TABLE OF CONTENTS

A list of abbreviations and symbols used in this manual will be found on page 6-1.

SECTION 1
CHARACTERISTICS

General Information

This is a Tektronix, Inc., commercial manual revised to meet Government commercial manual specification requirements. Sections 1 through 6 contain instructions with parts list for operation and maintenance of Oscilloscope, Tektronix Type RM647. Section 7 contains the information necessary to adapt this manual to Oscilloscope, General Dynamics Electronics Division Part Number A11846-001.

The Tektronix Type RM647 is a general purpose, high-performance oscilloscope designed to operate under severe environmental conditions. The oscilloscope requires a Tektronix 10-Series vertical plug-in unit in the left-hand compartment and a Tektronix 11-Series horizontal plug-in unit in the right-hand compartment.

The electrical characteristics listed below are those of the Type RM647, independent of the plug-in units. The environmental characteristics apply to the Type RM647 and its plug-in units as a system.

NOTE

Range I and Range II, referred to in certain parts of this section, are the ambient air temperature ranges that apply for a particular characteristic. These ranges are—Range I: 0° C to +40° C, Range II: —30° C to +65° C.

Vertical Amplifier (Range I)

Sensitivity

300 mv/cm, ±1%, through 186 Ω push-pull.

Risetime

Less than 5.8 nsec; 5.5 nsec typical.

Bandwidth

Dc to greater than 60 mc (30% down); 64 mc typical.

Display Linearity

A 2 cm centered signal will not change amplitude more than ±1 mm when offset to top or bottom of graticule.

Trace Finder

Compresses display to bring it within graticule area. Used to determine nature of improper deflection signal. Push-button also actuates trace-finder switch in Horizontal Amplifier. See Section 2.

Horizontal Amplifier

Sensitivity

347 μa/cm per side, ±1%, push-pull.

Maximum Calibrated Deflection Rate

10 nsec/cm.

Bandwidth

Dc to —3 db at 3 mc, or higher. Refer to appropriate horizontal plug-in manual for combined response.

Trace Finder

See "Trace Finder" in Vertical Amplifier characteristics.

Single-Sweep Reset

Connection between J101 on the rear panel and the 11-Series plug-in unit interconnecting socket provides for external reset of the single-sweep circuit in certain plug-in units. See J101 under "Rear Panel Connectors" in Section 2.

Cathode-Ray Tube

Type

T6470-31-1.

Phosphor

Type 31 normally supplied.

Accelerating Potential

14 kv.

Graticule Area

6 x 10 cm.

Graticule Markings

Internally marked in 6 vertical and 10 horizontal 1-cm spaces. 2-mm divisions marked on the vertical and horizontal centerlines. No parallax.

Graticule Illumination

Variable edge-lighting produces white (no filters) or red (with filters) graticule markings.

Unblanking

Bias-type, dc-coupled from 11-Series plug-in unit.

Crt Grid Z-Axis Modulation

Dc-coupled from rear-panel CRT GRID binding post. Input resistance about 22 kΩ. Bandwidth for small signals is dc to 10 mc (30% down point), or greater. Typically, ±2 volts peak will produce a visible change in display brightness.

Crt Cathode Z-Axis Modulation

Ac-coupled from rear-panel CRT CATHODE binding post. Input time constant is about 330 μsec (0.015 μf and 22 kΩ). Typically, a ±3-volt, fast-rise pulse will produce a visible change in display brightness.

Multi-Trace Chop Blanking

Crt circuitry permits multi-trace plug-in units, operating in chopped mode, to momentarily blank the display while switching between input channels.

Trace Rotation Control

Permits alignment of the trace with the graticule lines.

1-Kc Calibrator

Output Voltage Range

Square waves, 0.2 mv to 100 v peak-to-peak and 100 vdc.

Output Voltage Accuracy
(Load resistors 10 megΩ or higher)

0.1 and 100 VOLTS		All Other Voltages	
Range I	Range II	Range I	Range II
±1%	±1.5%	±2%	±3%

Output Resistance

0.2 mVOLTS to 0.1 VOLTS:	50 Ω, ±0.25%
0.2 VOLTS:	50 Ω, ±1%
0.5 to 100 VOLTS:	Varies with switch setting; about 4 kΩ maximum.

Current Through Loop

Square wave at 5 ma peak-to-peak, ±1.5%.

Frequency

1000 cps, ±0.1% (Range II).

Duty Factor

0.5, ±0.1% (Range II).

POWER REQUIREMENTS

Voltage Ranges

95 to 122 vac	190 to 244 vac
100 to 130 vac	200 to 260 vac
106 to 137 vac	212 to 296 vac

When shipped, instrument is wired for voltage range indicated on rear panel. Voltage range can be changed; see fan and transformer diagram and fuse data in Section 2.

Line Voltage Distortion

For proper power supply operation at the lower line voltage limit, the line-voltage sine wave distortion must not exceed 1%.

Line Frequency

*50 to 60 cps, ±10%.

Power Consumption

About 200 watts (with Type 10A2 and Type 11B2 plug-in units and 115-volt line).

***A special fan modification is available which will allow 50 thru 400 cps operation of the instrument.**

Power Output Connector J101

Provides power from the regulated supplies of the Type RM647 for operating external devices. Also provides an input connection for an external signal to reset the single-sweep circuit in certain 11-Series plug-in units. See Section 2.

ENVIRONMENTAL CHARACTERISTICS

Operating

Temperature

−30° C to +65° C continuous. If operating at −30° C, allow 30 minutes for stabilization. A thermal cutout interrupts power to the fan when the internal temperature drops below 0° C.

A self-resetting thermal cutout interrupts instrument power if internal temperature becomes excessive. A front panel lamp lights when the cutout is activated.

Altitude

15,000 feet, maximum.

Vibration

0.025 inch peak-to-peak, 10-55-10 cps (4 G's) for 15 minutes on each axis in one-minute sweeps. Refer to Installation paragraph in this section for the mounting method required to achieve this.

Non-Operating

Temperature

−55° C to +75° C.

Altitude

50,000 feet, maximum.

Humidity

Meets Mil-Std-202B, method 106A through five cycles (120 hours), freezing and vibration excluded.

Shock

20 G's one-half sine, for 11 milliseconds. Two shocks each direction along each of the three major axes (total of 12 shocks).

Vibration

Same as under "Operating".

Transit

Meets National Safe Transit type of test when factory packaged: Vibration for one hour at slightly greater than 1 G. 18-inch drops on corners, edges, and flat surfaces.

MECHANICAL CHARACTERISTICS

Construction

Front panel is anodized aluminum. Chassis is aluminum-alloy.

Dimensions

Overall: 19.016 in. wide, 6.984 in. high, 20.703 in. deep (includes front handle).

Weight

38 lbs., 14 oz.

Installation

The instrument has been designed to fit most 19-inch wide cabinet type racks whose dimensions conform to EIA specifications. This instrument is intended to be locked in place to the front rails of the cabinet type rack with the two pawl fasteners. If additional support is needed, the front panel of the instrument is then also fastened to the front rack rails with four screws. When the instrument is fastened to the front rack rails with both the RELEASE knobs and the four screws, and with the Rackmount Rear Support Kit (optional) installed, the instrument is capable of withstanding 4 G's of vibration, as measured at the point of mounting, while mounted in the rack.

ACCESSORIES INCLUDED

	Tektronix Part No.
2 — Instruction Manuals	070-435
1 — Light Filter	378-548
1 — 3-Conductor Power Cord	161-022
1 — 3-Wire to 2-Wire Adapter	103-013
1 — BNC to Binding Post Adapter	103-033
1 — 20-Inch 50 Ω Coaxial Cable with BNC Connectors	012-076

OPTIONAL ACCESSORIES

Rack Mount Rear Support kit	016-065

SECTION 2

OPERATING INSTRUCTIONS

Introduction

The Type RM647, when combined with a 10-Series and an 11-Series plug-in unit, is a complete oscilloscope system. The 10-Series plug-in unit can be operated only in the left compartment and the 11-Series only in the right.

This section of the manual describes the function of each control and connector on the Type RM647, as well as general operating information.

Operating Temperature

The Type RM647 Oscilloscope can be stored where the ambient air temperature is between —55° C and +75° C, and operated where the ambient air temperature is between —30° C and +65° C. After storage at temperatures beyond the operating limits, be certain to allow the chassis temperature to come within the operating limits before power is applied.

Proper cooling of the Type RM647 depends on proper air flow. It is important to choose a location for operation where the required air flow, particularly to the rear of the instrument, is not restricted. At least two inches of clearance on both sides and the rear are recommended.

Air flow is into the rear of the instrument. If desired the air flow direction may be reversed by mechanically reversing the fan (see Maintenance section of this manual).

Power Requirements

Transformer

Unless tagged otherwise, the transformer was connected at the factory for operation at 100 to 130 volts. However, provisions have been made for easy conversion to operation at 200 to 260 volts.

TRANSFORMER PRIMARY CONNECTIONS

Nominal Line Voltage	Connect Jumper Wire Or Wires Between Terminals As Follows
110	1 to 6 and 4 to 5
115	1 to 2 and 3 to 4
124	1 to 8 and 4 to 7
220	5 to 6
230	2 to 3
248	7 to 8

Fan. The cooling fan is powered by a 115-volt ac motor. If the instrument is converted, for example to operate from a 230-volt line, a change in the fan wiring must be made so that it operates from a 115-volt source The correct connections for 95 to 137 and 190 to 296 volt operation are shown in Figure 2-1.

Fuse. The following chart lists the proper current ratings for fuses in the Type RM647.

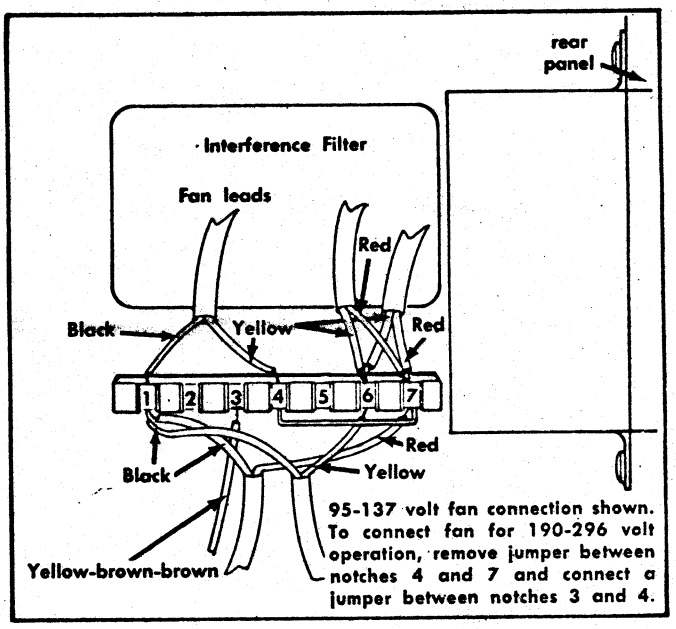


Fig. 2-1. Fan connections for 95-137 and 190-296 line-voltage ranges.

Fuse	60 cps 115-Volt Range	50 cps 115-Volt Range	60 cps 230-Volt Range	50 cps 230-Volt Range
F601	3 amp slow-blow	4 amp slow-blow	1.5 amp slow-blow	2 amp slow-blow
F602	4 amp slow-blow			
F613	0.5 amp fast-blow			
F703	0.75 amp fast-blow			
F743	0.75 amp fast-blow			
F820	2 amp fast-blow			

FIRST-TIME OPERATION

The following describes one way to properly set the FOCUS, ASTIG and TRACE ROTATION controls.

1. Install the plug-in units.

2. Set the Type RM647 INTENSITY control fully counterclockwise and apply power to the instrument. Allow several minutes for warmup.

3. Set the controls on the plug-in units and the Type RM-647 for a free-running, vertically-centered trace of moderate intensity.

4. Set the controls on the 11-Series plug-in unit for a 0.1 μsec/cm sweep rate.

5. Set the controls on the 10-Series plug-in unit for a vertical sensitivity of 0.05 volt/cm.

6. Set the 1 KC CALIBRATOR switch to .2 VOLTS and attach a cable from the CAL OUT connector to the vertical input.

7. Set the controls on the 11-Series plug-in unit for a triggered display.

8. With the FOCUS and ASTIG controls set at midrange, set the INTENSITY control so that part of the vertical portion of the trace can be seen.

9. Set the ASTIG control so that the horizontal and vertical portions of the display are **equally** focused, but not necessarily **well** focused.

10. Set the FOCUS control so that the vertical portion of the trace is as thin as possible.

11. Repeat steps 9 and 10 for best results. Make the final settings with the INTENSITY control set for the desired display brightness.

NOTE

To check for proper setting of the ASTIG control, slowly turn the FOCUS control back and forth through its optimum setting. If the ASTIG control is properly set the horizontal and vertical portions of the trace will individually come into sharpest focus at the same position of the FOCUS control. This setting of the ASTIG control should be correct for any type of display. However, it may be necessary to reset the FOCUS control slightly if a large change is made in the INTENSITY control setting.

12. Disconnect the input signal and obtain a free-running, vertically-centered trace.

13. If necessary, set the TRACE ROTATION control (a screwdriver adjustment concentric with the ASTIG control) so that the trace is parallel with the graticule lines.

FUNCTION OF CONTROLS

INTENSITY	Permits control of display brightness. Lowest useable brightness is generally best for precise measurements since trace thickness decreases as intensity decreases.
FOCUS	Adjusted in conjunction with the ASTIG control to obtain sharp display definition. See "First-Time Operation" for a recommended adjustment method.
ASTIGMATISM	Adjusted so that the vertical and horizontal portions of a display are individually brought into sharpest focus at the same position of the FOCUS control.
TRACE ROTATION	A screwdriver adjustment concentric with the ASTIG control. Permits the operator to offset any trace tilt introduced by the earth magnetic field.
SCALE ILLUM	Varies brightness of the graticule markings.
1 KC CALIBRATOR	Provides accurate peak-to-peak square-wave voltages available at the CAL OUT connector. 100-volts dc and 5-ma square wave (through the current loop) also provided. Square-wave frequency is an accurate 1 kc. (See the discussion under "1 KC CALIBRATOR" in this section.)
HORIZ POSITION and VERNIER	Used to move the display horizontally. These controls are electrically part of whichever 11-Series plug-in unit is installed in the Type RM647.
TRACE FINDER	When excessive deflection or improper centering result in loss of display, push the TRACE FINDER button so that the display is compressed to within the graticule area. Center the display with the positioning controls and establish a vertical deflection amplitude of about 4 cm or less. Release the TRACE FINDER button. The display should then be restored.
POWER ON	Line switch for oscilloscope. Pilot lamp brightness can be varied by turning the bezel on the lamp housing.
FUSE OUT	Indicator lamp which lights indicating that the input ac-line fuse F601 has blown.
OVER TEMP	Indicator lamp which lights when thermal cutout TK601 disconnects power to the instrument because of excessive interior temperature. If the instrument is connected for 108, 115 or 122 volt operation, the fan will continue to run after TK601 disconnects power to the rest of the instrument, thereby helping to reduce the interior temperature.

1 KC CALIBRATOR

The following characteristics of the 1 Kc Calibrator provide a convenient means of verifying the accuracy of an oscilloscope system:

1. Accurate peak-to-peak and dc voltage output.
2. Accurate 5 ma peak-to-peak closed-loop current signal.
3. Accurate frequency.
4. Square-wave output signal.

Voltage

The 1 Kc Calibrator provides peak-to-peak voltage from 0.2 mvolts to 100 volts into high-resistance loads. With switch settings of .2 VOLTS and below, the output source resistance is 50 Ω as indicated by the voltages printed in red on the panel of the Type RM647. The voltage across a 50 Ω termination will then be accurate at one-half the value indicated by the switch setting, provided the termination resistance is an accurate 50 Ω.

The +100-volt dc output of the calibrator has many uses, limited only by its current capability. The load resistance should be as high as possible (the output voltage will drop to 99 volts at about 35 kΩ).

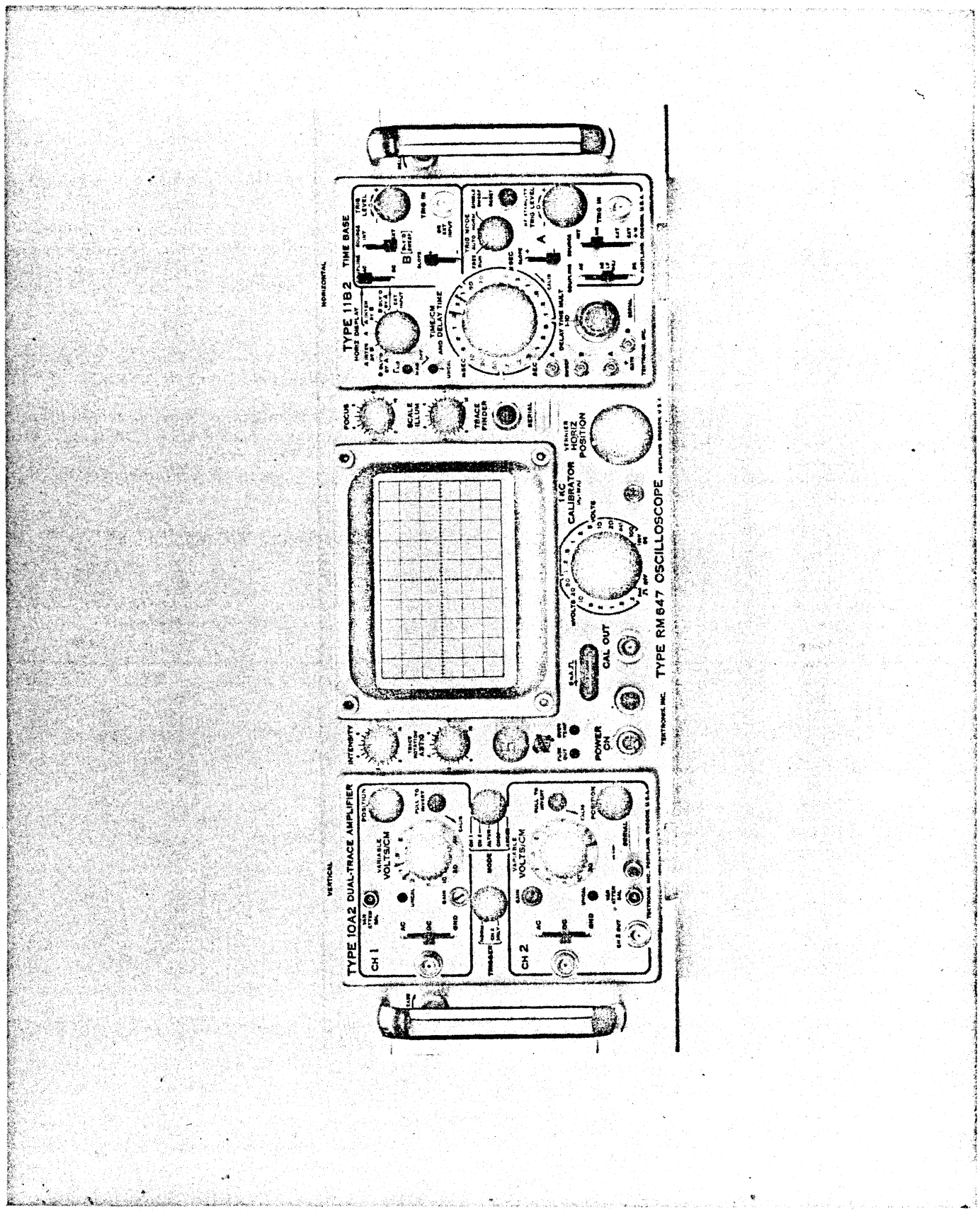


Figure 2-2. The Type RM647 Front Panel Controls.

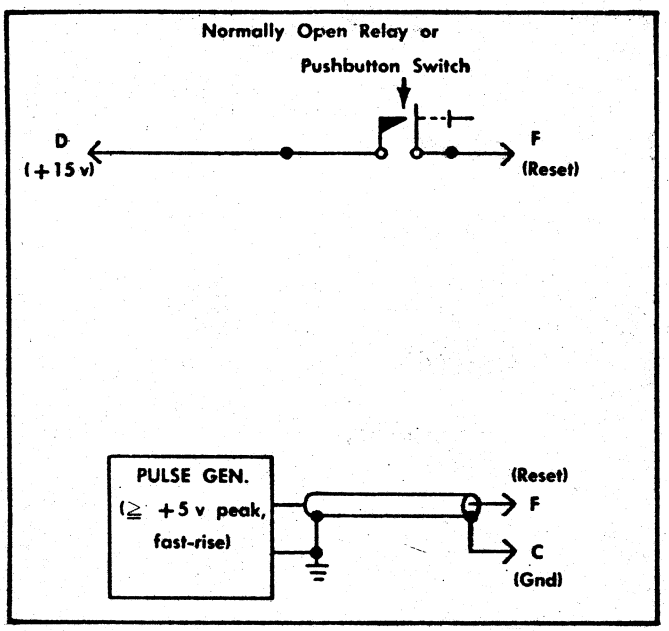


Fig. 2-3. Two means of providing an external single sweep reset pulse.

Current

The current loop, located above the CAL OUT connector, provides a 5-ma peak-to-peak square wave which can be used for calibrating and checking current-probe systems such as the P6016/131. This current signal is obtained by clipping the probe through the loop and by setting the 1 KC CALIBRATOR switch to the first position clockwise from OFF.

The arrow on the front panel above the current loop indicates conventional current flow: + to —.

Frequency

The 1 Kc Calibrator is crystal controlled so that the frequency is accurate at 1 kc and the duty factor is stable at 0.5. Thus, the calibrator signal can be used as a time reference for checking or calibrating the basic sweep rate adjustments of 11-Series plug-in units such as the Type 11B2.

Wave Shape

The calibrator square-wave output signal can be used as a reference wave shape when checking or adjusting the compensation elements in passive, high-resistance, voltage probes. Since the flat-top characteristic of the square wave is known, the probe compensation is adjusted so that the signal delivered by the probe produces a flat-topped square-wave display.

REAR-PANEL CONNECTORS

J101

Ten-contact connector J101 on the rear panel of the Type RM647 provides power from the regulated low-voltage

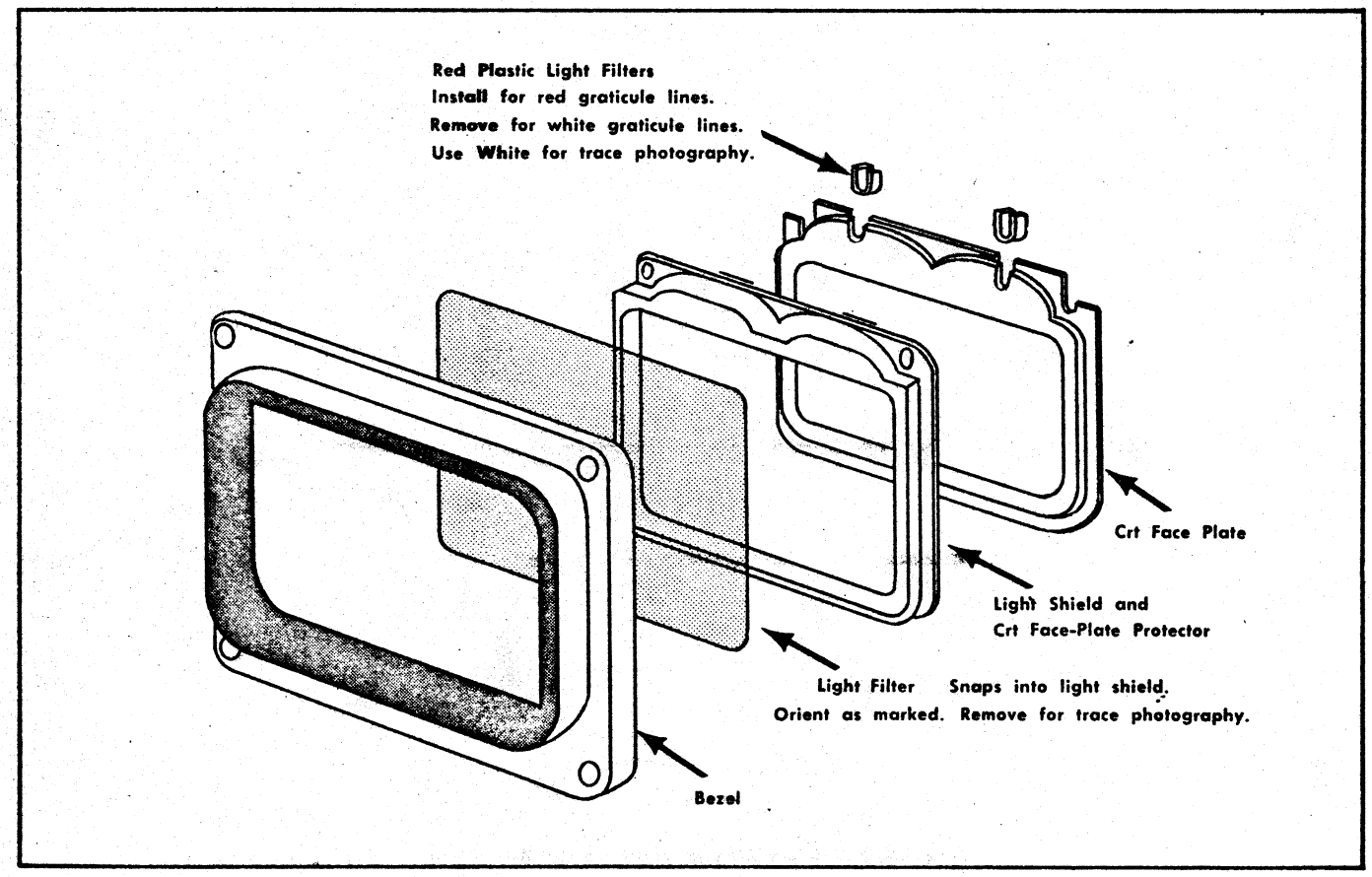


Fig. 2-4. Crt face-plate assembly.

supplies for operating external devices and the signal input connection for external single sweep reset of certain 11-Series plug-in units such as the Type 11B2.

J101 Contact	Voltage	Maximum Current*
A	—75 v	50 ma
B	—15 v	20 ma
C	ground	
D	+15 v	200 ma
E	+100 v	20 ma
F	Single sweep reset input.	
G	nc	
H	nc	
J	nc	
K	nc	

***When the Type 10A2 and 11B2 plug-in units are used.**

Fig. 2-3 illustrates two ways to provide an external single-sweep reset pulse suitable for the Type 11B2 plug-in unit.

CRT CATHODE

The ac-coupled CRT CATHODE input connector permits intensity (Z-axis) modulation of the crt display. The input time-constant is about 330 μsec (0.015 μf and 22 kΩ) which corresponds to a low-frequency response at the crt cathode of —3 db at about 500 cps.

