C919        | 281-0852-00           |                                            | CAP,FXD,CER DI:1800PF,10%,100VDC                 | 04222        | MA101C182KAA     |
| A1C922        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C925        | 290-0973-00           |                                            | CAP,FXD,ELCTLT:100UF,20%,25VDC                   | 55680        | ULB1E101MPA      |
| A1C940        | 290-0922-00           |                                            | CAP,FXD,ELCTLT:1000UF,20%,50V                    | 55680        | ULB1E102TFAANA   |
| A1C941        | 285-1460-00           |                                            | CAP,FXD,MTLZD:0.1UF,20%,250V,5MM LEAD<br>SPACING | TK1913       | MKS 2 0.1/250/20 |
| A1C942        | 290-0768-00           |                                            | CAP,FXD,ELCTLT:10UF,+50-20%,100WVDC              | 54473        | ECE-A100V10L     |
| A1C943        | 290-0768-00           |                                            | CAP,FXD,ELCTLT:10UF,+50-20%,100WVDC              | 54473        | ECE-A100V10L     |
| A1C944        | 290-0183-00           |                                            | CAP,FXD,ELCTLT:1UF,10%,35V                       | 05397        | T3228105K035AS   |
| A1C945        | 281-0775-01           |                                            | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222        | SA105E104MAA     |
| A1C954        | 290-0947-00           |                                            | CAP,FXD,ELCTLT:33UF,+50-10%,160V W/SLEEVE        | 55680        | UHC2C330TFA      |
| A1C956        | 290-0768-00           |                                            | CAP,FXD,ELCTLT:10UF,+50-20%,100WVDC              | 54473        | ECE-A100V10L     |
| A1C957        | 290-0946-00           |                                            | CAP,FXD,ELCTLT:270UF,+100-10%,40V                | 00853        | 301EN271W040B2   |
| A1C960        | 290-1129-00           |                                            | CAP,FXD,ELCTLT:1000UF,+100%-10%,12V              | 56289        | ORDER BY DESCR   |
| A1C961        | 290-1129-00           |                                            | CAP,FXD,ELCTLT:1000UF,+100%-10%,12V              | 56289        | ORDER BY DESCR   |
| A1C962        | 290-1129-00           |                                            | CAP,FXD,ELCTLT:1000UF,+100%-10%,12V              | 56289        | ORDER BY DESCR   |
| A1C963        | 290-1129-00           |                                            | CAP,FXD,ELCTLT:1000UF,+100%-10%,12V              | 56289        | ORDER BY DESCR   |
| A1C968        | 290-1129-00           |                                            | CAP,FXD,ELCTLT:1000UF,+100%-10%,12V              | 56289        | ORDER BY DESCR   |
| A1C970        | 290-0989-00           |                                            | CAP,FXD,ELCTLT:4700UF,20%,10V                    | TK0510       | ECEA1AS472       |
| A1C975        | 285-1255-00           |                                            | CAP,FXD,PLASTIC:0.01UF,20%,3KV                   | 56289        | 430P582          |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Dscont | Name & Description                                     | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|-----------------------------------------|--------------------------------------------------------|--------------|-----------------|
| A1C976        | 285-1255-00           |                                         | CAP,FXD,PLASTIC:0.01UF,20%,3KV                         | 56289        | 430P582         |
| A1C979        | 285-1255-00           |                                         | CAP,FXD,PLASTIC:0.01UF,20%,3KV                         | 56289        | 430P582         |
| A1C987        | 285-1100-00           |                                         | CAP,FXD,PLASTIC:0.022UF,5%,200V                        | 19396        | 223J02PT485     |
| A1CR133       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR183       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR200       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR201       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR202       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR203       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR226       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR227       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR228       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR229       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR372       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR393       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR399       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR405       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR406       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR409       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR414       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR415       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR419       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR467       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR476       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR477       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR501       | 152-0075-00           |                                         | SEMICON DVC,DI:SW,GE,22V,80MW,DO-7                     | 80009        | 152-0075-00     |
| A1CR502       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR503       | 152-0951-00           |                                         | DIODE,SIG:SCHTKY,;60V,2.25PF;1N6263(HSCH1001),DO-35,TR | 80009        | 152-0951-00     |
| A1CR508       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR509       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR514       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR518       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR529       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR551       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR564       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR641       | 152-0951-00           |                                         | DIODE,SIG:SCHTKY,;60V,2.25PF;1N6263(HSCH1001),DO-35,TR | 80009        | 152-0951-00     |
| A1CR647       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR648       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR649       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR712       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR731       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR764       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR770       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR780       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR805       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR818       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR820       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR823       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR824       | 152-0951-00           |                                         | DIODE,SIG:SCHTKY,;60V,2.25PF;1N6263(HSCH1001),DO-35,TR | 80009        | 152-0951-00     |
| A1CR825       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR829       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR840       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR845       | 152-0141-02           |                                         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35               | 03508        | DA2527 (1N4152) |
| A1CR851       | 152-0400-00           |                                         | SEMICON DVC,DI:RECT,SI,400V,1A                         | 14552        | MB2501          |
| A1CR853       | 152-0400-00           |                                         | SEMICON DVC,DI:RECT,SI,400V,1A                         | 14552        | MB2501          |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                       | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|--------------------------------------------|------------------------------------------|--------------|-----------------|
| A1CR854       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR855       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR882       | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 | 03508        | DA2527 (1N4152) |
| A1CR901       | 152-0040-00           |                                            | SEMICON DVC,DI:RECT,SI,600V,1A,DO-41     | 80009        | 152-0040-00     |
| A1CR902       | 152-0040-00           |                                            | SEMICON DVC,DI:RECT,SI,600V,1A,DO-41     | 80009        | 152-0040-00     |
| A1CR903       | 152-0040-00           |                                            | SEMICON DVC,DI:RECT,SI,600V,1A,DO-41     | 80009        | 152-0040-00     |
| A1CR904       | 152-0040-00           |                                            | SEMICON DVC,DI:RECT,SI,600V,1A,DO-41     | 80009        | 152-0040-00     |
| A1CR907       | 152-0661-01           |                                            | SEMICON DVC,DI:RECT,SI,600V,3A           | 80009        | 152-0661-01     |
| A1CR908       | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 | 03508        | DA2527 (1N4152) |
| A1CR920       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR946       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR947       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR948       | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35 | 03508        | DA2527 (1N4152) |
| A1CR954       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR955       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR956       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR957       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR960       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR961       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR962       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR963       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR965       | 152-0400-00           |                                            | SEMICON DVC,DI:RECT,SI,400V,1A           | 14552        | MB2501          |
| A1CR967       | 152-0581-00           |                                            | SEMICON DVC,DI:RECT,SI,20V,1A,A59        | 80009        | 152-0581-00     |
| A1CR970       | 152-0581-04           |                                            | SEMICON DVC,DI:RECT,SI,20V,1A,A59        | 04713        | 1N5817RL        |
| A1DS856       | 150-0035-00           |                                            | LAMP,GLOW:90V MAX,0.3MA,AID-T,WIRE LD    | 71744        | A1B-120         |
| A1DS858       | 150-0035-00           |                                            | LAMP,GLOW:90V MAX,0.3MA,AID-T,WIRE LD    | 71744        | A1B-120         |
| A1DS870       | 150-0035-00           |                                            | LAMP,GLOW:90V MAX,0.3MA,AID-T,WIRE LD    | 71744        | A1B-120         |
| A1E200        | 276-0752-00           |                                            | CORE,EM:FERRITE                          | 34899        | 2743001111      |
| A1E201        | 276-0752-00           |                                            | CORE,EM:FERRITE                          | 34899        | 2743001111      |
| A1E272        | 276-0752-00           |                                            | CORE,EM:FERRITE                          | 34899        | 2743001111      |
| A1E590        | 276-0752-00           |                                            | CORE,EM:FERRITE                          | 34899        | 2743001111      |
| A1E970        | 276-0635-00           |                                            | CORE,EM:TOROID,FERRITE                   | 02114        | 768 T188/3E2A   |
| A1J2222       | 136-0949-00           |                                            | SKT,PL-IN ELEK:18 POS,SIP,LOW PROFILE    | 80009        | 136-0949-00     |
| A1J2223       | 136-0949-00           |                                            | SKT,PL-IN ELEK:18 POS,SIP,LOW PROFILE    | 80009        | 136-0949-00     |
| A1J2300       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J2400       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J2500       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J2600       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J2700       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J2850       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9103       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9108       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9400       | 131-4888-00           |                                            | CONN,RCPT,ELEC:HEADER,1 X 15             | 80009        | 131-4888-00     |
| A1J9644       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9870       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9882       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1J9884       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL | 22526        | 48283-029       |
| A1L266        | 108-1488-00           |                                            | COIL,RF:FXD,1UH,10%                      | 80009        | 108-1488-00     |
| A1L267        | 108-1488-00           |                                            | COIL,RF:FXD,1UH,10%                      | 80009        | 108-1488-00     |
| A1L451        | 108-1488-00           |                                            | COIL,RF:FXD,1UH,10%                      | 80009        | 108-1488-00     |
| A1L499        | 108-1488-00           |                                            | COIL,RF:FXD,1UH,10%                      | 80009        | 108-1488-00     |
| A1L956        | 108-1319-00           |                                            | INDUCTOR,FIXED:33UH,10%,1.8A             | 80009        | 108-1319-00     |
| A1L960        | 108-1319-00           |                                            | INDUCTOR,FIXED:33UH,10%,1.8A             | 80009        | 108-1319-00     |
| A1L961        | 108-1319-00           |                                            | INDUCTOR,FIXED:33UH,10%,1.8A             | 80009        | 108-1319-00     |
| A1L968        | 108-1319-00           |                                            | INDUCTOR,FIXED:33UH,10%,1.8A             | 80009        | 108-1319-00     |
| A1Q102        | 151-0712-00           |                                            | TRANSISTOR:PNP,SI,TO-92                  | 80009        | 151-0712-00     |
| A1Q103        | 151-0712-00           |                                            | TRANSISTOR:PNP,SI,TO-92                  | 80009        | 151-0712-00     |
| A1Q114        | 151-0190-00           |                                            | TRANSISTOR:NPN,SI,TO-92                  | 80009        | 151-0190-00     |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Dscont | Name & Description                                                                     | Mfr.<br>Code | Mfr. Part No. |
|---------------|-----------------------|-----------------------------------------|----------------------------------------------------------------------------------------|--------------|---------------|
| A1Q115        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q152        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q153        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q164        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q165        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q202        | 151-0944-00           |                                         | TRANSISTOR,SIG:BIPOAR,NPN;15V,30A,4.5GHZ;M<br>PS901,TO-92,(BEC PINOUT)TAPE & AMMO PACK | 80009        | 151-0944-00   |
| A1Q203        | 151-0944-00           |                                         | TRANSISTOR,SIG:BIPOAR,NPN;15V,30A,4.5GHZ;M<br>PS901,TO-92,(BEC PINOUT)TAPE & AMMO PACK | 80009        | 151-0944-00   |
| A1Q206        | 151-0369-00           |                                         | TRANSISTOR:PNP,SI,X-55                                                                 | 80009        | 151-0369-00   |
| A1Q207        | 151-0369-00           |                                         | TRANSISTOR:PNP,SI,X-55                                                                 | 80009        | 151-0369-00   |
| A1Q230        | 151-0271-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0271-00   |
| A1Q231        | 151-0271-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0271-00   |
| A1Q254        | 151-0752-01           |                                         | TRANSISTOR:NPN,SI,MARCO T                                                              | 04713        | SRF3188       |
| A1Q255        | 151-0752-01           |                                         | TRANSISTOR:NPN,SI,MARCO T                                                              | 04713        | SRF3188       |
| A1Q256        | 151-0752-00           |                                         | TRANSISTOR:NPN,SI,MARCO T                                                              | 25403        | BFR96         |
| A1Q257        | 151-0752-00           |                                         | TRANSISTOR:NPN,SI,MARCO T                                                              | 25403        | BFR96         |
| A1Q283        | 151-0736-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0736-00   |
| A1Q284        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q285        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q302        |                       |                                         | Q302 & Q303 MATCHED                                                                    |              |               |
| A1Q302        | 151-0711-01           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 04713        | SPS8608M      |
| A1Q327        |                       |                                         | Q327 & Q328 MATCHED                                                                    |              |               |
| A1Q327        | 151-0711-01           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 04713        | SPS8608M      |
| A1Q328        | 151-0711-01           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 04713        | SPS8608M      |
| A1Q369        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q381        | 151-1042-01           |                                         | SEMICON DVC SE:FET,SI,TO-92                                                            | 22229        |               |
| A1Q382        | 151-1042-00           |                                         | SEMICON DVC SE:FET,SI,TO-92<br>(LOCATIONS A & B)                                       | 80009        | 151-1042-00   |
| A1Q384        | 151-0711-02           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0711-02   |
| A1Q392        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q397        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q399        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q400        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q402        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q406        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q409        | 151-0711-00           |                                         | TRANSISTOR:NPN,SI,TO-92B                                                               | 80009        | 151-0711-00   |
| A1Q409        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q413        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q419        | 151-0711-00           |                                         | TRANSISTOR:NPN,SI,TO-92B                                                               | 80009        | 151-0711-00   |
| A1Q420        | 151-0711-02           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0711-02   |
| A1Q421        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q422        | 151-0199-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0199-00   |
| A1Q423        | 151-0424-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0424-00   |
| A1Q428        | 151-0711-00           |                                         | TRANSISTOR:NPN,SI,TO-92B                                                               | 80009        | 151-0711-00   |
| A1Q429        | 151-0712-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0712-00   |
| A1Q440        | 151-0711-00           |                                         | TRANSISTOR:NPN,SI,TO-92B                                                               | 80009        | 151-0711-00   |
| A1Q441        | 151-0711-00           |                                         | TRANSISTOR:NPN,SI,TO-92B                                                               | 80009        | 151-0711-00   |
| A1Q446        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q450        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q473        | 151-0276-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0276-00   |
| A1Q474        | 151-0276-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0276-00   |
| A1Q476        | 151-0190-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0190-00   |
| A1Q477        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q487        | 151-0424-00           |                                         | TRANSISTOR:NPN,SI,TO-92                                                                | 80009        | 151-0424-00   |
| A1Q501        | 151-0216-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0216-00   |
| A1Q509        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |
| A1Q511        | 151-0188-00           |                                         | TRANSISTOR:PNP,SI,TO-92                                                                | 80009        | 151-0188-00   |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No. |         | Name & Description                                   | Mfr.<br>Code | Mfr. Part No.  |
|---------------|-----------------------|---------------------|---------|------------------------------------------------------|--------------|----------------|
|               |                       | Effective           | Discont |                                                      |              |                |
| A1Q525        | 151-0190-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0190-00    |
| A1Q555        | 151-0190-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0190-00    |
| A1Q576        | 151-0199-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0199-00    |
| A1Q578        | 151-0199-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0199-00    |
| A1Q583        | 151-0198-00           |                     |         | TRANSISTOR:SELECTED                                  | 80009        | 151-0198-00    |
| A1Q586        | 151-0198-00           |                     |         | TRANSISTOR:SELECTED                                  | 80009        | 151-0198-00    |
| A1Q641        | 151-0190-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0190-00    |
| A1Q768        | 151-0190-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0190-00    |
| A1Q770        | 151-0221-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0221-00    |
| A1Q775        | 151-0347-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0347-00    |
| A1Q778        | 151-0188-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0188-00    |
| A1Q779        | 151-0350-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 04713        | 2N5401         |
| A1Q780        | 151-0424-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0424-00    |
| A1Q785        | 151-0347-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0347-00    |
| A1Q789        | 151-0350-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 04713        | 2N5401         |
| A1Q804        | 151-0188-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0188-00    |
| A1Q814        | 151-0188-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0188-00    |
| A1Q825        | 151-0424-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0424-00    |
| A1Q829        | 151-0199-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0199-00    |
| A1Q835        | 151-0199-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0199-00    |
| A1Q840        | 151-0347-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0347-00    |
| A1Q845        | 151-0350-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 04713        | 2N5401         |
| A1Q882        | 151-0736-00           |                     |         | TRANSISTOR:NPN,SI,TO-92                              | 80009        | 151-0736-00    |
| A1Q885        | 151-0443-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0443-00    |
| A1Q908        | 151-0164-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 04713        | MPS2907A       |
| A1Q928        | 151-0432-00           |                     |         | TRANSISTOR:NPN,SI,625MW,TO-92                        | 27014        | T07391E2       |
| A1Q930        | 151-0164-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 04713        | MPS2907A       |
| A1Q935        | 151-0565-00           |                     |         | THYRISTOR,SCR:8A,200V,SENS GATE,TO-220<br>W/LEADFORM | 80009        | 151-0565-00    |
| A1Q938        | 151-0276-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0276-00    |
| A1Q939        | 151-0276-00           |                     |         | TRANSISTOR:PNP,SI,TO-92                              | 80009        | 151-0276-00    |
| A1Q944        | 151-0432-00           |                     |         | TRANSISTOR:NPN,SI,625MW,TO-92                        | 27014        | T07391E2       |
| A1Q946        | 151-0852-00           |                     |         | TRANSISTOR:                                          | 80009        | 151-0852-00    |
| A1Q947        | 151-0852-00           |                     |         | TRANSISTOR:                                          | 80009        | 151-0852-00    |
| A1Q9070       | 151-1245-00           |                     |         | TRANSISTOR:MOSFET,N-CHAN,TO-220                      | 80009        | 151-1245-00    |
| A1R100        | 313-1430-00           |                     |         | RES,FXD,FILM:43 OHM,5%,0.2W                          | 57668        | TR20JT68 43E   |
| A1R101        | 313-1430-00           |                     |         | RES,FXD,FILM:43 OHM,5%,0.2W                          | 57668        | TR20JT68 43E   |
| A1R102        | 322-3155-00           |                     |         | RES,FXD,FILM:402 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 402E |
| A1R103        | 322-3155-00           |                     |         | RES,FXD,FILM:402 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 402E |
| A1R104        | 322-3101-00           |                     |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO                   | 91637        | CCF50-26110R0F |
| A1R105        | 322-3101-00           |                     |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO                   | 91637        | CCF50-26110R0F |
| A1R106        | 322-3161-00           |                     |         | RES,FXD,FILM:464 OHM,1%,0.2W,TC=TO                   | 91637        | CCF50-26464R0F |
| A1R108        | 322-3223-00           |                     |         | RES,FXD,FILM:2.05K OHM,1%,0.2W,TC=TO                 | 57668        | CRB20 FXE 2K05 |
| A1R109        | 322-3221-00           |                     |         | RES,FXD,FILM:1.96K OHM,1%,0.2W,TC=TO                 | 80009        | 322-3221-00    |
| A1R113        | 322-3193-00           |                     |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 1K00 |
| A1R114        | 322-3210-00           |                     |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                  | 57668        | CRB20 FXE 1K50 |
| A1R115        | 322-3210-00           |                     |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                  | 57668        | CRB20 FXE 1K50 |
| A1R116        | 313-1511-00           |                     |         | RES,FXD,FILM:510 OHM,5%,0.2W                         | 57668        | TR20JT68 510E  |
| A1R117        | 322-3193-00           |                     |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 1K00 |
| A1R118        | 322-3193-00           |                     |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 1K00 |
| A1R119        | 322-3293-00           |                     |         | RES,FXD,FILM:11K OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 11K0 |
| A1R120        | 322-3123-00           |                     |         | RES,FXD,FILM:187 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 187E |
| A1R121        | 322-3123-00           |                     |         | RES,FXD,FILM:187 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 187E |
| A1R122        | 313-1820-00           |                     |         | RES,FXD,FILM:82 OHM,5%,0.2W                          | 57668        | TR20JE 82E     |
| A1R123        | 313-1622-00           |                     |         | RES,FXD,FILM:6.2K OHM,5%,0.2W                        | 57668        | TR20JE 06K2    |
| A1R124        | 313-1622-00           |                     |         | RES,FXD,FILM:6.2K OHM,5%,0.2W                        | 57668        | TR20JE 06K2    |
| A1R125        | 322-3172-00           |                     |         | RES,FXD,FILM:604 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 604E |
| A1R126        | 322-3160-00           |                     |         | RES,FXD,FILM:453 OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 453E |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective | Discont | Name & Description                   | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|-------------------------------|---------|--------------------------------------|-----------|----------------|
| A1R127        | 322-3212-00        |                               |         | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K58 |
| A1R130        | 313-1510-00        |                               |         | RES,FXD,FILM:51 OHM,5%,0.2W          | 80009     | 313-1510-00    |
| A1R131        | 313-1510-00        |                               |         | RES,FXD,FILM:51 OHM,5%,0.2W          | 80009     | 313-1510-00    |
| A1R132        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W         | 57668     | TR20JT68 510E  |
| A1R133        | 322-3101-00        |                               |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G110R0F |
| A1R135        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R136        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R138        | 313-1182-00        |                               |         | RES,FXD,FILM:1.8K OHM 5%,0.2W        | 57668     | TR20JT681K8    |
| A1R139        | 313-1302-00        |                               |         | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668     | TR20JE 03K0    |
| A1R142        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R143        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R144        | 313-1471-00        |                               |         | RES,FXD,FILM:470 OHM,5%,0.2W         | 57668     | TR20JE 470E    |
| A1R145        | 311-2271-00        |                               |         | RES,VAR,NONWV:TRMR,5K OHM,20%,0.5W   | 80009     | 311-2271-00    |
| A1R150        | 313-1430-00        |                               |         | RES,FXD,FILM:43 OHM,5%,0.2W          | 57668     | TR20JT68 43E   |
| A1R151        | 313-1430-00        |                               |         | RES,FXD,FILM:43 OHM,5%,0.2W          | 57668     | TR20JT68 43E   |
| A1R152        | 322-3155-00        |                               |         | RES,FXD,FILM:402 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 402E |
| A1R153        | 322-3155-00        |                               |         | RES,FXD,FILM:402 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 402E |
| A1R154        | 322-3101-00        |                               |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G110R0F |
| A1R155        | 322-3101-00        |                               |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G110R0F |
| A1R156        | 322-3161-00        |                               |         | RES,FXD,FILM:464 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G464R0F |
| A1R158        | 322-3223-00        |                               |         | RES,FXD,FILM:2.05K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 2K05 |
| A1R159        | 322-3221-00        |                               |         | RES,FXD,FILM:1.96K OHM,1%,0.2W,TC=TO | 80009     | 322-3221-00    |
| A1R163        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R164        | 322-3210-00        |                               |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K50 |
| A1R165        | 322-3210-00        |                               |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K50 |
| A1R166        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W         | 57668     | TR20JT68 510E  |
| A1R167        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R168        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R169        | 322-3293-00        |                               |         | RES,FXD,FILM:11K OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 11K0 |
| A1R170        | 322-3123-00        |                               |         | RES,FXD,FILM:187 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 187E |
| A1R171        | 322-3123-00        |                               |         | RES,FXD,FILM:187 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 187E |
| A1R172        | 313-1820-00        |                               |         | RES,FXD,FILM:82 OHM,5%,0.2W          | 57668     | TR20JE 82E     |
| A1R173        | 313-1622-00        |                               |         | RES,FXD,FILM:6.2K OHM,5%,0.2W        | 57668     | TR20JE 06K2    |
| A1R174        | 313-1622-00        |                               |         | RES,FXD,FILM:6.2K OHM,5%,0.2W        | 57668     | TR20JE 06K2    |
| A1R175        | 322-3172-00        |                               |         | RES,FXD,FILM:604 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 604E |
| A1R176        | 322-3160-00        |                               |         | RES,FXD,FILM:453 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 453E |
| A1R177        | 322-3212-00        |                               |         | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K58 |
| A1R180        | 313-1510-00        |                               |         | RES,FXD,FILM:51 OHM,5%,0.2W          | 80009     | 313-1510-00    |
| A1R181        | 313-1510-00        |                               |         | RES,FXD,FILM:51 OHM,5%,0.2W          | 80009     | 313-1510-00    |
| A1R182        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W         | 57668     | TR20JT68 510E  |
| A1R183        | 322-3101-00        |                               |         | RES,FXD,FILM:110 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G110R0F |
| A1R185        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R186        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R188        | 313-1182-00        |                               |         | RES,FXD,FILM:1.8K OHM 5%,0.2W        | 57668     | TR20JT681K8    |
| A1R189        | 313-1302-00        |                               |         | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668     | TR20JE 03K0    |
| A1R192        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R193        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R194        | 313-1471-00        |                               |         | RES,FXD,FILM:470 OHM,5%,0.2W         | 57668     | TR20JE 470E    |
| A1R195        | 311-2271-00        |                               |         | RES,VAR,NONWV:TRMR,5K OHM,20%,0.5W   | 80009     | 311-2271-00    |
| A1R200        | 313-1911-00        |                               |         | RES,FXD,FILM:910 OHM,5%,0.2W         | 57668     | TR20JE910E     |
| A1R202        | 322-3178-00        |                               |         | RES,FXD,FILM:698 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G698R0F |
| A1R203        | 322-3178-00        |                               |         | RES,FXD,FILM:698 OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2G698R0F |
| A1R204        | 322-3089-00        |                               |         | RES,FXD,FILM:82.5 OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 82E5 |
| A1R206        | 322-3139-00        |                               |         | RES,FXD,FILM:274 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 274E |
| A1R207        | 322-3139-00        |                               |         | RES,FXD,FILM:274 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 274E |
| A1R210        | 313-1121-00        | B010100                       | B010245 | RES,FXD,FILM:120 OHM,5%,0.2W         | 80009     | 313-1121-00    |
| A1R210        | 313-1271-00        | B010246                       |         | RES,FXD,FILM:270 OHM,5%,0.2W         | 57668     | TR20JE 270E    |
| A1R212        | 322-3086-00        |                               |         | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO  | 91637     | CCF50-2G768R0F |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                        | Mfr.<br>Code | Mfr. Part No.    |
|---------------|-----------------------|--------------------------------------------|-------------------------------------------|--------------|------------------|
| A1R213        | 322-3086-00           |                                            | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO       | 91637        | CCF50-2G76R80F   |
| A1R215        | 322-3135-00           |                                            | RES,FXD,FILM:249 OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 249E   |
| A1R216        | 322-3163-00           |                                            | RES,FXD,FILM:487 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2G487R0F   |
| A1R217        | 322-3163-00           |                                            | RES,FXD,FILM:487 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2G487R0F   |
| A1R218        | 322-3102-00           |                                            | RES,FXD,FILM:113 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2F113R0F   |
| A1R219        | 322-3102-00           |                                            | RES,FXD,FILM:113 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2F113R0F   |
| A1R220        | 307-0104-00           |                                            | RES,FXD,CMPSN:3.3 OHM,5%,0.25W            | 01121        | CB33G5           |
| A1R222        | 322-3318-00           |                                            | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 20K0   |
| A1R223        | 322-3318-00           |                                            | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 20K0   |
| A1R225        | 322-3289-00           |                                            | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 10K0   |
| A1R226        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R227        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R230        | 322-3086-00           |                                            | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO       | 91637        | CCF50-2G76R80F   |
| A1R231        | 322-3086-00           |                                            | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO       | 91637        | CCF50-2G76R80F   |
| A1R233        | 322-3086-00           |                                            | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO       | 91637        | CCF50-2G76R80F   |
| A1R234        | 313-1360-00           |                                            | RES,FXD,FILM:36 OHM,5%,0.2W               | 57668        | TR20JE 36E       |
| A1R235        | 313-1360-00           |                                            | RES,FXD,FILM:36 OHM,5%,0.2W               | 57668        | TR20JE 36E       |
| A1R236        | 313-1821-00           |                                            | RES,FXD,FILM:820 OHM,5%,0.2W              | 57668        | TR20JE 820E      |
| A1R239        | 313-1242-00           |                                            | RES,FXD,FILM:2.4K OHM,5%,0.2W             | 57668        | TR20JE 02K4      |
| A1R240        | 311-2257-00           |                                            | RES,VAR,NONW:TRMR,500 OHM,20%,0.5W        | 80009        | 311-2257-00      |
| A1R241        | 311-2273-00           |                                            | RES,VAR,NONW:TRMR,2K OHM,20%,0.5W         | 80009        | 311-2273-00      |
| A1R242        | 313-1273-00           |                                            | RES,FXD,FILM:27K OHM,5%,0.2W              | 57668        | TR20JE 27K       |
| A1R244        | 322-3172-00           |                                            | RES,FXD,FILM:604 OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 604E   |
| A1R245        | 322-3172-00           |                                            | RES,FXD,FILM:604 OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 604E   |
| A1R250        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R251        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R254        | 322-3110-00           |                                            | RES,FXD,FILM:137 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2G137R0F   |
| A1R255        | 322-3110-00           |                                            | RES,FXD,FILM:137 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2G137R0F   |
| A1R256        | 322-0175-00           |                                            | RES,FXD,FILM:649 OHM,1%,0.25W,TC=TO       | 75042        | CEBT0-6490F      |
| A1R257        | 322-0175-00           |                                            | RES,FXD,FILM:649 OHM,1%,0.25W,TC=TO       | 75042        | CEBT0-6490F      |
| A1R258        | 322-0180-00           |                                            | RES,FXD,FILM:732 OHM,1%,0.25W,TC=TO       | 75042        | CEBT0-7320F      |
| A1R259        | 322-0180-00           |                                            | RES,FXD,FILM:732 OHM,1%,0.25W,TC=TO       | 75042        | CEBT0-7320F      |
| A1R261        | 323-0058-00           |                                            | RES,FXD,FILM:39.2 OHM,1%,0.5W,TC=TO       | 57668        | CRB11FX39R2E     |
| A1R262        | 322-3114-00           |                                            | RES,FXD,FILM:150 OHM,1%,0.2W,TC=TO        | 57668        | CRB20FX150EAXIAL |
| A1R266        | 307-1502-02           |                                            | NTWK,HYBRID CKT:VERTICAL OUTPUT SUBSTRATE | 17735        | 1669A            |
| A1R279        | 313-1223-00           |                                            | RES,FXD,FILM:22K,OHM,5%,0.2W              | 57668        | TR20JE 22K       |
| A1R281        | 313-1821-00           |                                            | RES,FXD,FILM:820 OHM,5%,0.2W              | 57668        | TR20JE 820E      |
| A1R282        | 322-3277-00           |                                            | RES,FXD,FILM:7.5K OHM,1%,0.2W,TC=TO       | 57668        | CRB20 FXE 7K50   |
| A1R283        | 313-1471-00           |                                            | RES,FXD,FILM:470 OHM,5%,0.2W              | 57668        | TR20JE 470E      |
| A1R284        | 313-1621-00           |                                            | RES,FXD,FILM:620 OHM,5%,0.2W              | 57668        | TR20JE 620E      |
| A1R285        | 313-1561-00           |                                            | RES,FXD,FILM:560 OHM,5%,0.2W              | 57668        | TR20JE 560E      |
| A1R286        | 322-3068-00           |                                            | RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=TO       | 80009        | 322-3068-00      |
| A1R287        | 322-3068-00           |                                            | RES,FXD,FILM:49.9 OHM,1%,0.2W,TC=TO       | 80009        | 322-3068-00      |
| A1R288        | 313-1431-00           |                                            | RES,FXD,FILM:430 OHM,5%,0.2W              | 57668        | TR20JE 430E      |
| A1R289        | 313-1431-00           |                                            | RES,FXD,FILM:430 OHM,5%,0.2W              | 57668        | TR20JE 430E      |
| A1R292        | 322-3178-00           |                                            | RES,FXD,FILM:698 OHM,1%,0.2W,TC=TO        | 91637        | CCF50-2G698R0F   |
| A1R293        | 322-3085-00           |                                            | RES,FXD,FILM:75 OHM,1%,0.2W,TC=TO         | 57668        | CRB20 FXE 75E0   |
| A1R301        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R302        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R303        | 313-1221-00           |                                            | RES,FXD,FILM:220 OHM,5%,0.2W              | 57668        | TR20JE220E       |
| A1R304        | 322-3210-00           |                                            | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO       | 57668        | CRB20 FXE 1K50   |
| A1R305        | 322-3210-00           |                                            | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO       | 57668        | CRB20 FXE 1K50   |
| A1R306        | 313-1470-00           |                                            | RES,FXD,FILM:47 OHM,5%,0.2W               | 57668        | TR20JE 47E       |
| A1R307        | 313-1470-00           |                                            | RES,FXD,FILM:47 OHM,5%,0.2W               | 57668        | TR20JE 47E       |
| A1R309        | 311-2230-00           |                                            | RES,VAR,NONW:TRMR,500 OHM,20%,0.50 LINEAR | TK1450       | GF06UT 500       |
| A1R310        | 322-3193-00           |                                            | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO         | 57668        | CRB20 FXE 1K00   |
| A1R311        | 322-3193-00           |                                            | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO         | 57668        | CRB20 FXE 1K00   |
| A1R312        | 322-3098-00           |                                            | RES,FXD,FILM:102 OHM,1%,0.2W,TC=TO        | 57668        | CRB20 FXE 102E   |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Dscont | Name & Description                   | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|--------------------------------------|--------------------------------------|-----------|----------------|
| A1R314        | 322-3170-00        |                                      | RES,FXD,FILM:576 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 576E |
| A1R315        | 322-3170-00        |                                      | RES,FXD,FILM:576 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 576E |
| A1R317        | 322-3243-00        |                                      | RES,FXD,FILM:3.32K OHM,1%,0.2W,TC=TO | 80009     | 322-3243-00    |
| A1R318        | 322-3243-00        |                                      | RES,FXD,FILM:3.32K OHM,1%,0.2W,TC=TO | 80009     | 322-3243-00    |
| A1R319        | 322-3212-00        |                                      | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K58 |
| A1R320        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R321        | 322-3208-00        |                                      | RES,FXD,FILM:1.43K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K43 |
| A1R322        | 322-3238-00        |                                      | RES,FXD,FILM:2.94K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 2K94 |
| A1R324        | 322-3097-00        |                                      | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R326        | 313-1221-00        |                                      | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668     | TR20JE220E     |
| A1R327        | 313-1221-00        |                                      | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668     | TR20JE220E     |
| A1R328        | 313-1221-00        |                                      | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668     | TR20JE220E     |
| A1R329        | 322-3210-00        |                                      | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K50 |
| A1R330        | 322-3210-00        |                                      | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K50 |
| A1R331        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R332        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R335        | 322-3203-00        |                                      | RES,FXD,FILM:1.27K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K27 |
| A1R336        | 322-3203-00        |                                      | RES,FXD,FILM:1.27K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K27 |
| A1R337        | 322-3098-00        |                                      | RES,FXD,FILM:102 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 102E |
| A1R339        | 322-3170-00        |                                      | RES,FXD,FILM:576 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 576E |
| A1R340        | 322-3170-00        |                                      | RES,FXD,FILM:576 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 576E |
| A1R342        | 322-3243-00        |                                      | RES,FXD,FILM:3.32K OHM,1%,0.2W,TC=TO | 80009     | 322-3243-00    |
| A1R343        | 322-3243-00        |                                      | RES,FXD,FILM:3.32K OHM,1%,0.2W,TC=TO | 80009     | 322-3243-00    |
| A1R344        | 322-3212-00        |                                      | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K58 |
| A1R345        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R346        | 322-3208-00        |                                      | RES,FXD,FILM:1.43K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K43 |
| A1R347        | 322-3238-00        |                                      | RES,FXD,FILM:2.94K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 2K94 |
| A1R349        | 322-3097-00        |                                      | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R350        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R351        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R352        | 322-3274-00        |                                      | RES,FXD,FILM:6.98K OHM,1%,0.2W,TC=TO | 91637     | CCF502G69800FT |
| A1R353        | 322-3274-00        |                                      | RES,FXD,FILM:6.98K OHM,1%,0.2W,TC=TO | 91637     | CCF502G69800FT |
| A1R354        | 313-1272-00        |                                      | RES,FXD,FILM:1.27K OHM,5%,0.2W       | 57668     | TR20JE 02K7    |
| A1R356        | 313-1622-00        |                                      | RES,FXD,FILM:6.2K OHM,5%,0.2W        | 57668     | TR20JE 06K2    |
| A1R357        | 322-3149-00        |                                      | RES,FXD,FILM:348 OHM,1%,0.2W,TC=TO   | 80009     | 322-3149-00    |
| A1R358        | 322-3097-00        |                                      | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R359        | 322-3148-00        |                                      | RES,FXD,FILM:340 OHM,1%,0.2W,TC=TO   | 80009     | 322-3148-00    |
| A1R360        | 322-3156-00        |                                      | RES,FXD,FILM:412 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 412E |
| A1R361        | 322-3097-00        |                                      | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R363        | 313-1331-00        |                                      | RES,FXD,FILM:330 OHM,5%,0.2W         | 57668     | TR20JE 330E    |
| A1R364        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668     | TR20JE 03K0    |
| A1R365        | 313-1620-00        |                                      | RES,FXD,FILM:62 OHM,5%,0.2W          | 57668     | TR20JT6862E0   |
| A1R366        | 322-3222-00        |                                      | RES,FXD,FILM:2K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 2K00 |
| A1R367        | 313-1911-00        |                                      | RES,FXD,FILM:910 OHM,5%,0.2W         | 57668     | TR20JE910E     |
| A1R368        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R369        | 313-1301-00        |                                      | RES,FXD,FILM:300 OHM,5%,0.2W,MI      | 57668     | TR20JT68-300E  |
| A1R372        | 313-1220-00        |                                      | RES,FXD,FILM:22 OHM,5%,0.2W          | 57668     | TR20JE22E      |
| A1R373        | 322-3203-00        |                                      | RES,FXD,FILM:1.27K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K27 |
| A1R374        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R375        | 322-3289-00        |                                      | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 10K0 |
| A1R381        | 322-3444-00        |                                      | RES,FXD,FILM:412K OHM,1%,0.2W,TC=TO  | 91637     | CCF50-2F41202F |
| A1R382        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R383        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668     | TR20JE 03K0    |
| A1R384        | 313-1121-00        |                                      | RES,FXD,FILM:120 OHM,5%,0.2W         | 80009     | 313-1121-00    |
| A1R385        | 307-0106-00        |                                      | RES,FXD,CMPSN:4.7 OHM,5%,0.25W       | 01121     | CB 47G5        |
| A1R386        | 313-1911-00        |                                      | RES,FXD,FILM:910 OHM,5%,0.2W         | 57668     | TR20JE910E     |
| A1R387        | 311-2269-00        |                                      | RES,VAR,NONW:TRMR,20K OHM,20%,0.5W   | 80009     | 311-2269-00    |
| A1R388        | 313-1822-00        |                                      | RES,FXD,FILM:8.2K OHM,5%,0.2W        | 57668     | TR20JE 08K2    |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Discnt | Name & Description                   | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|-----------------------------------------|--------------------------------------|--------------|-----------------|
| A1R389        | 313-1100-00           |                                         | RES,FXD,FILM:10 OHM,5%,0.2W          | 57668        | TR20JE10E0      |
| A1R390        | 322-3097-00           |                                         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 100E  |
| A1R391        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R392        | 313-1301-00           |                                         | RES,FXD,FILM:300 OHM,5%,0.2W,MI      | 57668        | TR20JT68-300E   |
| A1R393        | 313-1160-00           |                                         | RES,FXD,FILM:16 OHM,0.5%,0.2W        | 80009        | 313-1160-00     |
| A1R394        | 313-1302-00           |                                         | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668        | TR20JE 03K0     |
| A1R395        | 313-1911-00           |                                         | RES,FXD,FILM:910 OHM,5%,0.2W         | 57668        | TR20JE910E      |
| A1R396        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R397        | 313-1220-00           |                                         | RES,FXD,FILM:22 OHM,5%,0.2W          | 57668        | TR20JE22E       |
| A1R398        | 313-1221-00           |                                         | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668        | TR20JE220E      |
| A1R399        | 313-1301-00           |                                         | RES,FXD,FILM:300 OHM,5%,0.2W,MI      | 57668        | TR20JT68-300E   |
| A1R400        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R402        | 313-1332-00           |                                         | RES,FXD,FILM:3.3K OHM,5%,0.2W        | 57668        | TR20JE 03K3     |
| A1R403        | 313-1512-00           |                                         | RES,FXD,FILM:5.1K OHM,5%,0.2W        | 57668        | TR20JE 5K1      |
| A1R404        | 313-1302-00           |                                         | RES,FXD,FILM:3K OHM,5%,0.2W          | 57668        | TR20JE 03K0     |
| A1R405        | 313-1391-00           |                                         | RES,FXD,FILM:390 OHM,5%,0.2W         | 57668        | TR20JE 390E     |
| A1R406        | 313-1391-00           |                                         | RES,FXD,FILM:390 OHM,5%,0.2W         | 57668        | TR20JE 390E     |
| A1R407        | 313-1220-00           |                                         | RES,FXD,FILM:22 OHM,5%,0.2W          | 57668        | TR20JE22E       |
| A1R408        | 322-3097-00           |                                         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 100E  |
| A1R409        | 313-1182-00           |                                         | RES,FXD,FILM:1.8K OHM 5%,0.2W        | 57668        | TR20JT681K8     |
| A1R410        | 322-3204-00           |                                         | RES,FXD,FILM:1.3K OHM,1%,0.2W,TC=TO  | 57668        | CRB20 FXE 1K30  |
| A1R411        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 10K0  |
| A1R412        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R413        | 322-3293-00           |                                         | RES,FXD,FILM:11K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 11K0  |
| A1R414        | 313-1244-00           |                                         | RES,FXD,FILM:240K OHM,5%,0.2W        | 57668        | TR20JE 240K     |
| A1R415        | 313-1244-00           |                                         | RES,FXD,FILM:240K OHM,5%,0.2W        | 57668        | TR20JE 240K     |
| A1R416        | 313-1473-00           |                                         | RES,FXD,FILM:47K OHM,5%,0.2W         | 57668        | TR20JE 47K      |
| A1R417        | 313-1473-00           |                                         | RES,FXD,FILM:47K OHM,5%,0.2W         | 57668        | TR20JE 47K      |
| A1R419        | 313-1182-00           |                                         | RES,FXD,FILM:1.8K OHM 5%,0.2W        | 57668        | TR20JT681K8     |
| A1R420        | 322-3097-00           |                                         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 100E  |
| A1R421        | 322-3306-00           |                                         | RES,FXD,FILM:15K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 15K0  |
| A1R422        | 313-1100-00           |                                         | RES,FXD,FILM:10 OHM,5%,0.2W          | 57668        | TR20JE10E0      |
| A1R423        | 313-1100-00           |                                         | RES,FXD,FILM:10 OHM,5%,0.2W          | 57668        | TR20JE10E0      |
| A1R424        | 322-3306-00           |                                         | RES,FXD,FILM:15K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 15K0  |
| A1R426        | 313-1434-00           |                                         | RES,FXD,FILM:430K OHM,5%,0.2W        | 91637        | CCF50-2-64303JT |
| A1R427        | 313-1434-00           |                                         | RES,FXD,FILM:430K OHM,5%,0.2W        | 91637        | CCF50-2-64303JT |
| A1R428        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R429        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668        | CRB20 FXE 1K00  |
| A1R431        | 313-1470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668        | TR20JE 47E      |
| A1R432        | 322-3385-00           |                                         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO  | 57668        | CRB20 FXE 100K  |
| A1R433        | 322-3385-00           |                                         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO  | 57668        | CRB20 FXE 100K  |
| A1R434        | 311-2262-00           |                                         | RES,VAR,NONWW:TRMR,1M OHM,20%,0.5W   | 80009        | 311-2262-00     |
| A1R435        | 311-2262-00           |                                         | RES,VAR,NONWW:TRMR,1M OHM,20%,0.5W   | 80009        | 311-2262-00     |
| A1R436        | 313-1242-00           |                                         | RES,FXD,FILM:2.4K OHM,5%,0.2W        | 57668        | TR20JE 02K4     |
| A1R437        | 313-1242-00           |                                         | RES,FXD,FILM:2.4K OHM,5%,0.2W        | 57668        | TR20JE 02K4     |
| A1R439        | 313-1470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668        | TR20JE 47E      |
| A1R440        | 322-3097-00           |                                         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 100E  |
| A1R441        | 322-3097-00           |                                         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 100E  |
| A1R442        | 322-3086-00           |                                         | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO  | 91637        | CCF50-2G76R80F  |
| A1R443        | 322-3086-00           |                                         | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO  | 91637        | CCF50-2G76R80F  |
| A1R444        | 322-3212-00           |                                         | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO | 57668        | CRB20 FXE 1K58  |
| A1R445        | 313-1470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668        | TR20JE 47E      |
| A1R446        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 10K0  |
| A1R447        | 322-3210-00           |                                         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668        | CRB20 FXE 1K50  |
| A1R448        | 313-1270-00           |                                         | RES,FXD,FILM:27 OHM 5%,0.2W          | 57668        | TR20JT68 27E    |
| A1R449        | 313-1270-00           |                                         | RES,FXD,FILM:27 OHM 5%,0.2W          | 57668        | TR20JT68 27E    |
| A1R450        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO   | 57668        | CRB20 FXE 10K0  |
| A1R452        | 322-3130-00           |                                         | RES,FXD,FILM:221 OHM,1%,0.2W,TC=TO   | 80009        | 322-3130-00     |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective | Discont | Name & Description                   | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|-------------------------------|---------|--------------------------------------|-----------|----------------|
| A1R453        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R455        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R457        | 322-3145-00        |                               |         | RES,FXD,FILM:316 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 316E |
| A1R458        | 322-3182-00        |                               |         | RES,FXD,FILM:768 OHM,1%,0.2W,TC=TO   | 80009     | 322-3182-00    |
| A1R459        | 322-3180-00        |                               |         | RES,FXD,FILM:732 OHM,1%,0.2W,TC=TO   | 80009     | 322-3180-00    |
| A1R460        | 322-3141-00        |                               |         | RES,FXD,FILM:287 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 287E |
| A1R461        | 322-3141-00        |                               |         | RES,FXD,FILM:287 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 287E |
| A1R462        | 322-3196-00        |                               |         | RES,FXD,FILM:1.07K OHM,1%,0.2W,TC=TO | 80009     | 322-3196-00    |
| A1R463        | 322-3215-00        |                               |         | RES,FXD,FILM:1.69K OHM,1%,0.2W,TC=TO | 80009     | 322-3215-00    |
| A1R464        | 313-1431-00        |                               |         | RES,FXD,FILM:430 OHM,5%,0.2W         | 57668     | TR20JE 430E    |
| A1R465        | 313-1431-00        |                               |         | RES,FXD,FILM:430 OHM,5%,0.2W         | 57668     | TR20JE 430E    |
| A1R467        | 313-1392-00        |                               |         | RES,FXD,FILM:3.9K OHM,5%,0.2W        | 57668     | TR20JE 03K9    |
| A1R468        | 313-1392-00        |                               |         | RES,FXD,FILM:3.9K OHM,5%,0.2W        | 57668     | TR20JE 03K9    |
| A1R469        | 313-1392-00        |                               |         | RES,FXD,FILM:3.9K OHM,5%,0.2W        | 57668     | TR20JE 03K9    |
| A1R470        | 313-1392-00        |                               |         | RES,FXD,FILM:3.9K OHM,5%,0.2W        | 57668     | TR20JE 03K9    |
| A1R473        | 313-1182-00        |                               |         | RES,FXD,FILM:1.8K OHM 5%,0.2W        | 57668     | TR20JT681K8    |
| A1R474        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R476        | 313-1301-00        |                               |         | RES,FXD,FILM:300 OHM,5%,0.2W,MI      | 57668     | TR20JT68-300E  |
| A1R477        | 322-3205-00        |                               |         | RES,FXD,FILM:1.33K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 1K33 |
| A1R478        | 322-3215-00        |                               |         | RES,FXD,FILM:1.69K OHM,1%,0.2W,TC=TO | 80009     | 322-3215-00    |
| A1R479        | 311-2273-00        |                               |         | RES,VAR,NONW:TRMR,2K OHM,20%,0.5W    | 80009     | 311-2273-00    |
| A1R480        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R481        | 313-1431-00        |                               |         | RES,FXD,FILM:430 OHM,5%,0.2W         | 57668     | TR20JE 430E    |
| A1R482        | 313-1221-00        |                               |         | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668     | TR20JE220E     |
| A1R486        | 313-1301-00        |                               |         | RES,FXD,FILM:300 OHM,5%,0.2W,MI      | 57668     | TR20JT68-300E  |
| A1R487        | 313-1221-00        |                               |         | RES,FXD,FILM:220 OHM,5%,0.2W         | 57668     | TR20JE220E     |
| A1R488        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W          | 57668     | TR20JE 47E     |
| A1R492        | 313-1270-00        |                               |         | RES,FXD,FILM:27 OHM 5%,0.2W          | 57668     | TR20JT68 27E   |
| A1R494        | 307-0104-00        |                               |         | RES,FXD,CMPSN:3.3 OHM,5%,0.25W       | 01121     | CB33G5         |
| A1R500        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 100E |
| A1R501        | 313-1512-00        |                               |         | RES,FXD,FILM:5.1K OHM,5%,0.2W        | 57668     | TR20JE 5K1     |
| A1R502        | 313-1911-00        |                               |         | RES,FXD,FILM:910 OHM,5%,0.2W         | 57668     | TR20JE910E     |
| A1R503        | 313-1222-00        |                               |         | RES,FXD,FILM:2.2K OHM,5%,0.2W        | 57668     | TR20JE 02K2    |
| A1R504        | 313-1124-00        |                               |         | RES,FXD,FILM:120K OHM,5%,0.2W        | 57668     | TR20JE120K     |
| A1R505        | 313-1473-00        |                               |         | RES,FXD,FILM:47K OHM,5%,0.2W         | 57668     | TR20JE 47K     |
| A1R506        | 322-3385-00        |                               |         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 100K |
| A1R507        | 313-1391-00        |                               |         | RES,FXD,FILM:390 OHM,5%,0.2W         | 57668     | TR20JE 390E    |
| A1R508        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R509        | 313-1222-00        |                               |         | RES,FXD,FILM:2.2K OHM,5%,0.2W        | 57668     | TR20JE 02K2    |
| A1R510        | 313-1471-00        |                               |         | RES,FXD,FILM:470 OHM,5%,0.2W         | 57668     | TR20JE 470E    |
| A1R511        | 313-1332-00        |                               |         | RES,FXD,FILM:3.3K OHM,5%,0.2W        | 57668     | TR20JE 03K3    |
| A1R512        | 313-1432-00        |                               |         | RES,FXD,FILM:4.3K OHM,5%,0.2W        | 57668     | TR20JE 04K3    |
| A1R513        | 313-1391-00        |                               |         | RES,FXD,FILM:390 OHM,5%,0.2W         | 57668     | TR20JE 390E    |
| A1R514        | 313-1471-00        |                               |         | RES,FXD,FILM:470 OHM,5%,0.2W         | 57668     | TR20JE 470E    |
| A1R516        | 313-1392-00        |                               |         | RES,FXD,FILM:3.9K OHM,5%,0.2W        | 57668     | TR20JE 03K9    |
| A1R517        | 313-1432-00        |                               |         | RES,FXD,FILM:4.3K OHM,5%,0.2W        | 57668     | TR20JE 04K3    |
| A1R518        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |
| A1R523        | 322-3306-00        |                               |         | RES,FXD,FILM:15K OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 15K0 |
| A1R524        | 322-3318-00        |                               |         | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 20K0 |
| A1R525        | 322-3322-00        |                               |         | RES,FXD,FILM:22.1K OHM,1%,0.2W,TC=TO | 57668     | CRB20 FXE 22K1 |
| A1R526        | 322-3210-00        |                               |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K50 |
| A1R527        | 313-1472-00        |                               |         | RES,FXD,FILM:4.7K OHM,5%,0.2W        | 57668     | TR20JE 04K7    |
| A1R528        | 322-3197-00        |                               |         | RES,FXD,FILM:1.1K OHM,1%,0.2W,TC=TO  | 57668     | CRB20 FXE 1K10 |
| A1R529        | 313-1822-00        |                               |         | RES,FXD,FILM:8.2K,OHM,5%,0.2W        | 57668     | TR20JE 08K2    |
| A1R540        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W         | 57668     | TR20JT68 510E  |
| A1R541        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W         | 57668     | TR20JT68 510E  |
| A1R544        | 313-1431-00        |                               |         | RES,FXD,FILM:430 OHM,5%,0.2W         | 57668     | TR20JE 430E    |
| A1R545        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K00 |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective | Discont | Name & Description                     | Mfr. Code | Mfr. Part No.    |
|---------------|--------------------|-------------------------------|---------|----------------------------------------|-----------|------------------|
| A1R547        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R548        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R549        | 313-1681-00        |                               |         | RES,FXD,FILM:680 OHM,5%,0.2W           | 57668     | TR20JE 680E      |
| A1R550        | 307-0445-00        |                               |         | RES NTK,FXD,FI:4.7K OHM,20%,(9)RES     | 32997     | 4310R-101-472    |
| A1R554        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R555        | 313-1821-00        |                               |         | RES,FXD,FILM:820 OHM,5%,0.2W           | 57668     | TR20JE 820E      |
| A1R564        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R565        | 313-1301-00        |                               |         | RES,FXD,FILM:300 OHM,5%,0.2W,MI        | 57668     | TR20JT68-300E    |
| A1R566        | 313-1511-00        |                               |         | RES,FXD,FILM:510 OHM,5%,0.2W           | 57668     | TR20JT68 510E    |
| A1R568        | 313-1332-00        |                               |         | RES,FXD,FILM:3.3K OHM,5%,0.2W          | 57668     | TR20JE 03K3      |
| A1R569        | 313-1432-00        |                               |         | RES,FXD,FILM:4.3K OHM,5%,0.2W          | 57668     | TR20JE 04K3      |
| A1R571        | 313-1222-00        |                               |         | RES,FXD,FILM:2.2K OHM,5%,0.2W          | 57668     | TR20JE 02K2      |
| A1R572        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R573        | 313-1222-00        |                               |         | RES,FXD,FILM:2.2K OHM,5%,0.2W          | 57668     | TR20JE 02K2      |
| A1R574        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R576        | 313-1561-00        |                               |         | RES,FXD,FILM:560 OHM,5%,0.2W           | 57668     | TR20JE 560E      |
| A1R577        | 313-1221-00        |                               |         | RES,FXD,FILM:220 OHM,5%,0.2W           | 57668     | TR20JE220E       |
| A1R578        | 313-1561-00        |                               |         | RES,FXD,FILM:560 OHM,5%,0.2W           | 57668     | TR20JE 560E      |
| A1R580        | 313-1181-00        |                               |         | RES,FXD,FILM:180 OHM,5%,0.2W           | 57668     | TR20JE180E       |
| A1R582        | 322-3114-00        |                               |         | RES,FXD,FILM:150 OHM,1%,0.2W,TC=TO     | 57668     | CRB20FX150EAXIAL |
| A1R583        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO     | 57668     | CRB20 FXE 100E   |
| A1R586        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO     | 57668     | CRB20 FXE 100E   |
| A1R591        | 313-1100-00        |                               |         | RES,FXD,FILM:10 OHM,5%,0.2W            | 57668     | TR20JE10E0       |
| A1R641        | 313-1472-00        |                               |         | RES,FXD,FILM:4.7K OHM,5%,0.2W          | 57668     | TR20JE 04K7      |
| A1R645        | 322-3126-00        |                               |         | RES,FXD,FILM:200 OHM,1%,0.2W,TC=TO     | 91637     | CCF501G200ROF    |
| A1R646        | 311-2258-00        |                               |         | RES,VAR,NONW:TRMR,1K OHM,20%,0.5W      | TK1450    | GF06VT 1 K OHM   |
| A1R647        | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO      | 57668     | CRB20 FXE 1K00   |
| A1R648        | 313-1512-00        |                               |         | RES,FXD,FILM:5.1K OHM,5%,0.2W          | 57668     | TR20JE 5K1       |
| A1R649        | 313-1512-00        |                               |         | RES,FXD,FILM:5.1K OHM,5%,0.2W          | 57668     | TR20JE 5K1       |
| A1R673        | 313-1472-00        |                               |         | RES,FXD,FILM:4.7K OHM,5%,0.2W          | 57668     | TR20JE 04K7      |
| A1R676        | 313-1471-00        |                               |         | RES,FXD,FILM:470 OHM,5%,0.2W           | 57668     | TR20JE 470E      |
| A1R757        | 322-3197-00        |                               |         | RES,FXD,FILM:1.1K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K10   |
| A1R763        | 322-3130-00        |                               |         | RES,FXD,FILM:221 OHM,1%,0.2W,TC=TO     | 80009     | 322-3130-00      |
| A1R764        | 322-3277-00        |                               |         | RES,FXD,FILM:7.5K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 7K50   |
| A1R766        | 322-3114-00        |                               |         | RES,FXD,FILM:150 OHM,1%,0.2W,TC=TO     | 57668     | CRB20FX150EAXIAL |
| A1R768        | 322-3155-00        |                               |         | RES,FXD,FILM:402 OHM,1%,0.2W,TC=TO     | 57668     | CRB20 FXE 402E   |
| A1R770        | 313-1181-00        |                               |         | RES,FXD,FILM:180 OHM,5%,0.2W           | 57668     | TR20JE180E       |
| A1R771        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W            | 57668     | TR20JE 47E       |
| A1R772        | 313-1302-00        |                               |         | RES,FXD,FILM:3K OHM,5%,0.2W            | 57668     | TR20JE 03K0      |
| A1R773        | 322-3182-00        |                               |         | RES,FXD,FILM:768 OHM,1%,0.2W,TC=TO     | 80009     | 322-3182-00      |
| A1R774        | 313-1332-00        |                               |         | RES,FXD,FILM:3.3K OHM,5%,0.2W          | 57668     | TR20JE 03K3      |
| A1R775        | 323-0310-00        |                               |         | RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=TO   | 75042     | CECTO-1652F      |
| A1R776        | 322-3204-00        |                               |         | RES,FXD,FILM:1.3K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K30   |
| A1R777        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W            | 57668     | TR20JE 47E       |
| A1R778        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO     | 57668     | CRB20 FXE 100E   |
| A1R779        | 313-1243-00        |                               |         | RES,FXD,FILM:24K OHM,5%,0.2W           | 80009     | 313-1243-00      |
| A1R780        | 313-1181-00        |                               |         | RES,FXD,FILM:180 OHM,5%,0.2W           | 57668     | TR20JE180E       |
| A1R781        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W            | 57668     | TR20JE 47E       |
| A1R782        | 321-0209-00        |                               |         | RES,FXD,FILM:1.47K OHM,1%,0.125W,TC=TO | 19701     | 5033ED1K47F      |
| A1R783        | 322-3203-00        |                               |         | RES,FXD,FILM:1.27K OHM,1%,0.2W,TC=TO   | 57668     | CRB20 FXE 1K27   |
| A1R784        | 313-1391-00        |                               |         | RES,FXD,FILM:390 OHM,5%,0.2W           | 57668     | TR20JE 390E      |
| A1R785        | 323-0310-00        |                               |         | RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=TO   | 75042     | CECTO-1652F      |
| A1R786        | 322-3204-00        |                               |         | RES,FXD,FILM:1.3K OHM,1%,0.2W,TC=TO    | 57668     | CRB20 FXE 1K30   |
| A1R787        | 313-1470-00        |                               |         | RES,FXD,FILM:47 OHM,5%,0.2W            | 57668     | TR20JE 47E       |
| A1R788        | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO     | 57668     | CRB20 FXE 100E   |
| A1R789        | 313-1243-00        |                               |         | RES,FXD,FILM:24K OHM,5%,0.2W           | 80009     | 313-1243-00      |
| A1R792        | 322-3263-00        |                               |         | RES,FXD,FILM:5.36K OHM,1%,0.2W,TC=TO   | 56845     | ORDER BY DESCR   |
| A1R793        | 322-3361-00        |                               |         | RES,FXD,FILM:56.2K OHM,1%,0.2W,TC=TO   | 91637     | CCF50-2F56201F   |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Discnt | Name & Description                          | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|--------------------------------------|---------------------------------------------|-----------|----------------|
| A1R796        | 313-1100-00        |                                      | RES,FXD,FILM:10 OHM,5%,0.2W                 | 57668     | TR20JE10E0     |
| A1R797        | 313-1100-00        |                                      | RES,FXD,FILM:10 OHM,5%,0.2W                 | 57668     | TR20JE10E0     |
| A1R799        | 313-1100-00        |                                      | RES,FXD,FILM:10 OHM,5%,0.2W                 | 57668     | TR20JE10E0     |
| A1R804        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 1K00 |
| A1R805        | 313-1562-00        |                                      | RES,FXD,FILM:5.6K OHM,5%,0.2W               | 57668     | TR20JE 05K6    |
| A1R814        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 1K00 |
| A1R818        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W                 | 57668     | TR20JE 03K0    |
| A1R820        | 313-1332-00        |                                      | RES,FXD,FILM:3.3K OHM,5%,0.2W               | 57668     | TR20JE 03K3    |
| A1R822        | 301-0512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.5W               | 19701     | 5053CX5K100J   |
| A1R823        | 301-0512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.5W               | 19701     | 5053CX5K100J   |
| A1R825        | 322-3085-00        |                                      | RES,FXD,FILM:75 OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 75E0 |
| A1R826        | 322-3385-00        |                                      | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO         | 57668     | CRB20 FXE 100K |
| A1R828        | 313-1620-00        |                                      | RES,FXD,FILM:62 OHM,5%,0.2W                 | 57668     | TR20JT6862E0   |
| A1R830        | 322-3212-00        |                                      | RES,FXD,FILM:1.58K OHM,1%,0.2W,TC=TO        | 57668     | CRB20 FXE 1K58 |
| A1R832        | 322-3222-00        |                                      | RES,FXD,FILM:2K OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 2K00 |
| A1R834        | 322-3097-00        |                                      | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO          | 57668     | CRB20 FXE 100E |
| A1R835        | 322-3228-00        |                                      | RES,FXD,FILM:2.32K OHM,1%,0.2W,TC=TO        | 57668     | CRB20 FXE 2K32 |
| A1R836        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 1K00 |
| A1R840        | 313-1561-00        |                                      | RES,FXD,FILM:560 OHM,5%,0.2W                | 57668     | TR20JE 560E    |
| A1R841        | 322-0322-00        |                                      | RES,FXD,FILM:22.1K OHM,1%,0.25W,TC=TO       | 19701     | 5034RD22K1     |
| A1R842        | 315-0241-00        |                                      | RES,FXD,FILM:240 OHM,5%,0.25W               | 19701     | 5043CX240R0J   |
| A1R843        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W                 | 57668     | TR20JE 03K0    |
| A1R844        | 322-3385-00        |                                      | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO         | 57668     | CRB20 FXE 100K |
| A1R845        | 313-1472-00        |                                      | RES,FXD,FILM:4.7K OHM,5%,0.2W               | 57668     | TR20JE 04K7    |
| A1R846        | 313-1512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.2W               | 57668     | TR20JE 5K1     |
| A1R849        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO           | 57668     | CRB20 FXE 1K00 |
| A1R851        | 311-2236-00        |                                      | RES,VAR,NONWW:TRMR,20K OHM,20%,0.5W LINEAR  | TK1450    | GF06UT 20K     |
| A1R852        | 322-3318-00        |                                      | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO          | 57668     | CRB20 FXE 20K0 |
| A1R853        | 315-0244-00        |                                      | RES,FXD,FILM:240K OHM,5%,0.25W              | 19701     | 5043CX240K0J   |
| A1R854        | 315-0472-03        |                                      | RES,FXD,CMPSN:4.7K OHM,5%,0.25W             | 01121     | CB4725         |
| A1R855        | 315-0102-00        |                                      | RES,FXD,FILM:1K OHM,5%,0.25W                | 57668     | NTR25JE01K0    |
| A1R858        | 315-0511-00        |                                      | RES,FXD,FILM:510 OHM,5%,0.25W               | 19701     | 5043CX510R0J   |
| A1R860        | 315-0625-00        |                                      | RES,FXD,FILM:6.2M OHM,5%,0.25W              | 01121     | CB6255         |
| A1R870        | 311-2239-00        |                                      | RES,VAR,NONWW:TRMR,100K OHM,20%,0.5W LINEAR | TK1450    | GF06UT 100K    |
| A1R871        | 315-0102-00        |                                      | RES,FXD,FILM:1K OHM,5%,0.25W                | 57668     | NTR25JE01K0    |
| A1R872        | 313-1223-00        |                                      | RES,FXD,FILM:22K OHM,5%,0.2W                | 57668     | TR20JE 22K     |
| A1R873        | 313-1513-00        |                                      | RES,FXD,CMPSN:51K OHM,5%,0.2W               | 57668     | TR20JE 51K     |
| A1R874        | 311-2239-00        |                                      | RES,VAR,NONWW:TRMR,100K OHM,20%,0.5W LINEAR | TK1450    | GF06UT 100K    |
| A1R875        | 315-0102-00        |                                      | RES,FXD,FILM:1K OHM,5%,0.25W                | 57668     | NTR25JE01K0    |
| A1R877        | 315-0102-00        |                                      | RES,FXD,FILM:1K OHM,5%,0.25W                | 57668     | NTR25JE01K0    |
| A1R880        | 322-3314-00        |                                      | RES,FXD,FILM:18.2K OHM,1%,0.2W,TC=TO        | 80009     | 322-3314-00    |
| A1R881        | 313-1220-00        |                                      | RES,FXD,FILM:22 OHM,5%,0.2W                 | 57668     | TR20JE22E      |
| A1R883        | 322-3314-00        |                                      | RES,FXD,FILM:18.2K OHM,1%,0.2W,TC=TO        | 80009     | 322-3314-00    |
| A1R884        | 322-3308-00        |                                      | RES,FXD,FILM:15.8K OHM,1%,0.2W,TC=TO        | 57668     | CRB20 FXE 15K8 |
| A1R885        | 313-1912-00        |                                      | RES,FXD,FILM:9.1K OHM,5%,0.2W               | 57668     | TR20 FXE 9.1K  |
| A1R886        | 315-0184-00        |                                      | RES,FXD,FILM:180K OHM,5%,0.25W              | 19701     | 5043CX180K0J   |
| A1R887        | 322-3354-00        |                                      | RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=TO        | 80009     | 322-3354-00    |
| A1R888        | 322-3318-00        |                                      | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO          | 57668     | CRB20 FXE 20K0 |
| A1R889        | 322-3289-00        |                                      | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO          | 57668     | CRB20 FXE 10K0 |
| A1R890        | 307-2173-00        |                                      | RES NTWK,FXD,FI:HIGH VOLTAGE,FINISHED       | 80009     | 307-2173-00    |
| A1R891        | 322-3354-00        |                                      | RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=TO        | 80009     | 322-3354-00    |
| A1R893        | 311-1933-00        |                                      | RES,VAR,NONWW:PNL,5M OHM,10%,0.5W           | 01121     | 23M909         |
| A1R905        | 301-0823-00        |                                      | RES,FXD,FILM:82K OHM,5%,0.5W                | 19701     | 5053CX82K00J   |
| A1R906        | 301-0823-00        |                                      | RES,FXD,FILM:82K OHM,5%,0.5W                | 19701     | 5053CX82K00J   |
| A1R907        | 308-0843-00        |                                      | RES,FXD,WW:0.2 OHM,5%,1/0W                  | 91637     | RS1A-90-R2J    |
| A1R908        | 313-1222-00        |                                      | RES,FXD,FILM:2.2K OHM,5%,0.2W               | 57668     | TR20JE 02K2    |
| A1R909        | 315-0390-00        |                                      | RES,FXD,FILM:39 OHM,5%,0.25W                | 57668     | NTR25J-E39E0   |
| A1R912        | 322-3162-00        |                                      | RES,FXD,FILM:175 OHM,1%,0.2W,TC=TO          | 57668     | CRB20 FXE 475E |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Discnt | Name & Description                                    | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|-----------------------------------------|-------------------------------------------------------|--------------|-----------------|
| A1R913        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 10K0  |
| A1R914        | 322-3378-00           |                                         | RES,FXD,FILM:84.5K OHM,1%,0.2W,TC=TO                  | 91637        | CCF50-2F84501F  |
| A1R915        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 10K0  |
| A1R916        | 313-1514-00           |                                         | RES,FXD,FILM:510K OHM,5%,0.2W                         | 57668        | TR20JE 510K     |
| A1R917        | 313-1303-00           |                                         | RES,FXD,FILM:30K OHM,5%,0.2W                          | 57668        | TR20JE 30K      |
| A1R919        | 322-3289-00           |                                         | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 10K0  |
| A1R921        | 313-1303-00           |                                         | RES,FXD,FILM:30K OHM,5%,0.2W                          | 57668        | TR20JE 30K      |
| A1R922        | 322-3318-00           |                                         | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 20K0  |
| A1R925        | 313-1124-00           |                                         | RES,FXD,FILM:120K OHM,5%,0.2W                         | 57668        | TR20JE120K      |
| A1R926        | 303-0154-00           |                                         | RES,FXD,CMPSN:150K OHM,5%,1W                          | 24546        | FP1 150K OHM 5% |
| A1R927        | 322-3385-00           |                                         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 100K  |
| A1R928        | 313-1682-00           |                                         | RES,FXD,FILM:6.8K OHM,5%,0.2W                         | 57668        | TR20JE 06K8     |
| A1R929        | 313-1302-00           |                                         | RES,FXD,FILM:3K OHM,5%,0.2W                           | 57668        | TR20JE 03K0     |
| A1R930        | 322-3385-00           |                                         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 100K  |
| A1R935        | 315-0121-00           |                                         | RES,FXD,FILM:120 OHM,5%,0.25W                         | 19701        | 5043CX120R0J    |
| A1R937        | 322-3234-00           |                                         | RES,FXD,FILM:2.67K OHM,1%,0.2W,TC=TO                  | 80009        | 322-3234-00     |
| A1R938        | 311-1248-00           |                                         | RES,VAR,NONWW:TRMR,500 OHM,0.5W                       | 32997        | 3386X-T07-501   |
| A1R939        | 322-3304-00           |                                         | RES,FXD,FILM:14.3K OHM,1%,0.2W,TC=TO                  | 57668        | CRB20 FXE 14K3  |
| A1R940        | 322-3318-00           |                                         | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 20K0  |
| A1R941        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                     | 57668        | CRB20 FXE 1K00  |
| A1R942        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                     | 57668        | CRB20 FXE 1K00  |
| A1R943        | 301-0472-00           |                                         | RES,FXD,FILM:4.7K OHM,5%,0.5W                         | 19701        | 5053CX4K700J    |
| A1R944        | 322-3193-00           |                                         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                     | 57668        | CRB20 FXE 1K00  |
| A1R945        | 301-0202-00           |                                         | RES,FXD,FILM:2K OHM,5%,0.5W                           | 19701        | 5053CX2K000J    |
| A1R946        | 315-0470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.25W                          | 57668        | NTR25J-E47E0    |
| A1R947        | 315-0470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.25W                          | 57668        | NTR25J-E47E0    |
| A1R948        | 313-1100-00           |                                         | RES,FXD,FILM:10 OHM,5%,0.2W                           | 57668        | TR20JE10E0      |
| A1R949        | 308-0755-00           |                                         | RES,FXD,WW:0.75 OHM,5%,2W                             | 75042        | BWH-R7500J      |
| A1R964        | 307-0106-00           |                                         | RES,FXD,CMPSN:4.7 OHM,5%,0.25W                        | 01121        | CB 47G5         |
| A1R975        | 315-0470-00           |                                         | RES,FXD,FILM:47 OHM,5%,0.25W                          | 57668        | NTR25J-E47E0    |
| A1R976        | 315-0472-03           |                                         | RES,FXD,CMPSN:4.7K OHM,5%,0.25W                       | 01121        | CB4725          |
| A1R978        | 315-0472-03           |                                         | RES,FXD,CMPSN:4.7K OHM,5%,0.25W                       | 01121        | CB4725          |
| A1R984        | 311-2257-00           |                                         | RES,VAR,NONWW:TRMR,500 OHM,20%,0.5W                   | 80009        | 311-2257-00     |
| A1R985        | 322-3354-00           |                                         | RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=TO                  | 80009        | 322-3354-00     |
| A1R986        | 322-3318-00           |                                         | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 20K0  |
| A1R987        | 322-3318-00           |                                         | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO                    | 57668        | CRB20 FXE 20K0  |
| A1R988        | 322-3385-00           |                                         | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO                   | 57668        | CRB20 FXE 100K  |
| A1R989        | 322-3354-00           |                                         | RES,FXD,FILM:47.5K OHM,1%,0.2W,TC=TO                  | 80009        | 322-3354-00     |
| A1R990        | 311-2269-00           |                                         | RES,VAR,NONWW:TRMR,20K OHM,20%,0.5W                   | 80009        | 311-2269-00     |
| A1R991        | 322-3238-00           |                                         | RES,FXD,FILM:2.94K OHM,1%,0.2W,TC=TO                  | 57668        | CRB20 FXE 2K94  |
| A1RT236       | 307-0125-00           |                                         | RES,THERMAL:500 OHM,10%,NTC                           | 15454        | 10B501K-220-EC  |
| A1S901        | 260-2443-00           |                                         | SWITCH,PUSH:POWER,DPST,6A,250VAC                      | 80009        | 260-2443-00     |
| A1T390        | 120-1401-00           |                                         | XFMR,TRIGGER:LINE,1:1 TURNS RATIO                     | 54937        | DMI 500-2044    |
| A1T906        | 120-1439-01           |                                         | TRANSFORMER,RF:ENERGY STORAGE                         | TK1339       | 120-1439-01     |
| A1T944        | 120-1347-00           |                                         | TRANSFORMER,RF:DRIVER SATURATING                      | 80009        | 120-1347-00     |
| A1T948        | 120-1601-01           |                                         | XFMR,PWR SDN&UP:HIGH VOLTAGE                          | 80009        | 120-1601-01     |
| A1TP940       | 131-0589-00           |                                         | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL              | 22526        | 48283-029       |
| A1TP950       | 131-0589-00           |                                         | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL              | 22526        | 48283-029       |
| A1U120        | 156-0495-00           |                                         | MICROCKT,LINEAR:OPNL AMPL                             | 80009        | 156-0495-00     |
| A1U130        | 234-0133-20           |                                         | INTEGRATED CKT:SH III VERSION OF M-84<br>VERTICAL AMP | 80009        | 234-0133-20     |
| A1U180        | 234-0133-20           |                                         | INTEGRATED CKT:SH III VERSION OF M-84<br>VERTICAL AMP | 80009        | 234-0133-20     |
| A1U225        | 156-0067-00           |                                         | MICROCKT,LINEAR:BIPOLAR,OPNL AMPL                     | 80009        | 156-0067-00     |
| A1U310        | 156-0534-00           |                                         | MICROCKT,LINEAR:DUAL DIFF AMPL                        | 02735        | CA3102E-98      |
| A1U335        | 156-0534-00           |                                         | MICROCKT,LINEAR:DUAL DIFF AMPL                        | 02735        | CA3102E-98      |
| A1U350        | 156-1294-00           |                                         | MICROCKT,LINEAR:NPN,5 TRANSISTOR ARRAY H<br>FREQ      | 80009        | 156-1294-00     |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Dscont | Name & Description                                                                                    | Mfr. Code | Mfr. Part No. |
|---------------|--------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------|-----------|---------------|
| A1U426        | 156-0158-00        |                                      | MICROCKT, LINEAR: BIPOLAR, DUAL OPNL AMPL                                                             | 80009     | 156-0158-00   |
| A1U460        | 234-0107-20        |                                      | INTEGRATED CKT: SCHMITT TRIGGER                                                                       | 80009     | 234-0107-20   |
| A1U502        | 156-1713-00        |                                      | MICROCKT, DGT: ECL, RETRIG MONOSTABLE MV                                                              | 80009     | 156-1713-00   |
| A1U504        | 156-1335-00        |                                      | MICROCKT, DGT: LSTTL, DUAL RETRIGGERABLE                                                              | 80009     | 156-1335-00   |
| A1U506        | 156-1639-00        |                                      | RESETTABLE MONOSTABLE MV, SCRIP<br>IC, DIGITAL: ECL, FLIP FLOP; DUAL MASTER-SLAVE;<br>10H131, DIP16.3 | 80009     | 156-1639-00   |
| A1U532        | 156-1641-00        |                                      | MICROCKT, DGT: ECL, QUAD 2-INPUT NOR GATE                                                             | 80009     | 156-1641-00   |
| A1U537        | 156-0721-00        |                                      | IC, DIGITAL: LSTTL, SCHMITT TRIG; QUAD 2-INPUT<br>NAND; 74LS132, DIP14.3, TUBE                        | 80009     | 156-0721-00   |
| A1U540        | 156-0388-00        |                                      | IC, DIGITAL: LSTTL, FLIP FLOP; DUAL D-TYPE; 74LS<br>74, DIP14.3, TUBE                                 | 80009     | 156-0388-00   |
| A1U555        | 160-6757-00        |                                      | MICROCKT, DGT: STTL, OCTAL 16-IN AO1GAK ARRAY                                                         | 80009     | 160-6757-00   |
| A1U565        | 156-0386-00        |                                      | IC, DIGITAL: LSTTL, GATES; TRIPLE 3-INPUT NAND;<br>74LS10, DIP14.3, TUBE                              | 80009     | 156-0386-00   |
| A1U882        | 156-0158-00        |                                      | MICROCKT, LINEAR: BIPOLAR, DUAL OPNL AMPL                                                             | 80009     | 156-0158-00   |
| A1U830        | 156-1627-00        |                                      | MICROCKT, LINEAR: BIPOLAR, PWM PWR SPLY CONT                                                          | 12969     | UC494ACN      |
| A1U975        | 152-1046-00        |                                      | SEMICON DVC, DI: HV MULT, 4KVAC INPUT, 12KVAC                                                         | U4144     | MSL8524       |
| A1U985        | 156-0745-00        |                                      | IC, DIGITAL: CMOS, GATES; HEX INV; 4069B, DIP14.3<br>, TUBE, CERAMIC                                  | 80009     | 156-0745-00   |
| A1VR200       | 152-0149-00        |                                      | SEMICON DVC, DI: ZEN, SI, 10V, 5%, 0.4W, DO-7                                                         | 04713     | 1N961B        |
| A1VR645       | 152-0317-00        |                                      | SEMICON DVC, DI: ZEN, SI, 6.2V, 5%, 0.4W, DO-35                                                       | 04713     | 1N825         |
| A1VR712       | 152-0508-00        |                                      | SEMICON DVC, DI: ZEN, SI, 12.6V, 5%, 0.4W, DO-7                                                       | 80009     | 152-0508-00   |
| A1VR764       | 152-0702-00        |                                      | SEMICON DVC, DI: ZEN, SI, 13V, 2%, 500MW, DO-7                                                        | 80009     | 152-0702-00   |
| A1VR782       | 152-0243-00        |                                      | SEMICON DVC, DI: ZEN, SI, 15V, 5%, 0.4W, DO-7                                                         | 14433     | Z5412         |
| A1VR828       | 152-0514-00        |                                      | SEMICON DVC, DI: ZEN, SI, 10V, 1%, 0.4W, DO-7                                                         | 80009     | 152-0514-00   |
| A1VR925       | 152-0317-00        |                                      | SEMICON DVC, DI: ZEN, SI, 6.2V, 5%, 0.4W, DO-35                                                       | 04713     | 1N825         |
| A1VR935       | 152-0255-00        |                                      | SEMICON DVC, DI: ZEN, SI, 51V, 5%, 0.4W, DO-7                                                         | 80009     | 152-0255-00   |
| A1VR943       | 152-0317-00        |                                      | SEMICON DVC, DI: ZEN, SI, 6.2V, 5%, 0.4W, DO-35                                                       | 04713     | 1N825         |
| A1W101        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W102        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W199        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W226        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W262        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W272        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W281        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W282        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W283        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W310        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W318        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W343        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W350        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W351        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W392        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W399        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W408        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W410        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W494        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W499        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W535        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W537        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W538        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W551        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W552        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W553        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W554        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |
| A1W591        | 131-0566-00        |                                      | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                                         | 24546     | OMA 07        |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discnt | Name & Description                                                                         | Mfr.<br>Code | Mfr. Part No.  |
|---------------|-----------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|--------------|----------------|
| A1W592        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W602        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W603        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W634        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W635        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W636        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W648        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W649        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W732        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W881        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W885        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W954        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W955        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W956        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W957        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W959        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W960        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W961        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W964        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W965        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W966        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W968        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W971        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W972        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W974        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W975        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W976        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W977        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W979        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W991        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W993        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W995        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W997        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W998        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W999        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L                                              | 24546        | OMA 07         |
| A1W9070       | 198-4819-01           |                                            | WIRE SET, ELEC: 3 DISCRETE WIRES, 22 AWG IN<br>CONN, (9-1)4.25 L, (9-2)4.25 L, (9-3)3.75 L | TK1544       | ORDER BY DESCR |
| A1W9272       | 196-3257-00           |                                            | LEAD, ELECTRICAL: 22 AWG, 3.2 L, 9-5                                                       | 80009        | 196-3257-00    |
| A1W9273       | 196-3225-00           |                                            | LEAD, ELECTRICAL: 22 AWG, 3.6 L, 9-5                                                       | 80009        | 196-3225-00    |
| A1W9440       | 174-1971-00           |                                            | CA ASSY, SP, ELEC: 4, 26 AWG, 7.0 L, RIBBON                                                | 80009        | 174-1971-00    |
| A1W9700       | 174-2076-00           |                                            | CA ASSY, RF: 8.26 AWG, COA                                                                 | TK1544       | ORDER BY DESCR |
| A1W9705       | 174-1973-00           |                                            | CA ASSY, SP, ELEC: 8, 26 AWG, 6.0 L, RIBBON                                                | 80009        | 174-1973-00    |
| A1W9778       | 195-7064-00           |                                            | LEAD, ELECTRICAL: 22 AWG, 2.25 L, 9-N                                                      | 80009        | 195-7064-00    |
| A1W9788       | 195-7064-00           |                                            | LEAD, ELECTRICAL: 22 AWG, 2.25 L, 9-N                                                      | 80009        | 195-7064-00    |
| A1W9870       | 136-1075-00           |                                            | SKT, PL-IN ELEK: CRT SOCKET ASSY                                                           | TK1544       | ORDER BY DESCR |
| A1W9965       | 131-0589-00           |                                            | TERM, PIN: 0.46 L X 0.025 SQ PH BRZ GLD PL                                                 | 22526        | 48283-029      |
| A1W9991       | 174-1972-00           |                                            | CA ASSY, SP, ELEC: 4, 26 AWG, 6.0 L, RIBBON                                                | 80009        | 174-1972-00    |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discont | Name & Description                                      | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|---------------------------------------------|---------------------------------------------------------|--------------|-----------------|
| A2            | 671-1423-00           |                                             | CIRCUIT BD ASSY:ATTEN                                   | 80009        | 671-1423-00     |
| A2AT1         | 307-1014-06           |                                             | ATTENUATOR, FXD:100X                                    | 80009        | 307-1014-06     |
| A2AT2         | 307-1013-00           |                                             | ATTENUATOR, FXD:10X                                     | 80009        | 307-1013-00     |
| A2AT51        | 307-1014-06           |                                             | ATTENUATOR, FXD:100X                                    | 80009        | 307-1014-06     |
| A2AT52        | 307-1013-00           |                                             | ATTENUATOR, FXD:10X                                     | 80009        | 307-1013-00     |
| A2C2          | 285-1461-00           |                                             | CAP, FXD, PLSTC:0.022UF, 10%, 400V                      | TK1913       | MKP10.02240010  |
| A2C3          | 281-0294-00           |                                             | CAP, VAR, CER DI:6-50PF, 250VDC                         | 52769        | GKU50000        |
| A2C6          | 285-1462-00           |                                             | CAP, FXD, PLASTIC:1000PF, 20%, 400V                     | TK1913       | FKS2100040020   |
| A2C7          | 281-0305-00           |                                             | CAP, VAR, CER DI:1.5-4.0PF                              | 52769        | GKU 4R000       |
| A2C9          | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C10         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C13         | 281-0862-00           |                                             | CAP, FXD, CER DI:0.001UF, +80-20%, 100V                 | 04222        | MA101C10ZMAA    |
| A2C17         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C19         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C21         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C26         | 281-0294-00           |                                             | CAP, VAR, CER DI:6-50PF, 250VDC                         | 52769        | GKU50000        |
| A2C27         | 281-0893-00           |                                             | CAP, FXD, CER DI:4.7PF, +/-0.5PF, 100V                  | 04222        | MA101A4R7DAA    |
| A2C30         | 281-0775-01           |                                             | CAP, FXD, CER DI:0.1UF, 20%, 50V                        | 04222        | SA105E104MAA    |
| A2C35         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C38         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C52         | 285-1461-00           |                                             | CAP, FXD, PLSTC:0.022UF, 10%, 400V                      | TK1913       | MKP10.02240010  |
| A2C53         | 281-0294-00           |                                             | CAP, VAR, CER DI:6-50PF, 250VDC                         | 52769        | GKU50000        |
| A2C56         | 285-1462-00           |                                             | CAP, FXD, PLASTIC:1000PF, 20%, 400V                     | TK1913       | FKS2100040020   |
| A2C57         | 281-0305-00           |                                             | CAP, VAR, CER DI:1.5-4.0PF                              | 52769        | GKU 4R000       |
| A2C59         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C60         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C63         | 281-0862-00           |                                             | CAP, FXD, CER DI:0.001UF, +80-20%, 100V                 | 04222        | MA101C10ZMAA    |
| A2C67         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C69         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C71         | 285-1458-00           |                                             | CAP, FXD, MTLZD:4700PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0247006310   |
| A2C76         | 281-0294-00           |                                             | CAP, VAR, CER DI:6-50PF, 250VDC                         | 52769        | GKU50000        |
| A2C77         | 281-0893-00           |                                             | CAP, FXD, CER DI:4.7PF, +/-0.5PF, 100V                  | 04222        | MA101A4R7DAA    |
| A2C80         | 281-0775-01           |                                             | CAP, FXD, CER DI:0.1UF, 20%, 50V                        | 04222        | SA105E104MAA    |
| A2C85         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C88         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C90         | 290-0776-00           |                                             | CAP, FXD, ELCTLT:22UF, +50-20 %, 10V                    | 55680        | ULA1A220TAA     |
| A2C91         | 290-0776-00           |                                             | CAP, FXD, ELCTLT:22UF, +50-20 %, 10V                    | 55680        | ULA1A220TAA     |
| A2C93         | 290-0776-00           |                                             | CAP, FXD, ELCTLT:22UF, +50-20 %, 10V                    | 55680        | ULA1A220TAA     |
| A2C94         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2C96         | 290-0776-00           |                                             | CAP, FXD, ELCTLT:22UF, +50-20 %, 10V                    | 55680        | ULA1A220TAA     |
| A2C97         | 285-1459-00           |                                             | CAP, FXD, MTLZD:2200PF, 10%, 63V, 2.5MM LEAD<br>SPACING | TK1913       | MKS0222006310   |
| A2CR7         | 152-0324-00           |                                             | SEMICON DVC, DI:SW, SI, 35V, 0.1A, DO-7                 | 14552        | MT5128          |
| A2CR18        | 152-0141-02           |                                             | SEMICON DVC, DI:SW, SI, 30V, 150MA, 30V, DO-35          | 03508        | DA2527 (1N4152) |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                                                                   | Mfr.<br>Code | Mfr. Part No.   |
|---------------|-----------------------|--------------------------------------------|--------------------------------------------------------------------------------------|--------------|-----------------|
| A2CR57        | 152-0324-00           |                                            | SEMICON DVC,DI:SW,SI,35V,0.1A,DO-7                                                   | 14552        | MT5128          |
| A2CR68        | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                             | 03508        | DA2527 (1N4152) |
| A2CR85        | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                             | 03508        | DA2527 (1N4152) |
| A2CR88        | 152-0141-02           |                                            | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                             | 03508        | DA2527 (1N4152) |
| A2E90         | 119-1771-00           |                                            | FERRITE BEAD AS:276-0532-00 W/22 AWG WIRE                                            | 80009        | 119-1771-00     |
| A2E91         | 119-1771-00           |                                            | FERRITE BEAD AS:276-0532-00 W/22 AWG WIRE                                            | 80009        | 119-1771-00     |
| A2J2900       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                             | 22526        | 48283-029       |
| A2J2950       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                             | 22526        | 48283-029       |
| A2J9200       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                             | 22526        | 48283-029       |
| A2J9991       | 131-0589-00           |                                            | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                             | 22526        | 48283-029       |
| A2L93         | 108-1485-00           |                                            | COIL,RF:FXD,INDUCTOR,220UH,10%,0.41A,BOBBIN<br>CORE,RADIAL LEAD 0.2 IN LEAD SPACING, | TK2058       | TSL0707-221KR41 |
| A2L96         | 108-1485-00           |                                            | COIL,RF:FXD,INDUCTOR,220UH,10%,0.41A,BOBBIN<br>CORE,RADIAL LEAD 0.2 IN LEAD SPACING, | TK2058       | TSL0707-221KR41 |
| A2Q13         | 151-1124-00           |                                            | TRANSISTOR:JFE,N-CHAN,SI,SEL,TO-92                                                   | 17856        | J-2400          |
| A2Q15         | 151-0711-00           |                                            | TRANSISTOR:NPN,SI,TO-92B                                                             | 80009        | 151-0711-00     |
| A2Q18         | 151-0711-00           |                                            | TRANSISTOR:NPN,SI,TO-92B                                                             | 80009        | 151-0711-00     |
| A2Q63         | 151-1124-00           |                                            | TRANSISTOR:JFE,N-CHAN,SI,SEL,TO-92                                                   | 17856        | J-2400          |
| A2Q65         | 151-0711-00           |                                            | TRANSISTOR:NPN,SI,TO-92B                                                             | 80009        | 151-0711-00     |
| A2Q68         | 151-0711-00           |                                            | TRANSISTOR:NPN,SI,TO-92B                                                             | 80009        | 151-0711-00     |
| A2R1          | 315-0620-02           |                                            | RES,FXD,CMPSN:62 OHM,5%,0.25W                                                        | 01121        | CB6205          |
| A2R2          | 322-3481-00           |                                            | RES,FXD,FILM:1M OHM,1%,0.2W,TC=TO                                                    | 57668        | CRB20 FXE 1M00  |
| A2R3          | 322-0614-07           |                                            | RES,FXD,FILM:250K OHM,0.1%,0.25W,TC=T9                                               | 19701        | 5043RE250K0B    |
| A2R4          | 313-1082-00           |                                            | RES,FXD,FILM:8.2 OHM,5%,0.2W                                                         | 80009        | 313-1082-00     |
| A2R5          | 321-0469-07           |                                            | RES,FXD,FILM:750K OHM,0.1%,0.125W,TC=T9                                              | 19701        | 5033RE750K0B    |
| A2R6          | 315-0105-03           |                                            | RES,FXD,CMPSN:1M OHM,5%,0.25W                                                        | 80009        | 315-0105-03     |
| A2R7          | 313-1160-00           |                                            | RES,FXD,FILM:16 OHM,0.5%,0.2W                                                        | 80009        | 313-1160-00     |
| A2R8          | 315-0620-02           |                                            | RES,FXD,CMPSN:62 OHM,5%,0.25W                                                        | 01121        | CB6205          |
| A2R9          | 313-1432-00           |                                            | RES,FXD,FILM:4.3K OHM,5%,0.2W                                                        | 57668        | TR20JE 04K3     |
| A2R10         | 311-2238-00           |                                            | RES,VAR,NONWV:TRMR,50K OHM,20%,0.5W LINEAR                                           | TK1450       | GF06UT 50 K     |
| A2R11         | 322-3193-00           |                                            | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                                                    | 57668        | CRB20 FXE 1K00  |
| A2R12         | 313-1360-00           |                                            | RES,FXD,FILM:36 OHM,5%,0.2W                                                          | 57668        | TR20JE 36E      |
| A2R13         | 322-3097-00           |                                            | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 100E  |
| A2R14         | 313-1161-00           |                                            | RES,FXD,FILM:160 OHM,5%,0.2W                                                         | 57668        | TR20JE160E      |
| A2R15         | 322-3097-00           |                                            | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 100E  |
| A2R16         | 313-1162-00           |                                            | RES,FXD,FILM:1.6K OHM,5%,0.2W                                                        | 57668        | TR20JT681K6     |
| A2R17         | 322-3097-00           |                                            | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 100E  |
| A2R18         | 313-1911-00           |                                            | RES,FXD,FILM:910 OHM,5%,0.2W                                                         | 57668        | TR20JE910E      |
| A2R19         | 307-0843-00           |                                            | RES NTWK,FXD,FI:INPUT ATTENUATOR                                                     | 80009        | 307-0843-00     |
| A2R20         | 313-1332-00           |                                            | RES,FXD,FILM:3.3K OHM,5%,0.2W                                                        | 57668        | TR20JE 03K3     |
| A2R21         | 313-1160-00           |                                            | RES,FXD,FILM:16 OHM,0.5%,0.2W                                                        | 80009        | 313-1160-00     |
| A2R22         | 322-3210-00           |                                            | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                                                  | 57668        | CRB20 FXE 1K50  |
| A2R23         | 322-3210-00           |                                            | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                                                  | 57668        | CRB20 FXE 1K50  |
| A2R25         | 311-2226-00           |                                            | RES,VAR,NONWV:TRMR,50 OHM,20%,0.5W<br>LINEARTAPE & REEL                              | TK1450       | GF06UT 50 OHM   |
| A2R26         | 311-0643-00           |                                            | RES,VAR,NONWV:TRMR,50 OHM,0.5W                                                       | 32997        | 3329H-L58-500   |
| A2R27         | 313-1160-00           |                                            | RES,FXD,FILM:16 OHM,0.5%,0.2W                                                        | 80009        | 313-1160-00     |
| A2R29         | 322-3089-00           | B010100                                    | RES,FXD,FILM:82.5 OHM,1%,0.2W,TC=TO                                                  | 57668        | CRB20 FXE 82E5  |
| A2R29         | 322-3086-00           | B011890                                    | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO                                                  | 91637        | CCF50-2676R80F  |
| A2R30         | 313-1124-00           |                                            | RES,FXD,FILM:120K OHM,5%,0.2W                                                        | 57668        | TR20JE120K      |
| A2R31         | 322-3085-00           |                                            | RES,FXD,FILM:75 OHM,1%,0.2W,TC=TO                                                    | 57668        | CRB20 FXE 75E0  |
| A2R33         | 311-2238-00           |                                            | RES,VAR,NONWV:TRMR,50K OHM,20%,0.5W LINEAR                                           | TK1450       | GF06UT 50 K     |
| A2R34         | 322-3097-00           |                                            | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 100E  |
| A2R35         | 322-3143-00           |                                            | RES,FXD,FILM:301 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 301E  |
| A2R37         | 322-3193-00           |                                            | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                                                    | 57668        | CRB20 FXE 1K00  |
| A2R38         | 322-3143-00           |                                            | RES,FXD,FILM:301 OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 301E  |
| A2R39         | 322-3231-00           |                                            | RES,FXD,FILM:2.49K OHM,1%,0.2W,TC=TO                                                 | 57668        | CRB20 FXE 2K49  |
| A2R41         | 322-3318-00           |                                            | RES,FXD,FILM:20K OHM,1%,0.2W,TC=TO                                                   | 57668        | CRB20 FXE 20K0  |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective | Discont | Name & Description                                          | Mfr. Code | Mfr. Part No.    |
|---------------|--------------------|-------------------------------|---------|-------------------------------------------------------------|-----------|------------------|
| A2R42         | 322-3282-00        |                               |         | RES,FXD,FILM:8.45K OHM,1%,0.2W,TC=TO                        | 80009     | 322-3282-00      |
| A2R43         | 311-2179-00        |                               |         | RES,VAR,NONW:PNL,10K OHM,10%,0.5W                           | 32997     | 91Z1D-Z07-EA0037 |
| A2R46         | 322-3219-09        |                               |         | RES,FXD,FILM:1.87K OHM,1%,0.2W,TC=T9,SMALL BODY,TAPE & REEL | 91637     | CCF50-2-C1871FT  |
| A2R47         | 311-2229-00        |                               |         | RES,VAR,NONW:TRMR,250 OHM,20%,0.5W LINEAR                   | TK1450    | GF06UT 250       |
| A2R48         | 322-3276-09        |                               |         | RES,FXD,FILM:7.32K OHM,1%,0.2W,TC=T9,SMALL BODY,TAPE & REEL | 91637     | CCF50-2-C73200FT |
| A2R51         | 315-0620-02        |                               |         | RES,FXD,CMPNS:62 OHM,5%,0.25W                               | 01121     | CB6205           |
| A2R52         | 322-3481-00        |                               |         | RES,FXD,FILM:1M OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 1M00   |
| A2R53         | 322-0614-07        |                               |         | RES,FXD,FILM:250K OHM,0.1%,0.25W,TC=T9                      | 19701     | 5043RE250K0B     |
| A2R54         | 313-1082-00        |                               |         | RES,FXD,FILM:8.2 OHM,5%,0.2W                                | 80009     | 313-1082-00      |
| A2R55         | 321-0469-07        |                               |         | RES,FXD,FILM:750K OHM,0.1%,0.125W,TC=T9                     | 19701     | 5033RE750K0B     |
| A2R56         | 315-0105-03        |                               |         | RES,FXD,CMPNS:1M OHM,5%,0.25W                               | 80009     | 315-0105-03      |
| A2R57         | 313-1160-00        |                               |         | RES,FXD,FILM:16 OHM,0.5%,0.2W                               | 80009     | 313-1160-00      |
| A2R58         | 315-0620-02        |                               |         | RES,FXD,CMPNS:62 OHM,5%,0.25W                               | 01121     | CB6205           |
| A2R59         | 313-1432-00        |                               |         | RES,FXD,FILM:4.3K OHM,5%,0.2W                               | 57668     | TR20JE 04K3      |
| A2R60         | 311-2238-00        |                               |         | RES,VAR,NONW:TRMR,50K OHM,20%,0.5W LINEAR                   | TK1450    | GF06UT 50 K      |
| A2R61         | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 1K00   |
| A2R62         | 313-1360-00        |                               |         | RES,FXD,FILM:36 OHM,5%,0.2W                                 | 57668     | TR20JE 36E       |
| A2R63         | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 100E   |
| A2R64         | 313-1161-00        |                               |         | RES,FXD,FILM:160 OHM,5%,0.2W                                | 57668     | TR20JE160E       |
| A2R65         | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 100E   |
| A2R66         | 313-1162-00        |                               |         | RES,FXD,FILM:1.6K OHM,5%,0.2W                               | 57668     | TR20JT681K6      |
| A2R67         | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 100E   |
| A2R68         | 313-1911-00        |                               |         | RES,FXD,FILM:910 OHM,5%,0.2W                                | 57668     | TR20JE910E       |
| A2R69         | 307-0843-00        |                               |         | RES NTWK,FXD,FI:INPUT ATTENUATOR                            | 80009     | 307-0843-00      |
| A2R71         | 313-1160-00        |                               |         | RES,FXD,FILM:16 OHM,0.5%,0.2W                               | 80009     | 313-1160-00      |
| A2R72         | 322-3210-00        |                               |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                         | 57668     | CRB20 FXE 1K50   |
| A2R73         | 322-3210-00        |                               |         | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                         | 57668     | CRB20 FXE 1K50   |
| A2R75         | 311-2226-00        |                               |         | RES,VAR,NONW:TRMR,50 OHM,20%,0.5W LINEAR TAPE & REEL        | TK1450    | GF06UT 50 OHM    |
| A2R76         | 311-0643-00        |                               |         | RES,VAR,NONW:TRMR,50 OHM,0.5W                               | 32997     | 3329H-L58-500    |
| A2R77         | 313-1160-00        |                               |         | RES,FXD,FILM:16 OHM,0.5%,0.2W                               | 80009     | 313-1160-00      |
| A2R79         | 322-3089-00        | B010100                       | B011889 | RES,FXD,FILM:82.5 OHM,1%,0.2W,TC=TO                         | 57668     | CRB20 FXE 82E5   |
| A2R79         | 322-3086-00        | B011890                       |         | RES,FXD,FILM:76.8 OHM,1%,0.2W,TC=TO                         | 91637     | CCF50-2G7680F    |
| A2R80         | 313-1124-00        |                               |         | RES,FXD,FILM:120K OHM,5%,0.2W                               | 57668     | TR20JE120K       |
| A2R81         | 322-3085-00        |                               |         | RES,FXD,FILM:75 OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 75E0   |
| A2R83         | 311-2238-00        |                               |         | RES,VAR,NONW:TRMR,50K OHM,20%,0.5W LINEAR                   | TK1450    | GF06UT 50 K      |
| A2R84         | 322-3097-00        |                               |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 100E   |
| A2R85         | 322-3143-00        |                               |         | RES,FXD,FILM:301 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 301E   |
| A2R87         | 322-3193-00        |                               |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 1K00   |
| A2R88         | 322-3143-00        |                               |         | RES,FXD,FILM:301 OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 301E   |
| A2R91         | 322-3308-00        |                               |         | RES,FXD,FILM:15.8K OHM,1%,0.2W,TC=TO                        | 57668     | CRB20 FXE 15K8   |
| A2R92         | 322-3277-00        |                               |         | RES,FXD,FILM:7.5K OHM,1%,0.2W,TC=TO                         | 57668     | CRB20 FXE 7K50   |
| A2R93         | 311-2179-00        |                               |         | RES,VAR,NONW:PNL,10K OHM,10%,0.5W                           | 32997     | 91Z1D-Z07-EA0037 |
| A2R96         | 313-1182-00        |                               |         | RES,FXD,FILM:1.8K OHM 5%,0.2W                               | 57668     | TR20JT681K8      |
| A2R97         | 311-2230-00        |                               |         | RES,VAR,NONW:TRMR,500 OHM,20%,0.50 LINEAR                   | TK1450    | GF06UT 500       |
| A2R98         | 322-3277-00        |                               |         | RES,FXD,FILM:7.5K OHM,1%,0.2W,TC=TO                         | 57668     | CRB20 FXE 7K50   |
| A2S1          | 263-1040-03        |                               |         | SWITCH ASSEMBLY:ACTUATOR,COUPLING                           | 80009     | 263-1040-03      |
| A2S10         | 263-1041-02        |                               |         | SWITCH ASSEMBLY:ACTUATOR,VOLTS/DIV                          | 80009     | 263-1041-02      |
| A2S51         | 263-1040-03        |                               |         | SWITCH ASSEMBLY:ACTUATOR,COUPLING                           | 80009     | 263-1040-03      |
| A2S60         | 263-1041-02        |                               |         | SWITCH ASSEMBLY:ACTUATOR,VOLTS/DIV                          | 80009     | 263-1041-02      |
| A2U10         | 156-2469-00        |                               |         | MICROCKT,DGTL:OP AMP                                        | 80009     | 156-2469-00      |
| A2U30         | 234-0134-20        |                               |         | QUICK CHIP:VERTICAL AMPLIFIER,IC                            | 80009     | 234-0134-20      |
| A2U60         | 156-2469-00        |                               |         | MICROCKT,DGTL:OP AMP                                        | 80009     | 156-2469-00      |
| A2U80         | 234-0134-20        |                               |         | QUICK CHIP:VERTICAL AMPLIFIER,IC                            | 80009     | 234-0134-20      |
| A2U90         | 156-0991-00        |                               |         | MICROCKT,LINEAR:VOLTAGE REGULATOR                           | 80009     | 156-0991-00      |
| A2U91         | 156-0991-00        |                               |         | MICROCKT,LINEAR:VOLTAGE REGULATOR                           | 80009     | 156-0991-00      |

