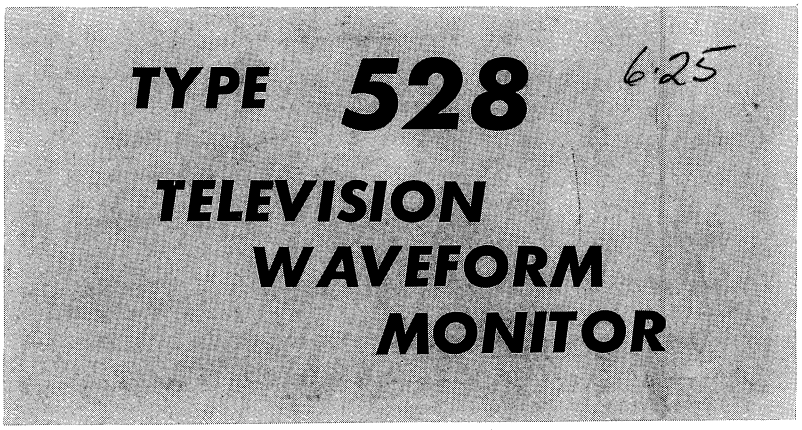
INSTRUCTION MANUAL

Serial Number 5261933



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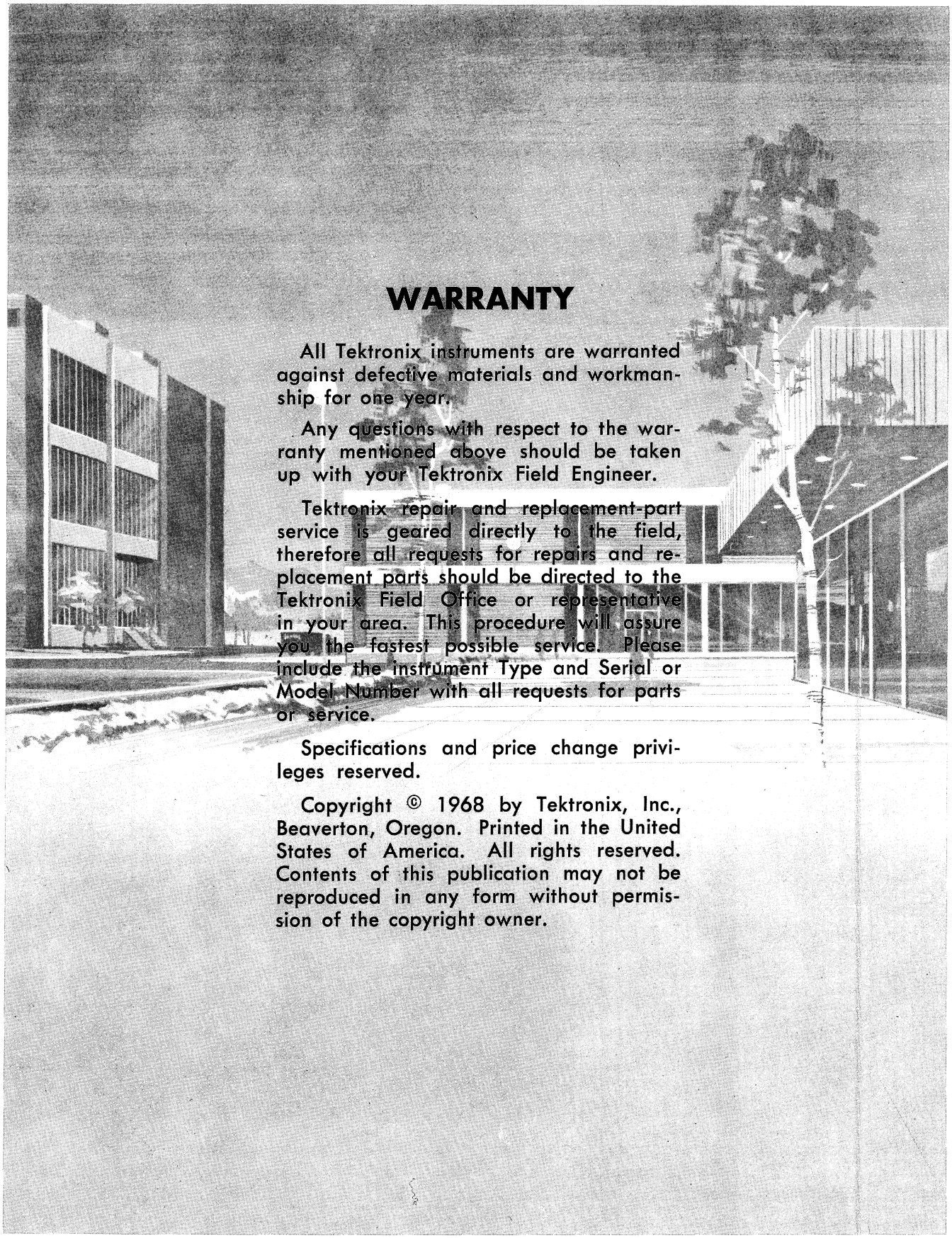


WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

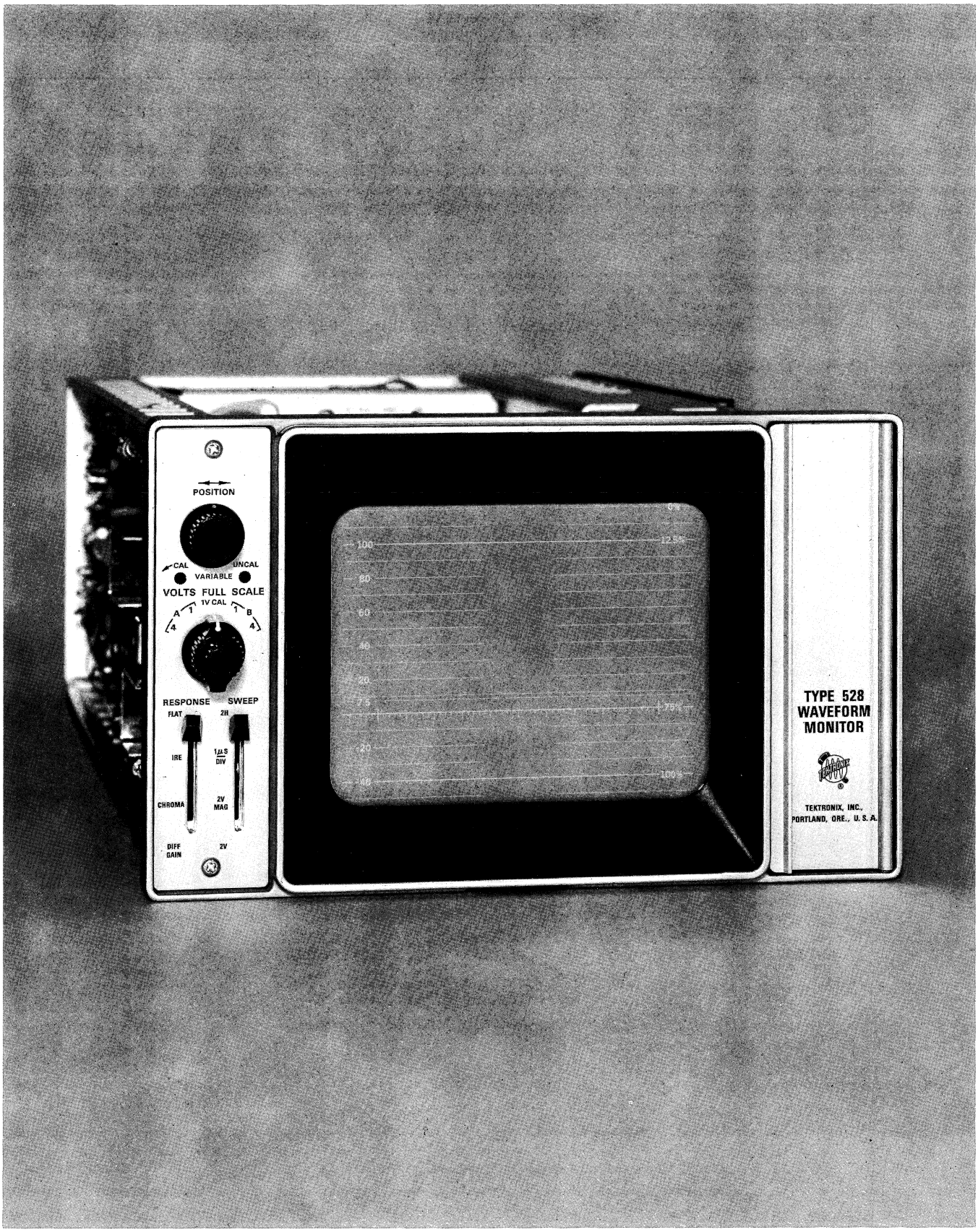


Fig. 1-1. The Type 528 Waveform Monitor.

SECTION 1
TYPE 528 SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

General Information

The solid-state Type 528 Television Waveform Monitor provides bright, easy-to-observe video waveform displays on a 5-inch CRT, yet requires only 5¼ inch vertical height and one-half rack-width mounting space. This compact instrument is especially well suited for monitoring signals from camera outputs, video system output lines, transmitter video input lines, closed-circuit TV systems and educational TV systems utilizing 525 line, 30 frame (60 Hz field rate) scan. The instrument can be easily modified to work with 625 line, 25 frame (50 Hz field rate) scan.

Either of two video inputs, selectable from the front panel, may be displayed. The displayed video signal is also provided at a video output connector for viewing on a picture monitor. Calibrated 1-volt and 4-volt full scale (140 IRE units) sensitivities are provided for displaying common video and sync signal levels. A variable sensitivity control permits uncalibrated displays from 0.25-volt to 4.0-volts full scale. The built-in 1-volt calibration signal may be switched on to check vertical sensitivity calibration. FLAT, IRE, CHROMA and DIFF GAIN frequency response positions permit observation of various signal characteristics.

Horizontal SWEEP selection provides 2H (2 line), 1 μs/DIV (expanded 2 line), 2V (2 field) and 2V MAG (expanded 2 field). RGB and YRGB waveforms from color processing amplifiers may be displayed through the use of the rear-panel 9-pin connector.

A DC Restorer maintains the back porch at an essentially constant level despite changes in signal amplitude, Average Picture Level (APL) and color burst. This circuit may be turned off when not needed.

Low power consumption and long-term reliability are features of the solid-state circuitry used in the Type 528.

A Tektronix Type C-30 or C-30A camera may be used for display photography with the Type 528.

ELECTRICAL CHARACTERISTICS

The following performance requirements apply over an ambient temperature range of 0° C to +50° C. The rated accuracies are valid when the instrument is calibrated at +20° C to +30° C, after a warm up time of three minutes. A twenty minute warm-up is required for rated accuracies at 0° C ambient temperature.

NOTE

Control names which are capitalized or abbreviated on the front and rear panels of the Type 528 are similarly capitalized or abbreviated in the text and illustrations.

TABLE 1-1

VERTICAL DEFLECTION SYSTEM ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Frequency Response at 1 V FULL SCALE or 4 V FULL SCALE:	
FLAT	Response from 25 Hz to 3.6 MHz within 1% of response at 50 kHz. 3.6 MHz to 5 MHz within +1%, −3% of response at 50 kHz, and +1%, −3% of response at 3.58 MHz.
IRE	Response per 1958 IRE STD 23 S-1 (see Fig. 1-2). Attenuation at 4.43 MHz greater than 22 dB.
CHROMA	Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%. Attenuation at 7.2 MHz is greater than 25 dB. −3 dB between 3.1 MHz and 3.4 MHz. −3 dB between 3.8 MHz and 4.1 MHz.
DIFF GAIN	Same as the CHROMA response; gain is increased 3 to 5.5 times.
Transient Response at 1 V FULL SCALE, FLAT (using 125-ns H.A.D. $\sin^2$ pulse and bar):	
Preshoot	1 IRE unit or less
Pulse to Bar Ratio	0.99:1 to 1.01:1
Overshoot	2 IRE units or less
Ringing	2 IRE units or less
Tilt	
Field Rate Square wave or Vertical Window	1% or less
25 μs Pulse	1% or less
Differential Gain	When the baseline is at 50 IRE and the signal is adjusted to 100 IRE: Displayed differential gain 1% or less with 20-90% APL changes.
Deflection Factor:	
1 V FULL SCALE	140 IRE units within 1% with 1 volt input.
4 V FULL SCALE	140 IRE units within 3% with 4 volts input.

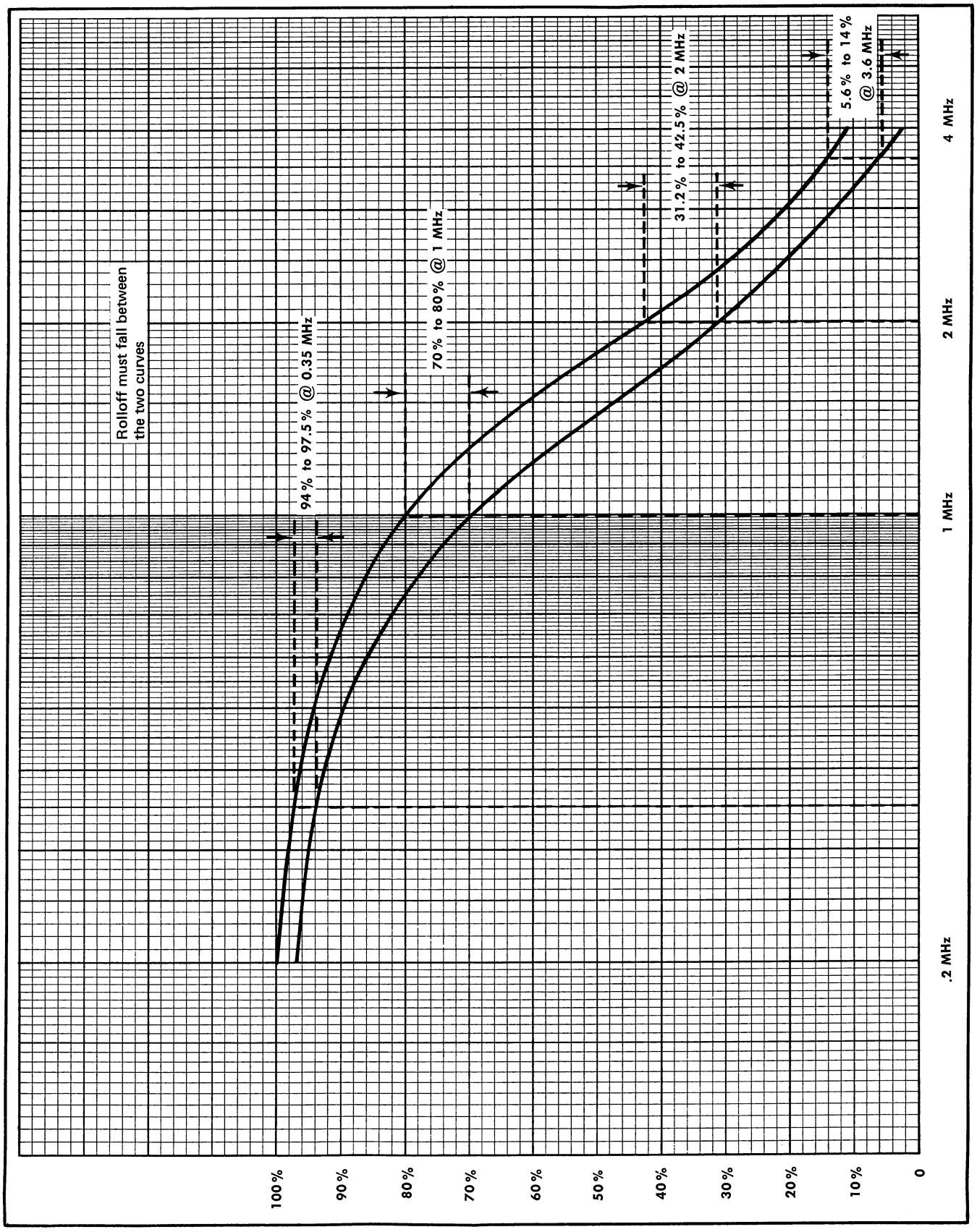


Fig. 1-2. IRE 1958 standard 23S-1.

Maximum Input Level AC coupled:	
1 V FULL SCALE	±5 Volts DC
4 V FULL SCALE	±5 Volts DC
Maximum Amplitude:	
FLAT or IRE	Displays in excess of 200 IRE units may cause overload.
CHROMA	140 millivolts (20 IRE units) of burst frequency in 1 V CAL, may be expanded to 30 IRE units for differential gain measurements at any APL from 10% to 90%.
DIFF GAIN	Normal subcarrier signal level of 143 mV P-P may be expanded to 100 IRE units for measurement of differential gain with any APL. Subcarrier signals may be as low as 90 mV and be displayed as 100 IRE units.
Input Impedance (not terminated):	
1 V FULL SCALE	15 kΩ paralleled with 50 pF.
4 V FULL SCALE	60 kΩ paralleled with 50 pF.
Maximum Return Loss: VIDEO INPUTS (A and B terminated in 75 Ω at all deflection factor settings, inputs in use or not in use, instrument on or off)	At least 46 dB to 5 MHz.
VARIABLE (VOLTS FULL SCALE) Range:	
1 V FULL SCALE	0.25 volt or less to 1 volt for 140 IRE unit display.
4 V FULL SCALE	1.0 volt or less to 4 volts for 140 IRE unit display.
Video Output:	
Frequency Response	25 Hz to 5 MHz within 3%.
Differential Gain 50% APL	Within 2% with 140 IRE unit display.
Differential Phase 50% APL	Within 3° with 140 IRE unit display.
DC Level On Output	2 volts or less into 75 Ω load.
Nominal Output Impedance	75 Ω
Output Signal Amplitude	
1 V FULL SCALE, 4 V FULL SCALE or any position of VARIABLE control	1 volt within 15% for 140 IRE unit display with RESPONSE at FLAT.

TABLE 1-2

HORIZONTAL DEFLECTION SYSTEM ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Sweep Base Line	Visible at all settings of SWEEP switch with no video or external sync inputs.
2V Sweep:	
Repetition Rate	Equal to frame rate of applied video or external sync.
Length (when sync'd to video signal)	12.1 div within 0.5 div.
2V MAG Sweep:	
Magnification	≃ X20
2H Sweep:	
Repetition Rate	Equal to half line rate of applied video or external sync.
1 μs/DIV Sweep:	
Accuracy	1 μs/div within 3% excluding first and last major division.
Linearity	3% or less throughout horizontal POSITION range excluding first and last major division.

TABLE 1-3

RGB/YRGB ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
RGB/YRGB:	Factory connected for RGB input, (3 step).
Staircase Amplitude:	
RGB (3 step)	10 volts within 15% for 9 div displacement.
YRGB (4 step)	10 volts within 15% for 9 div displacement.
Maximum Staircase Input	Peak AC plus DC signal levels shall not exceed limits of —12 to +12 volts. Maximum AC signal level is 12 volts peak to peak.
Sweep Repetition Rate In RGB/YRGB:	
2V	Field rate of applied video or external sync signal.
2H	Line rate of applied video or external sync signal.
Sweep Length:	
RGB (3 step)	27% to 33% of normal sweep 2V or 2H).
YRGB (4 step)	20% to 25% of normal sweep (2V or 2H).
Staircase Transient Response	Designed for either line or field rate commutation of input.
Control Signal (External Power)	12 volts to 15 volts between pins 4 (pos) and 5 (neg) of J370.
Control Signal (Internal Power)	Jumper pin 5 to pin 6 of J370. Ground pin 4 to actuate RGB/YRGB circuit.
Control Circuit Internal Resistance (25° C)	250 Ω within 20%.

TABLE 1-4

DC RESTORATION ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Clamp Time	Back Porch

Low Frequency Response at 60 Hz:	
Attenuation of 60 Hz Added to Input Signal	20% or less DC RESTORER switch set from OFF to ON.
Blanking Level Shift Due to Presence or Absence of Burst	1 IRE unit or less shift from no color burst to presence of color burst.
Blanking Level Shift With 10% to 90% APL Change	APL changes from 50% to either 10% or 90% will cause blanking level shift of 1 IRE unit or less.

TABLE 1-5

CALIBRATOR ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Calibrator Frequency	At least 2 cycles will be displayed in 2H. Must synchronize 2H sweep.
Amplitude	1.0 volt within 1%.

TABLE 1-6

EXTERNAL SYNC ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Input Signal Requirement	1.5 volt to 4.5 volts composite sync will synchronize sweeps.
Input Impedance (Unterminated)	$\simeq$ 15 kΩ in parallel with $\simeq$ 5 pF.
Maximum Return Loss When Terminated in 75 Ω Loop Through Connector	46 dB from 25 Hz to 5 MHz.
Maximum Input Voltage	±20 volts

TABLE 1-7

POWER SOURCE ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement
Line Voltage Ranges	99 volts AC to 132 volts AC, 198 volts AC to 264 volts AC.
Line Frequency Ranges	48 Hz to 66 Hz. From 66 Hz to 440 Hz, Line Voltage Range is 115 volts AC ±10% or 230 volts AC ±10%.
Power Consumption at 115 Volts AC 60 Hz	$\simeq$48 watts

TABLE 1-8

PHYSICAL CHARACTERISTICS

Characteristic	Information
Finish	Anodized aluminum front panel.
Dimensions	5¼ inches high, 8½ inches wide and 18½ inches long.

ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits given in Table 1-9 apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

TABLE 1-9

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Information
Temperature:	
Non-operating	−40° C to +65° C
Operating	0° C to +50° C
Altitude:	
Non-operating	To 50,000 feet
Operating	To 15,000 feet
Transportation	Qualified under NSTC test procedure 1A, Category II (24" drop).

STANDARD ACCESSORIES

Standard accessories supplied with this instrument can be found on the last page in the Mechanical Parts List portion of this manual. For additional accessories, refer to the current Tektronix, Inc. catalog.

SECTION 2
OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

General

This section of the manual provides general operating information. Included is a brief description of the Type 528 controls and connectors, and a suggested First-Time Operation procedure.

Power Requirements

The regulated power supplies in the Type 528 will operate with line voltages from 99 volts AC to 132 volts AC when the LINE VOLTS switch is set to the 99-132 V position, and from 198 volts AC to 264 volts AC when the LINE VOLTS switch is set to the 198-264 V position. The fuse data provided on the rear panel of the instrument gives the correct fuse to use for each line-voltage operating range.

For maximum dependability and long life, the line voltage applied to the Type 528 should be within the line voltage operating range for the LINE VOLTS switch position used. If the line voltage exceeds the operating limits, or has a poor waveform (distorted sine waves), unstable power-supply operation may result. Check for proper line voltage and waveform before checking for other causes of unstable operation.

Cooling

The Type 528 is cooled by convection air flow through the instrument. For information concerning minimum clearance needed around the instrument for proper air circulation, refer to the Dimension Drawing page.

Installing the Type 528

The Type 528 is designed to be cradle-mounted in a standard 19-inch rack or console side by side with another Type 528. The Tektronix part number for the rack adapter is 016-0115-01. If only one Type 528 is mounted on the rack adapter, a panel assembly that covers one-half of the rack can be obtained by specifying Tektronix part number 016-0116-00.

For portable use the Type 528 can be removed from the rack and slipped into a cabinet. The Tektronix, Inc., part number for the cabinet is 390-0018-00.

All items can be ordered through your local Tektronix Field Office or representative.

When planning a custom installation that does not require the use of a Tektronix rack adapter and panel assembly, use the Dimension Drawing as a reference for determining the mounting dimensions.

CONTROLS AND CONNECTORS

Introduction

A brief description of the function or operation of the Type 528 front and rear-panel controls, adjustments and connectors is provided here (see Fig. 2-1). The front-panel indicator lights are also included.

Front-Panel Controls and Lights (left side)

POSITION (Horizontal) Control	A ten turn control to position the display horizontally.
CAL and UNCAL Indicators	Indicate when the VARIABLE (VOLTS FULL SCALE) control is set to the calibrated (CAL green light) or uncalibrated (UNCAL red light) position. The indicators also function as a pilot light to indicate when the instrument is on.
VOLTS FULL SCALE Switch	Five position switch selects the full scale vertical deflection factors for Video Input A, Video Input B, or the internal 1 V CAL (1 volt) calibrator signal.
VARIABLE (VOLTS FULL SCALE) Control	Continuously variable control with a minimum range of 1 to 4 to permit variable adjustment of gain for each VOLTS FULL SCALE switch position. Used in conjunction with the VOLTS FULL SCALE switch to accommodate input signals from 0.25 volt to 4 volts.
RESPONSE Switch	Four position switch selects FLAT, IRE or CHROMA frequency response characteristics. A fourth position, DIFF GAIN, provides the same frequency response as the CHROMA position but with an additional gain of 3X to 5.5X.
SWEEP Switch	Four-position switch selects 2H, 1 μs/DIV, 2 V MAG and 2 V sweep rates. 2H: Sweep repetition is half line rate to display two television lines. 1 μs/DIV: Expands the two-line display to provide 10× magnification of the horizontal blanking interval or any other portion of the two-line display. 2V MAG: Expands the two-field display to provide 20× magnification of the vertical blanking interval or any other portion of the two-field display. 2V: Sweep repetition is half field rate to display two fields (one frame).
INTENSITY Control	Controls brightness of the display.
POWER-SCALE ILLUM Control	POWER switch turns instrument on or off. SCALE ILLUM control sets light level of graticule markings.
FOCUS Control	Permits adjustment of CRT beam for optimum definition.

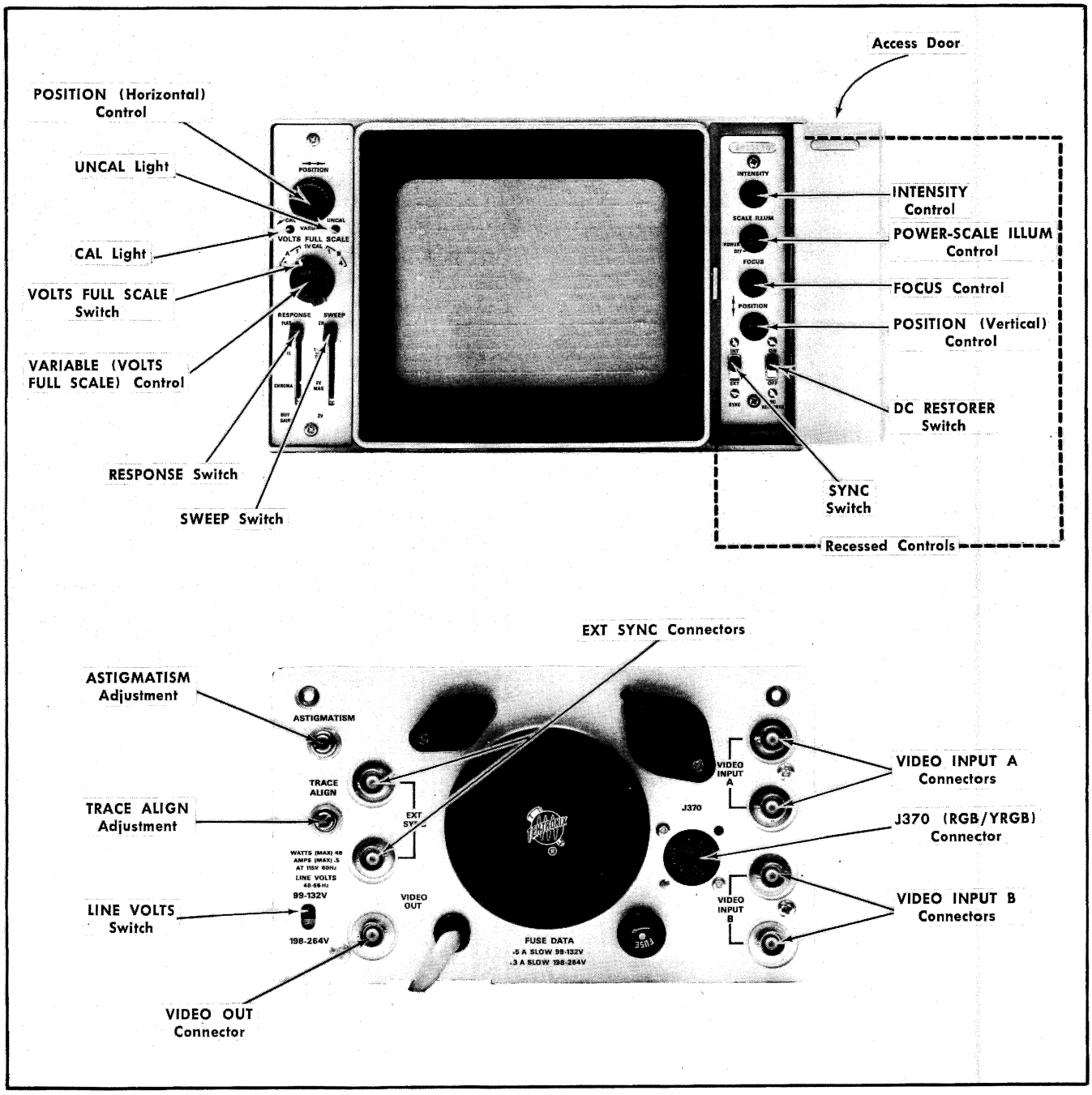


Fig. 2-1. Controls, lights, adjustments and connectors on the Type 528 Waveform Monitor.

POSITION (Vertical) Control — Vertically positions the display.

SYNC Switch — Two-position slide switch to select INT or EXT sync.

DC RESTORER Switch — Two-position slide switch to turn the DC restorer ON or OFF.

Rear-Panel Controls and Connectors

ASTIGMATISM Adjustment — Screwdriver adjustment permits adjustment of the CRT beam for optimum definition when used in conjunction with the FOCUS control.

TRACE ALIGN Adjustment — Screwdriver adjustment to align the trace or the display with the horizontal graticule lines.

LINE VOLTS Switch — Two-position slide switch for selecting a line voltage range of 99-132 volts or 198-264 volts.

VIDEO OUT Connector — BNC connectors for monitoring the displayed signal on a picture monitor.

EXT SYNC Connectors	BNC connectors for accepting external sync signals. The inputs are loop-through and compensated for 75 ohms.
VIDEO INPUT A Connectors	BNC connectors for applying an external video signal to VIDEO INPUT A. The inputs are loop-through and compensated for 75 ohms.
VIDEO INPUT B Connectors	BNC connectors for applying an external video signal to VIDEO INPUT B. The inputs are loop-through and compensated for 75 ohms.
J370 (RGB/ YRGB) Connector	Nine-pin socket for accepting external staircase and relay control signals.

FIRST-TIME OPERATION

The following procedure is suggested as a way of becoming familiar with the operation of the Type 528. A 1-volt modulated staircase signal is used in this procedure to illustrate the displays. The First-Time Operation procedure is as follows:

1. Set the INTENSITY control fully counterclockwise.

2. Check that the LINE VOLTS switch is set to the proper line voltage operating range.

3. Connect the instrument to a suitable power source and turn on the POWER-SCALE ILLUM control.

4. While the instrument is warming up (at least 3 minutes), set the Type 528 front-panel controls as follows:

Left Front-Panel Controls:

POSITION (Horizontal)	Midrange
VOLTS FULL SCALE	A 1
VARIABLE (VOLTS FULL SCALE)	CAL
RESPONSE	FLAT
SWEEP	2H

Recessed Front-Panel Controls:

POWER-SCALE ILLUM	Desired graticule illumination
FOCUS	As is
POSITION (Vertical)	Midrange
SYNC	INT
DC RESTORER	ON

Rear-Panel Controls:

ASTIGMATISM	As is
TRACE ALIGN	As is

5. Rotate the INTENSITY control clockwise until the trace is at the desired brightness.

6. Use the Vertical POSITION control to position the trace to the 0 IRE graticule line. Use the Horizontal POSITION to position the start (left end) of the trace to the first major division mark on the 0 IRE graticule line.

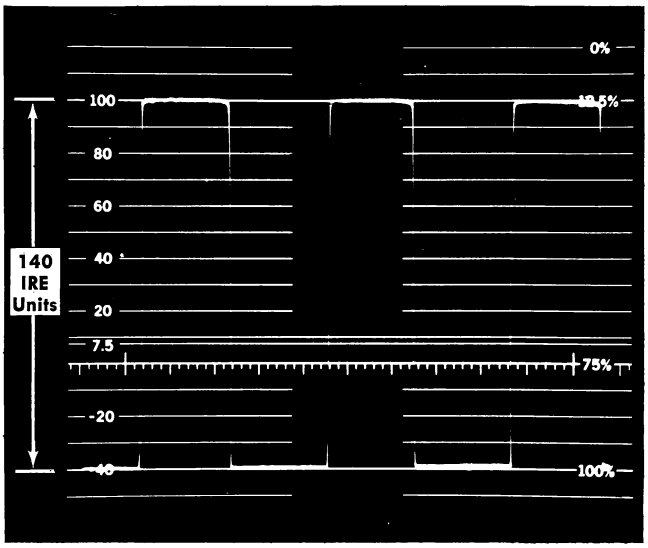


Fig. 2-2. Typical calibrator waveform display obtained when the VOLTS FULL SCALE switch is set to 1 V CAL, the VARIABLE VOLTS FULL SCALE control is set to CAL and the display is properly focused.

7. Adjust the FOCUS control to obtain a well-defined trace.

8. Check that the trace aligns with the 0 IRE graticule line. If not, adjust the TRACE ALIGN control to obtain proper alignment.

9. Set the VOLTS FULL SCALE switch to the 1 V CAL position. Use the Vertical POSITION control to vertically center the display in the —40 to 100 IRE unit area of the graticule. Adjust the ASTIGMATISM and FOCUS controls to obtain a well-defined waveform. The calibrator waveform should be 140 IRE units (within 1.4 units) in amplitude (see Fig. 2-2).

10. Connect a 1-volt modulated staircase signal to the VIDEO INPUT A connector.

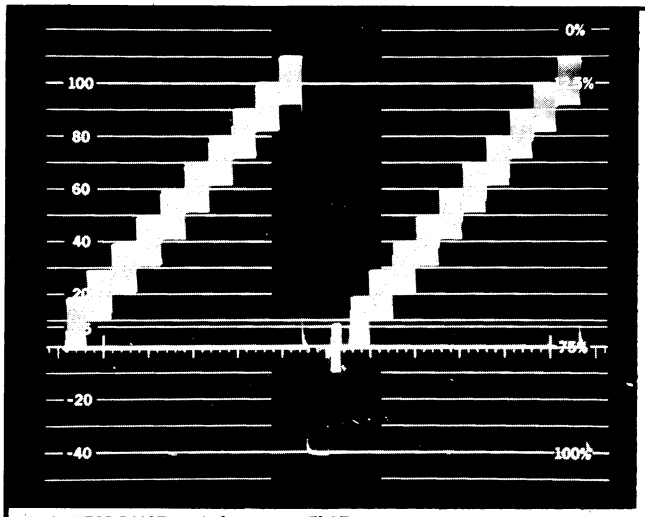
NOTE

If the Type 528 is connected to the output of a video signal distribution system, connect a 75 ohm termination resistor to the other unused VIDEO INPUT A connector.

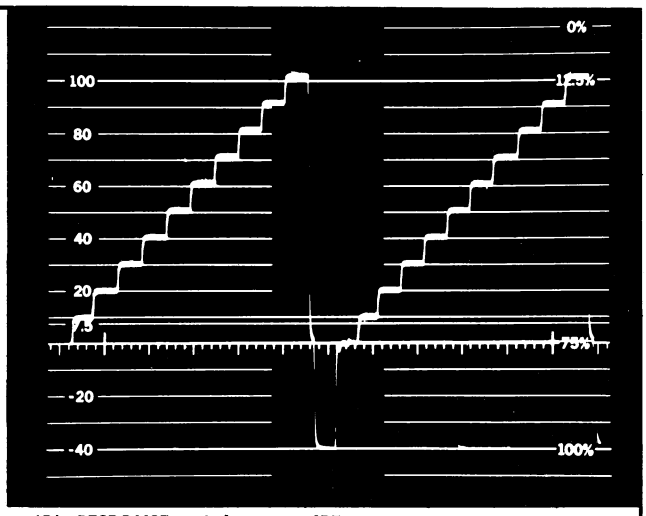
11. Set the VOLTS FULL SCALE switch to A 1. Use the Vertical POSITION control to align the blanking level of the waveform with the 0 IRE graticule line. A modulated staircase waveform similar to the one shown in Fig. 2-3A will be displayed. The FLAT position of the RESPONSE switch provides a flat frequency response from 25 Hz to approximately 5 MHz.

12. Set the RESPONSE switch to IRE (see Fig. 2-3B). This position of the switch provides a frequency response with a rolloff as illustrated in Fig. 1-2 (refer to the Specification section of this manual).

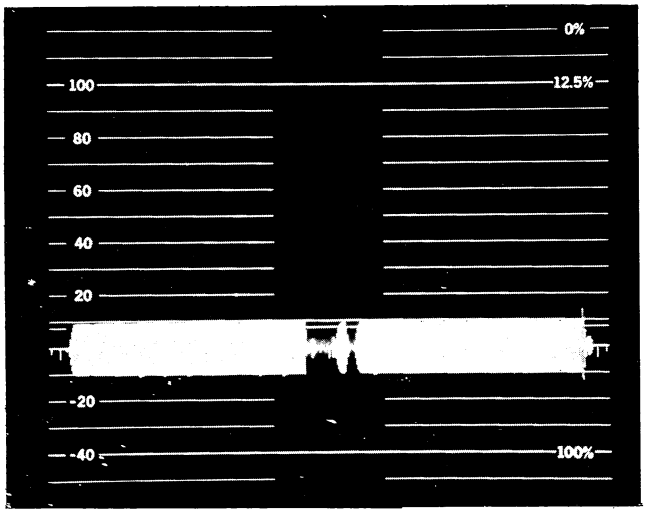
13. Set the RESPONSE switch to CHROMA (see Fig. 2-3C). In this position of the switch, only the components of the signals within the 3.2 to 4.0 MHz frequency range are displayed.



