Stan Griffiths

INSTRUCTION MANUAL

326 DUAL-TRACE OSCILLOSCOPE

Serial Number _____

Tektronix, Inc. • P.O. Box 500 • Beaverton, Oregon 97005 • Phone: 644-0161 • Cables: Tektronix

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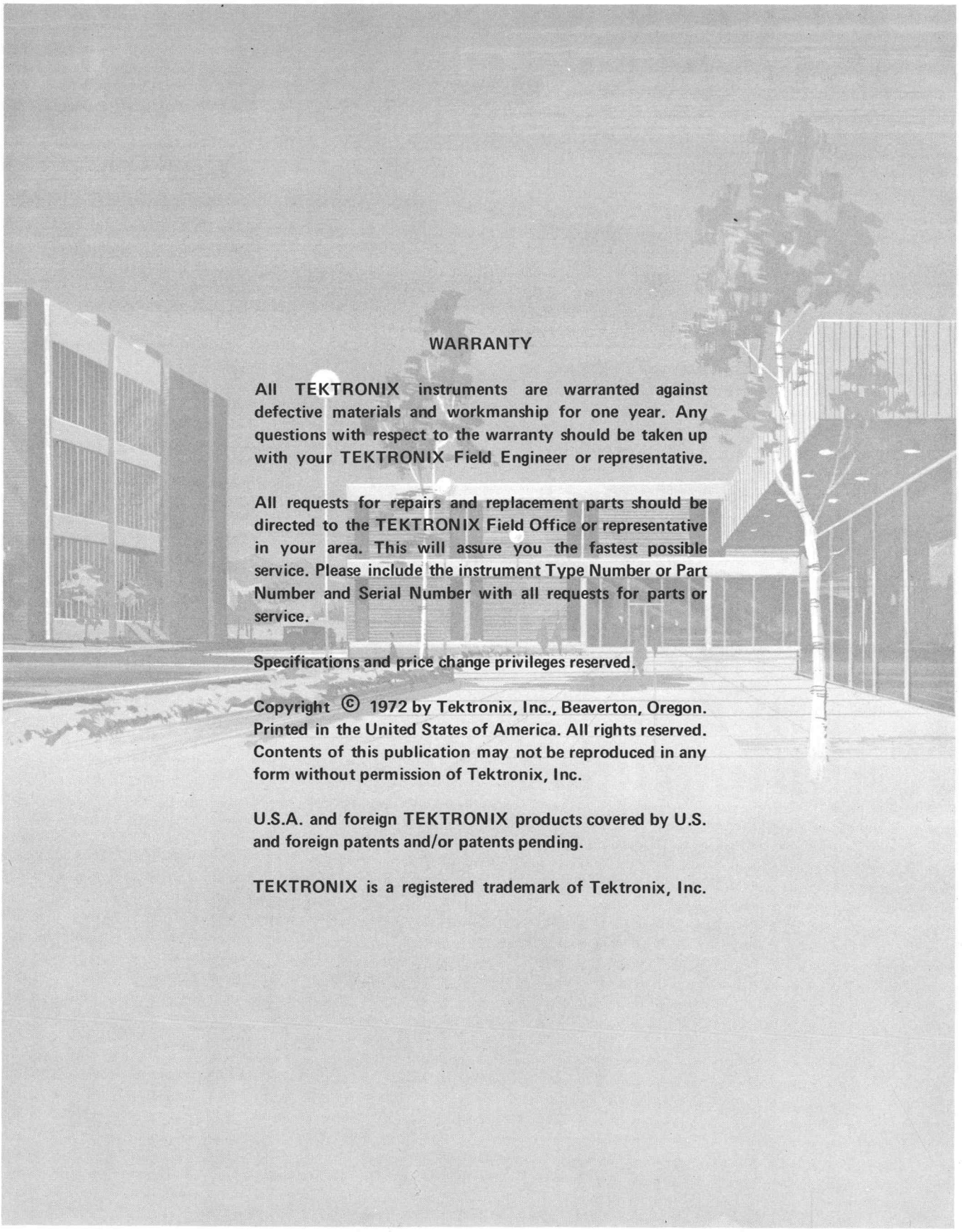

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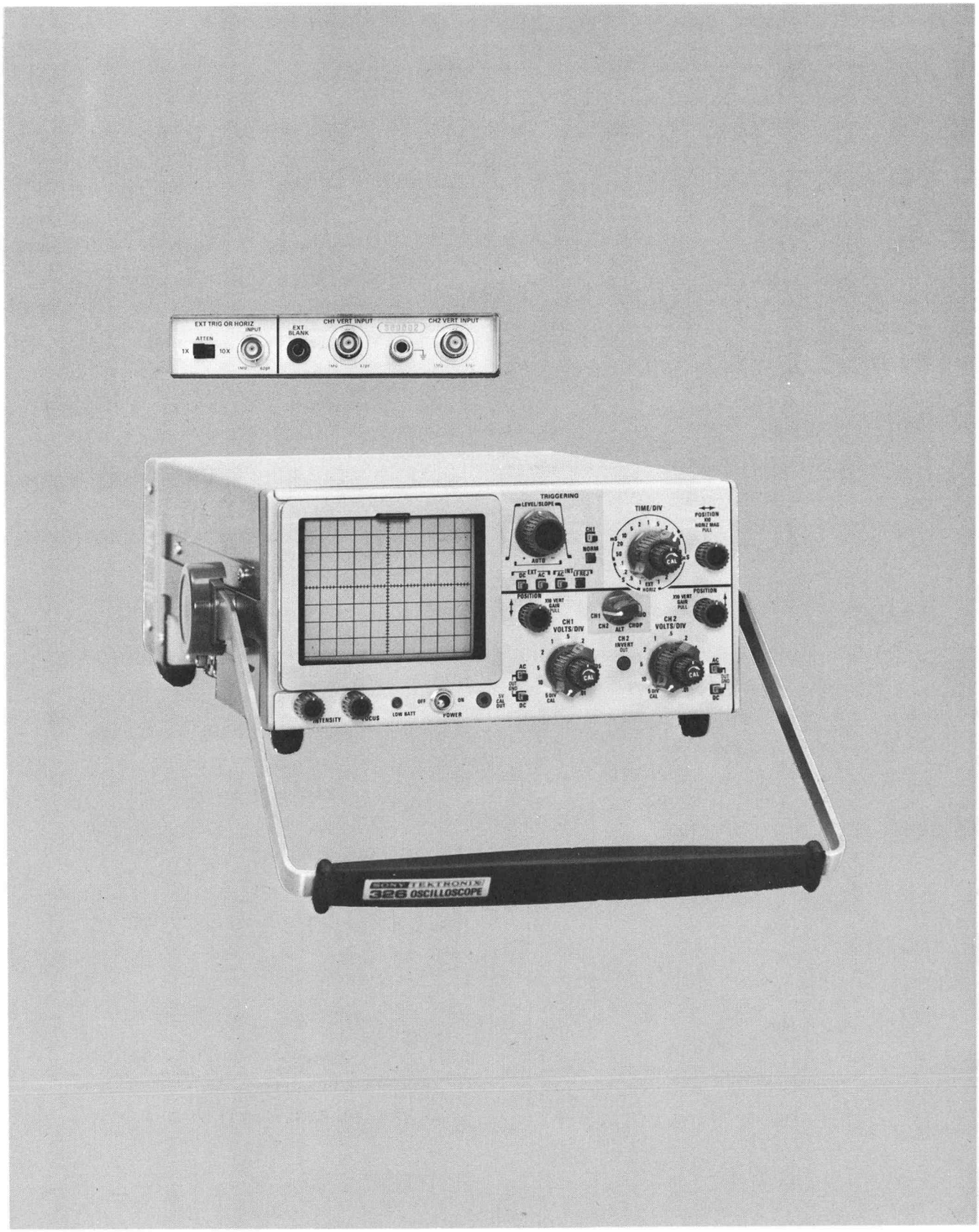
TABLE OF CONTENTS



SONY/TEKTRONIX 326 Oscilloscope.

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326 SPECIFICATION

Introduction

The SONY/TEKTRONIX 326 Oscilloscope is a solid-state portable instrument that combines small size and light weight with the ability to make precision waveform measurements.

A dual-trace DC to 10 MHz vertical system provides calibrated deflection factors from 0.01 Volt/Div to 10 Volts/Div (0.001 Volt/Div minimum with reduced frequency response).

The trigger circuit provides stable triggering over the full vertical bandwidth. A 300 ns delay line in the vertical system allows the operator to view the portion of the waveform on which triggering occurs.

The horizontal deflection system provides calibrated sweep rates from 1 μs/Div to 1 s/Div. A 10X magnifier extends the sweep rate to 0.1 μs/Div.

The 326 can be operated from internal battery, an external DC source, or from the AC line (with battery charger attached).

The following electrical characteristics apply over an ambient temperature range of +20°C to +30°C (+68°F to +86°F). Warmup time for the accuracies given is approximately 10 seconds.

CHARACTERISTICS

VERTICAL AMPLIFIER

Deflection Factor

Ranges: 10 mV/Div to 10 V/Div in X1 Gain and 1 mV/Div to 1 V/Div in X10 Gain. 10 steps in a 1-2-5 sequence. Accuracy within 3% over the calibrated range.

Variable: Variable between calibrated deflection factor settings. Extends the highest deflection factor to at least 25 V/Div.

Attenuator Compensation: +1%, −1%, or less, 0°C to +55°C (+32°F to +131°F). +2%, −2%, or less, −15°C to 0°C (+5°F to +32°F).

Frequency Response

Bandwidth (Variable Volts/Div at CAL, 5 division reference) direct coupled: 1X Gain, DC to at least 10 MHz (upper −3 dB point) with the P6049A Probe. Capacitively coupled, 4 division reference: from 10 Hz or less (lower −3 dB point) at all deflection factors. 1 Hz or less with the P6049A Probe.

Step Response (risetime), 4 division step input: 36 ns or less in X1 Gain and 72 ns or less with X10 Gain.

Aberrations: +2%, −2% with total of 4% or less in all modes except ADD ALG. +3%, −3% with total of 6% or less in ADD ALG Mode.

Input

Maximum Voltage: 500 volts direct coupled (DC + peak AC) or capacitively coupled DC voltage.

Resistance: 1 MΩ, within 2%, direct and 10 MΩ, within 2%, with the P6049A Probe.

Capacitance: 47 pF within 4 pF direct and 13.5 pF or less with the P6049A Probe.

Amplifier

Linear dynamic range in Added Mode: Equal to or greater than 8 times the Volts/Div setting for 10% distortion.

Common-Mode Rejection: At least 20:1 at 2 MHz for a common-mode signal of 80 mV peak-to-peak, Volts/Div set at 10 mV and CH 2 set for maximum CMRR at 50 kHz and 10 mV.

DC Drift

With Time (short term): 0.2 div or less during any minute within the first hour after a 10 second warmup (with temperature and line voltage constant).

Chopped Mode

Repetition Rate: 110 kHz within 20%.

TIME BASE

Sweep Time/Div

Calibrated Range: 1 s/Div to 1 μs/Div in 19 steps in a 1-2-5 sequence. 10X magnifier extends the displayed sweep time to 0.1 μs/Div.

Accuracy, X1 Gain: within 3% over the center eight graticule divisions from 1 μs/Div to 0.2 μs/Div, increasing to 4% from 0.5 s/Div to 1 s/Div.

X10 Gain: within 4% over the center eight graticule divisions, 0.5 μs/Div to 20 ms/Div, increasing to 5% at 0.1 μs/Div, 0.2 μs/Div, 0.1 s/Div, and 50 ms/Div.

Variable: at least 2.5:1.

Trigger

Internal: DC to 10 MHz on signals causing 1.0, or more, division of vertical deflection and to approximately 1.0 MHz on signals causing 0.3 division of vertical deflection.

External: DC to 10 MHz on signals of 500 mV or more, decreasing to approximately 1.0 MHz on signals of 150 mV.

Coupling: AC attenuates signals below 30 Hz; LF REJ attenuates signals below 50 kHz.

External Level Range: Atten at X1, +0.8 V to −0.8 V; Atten at X10, +8 V to −8 V.

Maximum Input Voltage: 300 V (DC + peak AC).

CALIBRATOR

Output

Voltage Accuracy (into a load of 1 MΩ or greater): 0.5 V, within 1% from +20°C to +30°C (+68°F to +86°F), decreasing to within 2% from −15°C to +20°C (+5°F to +68°F) and +30°C to +55°C (+86°F to +131°F).

Duty Cycle: 40% to 60%.

Resistance: Approximately 10 kΩ.

EXTERNAL HORIZONTAL INPUT

Deflection Factor

Horiz Mag X10, Ext Atten 1X: 15 mV/Div to 25 mV/Div.

Horiz Mag off, Ext Atten 1X: 150 mV/Div to 250 mV/Div.

Horiz Mag X10, Ext Atten 10X: 150 mV/Div to 250 mV/Div.

Horiz Mag off, Ext Atten 10X: 1.5 V/Div to 2.5 V/Div.

Bandwidth

DC to at least 200 kHz (upper −3 dB point).

Dynamic Range

At least 20 divisions (+2.5 volts to −2.5 volts) with EXT TRIG OR HORIZ ATTEN switch set to X10, and EXT HORIZ Variable control set to CAL.

Variable Range

At least 10:1.

EXTERNAL BLANKING

Sensitivity

DC Coupled: +5 volts to +20 volts.

Usable Frequency Range

To approximately 100 kHz.

Input Voltage

Maximum: 50 V (DC + peak AC).

CRT DISPLAY

Graticule Area

8 X 10 one-fourth inch divisions.

Geometry

Within 0.1 division.

POWER SOURCE

Power Line

Voltage Ranges (Battery Charger): 90 V to 136 V and 180 V to 272 V.

Frequency (Battery Charger): 48 Hz to 440 Hz.

Maximum Power Consumption: 35 VA, with 136 volt AC line, a 10 MHz 6-division signal displayed, full intensity, and full charge rate.

External DC

Voltage Range: +9 V to +32 V.

Maximum Power Consumption: 12 watts, with 10 MHz, 6-division signal displayed and full intensity.

INTERNAL BATTERY SUPPLY

Battery

9 size C, 1.5 AH NiCd cells.

Charge Time

Full Charge (instrument off): at least 16 hours.

Operating Time, +20°C to +25°C (+68°F to +77°F) charge temperature and +10°C to +30°C (+50°F to +86°F) operating temperature:

15 μA or less cathode current

Calibrator Waveform displayed: 4 hours or greater.

6 divisions of 10 MHz signal displayed: 1.8 hours or greater.

315 μA cathode current (full intensity)

Calibrator waveform displayed: 2.5 hours or greater.

6 divisions of 10 MHz signal displayed: 1.5 hours or greater.

ENVIRONMENTAL

Temperature

Nonoperating: −40°C to +75°C (−40°F to +167°F).

Operating: −15°C to +55°C (+5°F to +131°F).

Charging: 0°C to +40°C (+32°F to +104°F).

Altitude

Nonoperating: to 50,000 feet.

Operating: to 15,000 feet. Maximum allowable ambient temperature decreases by 1°C/1000 feet from 5,000 feet to 15,000 feet.

OPERATING INSTRUCTIONS

General

This section explains power source requirements, describes the functions and uses of controls and connectors, and gives first time and general operating information.

POWER SOURCE REQUIREMENTS

General

The 326 may be powered from either the internal Battery Pack (nine NiCd cells connected in series) or on an external DC voltage source ranging from +9 volts to +32 volts.

The internal battery pack is removable and may be charged (while in the instrument or externally) by the battery charger.

Typical operating time from a fully charged battery pack is approximately 4 to 5 hours. Actual operating time varies with sweep rate, the displayed signal frequency and amplitude, display brightness, and the ambient temperature during cell charge.

Internal Battery Operation

Sliding the power source switch to the BATT OR AC ADPT position connects the internal battery to the 326 front-panel POWER switch. Internal battery powered operation is not possible with the source switch in the EXT DC POWER position.

Internal battery powered operation should be discontinued after the LOW BATT lamp starts flashing. The battery should immediately be put on charge or the battery pack should be replaced with a fully charged pack.

If the internal battery-powered operation is continued after the LOW BATT lamp starts flashing, the trace will disappear in a short time and the LOW BATT lamp will stop flashing; damage to some of the NiCd cells might result.

If the cells must be removed from the battery pack, use the following procedure:

WARNING

The cells used in the battery pack are capable of delivering a large amount of energy in a short time. Rings, watch bands and other metallic items that might short circuit the battery can rapidly become hot enough to cause severe burns.

Cell Removal (see Fig. 2-1)

1. Remove the three machine screws from the left edge of the Battery Pack front panel.

2. Remove two machine screws from the rear (same edge as those removed from the front) panel.

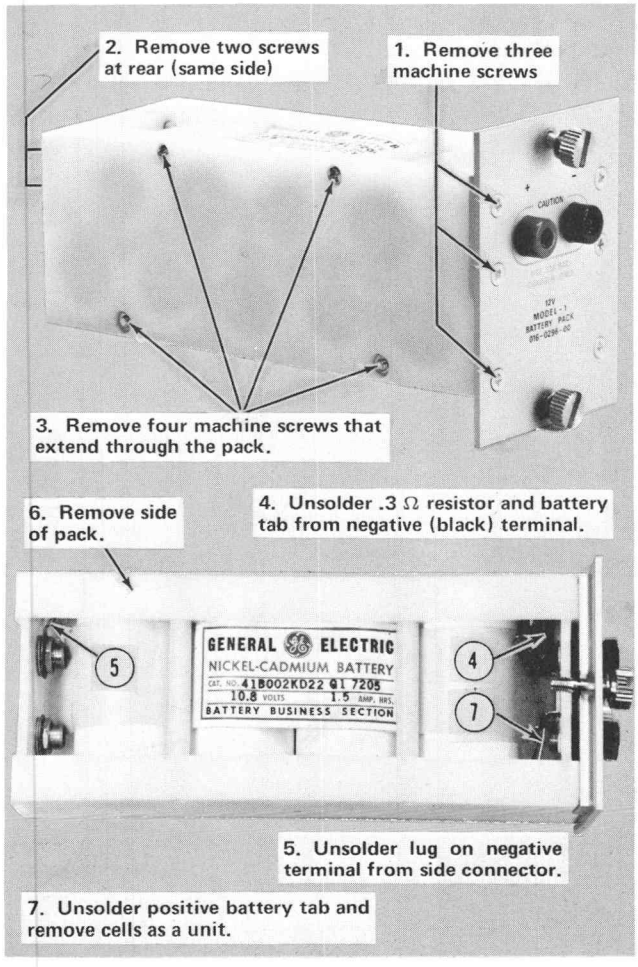


Fig. 2-1. Battery Pack cell removal.

3. Remove the four machine screws that extend through the pack.

4. Carefully unsolder the copper strap and bare wire from the connector lug at the front end.

5. Unsolder connector lug from side-panel conductor at the rear of the pack.

6. Lift the side away from the pack.

7. Unsolder the copper strap from the negative connector lug.

8. Carefully lift the cells (as a unit) away from the case. Do not allow the copper cell tabs to contact each other while removing cells.

External DC-Powered Operation

The instrument can be powered by an external DC source between +9 and +32 volts. The Power Source switch must be in the EXT DC POWER position and the external supply must be connected to the + (red) and — (black) connectors on the rear panel of the instrument. The external DC source will not charge the internal battery.

CAUTION

Applying external DC power with the polarity reversed will cause the Power Regulator fuse, F870 on the Horizontal circuit board, to open.

Battery Charger

The internal battery pack may be charged either within or outside the instrument. When charging the battery pack inside the instrument the battery charger attaches to the rear of the instrument.

Instrument operation can be continued while the internal battery is charging or a spare battery pack can be charged while the instrument operates on internal battery.

The battery pack may be charged in the instrument while the instrument is operating on an external DC source.

Slip-on connectors in the battery charger must be connected to match the line voltage to be used. The internal fuse must be changed when the AC line voltage is changed. Use a 0.4 A fuse for 115-volt operation and a 0.2 A fuse for 230-volt operation. See Fig. 2-2.

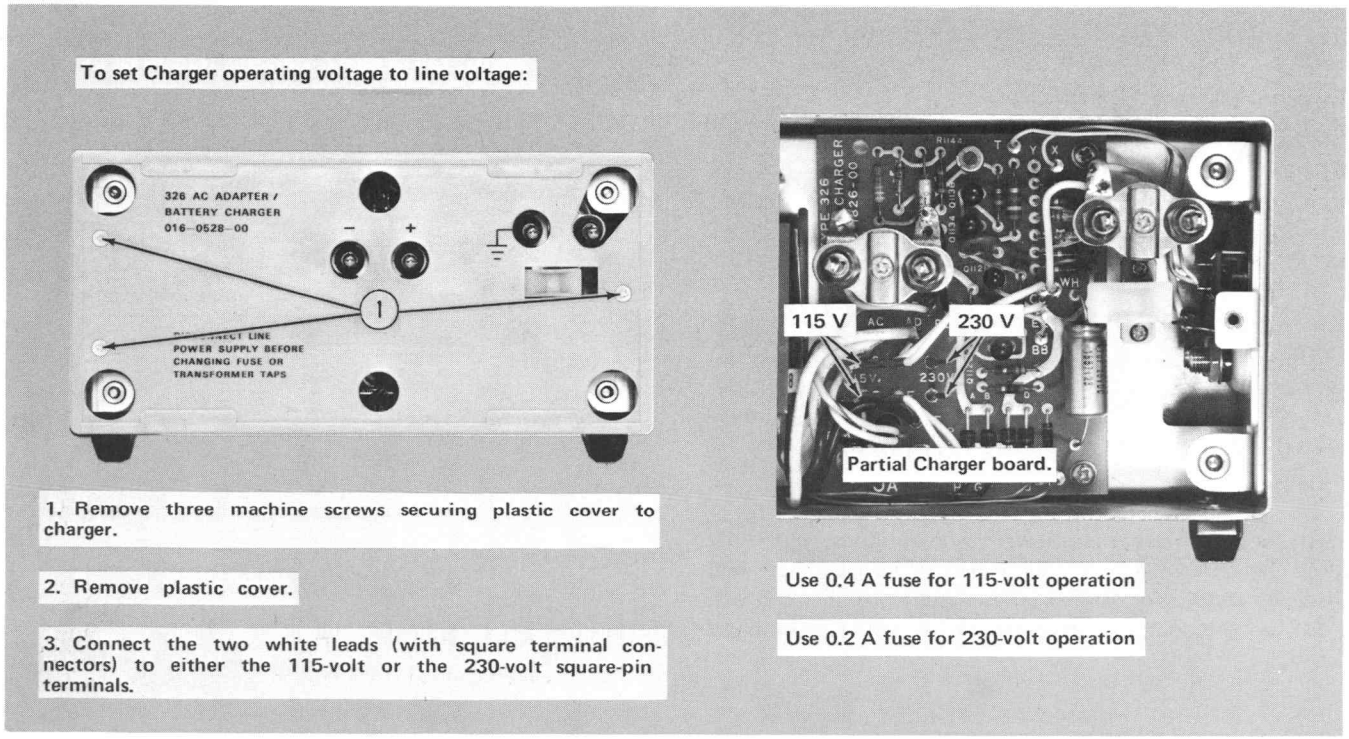


Fig. 2-2. Location of line-voltage selection terminals.

Battery Charging

Although the battery contained in the 326 is charged before packaging, it should be recharged for 16 hours at FULL CHG rate before being put into service.

The charging characteristics of NiCd cells vary with cell temperature during charge. The energy delivered is inversely proportional to the cell temperature during the first three-fourths to seven-eighths of the full charge cycle.

If NiCd cells become reverse charged, their capacity for recharging can be impaired or destroyed. An imbalance between cells in a battery can develop during operation or during partial charging. It is possible for the imbalance to become so great that during discharge the weakest cells completely lose their charge and become reverse charged by the current from the charged cells.

To avoid reverse charging one or more cells, fully charge the battery after each discharge (16 hours) on FULL CHG. Although partial recharge is not recommended as a common practice, occasional recharges can be tolerated. About 30 to 45 minutes of operating time can be expected for each hour of charge.

In addition, the battery should be charged at the FULL CHG rate for 24 hours approximately once a month or every 15 charge/discharge cycles. Once the battery has been fully charged, the charge rate should be set to TRICKLE. The trickle charge rate provides only enough current to offset the internal losses, and will keep the battery fully charged.

FUNCTION OF EXTERNAL CONTROLS, CONNECTORS AND INDICATORS

General

The controls, connectors, and indicators listed are contained on the external surfaces of the 326, and are used during routine oscilloscope operation. All other controls are inside the instrument covers and should be adjusted only during instrument calibration.

The external control, connector, and indicator nomenclature is shown in CAPITAL letters wherever it appears in this manual.

Front Panel (see Fig. 2-3)

POWER ON-OFF — Two position toggle switch. Connects the oscilloscope circuitry to the power source.

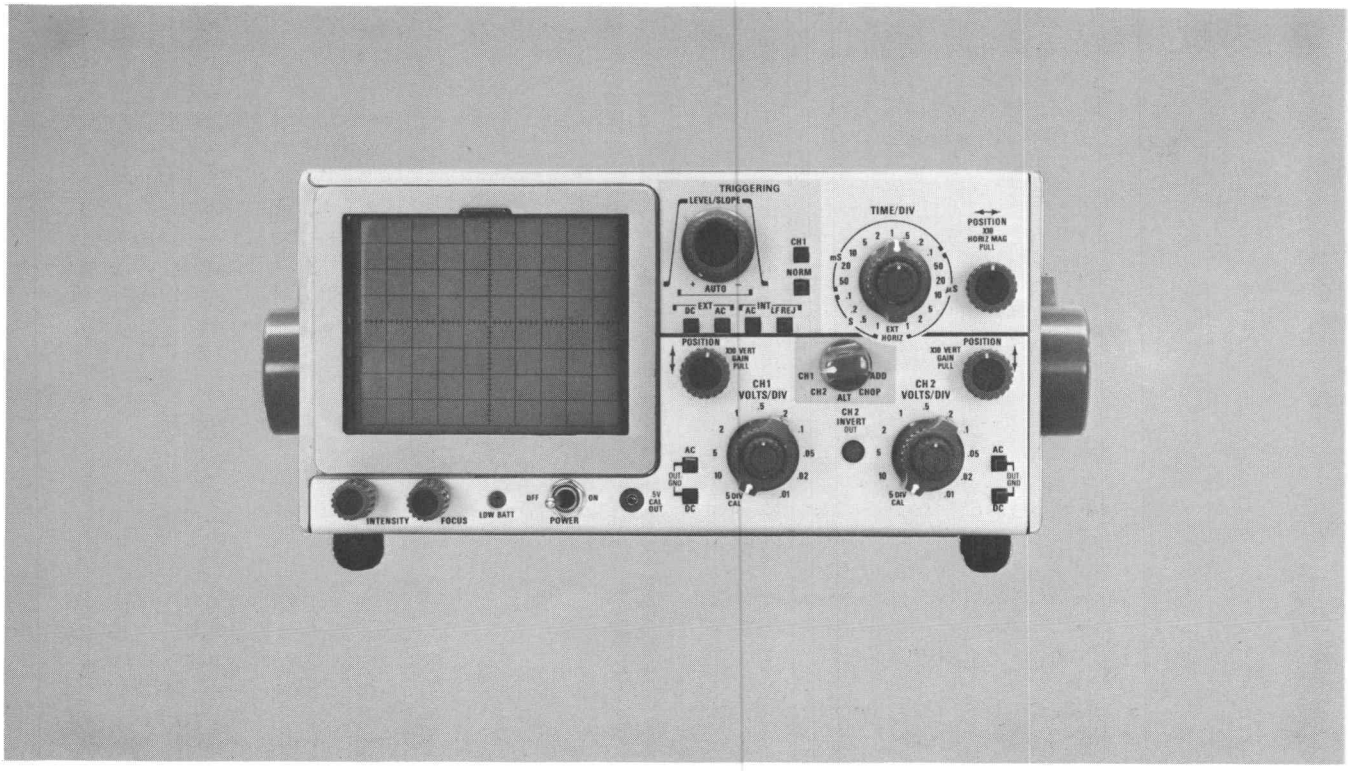


Fig. 2-3. 326 Front panel.

LOW BATT — Indicator lamp. During battery operation, the lamp flashes to indicate that internal battery voltage is low. If the battery voltage is sufficiently low the lamp will stop flashing and the instrument will stop operating. To distinguish this condition from equipment failure, connect the charger at FULL CHG rate for a few minutes. Then disconnect the charger and check for oscilloscope operation and LOW BATT indicator lamp operation.

CH 1 VOLTS/DIV — Selects calibrated deflection factors from 0.1 Volts/Div to 10 Volts/Div (Variable in CAL position and X10 GAIN pushed in). When set to the 5 DIV CAL position, a 5-division square-wave calibrator signal is displayed.

Variable — Varies Volts/Div between calibrated steps. Range is at least 2.5X. The uncalibrated range is extended to 25 Volts/Div.

CH 1 Input Coupling Switch

AC — Capacitively couples the input signal to the input attenuator.

GND — Grounds the input attenuator (both pushbuttons out) and connects the signal through 470 kΩ and 0.0185 μF to ground.

NOTE

The GND configuration (both AC and DC buttons out) provides a precharge circuit. The input coupling capacitor charges to the DC level of the input signal. This precharge feature prevents offscreen deflection which occurs when connecting a signal to the input with the AC button pushed. Always use the precharge feature before connecting the signal to the input (with both buttons out, connect the signal to the input and then push the AC button).

DC — Couples the input signal directly to the input attenuator.

Vert Position — Vertically adjusts the display position.

X10 GAIN — Pull the POSITION control knob to increase the vertical gain by a factor of 10. Extends the calibrated deflection factor to 1 mV/Div. Bandwidth is reduced to 5 MHz.

CH 2 — VOLTS/DIV, Variable, input coupling switches, POSITION and X10 GAIN provide the same functions as those of CH 1.

Mode Selector

CH 1 — Displays channel 1 only.

CH 2 — Displays channel 2 only.

ALT — Displays channel 1 and channel 2 alternately. When both channels are displayed, the channels are switched electronically during beam retrace interval.

CHOP — Displays channel 1 and channel 2 simultaneously.

ADD — Displays the algebraic sum of the signals applied to channels 1 and 2.

CH 2 INVERT — Channel 2 display is inverted with the INVERT switch in the OUT position.

TIME/DIV — Selects the horizontal sweep rate. Sweep rates are 1 μs/DIV to 1 s/DIV in a 1-2-5 sequence, plus an EXT HORIZ position. In the EXT HORIZ position horizontal deflection depends on signal applied to the EXT HORIZ INPUT connector on the side panel.

NOTE

For external sweep, the EXT Trigger Selector button must be pushed.

Variable — Varies the TIME/DIV between calibrated steps. Range is at least 2.5X. The uncalibrated sweep rate is extended to 2.5 s/Div. With the TIME/DIV selector in the EXT HORIZ position, the Variable control attenuates the external horizontal signal from 1X to 10X.

POSITION X10 HORIZ MAG — Horizontally positions the display. Pull the POSITION X10 HORIZ MAG knob to increase the horizontal gain by a factor of 10 (the sweep expands from graticule center). X10 magnification extends the fastest displayed sweep rate to .1 μs/DIV.

EXT (pushbuttons) — Triggers the sweep from a trigger signal applied to the EXT HORIZ INPUT (side panel).

AC — Capacitively couples the external trigger signal. Low frequency cutoff is about 30 Hz.

DC — Triggers on DC level changes as well as AC signals.

INT (pushbuttons) — Triggers the sweep on the signal applied to the Vertical Input(s).

AC — Capacitively couples the internal trigger signal. Low frequency cutoff is about 30 Hz.

LF REJ — Capacitively couples the internal trigger signal. Makes high frequency triggering more dependable by rejecting frequency components below about 50 kHz.

CH 1-NORM (pushbuttons) — Selects the internal triggering source. NORM button selects an internal signal, dependent on the position of the Mode switch. CH 1 button selects Channel 1 only as the trigger source.

LEVEL/SLOPE — Selects the level and slope of the displayed signal on which triggering occurs. In the fully ccw position, triggering is automatic on the positive-going (+) trigger signal. In the fully cw position, triggering is automatic on the negative-going (-) triggering signal. Between the two extreme positions the control selects the triggering level on either the + or – slope. AUTO triggering provides a baseline in the absence of triggering signal, but triggering is normal on recurrent signals.

INTENSITY — Adjusts the display brightness. Display brightness affects battery operating time.

FOCUS — Adjusts for a sharp, well defined trace. Interacts somewhat with the INTENSITY control.

LOW BATT — Indicator light flashes when battery needs recharging. Does not flash when battery is completely discharged.

POWER OFF-ON — Switches power to the oscilloscope circuits. Does not affect battery charging.

.5 V CAL OUT — Source of calibration square wave. 0.5 volts, peak to peak.

Side Panel

EXT TRIG OR HORIZ INPUT — Apply external trigger or external horizontal input signal to this BNC connector.

ATT X1-X10 Switch — Selects attenuation factor (X1 or X10) for the external signal.

INSTRUMENT FAMILIARIZATION

This procedure provides a means of quickly checking the operation of the 326.

Preliminary

Preset the front-panel controls as follows:

LEVEL/SLOPE	+AUTO
AC–LF REJ	AC
CH 1–NORM	CH 1
TIME/DIV	1 ms
Variable	CAL
Horiz POSITION	midrange
X10 HORIZ MAG	pushed in
Mode	CH 1
CH 1 and CH 2	
VOLTS/DIV	5 DIV CAL
Variable	CAL
Input AC–DC	DC
Vertical POSITION	midrange
X10 GAIN	pushed in
INTENSITY	midrange
FOCUS	midrange

Set rear-panel EXT DC POWER-BATT OR AC ADPT switch to BATT OR AC ADPT.

1. Check Battery Charge Level

a. Switch POWER switch to ON.

b. CHECK—The LOW BATT Indicator should not flash.

c. If LOW BATT Indicator flashes, charge the battery pack, replace the battery pack with a fully charged pack, or operate on an external DC supply. Proceed with the checkout.

d. The lower portion of the calibrator signal should appear within the graticule area. Adjust FOCUS and INTENSITY for suitable viewing. Vertically position the bottom of the display to the bottom graticule line. Horizontally position the start of the display to the first graticule line (left).

2. Check Vertical Deflection Factor

a. CHECK—The amplitude of the displayed square wave should equal 5 divisions.

b. Pull out the CH 1 X10 VERT GAIN control knob.

c. CHECK—The display amplitude should equal 5 divisions.

3. Check Probe Compensation

a. Connect a P6049A Probe to the CH 1 VERT INPUT connector. Set CH 1 VOLTS/DIV selector to .01 V, TIME/DIV to 1 ms, and Mode to CH 1.

b. Touch the probe tip to the CAL OUT jack and check the display for proper probe compensation (see Fig. 2-4).

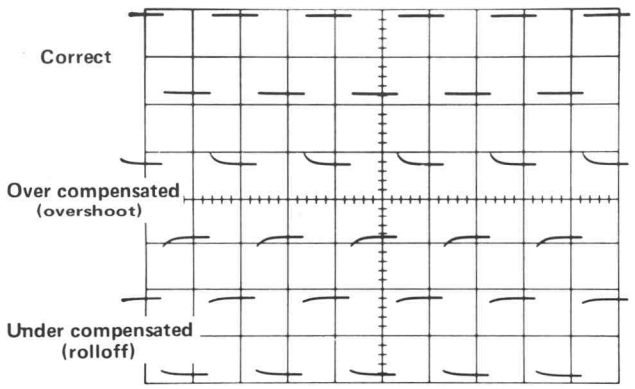


Fig. 2-4. Probe Compensation.

c. If necessary, adjust the probe compensation for the best front corner response to the square waves as shown in Fig. 2-4.

4. Check Trigger Sensitivity and Polarity

a. Set CH 1 VOLTS/DIV selector to 1 volt, TIME/DIV to 1 ms, push INT AC and CH 1 buttons. Pull out the CH 1 X10 VERT GAIN control and apply the CAL OUT signal to CH 1 VERT INPUT and to EXT TRIG OR HORIZ INPUT by means of patch cords.

b. Adjust the CH 1 VOLTS/DIV Variable control for a 3-division display amplitude.

c. CHECK—For stable triggering on the + slope and on the – slope of the displayed signal (turn the LEVEL/SLOPE control throughout its range and check for proper triggering). Check for stable triggering in both + AUTO and – AUTO.

d. Connect the CAL OUT signal to CH 2. Switch CH 2 VOLTS/DIV to 1 V, Mode to CH 2, and CH 1—NORM to NORM.

e. Adjust the CH 2 VOLTS/DIV Variable control for a 3-division display amplitude.

f. CHECK—For stable triggering on the + slope and on the – slope of the displayed signal, including the + AUTO and – AUTO positions.

g. Reconnect the CAL OUT signal to both CH 1 VERT INPUT and EXT TRIG OR HORIZ INPUT.

h. Switch Mode to CH 1, TRIGGERING to EXT AC, CH 1—NORM to CH 1.

i. CHECK—For stable triggering on the + slope and – slope, including the + AUTO and – AUTO positions.

5. Check External Horizontal

NOTE

In the Ext Horiz mode, the internal sweep is disabled and the CRT beam is unblanked. Consequently, a brighter than normal stationary spot will appear on the CRT face unless an external sweep is applied. The INTENSITY setting should be changed to reduce the brightness level consistent with good viewing.

a. Apply the CAL OUT signal to the EXT TRIG OR HORIZ INPUT connector using a patch cord.

b. Set the EXT TRIG OR HORIZ ATTEN to 1X.

c. Set the TIME/DIV to EXT HORIZ and TRIGGERING Coupling to EXT AC.

d. Check for two spots separated by approximately 3 divisions.

e. Set the EXT TRIG OR HORIZ ATTEN to 10X. Horizontally center the display.

f. Note that the distance between the two spots decreases by a factor of 10.

g. Pull the X10 HORIZ MAG. Position horizontally as necessary to keep the display approximately centered.

h. Note that the distance between spots increases by a factor of approximately 10.

Charging the Battery (Battery Pack out of the Instrument)

Plug the battery charger banana plugs into the battery pack banana jacks, being sure that the polarity is correct (mount the charger in the same position relative to the battery pack that it would be in if charging the battery pack in the instrument).

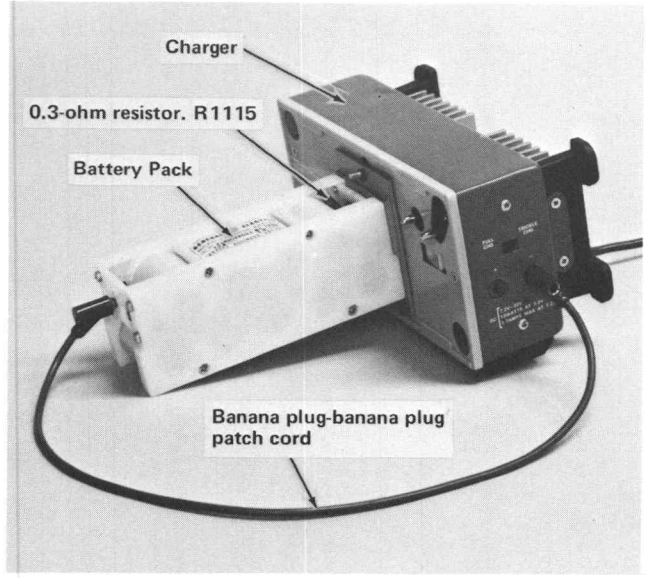


Fig. 2-5. Ground connection required to charge Battery Pack outside of instrument.

Connect a banana-banana patchcord from the negative (gnd) battery pack output terminal to the negative (gnd) external DC supply banana jack. See Fig. 2-5.

Plug the AC power cord into the charger and connect to the power line. Set the FULL CHG—TRICKLE switch to FULL CHG.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the 326 Oscilloscope. A brief description of the instrument block diagram (preceding the foldout circuit schematics) is followed by a somewhat more detailed description of the individual blocks. Since the Power Regulator contains unique circuits, additional detail is provided.

If more information is desired on the commonly used circuits, refer to the following textbooks:

TEKTRONIX Circuit Concepts Books (order from your local TEKTRONIX Field Office or representative).

Cathode Ray Tubes, TEKTRONIX Part Number 062-0852-01.

Horizontal Amplifier Circuits, TEKTRONIX Part Number 062-1141-00.

Oscilloscope Trigger Circuits, TEKTRONIX Part Number 062-1056-11.

Power Supply Circuits, TEKTRONIX Part Number 062-0888-00.

Sweep Generator Circuits, TEKTRONIX Part Number 062-1098-01.

Vertical Amplifier Circuits, TEKTRONIX Part Number 062-1145-01.

Phillip Cutler, "Semiconductor Circuit Analysis", McGraw Hill, New York, 1964.

Lloyd P. Hunter, "Handbook of Semiconductor Electronics", second edition, McGraw Hill, New York, 1962.

Millman and Taub, "Pulse, Digital, and Switching Waveforms", McGraw Hill, New York, 1965.

BLOCK DIAGRAM DESCRIPTION

Intrument Block

The block diagram shows only the basic interconnections between individual blocks (see the foldout Block Diagram preceding the Schematic foldouts at the rear of the manual).

Signals applied to the vertical inputs are applied to the Vertical Preamp through the input coupling selector switch and the input step attenuators.

The Vertical Preamps contain gain, balance, and positioning controls as well as controls for setting the CRT vertical deflection plate DC levels.

A five division calibration signal is introduced into each channel via the input attenuators.

Signal is picked off at channel 1 preamp output for use as triggering signal.

The two vertical channels are switched electronically by the channel switching multi and gating diodes to provide five modes of operation: CH 1, CH 2, ALT, CHOP, and ADD.

Signal is picked off ahead of the delay line to provide trigger signal from whichever signal is being gated through to the output amplifier.

A 300 ns delay line provides sufficient signal delay to the CRT vertical deflection plates to allow observation of the transition which triggers the sweep.

The Output Amplifier provides high frequency compensation, and the current capability to drive the vertical deflection plates.

The Trigger Preamp selects the trigger source and amplifies the signal selected to a level compatible with the trigger generator input.

The trigger source (either the signal from the Trigger Preamp or the EXT TRIG) and the method of coupling are selected in the Trigger Generator. The trigger signal selected is coupled to a DC comparator amplifier to select the point on the signal at which triggering occurs. A switch in the comparator output selects trigger polarity. The signal is then shaped in the Schmitt multi and is coupled to the Sweep Generator to start the sweep voltage runup.

The Sweep Generator is a Miller integrator (runup) which provides a linear sawtooth voltage to the horizontal amplifier. A gate-amplifier circuit provides signal to the CRT to blank the trace during the retrace interval.

The Horizontal Amplifier contains adjustable components to set horizontal X1 Gain, X10 Gain, and positional registration in the magnified mode. The output circuitry provides drive to the CRT horizontal deflection plates.

The Power Regulator derives all of the regulated operating voltages from the DC source voltage (internal battery or external DC source). Adjustments are provided to set the CRT beam accelerating potential, focus, beam intensity, and the + and − 5-volt supply levels.

The Battery Charger circuit provides current either for charging the battery in about 16 hours or a trickle charge which just offsets the internal losses of a fully charged battery. An internal adjustment sets the charge current level.

BASIC BLOCK DESCRIPTION

Introduction

This section describes briefly each of the basic circuits. The description of each block is keyed to the circuit schematic (foldout at rear of manual), i. e., (2) indicates schematic No. 2, CH 1 Vertical Preamplifier.

Ch 1 Vertical Preamplifier (2)

Input Coupling. Determines the method of coupling the signal to the amplifier input (AC—DC—GND).

Attenuators. Conventional frequency compensated step attenuators which maintain the input RC at 1 MΩ and 47 pF in each of the 10 switch positions.

Input. D30 through D33 prevent overdrive to the input FET, Q31A. R36 permits adjustment for any differences in the characteristics of Q31A and Q31B, which are electrically and thermally paired.

The first amplifier stage is a feedback amplifier consisting of the paraphase configuration Q41A and Q41B and the common-base section Q51-Q52 and Q53-Q59. R41 (X10 Vert Gain) adjusts the gain in the X10 switch (S40) position. R37 (Var Volts/Div Bal) adjusts Q41A and Q41B collector loads to prevent display shift as the VOLTS/DIV Variable is rotated throughout its range.

A push-pull emitter follower, Q55-Q57 drives the push-pull amplifier Q61-Q71. X1 Gain calibration and Volts/Div Variable are adjusted in the common-emitter circuit and display vertical position is adjusted in the collector circuits.

Q81-Q91-Q88-Q99 is a push-pull feedback amplifier in which the upper and lower deflection plate DC levels are adjusted.

Q95 and Q98 supply CH 1 signal to the triggering selector circuit.

Calibrator (shown on schematic (1)). The calibrator (an astable multi, Q1 and Q9, and a precision voltage divider) provide a 0.5-volt square wave to the front-panel CAL OUT jack, and to the Input FET via the 5 DIV CAL position of each (CH 1 and CH 2) attenuator switch.

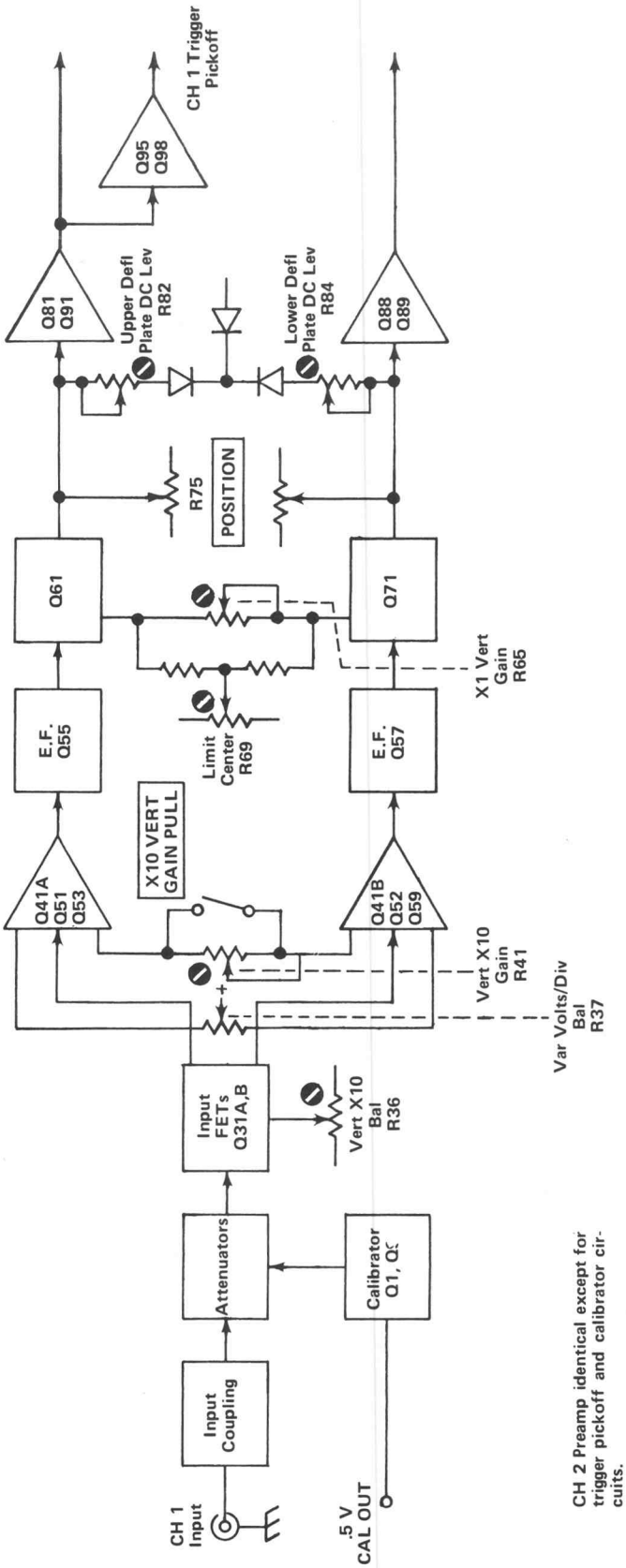
CH 2 Vertical Preamplifier (diagram (4)). Same as CH 1 Vertical Preamplifier except for Trigger Pickoff and Calibrator.

Vertical Switching and Output (5). Q333-Q343-Q355, a multivibrator with several operating modes, provides channel switching by gating the signal through the appropriate diodes in the switching matrix (D311 through D313 and D315 through D318). The operating modes (selected by the Mode switch) are:

CH 1. +5 volts is applied to Q333 base divider resistor, R342, and to D316-D317, blocking CH 2, gating only CH 1 through to the Output Amplifier.

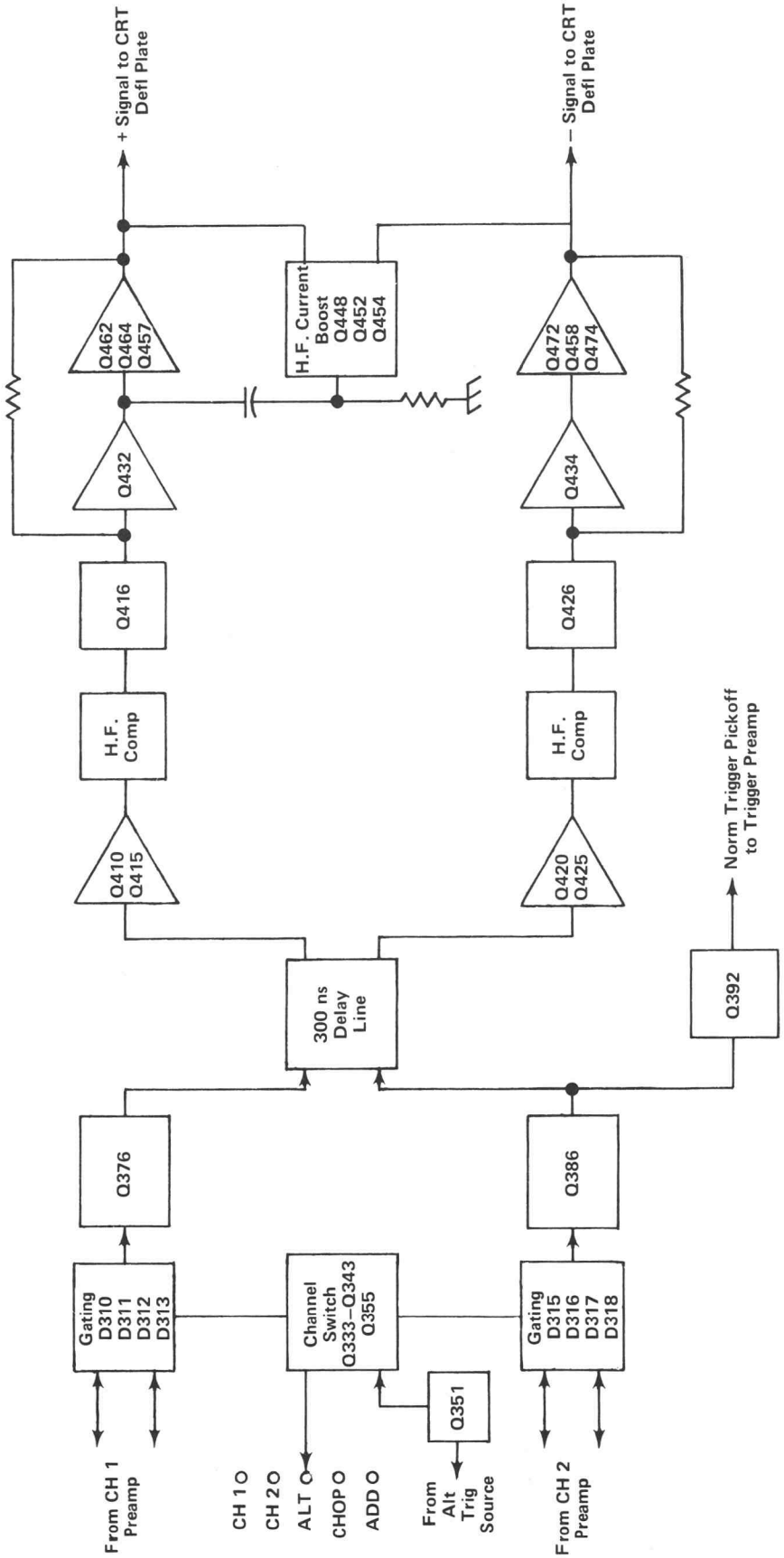
CH 2. Applies +5 volts to Q343 base divider resistor, R332, and to D311-D312, blocking CH 1, gating only CH 2 through to the Output Amplifier.

CHOP. Applies +5 volts to the junction of R335-R345. The switching circuit operates as an astable (free running) multi at a 110 kHz rate, alternately gating CH 1 and CH 2 into conduction. Since the switching rate is fixed (not dependent on trigger signal) both signals are displayed simultaneously on the viewing screen. A signal is taken



CH 1 Vertical Preamplifier (2)

CH 2 Preamp identical except for trigger pickoff and calibrator circuits.



Vertical Switching and Output Amplifier (5)

from the junction of C335-C345, amplified in Q361, and fed to the blanking circuit via D668, (7), to blank the CRT beam during the switching interval.

ALT. Collector voltage supply is connected to Q351 via R350. Trigger signal from the Alt Trigger Source, (6), is connected to the steering diodes, D335 and D345. The channel switched on depends on the last previous condition of the multi (which side was turned on). Each incoming trigger switches the multi, turning one set of channel switching diodes on and turning the other set off. Channel 1 and Channel 2 are displayed alternately.

ADD ALG. +5 volts is applied to the junction of R370-R380, gating both channels through to the Output Amplifier, displaying the algebraic sum of the two signals.

The amplifier following the gating is a common-base pushpull amplifier (Q376-Q386) driving the 300 ns delay line. Norm trigger is picked off at Q386, amplified in Q392 and fed to the Trigger Source switch, (6).

The feedback amplifier Q410-Q415, Q420-Q425, is followed by the high frequency compensation network. Common-base stage Q416-Q426 feeds the Output feedback amplifier, Q432-Q457-Q462-Q464 and Q434-Q458-Q472-Q474.

Amplifier Q448-Q452-Q454 provides deflection plate current boost for high frequency signals.