| Component No. | Tektronix   | Serial/Assembly No. |         | Name & Description                    | Mfr.  | Mfr. Part No. |
|---------------|-------------|---------------------|---------|---------------------------------------|-------|---------------|
|               | Part No.    | Effective           | Discont |                                       | Code  |               |
| A2W9103       | 174-1972-00 |                     |         | CA ASSY,SP,ELEC:4,26 AWG,6.0 L,RIBBON | 80009 | 174-1972-00   |
| A2W9108       | 174-1972-00 |                     |         | CA ASSY,SP,ELEC:4,26 AWG,6.0 L,RIBBON | 80009 | 174-1972-00   |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discont | Name & Description                                      | Mfr.<br>Code | Mfr. Part No.    |
|---------------|-----------------------|---------------------------------------------|---------------------------------------------------------|--------------|------------------|
| A3            | 671-1415-00           |                                             | CIRCUIT BD ASSY:FRONT PANEL                             | 80009        | 671-1415-00      |
| A3C89         | 281-0775-01           |                                             | CAP,FXD,CER DI:0.1UF,20%,50V                            | 04222        | SA105E104MAA     |
| A3C376        | 285-1461-00           |                                             | CAP,FXD,PLSTC:0.022UF,10%,400V                          | TK1913       | MKP10.02240010   |
| A3C377        | 283-1045-00           |                                             | CAP,FXD,MICA DI:15PF,0.5PF,500V                         | 09023        | CDA15CD150D03    |
| A3C379        | 283-0768-00           |                                             | CAP,FXD,MICA DI:132 PF,1%,500V                          | 00853        | D155F1320F0      |
| A3C380        | 283-0643-00           |                                             | CAP,FXD,MICA DI:22PF,0.5%,500V                          | 00853        | D105E220D0       |
| A3CR537       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR538       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR539       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR540       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR541       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR542       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR988       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3CR989       | 152-0141-02           |                                             | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                | 03508        | DA2527 (1N4152)  |
| A3DS518       | 150-1029-00           |                                             | LT EMITTING DIO:GREEN,565NM,35MA                        | 58361        | Q6480/MV5274C    |
| A3DS915       | 150-1071-00           |                                             | LT EMITTING DIO:GREEN,565NM,20MA MAX                    | 80009        | 150-1071-00      |
| A3J9006       | 131-0589-00           |                                             | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                | 22526        | 48283-029        |
| A3J9900       | 131-4522-00           |                                             | CONN ASSY,ELEC:PROBE ADJUST,BRASS                       | TK1326       | ORDER BY DESC    |
| A3Q550        | 151-0190-00           |                                             | TRANSISTOR:NPN,SI,T0-92                                 | 80009        | 151-0190-00      |
| A3R89         | 322-3231-00           |                                             | RES,FXD,FILM:2.49K OHM,1%,0.2W,TC=T0                    | 57668        | CRB20 FXE 2K49   |
| A3R110        | 322-3289-00           |                                             | RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0                      | 57668        | CRB20 FXE 10K0   |
| A3R111        | 322-3289-00           |                                             | RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0                      | 57668        | CRB20 FXE 10K0   |
| A3R112        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R160        | 322-3289-00           |                                             | RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0                      | 57668        | CRB20 FXE 10K0   |
| A3R161        | 322-3289-00           |                                             | RES,FXD,FILM:10K OHM,1%,0.2W,TC=T0                      | 57668        | CRB20 FXE 10K0   |
| A3R162        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R201        | 313-1220-00           |                                             | RES,FXD,FILM:22 OHM,5%,0.2W                             | 57668        | TR20JE22E        |
| A3R224        | 313-1220-00           |                                             | RES,FXD,FILM:22 OHM,5%,0.2W                             | 57668        | TR20JE22E        |
| A3R280        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R371        | 313-1181-00           |                                             | RES,FXD,FILM:180 OHM,5%,0.2W                            | 57668        | TR20JE180E       |
| A3R376        | 315-0620-00           |                                             | RES,FXD,FILM:62 OHM,5%,0.25W                            | 19701        | 5043CX63R00J     |
| A3R377        | 321-0807-00           |                                             | RES,FXD,FILM:900K OHM,1%,0.125W,TC=T0                   | 19701        | 5033RD900K0F     |
| A3R378        | 321-0617-00           |                                             | RES,FXD,FILM:111K OHM,1%,0.125W,TC=T0                   | 19701        | 5043ED250K0F     |
| A3R379        | 313-1130-00           |                                             | RES,FXD,FILM:13 OHM,5%,0.2W                             | 91637        | CCF50-2-13R00J   |
| A3R380        | 321-0459-00           |                                             | RES,FXD,FILM:590K OHM,1%,0.125W,TC=T0                   | 19701        | 5043ED590K0F     |
| A3R401        | 313-1220-00           |                                             | RES,FXD,FILM:22 OHM,5%,0.2W                             | 57668        | TR20JE22E        |
| A3R438        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R519        | 313-1682-00           |                                             | RES,FXD,FILM:6.8K OHM,5%,0.2W                           | 57668        | TR20JE 06K8      |
| A3R520        | 313-1912-00           |                                             | RES,FXD,FILM:9.1K OHM,5%,0.2W                           | 57668        | TR20 FXE 9.1K    |
| A3R521        | 311-2428-00           |                                             | RES,VAR,NONWW:50K OHM,20%,0.5W                          | 01121        | W8860            |
| A3R538        | 313-1392-00           |                                             | RES,FXD,FILM:3.9K OHM,5%,0.2W                           | 57668        | TR20JE 03K9      |
| A3R539        | 313-1472-00           |                                             | RES,FXD,FILM:4.7K OHM,5%,0.2W                           | 57668        | TR20JE 04K7      |
| A3R546        | 313-1333-00           |                                             | RES,FXD,FILM:33K OHM,5%,0.2W                            | 57668        | TR20JE 33K       |
| A3R570        | 313-1682-00           |                                             | RES,FXD,FILM:6.8K OHM,5%,0.2W                           | 57668        | TR20JE 06K8      |
| A3R602        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R720        | 313-1220-00           |                                             | RES,FXD,FILM:22 OHM,5%,0.2W                             | 57668        | TR20JE22E        |
| A3R800        | 313-1682-00           |                                             | RES,FXD,FILM:6.8K OHM,5%,0.2W                           | 57668        | TR20JE 06K8      |
| A3R802        | 311-2427-01           |                                             | RES,VAR,NONWW:10K,10%,0.25W,LINEAR<br>(LOCATIONS A & B) | 12697        | CM45280          |
| A3R810        | 313-1682-00           |                                             | RES,FXD,FILM:6.8K OHM,5%,0.2W                           | 57668        | TR20JE 06K8      |
| A3R882        | 311-2469-00           |                                             | RES,VAR,NONWW:5K OHM,20%                                | 50139        | W8874            |
| A3R910        | 313-1621-00           |                                             | RES,FXD,FILM:620 OHM,5%,0.2W                            | 57668        | TR20JE 620E      |
| A3R950        | 322-3114-00           |                                             | RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0                      | 57668        | CRB20FX150EAXIAL |
| A3R951        | 322-3114-00           |                                             | RES,FXD,FILM:150 OHM,1%,0.2W,TC=T0                      | 57668        | CRB20FX150EAXIAL |
| A3R982        | 311-1227-00           |                                             | RES,VAR,NONWW:TRMR,5K OHM,0.5W                          | 32997        | 3386F-T04-502    |
| A3R983        | 322-3126-00           |                                             | RES,FXD,FILM:200 OHM,1%,0.2W,TC=T0                      | 91637        | CCF501G200ROF    |
| A3R992        | 322-3126-00           |                                             | RES,FXD,FILM:200 OHM,1%,0.2W,TC=T0                      | 91637        | CCF501G200ROF    |
| A3R993        | 313-1220-00           |                                             | RES,FXD,FILM:22 OHM,5%,0.2W                             | 57668        | TR20JE22E        |