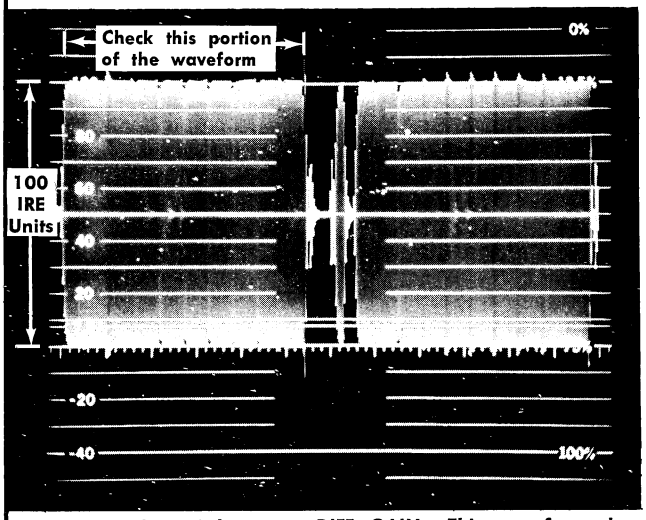
(A) RESPONSE switch set to FLAT.



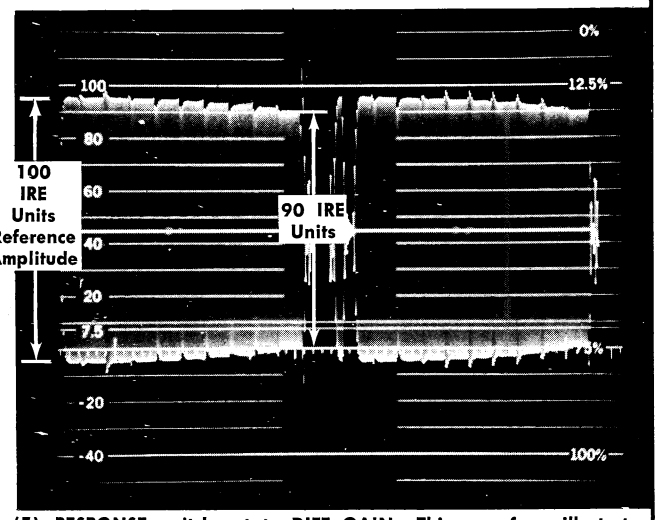
(B) RESPONSE switch set to IRE.



(C) RESPONSE switch set to CHROMA.



(D) RESPONSE switch set to DIFF GAIN. This waveform shows absence of differential gain.



(E) RESPONSE switch set to DIFF GAIN. This waveform illustrates presence of approximately 10% differential gain.

Fig. 2-3. Typical displays obtained for each position of the RESPONSE switch when the SWEEP switch is set to 2H.

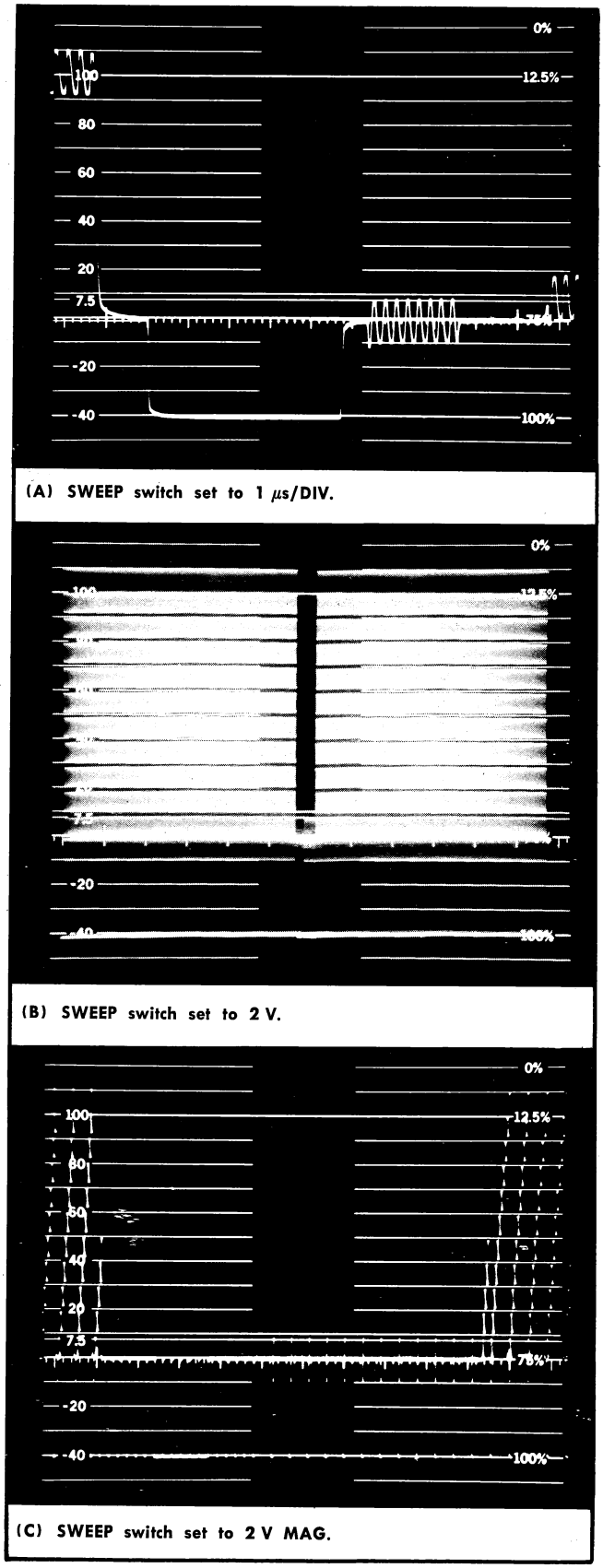


Fig. 2-4. Typical displays obtained for the last three positions of the SWEEP switch when the RESPONSE switch is set to FLAT.

14. Place the RESPONSE switch to the DIFF GAIN position. The display should be similar to the one shown in Fig. 2-3C except the amplitude of the DIFF GAIN display will be 3X to 5.5X greater. The DIFF GAIN switch position is used when checking the equipment for differential gain using a test signal such as a modulated staircase or ramp. To perform this check, a suggested procedure is as follows:

a. Adjust the VARIABLE (VOLTS FULL SCALE) control until the display is exactly 100 IRE units peak to peak in amplitude. Use the Vertical POSITION control to center the display about the 50 IRE unit graticule line (see Fig. 2-3D).

b. Check the waveform for uniform amplitude. The departure of any portion of the staircase modulation from the 100 IRE units of amplitude chosen as a reference represents differential gain. For example, Fig. 2-3E illustrates a waveform containing 10% differential gain; that is, there is a total variation in amplitude of 10 IRE units with respect to the 100 IRE unit reference amplitude. For this illustration, the POSITION controls were used to move the waveform to a location where the graticule lines can be utilized for the differential gain measurement.

15. Set the VARIABLE (VOLTS FULL SCALE) control to CAL, the RESPONSE switch to FLAT and the SWEEP switch to 1 μs/DIV. A magnified display of the horizontal blanking interval should be obtained. A typical display is shown in Fig. 2-4A.

16. Set the SWEEP switch to 2 V and note that a two field display is obtained (see Fig. 2-4B).

17. Set the SWEEP switch to 2 V MAG. Observe that a magnified display of the vertical blanking interval is obtained (see Fig. 2-4C).

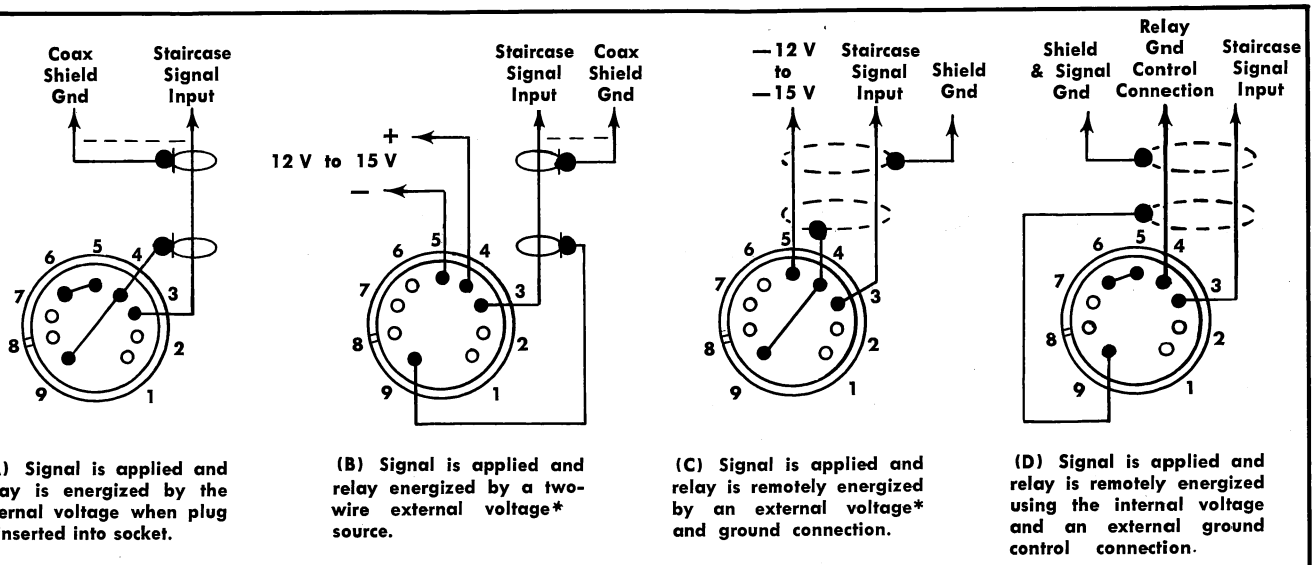
18. Set the VOLTS FULL SCALE switch to A 4 and the SWEEP switch to 2 V. Observe that the vertical amplitude of the display is one-fourth of the display amplitude obtained in step 16; that is, one fourth amplitude is about 35 IRE units peak to peak. The A 4 and B 4 positions of the VOLTS FULL SCALE switch are primarily used to observe composite sync signals that are 4 volts in amplitude but these switch positions may also be used in conjunction with the VARIABLE (VOLTS FULL SCALE) control to observe composite video signals whose amplitudes lie between 1 and 4 volts. This completes the First-Time Operation procedure.

REAR-PANEL CABLE CONNECTORS

For more information about the circuit characteristics associated with the connector(s), refer to the Specification section of this manual.

Video Input A, Video Input B

Two pairs of BNC connectors are provided for accepting 1 volt or 4 volt video input signals. These connectors are VIDEO INPUT A and VIDEO INPUT B, selectable by the VOLTS FULL SCALE switch. The video inputs provide high-



(A) Signal is applied and relay is energized by the internal voltage when plug is inserted into socket.

(B) Signal is applied and relay energized by a two-wire external voltage* source.

(C) Signal is applied and relay is remotely energized by an external voltage* and ground connection.

(D) Signal is applied and relay is remotely energized using the internal voltage and an external ground control connection.

*** If the external voltage for energizing relay K370 is greater than 15 volts, connect a resistor in series with the voltage source. Resistance and wattage of the series resistor can be determined using the following information:**

1. **Relay control circuit internal resistance at 25°C is 250 ohms within 20%.**
2. **Relay control circuit current when 12 volts (for example) is applied: 48 mA.**

Fig. 2-5. Rear (wiring) view of 9-pin male plug to show the signal and various relay control connections. Description of plug and cover: Plug, 9-pin cable end, Eby, Tektronix Part No. 136-0099-00. Cover for plug, black plastic, Tektronix Part No. 200-0249-00.

impedance loop-through compensated for 75 ohms connections so that the instrument may be connected into any part of a properly terminated 75-ohm system.

When the Type 528 is connected to the output of a system where loop-through connections are not required, a 75-ohm terminating resistor should be connected to the unused input connector to properly terminate the system.

Video Out

The VIDEO OUT connector (BNC Type) permits monitoring the Type 528 displayed signal on a picture monitor. The output signal is 1 volt ±15% for 140 IRE units of signal amplitude displayed on the Type 528 CRT when the RESPONSE switch is set to FLAT and the VIDEO OUT connector is connected to a properly terminated system. Output impedance is 75 ohms.

External Sync

A pair of BNC connectors marked EXT SYNC is provided on the rear panel to couple an external negative-going sync signal to the sweep circuit when the SYNC switch is set to the EXT position. This input is a 75-ohm loop-through connection. The unterminated input impedance is about 15 kΩ in parallel with 5 pF. The input sync signal requirement for synchronizing the Type 528 sweeps is a 1.5 volt to 4.5 volts composite sync signal.

RGB/YRGB J370

A 9-pin socket connector, marked J370, is provided to connect an external staircase signal and relay control wiring to the Type 528. The input impedance between pin 3 (staircase signal input) and ground is 1.1 megohm shunted by approximately 50 pF. Fig. 2-5 shows how to wire the male plug connector (supplied with the Type 528) so the staircase signal can be applied to the instrument. In addition, the illustrations show several ways to connect relay K370 so it can be actuated directly or remotely using internal or external power.

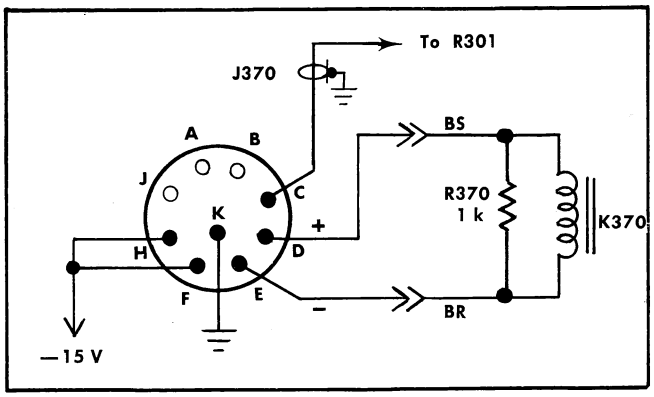
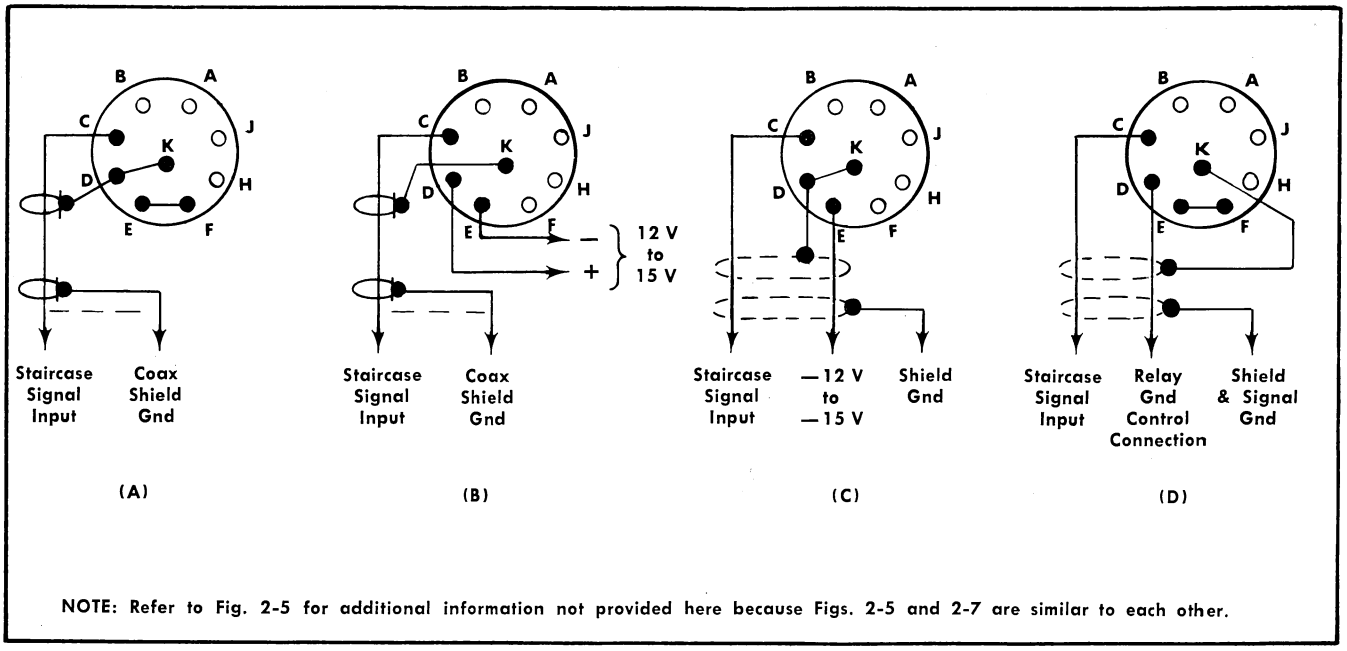


Fig. 2-6. Rear (wiring) view of lettered-pin socket. Description: Socket, 9-pin, chassis mounting with female insert, Amphenol, Tektronix Part No. 136-0089-00.



NOTE: Refer to Fig. 2-5 for additional information not provided here because Figs. 2-5 and 2-7 are similar to each other.

Fig. 2-7. Rear (wiring) view of letter-pin male plug if used with the socket shown in Fig. 2-6. Description: Plug, 9-pin cable, No. 165-13 Amphenol, with male insert, Tektronix Part No. 134-0049-00.

NOTE

Relay K370 is polarized. Observe proper polarity when making connections to the relay by way of the connectors.

Figs. 2-6 and 2-7 give the necessary wiring information required if the numbered-pin Eby socket is replaced by a letter-pin Amphenol socket. The lettered-pin socket, wired as shown in Fig. 2-6 is identical in function to J501 on the Tektronix Type 529 and RM529 Waveform Monitors. Note: The polarity of the relay control signal is important to the Type 528 whereas the Type 529 or RM529 employs a non-polarized relay.

When K370 is actuated and the SWEEP switch is set to 2H or 2V, the sweep length is 27% to 33% of the normal sweep length if TP263 is jumpered to TP264 and if TP293 is jumpered to TP294 (factory wired; see Fig. 2-8 for location of test points). Then, when a 20 Hz 3-step RGB staircase signal of correct amplitude (about 10 volts overall amplitude) is applied through pin 3 of J370, the display will be properly positioned if the DC Level control R304 (described later) is properly adjusted. The total length of the three stepped sweeps will be approximately equal to a normal sweep-trace length in accordance with the staircase output from a color processor (see Fig. 2-9).

To obtain the displays shown in Fig. 2-9, red, green and blue non-composite outputs from a color-bar generator were fed to a line-rate video switcher and to the Type 528 VIDEO INPUT A connector. The staircase output from the video switcher was applied to pin 3 of J370 to step the sweep sideways so that the red, blue and green signals are displayed from left to right respectively. This illustration is intended to simulate the display that could be obtained from a color television camera equipped with a RGB video switcher.

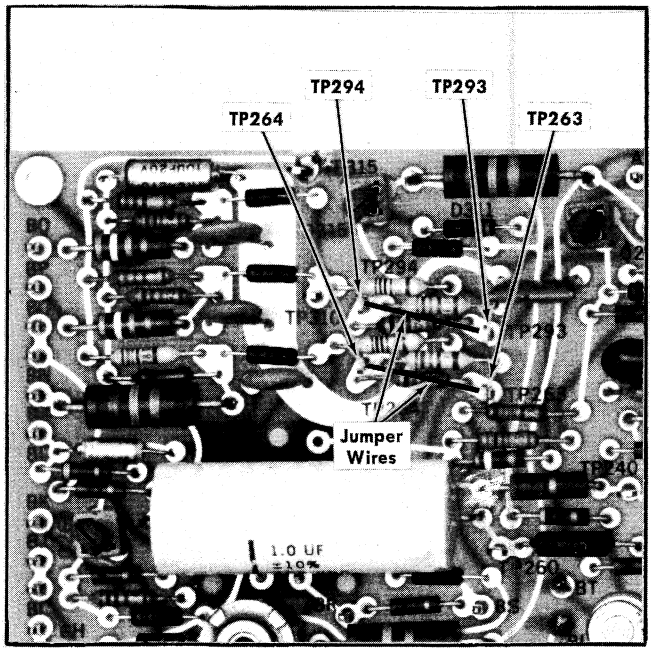


Fig. 2-8. Left side rear view of Main board showing location of test point connections for controlling the sweep length when K370 is actuated. For RGB operation leave the test points connected as shown. For YRGB operation the jumper wires must be removed.

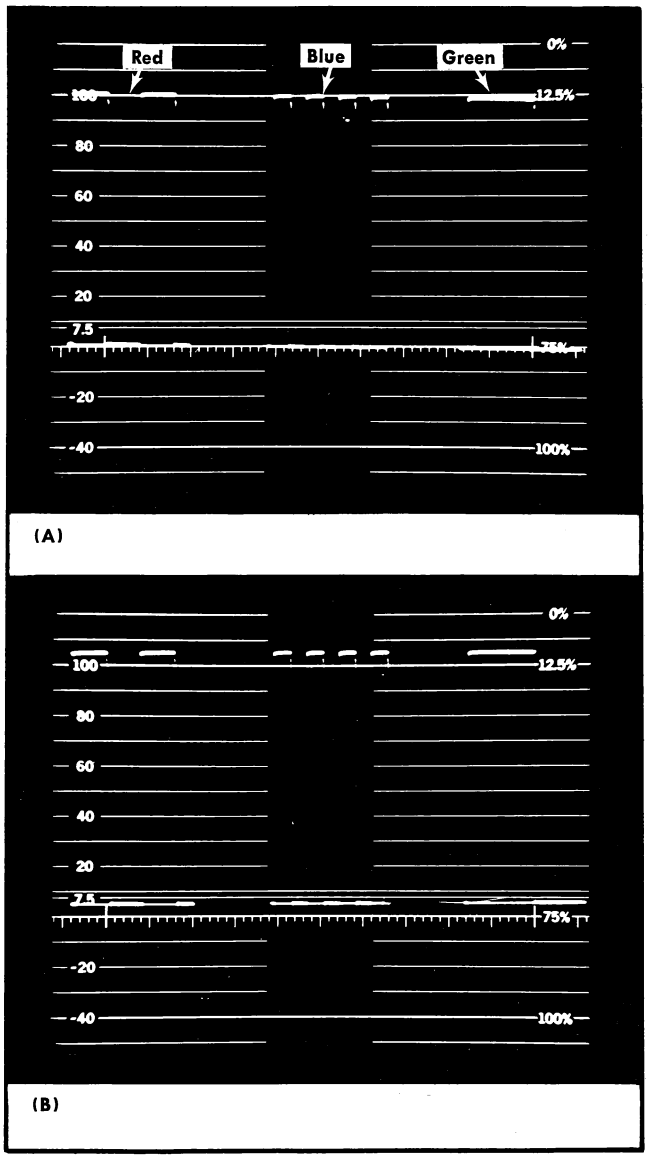


Fig. 2-9. Display obtained when using one type of RGB switcher. With DC RESTORER switch set to ON, the Vertical POSITION control was used to position the black level of display (A) at 0 IRE and display (B) slightly above the 0 IRE graticule line (to show clearer view of waveform).

For YRGB operation proper sweep length can be obtained by removing the TP263-TP264 and TP292-TP294 jumpers. With the jumpers disconnected and relay K370 energized, the sweep length is 20% to 25% of normal sweep. When the YRGB signal is applied to pin 3 of J370, the signal will step the sweep so the total length of the four stepped sweeps will be approximately equal to a normal sweep-trace length.

Some RGB and YRGB systems have a staircase signal output with a positive DC component and some with a negative DC component. The DC component positions the display to the left or right on the CRT, depending on the polarity. To properly position the display, proceed as follows:

1. De-energize the relay and set the SWEEP switch to 2H or 2V. Check that the sweep starts at the first left major graticule division mark.

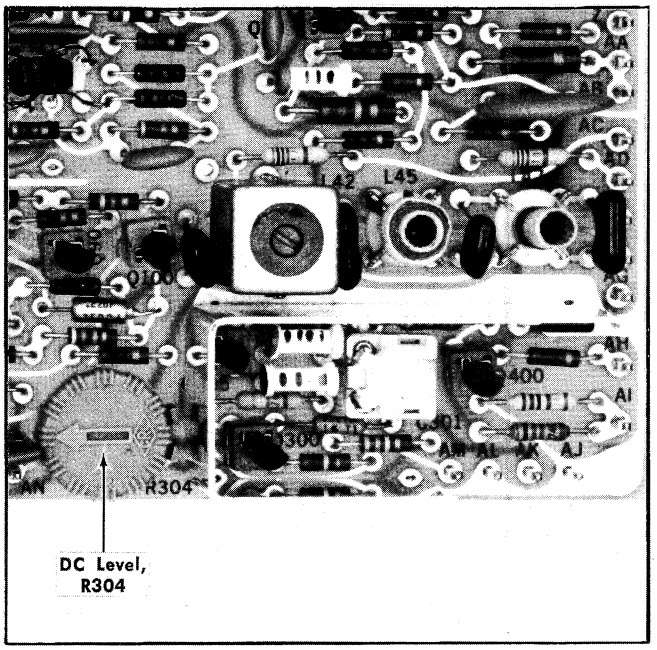


Fig. 2-10. Left side bottom-center view of the Main board showing the location of the DC Level control.

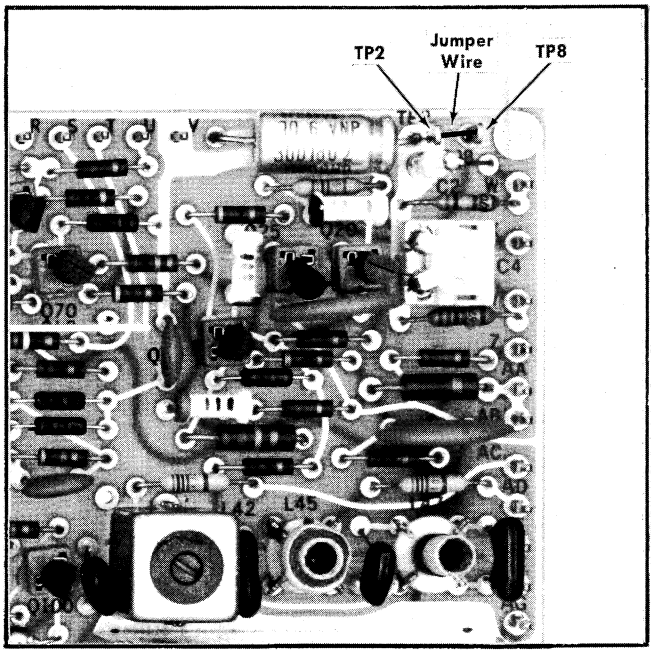


Fig. 2-11. Left side top-front view of the Main board showing location of TP2 and TP8. With jumper connected as shown, the vertical amplifier is DC-coupled. (To revert to AC input coupling, remove the jumper.)

2. Energize the relay.

3. Adjust the DC Level control R304 (see Fig. 2-10) so the display starts at the same point as the normal (2H or 2V) sweep.

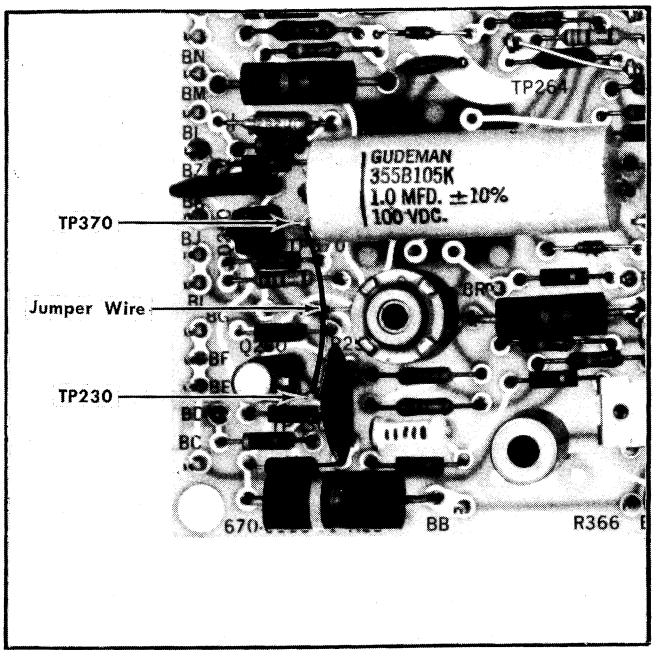


Fig. 2-12. Left side rear view of Main board showing location of TP230 and TP370, with jumper wire as shown and in RGB/YRGB mode of operation, the CRT will be unblanked.

MODIFICATIONS

Introduction

The Type 528 can be modified to satisfy certain studio conditions. Some possible modifications are as follows:

1. Changing to DC Input Coupling

Sometimes it is necessary to observe the demodulated output from a television transmitter using a DC oscilloscope. The 528 vertical amplifier can be DC coupled and used for this purpose. The information that follows describes how to make the modification:

Solder a jumper wire between TP2 and TP8 as shown in Fig. 2-11. The jumper shorts out coupling capacitor C8, and all signals selected by the VOLTS FULL SCALE switch are now DC coupled from the input through the vertical amplifier to the CRT vertical deflection plates with the RESPONSE switch set to FLAT or IRE.

2. Changing 3-step RGB Mode of Operation to 4-step YRGB

Refer to the topic entitled, "RGB/YRGB J370" that precedes MODIFICATIONS.

3. SN B080560-up. Eliminating CRT blanking during RGB/YRGB mode of operation.

To observe the entire RGB/YRGB display (including retrace), connect a short jumper wire between TP230 and TP370 as shown in Fig. 2-12. The jumper applies +10 V via K370F to the emitter of Q230, which holds Q230 at cutoff. With Q230 cutoff, the CRT will be unblanked at all times.

4. Changing to 625-Line 25-Frame Scan

The Type 528 can be easily modified to work with a 625-line 25-frame (50 Hz field rate) scan system. For information concerning this modification, contact your local Tektronix Field Office or representative and ask for: Instruction Manual Modification Insert, MOD 188G, for the Type 528 Waveform Monitor.

NOTES

SECTION 3
CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual begins with a functional block diagram description of the Type 528. Signal flow is traced from one block to the next. Only the basic interconnections between the individual blocks are shown. Each block represents a stage or circuit which is described as a separate topic in the detailed description. Some exceptions occur where several stages are so interrelated that they are best described together. Use the block diagram located on a pull-out page at the rear of the manual when following the block diagram description.

Next, a detailed description is given to explain the purpose and electrical operation of each stage or circuit. Use the schematic diagrams provided on the pull-out pages at the rear of the manual when following this description. The diagrams have voltages and time-related waveforms that are useful when analyzing the operation of a circuit.

Conventional current flow is used in all references to direction of current flow in the detailed circuit description.

NOTE

Circuit voltages, currents, gain and waveform peak-to-peak amplitudes given in this manual are not absolute but are approximate due to normal manufacturing tolerances and component characteristics.

Proper understanding of the circuit description to follow will depend to some extent on the readers' knowledge of the operation of typical electronic circuits using solid-state devices. The following list of references provide an index of reference material relating to some of these typical circuits.

1. Operational Amplifiers
   a. Jacob Millman and Herbert Taub, "Pulse, Digital and Switching Waveform", McGraw-Hill, New York, 1965, pp. 15-18.
   b. "Operational Amplifiers and Their Applications", Tektronix, Inc., Beaverton, Oregon, 1965, Part No. 070-0526-00.
2. Blocking Oscillator
   Jacob Millman and Herbert Taub, "Pulse, Digital and Switching Waveforms, McGraw-Hill, New York, 1965, pp. 597-621.
3. Miller Sweep Generator
   Jacob Millman and Herbert Taub, "Pulse, Digital and Switching Waveforms", McGraw-Hill, New York, 1965, pp. 540-548.
4. Regulated Power Supply
   Phillip Cutler, "Semiconductor Circuit Analysis", McGraw-Hill, New York, 1964, pp. 559-625.

BLOCK DIAGRAM

The VOLTS FULL SCALE switch SW4 selects 1-volt or 4-volt signals applied to the VIDEO INPUT A and VIDEO INPUT B connectors. In addition, the switch is used to select an internal square wave from the 1 Volt Calibrator Q400. This signal is used to check the calibration of the vertical amplifier. The VOLTS FULL SCALE switch also selects the attenuators (not shown in detail on the block diagram) within the Input Attenuator block.

If the VOLTS FULL SCALE switch is set to A 4, with a 4-volt signal applied to the VIDEO INPUT A connector, the signal will pass through a 4 V (4 volt) full scale attenuator in the Input Attenuator block to the Input Amplifier (Q20, Q25, Q30). If the switch is set to A 1 with a 1-volt signal applied, the signal goes through a 1 V (1 volt) full scale attenuator to the Input Amplifier. The gain of the Input Amplifier can be varied by means of the VARIABLE (VOLTS FULL SCALE) control.

The signal from the Input Amplifier is applied to the RESPONSE switch. This switch selects the filters that control the bandwidth of the vertical amplifier. The signal is also applied to the Video Output Amplifier (Q70, Q80). This amplifier provides a sample of the signal to the VIDEO OUT connector. The signal is also applied to the Sync Separator circuit (Q90, Q95, Q100) when the SYNC switch is set to INT. If the SYNC switch is set to EXT, an external sync signal is applied to the Sync Separator circuit.

As stated above, signal from the Input Amplifier passes to a selected filter through the RESPONSE switch. The signal at the output of the filter is applied to the Vertical Amplifier Driver (Q50, Q60). This amplifier converts the high input impedance to a low output impedance for driving the Vertical Amplifier (Q150, Q160, Q170) and the DC Restorer (Q110). The Vertical Amplifier amplifies the signal and provides push-pull drive to the CRT vertical deflection plates. The output signal amplitude is sufficient to obtain a full scale display when the proper amplitude signal is applied to the input of the vertical amplifier and the VARIABLE (VOLTS FULL SCALE) control is set to CAL.

The DC Restorer (Q110), when turned on by means of the DC RESTORER switch, holds the display steady at the video backporch level so the display will not shift up or down with changes in signal amplitude or APL. The Emitter Follower stages (Q130, Q140) provide the means for DC coupling the DC Restorer and Vertical POSITION voltages to the Vertical Amplifier (Q150, Q160, Q170).

The Sync Separator circuit (Q90, Q95, Q100) removes the video information from the composite video, leaving sync with sync tips clamped at a certain voltage level for application to the Sync Amp & Vertical Separator (Q200, Q210, Q225) and DC Restorer (Q110) circuits. The Sync Amp &

Vertical Separator is an amplifier, a sync clipper, and a pulse width discriminator to provide horizontal or vertical sync pulses to the Gating Multi (Q220, Q240, Q270).

In the Gating Multi circuit, Q220 is one half of a complementary multivibrator; the other half is either Q240 or Q270, depending on the setting of the SWEEP switch. For two line sweep mode of operation, the SWEEP switch is set to 2H or 1 μs/DIV. With the switch in either of these positions, the Gating Multi consists of Q220 and Q270. Transistor Q270 places the Horizontal Miller (Q290) into active operation. Q240 is disabled by the SWEEP switch to prevent the Vertical Miller circuit (Q260) from generating a sweep.

In two-line sweep mode of operation, the Gating Multi (Q220 and Q270) applies gating pulses at half the line rate to the Horizontal Miller (Q290) to control the sweep. The gating pulses are also applied to the Blanking Amplifier (Q230) for amplification. The amplified gating pulses from Q230 are applied to the CRT to blank (turn off) the beam at the same time that the gate applied to the Horizontal Miller is resetting the sweep. At the termination of the gate, the beam is unblanked (turned on) and the Horizontal Miller is allowed to generate a sweep.

The beam is blanked between sweeps by special deflection plates (located in the focus electrode area of the CRT). Blanking the beam is accomplished by diverting the electron beam away from the apertures within the electron gun and toward the more positive blanking plate, thereby effectively cutting off the electron beam. Henceforth in this manual, blanking the beam is referred to as "turning off the beam"; unblanking is referred to as "turning on the beam".

For two-field sweep mode of operation, the SWEEP switch is set to 2V or 2V MAG. With the switch in either of these positions, the Gating Multi is Q220 and Q240. Transistor Q240 places the Vertical Miller (Q260) into active operation. Q270 in the Gating Multi is disabled by the SWEEP switch to prevent the Horizontal Miller circuit (Q290) from generating a sweep.

In two-field sweep mode of operation, the Gating Multi (Q220 and Q240) applies gating pulses at half the field rate to the Vertical Miller (Q260) to control the sweep. The gating pulses are also applied to the Blanking Amplifier for amplification. The amplified pulses from Q230 are applied to the CRT to turn off the beam at the same time that the gate applied to the Vertical Miller is resetting the sweep. At the termination of the gate, the beam is turned on and the Vertical Miller is allowed to generate a sweep.

If no sync pulses are applied from the Sync Amp & Vertical Separator to the Gating Multi, the rising sawtooth from the active Miller circuit will revert the Gating Multi to automatically reset the sweep. After the sweep resets, the Gating Multi will allow the sweep to run again to produce a free-running sweep.

The RGB Amplifier (Q300, Q305) is connected to the Horizontal Driver (Q315) when K370 is energized. The relay changes the active Miller circuit sweep rates by a factor of two and decreases the magnitude of the sweeps. Thus, when a RGB or YRGB signal is applied to pin 3 of J370, the staircase signal will horizontally position the shortened sweeps for sequential presentation of the red, blue and green portions of a color studio camera output in RGB mode of operation; for YRGB mode of operation the white, red, green and blue portions of a color studio camera output are presented.

The sweep sawtooth, selected by the SWEEP switch, is applied to the Horizontal Driver (Q315) for amplification and gain selection. When the SWEEP switch is set to 2H or 2V, the relative gain is ×1; with the SWEEP switch set to 1 μs/DIV, the relative gain is ×10, and when the SWEEP switch is set to 2 V MAG, the relative gain is ×20. The Horizontal POSITION control applies a DC voltage to the input of the Horizontal Driver stage for positioning the trace or display to the left or right on the CRT screen.

The sweep sawtooth with its DC positioning component is applied to the Horizontal Amplifier (Q350, Q360). This amplifier converts the single-ended sawtooth waveform to a push-pull amplified signal for driving the CRT horizontal deflection plates.

The high-voltage circuits contain a High Voltage Oscillator (Q430), High Voltage Regulator (Q410, Q420) and a 1 Volt Calibrator (Q400). The High Voltage Oscillator operates at a frequency of about 20 kHz and furnishes energy for the CRT, 1 volt Calibrator and +300 volt power supply. Voltage regulation is accomplished by means of the High Voltage Regulator.

INPUT & VERTICAL AMPLIFIER ◇1

Input Signal and Attenuator Selection

The VOLTS FULL SCALE switch SW4 provides manual selection of either of two input signals applied to the VIDEO INPUT A and VIDEO INPUT B connectors. It further permits the selection of attenuation suitable for full screen display of 1 V (1 Volt) or 4 V (4 Volt) signals. The switched portion of the frequency-compensated step attenuator for the A1 or B1 position is C4 and R4; for the A4or B4 position the switched portion is C2 and R2. The non-switched portion is the feedback network, C23 and R23, in the Input Amplifier stage. C2 and C4 are adjusted for optimum response to a $\sin^2$ pulse and bar signal. When this is accomplished, C2 and C4 equalize the input high frequency time constant with respect to the feedback time constant of C23 and R23.