Display intensity increases during negative-going changes in the modulating signal and decreases during positive-going changes. Generally, at least 5-volts peak signal amplitude is required for visible display modulation, depending on the intensity level of the unmodulated display.

CRT GRID

The CRT GRID connector permits gating or modulating the intensity of the crt display through the wide-band, dc-coupled Z-Axis Amplifier in the Type RM647. Since the amplifier inverts the signal, negative voltages increase display intensity and positive voltages decrease intensity. The voltage magnitude required for visible modulation depends on the intensity level of the unmodulated display; typically, a 2-volt signal will produce a visible change in the brightness.

SECTION 3

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains descriptions of each circuit in the Type RM647 Oscilloscope. Block diagrams are included in each description to show the major stages of the circuit and the signal flow.

A complete block diagram, showing the relationship between major circuits in the Type RM647, is located in Section 6. Complete schematics for each circuit are also located in Section 6.

VERTICAL AMPLIFIER

The Type RM647 Vertical Amplifier block diagram is shown in Fig. 3-1. It is a dc-coupled push-pull voltage amplifier having a maximum gain of about 42. A delay line is provided so that the rising portion of a fast-rise event which internally triggers a sweep will be displayed on the crt. RC networks in the emitter circuits provide the high-frequency peaking required to obtain broadband operation.

If the display is driven out of the graticule area by an excessive deflection signal, the TRACE FINDER button may be pressed to actuate switches in the vertical and horizontal amplifiers. The vertical deflection signal is compressed to within the limits of the graticule so that the direction of the display loss can easily be determined.

The 186 Ω delay line delays the vertical signal for about 140 nanoseconds. The Phase and Atten Equalizers compensate for distortion introduced by the delay line.

The VERT GAIN control R414 delivers the required portion of the vertical deflection signal to Q423 and Q433. These emitter followers drive Q444 and Q454 which form a paraphase amplifier with R445, R447, R457, and R448 as the basic common-emitter elements. The series-parallel RC components in the common-emitter circuit maintain the stage gain at high frequencies. DAMPING control R456D is set to obtain critical damping of the compensation network. VERT CENT control R441 is set to balance the amplifier.

When the TRACE FINDER button is pressed, the dynamic range of the Q444-Q454 stage is decreased. This limits the vertical deflection to less than ±3 centimeters.

The Q444-Q454 collectors drive parallel, push-pull amplifiers Q464A-Q474A and Q464B-Q474B. The common-emitter circuits of these amplifiers are compensated for high frequencies in much the same manner as the previous stage.

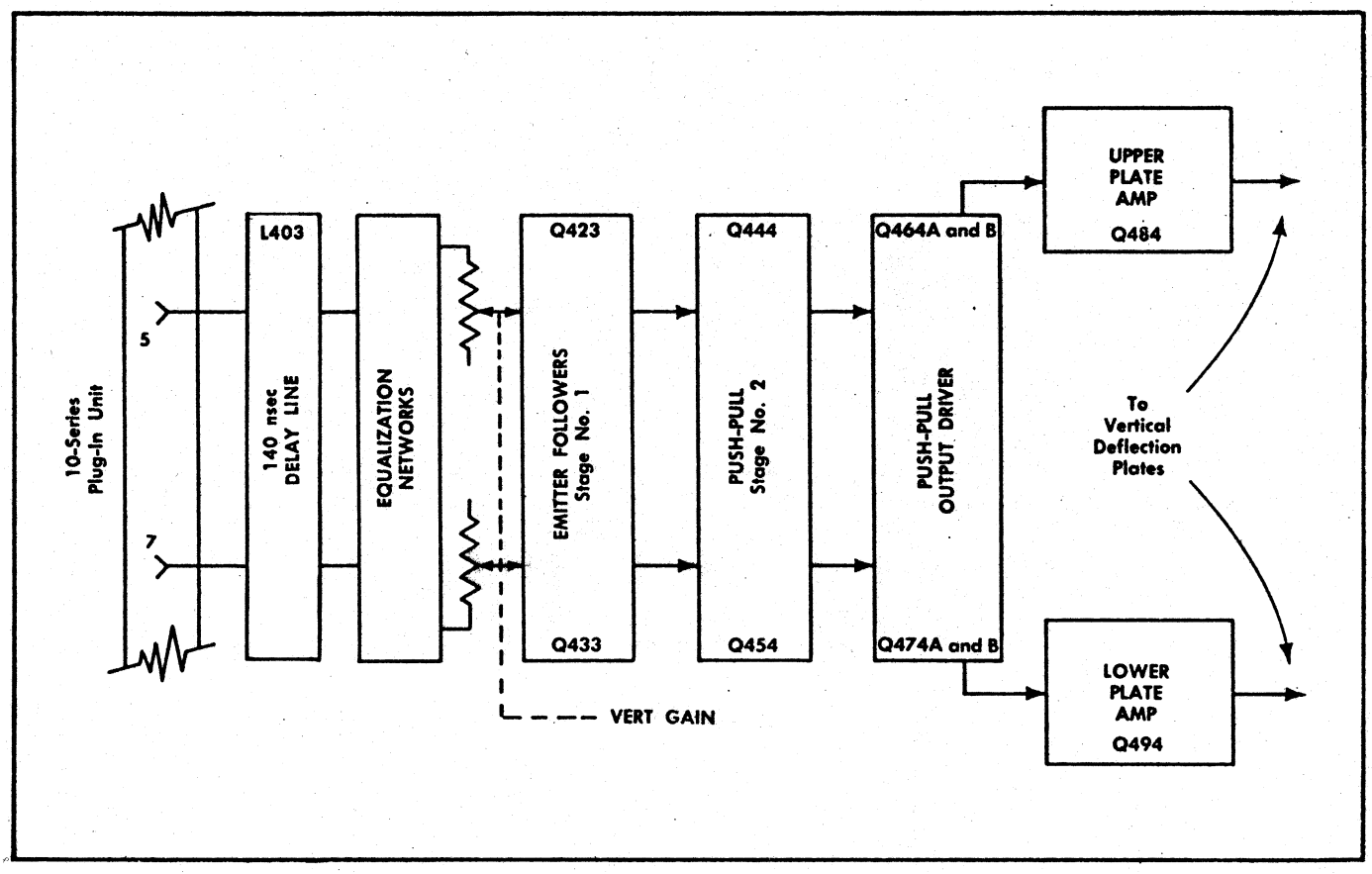


Fig. 3-1. Vertical Amplifier block diagram.

The collectors of the parallel, push-pull amplifiers provide current drive to the emitters of output amplifiers Q484 and Q494. Feedback to the bases of Q484 and Q494 permits the output voltage swing to be shared by the driver stage.

HORIZONTAL AMPLIFIER

The Type RM647 Horizontal Amplifier block diagram is shown in Fig. 3-2. The dc-coupled amplifier consists of two independent current-driven operational amplifiers. A 1-ma change in input current will produce about 22-volts change in the output voltage with the HORIZ GAIN control set to midrange. The feedback circuit in each operational amplifier is compensated for best high-frequency response.

If the display is driven off the graticule by an excessive deflection signal, the TRACE FINDER button may be pressed to actuate switches in the horizontal and vertical amplifiers. When the switch in the horizontal amplifier is actuated, one of the operational amplifiers is disconnected so that the overall sensitivity decreases by two-to-one. The clipping levels of the remaining operational amplifier will compress the horizontal deflection to within the limits of the graticule.

Current-driven operational amplifiers, such as those used in the Type RM647, have a low input impedance due to the negative feedback. Any change in the input current results in a nearly equal change in the feedback current. Since the open-loop sensitivity of the operational amplifier is very high, a minute difference between the input and feedback currents is sufficient to control a large voltage swing at the output.

The feedback impedance value determines the magnitude of the output voltage swing according to Ohm's law as follows:

$$(Z_{feedback})\ (\Delta I_{feedback} \approx \Delta I_{input}) = \Delta V_{output}$$

D361, D371, D362, and D363 limit the dynamic input current range to about 5.5 ma per side; a range adequate to provide horizontal deflection to about 2.5 cm beyond the edges of the graticule. D360 shunts excess signal current when D361 and D362 are off due to excess deflection to the left of the graticule.

The voltage at the junction of Zener diode D397 and R397 is about +120 volts. Clamp diode D395, connected to this voltage, prevents the output of the Q373-Q374 amplifier from going higher than +120 volts. Diode D396 serves the same purpose of the Q393-Q394 amplifier.

When the TRACE FINDER button is pushed, a known current is supplied to the Q393-Q394 amplifier which sets the output voltage at +55 to +75 volts. This is approximately the same voltage as would be produced by a "zero deflection" input signal. With one of the two dynamic deflection signals eliminated, the observed deflection is reduced by one half and the dynamic range of the Q373-Q374 amplifier, working alone, is insufficient to deflect the beam beyond the graticule limits.

HORIZ CENT is set so that the spot will be centered in the graticule when a "zero deflection" current signal is applied to the Horizontal Amplifier.

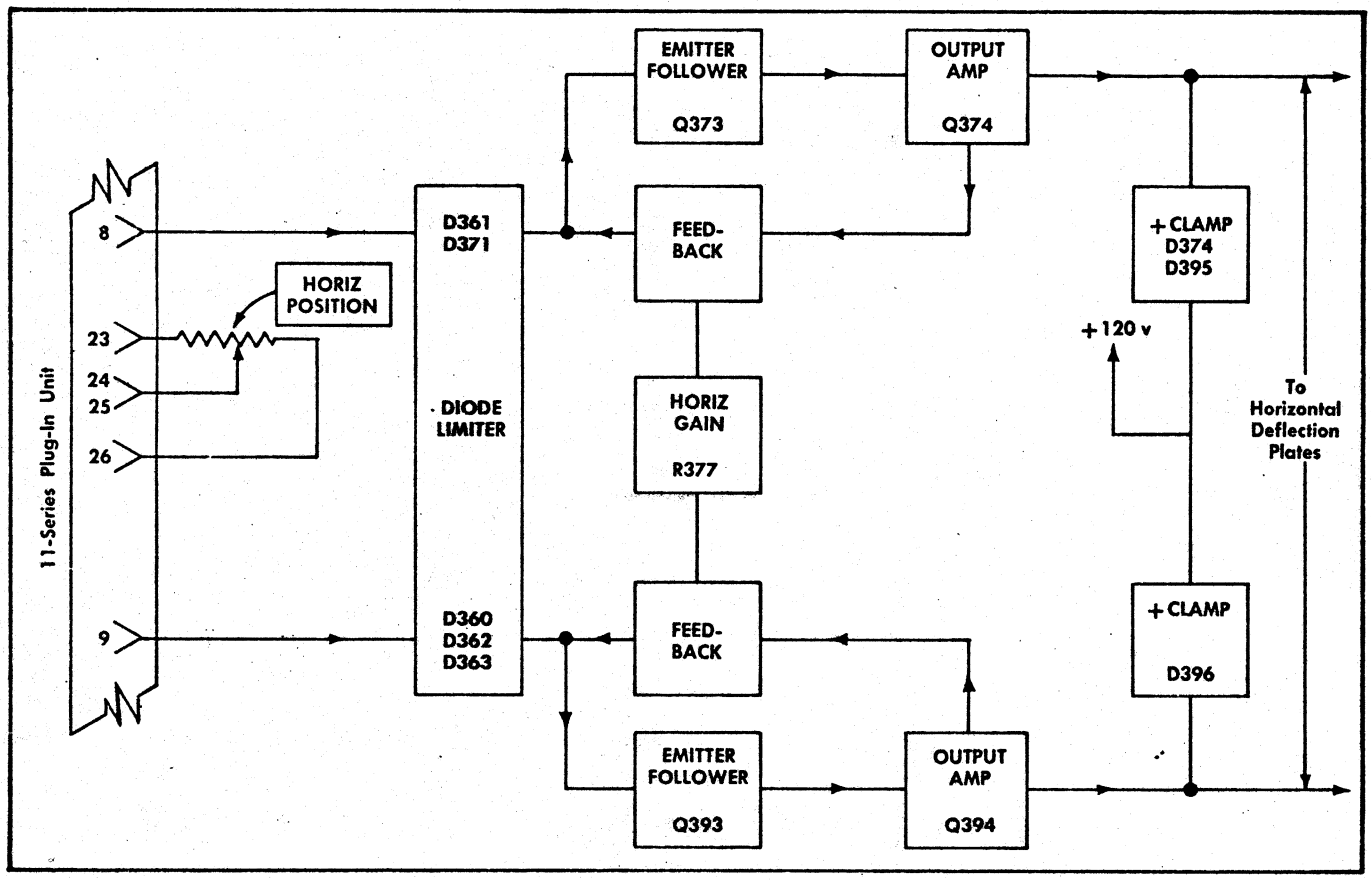


Fig. 3-2. Horizontal Amplifier block diagram

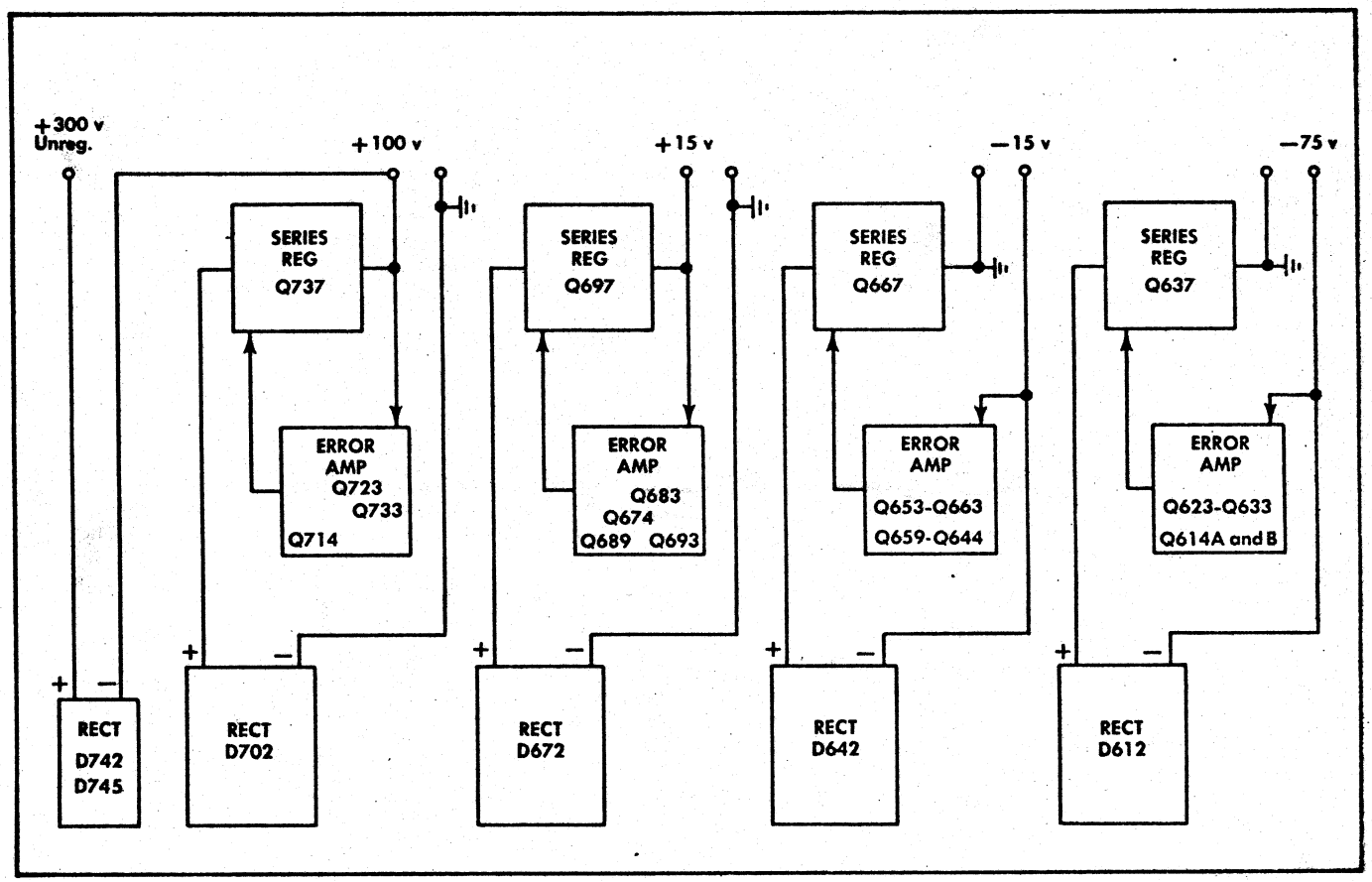


Fig. 3-3. Low-Voltage Power Supply block diagram.

Variable capacitors C377, C378 and C397 are set to provide the best amplifier linearity and correct response at high sweep rates.

LOW-VOLTAGE POWER SUPPLY

The Type RM647 Low-Voltage Power Supply consists of two positive and two negative interdependent accurately-regulated supplies, and one positive unregulated supply. See Fig. 3-3. The most negative supply, −75 volts, is regulated by reference to a Zener diode, while the remaining regulated supplies are referenced to the −75-volt supply. The supplies are also dependent on one another since the error amplifier in each supply is powered by at least one of the other supplies.

The basic operating principle of the supplies is illustrated in Fig. 3-4. A variable resistance, in series with the load across an unregulated dc source, is varied as required so the supplied current will produce the proper voltage across the load. Control of the series resistance element, a transistor, is provided by the error amplifier which constantly compares the voltage across the load to a reference voltage. The error amplifier must detect a constant relationship between the output and reference voltages and will adjust the series resistance value as required to maintain that relationship.

With a line voltage near the center of the instrument operating range, the voltage across C612 in the −75-volt supply is about 105 volts dc. Of this voltage, 75 volts is across the load and the remainder is across the series combination of R613, R637, and Q637.

Since the Q637 emitter current is also the load current, its magnitude determines the output voltage across the load. The output voltage is sampled by divider R630-R631-R632-R634 and sets the Q614B base voltage. If the voltage across the load begins to change, the Q614B base voltage will change. The Q614A collecter current will then change due to common-emitter coupling between Q614A and Q614B. The variation in Q614A collector current is amplified by Q623-Q633 and changes the Q637 current, restoring the voltage across the load to the proper value.

This negative feedback causes voltage comparator Q614A-Q614B to seek a condition of equal base voltages. The Q614A base voltage is fixed to about −9 volts by Zener diode D609. Thus, the voltage comparator forces the supply to provide an output voltage which, when divided by R630-R631-R632-R634, will also be −9 volts at the Q614B base.

It is important to note that the voltage comparator will have equal base voltages with any setting of −75 VOLTS adjustmment R631, even though the output voltage may not be exactly −75 volts. To obtain a −75-volt output, R631 is set so that the resistive division ratio equals the ratio of 9 volts to the desired output voltage.

The high gain of the error amplifier at dc gives the supply a high degree of dc stability.

One difference between the −75-volt supply and the three remaining regulated supplies is in the way the voltage com-

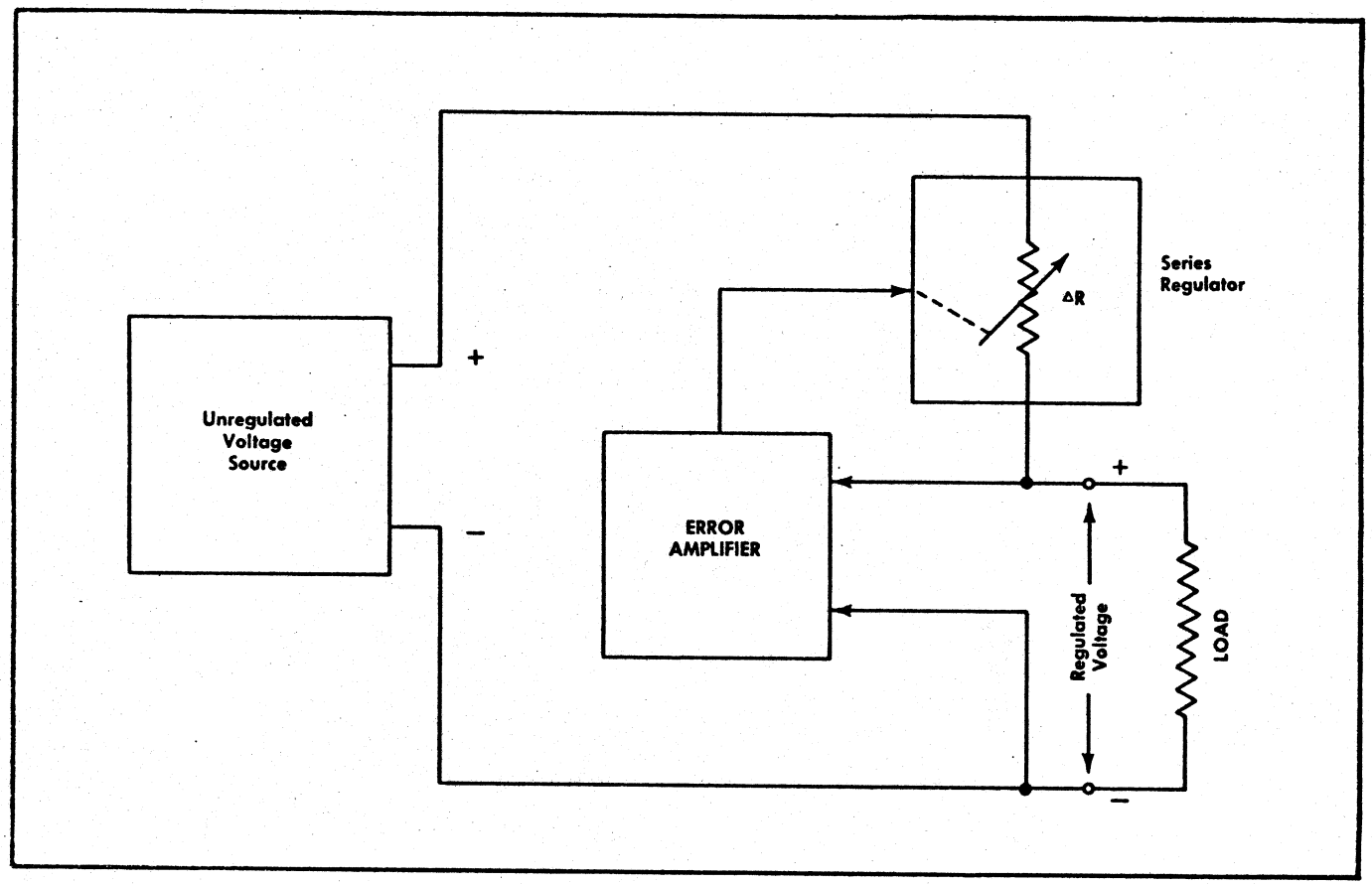


Fig. 3-4. Series regulated supply principle.

parators are connected. For example, in the +100-volt supply, divider R730-R731-R732 is connected between the −75-volt reference and the +100-volt output. Since the emitter of Q714 is connected to ground, any change in the +100-volt output will change the Q714 base current. This same form of voltage comparator is used in the +15-volt supply.

In the −15-volt supply, two connections are interchanged from those in the two positive voltage supplies. The emitter of Q667 is connected to ground and the emitter of Q644 is connected to the supply output. However, the operation is the same as in the +15- and +100-volt supplies; any change in the −15-volt output will produce a change in the Q644 emitter circuit.

CRT CIRCUIT

The Crt Circuit consists of a cathode-ray tube, its regulated high-voltage power supply, and a Z-axis (intensity) modulation amplifier. See Fig. 3-5. The crt requires operating voltages of +11.8 kv (post accelator), −2.2 kv (cathode), −2.25 kv variable (control grid), and several lesser variable and fixed voltages for control of focus, astigmatism, geometry, 'Y' axis alignment, etc.

The high-voltage power supply contains a controlled-amplitude oscillator which drives a step-up transformer. Rectifiers in the transformer secondaries provide the three high voltages for the crt. Negative feedback from the −2.2 kv supply through a voltage comparator regulates the oscillator output amplitude so that the −2.2 kv remains constant with variations in load. To protect the oscillator transistor from excessive dissipation, a protection circuit turns off the oscillator for about 4 seconds if there is an overload on any of the high-voltage supplies.

The correct ratio between the crt cathode supply voltage and the control-grid and post-accelerator supply is established by the turns ratio of the high-voltage transformer and by the CRT GRID BIAS calibration control which has the effect of a variable volts per turn ratio.

The Z-axis (intensity modulation) amplifier permits changing the crt control grid bias so that the display brightness can be controlled. The amplifier output is connected to the positive end of the floating high-voltage crt control-grid supply, and can vary the grid over a range of about 90 volts. The current input signal for the dc-coupled amplifier is obtained from the INTENSITY control, either or both plug-in units, and/or an external source through the CRT GRID connector on the rear of the instrument. Sensitivity of the wideband, negative feedback amplifier is about 30 v/ma.