| Component No. | Tektronix   |  | Serial/Assembly No. |         | Name & Description                         | Mfr. Code | Mfr. Part No.  |
|---------------|-------------|--|---------------------|---------|--------------------------------------------|-----------|----------------|
|               | Part No.    |  | Effective           | Discont |                                            |           |                |
| A3S90         | 260-2075-00 |  |                     |         | SWITCH,PUSH:SPDT,50VDC,500M AMP            | 80009     | 260-2075-00    |
| A3S200        | 260-2111-00 |  |                     |         | SWITCH,PUSH:SPDT,MOMENTARY                 | 59821     | 2LL199NB021085 |
| A3S226        | 260-2075-00 |  |                     |         | SWITCH,PUSH:SPDT,50VDC,500M AMP            | 80009     | 260-2075-00    |
| A3S380        | 260-2033-03 |  |                     |         | SWITCH,SLIDE:DPTT,125V,0.5A                | 95348     | 51523-SL       |
| A3S390        | 260-2111-00 |  |                     |         | SWITCH,PUSH:SPDT,MOMENTARY                 | 59821     | 2LL199NB021085 |
| A3S392        | 260-2419-00 |  |                     |         | SWITCH:DOUBLE POLE 4-POS                   | 82104     | 51524 - SL     |
| A3S401        | 260-2110-00 |  |                     |         | SWITCH,PUSH:1 SPDT/2 DPDT                  | 59821     | ORDER BY DESCR |
| A3S460        | 260-2075-00 |  |                     |         | SWITCH,PUSH:SPDT,50VDC,500M AMP            | 80009     | 260-2075-00    |
| A3S545        | 260-2033-03 |  |                     |         | SWITCH,SLIDE:DPTT,125V,0.5A                | 95348     | 51523-SL       |
| A3S550        | 260-2033-03 |  |                     |         | SWITCH,SLIDE:DPTT,125V,0.5A                | 95348     | 51523-SL       |
| A3S555        | 260-2419-00 |  |                     |         | SWITCH:DOUBLE POLE 4-POS                   | 82104     | 51524 - SL     |
| A3S602        | 260-2075-00 |  |                     |         | SWITCH,PUSH:SPDT,50VDC,500M AMP            | 80009     | 260-2075-00    |
| A3S648        | 260-2033-03 |  |                     |         | SWITCH,SLIDE:DPTT,125V,0.5A                | 95348     | 51523-SL       |
| A3VR950       | 152-0317-00 |  |                     |         | SEMICON DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-35   | 04713     | 1N825          |
| A3VR951       | 152-0317-00 |  |                     |         | SEMICON DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-35   | 04713     | 1N825          |
| A3W90         | 131-0566-00 |  |                     |         | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L | 24546     | OMA 07         |
| A3W91         | 131-0566-00 |  |                     |         | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L | 24546     | OMA 07         |
| A3W2222       | 174-1968-00 |  |                     |         | CA ASSY,SP,ELEC:18,27 AWG,1.9 L            | 80009     | 174-1968-00    |
| A3W2223       | 174-1968-00 |  |                     |         | CA ASSY,SP,ELEC:18,27 AWG,1.9 L            | 80009     | 174-1968-00    |
| A3W9200       | 174-1959-00 |  |                     |         | CA ASSY,SP,ELEC:4,26 AWG,8.5 L,RIBBON      | 80009     | 174-1959-00    |
| A3W9201       | 174-1959-00 |  |                     |         | CA ASSY,SP,ELEC:4,26 AWG,8.5 L,RIBBON      | 80009     | 174-1959-00    |
| A3W9884       | 174-1379-00 |  |                     |         | CA ASSY,SP,ELEC:2,28 AWG,2.25 L            | 80009     | 174-1379-00    |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Dscont | Name & Description                               | Mfr. Code | Mfr. Part No.    |
|---------------|--------------------|--------------------------------------|--------------------------------------------------|-----------|------------------|
| A4            | 671-1420-00        |                                      | CIRCUIT BD ASSY:TIMING                           | 80009     | 671-1420-00      |
| A4C702        | 281-0764-00        |                                      | CAP,FXD,CER DI:82PF,5%,100V                      | 04222     | MA101A820JAA     |
| A4C703        | 281-0303-00        |                                      | CAP,VAR,CER DI:2.5-20PF,250V                     | 80009     | 281-0303-00      |
| A4C705        | 281-0813-00        |                                      | CAP,FXD,CER DI:0.047UF,20%,50V                   | 05397     | C412C473M5V2CA   |
| A4C706        | 281-0773-00        |                                      | CAP,FXD,CER DI:0.01UF,10%,100V                   | 04222     | MA201C103KAA     |
| A4C707        | 281-0773-00        |                                      | CAP,FXD,CER DI:0.01UF,10%,100V                   | 04222     | MA201C103KAA     |
| A4C708        | 281-0756-00        |                                      | CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V               | 04222     | SA102A2R2DAA     |
| A4C710        | 281-0813-00        |                                      | CAP,FXD,CER DI:0.047UF,20%,50V                   | 05397     | C412C473M5V2CA   |
| A4C712        | 281-0764-00        |                                      | CAP,FXD,CER DI:82PF,5%,100V                      | 04222     | MA101A820JAA     |
| A4C713        | 281-0303-00        |                                      | CAP,VAR,CER DI:2.5-20PF,250V                     | 80009     | 281-0303-00      |
| A4C714        | 281-0756-00        |                                      | CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V               | 04222     | SA102A2R2DAA     |
| A4C715        | 290-0776-00        |                                      | CAP,FXD,ELCTLT:22UF,+50-20%,10V                  | 55680     | ULA1A220TAA      |
| A4C717        | 281-0768-00        |                                      | CAP,FXD,CER DI:470PF,20%,100V                    | 04222     | MA101A471MAA     |
| A4C720        | 290-0246-00        |                                      | CAP,FXD,ELCTLT:3.3UF,10%,15V                     | 12954     | D3R3EA15K1       |
| A4C722        | 290-0246-00        |                                      | CAP,FXD,ELCTLT:3.3UF,10%,15V                     | 12954     | D3R3EA15K1       |
| A4C724        | 290-0136-00        |                                      | CAP,FXD,ELCTLT:2.2UF,20%,20V                     | 05397     | T322B225M020AS   |
| A4C728        | 283-0203-00        |                                      | CAP,FXD,CER DI:0.47UF,20%,50V                    | 04222     | SR305SC474MAA    |
| A4C737        | 281-0862-00        | B011625                              | CAP,FXD,CER DI:0.001UF,+80-20%,100V              | 04222     | MA101C10ZMAA     |
| A4C749        | 281-0775-01        |                                      | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222     | SA105E104MAA     |
| A4C750        | 290-0246-00        |                                      | CAP,FXD,ELCTLT:3.3UF,10%,15V                     | 12954     | D3R3EA15K1       |
| A4C751        | 281-0809-00        |                                      | CAP,FXD,CER DI:200 PF,5%,100V                    | 04222     | MA101A201JAA     |
| A4C752        | 281-0775-01        |                                      | CAP,FXD,CER DI:0.1UF,20%,50V                     | 04222     | SA105E104MAA     |
| A4C762        | 281-0758-00        |                                      | CAP,FXD,CER DI:15PF,20%,100V                     | 04222     | SA102A150MAA     |
| A4CR730       | 152-0141-02        |                                      | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35         | 03508     | DA2527 (1N4152)  |
| A4CR731       | 152-0141-02        |                                      | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35         | 03508     | DA2527 (1N4152)  |
| A4CR740       | 152-0141-02        |                                      | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35         | 03508     | DA2527 (1N4152)  |
| A4ID37        | 210-0413-00        |                                      | NUT,PLAIN,HEX:0.375-32 X 0.5,BRS CD PL           | 73743     | 3145-402         |
| A4P9201       | 131-0589-00        |                                      | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL         | 22526     | 48283-029        |
| A4P9700       | 131-0589-00        |                                      | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL         | 22526     | 48283-029        |
| A4P9705       | 131-0589-00        |                                      | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL         | 22526     | 48283-029        |
| A4Q701        | 151-0424-00        |                                      | TRANSISTOR:NPN,SI,TO-92                          | 80009     | 151-0424-00      |
| A4Q704        | 151-1042-00        |                                      | SEMICON DVC SE:FET,SI,TO-92<br>(LOCATIONS A & B) | 80009     | 151-1042-00      |
| A4Q706        | 151-0736-00        |                                      | TRANSISTOR:NPN,SI,TO-92                          | 80009     | 151-0736-00      |
| A4Q709        | 151-0424-00        |                                      | TRANSISTOR:NPN,SI,TO-92                          | 80009     | 151-0424-00      |
| A4Q710        | 151-1042-00        |                                      | SEMICON DVC SE:FET,SI,TO-92<br>(LOCATIONS A & B) | 80009     | 151-1042-00      |
| A4Q712        | 151-0736-00        |                                      | TRANSISTOR:NPN,SI,TO-92                          | 80009     | 151-0736-00      |
| A4Q730        | 151-0188-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0188-00      |
| A4Q732        | 151-0712-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0712-00      |
| A4Q737        | 151-0188-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0188-00      |
| A4Q740        | 151-0188-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0188-00      |
| A4Q742        | 151-0712-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0712-00      |
| A4Q745        | 151-0188-00        |                                      | TRANSISTOR:PNP,SI,TO-92                          | 80009     | 151-0188-00      |
| A4R701        | 307-0780-01        |                                      | RES NTWK,FXD,FI:TIMING                           | 80009     | 307-0780-01      |
| A4R702        | 322-0519-01        |                                      | RES,FXD,FILM:2.49M OHM,0.5%,0.25W,TC=TO          | 07716     | CCAD24903D       |
| A4R703        | 313-1100-00        |                                      | RES,FXD,FILM:10 OHM,5%,0.2W                      | 57668     | TR20JE10E0       |
| A4R705        | 322-3114-00        |                                      | RES,FXD,FILM:150 OHM,1%,0.2W,TC=TO               | 57668     | CRB20FX150EAXIAL |
| A4R707        | 301-0202-00        |                                      | RES,FXD,FILM:2K OHM,5%,0.5W                      | 19701     | 5053CX2K000J     |
| A4R709        | 313-1100-00        |                                      | RES,FXD,FILM:10 OHM,5%,0.2W                      | 57668     | TR20JE10E0       |
| A4R710        | 322-3114-00        |                                      | RES,FXD,FILM:150 OHM,1%,0.2W,TC=TO               | 57668     | CRB20FX150EAXIAL |
| A4R711        | 307-0780-01        |                                      | RES NTWK,FXD,FI:TIMING                           | 80009     | 307-0780-01      |
| A4R713        | 301-0202-00        |                                      | RES,FXD,FILM:2K OHM,5%,0.5W                      | 19701     | 5053CX2K000J     |
| A4R715        | 322-3308-00        |                                      | RES,FXD,FILM:15.8K OHM,1%,0.2W,TC=TO             | 57668     | CRB20 FXE 15K8   |
| A4R716        | 322-3304-00        |                                      | RES,FXD,FILM:14.3K OHM,1%,0.2W,TC=TO             | 57668     | CRB20 FXE 14K3   |
| A4R717        | 322-3304-00        |                                      | RES,FXD,FILM:14.3K OHM,1%,0.2W,TC=TO             | 57668     | CRB20 FXE 14K3   |
| A4R718        | 322-3308-00        |                                      | RES,FXD,FILM:15.8K OHM,1%,0.2W,TC=TO             | 57668     | CRB20 FXE 15K8   |
| A4R719        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W                      | 57668     | TR20JE 47E       |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discont | Name & Description                                                | Mfr.<br>Code | Mfr. Part No.  |
|---------------|-----------------------|---------------------------------------------|-------------------------------------------------------------------|--------------|----------------|
| A4R721        | 311-2151-00           |                                             | RES,VAR,NONWW:P.NL,500 OHM,20%,0.5W,DPST                          | 12697        | CM43499        |
| A4R722        | 322-3126-00           |                                             | RES,FXD,FILM:200 OHM,1%,0.2W,TC=TO                                | 91637        | CCF501G200ROF  |
| A4R724        | 313-1200-00           |                                             | RES,FXD,FILM:20 OHM,5%,0.2W                                       | 57668        | TR20JE20E      |
| A4R725        | 322-3271-00           |                                             | RES,FXD,FILM:6.49K OHM,1%,0.2W,TC=TO                              | 91637        | CCF502G64900FT |
| A4R727        | 322-3243-00           |                                             | RES,FXD,FILM:3.32K OHM,1%,0.2W,TC=TO                              | 80009        | 322-3243-00    |
| A4R728        | 322-3208-00           |                                             | RES,FXD,FILM:1.43K OHM,1%,0.2W,TC=TO                              | 57668        | CRB20 FXE 1K43 |
| A4R729        | 313-1302-00           |                                             | RES,FXD,FILM:3K OHM,5%,0.2W                                       | 57668        | TR20JE 03K0    |
| A4R730        | 311-2232-00           |                                             | RES,VAR,NONWW:TRMR,2K OHM,20%,0.5W LINEAR                         | TK1450       | GF06UT 2K      |
| A4R731        | 322-3255-00           |                                             | RES,FXD,FILM:4.42K OHM,1%,0.2W,TC=TO                              | 57668        | CRB20 FXE 4K42 |
| A4R732        | 313-1123-00           |                                             | RES,FXD,FILM:12K OHM,5%,0.2W                                      | 57668        | TR20JE12K0     |
| A4R733        | 322-3210-00           |                                             | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                               | 57668        | CRB20 FXE 1K50 |
| A4R734        | 322-3232-00           |                                             | RES,FXD,FILM:2.55K OHM,1%,0.2W,TC=TO                              | 80009        | 322-3232-00    |
| A4R735        | 322-3271-00           |                                             | RES,FXD,FILM:6.49K OHM,1%,0.2W,TC=TO                              | 91637        | CCF502G64900FT |
| A4R737        | 313-1392-00           |                                             | RES,FXD,FILM:3.9K OHM,5%,0.2W                                     | 57668        | TR20JE 03K9    |
| A4R738        | 313-1512-00           |                                             | RES,FXD,FILM:5.1K OHM,5%,0.2W                                     | 57668        | TR20JE 5K1     |
| A4R739        | 313-1302-00           |                                             | RES,FXD,FILM:3K OHM,5%,0.2W                                       | 57668        | TR20JE 03K0    |
| A4R740        | 311-2232-00           |                                             | RES,VAR,NONWW:TRMR,2K OHM,20%,0.5W LINEAR                         | TK1450       | GF06UT 2K      |
| A4R741        | 322-3255-00           |                                             | RES,FXD,FILM:4.42K OHM,1%,0.2W,TC=TO                              | 57668        | CRB20 FXE 4K42 |
| A4R742        | 313-1123-00           |                                             | RES,FXD,FILM:12K OHM,5%,0.2W                                      | 57668        | TR20JE12K0     |
| A4R743        | 322-3210-00           |                                             | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                               | 57668        | CRB20 FXE 1K50 |
| A4R744        | 322-3232-00           |                                             | RES,FXD,FILM:2.55K OHM,1%,0.2W,TC=TO                              | 80009        | 322-3232-00    |
| A4R745        | 313-1431-00           |                                             | RES,FXD,FILM:430 OHM,5%,0.2W                                      | 57668        | TR20JE 430E    |
| A4R746        | 313-1621-00           |                                             | RES,FXD,FILM:620 OHM,5%,0.2W                                      | 57668        | TR20JE 620E    |
| A4R747        | 322-3126-00           |                                             | RES,FXD,FILM:200 OHM,1%,0.2W,TC=TO                                | 91637        | CCF501G200ROF  |
| A4R748        | 322-3293-00           |                                             | RES,FXD,FILM:11K OHM,1%,0.2W,TC=TO                                | 57668        | CRB20 FXE 11K0 |
| A4R749        | 311-2234-00           |                                             | RES,VAR,NONWW:TRMR,5K OHM,20%,0.5W LINEAR TA<br>PE & REEL         | TK1450       | GF06UT 5K      |
| A4R750        | 322-3293-00           |                                             | RES,FXD,FILM:11K OHM,1%,0.2W,TC=TO                                | 57668        | CRB20 FXE 11K0 |
| A4R751        | 322-3326-00           |                                             | RES,FXD,FILM:24.3K OHM,1%,0.2W,TC=TO                              | 91637        | CCF50-2F24301F |
| A4R752        | 313-1100-00           |                                             | RES,FXD,FILM:10 OHM,5%,0.2W                                       | 57668        | TR20JE10E0     |
| A4R753        | 322-3215-00           |                                             | RES,FXD,FILM:1.69K OHM,1%,0.2W,TC=TO                              | 80009        | 322-3215-00    |
| A4R754        | 311-0622-00           |                                             | RES,VAR,NONWW:TRMR,100 OHM,0.5W                                   | 32997        | 3329H-L58-101  |
| A4R755        | 313-1121-00           |                                             | RES,FXD,FILM:120 OHM,5%,0.2W                                      | 80009        | 313-1121-00    |
| A4R758        | 313-1333-00           |                                             | RES,FXD,FILM:33K OHM,5%,0.2W                                      | 57668        | TR20JE 33K     |
| A4R759        | 322-3204-00           |                                             | RES,FXD,FILM:1.3K OHM,1%,0.2W,TC=TO                               | 57668        | CRB20 FXE 1K30 |
| A4R760        | 311-2229-00           |                                             | RES,VAR,NONWW:TRMR,250 OHM,20%,0.5W LINEAR                        | TK1450       | GF06UT 250     |
| A4R761        | 322-3210-00           |                                             | RES,FXD,FILM:1.5K OHM,1%,0.2W,TC=TO                               | 57668        | CRB20 FXE 1K50 |
| A4R762        | 313-1512-00           |                                             | RES,FXD,FILM:5.1K OHM,5%,0.2W                                     | 57668        | TR20JE 5K1     |
| A4RT715       | 307-0125-00           |                                             | RES,THERMAL:500 OHM,10%,NTC                                       | 15454        | 1DB501K-220-EC |
| A4S701        | 260-2023-03           |                                             | SWITCH,ROTARY:TIMING,A/B SWEEP                                    | 82104        | ORDER BY DESCR |
| A4U715        | 156-1272-00           |                                             | MICROCKT,LINEAR:DUAL OPERATIONAL AMPLIFIER                        | 80009        | 156-1272-00    |
| A4U750        | 156-1150-00           |                                             | IC,LINEAR:BIPOLAR,VOLTAGE REGULATOR;NEG 5V,<br>100MA;79L05A,TO-92 | 80009        | 156-1150-00    |
| A4U760        | 155-0124-00           |                                             | MICROCKT,LINEAR:HORIZ PREAMP                                      | 80009        | 155-0124-00    |
| A4VR720       | 152-0195-00           |                                             | SEMICON DVC,DI:ZEN,SI,5.1V,5%,0.4W,DO-7                           | 80009        | 152-0195-00    |
| A4VR749       | 152-0744-00           |                                             | SEMICON DVC,DI:ZEN,SI,3.6V,5%,0.4W,DO-7                           | 80009        | 152-0744-00    |
| A4W709        | 131-0566-00           |                                             | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                        | 24546        | OMA 07         |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix Part No. | Serial/Assembly No. |         | Name & Description                                                                | Mfr. Code | Mfr. Part No.   |
|---------------|--------------------|---------------------|---------|-----------------------------------------------------------------------------------|-----------|-----------------|
|               |                    | Effective           | Discont |                                                                                   |           |                 |
| A5            | 671-1422-00        |                     |         | CIRCUIT BD ASSY:ALT SWEEP                                                         | 80009     | 671-1422-00     |
| A5C605        | 281-0826-00        |                     |         | CAP,FXD,CER DI:2200PF,10%,100V                                                    | 20932     | 401EM100AD222K  |
| A5C606        | 290-0776-00        |                     |         | CAP,FXD,ELCTLT:22UF,+50-20 %,10V                                                  | 55680     | ULA1A220TAA     |
| A5C610        | 281-0862-00        |                     |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V                                               | 04222     | MA101C10ZMAA    |
| A5C641        | 290-0776-00        |                     |         | CAP,FXD,ELCTLT:22UF,+50-20 %,10V                                                  | 55680     | ULA1A220TAA     |
| A5C643        | 281-0904-00        |                     |         | CAP,FXD,CER DI:12PF,10%                                                           | 04222     | MA101A120KAA    |
| A5C655        | 281-0773-00        |                     |         | CAP,FXD,CER DI:0.01UF,10%,100V                                                    | 04222     | MA201C103KAA    |
| A5C657        | 281-0862-00        |                     |         | CAP,FXD,CER DI:0.001UF,+80-20%,100V                                               | 04222     | MA101C10ZMAA    |
| A5C659        | 281-0773-00        |                     |         | CAP,FXD,CER DI:0.01UF,10%,100V                                                    | 04222     | MA201C103KAA    |
| A5C665        | 281-0797-00        |                     |         | CAP,FXD,CER DI:15PF,10%,100V                                                      | 04222     | SA106A150KAA    |
| A5C667        | 281-0759-00        |                     |         | CAP,FXD,CER DI:22PF,10%,100V                                                      | 04222     | MA101A220KAA    |
| A5C670        | 281-0773-00        |                     |         | CAP,FXD,CER DI:0.01UF,10%,100V                                                    | 04222     | MA201C103KAA    |
| A5C672        | 281-0759-00        | B010100             | B011670 | CAP,FXD,CER DI:22PF,10%,100V                                                      | 04222     | MA101A220KAA    |
| A5C672        | 281-0785-00        | B011671             |         | CAP,FXD,CER DI:68PF,10%,100V                                                      | 04222     | MA101A680KAA    |
| A5C680        | 281-0773-00        |                     |         | CAP,FXD,CER DI:0.01UF,10%,100V                                                    | 04222     | MA201C103KAA    |
| A5CR625       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR680       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR684       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR685       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR687       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR816       | 152-0153-00        |                     |         | SEMICON DVC,DI:SW,SI,10V,50MA,DO-7                                                | 07263     | FD7003          |
| A5CR817       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5CR826       | 152-0141-02        |                     |         | SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35                                          | 03508     | DA2527 (1N4152) |
| A5L667        | 108-1485-00        |                     |         | COIL,RF:FXD,INDUCTOR,220UH,10%,0.41A,BOBBIN CORE,RADIAL LEAD 0.2 IN LEAD SPACING, | TK2058    | TSL0707-221KR41 |
| A5P2100       | 131-0589-00        |                     |         | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                          | 22526     | 48283-029       |
| A5P2200       | 131-0589-00        |                     |         | TERM,PIN:0.46 L X 0.025 SQ PH BRZ GLD PL                                          | 22526     | 48283-029       |
| A5P9400       | 136-1088-00        |                     |         | SKT,PL-IN ELEK:1 X 15,RITHY ANGLE                                                 | 80009     | 136-1088-00     |
| A5Q630        | 151-0199-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0199-00     |
| A5Q631        | 151-0199-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0199-00     |
| A5Q637        | 151-0276-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0276-00     |
| A5Q643        | 151-0190-00        |                     |         | TRANSISTOR:NPN,SI,TO-92                                                           | 80009     | 151-0190-00     |
| A5Q670        | 151-0188-05        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0188-05     |
| A5Q674        | 151-0188-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0188-00     |
| A5Q682        | 151-0188-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0188-00     |
| A5Q683        | 151-0188-00        |                     |         | TRANSISTOR:PNP,SI,TO-92                                                           | 80009     | 151-0188-00     |
| A5Q684        | 151-0190-00        |                     |         | TRANSISTOR:NPN,SI,TO-92                                                           | 80009     | 151-0190-00     |
| A5Q687        | 151-0190-00        |                     |         | TRANSISTOR:NPN,SI,TO-92                                                           | 80009     | 151-0190-00     |
| A5R604        | 322-3180-00        |                     |         | RES,FXD,FILM:732 OHM,1%,0.2W,TC=TO                                                | 80009     | 322-3180-00     |
| A5R605        | 322-3141-00        |                     |         | RES,FXD,FILM:287 OHM,1%,0.2W,TC=TO                                                | 57668     | CRB20 FXE 287E  |
| A5R606        | 322-3197-00        |                     |         | RES,FXD,FILM:1.1K OHM,1%,0.2W,TC=TO                                               | 57668     | CRB20 FXE 1K10  |
| A5R609        | 313-1222-00        |                     |         | RES,FXD,FILM:2.2K OHM,5%,0.2W                                                     | 57668     | TR20JE 02K2     |
| A5R610        | 313-1241-00        |                     |         | RES,FXD,FILM:240 OHM,5%,0.2W                                                      | 57668     | TR20JE 240E     |
| A5R611        | 313-1470-00        |                     |         | RES,FXD,FILM:47 OHM,5%,0.2W                                                       | 57668     | TR20JE 47E      |
| A5R613        | 322-3097-00        |                     |         | RES,FXD,FILM:100 OHM,1%,0.2W,TC=TO                                                | 57668     | CRB20 FXE 100E  |
| A5R614        | 322-3130-00        |                     |         | RES,FXD,FILM:221 OHM,1%,0.2W,TC=TO                                                | 80009     | 322-3130-00     |
| A5R616        | 322-3145-00        |                     |         | RES,FXD,FILM:316 OHM,1%,0.2W,TC=TO                                                | 57668     | CRB20 FXE 316E  |
| A5R617        | 322-3182-00        |                     |         | RES,FXD,FILM:768 OHM,1%,0.2W,TC=TO                                                | 80009     | 322-3182-00     |
| A5R618        | 322-3141-00        |                     |         | RES,FXD,FILM:287 OHM,1%,0.2W,TC=TO                                                | 57668     | CRB20 FXE 287E  |
| A5R619        | 322-3215-00        |                     |         | RES,FXD,FILM:1.69K OHM,1%,0.2W,TC=TO                                              | 80009     | 322-3215-00     |
| A5R621        | 322-3215-00        |                     |         | RES,FXD,FILM:1.69K OHM,1%,0.2W,TC=TO                                              | 80009     | 322-3215-00     |
| A5R623        | 313-1431-00        |                     |         | RES,FXD,FILM:430 OHM,5%,0.2W                                                      | 57668     | TR20JE 430E     |
| A5R624        | 313-1431-00        |                     |         | RES,FXD,FILM:430 OHM,5%,0.2W                                                      | 57668     | TR20JE 430E     |
| A5R625        | 313-1512-00        |                     |         | RES,FXD,FILM:5.1K OHM,5%,0.2W                                                     | 57668     | TR20JE 5K1      |
| A5R626        | 322-3193-00        |                     |         | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                                                 | 57668     | CRB20 FXE 1K00  |
| A5R627        | 311-2273-00        |                     |         | RES,VAR,NONWV:TRMR,2K OHM,20%,0.5W                                                | 80009     | 311-2273-00     |
| A5R628        | 313-1512-00        |                     |         | RES,FXD,FILM:5.1K OHM,5%,0.2W                                                     | 57668     | TR20JE 5K1      |
| A5R630        | 313-1431-00        |                     |         | RES,FXD,FILM:430 OHM,5%,0.2W                                                      | 57668     | TR20JE 430E     |

| Component No. | Tektronix Part No. | Serial/Assembly No. Effective Discnt | Name & Description                                            | Mfr. Code | Mfr. Part No.  |
|---------------|--------------------|--------------------------------------|---------------------------------------------------------------|-----------|----------------|
| A5R631        | 313-1431-00        |                                      | RES,FXD,FILM:430 OHM,5%,0.2W                                  | 57668     | TR20JE 430E    |
| A5R632        | 322-3126-00        |                                      | RES,FXD,FILM:200 OHM,1%,0.2W,TC=TO                            | 91637     | CCF501G200ROF  |
| A5R633        | 313-1181-00        |                                      | RES,FXD,FILM:180 OHM,5%,0.2W                                  | 57668     | TR20JE180E     |
| A5R634        | 313-1181-00        |                                      | RES,FXD,FILM:180 OHM,5%,0.2W                                  | 57668     | TR20JE180E     |
| A5R635        | 313-1470-00        |                                      | RES,FXD,FILM:47 OHM,5%,0.2W                                   | 57668     | TR20JE 47E     |
| A5R637        | 322-3385-00        |                                      | RES,FXD,FILM:100K OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 100K |
| A5R638        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R640        | 313-1114-00        |                                      | RES,FXD,FILM:110K,5%,0.2W                                     | 57668     | TR20JE110K     |
| A5R642        | 322-3314-00        |                                      | RES,FXD,FILM:18.2K OHM,1%,0.2W,TC=TO                          | 80009     | 322-3314-00    |
| A5R643        | 322-3322-00        |                                      | RES,FXD,FILM:22.1K OHM,1%,0.2W,TC=TO                          | 57668     | CRB20 FXE 22K1 |
| A5R644        | 313-1512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.2W                                 | 57668     | TR20JE 5K1     |
| A5R650        | 313-1512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.2W                                 | 57668     | TR20JE 5K1     |
| A5R651        | 322-3277-00        |                                      | RES,FXD,FILM:7.5K OHM,1%,0.2W,TC=TO                           | 57668     | CRB20 FXE 7K50 |
| A5R652        | 311-2271-00        |                                      | RES,VAR,NONWV:TRMR,5K OHM,20%,0.5W                            | 80009     | 311-2271-00    |
| A5R653        | 322-3289-00        |                                      | RES,FXD,FILM:10K OHM,1%,0.2W,TC=TO                            | 57668     | CRB20 FXE 10K0 |
| A5R659        | 313-1221-00        |                                      | RES,FXD,FILM:220 OHM,5%,0.2W                                  | 57668     | TR20JE220E     |
| A5R660        | 313-1471-00        |                                      | RES,FXD,FILM:470 OHM,5%,0.2W                                  | 57668     | TR20JE 470E    |
| A5R662        | 313-1392-00        |                                      | RES,FXD,FILM:3.9K OHM,5%,0.2W                                 | 57668     | TR20JE 03K9    |
| A5R663        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R664        | 313-1392-00        |                                      | RES,FXD,FILM:3.9K OHM,5%,0.2W                                 | 57668     | TR20JE 03K9    |
| A5R665        | 313-1513-00        |                                      | RES,FXD,CMPNSN:51K OHM,5%,0.2W                                | 57668     | TR20JE 51K     |
| A5R667        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W                                   | 57668     | TR20JE 03K0    |
| A5R668        | 313-1512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.2W                                 | 57668     | TR20JE 5K1     |
| A5R669        | 313-1512-00        |                                      | RES,FXD,FILM:5.1K OHM,5%,0.2W                                 | 57668     | TR20JE 5K1     |
| A5R670        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R671        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R672        | 313-1331-00        |                                      | RES,FXD,FILM:330 OHM,5%,0.2W                                  | 57668     | TR20JE 330E    |
| A5R674        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R675        | 322-3193-00        |                                      | RES,FXD,FILM:1K OHM,1%,0.2W,TC=TO                             | 57668     | CRB20 FXE 1K00 |
| A5R678        | 322-3163-00        |                                      | RES,FXD,FILM:487 OHM,1%,0.2W,TC=TO                            | 91637     | CCF50-26487ROF |
| A5R679        | 322-3126-00        |                                      | RES,FXD,FILM:200 OHM,1%,0.2W,TC=TO                            | 91637     | CCF501G200ROF  |
| A5R682        | 313-1431-00        |                                      | RES,FXD,FILM:430 OHM,5%,0.2W                                  | 57668     | TR20JE 430E    |
| A5R683        | 313-1431-00        |                                      | RES,FXD,FILM:430 OHM,5%,0.2W                                  | 57668     | TR20JE 430E    |
| A5R684        | 313-1331-00        |                                      | RES,FXD,FILM:330 OHM,5%,0.2W                                  | 57668     | TR20JE 330E    |
| A5R686        | 313-1181-00        |                                      | RES,FXD,FILM:180 OHM,5%,0.2W                                  | 57668     | TR20JE180E     |
| A5R687        | 313-1331-00        |                                      | RES,FXD,FILM:330 OHM,5%,0.2W                                  | 57668     | TR20JE 330E    |
| A5R688        | 313-1181-00        |                                      | RES,FXD,FILM:180 OHM,5%,0.2W                                  | 57668     | TR20JE180E     |
| A5R689        | 313-1471-00        |                                      | RES,FXD,FILM:470 OHM,5%,0.2W                                  | 57668     | TR20JE 470E    |
| A5R816        | 313-1562-00        |                                      | RES,FXD,FILM:5.6K OHM,5%,0.2W                                 | 57668     | TR20JE 05K6    |
| A5R817        | 313-1302-00        |                                      | RES,FXD,FILM:3K OHM,5%,0.2W                                   | 57668     | TR20JE 03K0    |
| A5U605        | 234-0107-20        |                                      | INTEGRATED CKT: SCHMITT TRIGGER                               | 80009     | 234-0107-20    |
| A5U655        | 156-1126-00        |                                      | MICROCKT, LINEAR: VOLTAGE COMPARATOR                          | 80009     | 156-1126-00    |
| A5U660        | 156-0385-00        |                                      | IC,DIGITAL:LSTTL,GATES;HEX INV;74LS04,DIP14 .3,TUBE           | 80009     | 156-0385-00    |
| A5U665        | 156-0382-00        |                                      | IC,DIGITAL:LSTTL,GATES;QUAD 2-INPUT NAND;74 LS00,DIP14.3,TUBE | 80009     | 156-0382-00    |
| A5U670        | 156-1639-00        |                                      | IC,DIGITAL:ECL,FLIP FLOP;DUAL MASTER-SLAVE; 10H131,DIP16.3    | 80009     | 156-1639-00    |
| A5U680        | 156-0382-00        |                                      | IC,DIGITAL:LSTTL,GATES;QUAD 2-INPUT NAND;74 LS00,DIP14.3,TUBE | 80009     | 156-0382-00    |
| A5VR660       | 152-0195-00        |                                      | SEMICON DVC,DI:ZEN,SI,5.1V,5%,0.4W,DO-7                       | 80009     | 152-0195-00    |
| A5W637        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |
| A5W638        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |
| A5W643        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |
| A5W655        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |
| A5W672        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |
| A5W674        | 131-0566-00        |                                      | BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L                    | 24546     | OMA 07         |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                            | Mfr.<br>Code | Mfr. Part No. |
|---------------|-----------------------|--------------------------------------------|-----------------------------------------------|--------------|---------------|
| A5W678        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W682        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W689        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W690        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W691        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W695        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |
| A5W696        | 131-0566-00           |                                            | BUS, CONDUCTOR: DUMMY RES, 0.094 OD X 0.225 L | 24546        | OMA 07        |

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                        | Mfr.<br>Code | Mfr. Part No.  |
|---------------|-----------------------|--------------------------------------------|-------------------------------------------|--------------|----------------|
| A6            | 670-7615-01           |                                            | CIRCUIT BD ASSY:EMI FILTER                | 80009        | 670-7615-01    |
| A6C900        | 285-1252-00           |                                            | CAP,FXD,PLASTIC:0.15UF,10%,250VAC         | D5243        | F1772-415-2000 |
| A6C902        | 285-1191-00           |                                            | CAP,FXD,PLASTIC:0.012 UF,5%,1000V         | 14752        | C-2524         |
| A6C903        | 285-1191-00           |                                            | CAP,FXD,PLASTIC:0.012 UF,5%,1000V         | 14752        | C-2524         |
| A6R900        | 301-0474-00           |                                            | RES,FXD,FILM:470K OHM,5%,0.5W             | 19701        | 5053CX470K0J   |
| A6R901        | 301-0512-00           |                                            | RES,FXD,FILM:5.1K OHM,5%,0.5W             | 19701        | 5053CX5K100J   |
| A6R903        | 301-0131-00           |                                            | RES,FXD,FILM:130 OHM,5%,0.5W              | 19701        | 5053CX130R0J   |
| A6RT901       | 307-0863-00           |                                            | RES,THERMAL:10 OHM,10%,NTC                | 15454        | SG-13S         |
| A6RV901       | 307-0456-00           |                                            | RES,V SENSITIVE:250VAC,20W,METAL OXIDE    | 03508        | MOV-V250LA15A  |
| A6T901        | 120-1449-00           |                                            | TRANSFORMER,RF:COMMON MODE,2.7MH,2A       | 80009        | 120-1449-00    |
| A6T903        | 120-1455-00           |                                            | TRANSFORMER,RF:DIFFERENTIAL MODE,POT CORE | 64053        | 120-1455-00    |
| A6W9011       | 196-0531-00           |                                            | LEAD,ELECTRICAL:18 AWG,3.0 L,8-01         | 80009        | 196-0531-00    |
| A6W9041       | 195-7745-00           |                                            | LEAD,ELECTRICAL:18 AWG,3.5 L,8-04         | 80009        | 195-7745-00    |
| A6W9091       | 196-0505-00           |                                            | LEAD,ELECTRICAL:18 AWG,3.0 L,8-9          | 80009        | 196-0505-00    |
| A6W9191       | 195-7747-00           |                                            | LEAD,ELECTRICAL:18 AWG,3.5 L,8-19         | 80009        | 195-7747-00    |

# Replaceable Electrical Parts - 2235A Service

| Component No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Name & Description                       | Mfr.<br>Code | Mfr. Part No. |
|---------------|-----------------------|--------------------------------------------|------------------------------------------|--------------|---------------|
| A7            | 671-1463-00           |                                            | CIRCUIT BD ASSY:SCALE ILLUM              | 80009        | 671-1463-00   |
| A7DS881       | 150-0077-01           |                                            | LAMP, INCAND:14V,0.08A,#2282D,WIRE LEADS | 08806        | 2162D         |
| A7DS882       | 150-0077-01           |                                            | LAMP, INCAND:14V,0.08A,#2282D,WIRE LEADS | 08806        | 2162D         |
| A7W9882       | 174-1379-00           |                                            | CA ASSY,SP,ELEC:2,28 AWG,2.25 L          | 80009        | 174-1379-00   |

| Component No. | Tektronix   | Serial/Assembly No. |         | Name & Description                        | Mfr.  | Mfr. Part No. |
|---------------|-------------|---------------------|---------|-------------------------------------------|-------|---------------|
|               | Part No.    | Effective           | Discont |                                           | Code  |               |
| DL9210        | 119-1515-00 |                     |         | DELAY LINE, ELEC: 93NS, 150 OHM, ASSEMBLY | 80009 | 119-1515-00   |
| F9001         | 159-0041-00 |                     |         | FUSE, CARTRIDGE: 3AG, 1.25A, 250V, 20SEC  | 71400 | MSL 1 1/4     |
| V9870         | 154-0861-10 |                     |         | ELECTRON TUBE: T4655-31-2                 | 80009 | 154-0861-10   |



# DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## Symbols

Graphics symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI/IEEE 91-1984. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The (L) after a signal name indicates that the signal performs its intended function when it is in the LO state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc., are:

|             |                                 |
|-------------|---------------------------------|
| Y14.15-1966 | Drafting Practices.             |
| Y14.2M-1979 | Line Conventions and Lettering. |

ANSI/IEEE 280-1985 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standards Institute  
1430 Broadway  
New York, New York 10018

## Component Values

Electrical Components shown on the diagrams are in the following units unless noted otherwise:

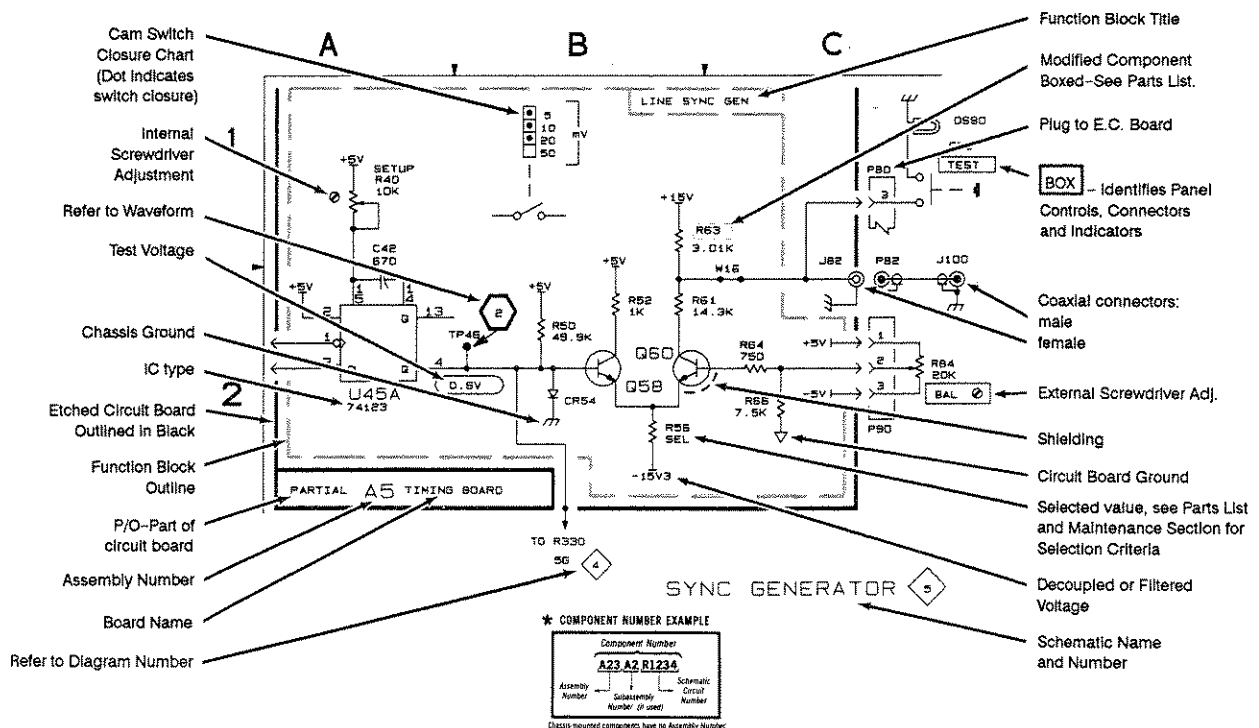
|            |                                                                                                |
|------------|------------------------------------------------------------------------------------------------|
| Capacitors | Values one or greater are in picofarads (pF).<br>Values less than one are in microfarads (μF). |
| Resistors  | Ohms (Ω).                                                                                      |

— The information and special symbols below may appear in this manual. —

## Assembly Numbers and Grid Coordinates

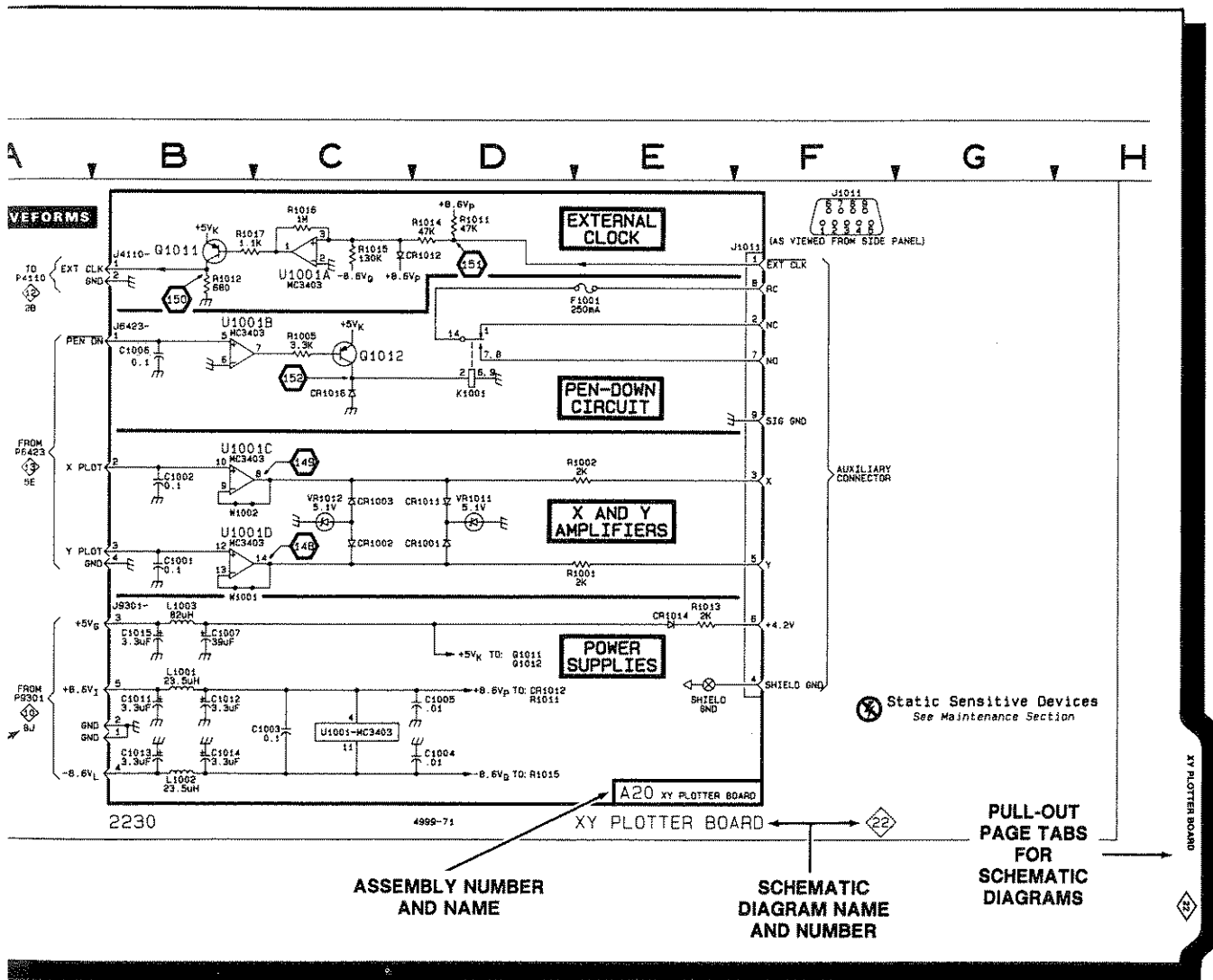
Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number \* (see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustrations have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



c. In the SCHEM LOCATION column next to the component, read the grid coordinates of the component in the schematic.

d. Using the grid coordinates given, find the component in the schematic diagram.



circuit

board  
board

Instruction

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grams are in the  
farads (pF).  
ofarads (μF).

Component location  
grid coordinates is  
only the components  
lookup table. When  
locate the circuitry  
in may only appear  
illustrated; the lookup  
is that the circuitry

e

component  
List.

Panel  
dis

z

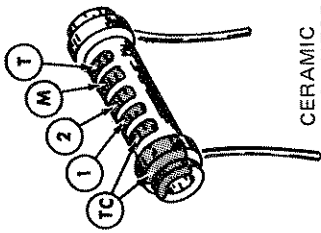
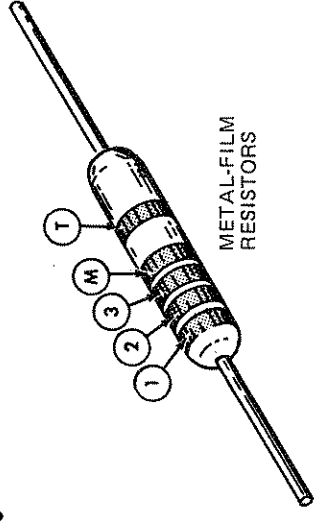
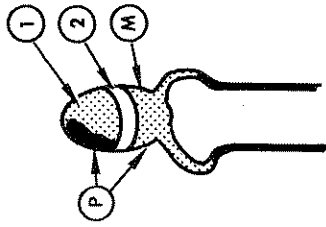
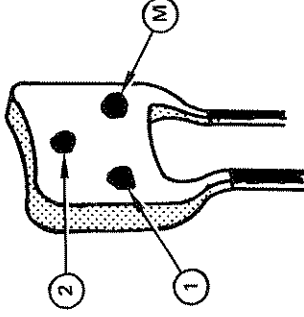
driver Adj.

round

see Parts List  
Section for

filtered

COLOR CODE

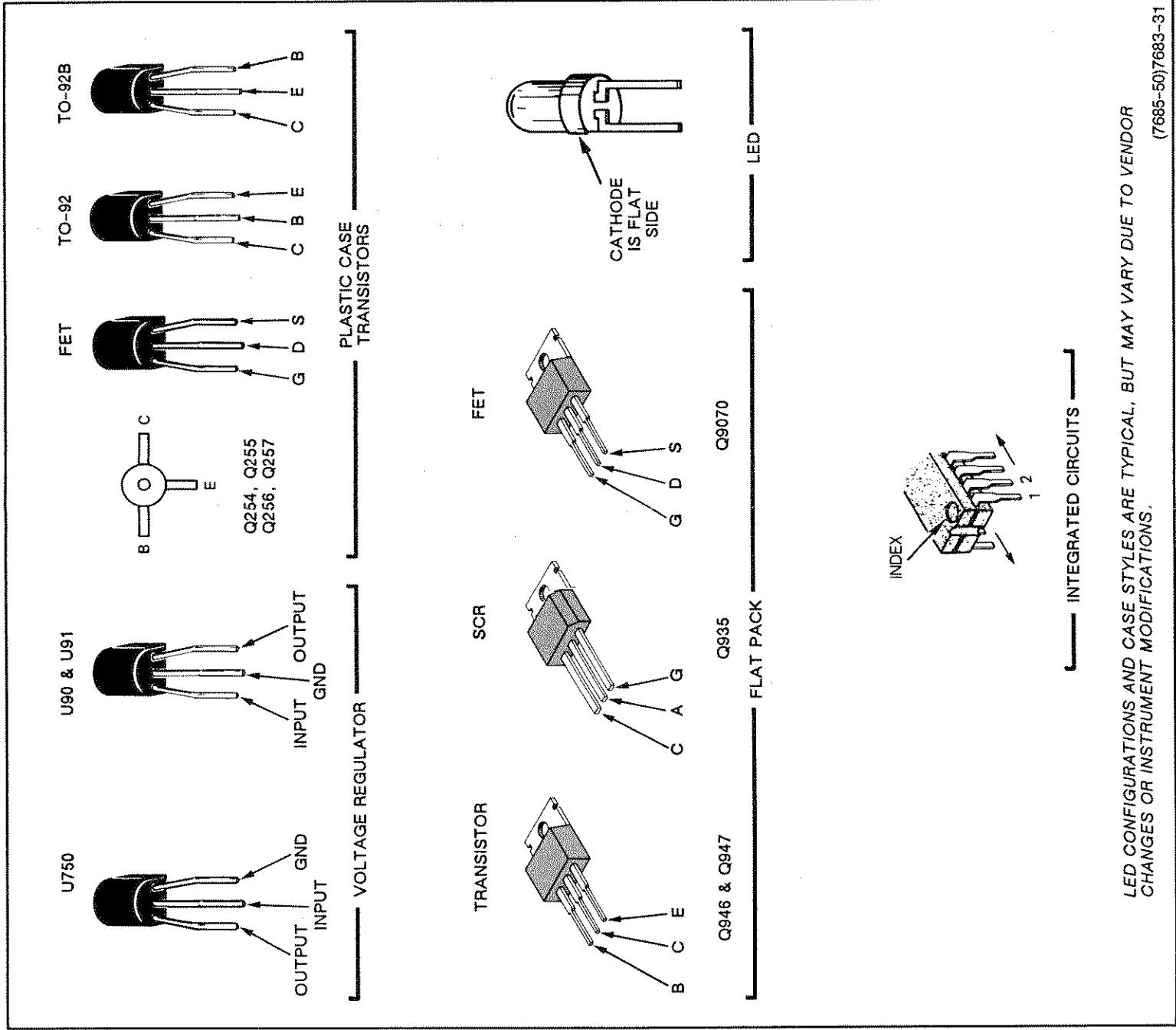


- 1 2 and 3 — 1st, 2nd, and 3rd significant figures  
M — multiplier T — tolerance  
TC — temperature coefficient  
P — polarity and voltage rating  
T and/or TC color code may not be present on some capacitors

| COLOR  | SIGNIFICANT FIGURES | RESISTORS                |           | CAPACITORS                   |                    | DIPPED TANTALUM VOLTAGE RATING |
|--------|---------------------|--------------------------|-----------|------------------------------|--------------------|--------------------------------|
|        |                     | MULTIPLIER               | TOLERANCE | MULTIPLIER                   | TOLERANCE          |                                |
| BLACK  | 0                   | 1                        | —         | 1                            | over 10 pF<br>±20% | 4 VDC                          |
| BROWN  | 1                   | 10                       | ±1%       | 10                           | under 10 pF<br>±1% | 6 VDC                          |
| RED    | 2                   | 10 <sup>2</sup> or 100   | ±2%       | 10 <sup>2</sup> or 100       | ±2%                | 10 VDC                         |
| ORANGE | 3                   | 10 <sup>3</sup> or 1 K   | ±3%       | 10 <sup>3</sup> or 1000      | ±3%                | 15 VDC                         |
| YELLOW | 4                   | 10 <sup>4</sup> or 10 K  | ±4%       | 10 <sup>4</sup> or 10,000    | +100% — 9%         | 20 VDC                         |
| GREEN  | 5                   | 10 <sup>5</sup> or 100 K | ±½%       | 10 <sup>5</sup> or 100,000   | ±5%                | 25 VDC                         |
| BLUE   | 6                   | 10 <sup>6</sup> or 1 M   | ±¼%       | 10 <sup>6</sup> or 1,000,000 | —                  | 35 VDC                         |
| VIOLET | 7                   | —                        | ±1/10%    | —                            | —                  | 50 VDC                         |
| GRAY   | 8                   | —                        | —         | 10 <sup>-2</sup> or 0.01     | +80% — 20%         | —                              |
| WHITE  | 9                   | —                        | —         | 10 <sup>-1</sup> or 0.1      | ±10%               | —                              |
| GOLD   | —                   | 10 <sup>-1</sup> or 0.1  | ±5%       | —                            | —                  | —                              |
| SILVER | —                   | 10 <sup>-2</sup> or 0.01 | ±10%      | —                            | —                  | —                              |
| NONE   | —                   | —                        | ±20%      | —                            | ±10%               | ±1 pF                          |

(1861-20A)4206-31

Figure 9-1. Color codes for resistors and capacitors.



LED CONFIGURATIONS AND CASE STYLES ARE TYPICAL, BUT MAY VARY DUE TO VENDOR CHANGES OR INSTRUMENT MODIFICATIONS.

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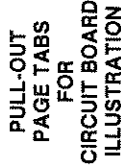
Figure 9-2. Semiconductor lead configurations.

3. Locate the Component on the Schematic Diagram.

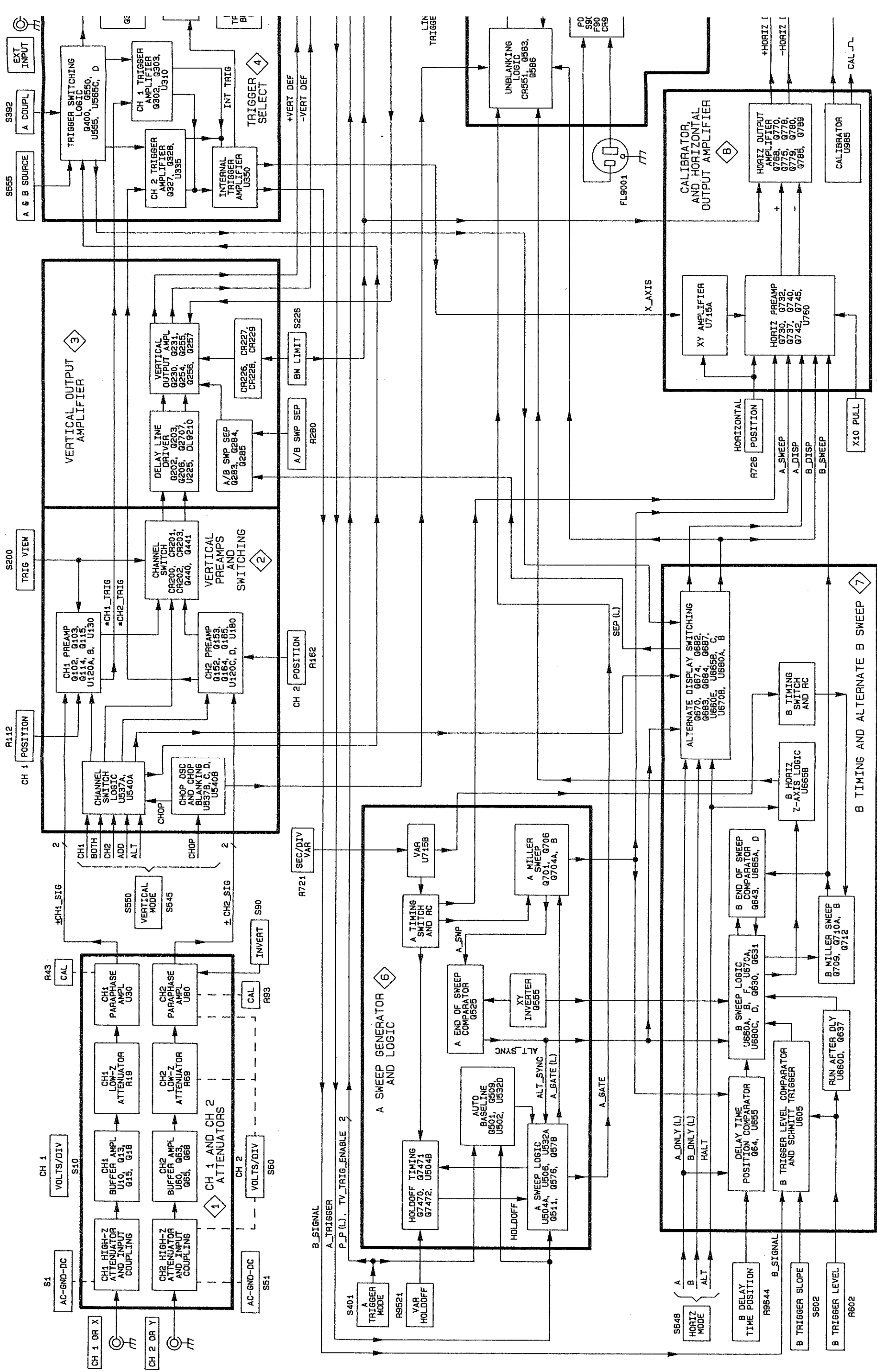
- Compare the circuit board with its illustration. Locate the component you are looking for by area and shape on the illustration to determine its Circuit Number.
- Scan the lookup table next to the Circuit Board illustration to find the Circuit Number of the component.
- Read the SCHEM NUMBER column next to the component's circuit number to find the Schematic Diagram number.

b. Scan the lookup table next to the  
Circuit Number of the component.

b. Locate the Assembly Number in the Component Location lookup next to the schematic diagram. Scan the CIRCUIT NUMBER that table to find the Circuit Number of the component you are in the schematic.



**Figure 9-3. Locating components on schematic diagrams and circuit board illustrations.**



## POWER SUPPLY ISOLATION PROCEDURE

Each regulated supply has numerous feed points to external loads throughout the instrument. The power distribution diagram is used in conjunction with the schematic diagrams to determine those loads that can be isolated by removing service jumpers and those that cannot.

The power distribution and circuit board interconnections diagrams are divided into circuit boards. Each power supply feed to a circuit board is indicated by the schematic diagram number on which the voltage appears. The schematic diagram grid location of a service jumper or component is given adjacent to the component number on the power distribution and circuit board interconnect diagrams.

If a power supply comes up after lifting one of the main jumpers from the power supply to isolate that supply, it is very probable that a short exists in the circuitry on that supply line. By lifting jumpers farther down the line, the circuit in which a short exists may be located.

Always set the POWER switch to OFF before soldering or unsoldering service jumpers or other components and before attempting to measure component resistance values.

### OTHER PARTS

| CIRCUIT NUMBER | SCHEM NUMBER | SCHEM LOCATION | CIRCUIT NUMBER | SCHEM NUMBER | SCHEM LOCATION | CIRCUIT NUMBER | SCHEM NUMBER | SCHEM LOCATION |
|----------------|--------------|----------------|----------------|--------------|----------------|----------------|--------------|----------------|
| B1             | D10          | 5G             | J9376          | D04          | 3A             | Q9070          | D09          | 3F             |
| F9001          | D09          | 1A             | J9510          | D01          | 4A             | R9644          | D07          | 3B             |
| FL9001         | D09          | 1A             | J9800          | D10          | 1B             | V9870          | D10          | 2G             |
| J9100          | D01          | 2A             |                |              |                |                |              |                |

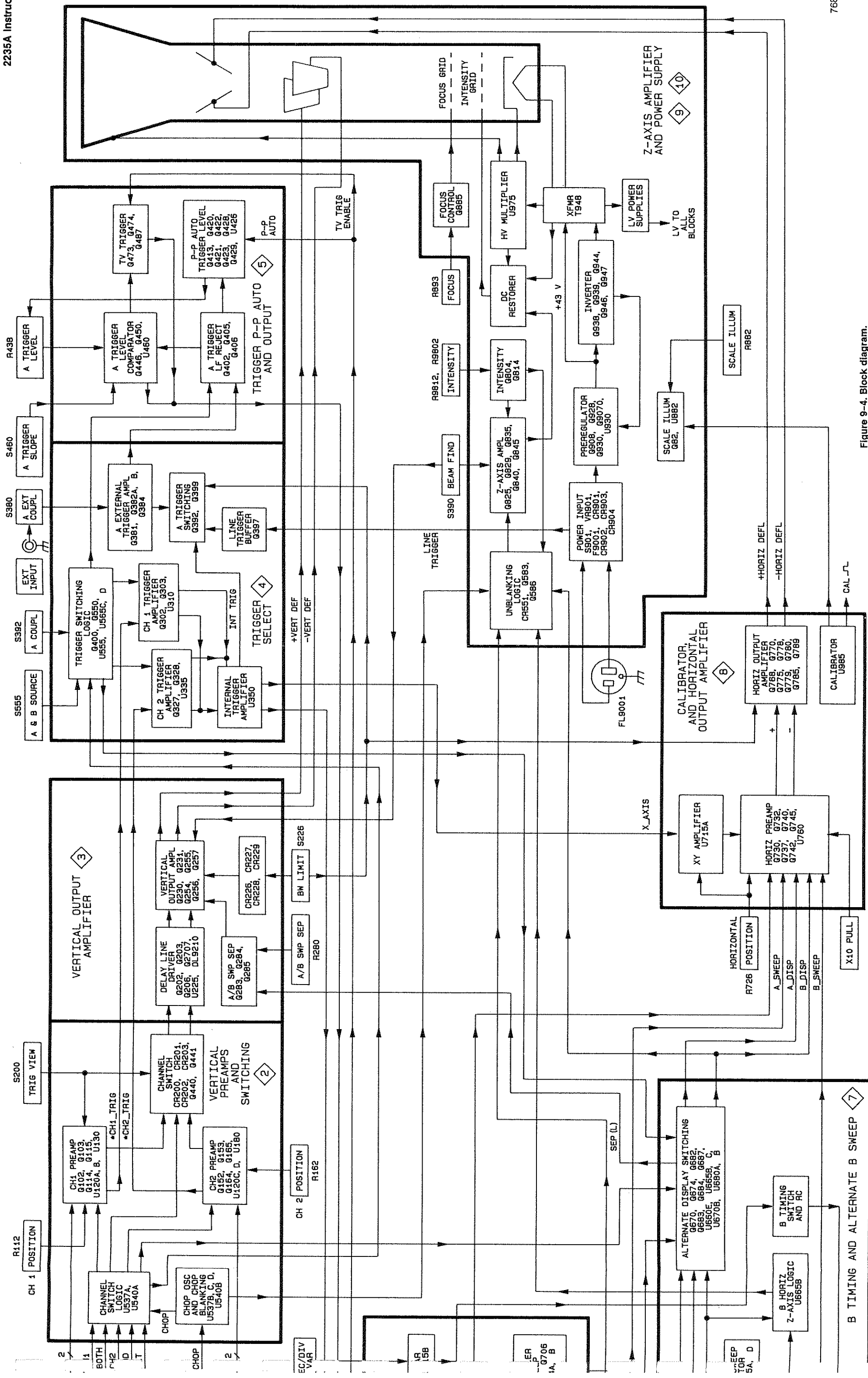


Figure 9-4. Block diagram.

TEST WAVEFORM AND VOLTAGE SETUPS

WAVEFORM MEASUREMENTS

On the left-hand pages preceding the schematic diagrams are test waveform illustrations that are intended to aid in troubleshooting the instrument. To test the instrument for these waveforms, make the initial control settings as follows:

Vertical (Both Channels)

- POSITION

MODE

BW LIMIT

INVERT

VOLTS/DIV

VOLTS/DIV Variable

Input Coupling
- Midrange

CH 1

Off (button out)

Off (button out)

0.5 V

CAL detent

GND

Horizontal

- POSITION

MODE

A and B SEC/DIV

SEC/DIV Variable

X10 Magnifier

B DELAY TIME POSITION
- Midrange

A

0.5 ms

CAL detent

Off (knob in)

0.5 ms

B TRIGGER

- SLOPE

LEVEL
- Positive (button out)

Midrange

A TRIGGER

- VAR HOLDOFF

Mode

SLOPE

LEVEL

A & B SOURCE

A COUPL
- NORM

P-P AUTO

Positive (button out)

Midrange

VERT MODE

NORM

Changes to the control settings for specific waveforms are noted at the beginning of each set of waveforms. Input signals and hookups required are also indicated, if needed, for each set of waveforms.

DC VOLTAGE MEASUREMENTS

Typical voltage measurements, located on the schematic diagram, were obtained with the instrument operating under the conditions specified in the Waveforms Measurements setup. Control-setting changes required for specific voltages are indicated on each waveform page. Measurements are referenced to chassis ground with the exception of the preregulator and inverter voltages on Diagram 9. These voltages are referenced as indicated on the schematic diagram.

RECOMMENDED TEST EQUIPMENT

Test equipment in Table 4-1 in the "Performance Check Procedure", Section 4, of this manual, meets the required specifications for testing this instrument.

POWER SUPPLY ISOLATION PROCEDURE

Each regulated supply has numerous feed points to external loads throughout the instrument. The power distribution diagram is used in conjunction with the schematic diagrams to determine those loads that can be isolate by removing service jumpers and those that cannot.

The power distribution and circuit board interconnections diagrams are divided into circuit boards. Each power supply feed to a circuit board is indicated by the schematic diagram number on which the voltage appears. The schematic diagram grid location of a service jumper or component is given adjacent to the component number on the power distribution and circuit board interconnect diagrams.

If a power supply comes up after lifting one of the main jumpers from the power supply to isolate that supply, it is very probable that a short exists in the circuitry on that supply line. By lifting jumpers farther down the line, the circuit in which a short exists may be located.

Always set the POWER switch to OFF before soldering or unsoldering service jumpers or other components and before attempting to measure component resistance values.

