

INSTRUCTION MANUAL

TYPE 561A
OSCILLOSCOPE

Tektronix, Inc.

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CONTENTS

	Warranty
Section 1	Characteristics
Section 2	Operating Instructions
Section 3	Circuit Description
Section 4	Maintenance
Section 5	Calibration
Section 6	Accessories
Section 7	Parts List and Schematics

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WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

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

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

Specifications and price change privileges reserved.



The Type 561A Oscilloscope, including the Type 3A1 Dual-Trace Amplifier and the Type 3B3 Time Base.

Type 561A

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Section 1

Characteristics

General Information

The Tektronix Type 561A Oscilloscope is essentially an indicator unit with provision for two of a number of plug-in units. The plug-in unit in the right-hand opening controls the horizontal (X-axis) deflection, and the plug-in unit in the left-hand opening controls the vertical (Y-axis) deflection. The plug-in units can be selected from any of the Tektronix '2' Series or '3' Series groups to provide the desired oscilloscope performance.

Bandpass, Risetime, Vertical Deflection Factors, Input Impedance, and Sweep Rates are determined by the plug-in units used.

Cathode-Ray Tube

Type — T561 (rectangular ceramic-envelope).

Phosphor — P31.

Unblanking — Deflection type, dc-coupled, with grid intensification.

Graticule — Variable edge lighted "no parallax" internal graticule. Marked in 8 vertical and 10 horizontal divisions with each major division divided into 5 minor divisions on centerline.

Accelerating potential — 3.5 kv.

Usable viewing area — 8 divisions vertical by 10 divisions horizontal.

Deflection plate sensitivities — 18.5 to 20.5 volts per division vertical, and 17.5 to 19.3 volts per division horizontal.

Calibrator

Waveform — Square waves at the line frequency.

Output voltage — 0.2 millivolt to 100 volts, peak-to-peak, in 18 steps.

Accuracy — Peak-to-peak amplitude within 3% of indicated voltage.

Risetime — Typically 4 microseconds.

Power Supplies

Electronically regulated for stable operation with widely varying line voltages and loads.

Line voltage requirements — 105 to 125 volts, or 210 to 250 volts, rms, 50 to 400 cps, single-phase ac.

Fuse — 2-amp slow-blowing type for 117 volts, 1-amp slow-blowing type for 234 volts.

Ventilation

Convection air cooled. Thermal cutout interrupts instrument power in the event of overheating.

Construction

Aluminum-alloy chassis and 2-piece cabinet.

Photo-etched anodized panel, blue vinyl paint over textured aluminum on cabinet.

Dimensions — Height 13½ inches, width 9¾ inches, and depth 21½ inches.

Weight — 30½ pounds, indicator unit only.

Section 2

Operating Instructions

Introduction

Before operating the Type 561A Oscilloscope, be sure that the instrument will cool properly, the proper line voltage is used, and the crt deflection potentials are correct.

Cooling

The air must be able to flow freely around the instrument so that it may cool. Vacuum tubes should not be operated with envelope temperatures above 150° C when the ambient temperature is at 25° C, or above 175° C when the ambient temperature is at 50° C. The Type 561A can operate in ambient temperatures up to 50° C. If the instrument overheats, the thermal cutout will turn off the power.

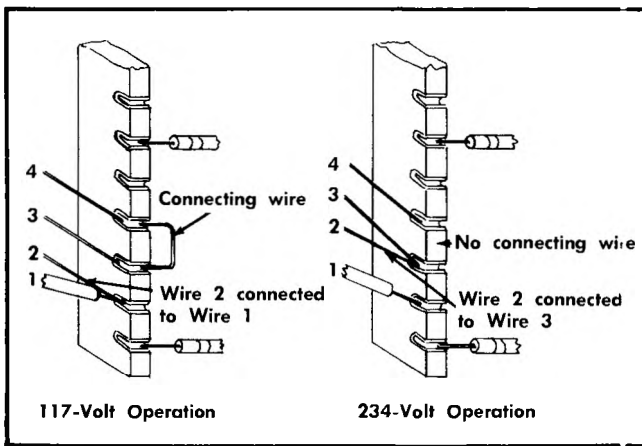


Fig. 2-1. Power transformer primary connections for operation of Type 561A Oscilloscope at 117 or 234 volts.

Line Voltage

The Type 561A instrument can be wired for either 117-volt or 234-volt operation. It will operate properly between 105 and 125 volts when wired for 117-volt operation, and between 210 and 250 volts when wired for 234-volt operation. A small metal tag on the rear of the instrument indicates the voltage for which it is wired at the factory.

Converting from one operating voltage to another requires a change in the power transformer primary connections, the fuse, and the male line cord plug.