High-Voltage Power Supply

Q820 and the T820 primaries form an Armstrong oscillator. Q804 is a shunt regulator of the Q820 base drive. If Q804 conducts heavily, the base current and therefore the collector current of Q820 decreases. This decreases the ampere-turns ratio in the T820 primary, which results in a decrease in the

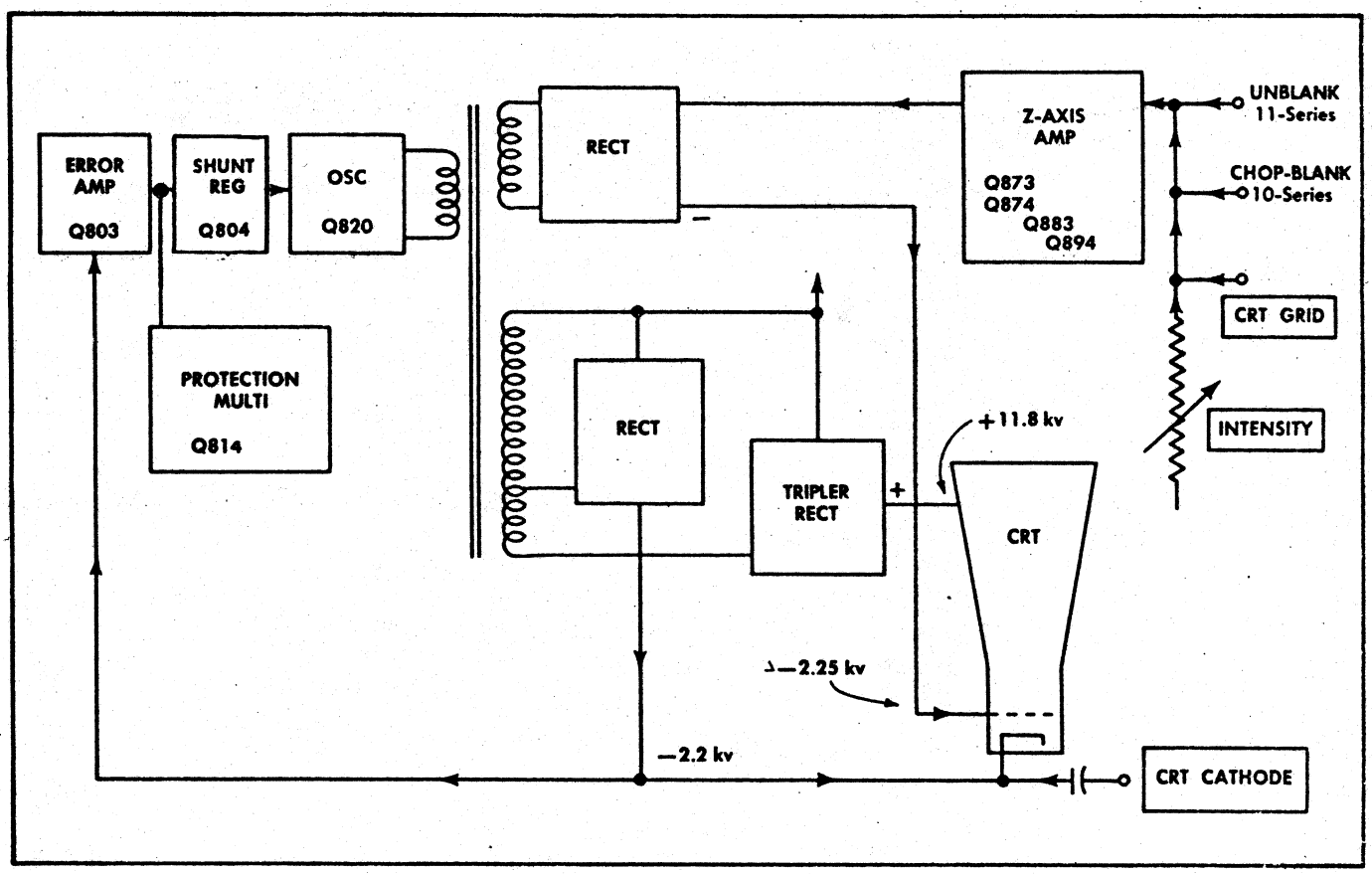


Fig. 3-5. Crt Circuit block diagram.

dc high voltages developed in its secondaries. Conversely, if the Q804 conduction decreases, the magnitude of the dc high voltages will increase.

The conduction level of Q804 is controlled by error amplifier Q803A-Q803B which monitors the output of the —2.2-kv crt cathode supply and compares it with the +100-volt supply. When HIGH VOLTAGE control R801 is set so that the output high voltage is —2.2 kv, there is a 110 μampere current through resistors R802A-R802F. Any change in the crt cathode voltage will change the R802A-R802F current. An amplified current change at oscillator Q820 will cause a change in the oscillator output amplitude, restoring the high voltage to the proper value.

The Q814A-Q814B multivibrator protects oscillator Q820 from damage by attempting to correct for certain abnormal loads, such as accidental shorting of the high-voltage during maintenance. In attempting to correct for overloads, the dissipation rating of transistor Q820 could be exceeded.

Under normal conditions, Q814A is saturated and Q814B is off. The low Q814A collector voltage holds off diode D811 and transistor Q814B. With Q814B off, capacitor C818 is charged to about 29 volts.

If the —2.2-kv supply goes out of regulation with a decrease in output voltage, the voltage at the junction of R810 and D815 will become more negative. This turns on diodes D815 and D816, diverting R817 current from the base of Q814A. The Q814A collector voltage then rises, turning on Q814B.

When Q814B turns on, its collector drops and the charge on C818 turns off D817 and Q814A. This positive feedback drives Q814B into saturation. When Q814A turns off, diode D811 turns on, clamping the Q804 base at a level which turns off oscillator Q820. Diodes D815 and D816 prevent the D811 turn-on from turning on Q814A.

When Q814B turns on, C818 begins to discharge through R817. The charge will have decreased sufficiently in about 4 seconds to turn on Q814A. Positive feedback (via the Q814B collector and C818) will drive Q814A into saturation and turn off Q814B and D811.

When D811 turns off, Q804 turns on oscillator Q820. Since no high voltage was produced while the oscillator was off, the error amplifier causes Q820 to immediately produce a very high-amplitude output. If the cause of the original overload has been removed, the crt cathode voltage will rapidly increase to —2.2 kv. The error amplifier will then decrease the Q820 output amplitude to the normal level before the temperature of transistor Q820 has risen enough to cause damage.

The protection circuit will not respond to this momentarily large error signal at the Q804 base. When Q814B turns off, C818 must be recharged. A major portion of the required charge current is supplied by Q814A base current. Thus Q814A will be unaffected by the Q803B collector current level for about 250 milliseconds while the C818 charge is being restored. Then, if the high-voltage overload still exists, the Q803B error signal will again actuate the protection circuit.

Since only the —2.2-kv supply is regulated directly, the correct crt control-grid and post-accelerator supply voltages are established by the turns ratio of transformer T820 and by the setting of CRT GRID BIAS R832. The high-voltage oscillator will produce whatever amplitude is required to maintain the correct voltage at the negative end of C832, regardless of the voltage value at the positive end of C832. For example, if the R832 setting is changed from zero to +100 volts, the high-voltage oscillator amplitude must increase to produce an additional 100 volts across C832. The increased oscillator amplitude will also increase the voltage across C822 in the crt control-grid supply.

But since the voltage at the positive-end of C822 does not vary with the setting of CRT GRID BIAS R832, the full variation appears at the crt control grid. The setting of R832 has only a slight effect on the post-accelerator supply (voltage-tripler) voltage.

Z-Axis Amplifier

The voltage at the positive end of C827 in the crt control-grid supply can be varied with no effect on the voltage across the capacitor. By varying the voltage at the positive end of C827, the crt bias and therefore the display brightness can be varied. The multiple-input Z-axis modulation amplifier provides the means for varying this bias.

Q894 provides current drive to an operational amplifier consisting of Q883 and Q874. The operational amplifier drives emitter follower Q873 which sets the voltage at the positive-end of the control grid high-voltage bias supply.

Four sources can vary the Q894 emitter current:

1. The INTENSITY control.
2. The unblanking signal from the 11-Series plug-in unit.
3. The chopped-mode blanking pulse from the 10-Series plug-in unit.
4. An external source connected to the rear-panel CRT GRID binding post.

Since the operational amplifier negative feedback via R878 makes the Q883 base a low-impedance point, the Q894 collector and Q883 base voltages are essentially constant. When any of the four current sources increase the Q894 current, the D886 current will increase causing a decrease in the Q883 and Q874 currents. The Q874 collector voltage will then rise to a level where, according to Ohm's Law:

$$\Delta V_{Q874\ \text{collector}} = R_{878} \times \Delta I_{886}$$

Thus ΔI_{R878} essentially equals ΔI_{D886}. (ΔI_{R878} is less than ΔI_{D886} by an amount equal to ΔI_{D886} divided by the operational amplifier open-loop gain. Since this gain is quite high, the difference is slight.) The Q874 collector voltage is applied to emitter follower Q873 which sets the crt control-grid voltage.

Capacitors C878, C877, and C879 provide control over the high-frequency response of the amplifier. During a rapid positive-going change at the emitter of Q873, C874 turns off diode D874 and bootstraps R874 to a more positive voltage, enabling the Q873 base current to rise rapidly. During a rapid negative-going change at the collector of Q874, Q873 may momentarily turn off and diode D873 will turn on to pull down the Q873 emitter voltage.

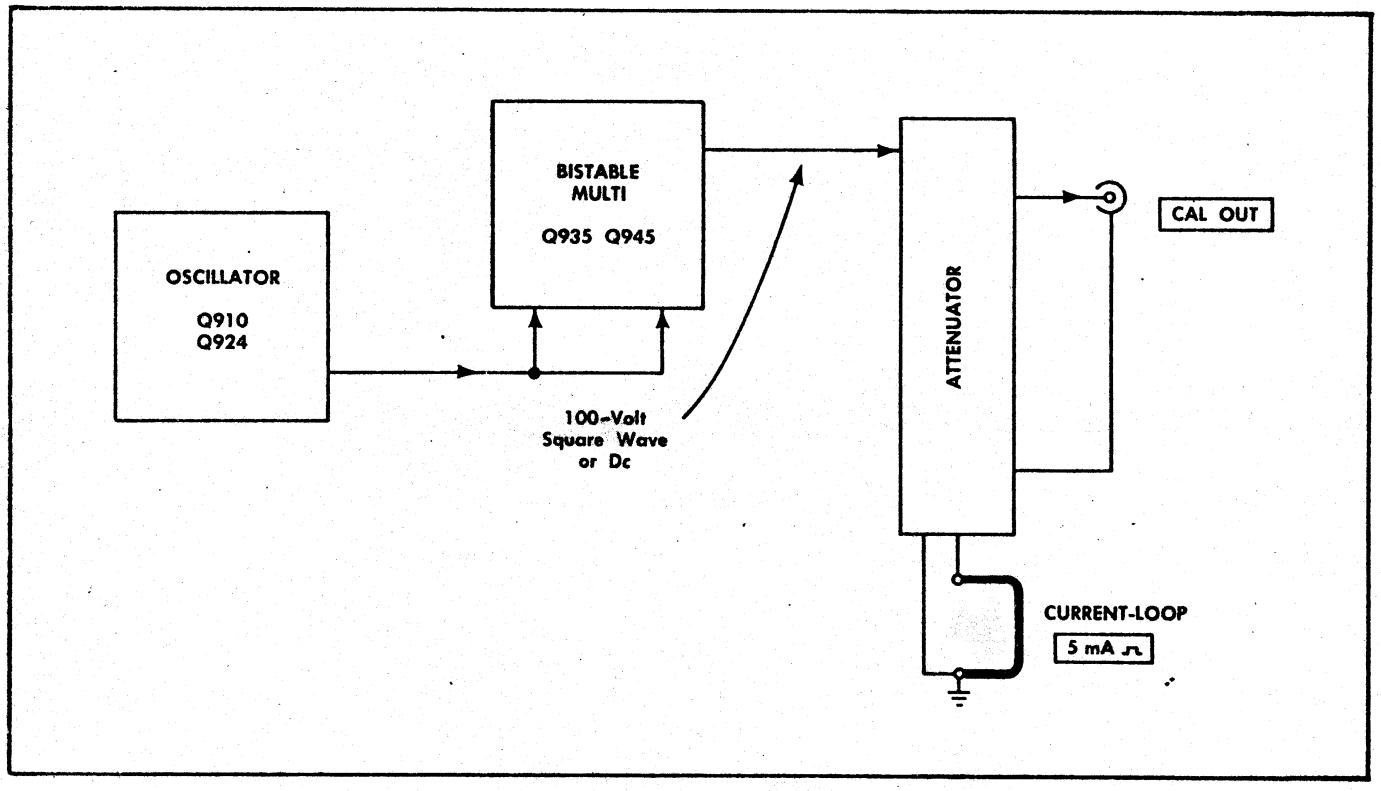


Fig. 3-6. 1-Kc Calibrator block diagram.

Diode D884 will clamp the Q894 collector at about +2 volts if an excessive input signal drives Q894 near turnoff. Diodes D870 and D871 protect the amplifier from the high voltage across C827 in the event that the crt control grid is shorted to chassis.

Trace rotation coil L861 provides the means for rotating the display to align the trace with the internal graticule.

'Y' axis alignment coil L865 allows adjustment of vertical display lines within about a 4° range.

1 KC CALIBRATOR

As shown in Fig. 3-6, the calibrator consists of a crystal-controlled 4-kc oscillator driving a bistable multivibrator which has clamped output levels of zero and —100 volts. These clamp levels provide a precise 100-volt peak-to-peak square wave which may be selected for output or divided to one of 17 lower amplitudes by a precision attenuator. 100-volts dc and a 5-ma square-wave output through a current loop are also available.

The clipped output of crystal-stabilized oscillator Q910-Q924 is applied to the bistable multivibrator through capacitors C924 and C925. Assume that Q935 has just switched off and Q945 has just switched on. When Q935 turned off, the positive-going change at its collector turned on diode D933. C924 then charges through R933 and places a substantial reverse bias on D932.

When Q945 turned on, the negative-going change at its collector turned off D943. C925 then began to discharge through R942. The discharge period is such that the negative-going portion of the first oscillator cycle following Q945 turn-on does not turn on D942. But after skipping one cycle, the C925 charge is depleted and D942 turns on during the fast, negative-going change in the second oscillator cycle. This diverts current from the Q945 base, causing the multivibrator to switch states.

Since only every other cycle of the oscillator signal causes the multivibrator to switch states, the frequency division factor is 4, instead of the usual 2.

When Q945 is on, its collector voltage is about —14 volts which turns off D948, since the attenuator series resistors are returned to chassis. When Q945 is off, D944 is off and R947 turns on both D947 and D948. The voltage across the series combination of D947 and R946 will essentially equal the voltage across D948. Thus the voltage at the junction of D948 and R948B will switch between an accurate +100 volts, established by the 100-volt supply, and zero volts.

The attenuator accurately divides the basic 100-volt square wave to lower amplitudes and provides an accurate 50 Ω output resistance with a switch setting of .2 VOLTS and below. If the 50 Ω output is terminated in 50 Ω, the peak voltage across the termination will be one-half that indicated by the switch setting.

100 volts dc is available for use as a reference when the —15-volt supply is disconnected from the Q935 and Q945 emitters by the switch.

When the attenuator switch is set to the 5-ma square-wave position, an accurate 5 ma through the current loop is switched on and off. The accuracy of this current is established by the accurate 20-kΩ series resistance of attenuator resistors R948B through R948K.

SECTION 4

MAINTENANCE

PREVENTIVE MAINTENANCE

Cleaning the Interior

Internal cleaning should precede calibration since the cleaning processs could alter the setting of certain calibration controls.

One way to clean the interior is by vacuum and/or low-pressure compressed air (high-velocity air could damage certain components). Hardened dirt may be removed with a soft paint brush, cotton-tipped swab, or cloth dampened with a water and mild detergent solution. Pay special attention to high-voltage circuits where conductive dust can cause arcing.

Cleaning the Exterior

Loose dust may be removed with a cloth and a dry paint brush. Water and mild detergents such as Kelite or Spray White may be used. Abrasive cleansers should not be used.

The crt face-plate may be cleaned with a soft, lint-free cloth dampened with denatured alcohol.

Lubrication

The contacts on the plug-in interconnecting jacks and plugs should be lightly lubricated with an oil of the type used on rotary-switch contacts. (Use Dow Corning No. 5 Compound. Manufacturer - Dow Corning Corp., Alpha Molykote Plant, 64 Harvard Ave, Stamford, Connecticut 06902.) To extend the life of the contacts, clean and relubricate if the oil becomes contaminated with abrasive dust.

The plug-in unit frame-rod contact springs (located just inside the upper corners of the plug-in unit compartments) should be lubricated with a grease of the type used on rotary-switch detents (MIL-G-23827).

Fan Oiling

The fan is permanently lubricated and should not require further attention.

Visual Inspection

The instrument should be inspected occasionally for such defects as poor connections, broken or damaged ceramic terminal strips, improperly seated tubes or transistors, and heat-damaged parts. The remedy for most visible defects is obvious. But overheating is usually a symptom of other unseen defects and unless the cause is determined before parts are replaced, the damage may be repeated.

Tube and Transistor Checks

Periodic preventive maintenance checks on the tubes and transistors used in the instrument are not recommended. The circuits within the instrument generally provide the most satisfactory means of checking tube or transistor performance. Performance of the circuits is throughly checked during recalibration so that substandard tubes and transistors will usually be detected at that time.

Recalibration

To insure accurate measurements, the instrument calibration should be checked after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions are contained in Section 5 of this manual.

The calibration procedure can be helpful in isolating major troubles in the instrument. Moreover, minor troubles not apparent during regular operation may be revealed and corrected during calibration.

COMPONENT REPLACEMENT

CAUTION

The crt leads must be disconnected before pulling out either the Vertical or Horizontal chassis.

General Information

Certain parts in the instrument are best replaced if definite procedures are followed as outlined in the following paragraphs.

Many electrical components are mounted in a particular way to reduce or control stray capacitance and inductance. When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. After repair, portions of the instrument may require recalibration; see Section 5.

Soldering

Special silver-bearing solder is used to establish a bond to the ceramic terminal strips in this instrument. This bond may be broken by repeated use (especially if ordinary tin-lead solder is used) or by excessive heating. A solder containing about 3% silver is recommended. A small supply of this solder is provided on a spool mounted inside the instrument.

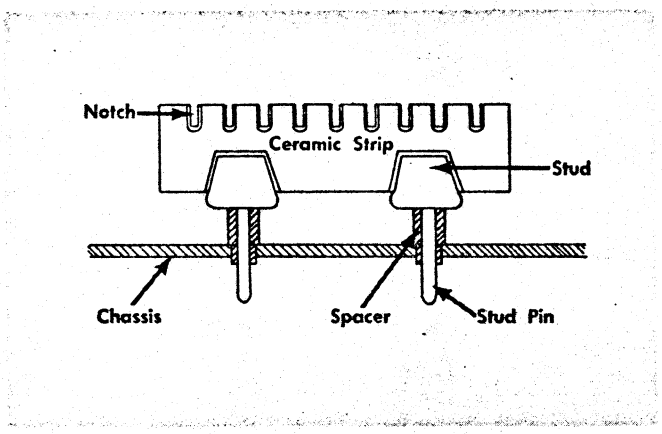


Fig. 4-1. Ceramic strip assembly.

Soldering To Ceramic Strips:

1. Use a wedge-shaped soldering iron tip about 1/8-inch wide. This will allow you to apply heat directly to the solder in the terminal without touching the ceramic, thereby reducing the amount of heat required.

2. Maintain a clean, properly tinned tip.

3. Use a hot iron for a short time. A 50- to 75-watt iron with good heat storage and transfer properties is adequate.

4. Avoid putting pressure on the strip with the soldering iron or other tools. Excessive pressure may cause the strip to crack or chip.

Ceramic Terminal Strips

Fig. 4-1 shows an assembled ceramic terminal strip. Replacement strips with studs attached are supplied under a single part number and spacers under another number. The original spacers may be reused if undamaged.

Usually, a strip can be pried out of the chassis or pulled out with a pair of pliers. In some cases, you may choose to use a hammer and punch to drive out the studs from the opposite side of the chassis.

When the damaged strip has been removed, place new or used (but undamaged) spacers in the chassis holes. Then carefully force the studs of the new strip into the spacers until they are competely seated. If necessary, use a soft-faced mallet, tapping lightly directly over the stud area of the strip.

Switch Replacement

Individual wafers normally are not replaced in switch assemblies.

When soldering leads to a switch, do not let solder flow around and beyond the terminal rivet as this may destroy the contact spring tension.

Tubes and Transistors

Tubes and transistors should not be replaced unless actually defective. When a defect is suspected, it is suggested that circuit conditions be checked first to be certain that a replacement tube or transisor will not be immediately destroyed. In some cases, these checks will also show whether or not the tube or transistor is at fault.

When circuit conditions are known to be safe, install a tube or transistor of the same type that is known to be good and check for proper operation. If the original tube or transistor proves acceptable, return it to its original socket to avoid unnecessary recalibration.

When installing replacement transistors on heat sinks in the instrument, the bottom of the transistor where it contacts the heat sink should be coated with silicon grease. If a heat sink has been replaced along with the transistor, then that area of the heat sink which contacts the chassis of the instrument should also be coated with silicon grease. (Use Dow Corning 340. Manufacturer - Dow Corning Corp., Alpha Molykote Plant, 64 Harvard Ave, Stamford, Connecticut 06902.)

Cathode-Ray Tube and Shield

The following procedure outlines the removal and replacement of the crt. Supplementary steps for removal and replacement of the crt shield are included. Replacement of certain components on the adjacent chassis is easier with the shield removed.

WARNING

Use care when handling a crt. Avoid striking it on any object that might cause it to crack and implode. Flying glass from an imploding crt can cause serious injury. Safety glasses or a plastic face mask are recommended.

To Remove the Crt:

1. Remove the four bezel nuts and the bezel.
2. Slip off the face-plate shield.
3. Remove the high-voltage anode connector.
4. Remove the four deflection-plate leads. Be careful not to bend the crt connector pins.
5. Loosen the base clamp screw.
6. Start the crt forward by pressing on the crt base center pin.
7. Remove the crt base socket.

CAUTION

Support front of crt with hand when moving crt into or out of crt shield.

8. Remove the crt.

To Replace the Crt:

1. Insert the crt.
2. All four edges of the flange around the crt face-plate should touch the front panel of the instrument, but must not be forced. Instead, the crt base clamp should be repositioned so that all four edges of the flange contact the front panel at the same time when the crt is inserted. The crt base clamp is held in place by two allen-head machine screws which are accessible from the rear of the instrument through holes. Loosen the screws and reposition the clamp as required. When the physical alignment of the crt is correct, tighten the

machine screws and proceed with the next step. Do not tighten the clamp to the crt base at this time.

3. Replace the base socket, deflection plate leads, and anode lead.

4. Clean the crt face-plate and face-plate shield, and the mount the face-plate shield and bezel. Tighten the four bezel nuts.

5. Push lightly on the crt base socket to be certain that the crt is as far forward as it will go and then tighten the base clamp.

To Remove and Replace the Crt Shield:

1. With the crt removed, take out the four screws holding the front end of the shield and the two screws holding the rear.

2. Remove the grommet from the anode connector opening.

3. Slide the shield out so that the Trace Rotation Coil leads are accessible. Unsolder the leads, noting the polarity for reinstallation. The shield can now be separated from the instrument.

4. To reinstall the shield, reverse the above procedure.

CORRECTIVE MAINTENANCE

Troubleshooting Aids

This manual and the instrument contain many features intended to speed and simplify maintenance.

The schematics in Section 6 provide a circuit reference number for each electrical component as well as important operating voltages, signals, and conditions for their measurement. The range of circuit reference numbers associated with a particular schematic appear on that schematic. The block diagram provides an overall picture of instrument operation.

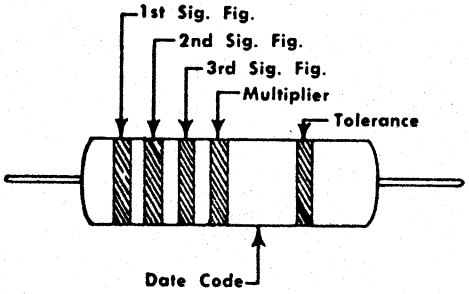


Fig. 4-2. Standard EIA color code for metal film resistors.

Most of the wire in the instrument is color striped to aid in circuit tracing. All regulated low-voltage power supply leads are coded as follows:

1. The basic wire color indicates voltage polarity: tan for negative, white for positive.

2. The stripe colors indicate supply voltage according to the standard EIA color code. Stripes are read in order of decreasing width.

For example, the —75-volt supply leads are tan wire (negative) bearing stripes of violet (seven), green (five), black (no zero).

The instrument contains a number of stable metal-film resistors identified by their gray background color and color coding. If a resistor has three significant figures and a multiplier, it will be EIA color coded. If it has four significant

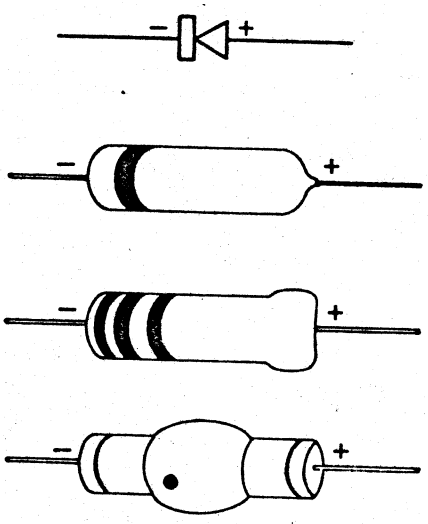


Fig. 4-3. Diode polarities.

TABLE 4-1
Color Code Sequence

Color	1st Sig. Fig.	2nd Sig. Fig.	3rd Sig. Fig.	Multiplier	Tolerance (±) %
Black	0	0	0	1	—
Brown	1	1	1	10	1
Red	2	2	2	100	2
Orange	3	3	3	1,000	—
Yellow	4	4	4	10,000	—
Green	5	5	5	100,000	0.50
Blue	6	6	6	1,000,000	0.25
Violet	7	7	7	10,000,000	0.10
Gray	8	8	8	100,000,000	0.05
White	9	9	9	1,000,000,000	—
Gold				0.1	5
Silver				0.01	—
No Color					10

figures and a multiplier, the value will be printed on the resistor. For example, a 333 k resistor will be color coded, but a 333.5 k resistor will have its value printed on the resistor body. The color coding sequence is shown in Table 4-1 and Fig. 4-2.

Switch wafers shown on the schematics are coded to indicate the physical positions of the wafers on a rotary switch. The number portion of the code refers to the wafer position as counted from the front- or driven-end of the switch shaft. Letters F and R indicate whether the front or rear of the wafer is used to perform the particular switching function.

Important test points are marked (e.g. TP374) on the schematics and on the instrument chassis. Pictures on a fold-out page following the schematics show the general locations of these test points.

Fig. 4-3 identifies the polarity of the various diode types used in the instrument.

Air Flow Reversal

As shipped, air flow is into the rear of the instrument. However, limited space may cause the air flow to become restricted, thus affecting proper cooling of the instrument. If such a situation cannot otherwise be remedied, mechanically reversing the fan, as explained below, will reverse the flow of air through the instrument and should adequately restore the cooling function of the fan.

Take off the top instrument dust cover. With a screwdriver, pry the fan guard screen off the rear of the instrument.

Place the screwdriver in the center of one of the fan clip guides and pry the clip outward from the fan about 1/4 inch. With the clip pried outward from the fan, grasp that side of the fan housing and pull it outward from the rear of the instrument about 1/2 inch. Release the other side of the fan in the same manner as described above.

Grasp the whole fan housing and pull it slightly away from the oscilloscope and rotate it 180°, to reverse air flow direction. Now insert the fan housing back into its hole in the rear panel, being sure to guide the fan leads so that they are not pinched. Push the fan housing in until the fan clip guides click, locking the fan housing into place.

Reinstall the fan guide screen by pushing it into place. Remove the bottom instrument dust cover and dress the fan leads. Replace both top and bottom dust covers.

NOTE

Arrows indicating direction of fan blade rotation and direction of air flow will be found on the top of the fan housing.