P9103 (A1) to W9103 (A2)

| WIRE NO. | LINE NAME | TO/FROM                        |                                |
|----------|-----------|--------------------------------|--------------------------------|
|          |           | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | GND       | 2, 1B                          | 1, 2H                          |
| 2        | -CH1_SIG  | 2, 2B                          | 1, 2H                          |
| 3        | +CH1_SIG  | 2, 1B                          | 1, 3H                          |
| 4        | GND       | 2, 2B                          | 1, 2H                          |

P9108 (A1) to W9108 (A2)

| WIRE NO. | LINE NAME | TO/FROM                        |                                |
|----------|-----------|--------------------------------|--------------------------------|
|          |           | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | GND       | 2, 3B                          | 1, 4H                          |
| 2        | -CH2_SIG  | 2, 4B                          | 1, 4H                          |
| 3        | +CH2_SIG  | 2, 3B                          | 1, 4H                          |
| 4        | GND       | 2, 4B                          | 1, 4H                          |

P9991 (A1) to W9991 (A2)

| WIRE NO. | LINE NAME          | TO/FROM                        |                                |
|----------|--------------------|--------------------------------|--------------------------------|
|          |                    | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | +8.6V <sub>b</sub> | 1, 4A                          | 11, 5G                         |
| 2        | GND                | 1, 4A                          | 11, 5G                         |
| 3        | CH1_PROBE_CODE     | 1, 1A                          | 1, 1A                          |
| 4        | -8.6V <sub>b</sub> | 1, 5A                          | 11, 5G                         |

P9200 (A2) to W9200 (A3)

| WIRE NO. | LINE NAME | TO/FROM                        |                                |
|----------|-----------|--------------------------------|--------------------------------|
|          |           | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | NOT USED  | 1, 3H                          | 1, 3H                          |
| 2        | INVERT    | 1, 5E                          | 1, 5E                          |
| 3        | NORMAL    | 1, 5E                          | 1, 5E                          |
| 4        | NOT USED  | 1, 5H                          | 1, 5H                          |

J2222 (A1) to W2222 (A3)

| WIRE NO. | LINE NAME      | TO/FROM                        |                                |
|----------|----------------|--------------------------------|--------------------------------|
|          |                | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | SCALE_ILUM     | 10, 4B                         |                                |
| 2        | GND            | 11, 2G                         |                                |
| 3        | A_INTENS       | 10, 2B                         |                                |
| 4        | B_INTENS       | 10, 2B                         |                                |
| 5        | BEAM_FIND      | 10, 3B                         |                                |
| 6        | CH1_POS        | 2, 1C                          |                                |
| 7        | A/B_SWP_SEP    | 3, 2D                          |                                |
| 8        | +8.6VH         | 11, 2G                         |                                |
| 9        | TRIG_VIEW      | 2, 5B                          |                                |
| 10       | CH2_POS        | 2, 3C                          |                                |
| 11       | CH2(L)         | 2, 5B                          |                                |
| 12       | BW_LIMIT       | 3, 2D                          |                                |
| 13       | -8.6VH         | 11, 2G                         |                                |
| 14       | VALT1(L)       | 4, 3C                          |                                |
| 15       | CH1(L)         | 2, 4B                          |                                |
| 16       | A_ONLY(L)      | 7, 2B                          |                                |
| 17       | B_LEVEL        | 7, 5D                          |                                |
| 18       | TV_TRIG_ENABLE | 6, 4B                          |                                |

P9201 (A4) to W9201 (A3)

| WIRE NO. | LINE NAME | TO/FROM                        |                                |
|----------|-----------|--------------------------------|--------------------------------|
|          |           | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | HOLDOFF   | 6, 2A                          | 6, 2A                          |
| 2        | NOT USED  | 6, 1D                          | 6, 1C                          |
| 3        | XY1(L)    | 4, 1A                          | 4, 1B                          |
| 4        | HORIZ_POS | 8, 1B                          | 8, 1B                          |

J9400 (A1) to P9400 (A5)

| WIRE NO. | LINE NAME     | TO/FROM                        |                                |
|----------|---------------|--------------------------------|--------------------------------|
|          |               | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | B_TRIG_SIGNAL | 7, 4D                          |                                |
| 2        | NOT USED      | 11, 3G                         |                                |
| 3        | B_SLOPE       | 7, 4D                          |                                |
| 4        | GND           | 11, 3G                         |                                |
| 5        | GND           | 11, 3G                         |                                |
| 6        | B_LEVEL       | 7, 4D                          |                                |
| 7        | A_DISP        | 7, 2H                          |                                |
| 8        | SEP(L)        | 7, 2H                          |                                |
| 9        | B_ONLY(L)     | 7, 2D                          |                                |
| 10       | B_INTENS      | 7, 3H                          |                                |
| 11       | Z_DRIVE       | 7, 3H                          |                                |
| 12       | HALT          | 7, 2D                          |                                |
| 13       | B_DISP        | 7, 2H                          |                                |
| 14       | CH1_SELECT    | 7, 2D                          |                                |
| 15       | A_ONLY(L)     | 7, 1D                          |                                |
| 16       | DELAY         | 7, 3D                          |                                |
| 17       | GND           | 11, 4G                         |                                |
| 18       | GND           | 11, 4G                         |                                |
| 19       | GND           | 11, 4G                         |                                |
| 20       | B_RETRACE     | 7, 4D                          |                                |
| 21       | GND           | 11, 4G                         |                                |
| 22       | VALT(L)       | 7, 2D                          |                                |
| 23       | A_SWP         | 7, 3D                          |                                |
| 24       | ALT_SYNC      | 7, 1D                          |                                |
| 25       | B_SWP         | 7, 3D                          |                                |
| 26       | GND           | 11, 4G                         |                                |
| 27       | GND           | 11, 4G                         |                                |
| 28       | -8.6V         | 11, 4G                         |                                |
| 29       | +5.2V         | 11, 3G                         |                                |
| 30       | +8.6V         | 11, 3G                         |                                |

P9700 (A4) to W9700 (A1)

| WIRE NO. | LINE NAME  | TO/FROM                        |                                |
|----------|------------|--------------------------------|--------------------------------|
|          |            | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | A_DISP     | 8, 3B                          |                                |
| 2        | B_DISP     | 8, 3B                          |                                |
| 3        | B_SWP      | 7, 3C                          |                                |
| 4        | NOT USED   | 6, 3C                          |                                |
| 5        | NOT USED   | 6, 3D                          |                                |
| 6        | NOT USED   | 6, 3C                          |                                |
| 7        | A_SWP      | 6, 4H                          |                                |
| 8        | A_GATE2(L) | 6, 2G                          |                                |
| 9        | GND        | 11, 1G                         |                                |
| 10       | B_RETRACE  | 7, 4C                          |                                |

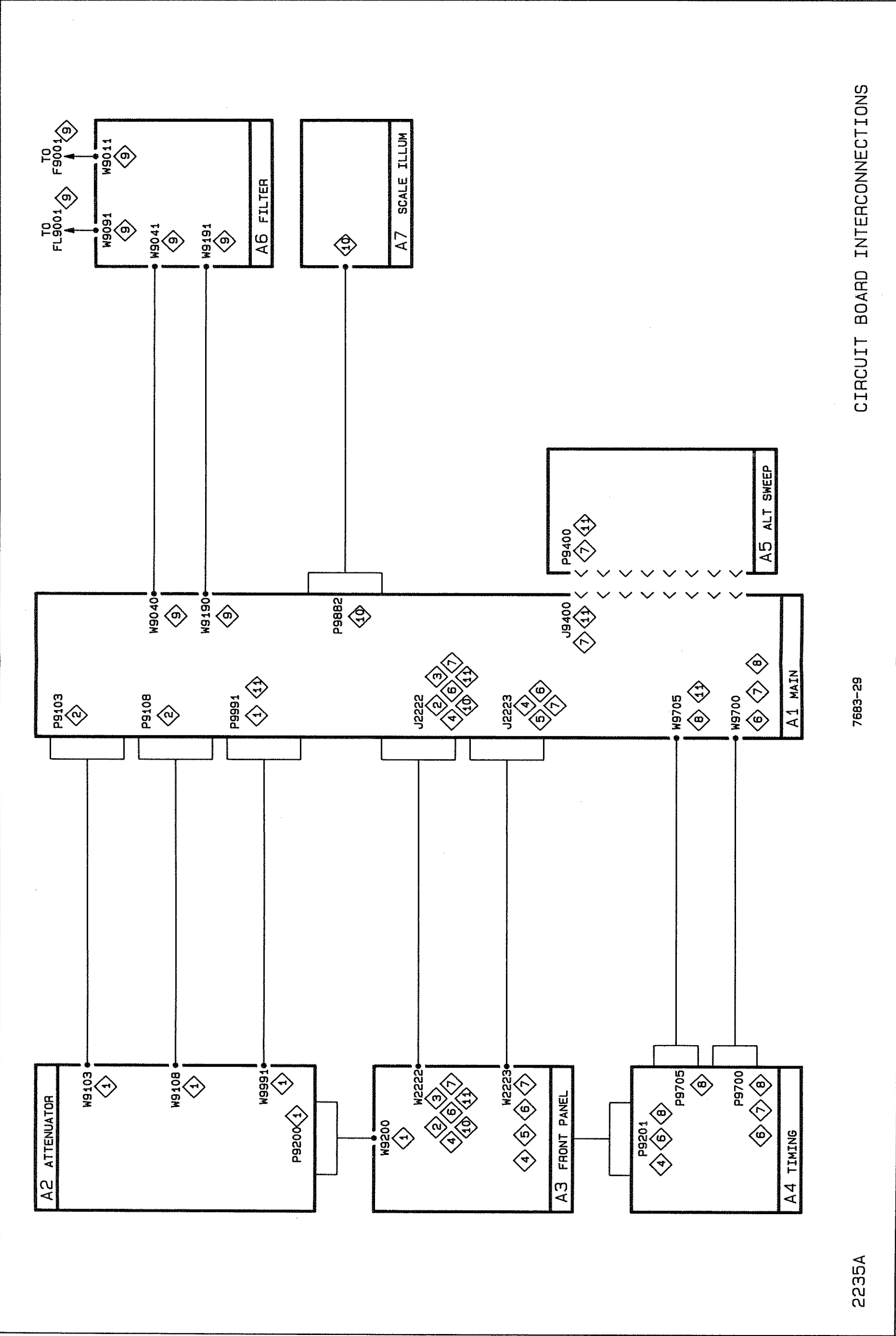
P9705 (A4) to W9705 (A1)

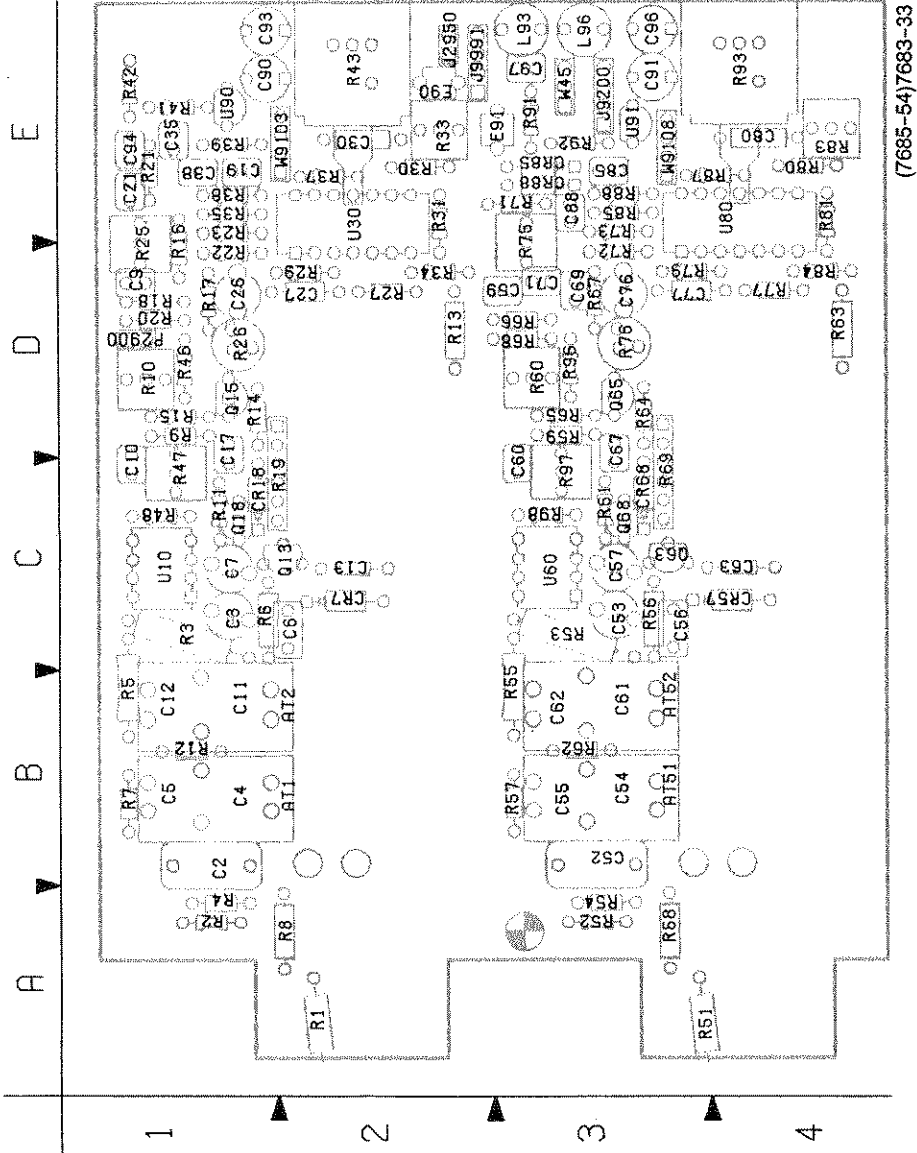
| WIRE NO. | LINE NAME          | TO/FROM                        |                                |
|----------|--------------------|--------------------------------|--------------------------------|
|          |                    | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | GND                | 8, 4B                          | 11, 2G                         |
| 2        | -SWP               | 8, 3E                          |                                |
| 3        | +SWP               | 8, 4E                          |                                |
| 4        | GN                 | 8, 5B                          | 11, 2G                         |
| 5        | X_AXIS_SIG         | 8, 2B                          |                                |
| 6        | -8.6V <sub>b</sub> | 8, 5B                          | 11, 2G                         |
| 7        | +8.6V <sub>b</sub> | 8, 4B                          | 11, 2G                         |
| 8        | +30V <sub>b</sub>  | 8, 4B                          | 11, 1G                         |

J2223 (A1) TO W2223 (A3)

| WIRE NO. | LINE NAME   | TO/FROM                        |                                |
|----------|-------------|--------------------------------|--------------------------------|
|          |             | DIAG. NO. AND GRID COORDINATES | DIAG. NO. AND GRID COORDINATES |
| 1        | NOT USED    | 5, 2G                          |                                |
| 2        | A_SLOPE     | 5, 5B                          |                                |
| 3        | A_LEVEL     | 5, 2G                          |                                |
| 4        | +AUTO_LEVEL | 5, 2G                          |                                |
| 5        | -AUTO_LEVEL | 5, 2G                          |                                |
| 6        | P-P(L)      | 6, 4B                          |                                |
| 7        | SS RESET    | 6, 3B                          |                                |
| 8        | B_ONLY(L)   | 7, 2B                          |                                |
| 9        | B_SLOPE     | 7, 5D                          |                                |
| 10       | TRIG'D_LED  | 6, 5F                          |                                |
| 11       | SS(L)       | 6, 5B                          |                                |
| 12       | HF REJ      | 4, 2C                          |                                |
| 13       | LF_REJ      | 4, 2C                          |                                |
| 14       | GND         | 4, 2C                          |                                |
| 15       | NOT USED    | 4, 2C                          |                                |
| 16       | NOT USED    | 4, 2C                          |                                |
| 17       | GND         | 4, 2C                          |                                |
| 18       | EXT_INPUT   | 4, 3C                          |                                |

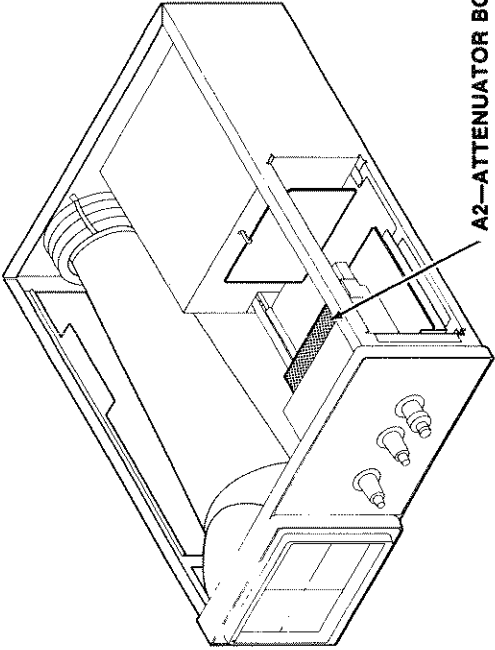






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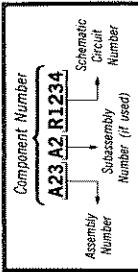
Figure 9-5. A2 – Attenuator board.



| A2—ATTENUATOR BOARD |              |                |              |                |              |                |              |                |              |
|---------------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|
| CIRCUIT NUMBER      | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER |
| AT1                 | 1            | C90            | 1            | R11            | 1            | R63            | 1            |                |              |
| AT2                 | 1            | C91            | 1            | R12            | 1            | R64            | 1            |                |              |
| AT51                | 1            | C93            | 1            | R13            | 1            | R65            | 1            |                |              |
| AT52                | 1            | C94            | 1            | R14            | 1            | R66            | 1            |                |              |
|                     |              | C96            | 1            | R15            | 1            | R67            | 1            |                |              |
| C2                  | 1            | C97            | 1            | R16            | 1            | R68            | 1            |                |              |
| C3                  | 1            |                |              | R17            | 1            | R69            | 1            |                |              |
| C4                  | 1            | CR7            | 1            | R18            | 1            | R71            | 1            |                |              |
| C5                  | 1            | CR18           | 1            | R19            | 1            | R72            | 1            |                |              |
| C6                  | 1            | CR57           | 1            | R20            | 1            | R73            | 1            |                |              |
| C7                  | 1            | CR68           | 1            | R21            | 1            | R75            | 1            |                |              |
| C9                  | 1            | CR85           | 1            | R22            | 1            | R76            | 1            |                |              |
| C10                 | 1            | CR88           | 1            | R23            | 1            | R77            | 1            |                |              |
| C11                 | 1            |                |              | R25            | 1            | R79            | 1            |                |              |
| C12                 | 1            | E90            | 1            | R26            | 1            | R80            | 1            |                |              |
| C13                 | 1            | E91            | 1            | R27            | 1            | R81            | 1            |                |              |
| C17                 | 1            |                |              | R29            | 1            | R83            | 1            |                |              |
| C19                 | 1            | J2950          | 1            | R30            | 1            | R84            | 1            |                |              |
| C21                 | 1            | J9200          | 1            | R31            | 1            | R85            | 1            |                |              |
| C26                 | 1            | J9991          | 1            | R33            | 1            | R87            | 1            |                |              |
| C27                 | 1            |                |              | R34            | 1            | R88            | 1            |                |              |
| C30                 | 1            | L93            | 1            | R35            | 1            | R91            | 1            |                |              |
| C35                 | 1            | L96            | 1            | R37            | 1            | R92            | 1            |                |              |
| C38                 | 1            |                |              | R38            | 1            | R93            | 1            |                |              |
| C52                 | 1            | P2900          | 1            | R39            | 1            | R96            | 1            |                |              |
| C53                 | 1            |                |              | R41            | 1            | R97            | 1            |                |              |
| C54                 | 1            | Q13            | 1            | R42            | 1            | R98            | 1            |                |              |
| C55                 | 1            | Q15            | 1            | R43            | 1            |                |              | S1             | 1            |
| C56                 | 1            | Q18            | 1            | R46            | 1            |                |              | S10            | 1            |
| C57                 | 1            | Q63            | 1            | R47            | 1            |                |              | S51            | 1            |
| C59                 | 1            | Q65            | 1            | R48            | 1            |                |              | S60            | 1            |
| C60                 | 1            | Q68            | 1            | R51            | 1            |                |              |                |              |
| C61                 | 1            |                |              | R52            | 1            |                |              |                |              |
| C62                 | 1            | R1             | 1            | R53            | 1            | U10            | 1            |                |              |
| C63                 | 1            | R2             | 1            | R54            | 1            | U30            | 1            |                |              |
| C67                 | 1            | R3             | 1            | R55            | 1            | U60            | 1            |                |              |
| C69                 | 1            | R4             | 1            | R56            | 1            | U80            | 1            |                |              |
| C71                 | 1            | R5             | 1            | R57            | 1            | U90            | 1            |                |              |
| C76                 | 1            | R6             | 1            | R58            | 1            |                |              | U91            | 1            |
| C77                 | 1            | R7             | 1            | R59            | 1            |                |              |                |              |
| C80                 | 1            | R8             | 1            | R60            | 1            |                |              | W9103          | 1            |
| C85                 | 1            | R9             | 1            | R61            | 1            |                |              | W9108          | 1            |
| C88                 | 1            | R10            | 1            | R62            | 1            |                |              |                |              |

Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE



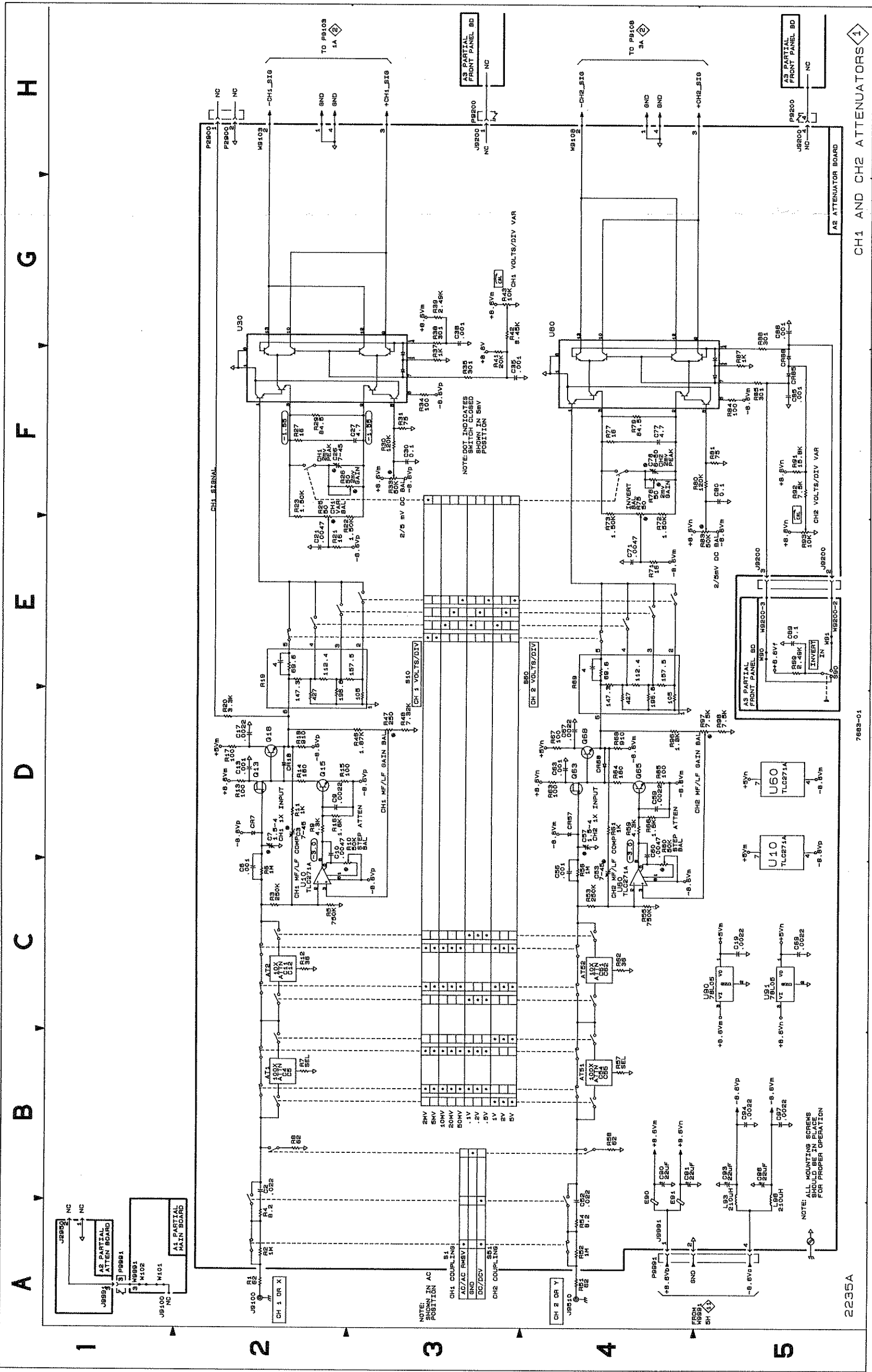
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

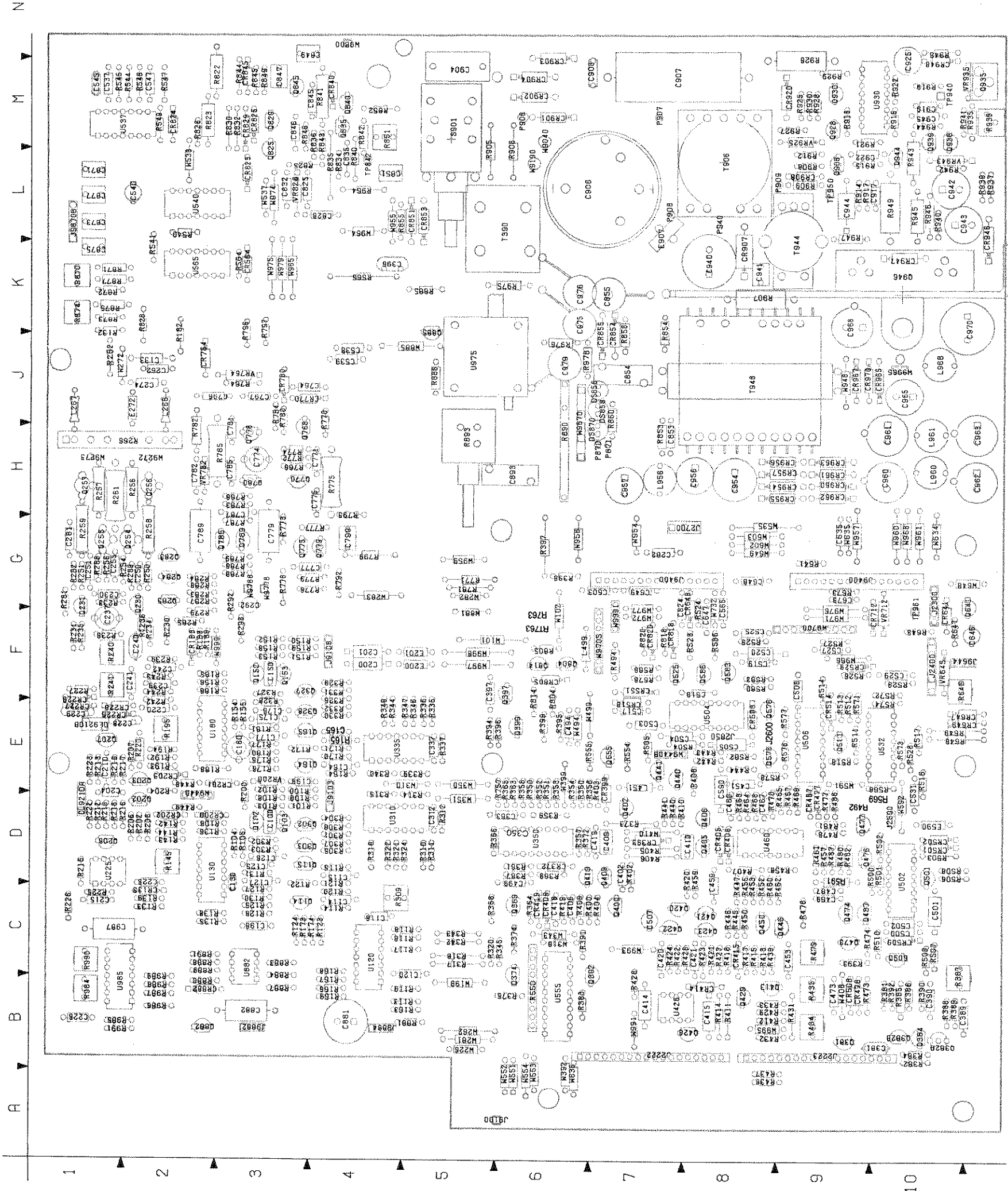
# CH 1 AND CH 2 ATTENUATORS DIAGRAM 1

| ASSEMBLY A1                                                           |                |                |                |                |                |                |                |                |                |                |                |
|-----------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER                                                        | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| J9100                                                                 | 1A             | 6A             | W101<br>W102   | 1A<br>1A       | 6F<br>6F       | W9991<br>W9991 | 1A<br>4A       | 7F<br>7F       |                |                |                |
| Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A2                                                           |                |                |                |                |                |                |                |                |                |                |                |
| AT1                                                                   | 2B             | 2B             | C91            | 4B             | 3E             | R9             | 2D             | 1D             | R82            | 4C             | 3B             |
| AT2                                                                   | 2C             | 2B             | C93            | 5B             | 1E             | R10            | 2C             | 1D             | R83            | 4D             | 4D             |
| AT51                                                                  | 4B             | 3B             | C94            | 5B             | 1E             | R11            | 2D             | 1C             | R84            | 4D             | 3D             |
| AT52                                                                  | 4C             | 3B             | C96            | 5B             | 3E             | R12            | 2C             | 1B             | R85            | 4D             | 3D             |
|                                                                       |                |                | C97            | 5B             | 3E             | R13            | 2D             | 2D             | R86            | 4D             | 3D             |
| C2                                                                    | 2B             | 1B             |                |                |                | R14            | 2D             | 1D             | R87            | 4D             | 3D             |
| C3                                                                    | 2D             | 1C             | CR7            | 2D             | 2C             | R15            | 2D             | 1D             | R88            | 4D             | 3D             |
| C4                                                                    | 2B             | 1B             | CR18           | 2D             | 1C             | R16            | 2D             | 1D             | R89            | 4E             | 3C             |
| C5                                                                    | 2B             | 1B             | CR57           | 4D             | 4C             | R17            | 2D             | 1D             | R71            | 4E             | 3E             |
| C6                                                                    | 2C             | 2C             | CR68           | 4D             | 3C             | R18            | 2D             | 1D             | R72            | 4F             | 3D             |
| C7                                                                    | 2D             | 1C             | CR85           | 5F             | 3E             | R19            | 2E             | 2C             | R73            | 4F             | 3E             |
| C9                                                                    | 2D             | 1D             | CR88           | 5F             | 3E             | R20            | 2D             | 1D             | R75            | 4F             | 3D             |
| C10                                                                   | 2D             | 1C             |                |                |                | R21            | 2E             | 1E             | R76            | 4F             | 3D             |
| C11                                                                   | 2C             | 1B             | E90            | 4A             | 2E             | R22            | 2E             | 1D             | R77            | 4F             | 4D             |
| C12                                                                   | 2C             | 1B             | E91            | 4A             | 3E             | R23            | 2E             | 1E             | R79            | 4F             | 3D             |
| C13                                                                   | 2D             | 2C             |                |                |                | R25            | 2E             | 1D             | R80            | 5F             | 4E             |
| C17                                                                   | 2D             | 1C             | J2950          | 1A             | 2E             | R26            | 2F             | 1D             | R81            | 5F             | 4E             |
| C19                                                                   | 5C             | 1E             | J2950          | 1A             | 2E             | R27            | 2F             | 2D             | R83            | 5E             | 4E             |
| C21                                                                   | 2E             | 1E             | J9200          | 3H             | 3E             | R29            | 2F             | 2D             | R84            | 5F             | 4D             |
| C26                                                                   | 2F             | 1D             | J9200          | 5E             | 3E             | R30            | 3F             | 2E             | R85            | 5F             | 3E             |
| C27                                                                   | 2F             | 2D             | J9200          | 5H             | 3E             | R31            | 3F             | 2E             | R87            | 5F             | 4E             |
| C30                                                                   | 3F             | 2E             | J9991          | 1A             | 2E             | R33            | 3F             | 2E             | R88            | 5F             | 3E             |
| C35                                                                   | 3F             | 1E             | J9991          | 4A             | 2E             | R34            | 3F             | 2D             | R91            | 5F             | 3E             |
| C38                                                                   | 3G             | 1E             |                |                |                | R35            | 3F             | 1E             | R92            | 5F             | 3E             |
| C52                                                                   | 4A             | 3B             | L93            | 5A             | 3E             | R37            | 3F             | 2E             | R93            | 5E             | 4E             |
| C53                                                                   | 4C             | 3C             | L96            | 5A             | 3E             | R38            | 3G             | 1E             | R96            | 4D             | 3D             |
| C54                                                                   | 4B             | 3B             |                |                |                | R39            | 3G             | 1E             | R97            | 5D             | 3C             |
| C55                                                                   | 4B             | 3B             | P2900          | 2H             | 1D             | R41            | 3F             | 1E             | R98            | 5D             | 3C             |
| C56                                                                   | 4C             | 3C             |                |                |                | R42            | 3G             | 1E             |                |                |                |
| C57                                                                   | 4D             | 3C             | Q13            | 2D             | 2C             | R43            | 3G             | 2E             | S1             | 3A             | 2A             |
| C59                                                                   | 4D             | 3D             | Q15            | 2D             | 1D             | R46            | 3D             | 1D             | S10            | 3E             | 2B             |
| C60                                                                   | 4D             | 3C             | Q18            | 2D             | 1C             | R47            | 3D             | 1C             | S51            | 3A             | 4A             |
| C81                                                                   | 4C             | 3B             | Q63            | 4D             | 3C             | R48            | 3D             | 1C             | S60            | 4E             | 4B             |
| C62                                                                   | 4C             | 3B             | Q65            | 4D             | 3D             | R51            | 4A             | 3A             |                |                |                |
| C63                                                                   | 4D             | 4C             | Q68            | 4D             | 3C             | R52            | 4A             | 3A             | U10            | 2C             | 1C             |
| C67                                                                   | 4D             | 3C             |                |                |                | R53            | 4C             | 3C             | U30            | 2G             | 2E             |
| C69                                                                   | 5C             | 3D             | R1             | 2A             | 2A             | R54            | 4A             | 3A             | U60            | 4C             | 3C             |
| C71                                                                   | 4E             | 3D             | R2             | 2A             | 1A             | R55            | 4C             | 3B             | U80            | 4G             | 4E             |
| C78                                                                   | 4F             | 3D             | R3             | 2C             | 1C             | R56            | 4C             | 3C             | U90            | 5C             | 1E             |
| C77                                                                   | 4F             | 3D             | R4             | 2A             | 1A             | R57            | 4B             | 3B             | U91            | 5C             | 3E             |
| C80                                                                   | 5F             | 4E             | R5             | 2C             | 1B             | R58            | 4B             | 3A             |                |                |                |
| C85                                                                   | 5F             | 3E             | R6             | 2C             | 1C             | R59            | 4D             | 3D             | W9103          | 2H             | 2E             |
| C88                                                                   | 5G             | 3E             | R7             | 2B             | 1B             | R60            | 4C             | 3D             | W9106          | 4H             | 3E             |
| C90                                                                   | 4B             | 1E             | R8             | 2B             | 2A             | R61            | 4D             | 3C             |                |                |                |
| ASSEMBLY A3                                                           |                |                |                |                |                |                |                |                |                |                |                |
| C89                                                                   | 5E             | 3B             | R89            | 5E             | 3B             | S90            | 5E             | 4B             | W9200          | 5F             | 2C             |
| Partial A3 also shown on diagrams 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| OTHER PARTS                                                           |                |                |                |                |                |                |                |                |                |                |                |
| J9100                                                                 | 2A             | CHASSIS        | J9510          | 4A             | CHASSIS        |                |                |                |                |                |                |

## A1—MAIN BOARD

| CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER |
|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| C100              | 2               | C519              | 6               | C970              | 10              | CR970             | 10              | Q382              | 4               | R120              | 2               |
| C114              | 2               | C520              | 6               | C975              | 10              |                   |                 | Q384              | 4               | R121              | 2               |
| C115              | 2               | C525              | 6               | C976              | 10              | DL9210            | 3               | Q392              | 4               | R122              | 2               |
| C116              | 3               | C527              | 6               | C979              | 10              |                   |                 | Q397              | 4               | R123              | 2               |
| C120              | 3               | C529              | 6               | C987              | 8               | DS856             | 10              | Q399              | 4               | R124              | 2               |
| C125              | 2               | C531              | 6               |                   |                 | DS858             | 10              | Q400              | 5               | R125              | 2               |
| C126              | 2               | C537              | 3               | CR133             | 2               | DS870             | 10              | Q402              | 5               | R126              | 2               |
| C127              | 2               | C538              | 2               | CR183             | 2               |                   |                 | Q405              | 5               | R127              | 2               |
| C130              | 2               | C539              | 2               | CR200             | 2               | E200              | 11              | Q406              | 5               | R130              | 2               |
| C133              | 2               | C540              | 3               | CR201             | 2               | E201              | 11              | Q409              | 4               | R131              | 2               |
| C150              | 2               | C540              | 11              | CR202             | 2               | E272              | 11              | Q413              | 5               | R132              | 2               |
| C164              | 2               | C545              | 2               | CR203             | 2               | E590              | 11              | Q419              | 4               | R133              | 2               |
| C165              | 2               | C547              | 2               | CR226             | 3               | E907              | 9               | Q420              | 5               | R135              | 2               |
| C175              | 2               | C565              | 4               | CR227             | 3               |                   |                 | Q421              | 5               | R136              | 2               |
| C176              | 2               | C590              | 5               | CR228             | 3               | J2222             | 2               | Q422              | 5               | R138              | 2               |
| C177              | 2               | C590              | 11              | CR229             | 3               | J2222             | 3               | Q423              | 5               | R139              | 2               |
| C180              | 2               | C603              | 7               | CR372             | 4               | J2222             | 4               | Q428              | 5               | R142              | 2               |
| C198              | 2               | C635              | 7               | CR393             | 4               | J2222             | 6               | Q429              | 5               | R143              | 2               |
| C199              | 2               | C646              | 7               | CR399             | 4               | J2223             | 4               | Q440              | 2               | R144              | 2               |
| C200              | 11              | C647              | 7               | CR405             | 5               | J2223             | 5               | Q441              | 2               | R145              | 2               |
| C201              | 11              | C648              | 7               | CR406             | 5               | J2223             | 6               | Q446              | 5               | R150              | 2               |
| C204              | 3               | C649              | 7               | CR409             | 4               | J2300             | 7               | Q450              | 5               | R151              | 2               |
| C210              | 3               | C673              | 7               | CR414             | 5               | J2400             | 11              | Q473              | 5               | R152              | 2               |
| C215              | 3               | C764              | 8               | CR415             | 5               | J2500             | 5               | Q474              | 5               | R153              | 2               |
| C220              | 11              | C771              | 8               | CR419             | 4               | J2600             | 6               | Q476              | 5               | R154              | 2               |
| C225              | 3               | C774              | 8               | CR467             | 5               | J2700             | 10              | Q477              | 5               | R155              | 2               |
| C226              | 3               | C775              | 8               | CR476             | 5               | J2850             | 6               | Q487              | 5               | R156              | 2               |
| C228              | 3               | C777              | 8               | CR477             | 5               | J9100             | 1               | Q501              | 6               | R158              | 2               |
| C229              | 3               | C779              | 8               | CR501             | 6               | J9103             | 2               | Q509              | 6               | R159              | 2               |
| C237              | 3               | C781              | 8               | CR502             | 6               | J9108             | 2               | Q511              | 6               | R163              | 2               |
| C239              | 3               | C782              | 8               | CR503             | 6               | J9400             | 7               | Q525              | 6               | R164              | 2               |
| C240              | 3               | C785              | 8               | CR508             | 6               | J9400             | 11              | Q555              | 6               | R165              | 2               |
| C241              | 3               | C787              | 8               | CR509             | 6               | J9644             | 7               | Q576              | 6               | R166              | 2               |
| C242              | 3               | C789              | 8               | CR514             | 6               | J9870             | 10              | Q578              | 6               | R167              | 2               |
| C250              | 3               | C796              | 11              | CR518             | 6               | J9882             | 10              | Q583              | 10              | R168              | 2               |
| C251              | 3               | C797              | 11              | CR529             | 6               | J9884             | 8               | Q586              | 10              | R169              | 2               |
| C255              | 3               | C799              | 11              | CR551             | 10              |                   |                 | Q641              | 7               | R170              | 2               |
| C262              | 3               | C824              | 10              | CR564             | 4               | L266              | 3               | Q768              | 8               | R171              | 2               |
| C274              | 11              | C825              | 10              | CR641             | 7               | L267              | 3               | Q770              | 8               | R172              | 2               |
| C281              | 3               | C828              | 10              | CR647             | 7               | L451              | 11              | Q775              | 8               | R173              | 2               |
| C282              | 3               | C832              | 10              | CR648             | 7               | L499              | 11              | Q778              | 8               | R174              | 2               |
| C292              | 3               | C835              | 10              | CR649             | 7               | L956              | 10              | Q779              | 8               | R175              | 2               |
| C312              | 4               | C845              | 10              | CR712             | 7               | L960              | 10              | Q780              | 8               | R176              | 2               |
| C337              | 4               | C846              | 10              | CR764             | 8               | L961              | 10              | Q785              | 8               | R177              | 2               |
| C350              | 4               | C847              | 10              | CR770             | 8               | L968              | 10              | Q789              | 8               | R180              | 2               |
| C363              | 4               | C849              | 10              | CR780             | 8               |                   |                 | Q804              | 10              | R181              | 2               |
| C381              | 4               | C851              | 10              | CR805             | 10              | P870              | 10              | Q814              | 10              | R182              | 2               |
| C389              | 4               | C853              | 10              | CR818             | 10              | P871              | 10              | Q825              | 10              | R183              | 2               |
| C390              | 4               | C854              | 10              | CR820             | 10              | P908              | 9               | Q829              | 10              | R185              | 2               |
| C396              | 9               | C855              | 10              | CR823             | 10              | P909              | 9               | Q835              | 10              | R186              | 2               |
| C397              | 4               | C871              | 10              | CR824             | 10              | P940              | 9               | Q840              | 10              | R188              | 2               |
| C402              | 5               | C873              | 10              | CR825             | 10              |                   |                 | Q845              | 10              | R189              | 2               |
| C406              | 4               | C875              | 10              | CR829             | 10              | Q102              | 2               | Q882              | 10              | R192              | 2               |
| C409              | 4               | C877              | 10              | CR840             | 10              | Q103              | 2               | Q885              | 10              | R193              | 2               |
| C410              | 5               | C881              | 10              | CR845             | 10              | Q114              | 2               | Q908              | 9               | R194              | 2               |
| C414              | 5               | C882              | 10              | CR851             | 10              | Q115              | 2               | Q928              | 9               | R195              | 2               |
| C415              | 5               | C893              | 10              | CR853             | 10              | Q152              | 2               | Q930              | 9               | R200              | 2               |
| C418              | 4               | C904              | 9               | CR854             | 10              | Q153              | 2               | Q935              | 9               | R202              | 3               |
| C419              | 4               | C906              | 9               | CR855             | 10              | Q164              | 2               | Q938              | 9               | R203              | 3               |
| C420              | 5               | C907              | 9               | CR882             | 10              | Q165              | 2               | Q939              | 9               | R204              | 3               |
| C421              | 5               | C908              | 9               | CR901             | 9               | Q202              | 3               | Q944              | 9               | R206              | 3               |
| C451              | 11              | C917              | 9               | CR902             | 9               | Q203              | 3               | Q946              | 9               | R207              | 3               |
| C453              | 5               | C919              | 9               | CR903             | 9               | Q206              | 3               | Q947              | 9               | R210              | 3               |
| C459              | 5               | C922              | 9               | CR904             | 9               | Q207              | 3               |                   |                 | R212              | 3               |
| C460              | 5               | C925              | 9               | CR907             | 9               | Q230              | 3               | R100              | 2               | R213              | 3               |
| C467              | 5               | C940              | 9               | CR908             | 9               | Q231              | 3               | R101              | 2               | R215              | 3               |
| C469              | 5               | C941              | 9               | CR920             | 9               | Q254              | 3               | R102              | 2               | R216              | 3               |
| C473              | 5               | C942              | 9               | CR946             | 9               | Q255              | 3               | R103              | 2               | R217              | 3               |
| C487              | 5               | C943              | 9               | CR947             | 9               | Q256              | 3               | R104              | 2               | R218              | 3               |
| C494              | 11              | C944              | 9               | CR948             | 9               | Q257              | 3               | R105              | 2               | R219              | 3               |
| C499              | 11              | C945              | 9               | CR954             | 10              | Q283              | 3               | R106              | 2               | R220              | 11              |
| C500              | 6               | C954              | 10              | CR955             | 10              | Q284              | 3               | R108              | 2               | R222              | 3               |
| C501              | 6               | C956              | 10              | CR956             | 10              | Q285              | 3               | R109              | 2               | R223              | 3               |
| C502              | 6               | C957              | 10              | CR957             | 10              | Q302              | 4               | R113              | 2               | R225              | 3               |
| C503              | 6               | C960              | 10              | CR960             | 10              | Q303              | 4               | R114              | 2               | R226              | 3               |
| C504              | 6               | C961              | 10              | CR961             | 10              | Q327              | 4               | R115              | 2               | R227              | 3               |
| C505              | 6               | C962              | 10              | CR962             | 10              | Q328              | 4               | R116              | 2               | R230              | 3               |
| C506              | 6               | C963              | 10              | CR963             | 10              | Q369              | 4               | R117              | 2               | R231              | 3               |
| C507              | 11              | C965              | 10              | CR965             | 10              | Q374              | 4               | R118              | 2               | R233              | 3               |
| C517              | 8               | C968              | 10              | CR967             | 10              | Q381              | 4               | R119              | 2               | R234              | 3               |
| C518              | 6               |                   |                 |                   |                 |                   |                 |                   |                 |                   |                 |

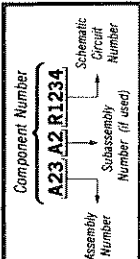




A1—MAIN BOARD

Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

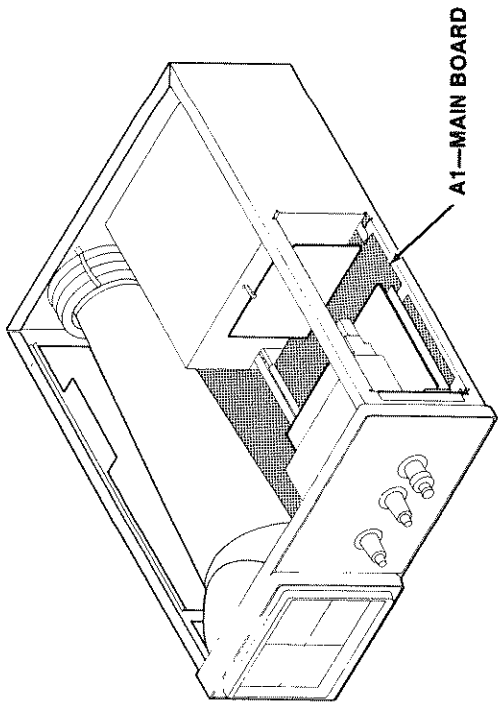


Figure 9-6. A1—Main board.

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# A1—MAIN BOARD (cont)

| CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER |
|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| R235              | 3               | R361              | 4               | R457              | 5               | R646              | 7               | R888              | 10              | U504              | 6               |
| R236              | 3               | R363              | 4               | R458              | 5               | R647              | 7               | R889              | 10              | U506              | 6               |
| R239              | 3               | R364              | 4               | R459              | 5               | R648              | 7               | R890              | 10              | U532              | 6               |
| R240              | 3               | R365              | 4               | R460              | 5               | R649              | 7               | R891              | 10              | U537              | 2               |
| R241              | 3               | R366              | 4               | R461              | 5               | R673              | 7               | R893              | 10              | U540              | 2               |
| R242              | 3               | R367              | 4               | R462              | 5               | R676              | 8               | R905              | 9               | U555              | 4               |
| R244              | 3               | R368              | 4               | R463              | 5               | R757              | 4               | R906              | 9               | U565              | 4               |
| R245              | 3               | R369              | 4               | R464              | 5               | R763              | 4               | R907              | 9               | U882              | 10              |
| R250              | 3               | R372              | 4               | R465              | 5               | R764              | 8               | R908              | 9               | U930              | 9               |
| R251              | 3               | R373              | 4               | R467              | 5               | R766              | 8               | R909              | 9               | U975              | 10              |
| R254              | 3               | R374              | 4               | R468              | 5               | R768              | 8               | R912              | 9               | U985              | 8               |
| R255              | 3               | R375              | 4               | R469              | 5               | R770              | 8               | R913              | 9               |                   |                 |
| R256              | 3               | R381              | 4               | R470              | 5               | R771              | 8               | R914              | 9               | VR200             | 2               |
| R257              | 3               | R382              | 4               | R473              | 5               | R772              | 8               | R915              | 9               | VR645             | 7               |
| R258              | 3               | R383              | 4               | R474              | 5               | R773              | 8               | R916              | 9               | VR712             | 7               |
| R259              | 3               | R384              | 4               | R476              | 5               | R774              | 8               | R917              | 9               | VR764             | 8               |
| R261              | 3               | R385              | 4               | R477              | 5               | R775              | 8               | R919              | 9               | VR782             | 8               |
| R262              | 3               | R386              | 4               | R478              | 5               | R776              | 8               | R921              | 9               | VR828             | 10              |
| R266              | 3               | R387              | 4               | R479              | 5               | R777              | 8               | R922              | 9               | VR925             | 9               |
| R279              | 3               | R388              | 4               | R480              | 5               | R778              | 8               | R925              | 9               | VR935             | 9               |
| R281              | 3               | R389              | 4               | R481              | 5               | R779              | 8               | R926              | 9               | VR943             | 9               |
| R282              | 3               | R390              | 4               | R482              | 5               | R780              | 8               | R927              | 9               |                   |                 |
| R283              | 3               | R391              | 4               | R486              | 5               | R781              | 8               | R928              | 9               | W101              | 1               |
| R284              | 3               | R392              | 4               | R487              | 5               | R782              | 8               | R929              | 9               | W102              | 1               |
| R285              | 3               | R393              | 4               | R492              | 5               | R783              | 8               | R930              | 9               | W199              | 2               |
| R286              | 3               | R394              | 4               | R494              | 11              | R784              | 8               | R935              | 9               | W226              | 3               |
| R287              | 3               | R395              | 4               | R500              | 6               | R785              | 8               | R937              | 9               | W262              | 3               |
| R288              | 3               | R396              | 4               | R501              | 6               | R786              | 8               | R938              | 9               | W272              | 11              |
| R289              | 3               | R397              | 9               | R502              | 6               | R787              | 8               | R939              | 9               | W281              | 3               |
| R292              | 3               | R398              | 9               | R503              | 6               | R788              | 8               | R940              | 9               | W282              | 3               |
| R293              | 3               | R399              | 4               | R504              | 6               | R789              | 8               | R941              | 9               | W283              | 3               |
| R301              | 4               | R400              | 5               | R505              | 6               | R792              | 8               | R942              | 9               | W310              | 4               |
| R302              | 4               | R402              | 5               | R506              | 6               | R793              | 8               | R943              | 9               | W318              | 4               |
| R303              | 4               | R403              | 5               | R507              | 6               | R796              | 11              | R944              | 9               | W343              | 4               |
| R304              | 4               | R404              | 5               | R508              | 6               | R797              | 11              | R945              | 9               | W350              | 4               |
| R305              | 4               | R405              | 5               | R509              | 6               | R799              | 11              | R946              | 9               | W351              | 4               |
| R306              | 4               | R406              | 5               | R510              | 6               | R804              | 10              | R947              | 9               | W392              | 4               |
| R307              | 4               | R407              | 5               | R511              | 6               | R805              | 10              | R948              | 9               | W399              | 4               |
| R309              | 4               | R408              | 5               | R512              | 6               | R814              | 10              | R949              | 9               | W408              | 11              |
| R310              | 4               | R409              | 4               | R513              | 6               | R818              | 10              | R964              | 11              | W410              | 5               |
| R311              | 4               | R410              | 5               | R514              | 6               | R820              | 10              | R975              | 10              | W494              | 11              |
| R312              | 4               | R411              | 5               | R516              | 6               | R822              | 10              | R976              | 10              | W499              | 11              |
| R314              | 4               | R412              | 5               | R517              | 6               | R823              | 10              | R978              | 10              | W535              | 2               |
| R315              | 4               | R413              | 5               | R518              | 6               | R825              | 10              | R984              | 8               | W537              | 2               |
| R317              | 4               | R414              | 5               | R523              | 6               | R826              | 10              | R985              | 8               | W538              | 2               |
| R318              | 4               | R415              | 5               | R524              | 6               | R828              | 10              | R986              | 8               | W551              | 4               |
| R319              | 4               | R416              | 5               | R525              | 6               | R830              | 10              | R987              | 8               | W552              | 4               |
| R320              | 4               | R417              | 5               | R526              | 6               | R832              | 10              | R988              | 8               | W553              | 4               |
| R321              | 4               | R419              | 4               | R527              | 6               | R834              | 10              | R989              | 8               | W554              | 4               |
| R322              | 4               | R420              | 5               | R528              | 6               | R835              | 10              | R990              | 8               | W591              | 11              |
| R324              | 4               | R421              | 5               | R529              | 6               | R836              | 10              | R991              | 8               | W592              | 11              |
| R326              | 4               | R422              | 5               | R540              | 2               | R840              | 10              |                   |                 | W602              | 7               |
| R327              | 4               | R423              | 5               | R541              | 2               | R841              | 10              | RT236             | 3               | W603              | 7               |
| R328              | 4               | R424              | 5               | R544              | 2               | R842              | 10              | RT763             | 4               | W634              | 7               |
| R329              | 4               | R426              | 5               | R545              | 2               | R843              | 10              |                   |                 | W635              | 7               |
| R330              | 4               | R427              | 5               | R547              | 2               | R844              | 10              | S901              | 9               | W636              | 4               |
| R331              | 4               | R428              | 5               | R548              | 2               | R845              | 10              |                   |                 | W648              | 7               |
| R332              | 4               | R429              | 5               | R549              | 2               | R846              | 10              | T390              | 9               | W649              | 7               |
| R335              | 4               | R431              | 5               | R550              | 4               | R849              | 10              | T906              | 9               | W732              | 8               |
| R336              | 4               | R432              | 5               | R554              | 6               | R851              | 10              | T944              | 9               | W881              | 10              |
| R337              | 4               | R433              | 5               | R555              | 6               | R852              | 10              | T948              | 10              | W885              | 10              |
| R339              | 4               | R434              | 5               | R564              | 4               | R853              | 10              |                   |                 | W948              | 10              |
| R340              | 4               | R435              | 5               | R565              | 4               | R854              | 10              | TP397             | 4               | W954              | 11              |
| R342              | 4               | R436              | 5               | R566              | 8               | R855              | 10              | TP460             | 5               | W955              | 11              |
| R343              | 4               | R437              | 5               | R568              | 6               | R858              | 10              | TP504             | 6               | W956              | 11              |
| R344              | 4               | R439              | 5               | R569              | 6               | R860              | 10              | TP842             | 10              | W957              | 11              |
| R345              | 4               | R440              | 2               | R571              | 6               | R870              | 10              | TP940             | 9               | W959              | 11              |
| R346              | 4               | R441              | 2               | R572              | 6               | R871              | 10              | TP950             | 9               | W960              | 11              |
| R347              | 4               | R442              | 2               | R573              | 6               | R872              | 10              | TP961             | 11              | W961              | 11              |
| R349              | 4               | R443              | 2               | R574              | 6               | R873              | 10              |                   |                 | W964              | 11              |
| R350              | 4               | R444              | 2               | R576              | 6               | R874              | 10              | U120              | 2               | W965              | 11              |
| R351              | 4               | R445              | 5               | R577              | 6               | R875              | 10              | U130              | 2               | W966              | 11              |
| R352              | 4               | R446              | 5               | R578              | 6               | R877              | 10              | U180              | 2               | W968              | 11              |
| R353              | 4               | R447              | 5               | R580              | 6               | R880              | 10              | U225              | 3               | W971              | 11              |
| R354              | 4               | R448              | 2               | R582              | 6               | R881              | 10              | U310              | 4               | W972              | 11              |
| R356              | 4               | R449              | 2               | R583              | 10              | R883              | 10              | U335              | 4               | W974              | 11              |
| R357              | 4               | R450              | 5               | R586              | 10              | R884              | 10              | U350              | 4               | W975              | 11              |
| R358              | 4               | R452              | 5               | R591              | 5               | R885              | 10              | U426              | 5               | W976              | 11              |
| R359              | 4               | R453              | 5               | R641              | 7               | R886              | 10              | U460              | 5               | W977              | 11              |
| R360              | 4               | R455              | 5               | R645              | 7               | R887              | 10              | U502              | 6               | W979              | 11              |





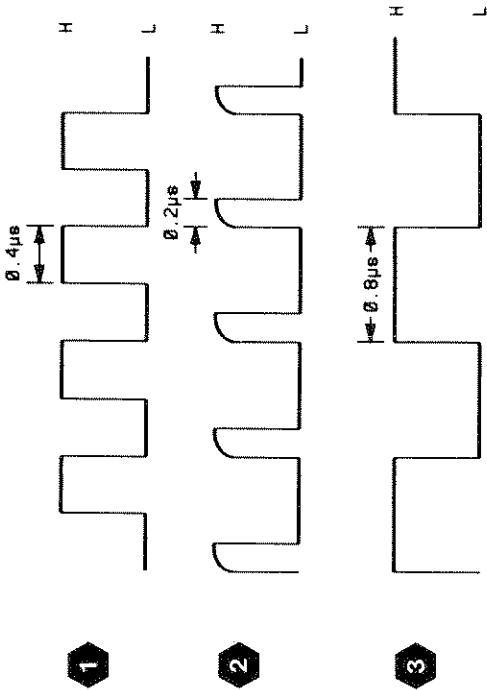
2235A CONTROL SETTINGS

DC Voltages

|                  |      |
|------------------|------|
| AC-GND-DC (both) | GND  |
| VOLTS/DIV (both) | 0.1V |

AC Waveforms

|                |            |
|----------------|------------|
| Vertical MODE  | BOTH, CHOP |
| A TRIGGER Mode | P-P AUTO   |



## VERTICAL PREAMPLIFIERS AND SWITCHING DIAGRAM 2

| ASSEMBLY A1    |                |                |                |                |                |                |                |                |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| C100           | 1B             | 3D             | Q153           | 4B             | 3F             | R143           | 2G             | 2D             | R195           | 3G             | 2E             |
| C114           | 1D             | 4C             | Q164           | 3D             | 4E             | R144           | 1G             | 2D             | R200           | 4G             | 3D             |
| C115           | 2D             | 4D             | Q165           | 4D             | 4E             | R145           | 2G             | 2D             | R440           | 5G             | 7D             |
| C125           | 2E             | 3D             | Q440           | 5G             | 7E             | R150           | 3B             | 4F             | R441           | 5F             | 7D             |
| C126           | 2E             | 3D             | Q441           | 5G             | 7E             | R151           | 4B             | 4F             | R442           | 5G             | 8E             |
| C127           | 2E             | 3D             |                |                |                | R152           | 3B             | 3F             | R443           | 5G             | 8E             |
| C130           | 2E             | 3C             | R100           | 1B             | 3E             | R153           | 4B             | 3F             | R444           | 5G             | 8E             |
| C133           | 5E             | 2J             | R101           | 2B             | 4D             | R154           | 3C             | 3E             | R448           | 5G             | 2E             |
| C150           | 3B             | 3F             | R102           | 1B             | 3E             | R155           | 4C             | 3E             | R449           | 4G             | 2D             |
| C164           | 3D             | 4E             | R103           | 2B             | 3D             | R156           | 3C             | 3F             | R540           | 5E             | 2L             |
| C165           | 4D             | 4E             | R104           | 1C             | 3D             | R158           | 3B             | 3F             | R541           | 5D             | 2K             |
| C175           | 3E             | 3E             | R105           | 2C             | 3D             | R159           | 3B             | 4F             | R544           | 5C             | 2M             |
| C176           | 3E             | 3E             | R106           | 2C             | 3D             | R163           | 3D             | 5B             | R545           | 5C             | 1M             |
| C177           | 3E             | 3E             | R108           | 1B             | 3D             | R164           | 3D             | 4E             | R547           | 4E             | 2M             |
| C180           | 3E             | 3E             | R109           | 2B             | 3D             | R165           | 4D             | 4E             | R548           | 4E             | 2M             |
| C198           | 5E             | 3C             | R113           | 1D             | 5B             | R166           | 3D             | 4B             | R549           | 4E             | 2M             |
| C199           | 5F             | 4E             | R114           | 1D             | 4C             | R167           | 4D             | 4B             |                |                |                |
| C538           | 4C             | 4J             | R115           | 2D             | 4D             | R168           | 4D             | 4C             | U120A          | 1D             | 4C             |
| C539           | 5C             | 4J             | R116           | 2D             | 5C             | R169           | 3D             | 4B             | U120B          | 2D             | 4C             |
| C545           | 5C             | 1M             | R117           | 2D             | 5C             | R170           | 3D             | 4E             | U120C          | 4D             | 4C             |
| C547           | 4D             | 2M             | R118           | 2D             | 5C             | R171           | 3D             | 4E             | U120D          | 3D             | 4C             |
|                |                |                | R119           | 2D             | 5B             | R172           | 3E             | 3E             | U130           | 2E             | 2D             |
| CR133          | 5E             | 2C             | R120           | 2D             | 4C             | R173           | 4D             | 3C             | U180           | 4F             | 2E             |
| CR183          | 5F             | 2F             | R121           | 2D             | 4D             | R174           | 3D             | 4C             | U537A          | 5D             | 2M             |
| CR200          | 4G             | 3D             | R122           | 2E             | 4D             | R175           | 3E             | 3E             | U537B          | 4E             | 2M             |
| CR201          | 5G             | 3E             | R123           | 2D             | 4C             | R176           | 3E             | 3E             | U537C          | 5D             | 2M             |
| CR202          | 4G             | 2D             | R124           | 1D             | 3C             | R177           | 3E             | 3E             | U537D          | 5C             | 2M             |
| CR203          | 5G             | 2E             | R125           | 1E             | 3C             | R180           | 3E             | 3E             | U540A          | 5E             | 2L             |
|                |                |                | R126           | 1E             | 3C             | R181           | 4E             | 3E             | U540B          | 5C             | 2L             |
| J2222          | 3D             | 7B             | R127           | 1E             | 3C             | R182           | 5E             | 2J             |                |                |                |
| J2222          | 4B             | 7B             | R130           | 1E             | 3C             | R183           | 5E             | 2F             | VR200          | 5F             | 3E             |
| J9103          | 1B             | 4D             | R131           | 2E             | 3D             | R185           | 4F             | 3F             |                |                |                |
| J9108          | 3B             | 4F             | R132           | 5E             | 1K             | R186           | 4F             | 3F             | W199           | 5D             | 5B             |
|                |                |                | R133           | 5E             | 2C             | R188           | 5F             | 3E             | W535           | 5C             | 8G             |
| Q102           | 1B             | 3D             | R135           | 3E             | 3C             | R189           | 5F             | 2F             | W537           | 5D             | 3L             |
| Q103           | 2B             | 3D             | R136           | 3E             | 3D             | R192           | 3G             | 2E             | W538           | 5D             | 2L             |
| Q114           | 1E             | 4C             | R138           | 5E             | 3C             | R193           | 4G             | 2E             | W9440          | 4G             | 2E             |
| Q115           | 2E             | 4D             | R139           | 5F             | 2C             | R194           | 3G             | 2E             | W9440B         | 4G             | 2E             |
| Q152           | 3B             | 3F             | R142           | 1G             | 2D             |                |                |                |                |                |                |

Partial A1 also shown on diagrams 1, 3, 4, 5, 6, 7, 8, 9, 10, and 11.

| ASSEMBLY A3    |                |                |                |                |                |                |                |                |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| CR537          | 4A             | 3C             | CR542          | 5A             | 4C             | R180           | 3C             | 5D             | S200           | 5A             | 3C             |
| CR538          | 4A             | 3D             |                |                |                | R161           | 3C             | 4D             | S545           | 5A             | 4C             |
| CR539          | 5A             | 3D             | R110           | 1C             | 3D             | R162           | 3C             | 4C             | S550           | 4A             | 2C             |
| CR540          | 4A             | 3C             | R111           | 1C             | 3D             | R201           | 5A             | 3C             |                |                |                |
| CR541          | 5A             | 5C             | R112           | 1C             | 2C             |                |                |                | W2222          | 1D             | 4A             |

Partial A3 also shown on diagrams 1, 3, 4, 5, 6, 7, 8, 9, 10, and 11.