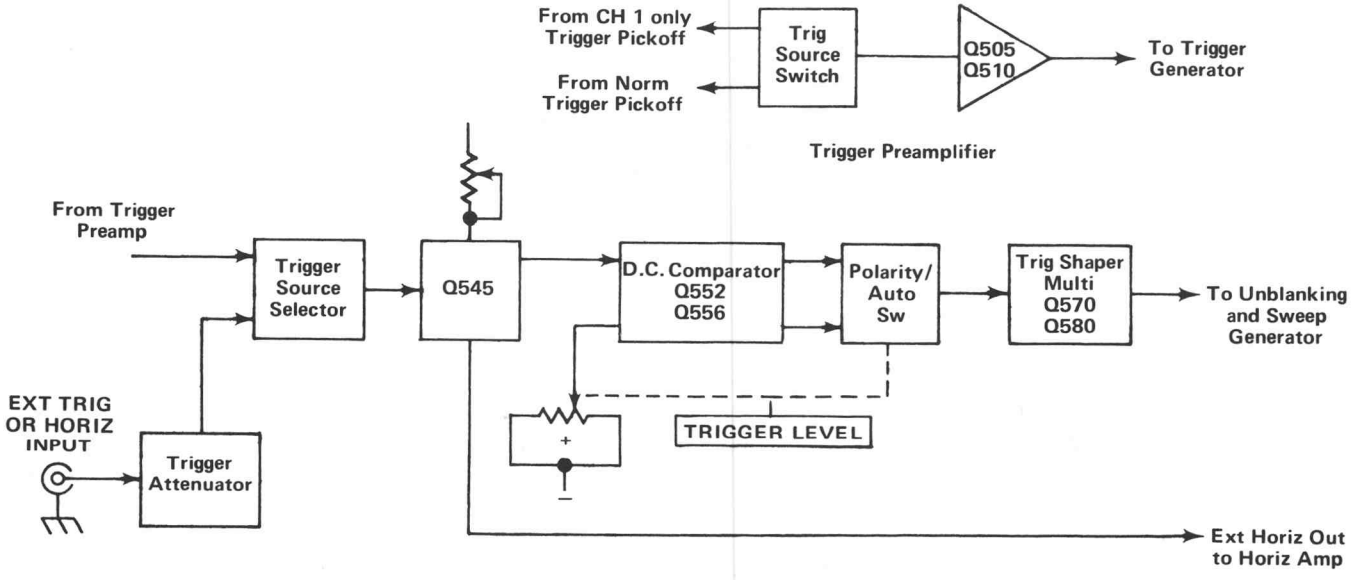
Trigger Preamplifier. Trigger source (CH 1 ONLY or NORM) is selected by S500, amplified by feedback amplifier Q505-Q505, and fed to the Trigger Generator, (6).

Trigger Generator. S540 (TRIGGERING SOURCE-COUPLING) selects trigger from either the Trigger Preamplifier, (6), or the EXT TRIG OR HORIZ INPUT connector (side panel). Signal is passed via a voltage limiting network to FET Q545, through switching (part of Trigger and part of TIME/DIV switches) and fed to a DC comparator amplifier, Q552-Q556, where the incoming trigger signal is compared to a DC level to set the point on the trigger signal at which triggering occurs. Trigger polarity is determined by the position of the switch in the collector circuits of Q552-Q556.

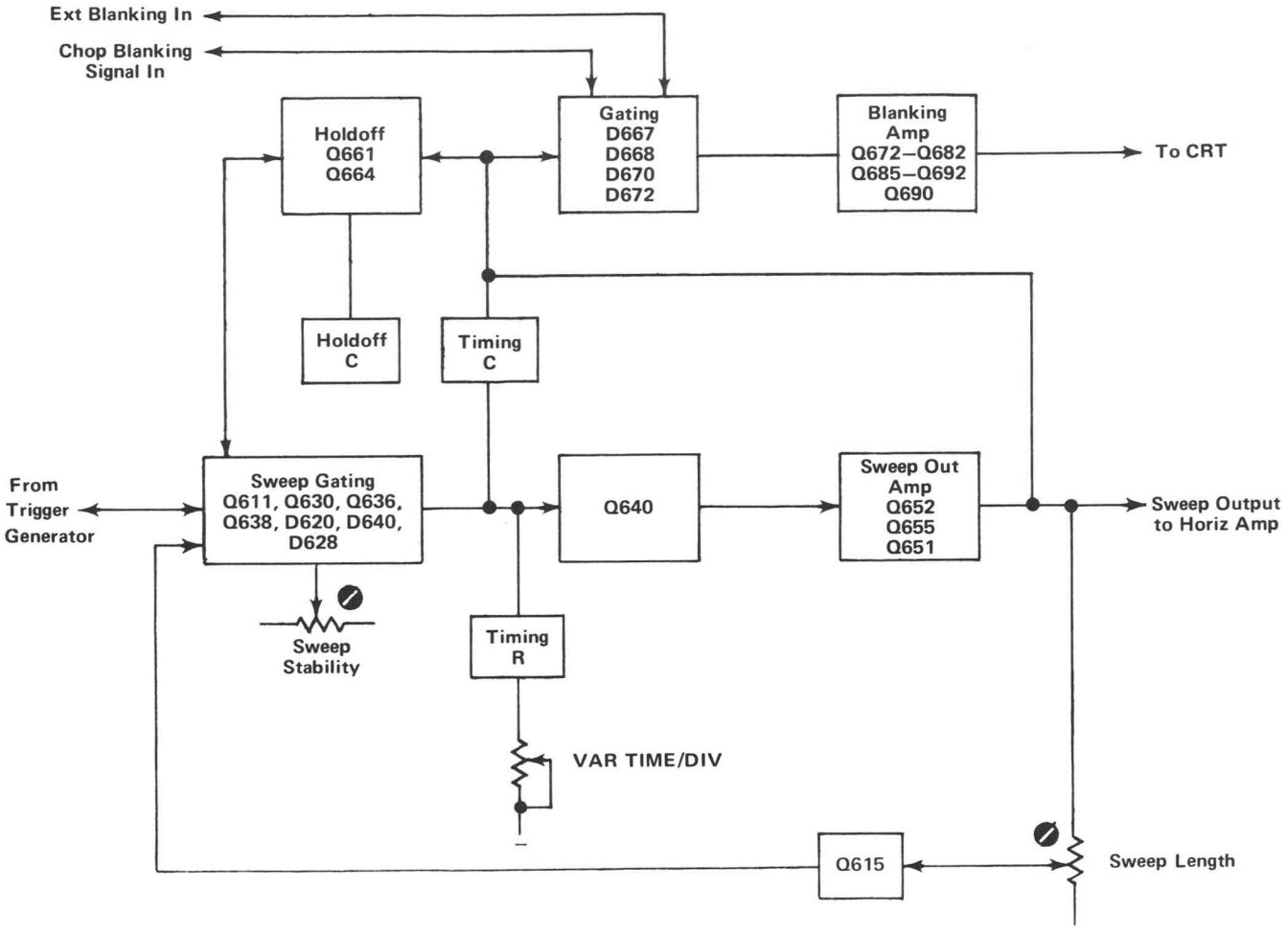
Q570 and Q580, a Schmitt multi shapes the trigger signal (square wave out) which is differentiated at the Sweep Generator, (7), input.

Trigger switch S560 also switches in the appropriate components to cause the trigger generator to act as a free running multi in the AUTO position of the LEVEL/SLOPE control. The free running multi provides a trace in the absence of trigger signal.

Unblanking and Sweep Generator. Differentiated trigger signal, applied to the trigger gating circuit, Q611-Q630-Q636-Q638-D620-D640-D628, provides signal to gate the Miller Integrator, (7).



Trigger Generator (6)



Unblanking and Sweep Generator (7)

Output from the Miller runup is amplified in the Sweep Output Amplifier. The output signal is fed back to Q640 through the timing capacitor and timing resistor to set the sweep rate. Output is also fed back via the sweep length control, R618, to the gating circuit to end the sweep. The output also supplies signal to the holdoff circuit, Q611-Q664, to block incoming trigger signals until the sweep has ended and the sweep circuitry ready to start another sweep.

Blanking signal is selected from one of three points; sweep output, EXT BLANK connector, or from the chopped blanking signal from the Vertical Switching circuit, (5).

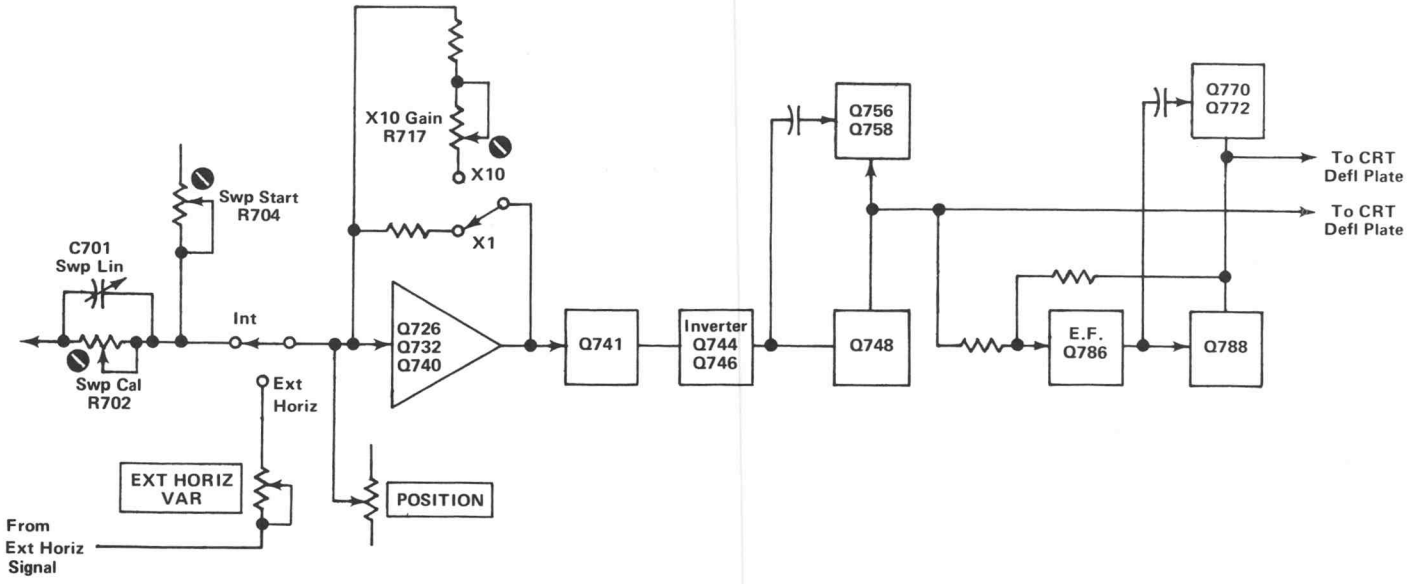
The blanking circuit, Q672-Q682-Q685-Q692-Q696, provides CRT beam blanking during retrace and during switching interval in Chopped Mode.

Horizontal Amplifier. Signal from either the Sweep Output, (7), or External Horizontal input is selected by the TIME/DIV switch. The input selector circuit contains adjustments for Sweep Start, Sweep Linearity, and Sweep Cal, (9).

The feedback amplifier Q726-Q732-Q738-Q740, contains components in the feedback loop to set the X10 Mag Gain and X10 Mag Registration. R708 adjusts horizontal display position.

Common-base amplifier, Q741, drives the inverter, Q744-Q746, which drives the Output amplifiers, Q756-Q758-Q748 and Q770-Q772-Q778.

Power Regulator Circuit. DC is supplied to the regulator through the ON-OFF switch and fuse, F870.

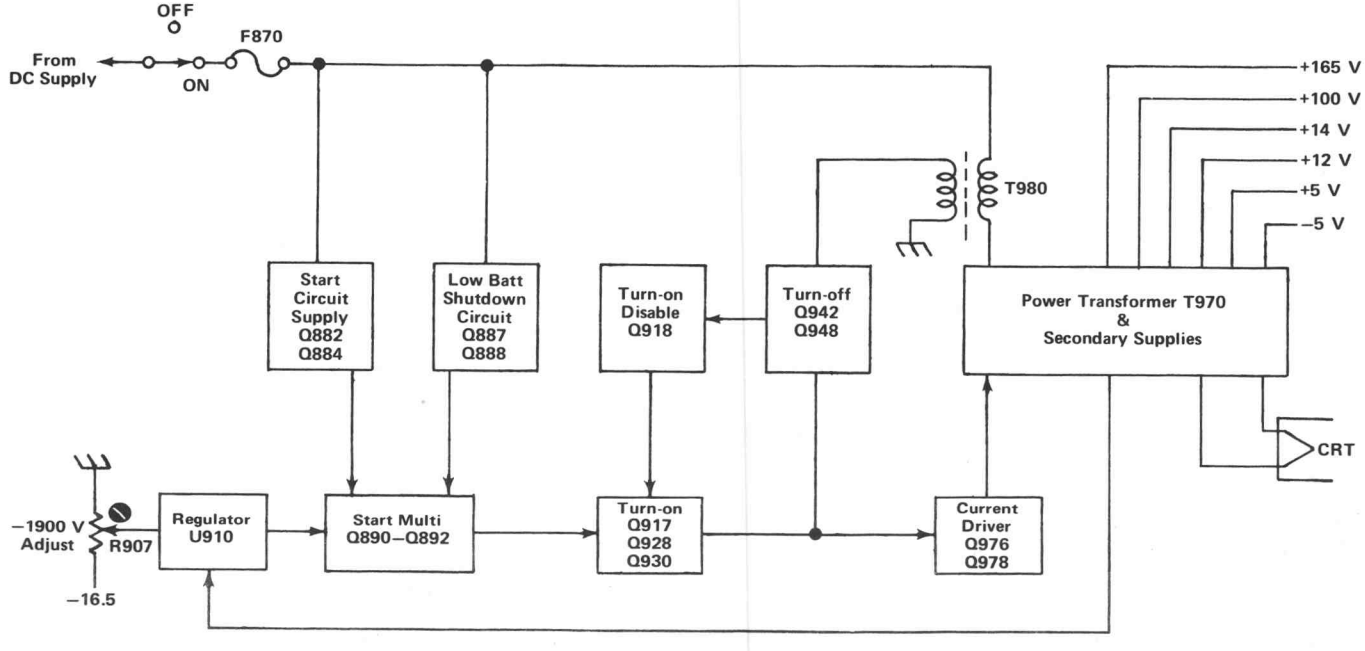


Horizontal Amplifier (9)

A low battery voltage indicator circuit flashes the front-panel LOW BATT lamp when the applied DC level drops below +7.2 volts.

The start circuit supply provides operating potential to the start multi until the power supply is operating.

Initially, the start multi provides a pulse to the turn-on circuit, which provides turn-on bias to the current driver circuit, gating current into T970 transformer primary. The current in T980 primary produces a secondary voltage which is connected to the turn-off circuit. When the T980 secondary current reaches a predetermined level the turn-off circuit reverse biases the current driver, rapidly termi-



Power Regulator (10) (11)

nating current in T970 and T980 primaries. At the same time a pulse is connected to the turn-on disable circuit which removes the turn-on signal to the current driver.

The next pulse from the start multi again starts the current buildup sequence.

Regulation is achieved by controlling the length of time that current is gated to T970 primary. The turn-on time is determined by the pulse repetition rate of the start multi, which is a function of the start multi collector supply voltage. The start multi collector supply levels are set by U910 (pin 6). The level at pin 6 is determined from two sources: a −16.5-volt DC supply (transformer secondary) to a variable divider, R907, and a sample of voltage from a section of the high voltage supply (transformer secondary).

Any attempted change of the output voltage (transformer secondary) causes the level at pin 6 (U910) to change, causing a change in start circuit multi switching rate, thus changing the transformer (T970) primary current duration, correcting the output voltage.

Once the supply output has come up to normal operating levels, the start circuit supply is reverse biased and T970 secondary supplies assume the regulator load.

In the event that the supply battery voltage drops to too low a level, the low battery shutdown circuit clamps one side of the start multi, turning off the current drive to T970 primary, thus shutting down the supply.

Detailed Regulator Description (10) (11)

D880 limits Zener current in D882 over the wide range of acceptable supply voltages. D882 sets the emitter levels of Q882 and Q884, providing start-up operating potential for the regulator. Once the regulator is functioning normally the start circuit supply is removed from the circuit (D886 and Q884 reverse biased).

Q890, Q892, and associated circuitry, an astable multi provide a negative-going pulse through C892 to the base of Q917, turning Q917 on. Q917 turns on Q928. Q928 turn on produces a positive step at T930 secondary, turning on Q930, providing turn-on bias for the current drivers, Q976 and Q978. At the same time, the positive-going pulse at T930 secondary is fed back through R927 to Q928 base, reinforcing the turn on.

Current builds up in T970 primary, causing voltage buildup in T970 secondaries. Since T980 primary is in series with T970 primary, a voltage builds up across T980 secondary. This secondary voltage forward biases D940, increasing the voltage level at Q942 anode. When Q942 anode comes to within 0.6 volts of Q942 gate level, Q942 turns on, biasing Q948 into saturation, pulling Q976 and Q978 bases toward ground reverse biasing Q976 and Q978, rapidly terminating current in T970 primary.

At the time that Q942 conducts to saturate Q948, a pulse is fed back to Q918, turning Q918 on, cutting off Q928 and Q930, reinforcing the turnoff.

The rapid field collapse in T970 produces the flyback voltage in T970 secondary.

U910, an integrated circuit voltage regulator, controls the voltage applied to the start multi collectors. Two voltages influence the U910 output voltage (pin 6). Variable R907 (with R905 and R909 and the −16.5 volt supply) connected to U910 inverting input adjust the supply output secondary level (secondary voltages).

A sample of voltage picked off of one section of the high voltage supply is fed back to U910 non-inverting input.

Both of these U910 input voltages correct the output voltage level by controlling the voltage at pin 6 (U910). The voltage level at pin 6 determines the switching repetition rate of the start multi, thus setting the time duration of current buildup in T970 primary, thereby setting the output voltage level in T970 secondary.

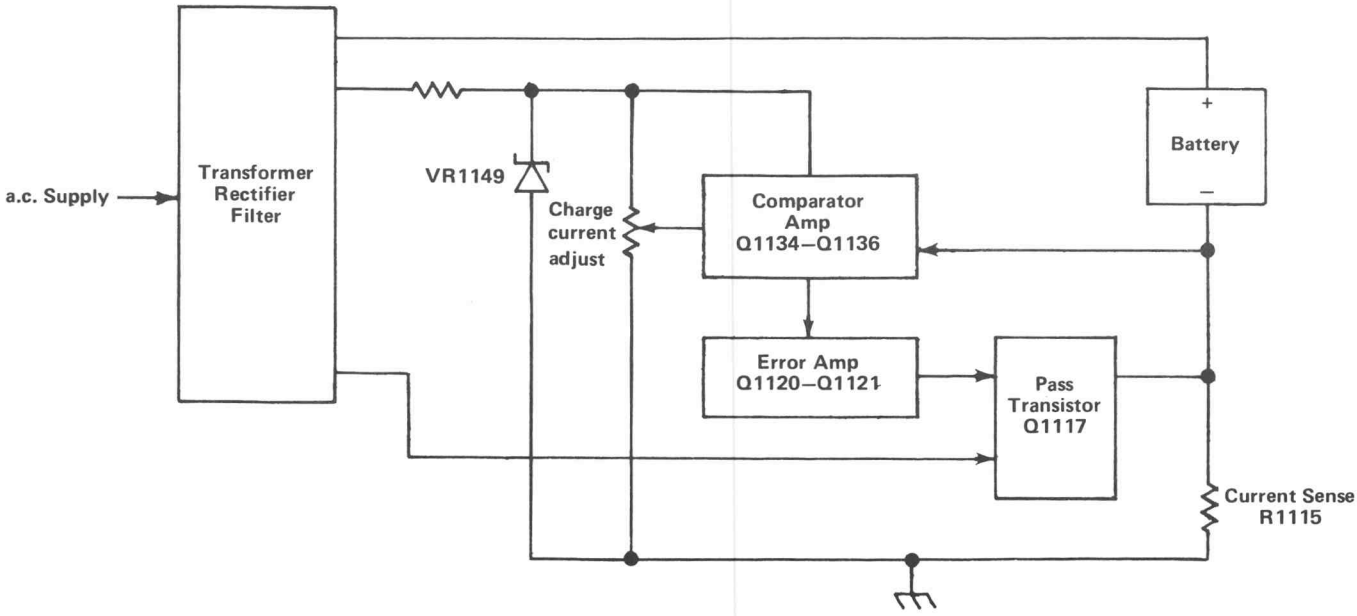
Any attempted change in supply output level is seen at U910, correcting the level at pin 6, changing the repetition rate of the start multi, correcting the supply output voltages.

In normal operation (normal DC input supply levels) Q888 is forward biased, holding Q887 cut off, having no effect on the start multi. If the DC input supply level drops too low, Q888 turns off, permitting Q887 to turn on, pulling Q887 collector toward ground, thereby disabling the start multi, shutting down the supply.

Since the secondary supplies and regulation are conventional circuitry, no detailed description is given.

Battery Charger (12)

With no instrument load on the battery, and FULL CHG-TRICKLE CHG switch in the FULL CHG position, the battery is charged at 150 mA as follows:



Battery Charger

Charge current is supplied by the 5-6 terminals of T1101 secondary, the diode bridge, D1110, through pass transistor, Q1117, and the sensing resistor, R1115.

The circuit which determines the charging current is a feedback amplifier consisting of a DC comparator (Q1134-Q1136), an error amplifier (Q1121-Q1120), and pass transistor (Q1117).

The base reference voltage of Q1136 is set by VR1149 and the divider, R1143 and variable R1144. Current for VR1149 is supplied by transformer secondary winding (7-8), rectifier CR1105, filter capacitor, C1105, and Zener current-setting resistor, R1105.

During full charge rate the voltage drop across sensing resistor, R1115 plus the drop across R1130 set the voltage level at Q1134. The base potential of Q1134 determines the current through R1139, setting the operating potential for Q1121. The current through the divider R1120-R1123 sets Q1120 base level. Q1120 conduction sets the base level for Q1117, the pass transistor, fixing the current to charge the battery at about 150 mA.

Any line voltage change is seen as a change in potential across the supply (transformer secondary terminals 5 and 6) and results in a change in potential across R1115 and is seen by Q1134 base as error signal.

The error signal is amplified in Q1121 and Q1120, which corrects the base drive to Q1117, bringing the feedback amplifier back to a state of balance.

If the instrument is turned on, the added load momentarily causes less charging current to flow to the battery. The reduced drop across R1115 is seen as error signal to the comparator Q1134-Q1146, causing a change in potential across R1139, which is amplified in Q1121-Q1120, increasing the drive to Q1117. The charge current increases to the point at which the feedback amplifier again reaches a balance (charge current back to 150 mA).

CR1137 and CR1138 prevent Q1134 and Q1136 collectors from rising to the point at which Q1134 and Q1136 would saturate during the periods when D110 (bridge) is not conducting.

The charge rate may be lowered to provide a trickle charge to the battery (to offset internal losses) by switching from FULL CHG to TRICKLE CHG. Switching R1133 into the circuit causes an additional drop across R1130, decreasing the voltage on Q1134 base. The reduced base voltage causes Q1117 drive (through Q1120-Q1121-R1139) to reduce the charge current to the battery.

MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive or corrective maintenance and troubleshooting the 326.

GENERAL

Cleaning

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid checmicals which contain benzene, toluene, xylene, acetone or similar solvents.

Semiconductor Checks

Periodic checks of the semiconductors in the 326 are not recommended. The best check of semiconductor performance is actual operation in the instrument.

Recalibration

A calibration check is recommended after each 1000 hours of operation or every year if used infrequently. Replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in the Performance Check/Adjust section.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in the Diagrams section. The circuit number and electrical value of each component are given on the diagrams. Important voltages are also shown.

Circuit Boards. A tint band outlines each circuit board on the Schematic Diagrams and a photograph of each board is shown to the left of the diagram. Each board-mounted electrical component is identified in the photograph by its circuit number.

Voltages. Often the defective components can be located by checking for the correct voltage in the circuit. Some typical voltages are given on the Schematic Diagrams. These voltages are not absolute, and may vary slightly from instrument to instrument.

Power Supply Voltage. Table 4-1 lists the voltage tolerances of the power supplies in the 326. If the power supply voltage is within the listed tolerance, the supply can be assumed to be operating properly. If outside the tolerance, the supply may be misadjusted or operating incorrectly.

TABLE 4-1

Supply	Voltage	Ripple
−5 V	Within 2%	10 mV
+5 V	Within 2%	10 mV
+14 V	−20%	200 mV
+100 V	−5%	750 mV
+165 V	+8%, −6%	750 mV
+1900 V	Within 2%	

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 326.

1. Semiconductor Tester. While the most convenient check of the semiconductor device is substitution or junction resistance measurement, some means of testing transistors and diodes may be helpful. For complete tests, the TEKTRONIX 576 Semiconductor Curve Tracer is recommended.

2. DC Voltmeter and Ohmmeter. For most applications a 20,000 ohms/volt VOM can be used to check voltages and resistance, if allowance is made for the circuit loading when making voltage measurements at high impedance points.

3. Test Oscilloscope. A test oscilloscope is required to check circuit waveforms. An oscilloscope having a DC to 10 MHz frequency response and 1 mV/Div to 10 V/Div vertical deflection factor is suggested. A 10X probe should be used where circuit loading is critical.

REPLACEMENT PARTS

Standard Parts

NOTE

All replacement parts should be direct replacements unless it is known that a different component will not adversely affect the instrument performance.

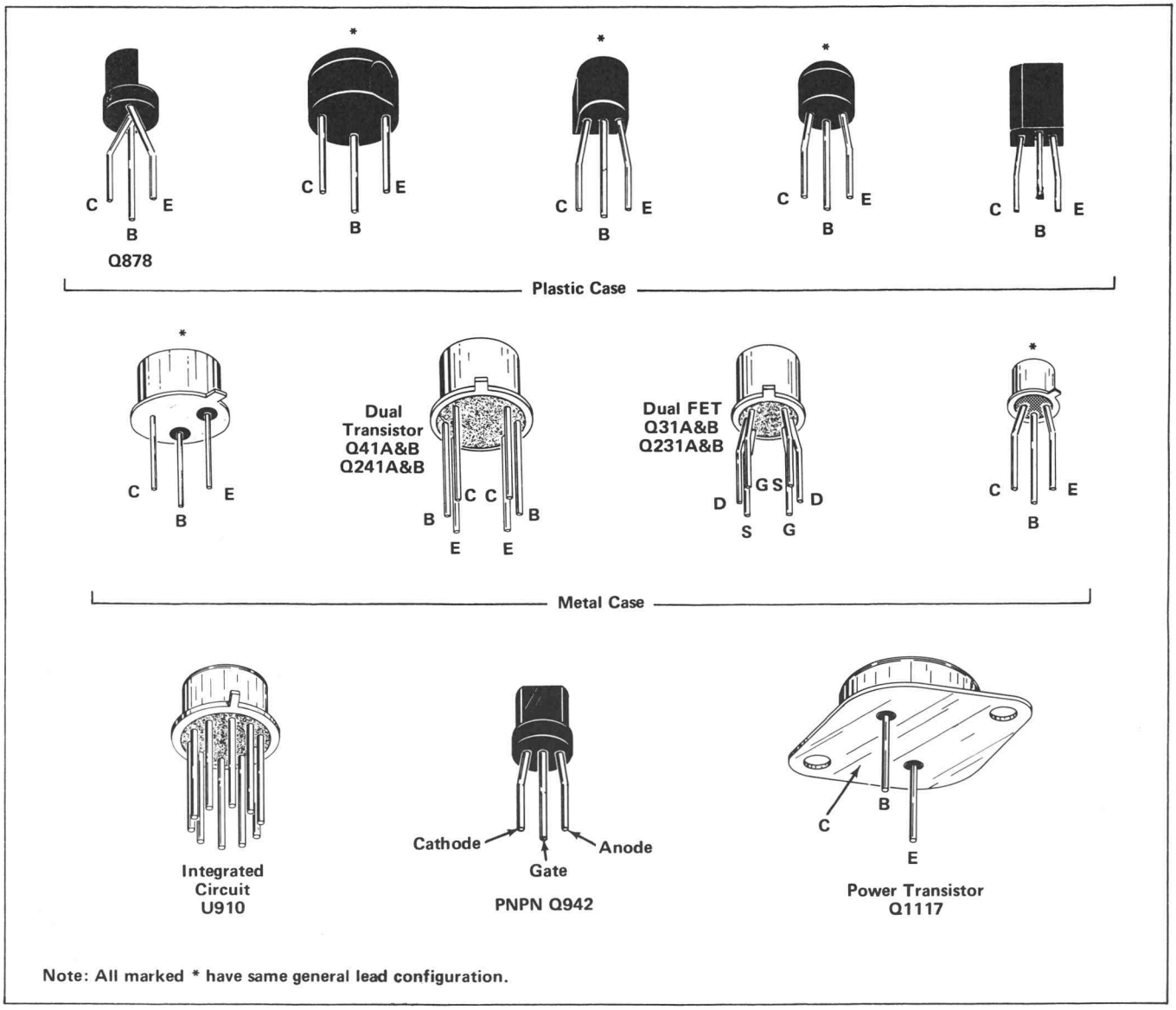


Fig. 4-1. Transistor lead configurations.

Refer to the Parts Ordering Information preceding the Electrical Parts List and Mechanical Parts List sections.

Special Parts

Some parts are manufactured or selected by SONY/TEKTRONIX to satisfy particular requirements, or are manufactured for SONY/TEKTRONIX to our specifications. These special parts are indicated in the parts lists by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by SONY/TEKTRONIX. Order all special parts directly from your local TEKTRONIX Field Office or Representative.

ASSEMBLY AND COMPONENT REPLACEMENT

General

The exploded-view drawings associated with the Mechanical Parts List pullout page (Fig. 1, EXPLODED) may be helpful when disassembling or reassembling individual components or sub-assemblies.

Semiconductor Replacement

Replacement semiconductors should be of the original type or a direct replacement. Fig. 4-1 shows the lead

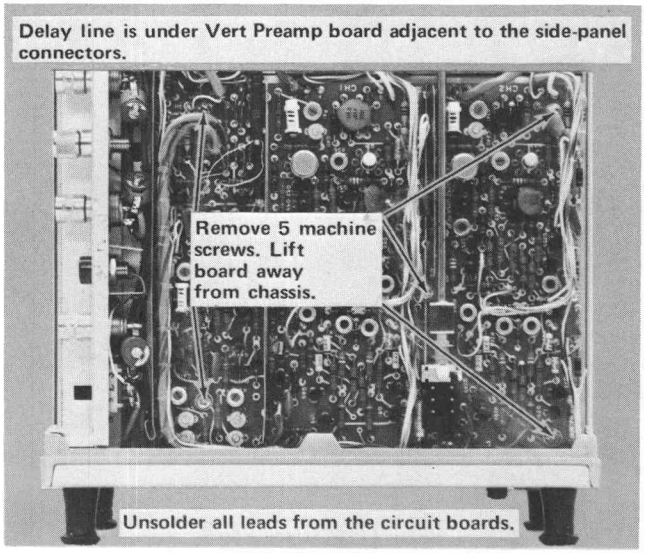


Fig. 4-2. Vertical Preamp circuit board removal.

configuration of the semiconductors used in this instrument. Some plastic cased transistors may have lead configurations which do not agree with those shown here. If a replacement transistor is made by a manufacturer other than the original, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing as used for metal-cased transistors.

Circuit Board Removal

Color codes for all wire connections to the boards can be found adjacent to the corresponding schematic (foldout at rear).

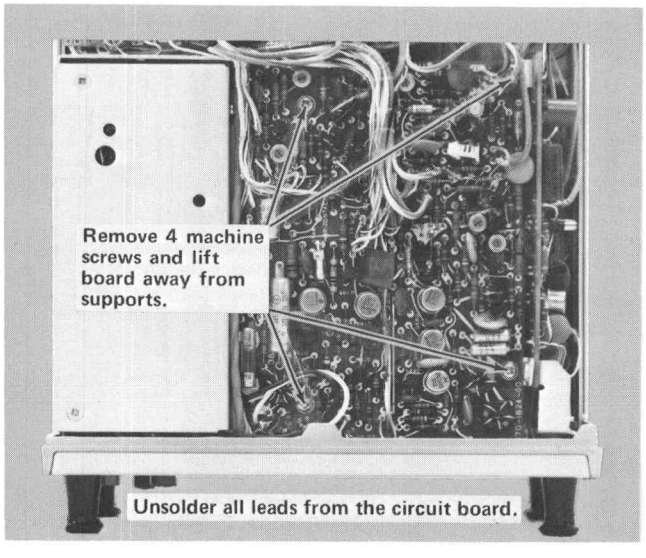


Fig. 4-3. Horizontal circuit board removal.

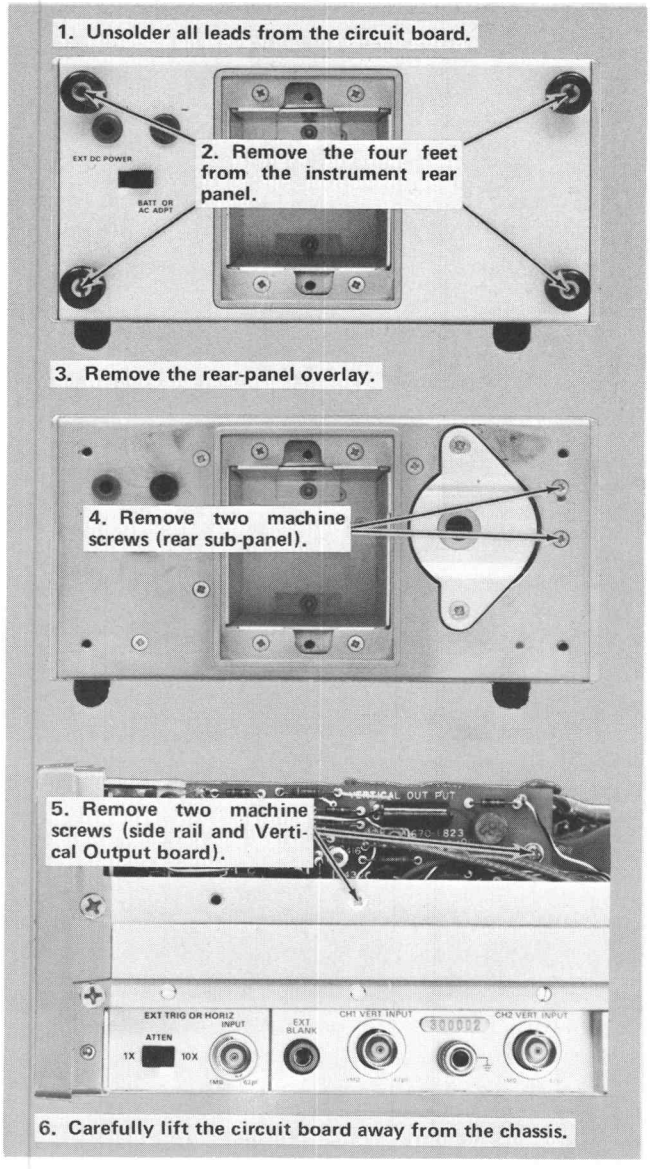


Fig. 4-4. Vertical Output circuit board removal.

Follow the instructions for the given circuit board in the following figures, 4-2 through 4-7.

Power Supply-Regulator Removal

CAUTION

Remove the battery pack before removing the Power Supply-Regulator board.

Remove the machine screws indicated by the arrows in Fig. 4-8A.

Very carefully pull the supply assembly straight up until the assembly is free of the chassis.

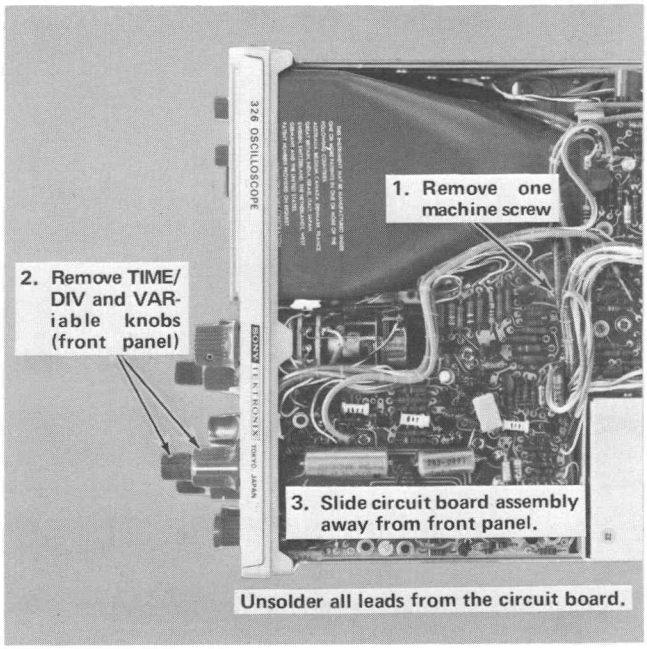


Fig. 4-5. Trigger Sweep circuit board removal.

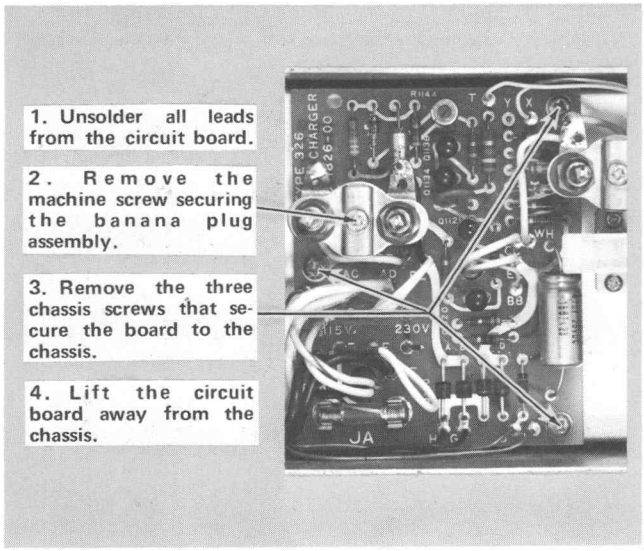


Fig. 4-7. Battery Charger circuit board removal.

Power Supply-Regulator Cover Removal

Remove the three machine screws indicated in Fig. 4-8B.

Remove the two machine screws on rear end of cover and remove the cover.

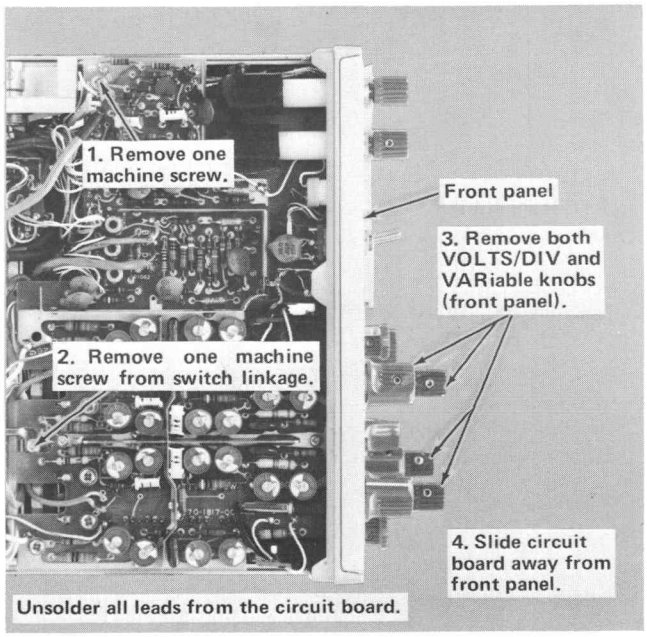


Fig. 4-6. Att/cal/sw circuit board removal.

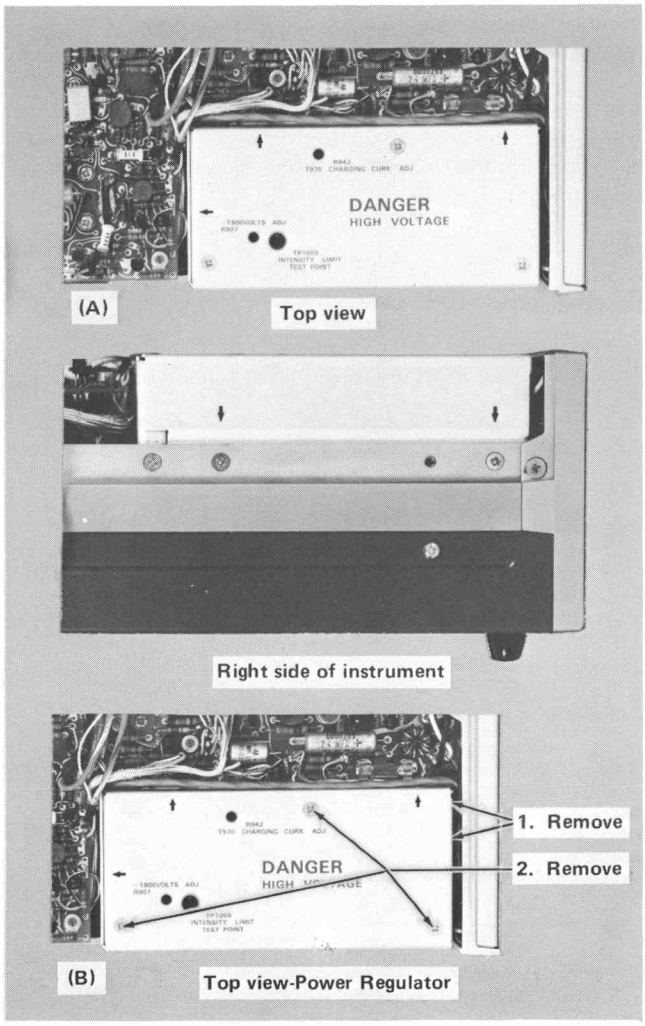


Fig. 4-8. Removing (A) Power Regulator and (B) Regulator cover.

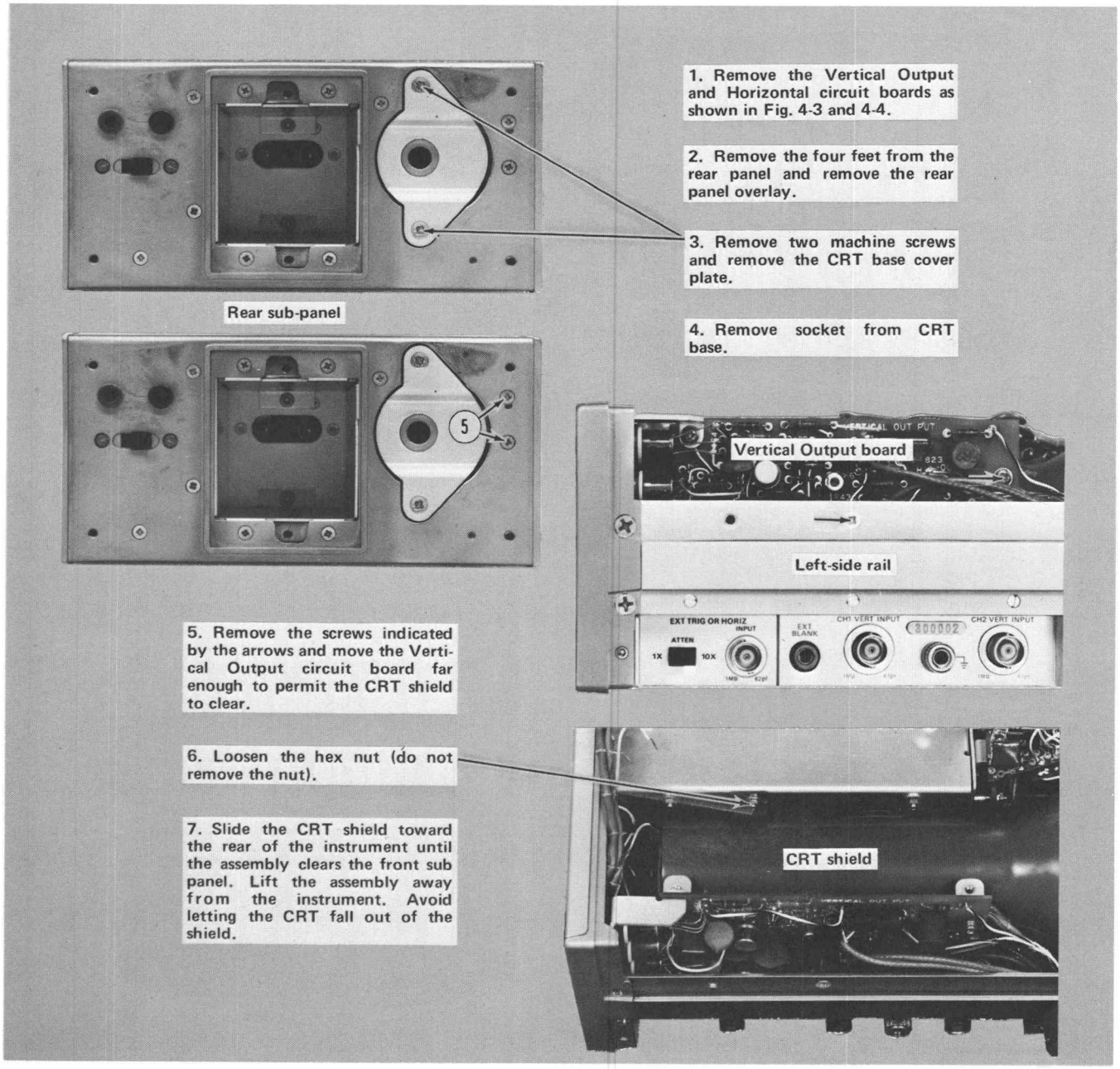


Fig. 4-9. CRT removal.

CRT Removal

Remove the CRT as shown in Fig. 4-9.

Cam Switch Replacement

Each new cam switch is shipped with a metal cover. This cover should be discarded after switch installation. Replace the switch as follows:

1. Remove the double cover from the pair of cam switches.

2. Remove the defective cam switch.

3. Leave the metal cover on the new cam switch and secure the switch to the circuit board in the same position as the switch just removed.

4. Check the new switch for proper mechanical operation (freedom of rotation, etc.).

5. Remove the metal cover from the switch just installed and replace the double cover over both switches.

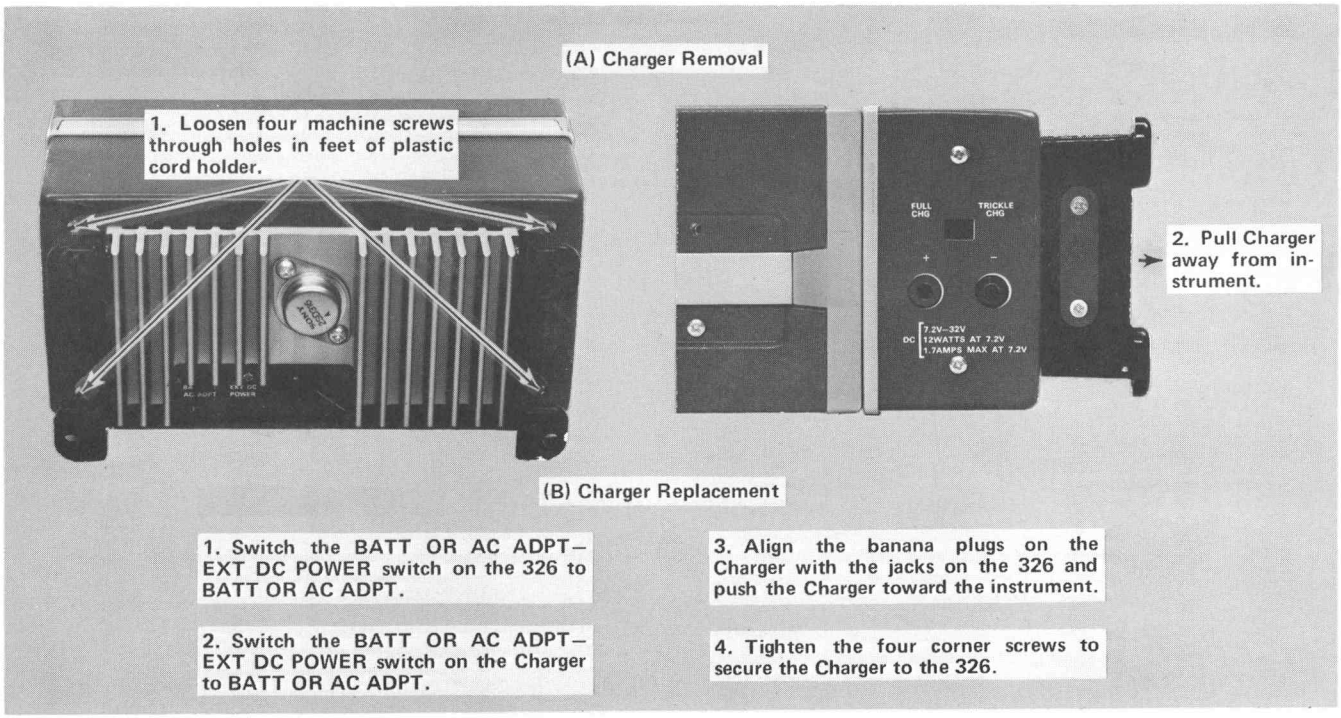


Fig. 4-10. Battery Charger (A) removal and (B) replacement.

Battery Charger Removal and Replacement

See Fig. 4-10 for Battery Charger removal and replacement instructions.

Instrument Repackaging

If the 326 is to be shipped over long distances by commercial transportation, it is recommended that the instrument be repackaged in the original manner for maximum protection. Repackaging information and/or new shipping carton may be obtained from Tektronix, Inc. Contact the nearest TEKTRONIX Field Office or Representative. See Fig. 2 Repackaging (pullout, Mechanical Parts List, Section 8).

PERFORMANCE CHECK/ADJUSTMENT

Introduction

A performance check is recommended every 1000 hours of operation, or every year if used infrequently. Before complete calibration, the instrument should be cleaned and inspected as outlined in the Maintenance section.

The Performance Check can be used to check instrument performance without making any internal adjustments.

As an aid to checking the performance of the 326, a Short-Form Procedure is given preceding the complete procedure. To facilitate instrument checkout, the Short-Form Procedure lists the check and applicable tolerances. This procedure also includes the step, number, and title as listed in the complete Performance Check, and the page number on which each step begins. The Short-Form Procedure also provides spaces to record performance data or to check off steps as they are completed.

Following the Performance Check is a complete ADJUSTMENT procedure. Completion of the Adjustment Procedure insures that the instrument meets the electrical specifications given in Section 1.

NOTE

Limits, tolerances, and waveforms in the ADJUSTMENT procedure are given as calibration guides and should not be interpreted as instrument specifications except as specified in Section 1.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or equivalent, are required for complete check or adjustment of the 326. Specifications given are the minimum necessary for accurate check or adjustment. Some of the recommended equipment may have specifications that exceed those given. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

Special TEKTRONIX calibration fixtures are used to facilitate calibration and performance checks. These special fixtures are available from Tektronix, Inc. Order by part number through your local TEKTRONIX Field Office or representative.

Test Equipment

1. Precision DC voltmeter. Accuracy, within ±0.1%; range, zero to 200 volts. For example, Fluke Model 825A Differential DC Voltmeter.

2. DC voltmeter (VOM). Minimum sensitivity, 20,000 ohms/volt; accuracy, checked to within 1% at −1900 volts. For example, Triplett Model 630-NA.

3. Variable DC power supply. Voltage range, at least +7 to +32 volts; current capability, at least 1.0 ampere; output voltage, measured within 3%.

4. Test oscilloscope. Bandwidth, DC to 10 MHz; minimum deflection factor, 2 mV/Div; accuracy, within 3%. SONY/TEKTRONIX Type 324 Oscilloscope is recommended.

5. Time-mark Generator. Marker output, 0.1 μs to 0.1 s; marker accuracy, within 0.1%. TEKTRONIX 2901 Time-Mark Generator is recommended.

6. Standard Amplitude Calibrator. Amplitude accuracy, within 0.25%; signal amplitude, 5 mV to 100 volts; output signal, square wave. TEKTRONIX Calibration Fixture 067-0502-01 is recommended.

7. Square-Wave Generator. Must have the following output capabilities (may be obtained from separate generators): 120 volts amplitude at 1 kHz repetition rate with a one microsecond risetime; 500 mV into 50 ohms at 1.0 kHz and 1.0 MHz repetition rates with a 50 ns risetime. TEKTRONIX Type 106 Square-Wave Generator is recommended (meets both output requirements).

8. High-Frequency Constant-Amplitude Sine-Wave Generator. Frequency, 350 kHz to above 10 MHz; reference frequency, 50 kHz; output amplitude, variable from 5 mV to 0.5 volt into 50 ohms; amplitude accuracy, constant

within 3% at 50 kHz and from 350 kHz to above 10 MHz. TEKTRONIX Type 191 Constant Amplitude Signal Generator is recommended.

9. Low-Frequency Constant-Amplitude Sine-Wave Generator. Frequency, 2 Hz to 100 kHz; output amplitude, variable from 50 mV to 16 volts, peak to peak; amplitude accuracy, constant within 3% from 2.0 Hz to 100 kHz. For example, General Radio 1310-A Oscillator (use a General Radio Type 274QBJ adapter to provide BNC output).

10. Variable Autotransformer[1]. Must be capable of supplying a range of 90 to 136 volts (180 to 272 volts for 230-volts nominal line). If autotransformer does not have an AC voltmeter, monitor the output with an AC voltmeter having a range of 136 or 272 volts, RMS. For example, General Radio W10MT3A Metered Variac Autotransformer for 115 volts or General Radio W20MT3A for 230-volt nominal operation.

11. 1X Probe with BNC connector. TEKTRONIX P6011 is recommended.

12. Cable. Impedance, 50 ohms; type, RG-58/U; length, 42 inches; connectors, BNC. TEKTRONIX Part Number 012-0057-01.

13. Calibration Shield. SONY/TEKTRONIX Calibration Fixture. TEKTRONIX Part Number 067-0669-00.

14. Adapter. Adapts GR874 to BNC male connector. TEKTRONIX Part Number 017-0063-00.

15. Termination. Impedance, 50 Ω; accuracy, ±2%; connectors, BNC. TEKTRONIX Part Number 011-0049-01.

16. 10X Attenuator. Impedance, 50 Ω; accuracy, ±2%; connectors, BNC. TEKTRONIX Part Number 011-0059-01.

17. Input RC Normalizer. Time constant, 1 MΩ and 47 pF; attenuation, 2X; connectors, BNC. TEKTRONIX Calibration Fixture 067-0541-00.

18. 10X probe for the 326 and the 324 Test Oscilloscope. TEKTRONIX P6049A Probe is recommended (two supplied as accessories).

19. Current Probe for the 324 Test Oscilloscope. TEKTRONIX P6021 is recommended. TEKTRONIX Part Number is 015-0140-02.

[1] **Not required for performance check only.**

20. Adapter, BNC to Binding Post. TEKTRONIX Part Number 103-0033-00.

21. BNC T Connector. TEKTRONIX Part Number 103-0030-00.

22. Patch Cord. Length, 18 inches; connectors, banana plug-jack and BNC male. TEKTRONIX Part Number 012-0090-00.

23. Patch Cord. Length, 18 inches; connectors, banana plug-jack to banana plug-jack. TEKTRONIX Part Number 012-0039-00.

24. Cable. Impedance, 50 Ω type RG-58/U; length, 18 inches; connectors, BNC. TEKTRONIX Part Number 012-0076-00.

25. Dual Input Coupler. Matched signal transfer to each input. TEKTRONIX Calibration Fixture 067-0525-00.

Adjustment Tool

26. Low-capacitance screwdriver. 1 1/2-inch shaft. TEKTRONIX Part Number 003-0000-00.

SHORT-FORM PERFORMANCE CHECK AND INDEX

326 Serial Number

Date

By

1. Check Astigmatism

   Sharp, well-defined trace.