SECTION 5

CALIBRATION

Introduction

This section of the manual contains a complete calibration procedure for the Type RM647 Oscilloscope. The instrument will not require frequent recalibration, but occasional adjustments will be necessary as components age or are replaced.

Calibration is a valuable part of preventive maintenance since many types of minor troubles may be discovered and corrected before they become serious enough to disable the instrument. Major troubles are often more easily isolated to a particular section of the instrument by attempting calibration.

For further calibration instructions on the Type RM647, refer to calibration procedures referenced in T.O. 33K-1-100.

Equipment Required

Equipment having similar characteristics to equipment recommended throughout this section, as required for calibration and/or test procedures, may be substituted.

1. Tektronix Type 10/11M1 Test Unit.

2. Tektronix 11-series time base plug-in unit.

3. Autotransformer such as Variac or Powerstat. Required characteristics: Output voltage range covering the full line-voltage range of the Type RM647. Volt-ampere rating of at least 500.

4. Ac voltmeter, calibrated in rms, for monitoring the autotransformer output. Required characteristics: 2% accuracy over the full line-voltage range of the Type RM647.

5. Dc voltmeter such as the Fluke Model 803 or the Electro Instruments Model Eitronic 880. Required characteristics: Input resistance at least 1 megohm. Accuracy at least ±0.05% of reading between 100 millivolts and 100 volts.

6. Oscilloscope such as the Tektronix Type 540- or 550-series with a Type D Plug-In and a Type L Plug-In. Required characteristics. Type D Plug-In—Maximum calibrated sensitivity of at least 5 mvolts/div. Type L Plug-In—Bandpass of at least 20 mc.

7. Dc voltmeter. Required characteristics: Range to at least 2.5 kv full scale. Input resistance of at least 20 kΩ/v. Accurate within 2% at 2.2 kv and within 10% at 300 volts.

8. Time-mark generator such as the Tektronix Type 180A. Required characteristics: Marker intervals of 1 millisecond and 20 nanoseconds (50-mc sine wave). Accuracy of at least ±0.01%.

9. Constant-Amplitude Signal Generator, Tektronix Type 190A or 190B. Signal Generator used must provide a 200-millivolt signal variable in frequency from 500 kc to 50 mc. The signal amplitude must remain constant (200 mv) over the entire frequency range.

10. TU-5 Pulser complete kit, Tektronix Part No. 015-043, contains the following items:

Qty.	Description	Part Number
1	TU-5 Pulser (alone) with BNC plug-and-jack connector fittings.	015-038
1	50-ohm termination with BNC plug-and-jack connector fittings.	011-049
1	50-ohm 10:1 T attenuator, ½ w, with BNC plug-and-jack connector fittings.	010-314
1	Connector adapter with UHF-plug and BNC-jack connector fittings.	103-015
1	50-ohm (nominal impedance) coaxial cable, 42" long, with a BNC connector on each end.	012-057

11. Tektronix 50 Ω 5XT attenuator: part number 011-060.

12. Miscellaneous

    1 — Insulated screwdriver: part number 003-001.

    1 — Adapter, BNC to alligator clips: part number 013-076.

PRELIMINARY PROCEDURE

1. Remove the covers from the Type RM647.

2. Disengage the captive screw which holds the bottom rear swing-out chassis closed.

3. Install the Type 10/11M1 plug-in unit in the horizontal compartment of the Type RM647.

4. Connect the Type RM647 and the ac voltmeter to the powerline autotransformer output.

5. Connect the autotransformer to the appropriate line-voltage source and set for an output near the center of the line-voltage range for which the Type RM647 is wired.

6 Set the controls on the Type RM647 and Type 10/11M1 as listed in Table 5-1.

TABLE 5-1

Type RM647	
INTENSITY	Counterclockwise
FOCUS	Midrange
ASTIG	Midrange
SCALE ILLUM	Counterclockwise
1 KC CALIBRATOR	OFF
HORIZ POSITION	Midrange
Type 10/11M1	
Horiz Cal	5
Load	Zero
Source (voltage)	—75 v
(function)	Gnd
Pulse Rate	OFF

7. Turn on the instrument power and allow several minutes for warmup.

NOTE

Pictures on a fold-out page preceding the schematics show the location of each calibration control and each of the numbered test points listed in the schematics.

CHECK AND ADJUSTMENT PROCEDURE

Low-Voltage Power Supplies

1. Adjust Voltage; Check Ripple and Regulation

NOTE

The following ripple checks can produce erroneous indications unless ground-loop hum is minimized. To minimize hum, the Type RM647 and the ripple-monitoring test oscilloscope should be powered from the same convenience outlet.

Proper power supply operation at the lower line-voltage limit requires that the line-voltage sine-wave contain less than 1% distortion.

a. Repeat steps (a) through (i) for each power supply in the order listed in Table 5-2. Be sure to adjust the supplies in the order listed, and then recheck all supply voltages. It may be necessary to adjust the supplies a second time.

After the regulation checks have been made on the —15-volt supply, the test oscilloscope may be disconnected from the Type 10/11M1 plug-in. The +300-volt supply is checked using the dc voltmeter at TP742. The ripple is checked at TP742 by connecting a probe between the test point and the test oscilloscope.

CAUTION

Do not reset the —75 v control unless the power supply voltages are actually out of tolerance (see Table 5-2) or you are planning to perform a complete calibration of the instrument.

b. Connect a coaxial cable from the Output connector on the Type 10/11M1 to the input connector on the plug-in of the test oscilloscope. Set the test oscilloscope controls to trigger and display automatically a line-frequency waveform with an amplitude of 5 mvolts or less. The waveform must be dc-coupled into the vertical amplifier of the test oscilloscope.

c. With the Source function switch on the Type 10/11M1 set at Gnd, position the trace on the test oscilloscope to a convenient reference point. With the test oscilloscope and plug-in set as in step (b), each 5 mvolts of deflection away from the reference point will indicate 0.1% of error in the supply voltage. The allowable error in each supply can be found in Table 5-2.

d. Set the Source function switch on the Type 10/11M1 to Dc Error and reset R631 (—75 VOLTS) for no deflection of the trace on the test oscilloscope as the source function switch is moved between the Gnd and Dc Error positions.

e. Set the 10/11M1 Source function switch to Dc Error and the Load switch to Full. Check that the trace deflection does not equal more than 0.2% (0.3%, if the allowable error in the setting accuracy is included) provided the supply was adjusted in step (d). Set the Load switch to Zero and the Source function switch to Ripple.

f. With the power-line autotransformer set for a line-voltage near the center of the Type RM647 operating range (indicated on a metal tag on the rear panel), check that the ripple is within the limits given in Table 5-2.

g. Set the power-line autotransformer for the lower line-voltage limit (design-center voltage less 10%) of the Type RM647 and the 10/11M1 Load switch to Full. Check that the ripple is within the limit given in Table 5-2.

TABLE 5-2

Supply Voltage	Setting Accuracy	Variation From Zero To Full Load	Maximum Ripple (mv p-p)	Voltage Control
—75 v	±0.1%	0.2%	3	—75 VOLTS R631
+100 v	±0.1%	0.2%	3	+100 VOLTS R731
+15 v	±0.1%	0.2%	3	+15 VOLTS R691
—15 v	±0.1%	0.2%	3	—15 VOLTS R661
+300 v	±10%		10 v	Unregulated

h. Set the power-line autotransformer for the upper line-voltage limit (design-center —10%) of the Type RM647.

i. Reset the power-line autotransformer for a line voltage near the center of the Type RM647 operating range. Disconnect the voltmeter and reset the Type 10/11M1 controls to the positions listed in Table 5-1 except for the Source voltage switch, which is set to the next supply in Table 5-2.

Crt Circuit

1. Adjust HIGH VOLTAGE R801

a. Connect the high-voltage dc voltmeter between the chassis and the HV TEST POINT TP833.

b. Adjust R801 for an exact 2.2 kv meter indication.

2. Check High-Voltage Regulation

a. Set the power-line autotransformer for the lower-limit operating voltage of the Type RM647.

b. With the crt beam positioned off-screen, slowly turn the INTENSITY control from stop to stop several times and check that the high voltage remains constant.

NOTE

Few high-voltage meters will resolve the slight voltage change (less than 50 volts) that normally occurs. Hence, unless a high-resolution meter is used, no change in the high voltage should be detected.

c. Reset the power-line autotransformer for a voltage near the center of the Type RM647 operating range.

d. Reset the INTENSITY control counterclockwise and disconnect the voltmeter.

3. Adjust CRT GRID BIAS R832

a. Set:

CRT GRID BIAS R832	Counterclockwise
POSITION (Type 10/11M1)	Midrange

b. Connect a dc voltmeter between TP873 and ground.

c. Set the INTENSITY control so a meter reading of +20 volts is obtained.

d. Turn CRT GRID BIAS clockwise to obtain a dim spot.

e. Remove the dc voltmeter from TP873.

f. Reset the INTENSITY control to 0.

4. Adjust TRACE ROTATION (front panel)

a. Remove the Type 10/11M1 from the horizontal compartment and install a 10-series plug-in in the vertical compartment and an 11-series plug-in in the horizontal compartment.

b. Set the 11-series plug-in for a free-running sweep with a rate of 1 msec.

c. Set the INTENSITY control for a trace of moderate brightness.

d. Center the trace vertically and horizontally.

e. Set the FOCUS control for minimum trace thickness.

f. Adjust TRACE ROTATION (front panel) so that the trace is parallel with the horizontal graticule lines.

5. Adjust GEOMETRY R863

a. Set:

1 KC CALIBRATOR	2 VOLTS
Input coupling (10-series)	Ac
Time/cm (11-series)	1 msec
Trigger mode (11-series)	Automatic
Source (11-series)	Internal

b. Connect a coaxial cable between the CAL OUT connector and the vertical input connector.

c. Set the volts/cm switch (10-series) to .2 and turn the variable control counterclockwise to obtain a 6-cm display amplitude.

d. Set the 11-series trigger level control, if used, for a triggered display.

e. Set the FOCUS and ASTIG controls for a well defined display.

f. Adjust GEOM R863 so that the row of pulse tops and the row of pulse bottoms form straight lines, ± 1 mm.

g. Increase the intensity to observe the vertical lines of the display.

h. Adjust R865 (Y AXIS ALIGN) so that the vertical lines of the pulses are perpendicular to the horizontal graticule lines.

i. Set the INTENSITY control counterclockwise and remove the signal connection.

6. Adjust Z-Axis Amplifier High-Frequency Response C879

a. Set:

Time/cm (11-series)	.5 μsec
Trigger mode (11-series)	Free running

b. Set the INTENSITY control for a dim trace.

c. Horizontally position the trace so the left end is near the center of the graticule.

d. Slowly turn C879 and note the action of the adjustment. A small segment (about 1-millimeter long) at the left end of the trace should vary in brightness.

e. Adjust C879 so the brightness of the trace segment most nearly matches that of the remainder of the trace.

f. Set the INTENSITY control to 4 and the time/cm control of the 11-series plug-in to .1 μsec.

g. Connect a 10X probe from the test oscilloscope (with 20 mc plug-in installed) to TP873 and observe a pulse about 35 volts high with a dc level of about +10 volts. Set the sweep rate of the test oscilloscope to 1 msec/cm.

h. Rotate the INTENSITY control from 0 to 8.5 and observe a pulse which varies from zero volts amplitude with a dc level of +10 volts to an amplitude of about +55 volts with a dc level of +40 volts.

i. Set the INTENSITY control to obtain a pulse with a 30-volt amplitude at TP873.

j. Check the risetime of the pulse in step (i); it should be less than 50 nsec. The overshoot on the pulse should be less than 3%.

k. Turn the INTENSITY control fully clockwise. Set the trigger mode control of the 11-series plug-in to single sweep, and position the spot off the crt.

l. Connect the output of a Type 190B to the CRT GRID connector.

m. Adjust the Type 190B controls to obtain a 4-volt 50-kc signal at TP873.

n. Adjust the test oscilloscope so that the 4-volt 50-kc signal is ac coupled into the test oscilloscope and will produce a 4-division display.

o. Increase the Type 190B output frequency to 10 MC and check the display of the test oscilloscope for a signal amplitude of at least 2.8 divisions.

p. Disconnect the Type 190B and test oscilloscope.

q. Set the INTENSITY control for normal trace brightness.

7. Check Alternate Sweep and Chopped Blanking

a. Do not do this check unless the 10-series plug-in being used has alternate and/or chopped provisions.

b. Set:

Mode (10-series)	Alternate
Time/cm (11-series)	.5 μsec
Trigger mode (11-series)	Free running

c. Check for dual trace in all sweep rates.

d. Set the mode switch (10-series) to chopped, the time/cm switch (11-series) to .5 μsec, and the trigger mode switch (11-series) to normal.

e. Adjust the trigger level control (11-series) to obtain a stable display and check for no vertical lines being visible at normal intensity.

1-Kc Calibrator

1. Check Voltage Accuracy

a. Turn off the instrument power and remove transistor Q945.

b. Restore instrument power.

c. Connect the precision dc voltmeter to the CAL OUT connector with a coaxial cable.

d. Set the 1 KC CALIBRATOR switch to 100 VOLTS or 100 VDC and check that the output dc voltage is between 99 and 101 volts.

NOTE

The accuracy of the 1 Kc Calibrator 100-volt output is directly determined by the accuracy of the +100-volt power supply.

e. Check the output voltage at each switch setting listed in Table 5-3.

TABLE 5-3

1 KC CALIBRATOR	Tolerance
50 VOLTS	49 — 51 v
20 VOLTS	19.6 — 20.4 v
10 VOLTS	9.8 — 10.2 v
5 VOLTS	4.9 — 5.1 v
2 VOLTS	1.96 — 2.04 v
1 VOLT	0 98 — 1.02 v
.5 VOLT	0.49 — 0.51 v
.2 VOLT	0.196 — 0.204 v
.1 VOLT	0.099 — 0.101 v

NOTE

Due to the type of attenuator used in the 1 Kc Calibrator, the remaining voltages need not be checked.

f. Turn off the instrument power and install transistor Q945.

g. Restore instrument power.

2. Check Frequency Accuracy

a. Set:

1 KC CALIBRATOR (RM647)	1 VOLT
Volts/cm (10-series)	2
Mode (10-series)	To display one channel only.
Time/cm (11-series)	1 msec
Trigger Mode (11-series)	Normal
Trigger level (11-series)	0
Coupling (11-series)	Ac low-frequency reject.
Source (11-series)	External

b. There should not be a trace on the crt. Connect a coaxial cable between the CAL OUT and the trigger input (11-series) connectors. There should now be a trace on the crt.

c. Apply 1-millisecond and 1-second markers from the Type 180A to the vertical input. Set the trigger level control on the 11-series plug-in for the most stable display.

d. Check the frequency accuracy by checking the dirft of the 1-millisecond markers across the crt for a period of 10 seconds, using the 1-second markers to count the 10 second time period. There should be no more than 5 cm of drift in the 10 second time period.

e. Remove the signal connections.

Horizontal Amplifier

1. Adjust HORIZ CENT R364

a. Remove the 10- and 11-series plug-ins from the Type RM647 and install the Type 10/11M1 in the horizontal compartment.

b. Set Type 10/11M1:

Horiz Cal	5
Load	Zero
Pulse Rate	Off
Position	Midrange

c. Set the INTENSITY, FOCUS and ASTIG controls for a fine and dim spot.

d. Adjust R364 HORIZ CENT to position the spot on the center vertical graticule line.

2. Adjust HORIZ GAIN R377

a. Set the Type 10/11M1 Horiz Cal to 1 and adjust R377 HORIZ GAIN to place the spot on the first centimeter line. Set the Horiz Cal to 9 and check that the spot is on the ninth centimeter line; if it is not adjust the HORIZ GAIN until the spot is on the first and ninth centimeter graticule lines as the Type 10/11M1 Horiz Cal control is switched between 1 and 9.

b. Recheck the HORIZ CENT to insure that the spot is still on the center vertical graticule line when the Type 10/11M1 Horiz Cal control is set to 5.

3. Adjust C378, C377, and C397

a. Remove the Type 10/11M1 from the Type RM647 and install an 11-series plug-in in the horizontal compartment and a 10-series plug-in in the vertical compartment.

b. Set:

Input coupling (10-series)	Ac
Volts/cm (10-series)	2
Time/cm (11-series)	.1 μsec
Trigger mode (11-series)	Normal
Source (11-series)	Internal

c. From the Type 180A, apply a 50 MC sine-wave signal to the vertical input connector of the 10-series plug-in and adjust the trigger level control of the 11-series plug-in for a stable display.

d. Set the HORIZ POSITION so that the display is centered. Turn the 11-series plug-in magnifier so that a sweep rate of 10 nsec/cm is achieved.

e. Adjust C377 and C397 for the best linearity from the center graticule line to the first and ninth centimeter graticule lines.

f. Set the HORIZ POSITION control to position the first five centimeters of sweep to the left of the first centimeter graticule line.

g. Adjust C378 so that the 1 cycle/2 cm display has a peak lined up with the first and ninth centimeter graticule lines. The peaks between the first and ninth graticule lines should be within ±2 mm of their respective graticule lines.

h. Repeat steps (d), (e), (f), and (g) to obtain optimum linearity and timing.

i. Remove input signal.

Vertical Amplifier

1. Adjust VERT CENT R441

a. Remove the 10-series plug-in from the vertical compartment and install the Type 10/11M1 into that compartment.

b. Set:

Vertical (Type 10/11M1)	Time Mark
Pulse Rate (Type 10/11M1)	Off
Position (Type 10/11M1)	Midrange
Magnifier (11-series)	Off
Trigger mode (11-series)	Normal
Trigger level (11-series)	0
Source (11-series)	External
Display (11-series)	Time base

c. Adjust R441 VERT CENT to position the spot on the center horizontal graticule line.

2. Adjust VERT GAIN R414

a. Set the Type 10/11M1 Vertical to +3 cm Dc Calibrate and adjust R414 VERT GAIN to place the spot on the top graticule line. Set the Vertical to −3 cm Dc Calibrate and check that the spot is on the bottom graticule line; if it is not adjust the VERT GAIN until the spot is on the top and bottom graticule lines as the Type 10/11M1 Vertical control is switched between +3 cm and −3 cm Dc Calibrate positions.

b. Recheck the VERT CENT to insure the spot is still on the center horizontal graticule line when the Type 10/11M1 Vertical control is set to Time Mark.

3. Adjust Vertical-System High-Frequency Response

a. Set:

Vertical (Type 10/11M1)	+ Pulse Polarity
Pulse Rate (Type 10/11M1)	One of the middle ranges.
Amplitude (Type 10/11M1)	To obtain a 4-cm high pulse.
Position (Type 10/11M1)	To position top of pulse 2 cm above horizontal center line.
Trigger mode (11-series)	Automatic
Slope (11-series)	+
Coupling (11-series)	Ac low-frequency reject
Source (11-series)	Internal

b. Adjust the trigger level for a stable display.

c. Adjust sweep rate of 11-series plug-in to obtain enough magnification to see the effect of the adjustment being made.

d. Adjust the high-frequency compensation:

1. Adjust R456D DAMPING to produce ringing on the front corner of the pulse, and then turn the control back until the ringing just disappears.

2. Adjust C484 and then C467 to make the front 10-50 nsec region of pulse top as straight and level as possible.

3. Adjust C456D to make the front pulse corner appear square with less than ½ mm of overshoot, rolloff or ringing.

e. Repeat the adjustments in step (d) until the best possible response is obtained. It may be necessary to slightly readjust R456D DAMPING to obtain minimum aberrations in the top of the waveform.

f. Set the 11-series plug-in for a sweep rate of 10 nsec/cm.

g. Check the risetime of the display (see Fig. 5-1); it should measure 6.5 nsec or less, from the 10% point to the 90% point.

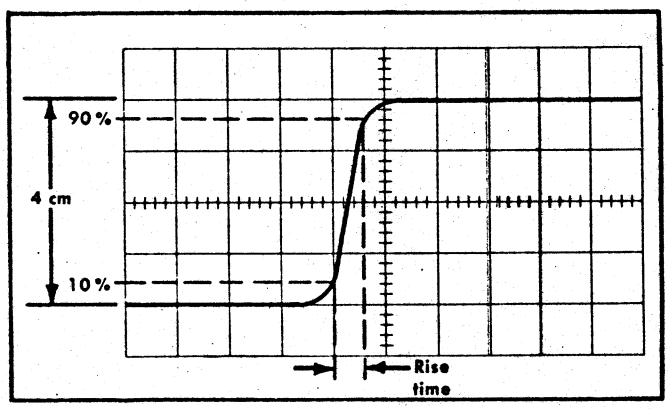


Fig. 5-1. Measuring positive going pulse risetime.

4. Check Vertical-System Negative Response

a. Set:

Vertical (Type 10/11M1)	—Pluse Polarity
Amplitude (Type 10/11M1)	To obtain a 4-cm high pulse.
Position (Type 10/11M1)	To position bottom of pulse 2 cm below horizontal centerline.
Slope (11-series)	—

b. Check for the same response as seen in steps (d) and (e) of the next check (5).

c. If necessary readjust R456D, C484, C467, and C456D slightly to obtain the same pulse shape in the negative polarity as in positive polarity.

d. Set the 11-series plug-in for a sweep rate of 10 nsec/cm.

e. Check the negative risetime of the display (see Fig. 5-2); it should measure 6.5 nsec or less, from the 10% point to the 90% point.

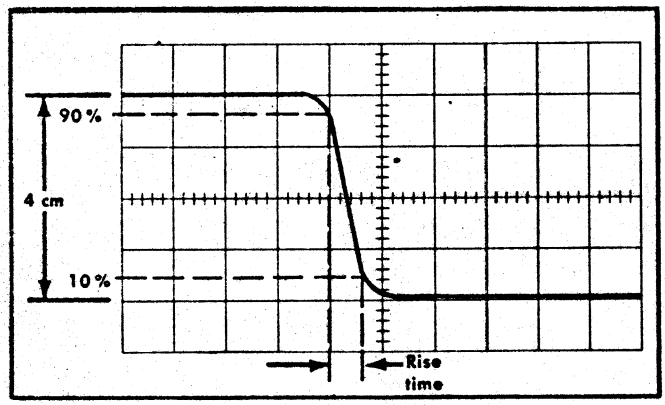


Fig. 5-2. Measuring negative going pulse risetime.

5. Check Step Response Variation and Amplitude and Dynamic range (±9 cm)

a. Set:

Vertical (Type 10/11M1)	—Pulse Polarity
Amplitude (Type 10/11M1)	To obtain a 6-cm high pulse.
Position (Type 10/11M1)	To position bottom of pulse on bottom graticule line.
Slope (11-series)	+

b. Vary the Type 10/11M1 Amplitude control and check for step response variations.

c. Set the Amplitude control as in step (a).

d. Check for less than 2 mm of overshoot on the bottom of the waveform.

e. Position the bottom of the pulse to the top graticule line. The rolloff at the front bottom corner should be less than 2 mm.

f. Set:

Vertical (Type 10/11M1)	+Pulse Polarity
Position (Type 10/11M1)	To position top of pulse to top graticule line.

g. Do steps (b) and (c) for the + pulse.

h. Check for less than 2 mm of overshoot on the top of the waveform.

i. Position the top of the pulse to the bottom graticule line. The rolloff of the front top corner should be less than 2 mm.

j. Position the top of the pulse 1 cm above the centerline and then adjust the pulse amplitude to obtain a 2-cm high pulse.

k. Position the pulse to the top and bottom areas of the graticule and note the compression or expansion of the display. The total compression and expansion must be less than ½ mm.

6. Check Delay Line Aberrations and Termination

a. Remove the Type 10/11M1 and install a 10-series plug-in in the vertical compartment.

b. Set:

Position (10-series)	Midrange
Volts/cm (10-series)	.01
Input coupling (10-series)	Dc
Time/cm (11-series)	.1 μsec
Magnifier (11-series)	Off
Trigger Mode (11-series)	Normal
Slope (11-series)	+
Coupling (11-series)	Ac low-frequency reject
Source (11-series)	Internal

c. Connect a Type TU-5 Pulser to the test oscilloscope 1 KC Cal Out connector with a 50-ohm coaxial cable and set the test oscilloscope Calibrator to 100 VOLTS. DO NOT use the Type RM647 1 KC CALIBATOR. It will not run the Type TU-5.

d. Connect the Type TU-5 to the vertical input connector of the 10-series plug-in through a 5XT attenuator and a 50-ohm termination.

e. Adjust the Type TU-5 until it generates a fast rise pulse on the crt of the Type RM647.

f. Adjust the trigger level control to obtain a stable display.

g. Check the top of the waveform for overshoot, rolloff or ringing. Any that appears should be less than 0.025 X waveform amplitude, above the top of the waveform.

h. With the variable on the 10-series plug-in, adjust the waveform so that it is 4 cm high.

i. Position the 4-cm high waveform to the center of the crt.

j. Set the sweep rate of the 11-series plug-in to 10 nsec/cm.

k. Measure the risetime of the waveform. It should be less than 7 nsec from the 10% point to the 90% point.

l. Remove the Type TU-5 and set:

Volts/cm (10-series)	.01
Variable (10-series)	Calibrated
Time/cm (11-series)	1 msec
Magnifier (11-series)	Off

m. Apply a 50-kc signal from a Type 190B through a 50-ohm coaxial cable and a 50-ohm termination to the vertical input connector of the 10-series plug-in.

n. Adjust the amplitude of the Type 190B signal to obtain a 4-cm high signal.

o. Increase the output frequency of the Type 190B to 50 MC and check for at least a 2.8-cm signal still remaining on the crt of the Type RM647.

Miscellaneous Checks

1. Check External Crt Cathode Input

a. Remove ground strap between CRT CATHODE and GND.

b. Connect a jumper between the CRT CATHODE and CAL OUT connectors.

c. Set:

Magnifier (11-series)	Off
Time/cm (11-series)	1 msec
Trigger mode (11-series)	Free running

d. Set the 1 KC CALIBRATOR to 5 VOLTS and check for intensity modulation.

e. Remove jumper and reconnect the ground strap between the CRT CATHODE and GND connectors.

2. Check External Crt Grid Input

a. Set:

Magnifier (11-series)	Off
Time/cm (11-series)	1 msec
Trigger mode (11-series)	Free running

b. Set the 1 KC CALIBRATOR to 5 VOLTS and connect a jumper from the CAL OUT connector to the CRT GRID connector.

c. Check for intensity modulation.

d. Remove the jumper.