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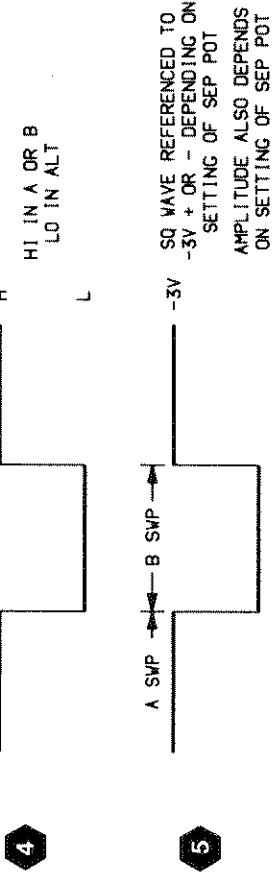
2235A CONTROL SETTINGS

DC Voltages

AC-GND-DC (both)  
VOLTS/DIV (both)      GND  
0.1V

AC Waveforms

Vertical MODE      BOTH, CHOP  
A TRIGGER Mode    P-P AUTO



### VERTICAL OUTPUT AMPLIFIER DIAGRAM 3

## ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| C116           | 5E             | 4C             | DL9210         | 3C             | 1E             | R215           | 3B             | 1D             | R259           | 2G             | 1G             |
| C120           | 4E             | 5C             |                |                |                | R216           | 3B             | 2D             | R261           | 3G             | 1H             |
| C204           | 3B             | 1E             | J2222          | 2D             | 7B             | R217           | 4B             | 2E             | R262           | 3G             | 1J             |
| C210           | 4B             | 1E             |                |                |                | R218           | 3B             | 1D             | R266           | 2H             | 2H             |
| C215           | 3B             | 1C             | L266           | 3G             | 2J             | R219           | 4B             | 1E             | R279           | 2F             | 2F             |
| C225           | 4B             | 2D             | L267           | 4G             | 1J             | R222           | 3C             | 1D             | R281           | 2E             | 1F             |
| C226           | 3D             | 1B             |                |                |                | R223           | 3C             | 1E             | R282           | 2E             | 1G             |
| C228           | 4D             | 2E             | Q202           | 3B             | 2D             | R225           | 4B             | 1C             | R283           | 2E             | 2G             |
| C229           | 3D             | 1E             | Q203           | 4B             | 2E             | R226           | 3D             | 1C             | R284           | 2F             | 2G             |
| C237           | 3F             | 1F             | Q206           | 3B             | 1D             | R227           | 3E             | 1F             | R285           | 2G             | 2F             |
| C239           | 3E             | 2F             | Q207           | 4B             | 1E             | R230           | 4F             | 2F             | R286           | 1F             | 2G             |
| C240           | 3E             | 2F             | Q230           | 4F             | 2F             | R231           | 3F             | 1F             | R287           | 1F             | 2G             |
| C241           | 3E             | 2F             | Q231           | 3F             | 1F             | R233           | 3F             | 1G             | R288           | 2F             | 1G             |
| C242           | 3E             | 2F             | Q254           | 4G             | 2G             | R234           | 4F             | 2F             | R289           | 2F             | 2G             |
| C250           | 4F             | 2G             | Q255           | 3G             | 1G             | R235           | 3F             | 1F             | R292           | 1F             | 3F             |
| C251           | 3F             | 1G             | Q256           | 4G             | 2H             | R236           | 3F             | 1F             | R293           | 1F             | 3F             |
| C255           | 2F             | 1G             | Q257           | 2G             | 1H             | R239           | 4E             | 2F             |                |                |                |
| C262           | 3G             | 2J             | Q283           | 2F             | 2G             | R240           | 3E             | 1F             | RT236          | 3F             | 2F             |
| C281           | 2E             | 1G             | Q284           | 2F             | 2G             | R241           | 3E             | 1F             |                |                |                |
| C282           | 2E             | 7G             | Q285           | 2F             | 2G             | R242           | 3E             | 2E             | U225           | 4B             | 1D             |
| C292           | 1F             | 3G             |                |                |                | R244           | 3E             | 2F             |                |                |                |
| C537           | 4D             | 1M             | R202           | 3B             | 2D             | R245           | 3E             | 2F             | W226           | 3D             | 5B             |
| C540           | 4D             | 2L             | R203           | 3B             | 2D             | R250           | 4F             | 2G             | W262           | 3G             | 5B             |
|                |                |                | R204           | 3B             | 2E             | R251           | 3F             | 1G             | W281           | 2E             | 5B             |
| CR226          | 3D             | 2E             | R206           | 3B             | 2D             | R254           | 4F             | 2G             | W282           | 2E             | 5G             |
| CR227          | 3D             | 1E             | R207           | 4B             | 2E             | R255           | 3F             | 1G             | W283           | 2E             | 4G             |
| CR228          | 3D             | 2E             | R210           | 3B             | 1D             | R256           | 4G             | 2H             | W8272          | 4H             | 2H             |
| CR229          | 3D             | 1F             | R212           | 3B             | 1D             | R257           | 2G             | 1H             | W9273          | 2H             | 1H             |
|                |                |                | R213           | 3B             | 1E             | R258           | 4G             | 2G             |                |                |                |

*Partial A1 also shown on diagrams 1, 2, 4, 5, 6, 7, 8, 9, 10, and 11.*

## ASSEMBLY A3

|      |    |    |      |    |    |      |    |    |  |  |  |
|------|----|----|------|----|----|------|----|----|--|--|--|
| R224 | 2C | 4C | R280 | 2C | 3C | S226 | 2C | 4C |  |  |  |
|------|----|----|------|----|----|------|----|----|--|--|--|

Partial A3 also shown on diagrams 1, 2, 4, 5, 6, 7, 8, 9, 10, and 11.

### A3—FRONT PANEL BOARD

| CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER |
|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| C89               | 1               |                   |                 | R538              | 4               | S226              | 3               |
| C376              | 4               | R89               | 1               | R539              | 4               | S380              | 4               |
| C377              | 4               | R110              | 2               | R546              | 4               | S390              | 10              |
| C379              | 4               | R111              | 2               | R570              | 4               | S392              | 4               |
| C380              | 4               | R112              | 2               | R602              | 7               | S401              | 6               |
|                   |                 | R160              | 2               | R720              | 8               | S460              | 5               |
| CR537             | 2               | R161              | 2               | R723              | 6               | S545              | 2               |
| CR538             | 2               | R162              | 2               | R726              | 8               | S550              | 2               |
| CR539             | 2               | R201              | 2               | R800              | 10              | S555              | 4               |
| CR540             | 2               | R224              | 3               | R802              | 10              | S602              | 7               |
| CR541             | 2               | R280              | 3               | R810              | 10              | S648              | 7               |
| CR542             | 2               | R371              | 4               | R882              | 10              |                   |                 |
| CR988             | 8               | R376              | 4               | R910              | 9               | VR950             | 11              |
| CR989             | 8               | R377              | 4               | R950              | 11              | VR951             | 11              |
|                   |                 | R378              | 4               | R951              | 11              |                   |                 |
| DS518             | 6               | R379              | 4               | R982              | 10              | W90               | 10              |
| DS915             | 9               | R380              | 4               | R983              | 10              | W91               | 10              |
|                   |                 | R401              | 6               | R992              | 8               | W2222             | 2               |
| J9006             | 10              | R438              | 5               | R993              | 8               | W2223             | 4               |
| J9900             | 8               | R519              | 6               |                   |                 | W9200             | 1               |
|                   |                 | R520              | 6               | S90               | 1               | W9201             | 4               |
| Q550              | 4               | R521              | 6               | S200              | 2               | W9884             | 8               |



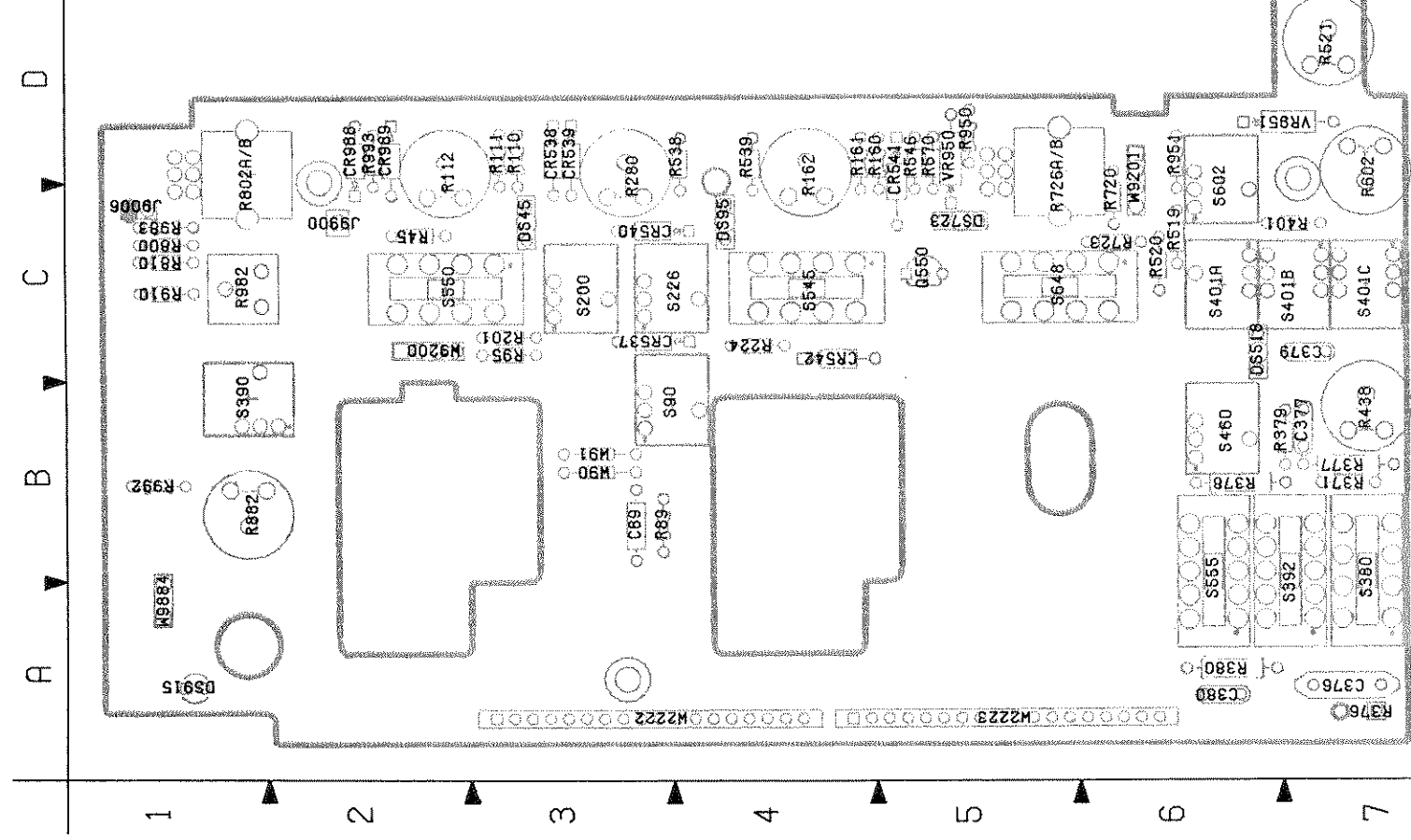
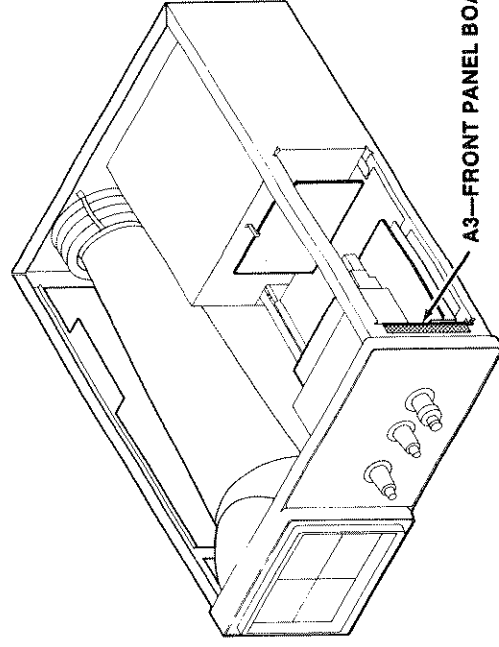
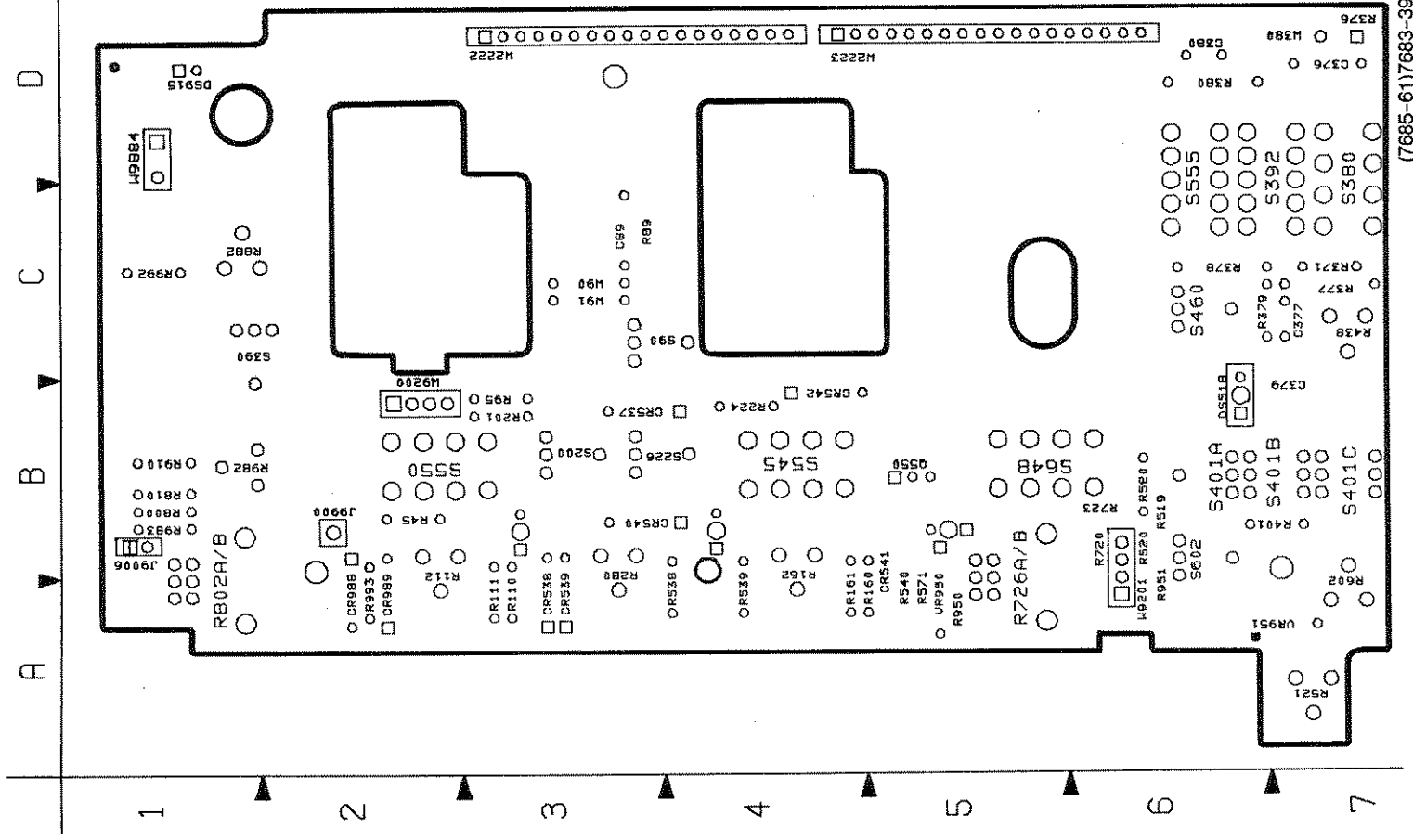


Figure 9-8. A3—Front Panel board.



**A3—FRONT PANEL BOARD**



**Figure 9-9. Circuit view of A3—Front Panel board.**

### TRIGGER SELECT DIAGRAM 4

## ASSEMBLY A1

[illegible]

*Partial A1 also shown on diagrams 1, 2, 3, 5, 6, 7, 8, 9, 10, and 11.*

## ASSEMBLY A3

|      |    |    |      |    |    |      |    |    |       |    |    |
|------|----|----|------|----|----|------|----|----|-------|----|----|
| C376 | 3A | 7A | R371 | 4B | 7B | R536 | 1B | 4D | S392  | 2B | 7A |
| C377 | 4A | 7B | R376 | 3A | 7A | R539 | 1B | 4D | S555  | 2B | 6A |
| C379 | 4B | 7C | R377 | 4A | 7B | R546 | 1B | 5D |       |    |    |
| C380 | 3B | 6A | R378 | 4A | 6B | R570 | 1B | 5D | W2223 | 2B | 5A |
|      |    |    | R379 | 4B | 7B |      |    |    | W9201 | 1A | 6C |
| Q550 | 1B | 5C | R380 | 3B | 6A | S380 | 3B | 7A |       |    |    |

Partial A3 also shown on diagrams 1, 2, 3, 5, 6, 7, 8, 9, 10, and 11.

## ASSEMBLY A4

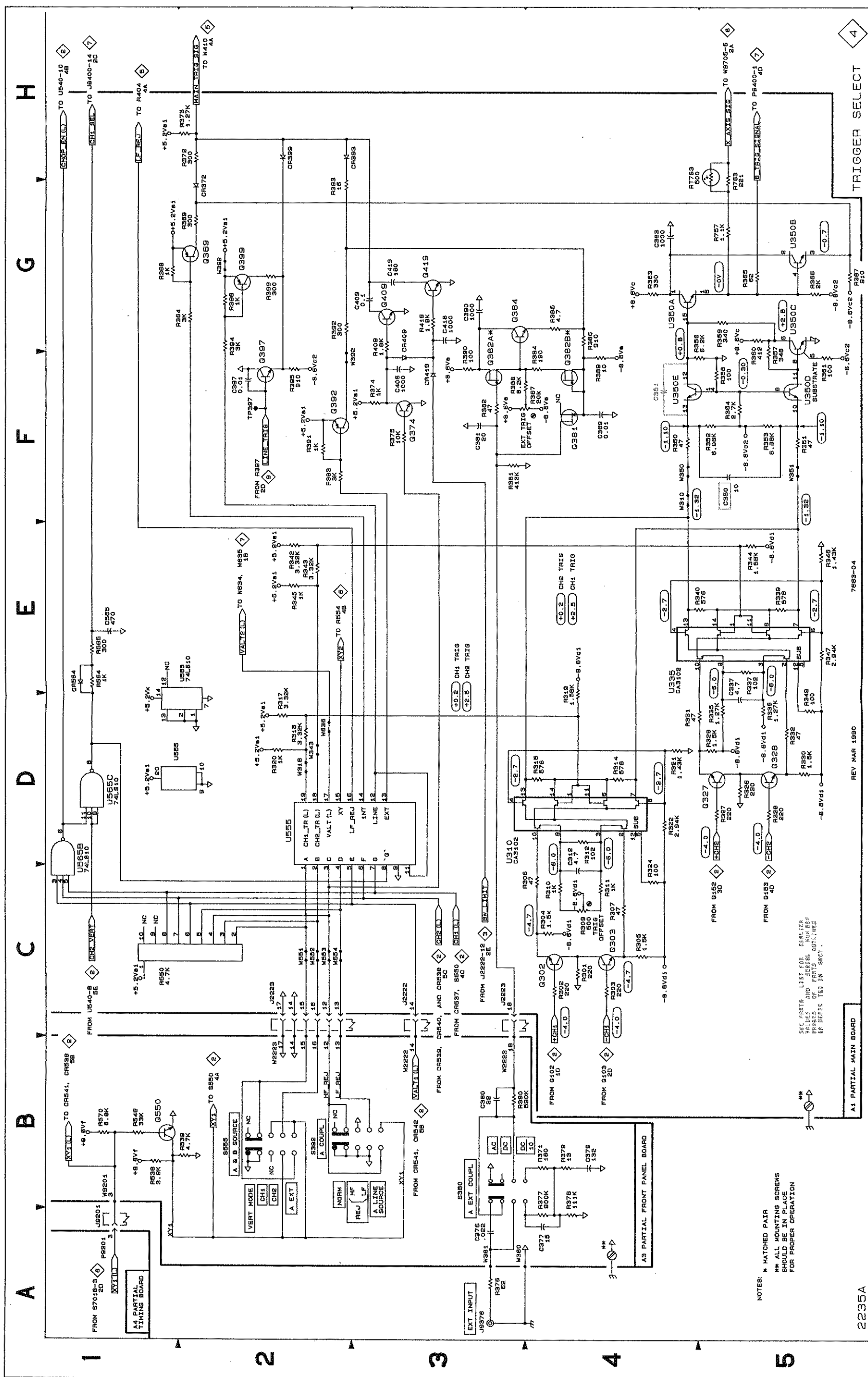
|       |    |    |  |  |  |  |  |  |  |  |
|-------|----|----|--|--|--|--|--|--|--|--|
| P9201 | 1A | 1A |  |  |  |  |  |  |  |  |
|-------|----|----|--|--|--|--|--|--|--|--|

Partial A4 also shown on diagrams 6, 7, and 8.

## OTHER PARTS

[illegible]







# TRIGGER P-P AUTO AND OUTPUT DIAGRAM 5

| ASSEMBLY A1                                                           |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
|-----------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| CIRCUIT<br>NUMBER                                                     | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION |
| C402                                                                  | 4B                | 7D                | Q420              | 2C                | 8C                | R420              | 4C                | 8C                |                   |                   |                   |
| C410                                                                  | 4B                | 8D                | Q421              | 3D                | 8C                | R421              | 3D                | 8C                | R463              | 5F                | 8D                |
| C414                                                                  | 2D                | 7B                | Q422              | 2D                | 7C                | R422              | 2C                | 7C                | R464              | 4F                | 8D                |
| C415                                                                  | 3D                | 8B                | Q423              | 3D                | 8C                | R423              | 3D                | 8C                | R465              | 4F                | 9D                |
| C420                                                                  | 1D                | 7C                | Q428              | 2D                | 8B                | R424              | 1C                | 7C                | R467              | 4F                | 9D                |
| C421                                                                  | 3D                | 8C                | Q429              | 3D                | 8B                | R426              | 2D                | 8C                | R468              | 4F                | 8D                |
| C453                                                                  | 3E                | 9C                | Q446              | 3E                | 9C                | R427              | 2D                | 8C                | R469              | 4F                | 9D                |
| C459                                                                  | 5B                | 8C                | Q450              | 3E                | 8C                | R428              | 2D                | 7B                | R470              | 4F                | 8D                |
| C460                                                                  | 1G                | 8D                | Q473              | 4G                | 9C                | R429              | 3D                | 9B                | R473              | 4G                | 9B                |
| C467                                                                  | 4F                | 8D                | Q474              | 4G                | 9C                | R431              | 3E                | 9B                | R474              | 5G                | 10C               |
| C469                                                                  | 4F                | 9C                | Q476              | 4G                | 9D                | R432              | 2D                | 9B                | R476              | 4F                | 9D                |
| C473                                                                  | 3F                | 9B                | Q477              | 4G                | 9D                | R433              | 3D                | 9B                | R477              | 4F                | 9D                |
| C487                                                                  | 4G                | 9C                | Q487              | 4G                | 9C                | R434              | 2C                | 9B                | R478              | 5F                | 9C                |
| C590                                                                  | 1F                | 8D                |                   |                   |                   | R435              | 3D                | 9B                | R479              | 5F                | 9C                |
|                                                                       |                   |                   | R400              | 4B                | 7C                | R436              | 2E                | 8A                | R480              | 4G                | 9D                |
| CR405                                                                 | 4B                | 8D                | R402              | 4B                | 7D                | R437              | 2E                | 8B                | R481              | 4G                | 9D                |
| CR406                                                                 | 4B                | 8D                | R403              | 4B                | 7D                | R439              | 3E                | 8C                | R482              | 4G                | 9D                |
| CR414                                                                 | 2C                | 8B                | R404              | 4B                | 7C                | R445              | 3E                | 8C                | R486              | 4F                | 9D                |
| CR415                                                                 | 2C                | 8C                | R405              | 4B                | 7D                | R446              | 3E                | 8C                | R487              | 4G                | 9D                |
| CR467                                                                 | 4F                | 9D                | R406              | 4B                | 7D                | R447              | 4E                | 8C                | R492              | 4H                | 9D                |
| CR476                                                                 | 3F                | 9B                | R407              | 4C                | 8D                | R450              | 3E                | 8C                | R591              | 3G                | 9D                |
| CR477                                                                 | 4F                | 9D                | R408              | 5B                | 8E                | R452              | 5F                | 8C                |                   |                   |                   |
| J2223                                                                 | 2G                | 9B                | R410              | 5B                | 8D                | R453              | 4F                | 8C                | TP460             | 4D                | 8D                |
| J2223                                                                 | 5B                | 9B                | R411              | 2C                | 8B                | R455              | 5F                | 8C                |                   |                   |                   |
| J2500                                                                 | 4H                | 10D               | R412              | 3C                | 9B                | R457              | 4E                | 9D                | U426A             | 2D                | 7B                |
|                                                                       |                   |                   | R413              | 2C                | 8C                | R458              | 4F                | 9D                | U426B             | 2E                | 7B                |
| Q400                                                                  | 4B                | 7C                | R414              | 2C                | 8B                | R459              | 5B                | 8C                | U460              | 4F                | 8D                |
| Q402                                                                  | 4B                | 7D                | R415              | 2C                | 8C                | R460              | 5E                | 8C                |                   |                   |                   |
| Q405                                                                  | 4B                | 8D                | R416              | 2C                | 8C                | R461              | 5C                | 9D                | W410              | 4B                | 7D                |
| Q406                                                                  | 4B                | 8D                | R417              | 3C                | 8C                | R462              | 5B                | 9C                |                   |                   |                   |
| Q413                                                                  | 3C                | 9B                |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Partial A1 also shown on diagrams 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11. |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| ASSEMBLY A3                                                           |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| R438                                                                  | 2H                | 7B                | S460              | 5A                | 6B                |                   |                   |                   |                   |                   |                   |
| Partial A3 also shown on diagrams 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11. |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |

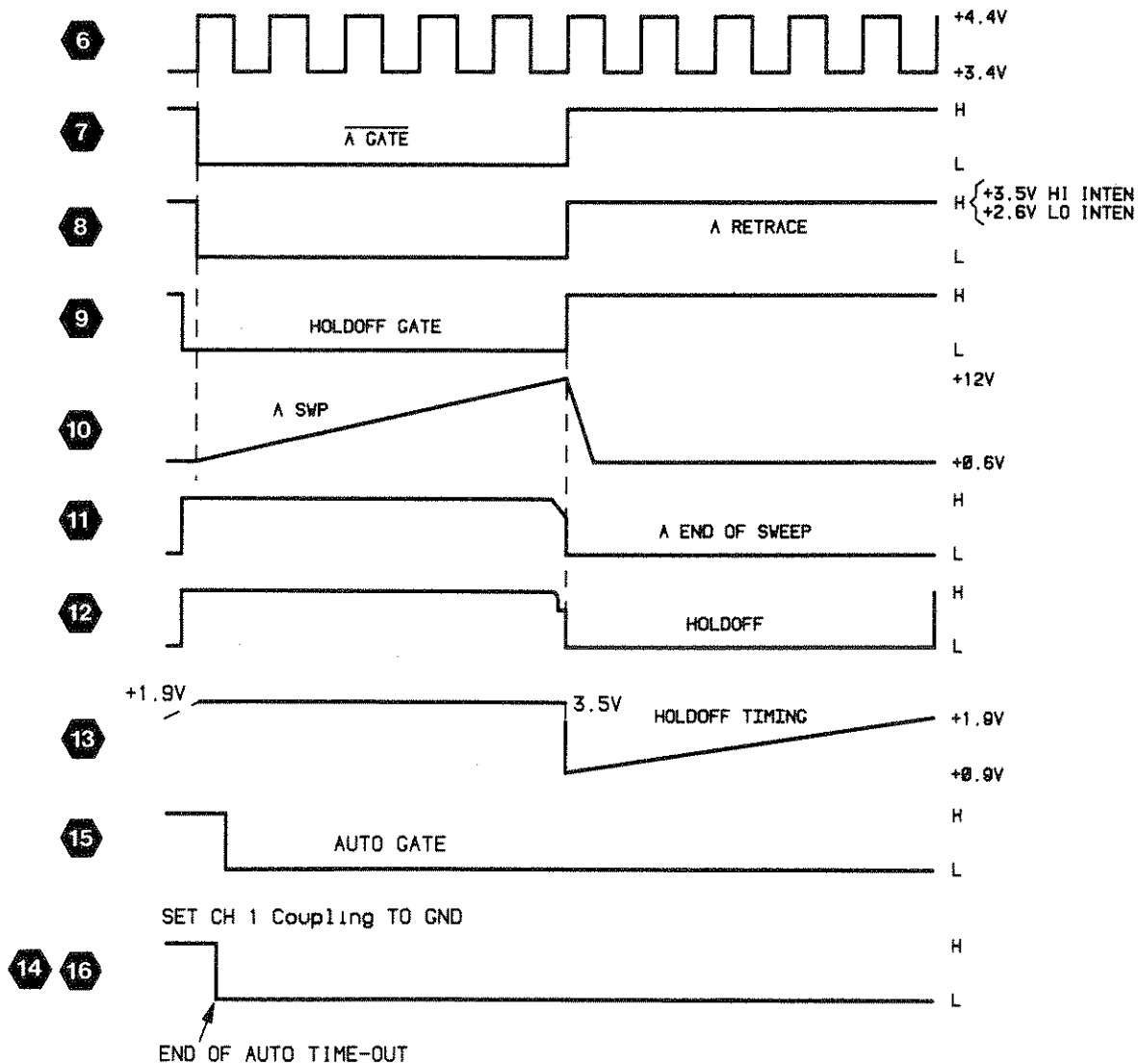
## 2235A CONTROL SETTINGS

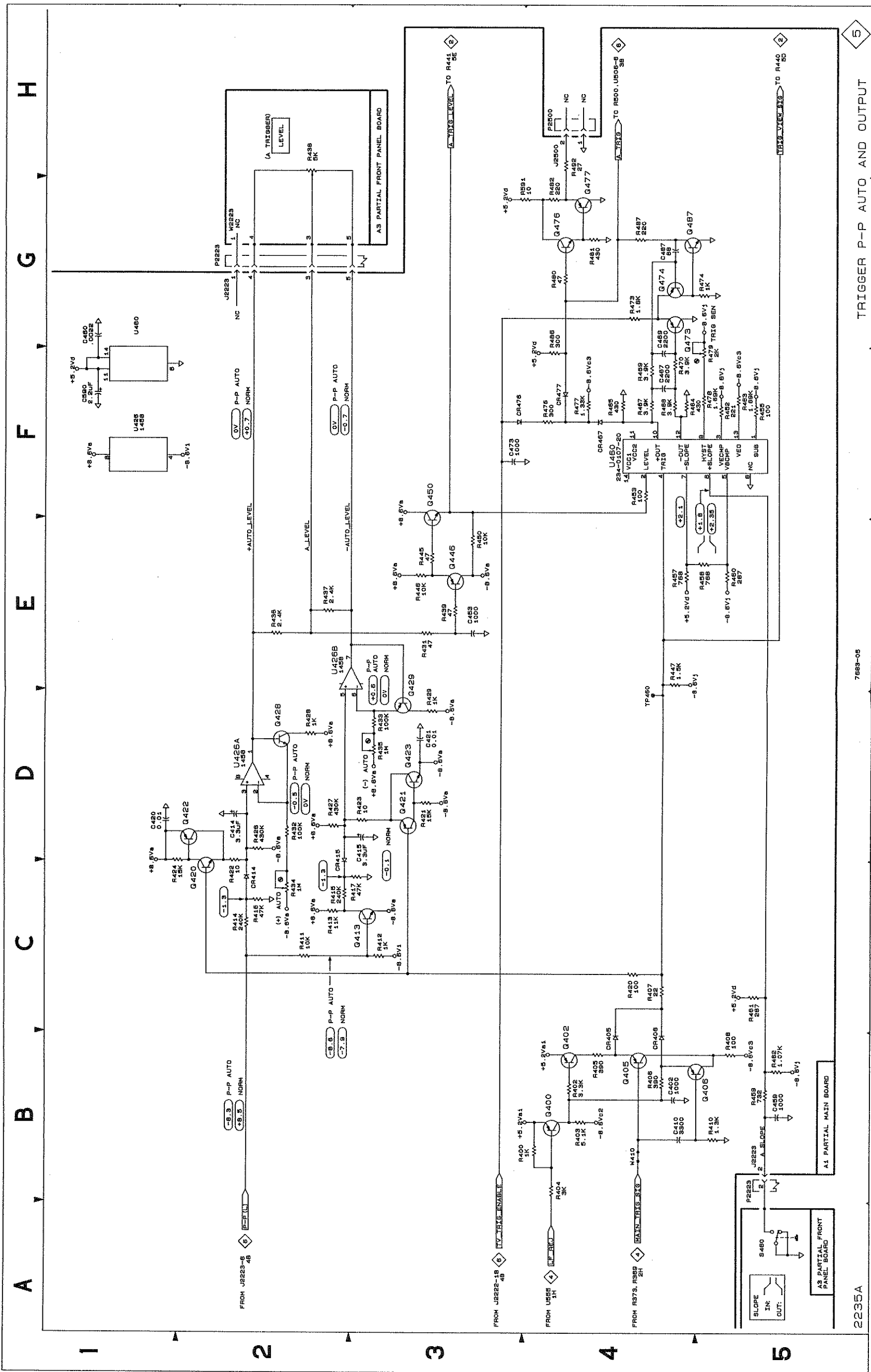
### DC Voltages

|                 |          |
|-----------------|----------|
| A INTENSITY     | Midrange |
| Horizontal MODE | A        |
| SEC/DIV         | 0.1 ms   |
| A TRIGGER Mode  | P-P AUTO |

### AC Waveforms

|                   |                         |
|-------------------|-------------------------|
| Vertical MODE     | CH 1                    |
| CH 1 VOLTS/DIV    | 1V                      |
| CH 1 AC-GND-DC    | DC                      |
| Horizontal MODE   | A                       |
| A TRIGGER LEVEL   | Midrange                |
| A TRIGGER Mode    | P-P AUTO                |
| A & B SOURCE      | VERT MODE               |
| A SOURCE          | NORM                    |
| CH 1 INPUT SIGNAL | 1-kHz sine wave, 4V P-P |





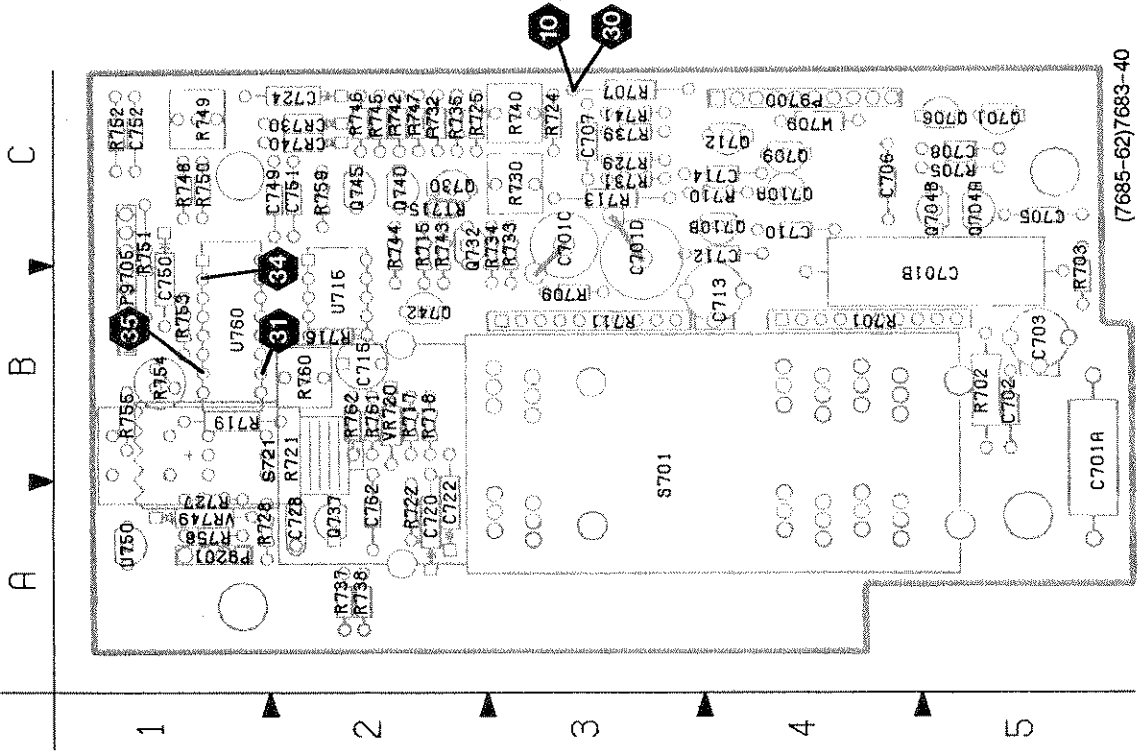
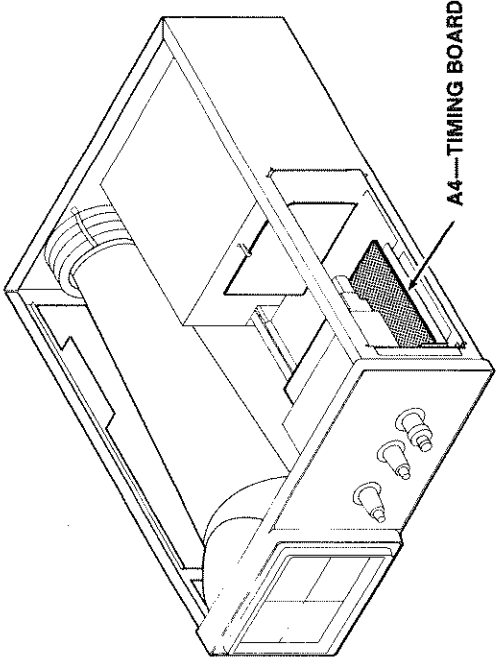


Figure 9-10. A4 – Timing board.



| A4—TIMING BOARD |              |                |              |                |              |
|-----------------|--------------|----------------|--------------|----------------|--------------|
| CIRCUIT NUMBER  | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER |
| C701            | 6            | Q732           | 8            | R742           | 8            |
| C701            | 7            | Q737           | 8            | R743           | 8            |
| C702            | 6            | Q740           | 8            | R744           | 8            |
| C703            | 6            | Q742           | 8            | R745           | 8            |
| C705            | 6            | Q745           | 8            | R746           | 8            |
| C706            | 6            |                |              | R747           | 8            |
| C707            | 8            | R701           | 6            | R748           | 8            |
| C708            | 6            | R702           | 6            | R749           | 8            |
| C710            | 7            | R703           | 6            | R750           | 8            |
| C712            | 7            | R705           | 6            | R751           | 8            |
| C713            | 7            | R707           | 6            | R752           | 8            |
| C714            | 7            | R709           | 7            | R753           | 8            |
| C715            | 6            | R710           | 7            | R754           | 8            |
| C720            | 6            | R711           | 7            | R755           | 8            |
| C722            | 6            | R713           | 7            | R758           | 8            |
| C724            | 8            | R715           | 6            | R759           | 8            |
| C728            | 8            | R716           | 6            | R760           | 8            |
| C749            | 8            | R717           | 6            | R761           | 8            |
| C750            | 8            | R718           | 6            | R762           | 8            |
| C751            | 8            | R719           | 6            | R715           | 6            |
| C752            | 8            | R721           | 6            |                |              |
| C762            | 8            | R722           | 6            |                |              |
| CR730           | 8            | R724           | 6            | S701           | 6            |
| CR740           | 8            | R725           | 8            | S701           | 7            |
|                 |              | R727           | 8            | S721           | 6            |
| P9201           | 4            | R728           | 8            | S721           | 8            |
| P9201           | 6            | R729           | 8            | U715           | 6            |
| P9700           | 6            | R730           | 8            | U715           | 8            |
| P9705           | 8            | R731           | 8            | U750           | 8            |
|                 |              | R732           | 8            | U760           | 8            |
| Q701            | 6            | R733           | 8            |                |              |
| Q704            | 6            | R734           | 8            | VR720          | 6            |
| Q706            | 6            | R735           | 8            | VR749          | 8            |
| Q709            | 7            | R737           | 8            |                |              |
| Q710            | 7            | R738           | 8            | W709           | 7            |
| Q712            | 7            | R739           | 8            |                |              |
| Q730            | 8            | R740           | 8            |                |              |
|                 |              | R741           | 8            |                |              |

⚡ Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number

Subassembly Number (if used)

Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

## ASSEMBLY A1

| CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| C500              | 5C                | 10C               | J2222             | 4B                | 7B                | R507              | 5C                | 10C               | R572              | 4E                | 10F               |
| C501              | 5B                | 10C               | J2223             | 3B                | 9B                | R508              | 5B                | 10D               | R573              | 5E                | 10E               |
| C502              | 3F                | 10C               | J2223             | 4B                | 9B                | R509              | 5C                | 10C               | R574              | 3E                | 10F               |
| C503              | 3G                | 7E                | J2223             | 5B                | 9B                | R511              | 5F                | 9E                | R576              | 4F                | 9E                |
| C504              | 3D                | 6E                | J2223             | 5F                | 9B                | R512              | 4F                | 9E                | R577              | 4G                | 9E                |
| C505              | 3B                | 8E                | J2600             | 4H                | 9D                | R513              | 4F                | 9E                | R578              | 3G                | 9E                |
| C506              | 3G                | 9F                | J2850             | 3H                | 8E                | R514              | 4F                | 9F                | R580              | 4F                | 8F                |
| C517              | 4D                | 7E                | J2850             | 8E                | 8E                | R516              | 5F                | 10E               | R582              | 4G                | 8E                |
| C518              | 3C                | 8F                |                   |                   |                   | R517              | 5F                | 10E               |                   |                   |                   |
| C519              | 3D                | 8F                | Q501              | 5B                | 10D               | R518              | 3E                | 9E                | TP504             | 3D                | 7F                |
| C520              | 3C                | 8F                | Q509              | 5C                | 10C               | R523              | 4C                | 8F                | U502              | 5C                | 10C               |
| C525              | 4G                | 8F                | Q511              | 4F                | 9E                | R524              | 4C                | 8F                | U504A             | 3D                | 8E                |
| C527              | 4G                | 9F                | Q525              | 4D                | 7F                | R525              | 5G                | 8F                | U504B             | 3C                | 8E                |
| C529              | 4G                | 10F               | Q555              | 4C                | 7E                | R526              | 3D                | 9F                | U506A             | 3F                | 9E                |
| C531              | 3F                | 10D               | Q576              | 4F                | 8E                | R527              | 4G                | 9F                | U506B             | 4E                | 9E                |
|                   |                   |                   | Q578              | 4G                | 8E                | R528              | 3D                | 10E               | U532A             | 5E                | 10F               |
| CR501             | 5B                | 10D               |                   |                   |                   | R529              | 4G                | 10F               | U532B             | 3D                | 10E               |
| CR502             | 5B                | 10D               | R500              | 5B                | 10D               | R554              | 4C                | 7E                | U532C             | 4E                | 10E               |
| CR503             | 3D                | 8E                | 5501              | 5B                | 10D               | R555              | 4C                | 7E                | U532D             | 4C                | 10E               |
| CR508             | 4B                | 9B                | R502              | 5C                | 10D               | R568              | 4C                | 10E               |                   |                   |                   |
| CR509             | 5C                | 10C               | R503              | 5C                | 10D               | R569              | 5C                | 10D               | W9700             | 3C                | 9F                |
| CR514             | 4F                | 9E                | R504              | 3D                | 8E                | R569              | 5C                | 10D               |                   |                   |                   |
| CR518             | 4D                | 7E                | R505              | 3B                | 7E                | R571              | 5D                | 9E                |                   |                   |                   |
| CR529             | 4G                | 9F                | R506              | 5B                | 10D               |                   |                   |                   |                   |                   |                   |

Partial A1 also shown on diagram 1, 2, 3, 4, 5, 7, 8, 9, 10, and 11.

## ASSEMBLY A3

|       |    |    |      |    |    |       |    |    |       |    |    |
|-------|----|----|------|----|----|-------|----|----|-------|----|----|
| DS518 | 5G | 6C | R519 | 2A | 6C | R723  | 1C | 6C | S401B | 5A | 7C |
|       |    |    | R520 | 2A | 6C |       |    |    | S401C | 5A | 7C |
| R401  | 5A | 7C | R521 | 2A | 7D | S401A | 3A | 6C |       |    |    |

Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 7, 8, 9, 10, and 11.

## ASSEMBLY A4

|       |    |    |       |    |    |      |    |    |       |    |    |
|-------|----|----|-------|----|----|------|----|----|-------|----|----|
| C701A | 1G | 5A | P8201 | 1D | 1A | R701 | 1D | 4B | R721  | 1D | 2B |
| C701B | 1G | 5B | P8201 | 2A | 1A | R702 | 1E | 5B | R722  | 1D | 2A |
| C702  | 1G | 5B | P9700 | 2C | 4C | R703 | 1G | 5B | RT715 | 2C | 2C |
| C703  | 1G | 5B | P9700 | 3D | 4C | R705 | 2H | 5C |       |    |    |
| C705  | 1H | 5C | P9700 | 4G | 4C | R707 | 1H | 3C | S701A | 1F | 3A |
| C706  | 2H | 4C | P9700 | 4H | 4C | R715 | 2C | 2C | S701B | 1B | 3A |
| C708  | 1H | 5C |       |    |    | R716 | 2C | 2B | S701B | 2G | 3A |
| C715  | 2C | 2B | Q701  | 1G | 5C | R717 | 2C | 2B |       |    |    |
| C720  | 2D | 2A | Q704A | 1H | 5C | R718 | 2C | 2B | U715B | 2C | 2B |
| C722  | 2D | 2A | Q704B | 2H | 5C | R719 | 2D | 1B |       |    |    |
|       |    |    | Q706  | 1H | 5C |      |    |    | VR720 | 2D | 2B |

Partial A4 also shown on diagrams 4, 7, and 8.

# 2235A CONTROL SETTINGS

## DC Voltages

AC-GND-DC (both)  
A TRIGGER Mode

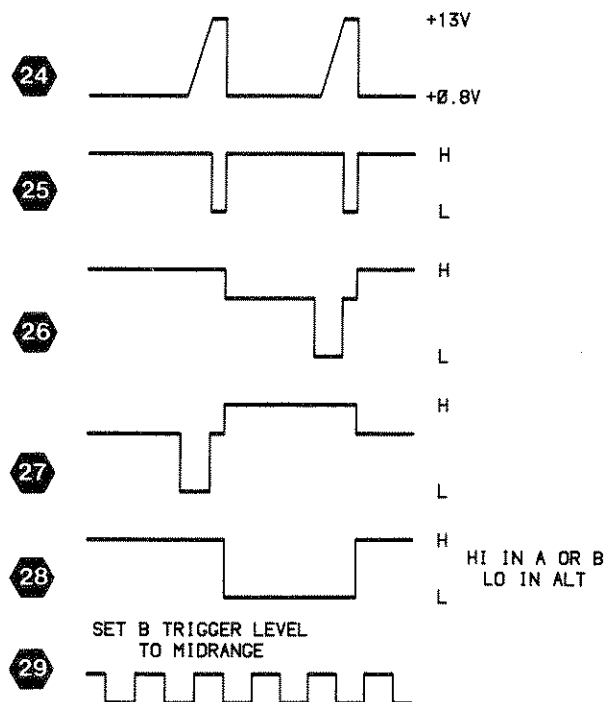
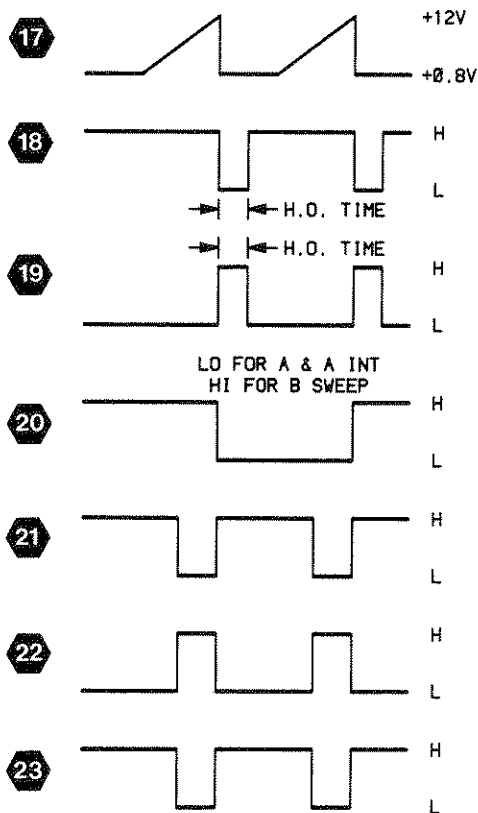
GND  
NORM (sweep  
not running)

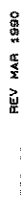
## AC Waveforms

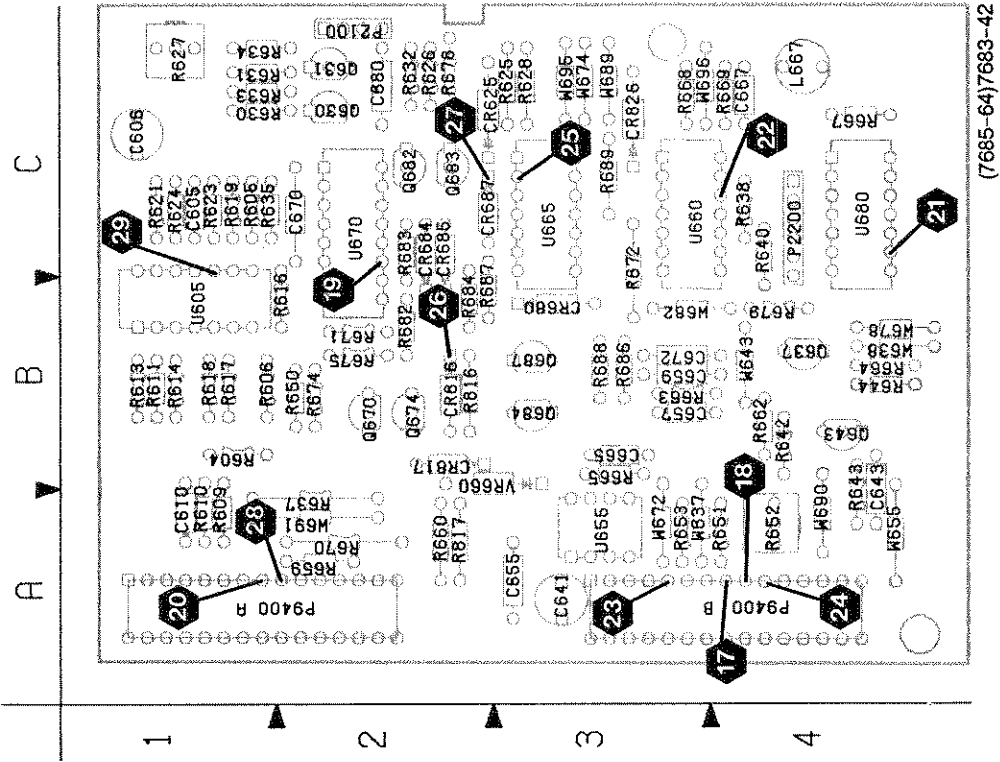
Vertical MODE  
CH 1 VOLTS/DIV  
AC-GND-DC (both)  
Horizontal MODE  
A SEC/DIV  
B SEC/DIV  
B DELAY TIME POSITION  
B TRIGGER LEVEL

A TRIGGER Mode  
A & B SOURCE  
A SOURCE  
CH 1 INPUT SIGNAL

CH 1  
5mV  
DC  
ALT  
50  $\mu$ s  
5  $\mu$ s  
MIDRANGE  
CW-RUNS  
AFTER DLY  
P-P AUTO  
CH 1  
NORM  
5-div,  
1-kHz sine wave

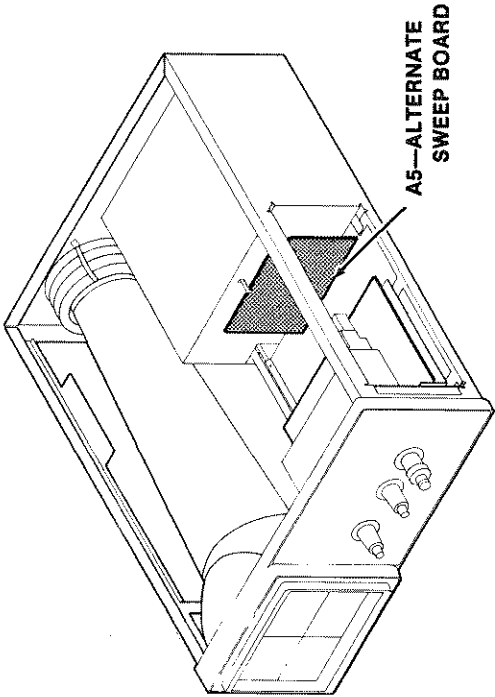






A5-ALTERNATE SWEEP BOARD  
FIG. 9-11

Figure 9-11. A5 - Alternate Sweep board.



| A5 - ALTERNATE SWEEP BOARD |              |                |              |                |              |                |              |
|----------------------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|
| CIRCUIT NUMBER             | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER |
| C605                       | 7            | Q637           | 7            | R634           | 7            | R687           | 7            |
| C606                       | 7            | Q643           | 7            | R635           | 7            | R688           | 7            |
| C610                       | 7            | Q670           | 7            | R637           | 7            | R689           | 7            |
| C641                       | 7            | Q674           | 7            | R638           | 7            | R816           | 7            |
| C643                       | 7            | Q682           | 7            | R640           | 7            | R817           | 7            |
| C655                       | 7            | Q683           | 7            | R642           | 7            |                |              |
| C657                       | 7            | Q684           | 7            | R643           | 7            | U605           | 7            |
| C659                       | 7            | Q687           | 7            | R644           | 7            | U655           | 7            |
| C665                       | 7            |                |              | R650           | 7            | U660           | 7            |
| C667                       | 7            | R604           | 7            | R651           | 7            | U665           | 7            |
| C670                       | 7            | R605           | 7            | R652           | 7            | U670           | 7            |
| C672                       | 7            | R606           | 7            | R653           | 7            | U680           | 7            |
| C680                       | 7            | R609           | 7            | R659           | 7            |                |              |
|                            |              | R610           | 7            | R660           | 7            | VR660          | 7            |
| CR625                      | 7            | R611           | 7            | R662           | 7            |                |              |
| CR680                      | 7            | R613           | 7            | R663           | 7            | W637           | 7            |
| CR684                      | 7            | R614           | 7            | R664           | 7            | W638           | 7            |
| CR685                      | 7            | R616           | 7            | R665           | 7            | W643           | 7            |
| CR687                      | 7            | R617           | 7            | R666           | 7            | W655           | 7            |
| CR816                      | 7            | R618           | 7            | R668           | 7            | W655           | 11           |
| CR817                      | 7            | R619           | 7            | R669           | 7            | W672           | 7            |
| CR826                      | 7            | R621           | 7            | R670           | 7            | W674           | 7            |
|                            |              | R623           | 7            | R671           | 7            | W678           | 7            |
| L667                       | 7            | R624           | 7            | R672           | 7            | W682           | 7            |
|                            |              | R625           | 7            | R674           | 7            | W689           | 7            |
| P2100                      | 7            | R626           | 7            | R675           | 7            | W690           | 7            |
| P2200                      | 7            | R627           | 7            | R678           | 7            |                |              |
| P9400                      | 7            | R628           | 7            | R679           | 7            | W691           | 11           |
|                            | 11           | R630           | 7            | R682           | 7            | W691           | 11           |
| Q630                       | 7            | R631           | 7            | R683           | 7            | W695           | 7            |
| Q631                       | 7            | R632           | 7            | R684           | 7            | W696           | 7            |
|                            |              | R633           | 7            | R686           | 7            |                |              |

Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

## B TIMING AND ALTERNATE B SWEEP DIAGRAM 7

| ASSEMBLY A1                                                           |                |                |                |                |                |                |                |                |                |                |                |
|-----------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER                                                        | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| C603                                                                  | 4D             | 7G             | CR641          | 3E             | 10F            | R645           | 3B             | 10F            | VR712          | 4C             | 10F            |
| C635                                                                  | 1C             | 9G             | CR647          | 2C             | 11E            | R646           | 3B             | 10F            | W602           | 4D             | 8G             |
| C646                                                                  | 3B             | 11F            | CR712          | 3C             | 10F            | R647           | 3B             | 10F            | W603           | 5D             | 8G             |
| C647                                                                  | 2C             | 8F             |                |                |                | R648           | 1C             | 10E            | W634           | 2B             | 10G            |
| C648                                                                  | 1C             | 8G             | J2300          | 1D             | 10F            | R649           | 2C             | 10E            | W635           | 2B             | 9G             |
| C649                                                                  | 2C             | 7G             | J8400          | 1D             | 7G             | R673           | 4C             | 9G             | W648           | 1B             | 11G            |
| C673                                                                  | 4C             | 9G             | Q641           | 3C             | 11F            |                |                |                | W649           | 2B             | 8G             |
| CR648                                                                 | 2C             | 8F             | R641           | 3C             | 9G             | VR645          | 3B             | 10F            | W9700          | 3C             | 9F             |
| Partial A1 also shown on diagram 1, 2, 3, 4, 5, 6, 8, 9, 10, and 11.  |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A3                                                           |                |                |                |                |                |                |                |                |                |                |                |
| R602                                                                  | 5D             | 7C             | S602           | 5D             | 6C             | S648           | 2A             | 5C             |                |                |                |
| Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 6, 8, 9, 10, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A4                                                           |                |                |                |                |                |                |                |                |                |                |                |
| C701C                                                                 | 5C             | 3C             | C714           | 5C             | 4C             | Q712           | 5C             | 4C             | R713           | 4C             | 3C             |
| C701D                                                                 | 5C             | 3B             |                |                |                |                |                |                |                |                |                |
| C710                                                                  | 5C             | 4C             | Q709           | 5C             | 4C             | R709           | 5C             | 3B             | S701C          | 4A             | 3A             |
| C712                                                                  | 5C             | 4C             | Q710A          | 5C             | 4C             | R710           | 5C             | 4C             |                |                |                |
| C713                                                                  | 5C             | 4B             | Q710B          | 5C             | 4C             | R711           | 4A             | 3B             | W709           | 5C             | 4C             |
| Partial A4 also shown on diagrams 4, 6, and 8.                        |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A5                                                           |                |                |                |                |                |                |                |                |                |                |                |
| C605                                                                  | 5F             | 1C             | Q670           | 1E             | 2B             | R640           | 4F             | 4C             | U605           | 5E             | 1B             |
| C606                                                                  | 5E             | 1C             | Q674           | 2E             | 2B             | R642           | 4E             | 4B             | U655           | 3D             | 3A             |
| C610                                                                  | 4E             | 1A             | Q682           | 1F             | 2C             | R643           | 4E             | 4A             | U660A          | 3F             | 3C             |
| C641                                                                  | 3D             | 3A             | Q683           | 1G             | 2C             | R644           | 3E             | 4B             | U660B          | 3F             | 3C             |
| C643                                                                  | 4E             | 4A             | Q684           | 2G             | 3B             | R650           | 2E             | 2B             | U660C          | 3G             | 3C             |
| C655                                                                  | 3E             | 3A             | Q687           | 2G             | 3B             | R651           | 3D             | 4A             | U660D          | 4F             | 3C             |
| C657                                                                  | 3D             | 3B             |                |                |                | R652           | 3D             | 4A             | U660E          | 1D             | 3C             |
| C659                                                                  | 3E             | 3B             | R604           | 5E             | 1B             | R653           | 4D             | 3A             | U660F          | 3E             | 3C             |
| C665                                                                  | 3E             | 3B             | R605           | 5E             | 1C             | R659           | 2H             | 2A             | U665A          | 4G             | 3C             |
| C667                                                                  | 1E             | 4C             | R606           | 5E             | 1B             | R660           | 3D             | 2A             | U665B          | 2G             | 3C             |
| C670                                                                  | 5F             | 2C             | R609           | 4E             | 1A             | R662           | 3E             | 4B             | U665C          | 2G             | 3C             |
| C672                                                                  | 4E             | 3B             | R610           | 4E             | 1A             | R663           | 3D             | 3B             | U665D          | 3G             | 3C             |
| C680                                                                  | 1H             | 2C             | R611           | 5E             | 1B             | R664           | 3E             | 4B             | U670A          | 3F             | 2C             |
|                                                                       |                |                | R613           | 5F             | 1B             | R665           | 3E             | 3B             | U670B          | 2F             | 2C             |
| CR625                                                                 | 3F             | 3C             | R614           | 5F             | 1B             | R667           | 1E             | 4C             | U680A          | 2E             | 4C             |
| CR680                                                                 | 3G             | 3B             | R616           | 5E             | 2B             | R668           | 1D             | 3C             | U680B          | 2E             | 4C             |
| CR684                                                                 | 2G             | 2C             | R617           | 5E             | 1B             | R669           | 2E             | 4C             | U680C          | 3E             | 4C             |
| CR685                                                                 | 2G             | 2C             | R618           | 5E             | 1B             | R670           | 1E             | 2A             | U680D          | 3E             | 4C             |
| CR687                                                                 | 3G             | 3C             | R619           | 5F             | 1C             | R671           | 1F             | 2B             |                |                |                |
| CR816                                                                 | 2H             | 2B             | R621           | 5F             | 1C             | R672           | 4F             | 3B             | VR660          | 3D             | 3B             |
| CR817                                                                 | 3H             | 2B             | R623           | 5F             | 1C             | R674           | 2E             | 2B             |                |                |                |
| CR826                                                                 | 3F             | 3C             | R624           | 5F             | 1C             | R675           | 2E             | 2B             | W637           | 2D             | 3A             |
|                                                                       |                |                | R625           | 3F             | 3C             | R678           | 1F             | 2C             | W638           | 1G             | 4B             |
| L667                                                                  | 1E             | 4C             | R626           | 3F             | 2C             | R679           | 3H             | 4B             | W643           | 4F             | 4B             |
|                                                                       |                |                | R627           | 5F             | 1C             | R682           | 2F             | 2B             | W655           | 1H             | 4A             |
| P2100                                                                 | 4H             | 2D             | R628           | 3F             | 3C             | R683           | 2F             | 2C             | W672           | 4E             | 3A             |
| P2200                                                                 | 4E             | 4C             | R630           | 3G             | 2C             | R684           | 2F             | 2B             | W674           | 4G             | 3C             |
| P9400A                                                                | 1D             | 2A             | R631           | 3G             | 2C             | R686           | 2F             | 3B             | W678           | 2D             | 4B             |
| P9400B                                                                | 1D             | 4A             | R632           | 3G             | 2C             | R687           | 2G             | 3B             | W682           | 3G             | 3B             |
|                                                                       |                |                | R633           | 4G             | 2C             | R688           | 2G             | 3B             | W689           | 1G             | 3C             |
| Q630                                                                  | 3G             | 2C             | R634           | 3G             | 2D             | R689           | 2G             | 3C             | W690           | 1H             | 4A             |
| Q631                                                                  | 3G             | 2C             | R635           | 4G             | 1C             | R816           | 3H             | 2B             | W691           | 1G             | 2A             |
| Q637                                                                  | 4E             | 4B             | R637           | 4E             | 2A             | R817           | 3H             | 2A             | W695           | 5G             | 3C             |
| Q643                                                                  | 4E             | 4B             | R638           | 4E             | 4C             |                |                |                | W696           | 5G             | 3C             |
| Partial A5 also shown on diagram 11.                                  |                |                |                |                |                |                |                |                |                |                |                |
| OTHER PARTS                                                           |                |                |                |                |                |                |                |                |                |                |                |
| R9644                                                                 | 3B             | CHASSIS        |                |                |                |                |                |                |                |                |                |

REV MAR 1990





|  | BOARD LOCATION |
|--|----------------|
|  | 10F            |
|  | 8G             |
|  | 8G             |
|  | 10G            |
|  | 9G             |
|  | 11G            |
|  | 8G             |
|  | 9F             |
|  |                |
|  |                |
|  |                |
|  |                |
|  | 3C             |
|  | 3A             |
|  | 4C             |
|  |                |
|  |                |
|  |                |
|  |                |
|  | 1B             |
|  | 3A             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 3C             |
|  | 2C             |
|  | 2C             |
|  | 4C             |
|  | 4C             |
|  | 4C             |
|  | 4C             |
|  | 3B             |
|  | 3A             |
|  | 4B             |
|  | 4B             |
|  | 4A             |
|  | 3A             |
|  | 3C             |
|  | 4B             |
|  | 3B             |
|  | 3C             |
|  | 4A             |
|  | 2A             |
|  | 3C             |
|  | 3C             |

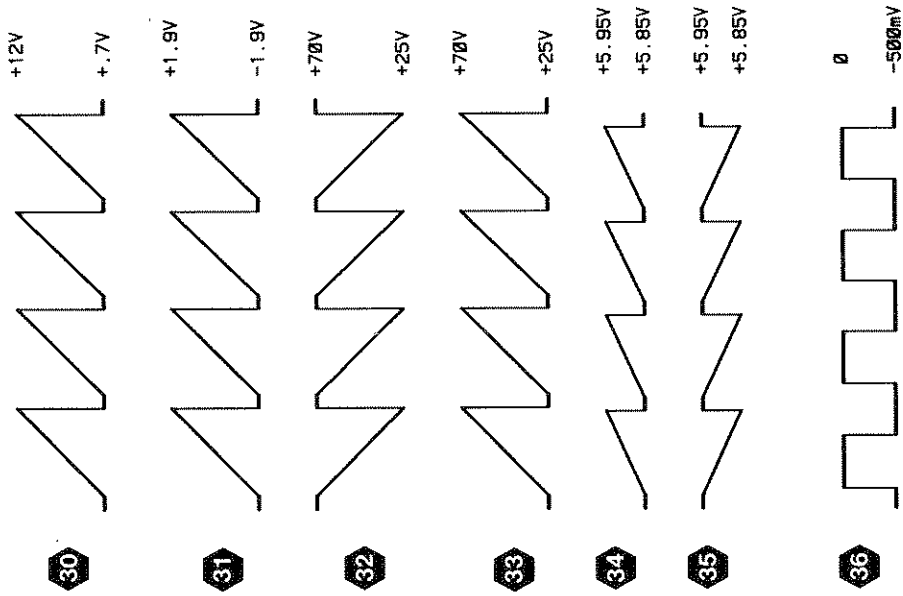
2235A CONTROL SETTINGS

DC Voltages

AC-GND-DC (both)      GND  
Horizontal MODE      A  
A TRIGGER Mode      P-P AUTO

AC Waveforms

AC-GND-DC (both)      GND  
Horizontal MODE      A  
X10 Magnifier      Off (knob in)  
VAR HOLDOFF      MIN (fully ccw)  
A TRIGGER Mode      P-P AUTO



### CALIBRATOR AND HORIZONTAL OUTPUT AMPLIFIER DIAGRAM 8

## ASSEMBLY A1

| CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| C764              | 4F                | 4J                | Q770              | 4F                | 3H                | R777              | 4H                | 4G                | R989              | 2F                | 2C                |
| C771              | 4G                | 4H                | Q775              | 5H                | 3G                | R778              | 5H                | 3G                | R990              | 2F                | 1C                |
| C774              | 4G                | 3H                | Q778              | 3F                | 3H                | R779              | 4H                | 4G                | R991              | 2G                | 2B                |
| C775              | 4G                | 4H                | Q779              | 4H                | 4G                | R780              | 3F                | 3H                |                   |                   |                   |
| C777              | 4H                | 4G                | Q780              | 3F                | 3H                | R781              | 3F                | 5G                | U985A             | 1F                | 2B                |
| C779              | 4G                | 3G                | Q785              | 3H                | 3G                | R782              | 3F                | 2H                | U985B             | 2F                | 2B                |
| C781              | 3G                | 3H                | Q789              | 3H                | 3G                | R783              | 3H                | 3H                | U985C             | 2F                | 2B                |
| C782              | 3G                | 2H                |                   |                   |                   | R784              | 3F                | 3J                | U985D             | 2G                | 2B                |
| C785              | 3G                | 3H                | R566              | 3B                | 7F                | R785              | 3G                | 3H                | U985E             | 2G                | 2B                |
| C787              | 3H                | 3H                | R676              | 3B                | 7F                | R786              | 2H                | 3G                | U985F             | 1G                | 2B                |
| C789              | 3G                | 2G                | R764              | 4F                | 3J                | R787              | 3H                | 3G                |                   |                   |                   |
| C987              | 1F                | 2C                | R766              | 4F                | 3H                | R788              | 3H                | 3G                | VR764             | 4F                | 3J                |
|                   |                   |                   | R768              | 4F                | 3H                | R789              | 3H                | 3G                | VR782             | 3G                | 2H                |
| CR764             | 4F                | 2J                | R770              | 4F                | 4H                | R792              | 4H                | 4G                |                   |                   |                   |
| CR770             | 4F                | 4J                | R771              | 4F                | 5G                | R793              | 4H                | 4H                | W732              | 3B                | 8F                |
| CR780             | 3F                | 3J                | R772              | 4F                | 3H                | R984              | 2G                | 1B                | W9700             | 3B                | 9F                |
|                   |                   |                   | R773              | 5H                | 3G                | R985              | 1F                | 2B                | W9705             | 2B                | 7F                |
| J9884             | 2G                | 4B                | R774              | 4G                | 3H                | R986              | 1F                | 2B                | W9778             | 5H                | 3G                |
|                   |                   |                   | R775              | 5G                | 4H                | R987              | 1F                | 2B                | W9788             | 3H                | 3G                |
| Q768              | 4F                | 3H                | R776              | 4H                | 4G                | R988              | 2F                | 2B                |                   |                   |                   |

Partial A1 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 9, 10, and 11.

## ASSEMBLY A3

|       |    |    |       |    |    |       |    |    |       |    |    |
|-------|----|----|-------|----|----|-------|----|----|-------|----|----|
| CR968 | 1H | 2D | J9900 | 1H | 2C | R726A | 1B | 5C | R993  | 1H | 2D |
| CR969 | 2H | 2D |       |    |    | R726B | 1A | 5C |       |    |    |
|       |    |    | R720  | 1B | 6C | R992  | 1H | 1B | W9884 | 2G | 1A |

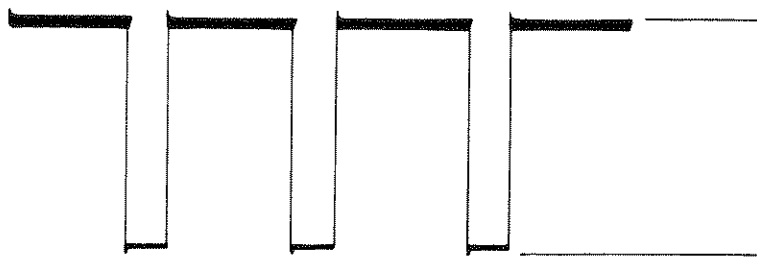
Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 9, 10, and 11.

## ASSEMBLY A4

|       |    |    |      |    |    |      |    |    |       |    |    |
|-------|----|----|------|----|----|------|----|----|-------|----|----|
| C707  | 4C | 3C | Q737 | 4D | 2A | R737 | 4D | 2A | R753  | 3E | 1B |
| C724  | 4C | 2C | Q740 | 3D | 2C | R738 | 4D | 2A | R754  | 3E | 1B |
| C728  | 2D | 2A | Q742 | 3D | 2B | R739 | 3C | 3C | R755  | 3E | 1B |
| C749  | 1E | 2C | Q745 | 3D | 2C | R740 | 3C | 3C | R758  | 2C | 1A |
| C750  | 4E | 1B |      |    |    | R741 | 3C | 3C | R759  | 2C | 2C |
| C751  | 2E | 2C | R724 | 5C | 3C | R742 | 3C | 2C | R760  | 2D | 2B |
| C752  | 4E | 1C | R725 | 3C | 2C | R743 | 3C | 2C | R761  | 2D | 2B |
| C762  | 2D | 2A | R727 | 1C | 1A | R744 | 3C | 2B | R762  | 2C | 2B |
|       |    |    | R728 | 2C | 1A | R745 | 3D | 2C |       |    |    |
| CR730 | 4C | 2C | R729 | 3C | 3C | R746 | 3D | 2C | S721  | 3E | 1B |
| CR740 | 3C | 2C | R730 | 4C | 3C | R747 | 2D | 2C |       |    |    |
|       |    |    | R731 | 4C | 3C | R748 | 3E | 1C | U715A | 2C | 2B |
| P9705 | 2B | 1B | R732 | 3C | 2C | R749 | 4E | 1C | U750  | 5D | 1A |
|       |    |    | R733 | 4D | 3C | R750 | 4E | 1C | U760  | 1D | 1B |
| Q730  | 3D | 2C | R734 | 4D | 3B | R751 | 2E | 1B |       |    |    |
| Q732  | 4D | 2B | R735 | 3C | 2C | R752 | 4E | 1C | VR749 | 1D | 1A |

Partial A4 also shown on diagrams 4, 6, and 7.

40



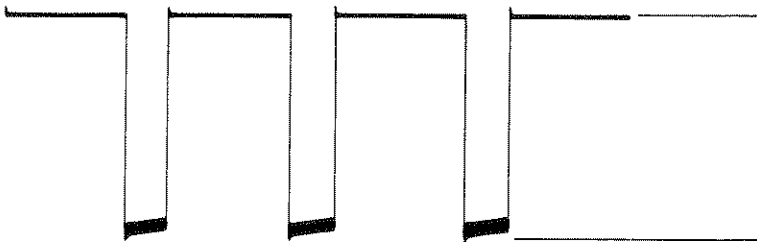
+175V

PROBE GROUND  
LEAD ON TP940

0V

VOLTAGE AND  
DUTY CYCLE  
VARY WITH  
INPUT LINE  
VOLTAGE

41

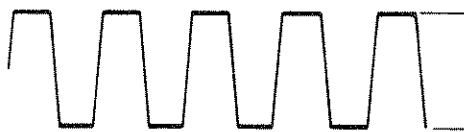


0V

PROBE GROUND  
LEAD ON TP940

-175V

42

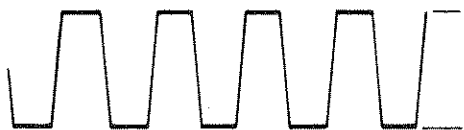


+80V

PROBE GROUND  
LEAD ON TP950

0V

43



+80V

PROBE GROUND  
LEAD ON TP950

0V

44



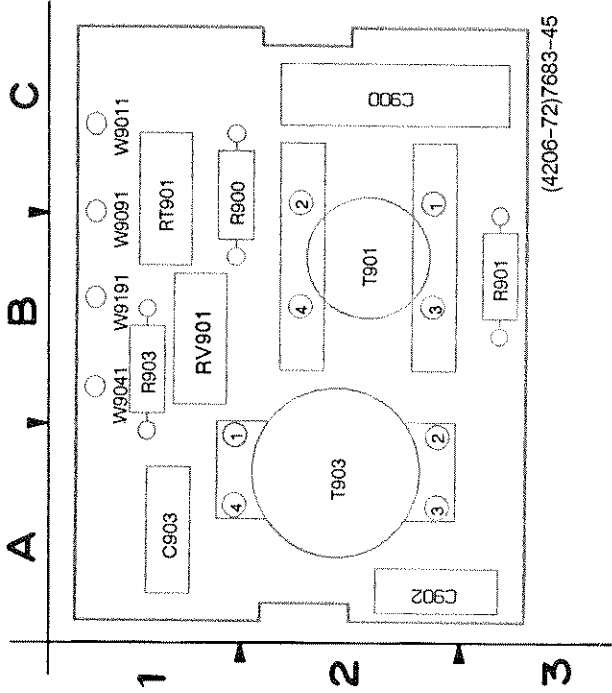
+0.8V

PROBE GROUND  
LEAD ON TP950

0V

(4204-61)7683-46

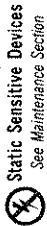
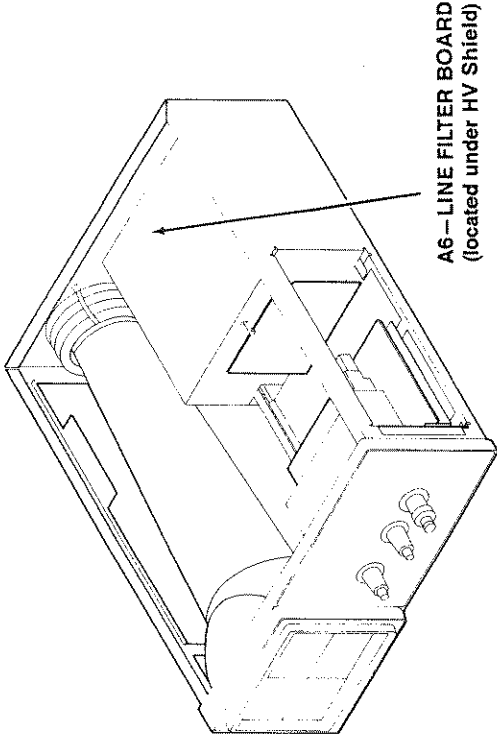




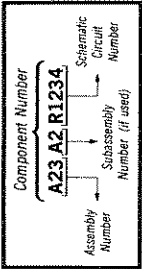
(4206-72)7683-45

Figure 9-12. A6—Line Filter board.

| A6—LINE FILTER BOARD |              |                |              |
|----------------------|--------------|----------------|--------------|
| CIRCUIT NUMBER       | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER |
| C900                 | 9            | RV901          | 9            |
| C902                 | 9            | T901           | 9            |
| C903                 | 9            | T903           | 9            |
| R900                 | 9            | W9011          | 9            |
| R901                 | 9            | W9041          | 9            |
| R903                 | 9            | W9091          | 9            |
| RT901                | 9            | W9191          | 9            |



COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix.—see end of Replaceable Electrical Parts List.

POWER SUPPLY WAVEFORMS

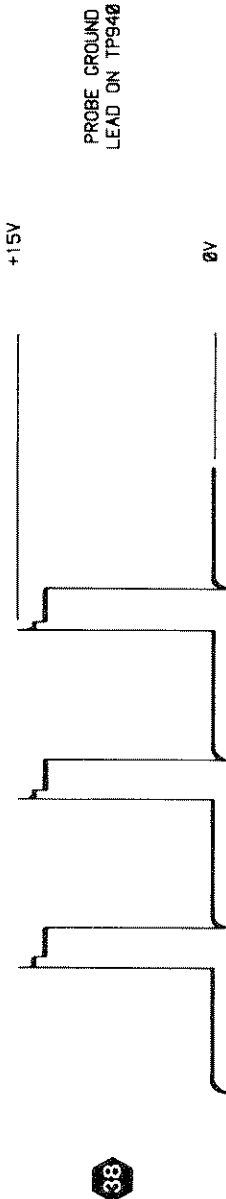
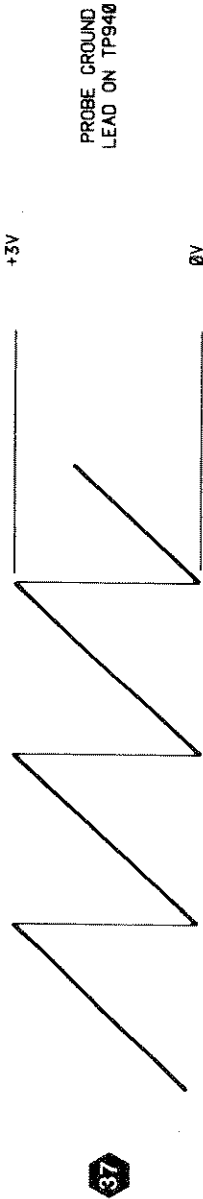
AC Waveforms

WARNING

Instrument must be connected to the ac-power source using a 1 : 1 isolation transformer. Do not connect the test oscilloscope probe ground lead to the inverter circuit test points if the instrument is not isolated AC-source voltage exists on reference points TP940 and TP950.

DC Voltages

Preregulator and inverter voltages are referenced to test point noted adjacent to the voltage. Power supply output voltages are referenced to chassis ground.

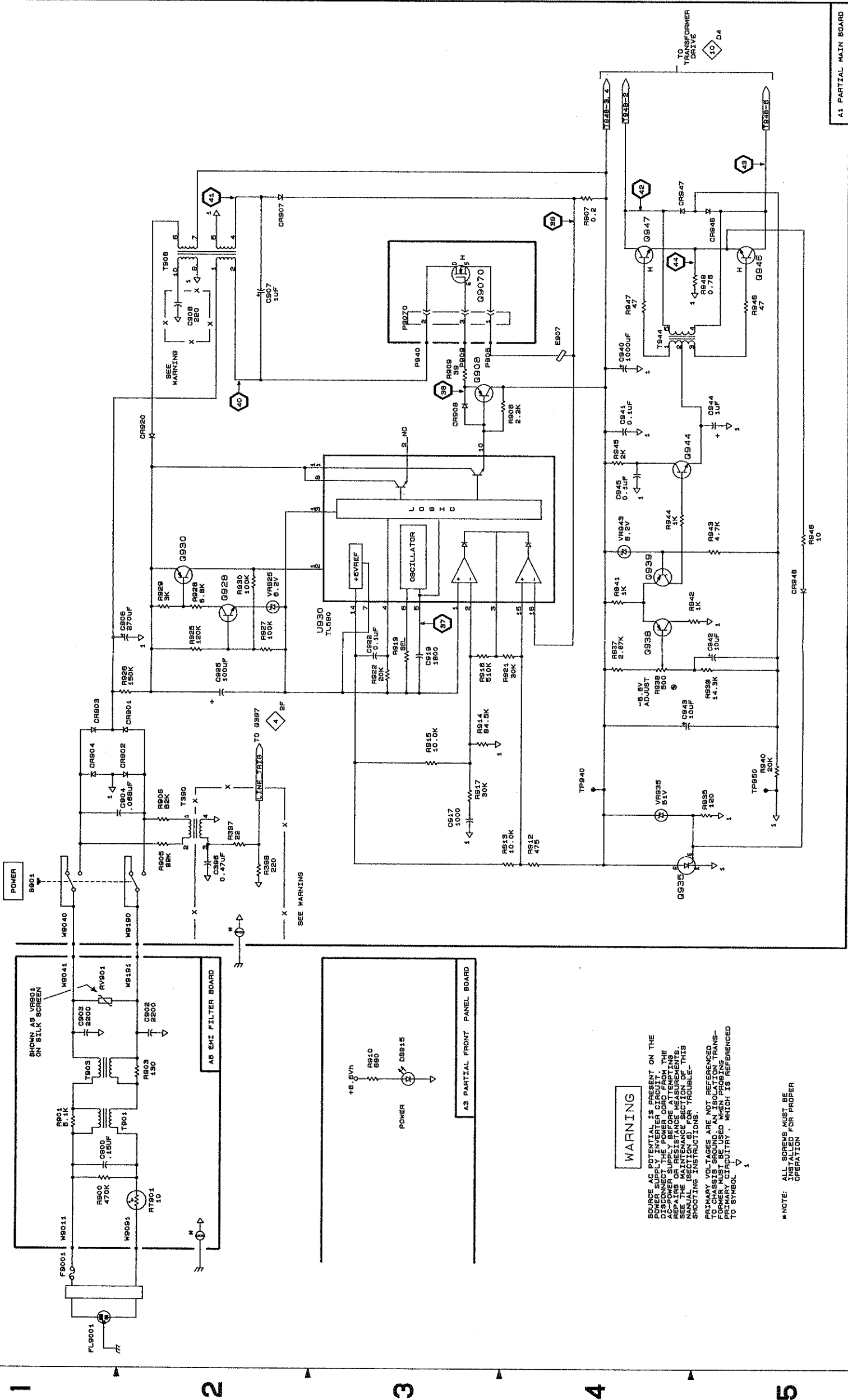


# POWER INPUT, PREREGULATOR, AND INVERTER DIAGRAM 9

| ASSEMBLY A1                                                           |                |                |                |                |                |                |                |                |                |                |                |
|-----------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER                                                        | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| C396                                                                  | 2C             | 4K             | CR948          | 5E             | 10M            | R912           | 4C             | 9L             | R946           | 5F             | 10L            |
| C904                                                                  | 1D             | 5M             |                |                |                | R913           | 3C             | 9M             |                |                |                |
| C906                                                                  | 1E             | 6L             | E907           | 4F             | 7K             | R914           | 3D             | 9L             | R947           | 4F             | 9L             |
| C907                                                                  | 2F             | 7M             |                |                |                | R915           | 3D             | 10L            | R948           | 5E             | 10N            |
| C908                                                                  | 2F             | 7M             | P908           | 3F             | 7L             | R916           | 3D             | 10M            | R949           | 4G             | 10L            |
| C917                                                                  | 3D             | 10L            | P909           | 3F             | 9L             | R917           | 3D             | 9L             |                |                |                |
| C919                                                                  | 3E             | 10L            | P940           | 3F             | 8L             | R919           | 3D             | 10M            | S901           | 1C             | 5M             |
| C922                                                                  | 3D             | 10L            |                |                |                | R921           | 3D             | 9M             |                |                |                |
| C925                                                                  | 2D             | 10L            | Q908           | 3F             | 9L             | R922           | 3D             | 10M            | T390           | 2D             | 6L             |
| C940                                                                  | 4F             | 8K             | Q928           | 2E             | 9M             | R925           | 2E             | 9M             | T906           | 2G             | 8L             |
| C941                                                                  | 4F             | 8K             | Q930           | 2E             | 9M             | R926           | 1D             | 9N             | T944           | 4F             | 9K             |
| C942                                                                  | 5D             | 10L            | Q935           | 4C             | 11M            | R927           | 2E             | 9M             |                |                |                |
| C943                                                                  | 4D             | 10L            | Q938           | 4E             | 10L            | R928           | 2E             | 9M             | TP940          | 4D             | 10M            |
| C945                                                                  | 2D             | 10M            | Q939           | 4E             | 10L            | R929           | 2E             | 9M             | TP950          | 5D             | 9L             |
| C944                                                                  | 5F             | 9L             | Q944           | 4E             | 10L            | R930           | 2E             | 9M             |                |                |                |
|                                                                       |                |                | Q946           | 5G             | 10K            | R935           | 5D             | 11M            | U930           | 3E             | 10M            |
| CR901                                                                 | 1D             | 6M             | Q947           | 4G             | 10K            | R937           | 4D             | 11L            |                |                |                |
| CR902                                                                 | 1D             | 6M             |                |                |                | R938           | 4D             | 11M            | VR925          | 2E             | 9M             |
| CR903                                                                 | 1D             | 6M             | R397           | 2C             | 6G             | R939           | 5D             | 11L            | VR935          | 4D             | 11M            |
| CR904                                                                 | 1D             | 6M             | R398           | 2C             | 6G             | R940           | 5D             | 10L            | VR943          | 4E             | 10L            |
| CR907                                                                 | 2G             | 8K             | R905           | 2C             | 5L             | R941           | 4E             | 10M            |                |                |                |
| CR908                                                                 | 3F             | 9L             | R906           | 2D             | 6L             | R942           | 4E             | 10L            | W9040          | 1C             | 6L             |
| CR920                                                                 | 2F             | 9M             | R907           | 4G             | 8K             | R943           | 5E             | 10L            | W9190          | 2C             | 6L             |
| CR946                                                                 | 5G             | 11K            | R908           | 3F             | 9L             | R944           | 4E             | 10M            |                |                |                |
| CR947                                                                 | 4G             | 10K            | R909           | 3F             | 9L             | R945           | 4F             | 10M            |                |                |                |
| Partial A1 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 10, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A3                                                           |                |                |                |                |                |                |                |                |                |                |                |
| DS915                                                                 | 4B             | 1A             | R910           | 3B             | 1C             |                |                |                |                |                |                |
| Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 10, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A6                                                           |                |                |                |                |                |                |                |                |                |                |                |
| C900                                                                  | 1B             | 1B             | R901           | 1B             | 2B             | RV901          | 1C             | 2A             | W9011          | 1A             | 1A             |
| C902                                                                  | 2B             | 3B             | R903           | 2B             | 2A             |                |                |                | W9041          | 1C             | 2A             |
| C903                                                                  | 1B             | 3A             |                |                |                | T901           | 1B             | 2B             | W9091          | 2A             | 2A             |
|                                                                       |                |                | RT901          | 2B             | 2A             | T903           | 1B             | 3B             | W9191          | 2C             | 2A             |
| R900                                                                  | 1B             | 2A             |                |                |                |                |                |                |                |                |                |
| OTHER PARTS                                                           |                |                |                |                |                |                |                |                |                |                |                |
| F9001                                                                 | 1A             | CHASSIS        | FL9001         | 1A             | CHASSIS        | Q9070          | 3F             | CHASSIS        |                |                |                |



A B C D E F G H

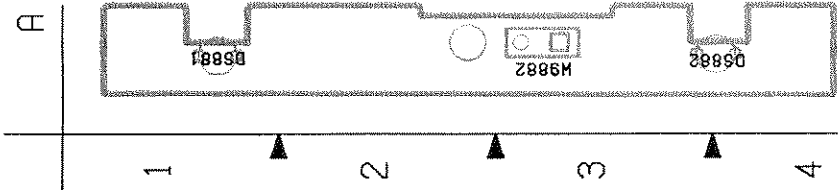


2235A POWER INPUT, PREREGULATOR, AND INVERTER 7683-08 A1 PARTIAL MAIN BOARD

2235A CONTROL SETTINGS

AC Waveforms

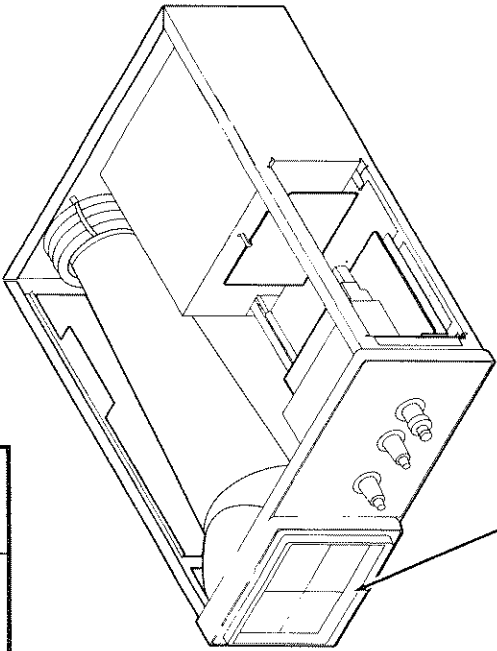
- Vertical MODECH 15mVDCALT50 μs5 μs5.0
- CH 1 VOLTS/DIVAC-GND-DCHorizontal MODEA SEC/DIVB SEC/DIVB DELAY TIME POSITIONB TRIGGER LEVELA TRIGGER ModeP-P AUTOCH 1NORM1-kHz sine wave, 5 div
- A & B SOURCEA SOURCECH 1 INPUT SIGNAL



(7685-69)7683-47

Figure 9-13. A7-Scale Illum board.

| A7—SCALE ILLUM BOARD |              |                |              |
|----------------------|--------------|----------------|--------------|
| CIRCUIT NUMBER       | SCHEM NUMBER | CIRCUIT NUMBER | SCHEM NUMBER |
| DS881                | 10           | W9882          | 10           |
| DS882                | 10           |                |              |



A10—SCALE ILLUM BOARD

Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

(4206-96)7683-48

# POWER SUPPLY SECONDARIES, Z AXIS, AND CRT DIAGRAM 10

| ASSEMBLY A1                                                          |                |                |                |                |                |                |                |                |                |                |                |
|----------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER                                                       | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| C824                                                                 | 1E             | 7F             | CR851          | 4F             | 5L             | Q845           | 1F             | 3M             | R871           | 2H             | 1K             |
| C825                                                                 | 1E             | 3L             | CR853          | 4F             | 5L             | Q882           | 4C             | 2B             | R872           | 3H             | 1K             |
| C828                                                                 | 2E             | 4L             | CR854          | 3F             | 7J             | Q885           | 2D             | 5K             | R873           | 3H             | 1K             |
| C832                                                                 | 1F             | 3L             | CR855          | 3F             | 7J             |                |                |                | R874           | 3H             | 1K             |
| C835                                                                 | 2F             | 4L             | CR882          | 4C             | 3B             | R583           | 2C             | 8F             | R875           | 3H             | 1K             |
| C845                                                                 | 2F             | 4M             | CR954          | 3D             | 9H             | R586           | 2C             | 8F             | R877           | 4H             | 1K             |
| C846                                                                 | 1F             | 3M             | CR955          | 4D             | 9H             | R804           | 2B             | 6E             | R880           | 4A             | 2B             |
| C847                                                                 | 1F             | 3M             | CR956          | 3D             | 9H             | R805           | 2B             | 6F             | R881           | 5C             | 5B             |
| C849                                                                 | 1F             | 4N             | CR957          | 4D             | 9H             | R814           | 2B             | 6E             | R883           | 5A             | 3C             |
| C851                                                                 | 4F             | 4L             | CR960          | 4D             | 9H             | R818           | 2C             | 7F             | R884           | 5B             | 3C             |
| C853                                                                 | 4F             | 7H             | CR961          | 5D             | 9H             | R820           | 2C             | 7F             | R885           | 2D             | 5K             |
| C854                                                                 | 4F             | 7J             | CR962          | 5E             | 9H             | R822           | 1C             | 3M             | R886           | 2D             | 5J             |
| C855                                                                 | 3F             | 7K             | CR963          | 5D             | 9H             | R823           | 1D             | 2M             | R887           | 4B             | 3B             |
| C871                                                                 | 2H             | 1L             | CR967          | 5D             | 9J             | R825           | 1E             | 4L             | R888           | 3B             | 2C             |
| C873                                                                 | 3H             | 1L             | CR970          | 5D             | 9J             | R826           | 1E             | 2M             | R889           | 4B             | 2C             |
| C875                                                                 | 4H             | 1K             |                |                |                | R828           | 2E             | 2K             | R890           | 3F             | 5H             |
| C877                                                                 | 4H             | 1L             | DS856          | 3F             | 7J             | R830           | 1E             | 3M             | R891           | 3B             | 2C             |
| C881                                                                 | 5B             | 4B             | DS858          | 3F             | 7J             | R832           | 1F             | 3M             | R893           | 4F             | 5H             |
| C882                                                                 | 4B             | 3B             | DS870          | 4E             | 7H             | R834           | 2F             | 4L             | R975           | 3E             | 6K             |
| C893                                                                 | 4F             | 6H             |                |                |                | R835           | 2E             | 4L             | R976           | 3E             | 6J             |
| C954                                                                 | 3E             | 8H             | J2700          | 5G             | 8G             | R836           | 2F             | 4L             | R978           | 3E             | 6J             |
| C956                                                                 | 4E             | 8H             | J9870B         | 2G             | 1L             | R840           | 2F             | 4L             |                |                |                |
| C957                                                                 | 4E             | 7H             | J9882          | 5C             | 3B             | R841           | 2F             | 4M             | T948           | 3D             | 8J             |
| C968                                                                 | 5E             | 9J             |                |                |                | R842           | 2F             | 4M             |                |                |                |
| C975                                                                 | 3E             | 6K             | L956           | 3E             | 7H             | R843           | 2F             | 4L             | TP842          | 2F             | 4L             |
| C976                                                                 | 3E             | 6K             |                |                |                | R844           | 1F             | 3M             |                |                |                |
| C979                                                                 | 3F             | 6J             | P870           | 5F             | 7H             | R845           | 1F             | 3M             | U882A          | 4B             | 3B             |
|                                                                      |                |                | P871           | 4E             | 7H             | R846           | 1F             | 3M             | U882B          | 4B             | 3B             |
|                                                                      |                |                |                |                |                | R849           | 1F             | 3M             | U975           | 3D             | 5J             |
| CR551                                                                | 2C             | 7F             |                |                |                | R851           | 4F             | 4M             |                |                |                |
| CR805                                                                | 2B             | 6F             | Q583           | 2C             | 8F             | R852           | 4F             | 4M             | VR828          | 2E             | 3L             |
| CR818                                                                | 2D             | 7F             | Q586           | 2C             | 8F             | R853           | 4F             | 7H             |                |                |                |
| CR820                                                                | 2D             | 7F             | Q804           | 2B             | 6F             | R854           | 4F             | 7J             | W262           | 3D             | 5B             |
| CR823                                                                | 1D             | 3L             | Q814           | 2B             | 6F             | R855           | 4F             | 4L             | W881           | 5C             | 5F             |
| CR824                                                                | 1E             | 2M             | Q825           | 1E             | 3L             | R858           | 3F             | 7J             | W885           | 2D             | 5J             |
| CR825                                                                | 1E             | 3M             | Q829           | 1F             | 3M             | R860           | 3F             | 7H             | W948           | 5E             | 9J             |
| CR829                                                                | 1E             | 3M             | Q835           | 2F             | 4M             | R870           | 2H             | 1K             | W9800          | 1B             | 4N             |
| CR840                                                                | 2F             | 4M             | Q840           | 2F             | 4M             |                |                |                | W9870          | 4G             | 6H             |
| CR845                                                                | 1F             | 3M             |                |                |                |                |                |                |                |                |                |
| Partial A1 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 9, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A3                                                          |                |                |                |                |                |                |                |                |                |                |                |
| J9006                                                                | 2H             | 1C             | R802B          | 2A             | 1C             | R983           | 2H             | 1C             | W90            | 5E             | 3B             |
| R800                                                                 | 1A             | 1C             | R810           | 1A             | 1C             |                |                |                | W91            | 5E             | 3B             |
| R802A                                                                | 2A             | 1C             | R882           | 3A             | 1B             | S390           | 2A             | 1B             |                |                |                |
|                                                                      |                |                | R982           | 2H             | 1C             |                |                |                |                |                |                |
| Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 9, and 11. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A7                                                          |                |                |                |                |                |                |                |                |                |                |                |
| DS881                                                                | 5C             | 1A             | DS882          | 5D             | 4A             | W9882          | 5C             | 3A             |                |                |                |
| OTHER PARTS                                                          |                |                |                |                |                |                |                |                |                |                |                |
| B1                                                                   | 5G             | CHASSIS        | J9800          | 1B             | CHASSIS        | V9870          | 2G             | CHASSIS        |                |                |                |





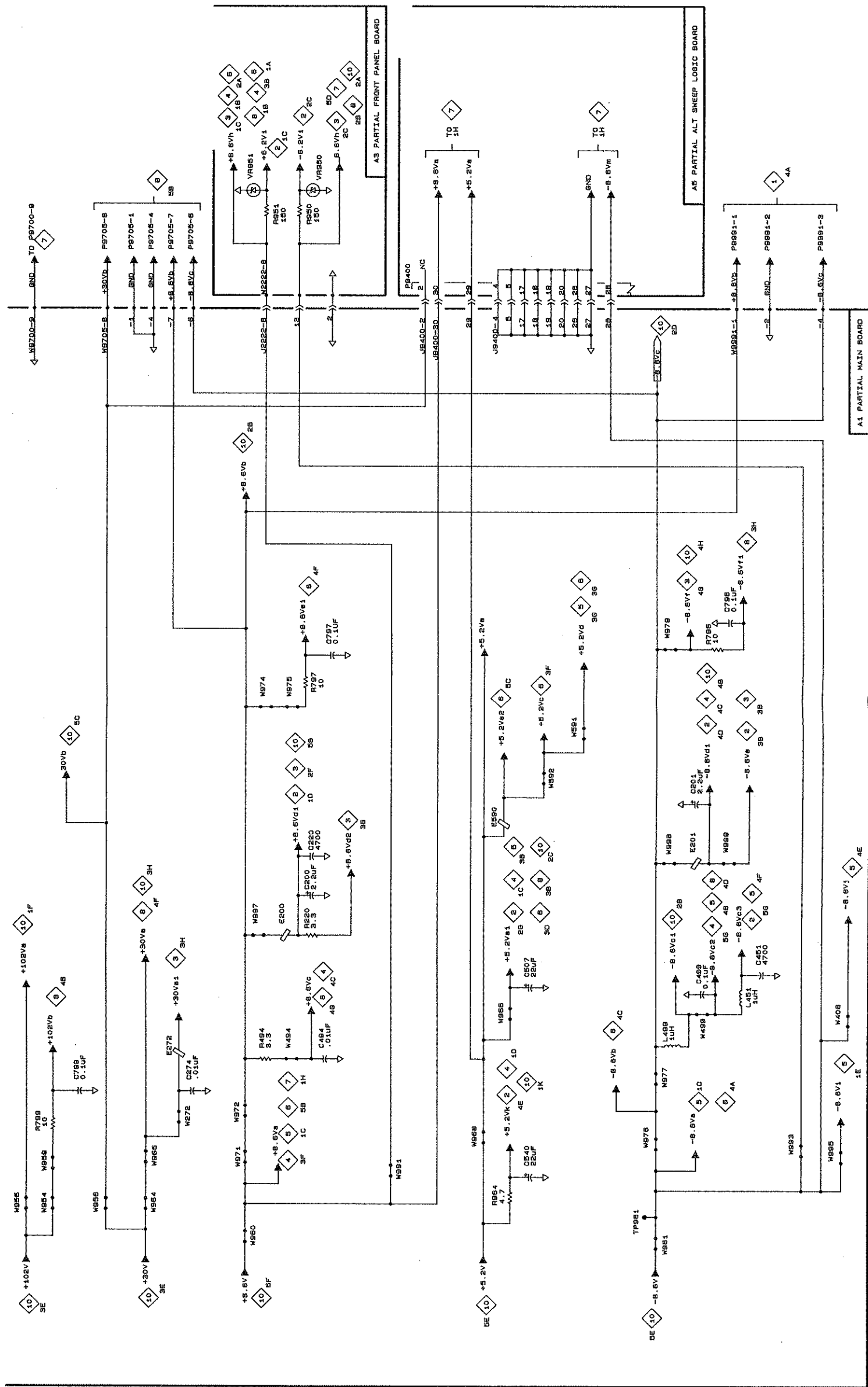


# POWER DISTRIBUTION DIAGRAM 11

| ASSEMBLY A1                                                          |                |                |                |                |                |                |                |                |                |                |                |
|----------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| CIRCUIT NUMBER                                                       | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
| C200                                                                 | 2D             | 4F             | J2400          | 2B             | 10F            | W408           | 5C             | 9B             | W968           | 3C             | 10G            |
| C201                                                                 | 4E             | 4F             | J8400          | 3G             | 7G             | W494           | 2C             | 6E             | W971           | 2C             | 9F             |
| C220                                                                 | 3D             | 2E             |                |                |                | W499           | 4D             | 7E             | W972           | 2C             | 7F             |
| C274                                                                 | 2C             | 2J             | L451           | 5C             | 7E             | W591           | 4E             | 9E             | W974           | 2E             | 3L             |
| C451                                                                 | 5D             | 8E             | L499           | 4C             | 6F             | W592           | 4E             | 10F            | W975           | 2E             | 3K             |
| C494                                                                 | 3C             | 6E             |                |                |                | W594           | 1C             | 7G             | W976           | 4C             | 9G             |
| C499                                                                 | 4D             | 6D             | R220           | 2D             | 2E             | W855           | 1C             | 4L             | W977           | 4C             | 7G             |
| C507                                                                 | 4D             | 7C             | R494           | 2C             | 7F             | W955           | 5C             | 4L             | W979           | 4E             | 3K             |
| C540                                                                 | 4C             | 2L             | R796           | 4E             | 3J             | W956           | 2C             | 6G             | W991           | 3C             | 7B             |
| C796                                                                 | 5F             | 3J             | R797           | 2E             | 3J             | W957           | 2B             | 9G             | W993           | 5C             | 7C             |
| C797                                                                 | 3E             | 3J             | R799           | 1C             | 4G             | W959           | 1C             | 5G             | W995           | 5C             | 9B             |
| C799                                                                 | 1C             | 4G             | R964           | 3C             | 4L             | W980           | 2B             | 10G            | W997           | 2D             | 5F             |
|                                                                      |                |                |                |                |                | W961           | 4B             | 10G            | W998           | 4D             | 5F             |
| E200                                                                 | 2D             | 5F             | TP961          | 4B             | 10F            | W964           | 2C             | 4L             | W999           | 5D             | 3F             |
| E201                                                                 | 4D             | 5F             |                |                |                | W965           | 1C             | 3K             | W9705          | 2G             | 7F             |
| E272                                                                 | 2C             | 2J             | W272           | 2C             | 1J             | W965           | 2C             | 3K             | W9991          | 5G             | 7F             |
| E590                                                                 | 3D             | 10D            |                |                |                | W966           | 3D             | 9F             |                |                |                |
| Partial A1 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 9, AND 10. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A3                                                          |                |                |                |                |                |                |                |                |                |                |                |
| R950                                                                 | 2H             | 5D             | R951           | 2H             | 6D             | VR950          | 2H             | 5D             | VR951          | 2H             | 7D             |
| Partial A3 also shown on diagrams 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. |                |                |                |                |                |                |                |                |                |                |                |
| ASSEMBLY A5                                                          |                |                |                |                |                |                |                |                |                |                |                |
| P9400A                                                               | 3G             | 2A             | P9400B         | 3G             | 4A             |                |                |                |                |                |                |
| Partial A4 also shown on diagram 7.                                  |                |                |                |                |                |                |                |                |                |                |                |



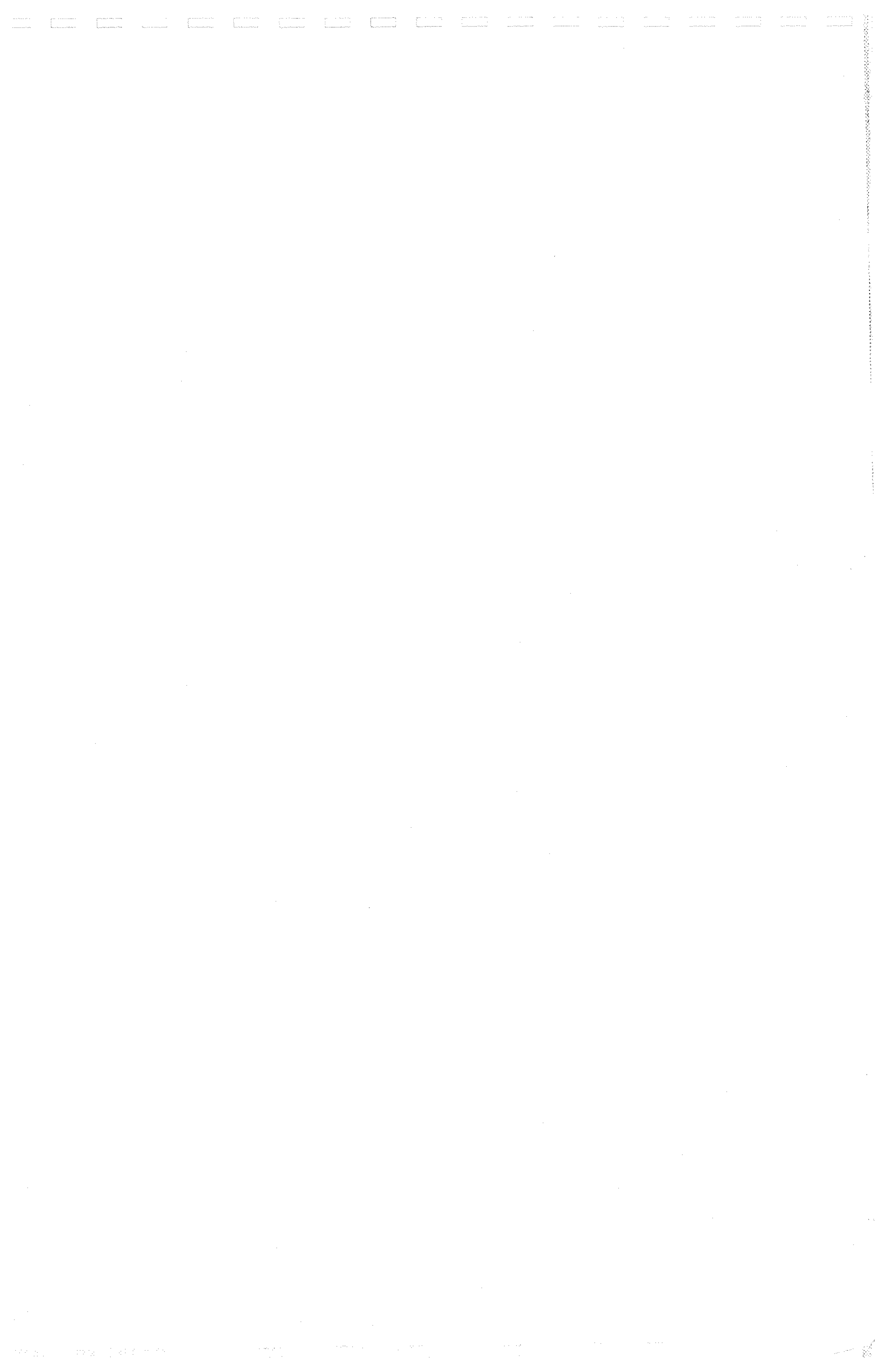
A B C D E F G H



POWER DISTRIBUTION

7689-11

2235A



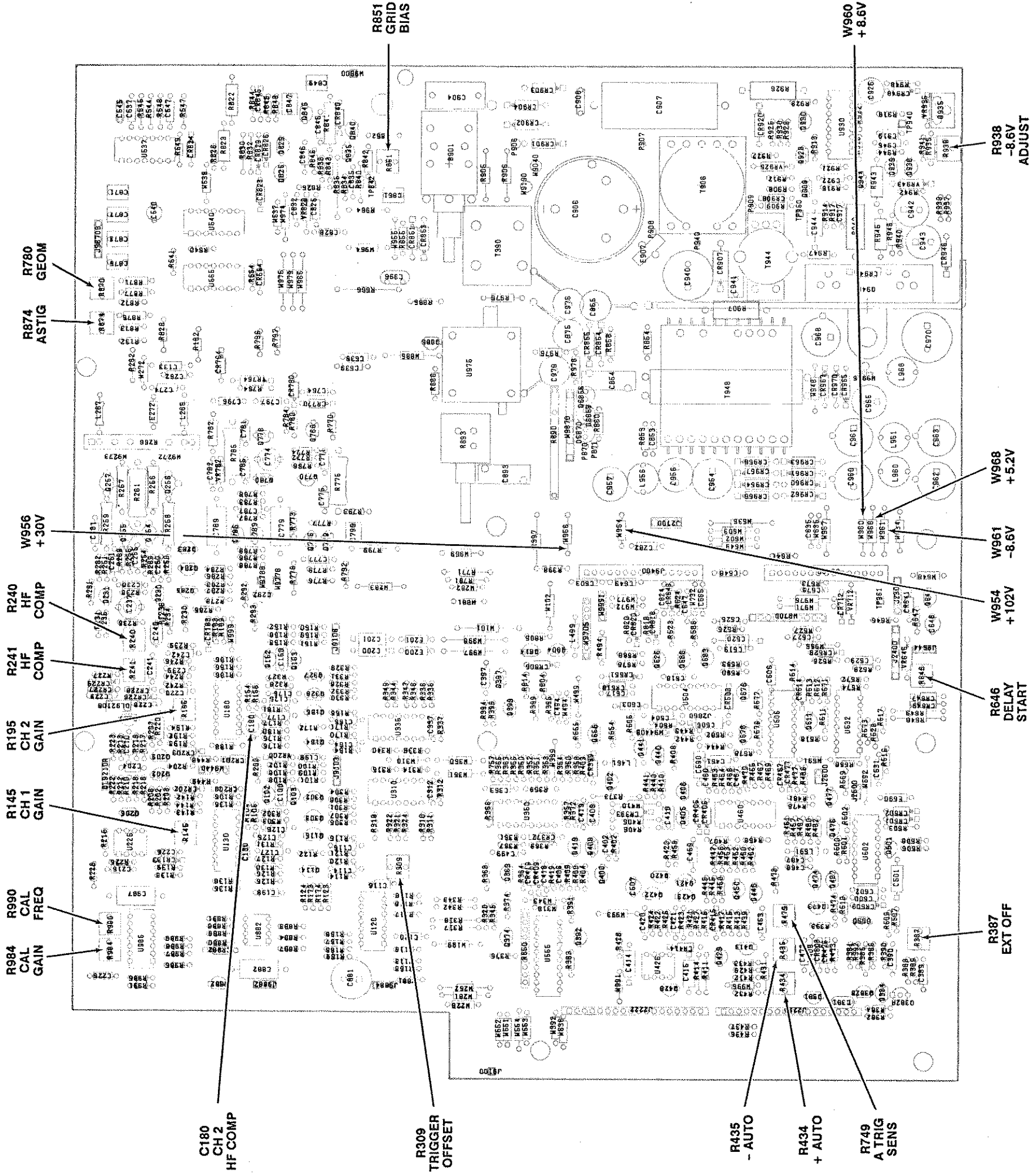
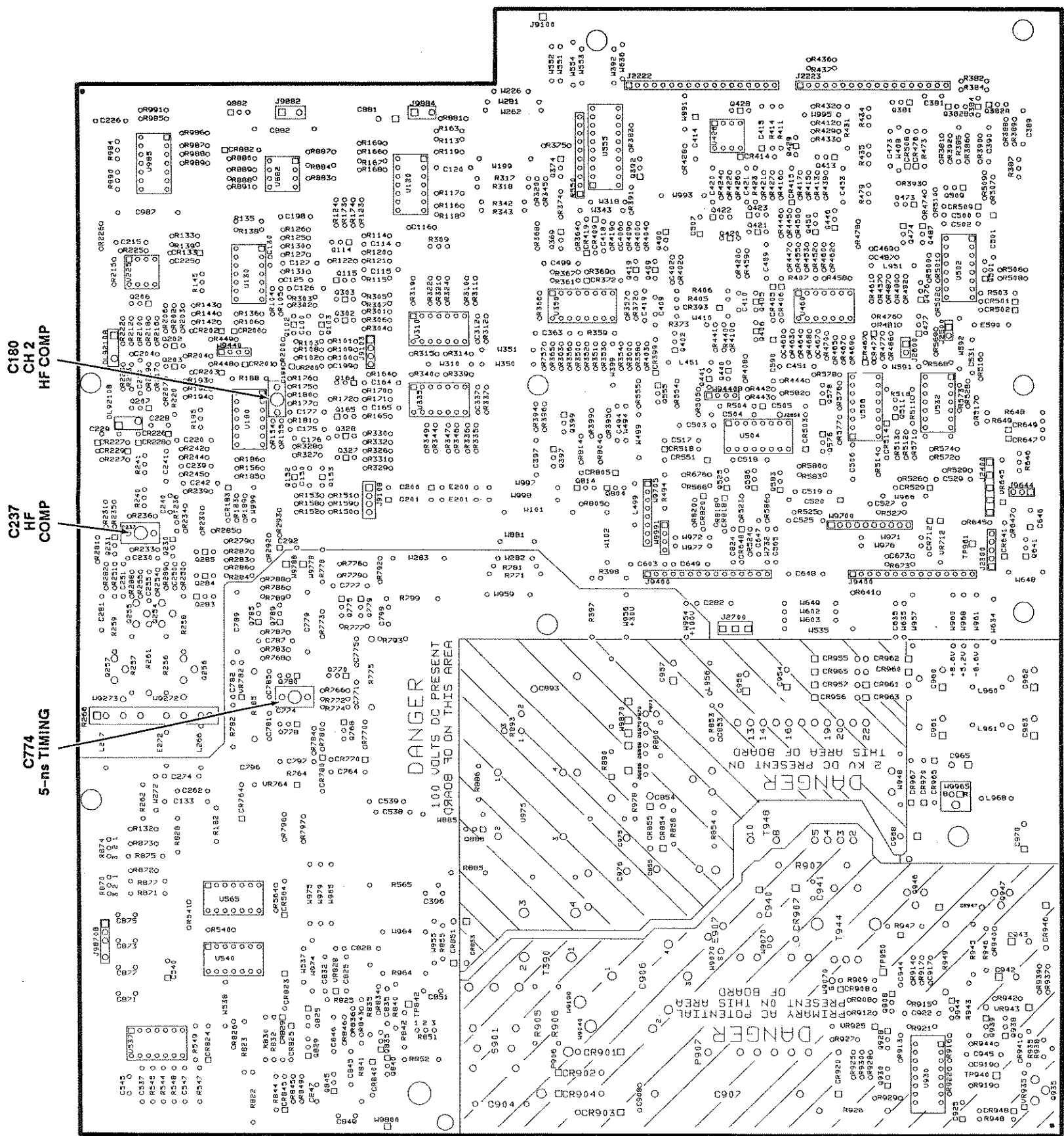


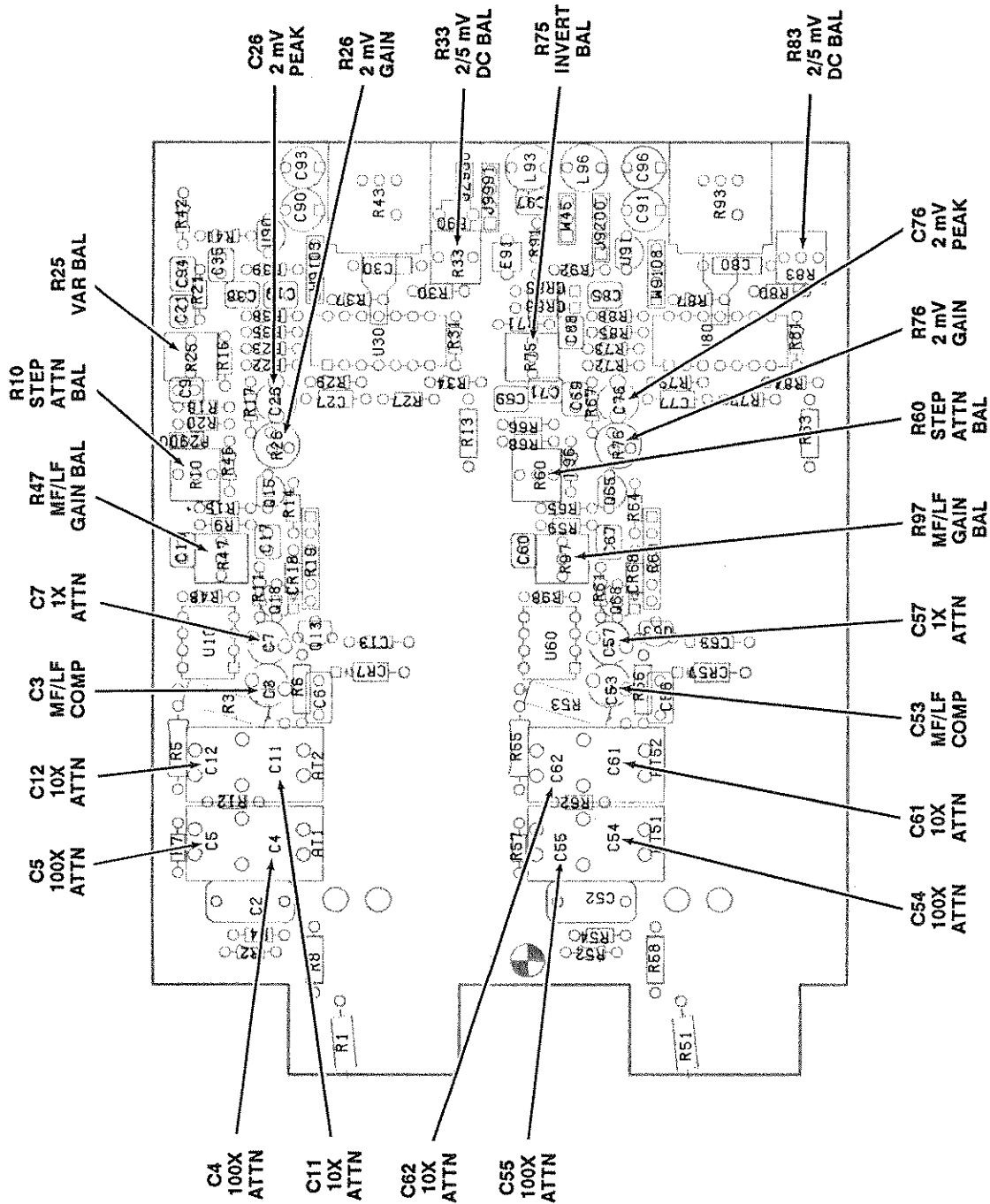
Figure 9-14. A1 - Main board component view adjustment locations.