2. Check Trace Alignment

   Marker baseline should be parallel to the horizontal graticule lines.

3. Check Geometry

   Deviation from a straight line, not more than 0.1 division.

4. Check Compression

Compression not to exceed 0.15 division.

5. Check CH 1 X1 Vertical Gain

Vertical deflection, 5 divisions, ±0.15 division.

6. Check CH 1 X10 Vertical Gain

Vertical deflection, 5 divisions, ±0.15 division.

7. Check CH 1 Vertical Deflection Accuracy

Indicated deflection, ±3%.

8. Check CH 1 Variable Volts/Div Range

Range at least 2.5:1.

9. Check High Frequency Compensation

Check for best square corner (leading edge). Aberrations not to exceed +2% or −2% with peak-to-peak not to exceed 3%.

10. Check CH 1 Input Capacitance

0.2 div, or less, overshoot or rounding (47 pF, ±4 pF).

11. Check CH 1 Volts/Div Switch Compensation

Optimum square corner and flat top at each Volts/Div switch setting.

12. Check CH 1 Vertical Upper −3 dB Point (X1 Gain)

At least 10 MHz.

13. Check CH 1 Vertical Upper −3 dB Point (X10 Gain)

At least 5 MHz.

14. Check CH 1 Vertical AC-Coupled Lower−3 dB Point

10 Hz or less.

Repeat steps 4 through 14 for CH 2.

15. Check Common-Mode Rejection

Rejection Ratio, 20:1.

16. Check Magnified Registration

Middle marker within 1.0 division of the center vertical graticule line.

17. Check Normal Timing

Check Timing as shown in Table 5-2.

18. Check Variable Time/Div Range

Range, at least 2.5:1.

19. Check Magnified Timing

Check timing as shown in Table 5-3.

20. Check External Horizontal

Horizontal deflection, 4 div to 6.7 div.

Variable range, 10:1 or greater.

21. Check External Horizontal Bandwidth (Upper −3 dB Point)

At least 200 kHz.

22. Check External Blanking

Check for blanking of a portion of each cycle.

23. Check High Frequency Triggering

Stable Triggering on:

0.3 div display at 1.0 MHz, INT LF REJ,

1.0 div display at 10.0 MHz, INT LF REJ,

1.5 div display at 1.0 MHz, EXT AC and DC.

24. Check Low-Frequency Triggering

Stable Triggering on:

1.5 div display at 30 Hz in EXT AC and DC,

0.3 div display at 30 Hz in INT AC.

25. Check Low-Frequency Reject

Stable display cannot be obtained at 30 Hz.

26. Check Calibrator

Duty Cycle, 40% to 60%.

Output amplitude, 5 divisions.

PERFORMANCE CHECK PROCEDURE

General

The following procedure uses the equipment listed under Test Equipment Required. If other equipment is substituted, control settings or checking setup may need to be altered to meet the requirements of the equipment used. Operating instructions for the test equipment are not given in this procedure. Refer to the test equipment instruction manual if more information is required.

The control settings throughout the procedure continue from the preceding step unless otherwise noted.

NOTE

Control titles that are printed on the front panel of the 326 are capitalized in this procedure (e.g., CH 1 VOLTS/DIV). Associated equipment controls are initial capitalized only (e.g., Output Amplitude).

PERFORMANCE CHECK

Initial Control Settings for Performance Check

CH 1 and CH 2	
VOLTS/DIV	.5 V
Input Coupling AC-DC	DC
Mode	CH 1
TRIGGERING	
CH 1—NORM	CH 1
Coupling	INT AC
TIME/DIV	1 ms
Horiz POSITION	Midrange

1. Check Astigmatism

a. Connect the Time-Mark Generator output to the CH 1 VERT INPUT with a BNC cable. Set the Time-Mark Generator for 1 ms markers.

b. Set the INTENSITY control midway between a barely visible trace and fully clockwise.

c. Set the trigger controls for a stable display.

d. CHECK—Markers should be well defined within the areas indicated in Fig. 5-1 with optimum setting of the FOCUS control.

2. Check Trace Alignment

a. Vertically position the marker baseline to the center horizontal graticule line.

b. CHECK—Marker baseline should be parallel to the center horizontal graticule line.

3. Check Geometry

a. Set VOLTS/DIV switch to .1.

b. Vertically position the marker baseline below the bottom graticule line.

c. CHECK—CRT display for minimum curvature of the vertical markers. Maximum deviation from a straight line, 0.1 division.

d. Disconnect the Time-Mark Generator.

e. Set LEVEL/SLOPE to +AUTO.

f. Vertically position the trace to the top graticule line.

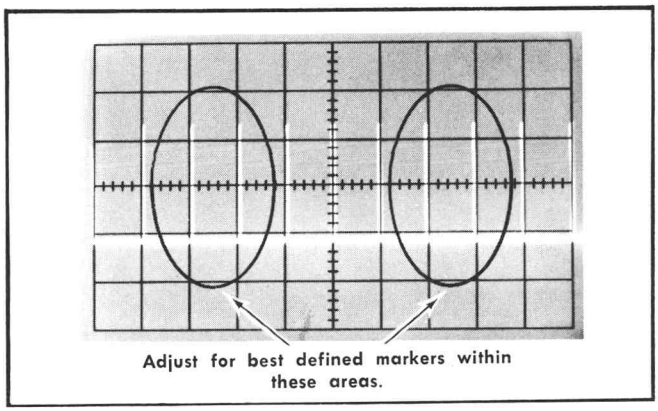


Fig. 5-1. Astigmatism check, typical display.

g. CHECK–Deviation from a straight line should not exceed 0.1 division.

h. Vertically position the trace to the bottom graticule line.

i. CHECK–Deviation from a straight line should not exceed 0.1 division.

4. Check Compression

a. Set CH 1 VOLTS/DIV to 5 DIV CAL.

b. Vertically position the bottom of the display to the first graticule line below the horizontal center line.

c. Reduce the display to exactly two divisions with the Variable VOLTS/DIV control.

d. Vertically position the top of the display to the top graticule line.

e. CHECK–Compression (reduction in amplitude) not to exceed 0.15 division.

f. Vertically position the bottom of the display to the bottom graticule line.

g. CHECK–Compression, not to exceed 0.15 division.

5. Check CH 1 X1 Vertical Gain

Reset the following controls:

VOLTS/DIV	0.1
Variable VOLTS/DIV	CAL

a. Connect the Standard Amplitude Calibrator output connector to CH 1 VERT INPUT connector via a 50-ohm BNC cable.

b. Set the Standard Amplitude Calibrator for a 50 mV square-wave output.

c. Vertically center the display.

d. CHECK–Vertical deflection equal to 5 divisions, ±0.15 division.

6. Check CH 1 X10 Vertical Gain

a. Set the Standard Amplitude Calibrator for a 5 mV square-wave output.

b. Pull the POSITION X10 VERT GAIN control.

c. Vertically center the display.

d. CHECK–Vertical deflection equal to 5 divisions, ±0.15 division.

7. Check CH 1 Vertical Deflection Accuracy

a. Push the POSITION X10 VERT GAIN control knob.

b. CHECK–Using the VOLTS/DIV switch and Standard Amplitude Calibrator settings given in Table 5-1, check deflection accuracy at each position of the VOLTS/DIV switch.

TABLE 5-1

VOLTS/DIV Switch Settings	Calibrator Amplitude	Vertical Deflection in divisions	Max Error in divisions
.01	50 mV	5	±0.15
.02	0.1 V	5	±0.15
.05	0.2 V	4	±0.12
.1	0.5 V	5	±0.15
.2	1 V	5	±0.15
.5	2 V	4	±0.12
1	5 V	5	±0.15
2	10 V	5	±0.15
5	20 V	4	±0.12
10	50 V	5	±0.15

8. Check CH 1 Variable Volts/Div Range

a. Set the Standard Amplitude Calibrator for a 50 mV square-wave output.

b. Reset CH 1 VOLTS/DIV to .01.

c. Vertically center the display.

d. CHECK–Rotate the CH 1 Variable VOLTS/DIV control fully counterclockwise. Display must reduce to two divisions or less.

e. Return the VOLTS/DIV Variable to the CAL position.

9. Check High Frequency Compensation

Reset the controls as follows:

X10 VERT GAIN	Pulled
X10 HORIZ MAG	Pulled
TIME/DIV	1 μs

a. Connect the Square-Wave Generator Fast-Rise + Output connector to CH 1 VERT INPUT connector through a GR to BNC adapter, 50-ohm BNC cable, 10X, 50-ohm attenuator, and a 50-ohm BNC termination in the order given.

b. Set the Square-Wave Generator for a four division display at 100 kHz.

c. Horizontally position the leading edge of the square wave into the viewing area. Reset triggering as necessary for correct display. See Fig. 5-2.

d. CHECK–The display for best square corner (aberrations not to exceed +2% or –2% with peak-to-peak aberrations not to exceed 4%.

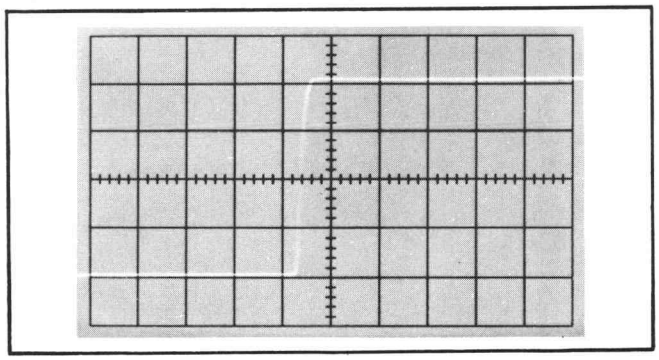


Fig. 5-2. High frequency response check, typical display.

10. Check CH 1 Input Capacitance

Reset the controls as follows:

TIME/DIV	.5 ms
CH 1 X10 VERT GAIN	Pushed

a. Connect the Square-Wave Generator High Amplitude Output connector to the CH 1 VERT INPUT connector through the GR to BNC adapter, 50-ohm BNC cable, 50-ohm termination, and 47 pF RC Normalizer in the order given.

b. Set the Square-Wave Generator for a five-division display at one kHz.

c. CHECK–CRT display for 0.2 division, or less, of overshoot or rounding (47 pF, ±4 pF; see Fig. 5-3).

11. Check CH 1 Volts/Div Switch Compensation

a. Connect a P6049A Probe to the CH 1 VERT INPUT connector.

b. From the Square-Wave Generator High Amplitude Output connect a GR to BNC adapter, 10X 50-ohm BNC attenuator and BNC binding post adapter.

c. Connect the P6049A Probe tip to the BNC-binding post adapter.

d. Set the Square-Wave Generator for a five-division display at 1 kHz.

e. Compensate the probe as described in the probe manual.

f. CHECK–CRT display for optimum square corner and flat top at each VOLTS/DIV switch setting. Adjust the generator output for each switch position to maintain a five-division display.

12. Check CH 1 Vertical –3 dB Point (X1 Gain)

Reset the controls as follows:

CH 1 VOLTS/DIV	.01
X10 VERT GAIN	Pushed in
TIME/DIV	1 ms

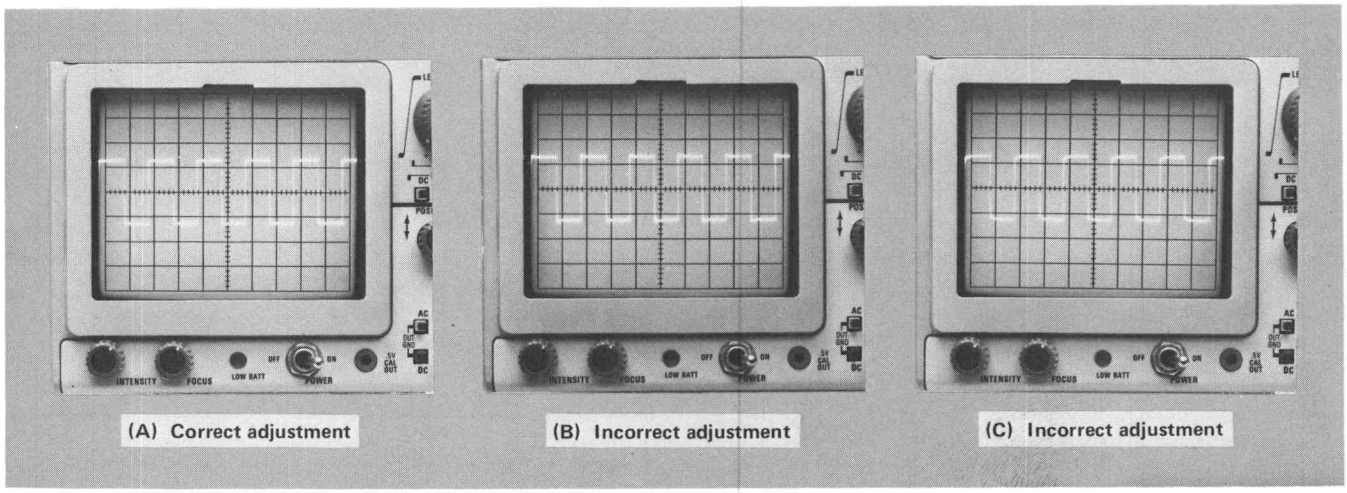


Fig. 5-3. Input capacitance check, typical displays.

a. Connect a High-Frequency Constant-Amplitude Sine-Wave Generator to the CH 1 VERT INPUT connector through the GR to BNC adapter, 50-ohm BNC cable, 10X 50-ohm BNC attenuator and a 50-ohm BNC termination.

b. Set the Constant-Amplitude Sine-Wave Generator for a four-division display, centered on the graticule, at the generator reference frequency (50 kHz).

c. Without changing the generator output amplitude, increase the frequency until the display amplitude is reduced to 2.8 divisions (–3 dB point).

d. CHECK–Generator output frequency must be at least 10 MHz.

13. Check CH 1 X10 Vertical Gain Upper –3 dB Point

a. Pull the X10 VERT GAIN switch.

b. Set the Constant-Amplitude Sine-Wave Generator for a four-division display, centered on the graticule, at the generator reference frequency (50 kHz).

c. Without changing the generator amplitude, increase the frequency until the display amplitude is reduced to 2.8 divisions (–3 dB point).

d. CHECK–Generator output frequency must be 5 MHz or greater.

14. Check CH 1 Vertical AC-Coupled Lower –3 dB Point

Reset the controls as follows:

CH 1 AC-DC	AC
X10 VERT GAIN	Pushed in
TIME/DIV	2 ms

a. Connect the Low-Frequency Constant-Amplitude Sine-Wave Generator to the CH 1 VERT INPUT connector through the 50-ohm BNC cable and a 50-ohm termination.

b. Set the generator for a four-division display, centered on the graticule, at a 1.0 kHz reference frequency.

c. Without changing the generator amplitude, decrease the frequency until the display amplitude decreases to 2.8 divisions.

d. CHECK–Generator frequency must be 10 Hz or less.

e. Remove the low-frequency generator, set the Mode switch to CH 2, and check CH 2, starting with step 4. After completing steps 4 through 14, for CH 2, continue with step 15.

15. Check Common-Mode Rejection

Change the following control settings:

TRIGGERING	
CH 1–NORM	CH 1
LEVEL/SLOPE	+AUTO
Coupling	INT AC

TIME/DIV	1 μs
Mode	CH 1
CH 1 VOLTS/DIV	0.01

a. Connect the Low-Frequency Constant-Amplitude Sine-Wave Generator output through a 50-ohm BNC cable, 50-ohm BNC termination, and a 50-ohm dual-input coupler to CH 1 and CH 2 VERT INPUT connectors.

b. Adjust the generator output amplitude for an eight-division display (80 mV) at 2 MHz.

c. Set Mode switch to ADD.

d. Set the CH 2 INVERT button to the OUT position.

e. CHECK—Display for not more than 0.4 division of display (20:1 rejection ratio).

16. Check Magnified Registration

Reset controls as follows:

CH 1 VOLTS/DIV	.1
Input AC-DC	DC
TIME/DIV	1 ms

a. Connect the Time-Mark Generator to the CH 1 VERT INPUT through the 50-ohm BNC cable and 50-ohm termination.

b. Set the Time-Mark Generator for 5 ms markers.

c. Set the trigger controls for a stable display in the variable positive-slope area.

d. Position the middle marker (of the three markers displayed) to the center vertical line.

e. Pull the X10 HORIZ MAG switch. Do not change knob rotational position.

f. CHECK—Middle marker should remain within one division of the center vertical graticule line.

17. Check Normal Timing

a. Push the X10 HORIZ MAG knob.

b. Set the Time-Mark Generator for 1-ms markers and the 326 TIME/DIV to 1 ms.

c. Set the trigger control for a stable display in the variable positive slope area.

d. CHECK—CRT display for one marker per division. With the second marker positioned exactly to the second vertical line, the tenth marker must be within 3% (0.24 div) of the tenth vertical line (see Fig. 5-4).

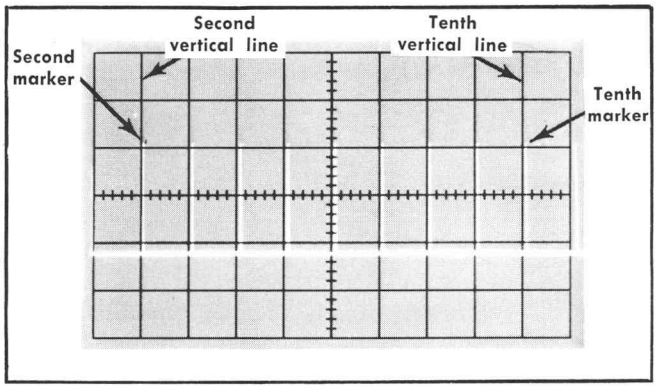


Fig. 5-4. Timing check.

NOTE

Unless otherwise noted, use the middle eight horizontal divisions (between the second and tenth vertical graticule lines) when checking timing.

e. CHECK—Timing through the remaining positions of the TIME/DIV switch as shown in Table 5-2.

TABLE 5-2

TIME/DIV Setting	Time Marks	Accuracy Center 8 Div	Accuracy Any 2 Div
1 s	1 s	4%	5%
.5 s	.5 s		
.2 s	.1 s		
.1 s	.1 s		
50 ms	50 ms		
20 ms	10 ms		
10 ms	10 ms		

TABLE 5-2 (cont)

TIME/DIV Setting	Time Marks	Accuracy Center 8 Div	Accuracy Any 2 Div
5 ms	5 ms	3%	4%
2 ms	1 ms		
1 ms	1 ms		
.5 ms	.5 ms		
.2 ms	.1 ms		
.1 ms	.1 ms		
50 μs	50 μs		
20 μs	10 μs		
10 μs	10 μs		
5 μs	5 μs		
2 μs	1 μs		
1 μs	1 μs		

18. Check Variable Time/Div Range

a. Set Time-Mark Generator to 10 ms marker and the 326 TIME/DIV to 1 ms.

b. Set trigger controls for a stable display in the variable positive-slope area.

c. Align the markers with the first and last graticule lines.

d. Turn the Variable TIME/DIV control fully counter-clockwise.

e. CHECK–Display for four-division maximum spacing between markers.

19. Check Magnified Timing

Reset the controls as follows:

Horizontal POSITION	Midrange
X10 HORIZ MAG	Pulled
Time-Mark Generator	.1 ms

a. Set TRIGGERING controls in the variable-slope area for a stable display.

b. CHECK–CRT display for one marker per division between the second and tenth vertical lines. With a marker positioned exactly to the second vertical line, a marker must coincide, within 4%, with the tenth vertical line.

c. CHECK–Each VOLTS/DIV switch position as shown in Table 5-3.

TABLE 5-3

TIME/DIV Setting	Time-Mark Gen Output	Display Markers/Div	Max Error for Given Accuracy
1 μs	.1 μs	1	5% (0.4 div)
2 μs	.1 μs	2	
5 μs	.1 μs	5	4% (0.32 div)
10 μs	1 μs	1	
20 μs	1 μs	2	
50 μs	1 μs	5	
.1 ms	10 μs	1	
.2 ms	10 μs	2	
.5 ms	10 μs	5	
1 ms	.1 ms	1	
2 ms	.1 ms	2	
5 ms	.1 ms	5	
10 ms	1 ms	1	
20 ms	1 ms	2	
50 ms	1 ms	5	
.1 s	10 ms	1	
.2 s	10 ms	2	
.5 s	10 ms	5	5% (0.4 div)
1 s	100 ms	1	

20. Check External Horizontal

a. Set TRIG OR HORIZ ATTEN switch (side panel) to 10X.

b. Set TIME/DIV to EXT HORIZ and TRIGGERING to EXT AC.

c. Connect the Standard-Amplitude Calibrator to the EXT TRIG OR HORIZ INPUT connector with a 50-ohm BNC cable.

d. Set the Standard-Amplitude Calibrator for a 10-volt square-wave output.

e. CHECK–CRT display for a horizontal deflection of 4.0 div to 6.7 div between dots (1.5 volts/div to 2.5 volts/div).

f. Set the calibrator to 1 volt and switch the EXT TRIG OR HORIZ ATTEN to X1.

g. CHECK–CRT display for a horizontal deflection of 4 div to 6.7 div between dots (150 mV to 250 mV/div).

h. Rotate the EXT HORIZ VARiable control fully counterclockwise.

i. CHECK–CRT display for at least one tenth the deflection measured in the preceding step (indicates 10:1, or greater, range).

21. Check External Horizontal Bandwidth (Upper –3 dB Point)

a. Set the EXT HORIZ Variable control to CAL (clockwise).

b. Connect the low-frequency Constant-Amplitude Sine-Wave Generator to the EXT TRIG OR HORIZ INPUT connector through a 50-ohm BNC cable and a 50-ohm BNC termination.

c. Set the generator output for five divisions of horizontal deflection at 1 kHz.

d. Without changing the output amplitude, increase the output frequency of the generator to 200 kHz.

e. CHECK–CRT display for at least 3.5 divisions of horizontal display.

f. Disconnect all test equipment.

22. Check External Blanking

Set the controls as follows:

CH 1 VOLTS/DIV	.2
TRIGGERING	INT AC
TIME/DIV	5 μs

a. Connect the low-frequency Sine-Wave Generator to the CH 1 VERT INPUT connector, through a BNC cable and BNC T connector.

b. Set the generator for a five-division vertical display (5-volt positive peaks) at 100 kHz.

c. Connect the output of the BNC T connector to the EXT BLANK connector with a BNC to banana patch cord.

d. CHECK–CRT display for blanking of a portion of each cycle (see Fig. 5-5). The INTENSITY control may require resetting to show the blanking.

23. Check High Frequency Triggering

Reset the controls as follows:

VOLTS/DIV CH 1	.1
TRIGGERING	CH 1, +AUTO
TIME/DIV	1 μs

a. Connect the high-frequency Constant-Amplitude Sine-Wave Generator to the CH 1 VERT INPUT connector through the GR to BNC adapter, 50-ohm BNC cable, 50-ohm BNC termination, and BNC T connector. Connect the output of the BNC T connector to the EXT TRIG OR HORIZ INPUT connector with a 50-ohm BNC cable.

b. Set the generator for a 0.3 division display at 1.0 MHz.

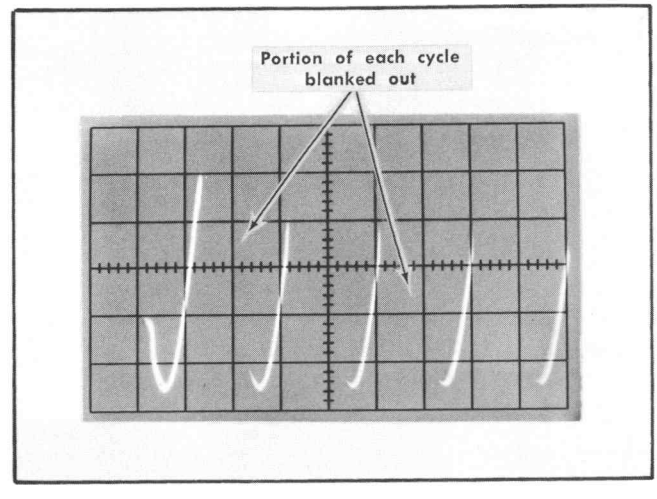


Fig. 5-5. External blanking check, typical display.

c. CHECK—Stable display is presented with the TRIGGERING controls set to INT AC and LF REJ, in the variable positive-slope area, in the variable-slope negative area, and in both +AUTO and —AUTO.

d. Set the generator for a one-division display at 10 MHz.

e. Pull the X10 HORIZ MAG knob.

f. CHECK—Stable display is presented with the TRIGGERING controls set to INT AC and LF REJ in the variable positive-slope area, in the variable negative-slope area, and in both +AUTO and —AUTO.

g. Reset the controls as follows:

TRIGGERING	EXT, AC
X10 HORIZ MAG	Pushed in

h. Set the generator for a 1.5-division display at 1.0 MHz.

i. CHECK—Stable display is presented in AC and DC in variable positive-slope area, variable negative-slope area, and in both +AUTO and —AUTO.

j. Reset the generator for a five-division display at 10 MHz.

k. Pull the X10 HORIZ MAG knob.

l. CHECK—Stable display is presented in AC and DC in the variable positive-slope area, variable negative-slope area, and in both +AUTO and —AUTO.

m. Move the signal to CH 2, switch CH 1—NORM to NORM, Mode to CH 2, and repeat steps a through l.

n. Disconnect the high-frequency generator.

24. Check Low-Frequency Triggering

Set the 326 controls as follows:

TIME/DIV	20 ms
X10 HORIZ MAG	Pushed in
TRIGGERING	+AUTO, CH 1

a. Connect the low-frequency Constant-Amplitude Sine-Wave Generator to the CH 1 VERT INPUT connector through the 50-ohm BNC cable, 50-ohm termination, and the 50-ohm BNC T connector. Connect the output of the BNC T connector to the EXT TRIG OR HORIZ INPUT connector with a 50-ohm BNC cable.

b. Set the low-frequency generator for a 1.5-division display (150 mV) at 30 Hz.

c. CHECK—Stable display is presented in EXT AC and DC, in the variable positive-slope, variable negative-slope area, and +AUTO and —AUTO.

d. Set the generator for a 0.3 division display at 30 Hz.

e. Set the TRIGGERING to INT AC.

f. CHECK—Stable display is presented in the variable negative-slope area, the variable positive-slope area, the +AUTO, and —AUTO positions.

25. Check Low-Frequency Reject

a. Change the low-frequency Sine-Wave Generator for a 0.3 division display at 15 kHz.

b. CHECK—Stable triggering can be obtained in + and —AUTO, and in variable positive- and negative-slope areas.

c. Without changing the generator output amplitude, set the frequency to 30 Hz.

d. Reset TIME/DIV to 10 ms.

e. CHECK—Stable display cannot be obtained at any setting of the TRIGGERING LEVEL/SLOPE controls.

26. Check Calibrator

Change the following control settings:

CH 1 VOLTS/DIV	5 DIV CAL
Input AC-DC	GND (both buttons out)
TRIGGERING	
LEVEL/SLOPE	—AUTO
Coupling	INT AC
TIME/DIV	.1 ms

a. Set the Variable TIME/DIV control for one complete cycle in ten divisions.

b. CHECK–The display for length of the positive segment of the square wave between four and six divisions (duty cycle 40% to 60%).

c. Change the following control settings:

VOLTS/DIV	.1
Input AC-DC	DC
TIME/DIV	.5 ms
Variable VOLTS/DIV	CAL

d. Connect a 1X probe to the CH 1 INPUT connector.

e. Connect the probe tip to the CAL OUT jack.

f. CHECK–Display for five divisions of vertical amplitude.

SHORT-FORM ADJUSTMENT PROCEDURE AND INDEX

326 Serial Number _____

Calibration Date _____

Calibrated By _____

1. Adjust T970 Primary Current

   ADJUST R942 for 3.6 A in T970 primary.

2. Adjust High Voltage Supply and Check Regulation

   ADJUST R907 for –1900 volts, within 2%.

3. Adjust Intensity Limit

   ADJUST R1064 for 315 μA CRT cathode current.

4. Adjust +5-Volt Power Supply

   ADJUST R1004 for 0.500 volt between CAL OUT jack and chassis ground.

5. Adjust –5-Volt Power Supply

   ADJUST R1030 for –5.0 volts, ±75 mV at –5-volt test point.

6. Check Low-Voltage Power Supply Ripple and Regulation

   CHECK the low-voltage supplies while varying the external DC supply voltage between +9.0 and +32 volts.

7. Adjust Variable Volts/Div Balance (each channel)

   ADJUST R37 and R237 for no trace shift as Variable VOLTS/DIV is rotated.

8. Adjust CH 1 Vertical X10 Balance

   ADJUST R36 for minimum trace shift as the X10 VERT GAIN switch is pulled out and pushed in.

9. Adjust CH 2 Vertical X10 Balance

   ADJUST R236 for minimum trace shift as the X10 VERT GAIN switch is pulled out and pushed in.

10. Adjust Deflection Plate DC Level (each channel)

    ADJUST R82 to center the measured range at +50 volts.

    ADJUST R84 to center the measured range at +50 volts.

    ADJUST R69 for a meter reading of +50 volts.

    ADJUST R282 to center the measured range at +50 volts.

    ADJUST R284 to center the measured range at +50 volts.

    ADJUST R269 for a meter reading of +50 volts.

11. Adjust Astigmatism

    ADJUST R1068 (with FOCUS) for the best marker definition.

12. Adjust Trace Alignment

    ADJUST R1060 to align marker baseline with graticule horizontal centerline.

13. Adjust CRT Geometry

ADJUST R1062 for minimum curvature of markers and baseline.

14. Adjust Limit Centering (each channel)

ADJUST R69 for minimum compression.

ADJUST R269 for minimum compression.

15. Adjust CH 1 X1 Vertical Gain

ADJUST R65 for 5.00 divisions of display.

16. Adjust CH 1 X10 Vertical Gain

ADJUST R41 for 5.00 divisions of display.

17. Adjust CH 2 Vertical X1 Gain

ADJUST R265 for 5.00 divisions of display.

18. Adjust CH 2 Vertical X10 Gain

ADJUST R241 for 5.00 divisions of display.

19. Adjust High Frequency Compensation

ADJUST R411 for the best flat top on the square wave.

ADJUST R421 for the best flat bottom on the square wave.

ADJUST R418, R428, C417, C427, C418, C428, and R430 for best front corner.

20. Adjust Input Capacitance

ADJUST C21 for minimum overshoot or rounding.

ADJUST C221 for minimum overshoot or rounding.

21. Adjust Volts/Div Switch Compensation

ADJUST each attenuator as shown in Table 5-5.

22. Adjust Magnified Registration

ADJUST R713 for position coincidence in X1 and X10.

23. Adjust Normal Timing

ADJUST R611 midway between triggered display and auto sweep.

ADJUST R702 for one marker per division.

24. Adjust Sweep Length and Centering

ADJUST R618 for 10.7 division sweep length.

ADJUST R704 to set trace start.

25. Adjust Magnified Timing

ADJUST R717 for one marker per division.

26. Adjust High Speed Timing

ADJUST C620F for 1 marker per division.

ADJUST C701 for best sweep start linearity.

ADJUST C782 for best sweep and linearity.

27. Adjust External Horizontal 10X Compensation

ADJUST C538 for minimum rounding or overshoot.

28. Adjust Battery Charger Charge Rate

ADJUST R1144 for 45 mV across R1115.

ADJUSTMENT PROCEDURE

Initial Control Settings:

INTENSITY	midrange
FOCUS	midrange
POWER	OFF
CH 1 and CH 2	
VOLTS/DIV	5 DIV CAL
POSITION	midrange
X10 VERT GAIN	pushed in
Input Coupling AC-DC	AC
Mode	CH 1
CH 2 INVERT	pushed in
TIME/DIV	.5 ms
TRIGGERING	
CH 1–NORM	CH 1
LEV/SLOPE	+AUTO
INT–EXT	INT AC
Horizontal POSITION	midrange

Preliminary Procedure for Complete Calibration

1. Remove the Battery Charger from the 326.

2. Remove the cabinet from the 326.

3. Remove the Battery Pack.

4. Remove the Power Regulator following the removal instructions in the Maintenance Section (4).

5. Connect an external DC supply to the 326 EXT DC POWER input jacks (note polarity).

6. Set the external DC supply output to +9 volts.

7. Switch the 326 POWER switch to ON.

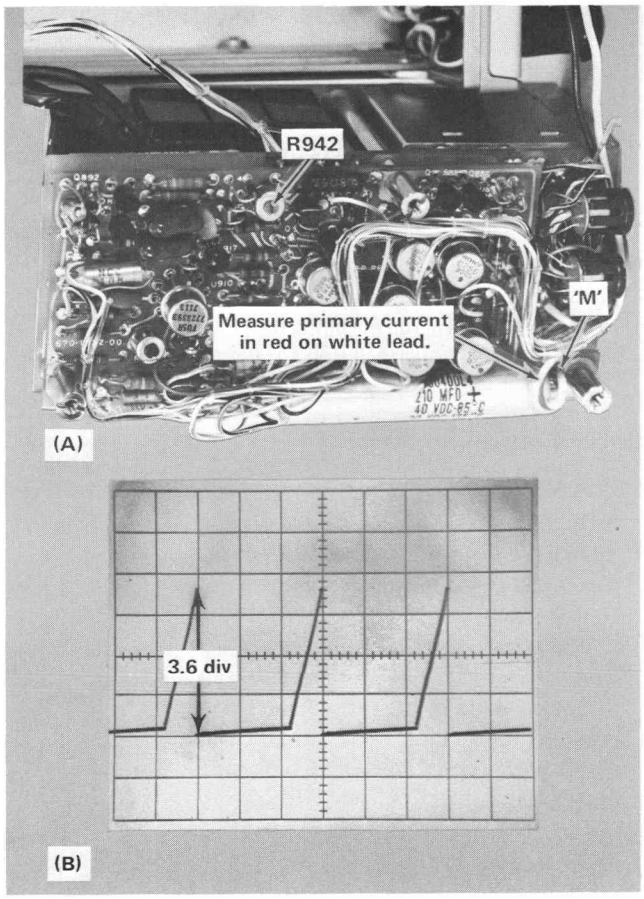


Fig. 5-6. T970 primary current adjust. (A) Location of terminal M. (B) Typical waveform.

1. Adjust T970 Primary Current (R942)

a. Connect the current probe around the red-on-white lead from terminal 'M' on the Power Regulator Control Board (see Fig. 5-6A for location).

b. Set the current probe Passive Termination for 2 mA/mV and the Test Oscilloscope vertical deflection to .5 V/Div.

c. Observe a waveform on the test oscilloscope similar to that shown in Fig. 5-6B.

d. ADJUST–R942 for 3.6 divisions (3.6 amp) of vertical display.

e. Remove the current probe.

2. Adjust High Voltage Supply and Check Regulation

a. Connect a DC voltmeter + lead to terminal 'O' or 'P' (see Fig. 5-7A) on H.V. board and – lead to chassis ground.

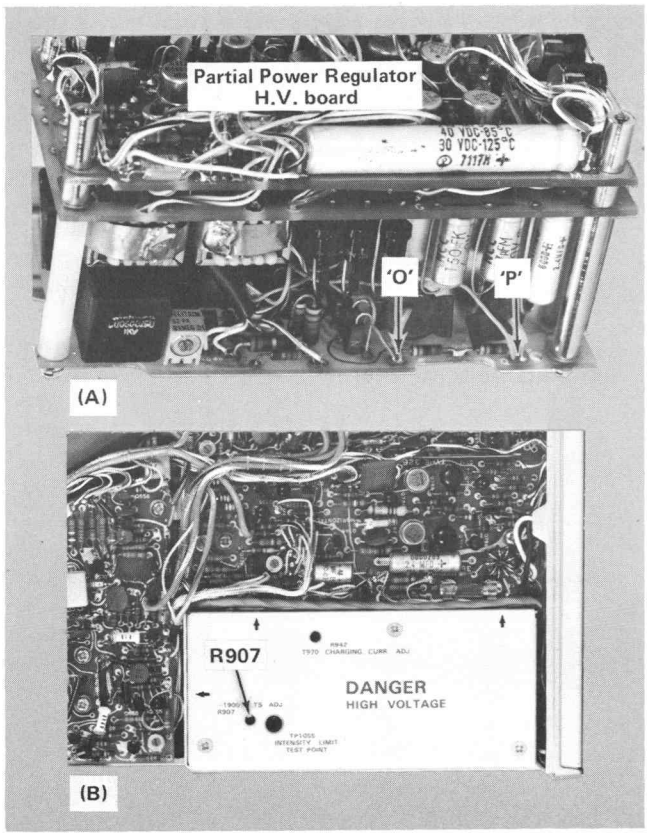


Fig. 5-7. High Voltage adjustment. Location of (A) Terminals O and P, and (B) Location of R907.

b. ADJUST–R907 (see Fig. 5-7B) for a meter reading of –1900 volts.

c. Change the variable DC power source output voltage between +9 and +32 volts. Set the INTENSITY control fully clockwise at +9 volts and fully counterclockwise at +32 volts.

d. CHECK–for less than ±40 volts change in the –1900-volt level (–1860 volts to –1940 volts).

NOTE

If the high-voltage supply is out of regulation, check the regulation of the low-voltage supplies (steps 4 and 5) before troubleshooting the high-voltage supply.

e. Return the variable DC power source to +9 volts.

f. INTERACTION–Adjusting the –1900-volt supply will affect the display. Therefore, a complete calibration must follow.

3. Adjust Intensity Limit (R1064)

NOTE

This step need not be performed except where display brightness is low or when replacing the CRT.

a. Unsolder the junction of R1056-R1057 (see Fig. 5-8) and lift the ends of the resistors clear of the circuit board. Connect the two resistor leads together and connect to the positive lead of the VOM set to read 600 μA, full scale. Connect the negative lead to the point on the circuit board to which the resistors were originally connected.

b. Set the 326 INTENSITY control fully clockwise.

c. ADJUST–R1064 (see Fig. 5-8 for location) for a meter reading of 315 μA.

d. Remove the meter and reconnect the resistors to the circuit board.

4. Adjust +5-Volt Power Supply (R1004)

a. Connect a precision DC voltmeter between the front-panel CAL OUT jack and chassis ground.

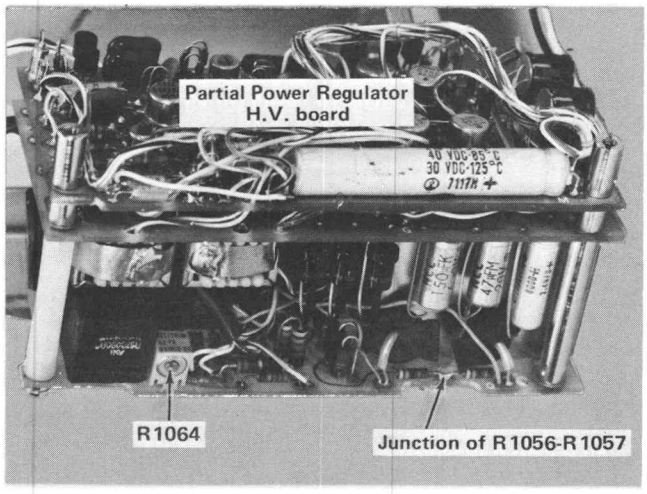


Fig. 5-8. Intensity Limit adjustment. Location of cathode current measurement point and R1064.

b. Remove Q9 from its socket on the ATT/CAL/SW circuit board (see Fig. 5-9A).

c. ADJUST–R1004 (see Fig. 5-9B for location) for a meter reading of 0.500 volt.

d. Disconnect the precision DC voltmeter and replace Q9.

e. Connect the precision DC voltmeter between terminal 'BZ' on the Horizontal board (see Fig. 5-10A for location) and chassis ground.

f. CHECK–for a meter reading of +5.0 volts, ±75 mV.

g. INTERACTION–may affect operation of all circuits within the instrument.

5. Adjust –5-Volt Power Supply (R1030)

a. Connect the precision DC voltmeter between terminal 'BB' on the Horizontal board (see Fig. 5-10A for location) and chassis ground.

b. ADJUST–R1030 (see Fig. 5-10A for location) for a meter reading of –5 volts, ±25 mV.

c. INTERACTION–may affect operation of all circuits within the instrument.

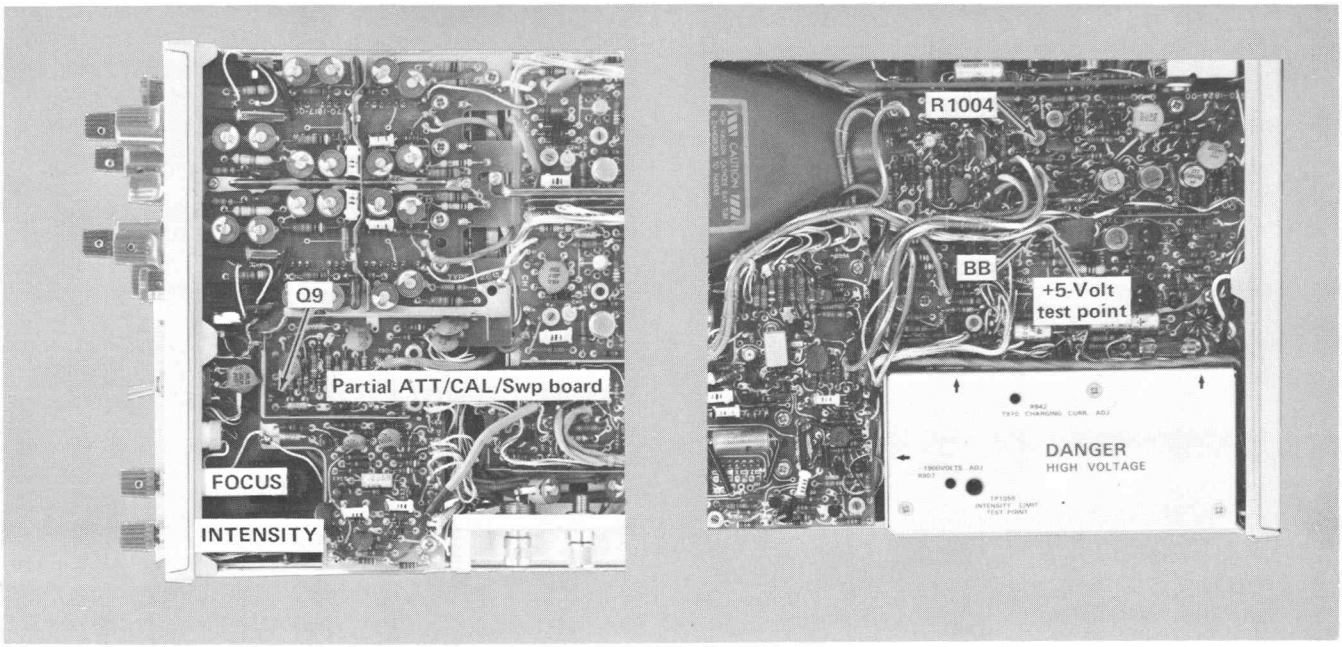


Fig. 5-9. +5-Volt supply adjustment. Location of (A) Q9, and (B) R1004 and +5-Volt test point.

6. Check Low-Voltage Power-Supply Ripple and Regulation

a. Set the following 326 front-panel controls:

TIME/DIV	EXT HORIZ
Vertical POSITION	Position spot off screen

b. Connect a 1X probe to the Test Oscilloscope vertical input.

c. Set the Test Oscilloscope vertical deflection factor to 0.01 Volts/Div, AC Coupled, and sweep rate at 20 μs/Div.

d. CHECK—the Test Oscilloscope display for ripple of each supply while varying the external DC voltage supply between +9 volts and +32 volts. Table 5-4 lists the supply voltage limits, ripple limits, and location of test point for each supply. See Fig. 5-10B.

e. Disconnect the external DC supply and replace the Power Regulator in the 326. Reconnect the external DC supply or replace the internal battery pack.

TABLE 5-4

Supply	Voltage Limits	Maximum Ripple	Location of Test Point
−5 V	Within 2%	10 mV	'BB' on Horiz Board
+5 V	Within 2%	10 mV	'BZ' on Horiz Board
+14 V	−20%	200 mV	'BD' on Horiz Board
+100 V	−5%	750 mV	'L' on Rect Board
+165 V	+8%, −6%	750 mV	'K' on Rect Board

7. Adjust Variable Volts/Div Balance (R37-R237)

a. Set the 326 Mode switch to CH 1.

b. Vertically position the trace to the center graticule line.

c. Rotate the CH 1 Var VOLTS/DIV control throughout its range noting the vertical trace shift.

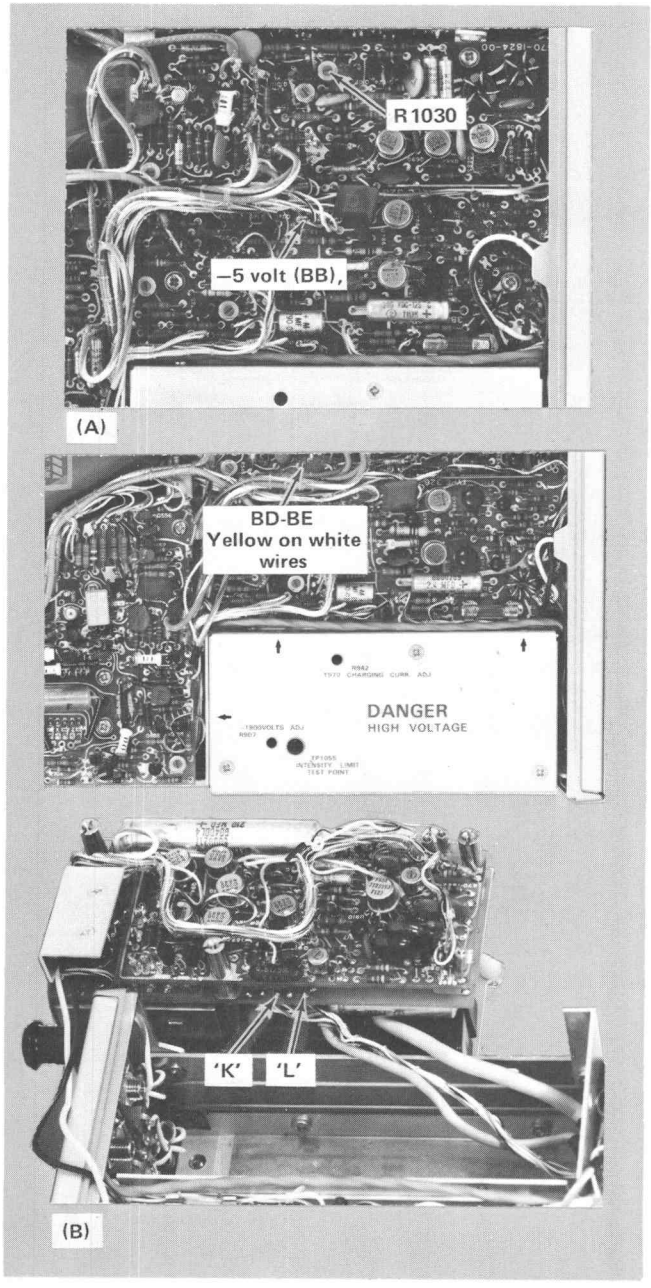


Fig. 5-10. –5-Volt adjustment. Location of (A) –5-Volt Test Point and R1030, and (B) unregulated supply test points.

d. ADJUST–R37 (see Fig. 5-11B) for no trace shift as the Variable VOLTS/DIV control is rotated. If necessary, use the Vertical POSITION control to keep the trace on screen during this adjustment. Set Mode to CH 2.

e. Rotate CH 2 Var VOLTS/DIV throughout its range.

f. ADJUST–R237 (see Fig. 5-11B) for no trace shift as the CH 2 Var VOLTS/DIV control is turned.

g. Return both CH 1 and CH 2 Var VOLTS/DIV controls to the CAL position.

h. Set Mode switch to CH 1.

8. Adjust CH 1 Vertical X10 Balance (R36)

a. Vertically position the CH 1 trace to the center horizontal line.

b. Pull the CH 1 X10 VERT GAIN switch and check trace shift as the knob is pulled.

c. ADJUST–R36 (see Fig. 5-11B) for minimum trace shift as the X10 VERT GAIN switch is pulled out and pushed in. To prevent changing the knob position (rotational) the X10 VERT GAIN switch can be actuated using the control bracket behind the front panel.

d. Push the CH 1 X10 VERT GAIN switch in and switch Mode to CH 2.

9. Adjust CH 2 Vertical X10 Balance (R236)

a. Vertically position the CH 2 trace to the center horizontal graticule line.

b. Pull the CH 2 X10 VERT GAIN switch and check trace shift as the knob is pulled out.

c. ADJUST–R236 (see Fig. 5-11B) for minimum trace shift as the X10 VERT GAIN switch is pulled out and pushed in. To prevent changing the knob position (rotational) the X10 VERT GAIN switch can be actuated using the control bracket behind the front panel.

d. Push the CH 2 X10 VERT GAIN switch in. Switch Mode to CH 1.

10. Adjust Deflection Plate DC Level (R82-R84-R69)

a. Connect a DC voltmeter between Q457 collector (case) on the Vertical Output board (see Fig. 5-11A) and chassis ground.

b. Turn the CH 1 Vertical POSITION control fully clockwise and note the meter reading. Rotate the Vertical POSITION control fully counterclockwise and again note the meter reading.

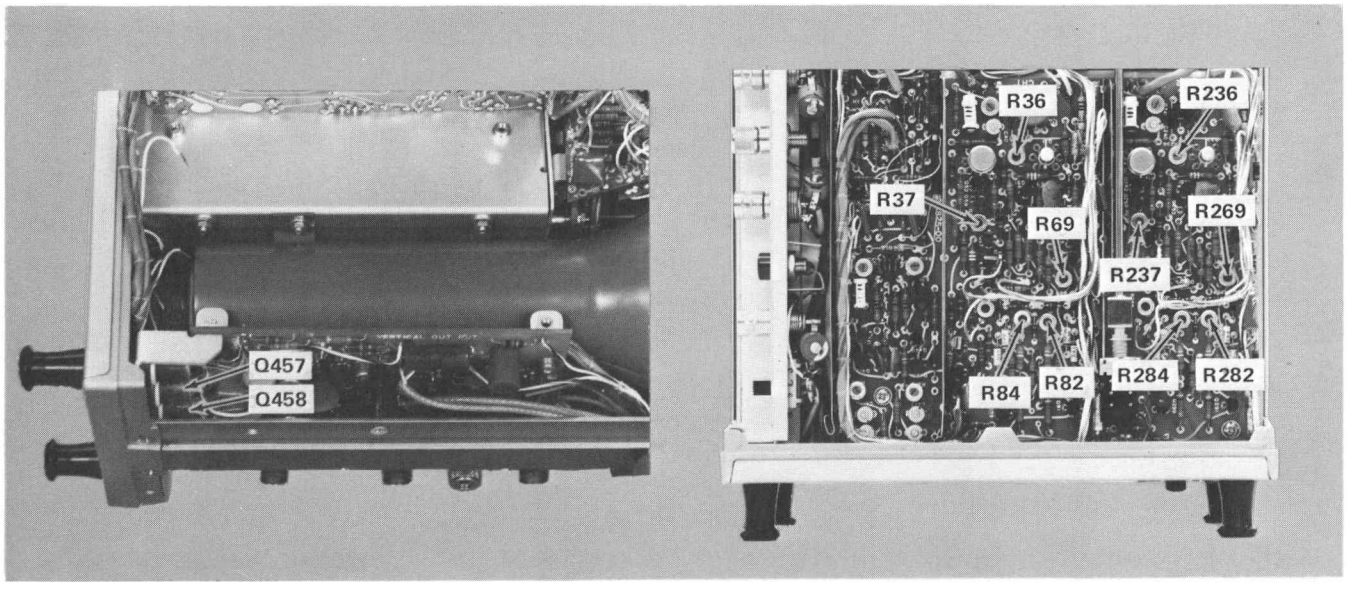


Fig. 5-11. Deflection Plate DC Level adjustment. Location of controls.

c. ADJUST–R82, Upper Defl Plate DC Level control (see Fig. 5-11B) to center the measured range at +50 volts.

d. Connect the DC voltmeter between Q458 collector (case) on the Vertical Output board (see Fig. 5-11A) and chassis ground.

e. Turn the CH 1 Vertical POSITION control fully clockwise and note the meter reading. Rotate the Vertical POSITION control fully counterclockwise and again note the meter reading.

f. ADJUST–R84, Lower Defl Plate DC Level control (see Fig. 5-11B) to center the measured range at +50 volts.

g. Vertically position the CH 1 trace to graticule centerline.

h. Connect the DC voltmeter between Q457 collector and chassis ground.

i. ADJUST–R69 for a meter reading of +50 volts.

j. Perform steps a through i, for CH 2, using controls R282, R284, and R269.

11. Adjust Astigmatism (R1068)

Reset the following 326 controls:

Mode	CH 1
CH 1 VOLTS/DIV	.5
CH 1 AC-GND-DC	DC
TIME/DIV	1 ms

a. Set the INTENSITY control midway between a barely visible trace and fully clockwise.

b. Connect a Time-Mark Generator (set to 1 ms markers) to the CH 1 VERT INPUT connector (use BNC cable). Trigger as necessary for stable display.

c. ADJUST–FOCUS (front panel) and Astig (R1068) controls (see Fig. 5-12A) for the best definition of the markers within the areas indicated in Fig. 5-12B.

12. Adjust Trace Alignment (R1060)

a. Vertically position the marker display baseline to the graticule horizontal centerline.

b. ADJUST–R1060, Trace Rotation control (see Fig. 5-12A) to align the marker display baseline parallel to the graticule horizontal centerline.

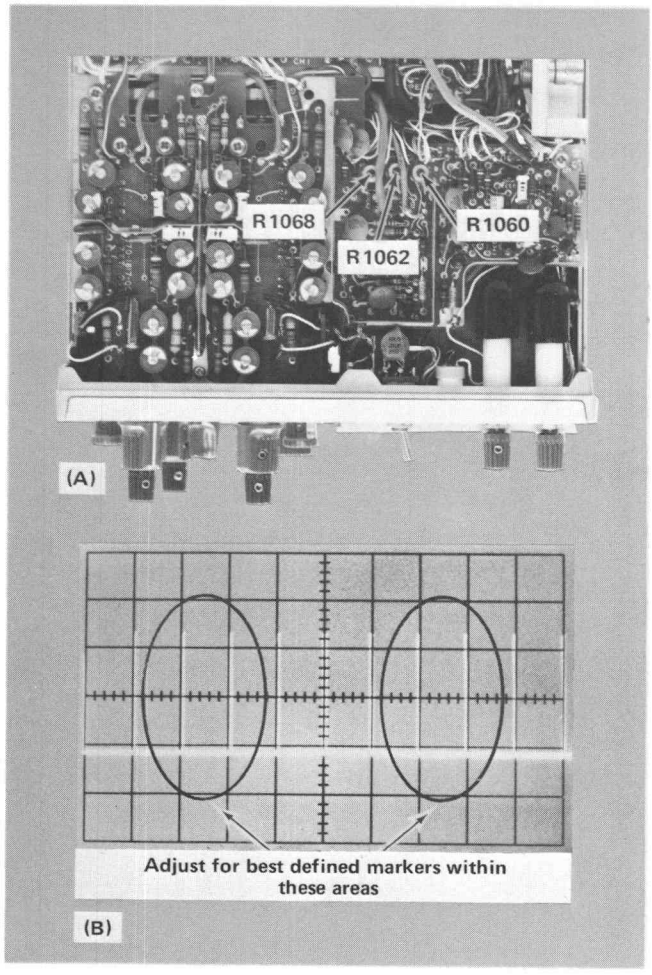


Fig. 5-12. (A) Location of Astigmatism, Trace Alignment, and Geometry controls and (B) Typical display.