Fig. 2-1 indicates the transformer primary connections for 117-volt and 234-volt operation. A 2-amp slow-blowing type fuse is required for 117-volt operation, and a 1-amp slow-blowing type fuse is required for 234-volt operation.

Deflection Plate Voltages

The Type 561A may be operated with only one plug-in unit if desired. For example, moving film recording may be

used in place of a sweep plug-in unit. However, it will be necessary to elevate the unconnected crt deflection plates to about +180 to +210 volts dc, to obtain proper focus and astigmatism control.

Blank Chassis

Blank-chassis plug-in units are available from your local Tektronix Field Office as Modification Kit number 040-245. Blank chassis permit you to build your own plug-in circuitry for use in the Type 561A.

Heat Dissipation — Plug-in unit circuitry should not elevate the instrument temperature above the limits discussed previously under Cooling.

Operation

Operation of the Tektronix Type 561A Oscilloscope with two plug-in units in place is much the same as that of a conventional Tektronix oscilloscope with corresponding vertical and horizontal deflection systems. The plug-in units take the place of the vertical and horizontal deflection systems in a conventional oscilloscope; their outputs connect directly to the deflection plates of the cathode-ray tube. The plug-in units can be selected to give the Type 561A Oscilloscope the degree and type of performance demanded of it by a particular application.

The front and back panels of the Type 561A have controls or switches that affect the display; however, the plug-in units determine the major characteristics of the display.

Front Panel

The POWER ON switch permits turning the instrument on or off.

The SCALE ILLUM. control permits adjustment of the brightness of the graticule markings.

The FOCUS control permits proper trace or spot focus for most intensity values.

The ASTIGMATISM control works in conjunction with the FOCUS control, and improves the focus over the entire crt display.

The INTENSITY control permits changing the crt display brightness.

The ALIGNMENT control permits electronically tilting the level of the crt trace to agree with the horizontal graticule markings.

The 18-position CALIBRATOR switch determines the peak-to-peak amplitude of the signal at the CAL. OUT connector. It also permits turning the CALIBRATOR off. The calibrator output is used to set the gain of the amplifier plug-in units and to check the basic timing of the time-base units.

Rear Panel

The CRT. CATHODE SELECTOR switch permits the operator to select either (1) internal DUAL-TRACE CHOPPED BLANKING to eliminate from the crt display any dual-trace chopped mode switching transients, or (2) external signals to be used for crt Z-axis intensity modulation.

The two binding posts located right above the CRT. CATHODE SELECTOR switch labeled EXT. CRT. CATHODE and GND. are the binding posts to be used in (2) above. Normally a metal strap is placed between the two binding posts. The strap must be removed from the EXT. CRT. CATHODE binding post when external Z-axis intensifying signals are used.

If the vertical plug-in unit does not have a dual-trace chopped mode of operation, leave the CRT. CATHODE SELECTOR switch in its up position. This connects the crt cathode circuit to ground for normal operation.

Changing Plug-In Units

To insert a plug-in unit into the Type 561A Oscilloscope, push it all the way into the opening. Then turn the aluminum knob, at the bottom center of the unit, clockwise until it is tight. To remove the unit, turn the knob counterclockwise several turns and pull.

Different plug-in units supply slightly different dc voltages to the crt deflection plates. Also, the Type 561A crt has a slightly higher horizontal deflection sensitivity than the vertical deflection sensitivity. Because of these differences, the plug-in unit gain should be adjusted when it is first inserted into the indicator. This is done by adjusting the GAIN ADJ., CALIBRATION, or SWEEP CAL. controls on the plug-in unit according to the instructions found in the corresponding plug-in unit instruction manual.

When the plug-in units are changed, the FOCUS and ASTIGMATISM controls on the Type 561A may have to be readjusted.

It is possible that only one plug-in unit may be used. When this is done, one set of crt deflection plates will not be connected to a plug-in. The unconnected deflection

plates must have +180 to +210 volts connected to them to permit proper display focus and astigmatism control.

Display Combinations

The plug-in unit in the right-hand opening of the Type 561A controls the horizontal (X-axis) deflection of the crt beam. The unit in the left-hand opening controls the vertical (Y-axis) deflection.

To obtain the conventional display of a horizontal sweep with vertical deflection by the input signal, insert a time-base plug-in unit on the right and an amplifier unit on the left. If a vertical sweep is desired with the input signal displayed horizontally, insert the time-base unit on the left and the amplifier unit on the right. If an X-Y display is desired, insert amplifier type plug-in units in both plug-in openings.

Intensity Modulation

Intensity (Z-axis) modulation of the crt beam is possible through the EXT. CRT. CATHODE binding post on the rear of the instrument. Depending on the setting of the INTENSITY control, a negative pulse of 5 volts or more will turn on the crt beam.