**Figure 9-15. Main board circuit view adjustment locations.**





(7685-78)7683-51

Figure 9-16. A2 - Attenuator board adjustment locations.







## GENERAL NOTES

- Use schematic diagrams, the overall block diagram, circuit board illustrations, and circuit descriptions when analyzing instrument malfunctions and locating test points. The schematic diagrams include typical waveforms and voltages that are intended as an aid in troubleshooting.
- Always set the POWER switch to OFF and unplug the line cord before swapping, removing, or replacing components, and before connecting or disconnecting instrument leads and cables.
- When analyzing circuit malfunctions, consider connectors and cables as possible causes of failure.

## SPECIFIC NOTES

- Set initial front-panel controls as follows:

|                          | POWER         | ON (button in) |
|--------------------------|---------------|----------------|
| A INTENSITY              | Midrange      | Midrange       |
| FOCUS                    | Midrange      | Midrange       |
| Vertical POSITION        | Midrange      | Midrange       |
| Vertical MODE            | CH 1          | CH 1           |
| CH 1 VOLTS/DIV           | 0.1 V         | 0.1 V          |
| CH 1 VOLTS/DIV Variable  | CAL detent    | CAL detent     |
| Channel 1 Input Coupling | GND           | GND            |
| Horizontal POSITION      | Midrange      | Midrange       |
| Horizontal MODE          | A             | A              |
| A SEC/DIV                | 0.1 ms        | 0.1 ms         |
| A SEC/DIV Variable       | CAL detent    | CAL detent     |
| X10 Magnifier            | Off (knob in) | Off (knob in)  |
| A TRIGGER Mode           | P-P AUTO      | P-P AUTO       |
| A & B SOURCE             | VERT MODE     | VERT MODE      |
| A COUPL                  | NORM          | NORM           |

- Verify the low-voltage power supplies at the following test points:

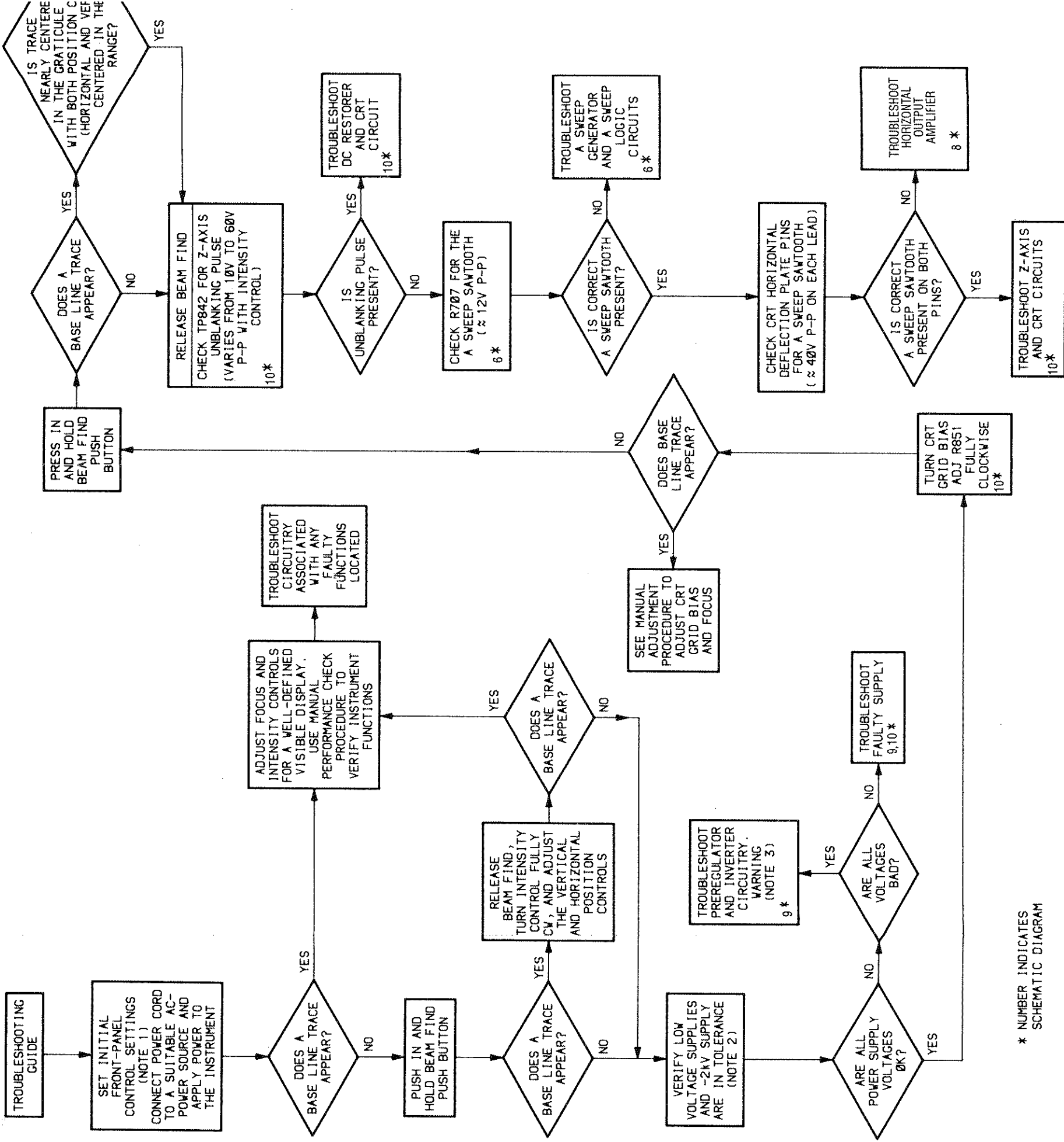
| SUPPLY | TEST POINT | TOLERANCE          |
|--------|------------|--------------------|
| -8.2 V | W961       | -8.56 V to -8.64 V |
| +5.2 V | W968       | 5.04 V to 5.35 V   |
| +8.6 V | W960       | 8.43 V to 8.77 V   |
| +30 V  | W956       | +29.1 V to 30.9 V  |
| +102 V | W954       | +99 V to 105 V     |

### NOTE

A HV probe is required to measure the -2kV supply. Turn off the power and make the test equipment connections to the oscilloscope. Set the voltmeter to read at least -3kV, then turn the oscilloscope power back on to take the reading. After obtaining the reading, turn off the oscilloscope power to disconnect the test equipment connections, and replace the crt socket cover. Verify the -2kV supply at pin 2 of the crt socket. The voltage should be between -1900 and -2100V.

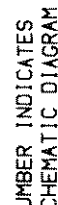
### WARNING

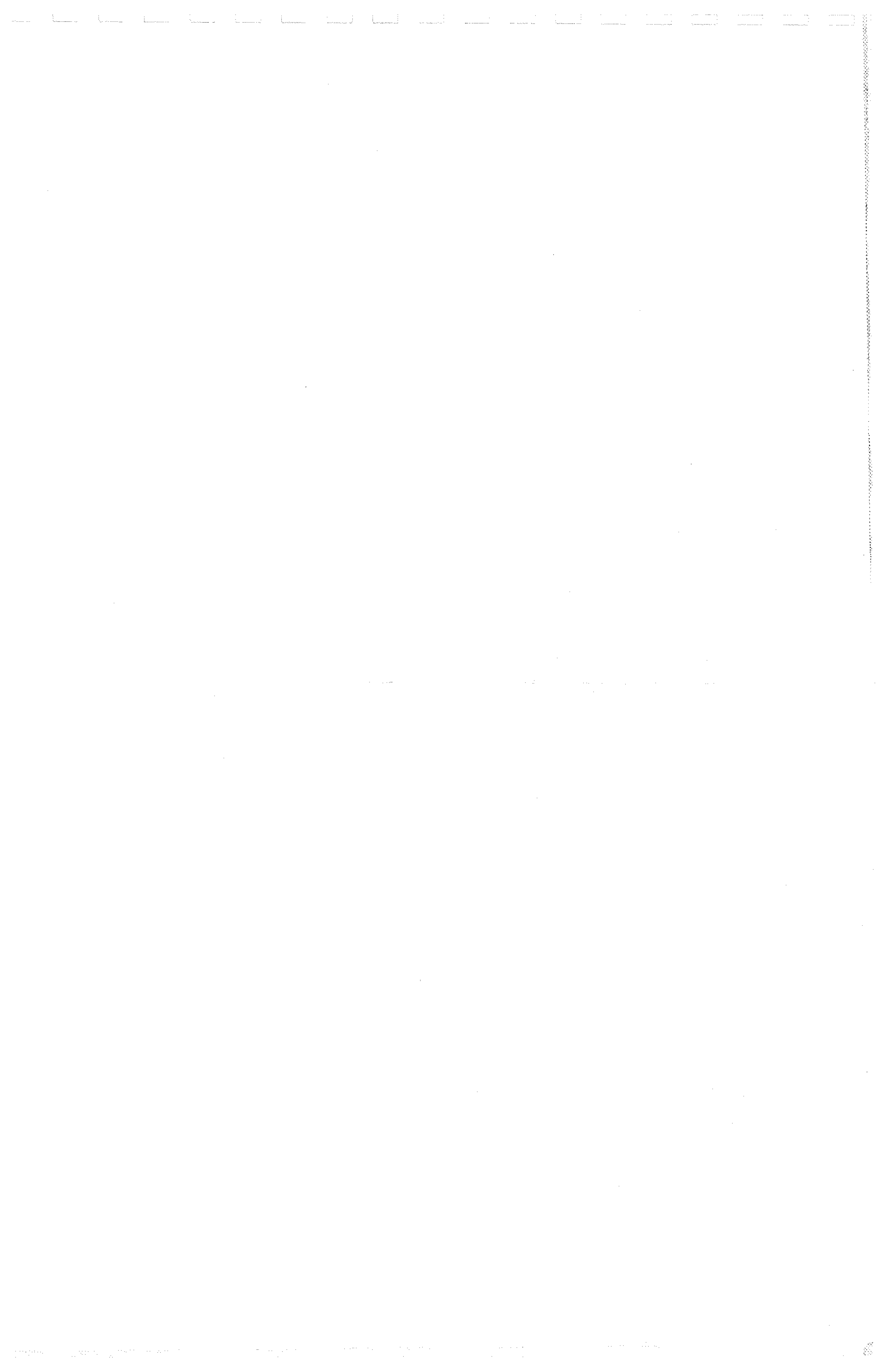
The preregulator and inverter circuits have a floating common reference with respect to chassis ground. Ac-source potential is present on the common reference points. Connect the instrument to the ac-power source through an isolation transformer to prevent the possibility of personal injury or equipment damage when troubleshooting these circuits.



\* NUMBER INDICATES SCHEMATIC DIAGRAM







## 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.

### 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.

### 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 | <i>Name &amp; Description</i> |
|-----------|-------------------------------|

*Assembly and/or Component*

*Attaching parts for Assembly and/or Component*

*END ATTACHING PARTS*

*Detail Part of Assembly and/or Component*

*Attaching parts for Detail Part*

*END ATTACHING PARTS*

*Parts of Detail Part*

*Attaching parts for Parts of Detail Part*

*END ATTACHING PARTS*

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.

**Attaching parts must be purchased separately, unless otherwise specified.**

### ABBREVIATIONS

Abbreviations conform to American National Standards Institute Y1.1

## CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer                                                         | Address                              | City, State, Zip Code      |
|-----------|----------------------------------------------------------------------|--------------------------------------|----------------------------|
| 01536     | TEXTRON INC<br>CAMCAR DIV<br>SEMS PRODUCTS UNIT                      | 1818 CHRISTINA ST                    | ROCKFORD IL 61108          |
| 02768     | ILLINOIS TOOL WORKS INC<br>FASTEX DIVISION                           | 195 ALGONQUIN ROAD                   | DES PLAINES IL 60016-6103  |
| 05129     | KILO ENGINEERING CO                                                  | 2118 D ST                            | LA VERNE CA 91750-5422     |
| 06383     | PANDUIT CORP                                                         | 17301 RIDGELAND                      | TINLEY PARK IL 07094-2917  |
| 06915     | RICHCO PLASTIC CO                                                    | 5825 N TRIPP AVE                     | CHICAGO IL 60646-6013      |
| 07416     | NELSON NAME PLATE CO                                                 | 3191 CASITAS                         | LOS ANGELES CA 90039-2410  |
| 0J260     | COMTEK MANUFACTURING OF OREGON<br>(METALS)                           | PO BOX 4200                          | BEAVERTON OR 97076-4200    |
| 12327     | FREEWAY CORP                                                         | 9301 ALLEN DR                        | CLEVELAND OH 44125-4632    |
| 13511     | AMPHENOL CADRE<br>DIV BUNKER RAMO CORP                               |                                      | LOS GATOS CA               |
| 22670     | G M NAMEPLATE INC                                                    | 2040 15TH AVE WEST                   | SEATTLE WA 98119-2728      |
| 23740     | AMUNEAL MFG CORP                                                     | 4737 DARRAH                          | PHILADELPHIA PA 19124-2705 |
| 24931     | SPECIALTY CONNECTOR CO INC                                           | 2100 EARLYWOOD DR<br>PO BOX 547      | FRANKLIN IN 46131          |
| 70903     | COOPER BELDEN ELECTRONICS WIRE AND C<br>SUB OF COOPER INDUSTRIES INC | 2000 S BATAVIA AVE                   | GENEVA IL 60134-3325       |
| 71400     | BUSSMANN<br>DIV OF COOPER INDUSTRIES INC                             | 114 OLD STATE RD<br>PO BOX 14460     | ST LOUIS MO 63178          |
| 73743     | FISCHER SPECIAL MFG CO                                               | 111 INDUSTRIAL RD                    | COLD SPRING KY 41076-9749  |
| 78189     | ILLINOIS TOOL WORKS INC<br>SHAKEPROOF DIV                            | ST CHARLES ROAD                      | ELGIN IL 60120             |
| 80009     | TEKTRONIX INC                                                        | 14150 SW KARL BRAUN DR<br>PO BOX 500 | BEAVERTON OR 97077-0001    |
| 83385     | MICRODOT MFG INC<br>GREER-CENTRAL DIV                                | 3221 W BIG BEAVER RD                 | TROY MI 48098              |
| 83486     | ELCO INDUSTRIES INC                                                  | 1101 SAMUELSON RD                    | ROCKFORD IL 61101          |
| 86113     | MICRODOT MFG INC<br>CENTRAL SCREW-KEENE DIV                          | 149 EMERALD ST                       | KEENE NH 03431-3628        |
| 86928     | SEASTROM MFG CO INC                                                  | 701 SONORA AVE                       | GLENDALE CA 91201-2431     |
| 93907     | TEXTRON INC<br>CAMCAR DIV                                            | 600 18TH AVE                         | ROCKFORD IL 61108-5181     |
| S3109     | FELLER                                                               | 72 Veronica Ave<br>Unit 4            | Summerset NJ 08873         |
| S3629     | SCHURTER AG H<br>C/O PANEL COMPONENTS CORP                           | 2015 SECOND STREET                   | BERKELEY CA 94170          |
| TK0174    | BADGLEY MFG CO                                                       | 1620 NE ARGYLE                       | PORTLAND OR 97211          |
| TK0858    | STAUFFER SUPPLY CO (DIST)                                            | 810 SE SHERMAN                       | PORTLAND OR 97214          |
| TK0861    | H SCHURTER AG DIST PANEL COMPONENTS                                  | 2015 SECOND STREET                   | BERKELEY CA 94170          |
| TK1154    | COMPLEX TOOLING INC                                                  | 4635 NAUTILUS COURT SOUTH            | BOULDER CO 80301           |
| TK1285    | GEROME MFG CO INC                                                    | PO BOX 737                           | NEWBURG OR 97132           |
| TK1287    | ENOCH MFG CO                                                         | 14242 SE 82ND DR<br>PO BOX 98        | CLACKAMAS OR 97015         |
| TK1319    | MORELLIS Q & D PLASTICS                                              | 1812 16-TH AVE                       | FOREST GROVE OR 97116      |
| TK1336    | PARSONS MFG CORP                                                     | 1055 OBRIEN                          | MENLO PARK CA 94025        |
| TK1544    | COMPUTER CONNECTIONS                                                 | 30608 SAN ANTONIO ST                 | HAYWARD CA 94544           |
| TK1570    | HERD MFG                                                             | 9227 CLINTON RD                      | CLEVELAND OH 44144         |
| TK1935    | ACCRA FAB INC                                                        | 11007 NE 37TH CIRCLE                 | VANCOUVER WA 98682         |
| TK2165    | TRIQUEST CORP                                                        | 3000 LEWIS AND CLARK HWY             | VANCOUVER WA 98661-2999    |
| TK2278    | COMTEK MANUFACTURING OF OREGON<br>(METALS)                           | PO BOX 4200                          | BEAVERTON OR 97076-4200    |

| Fig. &<br>Index<br>No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discnt | Qty | 12345    Name & Description                                                   | Mfr.<br>Code | Mfr. Part No.  |
|------------------------|-----------------------|--------------------------------------------|-----|-------------------------------------------------------------------------------|--------------|----------------|
| 1-1                    | 334-5001-06           |                                            | 1   | MARKER, IDENT: MKD CAUTION                                                    | 80009        | 334-5001-06    |
| -2                     | 200-3153-06           |                                            | 1   | COVER, REAR ASSY: W/LABELS                                                    | 80009        | 200-3153-06    |
| -3                     | 343-1278-00           |                                            | 2   | RTNR, POWER CORD: POLYCARBONATE GRAY<br>(ATTACHING PARTS)                     | TK2165       | ORDER BY DESCR |
| -4                     | 211-0712-00           |                                            | 2   | SCR, ASSEM WSHR: 6-32 X 1.25, PNH, STL, TORX<br>(END ATTACHING PARTS)         | 01536        | ORDER BY DESCR |
| -5                     | 211-0722-00           |                                            | 1   | SCREW, MACHINE: 6-32 X 0.25, PNH, STL                                         | 80009        | 211-0722-00    |
| -6                     | 334-7801-00           |                                            | 1   | MARKER, IDENT: MKD 2235A                                                      | 80009        | 334-7801-00    |
| -7                     | 367-0289-00           |                                            | 1   | HANDLE, CARRYING: 13.855, SST<br>(ATTACHING PARTS)                            | 80009        | 367-0289-00    |
| -8                     | 212-0144-00           |                                            | 2   | SCREW, TPG, TF: 8-16 X 0.562 L, PLASTITE, SPCL<br>HD<br>(END ATTACHING PARTS) | 93907        | 225-38131-012  |
| -9                     | 211-0325-00           |                                            | 1   | SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9                               | 01536        | ORDER BY DESCR |
| -10                    | 390-0790-00           |                                            | 1   | CABINET, SCOPE:                                                               | TK1935       | ORDER BY DESCR |
| -11                    | 348-0659-00           |                                            | 2   | FOOT, CABINET: BLACK POLYURETHANE                                             | TK2165       | ORDER BY DESCR |



FIG. 1 CABINET

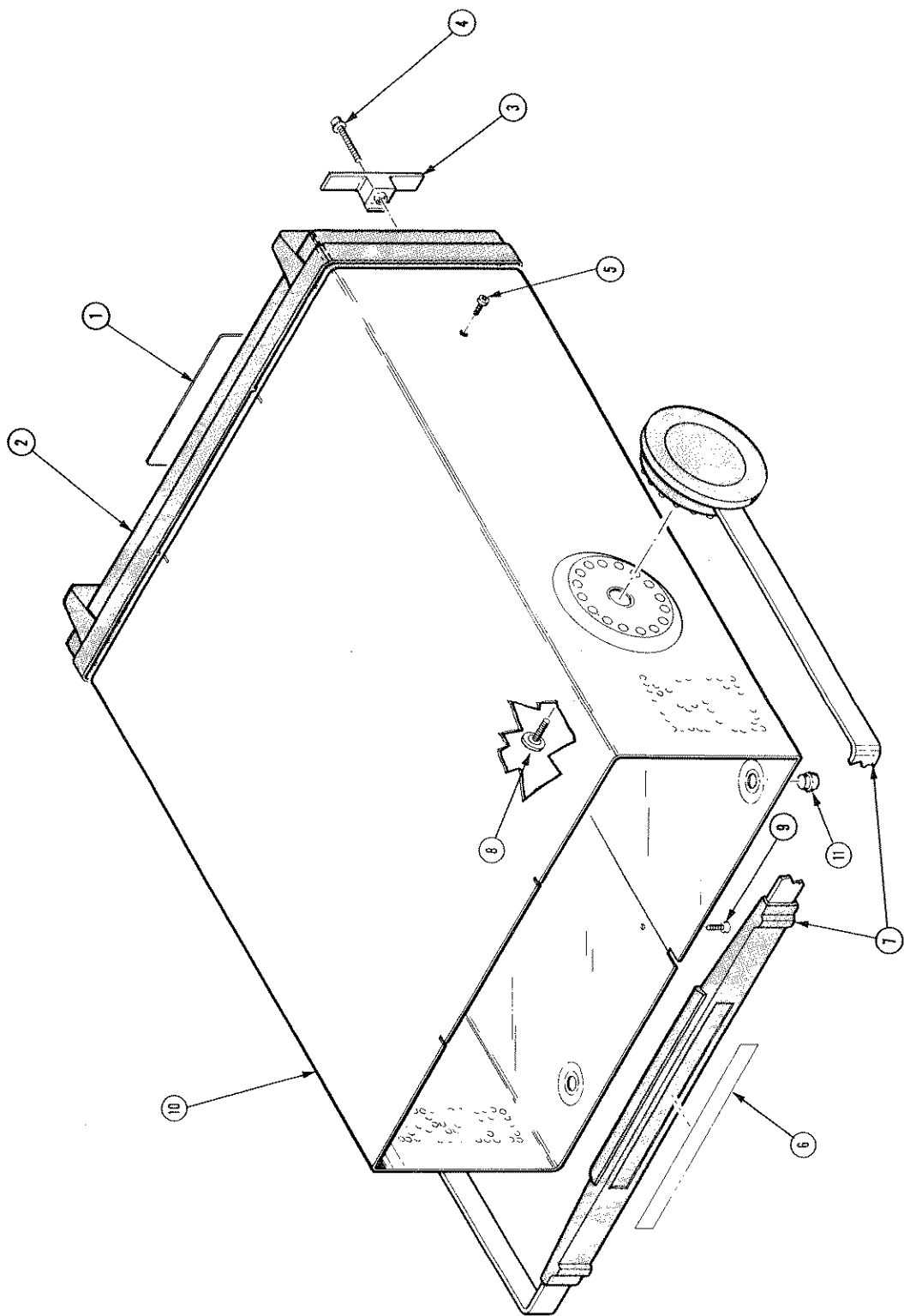
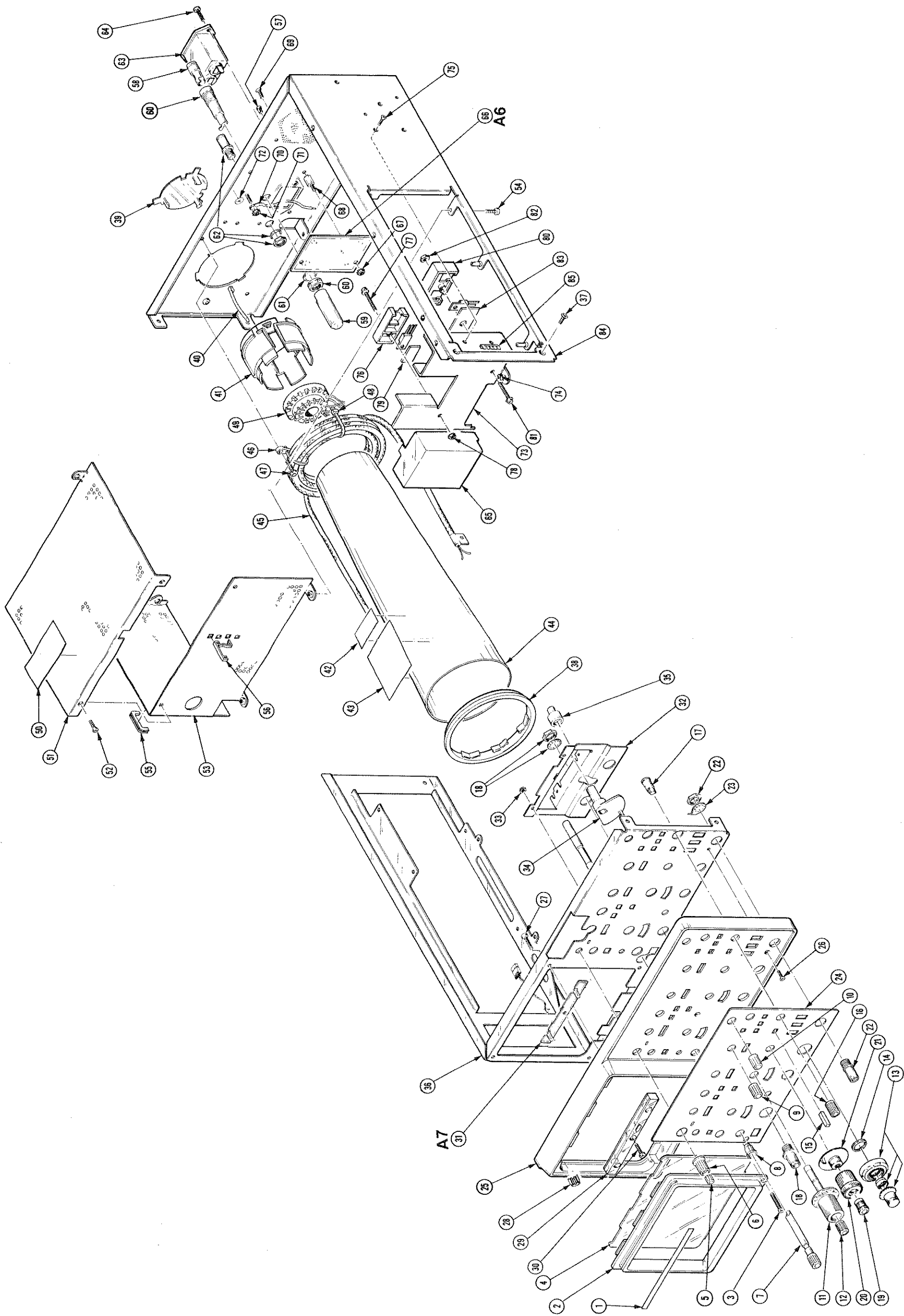


FIG. 2 LEFT & RIGHT SIDES



| Fig. &<br>Index<br>No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Dscont | Qty | 12345    Name & Description                                                 | Mfr.<br>Code | Mfr. Part No.  |
|------------------------|-----------------------|--------------------------------------------|-----|-----------------------------------------------------------------------------|--------------|----------------|
| 2-1                    | 334-7726-00           |                                            | 1   | MARKER, IDENT: MKD BEZEL                                                    | 80009        | 334-7726-00    |
| -2                     | 426-1765-02           |                                            | 1   | FRAME, CRT: POLYCARBONATE, GRAY<br>(ATTACHING PARTS)                        | TK2165       | ORDER BY DESCR |
| -3                     | 211-0690-01           |                                            | 2   | SCREW, MACHINE: 6-32 X 0.875 PNH, SST<br>(END ATTACHING PARTS)              | 86113        | ORDER BY DESCR |
| -4                     | 337-2775-00           |                                            | 1   | SHLD, IMPLSION: FILTER, BLUE 2211/2213/2215                                 | 80009        | 337-2775-00    |
| -5                     | 366-1391-04           |                                            | 1   | KNOB: GRAY, 0.3 OD X 0.14 ID X 0.32 H                                       | TK2165       | 366-1391-04    |
| -6                     | 366-1879-01           |                                            | 1   | KNOB: GRAY 0.5 OD X 0.531 H PLSTC                                           | 80009        | 366-1879-01    |
| -7                     | 384-1575-00           |                                            | 1   | EXTENSION SHAFT: 8.805 L, W/KNOB, PLASTIC                                   | 80009        | 384-1575-00    |
| -8                     | 358-0550-00           |                                            | 1   | BUSHING, SHAFT: 0.15 ID X 0.488 L, PLSTC                                    | TK2165       | ORDER BY DESCR |
| -9                     | 366-1146-00           |                                            | 2   | KNOB: GY, 0.127 ID X 0.392 OD X 0.466 H                                     | 80009        | 366-1146-00    |
| -10                    | 366-1146-00           |                                            | 2   | KNOB: GY, 0.127 ID X 0.392 OD X 0.466 H                                     | 80009        | 366-1146-00    |
| -11                    | 366-2148-01           |                                            | 2   | KNOB: GY, VOLTS/DIV, 0.72 OD, 0.79 HW/0.25 DIA<br>SHAFT & SKIRT             | 80009        | 366-2148-01    |
| -12                    | 366-0575-00           |                                            | 2   | KNOB: GRAY, CAL, 0.127 ID X 0.392 OD X 0.4 H                                | TK2165       | ORDER BY DESCR |
| -13                    | 331-0328-00           |                                            | 1   | DIAL, CONTROL: 10 TURN, 0.0 TO 9.99                                         | 05129        | 461-5-70       |
| -14                    | 210-0840-00           |                                            | 1   | WASHER, FLAT: 0.39 ID X 0.562 OD X 0.02, STL                                | 86928        | ORDER BY DESCR |
| -15                    | 366-0573-00           |                                            | 9   | PUSH BUTTON: IVORY GY, 0.186 SQ X 0.48 H                                    | TK2165       | ORDER BY DESCR |
| -16                    | 366-2049-01           |                                            | 6   | KNOB: GY, 0.172 ID X 0.41 OD X 0.496 H W/BAR                                | 80009        | 366-2049-01    |
| -17                    | 377-0512-03           |                                            | 6   | INSERT, KNOB: 0.128 ID X 0.37 OD X 0.67 L, XL                               | 80009        | 377-0512-03    |
| -18                    | 131-0126-00           |                                            | 2   | CONN, RCPT, ELEC: BNC, FEMALE                                               | 24931        | 28JR205-2      |
| -19                    | 366-0576-00           |                                            | 1   | KNOB: MED GRAY, CAL, 0.083 ID X 0.45 OD X<br>0.456 H                        | TK2165       | ORDER BY DESCR |
| -20                    | 366-1840-04           |                                            | 1   | KNOB: GY, TIME/DIV, 0.127 ID X 0.855 OD X<br>0.844 H                        | 80009        | 366-1840-04    |
| -21                    | 366-1850-00           |                                            | 1   | KNOB: CLEAR, 0.252 ID X 1.2 OD X 0.383 H                                    | 80009        | 366-1850-00    |
| -22                    | 131-0955-00           |                                            | 1   | CONN, RCPT, ELEC: BNC, FEMALE                                               | 13511        | 31-279         |
| -23                    | 210-0255-00           |                                            | 1   | TERMINAL, LUG: 0.391 ID, LOCKING, BRS CD PL                                 | 12327        | ORDER BY DESCR |
| -24                    | 333-3780-00           |                                            | 1   | PANEL, FRONT:                                                               | 07416        | ORDER BY DESCR |
| -25                    | 386-4850-04           |                                            | 1   | SUBPANEL, FRONT:<br>(ATTACHING PARTS)                                       | TK2165       | ORDER BY DESCR |
| -26                    | 213-0881-00           |                                            | 3   | SCREW, TPG, TR: 6-32 X 0.25 TYPE TT, FILH, STL                              | 83385        | ORDER BY DESCR |
| -27                    | 213-0882-00           |                                            | 2   | SCREW, TPG, TR: 6-32 X 0.437 TAPTITE, PNH, STL<br>(END ATTACHING PARTS)     | 83385        | ORDER BY DESCR |
| -28                    | 348-0660-00           |                                            | 4   | CUSHION, CRT: POLYURETHANE                                                  | 80009        | 348-0660-00    |
| -29                    | 378-0877-02           |                                            | 1   | REFLECTOR, LIGHT: PLASTIC<br>(ATTACHING PARTS)                              | 80009        | 378-0877-02    |
| -30                    | 213-0914-00           |                                            | 1   | SCREW, TPG, TR: 6-32 X 0.75, FLH, 100 DEG, STL<br>(END ATTACHING PARTS)     | 83385        | ORDER BY DESCR |
| -31                    | -----                 |                                            | 1   | SCALE ILLUM BOARD ASSY(SEE A7 REPL)                                         |              |                |
| -32                    | 407-3217-02           |                                            | 1   | BACKET, GROUND: ALUMINUM<br>(ATTACHING PARTS)                               | TK1570       | ORDER BY DESCR |
| -33                    | 210-0586-00           |                                            | 2   | NUT, PL, ASSEM WA: 4-40 X 0.25, STL CD PL<br>(END ATTACHING PARTS)          | 78189        | 211-041800-00  |
| -34                    | 214-3375-01           |                                            | 2   | LEVER, SWITCH: AC/DC, PLASTIC                                               | TK2165       | ORDER BY DESCR |
| -35                    | 358-0728-00           |                                            | 1   | BUSHING, BD MTG: ALUMINUM                                                   | TK1287       | ORDER BY DESCR |
| -36                    | 441-1571-00           |                                            | 1   | CHASSIS, SCOPE: FRONT, L FRAME<br>(ATTACHING PARTS)                         | TK1285       | ORDER BY DESCR |
| -37                    | 213-0881-00           |                                            | 4   | SCREW, TPG, TR: 6-32 X 0.25 TYPE TT, FILH, STL<br>(END ATTACHING PARTS)     | 83385        | ORDER BY DESCR |
| -38                    | 386-4443-00           |                                            | 1   | SUPPORT, SHIELD: CRT, FRONT, PLASTIC                                        | 80009        | 386-4443-00    |
| -39                    | 200-2519-00           |                                            | 1   | CAP, CRT SOCKET: NATURAL LEXAN                                              | 80009        | 200-2519-00    |
| -40                    | 214-1061-06           |                                            | 1   | SPRING, GROUND: CRT SHIELD                                                  | 80009        | 214-1061-06    |
| -41                    | 426-1766-00           |                                            | 1   | MOUNT, RESILIENT: CRT, REAR                                                 | 80009        | 426-1766-00    |
| -42                    | 334-1379-00           |                                            | 1   | MARKER, IDENT: MKD HI VACUUM                                                | 07416        | ORDER BY DESCR |
| -43                    | 334-1951-00           |                                            | 1   | MARKER, IDENT: MKD WARNING, CRT VOLTAGES                                    | 22670        | ORDER BY DESCR |
| -44                    | 337-2774-00           |                                            | 1   | SHIELD, ELEC: CRT, STEEL                                                    | 23740        | C-2059         |
| -45                    | -----                 |                                            | 1   | DELAY LINE, ELEC: (SEE DL9210 CHASSIS REPL)                                 |              |                |
| -46                    | 346-0121-00           |                                            | 2   | STRAP, TIEDOWN, E: 6.125 L, NYLON<br>(ATTACHING PARTS)                      | 06383        | PLC1.5I-S8     |
| -47                    | 213-0882-00           |                                            | 2   | SCREW, TPG, TR: 6-32 X 0.437 TAPTITE, PNH, STL<br>(END ATTACHING PARTS)     | 83385        | ORDER BY DESCR |
| -48                    | 346-0128-00           |                                            | 1   | STRAP, TIEDOWN, E: 8.0 L X 0.1 W, NYLON                                     | 06383        | PLT2M          |
| -49                    | 136-1075-00           |                                            | 1   | SKT, PL-IN ELEC: CRT SOCKET ASSY                                            | TK1544       | ORDER BY DESCR |
| -50                    | 334-4251-00           |                                            | 1   | MARKER, IDENT: MKD CAUTION                                                  | 07416        | ORDER BY DESCR |
| -51                    | 337-2772-04           |                                            | 1   | SHIELD, ELEC: POWER SUPPLY, TOP, ALUMINUM, MM &<br>NSO<br>(ATTACHING PARTS) | 80009        | 337-2772-04    |

| Fig. &<br>Index<br>No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Discnt | Qty | 12345 Name & Description                                           | Mfr.<br>Code | Mfr. Part No.  |
|------------------------|-----------------------|-----------------------------------------|-----|--------------------------------------------------------------------|--------------|----------------|
| 2-52                   | 211-0379-00           |                                         | 5   | SCREW,MACHINE:4-40 X 0.312,FLH,CD PL,T-9<br>(END ATTACHING PARTS)  | 80009        | 211-0379-00    |
| -53                    | 337-2772-03           |                                         | 1   | SHIELD,ELEC:POWER SUPPLY,SIDE,ALUMINUM,MM<br>(ATTACHING PARTS)     | 80009        | 337-2772-03    |
| -54                    | 211-0305-00           |                                         | 1   | SCR,ASSEM WSHR:4-40 X 0.437,PNH,STL,CD PL<br>(END ATTACHING PARTS) | 01536        | ORDER BY DESCR |
| -55                    | 348-0555-00           |                                         | 1   | GROMMET,PLASTIC:SIL GY,U SHAPE,0.52 ID                             | 80009        | 348-0555-00    |
| -56                    | 344-0334-01           |                                         | 1   | CLIP,CKT BD:PLASTIC,GRAY                                           | TK2165       | ORDER BY DESCR |
| -57                    | 134-0158-00           |                                         | 2   | BUTTON,PLUG:0.187 DIA,NYLON                                        | 02768        | 207-080501-00  |
| -58                    | 200-2264-00           |                                         | 1   | CAP,FUSEHOLDER:3AG FUSES                                           | S3629        | FEK 031 1666   |
| -59                    | 200-1388-03           |                                         | 1   | COVER,FUSE LEAD:POLYURETHANE                                       | 80009        | 200-1388-03    |
| -60                    | 204-0833-00           |                                         | 1   | BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES                               | TK0861       | 031 1653 (FEU) |
| -61                    | 210-1039-00           |                                         | 1   | WASHER,LOCK:0.521 ID,INT,0.025 THK,SST                             | 24931        | ORDER BY DESCR |
| -62                    | 131-0955-00           |                                         | 1   | CONN,RCPT,ELEC:BNC,FEMALE                                          | 13511        | 31-279         |
| -63                    | -----                 |                                         | 1   | FILTER,RFI:(SEE FL9001 CHASSIS REPL)<br>(ATTACHING PARTS)          |              |                |
| -64                    | 211-0379-00           |                                         | 2   | SCREW,MACHINE:4-40 X 0.312,FLH,CD PL,T-9<br>(END ATTACHING PARTS)  | 80009        | 211-0379-00    |
| -65                    | 200-2845-00           |                                         | 1   | COVER,CKT BOARD:LINE FILTER                                        | TK2165       | ORDER BY DESCR |
| -66                    | -----                 |                                         | 1   | CKT BOARD ASSY:EMI FILTER(SEE A6 REPL)<br>(ATTACHING PARTS)        |              |                |
| -67                    | 210-0586-00           |                                         | 2   | NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL                              | 78189        | 211-041800-00  |
| -68                    | 129-0999-00           |                                         | 2   | SPACER,POST:0.485 L,4-40 INT/EXT,STL,0.25<br>HEX                   | TK0858       | ORDER BY DESCR |
| -69                    | 211-0379-00           |                                         | 2   | SCREW,MACHINE:4-40 X 0.312,FLH,CD PL,T-9<br>(END ATTACHING PARTS)  | 80009        | 211-0379-00    |
| -70                    | 195-3990-00           |                                         | 1   | LEAD,ELECTRICAL:18 AWG,4.5 L,5-4<br>(ATTACHING PARTS)              | 80009        | 195-3990-00    |
| -71                    | 210-0457-00           |                                         | 1   | NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL<br>(END ATTACHING PARTS)    | 78189        | 511-061800-00  |
| -72                    | 334-3379-06           |                                         | 1   | MARKER,IDENT:MKD GROUND SYMBOL                                     | 80009        | 334-3379-06    |
| -73                    | 407-3673-00           |                                         | 1   | BRACKET,HEAT SK:ALUMINUM<br>(ATTACHING PARTS)                      | 80009        | 407-3673-00    |
| -74                    | 210-0586-00           |                                         | 1   | NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL                              | 78189        | 211-041800-00  |
| -75                    | 211-0379-00           |                                         | 2   | SCREW,MACHINE:4-40 X 0.312,FLH,CD PL,T-9<br>(END ATTACHING PARTS)  | 80009        | 211-0379-00    |
| -76                    | 343-1025-00           |                                         | 1   | RETAINER,XSTR:<br>(ATTACHING PARTS)                                | TK1154       | ORDER BY DESCR |
| -77                    | 211-0302-00           |                                         | 1   | SCR,ASSEM WSHR:4-40 X 0.75,PNH,STL,TORX DR                         | 01536        | ORDER BY DESCR |
| -78                    | 210-0586-00           |                                         | 1   | NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL<br>(END ATTACHING PARTS)     | 78189        | 211-041800-00  |
| -79                    | 342-0582-00           |                                         | 1   | INSULATOR,PLATE:TRANSISTOR,CERAMIC                                 | 80009        | 342-0582-00    |
| -80                    | 343-0969-00           |                                         | 1   | RETAINER,XSTR:<br>(ATTACHING PARTS)                                | 80009        | 343-0969-00    |
| -81                    | 211-0691-00           |                                         | 1   | SCREW,MACHINE:6-32 X 0.625,PNH,STL                                 | TK0858       | ORDER BY DESCR |
| -82                    | 210-0408-00           |                                         | 1   | NUT,PLAIN,HEX:6-32 X 0.312,BRS CD PL<br>(END ATTACHING PARTS)      | 73743        | 3040-402       |
| -83                    | 342-0555-00           |                                         | 2   | INSULATOR,PLATE:HEAT SINK,ALUMINA                                  | 80009        | 342-0555-00    |
| -84                    | 441-1536-03           |                                         | 1   | CHASSIS,SCOPE:REAR,L FRAME                                         | TK1285       | ORDER BY DESCR |
| -85                    | 344-0367-01           |                                         | 3   | CLIP,GROUND:CU-BE                                                  | 80009        | 344-0367-01    |

| Fig. &<br>Index<br>No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective Dscont | Qty | 12345 Name & Description                                                      | Mfr.<br>Code | Mfr. Part No.  |
|------------------------|-----------------------|-----------------------------------------|-----|-------------------------------------------------------------------------------|--------------|----------------|
| 3-1                    | 334-4251-00           |                                         | 1   | MARKER, IDENT: MKD CAUTION                                                    | 07416        | ORDER BY DESCR |
| -2                     | 337-2773-02           |                                         | 1   | SHIELD, ELEC: POWER SUPPLY, LOWER PLASTIC<br>(ATTACHING PARTS)                | 80009        | 337-2773-02    |
| -3                     | 211-0305-00           |                                         | 1   | SCR, ASSEM WSHR: 4-40 X 0.437, PNH, STL, CD PL<br>(END ATTACHING PARTS)       | 01536        | ORDER BY DESCR |
| -4                     | 366-1480-03           |                                         | 1   | PUSH BUTTON: BLACK, OFF                                                       | 80009        | 366-1480-03    |
| -5                     | 384-1576-01           |                                         | 1   | EXTENSION SHAFT: 12.544 L, PLASTIC                                            | 80009        | 384-1576-01    |
| -6                     | -----                 |                                         | 1   | SWITCH, PUSH: 4A 250VAC B (SEE A1S901 REPL)                                   |              |                |
| -7                     | 377-0512-03           |                                         | 6   | INSERT, KNOB: 0.128 ID X 0.37 OD X 0.67 L, XL                                 | 80009        | 377-0512-03    |
| -8                     | -----                 |                                         | 1   | CKT BOARD ASSY: FRONT PANEL (SEE A3 REPL)<br>(ATTACHING PARTS)                |              |                |
| -9                     | 211-0325-00           |                                         | 4   | SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9<br>(END ATTACHING PARTS)      | 01536        | ORDER BY DESCR |
| -10                    | -----                 |                                         | 1   | CKT BOARD ASSY: ALTERNATE SWEEP (SEE A5 REPL)                                 |              |                |
| -11                    | -----                 |                                         | 1   | CKT BOARD ASSY: MAIN (SEE A1 REPL)                                            |              |                |
| -12                    | 337-3201-04           |                                         | 1   | SHIELD, ELEC: TOP ATTN<br>(ATTACHING PARTS)                                   | TK1285       | ORDER BY DESCR |
| -13                    | 211-0325-00           |                                         | 4   | SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9                               | 01536        | ORDER BY DESCR |
| -14                    | 211-0326-00           |                                         | 2   | SCREW, MACHINE: 4-40 X 1.25, PNH, STL<br>(END ATTACHING PARTS)                | 83486        | ORDER BY DESCR |
| -15                    | -----                 |                                         | 1   | CKT BOARD ASSY: ATTENUATOR (SEE A2 REPL)<br>(ATTACHING PARTS)                 |              |                |
| -16                    | 211-0305-00           |                                         | 1   | SCR, ASSEM WSHR: 4-40 X 0.437, PNH, STL, CD PL                                | 01536        | ORDER BY DESCR |
| -17                    | 361-1166-00           |                                         | 1   | SPACER, SLEEVE: 0.228 L X 0.162 ID, BRS                                       | 0J260        | ORDER BY DESCR |
| -18                    | 211-0325-00           |                                         | 1   | SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9                               | 01536        | ORDER BY DESCR |
| -19                    | 129-0988-00           |                                         | 1   | SPACER, POST: 0.966 L, 4-40 EA END, AL, 0.188<br>HEX<br>(END ATTACHING PARTS) | TK0858       | ORDER BY DESCR |
| -20                    | 384-1056-00           |                                         | 2   | CKT BOARD ASSY INCLUDES;<br>.EXTENSION SHAFT: 6.58 L X 0.123 OD, EPOX GL      | TK2278       | ORDER BY DESCR |
| -21                    | 401-0370-01           |                                         | 2   | .BEARING, CAM SW: END, 0.6 DIA<br>(ATTACHING PARTS)                           | 80009        | 401-0370-01    |
| -22                    | 211-0343-00           |                                         | 2   | .SCREW, MACHINE: 4-40 X 0.25, TRUSS HD, STL                                   | TK0858       | ORDER BY DESCR |
| -23                    | 361-1300-00           |                                         | 2   | .SPACER, BEARING: 0.115 ID X 0.2 OD, BRASS                                    | TK2278       | ORDER BY DESCR |
| -24                    | 210-0406-00           |                                         | 8   | .NUT, PLAIN, HEX: 4-40 X 0.188, BRS CD PL<br>(END ATTACHING PARTS)            | 73743        | 12161-50       |
| -25                    | 214-1126-02           |                                         | 4   | .SPRING, FLAT: 0.7 X 0.125, CU BE RED CLR                                     | 80009        | 214-1126-02    |
| -26                    | 214-1752-00           |                                         | 8   | .ROLLER, DETENT: 0.125 OD X 0.16, SST                                         | 80009        | 214-1752-00    |
| -27                    | 105-0934-01           |                                         | 2   | .ACTUATOR, CAM SW: AC-GND-DC                                                  | 80009        | 105-0934-01    |
| -28                    | 401-0369-00           |                                         | 2   | .BEARING, CAM SW: CENTER, 0.6 DIA<br>(ATTACHING PARTS)                        | 80009        | 401-0369-00    |
| -29                    | 211-0325-00           |                                         | 4   | .SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9                              | 01536        | ORDER BY DESCR |
| -30                    | 210-0406-00           |                                         | 2   | .NUT, PLAIN, HEX: 4-40 X 0.188, BRS CD PL<br>(END ATTACHING PARTS)            | 73743        | 12161-50       |
| -31                    | 105-0935-02           |                                         | 2   | .ATTEN CAM SW: ATTENUATOR VOLTS PER DIVISION                                  | 80009        | 105-0935-02    |
| -32                    | 401-0370-00           |                                         | 2   | .BEARING, CAM SW: END, 0.6 DIA                                                | 80009        | 401-0370-00    |
| -33                    | 214-1126-01           |                                         | 4   | .SPRING, FLAT: 0.7 X 0.125, CU BE GRN CLR                                     | 80009        | 214-1126-01    |
| -34                    | 214-1752-00           |                                         | 8   | .ROLLER, DETENT: 0.125 OD X 0.16, SST                                         | 80009        | 214-1752-00    |
| -35                    | -----                 |                                         | 1   | .VAR RES 10K C (SEE A02R19/R93)                                               |              |                |
| -36                    | 343-1020-00           |                                         | 2   | .RETAINER, CONT: ABS GRAY<br>(ATTACHING PARTS)                                | TK2165       | ORDER BY DESCR |
| -37                    | 211-0325-00           |                                         | 4   | .SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9                              | 01536        | ORDER BY DESCR |
| -38                    | 361-1218-00           |                                         | 2   | .SPACER, SLEEVE: 0.738 L X 0.13 ID, BRS<br>(END ATTACHING PARTS)              | TK2278       | ORDER BY DESCR |
| -39                    | 131-1758-11           |                                         | 2   | .CONT ASSY, ELEC: 8 CONTACTS                                                  | TK2165       | ORDER BY DESCR |
| -40                    | 131-1758-12           |                                         | 2   | .CONT ASSY, ELEC: 8 CONTACTS                                                  | TK2165       | ORDER BY DESCR |
| -41                    | -----                 |                                         | 1   | CKT BOARD ASSY: TIMING (SEE A4 REPL)<br>(ATTACHING PARTS)                     |              |                |
| -42                    | 211-0325-00           |                                         | 3   | SCR, ASSEM WSHR: 4-40 X 0.25, PNH, STL, TORX T9<br>(END ATTACHING PARTS)      | 01536        | ORDER BY DESCR |
| -43                    | 337-3291-01           |                                         | 1   | SHIELD, ELEC: BOTTOM, 2200<br>(ATTACHING PARTS)                               | TK1285       | ORDER BY DESCR |
| -44                    | 210-0586-00           |                                         | 1   | NUT, PL, ASSEM WA: 4-40 X 0.25, STL CD PL<br>(END ATTACHING PARTS)            | 78189        | 211-041800-00  |
| -45                    | 129-0906-00           |                                         | 2   | SPACER, POST: 0.685 L, 4-40 INT/EXT, AL, 0.25<br>HEX                          | TK0858       | ORDER BY DESCR |
| -46                    | 129-0999-00           |                                         | 1   | SPACER, POST: 0.485 L, 4-40 INT/EXT, STL, 0.25<br>HEX                         | TK0858       | ORDER BY DESCR |



FIG. 3 ATTENUATOR ASSY.  
& BOTTOM

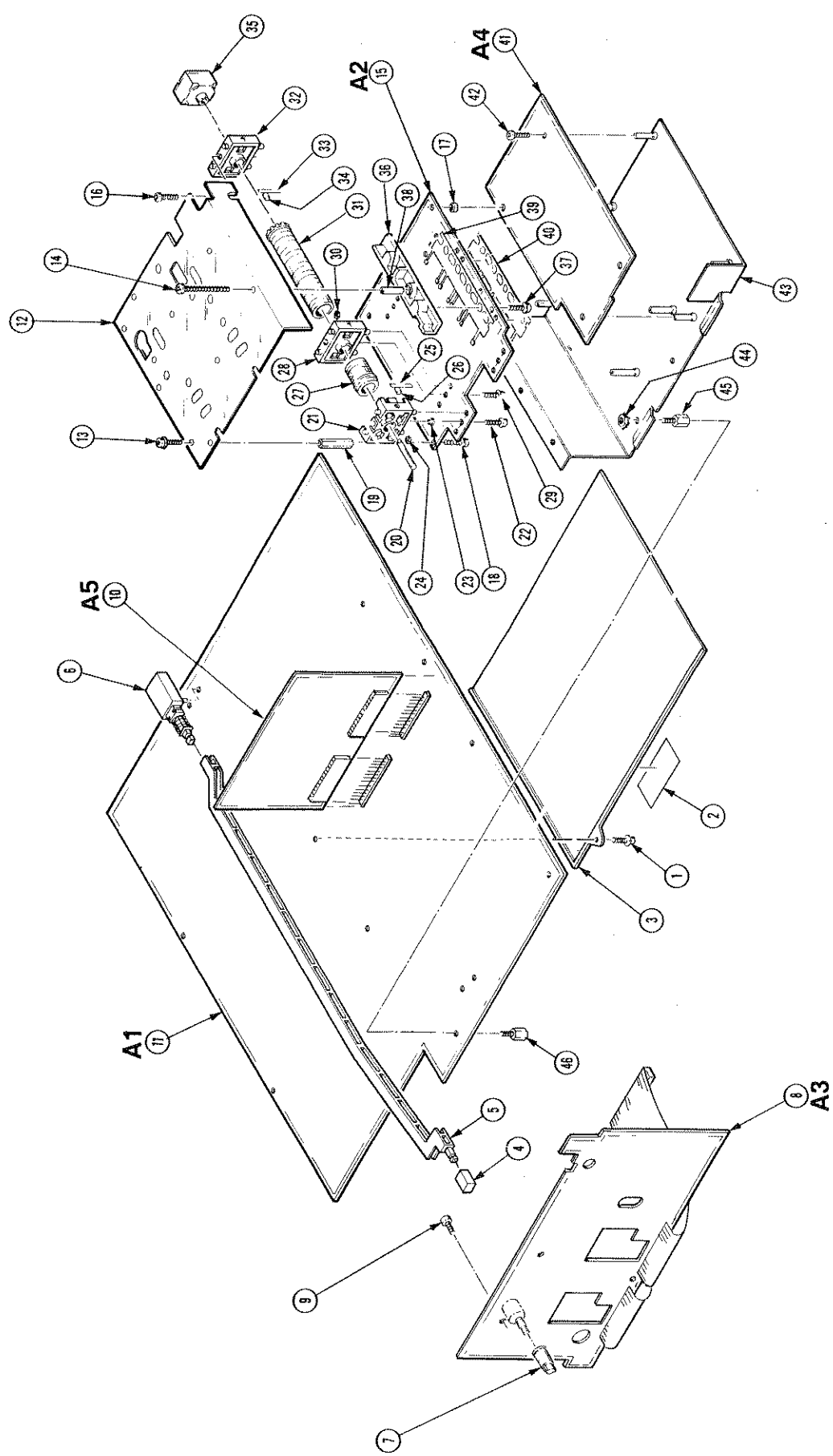
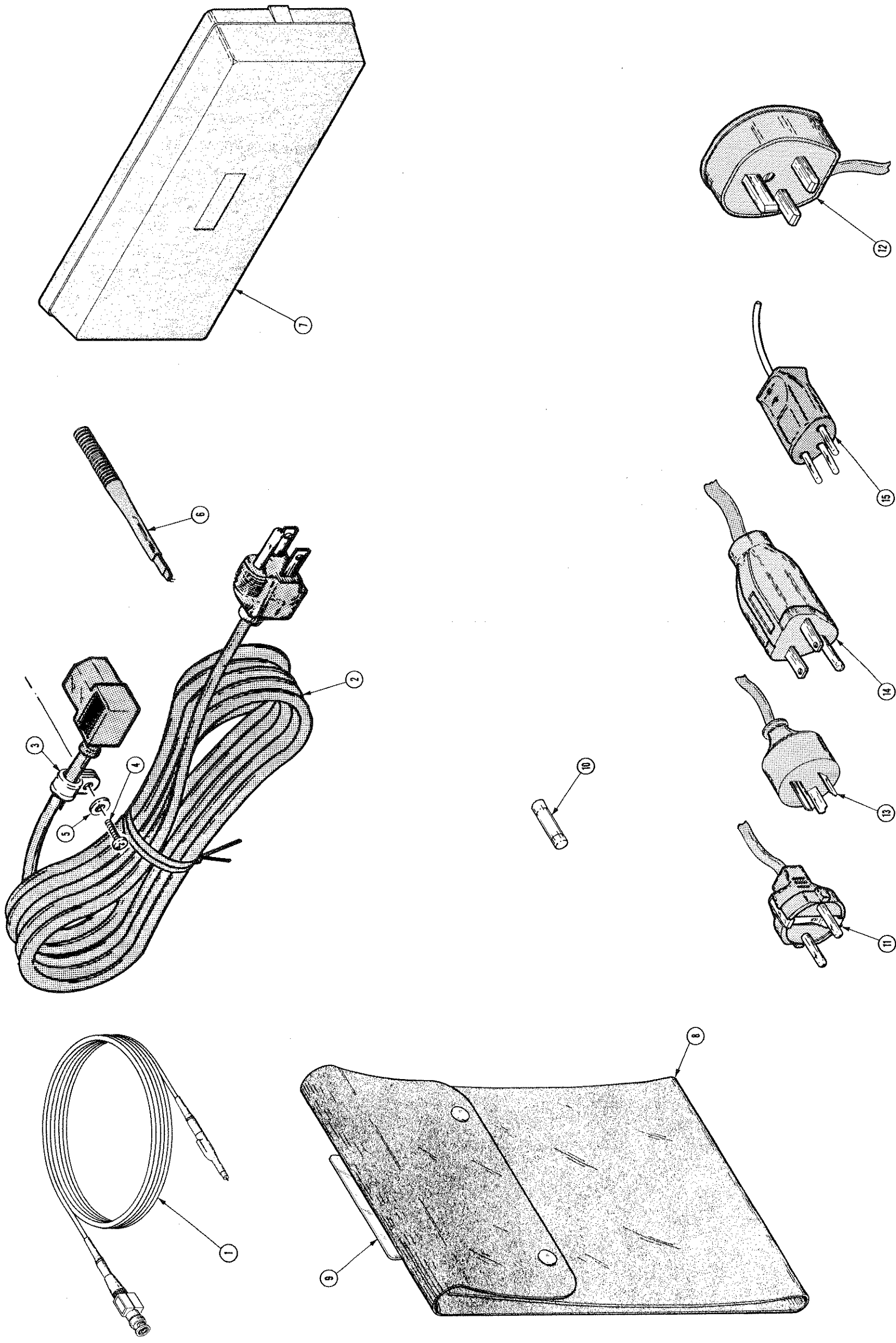


FIG. 4 ACCESSORIES



| Fig. &<br>Index<br>No. | Tektronix<br>Part No. | Serial/Assembly No.<br>Effective    Discnt | Qty | 12345    Name & Description                                       | Mfr.<br>Code | Mfr. Part No.  |
|------------------------|-----------------------|--------------------------------------------|-----|-------------------------------------------------------------------|--------------|----------------|
| 4-                     |                       |                                            |     | STANDARD ACCESSORIES                                              |              |                |
| -1                     | 015-0527-01           |                                            | 2   | ACCESSORY PKG:TWO P6109 OPT 01 PROBES                             | 80009        | 015-0527-01    |
|                        | 070-7683-00           |                                            | 1   | MANUAL,TECH: INSTRUCTION,2235A                                    | 80009        | 070-7683-00    |
|                        | 159-0041-00           |                                            | 1   | FUSE,CARTRIDGE:3AG,1.25A,250V,20SEC                               | 71400        | MSL 1 1/4      |
| -2                     | 161-0230-01           |                                            | 1   | CABLE ASSY,PWR,:3,18 AWG,92.0 L                                   | 80009        | 161-0230-01    |
| -3                     | 343-0003-00           |                                            | 1   | CLAMP,LOOP:0.25 ID,PLASTIC                                        | 06915        | E4 CLEAR ROUND |
| -4                     | 213-0882-00           |                                            | 1   | SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL                         | 83385        | ORDER BY DESCR |
| -5                     | 210-0803-00           |                                            | 1   | WASHER,FLAT:0.15 ID X 0.375 OD X 0.032,STL                        | 12327        | ORDER BY DESCR |
|                        |                       |                                            |     | OPTIONAL ACCESSORIES                                              |              |                |
|                        | -----                 |                                            | 1   | ACCESSORY PKG:TWO P6109 OPT 01 PROBES                             |              |                |
| -6                     | 013-0191-00           |                                            | 1   | TIP,PROBE:W/ACTUATOR                                              | 80009        | 013-0191-00    |
|                        | 020-0672-02           |                                            | 1   | ACCESSORY KIT:                                                    | 80009        | 020-0672-02    |
| -7                     | 200-2520-00           |                                            | 1   | .COVER,SCOPE:FRONT,ABS                                            | TK2165       | ORDER BY DESCR |
|                        | 016-0677-02           |                                            | 1   | .POUCH,ACCESSORY:W/PLATE                                          | TK0174       | 016-0677-02    |
| -8                     | 016-0535-01           |                                            | 1   | .POUCH,ACCESSORY:EXPANDED POLYESTER                               | 80009        | 016-0535-01    |
| -9                     | 386-4674-00           |                                            | 1   | .PLATE,MOUNTING:ACCESSORY POUCH,ALUMINUM                          | 0J260        | ORDER BY DESCR |
| -10                    | 159-0041-00           |                                            | 1   | .FUSE,CARTRIDGE:3AG,1.25A,250V,20SEC                              | 71400        | MSL 1 1/4      |
|                        | 016-1061-00           |                                            | 1   | PAPER,PRINTED:A-SIZE,COATED,210 X 297<br>(SEE MANUAL 070-4186-XX) | 80009        | 016-1061-00    |
|                        | 346-0199-00           |                                            | 1   | STRAP,CARRYING:MKD TEKTRONIX                                      | 80009        | 346-0199-00    |
|                        | 020-0859-00           |                                            | 1   | COMPONENT KIT:EUROPEAN                                            | 80009        | 020-0859-00    |
|                        | 343-0170-00           |                                            | 1   | .RTNR,CA TO CA:U/W 0.25 OD CABLES                                 | 80009        | 343-0170-00    |
|                        | 200-2265-00           |                                            | 1   | .CAP,FUSEHOLDER:5 X 20MM FUSES                                    | TK0861       | FEK 031.1663   |
| -11                    | 161-0104-06           |                                            | 1   | .CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L                        | S3109        | ORDER BY DESCR |
|                        | 020-0860-00           |                                            | 1   | COMPONENT KIT:UNITED KINGDOM                                      | 80009        | 020-0860-00    |
|                        | 343-0170-00           |                                            | 1   | .RTNR,CA TO CA:U/W 0.25 OD CABLES                                 | 80009        | 343-0170-00    |
|                        | 200-2265-00           |                                            | 1   | .CAP,FUSEHOLDER:5 X 20MM FUSES                                    | TK0861       | FEK 031.1663   |
| -12                    | 161-0104-07           |                                            | 1   | .CABLE ASSY,PWR,:3 X 0.75MM SQ,240V,98.0 L                        | 80009        | 161-0104-07    |
|                        | 020-0861-00           |                                            | 1   | COMPONENT KIT:AUSTRALIAN                                          | 80009        | 020-0861-00    |
|                        | 343-0170-00           |                                            | 1   | .RTNR,CA TO CA:U/W 0.25 OD CABLES                                 | 80009        | 343-0170-00    |
|                        | 200-2265-00           |                                            | 1   | .CAP,FUSEHOLDER:5 X 20MM FUSES                                    | TK0861       | FEK 031.1663   |
| -13                    | 161-0104-05           |                                            | 1   | .CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L                             | S3109        | ORDER BY DESCR |
|                        | 020-0862-00           |                                            | 1   | COMPONENT KIT:NORTH AMERICAN                                      | 80009        | 020-0862-00    |
|                        | 343-0170-00           |                                            | 1   | .RTNR,CA TO CA:U/W 0.25 OD CABLES                                 | 80009        | 343-0170-00    |
|                        | 200-2265-00           |                                            | 1   | .CAP,FUSEHOLDER:5 X 20MM FUSES                                    | TK0861       | FEK 031.1663   |
| -14                    | 161-0104-08           |                                            | 1   | .CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L                             | 70903        | ORDER BY DESCR |
|                        | 020-0863-00           |                                            | 1   | COMPONENT KIT:SWISS                                               | 80009        | 020-0863-00    |
|                        | 343-0170-00           |                                            | 1   | .RTNR,CA TO CA:U/W 0.25 OD CABLES                                 | 80009        | 343-0170-00    |
|                        | 200-2265-00           |                                            | 1   | .CAP,FUSEHOLDER:5 X 20MM FUSES                                    | TK0861       | FEK 031.1663   |
| -15                    | 161-0167-00           |                                            | 1   | .CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L                        | 80009        | 161-0167-00    |
|                        | 016-0792-01           |                                            | 1   | CASE,CARRYING:24.5 X 16.5 X 11.5                                  | TK1336       | ORDER BY DESCR |
|                        | 016-0848-00           |                                            | 1   | COVER,PROT:WATERPROOF VINYL                                       | 80009        | 016-0848-00    |
|                        | 390-0790-15           |                                            | 1   | CABINET ASSY:W/BUMPER & HANDLE<br>(OPTION 33 ONLY)                | TK1935       | ORDER BY DESCR |
|                        |                       |                                            |     | CABINET ASSY INCLUDES:                                            |              |                |
|                        | 200-2538-33           |                                            | 1   | .COVER ASSEMBLY:REAR,W/RUBBER BUMPER                              | 80009        | 200-2538-33    |
|                        | 212-0144-00           |                                            | 2   | .SCREW,TPG,TF:8-16 X 0.562 L,PLASTITE,SPCL<br>.HD                 | 93907        | 225-38131-012  |
|                        | 367-0289-00           |                                            | 1   | .HANDLE,CARRYING:13.855,SST                                       | 80009        | 367-0289-00    |
|                        | 390-0790-13           |                                            | 1   | .CABINET,SCOPE:W/BUMPER                                           | TK1319       | ORDER BY DESCR |



## **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.



Date: 3-28-90

Change Reference: M71722

Product: 2235A INSTRUCTION MANUAL

Manual Part Number: 070-7683-00

**DESCRIPTION**

Product Group 46

**EFFECTIVE SERIAL NUMBER: B011671**

**REPLACEABLE ELECTRICAL PARTS LIST CHANGES**

**CHANGE TO:**

A5C672 281-0785-00

CAP,FXD,CER DI: 68PF,10%,100V,MI

**DIAGRAM CHANGES**

DIAGRAM



**B TIMING & ALTERNATE B SWEEP**

Change the value of capacitor C672 (location 4E) to 68 pF.