13. Adjust CRT Geometry (R1062)

Set CH 1 VOLTS/DIV switch to .1.

a. Vertically position the marker display baseline below the bottom of the graticule.

b. Adjust the INTENSITY control as necessary for normal viewing brightness.

c. ADJUST—R1062, Geometry control (see Fig. 5-12A) for minimum curvature of the vertical markers.

d. Disconnect the Time-Mark Generator from the instrument.

e. Set the TRIGGERING LEVEL/SLOPE control to +AUTO.

f. Vertically position the trace to the top graticule line.

g. Trace deviation from a straight line should not exceed 1/2 minor division.

h. Vertically position the trace to the bottom graticule line.

i. Trace deviation from a straight line should not exceed 1/2 minor division.

NOTE

It may be necessary to compromise the setting of R1062 to provide acceptable displays in steps c, g, and i.

14. Adjust Limit Centering (R69 and R269)

Set CH 1 and CH 2 VOLTS/DIV to 5 DIV CAL.

Set Mode to CH 1.

a. Vertically position the bottom of the display to the first graticule line below the center line.

b. Reduce the display amplitude to two divisions, using the Var VOLTS/DIV control.

c. Vertically position the top of the display to the top graticule line and check for compression (decrease in display amplitude).

d. Vertically position the bottom of the display to the bottom graticule line and check for compression.

e. ADJUST—R69, Limit Centering control, for least compression. Compression should not exceed 0.1 division. See Fig. 5-13 for location of R69 and R269.

f. Set Mode switch to CH 2 and repeat steps a through d.

g. ADJUST—R269, Limit Centering control, for least compression.

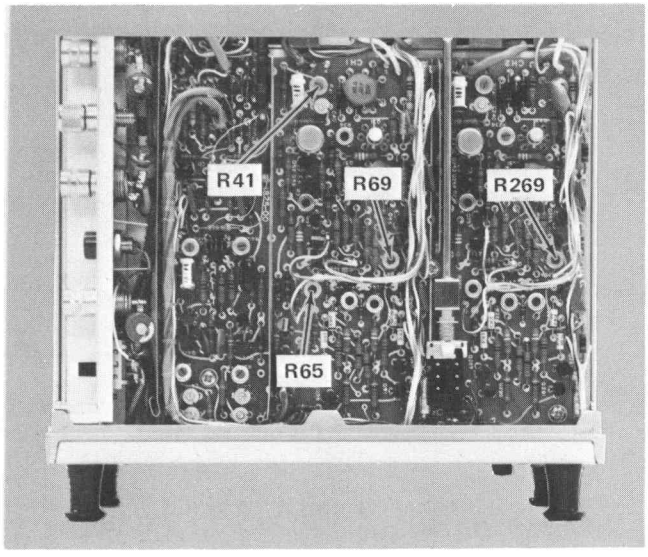


Fig. 5-13. Location of Limit Centering and Vertical Gain controls.

15. Adjust CH 1 Vertical Gain (R65)

Set the 326 controls as follows:

CH 1 VOLTS/DIV	.01
Var	CAL
Mode	CH 1
CH 1–NORM	CH 1

a. Connect the Standard Amplitude Calibrator output to CH 1 VERT INPUT connector via a 50 Ω BNC cable.

b. Set the Standard Amplitude Calibrator for a 50-mV square-wave output.

c. Vertically center the display about the center horizontal graticule line.

d. ADJUST–R65, X1 Vertical Gain adjustment, for 5.00 divisions of display. See Fig. 5-13 for location of Gain controls.

16. Adjust CH 1 X10 Vertical Gain (R41)

a. Reset the Standard Amplitude Calibrator to 5 mV, and pull the 326 CH 1 X10 VERT GAIN control.

b. Vertically center the display about the center horizontal graticule line.

c. ADJUST–R41, Vertical X10 Gain, for 5.00 divisions of display.

17. Adjust CH 2 X1 Vertical Gain (R265)

Reset the following controls:

Mode	CH 2
CH 1–NORM	NORM
CH 2 VOLTS/DIV	.01
Standard Amplitude Calibrator	50 mV

a. Connect the Standard Amplitude Calibrator output to CH 2 VERT INPUT connector.

b. Vertically center the display about the center horizontal graticule line.

c. ADJUST–R265, Vertical X1 Gain, for 5.00 divisions of display.

18. Adjust CH 2 X10 Vertical Gain (R241)

Reset Standard Amplitude Calibrator for 5 mV output and pull CH 2 X10 VERT GAIN control.

a. Vertically center the display about the center graticule line.

b. ADJUST–R241, Vert X10 Gain, for exactly 5 divisions of display.

19. Adjust High Frequency Compensation

Reset the following controls:

CH 1 VERT GAIN	pushed in
CH 1 VOLTS/DIV	1 volt
Mode	CH 1
CH 1–NORM	CH 1
TIME/DIV	1 μs

a. Connect the Square-Wave Generator Fast-Rise +Output connector to the 326 CH 1 VERT INPUT connector through a GR to BNC adapter; 42-inch, 50 Ω, BNC cable; 50 Ω, 10X, BNC attenuator; and a 50 Ω BNC termination.

b. Set the Square-Wave Generator for a four-division, 100 kHz display on the 326.

c. Move the leading edge of the square wave into the viewing area.

d. Set the Test Oscilloscope for 1 Volt/Div and 2 μs/Div.

e. Connect the Test Oscilloscope 10X probe tip to Q457 collector (case). See Fig. 5-14A for location.

f. ADJUST–R411 for a flat top on the Test Oscilloscope display.

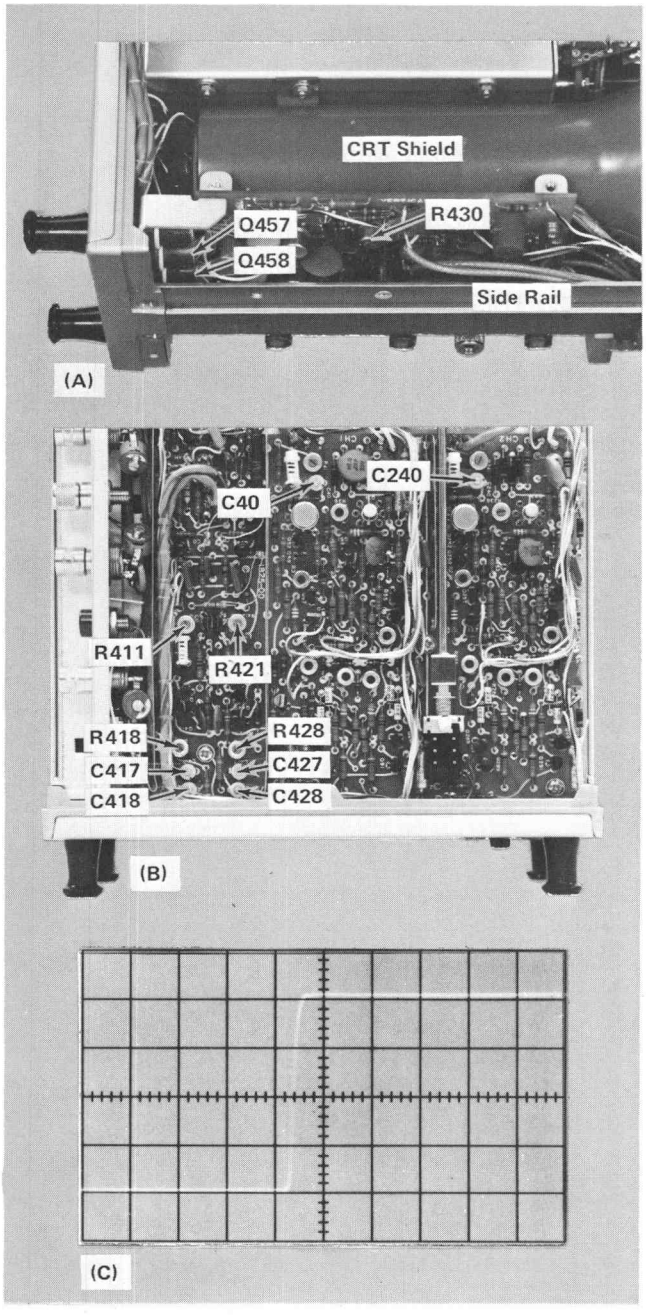


Fig. 5-14. High frequency compensation adjustment. (A) Location of test points, (B) Location of controls, and (C) Typical waveform.

g. Connect the probe tip to Q458 collector.

h. ADJUST–R421 for flat bottom on the Test Oscilloscope display.

i. PULL X10 HORIZ MAG.

j. ADJUST–R418, R428, C417, C427, C418, C428, and R430 for best front corner. See Fig. 5-14B for location of controls.

k. ADJUST–C40, CH 1 Vertical Amp board, for best front corner. See Fig. 5-14B for location of C40 and C240.

l. Move the signal source from CH 1 to CH 2 and switch Mode to CH 2 and TRIGGERING from CH 1 to NORM.

m. ADJUST–C240, CH 2 Vertical Amp board, for best front corner. See Fig. 5-14C for typical waveform indicating correct high frequency adjustment.

20. Adjust Input Capacitance (C21-C221)

Reset the following 326 controls:

CH 1–CH 2 VOLTS/DIV	.01
Mode	CH 1
TIME/DIV	.5 ms
CH 1–NORM	CH 1

a. Install the calibration shield on the 326.

b. Connect the Square-Wave Generator High-Amplitude +Output to the CH 1 VERT INPUT connector through a GR to BNC adapter; 42-inch, 50 Ω, BNC cable; 10X, 50 Ω, BNC attenuator; 50 Ω, BNC termination; and 47 pF Input RC Normalizer, in the order given.

c. Set the Square-Wave Generator for a five-division display at 1 kHz.

d. ADJUST–C21 (see Fig. 5-15A for location) for minimum overshoot and rounding of the leading edge of the square wave as shown in Fig. 5-15B.

Reset Mode switch to CH 2. Connect the square-wave signal to CH 2 VERT INPUT. Switch CH 1–NORM to NORM.

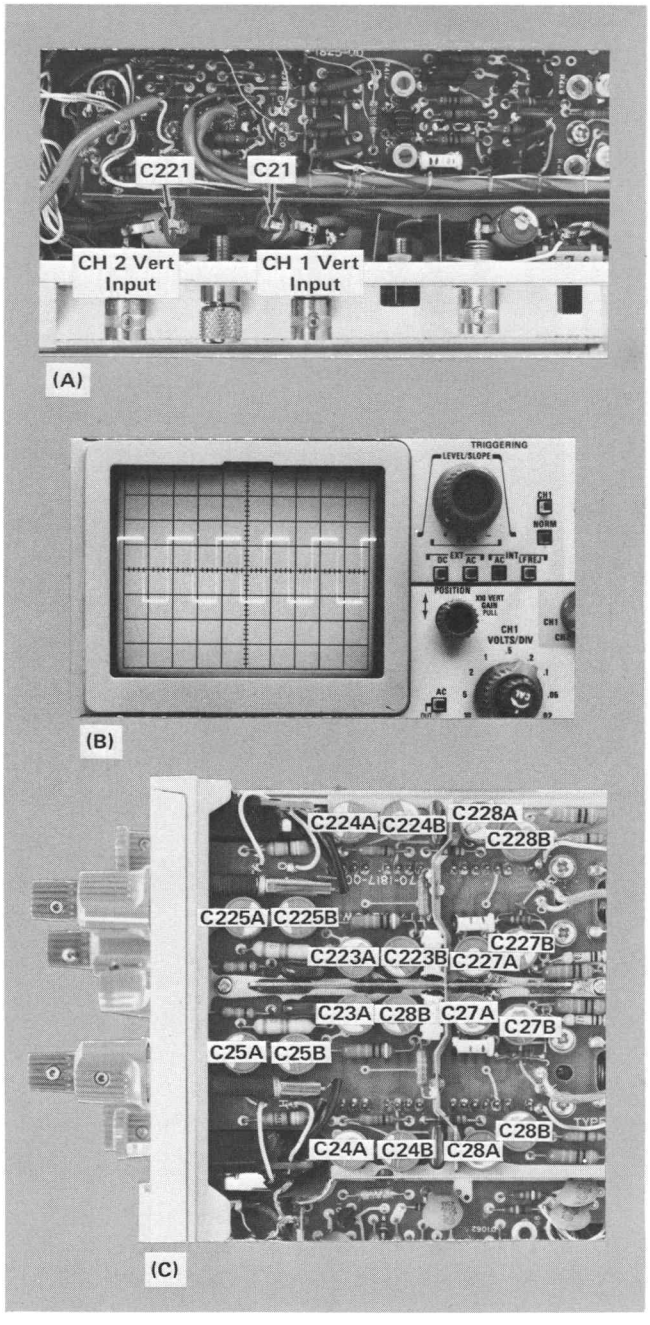


Fig. 5-15. Input capacitance adjustment (A) Location of controls, (B) Typical waveform, and (C) Location of Volts/Div switch compensation.

e. ADJUST–C221 for minimum overshoot and rounding of the leading edge of the square wave as shown in Fig. 5-15B.

f. Remove the signal and the 47 pF Input RC Normalizer.

21. Adjust Volts/Div Switch Compensation

Reset the following 326 controls:

CH 1 VOLTS/DIV	0.1
CH 1–NORM	CH 1

a. Connect the P6049A Probe to the 326 CH 1 VERT INPUT connector.

b. Install a GR to BNC adapter; 10X, 50 Ω, BNC attenuator; and BNC to Binding Post adapter on the Square-Wave Generator High-Amplitude Output connector in the order given.

c. Connect the P6049A Probe tip to the binding post adapter.

d. Set the square wave generator for a five-division display at 1 kHz.

e. Compensate the probe as described in the probe instruction manual.

f. ADJUST and CHECK–VOLTS/DIV switch compensation as detailed in Table 5-5 (use low-capacitance screwdriver). First adjust for best square corner and then for flat top (see Fig. 5-15C for location of controls).

g. Set CH 2 VOLTS/DIV to 0.1 and CH 1–NORM to NORM.

h. Move the probe to CH 2 VERT INPUT and repeat steps d through f for CH 2 (adjust C223 through C228).

TABLE 5-5

VOLTS/DIV Compensation

VOLTS/DIV Setting	Attenuator Compensated	Adjust for	
		Square Corner	Flat Top
.01	X1	Compensate Probe	
.02	X2	C27B	C27A
.05	X5	C28B	C28A
Remove external 10X attenuator			
.1	X10	C23B	C23A
.2	Check	If out of tolerance, compromise setting at .1 and .2 for best overall response.	

TABLE 5-5 (cont)

VOLTS/DIV Setting	Attenuator Compensated	Adjust for	
		Square Corner	Flat Top
.5	Check	If out of tolerance, compromise setting at .1, .2, and .5 for best overall response.	
1	X100	C24B	C24A
2	Check	If out of tolerance, compromise setting at 1 and 2 for best overall response.	
Pull 10X VERT GAIN switch			
5	Check	If out of tolerance, compromise setting at 1, 2, and 5 for best overall response.	
10	X200	C25B	C25A

i. Disconnect all test equipment.

j. Remove Calibration Shield.

22. Adjust Magnified Registration (R713)

Reset the following controls:

VOLTS/DIV	.5
CH 1 INPUT	DC
Mode	CH 1
CH 1–NORM	CH 1

a. Connect the Time-Mark Generator to CH 1 VERT INPUT connector through a 42-inch, 50 Ω, BNC cable and a 50 Ω termination.

b. Set the Time-Mark Generator for 5 ms markers and set the 326 TRIGGERING controls for a stable display.

c. Position the middle marker (three markers displayed) to the center vertical graticule line.

d. Pull the X10 HORIZ MAG switch. To prevent changing knob position (rotational) the X10 HORIZ MAG switch can be actuated using the Horizontal Position control bracket behind the front panel.

e. ADJUST–R713 (see Fig. 5-16A for location) to position the middle marker to the center vertical line.

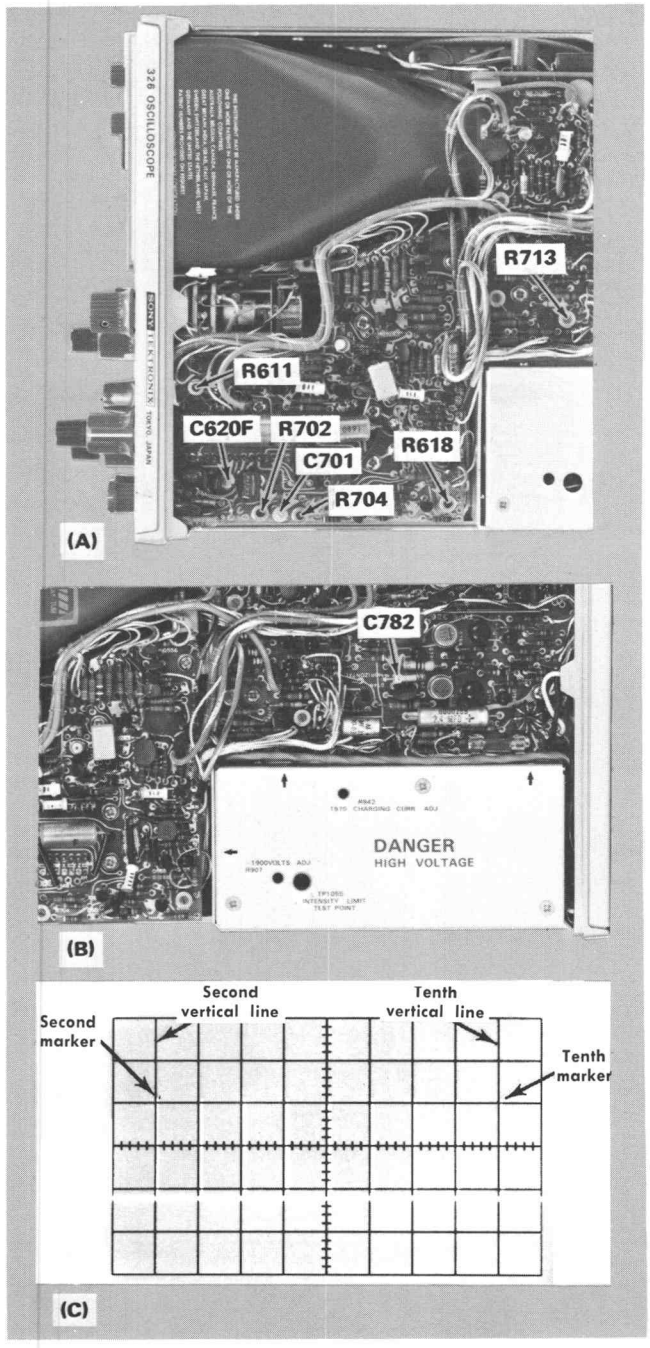


Fig. 5-16. Timing Adjustments (A) (B) Location of controls and (C) Typical waveform.

f. Push the X10 HORIZ MAG switch in.

23. Adjust Normal Timing

a. Set R611 (see Fig. 5-16B) midway between just triggered display and auto sweep (remove signal to determine auto sweep).

b. Set the Time-Mark Generator for 1 ms markers.

c. Set TRIGGERING controls for stable display.

NOTE

Unless otherwise noted, use the middle eight horizontal divisions (between the second and tenth vertical graticule lines) when checking or adjusting timing.

d. ADJUST–R702, X1 Gain (see Fig. 5-16A for location) for one marker per division over the center eight divisions. The first and ninth markers must coincide exactly with their respective graticule lines (reposition horizontally as needed). See Fig. 5-17.

24. Adjust Sweep Length and Centering (R618-R704)

a. Adjust the TRIGGERING controls for a stable display.

b. Set the tenth marker (see Fig. 5-17B) to the tenth vertical graticule line.

c. ADJUST–R618, Sweep Length adjustment, for a sweep length of 10.7 divisions (0.7 division of display to the right of the tenth marker).

d. Turn the Horizontal POSITION control fully clockwise.

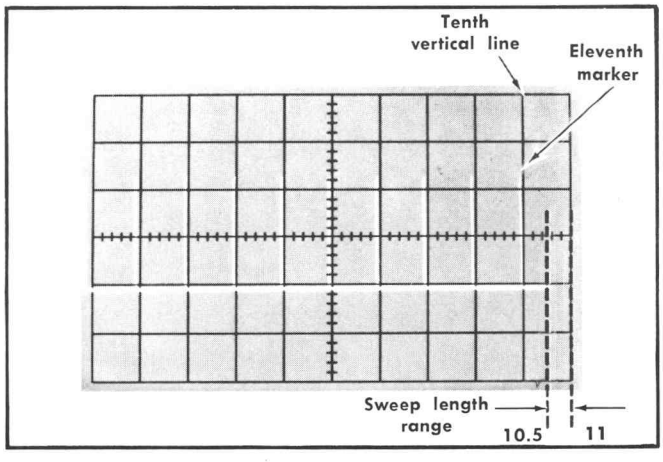


Fig. 5-17. Adjusting sweep length and centering. Typical waveform.

e. ADJUST–R704, Position Centering, to move the first marker two and one-half divisions to the right of graticule center.

f. Turn the Horizontal POSITION control fully counterclockwise and check for approximately two and one-half divisions from end of trace to graticule center.

g. ADJUST–R704 (if necessary) to set the distance from trace start to the center graticule line equal to the distance from end of trace to graticule center.

h. INTERACTION–R702 may have to be readjusted slightly to correct timing.

25. Adjust Magnified Timing (R717)

a. Set the Time-Mark Generator for .1 ms markers.

b. Set the 326 Horizontal POSITION control to midrange and pull the X10 HORIZ MAG knob.

c. ADJUST–R717, X10 Gain adjustment, for one marker per division over the center eight divisions. The second and tenth markers must coincide exactly with their respective graticule lines.

26. Adjust High Speed Timing

Reset the following 326 controls:

TIME/DIV	1 μs
X10 HORIZ MAG	PULL
Horizontal POSITION	midrange

Set the Time Mark Generator for .1 μs markers.

a. Observe approximately 1 marker per division displayed on 326.

b. ADJUST–C620F for best timing (1 marker per division).

c. Horizontally position the trace start to the viewing area.

d. ADJUST–C701 for best sweep start linearity.

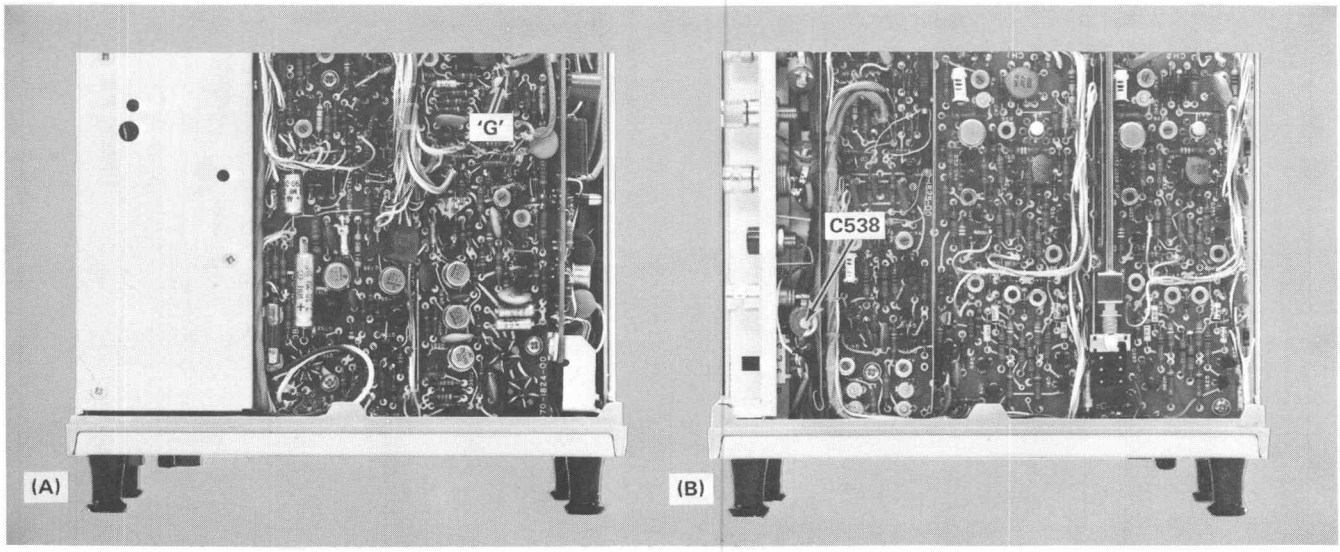


Fig. 5-18. Location of (A) Ext Horiz 10X Compensation test point 'G' and (B) C538.

e. Horizontally position the end of trace to the viewing area.

f. ADJUST–C782 for best sweep end linearity. See Fig. 5-16A and B for location of controls.

27. Adjust External Horizontal 10X Compensation (C538)

Set the 326 controls as follows:

TIME/DIV	EXT HORIZ
TRIGGERING	EXT DC
HORIZ MAG	Pushed in
EXT HORIZ ATTEN (side panel)	X10

a. Connect the Standard Amplitude Calibrator to EXT TRIG OR HORIZ INPUT. Set Standard Amplitude Calibrator for a 5-volt square wave.

b. Connect a properly compensated probe to the Test Oscilloscope Input.

c. Set the Test Oscilloscope for a vertical deflection factor of .02 Volt/Div and a sweep rate of .5 ms/Div.

d. Connect the probe tip to point G on the 326 Horizontal Circuit board (see Fig. 5-18A for location).

e. ADJUST–C538 (see Fig. 5-18B) for the best square wave (minimum rounding or overshoot). Use a low capacitance screwdriver.

28. Adjust Battery Charger Charge Rate

a. Plug the battery charger banana plugs into the battery pack jacks, being sure that polarity is correct (mount the charger in the same position, relative to the battery pack, that it would be in if charging the battery pack in the instrument).

b. Connect a banana-banana patchcord from the negative battery pack output terminal to the negative external DC supply banana plug. See Fig. 5-19.

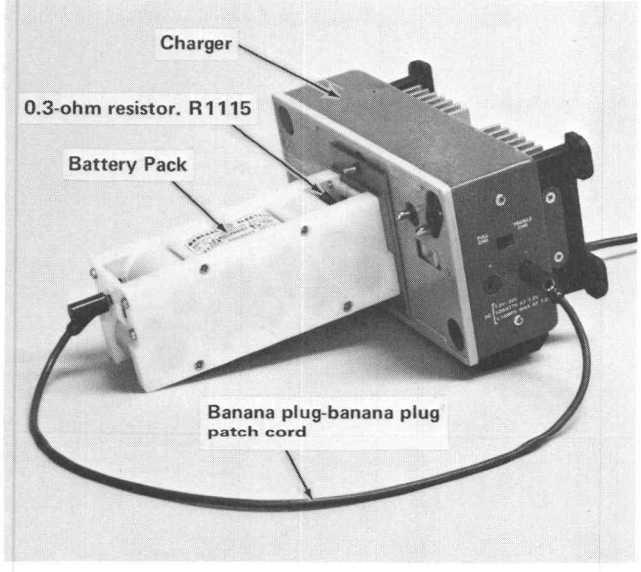


Fig. 5-19. Ground connection required to charge Battery Pack outside of instrument.

c. Connect a precision DC voltmeter across the 0.3-ohm resistor (R1115) in the battery pack.

d. Set the FULL CHG–TRICKLE switch to FULL CHG.

e. Plug the AC power cord into the variable line voltage source set to 115 volts.

f. ADJUST–R1144 for 0.45 volt (150 mA charge rate) across R1115 (0.3 ohms).

g. Vary the line voltage between 90 and 136 volts.

h. CHECK–Voltage drop across R1115 should not vary more than ±5 mV.

i. Switch the FULL CHG–TRICKLE switch to TRICKLE.

j. CHECK–For 16 mV, ±2 mV, across R1115.

SECTION 6
ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLY				
A1	670-1829-00			CH 1 AC-DC Circuit Board Assembly
A2	670-1830-00			CH 2 AC-DC Circuit Board Assembly
A3	670-1825-00			VERTICAL PREAMP. Circuit Board Assembly
A4	670-1817-00			ATTEN-CAL-SWITCHING Circuit Board Assembly
A5	670-1823-00			VERTICAL OUTPUT Circuit Board Assembly
A6	670-1827-00			TRIGGER SOURCE Circuit Board Assembly
A7	670-1828-00			TRIGGER SOURCE COUPLING Circuit Board Assembly
A8	670-1818-00			TRIGGER-SWEEP Circuit Board Assembly
A9	670-1819-00			TIMING Circuit Board Assembly
A10	670-1824-00			HORIZONTAL Circuit Board Assembly
A11	670-1821-00			POWER REGULATOR-RECTIFIER Circuit Board Assembly
A12	670-1820-00			POWER REGULATOR-H. V. Circuit Board Assembly
A13	670-1822-00			POWER REGULATOR-CONTROL Circuit Board Assembly
A14	670-1826-00			BATTERY CHARGER Circuit Board Assembly
BATTERY				
AT1115	146-0018-00			Battery, set of 9 NiCd cells
CAPACITORS				
C1	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C2	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C3	290-0183-01			1 µF, Elect., 35 V, 10%
C5	283-0023-00			0.1 µF, Cer, 10 V, +80%-20%
C6	290-0183-01			1 µF, Elect., 35 V, 10%
C7	290-0114-02			47 µF, Elect., 6 V, 10%
C8	290-0114-02			47 µF, Elect., 6 V, 10%
C19	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C20	285-0841-00			0.0185 µF, PTM, 500 V, 10%
C23A	281-0093-01			5.5-18 pF, Var, Cer

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C23B	281-0091-01			2-8 pF, Var, Cer
C23C	281-0600-00			35 pF, Cer, 10%
C24A	281-0093-01			5.5-18 pF, Var, Cer
C24B	281-0091-01			2-8 pF, Var, Cer
C24C	283-0597-01			470 pF, Mica, 300 V, 10%
C25A	281-0093-01			5.5-18 pF, Var, Cer
C25B	281-0091-01			2-8 pF, Var, Cer
C25C	283-0685-00			1000 pF, Mica, 300 V, 10%
C27A	281-0091-01			2-8 pF, Var, Cer
C27B	281-0093-01			5.5-18 pF, Var, Cer
C27C	281-0592-00			4.7 pF, Cer, ±0.5 pF
C27D	283-0201-00			27 pF, Cer, 200 V, 10%
C28A	281-0093-01			5.5-18 pF, Var, Cer
C28B	281-0091-01			2-8 pF, Var, Cer
C30	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C31	290-0183-01			1 µF, Elect., 35 V, 10%
C40	281-0122-00			2.5-9 pF, Var, Cer, 100 V
C41	281-0622-00			47 pF, Cer, 500 V, 1%
C48	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C95	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C201	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C202	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C207	290-0114-02			47 µF, Elect., 6 V, 10%
C208	290-0114-02			47 µF, Elect., 6 V, 10%
C220	285-0841-00			0.0185 µF, PTM, 500 V, 10%
C223A	281-0093-01			5.5-18 pF, Var, Cer
C223B	281-0091-01			2-8 pF, Var, Cer
C223C	281-0600-00			35 pF, Cer, 10%
C224A	281-0093-01			5.5-18 pF, Var, Cer
C224B	281-0091-01			2-8 pF, Var, Cer
C224C	283-0597-01			470 pF, Mica, 300 V, 10%
C225A	281-0093-01			5.5-18 pF, Var, Cer
C225B	281-0091-01			2-8 pF, Var, Cer
C225C	283-0685-00			1000 pF, Mica, 300 V, 10%
C227A	281-0091-01			2-8 pF, Var, Cer
C227B	281-0093-01			5.5-18 pF, Var, Cer
C227C	281-0592-00			4.7 pF, Cer, ±0.5 pF
C227D	283-0201-00			27 pF, Cer, 200 V, 10%
C228A	281-0093-01			5.5-18 pF, Var, Cer
C228B	281-0091-01			2-8 pF, Var, Cer
C230	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C231	290-0183-01			1 µF, Elect., 35 V, 10%
C240	281-0122-00			2.5-9 pF, Var, Cer
C241	281-0622-00			47 pF, Cer, 500 V, 1%
C248	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C332	283-0028-00			0.0022 µF, Cer, 50 V
C334	285-0685-00			0.0068 µF, PTM, 100 V, 10%
C335	281-0518-00			47 pF, Cer, 500 V, 20%
C342	283-0028-00			0.0022 µF, Cer, 50 V
C345	281-0518-00			47 pF, Cer, 500 V, 20%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C350	290-0183-01			1 µF, Elect., 35 V, 10%
C352	283-0230-00			470 pF, Cer, 500 V, 20%
C361	283-0003-00	300000	300025	0.01 µF, Cer, 150 V, +80%-20%
C361	283-0059-00	300026		1 µF, Cer, 25 V, +80%-20%
C397	283-0111-00			0.1 µF, Cer, 50 V
C400	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C411	281-0630-00			390 pF, Cer, 500 V, 5%
C413	283-0231-00			470 pF, Cer, 500 V, 10%
C417	281-0123-00			5-25 pF, Var, Cer, 100 V
C418	281-0122-00			2.5-9 pF, Var, Cer, 100 V
C421	281-0630-00			390 pF, Cer, 500 V, 5%
C427	281-0123-00			5-25 pF, Var, Cer, 100 V
C428	281-0122-00			2.5-9 pF, Var, Cer, 100 V
C444	283-0230-00			470 pF, Cer, 500 V, 20%
C446	283-0230-00			470 pF, Cer, 500 V, 20%
C449	283-0237-00			0.1 µF, Cer, 25 V, +80%-20%
C452	283-0237-00			0.1 µF, Cer, 25 V, +80%-20%
C454	283-0237-00			0.1 µF, Cer, 25 V, +80%-20%
C457	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C458	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C460	281-0724-00			0.3 pF, Cer, 500 V, 10%
C462	283-0235-00			0.05 µF, Cer, 50 V, +100%-0%
C464	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C470	281-0724-00			0.3 pF, Cer, 500 V, 10%
C472	283-0235-00			0.05 µF, Cer, 50 V, +100%-0%
C474	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C476	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C478	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C480	290-0271-00			9 µF, Elect., 125 V, +20%-15%
C508	283-0288-00			35 pF, Cer, 500 V, 10%
C510	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C540	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C542	283-0104-01			0.002 µF, Cer, 500 V, 5%
C549	283-0067-00			0.001 µF, Cer, 200 V, 10%
C555	283-0247-00			680 pF, Cer, 500 V, 10%
C558	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C565A	290-0460-00			10 µF, Elect., 25 V, 20%
C565B	290-0183-01			1 µF, Elect., 35 V, 10%
C565C	290-0450-00			0.1 µF, Elect., 35 V, 20%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C566	283-0228-00			51 pF, Cer, 50 V, 10%
C572	283-0228-00			51 pF, Cer, 50 V, 10%
C590	290-0457-00			4.7 µF, Elect., 10 V, 20%
C595	290-0457-00			4.7 µF, Elect., 10 V, 20%
C611	281-0578-00			18 pF, Cer, 500 V, 5%
C615[1]	283-0231-00			470 pF, Cer, 500 V, 10%
C616[1]	283-0236-00	X300026		0.01 µF, Cer, 50 V, 20%
C620A	295-0134-00			1 µF,
C620B				0.1 µF,
C620C				0.01 µF, Timing capacitor
C620D				0.001 µF,
C620E	283-0720-00			275 pF, Mica, 500 V, 1%
C620F	281-0123-00			5-25 pF, Var, Cer, 100 V
C626	283-0282-00			100 pF, Cer, 500 V, 20%
C628	281-0503-00			8 pF, Cer, 500 V, ±0.5 pF
C630	281-0622-00			47 pF, Cer, 500 V, 1%
C635	283-0224-00			5 pF, Cer, 50 V, ±0.5 pF
C636	283-0231-00			470 pF, Cer, 500 V, 10%
C642	290-0136-01			2.2 µF, Elect., 20 V, 20%
C644	283-0236-00			0.01 µF, Cer, 50 V, 20%
C648	290-0136-01			2.2 µF, Elect., 20 V, 20%
C650	281-0550-00			120 pF, Cer, 500 V, 10%
C655	290-0134-02			22 µF, Elect., 15 V, +20%-0%
C660A	290-0167-01			10 µF, Elect., 15 V
C660B	283-0203-00			0.47 µF, Cer, 50 V, 20%
C661	283-0232-00			0.001 µF, Cer, 50 V, 20%
C663	281-0523-00			100 pF, Cer, 350 V, 10%
C671	283-0675-01			82 pF, Mica, 300 V, 1%
C672	290-0136-01			2.2 µF, Elect., 20 V, 20%
C679	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C684	283-0231-00			470 pF, Cer, 500 V, 10%
C686	283-0236-00			0.01 µF, Cer, 50 V, 20%
C687	283-0230-00			470 pF, Cer, 50 V, 20%
C694	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C695	290-0457-00			4.7 µF, Elect., 10 V, 20%

[1]Individual timing capacitors in this assembly must be ordered by the 9 digit part number, letter suffix and tolerance printed on the timing capacitor to be replaced.
Example:

285-XXXX-XX F-

The letter suffix and the tolerance should be the same for all of the timing capacitors in the assembly.

ELECTRICAL PARTS LIST (cont)

Ckt. No.		Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS	(cont)				
C696		290-0457-00			4.7 µF, Elect., 10 V, 20%
C701		281-0123-00			5-25 pF, Var, Cer, 100 V
C702		281-0523-00			100 pF, Cer, 350 V, 10%
C705		283-0597-01			470 pF, Mica, 300 V, 10%
C722		281-0103-00			180 pF, Cer, 500 V, 5%
C736		283-0230-00			470 pF, Cer, 500 V, 20%
C750		283-0241-00			0.2 pF, Cer, 500 V, 20%
C754		283-0233-00			0.0022 µF, Cer, 500 V, 20%
C760		290-0449-00			3 µF, Elect., 250 V, +100%-0%
C762		283-0231-00			470 pF, Cer, 500 V, 10%
C763		281-0622-00	X300026		47 pF, Cer, 500 V, 1%
C764		283-0079-00			0.01 µF, Cer, 250 V, 20%
C782		281-0095-00			0.2-1.5 pF, Var, Teflon
C784		283-0240-00			1 pF, Cer, 500 V, 20%
C791		290-0114-01			47 µF, Elect., 6 V
C792		290-0114-01			47 µF, Elect., 6 V
C870B		290-0562-00			210 µF, Elect., 40 V, +75%-10%
C878		290-0164-00			1 µF, Elect., 150 V
C892		283-0231-00			470 pF, Cer, 500 V, 10%
C894		283-0597-01			470 pF, Mica, 300 V, 10%
C896		283-0597-01			470 pF, Mica, 300 V, 10%
C898		290-0136-01			2.2 µF, Elect., 20 V, 20%
C905		283-0000-01			0.001 µF, Cer, 500 V, +100%-0%
C910		283-0111-00			0.1 µF, Cer, 50 V,
C958		290-0167-01			10 µF, Elect., 15 V
C959		290-0565-00			150 µF, Elect., 6.3 V, 10%
C962		290-0167-01			10 µF, Elect., 15 V
C964		290-0183-01			1 µF, Elect., 35 V, 10%
C966		290-0183-01			1 µF, Elect., 35 V, 10%
C990		290-0449-00			3 µF, Elect., 250 V, +100%-0%
C992		290-0563-00			18 µF, Elect., +50%-10%
C994		290-0463-00			47 µF, Elect., 20 V, 20%
C1000		290-0564-00			560 µF, Elect., 7 V, +75%-10%
C1008		283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1014		290-0134-01			22 µF, Elect., 15 V, 20%
C1016		290-0564-00			560 µF, Elect., 7 V, +75%-10%
C1022		283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1026		283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1032		290-0134-01			22 µF, Elect., 15 V, 20%-0%
C1040	(7)	283-0151-00			0.01 µF, Cer, 500 V
C1041	(7)	283-0151-00			0.01 µF, Cer, 500 V
C1042	(7)	283-0151-00			0.01 µF, Cer, 500 V

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C1046	283-0293-00			0.05 µF, Cer, 1000 V, +100%-0%
C1048	283-0293-00			0.05 µF, Cer, 1000 V, +100%-0%
C1050	283-0068-00			0.01 µF, Cer, 500 V, +100%-0%
C1052	283-0292-00			0.04 µF, Cer, 2000 V, +100%-0%
C1055	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C1062	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1068	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1105	290-0287-00			47 µF, Elect., 25 V, 20%
C1123	283-0003-00	300000	300065	0.01 µF, Cer, 150 V, +80%-20%
C1123	283-0110-00	300066		0.005 µF, Cer, 150 V
C1136	290-0114-01			47 µF, Elect., 6 V
DIODES				
CR11	152-0327-00			50 V, 75 mA, BAX 13
CR12	152-0327-00			50 V, 75 mA, BAX 13
CR13	152-0327-00			50 V, 75 mA, BAX 13
CR30	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR31	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR32	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR33	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR50A	152-0327-00			50 V, 75 mA, BAX 13
CR50B	152-0327-00			50 V, 75 mA, BAX 13
CR74	152-0327-00			50 V, 75 mA, BAX 13
CR75	152-0327-00			50 V, 75 mA, BAX 13
CR76	152-0327-00			50 V, 75 mA, BAX 13
CR77	152-0327-00			50 V, 75 mA, BAX 13
CR79	152-0327-00			50 V, 75 mA, BAX 13
CR80	152-0071-00			Germanium, selected from ED-2007
CR81	152-0071-00			Germanium, selected from ED-2007
CR82	152-0327-00			50 V, 75 mA, BAX 13
CR83	152-0071-00			Germanium, selected from ED-2007
CR84	152-0071-00			Germanium, selected from ED-2007
CR86	152-0327-00			50 V, 75 mA , BAX 13
CR230	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR231	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR232	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR233	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR250A	152-0327-00			50 V, 75 mA, BAX 13
CR250B	152-0327-00			50 V, 75 mA, BAX 13
CR274	152-0327-00			50 V, 75 mA, BAX 13
CR275	152-0327-00			50 V, 75 mA, BAX 13
CR276	152-0327-00			50 V, 75 mA, BAX 13
CR277	152-0327-00			50 V, 75 mA, BAX 13

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR279	152-0327-00			50 V, 75 mA, BAX 13
CR280	152-0071-00			Germanium, selected from ED-2007
CR281	152-0071-00			Germanium, selected from ED-2007
CR282	152-0327-00			50 V, 75 mA, BAX 13
CR283	152-0071-00			Germanium, selected from ED-2007
CR284	152-0071-00			Germanium, selected from ED-2007
CR286	152-0327-00			50 V, 75 mA, BAX 13
CR310	152-0141-02			Silicon, replaceable by 1N4152
CR311	152-0141-02			Silicon, replaceable by 1N4152
CR312	152-0141-02			Silicon, replaceable by 1N4152
CR313	152-0141-02			Silicon, replaceable by 1N4152
CR315	152-0141-02			Silicon, replaceable by 1N4152
CR316	152-0141-02			Silicon, replaceable by 1N4152
CR317	152-0141-02			Silicon, replaceable by 1N4152
CR318	152-0141-02			Silicon, replaceable by 1N4152
CR331	152-0327-00			50 V, 75 mA, BAX 13
CR335	152-0327-00			50 V, 75 mA, BAX 13
CR341	152-0327-00			50 V, 75 mA, BAX 13
CR345	152-0327-00			50 V, 75 mA, BAX 13
CR400A	152-0327-00			50 V, 75 mA, BAX 13
CR400B	152-0327-00			50 V, 75 mA, BAX 13
CR400C	152-0327-00			50 V, 75 mA, BAX 13
CR440	152-0327-00			50 V, 75 mA, BAX 13
CR442	152-0327-00			50 V, 75 mA, BAX 13
CR542	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR543	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR611	152-0327-00			50 V, 75 mA, BAX 13
CR612	152-0327-00			50 V, 75 mA, BAX 13
CR613	152-0327-00			50 V, 75 mA, BAX 13
CR614	152-0327-00			50 V, 75 mA, BAX 13
CR616	152-0327-00			50 V, 75 mA, BAX 13
CR620	152-0249-00			Silicon, replaceable by CD61165 and CD12676
CR626	152-0327-00			50 V, 75 mA, BAX 13
CR628	152-0246-00			Silicon, replaceable by CD12676 or FD3375
CR636A	152-0327-00			50 V, 75 mA, BAX 13
CR636B	152-0327-00			50 V, 75 mA, BAX 13
CR638	152-0327-00			50 V, 75 mA, BAX 13
CR639	152-0516-00			Silicon, replaceable by 1N5297
CR640	152-0327-00			50 V, 75 mA, BAX 13
CR663	152-0327-00			50 V, 75 mA, BAX 13
CR667	152-0327-00			50 V, 75 mA, BAX 13
CR668	152-0327-00			50 V, 75 mA, BAX 13
CR670	152-0327-00			50 V, 75 mA, BAX 13
CR672	152-0327-00			50 V, 75 mA, BAX 13
CR728	152-0327-00			50 V, 75 mA, BAX 13
CR738	152-0327-00			50 V, 75 mA, BAX 13
CR741	152-0327-00			50 V, 75 mA, BAX 13
CR870	152-0107-00			Silicon, replaceable by TI60 or 1N647
CR880	152-0516-00			Silicon, replaceable by 1N5297
CR881	152-0327-00			50 V, 75 mA, BAX 13
CR886A	152-0327-00			50 V, 75 mA, BAX 13
CR886B	152-0327-00			50 V, 75 mA, BAX 13
CR886C	152-0327-00			50 V, 75 mA, BAX 13

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR888	152-0516-00			Silicon, replaceabe by 1N5297
CR890	152-0327-00			50 V, 75 mA, BAX 13
CR892	152-0327-00			50 V, 75 mA, BAX 13
CR894	152-0327-00			50 V, 75 mA, BAX 13
CR896	152-0327-00			50 V, 75 mA, BAX 13
CR922	152-0327-00			50 V, 75 mA, BAX 13
CR929	152-0333-00			Silicon, replaceable by FDH6012
CR930	152-0327-00			50 V, 75 mA, BAX 13
CR931	152-0333-00			Silicon, replaceable by FDH6012
CR932	152-0327-00			50 V, 75 mA, BAX 13
CR933	152-0327-00			50 V, 75 mA, BAX 13
CR934	152-0327-00			50 V, 75 mA, BAX 13
CR940	152-0061-00			Silicon, replaceable by CD8393 or FDH2161
CR948	152-0327-00			50 V, 75 mA, BAX 13
CR958	152-0327-00			50 V, 75 mA, BAX 13
CR959	152-0522-00			Silicon, replaceable by 1N1305
CR960	152-0522-00			Silicon, replaceable by 1N1305
CR962	152-0327-00			50 V, 75 mA, BAX 13
CR964	152-0327-00			50 V, 75 mA, BAX 13
CR966	152-0327-00			50 V, 75 mA, BAX 13
CR972	152-0327-00			50 V, 75 mA, BAX 13
CR976	152-0061-00			Silicon, replaceable by CD8393 or FDH2161
CR990	152-0242-00			Silicon, selected from 1N486A or replaceable by CD12691
CR992	152-0061-00			Silicon, replaceable by CD8393 or FDH2161
CR994	152-0333-00			Silicon, replaceable by FDH6012
CR995	152-0516-00			Silicon, replaceable by 1N5297
CR1000	152-0522-00			Silicon, replaceable by 1N1305
CR1004	152-0327-00			50 V, 75 mA, BAX 13
CR1015	152-0522-00			Silicon, replaceable by 1N1305
CR1026	152-0327-00			50 V, 75 mA, BAX 13
CR1040A-G	152-0331-00			Rectifier, 1.5 kV, 25 mA, fast recovery
CR1105	152-0107-00			Silicon, replaceable by TI60 or 1N647
CR1110A,B,C,D	152-0447-00			Silicon, replaceable by 10D2
CR1137	152-0008-00			Germanium, replaceable by T12G
CR1138	152-0008-00			Germanium, replaceable by T12G
VR95	152-0280-00			Zener, replaceable by 1N753A 0.4 W, 6.2 V, 5%
VR692	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
VR760	152-0127-00			Zener, replaceable by 1N755A, 0.4 W, 7.5 V, 5%
VR882	152-0195-00			Zener, selected from 1N751A, 0.4 W, 5.1 V, 5%
VR887	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
VR898	152-0278-00			Zener, replaceable by 1N4372A, 0.4 W, 3 V, 5%
VR941	152-0278-00			Zener, replaceable by 1N4372A, 0.4 W, 3 V, 5%
VR973	152-0195-00			Zener, selected from 1N751A, 0.4 W, 5.1 V, 5%
VR996	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
VR997	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
VR1051	152-0359-00			Zener, 0.25 W, 9 V, 5%
VR1062	152-0281-00			Zener, replaceable by 1N969B, 0.4 W, 22 V, 5%
VR1149	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
BULB				
DS878	150-0084-00			Neon, 2 AA

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
FUSES				
F870	159-0098-00			1.6 A, fast-blo
F1101	159-0097-00			0.4 A, fast-blo
F1101	159-0100-00			0.2 A, fast-blo
INDUCTORS				
L416	276-0543-00	X300026		Core, ferrite
L426	276-0543-00	X300026		Core, ferrite
L480	108-0587-00			5.6 mH
L612	108-0692-00			270 µH
L860A	108-0488-00			150 µH
L860B	108-0488-00			150 µH
L870	108-0464-00			125 µH
L943	108-0694-00			19 µH
L990	108-0692-00			270 µH
L994	108-0692-00			270 µH
L1014	108-0463-00			35 µH
L1032	108-0463-00			35 µH
L1055A	276-0638-00			Core, ferrite
L1055B	276-0638-00			Core, ferrite
L1060	108-0671-00			Trace rotation
TRANSISTORS				
Q1	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q9	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q31A,B	151-1010-00			Silicon, FET, replaceable by SU-2115 or D/2N3822, dual
Q41A,B	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q51	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q52	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q53	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q55	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q57	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q59	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q61	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q71	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q81	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q89	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q91	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q95	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q98	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q99	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q231A,B	151-1010-00			Silicon, FET, replaceable by SU-2115 or D/2N3822, dual
Q241A,B	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q251	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q252	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q253	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q255	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q257	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q259	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q261	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q271	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q281	151-0221-02			Silicon, PNP, replaceable by 2N4258
Q289	151-0221-02			Silicon, PNP, replaceable by 2N4258

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q291	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q299	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q333	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q343	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q351	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q355	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q361	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q376	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q386	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q392	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q410	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q415	151-0369-00			Silicon, PNP, Tek Spec
Q416	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q420	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q425	151-0369-00			Silicon, PNP, Tek Spec
Q426	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q432	151-0375-00			Silicon, NPN, replaceable by 2NC-403C
Q434	151-0375-00			Silicon, NPN, replaceable by 2NC-403C
Q448	151-0375-00			Silicon, NPN, replaceable by 2NC-403C
Q452	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q454	151-0376-00			Silicon, NPN, replaceable by 2NC-402C
Q457	151-0234-00			Silicon, NPN, replaceable by 2SC805
Q458	151-0234-00			Silicon, NPN, replaceable by 2SC805
Q462	151-0234-00			Silicon, NPN, replaceable by 2SC805
Q464	151-0214-00			Silicon, PNP, replaceable by 2N3495
Q472	151-0234-00			Silicon, PNP, replaceable by 2SC805
Q474	151-0214-00			Silicon, PNP, replaceable by 2N3495
Q505	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q510	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q545	151-1038-00	300000	300120	Silicon, FET,
Q545	151-1018-00	300121		Silicon, FET, N channel, replaceable by 2SK-12R
Q552	151-0376-00			Silicon, NPN, replaceable by 2SC-402C
Q556	151-0376-00			Silicon, NPN, replaceable by 2SC-402C
Q570	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q580	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q611	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q615	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q630	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q636	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q638	151-0367-00			Silicon, NPN, replaceable by SKA6516
Q640	151-1018-00			Silicon, FET, N channel, replaceable by 2SK-12R
Q652	151-0376-00			Silicon, NPN, replaceable by 2SC-402C
Q655	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q658	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q661	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q664	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q672	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q682	151-0234-00			Silicon, NPN, replaceable by 2SC805
Q685	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q690	151-0234-00			Silicon, NPN, replaceable by 2SC805
Q692	151-0214-00			Silicon, PNP, replaceable by 2N3495