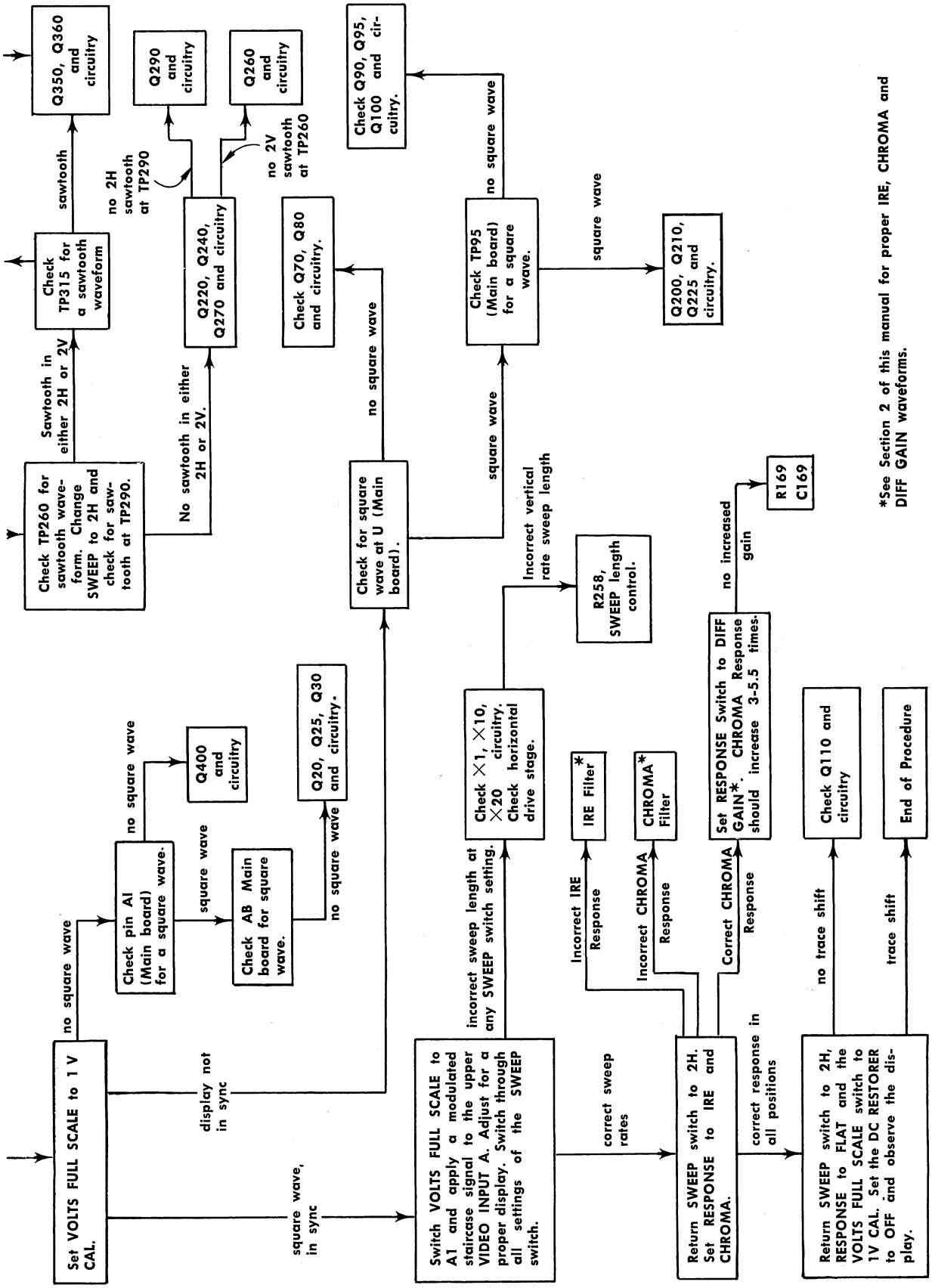
A fifth position of the VOLTS FULL SCALE switch provides for the selection of a 1 V (1 Volt) internal square wave for checking the calibration of the Type 528 vertical deflection system.

Input Coupling

A blocking capacitor, C8, together with the input resistance form an AC coupling time constant of at least one second. This capacitor may be shorted out by a jumper connection from TP2 to TP8 if DC input coupling is desired. When the capacitor is shorted out in this case, the Type 528 is direct coupled from the input to the vertical deflection plates of the CRT in the FLAT and IRE positions of the RESPONSE Switch SW40.

Input Amplifier Q20, Q25 and Q30

The purpose of the Input Amplifier is to present a high impedance to the input terminals to provide for step and



*See Section 2 of this manual for proper IRE, CHROMA and DIFF GAIN waveforms.

Fig. 4-3. Troubleshooting chart for the Type 528, excluding the RGB circuit.

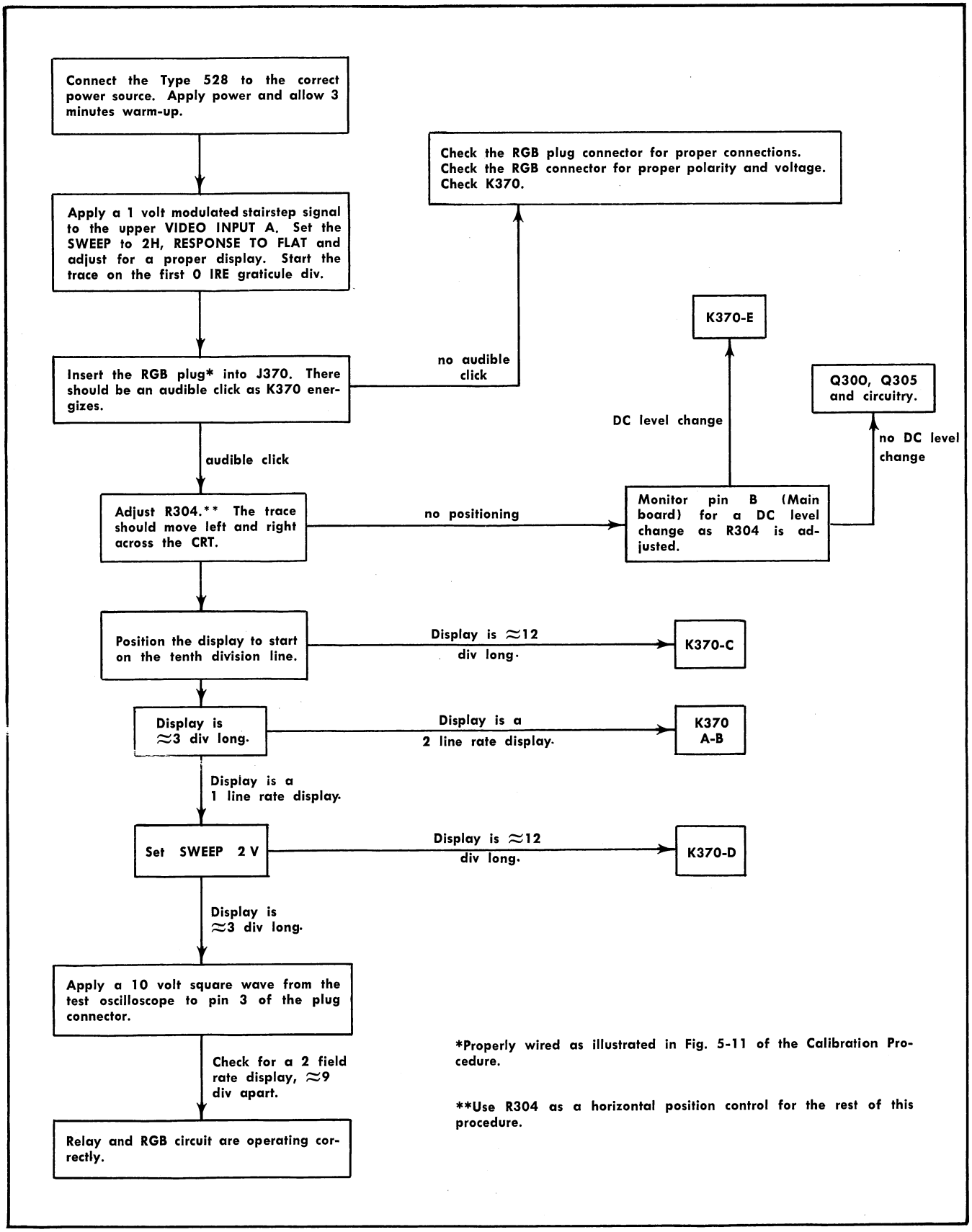


Fig. 4-4. Troubleshooting chart for the Type 528 RGB circuit.

NOTE

This instrument may be checked with a VTVM, 10 megohm input impedance and 0 to 500 volts range; ohmmeter, 0 to 50 megohms; accuracy within 3%.

Purpose: To check voltages and for general troubleshooting in this instrument.

3. Test Oscilloscope

Description: DC to 10 MHz frequency response (signal tracing). 10 millivolts to 200 volts/division deflection factor using a 10× probe.

Purpose: To check waveforms in this instrument.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple possibilities before proceeding with extensive troubleshooting. The first few checks assure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedures given under Corrective Maintenance.

1. Check Control Settings. Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of this manual.

2. Check Associated Equipment. Before proceeding with troubleshooting of the Type 528 check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source.

3. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

4. Check Instrument Calibration. Check the calibration of this instrument, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Performance Check/Calibration section of this manual.

5. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptoms. The symptoms often identify the circuit in which the trouble is located. For example, poor focus indicates that the CRT (includes high voltage) circuit is probably at fault. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. Table 4-3 lists the tolerances of the power supplies in this instrument. If a power-supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Calibration section to adjust the power supplies.

TABLE 4-3

Power Supply Tolerance

Power Supply	Tolerance
+300	5%
+100	5%
+10	5%
−15	See Step 1 in Calibration Procedure

Figs. 4-3 and 4-4 are block diagrams showing a set procedure to isolate any trouble to a particular circuit or block diagram.

After the defective circuit has been located, proceed with step 6 through 8 to locate the defective component(s).

6. Check Circuit Board Interconnections. After the trouble has been isolated to a particular circuit, check the pin connectors on the circuit board for correct connection. Figs. 4-12 through 4-16 show the correct connections for each board.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated to the power supply itself by disconnecting the pin connectors for the voltage at the remaining board.

7. Check Voltage and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the inside portion of the Input & Vertical Amplifier diagram pull-out page.

WARNING

"Ground lugs" and shield braids are not always at ground potential. Check the schematic before using such connections as a ground for the voltmeter test prod or oscilloscope probe. Some transistor cases may be elevated. This warning note also applies to recessed screws that hold transistors to the chassis.

8. Check Individual Components. The following procedures describe methods of checking individual components in the Type 528. Components which are soldered in place are best checked by disconnecting one end. This isolates the measurment from the effects of surrounding circuitry.

A. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new transistor or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use

a dynamic tester (such as Tektronix Type 575). Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

B. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 millivolts and 3 volts, the resistance should be very high on one direction and very low when the leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High current may damage the diode.

C. RESISTORS. Check the resistors with on ohmmeter. Check the Electrical Parts List for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

D. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

CAUTION

L2 and L4, feed-through coils, should not be moved, expanded or compressed. Refer to Section 5, Step 15, for any adjustment.

E. CAPACITORS. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open coupling capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

9. Repair and Readjust the Circuit. If any defective parts are located, follow the replacement procedure given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

General

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

Standard Parts. All electrical and mechanical part replacements for the Type 528 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special components are used in the Type 528. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special components are indicated in the Electrical Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

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

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Circuit Boards. Use ordinary 60/40 solder and a 35 to 40 watt pencil type soldering iron on the circuit boards. A higher wattage soldering iron may separate the etched wiring from the base material.

The tip should be made of copper and have a chisel or beveled shape, with a 1/8 inch width. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint.

The following technique should be used to replace a component on a circuit board. Most components can be replaced without removing the boards from the instrument.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick into the hole to clean it out. A vacuum-type desoldering tool can also be used for this purpose. If the removal is not accomplished in the first few seconds of heat application, go to another connection or

wait a few minutes before reheating the connection. This is to avoid transferring too much heat to the substrate.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint; do not apply too much solder. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers (see Fig. 4-5) or other heat sink.

5. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

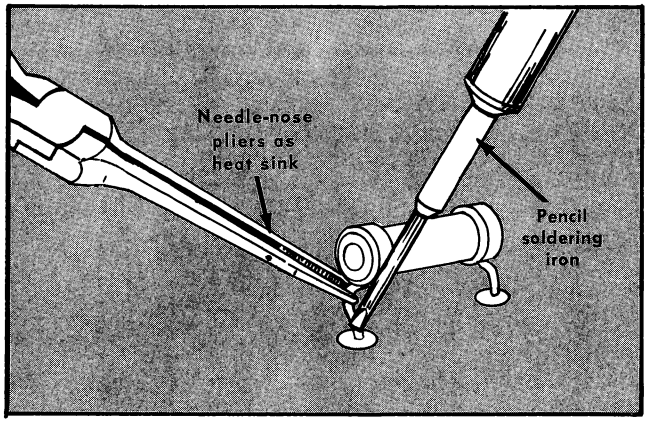


Fig. 4-5. Use of a heat sink to protect components during soldering.

Metal Terminals. When soldering to metal terminals (e.g., switch terminals, potentiometers, etc.), ordinary 60/40 solder can be used. Use a soldering iron with a 40- to 75-watt rating and a $^3/_{16}$ inch wide wedge-shaped tip.

Observe the following precautions when soldering to metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-remover solvent.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Circuit Boards. If the circuit board is damaged beyond repair, replacement can be made of the entire assembly including all soldered-on components, or of the board alone. Part numbers are given in the Mechanical Parts List for either the completely wired or the unwired board. Most of the components mounted on the circuit boards can be replaced without removing the boards from the instrument. However, if the bottom side of a board must be reached, the following procedure outlines the removal and replacement of the boards.

Removal:

1. Disconnect all pin connectors on both sides of the board. (See Fig. 4-12 through 4-15.)

2. Remove all interconnecting wires which do not have pin connectors. (See Fig. 4-16.)

3. Remove six (6) mounting screws. (See Fig. 4-11.)

4. Remove circuit board.

Circuit Board Replacement:

1. Position the circuit board over the mounting holes.

2. Install all six (6) mounting screws and tighten equally. Each screw must be installed to insure a good electrical connection between the board and chassis.

3. Connect all interconnecting wires.

4. Connect all pin connectors.

Cathode-Ray Tubes. Use care when handling a CRT. Protective clothing and safety glasses should be worn. Avoid striking it on any object which might cause it to crack or implode. When storing a CRT, place it face down on a smooth surface with a protective cover or soft mat under the faceplate to protect it from scratches.

The following procedure outlines the removal and replacement of the cathode-ray tube.

Removal:

1. Remove the four CRT deflection plate pin connectors as shown in Fig. 4-6. Do not bend the CRT deflection plate pins.

2. Remove the plastic bezel as shown in Fig. 4-7.

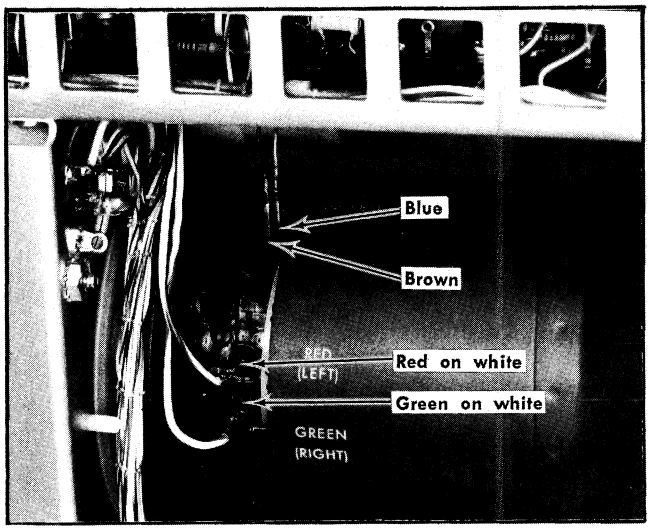


Fig. 4-6. CRT deflection plate pins and connecting wire color codes.

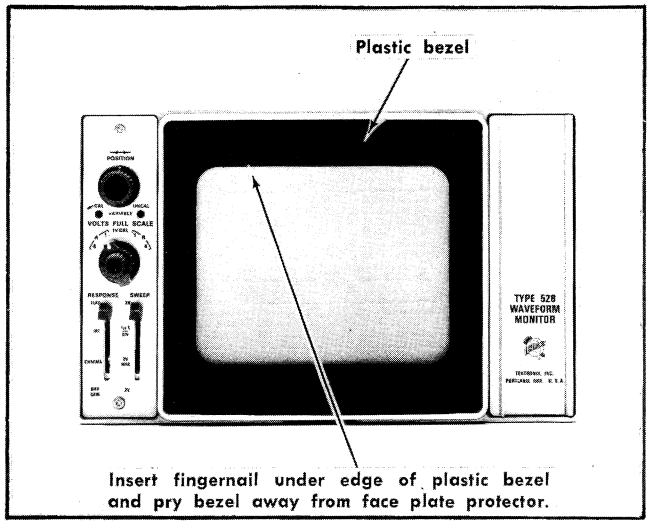


Fig. 4-7. Remove the plastic bezel.

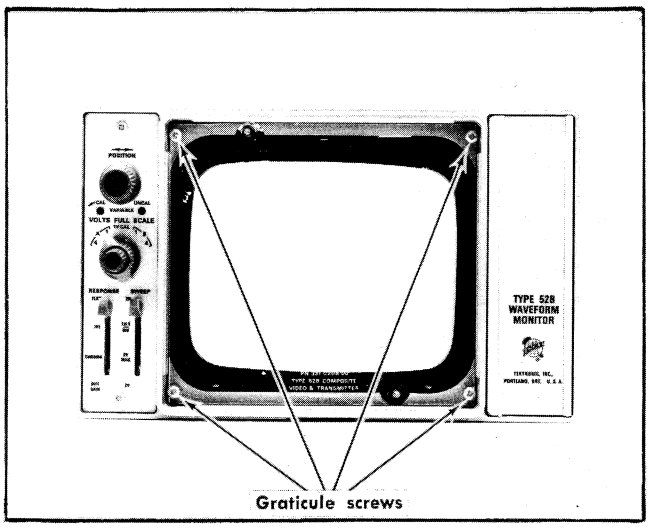


Fig. 4-8. Location of screws to remove graticule.

3. Remove four (4) phillips head screws holding the graticule as shown in Fig. 4-8.

4. Remove graticule.

5. Remove the CRT base cover from the rear of the instrument as shown in Fig. 4-9.

6. Remove the CRT base socket from the CRT.

7. Turn the CRT clamp screw until the CRT will slide within the clamp. (See Fig. 4-10.)

8. Push on the CRT base to slide the CRT forward. Pull the CRT out of the instrument from the front, making certain that the deflection plate pins clear the CRT shield.

CAUTION

Handle with care. Due to the high vacuum that exists inside the CRT, scratching any of the external surfaces or rough handling increases the implosion hazard.

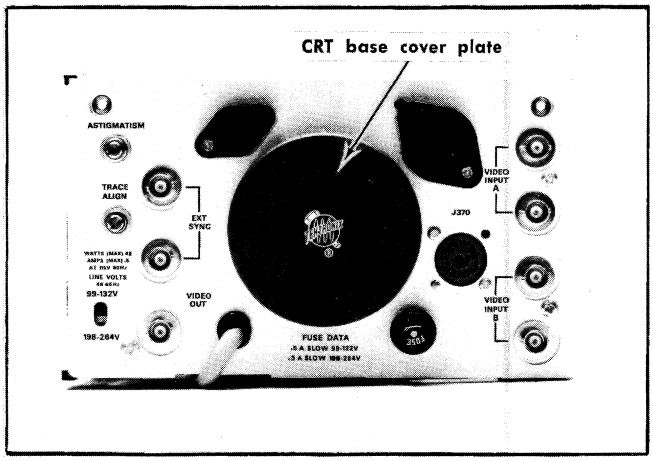


Fig. 4-9. Rear of instrument showing CRT base cover plate.

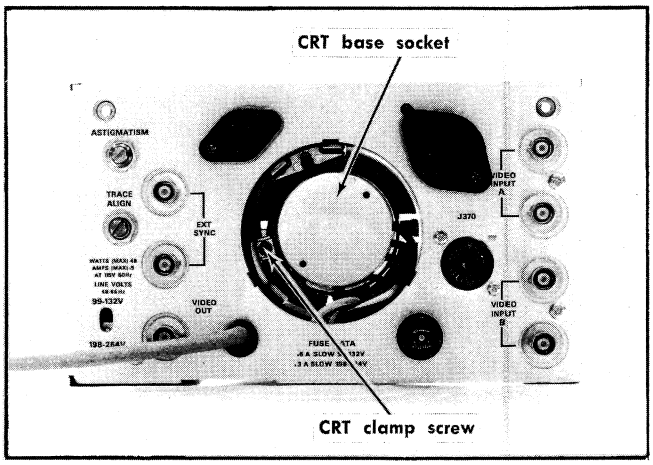


Fig. 4-10. Location of CRT clamp screw.

Replacement:

1. Slide the CRT into the CRT shield, being careful not to bend the deflection plate pins.

2. Guide the CRT base into the CRT clamp, and slide the CRT far enough to the rear of the instrument to allow the graticule to be replaced.

3. Replace the graticule (etched side towards CRT), insert phillips head screws and tighten.

4. Push the CRT forward until the CRT touches the graticule.

5. Tighten the CRT base clamp.

6. Replace the CRT deflection plate pin connectors. Do not bend the deflection plate pins.

7. Replace the CRT base socket and install the rear cover.

8. Replace the plastic bezel over the CRT graticule.

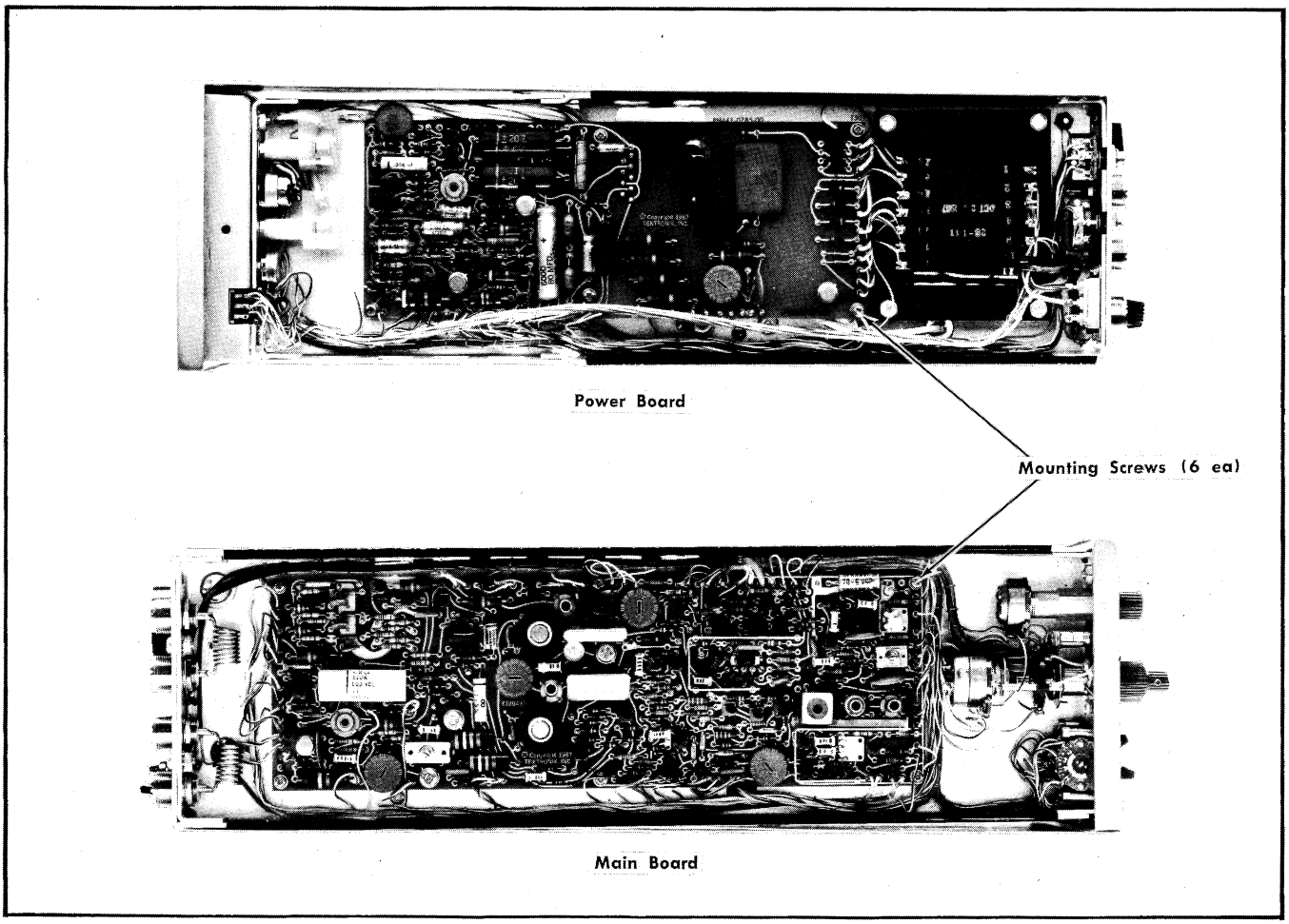


Fig. 4-11. Location of circuit boards in the Type 528.

Replacement of the CRT will necessitate instrument calibration. Refer to Calibration, Section 5.

Relay. To remove K370, it is not necessary to remove the circuit board. Care must be taken when a replacement is made to insure that the relay will not be damaged.

Removal:

With a small screwdriver, expand the metal clip that surrounds the body of the relay. At the same time gently pull the relay away from the circuit board until the clip frees the top of the circuit board. Once the clip has cleared, release, and pull the relay from the board.

Replacement:

Place the metal clip around the relay. Guide the relay into the circuit board until the metal clip comes into contact with the bottom of the circuit board. With the use of a small screwdriver, expand the clip out while pushing the relay into the circuit board. Once the clip has cleared the top of the circuit board, release. Both sides of the clip must rest on the top of the circuit board to insure that the relay will operate correctly.

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

CAUTION

The Power switch must be turned off before removing or replacing transistors.

Replacement transistors should be of the original type or a direct replacement. Re-mount the transistors in the same manner as the original. Transistors which have heat radiators or which are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

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

Fig. 4-2 shows the lead configurations of the transistors used in this instrument. This view is as seen from the bottom of the transistor.

Fuse Replacement. Table 4-4 gives the rating and function of the fuses used in this instrument.

TABLE 4-4

Fuse	Value	Function
F502	6/10 A slow (SN B100000 & up) 1/2 A slow (below SN 100000)	Line fuse
F542	3/4 A fast	—15 volt and +10 volt power supply protection

Switches. If a switch is defective replace the entire assembly. Replacement switches can be ordered by referring to the Parts List for the applicable part numbers.

When replacing a switch, tag the leads and switch terminals with corresponding identification tags as the leads are disconnected. Then, use the old switch as a guide for installing the new one. An alternative method is to draw a sketch of the switch layout and record the wire color at each terminal. When soldering to the new switch be careful that the solder does not flow beyond the rivets on the switch terminals. Spring tension of the switch contact can be destroyed by excessive solder.

Power Transformer Replacement. Be sure to replace only with a direct replacement Tektronix transformer.

When removing the transformer, tag the leads with the corresponding terminal numbers to aid in connecting the new transformer. After the transformer is replaced, check the performance of the complete instrument using the Performance Check procedure.

High Voltage. The components are located on the Power board. To remove or repair this section, refer to circuit board removal and replacement procedure provided in this section.

NOTE

All solder joints in the high voltage section should have smooth surfaces. Any protrusions may cause high-voltage arcing at high altitudes.

Recalibration After Repair

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits. Since the low voltage power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the low voltage supply or if the power transformer has been replaced. The Performance Check procedure in Section 5 provides a quick and convenient means of checking instrument operation.

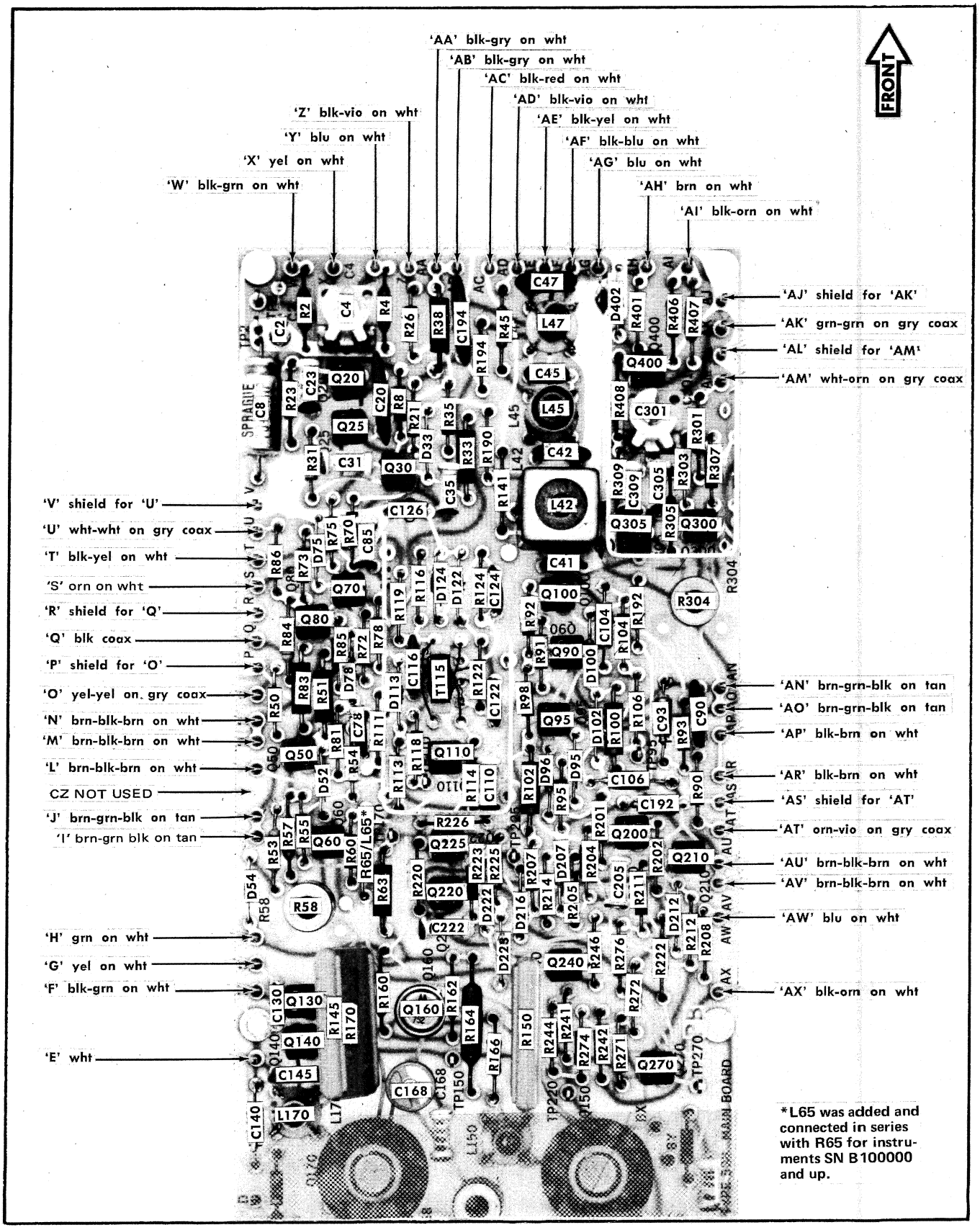


Fig. 4-12. Partial top view of Main board showing components and wire color codes for instruments SN B100000-up.

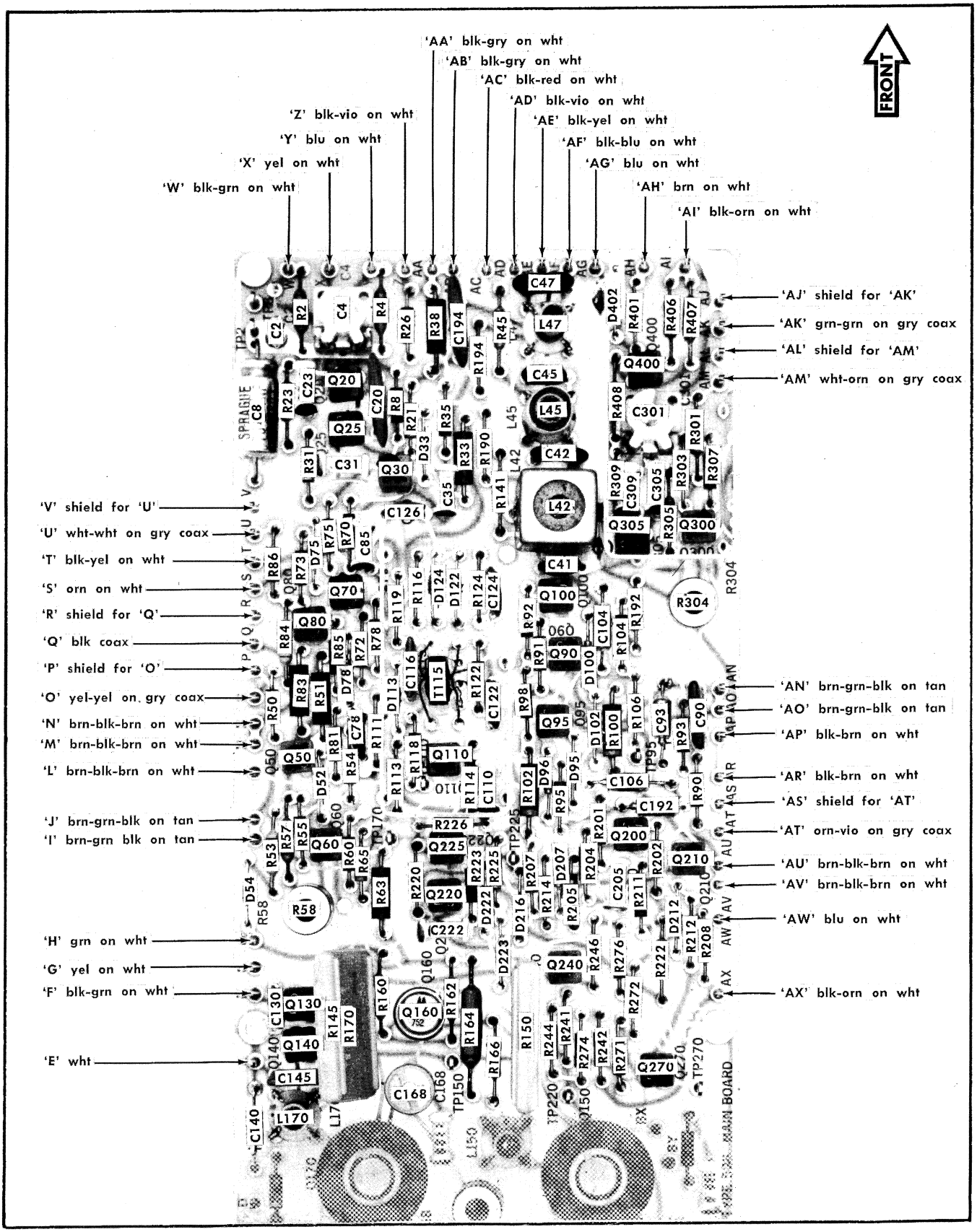


Fig. 4-12A. Partial top view of Main board showing components and wire color codes for instruments SN B080560-B099999.

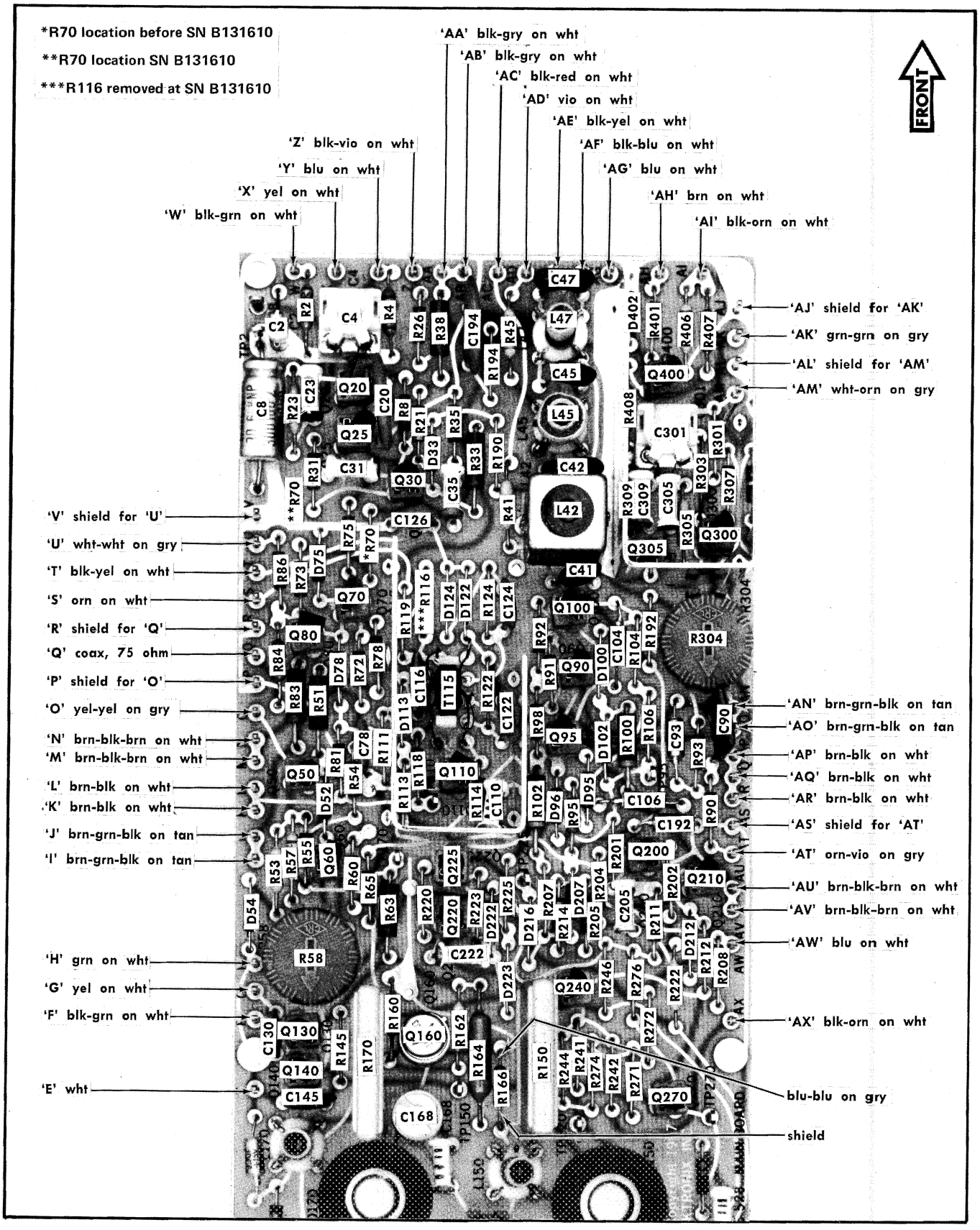


Fig. 4-12B. Partial top view of Main board showing components and wire color codes for instruments below SN B080560.