Date: 4-3-90

Change Reference: M71825

Product: 2235A INSTRUCTION MANUAL

Manual Part Number: 070-7683-00

**DESCRIPTION**

Product Group 46

**EFFECTIVE SERIAL NUMBER: B011890**

**REPLACEABLE ELECTRICAL PARTS LIST CHANGES**

**CHANGE TO:**

A2R29      322-3086-00  
A2R79      322-3086-00

RES,FXD,FILM: 76.8 OHM,1%,0.2W  
RES,FXD,FILM: 76.8 OHM,1%,0.2W

**DIAGRAM CHANGES**

**DIAGRAM  CH1 & CH2 ATTENUATORS**

Change the value of resistor R29 (location 2F) to 76.8  $\Omega$ .

Change the value of resistor R79 (location 4F) to 76.8  $\Omega$ .



Date: 3-28-90

Change Reference: M71843

Product: 2235A INSTRUCTION MANUAL

Manual Part Number: 070-7683-00

**DESCRIPTION**

Product Group 46

**EFFECTIVE SERIAL NUMBER: B011803**

**REPLACEABLE ELECTRICAL PARTS LIST CHANGES**

**CHANGE TO:**

A3R110 322-3289-00  
A3R111 322-3289-00  
A3R160 322-3289-00  
A3R161 322-3289-00

RES,FXD,FILM: 10K OHM,1%,0.2W  
RES,FXD,FILM: 10K OHM,1%,0.2W  
RES,FXD,FILM: 10K OHM,1%,0.2W  
RES,FXD,FILM: 10K OHM,1%,0.2W

**DIAGRAM CHANGES**

**DIAGRAM  VERTICAL PREAMPS & SWITCHING**

Change the value of resistor R110 (location 2C) to 10K  $\Omega$ .

Change the value of resistor R111 (location 1C) to 10K  $\Omega$ .

Change the value of resistor R160 (location 3C) to 10K  $\Omega$ .

Change the value of resistor R161 (location 3C) to 10K  $\Omega$ .



Date: 3-28-90

Change Reference: M71944

Product: 2235A INSTRUCTION MANUAL

Manual Part Number: 070-7683-00

### DESCRIPTION

Product Group 46

EFFECTIVE SERIAL NUMBER: B011625

### REPLACEABLE ELECTRICAL PARTS LIST CHANGES

#### ADD:

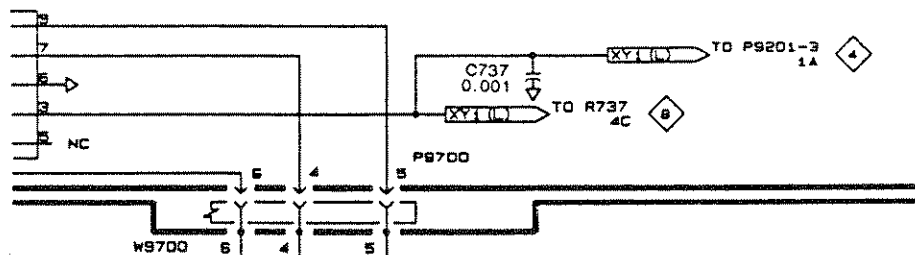
A4C737 281-0862-00

CAP,FXD,CER DI: 0.001UF, + 80-20%,100V

### DIAGRAM CHANGES

DIAGRAM 6 A SWEEP GENERATOR & LOGIC

Add capcitor C737 (0.001  $\mu$ F) to the XY1 (L) line as shown below. Grid location is 2D.





Date: 4-12-90Change Reference: M72010Product: 2235A INSTRUCTION MANUALManual Part Number: 070-7683-00**DESCRIPTION**

Product Group 40

**EFFECTIVE SERIAL NUMBER: B015000****REPLACEABLE ELECTRICAL PARTS LIST CHANGES****CHANGE TO:**

A1 671-1418-01  
A4 671-1420-01  
A5 671-1422-01

CIRCUIT BD ASSY: MAIN  
CIRCUIT BD ASSY: TIMING  
CIRCUIT BD ASSY: ALT SWEEP

A1C350 281-0893-00  
A1C965 290-1129-00  
A1CR501 152-1107-00  
A1R210 313-1431-00  
A1R407 313-1470-00  
A1R448 313-1470-00  
A1R449 313-1470-00  
A1R453 313-1470-00  
A1R463 322-3196-00  
A1R646 311-2257-00  
A1R482 322-3101-00

CAP,FXD,CER DI: 4.7PF, +/-0.5PF,100V  
CAP,FXD,ELCTLT: 1000UF, + 100%-10%,12V  
DIODE,SIG: SCHTKY,40V,350MA,12PF  
RES,FXD,FILM: 430 OHM,5%,0.2W  
RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 1.07K OHM,1%,0.2W  
RES,VAR,NONWW: TRMR,500 OHM,20%,0.5W  
RES,FXD,FILM: 110 OHM,1%,0.2W

A4R754 311-2227-00

RES,VAR,NONWW: TRMR,100 OHM,20%,0.5W LINEAR

A5R621 322-3196-00  
A5R651 322-3285-00  
A5R652 311-2273-00  
A5R653 322-3298-00

RES,FXD,FILM: 1.07K OHM,1%,0.2W  
RES,FXD,FILM: 9.09K OHM,1%,0.2W  
RES,VAR,NONWW: TRMR,2K OHM,20%,0.5W  
RES,FXD,FILM: 12.4K OHM,1%,0.2W

**REMOVE:**

A1C363 281-0862-00  
A1C646 290-0776-04  
A1C881 290-0946-00  
A1CR641 152-0951-00  
A1Q446 151-0188-05  
A1Q450 151-0190-09  
A1Q641 151-0190-09  
A1R439 313-1470-00  
A1R445 313-1470-00  
A1R446 322-3289-00  
A1R641 313-1472-00  
A1R647 322-3193-00  
A1W591 131-0566-00

CAP,FXD,CER DI: 0.001UF, + 80-20%,100V  
CAP,FXD,ELCTLT: 22UF,20%,10V,MI  
CAP,FXD,ELCTLT: 270UF, + 100-10%,40V  
DIODE,SIG: SCHTKY,60V,2.25PF  
TRANSISTOR: PNP,SI,TO-92  
TRANSISTOR: NPN,SI,TO-92  
TRANSISTOR: NPN,SI,TO-92

RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 47 OHM,5%,0.2W  
RES,FXD,FILM: 10K OHM,1%,0.2W  
RES,FXD,FILM: 4.7K OHM,5%,0.2W  
RES,FXD,FILM: 1K OHM,1%,0.2W

BUS,CONDUCTOR: DUMMY RES,0.094 OD X 0.225 L

A4CR731 152-0141-02  
A4VR749 152-0744-00

SEMICON DVC,DI: SW,SI,30V,150MA,30V,DO-35  
SEMICON DVC,DI: ZEN,SI,3.6V,5%,0.4W

# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

### REPLACEABLE ELECTRICAL PARTS LIST CHANGES (cont)

#### ADD:

|         |             |                                             |
|---------|-------------|---------------------------------------------|
| A1C370  | 281-0811-00 | CAP,FXD,CER DI: 10PF,10%,100V               |
| A1C452  | 281-0862-00 | CAP,FXD,CER DI: 0.001UF, + 80-20%,100V      |
| A1C456  | 281-0775-01 | CAP,FXD,CER DI: 0.1UF,20%,50V               |
| A1C883  | 290-0920-01 | CAP,FXD,ELCTLT: 33UF,35V,20%,AL             |
| A1C884  | 290-0920-01 | CAP,FXD,ELCTLT: 33UF,35V,20%,AL             |
| A1CR966 | 152-0400-00 | DIODE,RECT: FAST RCVRY,400V,1A,200NS        |
| A1L591  | 108-1488-00 | COIL,RF: FXD,1UH,10%                        |
| A1R370  | 322-3085-00 | RES,FXD,FILM: 75 OHM,1%,0.2W                |
| A1R456  | 313-1220-00 | RES,FXD,FILM: 22 OHM,5%,0.2W                |
| A1U427  | 156-0158-00 | IC,LINEAR: BIPOLAR,OP-AMP,DUAL              |
| A1W439  | 131-0566-00 | BUS,CONDUCTOR: DUMMY RES,0.094 OD X 0.225 L |
| A4U749  | 156-0991-02 | MICROCKT,LINEAR: VOLTAGE REGULATOR          |

# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

### DIAGRAM CHANGES

#### DIAGRAM VERTICAL PREAMPS & SWITCHING

Change the value of resistor R448 (location 5G) to 47  $\Omega$ .

Change the value of resistor R449 (location 4G) to 47  $\Omega$ .

#### DIAGRAM VERTICAL OUTPUT AMPLIFIER

Change the value of resistor R210 (location 3B) to 430  $\Omega$ .

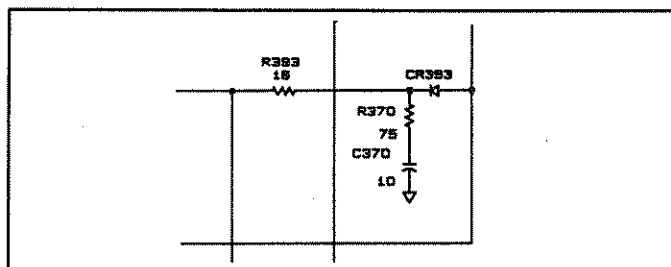
#### DIAGRAM TRIGGER SELECT

Change the value of capacitor C350 (location 5F) to 4.7 pF.

Note: *This capacitor was added at an earlier date and may not yet appear on the schematic diagram. If not, see Change Reference M71187.*

Remove capacitor C363 (location 4G) from the circuit.

Add resistor R370 (75  $\Omega$ ) and capacitor C370 (10pF) as shown below. Grid location is 3H.



# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

## DIAGRAM CHANGES

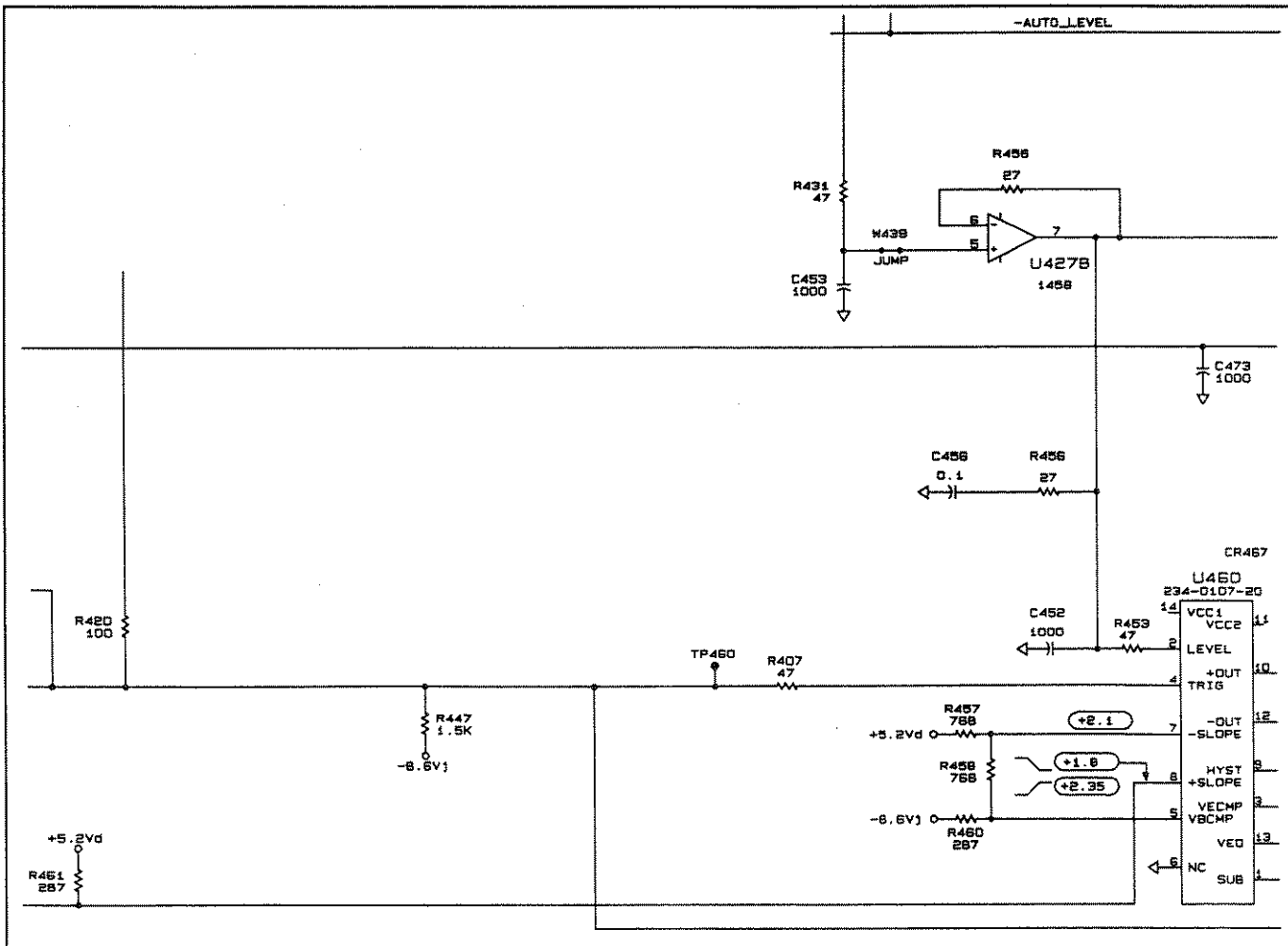
### DIAGRAM 5 TRIGGER P-P AUTO & OUTPUT

Change the value of resistor R482 (location 4G) to 110  $\Omega$ .

Change the value of resistor R463 (location 5F) to 1.07K  $\Omega$ .

The following parts changes and circuit wiring changes are illustrated with the partial schematic below.

| Remove | Add  | Move Location |
|--------|------|---------------|
| R439   | U427 | R447          |
| R445   | W439 | R407          |
| R446   | C456 | R450          |
| Q446   | R456 |               |
| Q450   | C452 |               |



# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

## DIAGRAM CHANGES

### DIAGRAM 7 B TIMING & ALTERNATE SWEEP

Change the value of resistor R621 (location 5F) to 1.07K  $\Omega$ .

Change the value of resistor R651 (location 3D) to 9.09K  $\Omega$ .

Change the value of variable resistor R652 (location 3D) to 2K  $\Omega$ .

Change the value of resistor R653 (location 4D) to 12.4K  $\Omega$ .

The following parts changes and circuit wiring changes are illustrated with the partial schematic below.

Remove \_\_\_\_\_ Add \_\_\_\_\_

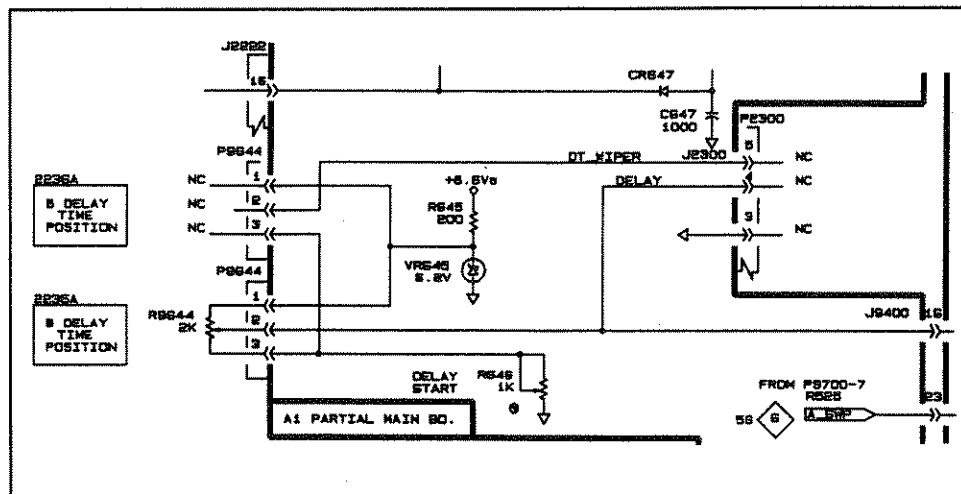
CR641 J9645

C646

Q641

R641

R647



# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

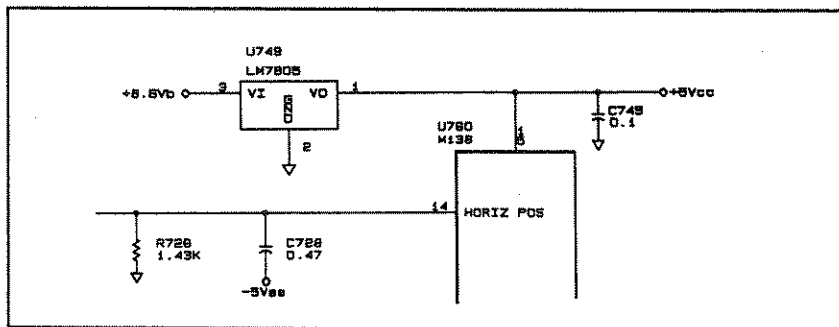
## DESCRIPTION

Product Group 40

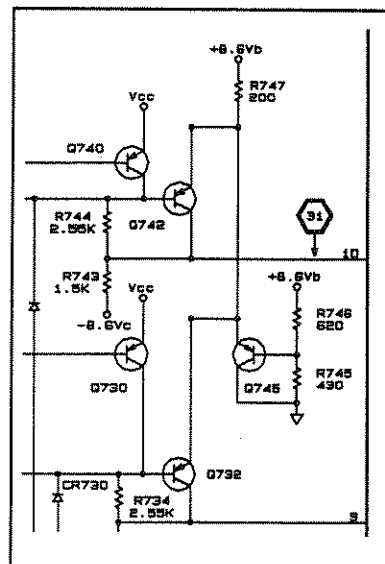
## DIAGRAM CHANGES

### DIAGRAM 8 CALIBRATOR & HORIZONTAL OUTPUT AMPLIFIER

Add U749 and remove VR749 from pin 15 of U760 (location 1D). See the partial schematic below.



Reconnect the emmitters of Q740 and Q730 as indicated below.



# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

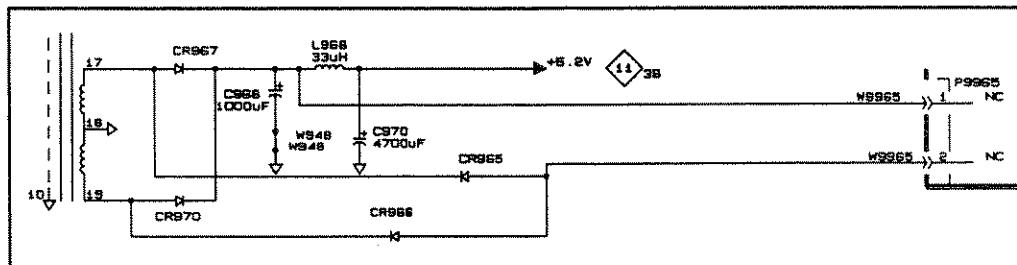
Product Group 40

## DIAGRAM CHANGES

### DIAGRAM 10 PWR SUPPLY, Z-AXIS, & CRT

Remove capacitor C881 (location 5B) and replace with capacitors C883 and C884 (33  $\mu$ F each).

Add diode CR966 from T948 pin 19 to the anode of diode CR965 (location 5D-E). See partial below.



### DIAGRAM 11 POWER DISTRIBUTION

Replace wire jumper W591 (location 4E) with coil L591 (1  $\mu$ H).

# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE Date: 4-12-90 Change Reference: M72010

## DESCRIPTION

Product Group 40

### A4 – TIMING BOARD

#### ASSEMBLY A4

| CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>NUMBER | BOARD<br>LOCATION |
|-------------------|-----------------|-------------------|-------------------|-----------------|-------------------|-------------------|-----------------|-------------------|-------------------|-----------------|-------------------|
| C701              | 6               | 5A                | P9700             | 6               | 4C                | R718              | 6               | 2B                | R750              | 8               | 1C                |
| C701              | 7               | 5B                | P9705             | 8               | 1B                | R719              | 6               | 1B                | R751              | 8               | 1B                |
| C702              | 6               | 5B                |                   |                 |                   | R721              | 6               | 2B                | R752              | 8               | 1C                |
| C703              | 6               | 5B                | Q701              | 6               | 5C                | R722              | 6               | 2A                | R753              | 8               | 1B                |
| C705              | 6               | 5C                | Q704              | 6               | 5C                | R724              | 8               | 3C                | R754              | 8               | 1B                |
| C706              | 6               | 4C                | Q706              | 6               | 5C                | R725              | 8               | 2C                | R755              | 8               | 1B                |
| C707              | 8               | 3C                | Q709              | 7               | 4C                | R727              | 8               | 1A                | R758              | 8               | 1A                |
| C708              | 6               | 5C                | Q710              | 7               | 4C                | R728              | 8               | 2A                | R759              | 8               | 2C                |
| C710              | 7               | 4C                | Q712              | 7               | 4C                | R729              | 8               | 3C                | R760              | 8               | 2B                |
| C712              | 7               | 4C                | Q730              | 8               | 2C                | R730              | 8               | 3C                | R761              | 8               | 2B                |
| C713              | 7               | 4B                | Q732              | 8               | 2C                | R731              | 8               | 3C                | R762              | 8               | 2B                |
| C714              | 7               | 4C                | Q737              | 8               | 2A                | R732              | 8               | 2C                |                   |                 |                   |
| C715              | 6               | 2B                | Q740              | 8               | 2C                | R733              | 8               | 3B                | RT715             | 6               | 2C                |
| C717              | 6               | 2B                | Q742              | 8               | 2B                | R734              | 8               | 3B                |                   |                 |                   |
| C720              | 6               | 2A                | Q745              | 8               | 2C                | R735              | 8               | 2C                | S701              | 6               | 4A                |
| C722              | 6               | 2A                |                   |                 |                   | R737              | 8               | 2A                | S701              | 7               | 4A                |
| C724              | 8               | 2C                | R701              | 6               | 4B                | R738              | 8               | 2A                | S721              | 8               | 1A                |
| C728              | 8               | 2A                | R702              | 6               | 5B                | R739              | 8               | 3C                |                   |                 |                   |
| C749              | 8               | 1A                | R703              | 6               | 5B                | R740              | 8               | 3C                | U715              | 6               | 2B                |
| C750              | 8               | 1B                | R705              | 6               | 5C                | R741              | 8               | 3C                | U715              | 8               | 2B                |
| C751              | 8               | 2B                | R707              | 6               | 3C                | R742              | 8               | 2C                | U749              |                 | 2C                |
| C752              | 8               | 1C                | R709              | 7               | 3B                | R743              | 8               | 2B                | U750              | 8               | 1A                |
| C762              | 8               | 2A                | R710              | 7               | 4C                | R744              | 8               | 2B                | U760              | 8               | 1B                |
|                   |                 |                   | R711              | 7               | 3B                | R745              | 8               | 2C                |                   |                 |                   |
| CR730             | 8               | 2C                | R713              | 7               | 3C                | R746              | 8               | 2C                | VR720             | 6               | 2B                |
| CR740             | 8               | 2C                | R715              | 6               | 2B                | R747              | 8               | 2C                |                   |                 |                   |
|                   |                 |                   | R716              | 6               | 2B                | R748              | 8               | 1C                |                   |                 |                   |
| P9201             | 6               | 1A                | R717              | 6               | 2B                | R749              | 8               | 1C                | W709              | 7               | 4C                |

# MANUAL CHANGE INFORMATION

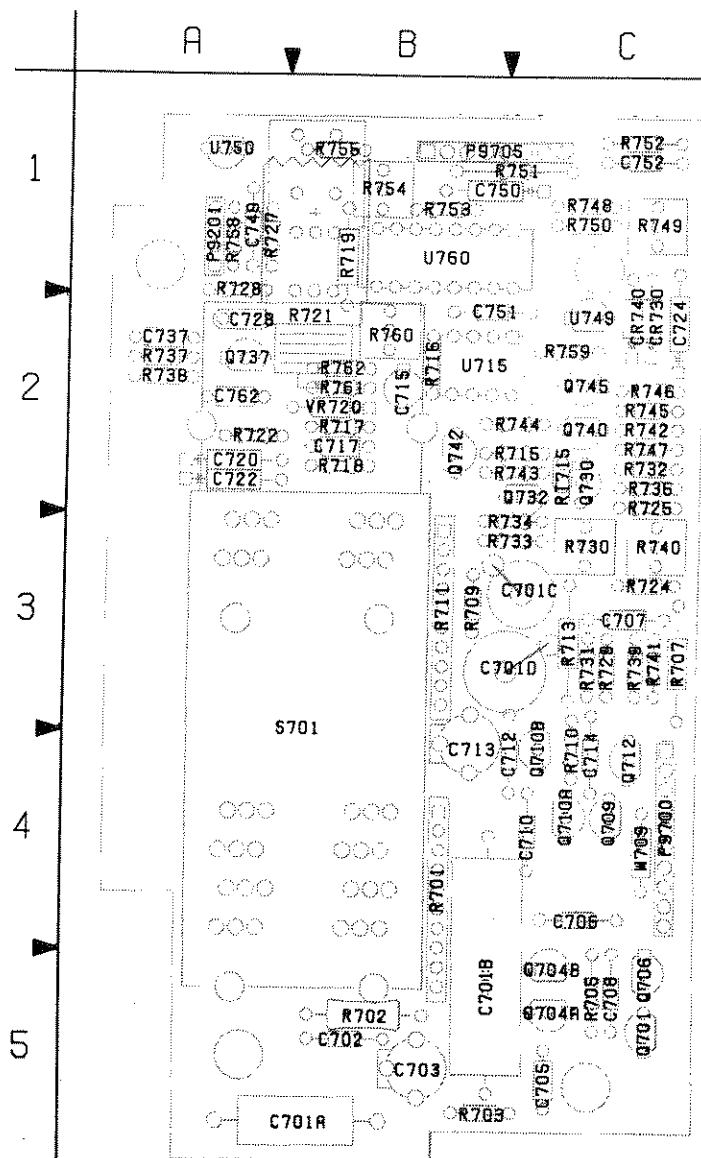
Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40



A4-TIMING BOARD



# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

### A1 - MAIN BOARD

#### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| C100           | 2              | 3D             | C502           | 8              | 10C            | C941           | 9              | 8K             | CR902          | 9              | 6M             |
| C114           | 2              | 4C             | C503           | 8              | 7E             | C942           | 9              | 10L            | CR903          | 9              | 6N             |
| C115           | 2              | 4D             | C504           | 8              | 8E             | C943           | 9              | 10L            | CR904          | 9              | 6M             |
| C116           | 3              | 4C             | C505           | 8              | 8E             | C944           | 9              | 9L             | CR907          | 9              | 8K             |
| C120           | 3              | 5C             | C506           | 8              | 9F             | C945           | 9              | 10M            | CR908          | 9              | 9L             |
| C125           | 2              | 3D             | C507           | 11             | 7C             | C954           | 10             | 8H             | CR920          | 9              | 9M             |
| C126           | 2              | 3D             | C517           | 6              | 7E             | C956           | 10             | 8H             | CR946          | 9              | 11K            |
| C127           | 2              | 3D             | C518           | 6              | 8F             | C957           | 10             | 7H             | CR947          | 9              | 10K            |
| C130           | 2              | 3C             | C519           | 6              | 8F             | C960           | 10             | 10H            | CR948          | 9              | 10M            |
| C133           | 2              | 2J             | C520           | 6              | 8F             | C961           | 10             | 10H            | CR954          | 10             | 9H             |
| C150           | 2              | 3F             | C525           | 6              | 8F             | C962           | 10             | 11H            | CR955          | 10             | 9H             |
| C164           | 2              | 4E             | C527           | 6              | 9F             | C963           | 10             | 11H            | CR956          | 10             | 9H             |
| C165           | 2              | 4E             | C529           | 8              | 10F            | C965           | 10             | 10J            | CR957          | 10             | 9H             |
| C175           | 2              | 3E             | C531           | 6              | 10E            | C968           | 10             | 9J             | CR960          | 10             | 9H             |
| C176           | 2              | 3E             | C537           | 3              | 1M             | C970           | 10             | 11J            | CR961          | 10             | 9H             |
| C177           | 2              | 3E             | C538           | 2              | 4J             | C975           | 10             | 6K             | CR962          | 10             | 9H             |
| C180           | 2              | 3E             | C539           | 2              | 4J             | C976           | 10             | 6K             | CR963          | 10             | 9H             |
| C198           | 2              | 3C             | C540           | 3              | 2L             | C979           | 10             | 6J             | CR965          | 10             | 10J            |
| C199           | 2              | 4E             | C540           | 11             | 2L             | C987           | 8              | 2C             | CR966          | 10             | 10J            |
| C200           | 11             | 4F             | C545           | 2              | 1M             |                |                |                | CR967          | 10             | 9J             |
| C201           | 11             | 4F             | C547           | 2              | 2M             | CR133          | 2              | 2C             | CR970          | 10             | 9J             |
| C204           | 3              | 1E             | C565           | 4              | 8F             | CR183          | 2              | 2F             |                |                |                |
| C210           | 3              | 1E             | C590           | 5              | 8D             | CR200          | 2              | 3D             | DL9210A        | 3              | 1D             |
| C215           | 3              | 1C             | C590           | 11             | 8D             | CR201          | 2              | 3E             | DL9210B        | 3              | 1E             |
| C220           | 11             | 2E             | C803           | 7              | 7G             | CR202          | 2              | 2D             |                |                |                |
| C225           | 3              | 2D             | C835           | 7              | 9G             | CR203          | 2              | 2E             | DS856          | 10             | 7J             |
| C226           | 3              | 1B             | C847           | 7              | 8F             | CR226          | 3              | 2E             | DS858          | 10             | 7J             |
| C228           | 3              | 2E             | C848           | 7              | 8G             | CR227          | 3              | 1E             | DS870          | 10             | 7H             |
| C229           | 3              | 1E             | C849           | 7              | 7G             | CR228          | 3              | 2E             |                |                |                |
| C237           | 3              | 1F             | C873           | 7              | 9G             | CR229          | 3              | 1F             | E200           | 11             | 5F             |
| C239           | 3              | 2F             | C784           | 8              | 4J             | CR372          | 4              | 6D             | E201           | 11             | 5F             |
| C240           | 3              | 2F             | C771           | 8              | 4H             | CR393          | 4              | 7D             | E272           | 11             | 2J             |
| C241           | 3              | 2F             | C774           | 8              | 3H             | CR399          | 4              | 7D             | E590           | 11             | 10D            |
| C242           | 3              | 2F             | C775           | 8              | 4H             | CR405          | 5              | 8D             | E907           | 9              | 7K             |
| C250           | 3              | 2G             | C777           | 8              | 4G             | CR406          | 5              | 8D             |                |                |                |
| C251           | 3              | 1G             | C779           | 8              | 3G             | CR409          | 4              | 6C             | J2222          | 2              | 7B             |
| C255           | 3              | 1G             | C781           | 8              | 3H             | CR414          | 5              | 8B             | J2222          | 3              | 7B             |
| C262           | 3              | 2J             | C782           | 8              | 2H             | CR415          | 5              | 6C             | J2222          | 4              | 7B             |
| C274           | 11             | 2J             | C785           | 8              | 3H             | CR419          | 4              | 6C             | J2222          | 6              | 7B             |
| C281           | 3              | 1G             | C787           | 8              | 3H             | CR467          | 5              | 9D             | J2223          | 4              | 9B             |
| C282           | 3              | 7G             | C789           | 8              | 2G             | CR476          | 5              | 9B             | J2223          | 5              | 9B             |
| C292           | 3              | 3G             | C796           | 11             | 3J             | CR477          | 5              | 9D             | J2223          | 6              | 9B             |
| C312           | 4              | 5D             | C797           | 11             | 3J             | CR501          | 6              | 10D            | J2300          | 7              | 10F            |
| C337           | 4              | 5E             | C799           | 11             | 4G             | CR502          | 8              | 10D            | J2400          | 11             | 10F            |
| C350           | 4              | 8D             | C824           | 10             | 8F             | CR503          | 8              | 8E             | J2500          | 5              | 10D            |
| C370           | 4              | 9C             | C825           | 10             | 3L             | CR508          | 8              | 9B             | J2600          | 6              | 8E             |
| C389           | 4              | 11B            | C828           | 10             | 4L             | CR509          | 8              | 10C            | J2700          | 10             | 8G             |
| C390           | 4              | 10B            | C832           | 10             | 3L             | CR514          | 6              | 9E             | J2850          | 6              | 8E             |
| C396           | 9              | 4K             | C835           | 10             | 4L             | CR518          | 6              | 7F             | J9100          | 1              | 6A             |
| C397           | 4              | 5E             | C845           | 10             | 4M             | CR529          | 6              | 9F             | J9103          | 2              | 4D             |
| C402           | 5              | 7C             | C846           | 10             | 3M             | CR551          | 10             | 7F             | J9108          | 2              | 4F             |
| C406           | 4              | 6C             | C847           | 10             | 3M             | CR564          | 4              | 3K             | J9400          | 7              | 10G            |
| C409           | 4              | 7D             | C849           | 10             | 4N             | CR647          | 7              | 11E            | J9400          | 11             | 7G             |
| C410           | 5              | 8D             | C851           | 10             | 4L             | CR648          | 7              | 8F             | J9644          | 5              | 11F            |
| C414           | 5              | 7B             | C853           | 10             | 7H             | CR649          | 7              | 11E            | J9645          | 5              | 11F            |
| C415           | 5              | 8B             | C854           | 10             | 7J             | CR712          | 7              | 10F            | J9870B         | 10             | 1L             |
| C418           | 4              | 6C             | C855           | 10             | 7K             | CR764          | 8              | 2J             | J9882          | 10             | 3B             |
| C419           | 4              | 7D             | C871           | 10             | 1L             | CR770          | 8              | 4J             | J9884          | 8              | 4B             |
| C420           | 5              | 7C             | C873           | 10             | 1L             | CR780          | 8              | 3J             |                |                |                |
| C421           | 5              | 8C             | C875           | 10             | 1K             | CR805          | 10             | 6F             | L266           | 3              | 2J             |
| C451           | 11             | 8E             | C877           | 10             | 1L             | CR818          | 10             | 7F             | L267           | 3              | 1J             |
| C452           | 5              | 8C             | C882           | 10             | 3B             | CR820          | 10             | 7F             | L451           | 11             | 7E             |
| C453           | 5              | 9C             | C883           | 10             | 4B             | CR823          | 10             | 3L             | L499           | 11             | 6F             |
| C456           | 5              | 9C             | C884           | 10             | 4B             | CR824          | 10             | 2M             | L591           | 11             | 9E             |
| C459           | 5              | 8C             | C893           | 10             | 6H             | CR825          | 10             | 3M             | L956           | 10             | 7H             |
| C460           | 5              | 8D             | C904           | 9              | 5M             | CR829          | 10             | 3M             | L960           | 10             | 10H            |
| C467           | 5              | 8D             | C906           | 9              | 7L             | CR840          | 10             | 4M             | L961           | 10             | 10H            |
| C469           | 5              | 9C             | C907           | 9              | 7M             | CR845          | 10             | 3M             | L968           | 10             | 10J            |
| C473           | 5              | 9B             | C908           | 9              | 7M             | CR851          | 10             | 5L             |                |                |                |
| C487           | 5              | 9D             | C917           | 9              | 10L            | CR853          | 10             | 5L             | P870           | 10             | 7H             |
| C484           | 11             | 6E             | C919           | 9              | 10M            | CR854          | 10             | 7J             | P871           | 10             | 7H             |
| C499           | 11             | 8D             | C922           | 9              | 10L            | CR855          | 10             | 7J             | P908           | 9              | 7L             |
| C500           | 6              | 10C            | C925           | 9              | 10M            | CR882          | 10             | 3B             | P909           | 9              | 9L             |
| C501           | 8              | 10C            | C940           | 9              | 8K             | CR901          | 9              | 6M             | P940           | 9              | 8L             |

# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

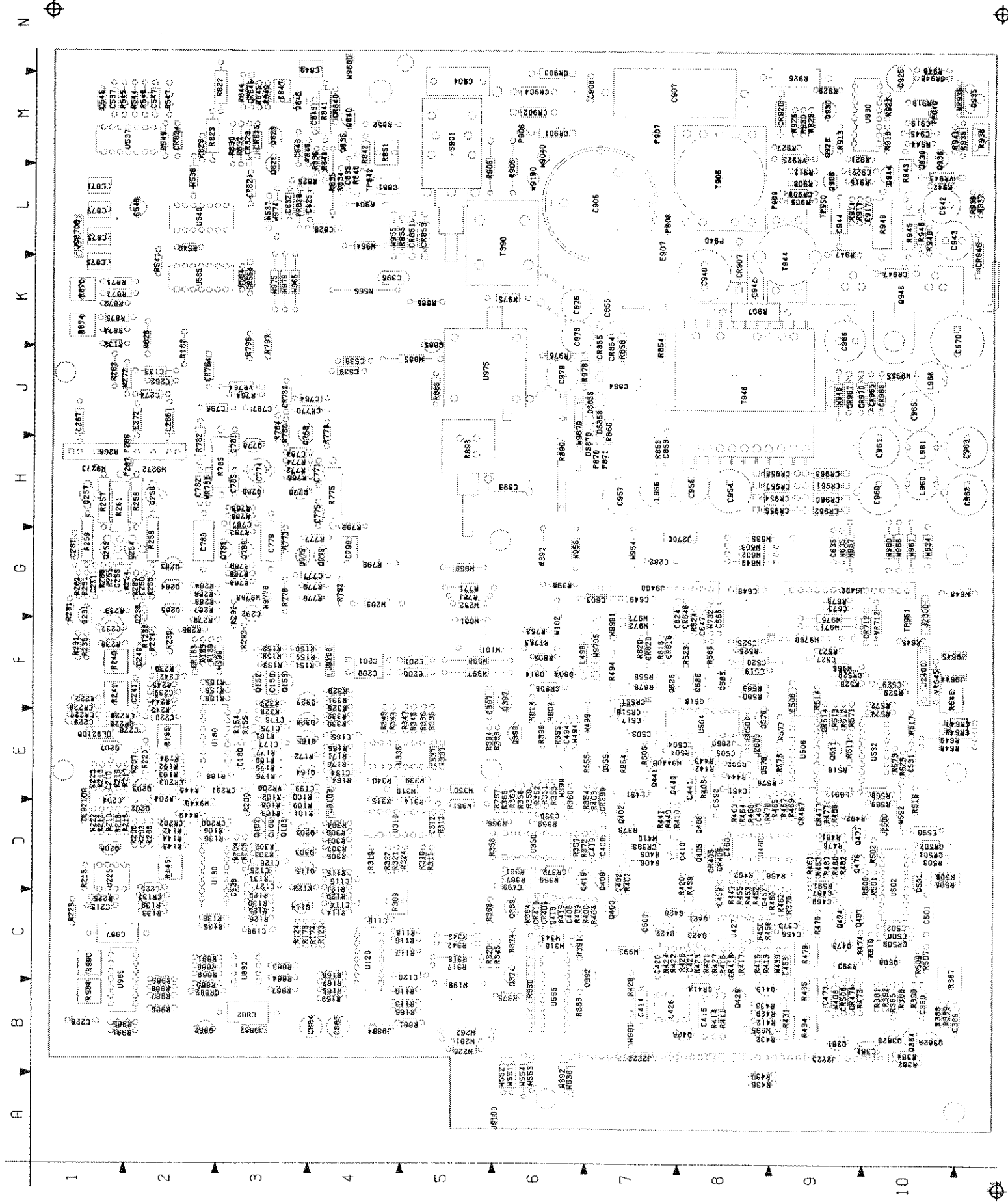
## DESCRIPTION

Product Group 40

### A1 - MAIN BOARD

#### ASSEMBLY A1

| CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Q102              | 2                 | 3D                | Q840              | 10                | 4M                | R183              | 2                 | 2F                | R314              | 4                 | 5E                |
| Q103              | 2                 | 3D                | Q845              | 10                | 3M                | R185              | 2                 | 3F                | R315              | 4                 | 4E                |
| Q114              | 2                 | 4C                | Q882              | 10                | 2B                | R186              | 2                 | 3F                | R317              | 4                 | 5C                |
| Q115              | 2                 | 4D                | Q885              | 10                | 5K                | R188              | 2                 | 3E                | R318              | 4                 | 5C                |
| Q152              | 2                 | 3F                | Q908              | 9                 | 9L                | R189              | 2                 | 2F                | R319              | 4                 | 4D                |
| Q153              | 2                 | 3F                | Q928              | 9                 | 9M                | R192              | 2                 | 2E                | R320              | 4                 | 5C                |
| Q164              | 2                 | 4E                | Q930              | 9                 | 9M                | R193              | 2                 | 2E                | R321              | 4                 | 4D                |
| Q165              | 2                 | 4E                | Q935              | 9                 | 11M               | R194              | 2                 | 2E                | R322              | 4                 | 4D                |
| Q202              | 3                 | 2D                | Q938              | 9                 | 10L               | R195              | 2                 | 2E                | R324              | 4                 | 5D                |
| Q203              | 3                 | 2E                | Q939              | 9                 | 10L               | R200              | 2                 | 3D                | R326              | 4                 | 4F                |
| Q206              | 3                 | 1D                | Q944              | 9                 | 10L               | R202              | 3                 | 2D                | R327              | 4                 | 3F                |
| Q207              | 3                 | 1E                | Q946              | 9                 | 10K               | R203              | 3                 | 2D                | R328              | 4                 | 3E                |
| Q230              | 3                 | 2F                |                   |                   |                   | R204              | 3                 | 2E                | R329              | 4                 | 4F                |
| Q231              | 3                 | 1F                | R100              | 2                 | 4E                | R206              | 3                 | 2D                | R330              | 4                 | 4E                |
| Q254              | 3                 | 2G                | R101              | 2                 | 4D                | R207              | 3                 | 2E                | R331              | 4                 | 4F                |
| Q255              | 3                 | 1G                | R102              | 2                 | 3E                | R210              | 3                 | 1D                | R332              | 4                 | 4E                |
| Q256              | 3                 | 2H                | R103              | 2                 | 3D                | R212              | 3                 | 1D                | R335              | 4                 | 5E                |
| Q257              | 3                 | 1H                | R104              | 2                 | 3D                | R213              | 3                 | 1E                | R336              | 4                 | 5E                |
| Q283              | 3                 | 2G                | R105              | 2                 | 3D                | R215              | 3                 | 1D                | R337              | 4                 | 5E                |
| Q284              | 3                 | 2G                | R106              | 2                 | 3D                | R216              | 3                 | 2D                | R339              | 4                 | 5E                |
| Q285              | 3                 | 2G                | R108              | 2                 | 3D                | R217              | 3                 | 2E                | R340              | 4                 | 4E                |
| Q302              | 4                 | 4D                | R109              | 2                 | 4D                | R218              | 3                 | 1D                | R342              | 4                 | 5C                |
| Q303              | 4                 | 4D                | R113              | 2                 | 5B                | R219              | 3                 | 1E                | R343              | 4                 | 5C                |
| Q327              | 4                 | 4F                | R114              | 2                 | 4C                | R220              | 11                | 2E                | R344              | 4                 | 4E                |
| Q328              | 4                 | 4E                | R115              | 2                 | 4D                | R222              | 3                 | 1D                | R345              | 4                 | 6C                |
| Q369              | 4                 | 6C                | R116              | 2                 | 5C                | R223              | 3                 | 1E                | R346              | 4                 | 5E                |
| Q374              | 4                 | 6B                | R117              | 2                 | 5C                | R225              | 3                 | 1C                | R347              | 4                 | 5E                |
| Q381              | 4                 | 9B                | R118              | 2                 | 5C                | R228              | 3                 | 1C                | R349              | 4                 | 4E                |
| Q382A             | 4                 | 10B               | R119              | 2                 | 5B                | R227              | 3                 | 1F                | R350              | 4                 | 6D                |
| Q382B             | 4                 | 10B               | R120              | 2                 | 4C                | R230              | 3                 | 2F                | R351              | 4                 | 6D                |
| Q384              | 4                 | 10B               | R121              | 2                 | 4D                | R231              | 3                 | 1F                | R352              | 4                 | 6D                |
| Q382              | 4                 | 7B                | R122              | 2                 | 4D                | R233              | 3                 | 1G                | R353              | 4                 | 6D                |
| Q397              | 4                 | 6E                | R123              | 2                 | 4C                | R234              | 3                 | 2F                | R354              | 4                 | 7D                |
| Q399              | 4                 | 6E                | R124              | 2                 | 3C                | R235              | 3                 | 1F                | R356              | 4                 | 6D                |
| Q400              | 5                 | 7C                | R125              | 2                 | 3C                | R236              | 3                 | 1F                | R357              | 4                 | 6D                |
| Q402              | 5                 | 7D                | R126              | 2                 | 3C                | R239              | 3                 | 2F                | R358              | 4                 | 6D                |
| Q405              | 5                 | 8D                | R127              | 2                 | 3C                | R240              | 3                 | 1F                | R359              | 4                 | 6D                |
| Q406              | 5                 | 8D                | R130              | 2                 | 3C                | R241              | 3                 | 1F                | R360              | 4                 | 6D                |
| Q409              | 4                 | 7D                | R131              | 2                 | 3D                | R242              | 3                 | 2F                | R361              | 4                 | 6D                |
| Q413              | 5                 | 9B                | R132              | 2                 | 1K                | R244              | 3                 | 2F                | R363              | 4                 | 6D                |
| Q419              | 4                 | 7D                | R133              | 2                 | 2C                | R245              | 3                 | 2F                | R364              | 4                 | 6C                |
| Q420              | 5                 | 8C                | R135              | 2                 | 3C                | R250              | 3                 | 2G                | R365              | 4                 | 6D                |
| Q421              | 5                 | 8C                | R136              | 2                 | 3D                | R251              | 3                 | 1G                | R366              | 4                 | 6D                |
| Q422              | 5                 | 7C                | R138              | 2                 | 3C                | R254              | 3                 | 2G                | R367              | 4                 | 6D                |
| Q423              | 5                 | 8C                | R139              | 2                 | 2C                | R255              | 3                 | 1G                | R368              | 4                 | 5C                |
| Q428              | 5                 | 8B                | R142              | 2                 | 2D                | R256              | 3                 | 2H                | R369              | 4                 | 6D                |
| Q429              | 5                 | 8B                | R143              | 2                 | 2D                | R257              | 3                 | 1H                | R370              | 4                 | 9C                |
| Q440              | 2                 | 7E                | R144              | 2                 | 2D                | R258              | 3                 | 2G                | R372              | 4                 | 7D                |
| Q441              | 2                 | 7E                | R145              | 2                 | 2D                | R259              | 3                 | 1G                | R373              | 4                 | 7D                |
| Q473              | 5                 | 9C                | R150              | 2                 | 4F                | R261              | 3                 | 1H                | R374              | 4                 | 6C                |
| Q474              | 5                 | 9C                | R151              | 2                 | 4F                | R262              | 3                 | 1J                | R375              | 4                 | 8B                |
| Q476              | 5                 | 9D                | R152              | 2                 | 3F                | R266              | 3                 | 1H                | R381              | 4                 | 10B               |
| Q477              | 5                 | 9D                | R153              | 2                 | 3F                | R279              | 3                 | 2F                | R382              | 4                 | 10B               |
| Q487              | 5                 | 9C                | R154              | 2                 | 3E                | R281              | 3                 | 1F                | R383              | 4                 | 6B                |
| Q501              | 6                 | 10D               | R155              | 2                 | 3E                | R282              | 3                 | 1G                | R384              | 4                 | 10B               |
| Q509              | 6                 | 10C               | R156              | 2                 | 3F                | R283              | 3                 | 2G                | R385              | 4                 | 10B               |
| Q511              | 6                 | 9E                | R158              | 2                 | 3F                | R284              | 3                 | 2G                | R386              | 4                 | 10B               |
| Q525              | 6                 | 7F                | R159              | 2                 | 4F                | R285              | 3                 | 2F                | R387              | 4                 | 10B               |
| Q555              | 6                 | 7E                | R163              | 2                 | 5B                | R286              | 3                 | 2G                | R388              | 4                 | 10B               |
| Q576              | 6                 | 8E                | R164              | 2                 | 4E                | R287              | 3                 | 2G                | R389              | 4                 | 10B               |
| Q578              | 6                 | 8E                | R165              | 2                 | 4E                | R288              | 3                 | 1G                | R390              | 4                 | 10B               |
| Q583              | 10                | 8F                | R166              | 2                 | 4B                | R289              | 3                 | 2G                | R391              | 4                 | 6C                |
| Q586              | 10                | 8F                | R167              | 2                 | 4B                | R292              | 3                 | 3F                | R392              | 4                 | 10B               |
| Q768              | 8                 | 3H                | R168              | 2                 | 4C                | R293              | 3                 | 3F                | R393              | 4                 | 9C                |
| Q770              | 8                 | 3H                | R169              | 2                 | 4B                | R301              | 4                 | 4D                | R394              | 4                 | 5E                |
| Q775              | 8                 | 3G                | R170              | 2                 | 4E                | R302              | 4                 | 3D                | R395              | 4                 | 6E                |
| Q778              | 8                 | 3H                | R171              | 2                 | 4E                | R303              | 4                 | 3D                | R396              | 4                 | 6E                |
| Q779              | 8                 | 4G                | R172              | 2                 | 4E                | R304              | 4                 | 4D                | R397              | 9                 | 6G                |
| Q780              | 8                 | 3H                | R173              | 2                 | 3C                | R305              | 4                 | 4D                | R398              | 9                 | 6G                |
| Q785              | 8                 | 3G                | R174              | 2                 | 4C                | R306              | 4                 | 4D                | R399              | 4                 | 6E                |
| Q789              | 8                 | 3G                | R175              | 2                 | 3E                | R307              | 4                 | 4D                | R400              | 5                 | 7C                |
| Q804              | 10                | 6F                | R176              | 2                 | 3E                | R309              | 4                 | 4C                | R402              | 5                 | 7D                |
| Q814              | 10                | 6F                | R177              | 2                 | 3E                | R310              | 4                 | 5D                | R403              | 5                 | 7D                |
| Q825              | 10                | 3L                | R180              | 2                 | 3E                | R311              | 4                 | 5D                | R404              | 5                 | 7C                |
| Q829              | 10                | 3M                | R181              | 2                 | 3E                | R312              | 4                 | 5D                | R405              | 5                 | 7D                |
| Q835              | 10                | 4M                | R182              | 2                 | 2J                |                   |                   |                   |                   |                   |                   |



A1 - MAIN BOARD

# MANUAL CHANGE INFORMATION

Product: 2235A SERVICE

Date: 4-12-90

Change Reference: M72010

## DESCRIPTION

Product Group 40

### A1 – MAIN BOARD

#### ASSEMBLY A1

| CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION | CIRCUIT<br>NUMBER | SCHEM<br>LOCATION | BOARD<br>LOCATION |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| W101              | 1                 | 6F                | W499              | 11                | 7E                | W954              | 11                | 7G                | W995              | 11                | 9B                |
| W102              | 1                 | 6F                | W535              | 2                 | 8G                | W955              | 11                | 4L                | W997              | 11                | 5F                |
| W199              | 2                 | 5B                | W537              | 2                 | 3L                | W956              | 11                | 8G                | W998              | 11                | 5F                |
| W226              | 3                 | 5B                | W538              | 2                 | 2L                | W957              | 11                | 9G                | W999              | 11                | 3F                |
| W262              | 3                 | 5B                | W551              | 4                 | 6A                | W959              | 11                | 5G                | W9040             | 9                 | 6L                |
| W272              | 11                | 2J                | W552              | 4                 | 6A                | W960              | 11                | 10G               | W9190             | 9                 | 6L                |
| W281              | 3                 | 5B                | W553              | 4                 | 6A                | W961              | 11                | 10G               | W9272             | 3                 | 2H                |
| W282              | 3                 | 5G                | W554              | 4                 | 6A                | W964              | 11                | 4L                | W9273             | 3                 | 1H                |
| W283              | 3                 | 4G                | W592              | 11                | 10D               | W965              | 11                | 3K                | W9440             | 2                 | 2D                |
| W310              | 4                 | 5E                | W602              | 7                 | 8G                | W966              | 11                | 9F                | W9700             | 6                 | 9F                |
| W316              | 4                 | 6C                | W603              | 7                 | 8G                | W968              | 11                | 10G               | W9700             | 7                 | 9F                |
| W343              | 4                 | 6C                | W634              | 7                 | 10G               | W971              | 11                | 9F                | W9700             | 8                 | 9F                |
| W350              | 4                 | 5E                | W635              | 7                 | 9G                | W972              | 11                | 7F                | W9705             | 11                | 7F                |
| W351              | 4                 | 5D                | W636              | 4                 | 6A                | W974              | 11                | 3L                | W9778             | 8                 | 3G                |
| W392              | 4                 | 6A                | W648              | 7                 | 11G               | W975              | 11                | 3K                | W9788             | 8                 | 3G                |
| W399              | 4                 | 6E                | W649              | 7                 | 8G                | W976              | 11                | 9G                | W9800             | 10                | 4M                |
| W408              | 11                | 9B                | W732              | 8                 | 8F                | W977              | 11                | 7G                | W9870             | 10                | 6H                |
| W410              | 5                 | 7D                | W881              | 10                | 5F                | W979              | 11                | 3K                | W9965             | 10                | 10J               |
| W439              | 5                 | 9C                | W885              | 10                | 5J                | W991              | 11                | 7B                | W9991             | 1                 | 7F                |
| W494              | 11                | 6E                | W948              | 10                | 9J                | W993              | 11                | 7C                | W9991             | 10                | 7F                |

Date: 05-09-90

Change Reference: M73007

Product: 2235A INSTRUCTION MANUAL

Manual Part Number: 070-7683-00

**DESCRIPTION**

Product Group 46

**EFFECTIVE SERIAL NUMBER: B015150**

**REPLACEABLE ELECTRICAL PARTS LIST CHANGES**

**DELETE:**

A1W410      131-0566-00      BUS CONDUCTOR: DUMMY RES,0.094 OD X 0.225 L W/WIRELEADS.

**ADD:**

A1R418      313-1100-00      RES,FXD,FILM: 10 OHM,5% 0.2W.

**DIAGRAM CHANGES**

DIAGRAM  TRIGGER P-P AUTO & OUTPUT

Replace W410 with R418 (grid location 4B) 10 Ohm resistor.