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q726	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q732	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q738	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q740	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q741	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q744	151-0376-00			Silicon, NPN, replaceable by 2SC-402C
Q746	151-0376-00			Silicon, NPN, replaceable by 2SC-402C
Q748	151-0233-00			Silicon, NPN, 2SC805
Q756	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q758	151-0228-00			Silicon, PNP, selected from 2N4888
Q770	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q772	151-0228-00			Silicon, PNP, selected from 2N4888
Q786	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q788	151-0233-00			Silicon, NPN, 2SC805
Q878	151-0179-00			Silicon, NPN, replaceable by 2N3877A
Q882	151-0306-00			Silicon, NPN, selected from 2SC756
Q884	151-0306-00			Silicon, NPN, selected from 2SC756
Q887	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q888	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q890	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q892	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q917	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q918	151-0306-00			Silicon, NPN, selected from 2SC756
Q928	151-0306-00			Silicon, NPN, selected from 2SC756
Q930	151-0306-00			Silicon, NPN, selected from 2SC756
Q942	151-0516-00			Silicon, unijunction, replaceable by D13T1
Q948	151-0306-00			Silicon, NPN, selected from 2SC756
Q976	151-0231-00			Silicon, NPN, replaceable by 2SC756-3
Q978	151-0231-00			Silicon, NPN, replaceable by 2SC756-3
Q1008	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q1010	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q1012	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q1018	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1022	151-0190-02			Silicon, NPN, replaceable by 2N3904
Q1024	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q1120	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q1121	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q1134	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q1136	151-0219-00			Silicon, PNP, replaceable by 2N4250
RESISTORS				
R1	315-0100-01			10 Ω, 1/4 W, 5%
R2	315-0100-01			10 Ω, 1/4 W, 5%
R3	315-0102-01			1 kΩ, 1/4 W, 5%
R4	315-0752-01			7.5 kΩ, 1/4 W, 5%
R6	315-0331-01			330 Ω, 1/4 W, 5%
R8	315-0103-02			10 kΩ, 1/4 W, 5%
R9	315-0822-01			8.2 kΩ, 1/4 W, 5%
R12	321-0316-30			19.1 kΩ, 1/8 W, 1%
R13	321-0318-30			20 kΩ, 1/8 W, 1%
R15	321-0336-30			30.9 kΩ, 1/8 W, 1%
R17	321-0753-31			9 kΩ, 1/8 W, 1/2%
R18	321-0754-31			900 Ω, 1/8 W, 1/2%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R19	321-0636-00			100 Ω, 1/8 W, 1/2%
R20	315-0474-01			470 kΩ, 1/4 W, 5%
R21	315-0470-02			47 Ω, 1/4 W, 5%
R23B	322-0621-31			900 kΩ, 1/4 W, 1/2%
R23C	321-1389-31			111 kΩ, 1/8 W, 1/2%
R24B	322-0624-01			990 kΩ, 1/4 W, 1/2%
R24C	321-1289-31			10.1 kΩ, 1/8 W, 1/2%
R25B	322-0625-01			995 kΩ, 1/4 W, 1/2%
R25C	321-0613-31			5.03 kΩ, 1/8 W, 1/2%
R27B	322-0610-31			500 kΩ, 1/4 W, 1/2%
R27C	323-0481-01			1 MΩ, 1/4 W, 1/2%
R27D	315-0333-01			33 kΩ, 1/4 W, 5%
R28B	322-0620-31			800 kΩ, 1/4 W, 1/2%
R28C	321-0618-31			250 kΩ, 1/8 W, 1/2%
R29	322-0481-01			1 MΩ, 1/4 W, 1/2%
R30	321-0385-31			100 kΩ, 1/8 W, 1%
R31	315-0201-01			200 Ω, 1/4 W, 5%
R32	321-0068-30			49.9 Ω, 1/8 W, 1%
R33	321-0249-30			3.83 kΩ, 1/8 W, 1%
R35	321-0249-30			3.83 kΩ, 1/8 W, 1%
R36	311-0622-00			100 Ω, Var
R37	311-0634-00			500 Ω, Var
R38	321-0213-30			1.62 kΩ, 1/8 W, 1%
R40	321-0210-30			1.5 kΩ, 1/8 W, 1%
R41	311-0643-00			50 Ω, Var
R42	321-0103-30			115 Ω, 1/8 W, 1%
R44	321-0213-30			1.62 kΩ, 1/8 W, 1%
R46	321-0265-30			5.62 kΩ, 1/8 W, 1%
R47	315-0101-01			100 Ω, 1/4 W, 5%
R48	321-0223-30			2.05 kΩ, 1/8 W, 1%
R50	321-0217-30			1.78 kΩ, 1/8 W, 1%
R51	315-0101-01			100 Ω, 1/4 W, 5%
R52	321-0265-30			5.62 kΩ, 1/8 W, 1%
R53	321-0181-30			750 Ω, 1/8 W, 1%
R54	321-0223-30			2.05 kΩ, 1/8 W, 1%
R55	315-0101-01			100 Ω, 1/4 W, 5%
R57	321-0277-30			7.5 kΩ, 1/8 W, 1%
R59	321-0277-30			7.5 kΩ, 1/8 W, 1%
R60	315-0101-01			100 Ω, 1/4 W, 5%
R61	321-0223-30			2.05 kΩ, 1/8 W, 1%
R63	321-0260-30			4.99 kΩ, 1/8 W, 1%
R64	321-0157-30			422 Ω, 1/8 W, 1%
R65	311-0605-00			200 Ω, Var
R66	311-1329-00			3 kΩ, Var
R68	321-0231-30			2.49 kΩ, 1/8 W, 1%
R69	311-0634-00			500 Ω, Var
R71	321-0231-30			2.49 kΩ, 1/8 W, 1%
R72	321-0260-30			4.99 kΩ, 1/8 W, 1%
R74	315-0243-01			24 kΩ, 1/4 W, 5%
R76	315-0243-01			24 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R77	321-0293-30			11 kΩ, 1/8 W, 1%
R79	321-0293-30			11 kΩ, 1/8 W, 1%
R81	321-0264-30			5.49 kΩ, 1/8 W, 1%
R82	311-0633-00			5 kΩ, Var
R84	311-0633-00			5 kΩ, Var
R85	321-0264-30			5.49 kΩ, 1/8 W, 1%
R87	315-0272-02			2.7 kΩ, 1/4 W, 5%
R88	321-0251-30			4.02 kΩ, 1/8 W, 1%
R90	321-0251-30			4.02 kΩ, 1/8 W, 1%
R91	315-0272-02			2.7 kΩ, 1/4 W, 5%
R93	321-0193-30			1 kΩ, 1/8 W, 1%
R94	315-0471-02			470 Ω, 1/4 W, 5%
R95	315-0272-02			2.7 kΩ, 1/4 W, 5%
R96	315-0751-03			750 Ω, 1/4 W, 5%
R97	315-0391-02			390 Ω, 1/4 W, 5%
R98	315-0203-01			20 kΩ, 1/4 W, 5%
R99	315-0471-02			470 Ω, 1/4 W, 5%
R100	321-0193-30			1 kΩ, 1/8 W, 1%
R102	315-0101-01			100 Ω, 1/4 W, 5%
R104	315-0101-01			100 Ω, 1/4 W, 5%
R201	315-0100-01			10 Ω, 1/4 W, 5%
R202	315-0100-01			10 Ω, 1/4 W, 5%
R220	315-0474-01			470 kΩ, 1/4 W, 5%
R221	315-0470-02			47 Ω, 1/4 W, 5%
R223B	322-0621-31			900 kΩ, 1/4 W, 1/2%
R223C	321-1389-31			111 kΩ, 1/8 W, 1/2%
R224B	322-0624-01			990 kΩ, 1/4 W, 1/2%
R224C	321-1289-31			10.1 kΩ, 1/8 W, 1/2%
R225B	322-0625-01			995 kΩ, 1/4 W, 1/2%
R225C	321-0613-31			5.03 kΩ, 1/8 W, 1/2%
R227B	322-0610-31			500 kΩ, 1/4 W, 1/2%
R227C	322-0481-01			1 MΩ, 1/4 W, 1/2%
R227D	315-0333-01			33 kΩ, 1/4 W, 5%
R228B	322-0620-31			800 kΩ, 1/4 W, 1/2%
R228C	321-0618-31			250 kΩ, 1/8 W, 1/2%
R229	322-0481-01			1 MΩ, 1/4 W, 1/2%
R230	321-0385-31			100 kΩ, 1/8 W, 1%
R231	315-0201-01			200 Ω, 1/4 W, 5%
R232	321-0068-30			49.9 Ω, 1/8 W, 1%
R233	321-0249-30			3.83 kΩ, 1/8 W, 1%
R235	321-0249-30			3.83 kΩ, 1/8 W, 1%
R236	311-0622-00			100 Ω, Var
R237	311-0634-00			500 Ω, Var
R238	321-0213-30			1.62 kΩ, 1/8 W, 1%
R240	321-0210-30			1.5 kΩ, 1/8 W, 1%
R241	311-0643-00			50 Ω, Var
R242	321-0103-30			115 Ω, 1/8 W, 1%
R244	321-0213-30			1.62 kΩ, 1/8 W, 1%
R246	321-0265-30			5.62 kΩ, 1/8 W, 1%
R247	315-0101-01			100 Ω, 1/4 W, 5%
R248	321-0223-30			2.05 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R250	321-0217-30			1.78 kΩ, 1/8 W, 1%
R251	315-0101-01			100 Ω, 1/4 W, 5%
R252	321-0265-30			5.62 kΩ, 1/8 W, 1%
R253	321-0181-30			750 Ω, 1/8 W, 1%
R254	321-0223-30			2.05 kΩ, 1/8 W, 1%
R255	315-0101-01			100 Ω, 1/4 W, 5%
R257	321-0277-30			7.5 kΩ, 1/8 W, 1%
R259	321-0277-30			7.5 kΩ, 1/8 W, 1%
R260	315-0101-01			100 Ω, 1/4 W, 5%
R261	321-0223-30			2.05 kΩ, 1/8 W, 1%
R263	321-0260-30			4.99 kΩ, 1/8 W, 1%
R264	321-0157-30			422 Ω, 1/8 W, 1%
R265	311-0605-00			200 Ω, Var
R266	311-1329-00			3 kΩ, Var
R268	321-0231-30			2.49 kΩ, 1/8 W, 1%
R269	311-0634-00			500 Ω, Var
R271	321-0231-30			2.49 kΩ, 1/8 W, 1%
R272	321-0260-30			4.99 kΩ, 1/8 W, 1%
R274	315-0243-01			24 kΩ, 1/4 W, 5%
R276	315-0243-01			24 kΩ, 1/4 W, 5%
R277	321-0293-30			11 kΩ, 1/8 W, 1%
R279	321-0293-30			11 kΩ, 1/8 W, 1%
R281	321-0264-30			5.49 kΩ, 1/8 W, 1%
R282	311-0633-00			5 kΩ, Var
R284	311-0633-00			5 kΩ, Var
R285	321-0264-30			5.49 kΩ, 1/8 W, 1%
R287	315-0272-02			2.7 kΩ, 1/4 W, 5%
R288	321-0251-30			4.02 kΩ, 1/8 W, 1%
R290	321-0251-30			4.02 kΩ, 1/8 W, 1%
R291	315-0272-02			2.7 kΩ, 1/4 W, 5%
R293	321-0193-30			1 kΩ, 1/8 W, 1%
R300	321-0193-30			1 kΩ, 1/8 W, 1%
R302	315-0101-01			100 Ω, 1/4 W, 5%
R304	315-0101-01			100 Ω, 1/4 W, 5%
R330	315-0152-01			1.5 kΩ, 1/4 W, 5%
R331	315-0272-02			2.7 kΩ, 1/4 W, 5%
R332	315-0222-02			2.2 kΩ, 1/4 W, 5%
R333	315-0222-02			2.2 kΩ, 1/4 W, 5%
R334	315-0391-02			390 Ω, 1/4 W, 5%
R335	315-0511-01			510 Ω, 1/4 W, 5%
R340	315-0152-01			1.5 kΩ, 1/4 W, 5%
R341	315-0272-02			2.7 kΩ, 1/4 W, 5%
R342	315-0222-02			2.2 kΩ, 1/4 W, 5%
R343	315-0222-02			2.2 kΩ, 1/4 W, 5%
R344	315-0391-02			390 Ω, 1/4 W, 5%
R345	315-0511-01			510 Ω, 1/4 W, 5%
R350	315-0201-01			200 Ω, 1/4 W, 5%
R351	315-0222-02			2.2 kΩ, 1/4 W, 5%
R352	315-0102-01			1 kΩ, 1/4 W, 5%
R355	315-0101-01			100 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R360	315-0104-02			100 kΩ, 1/4 W, 5%
R361	315-0122-01			1.2 kΩ, 1/4 W, 5%
R362	315-0471-02			470 Ω, 1/4 W, 5%
R363	315-0473-01			47 kΩ, 1/4 W, 5%
R370	321-0230-30			2.43 kΩ, 1/8 W, 1%
R375	321-0213-30			1.62 kΩ, 1/8 W, 1%
R376	315-0361-02			360 Ω, 1/4 W, 5%
R377	321-0099-30			105 Ω, 1/8 W, 1%
R380	321-0230-30			2.43 kΩ, 1/8 W, 1%
R385	321-0213-30			1.62 kΩ, 1/8 W, 1%
R386	315-0361-02			360 Ω, 1/4 W, 5%
R388	321-0099-30			105 Ω, 1/8 W, 1%
R390	315-0182-02			1.8 kΩ, 1/4 W, 5%
R391	315-0621-01			620 Ω, 1/4 W, 5%
R392	315-0512-01			5.1 kΩ, 1/4 W, 5%
R395	315-0471-02			470 Ω, 1/4 W, 5%
R397	321-0167-30			536 Ω, 1/8 W, 1%
R400	321-0223-30			2.05 kΩ, 1/8 W, 1%
R402	321-0223-30			2.05 kΩ, 1/8 W, 1%
R410	321-0097-30			100 Ω, 1/8 W, 1%
R411	311-0635-00			1 kΩ, Var
R412	321-0233-30			2.61 kΩ, 1/8 W, 1%
R413	321-0334-30			29.4 kΩ, 1/8 W, 1%
R414	321-0269-30			6.19 kΩ, 1/8 W, 1%
R415	315-0102-01			1 kΩ, 1/4 W, 5%
R416A	321-0261-30			5.11 kΩ, 1/8 W, 1%
R416B	315-0240-01			24 Ω, 1/4 W, 5%
R417	321-0233-30			2.61 kΩ, 1/8 W, 1%
R418	311-0609-00			2 kΩ, Var
R419	315-0101-01	300000	300025	100 Ω, 1/4 W, 5%
R419	315-0100-01	300026		10 Ω, 1/4 W, 5%
R420	321-0097-30			100 Ω, 1/8 W, 1%
R421	311-0635-00			1 kΩ, Var
R422	321-0233-30			2.61 kΩ, 1/8 W, 1%
R424	321-0269-30			6.19 kΩ, 1/8 W, 1%
R425	315-0102-01			1 kΩ, 1/4 W, 5%
R426A	321-0261-30			5.11 kΩ, 1/8 W, 1%
R426B	315-0240-01			24 Ω, 1/4 W, 5%
R427	321-0233-30			2.61 kΩ, 1/8 W, 1%
R428	311-0609-00			2 kΩ, Var
R429	315-0101-01	300000	300025	100 Ω, 1/4 W, 5%
R429	315-0100-01	300026		10 Ω, 1/4 W, 5%
R430	311-0607-00			10 kΩ, Var
R432	315-0561-02			560 Ω, 1/4 W, 5%
R434	315-0561-02			560 Ω, 1/4 W, 5%
R436	321-0253-30			4.22 kΩ, 1/8 W, 1%
R438	321-0253-30			4.22 kΩ, 1/8 W, 1%
R440	315-0272-02			2.7 kΩ, 1/4 W, 5%
R442	315-0101-01			100 Ω, 1/4 W, 5%
R444	315-0113-01			11 kΩ, 1/4 W, 5%
R446	315-0202-01			2 kΩ, 1/4 W, 5%
R448	315-0390-02			39 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R449	315-0392-01			3.9 kΩ, 1/4 W, 5%
R450	315-0822-01			8.2 kΩ, 1/4 W, 5%
R452	315-0302-01			3 kΩ, 1/4 W, 5%
R454	321-0113-30			147 Ω, 1/8 W, 1%
R456	321-0233-30			2.61 kΩ, 1/8 W, 1%
R457	321-0113-30			147 Ω, 1/8 W, 1%
R458	321-0113-30			147 Ω, 1/8 W, 1%
R459A	315-0101-01			100 Ω, 1/4 W, 5%
R459B	315-0101-01			100 Ω, 1/4 W, 5%
R460	321-0401-30			147 kΩ, 1/8 W, 1%
R462	315-0621-01			620 Ω, 1/4 W, 5%
R464	315-0562-01			5.6 kΩ, 1/4 W, 5%
R470	321-0401-30			147 kΩ, 1/8 W, 1%
R472	315-0621-01			620 Ω, 1/4 W, 5%
R474	315-0562-01			5.6 kΩ, 1/4 W, 5%
R476	315-0100-01			10 Ω, 1/4 W, 5%
R478	315-0100-01			10 Ω, 1/4 W, 5%
R480	315-0101-01			100 Ω, 1/4 W, 5%
R502	315-0511-01			510 Ω, 1/4 W, 5%
R503	315-0511-01			510 Ω, 1/4 W, 5%
R504A	315-0511-01			510 Ω, 1/4 W, 5%
R504B	315-0512-01			5.1 kΩ, 1/4 W, 5%
R505	315-0821-02			820 Ω, 1/4 W, 5%
R506	315-0202-01			2 kΩ, 1/4 W, 5%
R507	315-0202-01			2 kΩ, 1/4 W, 5%
R508	315-0751-03			750 Ω, 1/4 W, 5%
R510	315-0101-01			100 Ω, 1/4 W, 5%
R511	315-0472-01			4.7 kΩ, 1/4 W, 5%
R540	322-0481-00			1 MΩ, 1/4 W, 1%
R542	315-0104-02			100 kΩ, 1/4 W, 5%
R545	315-0332-02			3.3 kΩ, 1/4 W, 5%
R546	311-0644-00			20 kΩ, Var
R550	315-0472-01			4.7 kΩ, 1/4 W, 5%
R552	321-0237-30			2.87 kΩ, 1/8 W, 1%
R553	315-0161-01			160 Ω, 1/4 W, 5%
R554	321-0229-30			2.37 kΩ, 1/8 W, 1%
R556	321-0237-30			2.87 kΩ, 1/8 W, 1%
R557	315-0161-01			160 Ω, 1/4 W, 5%
R558	315-0472-01			4.7 kΩ, 1/4 W, 5%
R564	321-0297-30			12.1 kΩ, 1/8 W, 1%
R566	321-0269-30			6.19 kΩ, 1/8 W, 1%
R568	321-0333-30			28.7 kΩ, 1/8 W, 1%
R570	321-0177-30			681 Ω, 1/8 W, 1%
R572	321-0297-30			12.1 kΩ, 1/8 W, 1%
R574	321-0257-30			4.64 kΩ, 1/8 W, 1%
R576	321-0285-30			9.09 kΩ, 1/8 W, 1%
R578	321-0217-30			1.78 kΩ, 1/8 W, 1%
R580	321-0193-30			1 kΩ, 1/8 W, 1%
R582	321-0297-30	300000	300120	12.1 kΩ, 1/8 W, 1%
R582	321-0289-30	300121		10 kΩ, 1/8 W, 1%
R590	315-0100-01			10 Ω, 1/4 W, 5%
R595	315-0100-01			10 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R611	311-0609-00			2 kΩ, Var
R611A	315-0103-02			10 kΩ, 1/4 W, 5%
R611B	315-0222-02			2.2 kΩ, 1/4 W, 5%
R612	315-0332-02			3.3 kΩ, 1/4 W, 5%
R613	315-0104-02			100 kΩ, 1/4 W, 5%
R614	315-0512-01			5.1 kΩ, 1/4 W, 5%
R615	315-0333-01			33 kΩ, 1/4 W, 5%
R616	315-0104-02			100 kΩ, 1/4 W, 5%
R617	321-0277-30			7.5 kΩ, 1/8 W, 1%
R618	311-0633-00			5 Ω, Var
R619	321-0255-30			4.42 kΩ, 1/8 W, 1%
R620A	309-0095-00			10 MΩ, 1/2 W, 1%
R620B	309-0087-00			5 MΩ, 1/2 W, 1%
R620C	322-0481-01			1 MΩ, 1/4 W, 1/2%
R620D	322-0481-01			1 MΩ, 1/4 W, 1/2%
R620E	322-0610-31			500 kΩ, 1/4 W, 1/2%
R620F	321-0414-31			200 kΩ, 1/8 W, 1/2%
R620G	321-0385-31			100 kΩ, 1/8 W, 1/2%
R620H	321-0756-31			50 kΩ, 1/8 W, 1/2%
R622A,B	311-1330-00			50 kΩ x 20 kΩ, Var
R624	315-0123-01			12 kΩ, 1/4 W, 5%
R626	315-0102-01			1 kΩ, 1/4 W, 5%
R628	321-0251-30			4.02 kΩ, 1/8 W, 1%
R630	321-0235-30			2.74 kΩ, 1/8 W, 1%
R632	321-0239-30			3.01 kΩ, 1/8 W, 1%
R634	321-0263-30			5.36 kΩ, 1/8 W, 1%
R635	315-0752-01			7.5 kΩ, 1/4 W, 5%
R636	321-0268-30			6.04 kΩ, 1/8 W, 1%
R637	315-0563-02			56 kΩ, 1/4 W, 5%
R638	315-0152-01			1.5 kΩ, 1/4 W, 5%
R639A	315-0682-01			6.8 kΩ, 1/4 W, 5%
R640	315-0682-01			6.8 kΩ, 1/4 W, 5%
R642	315-0221-01			220 Ω, 1/4 W, 5%
R644	315-0153-02			15 kΩ, 1/4 W, 5%
R646	315-0563-02			56 kΩ, 1/4 W, 5%
R648	315-0511-01			510 Ω, 1/4 W, 5%
R650	315-0102-01			1 kΩ, 1/4 W, 5%
R652	315-0222-02			2.2 kΩ, 1/4 W, 5%
R653	315-0222-02			2.2 kΩ, 1/4 W, 5%
R655	315-0102-01			1 kΩ, 1/4 W, 5%
R656	315-0103-02			10 kΩ, 1/4 W, 5%
R658	315-0332-02			3.3 kΩ, 1/4 W, 5%
R660	315-0822-01			8.2 kΩ, 1/4 W, 5%
R661	316-0913-01			91 kΩ, 1/4 W, 5%
R663	315-0104-02			100 kΩ, 1/4 W, 5%
R664	315-0333-01			33 kΩ, 1/4 W, 5%
R665	315-0562-01			5.6 kΩ, 1/4 W, 5%
R666	315-0203-01			20 kΩ, 1/4 W, 5%
R667	315-0112-01			1.1 kΩ, 1/4 W, 5%
R669	315-0102-01			1 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R672	315-0101-01			100 Ω, 1/4 W, 5%
R674	315-0201-01			200 Ω, 1/4 W, 5%
R676	315-0272-02			2.7 kΩ, 1/4 W, 5%
R678	315-0752-01			7.5 kΩ, 1/4 W, 5%
R680	315-0202-01			2 kΩ, 1/4 W, 5%
R682	315-0473-01			47 kΩ, 1/4 W, 5%
R684	315-0103-02			10 kΩ, 1/4 W, 5%
R685	315-0202-01			2 kΩ, 1/4 W, 5%
R686	315-0274-01			270 kΩ, 1/4 W, 5%
R687	315-0474-01			470 kΩ, 1/4 W, 5%
R690	315-0102-01			1 kΩ, 1/4 W, 5%
R692	315-0682-01			6.8 kΩ, 1/4 W, 5%
R694	315-0101-01			100 Ω, 1/4 W, 5%
R695	315-0100-01			10 Ω, 1/4 W, 5%
R696	315-0100-01			10 Ω, 1/4 W, 5%
R701	321-0270-30			6.34 kΩ, 1/8 W, 1%
R702	311-0607-00			10 kΩ, Var
R703	321-0306-30			15 kΩ, 1/8 W, 1%
R704	311-0644-00			20 kΩ, Var
R705	315-0272-02			2.7 kΩ, 1/4 W, 5%
R706	315-0681-02			680 Ω, 1/4 W, 5%
R709	315-0272-02			2.7 kΩ, 1/4 W, 5%
R710	321-0318-30			20 kΩ, 1/8 W, 1%
R711	315-0104-02			100 kΩ, 1/4 W, 5%
R712	321-0556-30			49.9 kΩ, (nominal value) selected
R713	311-0644-00			2 kΩ, Var
R714	315-0272-02			2.7 kΩ, 1/4 W, 5%
R715	321-0264-30			5.49 kΩ, 1/8 W, 1%
R716	321-0309-30			16.2 kΩ, 1/8 W, 1%
R717	311-0633-00			5 kΩ, Var
R718	321-0223-30			2.05 kΩ, 1/8 W, 1%
R722	321-0126-30			200 Ω, 1/8 W, 1%
R724	321-0223-30			2.05 kΩ, 1/8 W, 1%
R726	321-0268-30			6.04 kΩ, 1/8 W, 1%
R728	321-0103-30			115 Ω, 1/8 W, 1%
R730	315-0512-01			5.1 kΩ, 1/4 W, 5%
R732	321-0239-30			3.01 kΩ, 1/8 W, 1%
R734	321-0260-30			4.99 kΩ, 1/8 W, 1%
R736	321-0260-30			4.99 kΩ, 1/8 W, 1%
R738	321-0356-30			49.9 kΩ, 1/8 W, 1%
R740	321-0289-30			10 kΩ, 1/8 W, 1%
R741	321-0233-30			2.61 kΩ, 1/8 W, 1%
R742	321-0226-30			2.21 kΩ, 1/8 W, 1%
R743	321-0231-30			2.49 kΩ, 1/8 W, 1%
R744	315-0223-02			22 kΩ, 1/4 W, 5%
R745	315-0242-02			2.4 kΩ, 1/4 W, 5%
R746	315-0242-02			2.4 kΩ, 1/4 W, 5%
R748	315-0332-02			3.3 kΩ, 1/4 W, 5%
R750	322-0610-31			500 kΩ, 1/4 W, 1/2%
R752	315-0303-02			30 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R754	315-0304-01			300 kΩ, 1/4 W, 5%
R756	315-0201-01			200 Ω, 1/4 W, 5%
R758	315-0103-02			10 kΩ, 1/4 W, 5%
R760	315-0105-01			1 MΩ, 1/4 W, 5%
R762	315-0102-01			1 kΩ, 1/4 W, 5%
R764	315-0203-01			20 kΩ, 1/4 W, 5%
R766	315-0303-02			30 kΩ, 1/4 W, 5%
R768	315-0244-01			240 kΩ, 1/4 W, 5%
R770	315-0201-01			200 Ω, 1/4 W, 5%
R772	315-0103-02			10 kΩ, 1/4 W, 5%
R775	315-0101-01			100 Ω, 1/4 W, 5%
R780	315-0101-01			100 Ω, 1/4 W, 5%
R782	322-0481-00			1 MΩ, 1/4 W, 1%
R784	322-0481-00			1 MΩ, 1/4 W, 1%
R786	321-0333-30			28.7 kΩ, 1/8 W, 1%
R788	315-0153-02			15 kΩ, 1/4 W, 5%
R791	315-0100-01			10 Ω, 1/4 W, 5%
R792	315-0100-01			10 Ω, 1/4 W, 5%
R870	321-0300-30			13 kΩ, 1/8 W, 1%
R871	321-0280-30			8.06 kΩ, 1/8 W, 1%
R872	321-0372-30			73.2 kΩ, 1/8 W, 1%
R873	321-0339-30			33.2 kΩ, 1/8 W, 1%
R878	315-0105-01			1 MΩ, 1/4 W, 5%
R880	315-0470-02			47 Ω, 1/4 W, 5%
R882	315-0470-02			47 Ω, 1/4 W, 5%
R884	315-0100-01			10 Ω, 1/4 W, 5%
R887	315-0243-01			24 kΩ, 1/4 W, 5%
R888	315-0562-01			5.6 kΩ, 1/4 W, 5%
R890	315-0243-01			24 kΩ, 1/4 W, 5%
R892	315-0243-01			24 kΩ, 1/4 W, 5%
R894	315-0204-01			200 kΩ, 1/4 W, 5%
R896	315-0204-01			200 kΩ, 1/4 W, 5%
R898	315-0432-01			4.3 kΩ, 1/4 W, 5%
R905	321-0318-30			20 kΩ, 1/8 W, 1%
R906	315-0125-02			1.2 MΩ, 1/4 W, 5%
R907	311-0609-00			2 kΩ, Var
R909	321-0260-30			4.99 kΩ, 1/8 W, 1%
R910	315-0103-02			10 kΩ, 1/4 W, 5%
R915	315-0102-01			1 kΩ, 1/4 W, 5%
R917	315-0101-01			100 Ω, 1/4 W, 5%
R922	315-0272-02			2.7 kΩ, 1/4 W, 5%
R924	315-0204-01			200 kΩ, 1/4 W, 5%
R926	315-0682-01			6.8 kΩ, 1/4 W, 5%
R927	315-0302-01			3 kΩ, 1/4 W, 5%
R928	315-0103-02			10 kΩ, 1/4 W, 5%
R930	315-0562-01			5.6 kΩ, 1/4 W, 5%
R932	315-0621-01			620 Ω, 1/4 W, 5%
R940	308-0503-00			6.8 Ω, (nominal value) selected
R941	315-0393-01			39 kΩ, 1/4 W, 5%
R942	311-1294-00			10 Ω, Var

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R943	315-0100-01			10 Ω, 1/4 W, 5%
R946	315-0103-02			10 kΩ, 1/4 W, 5%
R948	315-0221-01			220 Ω, 1/4 W, 5%
R962	315-0150-01			15 Ω, 1/4 W, 5%
R972	315-0103-02			10 kΩ, 1/4 W, 5%
R974	315-0102-01			1 kΩ, 1/4 W, 5%
R976	315-0100-01			10 Ω, 1/4 W, 5%
R1002	321-0378-30			84.5 kΩ, 1/8 W, 1%
R1004	311-0644-00			20 kΩ, Var
R1006	321-0308-30			15.8 kΩ, 1/8 W, 1%
R1008	321-0348-30			41.2 kΩ, 1/8 W, 1%
R1009	315-0474-01			470 kΩ, 1/4 W, 5%
R1010	315-0333-01			33 kΩ, 1/4 W, 5%
R1012	315-0182-02			1.8 kΩ, 1/4 W, 5%
R1018	315-0102-01			1 kΩ, 1/4 W, 5%
R1020	315-0472-01			4.7 kΩ, 1/4 W, 5%
R1022	315-0470-02			47 Ω, 1/4 W, 5%
R1024	315-0162-01			1.6 kΩ, 1/4 W, 5%
R1026	321-0334-30			29.4 kΩ, 1/8 W, 1%
R1028	321-0300-30			13 kΩ, 1/8 W, 1%
R1030	311-0633-00			5 Ω, Var
R1032	321-0331-30			27.4 kΩ, 1/8 W, 1%
R1040	301-0226-01			22 MΩ, 1/2 W, 5%
R1044	315-0155-01	300000	300065	1.5 MΩ, (nominal value) selected
R1044	315-0105-01	300066		1 MΩ, (nominal value) selected
R1046	311-1293-00			1 MΩ, Var
R1048	301-0106-01			10 MΩ, 1/2 W, 5%
R1049	301-0475-01			4.7 MΩ, 1/2 W, 5%
R1051A	315-0183-02			18 kΩ, 1/4 W, 5%
R1051B	315-0392-01			3.9 kΩ, 1/4 W, 5%
R1052	301-0685-01			6.8 MΩ, 1/2 W, 5%
R1053	301-0475-01			4.7 MΩ, 1/2 W, 5%
R1054	301-0475-01			4.7 MΩ, 1/2 W, 5%
R1055	301-0475-01			4.7 MΩ, 1/2 W, 5%
R1056	315-0470-02			47 Ω, 1/4 W, 5%
R1057	315-0470-02			47 Ω, 1/4 W, 5%
R1058	315-0754-02			750 kΩ, 1/4 W, 5%
R1059	315-0204-01			200 kΩ, 1/4 W, 5%
R1060	311-0607-00			10 kΩ, Var
R1062	311-0660-00			200 kΩ, Var
R1064	315-0204-01			200 kΩ, 1/4 W, 5%
R1066	315-0244-01			240 kΩ, 1/4 W, 5%
R1068	311-0660-00			200 kΩ, Var
R1070	315-0393-01			39 kΩ, 1/4 W, 5%
R1105	315-0562-01			5.6 kΩ, 1/4 W, 5%
R1115	308-0463-00			0.3 Ω, 3 W, WW, 1%
R1118	315-0472-01			4.7 kΩ, 1/4 W, 5%
R1119	315-0100-01			10 Ω, 1/4 W, 5%
R1120	315-0102-01			1 kΩ, 1/4 W, 5%
R1123	315-0471-02			470 Ω, 1/4 W, 5%
R1130	315-0272-02			2.7 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R1133	301-0185-01			1.8 MΩ, 1/2 W, 5%
R1135	315-0752-01			7.5 kΩ, 1/4 W, 5%
R1137	315-0102-01			1 kΩ, 1/4 W, 5%
R1138	315-0102-01			1 kΩ, 1/4 W, 5%
R1139	315-0152-01			1.5 kΩ, 1/4 W, 5%
R1141	315-0272-02			2.7 kΩ, 1/4 W, 5%
R1143	321-0341-30			34.8 kΩ, 1/8 W, 1%
R1144	311-0635-00			1 kΩ, Var
SWITCHES				
S20[1]	670-1829-00			Pushbutton, AC-GND-DC (INPUT COUPLING CH1)
S30	105-0302-00			Actuator assembly, VOLTS/DIV CH1
S220[1]	670-1830-00			Pushbutton, AC-GND-DC (INPUT GOUPLING CH2)
S230	105-0302-00			Actuator assembly, VOLTS/DIV CH2
S302[1]	260-1132-00			Push, INVERT CH2
S500[1]	670-1827-00			Pushbutton, TRIG SOURCE
S540[1]	670-1828-00			Pushbutton, TRIG SOURCE/COUPLING
S620	105-0301-00			Actuator assembly, TIME/DIV
TRANSFORMERS				
T410	120-0764-00			Toroid
T930	120-0760-00			Blocking
T970	120-0759-00			Fly-back
T980	120-0758-00			Current sensing
T1101	120-0757-00			Power
INTEGRATED CIRCUIT				
U910	156-0053-00			Voltage regulator, replaceable by UA723C

[1]See Mechanical Parts List for replacement parts.

SECTION 7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

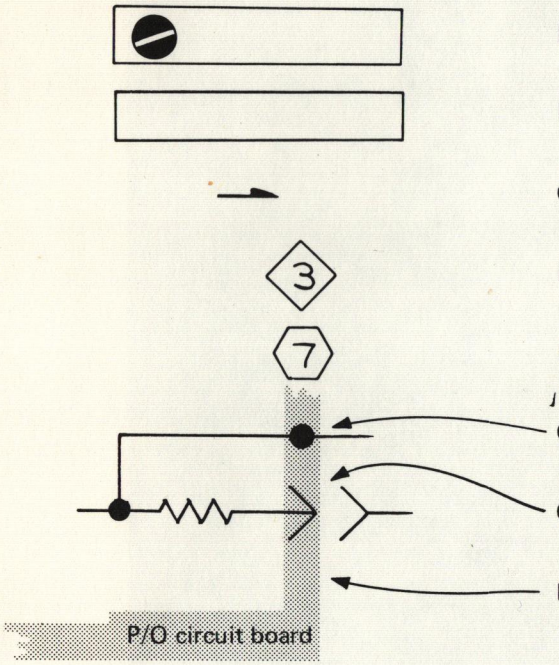
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

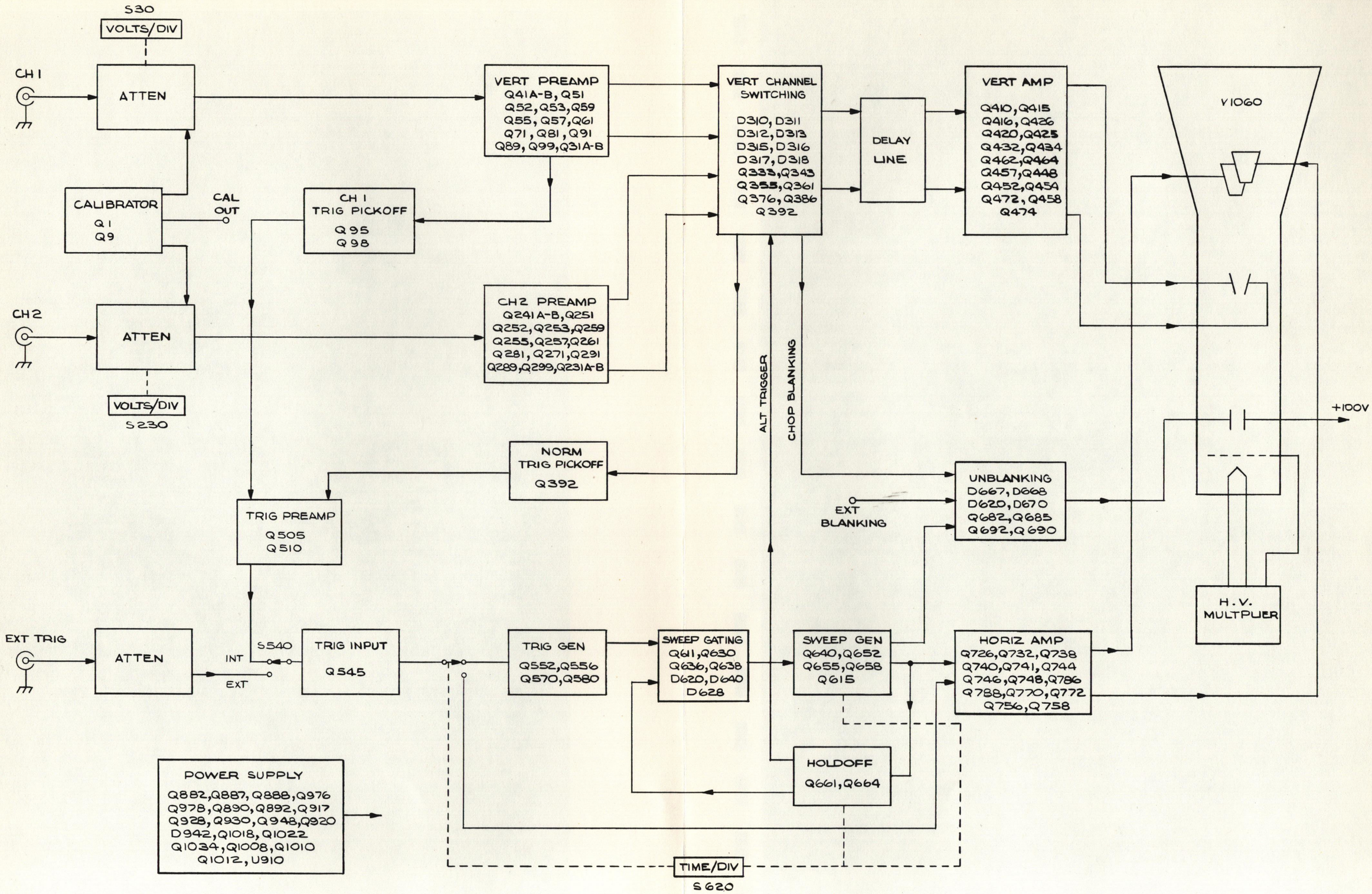
Connection soldered to circuit board.

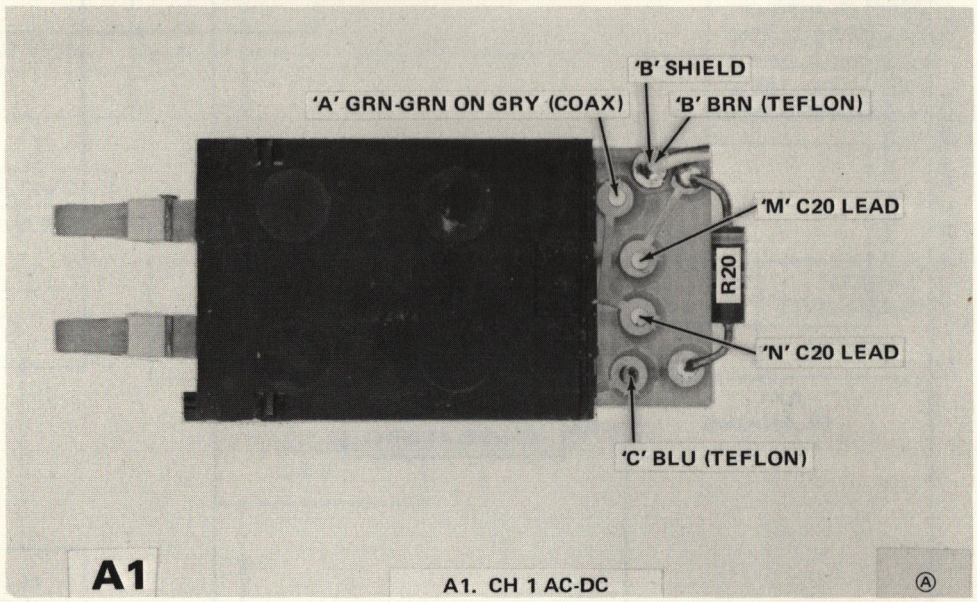
Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

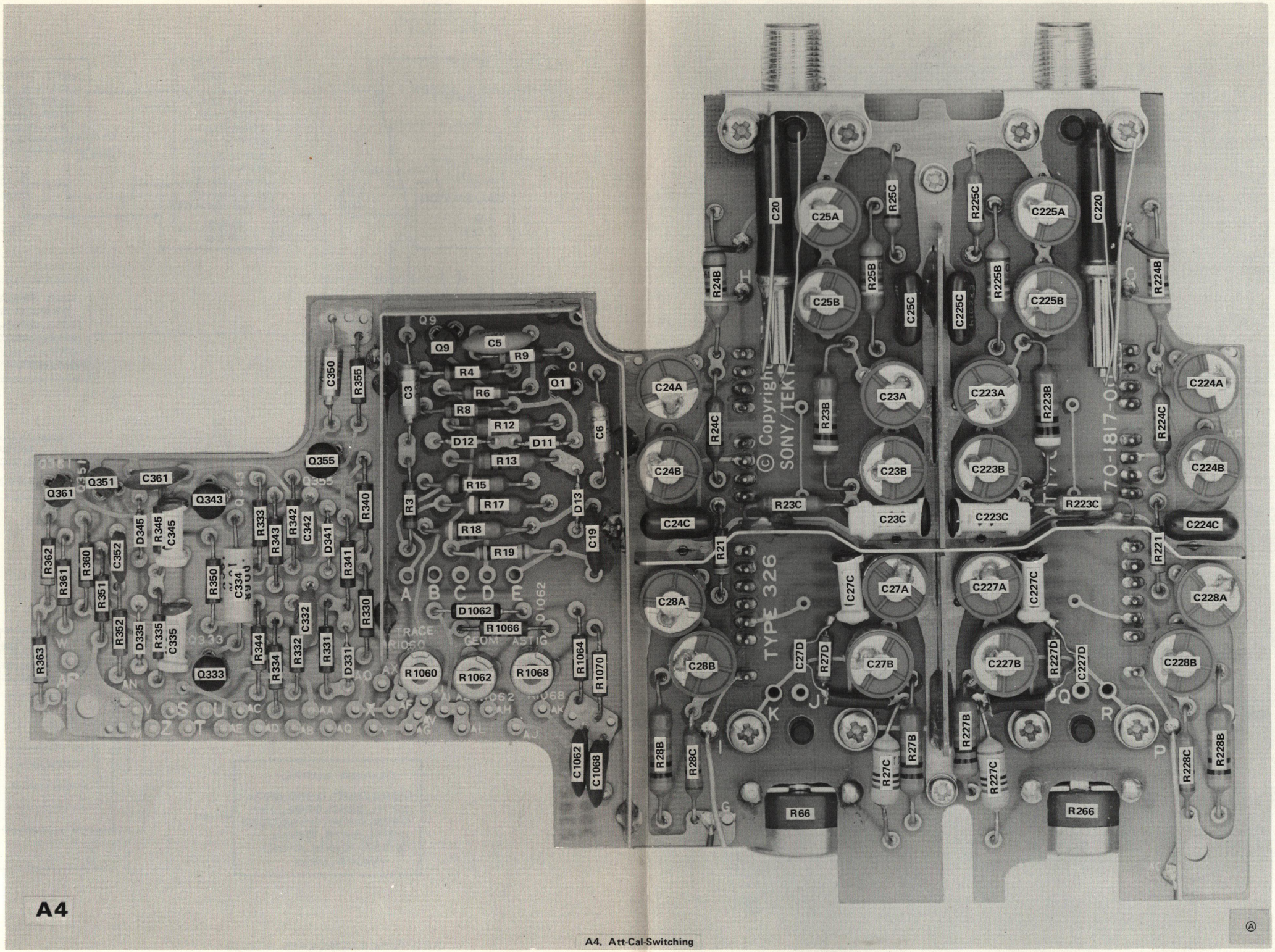
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

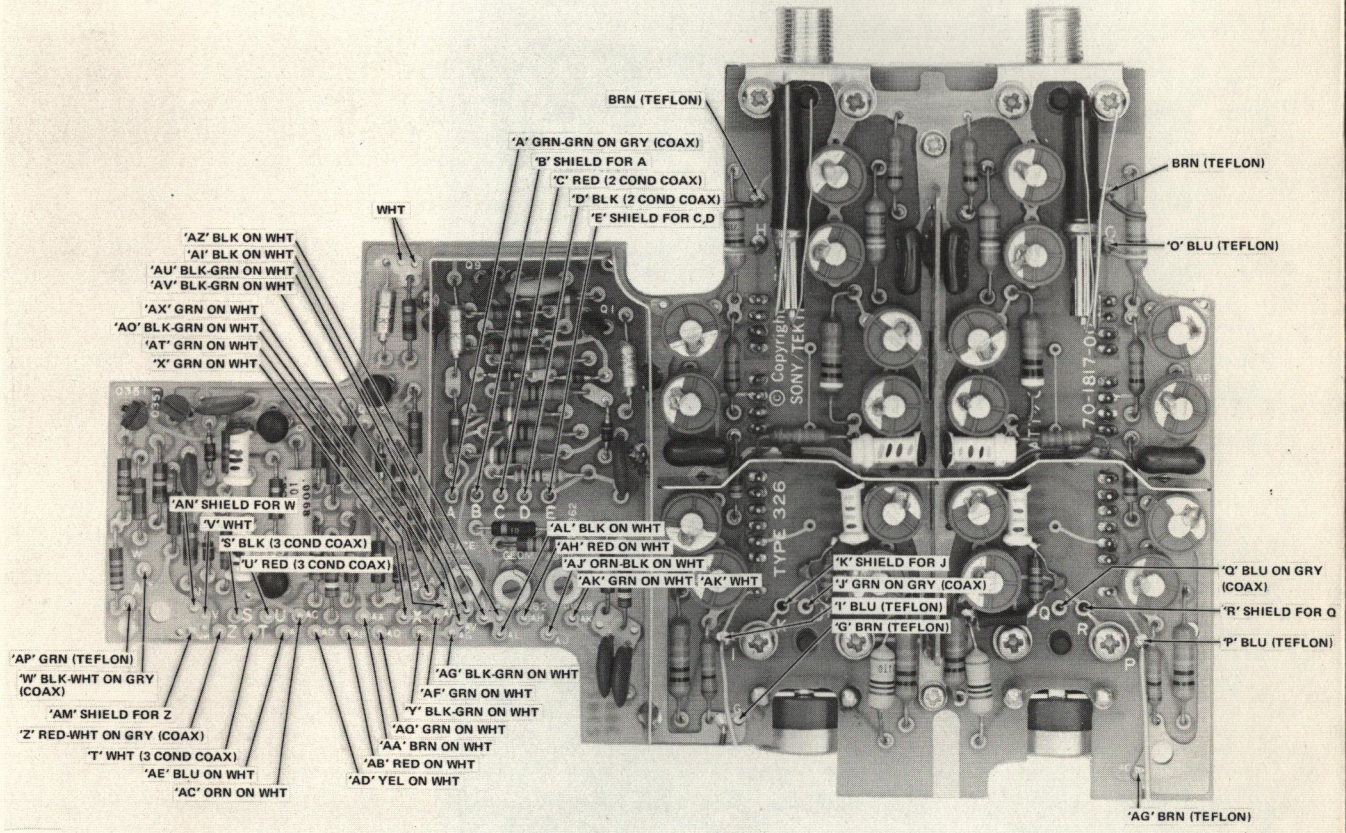

S30
VOLTS/DIV
CH 1
ATTEN
CALIBRATOR
Q1
Q9
CAL OUT
CH 1 TRIG PICKOFF
Q95
Q98
VERT PREAMP
Q41A-B, Q51
Q52, Q53, Q59
Q55, Q57, Q61
Q71, Q81, Q91
Q89, Q99, Q31A-B
VERT CHANNEL SWITCHING
D310, D311
D312, D313
D315, D316
D317, D318
Q333, Q343
Q355, Q361
Q376, Q386
Q392
DELAY LINE
VERT AMP
Q410, Q415
Q416, Q426
Q420, Q425
Q432, Q434
Q462, Q464
Q457, Q448
Q452, Q454
Q472, Q458
Q474
V1060
CH2
ATTEN
VOLTS/DIV
S230
CH2 PREAMP
Q241A-B, Q251
Q252, Q253, Q259
Q255, Q257, Q261
Q281, Q271, Q291
Q289, Q299, Q231A-B
ALT TRIGGER
CHOP BLANKING
+100V
NORM TRIG PICKOFF
Q392
UNBLANKING
D667, D668
D620, D670
Q682, Q685
Q692, Q690
EXT BLANKING
TRIG PREAMP
Q505
Q510
H.V. MULTPLIER
EXT TRIG
ATTEN
INT
EXT
S540
TRIG INPUT
Q545
TRIG GEN
Q552, Q556
Q570, Q580
SWEEP GATING
Q611, Q630
Q636, Q638
D620, D640
D628
SWEEP GEN
Q640, Q652
Q655, Q658
Q615
HORIZ AMP
Q726, Q732, Q738
Q740, Q741, Q744
Q746, Q748, Q786
Q788, Q770, Q772
Q756, Q758
HOLDOFF
Q661, Q664
POWER SUPPLY
Q882, Q887, Q888, Q976
Q978, Q890, Q892, Q917
Q928, Q930, Q948, Q920
D942, Q1018, Q1022
Q1034, Q1008, Q1010
Q1012, U910
TIME/DIV
S620