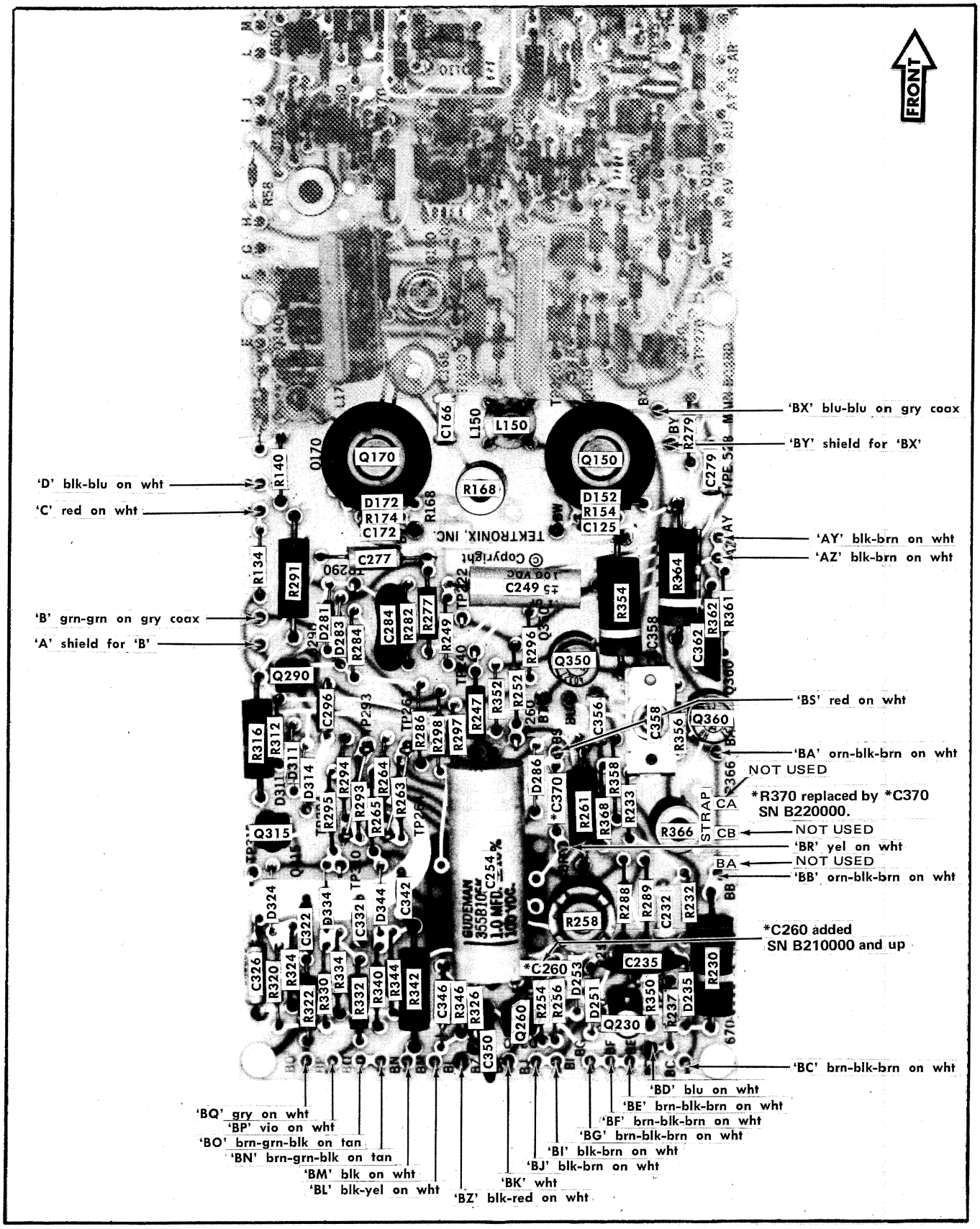


Fig. 4-13. Partial top view of Main board showing components and wire color codes for instruments SN B080560 and up.

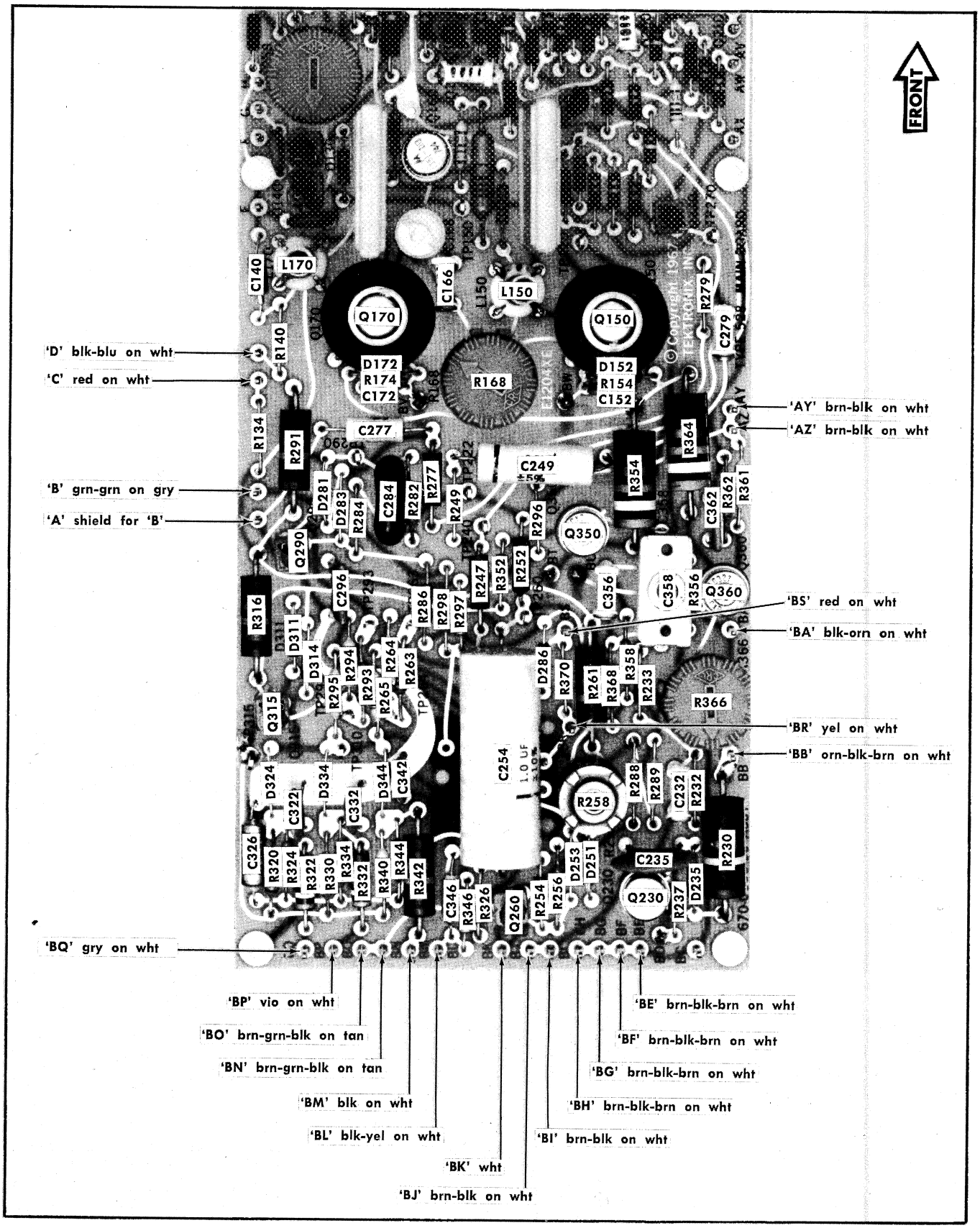


Fig. 4-13A. Partial top view of Main board showing components and wire color codes for instruments below SN B080560.

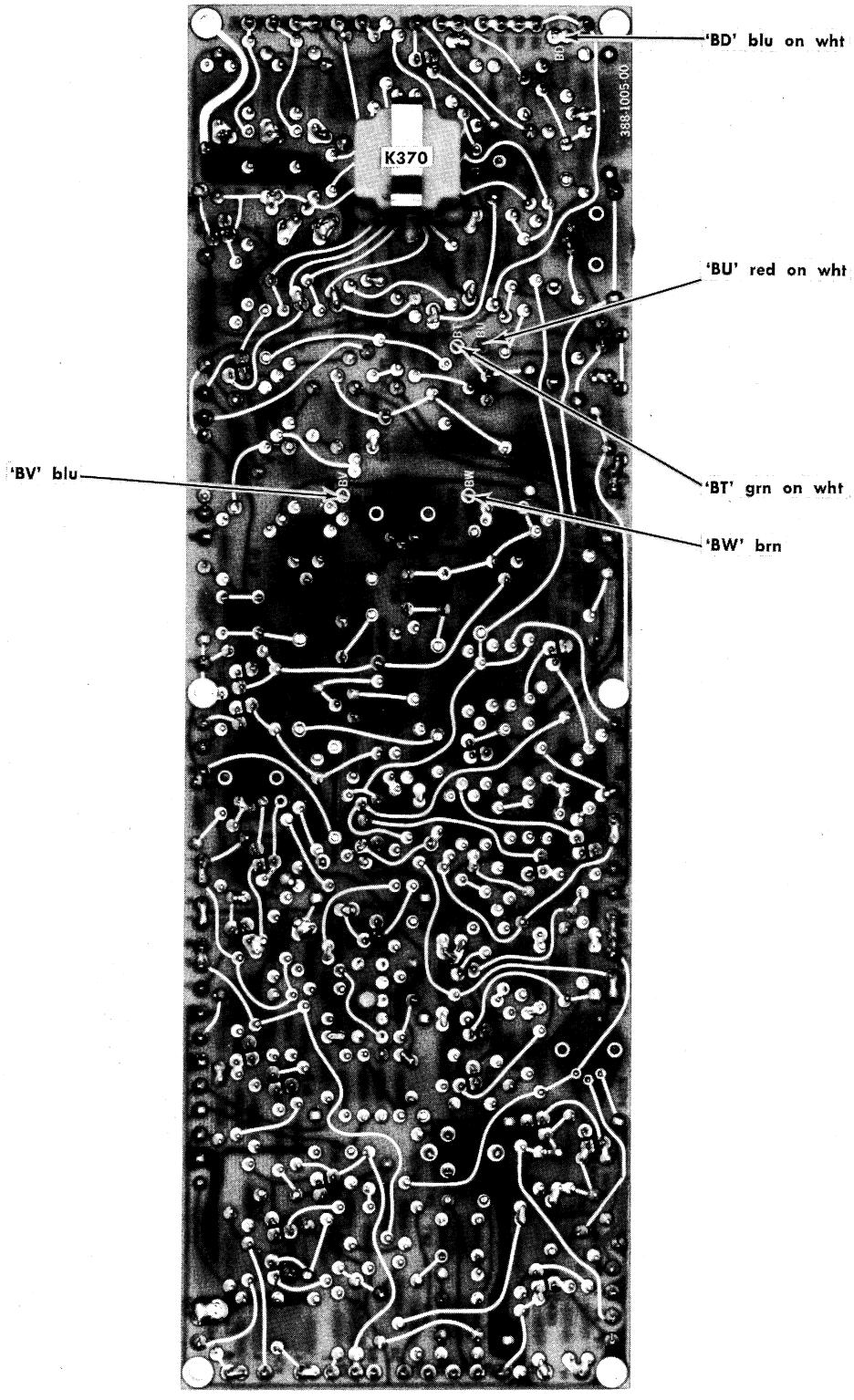


Fig. 4-14. Bottom view of Main board showing components and wire color codes.

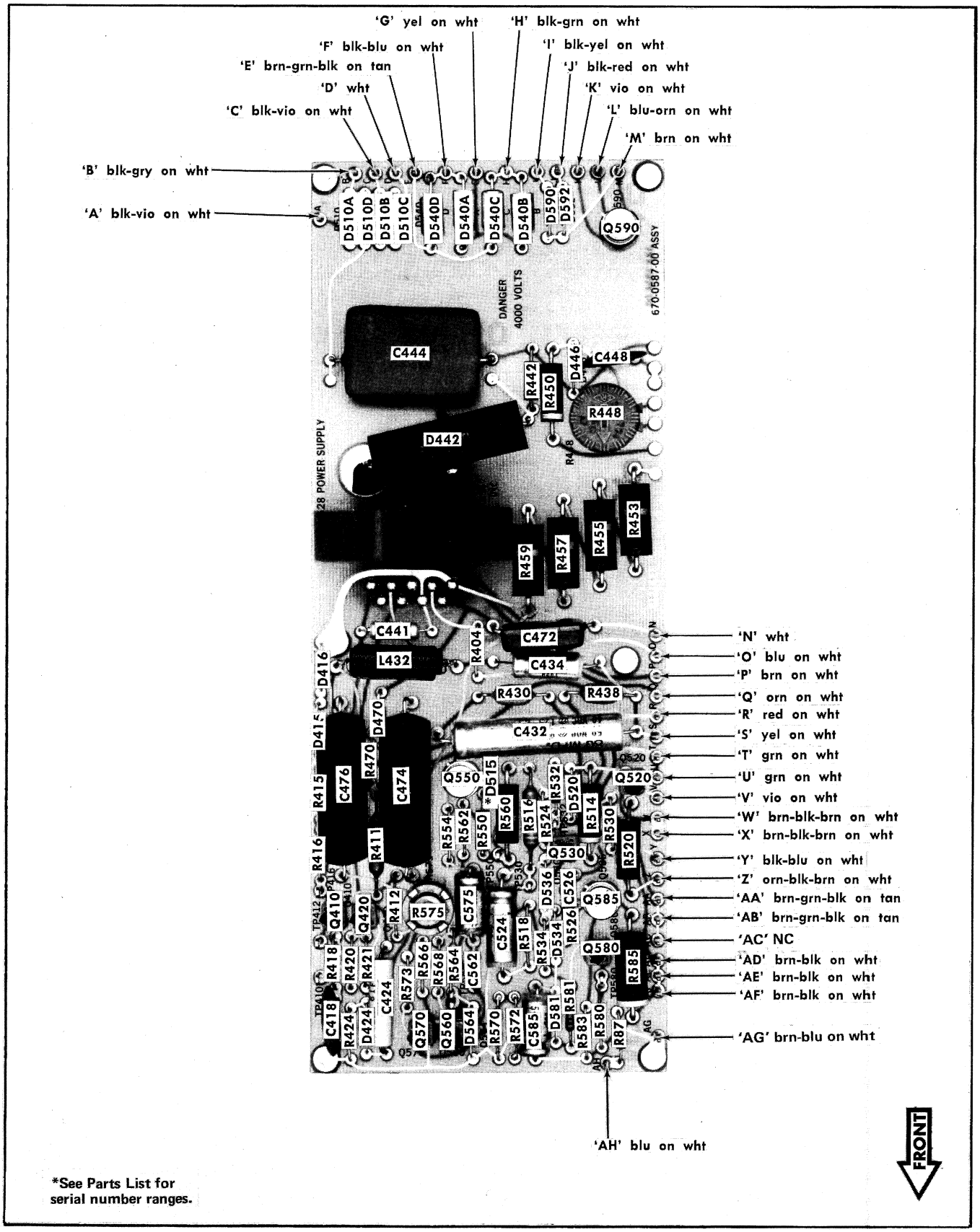


Fig. 4-15. Top view of Power board showing components and wire color codes.

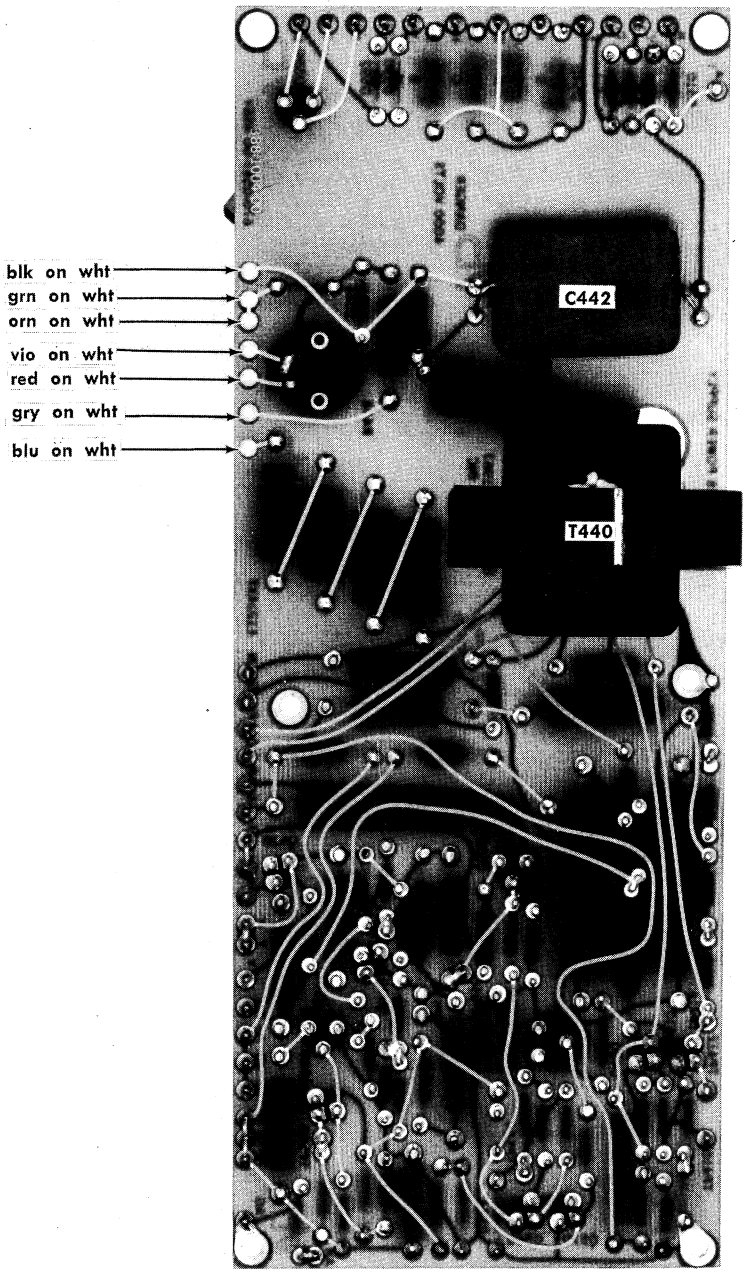


Fig. 4-16. Bottom view of Power board showing components and wire color codes.

SECTION 5
PERFORMANCE CHECK / CALIBRATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This procedure checks and/or calibrates the instrument to the performance requirements listed in the Specification section.

Performance Check. This part of the procedure checks the operation of the instrument without removing the covers or making internal adjustments. However, screwdriver adjustments located on the rear panel are adjusted in this part of the procedure.

If the instrument does not meet the performance requirements given in the Performance Check, internal checks and/or adjustment are required.

Calibration procedure. This part of the procedure can return the Type 528 to its original performance standards by completion of every step. Limits, tolerances, and waveforms in this section are given as calibration guides and are not instrument specifications. To merely touch up the calibration, perform only steps entitled "Adjust . . .". A short-form calibration procedure is also provided in this section for the convenience of the experienced calibrator.

The Type 528 should be checked, and recalibrated if necessary, after each 500 hours of operation, or every six months if used infrequently, to assure correct operation and accuracy.

TEST EQUIPMENT REQUIRED

General

All of the following test equipment, or its equivalent, is required for complete calibration of the Type 528. Some, but not all of the following test equipment will be required for the performance check. Test equipment used in this procedure is illustrated in the setup pictures relating to the steps in which the particular items of test equipment are used.

Specifications given are the minimum necessary for accurate calibration. 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.

For ease and accuracy in calibration, special calibration fixtures are used where necessary. All calibration fixtures listed are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Precision DC voltmeter.[1] Accuracy, within ±0.25%; range, 0 to 1 volt. For example, Fluke Model 825A.

2. Test oscilloscope. Bandwidth, DC to at least 30 MHz; minimum deflection factor, 1 mV/div; two input channels algebraically added with a common mode rejection ratio of 10,000:1 with one channel signal inverted. Tektronix Type 547 Oscilloscope with Type 1A5 Plug-In unit and one Tektronix P6023 (10×)[1] Probe recommended.

3. Variable autotransformer. Must be capable of supplying at least 50 volt-amperes over a voltage range of 99 to 132 volts (198 to 264 volts for 230 volt nominal line). If autotransformer does not have an AC voltmeter to indicate output voltage, monitor output with an AC voltmeter (RMS) with a range of at least 132 (or 264) volts. For example, General Radio W10MT3W Metered Variac Autotransformer.

4. Video signal source. Signals available, 3.58 MHz modulated one volt linearity stairstep, composite sync pulses at a line rate variable between 1.5 V and 4.5 V peak to peak, one volt composite video with possibility to add burst and one volt sin² pulse and bar video signal. For example, Riker Industries, Inc. or Telemet Company equipment.

5. Time-Mark generator. Marker outputs of 1 μs; accuracy, 0.001%. Tektronix Type 184 Time-Mark Generator recommended.

6. Vectorscope. Measuring functions, differential gain and phase; accuracy, 1% and 0.3° respectively. Tektronix Type 520 Vectorscope recommended.

7. Constant Amplitude Sine-wave Generator. Frequency, variable from below 25 Hz to above 5 MHz; output amplitude, adjustable from below 1 volt to about 2 volts; amplitude regulation, 0.5%. For example, Hewlett-Packard Model 652A generator.

8. Standard amplitude calibrator. Amplitude accuracy, within 0.25%; signal amplitudes, 1 volt and 2 volts square-wave, −1 volt, −10 volts, +1 volt and +10 volts DC; square-wave frequency, about 1 kHz. Tektronix calibration fixture 067-0502-00 recommended.

9. 067-0576-00 Return Loss Bridge. Tektronix calibration fixture 067-0576-00 recommended.

10. Cable (two). Impedance, 75 ohms; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0074-00.

11. Cable. Impedance, 50 ohm; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

12. Adapter. Connectors, BNC female to UHF male. Tektronix Part No. 103-0015-00. To be used with Type 520 Vectorscopes (item 6) Serial No. B010100 through B179999. Not needed if Vectorscope Serial No. is B180000 or higher.

[1]Not required for performance check procedure.

13. Attenuator. Connectors, BNC; impedance, 50 ohms to 75 ohms; type, minimum loss when going from a 50 ohm system to a 75 ohm system. Tektronix Part No. 011-0057-00.

14. Termination (two). Impedance 75 ohm; connectors, BNC; type, feed-thru; accuracy, ±3%. Tektronix Part No. 011-0055-00.

15. Termination. Impedance, 75 ohm; connector, UHF; type, end-line; accuracy, ±3%. Tektronix Part No. 011-0104-00. For use with Type 520 Vectorscopes (item 6) Serial No. B010100 through B179999. If Vectorscope Serial No. is B180000 or higher, use a 75 ohm BNC termination, Tektronix Part No. 011-0102-00.

16. 9-pin plug. Cover, Tektronix Part No. 200-0249-00; plug, Tektronix Part No. 136-0099-00; miscellaneous parts needed for wiring plug, 75 ohm coaxial cable 42 inches long, BNC male connector for cable and about 2 inches of strap wire. (See Fig. 5-11.)

17. Adjustment tools.

Description	Tektronix Part No.
a. Insulated screwdriver, 1½ inch shaft, non-metallic	003-0000-00
b. Tuning tool[1]	
Handle	003-0307-00
Insert for 5/64 inch (ID) hex cores	003-0310-00
c. Tuning tool; 5 inches long, plastic[1] for adjusting 0.1 inch (ID) hex cores	003-0301-00

CALIBRATION RECORD AND INDEX

This short-form procedure is provided to aid in checking the calibration of the Type 528. It may be used as a calibration guide by the experienced calibrator, or it may be used as a record of calibration. Since the step numbers and titles correspond to those in the complete procedure, this procedure also serves as an index to the complete Calibration Procedure. Where a step refers to one procedure or the other, it is so labeled. If it applies to both procedures, there is no special labeling. Performance requirements correspond to those given in the Specification section.

Type 528, Serial No., _____

Calibration Date _____

Calibration Technician _____

PERFORMANCE CHECK/CALIBRATION PROCEDURE

General

The following procedure is arranged in a sequence designed for checking or calibrating with minimum interaction of adjustments and reconnection of equipment. However, some adjustments affect the calibration of other circuits within the instrument, and, it may be necessary to check the operation of other parts of the instrument. When a step interacts with others, the steps which need to be checked are noted in the "INTERACTION— . . . . ." step.

Performance check procedure. Each performance requirement will be found at the start of the related step in the Performance Check procedure.

Calibration procedure. Any needed maintenance should be performed before proceeding with calibration. Troubles which become apparent during calibration should be corrected using the techniques given in the Maintenance section.

The steps titled "Adjust . . . .", or "Adjust/Check . . . ." in the following procedure provide a check of instrument performance, whenever possible, before the "CALIBRATION ADJUST— . . . ." step is performed. The symbol ◐ is used to identify the steps in which an adjustment is made. To prevent recalibration of other circuits when performing a partial calibration, readjust only if the listed tolerance is not met. However, when performing a complete calibration, best overall performance will be provided if each adjustment is made to the exact setting, even if the "CALIBRATION CHECK— . . . ." step is within the allowable tolerance.

Performance check and/or calibration procedure. In the following procedure, a test equipment setup picture is shown for each major group of adjustments and checks. Following each setup picture is a complete list of front-panel control settings for the Type 528. To aid in locating individual controls which have been changed during the complete performance check and/or calibration, these control names are printed in bold type. If only a partial performance check and/or calibration is performed, start with the preceding setup. Type 528 front-panel control titles are capitalized (e.g., RESPONSE). Internal adjustment titles are initial capitalized only (e.g., Sweep Length).

The following procedure uses the equipment listed under Equipment Required. If equipment is substituted, control settings or test equipment setup may need to be altered to meet the requirements of the equipment used.

NOTE

All waveforms shown in this procedure are actual waveform photographs taken with a Tektronix Oscilloscope Camera System.

Preliminary Procedure

1. (Calibration procedure only.) Remove the Type 528 from any enclosure so as to provide access to all internal adjustments and test points, including rear panel adjustments and connectors. Refer to the Dimension Drawing Section of this manual for cabinet removal details.

2. Check that a Type 528 composite video and transmitter graticule (331-0208-01) is installed.

3. Connect the autotransformer to a suitable power source, and the Type 528 to the autotransformer output.

4. Set the autotransformer output voltage to the design center voltage for which the Type 528 LINE VOLTS selector has been set.

5. Set the front- and rear-panel controls of the Type 528 as described below.

6. Set the Type 528 POWER-SCALE ILLUM switch to on. Allow at least 5 minutes warm-up at 25° C, ±5° C before checking the instrument to the given accuracy.

NOTES

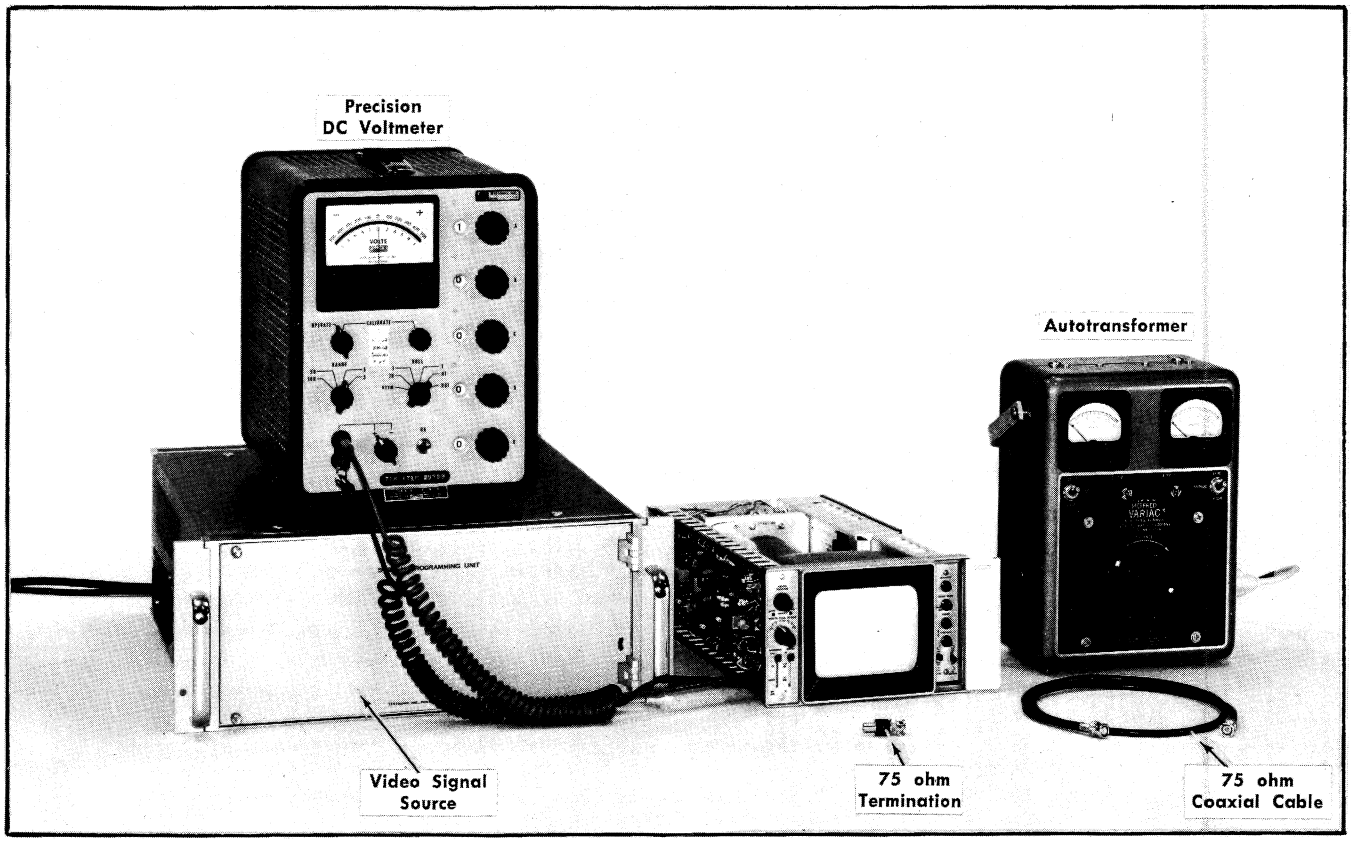


Fig. 5-1. Initial calibration test equipment setup for steps 1 through 5.

Left-Front Panel Controls:

POSITION (Horizontal)	Midrange
VOLTS FULL SCALE	A1
VARIABLE (VOLTS FULL SCALE)	CAL
RESPONSE	FLAT
SWEEP	2H

Recessed Front-Panel Controls:

INTENSITY	As desired
POWER-SCALE ILLUM	As desired
FOCUS	As desired
POSITION (Vertical)	Midrange
SYNC	INT
DC RESTORER	OFF

Rear-Panel Controls:

ASTIGMATISM	As is
TRACE ALIGN	As is
LINE VOLTS	Set for correct line voltage range

1. Adjust —15 Volt Power Supply

If this procedure is being used as a performance check omit this step and proceed to step 1A.

a. Test equipment setup is shown in Fig. 5-1.

b. Turn off Type 528 power.

c. Short together test points TP2 and TP8 on the main board; see Fig. 5-2.

d. Disconnect the blue on white wire from pin AG on the main board.

e. Connect a precision DC voltmeter between ground and pin AI on the main board.

f. Turn on Type 528 power and note the voltmeter reading after sufficient warm-up time.

g. Set the VOLTS FULL SCALE switch to 1 V CAL.

h. CALIBRATION CHECK—Voltmeter reading; should be one volt, ±1% higher than the voltmeter reading noted in part f of this step.

i. CALIBRATION ADJUST— —15 Volts control, R575, (see Fig. 5-3) until the voltmeter reading in part f (VOLTS FULL SCALE switch set to AI) and part h (VOLTS FULL SCALE switch set at 1 V CAL) show a difference of exactly one volt.

j. Turn off Type 528 power.

k. Remove the short from between test points TP2 and TP8 and disconnect the precision DC voltmeter.

l. Reconnect the blue on white wire to pin AG on the main board (removed in part d); see Fig. 5-2.

m. Turn on Type 528 power.

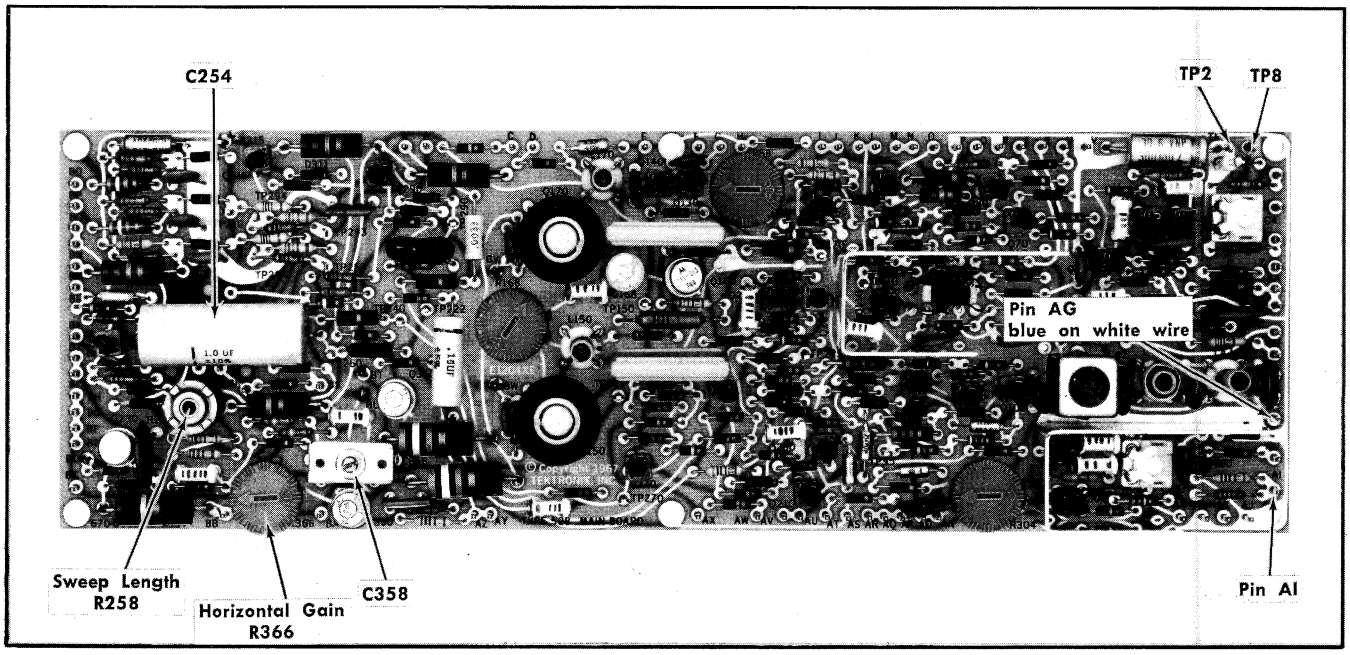


Fig. 5-2. Main board test point and control locations.

1A. (Performance Check) Check Calibrator Low- and High-Voltage Power Supplies

PERFORMANCE REQUIREMENT—Internal calibrator signal must be within 1% of 1 volt.

a. Connect a 1 V peak to peak square-wave signal from a standard amplitude calibrator via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector. Do not connect any termination to the lower VIDEO INPUT A connector.

b. Note Type 528 display amplitude (139.5, ±1.4 IRE units).

c. Set the Type 528 VOLTS FULL SCALE switch to 1 V CAL.

NOTE

If the display is not stable, the value of C472 (see Fig. 5-3) may be selected to provide proper triggering of the Calibrator display.

d. PERFORMANCE CHECK—Type 528 display amplitude; within 1% of the display amplitude noted in part b of this step.

e. Disconnect the standard amplitude calibrator and the 75 ohm coaxial cable.

2. Adjust Intensity Limit ◐

For Performance Check only, perform parts a through d and then proceed to step 3.

a. Set the VOLTS FULL SCALE switch to A1.

b. Connect a composite video signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. Adjust the vertical and horizontal positioning controls to center the display in the 140 IRE unit area of the CRT.

e. Rotate the INTENSITY control fully clockwise.

f. CALIBRATION CHECK—Display blooming less than 1 IRE unit vertical and less than 1 minor division horizontal deflection.

g. CALIBRATION ADJUST—Intens Limit control, R448, (see Fig. 5-3) for less than 1 IRE unit of vertical and less than 1 minor division of horizontal display blooming.

h. Reduce the display intensity to a usable level.

3. Check Low-Voltage Power Supply Voltages

Requirement—Display must remain stable and not change in amplitude as the line voltage and INTENSITY controls are varied throughout their ranges.

a. Set the SWEEP switch to 2 V.

b. Set the autotransformer output voltage to the lower voltage listed for the LINE VOLTS selector position being used.

c. Rotate the INTENSITY control from one extreme to the other.

d. PERFORMANCE/CALIBRATION CHECK—Display stability and amplitude; must not change as part c of this step is accomplished.