3. Check J101 for Voltages and External Single Sweep Reset

a. Check for proper voltage at pins A through E. See Table 5-4.

b. Set the 1 KC CALIBRATOR to 5 VOLTS and connect a coaxial cable between the CAL OUT connector and the vertical input connector on the 10-series plug-in.

c. Set:

Volts/cm (10-series)	2
Trigger Mode (11-series)	Normal
Trigger Level (11-series)	For a stable display
Source (11-series)	Internal

d. After obtaining a stable display set the trigger mode switch on the 11-series plug-in to single sweep.

e. Remove the coaxial cable or set the input coupling (10-series) to gnd and push the reset button on the 11-series plug-in.

f. Check that the ready neon lights and remains stable.

g. Reconnect the coaxial cable or reset the input coupling (10-series) to ac and note that one sweep occurs and that the ready light extinguishes.

h. Remove all connections.

TABLE 5-4

A	−75 v
B	−15 v
C	ground
D	+15 v
E	+100 v

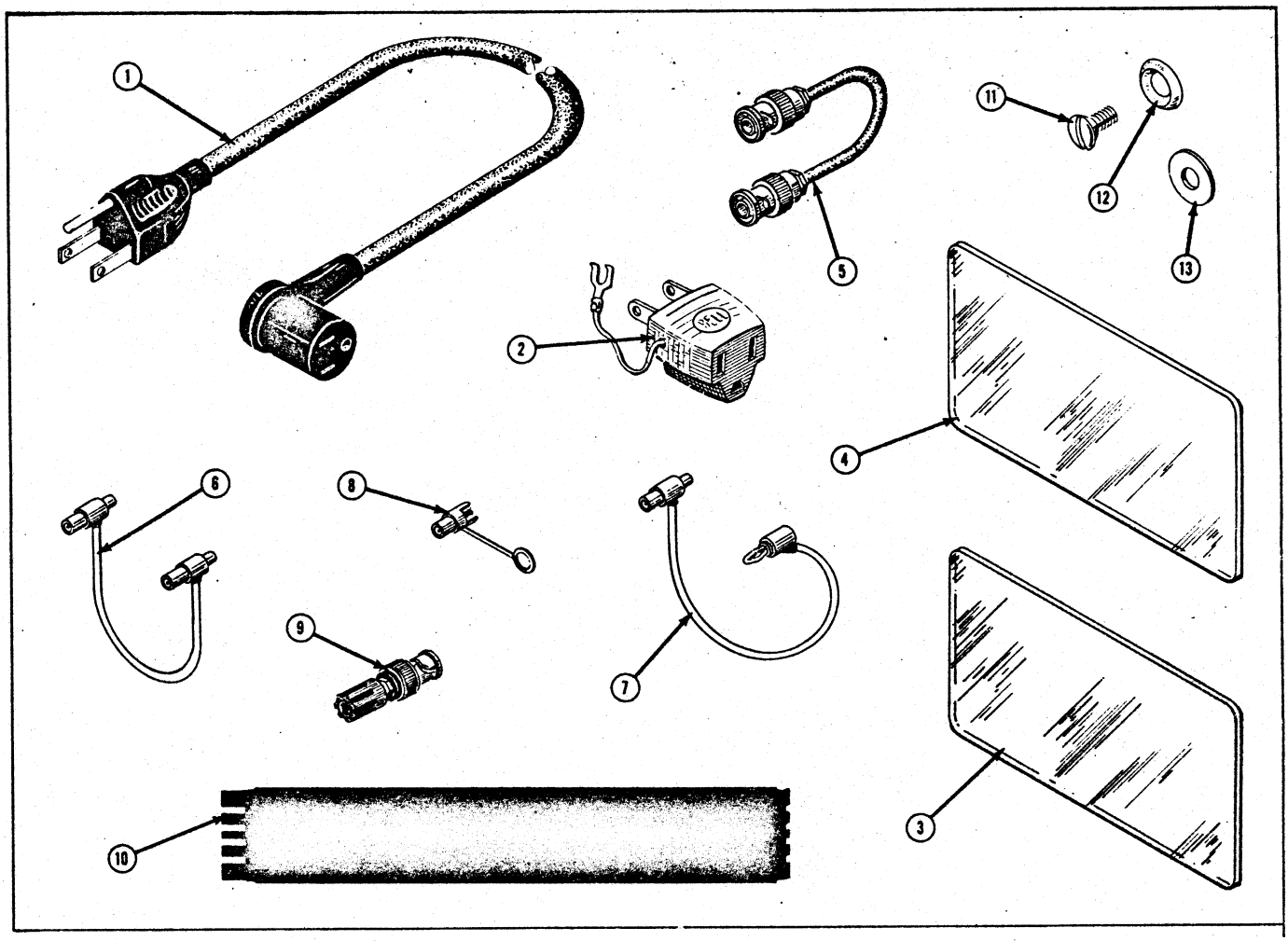


Figure 6-4. Accessories

ACCESSORIES

Fig 6-4

INDEX NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF	DISC	QTY	DESCRIPTION	MFG CODE	MANUFACTURERS PART NO.
1	161-0022-00			1	CORD, power	80009	
2	103-0013-00			1	ADAPTER, 3 to 2-wire	08556	350
3	378-0548-00			1	FILTER, gray (installed)	80009	
4	337-0573-00			1	SHIELD, implosion	80009	
5	012-0076-00			1	CABLE, 50 ohm	80009	
6	012-0087-00	X163		1	CORD, patch	80009	
7	012-0091-00	X163		1	CORD, patch	80009	
8	012-0092-00	X163		1	JACK, BNC-post	80009	
9	103-0033-00	100	162X	1	ADAPTER, BNC to binding post	95712	2048-2
10	351-0006-00	100	199	1	GUIDE, 1 pair	98376	TK-120
	351-0085-00	200		1	GUIDE, 1 pair	80009	
11	212-0567-00			4	SCREW, 10-32 x 7/8 inch OHS	24929	NOTE 358
12	210-0833-00			4	WASHER, steel, No. 10 finishing	12327	NOTE 018
13	210-0917-00			4	WASHER, teflon	78912	NOTE 031
	070-0435-00			2	MANUAL, instruction, (not shown)	80009	

Table 6-2

BULBS

Values are fixed unless marked Variable.

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
B601	150-0030-00	Lamp,glow	Neon	FUSE OUT	08806	A2BT	
B602	150-0030-00	Lamp,glow	Neon	OVER TEMP	08806	A2BT	
B604	150-0029-00	Lamp,incandesce		Graticule Light	08806	349	
B605	150-0029-00	Lamp,incandesce		Graticule Light	08806	349	
B606	150-0029-00	Lamp,incandesce		Pilot Light	08806	349	
B852	150-0030-00	Lamp,glow	Neon		08806	A2BT	
B853	150-0030-00	Lamp,glow	Neon		08806	A2BT	
B854	150-0030-00	Lamp,glow	Neon		08806	A2BT	

CAPACITORS

Tolerance ±20% unless otherwise indicated.

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
C365	283-0068-00	Cap.,fxd,cer di	0.01 µf		500 v	56289	19C241	
C366	283-0068-00	Cap.,fxd,cer di	0.01 µf		500 v	56289	19C241	
C369	283-0081-00	Cap.,fxd,cer di	0.1 µf		25 v	56289	33C158	
C375	281-0609-00	Cap.,fxd,cer di	1 pf	10%	200 v	72982	374-000C0K0109B	
C377	281-0095-00	Cap.,var,plstc	0.2-1.5 pf	Teflon		72982	570-001	
C378	281-0099-00	Cap.,var,air di	1.3-5.4 pf			74970	189-2-4	
C395	281-0609-00	Cap.,fxd,cer di	1 pf	10%	200 v	72982	374-000C0K0109B	
C397	281-0095-00	Cap.,var,plstc	0.2-1.5 pf	Teflon		72982	570-001	
C398	285-0572-00	Cap.,fxd,plstc	0.1 µf	PTM	200 v	01002	64F29BB104	
C404A	281-0503-00	Cap.,fxd,cer di	8 pf	±0.5 pf	500 v	72982	301-000C0H0809D	
C404B	281-0503-00	Cap.,fxd,cer di	8 pf	±0.5 pf	500 v	72982	301-000C0H0809D	
C404C	283-0557-00	Cap.,fxd,mica d	200 pf	10%	500 v	72982	654-03818A0201K	
C406A	281-0503-00	Cap.,fxd,cer di	8 pf	±0.5 pf	500 v	72982	301-000C0H0809D	
C406B	281-0503-00	Cap.,fxd,cer di	8 pf	±0.5 pf	500 v	72982	301-000C0H0809D	
C406C	283-0557-00	Cap.,fxd,mica d	200 pf	10%	500 v	72982	654-03818A0201K	
C417	283-0079-00	Cap.,fxd,cer di	0.01 µf		250 v	56289	44C56A4	
C443	283-0081-00	Cap.,fxd,cer di	0.1 µf		25 v	56289	33C158	
C445	281-0592-00	Cap.,fxd,cer di	4.7 pf	±0.5 pf	500 v	72982	301-023C0H0479D	
C456B	Use 281-0519-00	Cap.,fxd,cer di	47 pf	10%	500 v	72982	308-000C0G0470K	
C456D	281-0081-00	Cap.,var,air di	1.8-13 pf			74970	189-6-5	
C456E	281-0602-00	Cap.,fxd,cer di	68 pf	5%	500 v	72982	308-000P2G0680V	
C456F	281-0602-00	Cap.,fxd,cer di	68 pf	5%	500 v	72982	308-000P2G0680V	
C464	281-0603-00	Cap.,fxd,cer di	39 pf	5%	500 v	72982	308-000C0G0390J	

Table 6-2 CAPACITORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
C465	281-0576-00	Cap.,fxd,cer di	11 pf 5%	500 v	72982	301-000C0G0110J	
C466	281-0586-00	Cap.,fxd,cer di	25 pf 5%	500 v	72982	302-000C0G0250J	
C467	281-0079-00	Cap.,var,air di	1.5-9.1 pf		74970	189-4-5	
C469	283-0081-00	Cap.,fxd,cer di	0.1 µf	25 v	56289	33C158	
C474	281-0603-00	Cap.,fxd,cer di	39 pf 5%	500 v	72982	308-000C0G0390J	
C475	281-0576-00	Cap.,fxd,cer di	11 pf 5%	500 v	72982	301-000C0G0110J	
C476	281-0603-00	Cap.,fxd,cer di	39 pf 5%	500 v	72982	308-000C0G0390J	
C482	281-0572-00	Cap.,fxd,cer di	6.8 pf 10%	500 v	72982	301-000C0H0689K	
C483	283-0079-00	Cap.,fxd,cer di	0.01 µf	250 v	56289	44C56A4	
C484	281-0076-00	Cap.,var,air di	1.2-3.5 pf		74970	189-1-5	
C601, C602, C603, C609 [1]	290-0171-00	Cap.,fxd,elect.	100 µf EMT -10%, +75%	12 v	56289	30D107G012DC4	
C610	285-0644-00	Cap.,fxd,p diel	0.033 µf PTM	600 v	56289	160P33306	
C611	285-0572-00	Cap.,fxd,plstc	0.1 µf PTM	200 v	01002	64F29BB104	
C612	290-0169-00	Cap.,fxd,elect.	400 µf EMC -10%, +100%	250 v	56289	D35775	100-629
C612	290-0169-01	Cap.,fxd,elect.	400 µf EMC -10%, +100%	250 v	56289	D45022	630-up
C615	285-0623-00	Cap.,fxd,plstc	0.47 µf PTM	100 v	01002	64F40AB474	
C622	285-0569-00	Cap.,fxd,plstc	0.01 µf PTM	200 v	01002	64F15BB103	
C631	290-0198-00	Cap.,fxd,elect.	17 µf EMT -15%, +30%	150 v	56289	112D176C3150J1P2	
C642	290-0186-00	Cap.,fxd,elect.	3900 µf EMC -10%, +100%	30 v	56289	D36229	100-629
C642	290-0186-01	Cap.,fxd,elect.	3900 µf EMC -10%, +100%	30 v	56289	D45021	630-up
C644	281-0513-00	Cap.,fxd,cer di	27 pf	500 v	72982	301-000U2M0270M	X533-up
C660	285-0643-00	Cap.,fxd,plstc	0.0047 µf PTM 5%	100 v	01002	64F10AC472	
C661	Use 290-0189-00	Cap.,fxd,elect.	33 µf EMT	35 v	56289	150D336X9035S2	
C663	285-0598-00	Cap.,fxd,plstc	0.01 µf PTM 5%	100 v	01002	64F10AC103	
C665	283-0081-00	Cap.,fxd,cer di	0.1 µf	25 v	56289	33C158	
C672	290-0186-00	Cap.,fxd,elect.	3900 µf EMC -10%, +100%	30 v	56289	D36229	100-629
C672	290-0186-01	Cap.,fxd,elect.	3900 µf EMC -10%, +100%	30 v	56289	D45021	630-up
C674	281-0506-00	Cap.,fxd,cer di	12 pf 10%	500 v	72982	301-000U2M0120K	X533-up
C690	283-0078-00	Cap.,fxd,cer di	0.001 µf	500 v	56289	20C114A8	
C691	290-0162-00	Cap.,fxd,elect.	22 µf EMT	35 v	05397	K22J35S	
C692	283-0078-00	Cap.,fxd,cer di	0.001 µf	500 v	56289	20C114A8	
C694	283-0081-00	Cap.,fxd,cer di	0.1 µf	25 v	56289	33C158	
C701	285-0644-00	Cap., fxd, diel	0.033 µf PTM	600 v	56289	160P33306	
C702	290-0169-00	Cap.,fxd,elect.	400 µf EMC -10%, +100%	250 v	56289	D35775	100-629
C702	290-0169-01	Cap.,fxd,elect.	400 µf EMC -10%, +100%	250 v	56289	D45022	630-up

[1]Furnished as a unit with 119-0028-00 (Line Filter -T600).

Table 6-2

CAPACITORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
C714	285-0622-00	Cap.,fxd,plstc	0.1 µf PTM	100 v	01002	64F24AB104	
C731	290-0198-00	Cap.,fxd,elect.	17 µf EMT -15%, +30%	150 v	56289	112D176C3150J1P2	
C734	283-0081-00	Cap.,fxd,cer di	0.1 µf	25 v	56289	33C158	
C739	285-0626-00	Cap.,fxd,plstc	0.0015 µf PTM 10%	100 v	01002	64F10AA152	
C740	285-0644-00	Cap., fxd, diel	0.033 µf PTM	600 v	56289	160P33306	X740-up
C741	285-0644-00	Cap., fxd, diel	0.033 µf PTM	600 v	56289	160P33306	
C742	290-0202-00	Cap.,fxd,elect.	170 µf EMC -10%, +100%	250 v	56289	D38058	
C743	290-0171-00	Cap.,fxd,elect.	100 µf EMT -10%, +75%	12 v	56289	30D107G012DC4	
C744	285-0598-00	Cap.,fxd,plstc	0.01 µf PTM 5%	100 v	01002	64F10AC103	
C745	285-0587-00	Cap.,fxd,plstc	0.1 µf PTM	600 v	01002	64F49FB104	
C802	283-0010-00	Cap.,fxd,cer di	0.05 µf	50 v	56289	29C189A	100-199
C802	285-0622-00	Cap.,fxd,plstc	0.1 µf PTM	100 v	01002	64F24AB104	200-293
C802	290-0244-00	Cap.,fxd,elect.	0.47 µf EMT 5%	35 v	56289	150D474X5035A2	294-up
C803	283-0010-00	Cap.,fxd,cer di	0.05 µf	50 v	56289	29C189A	100-199X
C811	283-0081-00	Cap.,fxd,cer di	0.1 µf	25 v	56289	33C158	100-293X
C815	285-0598-00	Cap.,fxd,plstc	0.01 µf PTM 5%	100 v	01002	64F10AC103	100-293X
C818	290-0189-00	Cap.,fxd,elect.	33 µf EMT 10%	35 v	56289	150D336X9035S2	100-293X
C820	290-0117-00	Cap.,fxd,elect.	50 µf EMT -10%, +75%	50 v	56289	30D506G050DD4	
C821	285-0623-00	Cap.,fxd,plstc	0.47 µf PTM	100 v	01002	64F40AB474	100-293
C821	285-0629-00	Cap.,fxd,plstc	0.047 µf PTM	100 v	01002	64F19AB473	294-up
C822	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C827	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C831	285-0572-00	Cap.,fxd,plstc	0.1 µf PTM	200 v	01002	64F29BB104	
C832	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C833	283-0044-00	Cap.,fxd,cer di	0.001 µf	3000 v	56289	55C9A	
C835	281-0556-00	Cap.,fxd,cer di	500 pf	10000 v	14655	TM100T5XX	
C836	281-0556-00	Cap.,fxd,cer di	500 pf	10000 v	14655	TM100T5XX	
C837	281-0556-00	Cap.,fxd,cer di	500 pf	10000 v	14655	TM100T5XX	
C838	283-0096-00	Cap.,fxd,cer di	500 pf	20000 v	09023	TM200T5PP	
C844	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C845	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C846	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C851	285-0572-00	Cap.,fxd,plstc	0.1 µf PTM	200 v	01002	64F29BB104	
C854	283-0042-00	Cap.,fxd,cer di	0.015 µf	3000 v	56289	112C10A	
C863	283-0079-00	Cap.,fxd,cer di	0.01 µf	250 v	56289	44C56A4	
C864	285-0572-00	Cap.,fxd,plstc	0.1 µf PTM	200 v	01002	64F29BB104	
C870	283-0079-00	Cap.,fxd,cer di	0.01 µf	250 v	56289	44C56A4	
C874	281-0543-00	Cap.,fxd,cer di	270 pf 10%	500 v	72982	301-024X5P1271K	
C877	281-0534-00	Cap.,fxd,cer di	3.3 pf ±0.25 pf	500 v	72982	301-000C0J0339C	
C878	281-0500-00	Cap.,fxd,cer di	2.2 pf ±0.5 pf	500 v	72982	301-000C0J0229D	

Table 6-2

CAPACITORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
C879	281-0005-00	Cap.,var,cer di	1.5-7 pf			72982	503-000C0P010R	
C882	285-0569-00	Cap.,fxd,plstc	0.01 µf	PTM	200 v	01002	64F15BB103	
C891	283-0080-00	Cap.,fxd,cer di	0.022 µf		25 v	56289	19C383	
C902	285-0627-00	Cap.,fxd,plstc	0.0033 µf	PTM 5%	100 v	01002	64F10AC332	
C903	285-0626-00	Cap.,fxd,plstc	0.0015 µf	PTM	100 v	01002	64F10AA152	
C914	285-0622-00	Cap.,fxd,plstc	0.1 µf	PTM	100 v	01002	64F24AB104	
C916	Use 290-0187-00	Cap.,fxd,elect	4.7 µf	EMT	35 v	56289	150D475X0035B2	
C923	283-0081-00	Cap.,fxd,cer di	0.1 µf		25 v	56289	33C158	
C924	285-0627-00	Cap.,fxd,plstc	0.0033 µf	PTM 5%	100 v	01002	64F10AC332	
C925	285-0627-00	Cap.,fxd,plstc	0.0033 µf	PTM 5%	100 v	01002	64F10AC332	
C926	Use 290-0187-00	Cap.,fxd,elect	4.7 µf	EMT	35 v	56289	150D475X0035B2	
C935	281-0519-00	Cap.,fxd,cer di	47 pf	10%	500 v	72982	308-000C0G0470K	
C936	283-0081-00	Cap.,fxd,cer di	0.1 µf		25 v	56289	33C158	
C937	283-0081-00	Cap.,fxd,cer di	0.1 µf		25 v	56289	33C158	
C945	281-0504-00	Cap.,fxd,cer di	10 pf	10%	500 v	72982	301-000C0G0100F	
C946	285-0572-00	Cap.,fxd,plstc	0.1 µf	PTM	200 v	01002	64F29BB104	
C948A	281-0534-00	Cap.,fxd,cer di	3.3 pf	±0.25 pf	500 v	72982	301-000C0J0339C	
C948K	281-0525-00	Cap.,fxd,cer di	470 pf		500 v	72982	301-000X5U0471M	
C948Z	281-0523-00	Cap.,fxd,cer di	100 pf		350 v	72982	301-000U2M0101M	

DIODES

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
D360	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D361	152-0141-00	Semiconductor d	Silicon		03508	1N3605	
D362	152-0141-00	Semiconductor d	Silicon		03508	1N3605	
D363	152-0141-00	Semiconductor d	Silicon		03508	1N3605	
D371	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D374	152-0126-00	Semiconductor d	Zener	1w, 15v, 10%	04713	3-4M15Z10	
D395	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D396	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D397	152-0060-00	Semiconductor d	Zener	1w, 20v, 10%	04713	1M20Z10	
D609	152-0124-00	Semiconductor d	Zener	0.5w, 9v, 5% (0.001%/ C)	04713	SZ50642	
D611	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D612A,B,C,D	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D636	152-0096-00	Semiconductor d	Zener	10w, 51v, 5%	04713	10M51Z5	
D642A,B,C,D	152-0113-00	Semiconductor d	Silicon		02735	40108	
D650	152-0141-00	Semiconductor d	Silicon		03508	1N3605	X420-up

DIODES (Cont'd)

Table 6-2

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
D669	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D672A,B,C,D	152-0113-00	Semiconductor d	Silicon		02735	40108	
D699	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D702A,B,C,D	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D712	152-0061-00	Semiconductor d	Silicon		13715	FD2161	740-up
D714	152-0135-00	Semiconductor d	Zener	1w, 82v, 10%	04713	1N3042A	
D716	152-0134-00	Semiconductor d	Zener	1w, 100v, 10%	04713	3-4M100Z10	
D736	152-0133-00	Semiconductor d	Zener	10w, 68v, 5%	04713	10M68Z5	
D737	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D739	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D742	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D743	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D745	152-0066-00	Semiconductor d	Silicon		02735	1N3194	
D804	152-0119-00	Semiconductor d	Zener	0.4w, 22v, 10%	04713	1N969A	100-293X
D811	152-0141-00	Semiconductor d	Silicon		03508	1N3605	100-293X
D815	152-0141-00	Semiconductor d	Silicon		03508	1N3605	100-293X
D816	152-0141-00	Semiconductor d	Silicon		03508	1N3605	100-293X
D817	152-0141-00	Semiconductor d	Silicon		03508	1N3605	100-293X
D820	152-0104-00	Semiconductor d	Zener		04713	3-4M6-8Z10	100-293
D820	152-0066-00	Semiconductor d	Silicon		02735	1N3194	294-up
D821	152-0066-00	Semiconductor d	Silicon		02735	1N3194	X294-up
D822	152-0192-00	Semiconductor d	Silicon		83003	7701-5X	X294-up
D832	152-0192-00	Semiconductor d	Silicon		83003	7701-5X	X294-up
D870	152-0002-00	Semiconductor d	Silicon		04713	1N3283	
D871	152-0002-00	Semiconductor d	Silicon		04713	1N3283	
D872	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D873	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D874	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D884	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D886	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D891	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D932	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D933	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D942	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D943	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	
D944	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D947	152-0061-00	Semiconductor d	Silicon		13715	FD2161	
D948	Use 152-0185-00	Semiconductor d	Silicon	Replaceable by 1N3605	07910	CD6538	

Table 6-2

FUSES

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
F601	159-0005-00	Fuse,cartridge	3 Amp	3AG	Slo-Blo	71400	MDX3	
F602	159-0027-00	Fuse,cartridge	4 Amp	3AG	Slo-Blo	71400	MDX4	
F613	159-0025-00	Fuse,cartridge	0.5 Amp	3AG	Fast-Blo	71400	AGC1-2	
F703	159-0042-00	Fuse,cartridge	0.75 Amp	3AG	Fast-Blo	71400	AGC3-4	
F743	159-0042-00	Fuse,cartridge	0.75 Amp	3AG	Fast-Blo	71400	AGC3-4	
F820	159-0021-00	Fuse,cartridge	2 Amp	3AG	Fast-Blo	71400	AGC2	

RELAY

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
K360	148-0022-00	Relay,armature	12 v DC 185Ω	80009		

INDUCTORS

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
L394	108-0254-00	Coil,rf	600 µh	76493	A2479	
LR400	108-0278-00	Coil,rf	0.3 µh (wound on a 3.3Ω, 5%, 1/4w resistor)	80009		
LR401	108-0278-00	Coil,rf	0.3 µh (wound on a 3.3Ω, 5%, 1/4w resistor)	80009		
L403	119-0029-00	Delay line		80009		
L404	108-0220-00	Coil,rf	0.15 µh	80009		
L405	108-0277-00	Coil,rf	0.07 µh	80009		
L406	108-0220-00	Coil,rf	0.15 µh	80009		
L407	108-0088-00	Coil,rf	3.2 µh	80009		
L414	108-0182-00	Coil,rf	0.3 µh	80009		
L443	108-0088-00	Coil,rf	3.2 µh	80009		
L469	108-0260-00	Coil,rf	0.1 µh	80009		
L479	108-0260-00	Coil,rf	0.1 µh	80009		
L487	276-0532-00	Shielding bead		80009		100-719
L487	276-0507-00	Shielding bead		78488	57-0180-7D	720-up
L497	276-0532-00	Shielding bead		80009		100-719
L497	276-0507-00	Shielding bead		78488	57-0180-7D	720-up
L861	108-0279-00	Coil,alignment	Beam-Rotator (X-Axis)	80009		
L865	108-0295-00	Coil,alignment	Beam-Rotator (Y-Axis)	80009		

TRANSISTORS

Table 6-2

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
Q373	151-0133-00	Transistor		04713	SM3155	
Q374	151-0124-00	Transistor	Selected from 2N3119	80009		
Q393	151-0133-00	Transistor		04713	SM3155	
Q394	151-0124-00	Transistor	Selected from 2N3119	80009		
Q423	151-0127-00	Transistor		01295	SM4743	
Q433	151-0127-00	Transistor		01295	SM4743	
Q444	151-0127-00	Transistor		01295	SM4743	
Q454	151-0127-00	Transistor		01295	SM4743	
Q464A	151-0127-00	Transistor		01295	SM4743	
Q464B	151-0127-00	Transistor		01295	SM4743	
Q474A	151-0127-00	Transistor		01295	SM4743	
Q474B	151-0127-00	Transistor		01295	SM4743	
Q484 Q494	153-0524-00	Semiconductor d	Selected pair	80009		
Q614	151-0104-00	Transistor	Replaceable by 2N2913	80009		
Q623	151-0096-00	Transistor		02735	34663	
Q633	151-0096-00	Transistor		02735	34663	
Q637	151-0113-00	Transistor		02735	2N1488	
Q644	151-0126-00	Transistor	Replaceable by 2N2484	13715	S5684	
Q653	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q659	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q663	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q667	151-0112-00	Transistor		80009		
Q674	151-0126-00	Transistor	Replaceable by 2N2484	13715	S5684	
Q683	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q689	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q693	151-0125-00	Transistor		02735	2N1701	
Q697	151-0110-00	Transistor		80009		
Q714	151-0126-00	Transistor	Replaceable by 2N2484	13715	S5684	
Q723	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q733	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q737	151-0111-00	Transistor		80009		
Q803	151-0104-00	Transistor	Replaceable by 2N2913	80009		100-293
Q803	151-0126-00	Transistor	Replaceable by 2N2484	13715	S5684	294-up
Q804	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	100-293
Q804	151-0133-00	Transistor		04713	SM3155	294-up
Q814A	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	100-293X
Q814B	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	100-293X
Q814	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	X294-up