'B' SHIELD
'A' GRN-GRN ON GRY (COAX)
'B' BRN (TEFLON)
'M' C20 LEAD
R20
'N' C20 LEAD
'C' BLU (TEFLON)
A1

A1. CH 1 AC-DC

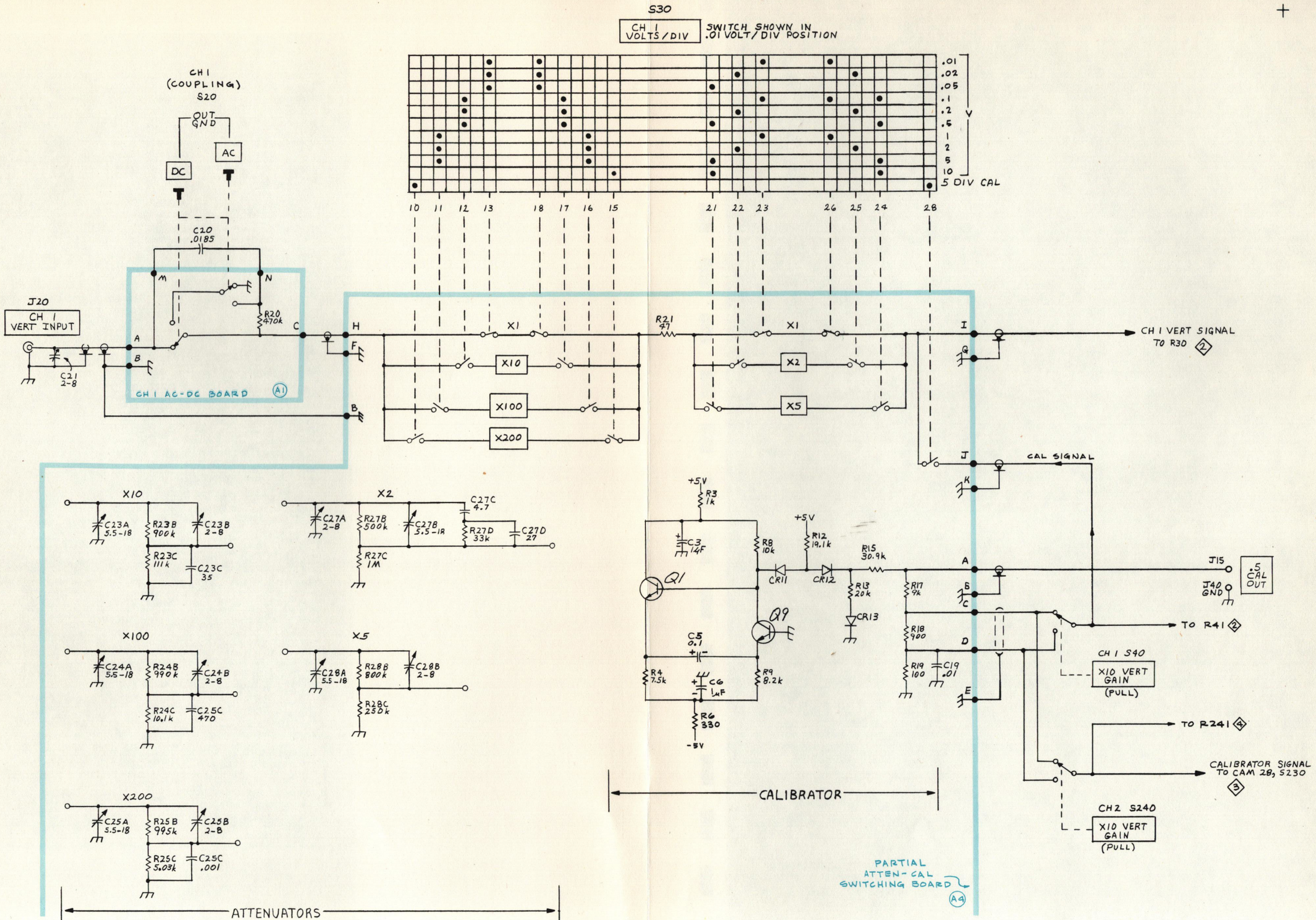


A4. Att-Cal-Switching



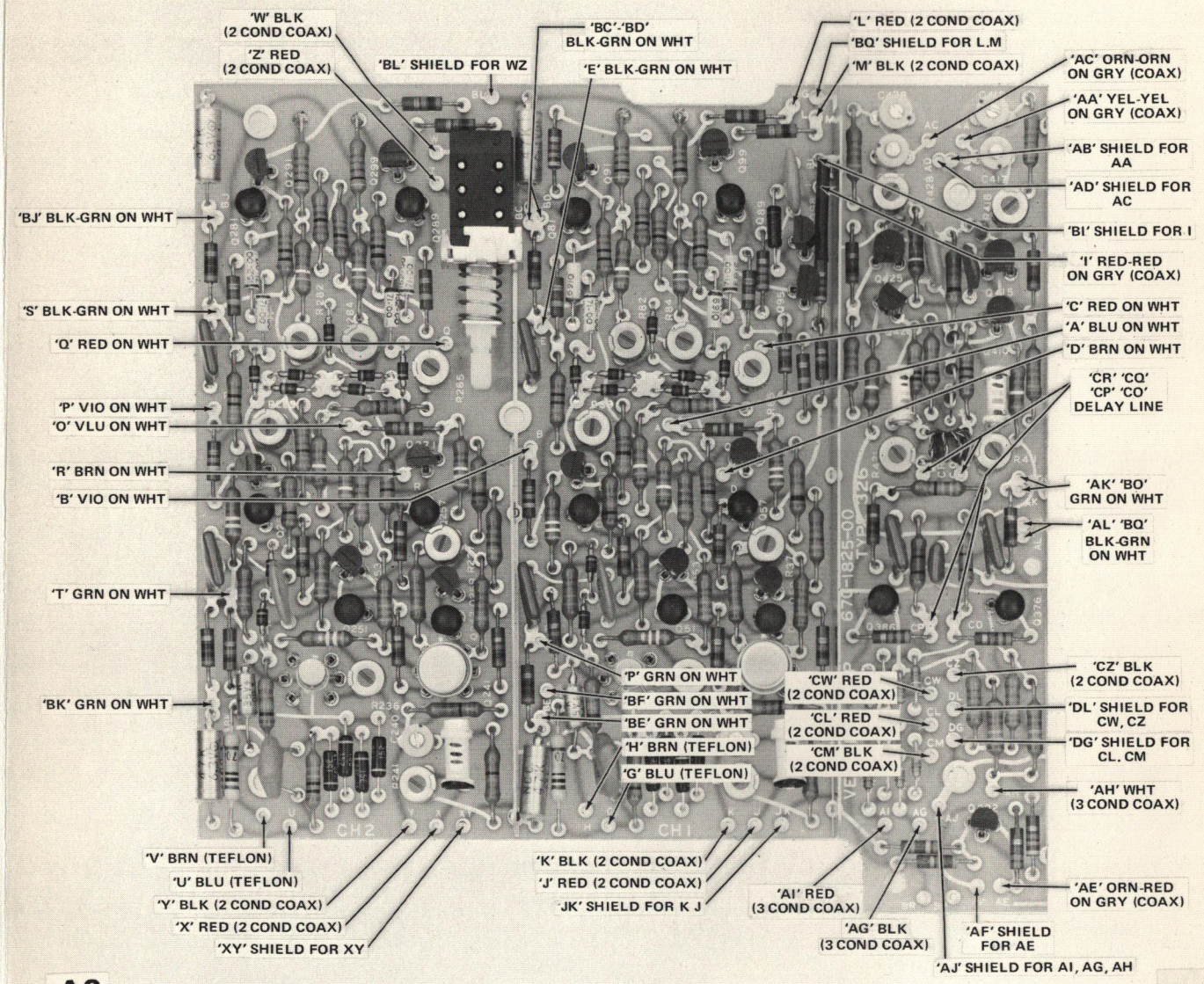
A4

A4. Att-Cal-Switching

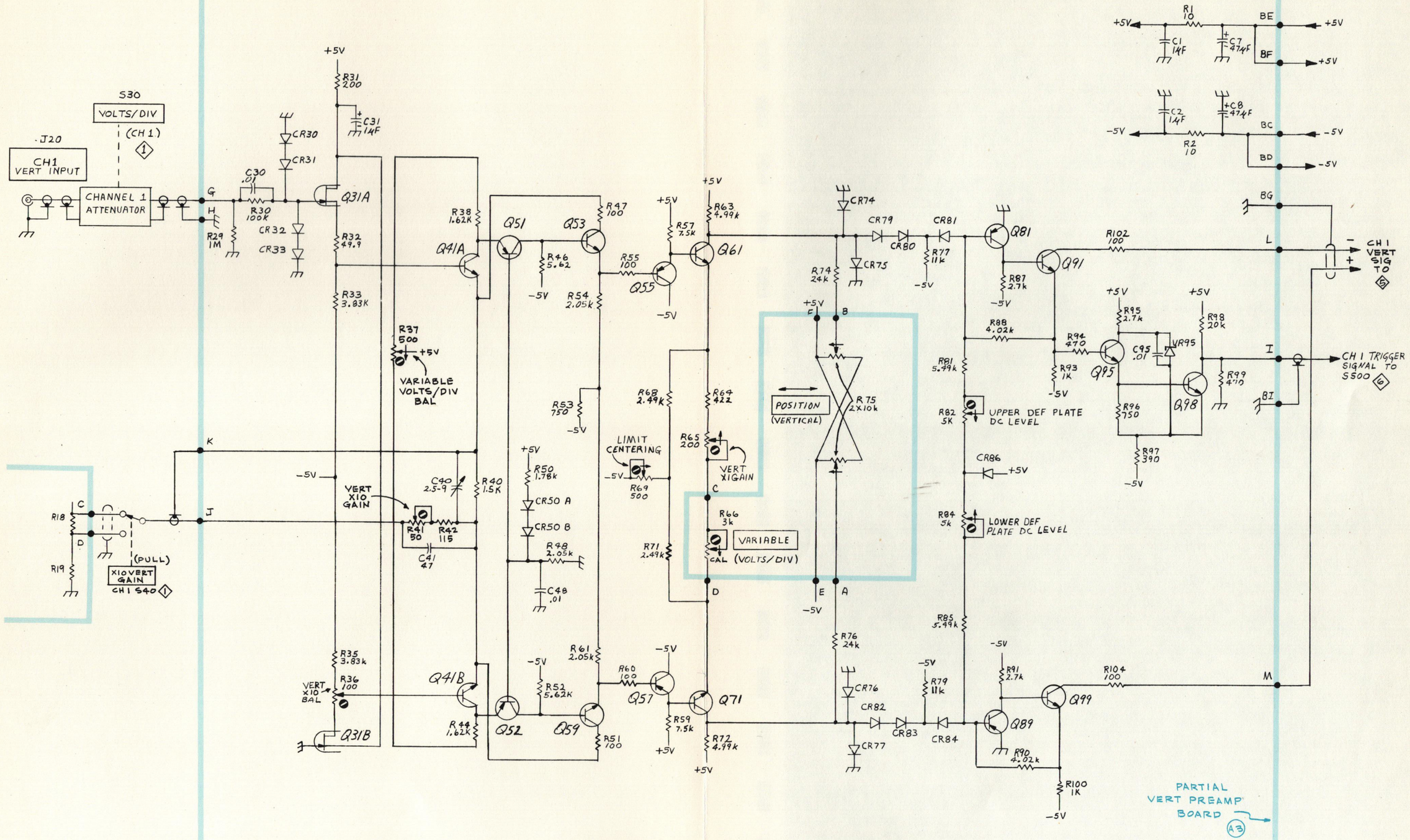


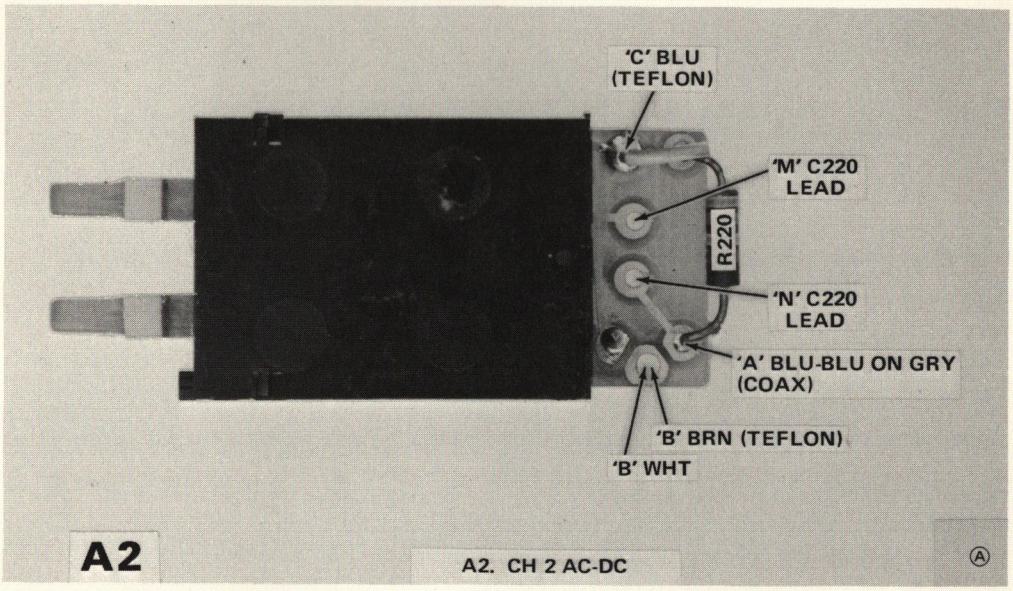
CHANNEL 1 ATTENUATORS & CALIBRATOR 1

2-15-72
DAJ

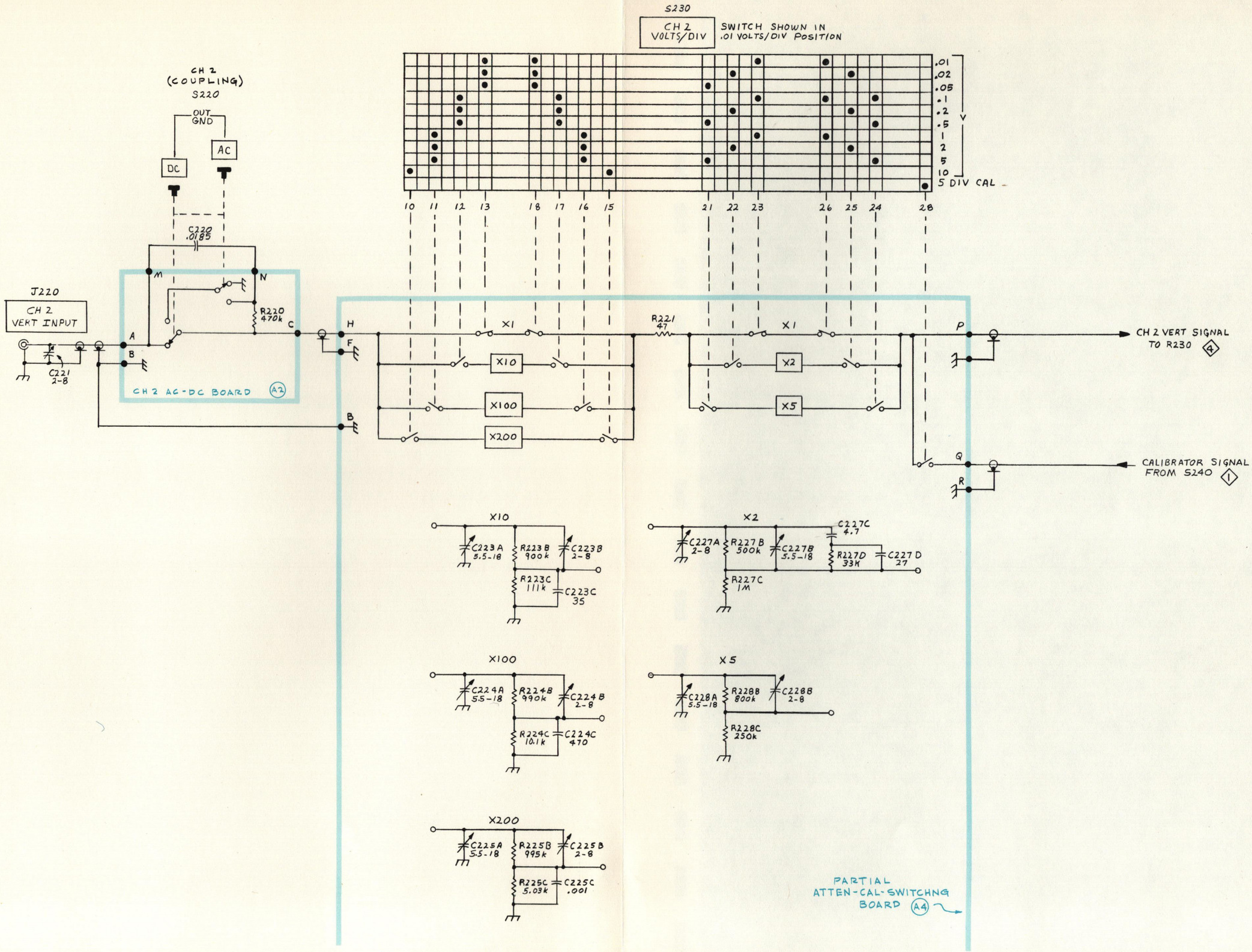


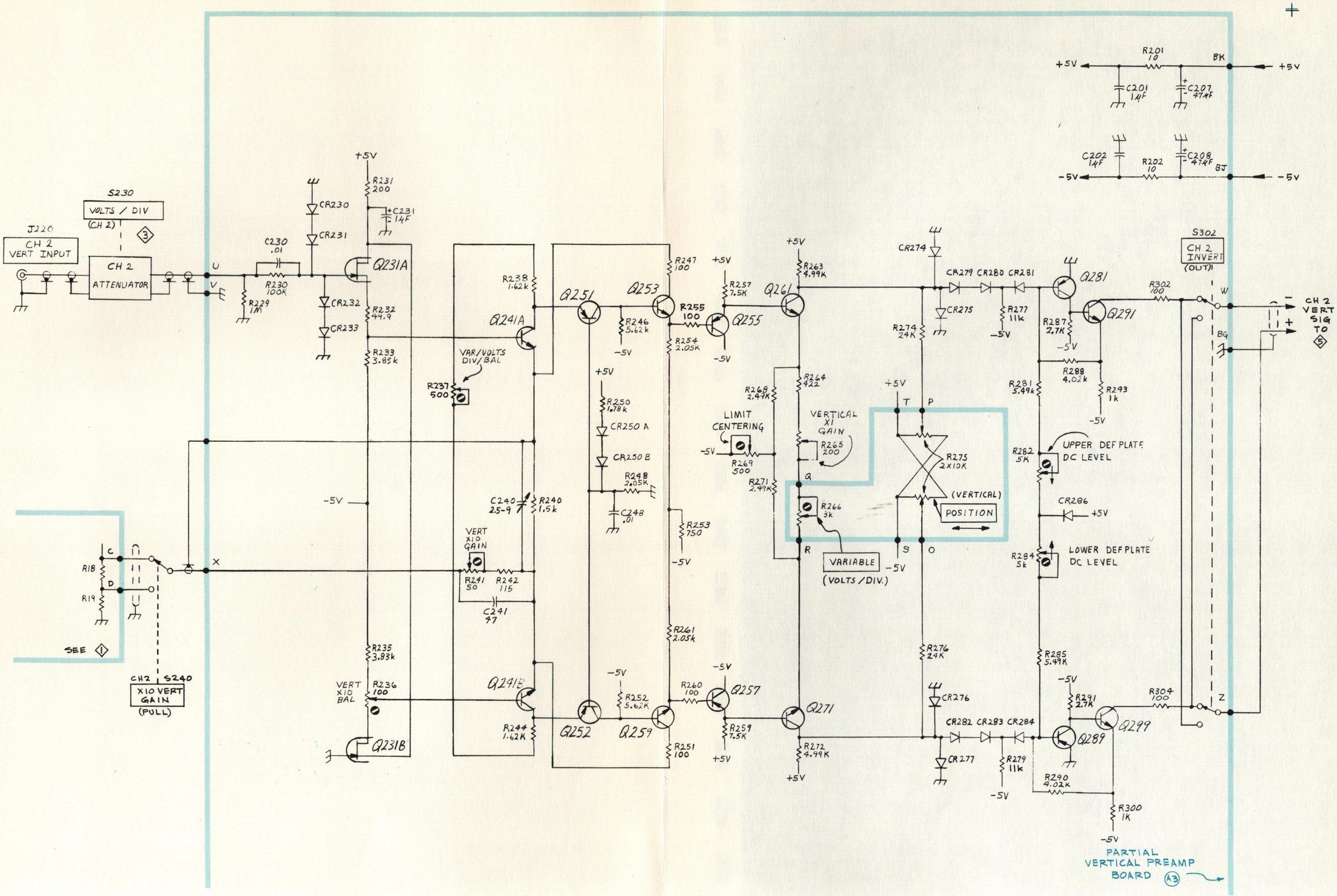
A3. Vertical Preamp

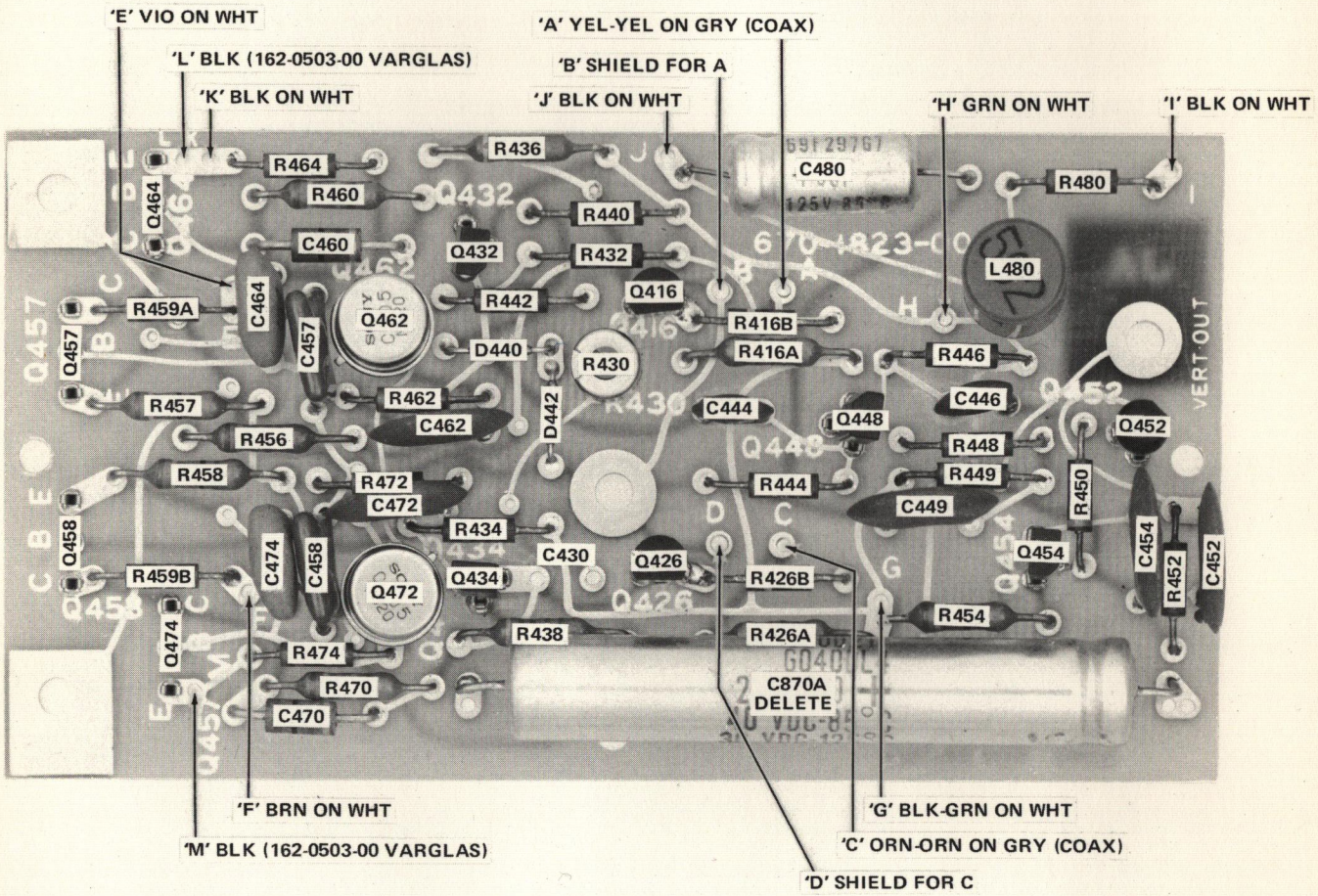

S30
VOLTS/DIV
(CH 1)
1
J20
CH1
VERT INPUT
CHANNEL 1
ATTENUATOR
G
H
R29
1M
C30
.01
R30
100K
CR30
CR31
CR32
CR33
+5V
R31
200
C31
14F
Q31A
R32
49.9
R33
3.83K
R37
500
+5V
VARIABLE
VOLTS/DIV
BAL
R38
1.62K
Q41A
Q51
Q53
R47
100
R46
5.62
-5V
R54
2.05k
Q55
R55
100
R57
7.5k
-5V
+5V
R63
4.99k
Q61
R53
750
-5V
R68
2.49k
R64
422
LIMIT
CENTERING
R69
500
R65
200
VERT
XIGAIN
C
R66
3k
VARIABLE
CAL (VOLTS/DIV)
R71
2.49k
D
E
A
-5V
CR74
CR79
CR80
CR81
CR75
R74
24k
R77
11k
-5V
+5V
F
B
POSITION
(VERTICAL)
R75
2X10k
Q81
Q91
R87
2.7k
-5V
R88
4.02k
R94
470
R93
1K
-5V
R81
5.49k
R82
5K
UPPER DEF PLATE
DC LEVEL
CR86
+5V
R84
5k
LOWER DEF
PLATE DC LEVEL
R85
5.49k
R102
100
BG
L
CH 1
VERT
SIG
TO
6
R1
10
BE
BF
C1
14F
C7
47µF
+5V
-5V
C2
14F
C8
47µF
R2
10
BC
BD
+5V
+5V
R95
2.7k
R98
20k
C95
.01
VR95
Q95
Q98
R99
470
R96
750
R97
390
-5V
I
BI
CH 1 TRIGGER
SIGNAL TO
S500
6
K
J
C
R18
D
R19
(PULL)
X10 VERT
GAIN
CH 1 S40
1
-5V
VERT
X10
GAIN
C40
2.5-9
R40
1.5K
R41
50
R42
115
C41
47
+5V
R50
1.78k
CR50 A
CR50 B
R48
2.05k
C48
.01
R35
3.83k
VERT
X10
BAL
R36
100
Q31B
Q41B
Q52
Q59
R44
1.62k
R52
5.62k
R51
100
R61
2.05k
R60
100
Q57
Q71
R59
7.5k
+5V
R72
4.99k
+5V
CR76
CR82
CR83
CR84
CR77
R76
24k
R79
11k
-5V
-5V
R91
2.7k
Q89
Q99
R90
4.02k
R104
100
M
R100
1K
-5V
PARTIAL
VERT PREAMP
BOARD
A3


'C' BLU
(TEFLON)
'M' C220
LEAD
R220
'N' C220
LEAD
'A' BLU-BLU ON GRY
(COAX)
'B' BRN (TEFLON)
'B' WHT
A2

A2. CH 2 AC-DC


S230
CH 2 VOLTS/DIV
SWITCH SHOWN IN .01 VOLTS/DIV POSITION
.01
.02
.05
.1
.2
.5
1
2
5
10
V
5 DIV CAL
10 11 12 13 18 17 16 15 21 22 23 26 25 24 28
CH 2 (COUPLING) S220
OUT
GND
AC
DC
C220 .0185
J220
CH 2 VERT INPUT
M
N
R220 470k
A
B
C
H
F
C221 2-8
CH 2 AC-DC BOARD (A2)
X1
X10
X100
X200
R221 47
X1
X2
X5
P
Q
R
CH 2 VERT SIGNAL TO R230 (4)
CALIBRATOR SIGNAL FROM S240 (1)
X10
C223A 5.5-18
R223B 900k
C223B 2-8
R223C 111k
C223C 35
X100
C224A 5.5-18
R224B 990k
C224B 2-8
R224C 10.1k
C224C 470
X200
C225A 5.5-18
R225B 995k
C225B 2-8
R225C 5.03k
C225C .001
X2
C227A 2-8
R227B 500k
C227B 5.5-18
C227C 4.7
R227D 33K
C227D 27
R227C 1M
X5
C228A 5.5-18
R228B 800k
C228B 2-8
R228C 250k
PARTIAL ATTEN-CAL-SWITCHNG BOARD (A4)


J220
CH 2 VERT INPUT
S230
VOLTS / DIV (CH 2)
3
CH 2 ATTENUATOR
U
V
C230 .01
R230 100K
R229 1M
+5V
R231 200
C231 14F
CR230
CR231
CR232
CR233
Q231A
R232 44.9
R233 3.83k
R235 3.83k
VERT X10 BAL
R236 100
Q231B
R237 500
VAR/VOLTS DIV/BAL
R238 1.62k
Q241A
Q241B
C240 2.5-9
R240 1.5k
VERT X10 GAIN
R241 50
R242 115
C241 47
-5V
R244 1.62K
Q251
Q252
Q253
Q259
R246 5.62k
R247 100
R248 2.05K
C248 .01
R250 1.78k
CR250 A
CR250 B
R251 100
R252 5.62K
R253 750
R254 2.05K
R255 100
R257 7.5K
Q255
R259 7.5K
R260 100
Q257
R261 2.05k
Q261
Q271
R263 4.99K
R264 422
R265 200
VERTICAL X1 GAIN
R266 3k
VARIABLE (VOLTS/DIV.)
R268 2.49K
LIMIT CENTERING
R269 500
R271 2.49K
R272 4.99K
T
P
Q
R
S
O
R275 2X10K
(VERTICAL) POSITION
CR274
CR275
CR276
CR277
R274 24K
R276 24K
CR279 CR280 CR281
R277 11k
CR282 CR283 CR284
R279 11k
Q281
Q289
Q291
Q299
R281 5.49k
R282 5k
UPPER DEF PLATE DC LEVEL
R284 5k
LOWER DEF PLATE DC LEVEL
R285 5.49K
R287 2.7K
R288 4.02k
R290 4.02K
R291 2.7K
R293 1k
R300 1K
R302 100
R304 100
S302
CH 2 INVERT (OUT)
W
X
Y
Z
BG
CH 2 VERT SIG TO 5
R201 10
BK
C201 1uF
C207 47uF
C202 1uF
R202 10
BJ
C208 47uF
R18
R19
C
D
SEE 1
CH2 S240
X10 VERT GAIN (PULL)
PARTIAL VERTICAL PREAMP BOARD A3



A5

A5. Vertical Output

PARTIAL VERTICAL PREAMP BOARD (A3)

FROM CH 1 (2)
FROM CH 1 (2)
FROM CH 2 (4)
FROM CH 2 (4)
CL CR310 CR311 CR312 CR313 DG
CW CR315 CR316 CR317 CR318 CZ DL
R375 1.62k +5V
R376 360
Q376
CO CP
L415 300NS
T410
R370 2.43k
R377 105
R397 536 -5V
C397 .1
R388 105
R380 2.93k
R385 1.62k +5V
Q386
R386 360
R395 470

R410 100
R411 1k
C411 390
Q410
Q415
R414 6.19k +5V
R419 10
R412
R415 1k -5V
R417 2.61k
R418 2K
C419 5-25
C418 2.5-9
R902 2.05k
CR400C
CR400B
CR400A
C400 .01
R400 2.05k -5V
C413 470
C428 2.5-9
R425 1k -5V
R428 2K
C429 5-25
R421 1k
C421 390
R422
R420 100
Q420
Q425
R424 6.19k +5V
R429 10 +5V
R427 2.61k

BP +5V (DCPL)
R478 10
AK +5V
80 +5V
+5V
C478 1μF

AA AB AC AD AE AF BR AL BQ AH AG AI
R392 5.1k +5V
Q392
R390 1.8k
R391 620 -5V
NORM TRIG SIG TO S500 (6)
+5(DCPL)
R476 10 +5V
C476 1μF -5V
+5V

A B C D
R416B 24
R416A 5.11k -5V
Q416
L416
R426A 5.11k -5V
L426
Q426
R426B 24
R436 4.22k +5V
R438 4.22 +5V
Q432
Q434
R432 560
R434 560
R430 10k -5V
R440 2.7k +5V
R442 100
CR440
CR442

R460 147k
C460 0.3
Q462
R462 620
C462 .05
R464 5.6k
Q464
C464 .01
L +100V TO M (DCPL)
K +100V FROM J (DCPL)
100 E +VERT SIGNAL TO CRT DEF PLATE
Q457
C457 14F
R457 147
C444 470
+5V
R446 2k
Q452
Q454
Q448
C446 470
R450 8.2k
R444 11k
R448 39
R452 3k
C452 0.1
C454 0.1
R454 147 -5V
R456 2.61k -5V
R458 147
C458 14F
Q458
R459B 100 F -VERT SIGNAL CRT DEF PLATE
R449 3.9k
C449 0.1
-5V
R472 620
C472 .05
C474 .01
Q474
Q472
R474 5.6k
M +100V (DCPL) FROM L
R470 147k
C470 0.3
J +100V (DCPL) TO K
L480 5.6μH
R480 100 I +100V (DCPL)
C480 9μF
+5V H +5V
-5V G -5V

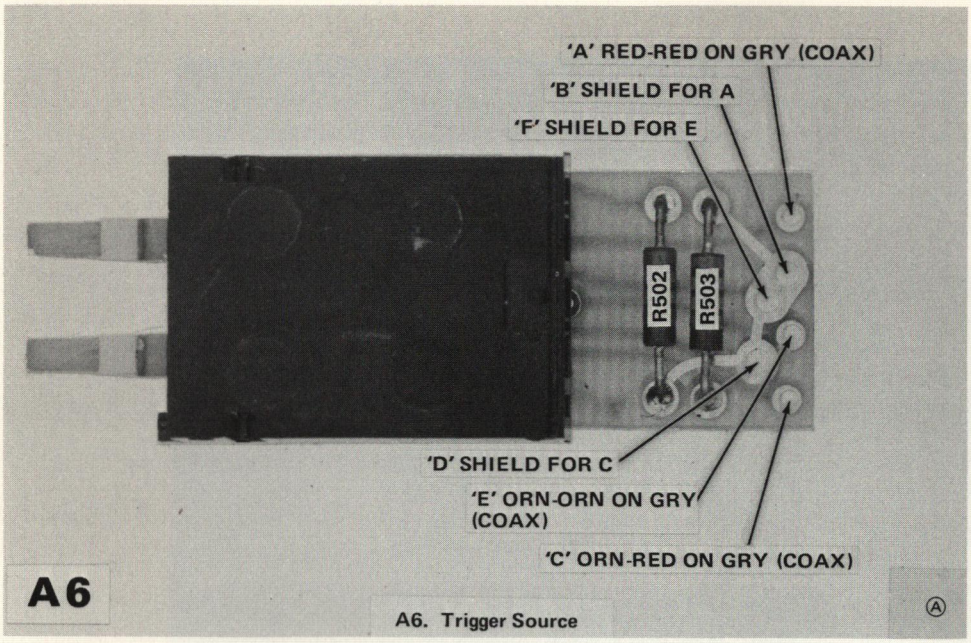
VERTICAL OUTPUT BOARD (A5)

ALT TRIG SIGNAL FROM R669 (7)
Z AN
R352 1k
C352 470
Q351
R351 2.2k
R350 200
S330 (VERT MODE)
ADD AQ +5V
ALT AG
CHOP AA
CH 2 AC
CH 1 AB
AD
R334 390
R344 390

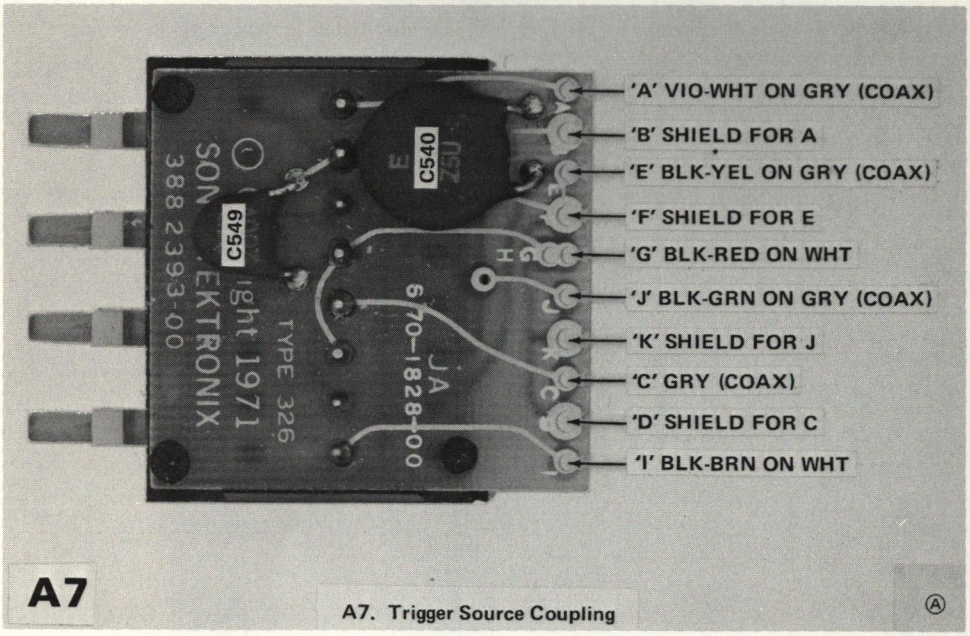
CR335 CR345
R335 510
R345 510
C335 47
C334 .0068
C345 47
+5V +5V
Q333 R333 2.2k
R343 2.2k Q343
R332 2.2k
R342 2.2k
C332 .0022
C342 .0022
R331 2.7k
R341 2.7k
R330 1.5k -5V
CR331
CR341
R340 1.5k -5V
C350 14F
Q355
R355 100 -5V

R360 100k +5V
R361 1.2k +5V
R362 470
R363 47k -5V
C361 1μF
W V CHOP BLANKING TO CRGGB (7)
AP AO Y -5V
X +5V

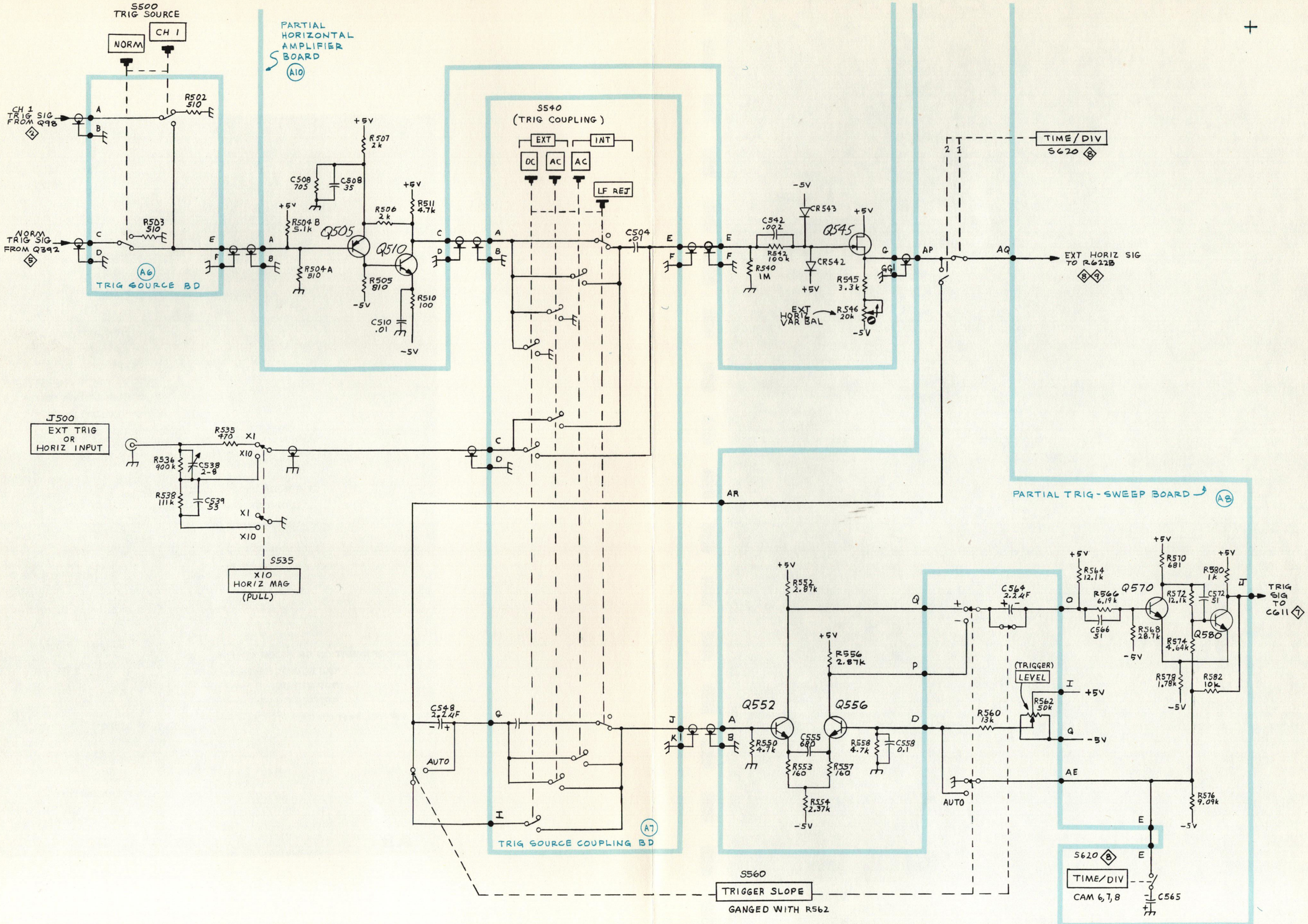
PARTIAL ATT-CAL-SWITCHING BOARD (A9)

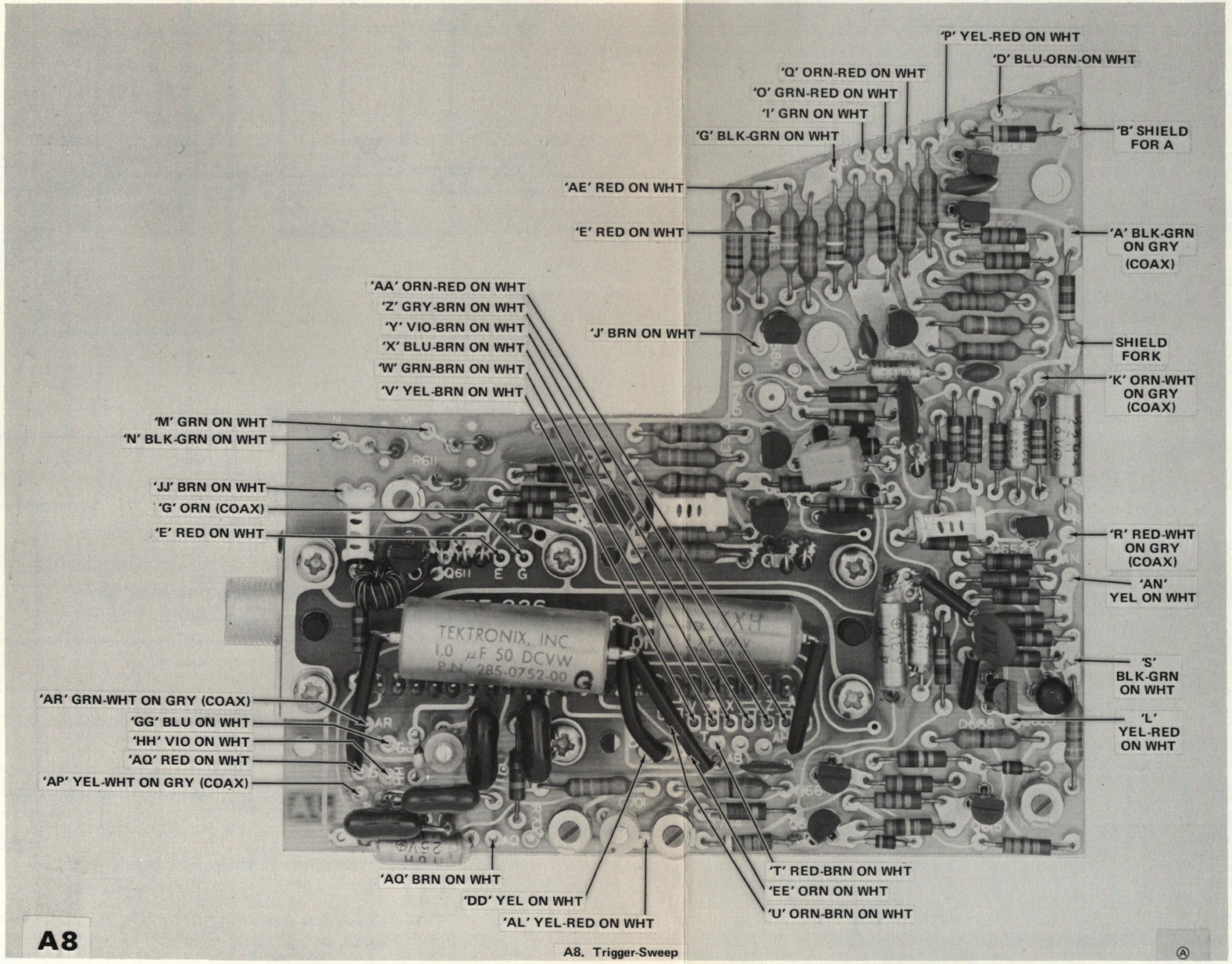


A6. Trigger Source



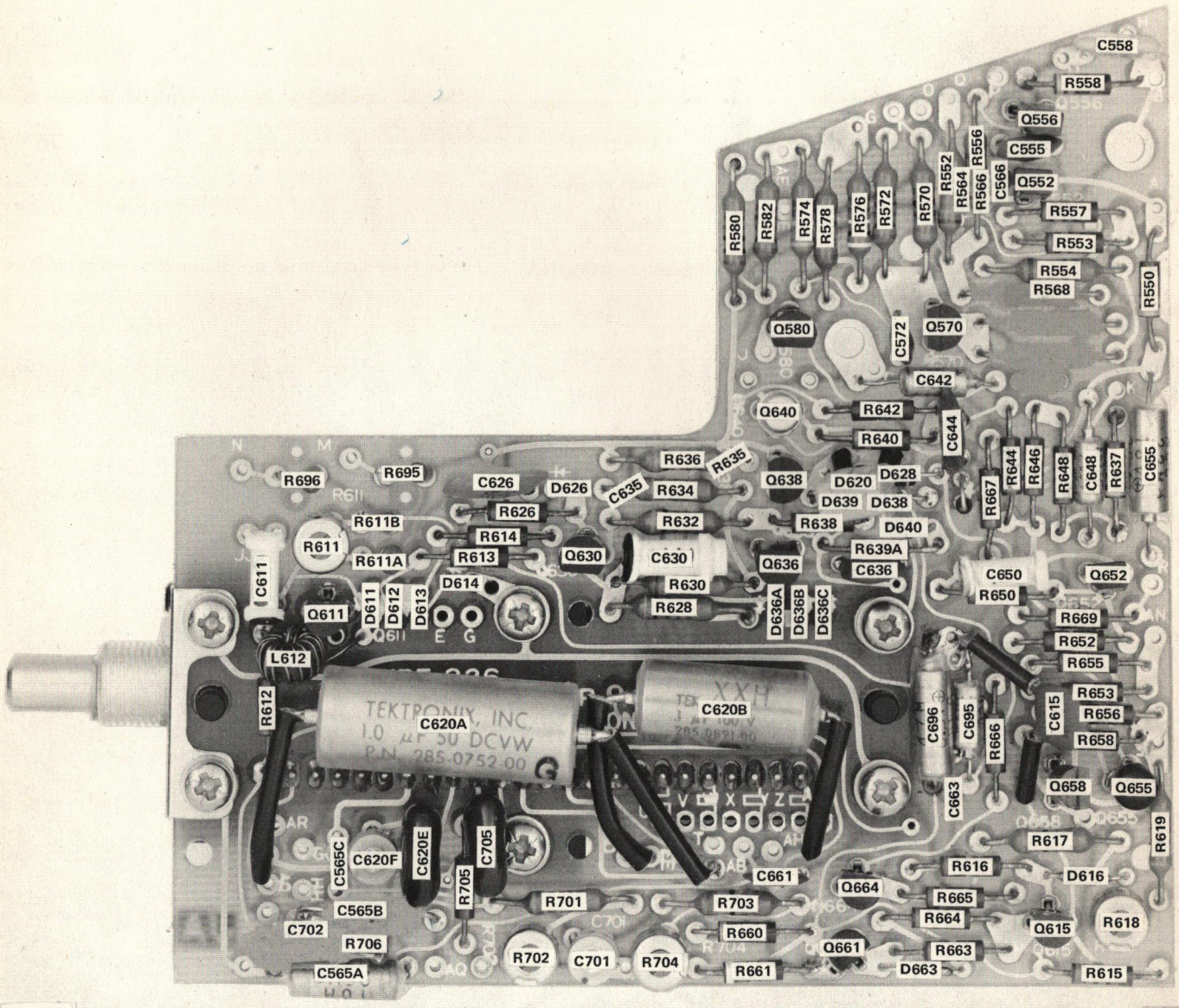
A7. Trigger Source Coupling


S500
TRIG SOURCE
NORM
CH 1
PARTIAL HORIZONTAL AMPLIFIER BOARD
A10
CH 1 TRIG SIG FROM Q98
4
R502 510
R503 510
NORM TRIG SIG FROM Q392
5
A6
TRIG SOURCE BD
+5V
R507 2k
C508 705
C508 35
R506 2k
R511 4.7k
R504 B 5.1k
Q505
Q510
R504 A 510
R505 810
-5V
R510 100
C510 .01
S540
(TRIG COUPLING)
EXT
INT
DC
AC
AC
LF REJ
C504 .01
-5V
CR543
+5V
C542 .002
Q545
R542 100k
CR542
R540 1M
+5V
R545 3.3k
EXT HORIZ VAR BAL
R546 20k
-5V
TIME/DIV
S620
8
AP
AQ
EXT HORIZ SIG TO R622B
8 9
J500
EXT TRIG OR HORIZ INPUT
R535 470
X1
X10
R536 900k
C538 2-8
R538 111k
C539 53
X1
X10
S535
X10 HORIZ MAG
(PULL)
AR
PARTIAL TRIG-SWEEP BOARD
AB
+5V
R552 2.87k
Q
C564 2.2µF
O
R564 12.1k
R566 6.19k
Q570
R510 681
R580 1k
R572 12.1k
C572 51
U
TRIG SIG TO C611
7
C566 51
R568 28.7k
-5V
Q580
R574 4.64k
R578 1.78k
R582 10k
-5V
+5V
R556 2.87k
P
(TRIGGER) LEVEL
I
+5V
R562 50k
Q
-5V
C548 2.2µF
AUTO
H
J
K
A
B
Q552
Q556
R550 4.7k
C555 680
R553 160
R557 160
R554 2.37k
-5V
R558 4.7k
C558 0.1
D
R560 13k
AUTO
AE
R576 9.09k
-5V
E
S620
8
TIME/DIV
CAM 6,7,8
C565
TRIG SOURCE COUPLING BD
AJ
S560
TRIGGER SLOPE
GANGED WITH R562

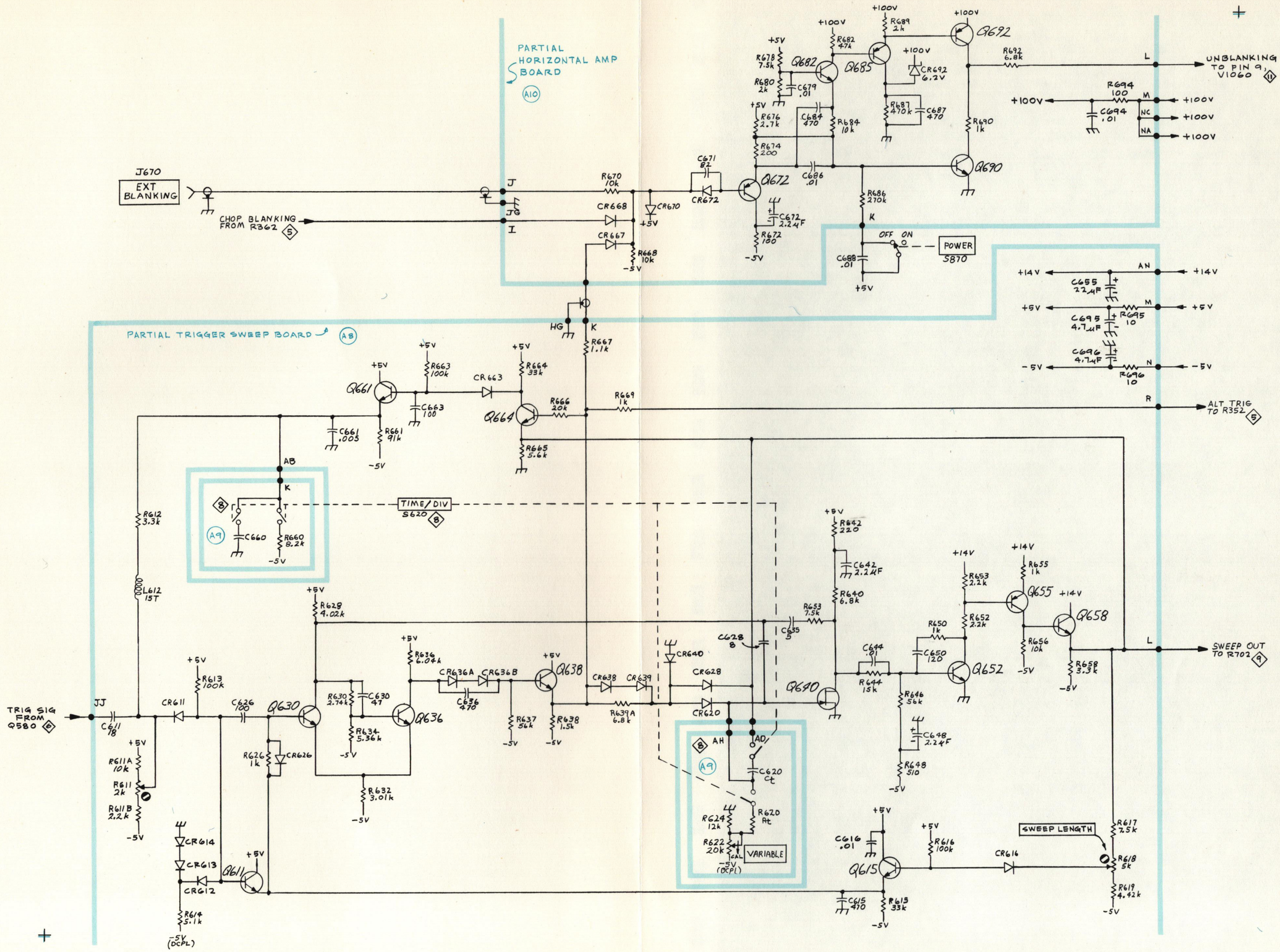


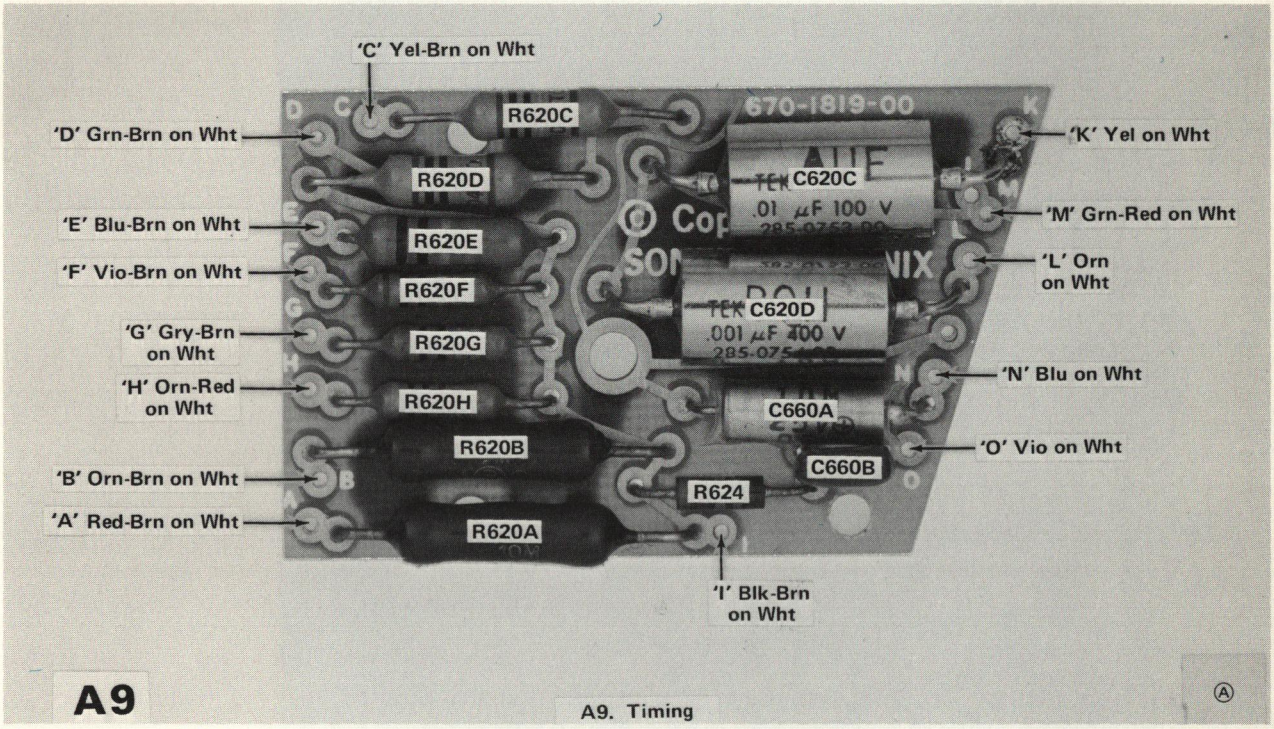
A8

A8. Trigger-Sweep



A8. Trigger-Sweep


PARTIAL HORIZONTAL AMP BOARD
A10
PARTIAL TRIGGER SWEEP BOARD
A8
J670
EXT BLANKING
CHOP BLANKING FROM R362
TRIG SIG FROM Q580
TIME/DIV S620
POWER S870
OFF ON
UNBLANKING TO PIN 9, V1060
ALT TRIG TO R352
SWEEP OUT TO R702
SWEEP LENGTH
VARIABLE
Q661
Q664
Q672
Q682
Q685
Q692
Q690
Q611
Q630
Q636
Q638
Q640
Q652
Q655
Q658
Q615
CR663
CR667
CR668
CR670
CR672
CR692
CR611
CR612
CR613
CR614
CR626
CR628
CR636A
CR636B
CR638
CR639
CR640
CR616
R612 3.3k
L612 15T
R613 100k
R614 5.1k
R626 1k
R628 4.02k
R630 2.74k
R632 3.01k
R634 5.36k
R636 6.04k
R637 56k
R638 1.5k
R639A 6.8k
R640 6.8k
R642 220
R644 15k
R646 56k
R648 510
R650 1k
R652 2.2k
R653 2.2k
R655 1k
R656 10k
R658 3.3k
R660 8.2k
R661 91k
R663 100k
R664 33k
R665 5.6k
R666 20k
R667 1.1k
R668 10k
R669 1k
R670 10k
R672 100
R674 200
R676 2.7k
R678 7.5k
R680 2k
R682 47k
R684 10k
R686 270k
R687 470k
R689 2k
R690 1k
R692 6.8k
R694 100
R695 10
R696 10
R611A 10k
R611 2k
R611B 2.2k
R620 At
R622 20k
R624 12k
R615 33k
R616 100k
R617 2.5k
R618 5k
R619 4.42k
C611 18
C615 470
C616 .01
C620 Ct
C626 100
C628 8
C630 47
C635 5
C636 470
C640 .01
C642 2.2µF
C644 .01
C648 2.2µF
C650 120
C660 .005
C661 .005
C663 100
C671 82
C672 2.2µF
C679 .01
C684 470
C686 .01
C687 470
C688 .01
C694 .01
C695 4.7µF
C696 4.7µF
C655 22µF
+100V
+14V
+5V
-5V
-5V (DCPL)
J
JG
I
JJ
HG
K
AB
AH
AD
T
L
M
N
NC
NA
AN