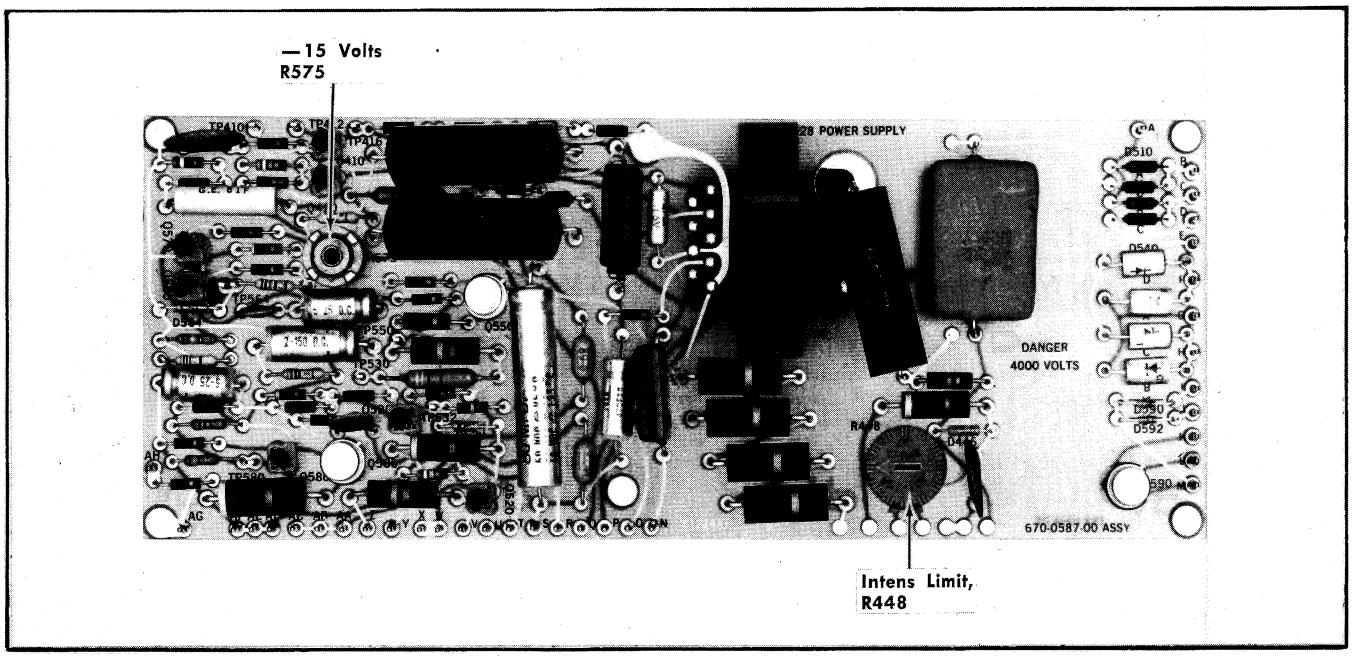


Fig. 5-3. Power supply board test point and control locations.

e. Set the autotransformer output voltage to the higher voltage listed for the LINE VOLTS selector position being used.

f. Repeat **d** of this step.

g. Set the autotransformer output voltage to the design center voltage for the LINE VOLTS selector position being used.

h. Disconnect the video signal source, 75 ohm coaxial cable and 75 ohm termination. Adjust the INTENSITY control for a usable display brightness.

i. Disconnect the autotransformer and connect the Type 528 directly to a suitable power source.

4. Adjust Astigmatism ◐

PERFORMANCE REQUIREMENT—A well defined display must be obtainable.

a. Set the VOLTS FULL SCALE switch to 1 V CAL and the SWEEP switch to 2H.

b. PERFORMANCE/CALIBRATION CHECK—Type 528 display; should be a well defined square-wave.

c. PERFORMANCE/CALIBRATION ADJUST—ASTIGMATISM control, R464, (see Fig. 5-4) and the recessed front-panel FOCUS control for a well defined square-wave.

5. Adjust Trace Alignment ◐

PERFORMANCE REQUIREMENT—Trace must have an adjustment range of 6° and be adjustable to parallel the horizontal graticule lines.

a. Set the VOLTS FULL SCALE switch to A1.

b. Rotate the TRACE ALIGN control, R462, to its fully clockwise position.

c. Note the angle of the trace to the horizontal graticule lines.

d. Rotate the TRACE ALIGN control, R462, to its fully counterclockwise position.

e. Note the angle of the trace to the horizontal graticule lines.

f. PERFORMANCE/CALIBRATION CHECK—Trace alignment range; the angular difference between the trace positions in parts c and e of this step must be at least 6°.

g. PERFORMANCE/CALIBRATION CHECK—Trace alignment; trace should be parallel throughout its length to the horizontal graticule lines.

h. PERFORMANCE/CALIBRATION ADJUST — TRACE ALIGN control, R462, until the trace parallels the horizontal graticule lines.

Fig. 5-4. Rear-panel control locations.

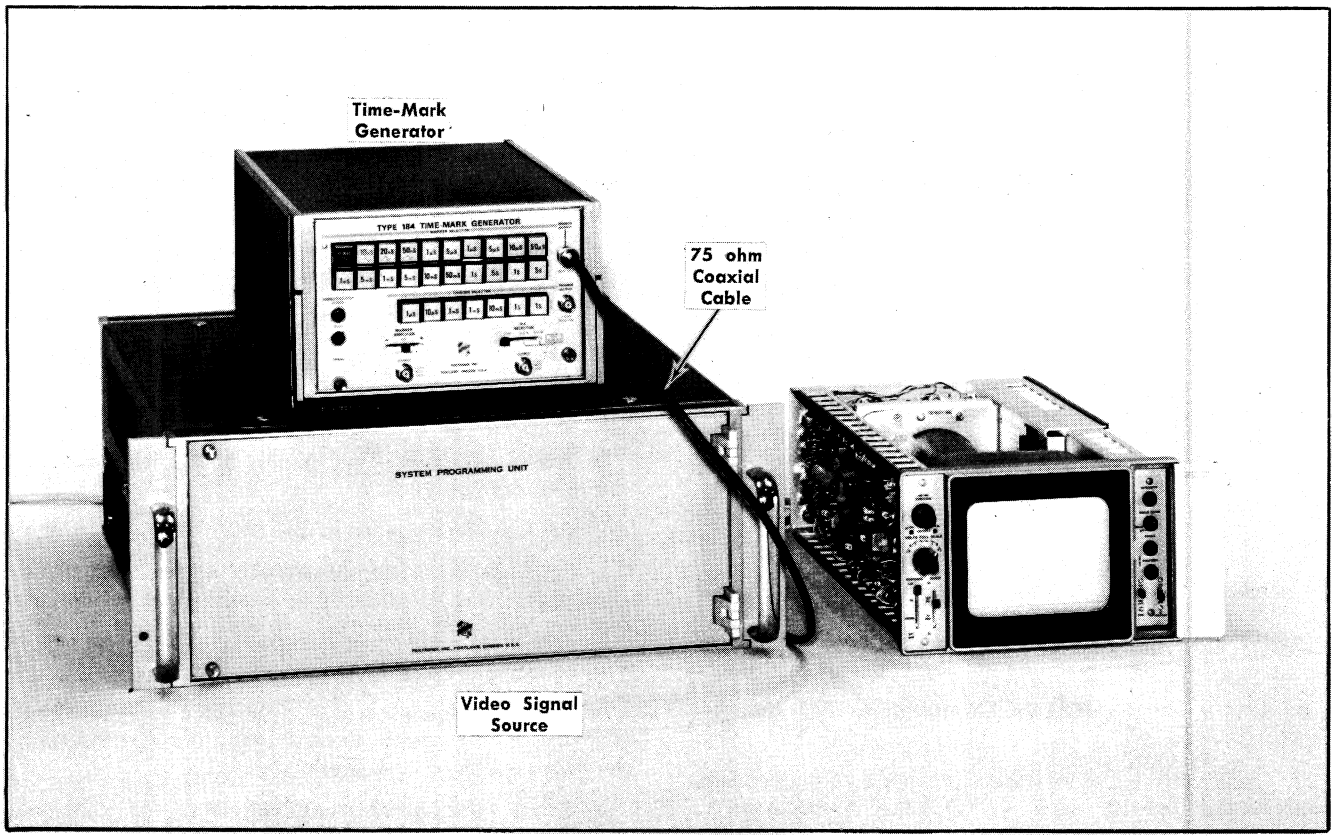


Fig. 5-5. Initial calibration test equipment setup for steps 6 through 10.

Left Front-Panel Controls:

POSITION (Horizontal)	Midrange
VOLTS FULL SCALE	**B 1**
VARIABLE (VOLTS FULL SCALE)	CAL
RESPONSE	FLAT
SWEEP	**1 μs/DIV**

Recessed Front-Panel Controls:

INTENSITY	As desired
POWER-SCALE ILLUM	As desired
FOCUS	As desired
POSITION (Vertical)	Midrange
SYNC	INT
DC RESTORER	OFF

Rear-Panel Controls:

ASTIGMATISM	As is
TRACE ALIGN	As is
LINE VOLTS	Set for correct line voltage range

6. Adjust/Check 1 μs Sweep Timing

PERFORMANCE REQUIREMENT—A 1 μs time marker input signal should produce a display of 1 time marker per major horizontal graticule division, ±3%

a. Test equipment setup is shown in Fig. 5-5.

b. Connect 1 μs time marker from a time-mark generator via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT B connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT B connector.

NOTE

If the display is not stable, adjust the VOLTS FULL SCALE and VARIABLE controls until a stable display is achieved.

d. PERFORMANCE/CALIBRATION CHECK—Type 528 display; should be one time-marker per major horizontal graticule division, ±3%.

e. CALIBRATION ADJUST—Horizontal Gain control, R366, (see Fig. 5-2) until there is one 1 μs time-marker per major horizontal graticule division.

f. Test equipment remains connected for step 7.

7. Adjust/Check Sweep Linearity

PERFORMANCE REQUIREMENT—Sweep must be within ±3% of linear over the width of the graticule excluding the first and last major horizontal graticule divisions.

a. Position the start (left side) of the SWEEP to the first major division mark on the 0 IRE graticule line.

b. PERFORMANCE/CALIBRATION CHECK—Type 528 display linearity; spacing should be equal between the time-markers over the width of the graticule within ±3%, excluding the first and last major horizontal graticule divisions.

c. CALIBRATION ADJUST—C358, see Fig. 5-2, until the spacing between the time-markers over the width of the graticule is as close as possible to being even, excluding the first and last major horizontal graticule divisions.

d. Disconnect the time-mark generator, 75 ohm coaxial cable and the 75 ohm termination.

8. Adjust/Check Sweep Length

PERFORMANCE REQUIREMENT—Sweep length should be 12.1 major horizontal graticule division ±0.5 major division.

a. Set the VOLTS FULL SCALE switch to A 1 and the SWEEP switch to 2V.

b. Connect a composite video signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. PERFORMANCE/CALIBRATION CHECK — Type 528 sweep length; 12.1 major horizontal graticule divisions ±0.5 major division.

e. CALIBRATION ADJUST—Sweep Length control, R258, (see Fig. 5-2) until a sweep length of 12.1 major horizontal graticule divisions is obtained.

f. Set the SWEEP switch to 2H.

g. PERFORMANCE/CALIBRATION CHECK — Type 528 sweep length; 12.1 major horizontal graticule division ±0.5 major division.

h. Test equipment remains connected for step 9.

9. Check Magnifier Registration

PERFORMANCE REQUIREMENT—When the start of an unmagnified sweep has been positioned to the first major graticule division marker, the 2V magnified sweep (SWEEP switch to 2V MAG) must show some part of the vertical blanking interval, and the 2H magnified sweep (SWEEP switch to 1 μs/DIV) must show some part of the horizontal sync interval. In both magnified sweep positions the start and end of the trace must be positionable into the viewing area.

a. Set the SWEEP switch to 2V.

b. Position the start of the display (left side of display) to the first major horizontal graticule division mark (first large horizontal graticule division mark on left side of graticule).

c. Set the SWEEP switch to 2V MAG.

d. PERFORMANCE/CALIBRATION CHECK—Type 528 display; part of the vertical blanking interval must be visible.

e. Rotate the horizontal position control clockwise until the start of the magnified display can be seen.

f. PERFORMANCE/CALIBRATION CHECK—Type 528 display; start of magnified display can be positioned into the viewing area of the CRT.

g. Rotate the horizontal position control counterclockwise until the end of the magnified display can be seen.

h. PERFORMANCE/CALIBRATION CHECK—Type 528 display; end of magnified display can be positioned into the viewing area of the CRT.

i. Set the SWEEP switch to 2H.

j. Position the start of the display to the first major graticule division mark.

k. Set the SWEEP switch to 1 μs/DIV.

l. PERFORMANCE/CALIBRATION CHECK—Type 528 display; part of the horizontal sync interval must be visible.

m. Rotate the horizontal position control clockwise until the start of magnified display can be seen.

n. PERFORMANCE/CALIBRATION CHECK—Type 528 display; the start of the magnified display can be positioned into the viewing area of the CRT.

o. Rotate the horizontal position control counterclockwise until the end of the magnified display can be seen.

p. PERFORMANCE/CALIBRATION CHECK—Type 528 display; end of magnified display can be positioned into the viewing area of the CRT.

q. Disconnect the video signal source, 75 ohm coaxial cable and the 75 ohm termination.

10. Check Sweep Repetition Rate

PERFORMANCE REQUIREMENT—2H sweep should display two horizontal lines showing burst that is not interlaced. 2V sweep should display two fields and the vertical blanking interval between them.

a. Set the SWEEP switch to 2H.

b. Connect a composite video signal showing burst via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. PERFORMANCE/CALIBRATION CHECK—Type 528 display; should consist of two horizontal lines showing burst that is not interlaced.

e. Set the SWEEP switch to 2V.

f. PERFORMANCE/CALIBRATION CHECK—Type 528 display; should consist of two fields and the vertical blanking interval between them.

g. Disconnect the video signal source, 75 ohm coaxial cable and 75 ohm termination.

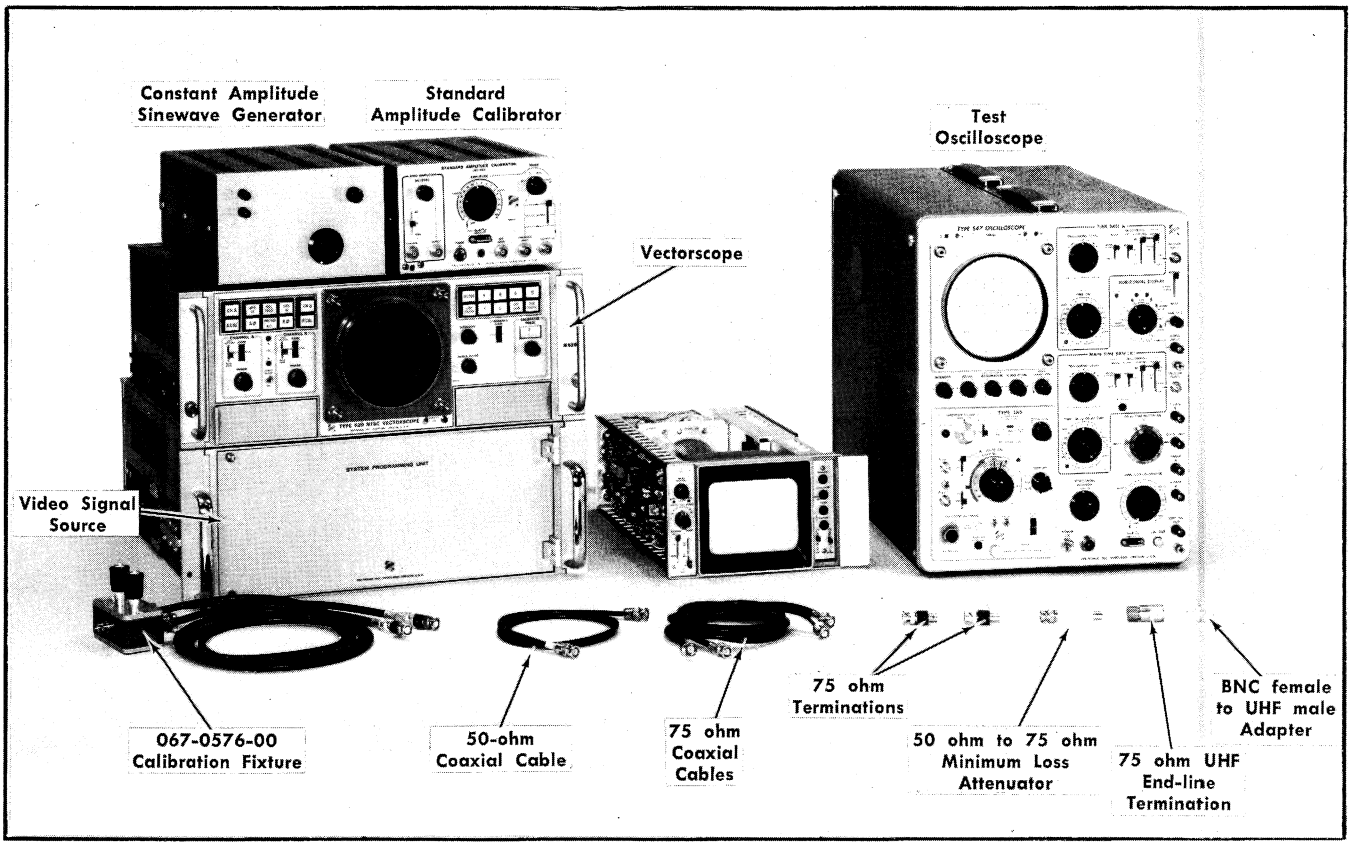


Fig. 5-6. Initial calibration test equipment setup for steps 11 through 19.

Left Front-Panel Controls	
POSITION (Horizontal)	Midrange
VOLTS FULL SCALE	**1 V CAL**
VARIABLE (VOLTS FULL SCALE)	CAL
RESPONSE	FLAT
SWEEP	2 V
Recessed Front Panel Controls:	
INTENSITY	As desired
POWER-SCALE ILLUM	As desired
FOCUS	As desired
POSITION (Vertical)	Midrange
SYNC	INT
DC RESTORER	OFF
Rear-Panel Controls:	
ASTIGMATISM	As is
TRACE ALIGN	As is
LINE VOLTS	Set for correct line voltage range

11. Adjust/Check Vertical Gain ◐

PERFORMANCE REQUIREMENT—1 volt square-wave signal should produce a display amplitude of 140 IRE units, ±1% when the VOLTS FULL SCALE switch is set to a 1 volt position, and a display amplitude of 35 IRE units, ±3% when the VOLTS FULL SCALE switch is set to a 4 volt position.

a. Test equipment setup is shown in Fig. 5-6.

b. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; 140, ±1.4 IRE units.

c. CALIBRATION ADJUST—Vert Gain control, R58, (see Fig. 5-7) until the square-wave display is exactly 140 IRE units high.

d. Connect a 1 V peak to peak square-wave signal from a standard amplitude calibrator via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT B connector. Do not connect any termination to the lower VIDEO INPUT B connector.

e. Set the Type 528 VOLTS FULL SCALE switch to B 1.

f. Observe that the display amplitude is within 1% of 139.5 IRE units.

g. Set the Type 528 VOLTS FULL SCALE switch to B 4.

h. Set the standard amplitude calibrator for a 2 V peak to peak square-wave output signal.

i. Check—Type 528 display amplitude; 70 IRE units, ±3%.

j. Disconnect the standard amplitude calibrator and 75 ohm coaxial cable.

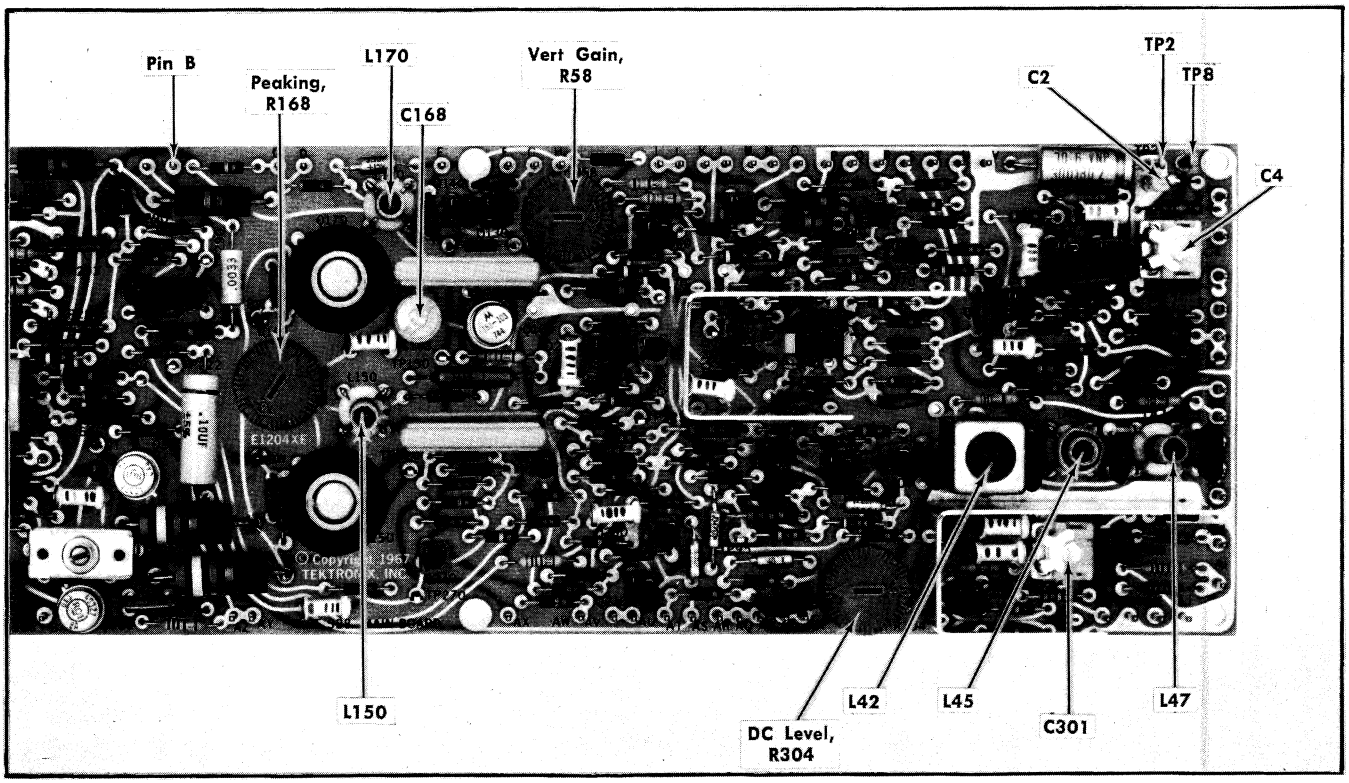


Fig. 5-7. Main board test point and control locations.

12. Check Video Out Signal Gain

PERFORMANCE REQUIREMENT—Output signal amplitude of 1 volt, ±15%, when displayed signal is 140 IRE units on the CRT of the Type 528.

a. Set the Type 528 VOLTS FULL SCALE switch to 1V CAL.

b. Connect the video out signal via a 75 ohm coaxial cable and a 75 ohm termination to the test oscilloscope vertical input connector.

c. Set the test oscilloscope for a vertical deflection of 0.5 V/division, DC coupled, at a sweep rate of 1 ms/division with internal triggering.

d. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; 1 volt, ±15%.

e. Disconnect the test oscilloscope, 75 ohm coaxial cable and 75 ohm termination.

13. Check Variable Volts Full Scale Control Range

PERFORMANCE REQUIREMENT—Must increase signal amplitude by at least 4 times.

a. Set the Type 528 VOLTS FULL SCALE switch to B 4.

b. Connect a 1 volt peak to peak square-wave signal from a standard amplitude calibrator via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT B connector. Do not connect any termination to the lower VIDEO INPUT B connector.

c. Rotate the VARIABLE (VOLTS FULL SCALE) control slowly clockwise to its fully clockwise position.

d. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude should slowly and smoothly increase until the display is at least 140 IRE units high when the VARIABLE (VOLTS FULL SCALE) control is at its fully clockwise position.

e. Set the VARIABLE (VOLTS FULL SCALE) control to CAL, noting that the indicator light changes from red (VOLTS FULL SCALE switch not calibrated) to green (VOLTS FULL SCALE switch calibrated.

f. Disconnect the standard amplitude calibrator and the 75 ohm coaxial cable.

14. Check Vertical Positioning Range

For Performance Check only, omit this step and proceed to step 17.

a. Set the VOLTS FULL SCALE switch to A 1.

b. Short together test points TP2 and TP8 on the main board. See Fig. 5-7.

c. Connect a +1 V DC signal from a standard amplitude calibrator via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector. Do not connect any termination to the lower VIDEO INPUT A connector.

d. Rotate the vertical position control to fully counterclockwise.

e. CALIBRATION CHECK—Type 528 display; must have been positioned below the +90 IRE units graticule line.

f. Disconnect the standard amplitude calibrator signal and connect a —1 V DC signal from the standard amplitude calibrator via a 75 ohm coaxial cable to the upper VIDEO INPUT A connector.

g. Rotate the vertical position control to its fully clockwise position.

h. CALIBRATION CHECK—Type 528 display; it must have been positioned above the —30 IRE units graticule line.

i. Disconnect the standard amplitude calibrator and 75 ohm coaxial cable.

j. Remove the short from test points TP2 and TP8 on the main board, and set the POSITION (Vertical) control to midrange.

15. Adjust/Check Instrument Return Loss ◐

PERFORMANCE REQUIREMENT—VIDEO INPUT connectors: Maximum return loss of —46 dB over a frequency range of 25 Hz to 5 MHz. EXT SYNC connector: Maximum return loss of —46 dB over a frequency range of 25 Hz to 5 MHz.

a. Connect the 067-0576-00 calibration fixture to the vertical input connectors of the test oscilloscope.

b. Connect a 5 MHz sine wave signal, approximately 1 volt in amplitude, from a constant amplitude sine wave generator via a 50 ohm coaxial cable and a 50 ohm to 75 ohm minimum loss attenuator to the signal input connector on the 067-0576-00 calibration fixture.

c. Connect the matched 75 ohm terminations to the end of each coaxial cable of the 067-0576-00 calibration fixture.

d. Set the test oscilloscope for a vertical deflection of 0.2 V/division both input channels set for A-B operation with a free running sweep.

e. Remove one matched 75 ohm termination and adjust the constant amplitude sine wave generator for a 0.5 V, 5 MHz output sine wave signal as observed on the test oscilloscope (use ony one channel for measurement), then replace the matched 75 ohm termination.

f. Set the test oscilloscope for a vertical deflection of 1 mV/division, both input channels AC coupled, and set for A-B operation at a sweep rate of 20 μs/division with a free-running sweep.

g. Vary the constant amplitude sine wave generator frequency from 25 Hz to 5 MHz.

h. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; should be 1 mV or less at any frequency between 25 Hz and 5 MHz.

i. Disconnect a 75 ohm termination from the end of the measuring cable then attach the measuring cable to the Type 528 upper VIDEO INPUT A connector and the 75 ohm termination just removed, to the lower VIDEO INPUT A connector.

j. Vary the constant amplitude sine wave generator frequency from 25 Hz to 5 MHz.

k. Rotate the Type 528 VOLTS FULL SCALE switch through all of its switch positions.

l. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; should never be more than 2.5 mV minus the signal amplitude noted in part h of this step, at any frequency from 25 Hz to 5 MHz.

m. CALIBRATION ADJUST—L2 (feed-through coil) by compressing the turns together or expanding them apart until the test oscilloscope display amplitude in all VOLTS FULL SCALE switch position stays at or below 2.5 mV minus the signal amplitude noted in part h of this step, at any frequency from 25 Hz to 5 MHz.

n. Disconnect the measuring cable from the Type 528 upper VIDEO INPUT A connector and connect it to the upper VIDEO INPUT B connector. Disconnect the 75 ohm termination from the lower VIDEO INPUT A connector and connect it to the lower VIDEO INPUT B connector.

o. Vary the constant amplitude sine wave generator frequency from 25 Hz to 5 MHz.

p. Rotate the Type 528 VOLTS FULL SCALE switch through all of its positions.

q. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; should never be more than 2.5 mV minus the signal amplitude noted in part h of this step, at any frequency from 25 Hz to 5 MHz.

r. CALIBRATION ADJUST—L4 (feed-through coil) by compressing the turns together or expanding them apart until the test oscilloscope display amplitude in all VOLTS. FULL SCALE switch positions stays at or below 2.5 mV minus the signal amplitude noted in part h of this step, at any frequency from 25 Hz to 5 MHz.

s. Disconnect the measuring cable from the Type 528 upper VIDEO INPUT B connector and connect it to the upper EXT SYNC connector. Disconnect the 75 ohm termination from the lower VIDEO INPUT B connector and connect it to the lower EXT SYNC connector.

t. Switch the Type 528 SYNC switch back and forth from INT to EXT.

u. Vary the constant amplitude sine wave generator frequency from 25 Hz to 5 MHz.

v. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; should never be more than 2.5 mV minus the signal amplitude noted in part h of this step, at any frequency from 25 Hz to 5 MHz.

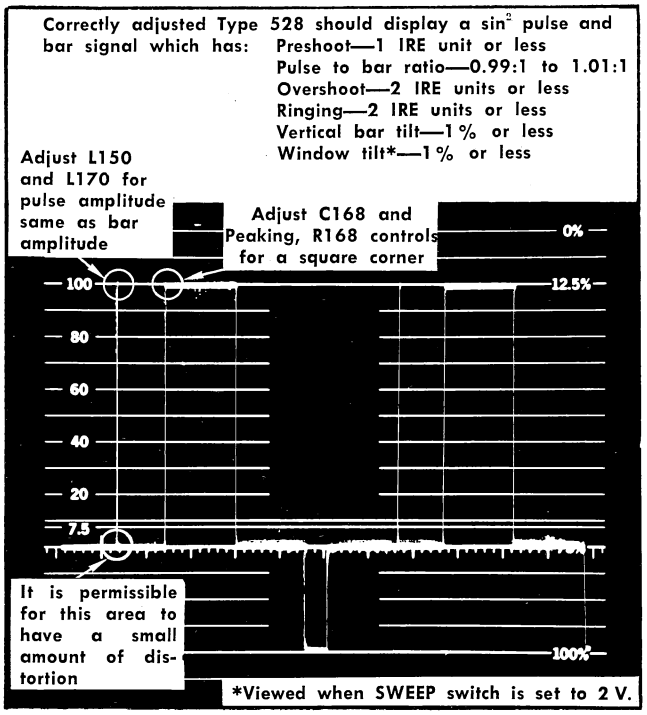


Fig. 5-8. Type 528 correctly adjusted using a standard sin² pulse and bar signal.

w. Disconnect the 067-0576-00 calibration fixture (this includes the 75 ohm termination still attached to the Type 528), constant amplitude sine wave generator, test oscilloscope, 50 ohm coaxial cable and 50 ohm to 75 ohm minimum loss attenuator.

16. Adjust/Check Transient Response ◐

PERFORMANCE REQUIREMENT—See table in Fig. 5-8.

a. Set the Type 528 VOLTS FULL SCALE switch to A 1, SWEEP switch to 2H and SYNC switch to INT.

b. Connect a one volt high standard sin² pulse and bar signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. Connect the output signal of the Type 528 VIDEO OUT connector via a 75 ohm coaxial cable and a 75 ohm termination to the vertical input connector on the test oscilloscope.

e. Set the test oscilloscope for a vertical deflection of 0.5 V/division, DC coupled, at a sweep rate of 20 μs/division with internal triggering.

f. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display; sin² pulse to bar signal ratio should be 0.99:1.01 or less.

g. CALIBRATION ADJUST—C4; see Fig. 5-7, for a test oscilloscope displayed sin² pulse to bar signal ratio of 0.99:1.01 or less.

h. PERFORMANCE/CALIBRATION CHECK—Type 528 display; see Fig. 5-8.

i. CALIBRATION ADJUST—C168, Peaking R168, L150 and L170 controls (see Fig. 5-7) for the correct sin² pulse and bar signal presentation as viewed on the Type 528.

j. PERFORMANCE/CALIBRATION CHECK—Type 528 vertical bar tilt; 1% or less.

k. Set the SWEEP switch to 2V.

l. PERFORMANCE/CALIBRATION CHECK—Type 528 bar tilt; 1% or less.

m. Set the Type 528 VOLTS FULL SCALE switch to A4, and the SWEEP switch to 2H.

n. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display; sin² pulse to bar signal ratio should be 0.99:1.01 or less.

o. CALIBRATION ADJUST—C2 for a test oscilloscope displayed sin² pulse and bar signal ratio of 0.99:1.01 or less.

NOTE

If it is possible, substitute a 4 volt sin² pulse and bar signal for the 1 volt signal when checking the 4 volt VOLTS FULL SCALE switch position.

p. Disconnect the video signal source test oscilloscope, two 75 ohm coaxial cables and two 75 ohm terminations.

17. Check Flat Frequency Response, Video Out Frequency Response and DC Level

NOTE

Removing or installing the Type 528 cabinet may slightly alter the Frequency Response. Any change should remain within specifications.

PERFORMANCE REQUIREMENT—Response should be flat to within 1% of the 50 kHz response over a frequency range of 25 Hz to 3.6 MHz. Response should be flat to within +1%, —3% of the 50 kHz and 3.58 MHz response over a frequency range of 3.6 MHz to 5 MHz. Response at VIDEO OUT connector must be within ±3% of flat over a frequency range of 25 Hz to 5 MHz. DC level: DC voltage level with no signal output must be no more than 2 volts when connector is properly terminated.

a. Set the Type 528 VOLTS FULL SCALE switch to A1.

b. Connect a 1 V, 50 kHz sine wave signal from a constant amplitude sine wave generator via a 50 ohm coaxial cable and a 50 ohm to 75 ohm minimum loss attenuator to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. Adjust the output sine wave signal amplitude to obtain exactly 100 IRE units of display on the Type 528.

e. Vary the frequency of the sine wave generator from 25 Hz to 3.6 MHz. Do not readjust the output sine wave signal amplitude from the level established in part d of this step.

f. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; should be 100 IRE units, ±1% at all frequencies between 25 Hz and 3.6 MHz. Note the display amplitude at 3.58 MHz for use later.

g. Vary the frequency of the sine wave generator from 3.6 MHz to 5 MHz. Do not change the output sine wave signal amplitude from the level established in part d of this step.

h. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; should be 100 IRE units, +1% and −3% at all frequencies between 3.6 MHz and 5 MHz. The display amplitude must also be within +1% and −3% of the 3.58 MHz display amplitude noted at all frequencies between 3.6 MHz and 5 MHz.

i. If the requirements in parts f and h of this step can not be met repeat step 16.

j. Connect the Type 528 video out signal via a 75 ohm coaxial cable and a 75 ohm termination to the test oscilloscope vertical input connector.

k. Set the test oscilloscope for a vertical deflection of 0.1 V/division, AC coupled, at a sweep rate of 20 μs/division with internal triggering.

l. Adjust the test oscilloscope variable volts/division control to obtain a display exactly 4 major divisions high.

m. Vary the output frequency of the sine wave generator from 25 Hz to 5 MHz. Do not change the output sine wave signal amplitude from the level established in part d of this step.

n. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display amplitude; four major divisions ±0.12 major division at all frequencies between 25 Hz and 5 MHz.

o. Disconnect the constant amplitude sine wave generator, 50 ohm coaxial cable, 50 ohm to 75 ohm minimum loss attenuator and the 75 ohm termination.

p. Set the test oscilloscope for a vertical deflection of 1 V/division, DC coupled, at a sweep rate of 1 ms/division with a free-running sweep.

q. Establish a ground reference point on the graticule of the test oscilloscope.

r. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope trace position; not more than 2 major divisions from ground reference point on the graticule.

s. Disconnect the test oscilloscope, 75 ohm termination and the 75 ohm coaxial cable.

18. Adjust/Check IRE and Chroma Response Filters

For performance check only, omit parts a through j and perform only step k through the end of this step.

PERFORMANCE REQUIREMENT—With the RESPONSE switch set CHROMA, the display amplitude must be within ±1% of the 100-IRE unit reference amplitude obtained when the RESPONSE switch is set to FLAT. Upper -3 dB point (100 IRE units signal reduced to 70 IRE units) must lie between 3.8 MHz and 4.1 MHz while the lower -3 dB point must lie between 3.1 MHz and 3.4 MHz (see Fig. 1-2).

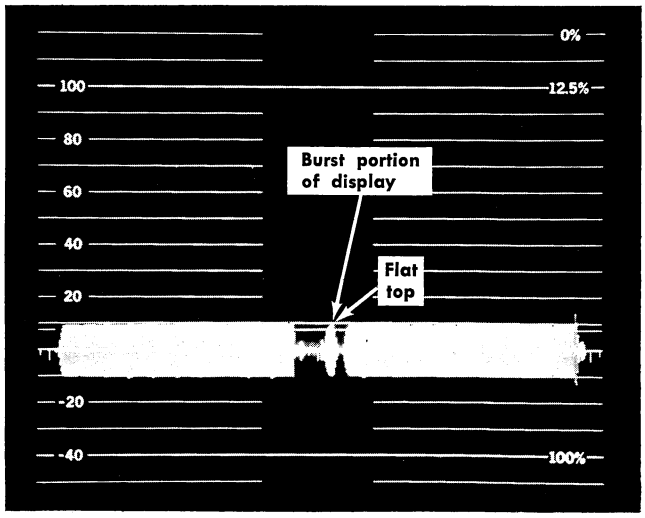


Fig. 5-9. Correct CHROMA response filter display of a linearity stairstep signal modulated with 3.58 MHz.

a. Connect a one volt linearity stairstep modulated with 3.58 MHz signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

b. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

c. Observe a normal modulated linearity stairstep display presentation on the Type 528.

d. Set the Type 528 RESPONSE switch to IRE.

e. CALIBRATION CHECK—Type 528 display; should be a linearity stairstep with 2 IRE units or less of modulation.

f. CALIBRATION ADJUST—L42 (see Fig. 5-7) until the 3.58 MHz modulation signal on the linearity stairstep is 2 IRE units or less.

g. Set the Type 528 RESPONSE switch to FLAT, observe the 3.58 MHz modulation amplitude of any one of the steps in the stairstep display and note for reference in step 18-i.

h. Set the Type 528 RESPONSE switch to CHROMA.

i. CALIBRATION ADJUST—L47 for maximum deflection of the displayed signal envelope (see Fig. 5-9), then adjust L45 to return to the amplitude of the signal envelope to the same level as observed in step 18-g. Repeat L47 and L45 adjustments to compensate for interaction.

j. Disconnect the video signal source, 75 ohm coaxial cable and the 75 ohm termination.

k. Set the Type 528 RESPONSE switch to FLAT.

l. Connect a 1 V, 3.58 MHz sine wave signal from a constant amplitude sine wave generator via a 50 ohm coaxial cable and a 50 ohm to 75 ohm minimum loss attenuator to the Type 528 upper VIDEO INPUT A connector.

m. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

n. Adjust the output sine wave signal amplitude to obtain exactly 100 IRE units of display on the Type 528.

o. Set the Type 528 RESPONSE switch to CHROMA.

p. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; 100 IRE units, ±1%.

q. Increase the output frequency of the sine wave generator until the display amplitude is 70 IRE units. Do not change the output sine wave signal amplitude from the level established in part n of this step.

r. PERFORMANCE/CALIBRATION CHECK — Sine wave generator frequency; upper —3 dB frequency must be between 3.8 MHz and 4.1 MHz.

s. Decrease the output frequency of the sine wave generator to 3.58 MHz, then decrease it still further until the display amplitude is 70 IRE units. Do not change the output sine wave signal amplitude from the level established in part n of this step.

t. PERFORMANCE/CALIBRATION CHECK — Sine wave generator frequency; lower —3 dB frequency must be between 3.1 MHz and 3.4 MHz.

u. Set the Type 528 RESPONSE switch to IRE.

v. Set the output frequency of the sine wave generator to 350 kHz. Do not change the output sine wave signal amplitude from the level established in part n of this step.

w. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; between 97.5 and 94 IRE units.

x. Set the output frequency of the sine wave generator to 1 MHz. Do not change the output sine wave signal amplitude from the level established in part n of this step.

y. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude;between 80 and 70 IRE units.

z. Set the output frequency of the sine wave generator to 2 MHz. Do not change the output sine wave signal amplitude from the level established in part n of this step.

aa. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; between 42.5 and 31.2 IRE units.

ab. Set the output frequency of the sine wave generator to 3.6 MHz. Do not change the output sine wave signal amplitude from the level established in part n of this step.

ac. PERFORMANCE/CALIBRATION CHECK—Type 528 display amplitude; between 14 and 5.6 IRE units.

ad. Disconnect the constant amplitude sine wave generator 50 ohm coaxial cable, 50 ohm to 75 ohm minimum loss attenuator and the 75 ohm termination.