Table 6-2

TRANSISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
Q820	Use 153-0531-00	Transistor	2N1489 Checked	80009		100-293
Q820	151-0140-00	Transistor		02735	36568	294-up
Q873	151-0124-00	Transistor	Selected from 2N3119	80009		
Q874	151-0124-00	Transistor	Selected from 2N3119	80009		
Q883	151-0108-00	Transistor	Replaceable by 2N2501	04713	SM1527	
Q894	151-0108-00	Transistor	Replaceable by 2N2501	04713	SM1527	
Q910	151-0126-00	Transistor	Replaceable by 2N2484	13715	S5684	
Q924	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q935	151-0103-00	Transistor	Replaceable by 2N2219	04713	SM1307	
Q945	151-0124-00	Transistor	Selected from 2N3119	80009		

RESISTORS

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

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R350A R350B	311-0401-00	Res.,variable	1 k 5 k	HORIZ POSITION VERNIER	2 w 2 w	12697	CM31066	
R360	324-0317-00	Res.,fxd,film	19.6 k	1%	1 w	75042	CCFT0-1962F	
R361	323-0302-00	Res.,fxd,film	13.7 k	1%	1/2 w	75042	CECT0-1372F	
R362	323-0347-00	Res.,fxd,film	40.2 k	1%	1/2 w	75042	CECT0-4022F	
R363	323-0338-00	Res.,fxd,film	32.4 k	1%	1/2 w	75042	CECT0-3242F	
R364	311-0400-00	Res.,variable	2 x 500 k	HORIZ CENT		71590	BA111-014	
R365	302-0274-00	Res.,fxd,comp	270 k		1/2 w	01121	EB2741	
R366	302-0274-00	Res.,fxd,comp	270 k		1/2 w	01121	EB2741	
R367	301-0153-00	Res.,fxd,comp	15 k	5%	1/2 w	01121	EB1535	
R369	302-0390-00	Res.,fxd,comp	39 Ω		1/2 w	01121	EB3901	
R370	323-0352-00	Res.,fxd,film	45.3 k	1%	1/2 w	75042	CECT0-4532F	
R371	323-0237-00	Res.,fxd,film	2.87 k	1%	1/2 w	75042	CECT0-2871F	
R373	301-0222-00	Res.,fxd,comp	2.2 k	5%	1/2 w	01121	EB2225	
R374	308-0178-00	Res.,fxd,ww	15 k	5%	8 w	63743	K46947	
R376	324-0296-00	Res.,fxd,film	11.8 k	1%	1 w	19701	MF8CD1182F	
R377	311-0326-00	Res.,variable	10 k	HORIZ GAIN		01121	GA1G024S103MA	
R378	321-0249-00	Res.,fxd,film	3.83 k	1%	1/8 w	75042	CEAT0-3831F	
R379	321-0249-00	Res.,fxd,film	3.83 k	1%	1/8 w	75042	CEAT0-3831F	
R390	324-0289-00	Res.,fxd,film	10 k	1%	1 w	19701	MF8CD1002F	
R391	323-0237-00	Res.,fxd,film	2.87 k	1%	1/2 w	75042	CECT0-2871F	
R393	301-0822-00	Res.,fxd,comp	8.2 k	5%	1/2 w	01121	EB8225	
R394	310-0607-00	Res.,fxd,ww	8.8 k	1%	10 w	80009		

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R396	324-0296-00	Res.,fxd,film	11.8 k	1%	1 w	19701	MF8CD1182F	
R397	302-0104-00	Res.,fxd,comp	100 k		1/2 w	01121	EB1041	
R398	316-0270-00	Res.,fxd,comp	27 Ω		1/4 w	01121	CB2701	
R404	321-0047-00	Res.,fxd,film	30.1 Ω	1%	1/8 w	75042	CEAT0-30R10F	
R406	321-0047-00	Res.,fxd,film	30.1 Ω	1%	1/8 w	75042	CEAT0-30R10F	
R407	315-0751-00	Res.,fxd,comp	750 Ω	5%	1/4 w	01121	CB7515	
R410	321-0121-00	Res.,fxd,film	178 Ω	1%	1/8 w	75042	CEAT0-1780F	
R411	321-0121-00	Res.,fxd,film	178 Ω	1%	1/8 w	75042	CEAT0-1780F	
R414A,B	311-0379-00	Res.,variable	2 x 200 Ω	VERT GAIN		71590	BA111-012	
R416	322-0171-00	Res.,fxd,film	590 Ω	1%	1/4 w	19701	MF6CD5900F	
R417	322-0187-00	Res.,fxd,film	866 Ω	1%	1/4 w	19701	MF6CD8660F	
R421	315-0151-00	Res.,fxd,comp	150 Ω	5%	1/4 w	01121	CB1515	
R423	315-0391-00	Res.,fxd,comp	390 Ω	5%	1/4 w	01121	CB3915	
R425	315-0221-00	Res.,fxd,comp	220 Ω	5%	1/4 w	01121	CB2215	
R433	315-0391-00	Res.,fxd,comp	390 Ω	5%	1/4 w	01121	CB3915	
R441	311-0389-00	Res.,variable	2 x 10 k	VERT CENT		71590	BA111-008	
R442	315-0472-00	Res.,fxd,comp	4.7 k	5%	1/4 w	01121	CB4725	
R444	323-0105-00	Res.,fxd,film	121 Ω	1%	1/2 w	75042	CECT0-1210F	
R445	322-0093-00	Res.,fxd,film	90.9 Ω	1%	1/4 w	19701	MF6CD90R90F	
R447	323-0607-00	Res.,fxd,film	600 Ω	1%	1/2 w	75042	CECT0-6000F	
R448	303-0121-00	Res.,fxd,comp	120 Ω	5%	1 w	01121	GB1215	
R452	315-0472-00	Res.,fxd,comp	4.7 k	5%	1/4 w	01121	CB4725	
R454	323-0105-00	Res.,fxd,film	121 Ω	1%	1/2 w	75042	CECT0-1210F	
R456B	315-0680-00	Res.,fxd,comp	68 Ω	5%	1/4 w	01121	CB6805	
R456D	311-0095-00	Res.,variable	500 Ω	DAMPING		11237	41022	
R456E	321-0195-00	Res.,fxd,film	1.05 k	1%	1/8 w	75042	CEAT0-1051F	
R456F	315-0822-00	Res.,fxd,comp	8.2 k	5%	1/4 w	01121	CB8225	
R457	323-0607-00	Res.,fxd,film	600 Ω	1%	1/2 w	75042	CECT0-6000F	
R458	301-0472-00	Res.,fxd,comp	4.7 k	5%	1/2 w	01121	EB4725	
R465	321-0097-00	Res.,fxd,film	100 Ω	1%	1/8 w	75042	CEAT0-1000F	
R466	Use 315-0221-00	Res.,fxd,comp	220 Ω	5%	1/4 w	01121	CB2215	
R467	310-0610-00	Res.,fxd,ww	970 Ω	1%	2 w	80009		
R468	310-0610-00	Res.,fxd,ww	970 Ω	1%	2 w	80009		
R469	301-0100-00	Res.,fxd,comp	10 Ω	5%	1/2 w	01121	EB1005	
R475	321-0097-00	Res.,fxd,film	100 Ω	1%	1/8 w	75042	CEAT0-1000F	
R476	315-0151-00	Res.,fxd,comp	150 Ω	5%	1/4 w	01121	CB1515	
R477	310-0610-00	Res.,fxd,ww	970 Ω	1%	2 w	80009		

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R478	310-0610-00	Res.,fxd,ww	970 Ω	1%	2 w	80009		
R480	323-0245-00	Res.,fxd,film	3.48 k	1%	1/2 w	75042	CECT0-3481F	
R481	310-0609-00	Res.,fxd,ww	4 k	1%	2 w	80009		
R482	323-0207-00	Res.,fxd,film	1.4 k	1%	1/2 w	75042	CECT0-1401F	
R483	301-0100-00	Res.,fxd,comp	10 Ω	5%	1/2 w	01121	EB1005	
R484A R484B	310-0608-00	Res.,fxd,ww	1400 Ω	1%	20 w	80009		
R490	323-0245-00	Res.,fxd,film	3.48 k	1%	1/2 w	75042	CECT0-3481F	
R491	310-0609-00	Res.,fxd,ww	4 k	1%	2 w	80009		
R492	323-0207-00	Res.,fxd,film	1.4 k	1%	1/2 w	75042	CECT0-1401F	
R601	302-0104-00	Res.,fxd,comp	100 k		1/2 w	01121	EB1041	
R602	302-0104-00	Res.,fxd,comp	100 k		1/2 w	01121	EB1041	
R604	311-0377-00	Res.,variable	25 Ω	SCALE ILLUM	12.5 w	44655	51181	
R607	304-0333-00	Res.,fxd,comp	33 k		1 w	01121	GB3331	
R609	324-0284-00	Res.,fxd,film	8.87 k	1%	1 w	75042	CCFT0-8871F	
R610	316-0333-00	Res.,fxd,comp	33 k		1/4 w	01121	CB3331	
R611	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	
R612	323-0368-00	Res.,fxd,film	66.5 k		1/2 w	75042	CECT0-6652F	
R613	307-0009-00	Res.,fxd,comp	4.7 Ω	1%	1 w	01121	GB47G1	
R614	323-0418-00	Res.,fxd,film	221 k	1%	1/2 w	75042	CECT0-2213F	
R615	316-0102-00	Res.,fxd,comp	1 k		1/4 w	01121	CB1021	
R622	302-0331-00	Res.,fxd,comp	330 Ω		1/2 w	01121	EB3311	
R623	302-0333-00	Res.,fxd,comp	33 k		1/2 w	01121	EB3331	
R630	308-0254-00	Res.,fxd,ww	1.37 k		1/2 w	15909	1195-1371F	
R631	311-0421-00	Res.,variable	1 k	-75 VOLTS		12697	CM31495	
R632	308-0259-00	Res.,fxd,ww	10.7 k	1%	1 w	15909	1252-1072F	
R633	302-0333-00	Res.,fxd,comp	33 k		1/2 w	01121	EB3331	
R634	322-0147-00	Res.,fxd,film	332 Ω	1%	1/4 w	19701	MF6CD3320F	
R636	304-0470-00	Res.,fxd,comp	47 Ω		1 w	01121	GB4701	
R637	308-0123-00	Res.,fxd,ww	20 Ω	5%	5 w	63743	K46605	
R642	302-0103-00	Res.,fxd,comp	10 k		1/2 w	01121	EB1031	
R644	316-0224-00	Res.,fxd,comp	220 k		1/4 w	01121	CB2241	
R649	308-0087-00	Res.,fxd,ww	0.5 Ω	1%	1 w	80009		
R653	316-0683-00	Res.,fxd,comp	68 k		1/4 w	01121	CB6831	
R660	308-0257-00	Res.,fxd,ww	5.11 k	1%	1/2 w	01686	7020-5111F	
R661	311-0378-00	Res.,variable	250 Ω	-15 VOLTS		71590	BA131-012	
R662	308-0263-00	Res.,fxd,ww	15.4 k	1%	1/2 w	15909	1195-1542F	
R663	306-0271-00	Res.,fxd,comp	270 Ω		2 w	01121	HB2711	
R664	302-0223-00	Res.,fxd,comp	22 k		1/2 w	01121	EB2231	

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R665	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	
R669	323-0391-00	Res.,fxd,film	115 k	1%	1/2 w	75042	CECT0-1153F	
R672	302-0103-00	Res.,fxd,comp	10 k		1/2 w	01121	EB1031	
R674	316-0184-00	Res.,fxd,comp	180 k		1/4 w	01121	CB1841	
R679	308-0244-00	Res.,fxd,ww	0.3 Ω		2 w	63743	K47428	
R683	302-0223-00	Res.,fxd,comp	22 k		1/2 w	01121	EB2231	
R690	308-0255-00	Res.,fxd,ww	3.65 k	1%	1/2 w	15909	1195-3651F	
R691	311-0378-00	Res.,variable	250 Ω	+15 VOLTS		71590	BA131-012	
R692	308-0261-00	Res.,fxd,ww	15 k	1%	1 w	15909	1252-1502F	
R693	302-0273-00	Res.,fxd,comp	27 k		1/2 w	01121	EB2731	
R694	316-0100-00	Res.,fxd,comp	10 Ω		1/4 w	01121	CB1001	
R699	323-0385-00	Res.,fxd,film	100 k	1%	1/2 w	75042	CECT0-1003F	
R702	304-0473-00	Res.,fxd,comp	47 k		1 w	01121	GB4731	
R703	308-0179-00	Res.,fxd,ww	5 Ω	5%	5 w	63743	K46948	
R714	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R716	316-0224-00	Res.,fxd,comp	220 k		1/4 w	01121	CB2241	
R719	302-0473-00	Res.,fxd,comp	47 k		1/2 w	01121	EB4731	
R723	302-0333-00	Res.,fxd,comp	33 k		1/2 w	01121	EB3331	
R730	308-0264-00	Res.,fxd,ww	21.5 k		1 w	15909	1252-2152F	
R731	311-0380-00	Res.,variable	500 Ω	+100 VOLTS		12697	CM30738	
R732	308-0260-00	Res.,fxd,ww	13.3 k		1 w	15909	1252-1332F	
R733	302-0333-00	Res.,fxd,comp	33 k		1/2 w	01121	EB3331	
R734	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	
R736	308-0223-00	Res.,fxd,ww	35 Ω	5%	3 w	56289	242E350J	
R737	308-0123-00	Res.,fxd,ww	20 Ω	5%	5 w	63743	K46605	
R739	323-0387-00	Res.,fxd,film	105 k	1%	1/2 w	75042	CECT0-1053F	
R742	304-0104-00	Res.,fxd,comp	100 k		1 w	01121	GB1041	
R744	302-0121-00	Res.,fxd,comp	120 Ω		1/2 w	01121	EB1211	100-739
R744	302-0680-00	Res.,fxd,comp	68 Ω		1/2 w	01121	EB6801	740-up
R745	302-0270-00	Res.,fxd,comp	27 Ω		1/2 w	01121	EB2701	
R800	323-0498-00	Res.,fxd,film	1.5 meg	1%	1/2 w	75042	CECT0-1504F	
R801	311-0408-00	Res.,variable	20 k	HIGH VOLTAGE		12697	CM31303	
R802A	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R802B	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R802C	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R802D	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R802E	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R802F	324-0531-00	Res.,fxd,film	3.32 meg	1%	1 w	56289	440E3324FC5	
R803	323-0476-00	Res.,fxd,film	887 k	1%	1/2 w	75042	CECT0-8873F	100-293
R803	323-0489-00	Res.,fxd,film	1.21 meg	1%	1/2 w	75042	CECT0-1214F	294-up

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R804	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R805	316-0123-00	Res.,fxd,comp	12 k		1/4 w	01121	CB1231	100-293
R805	323-0218-00	Res.,fxd,film	1.82 k	1%	1/2 w	75042	CECT0-1821F	294-up
R806	316-0222-00	Res.,fxd,comp	2.2 k		1/4 w	01121	CB2221	100-293
R806	323-0342-00	Res.,fxd,film	35.7 k	1%	1/2 w	75042	CECT0-3572F	294-up
R807	316-0335-00	Res.,fxd,comp	3.3 meg		1/4 w	01121	CB3351	100-293X
R808	304-0223-00	Res.,fxd,comp	22 k		1 w	01121	GB2231	100-293
R808	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	294-up
R809	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	100-293
R809	316-0104-00	Res.,fxd,comp	100 k		1/4 w	01121	CB1041	294-up
R810	316-0563-00	Res.,fxd,comp	56 k		1/4 w	01121	CB5631	100-293X
R811	315-0132-00	Res.,fxd,comp	1.3 k	5%	1/4 w	01121	CB1325	100-293X
R812	315-0432-00	Res.,fxd,comp	4.3 k	5%	1/4 w	01121	CB4325	100-293X
R814	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	100-293X
R815	316-0105-00	Res.,fxd,comp	1 meg		1/4 w	01121	CB1051	100-293X
R817	301-0564-00	Res.,fxd,comp	560 k	5%	1/2 w	01121	EB5645	100-293
R817	302-0333-00	Res.,fxd,comp	33 k		1/2 w	01121	EB3331	294-up
R818	301-0222-00	Res.,fxd,comp	2.2 k	5%	1/2 w	01121	EB2225	100-293X
R819	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	100-293
R819	316-0391-00	Res.,fxd,comp	390 Ω		1/4 w	01121	CB3911	294-up
R820	306-0151-00	Res.,fxd,comp	150 Ω		2 w	01121	HB1511	100-293X
R821	316-0563-00	Res.,fxd,comp	56 k		1/4 w	01121	CB5631	100-293X
R824	316-0183-00	Res.,fxd,comp	18 k		1/4 w	01121	CB1831	
R825	316-0105-00	Res.,fxd,comp	1 meg		1/4 w	01121	CB1051	
R826	306-0106-00	Res.,fxd,comp	10 meg		2 w	01121	HB1061	
R827	306-0106-00	Res.,fxd,comp	10 meg		2 w	01121	HB1061	
R828	306-0106-00	Res.,fxd,comp	10 meg		2 w	01121	HB1061	
R829	306-0106-00	Res.,fxd,comp	10 meg		2 w	01121	HB1061	
R831	302-0102-00	Res.,fxd,comp	1 k		1/2 w	01121	EB1021	
R832	311-0329-00	Res.,variable	50 k	CRT GRID BIAS		01121	GA2G024S503MA	
R833	302-0103-00	Res.,fxd,comp	10 k		1/2 w	01121	EB1031	
R834	302-0103-00	Res.,fxd,comp	10 k		1/2 w	01121	EB1031	
R838	302-0105-00	Res.,fxd,comp	1 meg		1/2 w	01121	EB1051	
R840	306-0395-00	Res.,fxd,comp	3.9 meg		2 w	01121	HB3951	
R841	306-0395-00	Res.,fxd,comp	3.9 meg		2 w	01121	HB3951	
R842	306-0395-00	Res.,fxd,comp	3.9 meg		2 w	01121	HB3951	
R843	306-0395-00	Res.,fxd,comp	3.9 meg		2 w	01121	HB3951	
R844	311-0121-00	Res.,variable	5 meg	FOCUS		12697	CM22218	
R845	302-0275-00	Res.,fxd,comp	2.7 meg		1/2 w	01121	EB2751	

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R850	316-0473-00	Res.,fxd,comp	47 k		1/4 w	01121	CB4731	
R851	316-0563-00	Res.,fxd,comp	56 k		1/4 w	01121	CB5631	
R852	302-0101-00	Res.,fxd,comp	100 Ω		1/2 w	01121	EB1011	
R853	301-0223-00	Res.,fxd,comp	22 k	5%	1/2 w	01121	EB2235	
R854	302-0105-00	Res.,fxd,comp	1 meg		1/2 w	01121	EB1051	
R855	302-0101-00	Res.,fxd,comp	100 Ω		1/2 w	01121	EB1011	
R856	302-0104-00	Res.,fxd,comp	100 k		1/2 w	01121	EB1041	
R861[3]	311-0412-00	Res.,variable	2 x 1 k	TRACE ROTATION		11237	34877	
R863	311-0110-00	Res.,variable	100 k	GEOMETRY		01121	GW4750C	
R864[3]	311-0412-00	Res.,variable	100 k	ASTIGMATISM		11237	34877	
R865	311-0458-00	Res.,variable	5 k	Y AXIS ALIGNMENT		12697	CM32116	
R870	316-0101-00	Res.,fxd,comp	100 Ω		1/4 w	01121	CB1011	
R871	316-0102-00	Res.,fxd,comp	1 k		1/4 w	01121	CB1021	
R873	306-0333-00	Res.,fxd,comp	33 k		2 w	01121	HB3331	
R874	305-0622-00	Res.,fxd,comp	6.2 k	5%	2 w	01121	HB6225	
R875	308-0178-00	Res.,fxd,ww	15 k	5%	8 w	63743	K46947	
R876	316-0470-00	Res.,fxd,comp	47 Ω		1/4 w	01121	CB4701	
R878	323-0335-00	Res.,fxd,film	30.1 k	1%	1/2 w	75042	CECT0-3012F	
R882	315-0202-00	Res.,fxd,comp	2 k	5%	1/4 w	01121	CB2025	
R884	316-0332-00	Res.,fxd,comp	3.3 k		1/4 w	01121	CB3321	
R885	321-0379-00	Res.,fxd,film	86.6 k	1%	1/8 w	75042	CEAT0-8662F	
R886	324-0317-00	Res.,fxd,film	19.6 k	1%	1 w	75042	CCFT0-1962F	
R891	316-0682-00	Res.,fxd,comp	6.8 k		1/4 w	01121	CB6821	
R892	316-0470-00	Res.,fxd,comp	47 Ω		1/4 w	01121	CB4701	
R893	316-0470-00	Res.,fxd,comp	47 Ω		1/4 w	01121	CB4701	
R894	301-0223-00	Res.,fxd,comp	22 k	5%	1/2 w	01121	EB2235	
R895	322-0229-00	Res.,fxd,film	2.37 k	1%	1/4 w	19701	MF6CD2371F	
R896	321-0253-00	Res.,fxd,film	4.22 k	1%	1/8 w	75042	CEAT0-4221F	
R897	Use 311-0011-00	Res.,variable	5 k	INTENSITY		12697	CM28216	
R902	316-0183-00	Res.,fxd,comp	18 k		1/4 w	01121	CB1831	
R903	316-0183-00	Res.,fxd,comp	18 k		1/4 w	01121	CB1831	
R904	316-0332-00	Res.,fxd,comp	3.3 k		1/4 w	01121	CB3321	
R911	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R914	316-0222-00	Res.,fxd,comp	2.2 k		1/4 w	01121	CB2221	
R916	316-0472-00	Res.,fxd,comp	4.7 k		1/4 w	01121	CB4721	
R921	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R923	316-0470-00	Res.,fxd,comp	47 Ω		1/4 w	01121	CB4701	
R924	315-0222-00	Res.,fxd,comp	2.2 k	5%	1/4 w	01121	CB2225	
R926	315-0272-00	Res.,fxd,comp	2.7 k	5%	1/4 w	01121	CB2725	

[3] R861 and R864 furnished as a unit.

Table 6-2

RESISTORS (Cont'd)

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION			MFR CODE NO.	MFR PART NO.	S/N RANGE
R931	316-0683-00	Res.,fxd,comp	68 k		1/4 w	01121	CB6831	
R932	323-0483-00	Res.,fxd,film	1.05 meg	1%	1/2 w	75042	CECT0-1054F	
R933	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R934	316-0152-00	Res.,fxd,comp	1.5 k		1/4 w	01121	CB1521	
R935	316-0392-00	Res.,fxd,comp	3.9 k		1/4 w	01121	CB3921	
R937	302-0100-00	Res.,fxd,comp	10 Ω		1/2 w	01121	EB1001	
R941	316-0683-00	Res.,fxd,comp	68 k		1/4 w	01121	CB6831	
R942	323-0483-00	Res.,fxd,film	1.05 meg	1%	1/2 w	75042	CECT0-1054F	
R943	316-0103-00	Res.,fxd,comp	10 k		1/4 w	01121	CB1031	
R944	316-0152-00	Res.,fxd,comp	1.5 k		1/4 w	01121	CB1521	
R945	316-0392-00	Res.,fxd,comp	3.9 k		1/4 w	01121	CB3921	
R946	302-0100-00	Res.,fxd,comp	10 Ω		1/2 w	01121	EB1001	
R947	308-0025-00	Res.,fxd,ww	20 k	5%	10 w	63743	K45769	
R948B	323-0289-00	Res.,fxd,film	10 k	1%	1/2 w	75042	CECT0-1002F	
R948C	323-0635-00	Res.,fxd,film	6.667 k	1%	1/2 w	75042	CECT0-66670F	
R948D	323-0634-00	Res.,fxd,film	1.789 k	1%	1/2 w	75042	CECT0-17890F	
R948E	323-0633-00	Res.,fxd,film	801 Ω	1%	1/2 w	75042	CECT0-8010F	
R948F	323-0632-00	Res.,fxd,film	452 Ω	1%	1/2 w	75042	CECT0-4520F	
R948G	323-0631-00	Res.,fxd,film	146.1 Ω	1%	1/2 w	75042	CECT0-146R10F	
R948H	323-0630-00	Res.,fxd,film	72.4 Ω	1%	1/2 w	75042	CECT0-72R40F	
R948J	323-0629-00	Res.,fxd,film	43.1 Ω	1%	1/2 w	75042	CECT0-43R10F	
R948K	323-0628-00	Res.,fxd,film	28.6 Ω	1%	1/2 w	75042	CECT0-28R60F	
R948L	323-0627-00	Res.,fxd,film	21.4 Ω	1%	1/2 w	75042	CECT0-21R40F	
R948X	323-0636-00	Res.,fxd,film	50 k	1%	1/2 w	75042	CECT0-5002F	
R948Y	323-0638-00	Res.,fxd,film	50 k	1/4%	1/2 w	19701	MF7CE5002C	
R948Z	323-0637-00	Res.,fxd,film	50 Ω	1%	1/2 w	19701	MF7CD50R0C	
R949	308-0090-00	Res.,fxd,ww	0.25 Ω		1 w	80009		

SWITCHES

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION		MFR CODE NO.	MFR PART NO.	S/N RANGE
SW360	Use 050-0201-00	Mod kit,electro	Replacement Kit	TRACE FINDER	80009		100-199
SW360	260-0645-00	Switch,push		TRACE FINDER	82389	12S-1019D	200-up
SW601	260-0515-00	Switch,toggle		POWER ON	15605	8360K7	
SW948	260-0536-00	Switch,rotary		1 KC CALIBRATOR	80009		
SW948	262-0674-00	Sw,rot.,wired		1 KC CALIBRATOR	80009		
TK601	260-0638-00	Sw,thermostatic	Thermal Cutout 75°C ±3°C		93410	S3530	
TK602	260-0637-00	Sw,thermostatic	Thermal Cutout closes at 18.3°C ±3°C, opens at 1.7°C ±4.4°C		93410	S3011	

Table 6-2

TRANSFORMERS

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
T600[4]	119-0028-00	Fil,rad.,intfer	Line Filter	56289	JN10-1028A	
T601	Use 120-0385-00	Xmfr,power	L. V. Power	80009		
T820	120-0332-00	Xmfr,pwr,step-u	H. V. Power	80009		