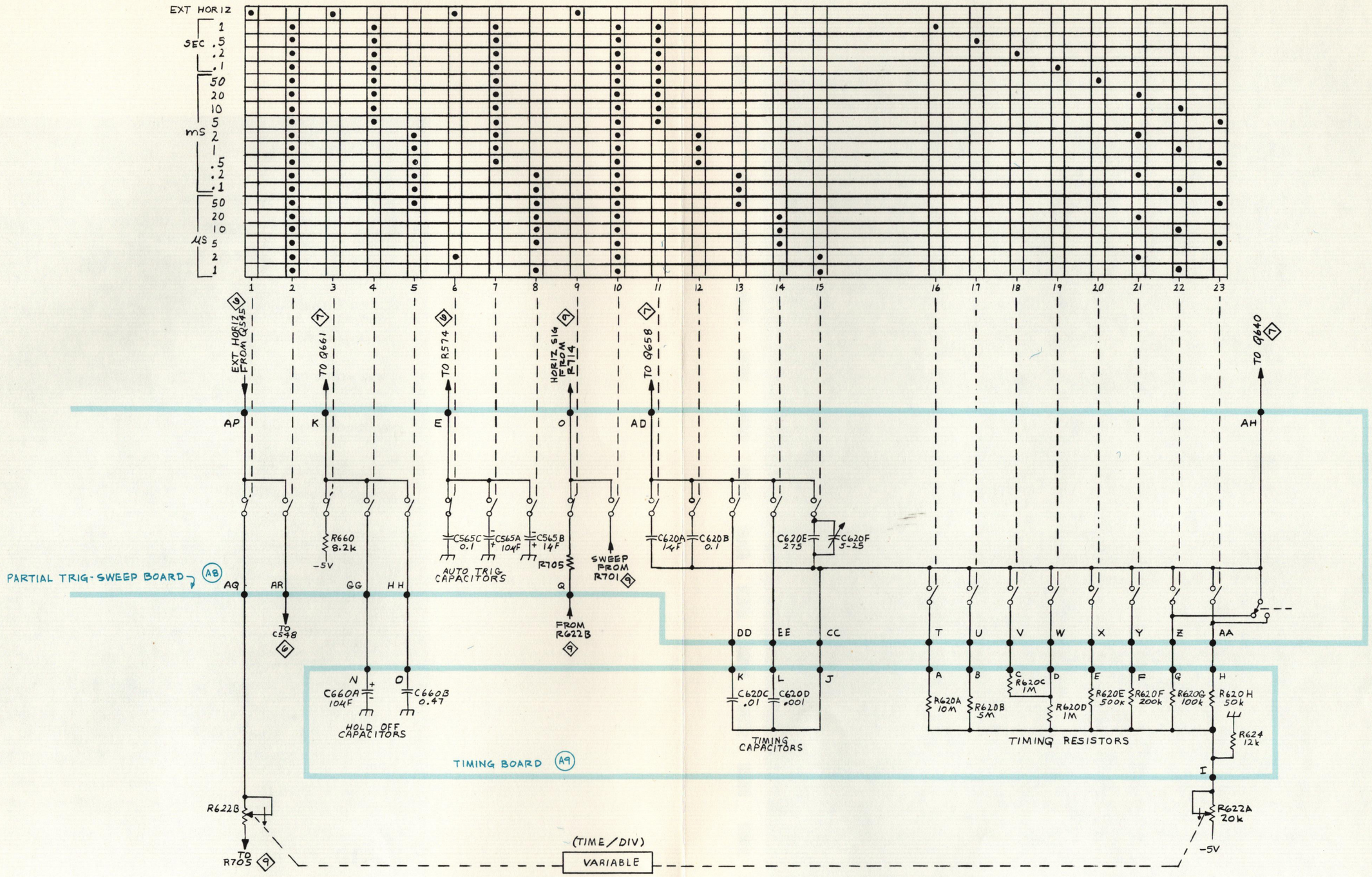

'C' Yel-Brn on Wht
'D' Grn-Brn on Wht
'E' Blu-Brn on Wht
'F' Vio-Brn on Wht
'G' Gry-Brn on Wht
'H' Orn-Red on Wht
'B' Orn-Brn on Wht
'A' Red-Brn on Wht
'I' Blk-Brn on Wht
'K' Yel on Wht
'M' Grn-Red on Wht
'L' Orn on Wht
'N' Blu on Wht
'O' Vio on Wht
R620C
R620D
R620E
R620F
R620G
R620H
R620B
R620A
R624
C620C
.01 μF 100 V
C620D
.001 μF 100 V
C660A
C660B
670-1819-00
A9

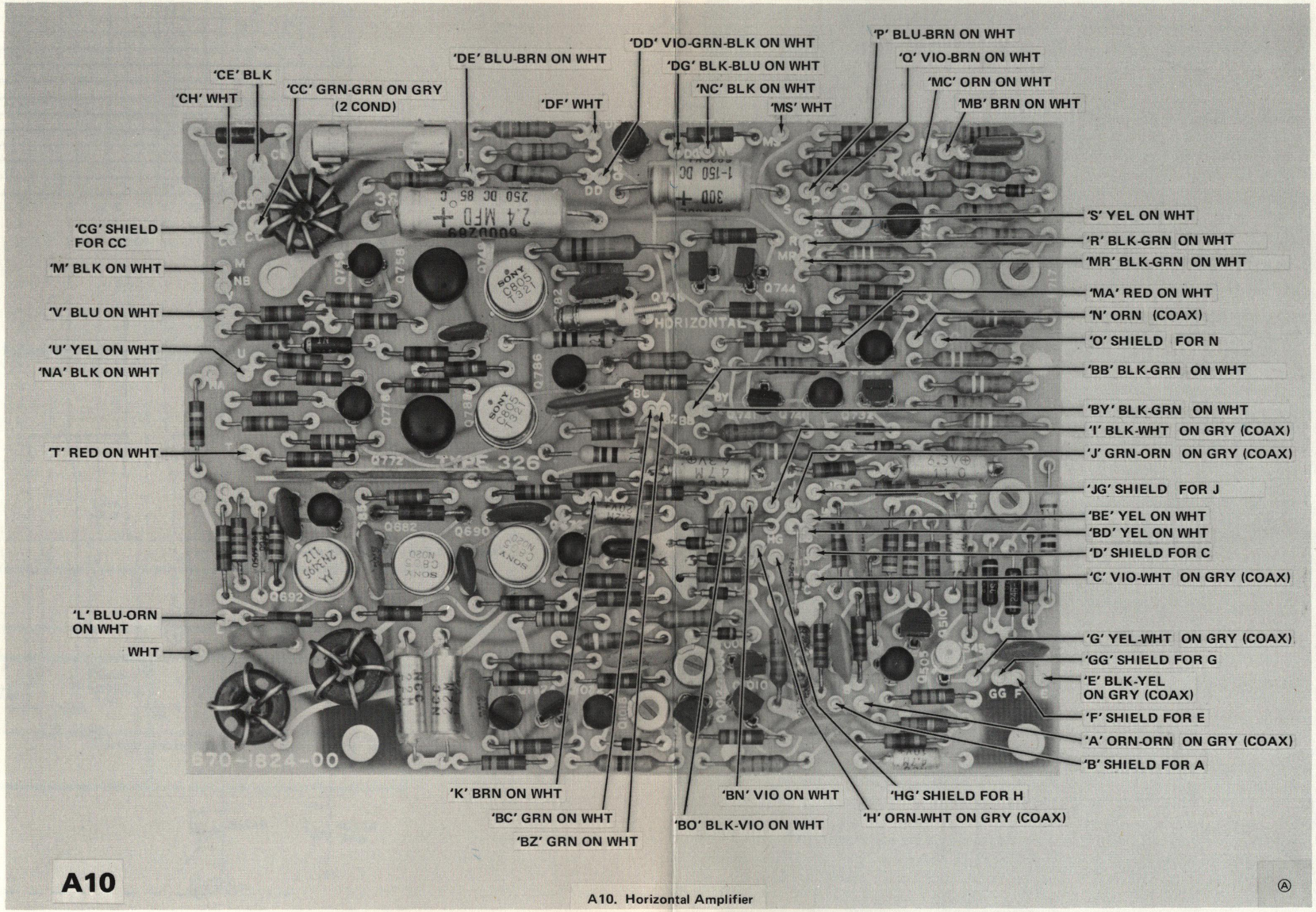
A9. Timing

S620

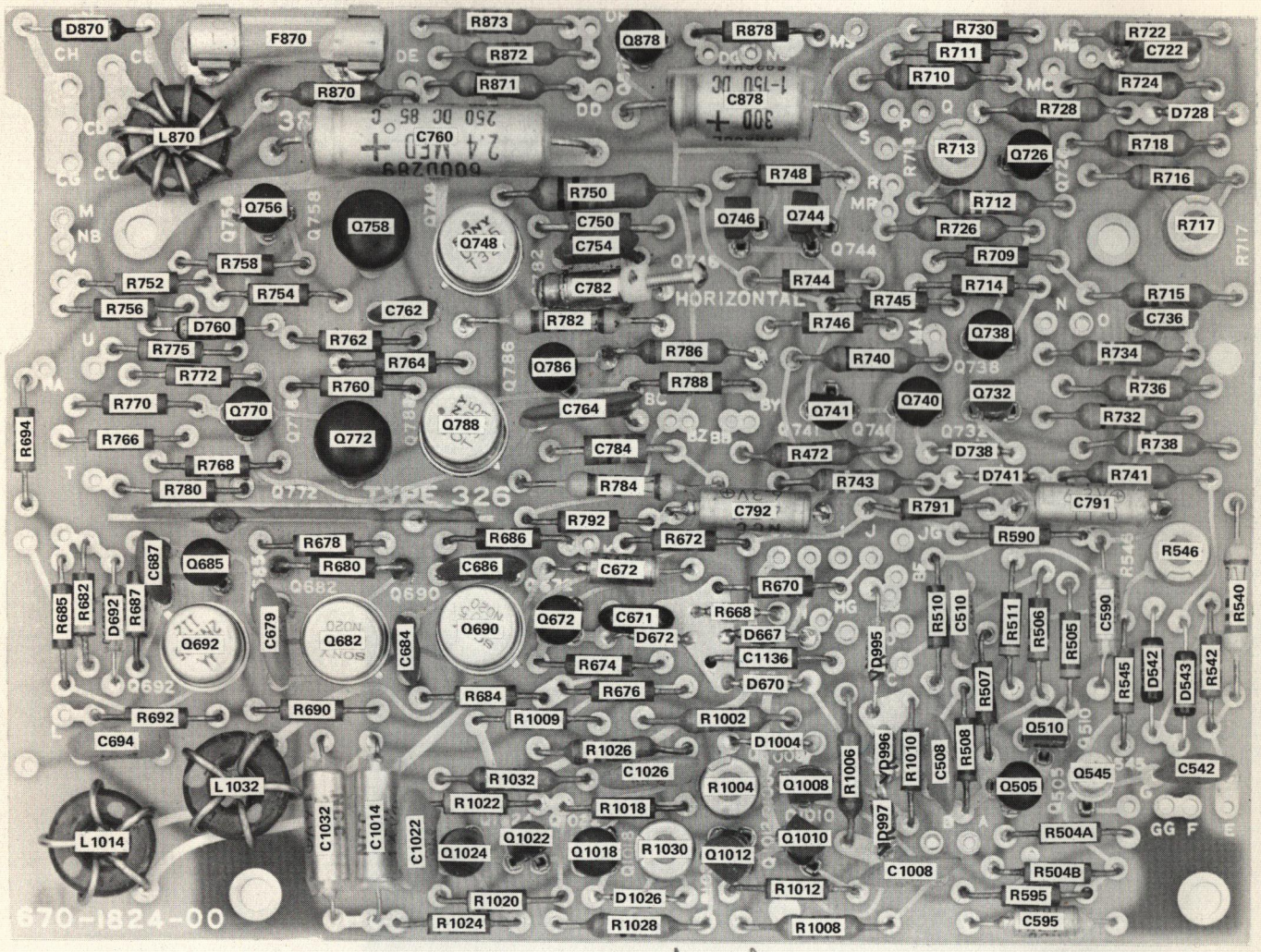
TIME / DIV

SHOWN IN EXT HORIZ POSITION



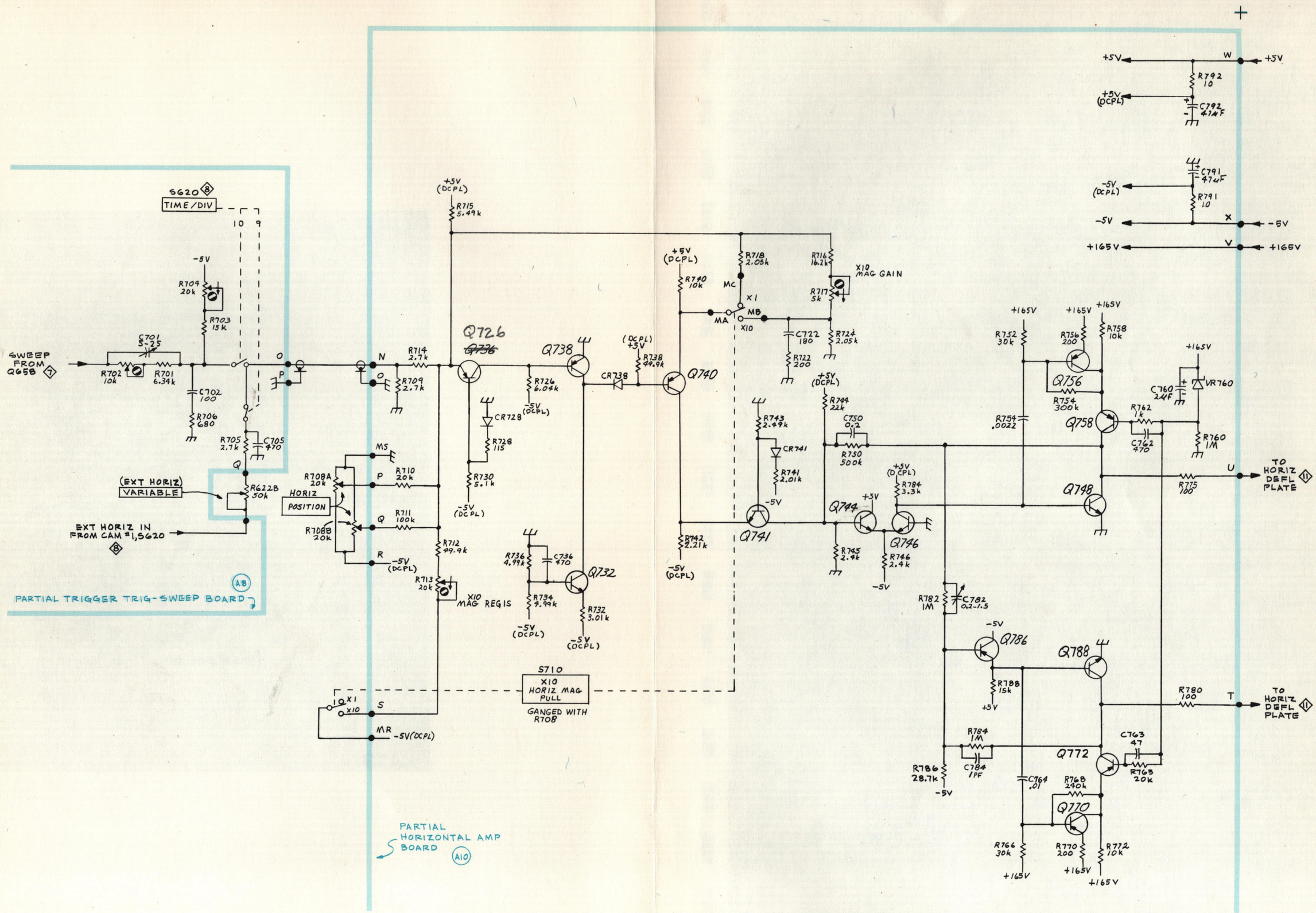


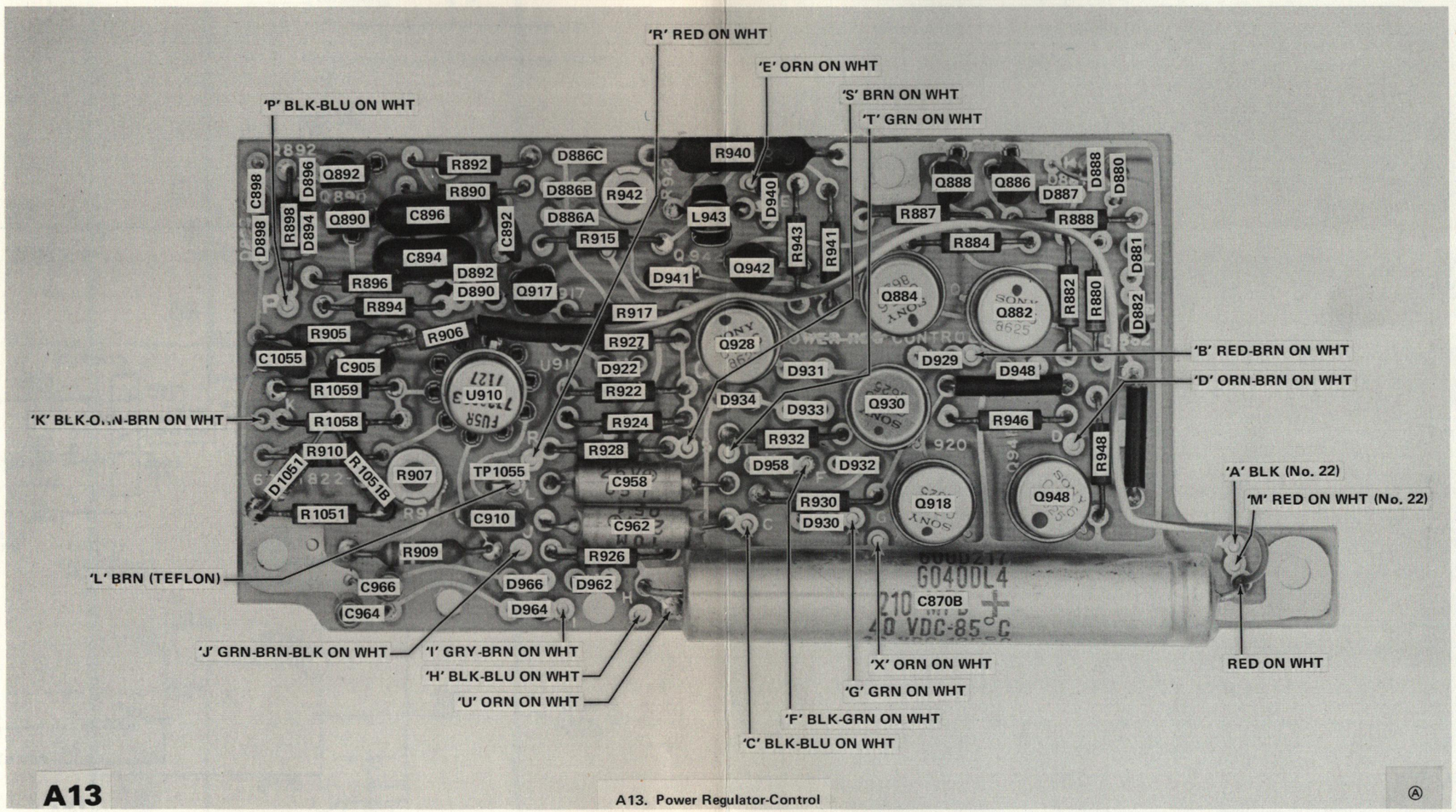
A10. Horizontal Amplifier

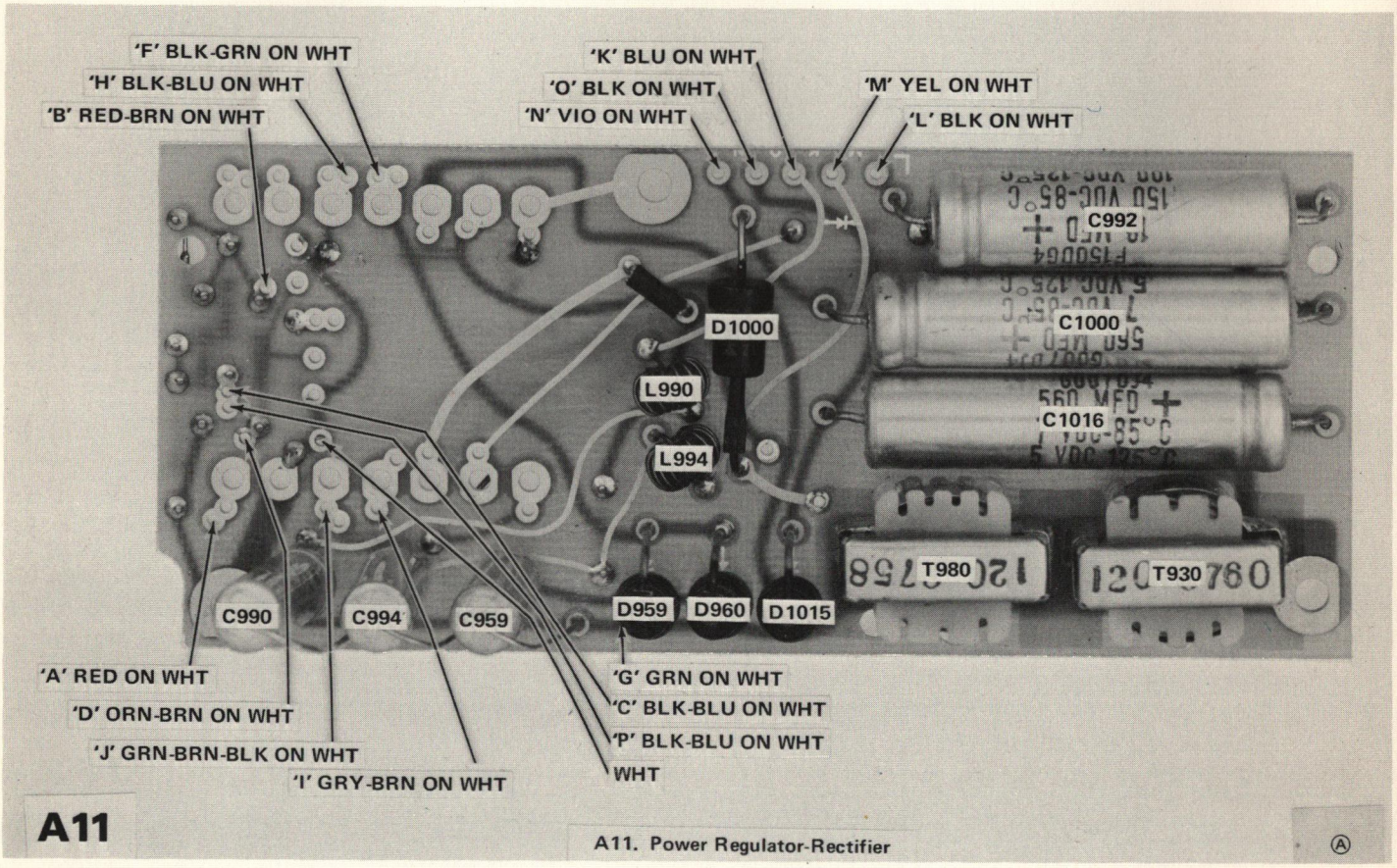


R1030
-5V adj

R1004
+5V adj


S620
TIME/DIV
10
9
-5V
R709 20k
R703 15k
C701 5-25
SWEEP FROM Q658
R702 10k
R701 6.34k
C702 100
R706 680
R705 2.7k
C705 470
Q
(EXT HORIZ) VARIABLE
R622B 50k
EXT HORIZ IN FROM CAM #1, S620
HORIZ POSITION
R708A 20k
R708B 20k
M
S
P
Q
R
R710 20k
R711 100k
R712 49.9k
R713 20k
X10 MAG REGIS
-5V (DCPL)
PARTIAL TRIGGER TRIG-SWEEP BOARD
N
O
P
R714 2.7k
R709 2.7k
+5V (DCPL)
R715 5.49k
Q726
Q736
CR728
R728 115
R730 5.1k
R726 6.04k
Q738
CR738
(DCPL) +5V
R738 49.9k
Q740
R736 4.99k
C736 470
Q732
R734 9.99k
R732 3.01k
S710
X10 HORIZ MAG PULL
GANGED WITH R708
1 X1
10 X10
S
MR
-5V(DCPL)
PARTIAL HORIZONTAL AMP BOARD
R718 2.05k
R716 16.2k
X10 MAG GAIN
R717 5k
R740 10k
MC
X1
MB
MA
X10
C722 180
R722 200
R724 2.05k
R744 22k
C750 0.2
R750 500k
R743 2.49k
CR741
R741 2.01k
Q741
R742 2.21k
Q744
Q746
R745 2.4k
R746 2.4k
R784 3.3k
Q748
+165V
R752 30k
R754 .0022
R756 200
R758 10k
Q756
R754 300k
Q758
C760 24F
VR760
R762 1k
C762 470
R760 1M
R775 100
U
TO HORIZ DEFL PLATE
R782 1M
C782 0.2-1.5
Q786
Q788
R788 15k
R780 100
T
TO HORIZ DEFL PLATE
R784 1M
C784 1PF
R786 28.7k
C763 47
R763 20k
C764 .01
Q772
R768 240k
Q770
R766 30k
R770 200
R772 10k
+5V
W
R792 10
C792 47µF
C791 47µF
R791 10
X
V


'R' RED ON WHT
'E' ORN ON WHT
'S' BRN ON WHT
'T' GRN ON WHT
'P' BLK-BLU ON WHT
'B' RED-BRN ON WHT
'D' ORN-BRN ON WHT
'K' BLK-ORN-BRN ON WHT
'A' BLK (No. 22)
'M' RED ON WHT (No. 22)
'L' BRN (TEFLON)
'J' GRN-BRN-BLK ON WHT
'I' GRY-BRN ON WHT
'H' BLK-BLU ON WHT
'U' ORN ON WHT
'X' ORN ON WHT
'G' GRN ON WHT
'F' BLK-GRN ON WHT
'C' BLK-BLU ON WHT
RED ON WHT
R940
D886C
R892
Q892
D896
C898
D898
R898
D894
Q890
C896
C892
D886B
D886A
R942
L943
D940
R915
R943
R941
C894
D892
D890
Q917
R896
R894
D941
Q942
R917
R905
R906
C1055
C905
R1059
R1058
R910
R907
D1051
R1051B
R1051
TP1055
C910
C958
C962
R909
R926
C966
C964
D966
D964
D962
R927
Q928
D922
R922
R924
R928
D931
D934
D933
R932
D958
D932
R930
D930
Q930
Q918
R946
R948
Q948
D929
D948
Q888
Q886
D887
D888
D880
R887
R888
R884
D881
R882
R880
D882
Q884
Q882
C870B
A13
A13. Power Regulator-Control



A11. Power Regulator-Rectifier

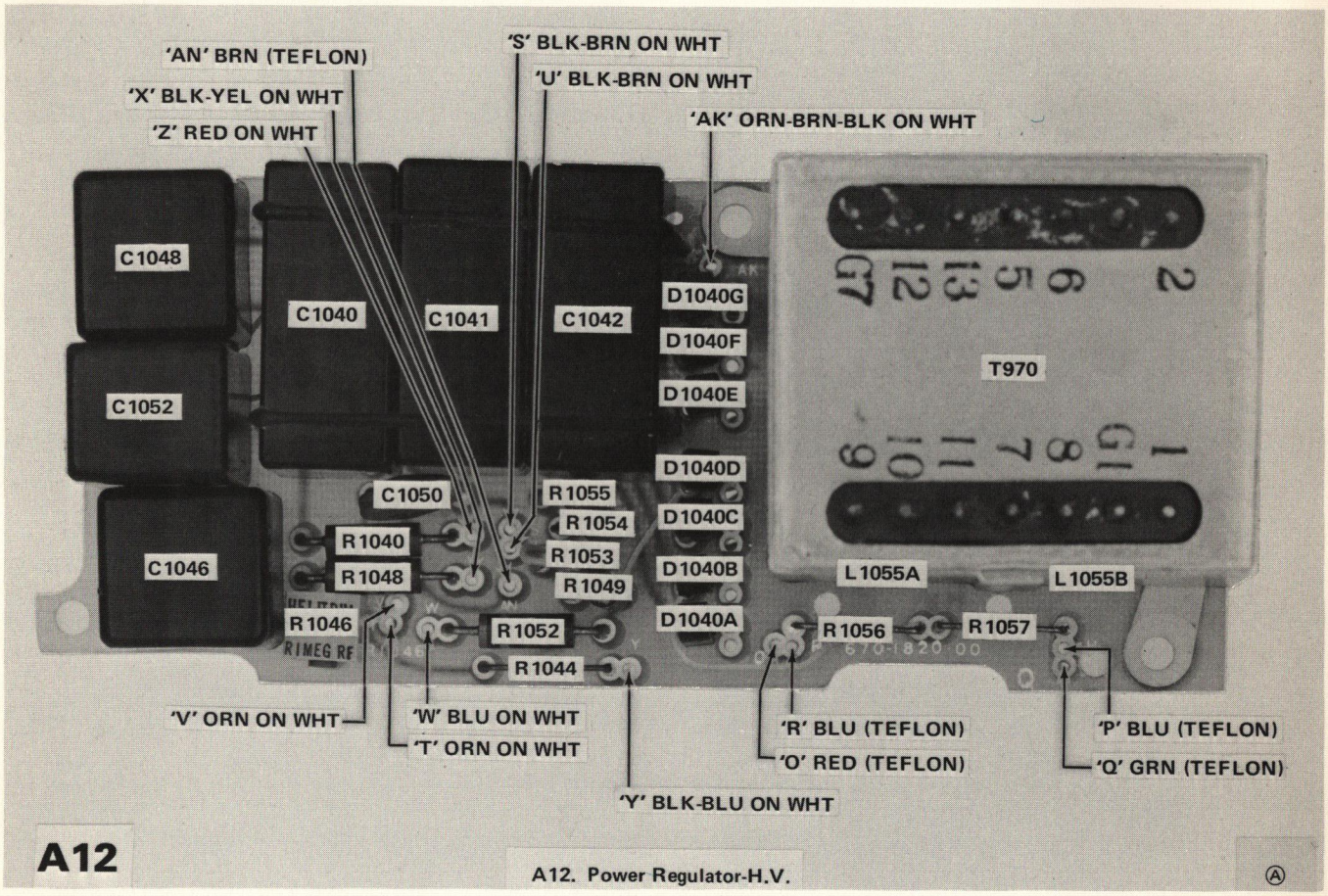
10.8VOLT PACK
J870
J871
J860
J861
BT1115
R1115 0.3Ω
C860 10kμF
INT BAT
EXT DC
ON
OFF
POWER S870
S860
F870 cc 1.6A
CR870
L870 12.8μH
CG
CE
A
M
A
1
2
BLACK
L860A L860B
+100V
R878 1M
DS878 LOW BAT
DG
C878 1μF
Q878 -179
+5V
R870 13k
R871 8.06k
R872 73.2k
R873 332k
DD
DE
DF
C870 210μF
+10.8V
PARTIAL HORIZONTAL AMP BOARD
A10
VERTICAL 1 AMP/DIV
HORIZONTAL 50μS/DIV
PARTIAL POWER REGULATOR RECTIFIER BOARD
A11
T970A
CR990 C990 2μF L990 +165V
CR992 C992 18μF +100V
CR994 C994 47μF L994 +14V
CR1000 C1000 560μF
G1
13 CR1015 C1016 560μF
PARTIAL HORIZONTAL AMP BOARD
A10
CR995
VR996
VR997
+12V
+5 VOLTS
R1002 84.5k
R1004 20k
R1006 15.8k
CR1004
R1008 41.2k
R1009 470k
C1008 .01
Q1008 -190
R1010 33k
Q1010 -190
R1012 1.8k
Q1012 -164
L1014 35μH
+5V
C1014 22μF
Q1018 -220
CR1026
R1018 1k
R1026 29.4k
C1026 .01
R1028 13k
R1030 5k
R1032 27.4k
C1022 .01
R1024 1.6k
C1012 22μF
L1032 35μH
-5V
R1022 47
Q1022 -190
R1020 9.7k
Q1024 -207
+7.2V (UNREG)
CR964 C964 1μF
CR959
CR960
C950 150μF
+5V (UNREG 1)
FROM Q884
CR930
CR95
C958 10μF
+5V (UNREG 2)
CR962 C962 10μF R962 15
-6V (UNREG)
CR966 C966 1μF
-16.5V (UNREG)
+10.8V
CR880
R880 47
R882 42
Q882 -306
CR881
VR882 5V
CR886A
CR886B
CR886C
R884 10
Q884 -306
TO CR958 +5V (UNREG 2)
FROM PING, U910
R890 24k
R892 24k
CR890
CR892
R896 200k
R894 200k
C894 470
C896 470
-3V
CR894
CR896
Q890
Q892
C892 470
R887 24k
Q888 -190
VR887 6V
R888 5.6k
Q886 -190
CR888
Q917 -220
CR922
R915 1k
R917 100
R926 6.8k
R924 200k
-6V (UNREG)
+5V (UNREG 2)
R922 2.7k
R924 3k
Q928 -306
R928 10k
R930 5.6k
Q930 -306
CR932
CR931
+5V (UNREG 1)
R932 620
CR933
CR934
CR929
VR898 3V
C898 2.2μF
R898 4.3k
VR973 5V
CR972
R974 1k
R972 10k
R976 10
Q976 -231
CR976
T980
Q978 -231
Q920 -306
Q948 -306
CR948
L943
R943 10
R942 10
R948 220
R940 6.8
R946 10k
R941 39k
VR941 3V
Q942
CR940
FROM R1058, R1059
R910 10k
-1900 VOLTS
+7.2V (UNREG)
+7.5V (UNREG)
R905 20k
R906 1.2M
R907 2k
R909 4.99k
+10.6V
C905 .001
1,9,10
-16.5V (UNREG)
C910 0.1
U910 μA723C
TO R890, R892
PARTIAL POWER REGULATOR CONTROL BOARD
A13

326 OSCILLOSCOPE

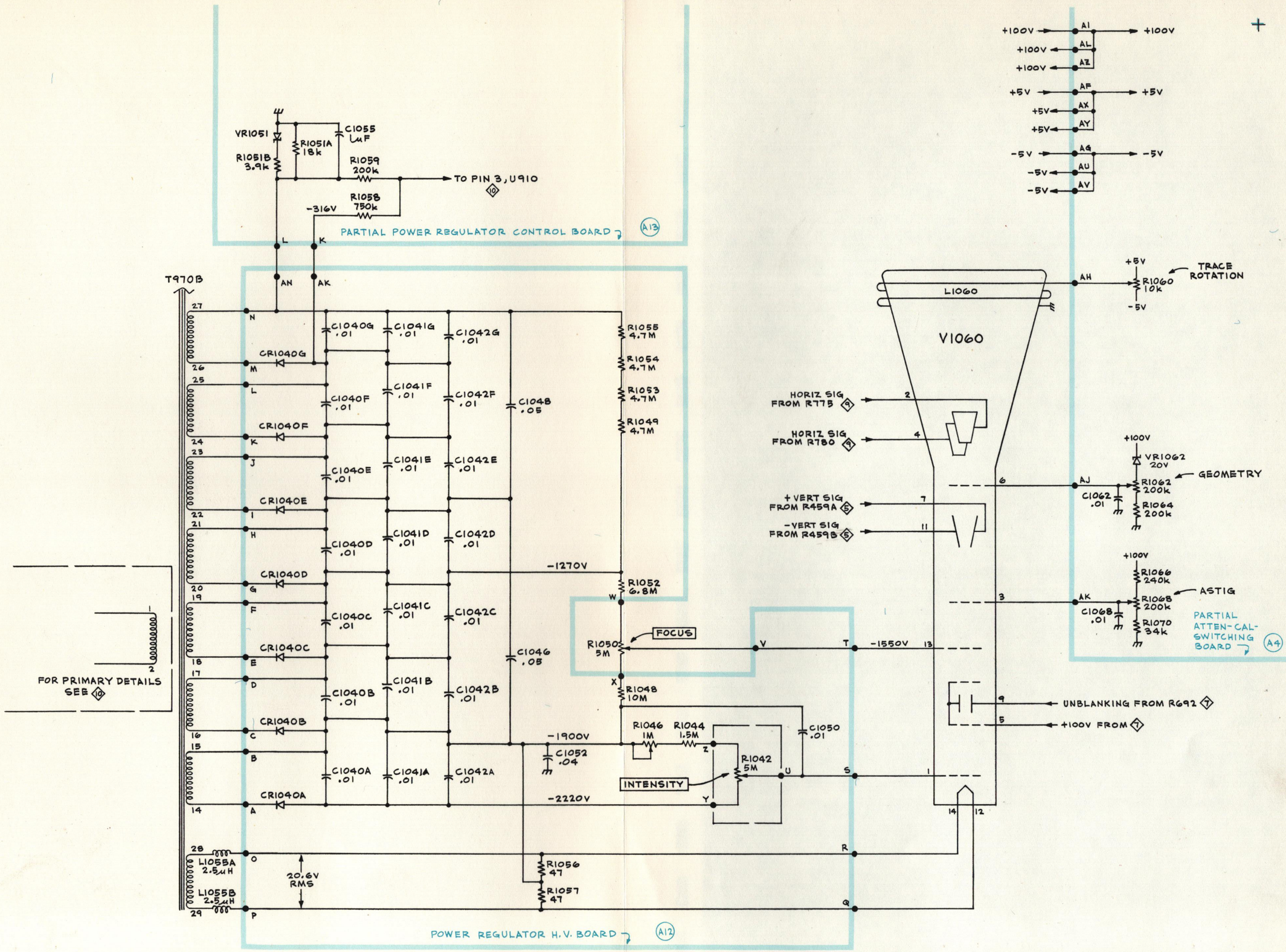
A

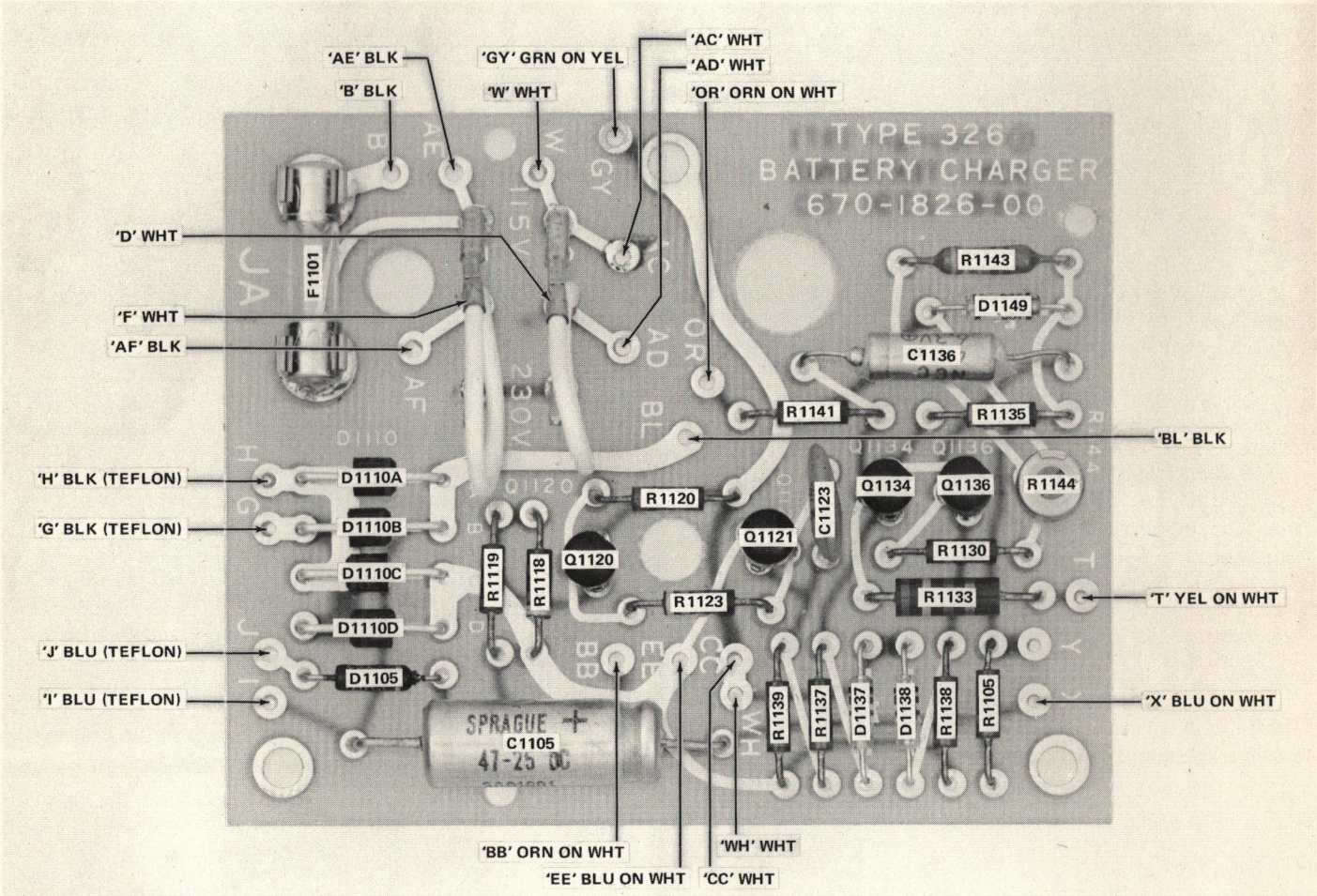
POWER SUPPLY 10

GAB 4-6-72



A12. Power Regulator-H.V.

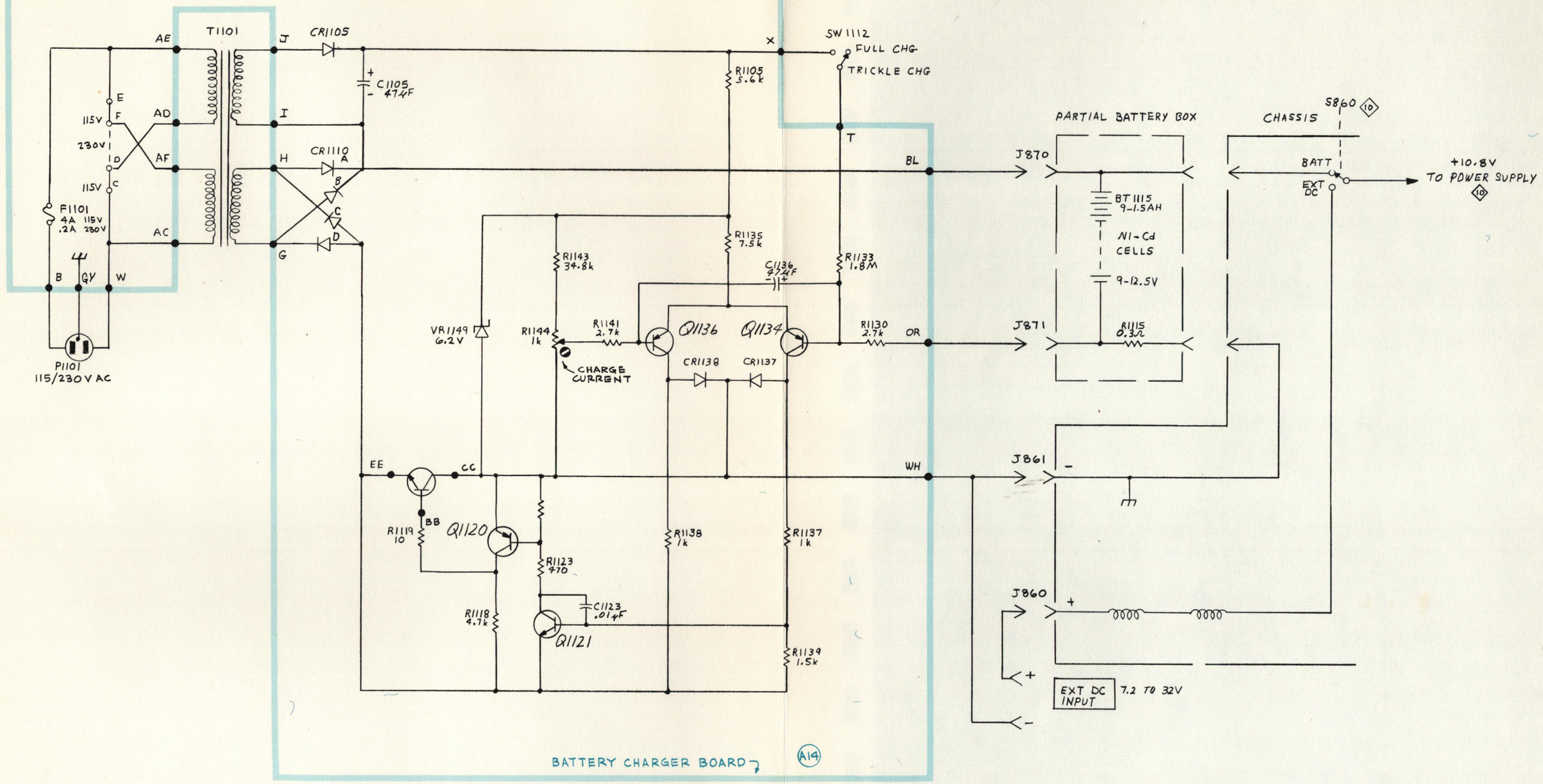

VR1051
R1051A 18k
C1055 1uF
R1051B 3.9k
R1059 200k
TO PIN 3, U910 10
R1058 750k
-316V
PARTIAL POWER REGULATOR CONTROL BOARD A13
L
K
AN
AK
T970B
27
N
CR1040G
26
M
25
L
CR1040F
24
K
23
J
CR1040E
22
I
21
H
CR1040D
20
G
19
F
CR1040C
18
E
17
D
CR1040B
16
C
15
B
CR1040A
14
A
C1040G .01
C1041G .01
C1042G .01
C1040F .01
C1041F .01
C1042F .01
C1040E .01
C1041E .01
C1042E .01
C1040D .01
C1041D .01
C1042D .01
C1040C .01
C1041C .01
C1042C .01
C1040B .01
C1041B .01
C1042B .01
C1040A .01
C1041A .01
C1042A .01
C1048 .05
C1046 .05
C1052 .04
R1055 4.7M
R1054 4.7M
R1053 4.7M
R1049 4.7M
-1270V
-1900V
-2220V
R1052 6.8M
R1050 5M
FOCUS
R1048 10M
R1046 1M
R1044 1.5M
C1050 .01
R1042 5M
INTENSITY
W
X
Y
Z
V
U
T
S
-1550V
13
1
R
Q
28
O
L1055A 2.5uH
L1055B 2.5uH
29
P
20.6V RMS
R1056 47
R1057 47
14
12
FOR PRIMARY DETAILS SEE 10
POWER REGULATOR H.V. BOARD A12
+100V
+100V
+100V
A1
AL
AZ
+100V
+5V
+5V
+5V
AF
AX
AY
+5V
-5V
-5V
-5V
AG
AU
AV
-5V
L1060
V1060
AH
+5V
R1060 10k
-5V
TRACE ROTATION
HORIZ SIG FROM R775 9
HORIZ SIG FROM R780 9
+ VERT SIG FROM R459A 5
-VERT SIG FROM R459B 5
2
4
6
7
11
AJ
+100V
VR1062 20V
R1062 200k
GEOMETRY
C1062 .01
R1064 200k
+100V
R1066 240k
AK
R1068 200k
ASTIG
C1068 .01
R1070 34k
3
PARTIAL ATTEN-CAL-SWITCHING BOARD A4
9
UNBLANKING FROM R692 7
5
+100V FROM 7



A14

A14. Battery Charger

Ⓐ


T1101
AE
AD
AF
AC
E
F
D
C
115V
230V
115V
F1101
4A 115V
.2A 230V
B
GY
W
P1101
115/230V AC
J
I
H
G
CR1105
CR1110
A
B
C
D
C1105
47μF
SW1112
FULL CHG
TRICKLE CHG
X
T
R1105
5.6k
BL
R1135
7.5k
R1143
34.8k
C1136
47μF
R1133
1.8M
VR1149
6.2V
R1144
1k
R1141
2.7k
Q1136
Q1134
R1130
2.7k
OR
CHARGE CURRENT
CR1138
CR1137
EE
CC
WH
R1119
10
BB
Q1120
R1123
470
R1118
4.7k
C1123
.01μF
Q1121
R1138
1k
R1137
1k
R1139
1.5k
BATTERY CHARGER BOARD
A14
PARTIAL BATTERY BOX
J870
J871
BT1115
9-1.5AH
NI-Cd
CELLS
9-12.5V
R1115
0.3Ω
CHASSIS
S860
10
BATT
EXT DC
+10.8V
TO POWER SUPPLY
10
J861
J860
EXT DC
INPUT
7.2 TO 32V

MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

FIGURE 1 FRONT & CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	390-0253-00			1		CABINET TOP
	- - - - - -			-		mounting hardware: (not included w/cabinet top)
-2	211-0008-00			4		SCREW, 4-40 x 0.25 inch, PHS
-3	342-0142-00			1		INSULATION, mylar
-4	200-1342-00			2		COVER, handle
-5	367-0157-00			1		HANDLE, carrying
	- - - - - -			-		mounting hardware: (not included w/handle)
-6	212-0004-00			2		SCREW, 8-32 x 0.312 inch, PHS
-7	210-0008-00			2		WASHER, lock, internal, 0.172 ID x 0.331 inch OD
-8	210-1144-00			2		WASHER, flat, 0.156 ID x 1.125 inches OD
-9	386-2181-00			2		PLATE, ring
-10	386-2182-00			4		PLATE, friction
-11	211-0559-00			4		SCREW, 6-32 x 0.375 inch, 100° csk, FHS
-12	384-0384-00			2		SHAFT, handle friction
-13	334-1898-00			1		PLATE, identification
-14	390-0254-00			1		CABINET BOTTOM
	- - - - - -			-		mounting hardware: (not included w/cabinet bottom)
-15	211-0008-00			4		SCREW, 4-40 x 0.25 inch, PHS
-16	348-0187-00			4		FOOT, cabinet
	426-0871-00			1		FRAME-FILTER ASSEMBLY
	- - - - - -			-		frame-filter assembly includes:
-17	426-0870-00			1		FRAME, plastic
-18	378-0706-00			1		FILTER, light
-19	366-1031-03			3		KNOB, red--VARIABLE
	- - - - - -			-		each knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-20	366-1029-00			3		KNOB, gray--VOLTS/DIV & TIME/DIV
	- - - - - -			-		each knob includes:
	213-0153-00			2		SETSCREW, 5-40 x 0.125 inch, HSS

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-21	366-1379-00			3	KNOB, gray--POSITION
	- - - - - -			-	each knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-22	366-0379-00			1	KNOB, gray--MODE
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-23	366-1039-00			1	KNOB, gray--LEVEL/SLOPE
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-24	366-1023-01			2	KNOB, gray--INTENSITY & FOCUS
	- - - - - -			-	each knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-25	214-1700-00			1	SPRING, flat
-26	200-1341-00			2	COVER, variable resistor
-27	- - - - - -			2	RESISTORS, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-28	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-29	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-30	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-31	262-0957-00			1	SWITCH, rotary--TRIGGERING, wired
	- - - - - -			-	switch includes:
	260-0886-00			1	SWITCH, rotary, unwired
-32	376-0051-00			1	COUPLING, flexible
	- - - - - -			-	coupling includes:
	354-0251-00			2	RING, coupling
	376-0049-00			1	COUPLING, plastic
	213-0048-00			4	SETSCREW, 4-40 x 0.125 inch, HSS
-33	- - - - - -			1	RESISTOR, variable, w/hardware
	- - - - - -			-	mounting hardware: (not included w/resistor)
-34	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
	- - - - - -			-	mounting hardware: (not included w/switch)
-35	210-0413-00			1	NUT, hex., 0.375-32 x 0.50 inch
-36	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-37	354-0427-00			1	RING, sleeve
	210-0840-00			1	WASHER, flat, 0.39 ID x 0.562 inch OD
-38	210-0012-00			1	WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-39	260-0834-00			1	SWITCH, toggle--POWER
	- - - - - -			-	mounting hardware: (not included w/switch)
-40	210-0562-00			1	NUT, hex., 0.25-40 x 0.312 inch
	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-41	337-1634-00			1	SHIELD, electrical, power switch
	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-100	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--ATTENUATOR/CAL
	- - - - - -			-	circuit board assembly includes:
-101	136-0252-04			21	SOCKET, pin connector
-102	131-0604-00			38	CONTACT, electrical
-103	337-1613-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/shield)
-104	211-0079-00			7	SCREW, 2-56 x 0.188 inch, PHS
-105	210-0001-00			7	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-106	344-0239-00			2	CLIP, grounding
-107	- - - - - -			2	RESISTOR, variable, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-108	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-109	386-2183-00			1	PLATE, mounting
-110	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-111	337-1618-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/shield)
-112	211-0079-00			2	SCREW, 2-56 x 0.188 inch, PHS
-113	337-1623-00			1	SHIELD, electrical, calibrator
-114	337-1621-00			1	SHIELD, electrical
-115	337-1622-00			1	SHIELD, electrical, attenuator
-116	337-1619-00			1	SHIELD, electrical, attenuator
	105-0302-00			2	ACTUATOR ASSEMBLY--VOLTS/DIV
	- - - - - -			-	each actuator assembly includes:
	200-1323-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
	211-0022-00			2	SCREW, 2-56 x 0.188 inch, PHS
	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-117	354-0219-00[1]			1	RING, retaining
-118	214-1126-00[1]			-	SPRING, flat, gold
	214-1126-02[1]			-	SPRING, flat, green
	214-1126-03[1]			-	SPRING, flat, red
-119	214-1127-00			1	ROLLER, detent
-120	401-0053-00			1	BEARING, front
-121	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-122	105-0304-00			1	DRUM ASSEMBLY
-123	401-0061-00			1	BEARING, rear
-124	407-0714-00			1	BRACKET, grounding
-125	211-0116-00			4	SCREW, sems, 4-40 x 0.312 inch, PHB
-126	210-0406-00			4	NUT, hex., 4-40 x 0.188 inch
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-127	211-0116-00			1	SCREW, sems, 4-40 x 0.312 inch, PHB
-128	352-0311-00			1	HOLDER, double angle
-129	210-0413-00			2	NUT, hex., 0.375-32 x 0.50 inch
-130	210-0840-00			2	WASHER, flat, 0.39 ID x 0.562 inch OD
-131	354-0427-00			2	RING, sleeve

[1]Replace only with part bearing the same color code as the original part in your instrument.