19. Check Differential Gain and Phase

PERFORMANCE REQUIREMENT—Differential gain: Less than 2% on a 1 volt input signal at the VIDEO OUT connector as measured on a Vectorscope. Less than 1% differential gain in a Type 528 display consisting of 100 IRE units of subcarrier frequency signal centered about the 50 IRE units graticule line on the Type 528. Differential phase: Less than 3° on a 1 volt input signal at the VIDEO OUT connector as measured on a Vectorscope. Gain increase: 3 to 5.5 times gain increase between RESPONSE switch CHROMA and DIFF GAIN positions.

a. Connect a one volt modulated linearity stairstep signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

b. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

c. Connect the Type 528 video out signal via a 75 ohm coaxial cable and a BNC female to UHF male adapter to an input connector on a Vectorscope.

d. Connect a 75 ohm UHF end-line termination to the other input connector of the loop-through connectors.

e. Set the Vectorscope for a differential gain measurement.

f. PERFORMANCE/CALIBRATION CHECK — Vectorscope differential gain reading; less than a 2% loss or gain between steps of linearity stairstep signal.

g. Set the Vectorscope for a differential phase measurement.

h. PERFORMANCE/CALIBRATION CHECK — Vectorscope differential phase reading; less than 3° phase distortion between steps of linearity stairstep signal.

i. Disconnect the Vectorscope, 75 ohm coaxial cable BNC female to UHF male adapter and 75 ohm UHF end-line termination. Input video signal remains connected.

j. Set the Type 528 RESPONSE switch to CHROMA.

k. Note Type 528 display amplitude.

l. Set the Type 528 Response switch to DIFF GAIN.

m. PERFORMANCE/CALIBRATION CHECK—Type 528 display; amplitude must have increased 3 to 5.5 times.

n. Adjust the Type 528 VARIABLE (VOLTS FULL SCALE) control until the Type 528 display is exactly 100 IRE units high.

o. Rotate the vertical position control to center the 100 IRE units high signal about the 50 IRE units graticule line.

p. PERFORMANCE/CALIBRATION CHECK—Type 528 display; must be within 1% of being the same peak to peak amplitude from end to end.

q. Disconnect the video signal source, 75 ohm coaxial cable and 75 ohm termination.

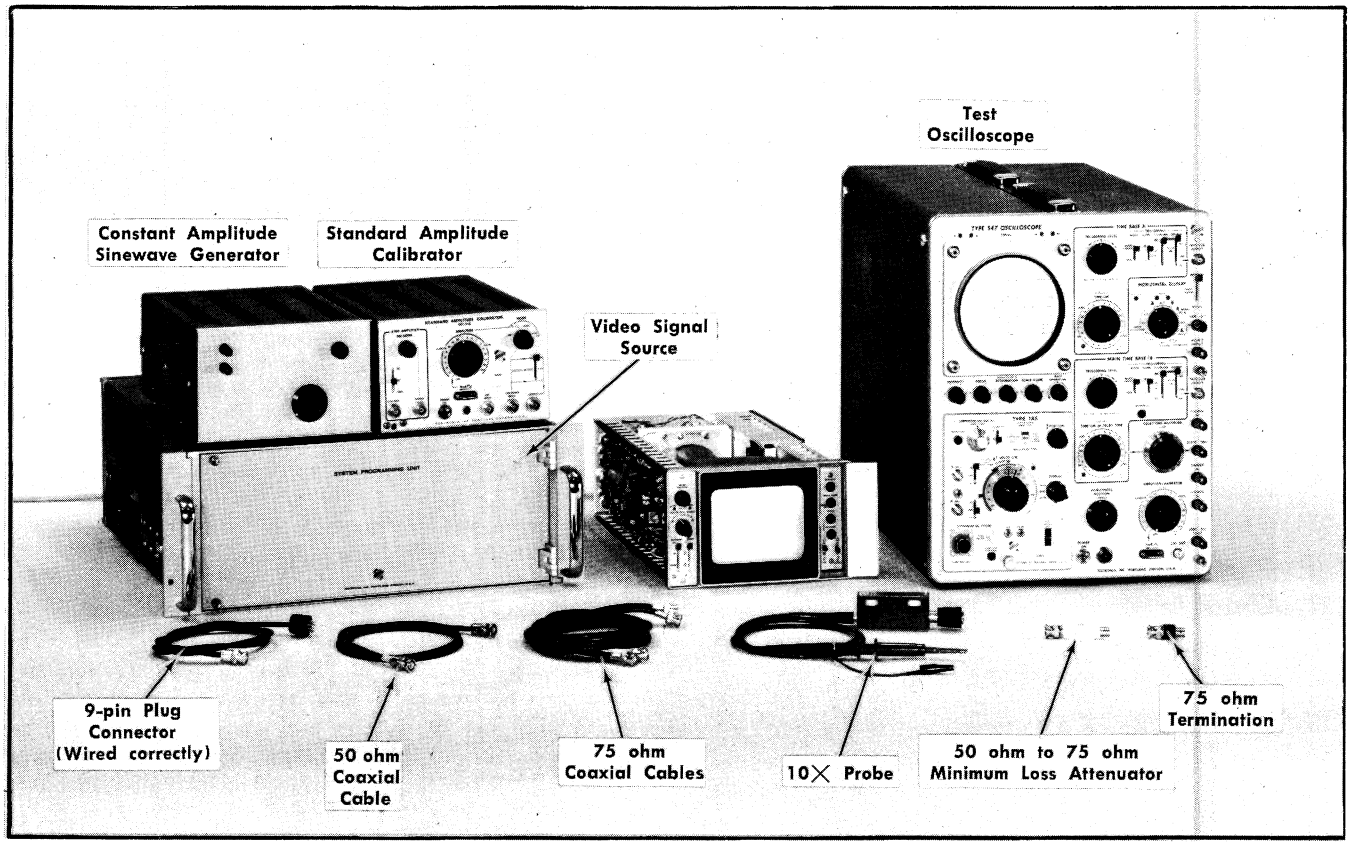


Fig. 5-10. Initial calibration test equipment setup for steps 20 through 22.

Left Front-Panel Controls:

POSITION (Horizontal)	Midrange
VOLTS FULL SCALE	A 1
VARIABLE (VOLTS FULL SCALE)	CAL
RESPONSE	**FLAT**
SWEEP	2H

Recessed Front-Panel Controls:

INTENSITY	As desired
POWER-SCALE ILLUM	As desired
FOCUS	As desired
POSITION (Vertical)	Midrange
SYNC	INT
DC RESTORER	OFF

Rear-Panel Controls:

ASTIGMATISM	As is
TRACE ALIGN	As is
LINE VOLTS	Set for correct line voltage range

20. Check DC Restorer

PERFORMANCE REQUIREMENT—Distortion to displayed video: None. Low frequency response at 60 Hz: Less than 20% attenuation of 60 Hz signal amplitude. Display shift due to presence of burst (3.58 MHz): Less than 1 IRE unit.

a. Test equipment setup is shown in Fig. 5-10.

b. Connect a one volt video signal without burst via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

c. Connect a 75 ohm termination to the lower VIDEO INPUT A connector.

d. Note the appearance of the back porch portion of the display.

e. Set the Type 528 DC RESTORER switch to ON.

f. PERFORMANCE/CALIBRATION CHECK Type 528 display; appearance of the back porch portion of the display should not have changed from part d of this step.

g. Set the Type 528 DC RESTORER switch to OFF.

h. Disconnect the video signal source and the 75 ohm coaxial cable.

i. Connect a 4 volt composite sync signal via a 75 ohm coaxial cable to the Type 528 upper EXT SYNC connector.

j. Connect a 75 ohm termination to the lower EXT SYNC connector.

k. Set the SYNC switch to EXT.

l. Connect a 0.5 V, 60 Hz sine wave signal from the sine-wave generator through a 50 ohm coaxial cable and a 50 ohm to 75 ohm minimum loss attenuator to the Type 528 upper VIDEO INPUT A connector.

m. Note the amplitude of the 60 Hz on the Type 528 display.

n. Set the Type 528 DC RESTORER switch to ON.

o. PERFORMANCE/CALIBRATION CHECK—Type 528 display; the amplitude of the 60 Hz on the display must not be attenuated more than 20%.

p. Disconnect the sine wave generator, 50 ohm coaxial cable and 50 ohm to 75 ohm minimum loss attenuator.

q. Connect a one volt video signal without burst via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector.

r. Position the back porch portion of the video signal to the 0 IRE graticule line. Now add burst to the video signal.

s. PERFORMANCE/CALIBRATION CHECK—Type 528 display position change; must have moved not more than 1 IRE vertically.

t. Test equipment remains connected for step 21.

21. Check External Sync Operation

PERFORMANCE REQUIREMENT—Stable display for external sync video signals from 1.5 V to 4.5 V.

a. Disconnect the 75 ohm termination to the lower EXT SYNC connector.

b. Connect a 75 ohm coaxial cable and a 75 ohm termination from the Type 528 lower EXT SYNC connector to the test oscilloscope vertical input connector.

c. Set the Type 528 SWEEP switch to 2V.

d. Set the test oscilloscope for a vertical deflection of 1 V/division, AC coupled, at a sweep rate of 20 μs/division with internal triggering.

e. Adjust the peak to peak output amplitude of the sync video signal until it is exactly 1.5 volt.

f. PERFORMANCE/CALIBRATION CHECK—Type 528 display; should be stable.

g. Vary the sync video signal amplitude between 1.5 V and 4.5 V peak to peak, using the test oscilloscope to verify the signal amplitude. Interrupt the sync video signal by momentarily setting the SYNC switch to INT before making the check at a particular sync video signal amplitude.

h. PERFORMANCE/CALIBRATION CHECK—Type 528 display; a stable display must be obtained whenever the SYNC switch is set to its EXT position as part f of this step is accomplished.

i. Disconnect the video signal source, test oscilloscope, three 75 ohm coaxial cables and two 75 ohm terminations.

22. Adjust/Check RGB and YRGB Operation ◐

Parts a through i-1 of this procedure describe the check and adjust procedure of R304 for a +10-volt DC system; parts a through d and e-2 through i-2 describe the check and adjust procedure of R304 for a —10-volt DC system. Perform those parts that are applicable to the DC system that will be used with the instrument. For example, if the Type 528 will be used with a —10-volt system, perform parts a through d and e-2 through i-2. If the DC system to be used with the instrument is not known, perform the procedures for both systems to check that R304 has sufficient adjustment range to operate the Type 528 with either system.

The final setting for R304 should be made after the performance check/calibration procedure for the instrument has been completed and the instrument is connected to the system that will be used in actual operation. Then R304 should be adjusted as described on page 2-6, RGB/YRGB J320 procedure, in the Operationg Instructions section of this manual.

The last portion of step 22 includes a check and adjust procedure for C301 (parts j through o), a check procedure for YRGB operation (parts p and q), a check procedure for RGB operation (parts r and s), and part t is the concluding part of this performance check/calibration procedure. If desired, the test points (TP263, TP264, TP293 and TP294) can remain as they are and the applicable portion of the procedure can be followed. For example, if the Type 528 is already connected for operation with a RGB system, perform steps j through o, skip parts p through r, and perform parts s through t.

This procedure provides for checking and adjustment of the Type 528 to operate with either a +10 volt DC level system or one using —10 volts DC. Parts e through i are repeated, with parts e-1 through i-1 showing the adjustments and limits for a +10 volt DC system, and parts e-2 through i-2 pertaining to the —10 volt DC system. Similarly, the final parts of the step apply to either a YRGB or an RGB system, with parts p and q applicable to YRGB and parts r through t arranged for checking RGB operation.

PERFORMANCE REQUIREMENT—Stairstep amplitude: 10 volts DC signal will cause a shift of 9 major horizontal graticule divisions ±15% in the position of the shortened trace. Stairstep transient response: less than 2% overshoot or tilt. Sweep length: 20% to 25% of normal unmagnified sweep length for YRGB, 27% to 33% of normal unmagnified sweep length for RGB.

a. Set the Type 528 SWEEP switch to 2H, SYNC switch to INT and the DC RESTORER switch to OFF.

b. Connect a one volt composite video signal via a 75 ohm coaxial cable to the Type 528 upper VIDEO INPUT A connector. Connect a 75 ohm termination to the Type 528 upper VIDEO INPUT A connector.

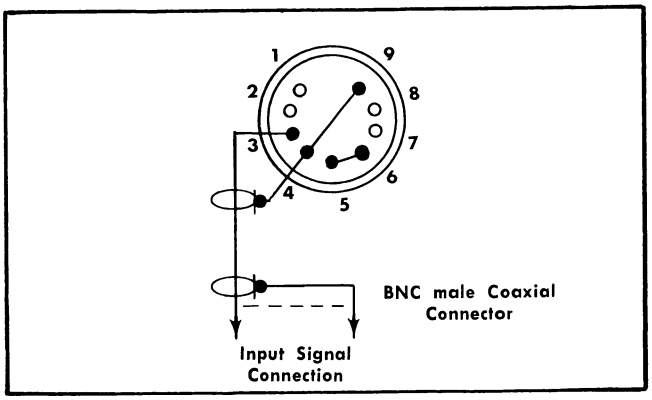


Fig. 5-11. Back view of 9-pin plug connector (Tektronix Part No. 136-0099-00) showing jumper wire connections to cause relay K370 to be energized whenever plug is in place.

c. Position the start of the trace to the first major division mark at the left side of the graticule 0 IRE line.

d. Wire the 9-pin plug connector (Tektronix Part No. 136-0099-00) as shown in Fig. 5-11, and connect it to J370 on the rear panel of the Type 528.

+10 Volt DC System

e-1. PERFORMANCE/CALIBRATION CHECK—Position of shortened Type 528 trace; must be in the right-hand side of the viewing area, with the right-hand end of the trace aligned with the last major division mark on the 0 IRE graticule line.

f-1. PERFORMANCE/CALIBRATION ADJUST — DC Level control, R304 (see Fig. 5-7) to position the shortened trace as stated in part e-1.

g-1. Connect a +10 volt DC signal from the standard amplitude calibrator via the signal lead of the 9-pin plug connector to the Type 528 J370 rear panel connector.

h-1. PERFORMANCE/CALIBRATION CHECK—Position of the shortened Type 528 trace; must be at the left side of the viewing area, with the right-hand end of the trace 9 major divisions (±15%) to the left of the last major division mark on the 0 IRE graticule line.

i-1. Disconnect the +10 Volt DC signal from the standard amplitude calibrator.

—10 Volt DC System

e-2. PERFORMANCE/CALIBRATION CHECK—Position of the shortened Type 528 trace; must be at the left side of the viewing area with the start of the trace aligned with the first major division mark on the 0 IRE graticule line.

f-2. PERFORMANCE/CALIBRATION ADJUST — DC Level control R304 to position the shortened trace as stated in part e-2.

g-2. Connect a —10 volt DC signal from the standard amplitude calibrator via the signal lead of the 9-pin plug connector to the Type 528 J370 rear panel connector.

h-2. PERFORMANCE/CALIBRATION CHECK—Position of the Type 528 shortened trace; must be at the right side of the viewing area with the start of the trace 9 major divisions (±15%) to the right of the first major division mark on the 0 IRE graticule line.

i-2. Disconnect the —10 volt DC signal from the standard amplitude calibrator.

All Systems

j. Connect a 1 volt peak to peak square wave from the standard amplitude calibrator through the 9-pin plug connector to the J370 on the Type 528 rear panel.

k. Connect a 10× probe from the test oscilloscope vertical input connector to pin B on the main board of the Type 528; See Fig. 5-7.

l. Set the test oscilloscope for a vertical deflection of 0.01 V/division, AC coupled, at a sweep rate of 0.2 ms/division with internal triggering.

m. PERFORMANCE/CALIBRATION CHECK—Test oscilloscope display; overshoot or tilt less than 2% of total waveform amplitude.

n. CALIBRATION ADJUST—C301 for waveform overshoot or tilt less than 2% of total amplitude as viewed on the test oscilloscope.

o. Disconnect the standard amplitude calibrator, test oscilloscope and 10× probe.

p. Disconnect any jumpers between TP263-TP264 and TP293-TP294 (YRGB operation).

q. PERFORMANCE/CALIBRATION CHECK—Type 528 trace length; between 2.4 and 3 major horizontal divisions.

r. Connect jumpers between TP263-TP264 and TP293-TP294 (RGB operation).

s. PERFORMANCE/CALIBRATION CHECK—Type 528 trace length; between 3.2 and 4 major horizontal divisions.

NOTE

Parts t through y are to be used only with instruments SN B080560-up. Proceed to part z for instruments below SN B080560.

t. Turn off the Type 528 power.

u. Connect a short jumper wire between TP230 and TP370.

v. Turn on the Type 528 power.

w. PERFORMANCE/CALIBRATION CHECK—Type 528 display; retrace must be visible.

x. Turn off the Type 528 power.

y. Remove jumper wire between TP230 and TP370.

z. Disconnect the 9-pin plug connector from J370. Disconnect the video signal source 75 ohm coaxial cable and 75 ohm termination.

This completes the performance check/calibration procedure of the Type 528. Disconnect all test equipment.

NOTES

PARTS LIST ABBREVIATIONS

BHB	binding head brass
BHS	binding head steel
cap.	capacitor
cer	ceramic
comp	composition
conn	connector
CRT	cathode-ray tube
csk	countersunk
DE	double end
dia	diameter
div	division
elect.	electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ext	external
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
h	height or high
hex.	hexagonal
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
ID	inside diameter
inc	incandescent
int	internal
lg	length or long
met.	metal
mtg hdw	mounting hardware
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
P/O	part of
PHB	pan head brass
PHS	pan head steel
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
RHB	round head brass
RHS	round head steel
SE	single end
SN or S/N	serial number
S or SW	switch
TC	temperature compensated
THB	truss head brass
thk	thick
THS	truss head steel
tub.	tubular
var	variable
w	wide or width
WW	wire-wound

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.

SECTION 6
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Bulbs			
B590	150-0059-00			Incandescent #386			
B592	150-0059-00			Incandescent #386			
B594	150-0047-00			Incandescent #CN8-398 200 mA			
B595	150-0047-00			Incandescent #CN8-398 200 mA			
				Capacitors			
Tolerance ±20% unless otherwise indicated.							
C1	281-0601-00	XB040000		7.5 pF	Cer	500 V	±0.5 pF
C2	281-0064-00			0.25-1.5 pF, Var	Tub.		
C3	281-0503-00	XB040000		8 pF	Cer	500 V	±0.5 pF
C4	281-0077-00			1.3-5.4 pF, Var	Air		
C5	281-0503-00	XB040000		8 pF	Cer	500 V	±0.5 pF
C8	290-0367-00			70 μF	Elect.	6 V	
C20	283-0081-00			0.1 μF	Cer	25 V	+80%—20%
C23	281-0534-00			3.3 pF	Cer		±0.25 pF
C25	281-0578-00	XB080000		18 pF	Cer	500 V	5%
C31	281-0546-00			330 pF	Cer	500 V	10%
C35	281-0518-00	B010100	B109999X	47 pF	Cer	500 V	
C41	283-0642-00			33 pF	Mica	300 V	1%
C42	283-0638-00			130 pF	Mica	100 V	1%
C45	283-0643-00			22 pF	Mica	300 V	1%
C47	283-0641-00			180 pF	Mica	100 V	1%
C78	283-0003-00			0.01 μF	Cer	150 V	
C84	281-0518-00	B0101000	B079999X	47 pF	Cer	500 V	
C85	281-0518-00	XB080000	B129999	47 pF	Cer	500 V	
C85	281-0528-00	B130000		82 pF	Cer	500 V	10%
C90	283-0059-00			1 μF	Cer	25 V	+80%—20%
C93	290-0267-00			1 μF	Elect.	35 V	
C104	290-0264-00			0.22 μF	Elect.	35 V	
C106	290-0282-00			0.047 μF	Elect.	35 V	10%
C110	281-0549-00			68 pF	Cer	500 V	10%
C116	283-0026-00			0.2 μF	Cer	25 V	
C122	283-0080-00	B010100	B149999	0.022 μF	Cer	25 V	+80%—20%
C122	283-0191-00	B150000	B179999	0.022 μF	Cer	50 V	
C122	283-0239-00	B180000		0.022 μF	Cer	50 V	10%
C124	283-0080-00	B010100	B149999	0.022 μF	Cer	25 V	+80%—20%
C124	283-0191-00	B150000	B179999	0.022 μF	Cer	50 V	
C124	283-0239-00	B180000		0.022 μF	Cer	50 V	10%
C126	283-0067-00			0.001 μF	Cer	200 V	10%
C130	283-0067-00			0.001 μF	Cer	200 V	10%
C140	290-0246-00			3.3 μF	Elect.	15 V	10%
C145	283-0023-00	B010100	B059999	0.1 μF	Cer	10 V	
C145	283-0026-00	B060000		0.2 μF	Cer	25 V	
C152	283-0067-00			0.001 μF	Cer	200 V	10%
C166	281-0513-00			27 pF	Cer	500 V	
C168	281-0092-00			9-35 pF, Var	Cer		
C169	283-0023-00	B080000	B129999	0.1 μF	Cer	10 V	
C169	283-0003-00	B130000		0.01 μF	Cer	150 V	
C172	283-0067-00			0.001 μF	Cer	200 V	10%
C192	290-0246-00	B010100	B219999	3.3 μF	Elect.	15 V	10%

Capacitors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C192	290-0529-00	B220000		47 μF	Elect.	20 V	
C194	283-0081-00			0.1 μF	Cer	25 V	+80%—20%
C205	281-0605-00			200 pF	Cer	500 V	
C222	281-0513-00	B010100	B219999	27 pF	Cer	500 V	
C222	281-0515-00	B220000		27 pF	Cer	500 V	
C232	281-0623-00			650 pF	Cer	500 V	5%
C235	283-0092-00			0.03 μF	Cer	200 V	+80%—20%
C249	285-0703-00			0.1 μF	PTM	100 V	5%
C254	285-0576-00			1 μF	PTM	100 V	10%
C260	283-0067-00	XB210000		0.0001 μF	Cer	200 V	10%
C277	285-0627-00			0.0033 μF	PTM	100 V	5%
C279	281-0605-00	B010100	B029999	200 pF	Cer	500 V	
C279	281-0525-00	B030000		470 pF	Cer	500 V	
C284	283-0627-00	B010100	B219999	0.0033 μF	PTM	100 V	5%
C284	283-0655-00	B220000		0.0033 μF	Mica	500 V	1%
C296	290-0136-00			2.2 μF	Elect.	20 V	
C301	281-0077-00			1.3-5.4 pF, Var	Air		
C305	281-0658-00			6.2 pF	Cer	500 V	+0.25 pF
C309	281-0523-00			100 pF	Cer	350 V	
C322	283-0003-00			0.01 μF	Cer	150 V	
C326	290-0301-00			10 μF	Elect.	20 V	10%
C332	283-0067-00			0.001 μF	Cer	200 V	10%
C342	283-0067-00			0.001 μF	Cer	200 V	10%
C346	290-0136-00			2.2 μF	Elect.	20 V	
C350	283-0059-00	XB080000		1 μF	Cer	25 V	+80%—20%
C356	281-0630-00			390 μF	Cer	500 V	5%
C358	281-0125-00			90-400 pF, Var	Mica		
C362	283-0026-00			0.2 μF	Cer	25 V	
C370	283-0057-00	XB220000		0.1 μF	Cer	200 V	+80%—20%
C418	283-0081-00			0.1 μF	Cer	25 V	+80%—20%
C424	285-0684-00			0.056 μF	PTM	100 V	5%
C432	290-0274-00			80 μF	Elect.	50 V	+75%—10%
C434	290-0272-00			47 μF	Elect.	50 V	
C441	290-0167-00			10 μF	Elect.	15 V	
C422	283-0071-00			0.0068 μF	Cer	5000 V	
C444	283-0071-00			0.0068 μF	Cer	5000 V	
C448	283-0006-00			0.02 μF	Cer	500 V	
C472	283-0531-00	B010100	B019999	0.0039 μF	Mica	500 V	5%
C472	283-0531-00	B020000	B079999	0.0039 μF (nominal value)	Selected		
C472	283-0530-00	B080000	B239999	0.0039 μF (nominal value)	Selected		
C472	283-0627-00	B240000		0.0033 μF (nominal value)	Selected		
C474	285-0526-00			0.1 μF	MT	400 V	
C476	285-0526-00			0.1 μF	MT	400 V	
C512A, C512B	290-0361-00			100 μF, 20 μf	Elect.	200 V	+75%—10%
C524	290-0159-00			2 μF	Elect.	150 V	
C526	283-0003-00			0.01 μF	Cer	150 V	
C542	290-0256-00			2 × 700 μF	Elect.	50 V	
C562	283-0003-00			0.01 μF	Cer	150 V	
C575	290-0219-00			5 μF	Elect.	25 V	
C585	290-0219-00			5 μF	Elect.	25 V	
C590	283-0177-00	XB170000		1 μF	Cer	25 V	+80%—20%

Semiconductor Device, Diodes

D33	*152-0185-00	Silicon	Replaceable by 1N4152
D52	*152-0185-00	Silicon	Replaceable by 1N4152
D54	*152-0185-00	Silicon	Replaceable by 1N4152
D75	*152-0185-00	Silicon	Replaceable by 1N4152
D78	*152-0185-00	Silicon	Replaceable by 1N4152

Semiconductor Device, Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
D95	*152-0185-00			Silicon Replaceable by 1N4152
D96	*152-0185-00			Silicon Replaceable by 1N4152
D100	*152-0185-00			Silicon Replaceable by 1N4152
D102	*152-0185-00			Silicon Replaceable by 1N4152
D113	*152-0185-00			Silicon Replaceable by 1N4152
D122	*152-0185-00			Silicon Replaceable by 1N4152
D124	*152-0185-00			Silicon Replaceable by 1N4152
D152	152-0286-00			Zener 1N982B 400 mW, 75 V, 5%
D172	152-0286-00			Zener 1N982B 400 mW, 75 V, 5%
D207	*152-0185-00			Silicon Replaceable by 1N4152
D212	*152-0185-00			Silicon Replaceable by 1N4152
D216	*152-0185-00			Silicon Replaceable by 1N4152
D222	*152-0185-00			Silicon Replaceable by 1N4152
D223	*152-0185-00			Silicon Replaceable by 1N4152
D235	*152-0061-00			Silicon Tek Spec
D251	*152-0061-00			Silicon Tek Spec
D253	*152-0185-00			Silicon Replaceable by 1N4152
D281	*152-0061-00			Silicon Tek Spec
D283	*152-0185-00			Silicon Replaceable by 1N4152
D286	*152-0185-00			Silicon Replaceable by 1N4152
D311	152-0217-00			Zener 1N756A 400 mW, 8.2 V, 5%
D314	*152-0185-00			Silicon Replaceable by 1N4152
D324	*152-0185-00			Silicon Replaceable by 1N4152
D334	*152-0185-00			Silicon Replaceable by 1N4152
D344	*152-0185-00			Silicon Replaceable by 1N4152
D402	*152-0185-00			Silicon Replaceable by 1N4152
D415	*152-0185-00			Silicon Replaceable by 1N4152
D416	*152-0185-00			Silicon Replaceable by 1N4152
D424	*152-0185-00			Silicon Replaceable by 1N4152
D442	152-0218-00	B010100	B069999	Silicon 10,000 V 20 mA
D442	152-0408-00	B070000		Silicon 10,000 V 5 mA
D446	*153-0034-00			Zener 400 mW, 105 V, 5% at 200 μA Tek Spec
D470	*152-0353-00			Silicon Tek Spec
D510A,B,C,D(4)	*152-0107-00			Silicon Replaceable by 1N647
D520	152-0166-00			Zener 1N753A 400 mW, 6.2 V, 5%
D534	*152-0185-00			Silicon Replaceable by 1N4152
D536	*152-0185-00			Silicon Replaceable by 1N4152
D540A,B,C,D(4)	152-0066-00			Silicon 1N3194
D564	152-0212-00			Zener 1N936 9 V, 5% 0.005%/°C TC
D581	*152-0185-00			Silicon Replaceable by 1N4152
D590	152-0333-00			Silicon High Speed and Conductance
D592	152-0333-00			Silicon High Speed and Conductance

Fuses

F502	159-0032-00	B010100	B099999	½ A 3AG Slo-Blo
F502	159-0043-00	B100000		6/10 A 3AG Slo-Blo
F542	159-0042-00			¾ A 3AG Fast-Blo

Connectors

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
J1	131-0126-00			BNC
J2	131-0126-00			BNC
J4	131-0126-00			BNC
J5	131-0126-00			BNC
J84	131-0126-00			BNC
J86	131-0126-00			BNC
J88	131-0126-00			BNC
J370	136-0015-00			Socket

Relay

K370	148-0027-00			300 Ω, 12 V, DC

Inductors

L2	*108-0496-00			0.4 μH
L4	*108-0496-00			0.4 μH
L42	114-0200-00			60-120 μH Core not replaceable
L45	*114-0219-00			45-130 μH Core 276-0568-00
L47	*114-0257-00			6-11 μH Core 276-0506-00
L65	*108-0443-00	XB100000		25 μH
L150	*114-0254-00			30-60 μH Core 276-0506-00
L170	*114-0254-00			30-60 μH Core 276-0506-00
L432	*108-0473-00			150 μH
L462	*108-0495-00			Trace Rotator

Transistors

Q20	*151-0192-00	B010100	B109999	Silicon	Replaceable by MPS 6521
Q20	151-0190-00	B110000		Silicon	2N3904
Q25	*151-0192-00	B010100	B109999	Silicon	Replaceable by MPS 6521
Q25	151-0190-00	B110000		Silicon	2N3904
Q30	151-0188-00	B010100	B129999	Silicon	2N3906
Q30	*151-0133-00	B130000		Silicon	Tek Spec
Q50	151-0190-00			Silicon	2N3904
Q60	151-0188-00			Silicon	2N3906
Q70	151-0190-00			Silicon	2N3904
Q80	151-0188-00	B010100	B049999	Silicon	2N3906
Q80	*151-0216-00	B050000	B079999	Silicon	Replaceable by Mot MPS 6523
Q80	151-0188-00	B080100	B129999	Silicon	2N3906
Q80	*151-0133-00	B130000	B149999	Silicon	Tek Spec
Q80	151-0188-00	B150000		Silicon	2N3906
Q90	151-0188-00			Silicon	2N3906
Q95	151-0190-00			Silicon	2N3904
Q100	*151-0192-00			Silicon	Replaceable by MPS 6521
Q110	151-0188-00			Silicon	2N3906
Q130	*151-0216-00			Silicon	Replaceable by Mot MPS 6523
Q140	151-0190-00			Silicon	2N3904
Q150	*151-0124-00			Silicon	Selected from 2N3119
Q160	*151-0103-00			Silicon	Replaceable by 2N2219

Transistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
Q170	*151-0124-00			Silicon Selected from 2N3119
Q200	151-0190-00			Silicon 2N3904
Q210	151-0190-00			Silicon 2N3904
Q220	*151-0192-00			Silicon Replaceable by MPS 6521
Q225	151-0188-00			Silicon 2N3906
Q230	*151-0096-00	B010100	B079999	Silicon Selected from 2N1893
Q230	151-0250-00	B080000		Silicon 2N5184
Q240	151-0188-00			Silicon 2N3906
Q260	*151-0192-00			Silicon Replaceable by MPS 6521
Q270	151-0188-00			Silicon 2N3906
Q290	*151-0192-00			Silicon Replaceable by MPS 6521
Q300	*151-0192-00			Silicon Replaceable by MPS 6521
Q305	151-0188-00			Silicon 2N3906
Q315	*151-0192-00			Silicon Replaceable by MPS 6521
Q350	*151-0253-00			Silicon Replaceable by 2N3439
Q360	*151-0253-00			Silicon Replaceable by 2N3439
Q400	151-0188-00			Silicon 2N3906
Q410	*151-0216-00			Silicon Replaceable by Mot MPS 6523
Q420	*151-0192-00			Silicon Replaceable by MPS 6521
Q430	*151-0140-00			Silicon Selected from 2N3055
Q510	151-0251-00			Silicon 2N4240
Q520	151-0188-00			Silicon 2N3906
Q530	151-0190-00			Silicon 2N3904
Q540	*151-0140-00			Silicon Selected from 2N3055
Q550	*151-0136-00			Silicon Replaceable by 2N3053
Q560	151-0190-00			Silicon 2N3904
Q570	151-0190-00			Silicon 2N3904
Q580	151-0188-00			Silicon 2N3906
Q585	*151-0136-00			Silicon Replaceable by 2N3053
Q590	*151-0136-00			Silicon Replaceable by 2N3053

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R2	321-0364-00			60.4 kΩ	1/8 W	Prec	1%
R4	321-0306-01			15 kΩ	1/8 W	Prec	1/2%
R3	315-0275-00			2.7 MΩ	1/4 W		5%
R21	315-0472-00			4.7 kΩ	1/4 W		5%
R23	321-0306-00			15 kΩ	1/8 W	Prec	1%
R25[1]	311-0773-00			500 Ω, Var			
R26	315-0121-00			120 Ω	1/4 W		5%
R31	315-0470-00			47 Ω	1/4 W		5%
R33	301-0683-00			68 kΩ	1/2 W		5%
R35	315-0271-00	B010100	B109999X	270 Ω	1/4 W		5%
R38	301-0152-00	B010100	B129999	1.5 kΩ	1/2 W		5%
R38	301-0821-00	B130000		820 Ω	1/2 W		5%
R40	315-0101-00			100 Ω	1/4 W		5%
R41	321-0193-00			1 kΩ	1/8 W	Prec	1%
R45	321-0193-00			1 kΩ	1/8 W	Prec	1%
R50	315-0510-00	XB080000	B189999	51 Ω	1/4 W		5%
R50	316-0471-00	B190000		470 Ω	1/4 W		
R51	301-0563-00			56 kΩ	1/2 W		5%