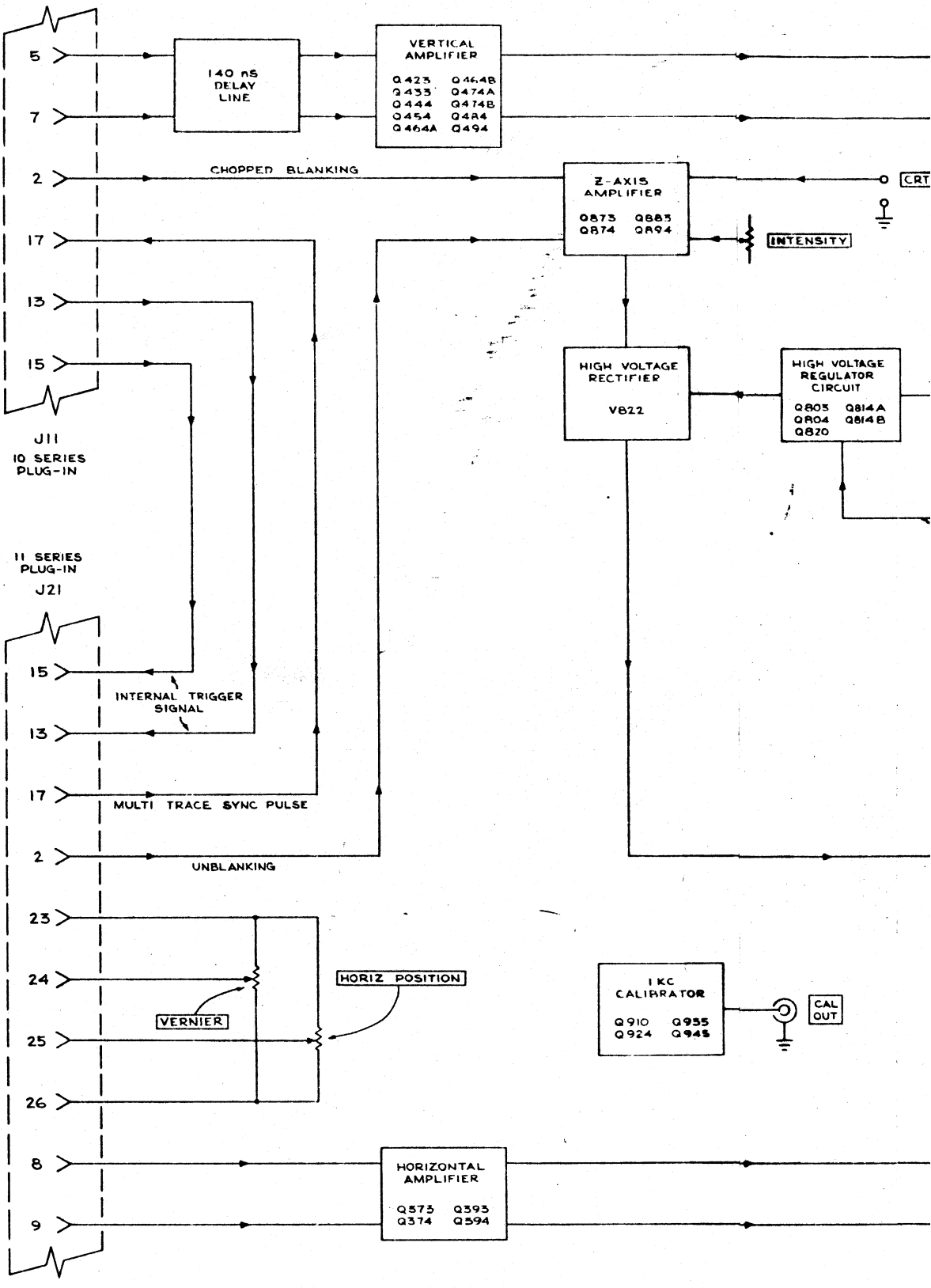
ELECTRON TUBES

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
V822	154-0051-00	Electron tube		96302	5642	100-293X
V832	154-0051-00	Electron tube		96302	5642	100-293X
V842	154-0051-00	Electron tube		96302	5642	
V852	154-0051-00	Electron tube		96302	5642	
V859	154-0448-00	Electron tube	Crt T6470-31-1 Standard Phosphor	80009		
V862	154-0051-00	Electron tube		96302	5642	

CRYSTAL

CKT NO.	TEKTRONIX PART NO.	ITEM NAME	DESCRIPTION	MFR CODE NO.	MFR PART NO.	S/N RANGE
Y910	158-0015-00	Xtal unit,qtz	4KC	75378	JKJH17T56	

[4]Furnished as a unit with C601, C602, C603.


5
7
140 nS DELAY LINE
VERTICAL AMPLIFIER
Q423 Q464B
Q433 Q474A
Q444 Q474B
Q454 Q484
Q464A Q494
2
CHOPPED BLANKING
Z-AXIS AMPLIFIER
Q873 Q885
Q874 Q894
CRT
INTENSITY
17
13
15
HIGH VOLTAGE RECTIFIER
V822
HIGH VOLTAGE REGULATOR CIRCUIT
Q803 Q814A
Q804 Q814B
Q820
J11
10 SERIES PLUG-IN
11 SERIES PLUG-IN
J21
15
INTERNAL TRIGGER SIGNAL
13
17
MULTI TRACE SYNC PULSE
2
UNBLANKING
23
24
25
26
VERNIER
HORIZ POSITION
1 KC CALIBRATOR
Q910 Q955
Q924 Q945
CAL OUT
8
9
HORIZONTAL AMPLIFIER
Q573 Q393
Q374 Q594

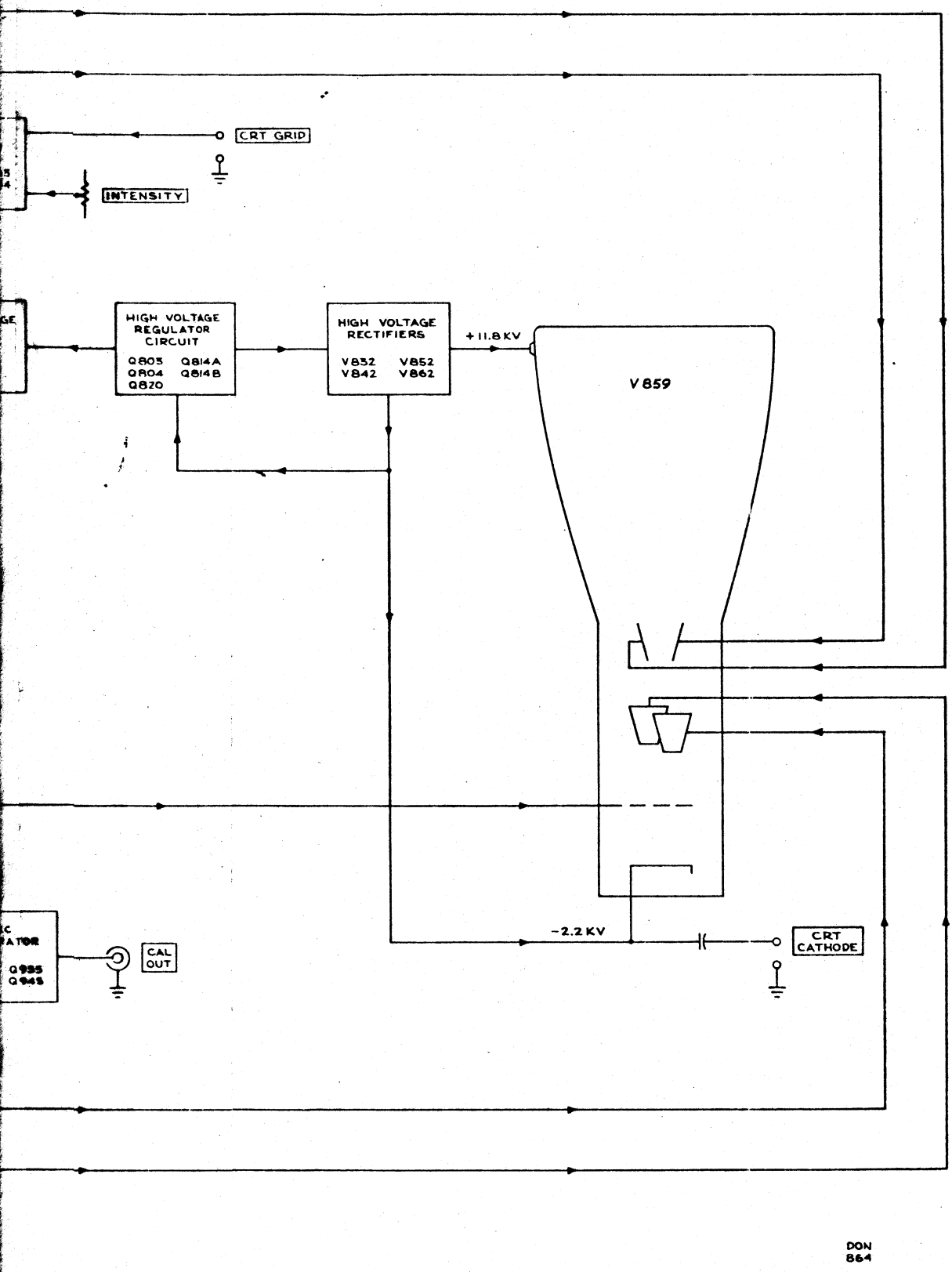
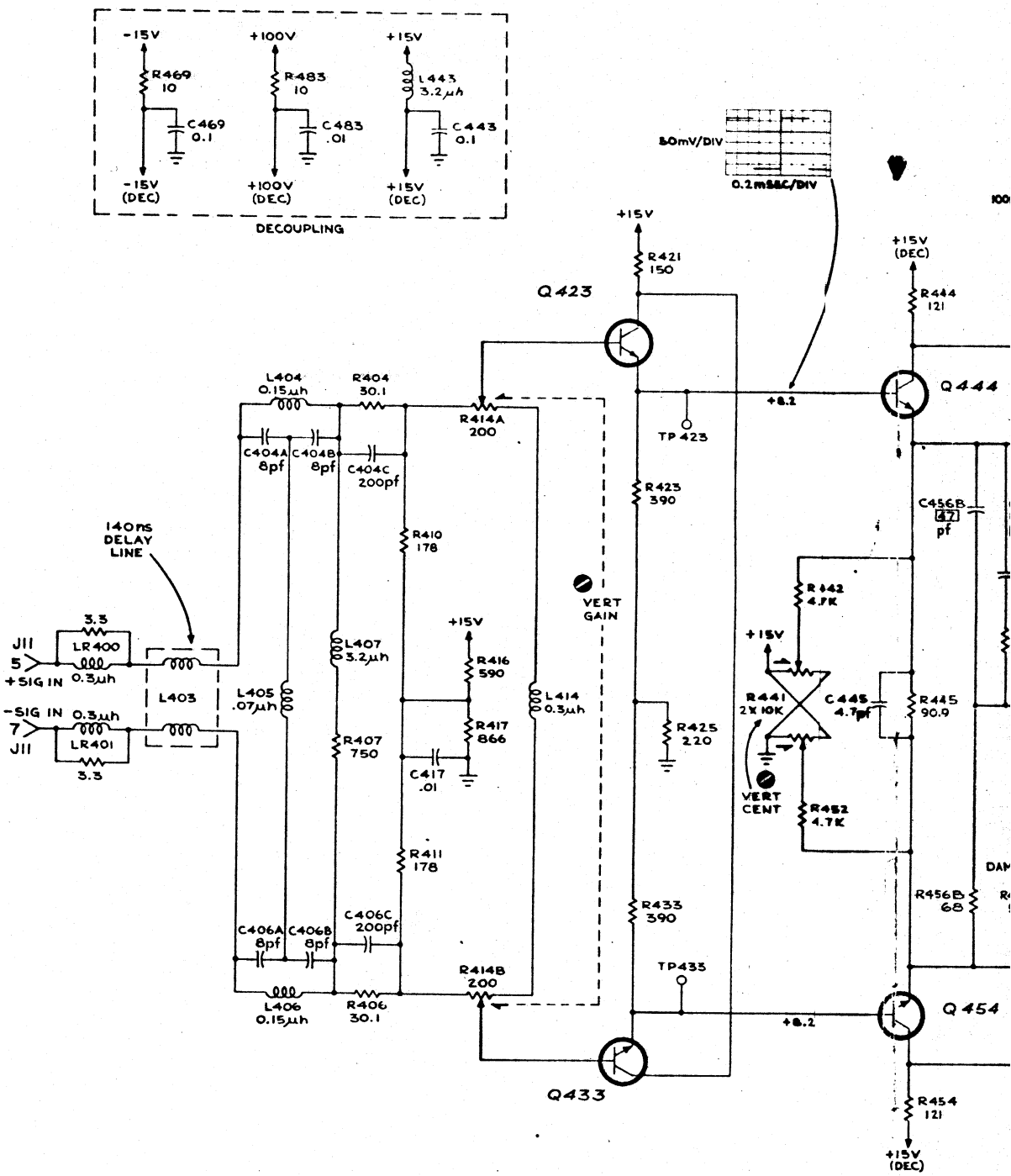


Figure 6-5. Type RM64/ Block Diagram



UNLESS O
RESISTAN
CAPACITA

SEE PAR
SEMICON

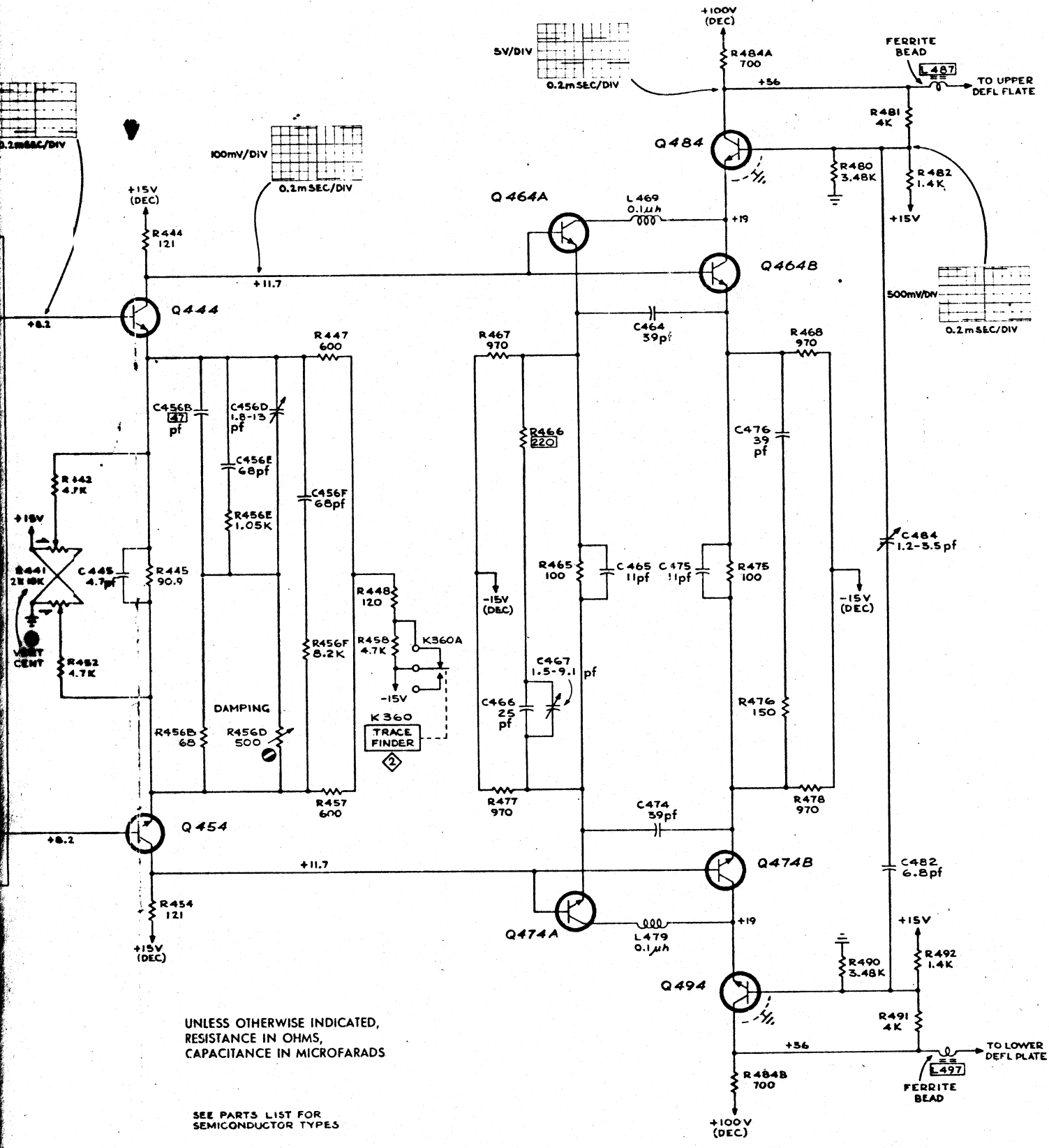


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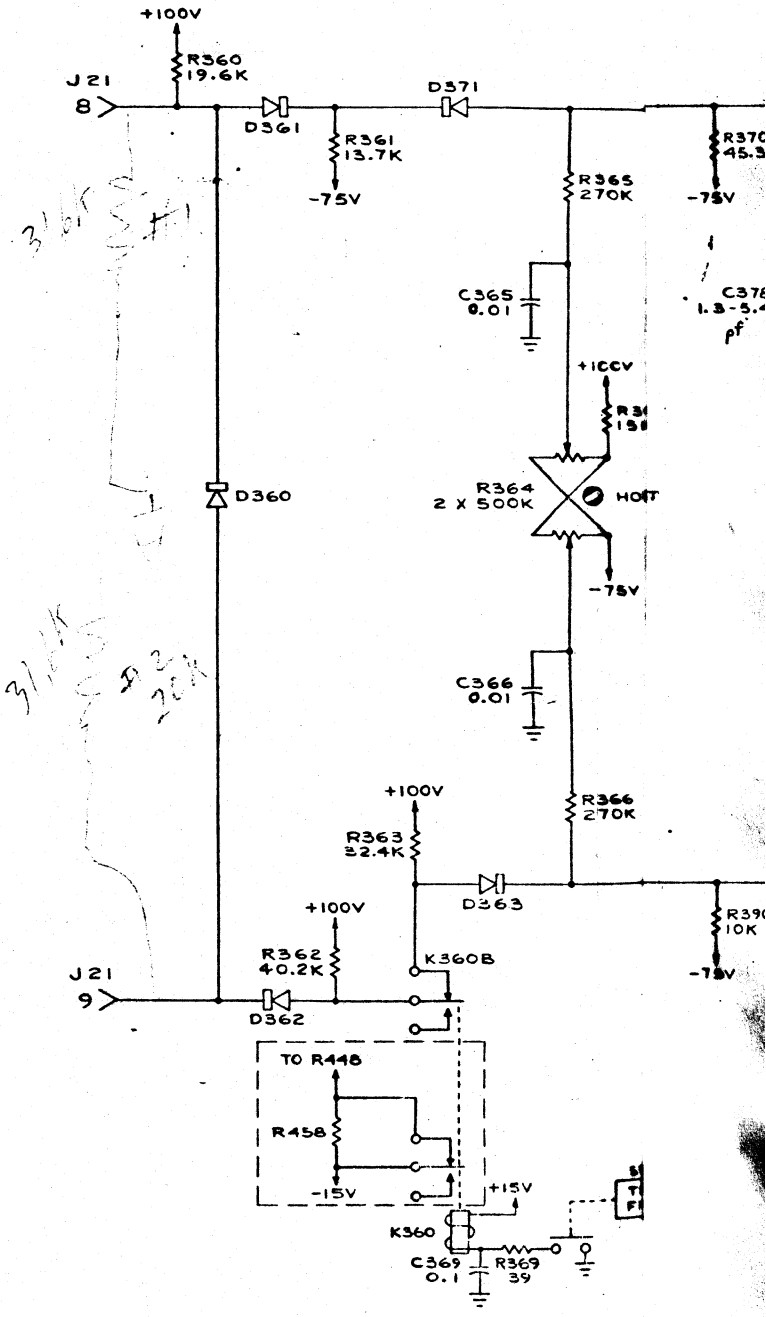
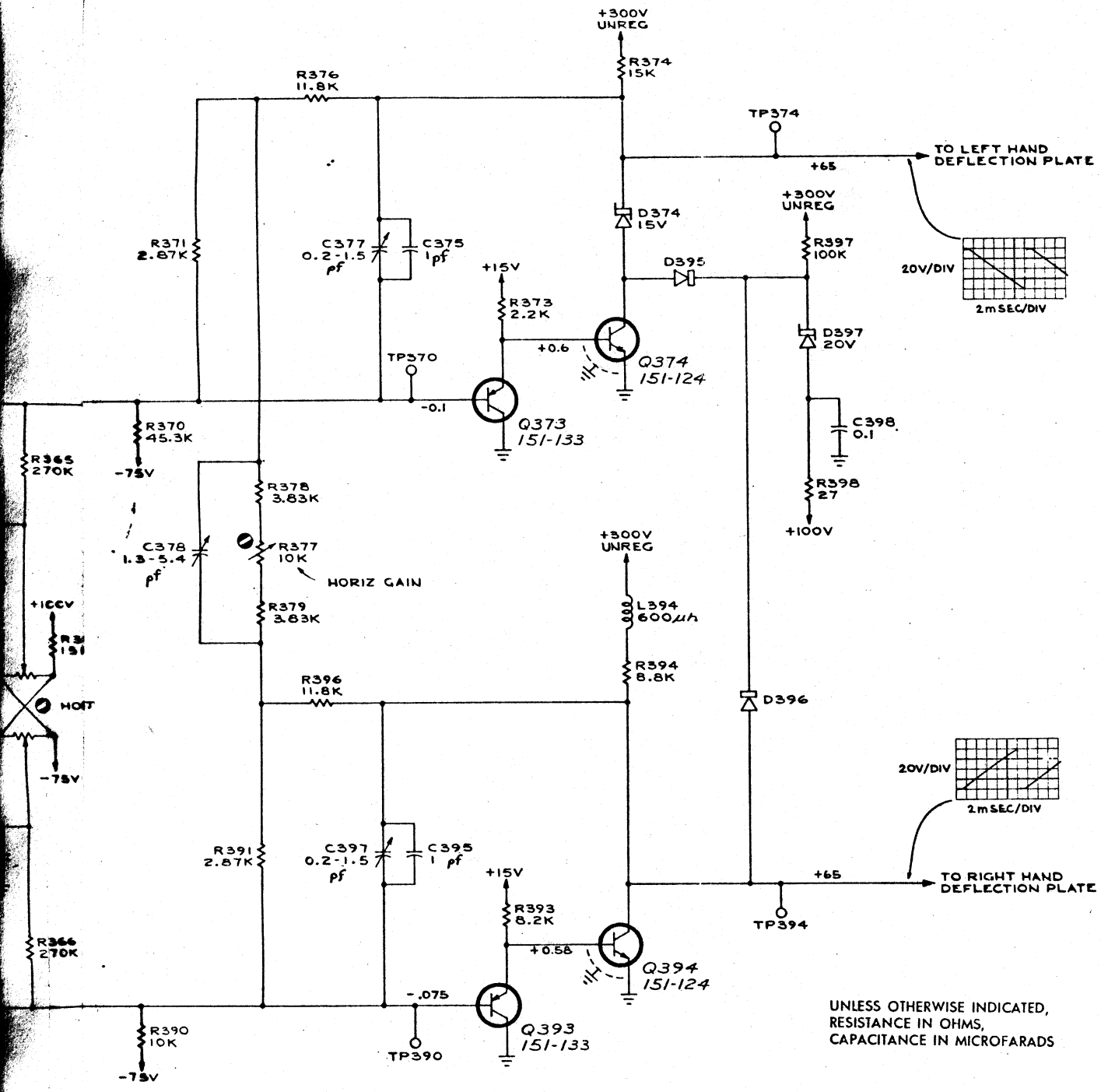
Figure 6-6. Type RM647 Vertical Amplifier Schematic Diagram

HORIZONTAL AMPLIFIER

See IMPORTANT note on Vertical Amplifier diagram for waveform and voltage conditions.





T6843002-002

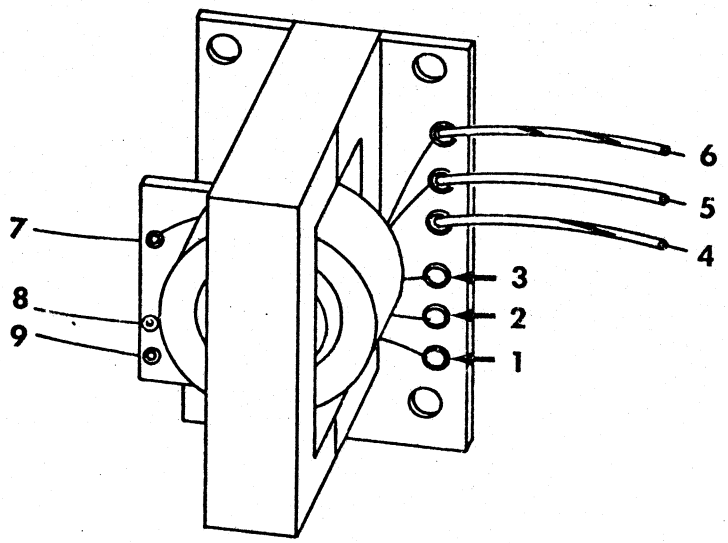
Figure 6-7. Type RM647 Horizontal Amplifier Schematic Diagram

CRT CIRCUIT

Note 1: Amplitude varies with intensity setting. Peak limits are about +10 and +100 volts.

* Intensity fully counterclockwise.