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-132	384-1377-00			1	KNOB, w/extension--INVERT
-133	384-1133-00			1	SHAFT, extension
	- - - - - -			-	mounting hardware: (not included w/shaft)
-134	211-0001-00			2	SCREW, 2-56 x 0.25 inch, PHS
-135	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-136	129-0359-00			1	POST, CH 2 invert switch
-137	376-0135-00			1	COUPLER, invert switch
-138	333-1547-00			1	PANEL, front
-139	131-0251-00			1	CONNECTOR, terminal jack
-140	200-0609-00			1	BASE, lampholder
-141	378-0541-00			1	FILTER
-142	352-0084-01			1	HOLDER
-143	- - - - - -			1	CIRCUIT BOARD ASSEMBLY, switch--TRIG. SOURCE (See A6
	- - - - - -			-	electrical list)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-144	211-0156-00			1	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-145	- - - - - -			1	CIRCUIT BOARD ASSEMBLY, switch--TRIG. SOURCE COUPLING (See
	- - - - - -				A7 electrical list)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
	211-0156-00			2	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-146	- - - - - -			1	CIRCUIT BOARD ASSEMBLY, switch-- AC DC CH1 (See A1
	- - - - - -			-	electrical list)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
	211-0156-00			1	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-147	- - - - - -			1	CIRCUIT BOARD ASSEMBLY, switch--AC DC CH2 (See A2 electrical
	- - - - - -			-	list)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-148	211-0156-00			1	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-149	407-1042-00			1	BRACKET, slide switch
	- - - - - -			-	mounting hardware: (not included w/bracket)
-150	211-0101-00			3	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-151	331-0301-00			1	MASK, CRT
-152	342-0140-00			1	INSULATOR, mylar, CRT shield top
-153	348-0031-00			1	GROMMET, plastic
-154	337-1620-00			1	SHIELD, CRT, 0.125 inch ID
-155	386-2177-01			1	SUBPANEL, front
-156	426-0873-00			1	FRAME SECTION, cabinet left
	- - - - - -			-	mounting hardware: (not included w/frame section)
	211-0633-00			4	SCREW, 6-32 x 4.50 mm, 100° csk, FHS

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-71	344-0237-00			1	CLIP, grounding
-72	361-0466-00			1	SPACER, plastic
-73	361-0452-00			1	SPACER
	- - - - - -			-	mounting hardware: (not included w/spacer)
-74	211-0116-00			1	SCREW, sems, 4-40 x 0.312 inch, PHB
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
	211-0116-00			1	SCREW, sems, 4-40 x 0.312 inch, PHB
-75	210-0413-00			1	NUT, hex., 0.375-32 x 0.50 inch
-76	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-77	354-0427-00			1	RING, sleeve
-78	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--TIMING (see A9 electrical list)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-79	210-0406-00			1	NUT, hex., 4-40 x 0.188 inch
-80	210-0054-00			1	WASHER, lock, split, 0.118 ID x 0.212 inch OD
-81	210-0994-00			1	WASHER, flat, 0.125 ID x 0.25 inch OD
-82	348-0055-00			1	GROMMET, plastic, 0.25 inch diameter
-83	354-0428-00			1	RING, coupling, mode switch
	213-0075-00			6	SETSCREW, 4-40 x 0.094 inch, HSS
-84	354-0426-00			2	RING, coupling, shaft
-85	384-1132-00			1	SHAFT, extension, Vert. mode switch
-86	384-0833-00			2	SHAFT, U position, plastic
-87	260-1367-00			1	SWITCH, rotary--MODE, unwired
	- - - - - -			-	mounting hardware: (not included w/switch)
-88	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-89	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-90	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-91	- - - - - -			2	RESISTOR, variable, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-92	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-93	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-94	407-1037-00			1	BRACKET, variable resistor
-95	260-0905-02			2	SWITCH, slide--X10 VERT GAIN
	- - - - - -			-	mounting hardware for each: (not included w/switch)
-96	211-0073-00			2	SCREW, 2-56 x 0.218 inch, 82° csk, FHS
-97	407-1039-00			1	BRACKET, slide switch
	- - - - - -			-	mounting hardware: (not included w/bracket)
-98	211-0101-00			5	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-99	407-1038-00			1	BRACKET, support, slide switch

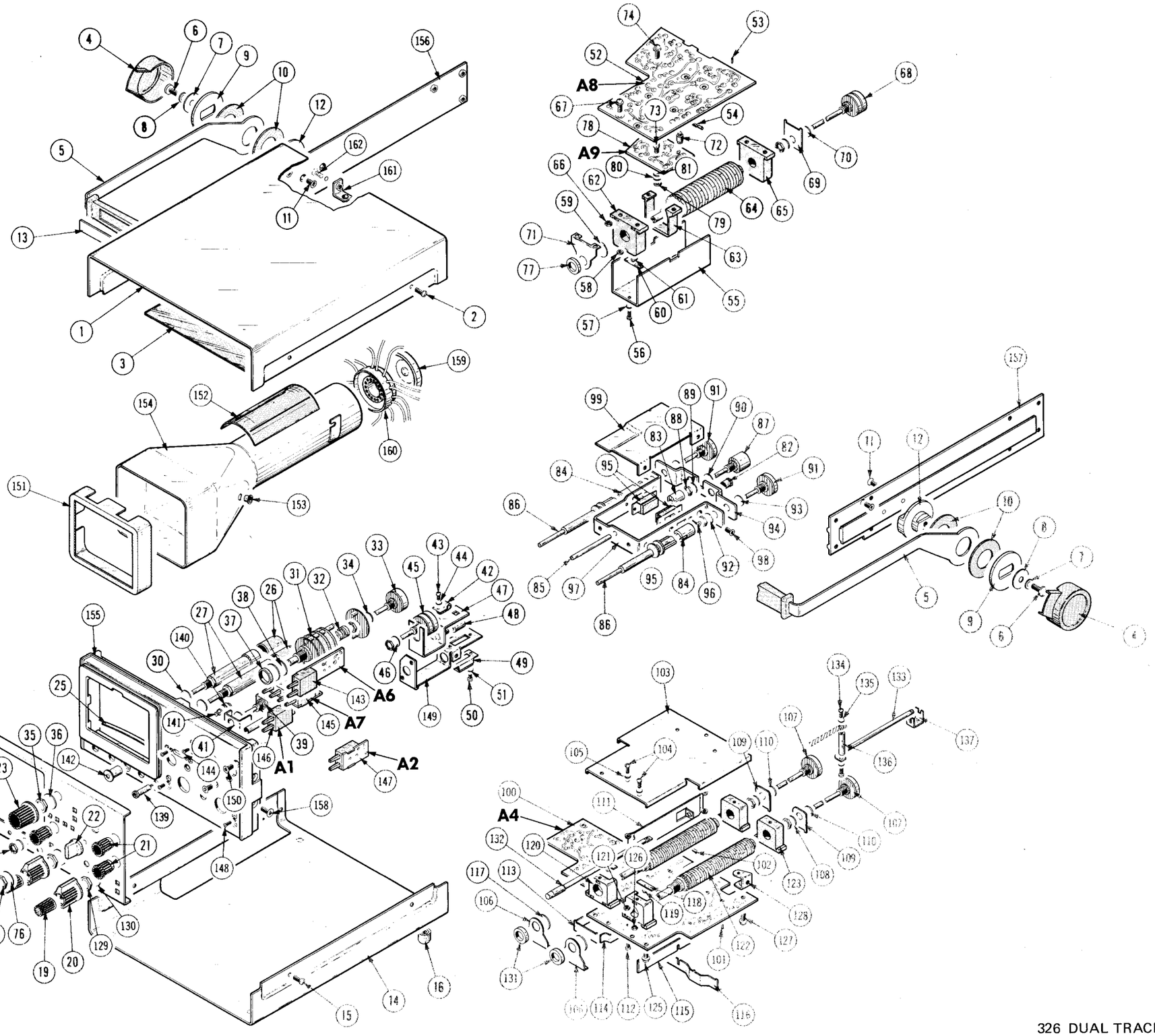
FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-42	343-0119-00			1	CLAMP, cable, 0.094 inch diameter
	- - - - - -			-	mounting hardware: (not included w/clamp)
-43	211-0079-00			1	SCREW, 2-56 x 0.188 inch, PHS
-44	210-0994-00			1	WASHER, flat, 0.125 ID x 0.25 inch OD
-45	- - - - - -			1	RESISTOR, variable, w/hardware
	- - - - - -			-	mounting hardware: (not included w/resistor)
-46	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-47	407-1043-00			1	BRACKET, variable resistor
-48	129-0378-00			1	POST
-49	260-0905-03			1	SWITCH, slide--X10 HORIZ MAG
	- - - - - -			-	mounting hardware: (not included w/switch)
-50	211-0079-00			2	SCREW, 2-56 x 0.188 inch, PHS
-51	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
	672-0040-00			1	CIRCUIT BOARD ASSEMBLY--TRIGGER SWEEP/TIMING
	- - - - - -			-	circuit board assembly includes:
-52	- - - - - -			-	CIRCUIT BOARD ASSEMBLY--TRIGGER SWEEP (See A8
	- - - - - -			-	electrical list)
	- - - - - -			-	circuit board assembly includes:
-53	136-0252-04			45	SOCKET, pin connector
-54	131-0604-00			23	CONTACT, electrical
	105-0301-00			1	ACTUATOR ASSEMBLY--TIME/DIV
	- - - - - -			-	actuator assembly includes:
-55	200-1324-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover)
-56	211-0022-00			4	SCREW, 2-56 x 0.188 inch, PHS
-57	210-0001-00			4	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-58	210-0405-00			4	NUT, hex., 2-56 x 0.188 inch
-59	354-0219-00[1]			1	RING, retaining
-60	214-1139-00[1]			-	SPRING, flat, gold
	214-1139-02[1]			-	SPRING, flat, green
	214-1139-03[1]			-	SPRING, flat, red
-61	214-1127-00			1	ROLLER, detent
-62	401-0054-00			1	BEARING, front
-63	407-0653-00			1	BRACKET, cam switch
-64	105-0303-00			1	DRUM ASSEMBLY
-65	401-0056-00			1	BEARING, rear
-66	210-0406-00			6	NUT, hex., 4-40 x 0.188 inch
	- - - - - -			-	mounting hardware: (not included w/actuator assembly)
-67	211-0116-00			6	SCREW, sems, 4-40 x 0.312 inch, PHS
-68	- - - - - -			1	RESISTOR, variable, w/hardware
	- - - - - -			-	mounting hardware: (not included w/resistor)
-69	386-2176-00			1	PLATE, mounting
-70	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD

[1]Replace only with part bearing the same color code as the original part in your instrument.

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-157	426-0869-00			1		FRAME SECTION, cabinet right
	- - - - - -			-		mounting hardware: (not included w/frame section)
-158	211-0633-00			4		SCREW, 6-32 x 4.50 mm, 100° csk, FHS
-159	386-1316-00			1		SUPPORT, CRT
-160	179-1792-00			1		WIRING HARNESS, CRT
	- - - - - -			-		wiring harness includes:
	136-0266-01			1		SOCKET, CRT
-161	352-0303-00			1		HOLDER, angle, circuit board
	- - - - - -			-		mounting hardware: (not included w/holder)
-162	211-0101-00			1		SCREW, 4-40 x 0.25 inch, 100° csk, FHS


A1
A2
A4
A6
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A9

FIG. 2. CHASSIS

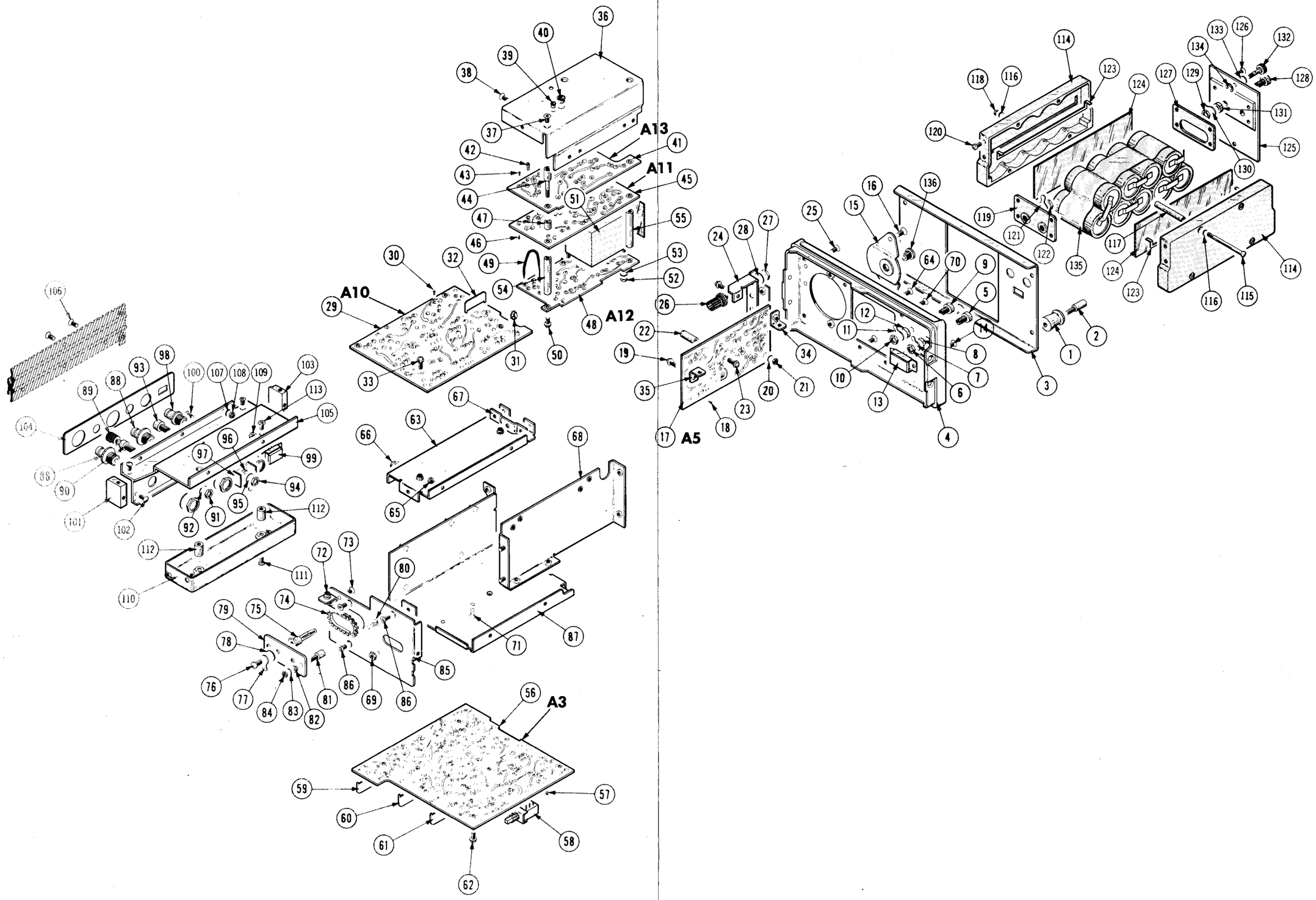


FIGURE 2 CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-1	348-0296-00			4		FOOT, cabinet
	- - - - - -			-		mounting hardware for each: (not included w/foot)
-2	213-0285-00			1		SCREW, foot
-3	333-1548-00			1		PANEL, rear
-4	386-2178-01			1		SUBPANEL, rear
-5	136-0490-00			1		SOCKET, banana jack, red
	- - - - - -			-		mounting hardware: (not included w/socket)
-6	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-7	210-0223-00			1		TERMINAL, lug, 0.25 inch diameter, SE
-8	210-0898-00			1		WASHER, insulating, red
-9	136-0491-00			1		SOCKET, banana jack, charcoal
	- - - - - -			-		mounting hardware: (not included w/socket)
-10	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-11	210-0223-00			1		TERMINAL, lug, 0.25 inch diameter, SE
-12	210-0895-00			1		WASHER, insulating, black
-13	260-1372-00			1		SWITCH, slide
	- - - - - -			-		mounting hardware: (not included w/switch)
-14	211-0101-00			2		SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-15	386-2179-00			1		PLATE, subpanel, rear
	- - - - - -			-		mounting hardware: (not included w/plate)
-16	211-0541-00			2		SCREW, 6-32 x 0.25 inch, 100° csk, FHS
-17	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--VERTICAL OUTPUT (See A5 electrical
	- - - - - -			-		list)
	- - - - - -			-		circuit board assembly includes:
-18	136-0252-04			39		SOCKET, pin connector
	- - - - - -			-		mounting hardware: (not included w/circuit board assembly)
-19	211-0116-00			3		SCREW, sems, 4-40 x 0.312 inch, PHB
-20	210-0994-00			1		WASHER, flat, 0.125 ID x 0.25 inch OD
-21	210-0406-00			1		NUT, hex., 4-40 x 0.188 inch
-22	129-0357-00			1		POST
	- - - - - -			-		mounting hardware: (not included w/post)
-23	211-0116-00			1		SCREW, sems, 4-40 x 0.312 inch, PHB
-24	407-1040-00			1		BRACKET, heatsink
	- - - - - -			-		mounting hardware: (not included w/bracket)
-25	211-0101-00			2		SCREW, 4-40 x 0.25 inch, 100° csk, FHS

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-26	214-1354-00			4	HEATSINK
	- - - - - -			-	mounting hardware for each: (not included w/heatsink)
-27	210-0409-00			1	NUT, hex., 8-32 x 0.312 inch
-28	210-0008-00			1	WASHER, lock, internal, 0.172 ID x 0.331 inch OD
-29	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--HORIZONTAL (See A10 electrical
	- - - - - -			-	list)
	- - - - - -			-	circuit board assembly includes:
-30	136-0252-04			87	SOCKET, pin connector
-31	214-0283-00			2	CONTACT, electrical
-32	337-1614-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-33	211-0116-00			3	SCREW, sems, 4-40 x 0.312 inch, PHB
-34	352-0302-00			1	HOLDER, angle, circuit board
-35	352-0301-00			1	HOLDER, angle, circuit board
-36	337-1611-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
-37	211-0105-00			4	SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-38	211-0101-00			4	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-39	348-0031-00			2	GROMMET, plastic, 0.125 inch ID
-40	348-0055-00			1	GROMMET, plastic, 0.25 inch diameter
	672-0039-00			1	CIRCUIT BOARD ASSEMBLY--POWER REGULATOR
	- - - - - -			-	circuit board assembly includes:
-41	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--CONTROL (See A13 electrical list)
	- - - - - -			-	circuit board assembly includes:
-42	214-0579-00			1	TERMINAL, test point
-43	136-0252-04			46	SOCKET, pin connector
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-44	351-0326-00			3	GUIDE POST, lock
-45	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--RECTIFIER (See A11 electrical
	- - - - - -			-	list)
	- - - - - -			-	circuit board assembly includes:
-46	136-0252-04			6	SOCKET, pin connector
	342-0142-00			1	INSULATOR, mylar
-47	351-0325-00			3	GUIDE POST
-48	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--REGULATOR (See A12 electrical list)
	- - - - - -			-	circuit board assembly includes:
-49	346-0032-00			2	STRAP, mouse tail
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-50	211-0116-00			3	SCREW, sems, 4-40 x 0.312 inch, PHB

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-51	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
-52	210-0406-00			2	NUT, hex., 4-40 x 0.188 inch
-53	210-0004-00			2	WASHER, lock, internal, 0.12 ID x 0.26 inch OD
-54	129-0360-00			1	POST, plastic
-55	129-0361-00			2	POST
-56	- - - - - -			-	CIRCUIT BOARD ASSEMBLY--VERTICAL PRE AMP (See A3
	- - - - - -			-	electrical list)
	- - - - - -			-	circuit board assembly includes:
-57	136-0252-04			111	SOCKET, pin connector
-58	260-1132-00			1	SWITCH, push-INVERT
-59	337-1615-00			1	SHIELD, electrical
-60	337-1616-00			1	SHIELD, electrical
-61	337-1617-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-62	211-0116-00			5	SCREW, sems, 4-40 x 0.312 inch, PHB
-63	337-1610-00			1	SHIELD, battery pack top
	- - - - - -			-	mounting hardware: (not included w/shield)
-64	211-0101-00			2	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-65	211-0005-00			3	SCREW, 4-40 x 0.125 inch, PHS
-66	210-0406-00			3	NUT, hex., 4-40 x 0.188 inch
	210-0004-00			3	WASHER, lock, internal, 0.12 ID x 0.26 inch OD
-67	407-1053-00			2	BRACKET, double angle
-68	337-1609-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/shield)
-69	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-70	211-0101-00			2	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-71	211-0105-00			4	SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-72	352-0304-00			1	HOLDER, circuit board
	- - - - - -			-	mounting hardware: (not included w/holder)
-73	211-0105-00			1	SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-74	255-0334-00			in	PLASTIC CHANNEL, 3 inches long
-75	134-0013-00			2	PLUG, tip, banana type
	- - - - - -			-	mounting hardware for each: (not included w/plug)
-76	211-0510-00			1	SCREW, 6-32 x 0.375 inch, PHS
-77	210-0203-00			1	LUG, solder, SE #6
-78	210-0811-00			1	WASHER, fiber

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-79	386-2184-00			1	PLATE, spacer
	- - - - - -			-	mounting hardware: (not included w/plate)
-80	211-0105-00			2	SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-81	361-0453-00			2	SPACER
-82	210-0994-00			2	WASHER, flat, 0.125 ID x 0.25 inch, OD
-83	210-0054-00			2	WASHER, lock, split, 0.118 ID x 0.212 inch OD
-84	210-0046-00			2	NUT, hex., 4-40 x 0.188 inch
-85	337-1612-00			1	SHIELD, electrical
	- - - - - -			-	mounting hardware: (not included w/shield)
-86	211-0101-00			3	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-87	441-1067-00			1	CHASSIS, main
-88	131-0274-00			2	CONNECTOR, BNC, insulated, w/hardware
	129-0103-00			1	POST, binding
	- - - - - -			-	post includes:
-89	200-0103-00			1	NUT, knurled, 0.25-28 x 0.375 inch OD
-90	129-0077-00			1	POST, binding, 0.25-28 x 0.938 inch long
	- - - - - -			-	mounting hardware: (not included w/post)
-91	210-0455-00			1	NUT, hex., 0.25-28 x 0.375 inch
-92	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-93	136-0491-00			1	SOCKET, banana jack, charcoal
	- - - - - -			-	mounting hardware: (not included w/socket)
-94	210-0465-00			1	POST, hex., 0.25-32 x 0.375 inch
-95	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-96	210-0895-00			1	WASHER, insulating, black
-97	337-1635-00			1	SHIELD, electrical
-98	131-0106-00			1	CONNECTOR, receptacle, female BNC, w/hardware
	- - - - - -			-	mounting hardware: (not included w/connector
	210-0255-00			1	TERMINAL, lug, 0.391 ID, SE
-99	260-0905-00			1	SWITCH, slide
	- - - - - -			-	mounting hardware: (not included w/switch)
-100	211-0073-00			2	SCREW, 2-56 x 0.218 inch, 82° csk, FHS
-101	391-0097-00			1	BLOCK, input bracket, right
	- - - - - -			-	mounting hardware: (not included w/block)
-102	211-0079-00			2	SCREW, 2-56 x 0.188 inch, PHS
-103	391-0098-00			1	BLOCK, input bracket, left
	- - - - - -			-	mounting hardware: (not included w/block)
	211-0079-00			2	SCREW, 2-56 x 0.188 inch, PHS

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-104	333-1549-00			1		PANEL, side
-105	407-1041-00			1		BRACKET, input
	- - - - - -			-		mounting hardware: (not included w/bracket)
-106	211-0073-00			3		SCREW, 2-56 x 0.218 inch, 82° csk, FHS
-107	210-0001-00			3		WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-108	210-0405-00			3		NUT, hex., 4-40 x1 0.188 inch
-109	210-0586-00			2		NUT, keps, 4-40 x 0.25 inch
-110	380-0274-00			1		HOUSING, delay line
	- - - - - -			-		mounting hardware: (not included w/housing)
-111	211-0005-00			2		SCREW, 4-40 x 0.125 inch, PHS
-112	129-0362-00			2		POST
-113	211-0105-00			2		SCREW, 4-40 x 0.188 inch, 100° csk, FHS
	016-0296-00			1		BATTERY PACK, complete
	- - - - - -			-		battery pack includes:
-114	343-0349-00			2		CLAMP, battery retaining
	- - - - - -			-		mounting hardware: (not included w/clamp)
-115	211-0194-00			4		SCREW, 4-40 x 47.5 mm, PHS
-116	210-0054-00			8		WASHER, lock, split, 0.118 ID x 0.212 inch OD
-117	129-0358-00			4		POST, plastic
-118	210-0406-00			4		NUT, hex., 4-40 x 0.188 inch
-119	136-0487-00			1		SOCKET, banana jack, twin
	- - - - - -			-		mounting hardware: (not included w/socket)
-120	213-0141-00			4		SCREW, thread forming, 4-40 x 0.25 inch, PHS
-121	210-0223-00			2		TERMINAL, lug, 0.25 inch diameter, SE
	- - - - - -			-		mounting hardware for each: (not included w/terminal)
-122	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-123	344-0238-00			2		CLIP, conductor, battery
-124	342-0139-00			2		INSULATOR, mylar
-125	333-1550-00			1		PANEL, battery pack
	- - - - - -			-		mounting hardware: (not included w/panel)
-126	211-0025-00			4		SCREW, 4-40 x 0.375 inch, 100° csk, FHS
	213-0107-00			2		SCREW, thread forming, 4-40 x 0.25 inch, 100° csk, FHS
-127	386-2180-00			1		PLATE, battery pack
-128	136-0491-00			1		SOCKET, banana jack, charcoal
	- - - - - -			-		mounting hardware: (not included w/socket)
-129	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-130	210-0223-00			1		TERMINAL, lug, 0.25 inch diameter, SE
-131	210-0895-00			1		WASHER, insulating, black

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-	136-0490-00			1	SOCKET, banana jack, red
	- - - - - -			-	mounting hardware: (not included w/socket)
	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
	210-0898-00			1	WASHER, insulating, red
-132	213-0283-00			2	THUMBSCREW
	- - - - - -			-	mounting hardware for each: (not included w/thumbscrew)
-133	210-1146-00			1	WASHER, 3.8 mm ID x 7 mm OD
-134	354-0165-00			1	RING, retaining
-135	146-0018-00			1	BATTERY SET
-136	213-0282-00			1	THUMBSCREW
					INCLUDED ACCESSORIES
	010-6049-01			2	PROBE PACKAGE, P6049A w/accessories
	016-0532-00			1	CARRYING CASE
	346-0098-00			1	STRAP ASSEMBLY
	016-0297-00			1	VIEWING HOOD
	426-0871-00			1	FRAME FILTER ASSEMBLY
	012-0406-00			1	CABLE ASSEMBLY, external, DC
	070-1209-00			1	HANDBOOK, operator's
	070-1208-00			1	MANUAL, instruction

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. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. 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 in this section, your manual is correct as printed.

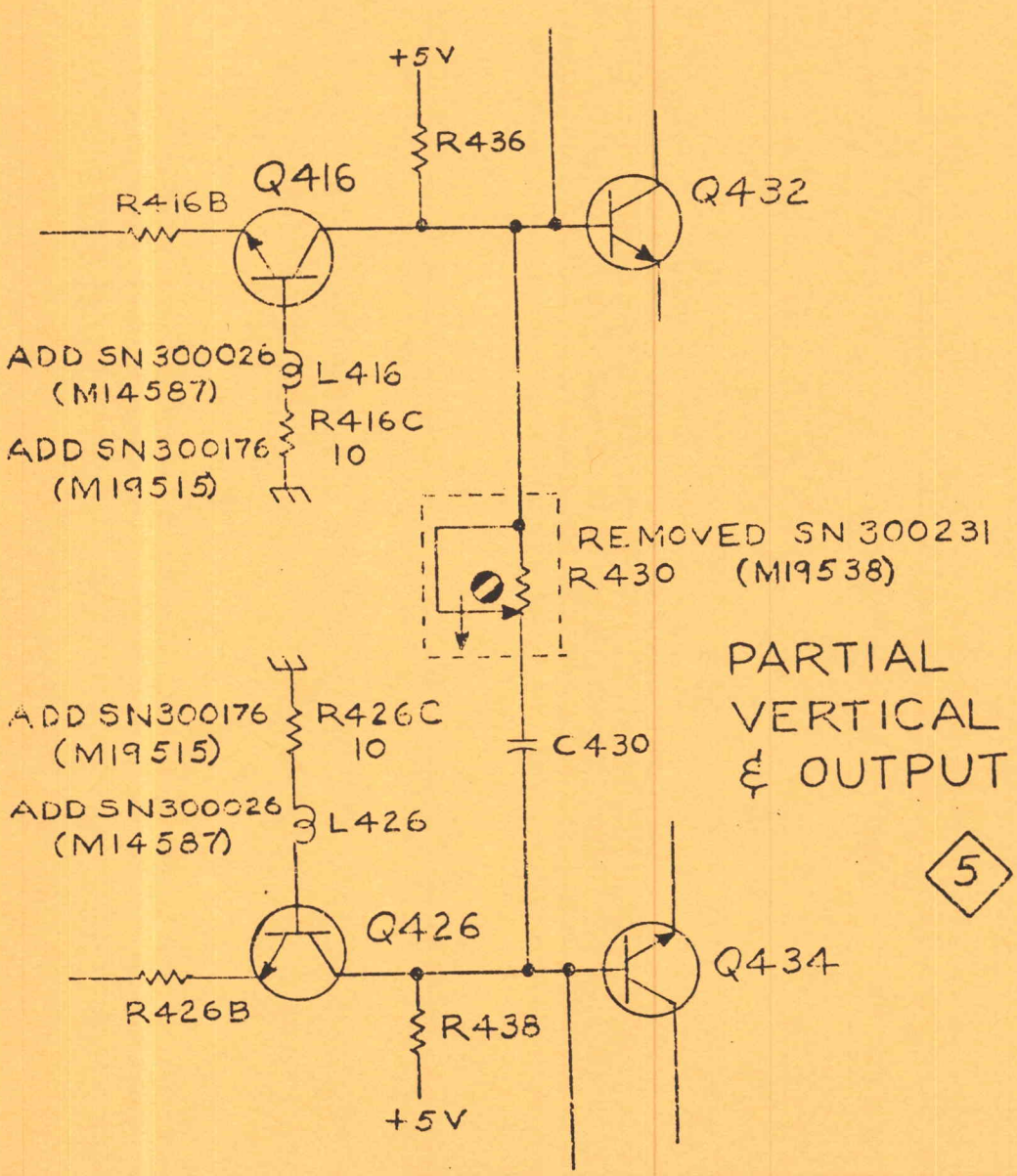
ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

					MOD NUMBER
C361	283-0059-00	1 µF	Cer	25 V	M14,592
R419	315-0100-01	10 Ω	1/4 W	5%	M14,591
R429	315-0100-01	10 Ω	1/4 W	5%	M14,591

ADD:

C616	283-0236-00	0.01 µF	50 V	20%	M14,589
C763	281-0622-00	47 pF	500 V	1%	M14,590
L416	276-0543-00	Ferramic Suppressor			M14,587
L426	276-0543-00	Ferramic Suppressor			M14,587



326 EFF SN 300066-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

C1123	283-0110-00	0.005 μF	Cer	150 V
R1044	315-0105-01	1 MΩ	1/4 W	5%

M14,588/772
M14,594/772

326 EFF SN 300121-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

Q545	151-1018-00	Silicon	2SK-12-R	
R582	321-0289-30	10 kΩ	1/8 W	1%

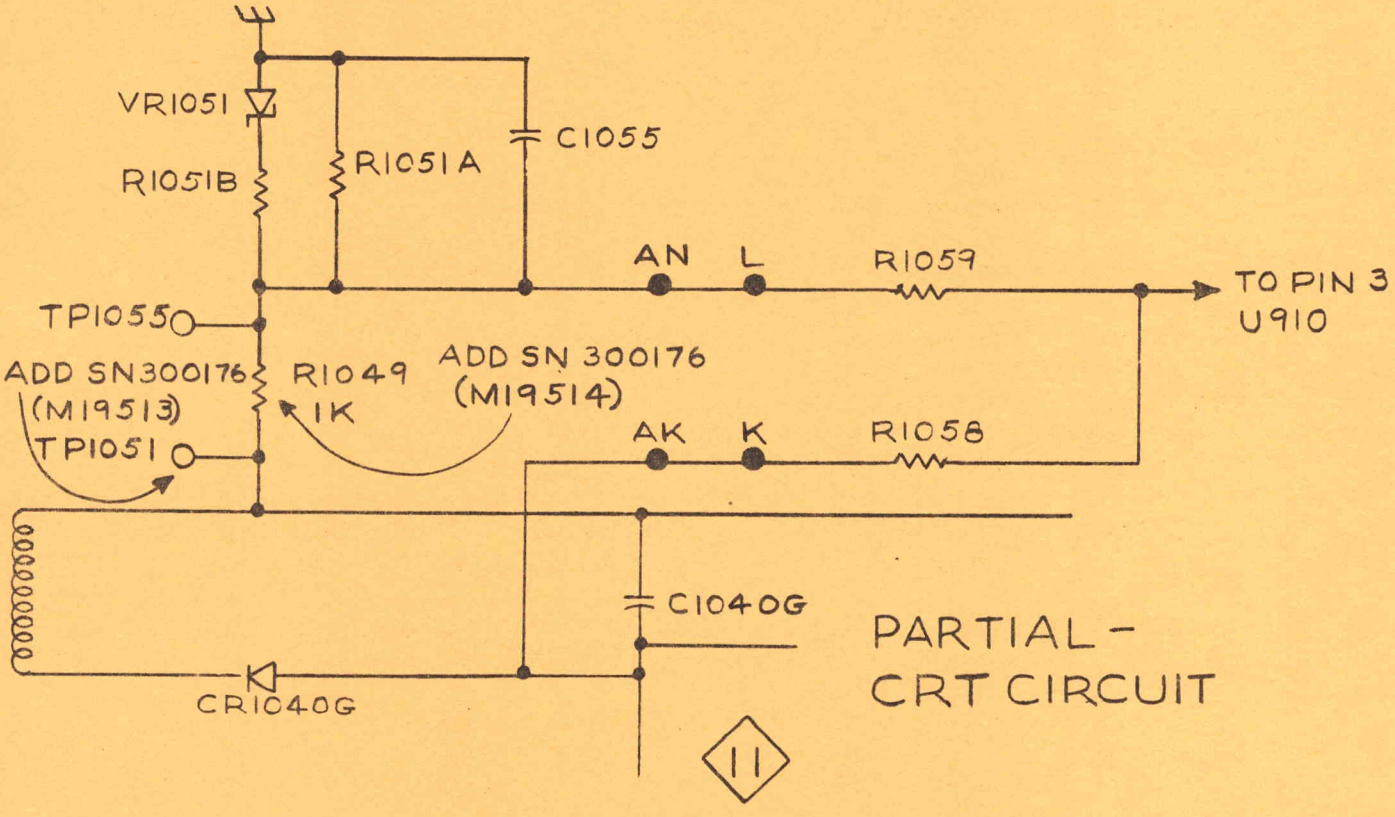
M14,595/772
M14,596/772

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

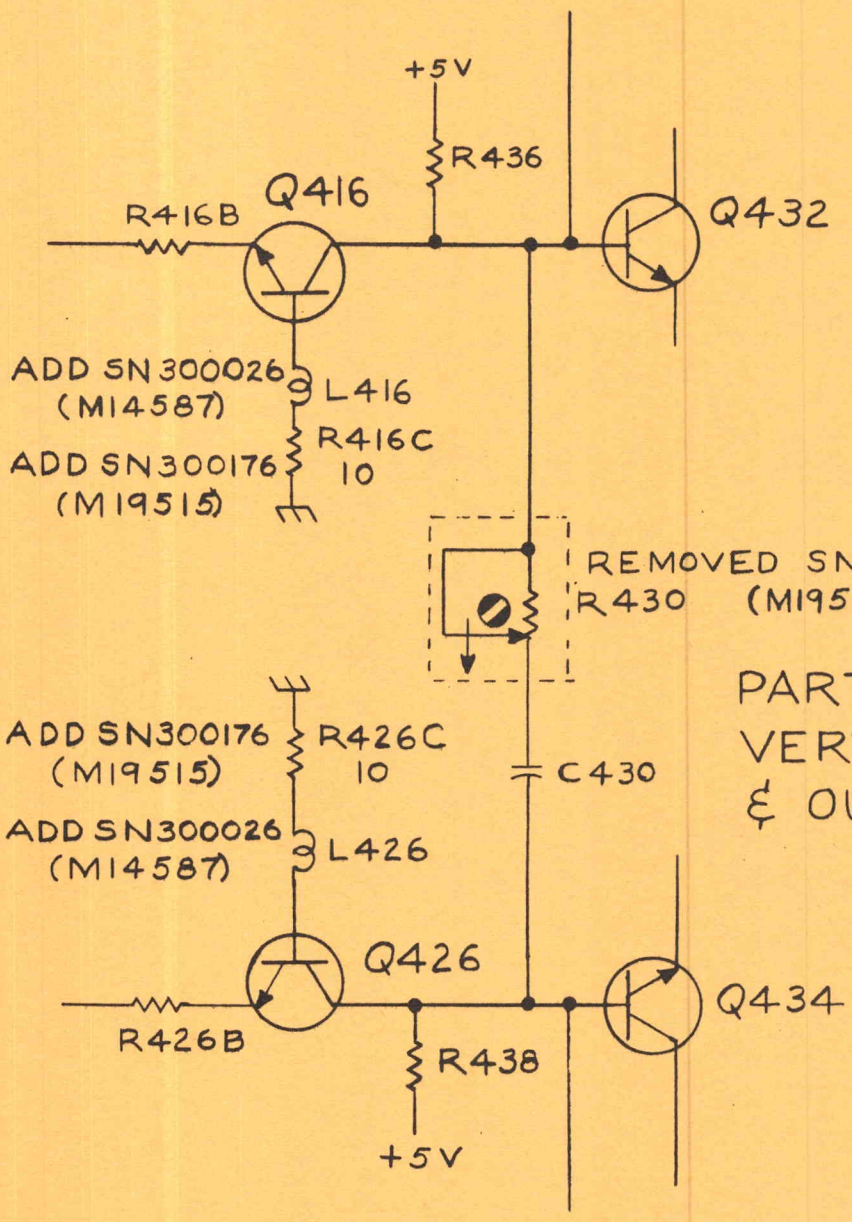
CHANGE TO:						MOD NUMBER
	670-1818-01	Trig/Sweep Board				M19,501
	670-1819-01	Timing Board				M19,502
	670-1820-01	Power Regulator H.V. Board				M18,503
	670-1821-01	Power Regulator Rectifier Board				M18,504
	670-1822-01	Power Regulator Control Board				M18,505
	670-1823-01	Vert Output Amp Board				M18,506
	670-1824-01	Horizontal Board				M18,507
	670-1825-01	Vert Preamp Board				M18,508
R706	311-0633-00	5 kΩ, Var				M19,509
C705	283-0231-00	470 pF	500 V	10%		M18,510
C611	281-0650-00	18 pF	200 V	10%		M18,511
ADD:						
TP1051	214-0579-00	Terminal Test Point				M19,513
R1049	321-0193-30	1 kΩ	1/8 W	1%		M19,514
R416C	315-0100-01	10 Ω	1/4 W	5%		M19,515
R426C	315-0100-01	10 Ω	1/4 W	5%		M19,515
CHANGE TO:						
L990	108-0587-00	5.6 mH				M19,523
R622A (B)	311-1330-01	Dual, 20 kΩ x 50 kΩ, Var w/screw & detent				M19,525
D760	152-0217-00	Zener 1N756A 0.4W 8.2 V ±4.5%				M19,526
R760	315-0474-01	470 kΩ	1/4 W	5%		M19,526
D966	152-0185-00	Silicon Replaceable by 1N4152				M19,527
R650	315-0511-01	510 Ω	1/4 W	5%		M19,530

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

REMOVE:					MOD NUMBER
C635	283-0224-00	5 pF	50 V	±0.5 pF	M19,531
R635	315-0752-01	7.5 kΩ	1/4 W	5%	M19,531
D638	152-0327-00	BAX13			M19,532
D639	152-0516-00	1N5297			M19,532
CHANGE TO:					
R639A	315-0332-02	3.3 kΩ	1/4 W	5%	M19,532
D628	152-0327-00	BAX13			M19,540

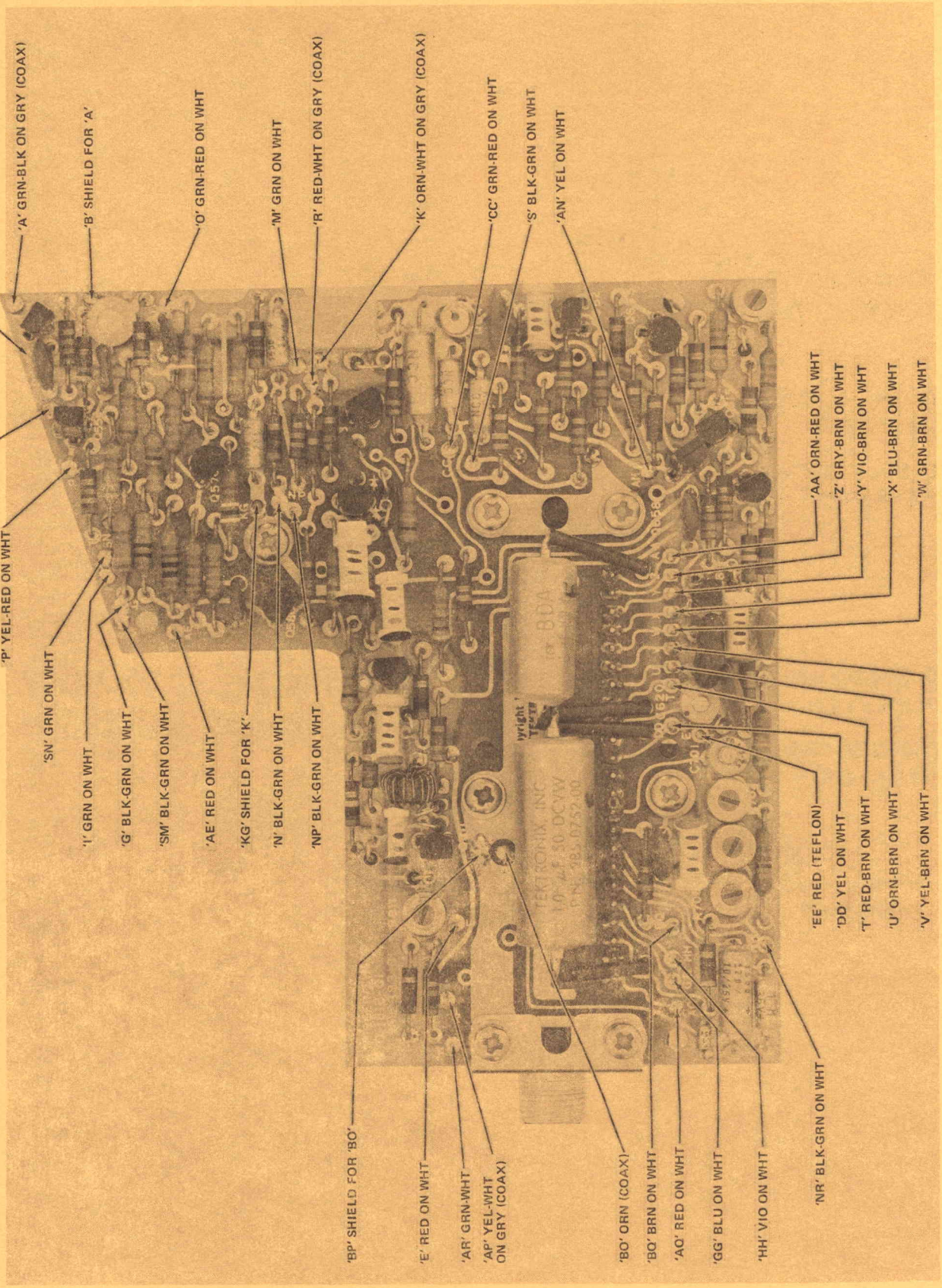


SCHEMATIC CORRECTION

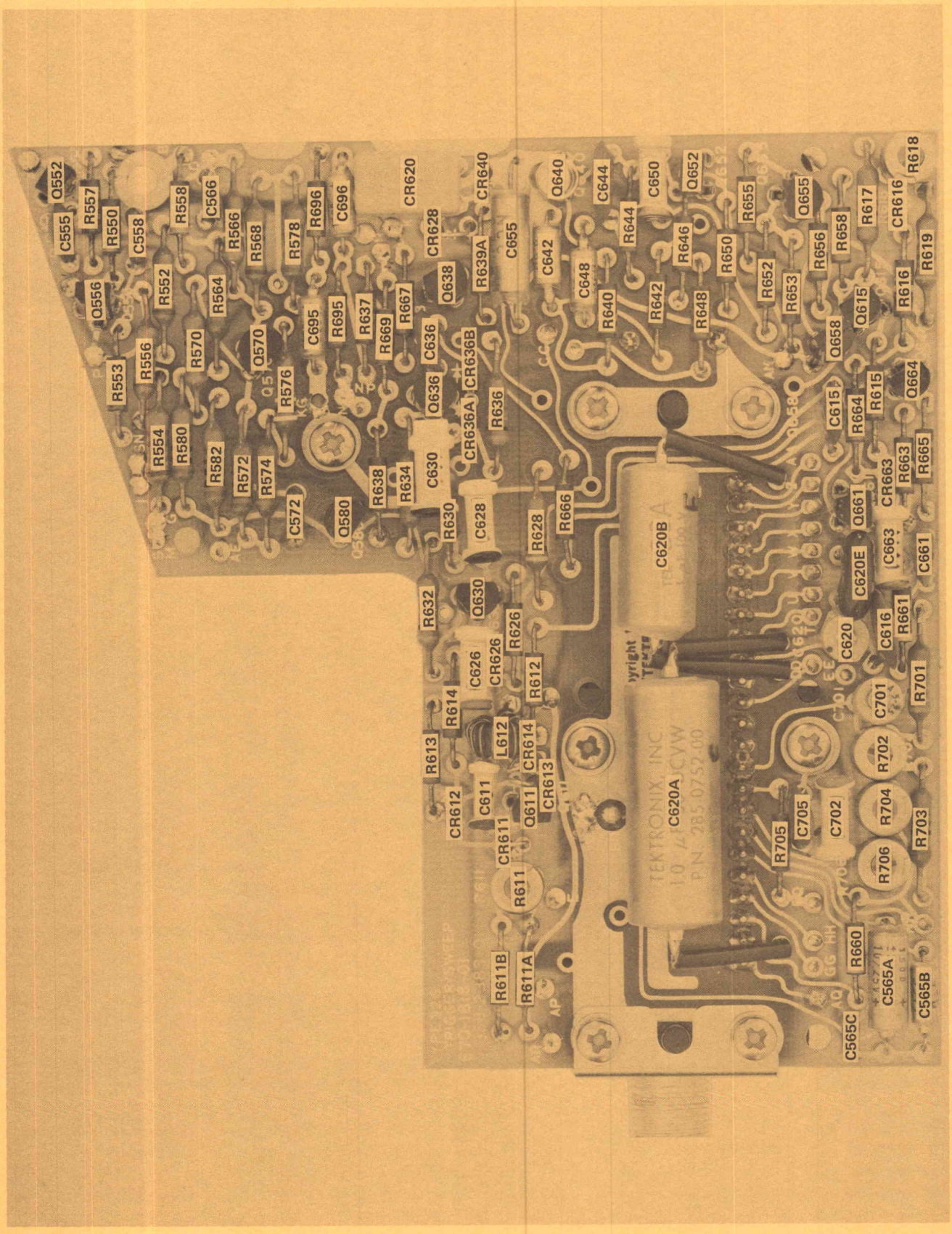


PARTIAL
VERTICAL SWITCHING
& OUTPUT AMP.

5



A8. Trigger-Sweep

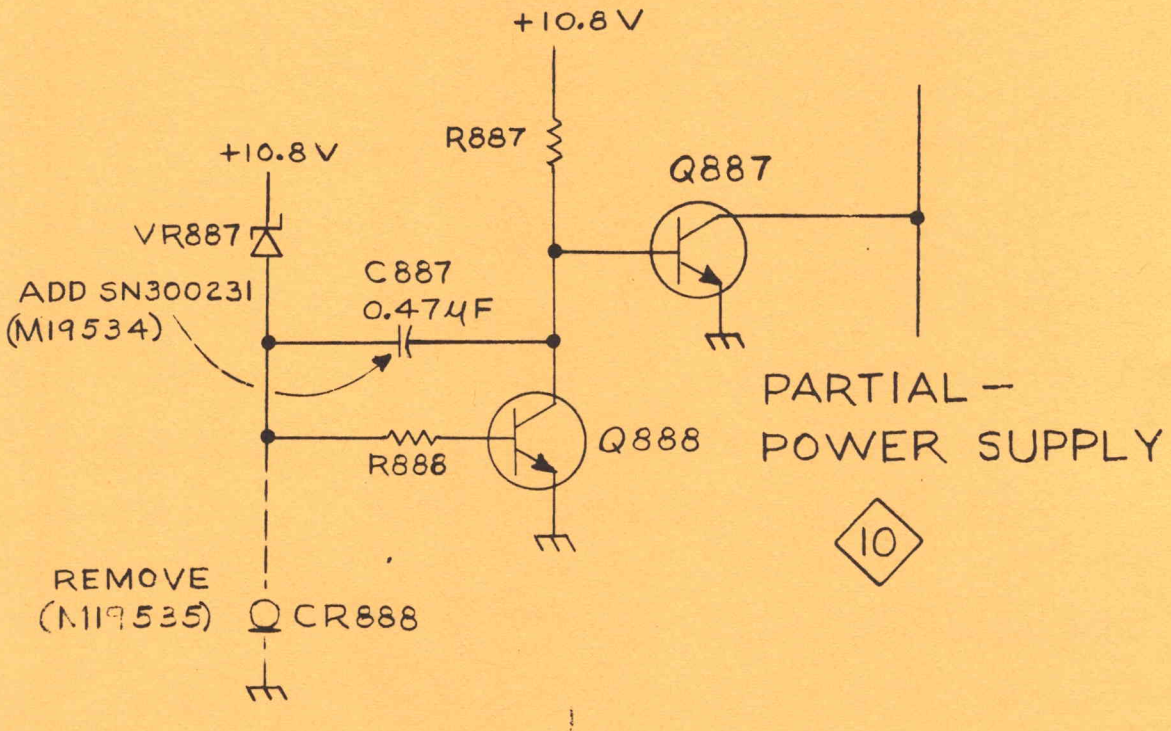


A8. Trigger-Sweep

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

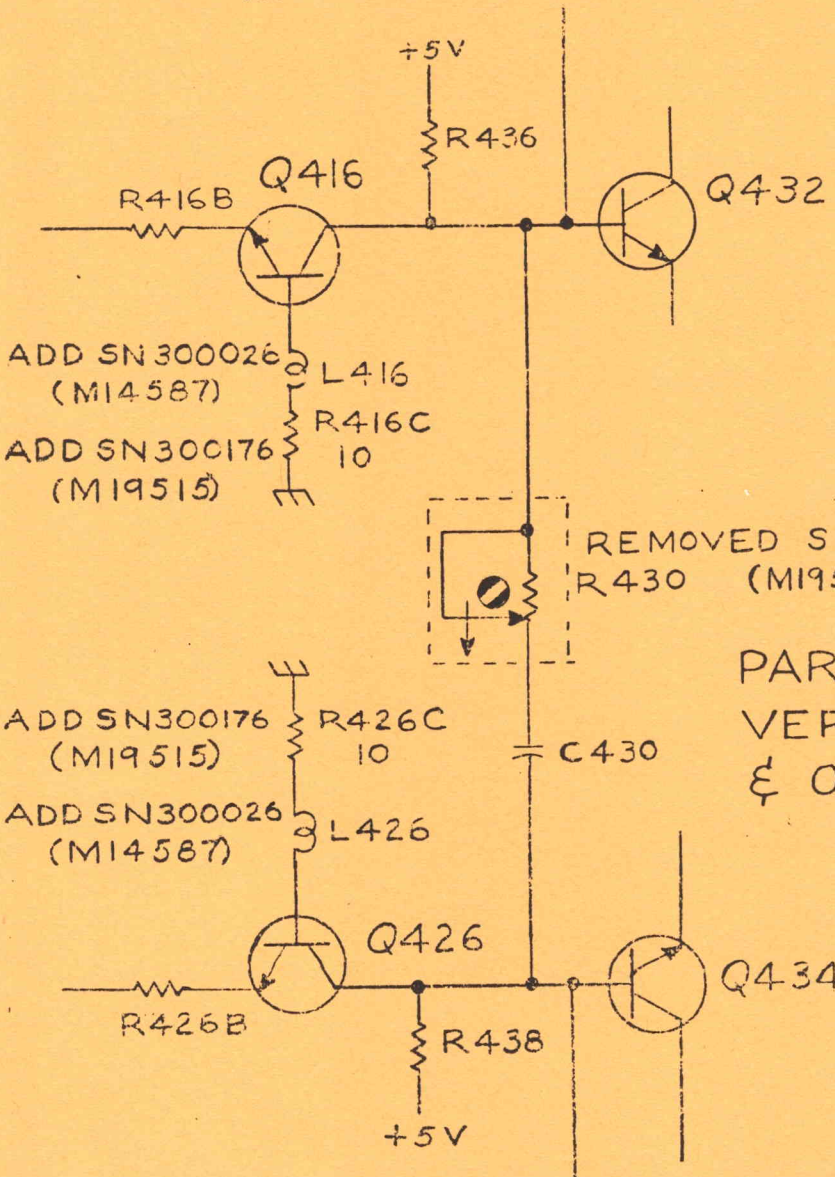
CHANGE TO:					MOD NUMBER
R66	311-1329-01	3 kΩ, Var w/screw & detent			M19,500
R266	311-1329-01	3 kΩ, Var w/screw & detent			M19,500
C1000	290-0643-00	470 µF Tantalum	10V	20%	M19,512
C1016	290-0643-00	470 µF Tantalum	10 V	20%	M19,512
C764	283-0079-02	0.01 µF Cer	250V	20%	M19,516
C679	283-0079-02	0.01 µF Cer	250V	20%	M19,517
ADD:					
C887	283-0203-00	0.47 µF Cer	50V	20%	M19,534
CHANGE TO:					
C21	281-0193-00	2-8 pF, Var			M19,537
C221	281-0193-00	2-8 pF, Var			M19,537
C28B	281-0194-00	2-8 pF, Var			M19,537
C228B	281-0194-00	2-8 pF, Var			M19,537
C27B	281-0195-00	5.5-18 pF, Var			M19,537
C227B	281-0195-00	5.5-18 pF, Var			M19,537
C28A	281-0195-00	5.5-18 pF, Var			M19,537
C228A	281-0195-00	5.5-18 pF, Var			M19,537
REMOVE:					
R430	311-0607-00	10 kΩ, Var			M19,538

SCHEMATIC CORRECTION



PARTIAL –
POWER SUPPLY

10



PARTIAL
VERTICAL SWITCHING
& OUTPUT AMP.

5

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

C460	283-0329-00	0.39 pF	Cer	500 V	10%
C470	283-0329-00	0.39 pF	Cer	500 V	10%
Q415	151-0216-00				
Q425	151-0216-00				
R77	321-0297-30	12.1 kΩ	1/8 W	1%	
R79	321-0297-30	12.1 kΩ	1/8 W	1%	
R277	321-0297-30	12.1 kΩ	1/8 W	1%	
R279	321-0297-30	12.1 kΩ	1/8 W	1%	
R370	321-0232-30	2.55 kΩ	1/8 W	1%	
R380	321-0232-30	2.55 kΩ	1/8 W	1%	
R412	321-0229-30	2.37 kΩ	1/8 W	1%	
R422	321-0229-30	2.37 kΩ	1/8 W	1%	