[1]**Furnished as a unit with SW25.**

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R53	321-0206-00			1.37 kΩ	1/8 W	Prec	1%
R54	315-0392-00			3.9 kΩ	1/4 W		5%
R55	315-0622-00			6.2 kΩ	1/4 W		5%
R57	321-0211-00	B010100	B049999	1.54 kΩ	1/8 W	Prec	1%
R57	321-0205-00	B050000		1.33 kΩ	1/8 W	Prec	1%
R58	311-0704-00	B010100	B049999	500 Ω, Var			
R58	311-0826-00	B050000	B209999	750 Ω, Var			
R58	311-1262-00	B210000		750 Ω, Var			
R60	315-0100-00			10 Ω	1/4 W		5%
R63	301-0152-00			1.5 kΩ	1/2 W		5%
R65	315-0392-00	B010100	B099999	3.9 kΩ	1/4 W		5%
R65	315-0271-00	B100000		270 Ω	1/4 W		5%
R70	315-0471-00	B010100	B129999	470 Ω	1/4 W		5%
R70	315-0102-00	B130000		1 kΩ	1/4 W		5%
R72	315-0153-00	B010100	B149999	15 kΩ	1/4 W		5%
R72	315-0822-00	B150000		8.2 kΩ	1/4 W		5%
R73	315-0102-00	B010100	B129999	1 kΩ	1/4 W		5%
R73	315-0202-00	B130000		2 kΩ	1/4 W		5%
R75	315-0103-00			10 kΩ	1/4 W		5%
R78	315-0124-00	B010100	B149999	120 kΩ	1/4 W		5%
R78	315-0623-00	B150000		62 kΩ	1/4 W		5%
R81	315-0101-00	B010100	B149999	100 Ω	1/4 W		5%
R81	315-0100-00	B150000		10 Ω	1/4 W		5%
R83	301-0821-00	B010100	B149999	820 Ω	1/2 W		5%
R83	301-0112-00	B150000		1.1 kΩ	1/2 W		5%
R84	321-0081-00	B010100	B079999	68.1 Ω	1/8 W	Prec	1%
R84	321-0080-00	B080000	B129999	66.5 Ω	1/8 W	Prec	1%
R84	321-0080-00	B130000		66.5 Ω (nominal value)		Selected	
R85	315-0750-00	XB080000		75 Ω	1/4 W		5%
R86	315-0512-00	B010100	B149999	5.1 kΩ	1/4 W		5%
R86	315-0242-00	B150000		2.4 kΩ	1/4 W		5%
R87	315-0101-00			100 Ω	1/4 W		5%
R88	315-0153-00			15 kΩ	1/4 W		5%
R90	315-0101-00			100 Ω	1/4 W		5%
R91	315-0823-00			82 kΩ	1/4 W		5%
R92	315-0243-00			24 kΩ	1/4 W		5%
R93	315-0222-00			2.2 kΩ	1/4 W		5%
R95	315-0682-00			6.8 kΩ	1/4 W		5%
R98	315-0684-00			680 kΩ	1/4 W		5%
R100	301-0333-00			33 kΩ	1/2 W		5%
R102	301-0333-00			33 kΩ	1/2 W		5%
R104	315-0433-00			43 kΩ	1/4 W		5%
R106	315-0243-00			24 kΩ	1/4 W		5%
R111	315-0101-00			100 Ω	1/4 W		5%
R113	315-0104-00			100 kΩ	1/4 W		5%
R114	315-0151-00			150 Ω	1/4 W		5%
R116	315-0682-00	B010100	B129999X	6.8 kΩ	1/4 W		5%
R118	315-0150-00			15 Ω	1/4 W		5%
R119	315-0392-00	B010100	B129999	3.9 kΩ	1/4 W		5%
R119	315-0101-00	B130000		100 Ω	1/4 W		5%
R122	315-0473-00			47 kΩ	1/4 W		5%
R124	315-0473-00			47 kΩ	1/4 W		5%
R132	311-0736-00			10 kΩ, Var			
R134	315-0154-00			150 kΩ	1/4 W		5%
R140	315-0471-00			470 Ω	1/4 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R145	315-0472-00			4.7 kΩ	1/4 W		5%
R150	*310-0664-00			2.4 kΩ	4 W	WW	1%
R154	315-0334-00			330 kΩ	1/4 W		5%
R160	321-0205-00			1.33 kΩ	1/8 W	Prec	1%
R162	321-0212-00			1.58 kΩ	1/8 W	Prec	1%
R164	323-0123-00			187 Ω	1/2 W	Prec	1%
R166	321-0097-00			100 Ω	1/8 W	Prec	1%
R168	311-0836-00	B010100	B209999	5 kΩ, Var			
R168	311-1267-00	B210000		5 kΩ, Var			
R169	321-0019-00			15.4 Ω	1/8 W	Prec	1%
R170	*310-0664-00			2.4 kΩ	4 W	WW	1%
R174	315-0334-00			330 kΩ	1/4 W		5%
R190	315-0220-00			22 Ω	1/4 W		5%
R192	315-0100-00			10 Ω	1/4 W		5%
R194	315-0100-00			10 Ω	1/4 W		5%
R201	315-0123-00			12 kΩ	1/4 W		5%
R202	315-0823-00			82 kΩ	1/4 W		5%
R204	315-0512-00			5.1 kΩ	1/4 W		5%
R205	315-0512-00			5.1 kΩ	1/4 W		5%
R207	315-0823-00			82 kΩ	1/4 W		5%
R208	315-0684-00			680 kΩ	1/4 W		5%
R211	315-0154-00			150 kΩ	1/4 W		5%
R212	315-0683-00			68 kΩ	1/4 W		5%
R214	315-0103-00			10 kΩ	1/4 W		5%
R220	315-0103-00			10 kΩ	1/4 W		5%
R222	321-0335-00	B010100	B209999	30.1 kΩ	1/8 W	Prec	1%
R222	321-0340-00	B210000	B219999	34 kΩ	1/8 W	Prec	1%
R222	321-0335-00	B220000		30.1 kΩ	1/8 W	Prec	1%
R223	315-0223-00			22 kΩ	1/4 W		5%
R225	315-0473-00			47 kΩ	1/4 W		5%
R226	315-0334-00	XB080000		330 kΩ	1/4 W		5%
R230	305-0104-00			100 kΩ	2 W		5%
R232	315-0102-00			1 kΩ	1/4 W		5%
R233	315-0102-00			1 kΩ	1/4 W		5%
R237	315-0472-00			4.7 kΩ	1/4 W		5%
R241	315-0103-00			10 kΩ	1/4 W		5%
R242	315-0184-00			180 kΩ	1/4 W		5%
R244	315-0223-00			22 kΩ	1/4 W		5%
R246	315-0183-00			18 kΩ	1/4 W		5%
R247	301-0511-00			510 Ω	1/2 W		5%
R249	315-0123-00			12 kΩ	1/4 W		5%
R252	321-0350-00	B010100	B219999	43.2 kΩ	1/8 W	Prec	1%
R252	321-0346-00	B220000		39.2 kΩ	1/8 W	Prec	1%
R254	315-0101-00	B010100	B049999	100 Ω	1/4 W		5%
R254	315-0470-00	B050000		47 Ω	1/4 W		5%
R256	321-0291-00			10.5 kΩ	1/8 W	Prec	1%
R258	311-0463-00	B010100	B209999	5 kΩ, Var			
R258	311-1227-00	B210000		5 kΩ, Var			
R261	303-0153-00			15 kΩ	1 W		5%
R263	321-0290-00			10.2 kΩ	1/8 W	Prec	1%
R264	321-0321-00	B010100	B049999	21.5 kΩ	1/8 W	Prec	1%
R264	321-0325-00	B050000		23.7 kΩ	1/8 W	Prec	1%
R265	321-0289-00			10 kΩ	1/8 W	Prec	1%
R271	315-0103-00			10 kΩ	1/4 W		5%

Resistors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R272	315-0184-00			180 kΩ	1/4 W		5%
R274	315-0223-00			22 kΩ	1/4 W		5%
R276	315-0183-00			18 kΩ	1/4 W		5%
R277	301-0331-00	B010100	B029999	330 Ω	1/2 W		5%
R277	301-0511-00	B030000		510 Ω	1/2 W		5%
R279	315-0123-00			12 kΩ	1/4 W		5%
R282	321-0343-00			36.5 kΩ	1/8 W	Prec	1%
R284	315-0101-00	B010100	B049999	100 Ω	1/4 W		5%
R284	315-0470-00	B050000		47 Ω	1/4 W		5%
R286	321-0302-00			13.7 kΩ	1/8 W	Prec	1%
R288	321-0225-00			2.15 kΩ	1/8 W	Prec	1%
R289	321-0218-00			1.82 kΩ	1/8 W	Prec	1%
R291	303-0153-00			15 kΩ	1 W		5%
R293	321-0290-00			10.2 kΩ	1/8 W	Prec	1%
R294	321-0321-00	B010100	B049999	21.5 kΩ	1/8 W	Prec	1%
R294	321-0325-00	B050000		23.7 kΩ	1/8 W	Prec	1%
R295	321-0289-00			10 kΩ	1/8 W	Prec	1%
R296	315-0821-00			820 Ω	1/4 W		5%
R297	315-0392-00	B010100	B049999	3.9 kΩ	1/4 W		5%
R297	315-0362-00	B050000	B089999	3.6 kΩ	1/4 W		5%
R297	315-0332-00	B090000		3.3 kΩ	1/4 W		5%
R298	321-0239-00			3.01 kΩ	1/8 W	Prec	1%
R301	321-1485-00			1.11 MΩ	1/8 W	Prec	1%
R303	315-0334-00			330 kΩ	1/4 W		5%
R304	311-0784-00	B010100	B079999	10 kΩ, Var			
R304	311-0950-00	B080000	B209999	10 kΩ, Var			
R304	311-1268-00	B210000		10 kΩ, Var			
R305	321-0452-00			499 kΩ	1/8 W	Prec	1%
R307	315-0154-00			150 kΩ	1/4 W		5%
R309	315-0222-00			2.2 kΩ	1/4 W		5%
R312	315-0105-00	XB080000		1 MΩ	1/4 W		5%
R316	303-0183-00			18 kΩ	1 W		5%
R320	321-0361-00			56.2 kΩ	1/8 W	Prec	1%
R322	301-0393-00			39 kΩ	1/2 W		5%
R324	321-0275-00			7.15 kΩ	1/8 W	Prec	1%
R326	315-0100-00			10 Ω	1/4 W		5%
R330	321-0332-00	B010100	B029999	28 kΩ	1/8 W	Prec	1%
R330	321-0330-00	B030000		26.7 kΩ	1/8 W	Prec	1%
R332	301-0393-00			39 kΩ	1/2 W		5%
R334	321-0273-00			6.81 kΩ	1/8 W	Prec	1%
R340	321-0232-00			2.55 kΩ	1/8 W	Prec	1%
R342	303-0183-00			3.92 kΩ	1 W		5%
R344	321-0250-00			3.92 kΩ	1/8 W	Prec	1%
R346	315-0472-00	B010100	B079999	4.7 kΩ	1/4 W		5%
R346	315-0432-00	B080000	B179999	4.3 kΩ	1/4 W		5%
R346	315-0392-00	B180000		3.9 kΩ	1/4 W		5%
R348	311-0772-00			2 kΩ, Var			
R350	315-0101-00	XB080000		100 Ω	1/4 W		5%
R352	315-0470-00			47 Ω	1/4 W		5%
R354	305-0393-00	B010100	B089999	39 kΩ	2 W		5%
R354	307-0223-00	B090000		39 kΩ	2 W		2%
R356	315-0102-00	B010100	B089999	1 kΩ	1/4 W		5%
R356	321-0193-00	B090000		1 kΩ	1/8 W	Prec	1%
R358	321-0269-00			6.19 kΩ	1/8 W	Prec	1%
R361	321-0197-00	B010100	B079999	1.1 kΩ	1/8 W	Prec	1%
R361	321-0197-00	B080000		1.1 kΩ	(nominal value)	Selected	
R362	321-0188-00			887 Ω	1/8 W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R364	305-0393-00	B010100	B089999	39 kΩ	2 W		5%
R364	307-0223-00	B090000		39 kΩ	2 W		2%
R366	311-0732-00	B010100	B209999	1 kΩ, Var			
R366	311-1263-00	B210000		1 kΩ, Var			
R368	321-0269-00			6.19 kΩ	1/8 W	Prec	1%
R370	315-0102-00	B010100	B219999X	1 kΩ	1/4 W		5%
R401	315-0822-00			8.2 kΩ	1/4 W		5%
R404	315-0822-00			8.2 kΩ	1/4 W		5%
R406	321-0197-00			1.1 kΩ	1/8 W	Prec	1%
R407	321-0290-00			10.2 kΩ	1/8 W	Prec	1%
R408	321-0251-00			4.02 kΩ	1/8 W	Prec	1%
R411	323-0429-00			287 kΩ	1/2 W	Prec	1%
R412	321-0306-00			15 kΩ	1/8 W	Prec	1%
R415	315-0822-00			8.2 kΩ	1/4 W		5%
R416	315-0202-00			2 kΩ	1/4 W		5%
R418	315-0202-00			2 kΩ	1/4 W		5%
R420	315-0393-00			39 kΩ	1/4 W		5%
R421	315-0123-00			12 kΩ	1/4 W		5%
R424	315-0392-00			3.9 kΩ	1/4 W		5%
R430	308-0245-00			0.6 Ω	2 W	WW	5%
R438	308-0245-00			0.6 Ω	2 W	WW	5%
R442	301-0223-00			22 kΩ	1/2 W		5%
R446	311-0397-00			2 MΩ, Var			
R448	311-0774-00	B010100	B199999	2 MΩ, Var			
R448	311-1257-00	B200000	B219999	5 MΩ, Var			
R448	311-0893-00	B220000		5 MΩ, Var			
R450	303-0565-00			5.6 MΩ	1 W		5%
R452	311-0254-00			5 MΩ, Var			
R453	305-0755-00			7.5 MΩ	2 W		5%
R455	305-0755-00			7.5 MΩ	2 W		5%
R457	305-0755-00			7.5 MΩ	2 W		5%
R459	305-0755-00			7.5 MΩ	2 W		5%
R462	311-0474-00			2 kΩ, Var			
R464	311-0366-00			500 kΩ, Var			
R466	315-0104-00			100 kΩ	1/4 W		5%
R470	315-0331-00			330 Ω	1/4 W		5%
R512	308-0018-00			2.5 kΩ	10 W	WW	5%
R514	303-0470-00			47 Ω	1 W		5%
R516	323-0356-00			49.9 kΩ	1/2 W	Prec	1%
R518	321-0277-00			7.5 kΩ	1/8 W	Prec	1%
R520	303-0823-00			82 kΩ	1 W		5%
R524	315-0103-00			10 kΩ	1/4 W		5%
R526	315-0221-00			220 Ω	1/4 W		5%
R530	315-0394-00			390 kΩ	1/4 W		5%
R532	315-0154-00			150 kΩ	1/4 W		5%
R534	315-0472-00			4.7 kΩ	1/4 W		5%
R542	301-0103-00			10 kΩ	1/2 W		5%
R550	301-0100-00			10 Ω	1/2 W		5%
R554	315-0222-00			2.2 kΩ	1/4 W		5%
R560	303-0223-00			22 kΩ	1 W		5%
R562	315-0101-00			100 Ω	1/4 W		5%
R564	321-0184-00			806 Ω	1/8 W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
R566	315-0471-00			470 Ω	1/4 W	5%
R568	315-0621-00			620 Ω	1/4 W	5%
R570	321-0211-00			1.54 kΩ	1/8 W Prec	1%
R572	321-0193-00			1 kΩ	1/8 W Prec	1%
R573	315-0512-00			5.1 kΩ	1/4 W	5%
R575	311-0510-00	B010100	B209999	10 kΩ, Var		
R575	311-1228-00	B210000		10 kΩ, Var		
R580	321-0207-00			1.4 kΩ	1/8 W Prec	1%
R581	321-0222-00	B010100	B179999	2 kΩ	1/8 W Prec	1%
R581	321-0224-00	B180000		2.1 kΩ	1/8 W Prec	1%
R583	315-0202-00			2 kΩ	1/4 W	5%
R585	305-0470-00			47 Ω	2 W	5%
R590[2]	311-0771-00			1 kΩ, Var		

Switches

	Unwired or Wired				
SW4[3]	Wired *262-0835-00	B010100	B139999	Rotary	VOLTS FULL SCALE
SW4[3]	Wired *262-0835-01	B140000		Rotary	VOLTS FULL SCALE
SW4	260-0930-00	B010100	B039999	Rotary	VOLTS FULL SCALE
SW4	260-0930-01	B040000	B139999	Rotary	VOLTS FULL SCALE
SW4	260-0930-02	B140000		Rotary	VOLTS FULL SCALE
SW25[4]	311-0773-00				
SW40	260-0931-01			Lever	RESPONSE
SW85	260-0816-00			Slide	SYNC
SW120	260-0816-00			Slide	DC RESTORER
SW240	260-0925-00			Lever	SWEEP
SW500[2]	311-0771-00				POWER
SW502	260-0675-00			Slide	LINE VOLTS

Test Points

TP2	*214-0579-00		Pin, Test Point
TP8	*214-0579-00		Pin, Test Point
TP95	214-0579-00		Pin, Test Point
TP110	*214-0579-00		Pin, Test Point
TP150	214-0579-00		Pin, Test Point
TP170	*214-0579-00		Pin, Test Point
TP220	*214-0579-00		Pin, Test Point
TP222	*214-0579-00		Pin, Test Point
TP225	*214-0579-00		Pin, Test Point
TP230	*214-0579-00	XB080000	Pin, Test Point
TP240	*214-0579-00		Pin, Test Point
TP260	*214-0579-00		Pin, Test Point
TP263	*214-0579-00		Pin, Test Point
TP264	*214-0579-00		Pin, Test Point
TP270	*214-0579-00		Pin, Test Point
TP290	*214-0579-00		Pin, Test Point

[2]R590 and SW500 furnished as a unit.

[3]Furnished as a unit with SW25 and R25.

[4]Furnished as a unit with R25.

Test Points *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TP293	*214-0579-00			Pin, Test Point
TP294	*214-0579-00			Pin, Test Point
TP310	*214-0579-00			Pin, Test Point
TP315	*214-0579-00			Pin, Test Point
TP370	*214-0579-00	XB080000		Pin, Test Point
TP410	*214-0579-00			Pin, Test Point
TP412	*214-0579-00			Pin, Test Point
TP416	*214-0579-00			Pin, Test Point
TP530	*214-0579-00			Pin, Test Point
TP532	*214-0579-00			Pin, Test Point
TP550	*214-0579-00			Pin, Test Point
TP564	*214-0579-00			Pin, Test Point
TP580	*214-0579-00			Pin, Test Point

Transformers

T115	*120-0568-00			Toroid, 4 windings
T440	*120-0567-00	B010100	B119999	H.V. Power
T440	*120-0567-01	B120000	B219999	H.V. Power
T440	*120-0567-02	B220000		H.V. Power
T501	*120-0566-00			L.V. Power

Electron Tube

V460	*154-0525-00	B010100	B219999	T5280-31 Crt Standard Phosphor
V460	*154-0525-10	B220000		T5280-31 Crt Standard Phosphor

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATION

(Located behind diagrams)

SECTION 7
MECHANICAL PARTS LIST

FIG. 1 EXPLODED VIEW

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-1	366-1024-00			1	KNOB, gray—POSITION
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set, 5-40 x 1/8 inch, HSS
-2	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			2	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-3	210-0429-00			1	NUT, hex., 3/8-32 x 1/2 x 1 1/16 inches long
-4	358-0029-05			1	BUSHING, hex., 0.438 inch long
-5	200-0263-00	B010100	B250820 X	1	COVER, plastic, variable resistor
-6	366-1023-00			1	KNOB, gray—VARIABLE
	- - - - - -			-	knob includes:
	213-0153-00			1	SCREW, set, 5-40 x 1/8 inch, HSS
-7	366-1029-00			1	KNOB, grey—VOLTS FULL SCALE
	- - - - - -			-	knob includes:
	213-0153-00			2	SCREW, set, 5-40 x 1/8 inch, HSS
-8	262-0835-00	B010100	B139999	1	SWITCH, wired—VOLTS FULL SCALE
	262-0835-01	B140000		1	SWITCH, wired—VOLTS FULL SCALE
	- - - - - -			-	switch includes:
	260-0930-00	B010000	B039999	1	SWITCH, unwired
	260-0930-01	B040000	B139999	1	SWITCH, unwired
	260-0930-02	B140000		1	SWITCH, unwired
	426-0261-00	XB140000		1	FRAME
	210-0001-00	XB140000		2	WASHER, lock, internal, #2
	210-0405-00	XB140000		2	NUT, hex., 2.56 x 0.188 inch
	210-0259-00	XB140000		2	LUG, solder, SE #2
-9	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	resistor includes:
	213-0048-00			1	SCREW, set, 4-40 x 1/8 inch, HSS
	- - - - - -			-	mounting hardware: (not included w/resistor)
-10	210-0590-00	B010100	B139999	2	NUT, hex., 3/8-32 x 7/16 inch
	220-0495-00	B140000		2	NUT, hex., 3/8-32 x 7/16 inch
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-11	210-0840-00	B010100	B140000X	1	WASHER, flat, 0.390 ID x 9/16 inch OD
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-12	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-13	384-0697-00	B010100	B039999	1	SHAFT, extension
	384-0697-01	B040000		1	SHAFT, extension
-14	366-0215-02			1	KNOB, lever—RESPONSE
-15	260-0931-01			1	SWITCH, lever—RESPONSE
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, hex., 4-40 x 3/16 x 0.562 inch long
-16	366-0215-02			1	KNOB, lever—SWEEP
-17	260-0925-00			1	SWITCH, lever—SWEEP
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, hex., 4-40 x 3/16 x 0.526 inch long

FIG. 1 EXPLODED VIEW *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-18	366-1035-01			1	KNOB, charcoal—INTENSITY
-19	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0046-00			1	LOCKWASHER, internal, 0.261 ID x 0.400 inch OD
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-20	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-22	366-1035-00			1	KNOB, charcoal—SCALE ILLUM
-22	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-23	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-24	366-1035-01			1	KNOB, charcoal—FOCUS
-25	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0046-00			1	LOCKWASHER, internal, 0.261 ID x 0.400 inch OD
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
-26	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-27	366-1035-01			1	KNOB, charcoal—POSITION
-28	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-29	200-0608-00			2	COVER, plastic, variable resistor
-30	260-0816-00			1	SWITCH, slide—SYNC
	- - - - - -			-	mounting hardware: (not included w/switch)
-31	211-0022-00			2	SCREW, 2-56 x 3/16 inch, RHS
	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
-32	260-0816-00			1	SWITCH, slide—DC RESTORER
	- - - - - -			-	mounting hardware: (not included w/switch)
-33	211-0022-00			2	SCREW, 2-56 x 3/16 inch, RHS
	210-0405-00			2	NUT, hex., 2-56 x 3/16 inch
	200-0861-02	B010100	B219999	1	ASSEMBLY, access panel door
	200-0861-05	B22000		1	ASSEMBLY, access panel door
	- - - - - -			-	assembly includes:
-34	200-0861-00			1	DOOR, access panel
-35	334-1198-00	B010100	B219999	1	PLATE, identification
	334-1198-02	B22000		1	PLATE, identification
	- - - - - -			-	mounting hardware: (not included w/assembly
	214-1028-00			2	SPRING, compression
-36	214-1029-00			2	PIN, hinge
-37	333-1065-00			1	PANEL, right front
	- - - - - -			-	mounting hardware: (not included w/panel)
-38	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
	210-1061-00			1	WASHER, flat, 0.203 ID x 0.625 inch OD

FIG. 1 EXPLODED VIEW *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5 Description
1-39	105-0072-00	B010100	B010131	1	CATCH, friction
	105-0072-01	B010132		1	CATCH, friction
	- - - - - -			-	mounting hardware: (not included w/catch)
-40	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-41	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-42	333-1066-00			1	PANEL, left front
	- - - - - -			-	mounting hardware: (not included w/panel)
-43	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
-44	378-0584-00			1	LENS, indicator light, green
-45	378-0583-00			1	LENS, indicator light, red
-46	331-0192-00			1	MASK, graticule
-47	331-0208-01			1	GRATICULE, CRT
	- - - - - -			-	mounting hardware: (not included w/graticule)
	211-0012-00	B010100	B020179	4	SCREW, 4-40 x 3/8 inch, PHS
	211-0097-00	B020180		4	SCREW, 4-40 x 5/16 inch, PHS
-48	386-1304-04	B010100	B229999	1	SUB-PANEL, front
	386-1304-14	B230000		1	SUB-PANEL, front
	- - - - - -			-	mounting hardware: (not included w/sub-panel)
-49	129-0159-00			2	POST, hex., metal
-50	210-0458-00			4	NUT, keps, 8-32 x 11/32 inch
	210-0205-00			1	LUG, solder, SE #8 (not shown)
-51	348-0090-00			2	SHOCKMOUNT, sponge
-52	354-0314-01			1	RING, CRT shockmount
-53	337-1011-01			1	SHIELD, CRT
	- - - - - -			-	mounting hardware: (not included w/shield)
-54	211-0590-00			3	SCREW, 6-32 x 1/4 inch, PHS
-55	337-1013-00			2	SHIELD, light, black plastic
-56	136-0273-00			2	LAMPHOLDER, single
	- - - - - -			-	mounting hardware for each: (not included w/lampholder)
	211-0590-00			1	SCREW, 6-32 x 1/4 inch, PHS
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex., 6-32 x 1/4 inch
-57	136-0277-00			1	LAMPHOLDER, dual
	- - - - - -			-	mounting hardware: (not included w/lampholder)
	210-0457-00	B010100	B182889	1	NUT, keps, 6-32 x 5/16 inch
	210-0407-00	B182890		1	NUT, hex., 6-32 x 1/25 inch
	210-0006-00	B182890		1	WASHER, lock, internal, #6
-58	441-0784-00	B010100	B229999	1	CHASSIS, main
	441-0784-01	B230000		1	CHASSIS, main
-59	441-0785-00			1	CHASSIS, power
-60	343-0088-00			3	CLAMP, cable, plastic, small
-61	343-0089-00			7	CLAMP, cable, plastic, large
-62	348-0056-00			1	GROMMET, plastic, 3/8 inch diameter
-63	348-0063-00			6	GROMMET, plastic, 1/2 inch diameter
-64	255-0249-00			FT	PLASTIC CHANNEL, two 9 inch and two 15 5/8 inch lengths

FIG. 1 EXPLODED VIEW *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-65	670-0588-00	B010100	B079999	1	ASSEMBLY, circuit board—MAIN
	670-0588-01	B080000	B149999	1	ASSEMBLY, circuit board—MAIN
	670-0588-02	B150000	B179999	1	ASSEMBLY, circuit board—MAIN
	670-0588-03	B180000	B189999	1	ASSEMBLY, circuit board—MAIN
	670-0588-04	B190000	B239999	1	ASSEMBLY, circuit board—MAIN
	670-0588-06	B240000		1	ASSEMBLY, circuit board—MAIN
	- - - - - -			-	assembly includes:
	388-1005-00	B010100	B079999	1	BOARD, circuit
	388-1005-01	B08000	B239999	1	BOARD, circuit
	388-1005-03	B240000		1	BOARD, circuit
	131-0633-00	XB240000		3	Connector pins
	136-0183-00	B080000		5	SOCKET, transistor, 3 pin
-66	136-0183-00	B010100	B079999	6	SOCKET, transistor, 3 pin
-67	136-0220-00	B010100	B079999	25	SOCKET, transistor, 3 pin
	136-0220-00	B080000		26	SOCKET, transistor, 3 pin
	214-1208-00	XB080000		2	HEAT SINK, transistor
-68	214-0506-00			75	PIN, connector
-69	214-0579-00	B010100	B079999	19	PIN, test point
	214-0579-00	B080000		21	PIN, test point
-70	214-0761-00			2	HEAT SINK
-71	337-0950-00			2	SHIELD
-72	426-0121-00			1	HOLDER, toroid
-73	361-0007-00			1	SPACER, plastic, $5/32$ inch long
	- - - - - -			-	mounting hardware: (not included w/assembly)
-74	211-0116-00			6	SCREW, sems, 4-40 x $5/16$ inch, PHB
-75	670-0587-00	B010100	B179999	1	ASSEMBLY, circuit board—POWER SUPPLY
	670-0587-01	B180000		1	ASSEMBLY, circuit board—POWER SUPPLY
	- - - - - -			-	assembly includes:
	388-1004-00			1	BOARD, circuit
-76	136-0183-00			3	SOCKET, transistor, 3 pin
-77	136-0220-00			7	SOCKET, transistor, 3 pin
-78	214-0506-00			34	PIN, connector
-79	214-0579-00			8	PIN, test point
-80	346-0032-00	B010100	B069999X	1	STRAP, mousetail, rubber
	- - - - - -			-	mounting hardware: (not included w/assembly)
-81	211-0116-00			6	SCREW, sems, 4-40 x $5/16$ inch, PHB
-82	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0798-00			1	WASHER, flat, $3/8$ ID x $1/2$ inch OD
-83	210-0590-00			1	NUT, hex., $3/8$-32 x $7/16$ inch
-84	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, $3/8$ ID x $1/2$ inch OD
	210-0978-00			1	WASHER, flat, $3/8$ ID x $1/2$ inch OD
-85	210-0590-00			1	NUT, hex., $3/8$-32 x $1/2$ inch
-86	260-0675-00			1	SWITCH, slide—LINE VOLTS
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0054-00			2	LOCKWASHER, split, #4
	210-0406-00			2	NUT, hex., 4-40 x $3/16$ inch
	337-1036-00	XB020180		1	SHIELD, solder (not shown)

FIG. 1 EXPLODED VIEW *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-87	131-0126-00			4	CONNECTOR, coaxial, 1 contact, BNC w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/connector)
	210-0241-00			1	LUG, terminal
-88	131-0126-00			4	CONNECTOR, coaxial, 1 contact, BNC w/hardware
-89	- - - - - -			1	TRANSFORMER
	- - - - - -			-	transformer includes:
-90	212-0553-00	B010100	B050409	4	SCREW, 10-32 x 1½ inches, HHS
	212-0590-00	B050410		4	SCREW, 10-32 x 1½ inches, HHS
-91	210-0812-00			4	WASHER, fiber, ⅛ ID x ⅜ inch long
	- - - - - -			-	mounting hardware: (not included w/transformer)
-92	220-0410-00			4	NUT, keps, 10-32 x ⅜ inch
-93	129-0006-00	B010100	B159999	2	POST, connecting
	129-0006-00	B160000		3	POST, connecting
	- - - - - -			-	mounting hardware for each: (not included w/post)
-94	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
-95	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
	211-0511-00			2	SCREW, 6-32 x ½ inch, PHS
-96	387-0345-00			1	PLATE, insulator
	210-0935-00			2	WASHER, fiber, shouldered, #6
	210-0803-00			2	WASHER, flat, 0.150 ID x ⅜ inch OD
	210-0202-00			1	LUG, solder, SE #6
-97	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-98	175-0587-00			1	WIRE, CRT lead, striped red
	175-0591-00			1	WIRE, CRT lead, striped green
	175-0641-00			1	WIRE, CRT lead, striped brown
	175-0642-00			1	WIRE, CRT lead, striped blue
	- - - - - -			-	each wire includes:
	131-0371-00			1	CONNECTOR, single contact
-99	252-0564-00			FT	PLASTIC CHANNEL, one 9⅞ inch length
-100	386-1398-00			1	SHIELD, chassis support
	- - - - - -			-	mounting hardware: (not included w/shield)
	211-0504-00			3	SCREW, 6-32 x ¼ inch, PHS
-101	200-0256-00			1	Cover, capacitor, plastic, 1 ID x 2 1/32 inches long
-102	200-0532-00			1	COVER, capacitor, plastic, 0.990 ID x 1¼ inches long
-103	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	211-0588-00			2	SCREW, 6-32 x ¾ inch, HHS
-104	432-0047-00			1	BASE, mounting, plastic
	386-0252-00			1	PLATE, fiber, small
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch

FIG. 1 EXPLODED VIEW *(cont)*

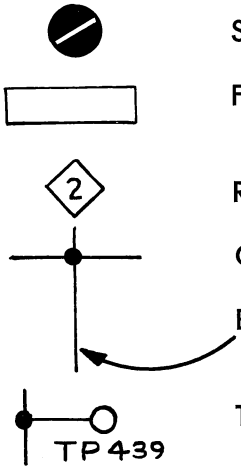
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-105	- - - - - -			1		CAPACITOR
	- - - - - -			-		mounting hardware: (not included w/capacitor)
	211-0588-00			2		SCREW, 6-32 x 3/4 inch, HHS
	432-0047-00			1		BASE, mounting, plastic
	386-0253-00			1		PLATE, metal, small
	210-0457-00			2		NUT, keps, 6-32 x 5/16 inch
-106	- - - - - -			1		RESISTOR
	- - - - - -			-		mounting hardware: (not included w/resistor)
-107	211-0553-00			1		SCREW, 6-32 x 1 1/2 inches, RHS
	210-0601-00			1		WASHER, centering
	210-0478-00			1		NUT, hex., 5/16 x 21/32 inch long
-108	211-0507-00			1		SCREW, 6-32 x 5/16 inch, PHS
-109	352-0031-00			1		HOLDER, fuse, single
	- - - - - -			-		mounting hardware: (not included w/holder)
	211-0507-00			1		SCREW, 6-32 x 5/16 inch, PHS
	210-0457-00			1		NUT, keps, 6-32 x 5/16 inch
-110	348-0145-00			1		GROMMET, plastic
-111	352-0091-01			2		HOLDER, CRT retainer
	- - - - - -			-		mounting hardware for each: (not included w/holder)
	211-0590-00			2		SCREW, 6-32 x 1/4 inch, PHS
-112	343-0124-00			1		CLAMP, retainer
	- - - - - -			-		mounting hardware: (not included w/clamp)
-113	211-0599-00			2		SCREW, 6-32 x 3/4 inch, Fil HS
-114	220-0444-00			2		NUT, square, 6-32 x 1/4 inch
-115	343-0123-01			2		CLAMP, CRT retainer
-116	211-0600-00			1		SCREW, 6-32 x 2 inches, Fil HS
-117	220-0444-00			1		NUT, square, 6-32 x 1/4 inch
	136-0303-00			1		ASSEMBLY, CRT socket
	- - - - - -			-		assembly includes:
-118	136-0202-02			1		SOCKET, CRT w/pins
-119	200-0616-00			1		COVER, socket
-120	131-0371-00			3		CONNECTOR, single contact
-121	136-0015-00			1		SOCKET, tube, 9 pin
	- - - - - -			-		mounting hardware: (not included w/socket)
	211-0008-00			2		SCREW, 4-40 x 1/4 inch, PHS
	210-0586-00			2		NUT, keps, 4-40 x 1/4 inch

FIG. 1 EXPLODED VIEW *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-122	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-123	211-0513-00			1	SCREW, 6-32 x 5/8 inch, PHS
	200-0692-00			1	COVER, transistor, large
-124	211-0511-00			1	SCREW, 6-32 x 1/2 inch, PHS
-125	387-0345-00			1	PLATE, insulator
	210-0935-00			2	WASHER, fiber, shouldered, #6
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
-126	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-127	- - - - - -			1	TRANSISTOR
	- - - - - -			-	mounting hardware: (not included w/transistor)
-128	211-0513-00			1	SCREW, 6-32 x 5/8 inch, PHS
	200-0669-00			1	COVER, transistor, small
-129	211-0511-00			1	SCREW, 6-32 x 1/2 inch, PHS
-130	386-0143-00			1	PLATE, insulating
	210-0935-00			2	WASHER, fiber, shouldered, #6
	210-0803-00			2	WASHER, flat, 0.150 ID x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
-131	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-132	161-0028-00			1	CORD, power
-133	358-0161-00			1	BUSHING, strain relief
-134	386-1399-00	B010100	B099999	1	PANEL, rear
	386-1399-01	B100000		1	PANEL, rear
	- - - - - -			-	mounting hardware: (not included w/panel)
-135	211-0510-00			4	SCREW, 6-32 x 3/8 inch, PHS
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
-136	200-0777-00			1	COVER, access, CRT socket
-137	352-0076-00			1	HOLDER, fuse w/hardware
	- - - - - -			-	mounting hardware: (not included w/holder)
-138	210-0873-00			1	WASHER, rubber, 1/2 ID x 11/16 inch OD
-139	179-1260-00	B010100	B079999	1	CABLE HARNESS, main
	179-1260-01	B080000		1	CABLE HARNESS, main
	- - - - - -			-	cable harness includes:
	131-0371-00			71	CONNECTOR, single contact
-140	179-1261-00	B010100	B079999	1	CABLE HARNESS, power
	179-1261-01	B080000		1	CABLE HARNESS, power
	- - - - - -			-	cable harness includes:
	131-0371-00			21	CONNECTOR, single contact
-141	179-1263-00	B010100	B159999	1	CABLE HARNESS, AC power
	179-1263-01	B160000		1	CABLE HARNESS, AC power

SECTION 8
DIAGRAMS

The following special symbols are used on the diagrams:



Screwdriver adjustment

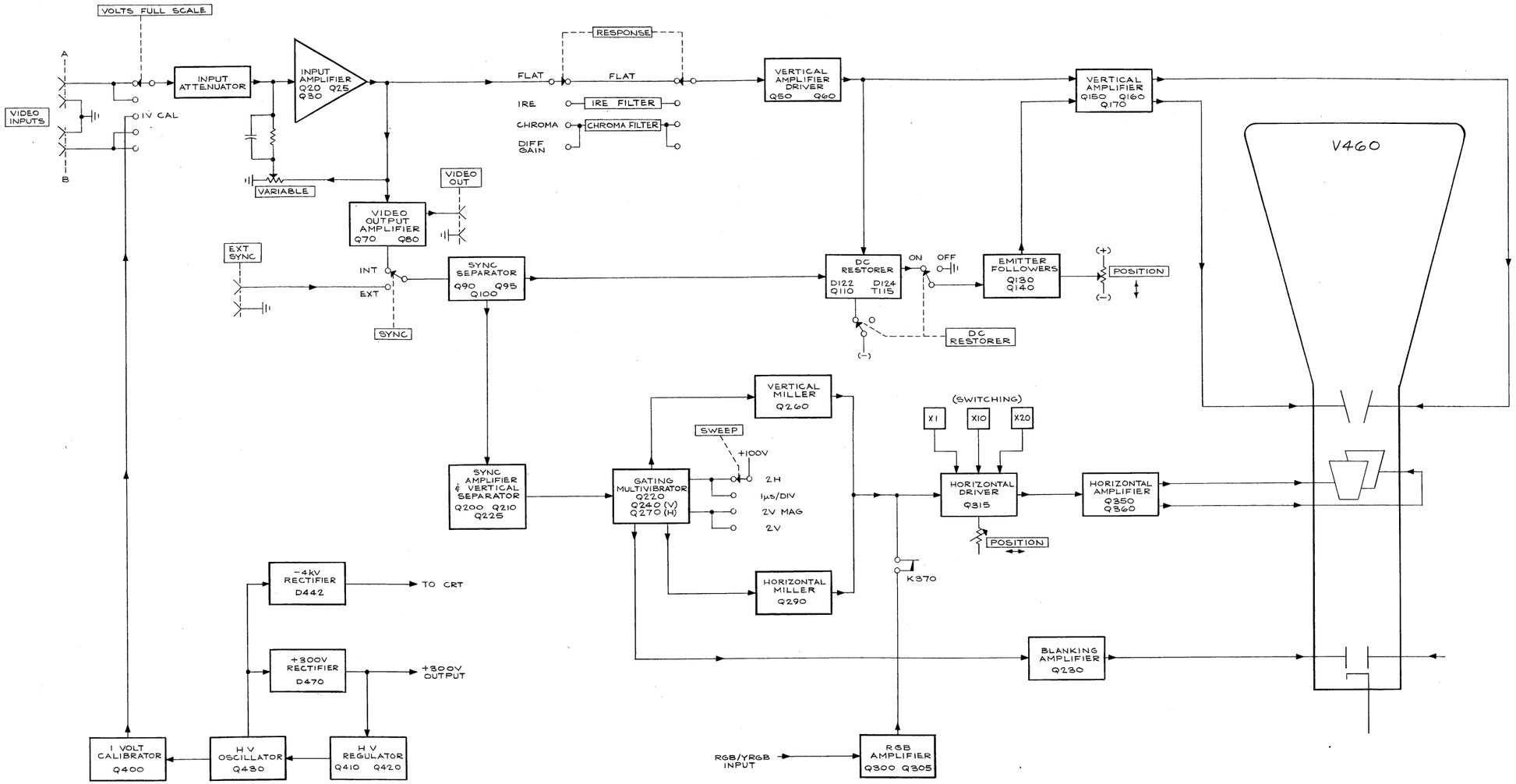
Front-, side- or rear-panel control or connector.

Refers to the indicated diagram.

Connection soldered to circuit board.

Blue line encloses components located on circuit board.

Test point.