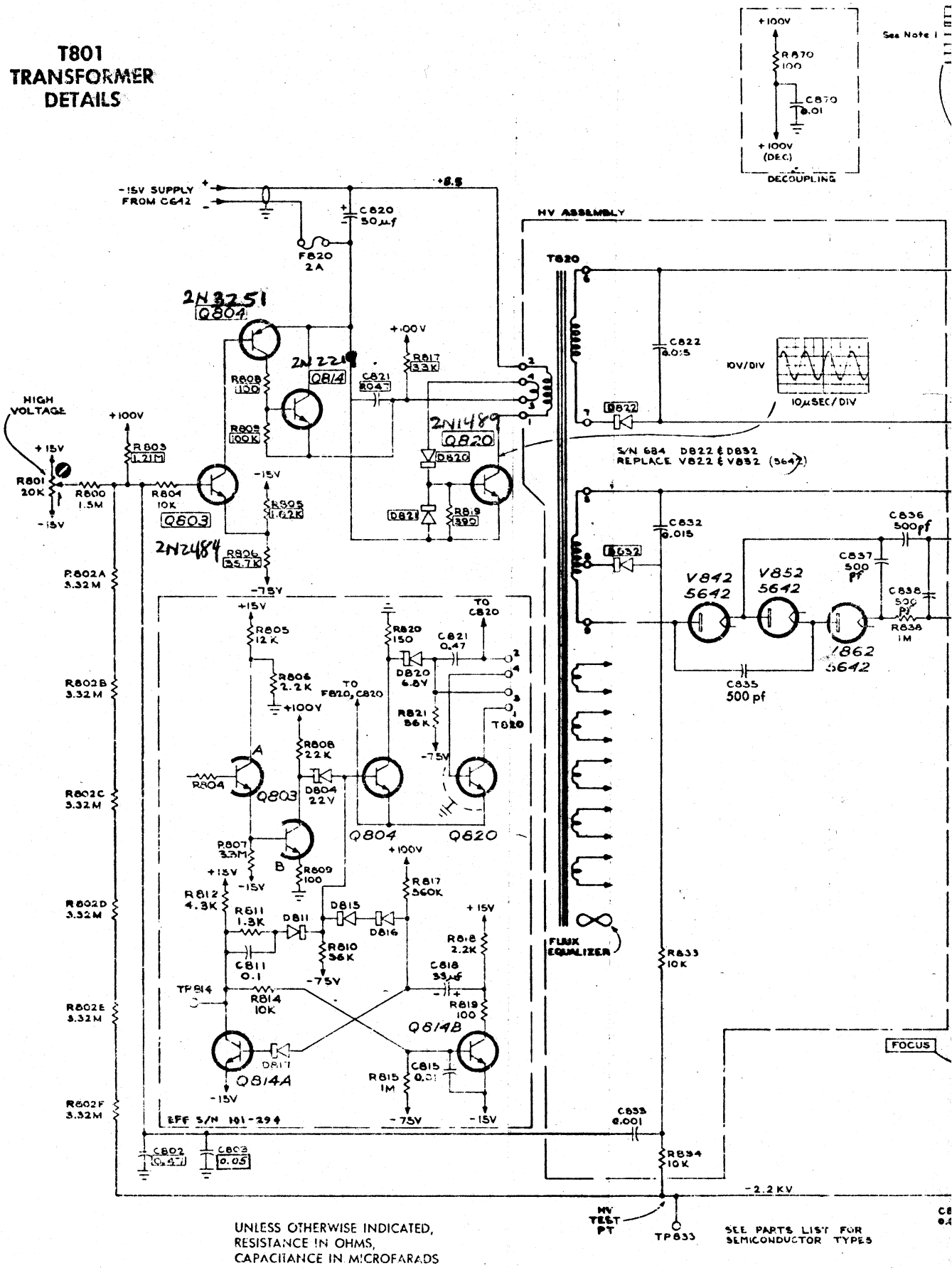
See IMPORTANT note on Vertical Amplifier diagram for waveform and voltage conditions.



T801 TRANSFORMER DETAILS

Q804 - 2N3251

T801 TRANSFORMER DETAILS



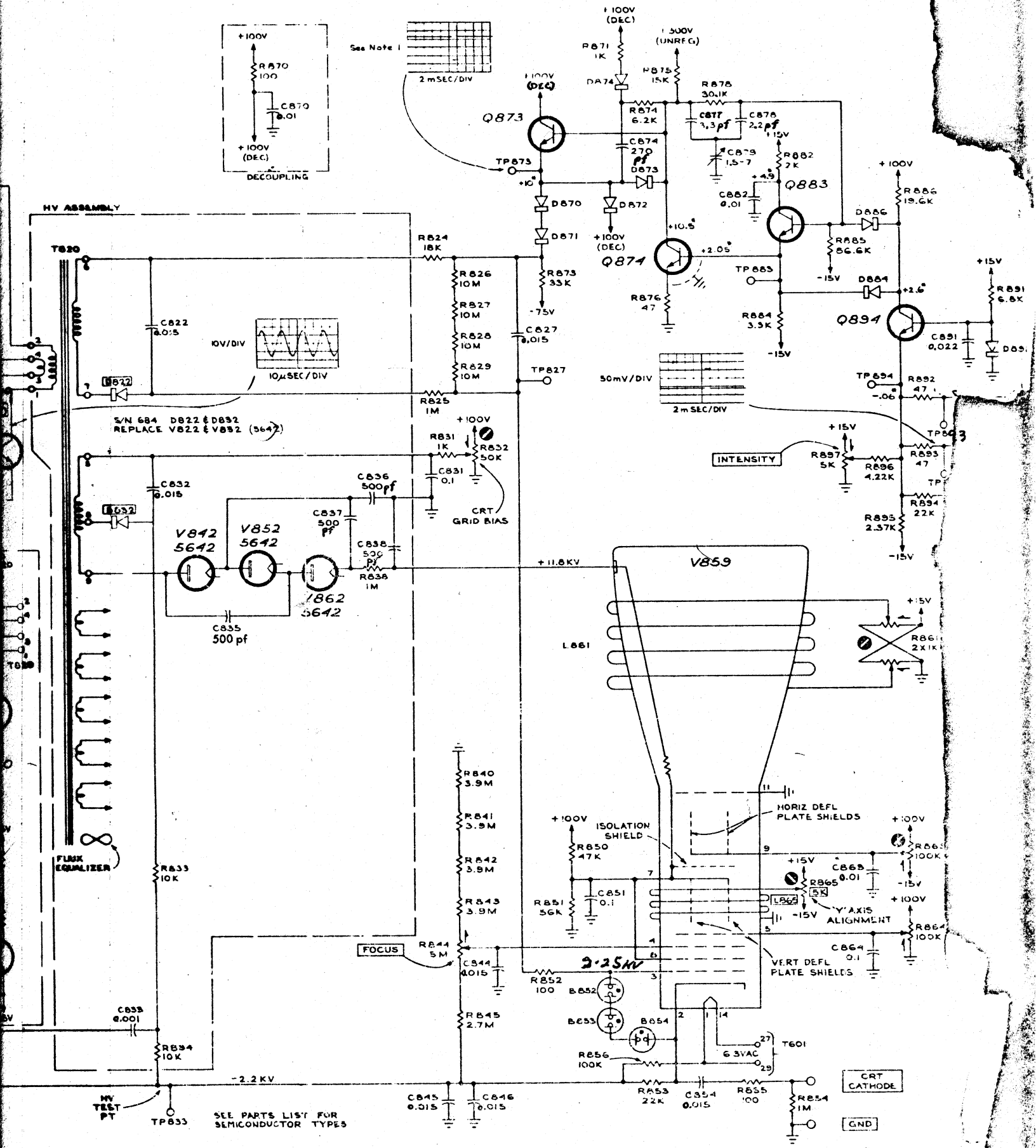
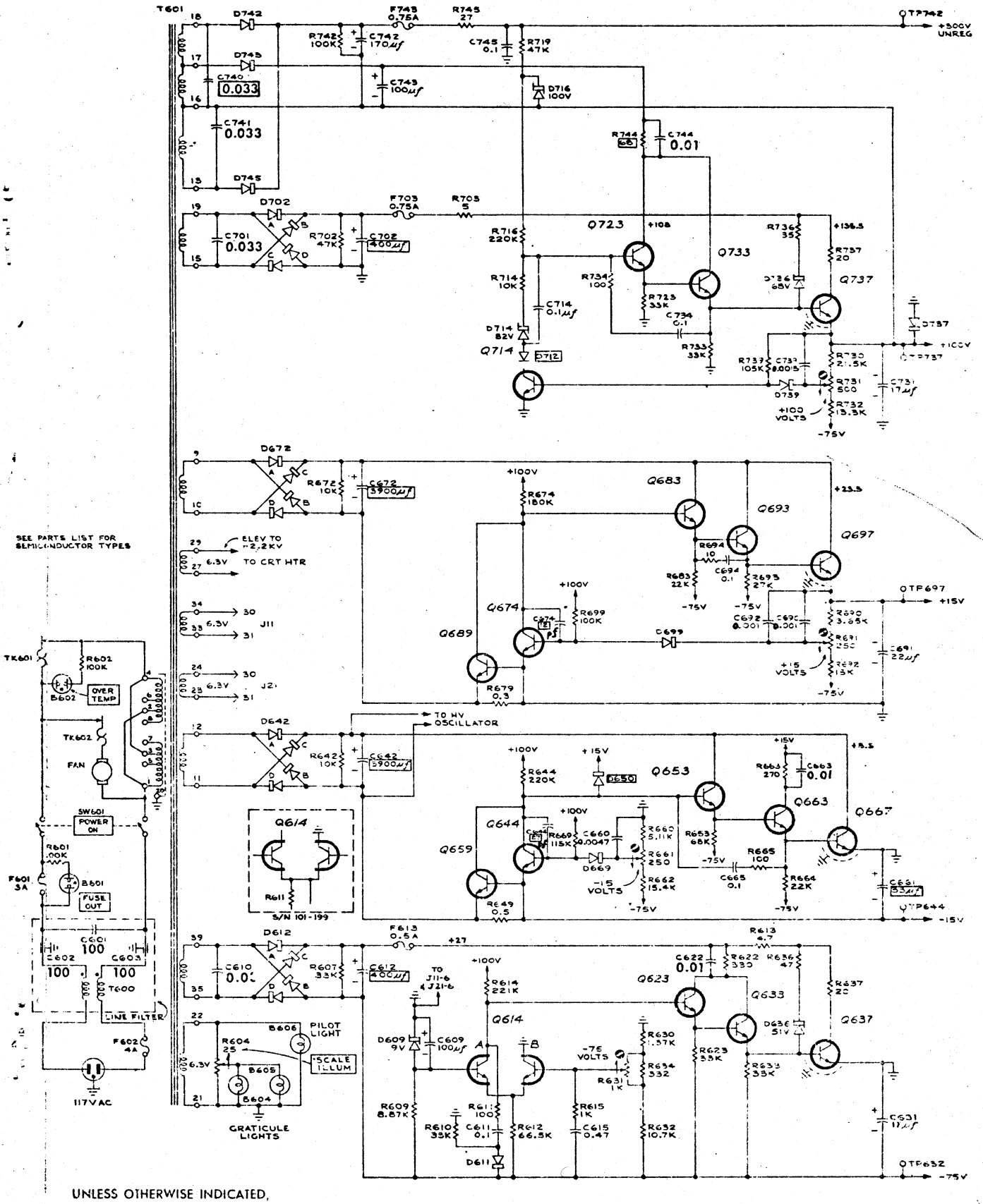


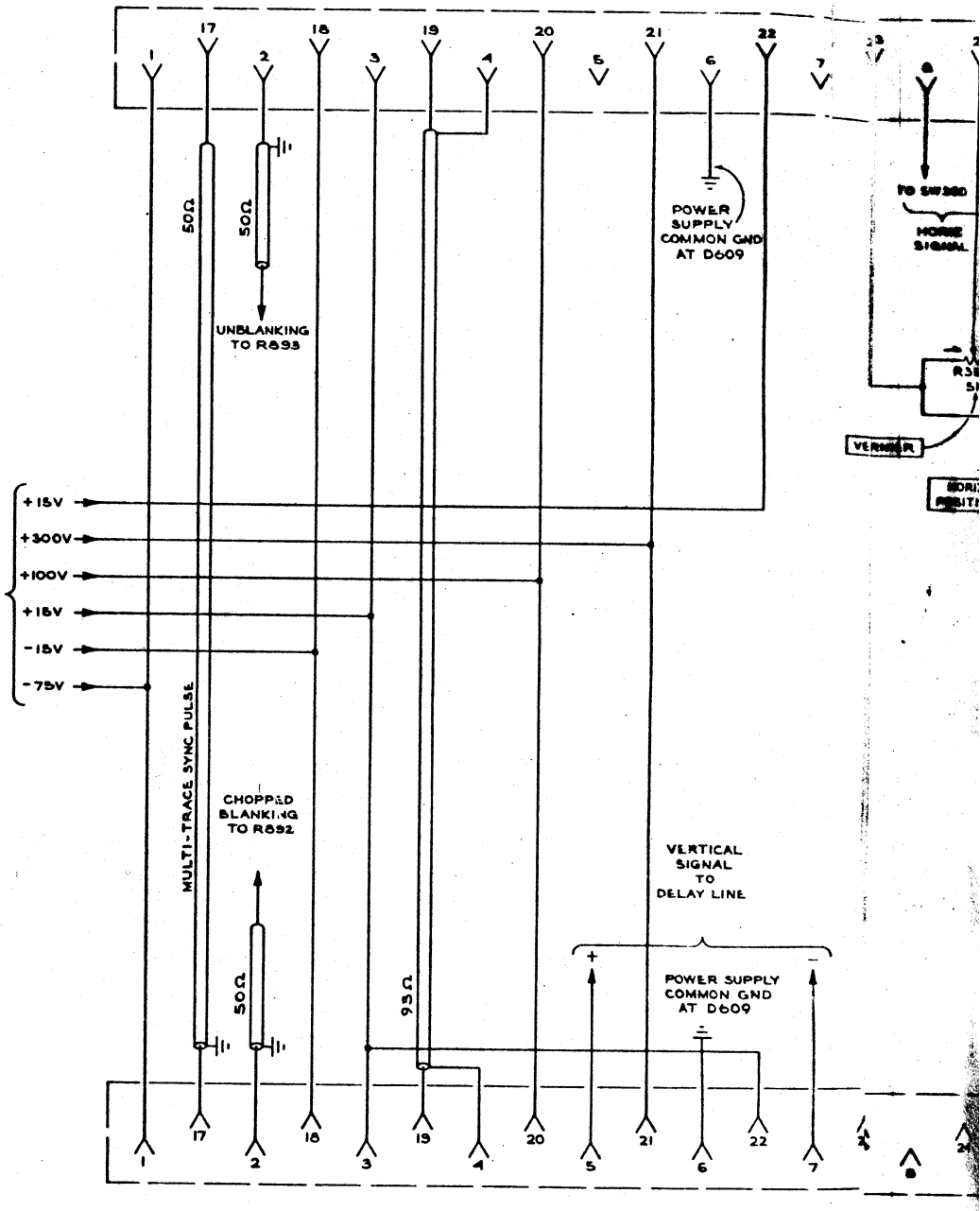
Figure 6-9. Type RM647 CRT Circuit Schematic Diagram



UNLESS OTHERWISE INDICATED,
RESISTANCE IN OHMS,
CAPACITANCE IN MICROFARADS

T6843002-003

Figure 6-8. Type RM647 Power Supply Schematic Diagram


17
18
19
20
21
22
1
2
3
4
5
6
7
50Ω
50Ω
UNBLANKING
TO R893
POWER
SUPPLY
COMMON GND
AT D609
+15V
+300V
+100V
+15V
-15V
-75V
MULTI-TRACE SYNC PULSE
CHOPPED
BLANKING
TO R892
50Ω
93Ω
VERTICAL
SIGNAL
TO
DELAY LINE
+
-
POWER SUPPLY
COMMON GND
AT D609

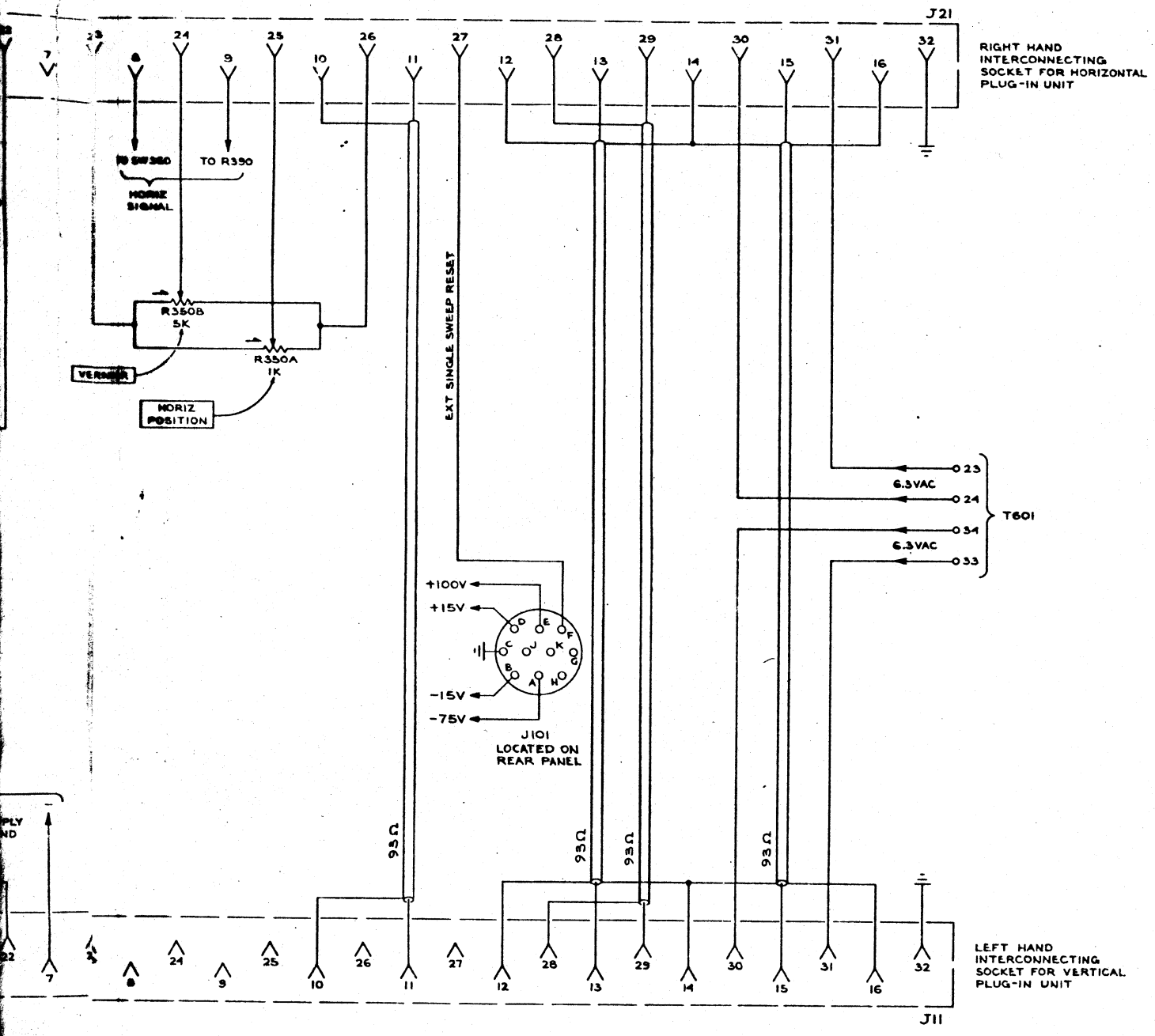
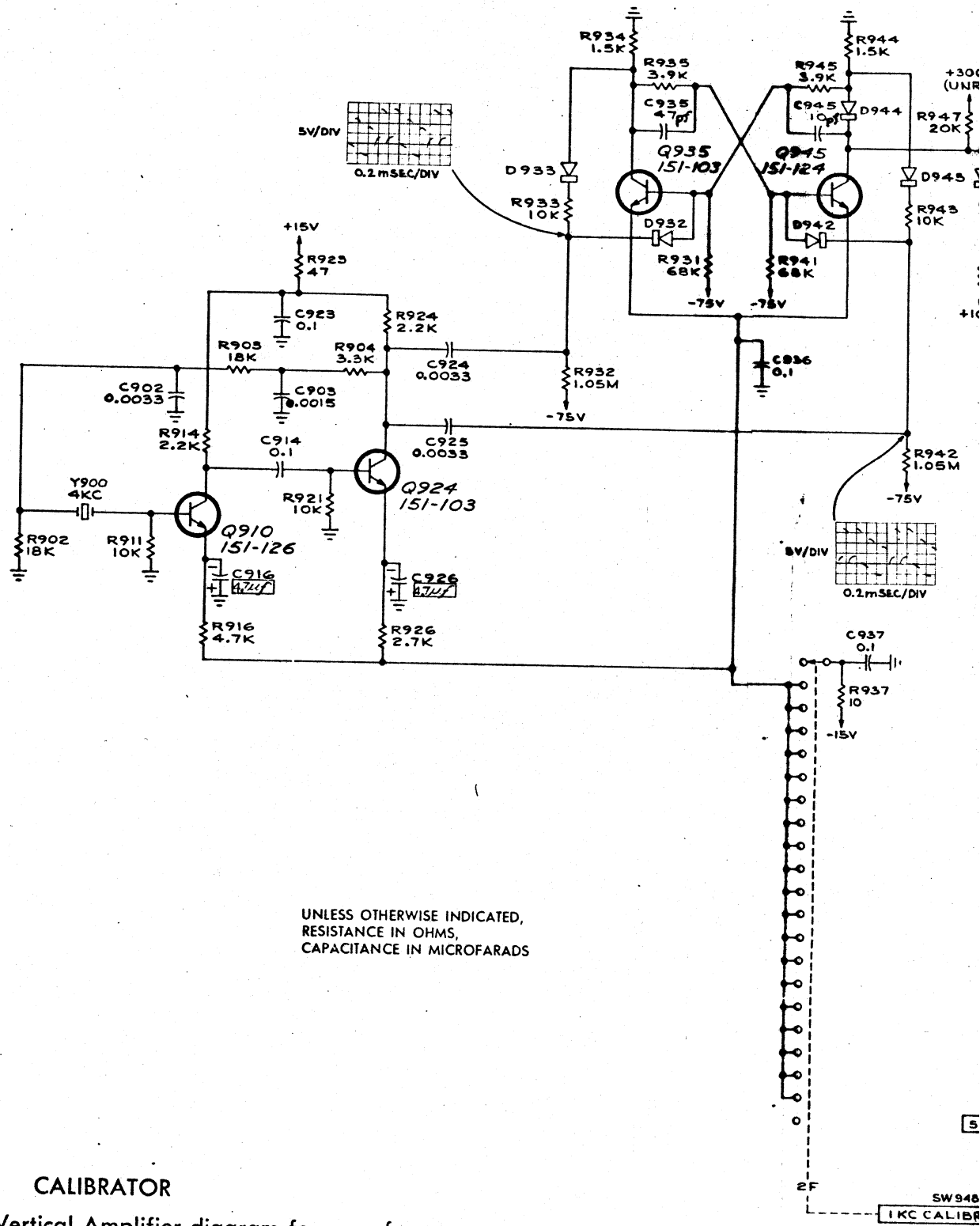


Figure 6-11. Type RM647 Interconnecting Sockets



UNLESS OTHERWISE INDICATED,
RESISTANCE IN OHMS,
CAPACITANCE IN MICROFARADS

CALIBRATOR

See IMPORTANT note on Vertical Amplifier diagram for waveform conditions.

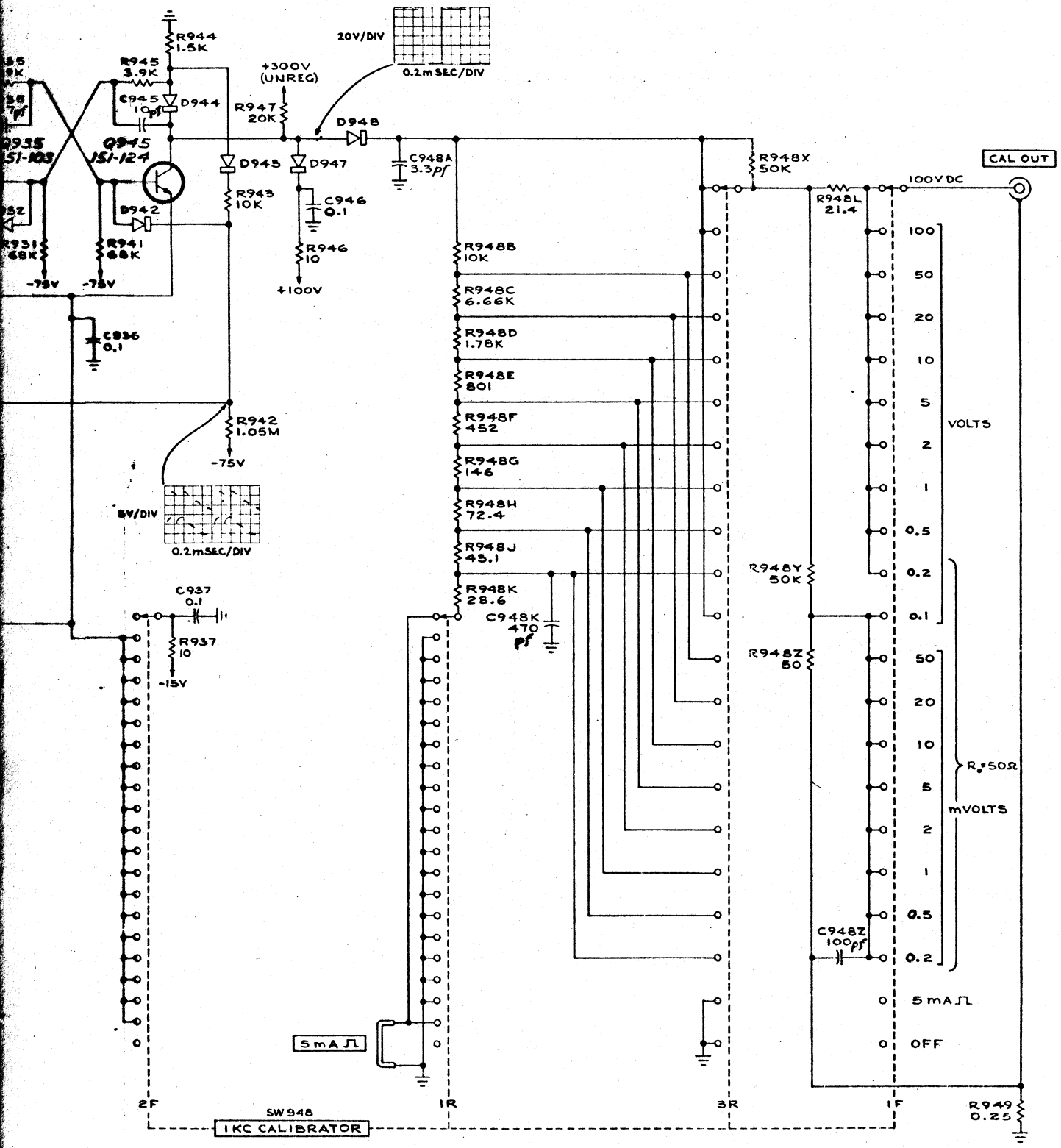


Figure 6-10. Type RM647 Calibrator Schematic Diagram

16843002-005

1A