VOLTS FULL SCALE
A
VIDEO INPUTS
B
1V CAL
INPUT ATTENUATOR
INPUT AMPLIFIER Q20 Q25 Q30
RESPONSE
FLAT
FLAT
IRE
IRE FILTER
CHROMA
CHROMA FILTER
DIFF GAIN
VERTICAL AMPLIFIER DRIVER Q50 Q60
VERTICAL AMPLIFIER Q150 Q160 Q170
V460
VARIABLE
VIDEO OUT
VIDEO OUTPUT AMPLIFIER Q70 Q80
EXT SYNC.
INT
EXT
SYNC
SYNC SEPARATOR Q90 Q95 Q100
DC RESTORER D122 D124 Q110 T115
ON
OFF
DC RESTORER
EMITTER FOLLOWERS Q130 Q140
(+)
(-)
POSITION
VERTICAL MILLER Q260
(SWITCHING)
X1
X10
X20
SWEEP
+100V
SYNC AMPLIFIER & VERTICAL SEPARATOR Q200 Q210 Q225
GATING MULTIVIBRATOR Q220 Q240 (V) Q270 (H)
2H
1μs/DIV
2V MAG
2V
HORIZONTAL DRIVER Q315
HORIZONTAL AMPLIFIER Q350 Q360
POSITION
K370
HORIZONTAL MILLER Q290
-4kV RECTIFIER D442
TO CRT
+300V RECTIFIER D470
+300V OUTPUT
BLANKING AMPLIFIER Q230
1 VOLT CALIBRATOR Q400
H V OSCILLATOR Q430
H V REGULATOR Q410 Q420
RGB/YRGB INPUT
RGB AMPLIFIER Q300 Q305

IMPORTANT

VOLTAGE AND WAVEFORM CONDITIONS

Circuit voltages were measured with a 20,000 Ω/V DC VOM. All readings are in volts and are measured with respect to ground.

Waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera, equipped with a projected graticule. Each major division represents one cm.

Voltage and waveforms on the schematics (shown in blue) are not absolute and may vary between Type 528 waveform Monitors. The difference between voltage readings and the DC levels indicated on the waveforms are due to such differences as circuit loading, operating mode and measurement resolution.

The waveforms were obtained using a Type 547 Oscilloscope 10X probe and a Type 1A5. The system characteristics are as follows: Minimum vertical deflection of 10 mV/cm with the 10X probe attenuation factor included. Frequency response of DC to 10 MHz. For obtaining time related waveforms, TP220 was used as an external trigger source, unless noted otherwise.

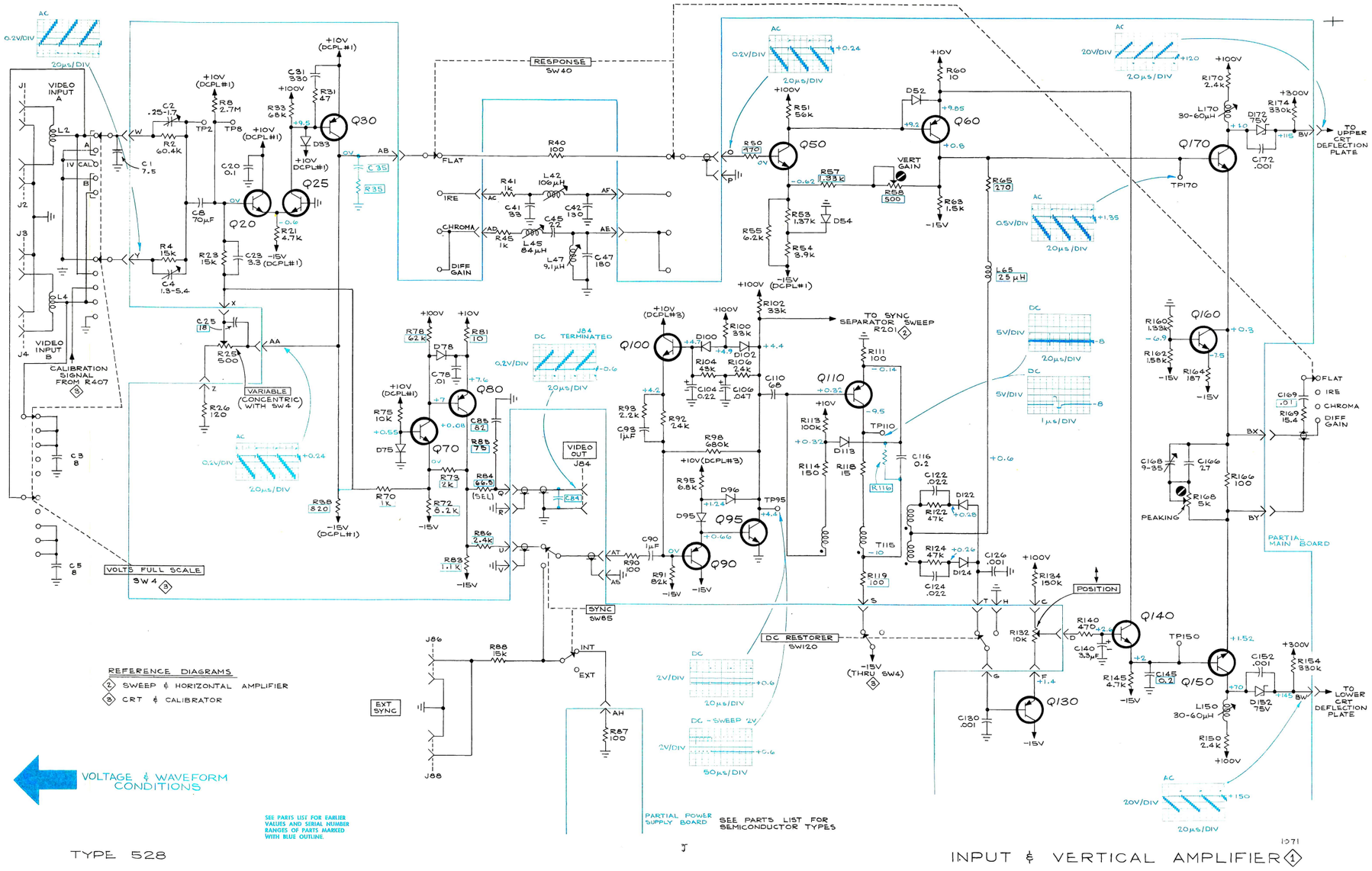
Type 547

HORIZONTAL DISPLAY	A
Sweep Magnifier	Off
Time/CM	See schematic diagrams
Variable Time/CM	Calibrated
Single Sweep	Normal
Triggering Mode	Auto Stability
Slope	—
Coupling	AC, unless noted otherwise
Source	EXT., unless noted otherwise
Level	Near 0, pushed in
Position	Midrange
Intensity	As desired
Focus	As desired
Astigmatism	As desired
Scale Illumination	As desired
Trace Separation	0

Type 1A5

Comparison Voltage Amplitude	Any
Polarity	0
Position	Normal viewing
A Input	AC, unless noted otherwise
B Input	Gnd
Display	A-Vc
Volts/CM	See schematics
Variable Volts/CM	Calibrated

Continued on ②

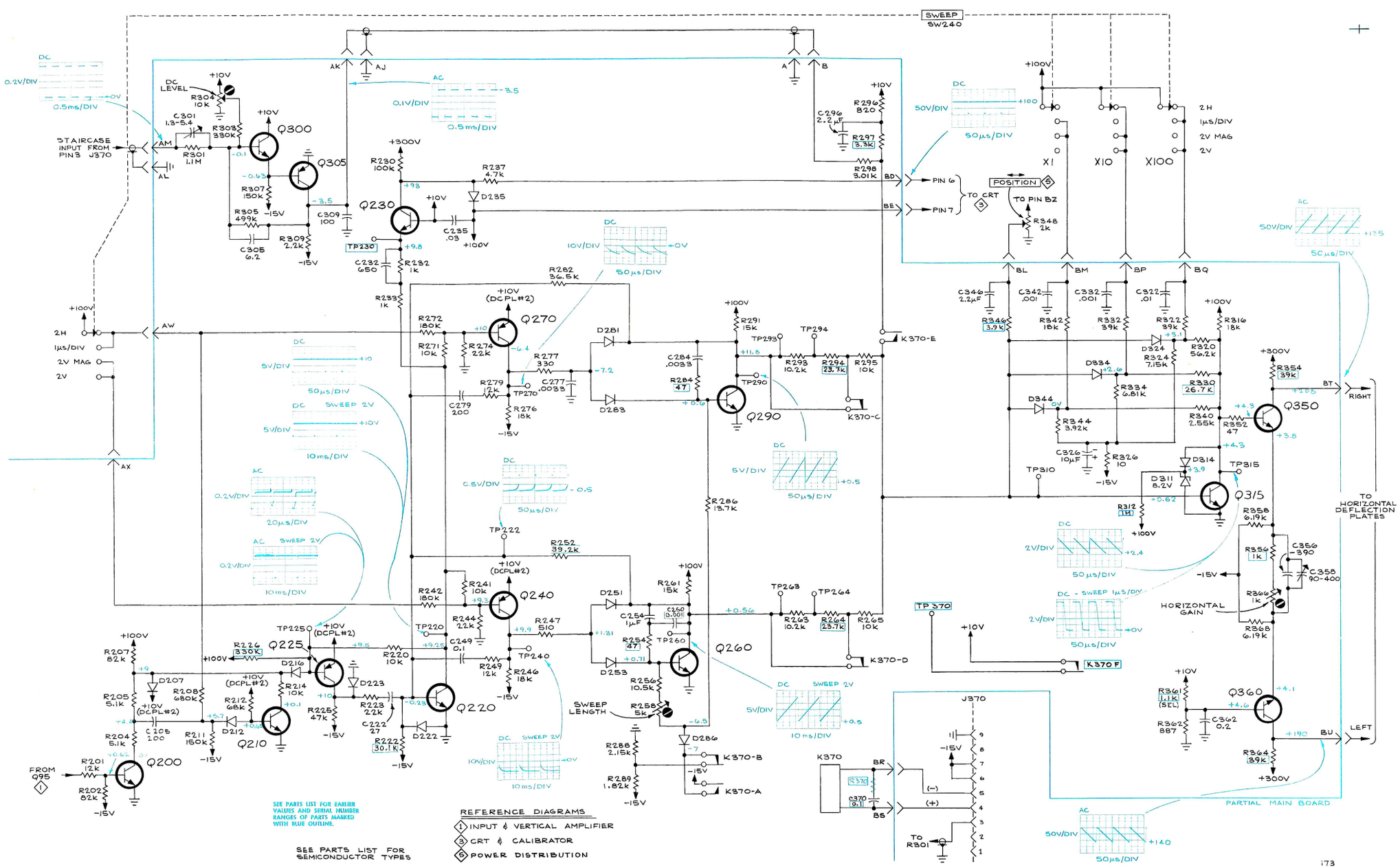


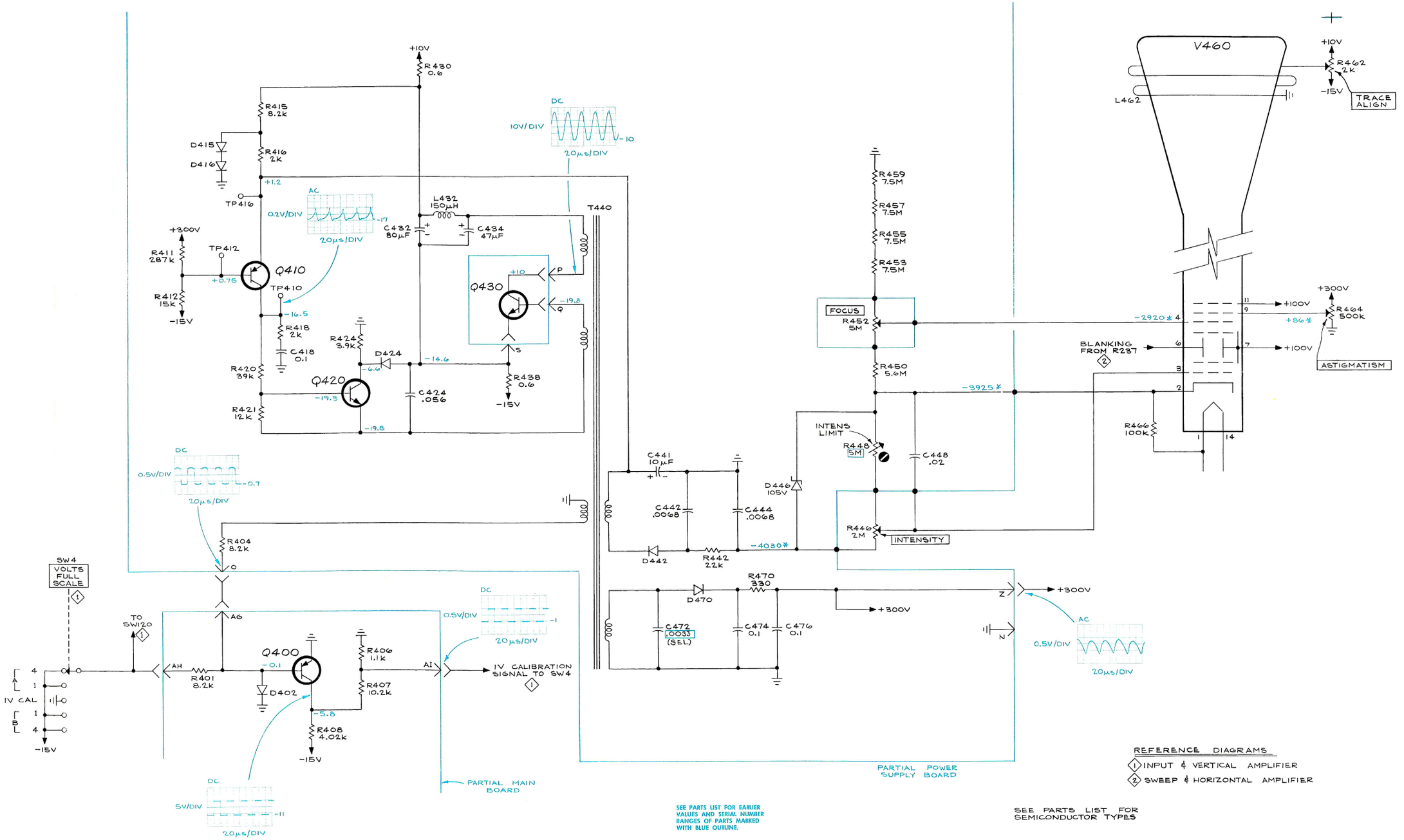
Type 528

Left Front-Panel Controls:	
POSITION (Horizontal)	Trace on first major div.
VOLTS FULL SCALE	B 1 - Voltages A 1 - Waveforms 1 V CAL - CRT and Calibrator
VARIABLE VOLTS FULL SCALE	Calibrated
RESPONSE	Flat
SWEEP	2H
Recessed Front-Panel Controls:	
INTENSITY	As desired
POWER-SCALE ILLUM	On-as desired
POSITION (Vertical)	0 IRE
SYNC	Int
DC RESTORER	ON
Rear-Panel Controls:	
ASTIGMATISM	As is
TRACE ALIGN	As is
Internal control:	
R304	—3.5 volts on the collector of Q305 when K370 is energized.

Input Signals

Voltages	No signal applied.
Waveforms	1 volt modulated staricase applied to upper VIDEO INPUT A.
RGB	1 volt square wave from test oscilloscope calibrator. Oscilloscope externally triggered from point AM on Main board.


SWEEP
SW240
STAIRCASE INPUT FROM PIN 3 J370
Q300
Q305
Q230
Q270
Q290
Q240
Q260
Q225
Q220
Q210
Q200
Q350
Q315
Q360
TO CRT
PIN 6
PIN 7
POSITION
TO PIN BZ
X1
X10
X100
2 H
1 µs/DIV
2 V MAG
2 V
TO HORIZONTAL DEFLECTION PLATES
RIGHT
LEFT
HORIZONTAL GAIN
PARTIAL MAIN BOARD
J370
K370
K370-A
K370-B
K370-C
K370-D
K370-E
K370F
TP370
FROM Q95
TO R301
SWEEP LENGTH
REFERENCE DIAGRAMS
1 INPUT & VERTICAL AMPLIFIER
3 CRT & CALIBRATOR
5 POWER DISTRIBUTION
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
VOLTAGES and WAVEFORMS obtained under conditions given on Diagram 1.
TYPE 528
SWEEP & HORIZONTAL AMPLIFIER 2
SWEEP & HORIZONTAL AMP 2



REFERENCE DIAGRAMS

1 INPUT & VERTICAL AMPLIFIER

2 SWEEP & HORIZONTAL AMPLIFIER

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

VOLTAGES and WAVEFORMS obtained under conditions given on Diagram 1, except as follows:

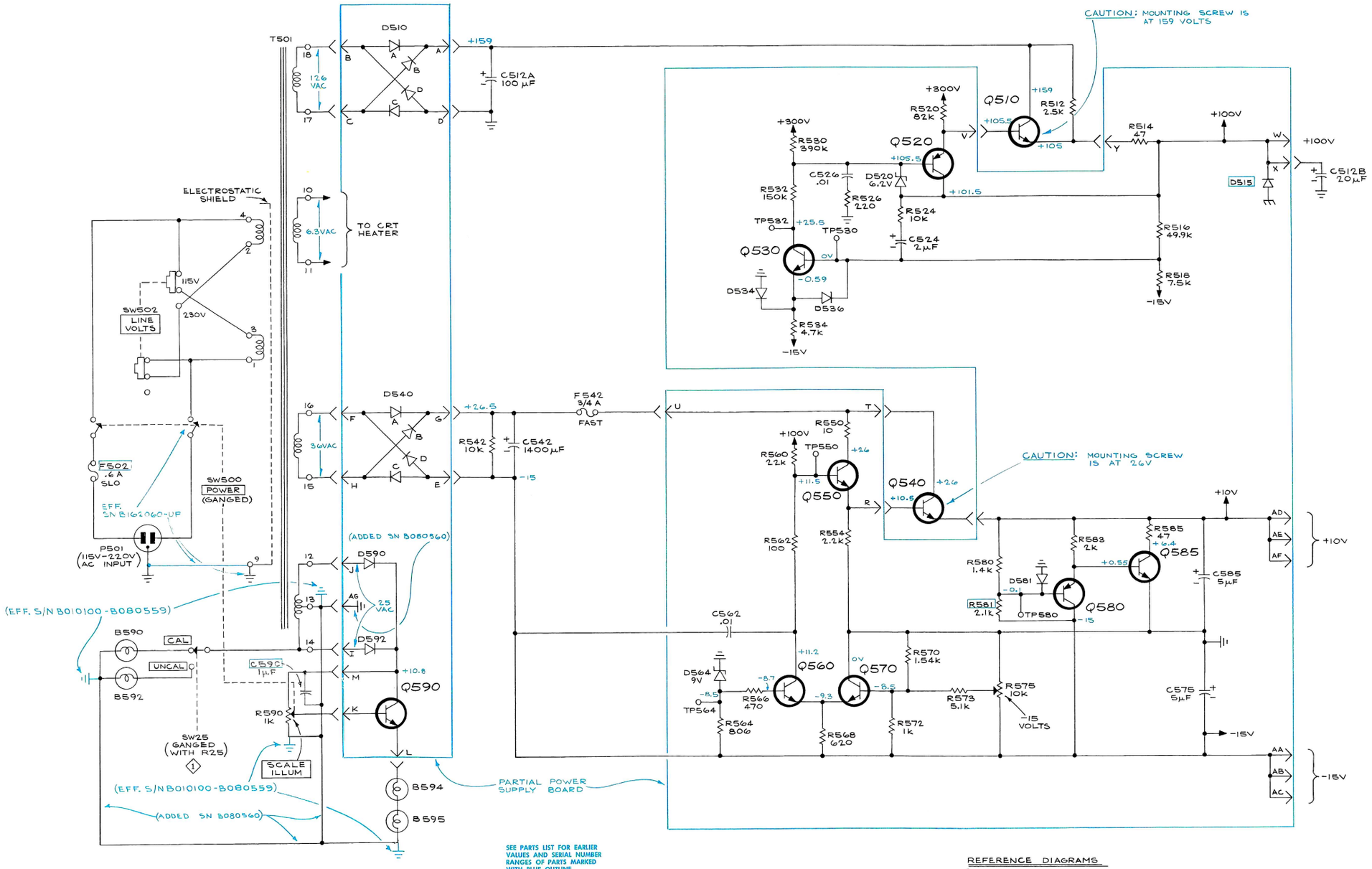
* Denotes voltage dependent on control setting and/or meter loading.

REV E, AUG 1974

TYPE 528

1071

CRT & CALIBRATOR 3



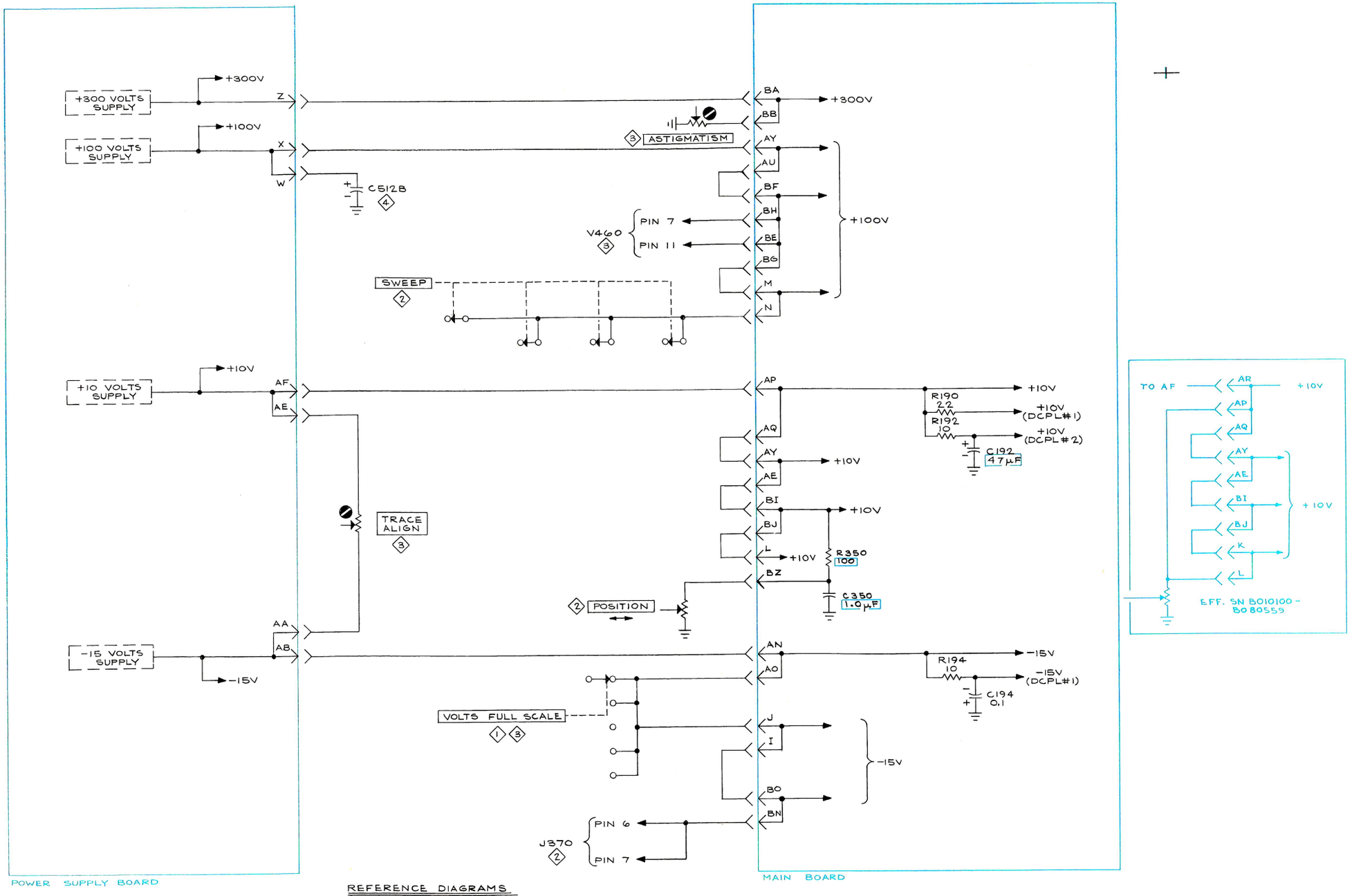
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGES obtained under conditions given on Diagram ①.

REFERENCE DIAGRAMS

① INPUT & VERTICAL AMPLIFIER

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

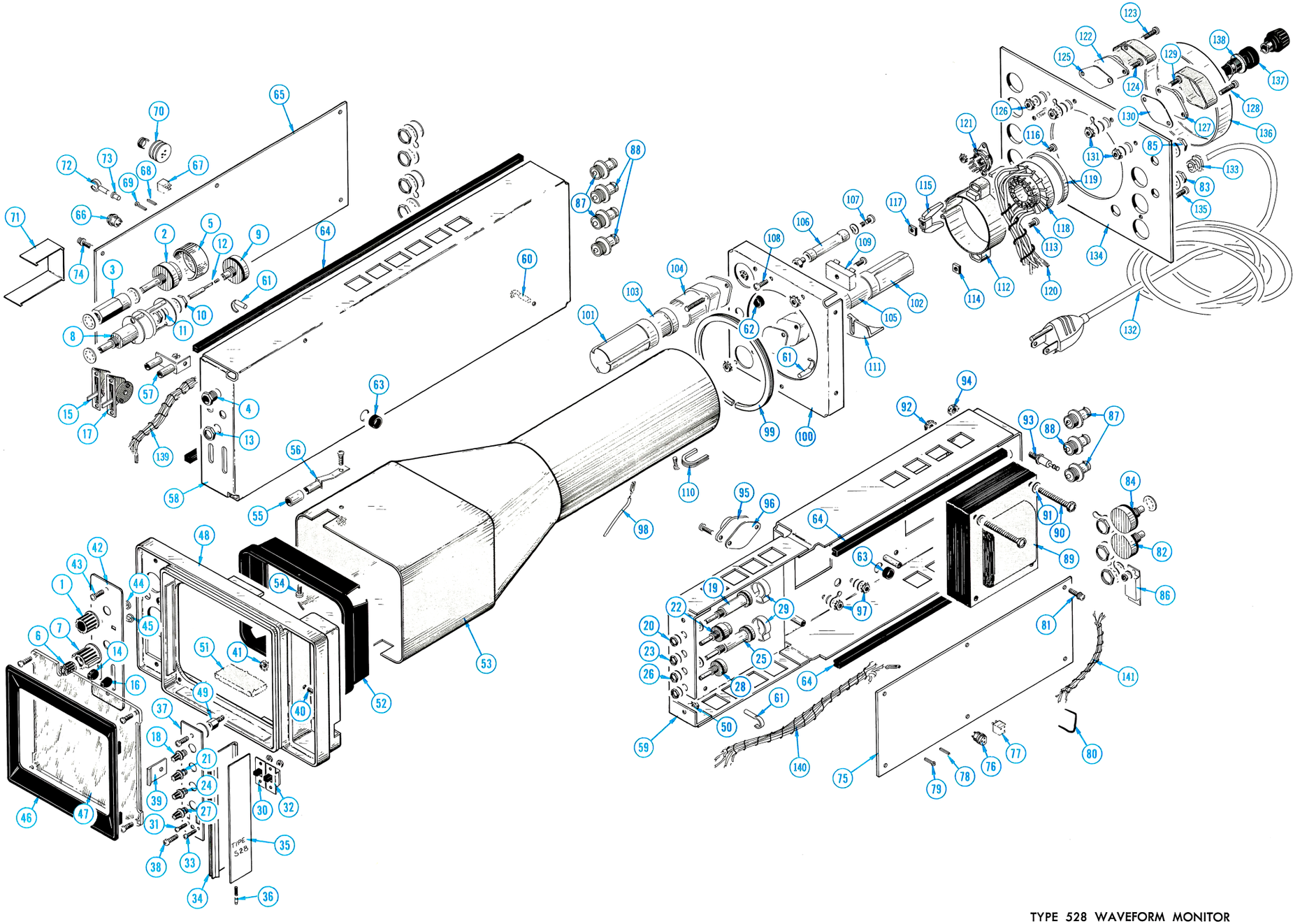


REFERENCE DIAGRAMS

1. INPUT & VERTICAL AMPLIFIER
2. SWEEP & HORIZONTAL AMPLIFIER
3. CRT & CALIBRATOR
4. POWER SUPPLY

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

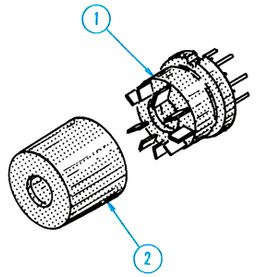
FIG. 1 EXPLODED VIEW



OPTIONAL ACCESSORIES (not shown)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
	016-0115-01	B010100	B129999	1		RACK ADAPTER
	016-0115-02	B130000		1		RACK ADAPTER
	016-0116-00			1		PANEL ASSEMBLY
	390-0018-00	B010100	B129999	1		CABINET, wrap-around
	390-0018-01	B130000		1		CABINET, wrap-around

FIG. 2 STANDARD ACCESSORIES



[B]

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-1	136-0099-00			1		SOCKET, 9 pin, cable end
-2	200-0249-00			1		COVER, 9 pin socket
	070-0800-00			1		MANUAL, instruction (not shown)

Cooling

The Type 528 is cooled by convection air flow through the instrument. Allow at least 2 inches clearance at the rear and the left or right side (or about 1 inch on the left and right sides) of the instrument for air circulation. If possible, allow some space (1/4 inch or more) at the top and/or bottom for additional air circulation through the ventilating holes in the metal cabinet. Temperature of the circulating air should not exceed +50° C (122° F) for safe operation.

Rackmounting the Type 528

The metal cabinet (added SN B060460 and up) for the Type 528 provides the proper electrical environment for the instrument, minimizes handling damage and reduces dust collection within the instrument. The four 0.156-inch diameter holes in the bottom of the cabinet depressions provide a means for mounting the instrument solidly to a surface such as a metal shelf (rack adapter) in a cabinet rack or console.

The Type 528 is designed to be cradle-mounted in a standard 19-inch rack or console side by side with another Type 528 or other instrument. The Tektronix part number for the rack adapter[1] to cradle mount the instrument is 016-0115-02. If only one Type 528 is mounted on the rack adapter, a panel assembly[1] that goes around the Type 528 cabinet front dimension and covers the space for the other half of the rack width can be obtained by specifying Tektronix part number 016-0116-00.

Custom Installation

Dimensional drawings provided on this fold-out page can be used as a reference for planning a custom installation before the instrument is obtained or they can be used for the actual installation. There are two possible ways to install the Type 528: (1) Use the front dimensional view of the cabinet to cut an opening for the cabinet, or (2) use the front dimensional view of the Type 528 to cut an opening the same size as the outside dimension of the front sub-panel casting.

The first installation method allows the Type 528 front sub-panel casting to cover the opening made in the custom panel. The second installation method requires a larger opening to allow the instrument to be positioned about 7/16 inch further back on the shelf to make the Type 528 front panel surface align with the custom panel surface.

[1]**All items can be ordered through your local Tektronix Field Office or representative.**

To install the instrument using the first method, proceed as follows:

a. Remove the two screws shown in the rear view drawing of the Type 528 and slide the instrument out through the front of the cabinet.

b. Cut hole in custom panel. Use the front dimensional view of the cabinet or the cabinet itself to determine size of opening.

c. Slide cabinet through rear side of custom panel opening. Let cabinet protrude through the front panel about 1/8 inch. (Front sub-panel casting on the Type 528 has groove to accept this amount of cabinet protrusion.)

d. Mark locations where cabinet will be fastened to shelf. (The bottom dimensional view drawing shows the 0.156-inch diameter hole locations in the cabinet.) Temporarily remove cabinet; drill holes in shelf.

e. Reinsert cabinet through custom panel opening. Fasten cabinet to shelf.

f. Insert Type 528 into front of cabinet. Secure instrument to cabinet by installing the two rear panel screws removed earlier.

To install the instrument using the second method, the following procedure is suggested:

a. Measure the distance from the front edge of the Type 528 front sub-panel casting to the center of the front mounting holes in the bottom of the cabinet. (This dimension should be about 2 1/16 inches.)

b. Remove the two screws shown in the rear view drawing of the Type 528 and slide the instrument out through the front of the cabinet.

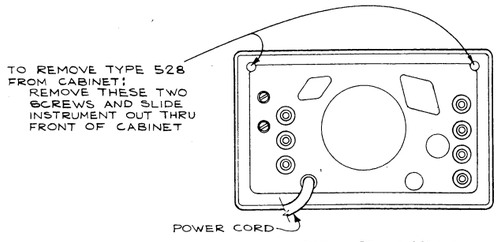
c. Cut hole in custom panel. Use the front dimensional view of the Type 528 or use rear casting on cabinet to determine size of opening.

d. Mark locations of front mounting holes for cabinet. Then use cabinet to mark rear hole locations for cabinet or use dimensional drawing for guide in marking hole locations. Temporarily remove cabinet; drill holes in shelf.

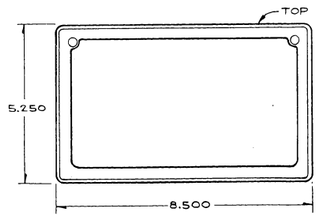
e. Use steps e and f of the first method as a guide for completing the installation.

Portable Usage

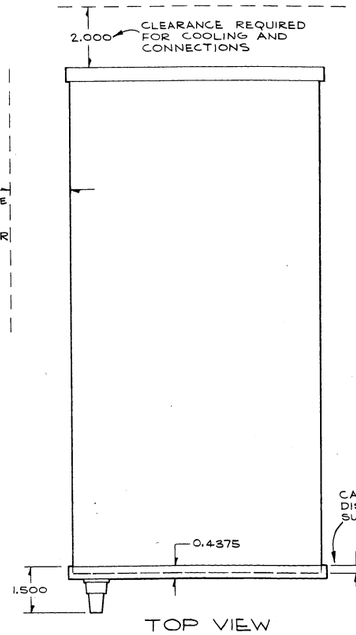
For portable use the Type 528 can be removed from the rack or custom installation and slipped into a blue-vinyl aluminum field case.[1] The field case has a latch to hold the instrument in the case. In addition, the field case is equipped with a handle and rubber feet. Tektronix part number for the field case is 390-0018-00.



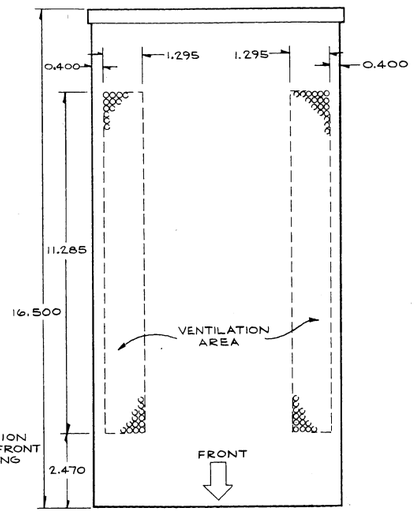
REAR VIEW



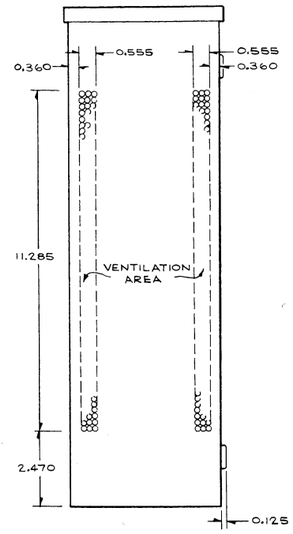
REAR VIEW



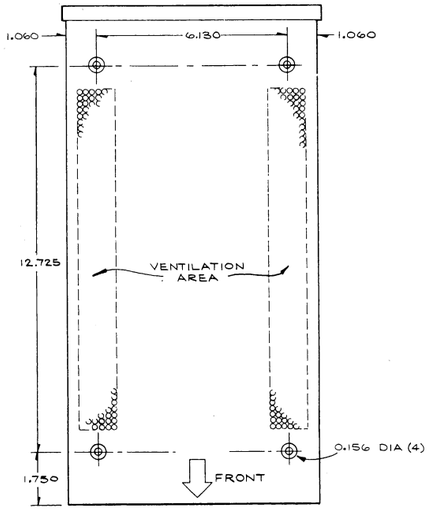
TOP VIEW



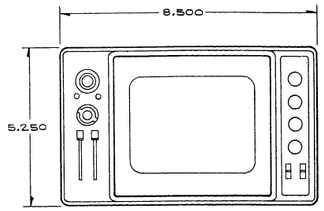
TOP VIEW



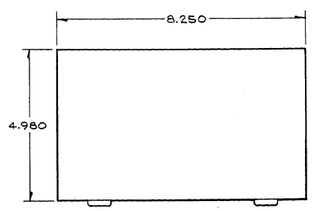
RIGHT SIDE VIEW



BOTTOM VIEW



FRONT VIEW



FRONT VIEW

NOTES:

1. VENTILATION AREAS ARE THE SAME FOR BOTH TOP & BOTTOM VIEWS.
2. VENTILATION AREAS ARE IDENTICAL FOR RIGHT & LEFT SIDES.
3. LARGER DIMENSIONS VARY APPROXIMATELY ±0.060.

TYPE 528 INSTALLED — METAL CABINET ONLY (TEKTRONIX PART NO. 437-0100-00)

TYPE 528

Ⓑ

DIMENSION DRAWING

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.

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committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT GENERAL

CHANGE REFERENCE S23351

DATE 4-10-75

CHANGE:	DESCRIPTION

POWER CORD CHANGES

The 1974 National Electrical Code permits the use of IEC (International Electrotechnical Commission) power cord color codes. As production permits, we are changing the entire Tektronix product line to comply with IEC power cord color code requirements. As a result, the power cord on Tektronix instruments may conform to either IEC or the older NEC requirements. The change consists of the following:

Conductor	NEC	IEC
Line	Black	Brown
Neutral	White	Light Blue*
Safety Earth	Green w/Yellow Stripe	Green w/Yellow Stripe

*Tinned copper conductor.

TEKTRONIX®
committed to technical excellence

MANUAL CHANGE INFORMATION

PRODUCT 528

CHANGE REFERENCE M23,090

DATE 1-29-75

CHANGE:	DESCRIPTION

070-0800-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

ADD:

D515	152-0107-00	Silicon	Replaceable by 1N647

DIAGRAM 4 POWER SUPPLY - Partial