To accomplish this, remove the ground strap from the EXT. CRT. CATHODE binding post, apply the Z-axis signal to the binding post, and set the CRT. CATHODE SELECTOR switch to the EXT. CRT. CATHODE position.

Display Photography

The numbered setting of the SCALE ILLUM. control may be used as an approximate exposure guide for photographing waveforms. The numbers indicate the approximate diaphragm opening for the camera when using the type of film and exposure time indicated on the panel beside the control.

After setting the SCALE ILLUM. control to the desired point, adjust the trace intensity so that it is about the same intensity as the graticule lines. The intensity should be checked after each significant change in sweep rate.

Section 3

Circuit Description

Introduction

The Tektronix Type 561A Oscilloscope contains a low-voltage power supply circuit, a cathode-ray-tube circuit, and a calibrator.

The low-voltage power supply circuit provides the regulated and unregulated power used by the instrument and the plug-in units.

The crt circuit contains the necessary controls and input facilities to present a sharp trace of desired intensity for displaying a signal. Two negative high-voltage power supplies provide the voltages for the crt cathode, focus element, and control grid.

Amplitude-calibrated square waves are produced by the calibrator.

LOW-VOLTAGE POWER SUPPLY

Power for the Type 561A Oscilloscope and its plug in units is supplied through the power transformer T601. The two primary windings of T601 are connected in parallel for 117-volt operation, or in series for 234-volt operation, as shown on the schematic diagram.

The low-voltage power supply provides regulated outputs of -100 , -12.2 , $+125$, and $+300$ volts, and an unregulated output of $+420$ volts. Each circuit is a series-regulator type, employing silicon diodes for rectifiers. A series regulator circuit uses a vacuum tube (or transistor, in the case of the -12.2 -volt supply) in series with the load. This tube controls the current through the load to maintain a constant voltage drop across the load. For example, if the load increases (resistance of load decreases) the series tube allows more current to flow; if the load decreases it allows less current to flow.

-100 -Volt Supply

Reference voltage for the -100 -volt supply is established by the gas diode, V609. The constant voltage drop across V609 establishes a fixed potential of about -85 volts at the grid of V634B. Voltage at the grid of V634A is established by the divider R616, R617, and R618. The difference in voltage between the two grids of V634 determines the plate current of V634A. Plate current of V634A determines the base voltage of transistor Q624 which in turn determines the grid voltage of the series tube, V627. The series tube controls the current through the load to hold the load voltage constant. R616, -100 V adjustment, determines the percentage of the total divider voltage applied to the grid of V634A and thus controls the output voltage. When this control is properly adjusted, the output is exactly -100 volts.

Should the output voltage tend to change because of a change in input voltage or a change in load current, the potential at the grid of V634A will change a proportional amount. Any change at the grid of V634A is amplified by

V634A and Q624 and applied to the grid of V627. The resulting grid change at V627 will cause the load current to change in the direction needed to bring the output back to -100 volts. C616 improves the response of the regulator to sudden changes in output voltage.

$+125$ -Volt Supply

The -100 -volt supply serves as a reference for the $+125$ -volt supply. With the lower end of R651 fixed at -100 volts, any change in the $+125$ -volt output produces a proportional change at the grid of V654. This change is amplified and supplied to the grid of the series regulator tube, V667A. The change at the grid of V667A changes the load current in the manner needed to bring the output voltage back to a nominal $+125$ volts. C650 improves the response of the regulator to sudden changes in output voltage.

A small sample of the unregulated-bus ripple appears at the screen of V654 through R657. The ripple at the screen (which acts as an injector grid) produces a ripple at the grid of V667A which is opposite in polarity to the ripple at the plate of V667A. This tends to cancel ripple at the output. This same circuit also improves the regulation of the circuit in the presence of line voltage variation.

$+300$ -Volt Supply

The $+300$ -volt supply functions in the same manner as the $+125$ -volt supply. To supply the voltage for the $+300$ -volt regulator, rectified voltage from transformer terminals 21 and 22 is added to the voltage supplying the $+125$ -volt regulator.

The $+300$ -volt supply provides an unregulated output of $+420$ volts for the crt circuit.

-12.2 -Volt Supply

Operation of the -12.2 -volt regulating circuit is essentially the same as that of the other regulating circuits, except that transistors are used instead of vacuum tubes. The base of Q734 is fixed near -12 volts by the voltage divider R731-R732 between -100 volts and ground. Any variation of the -12.2 -volt output at the emitter of Q734 is amplified by Q734 and Q744 to change the emitter-collector current of Q757 which is in series with the supply load. F720 protects the transistors in case of an overload on the -12.2 -volt supply.

The collector of Q757 is connected to pin 5 of the Interconnecting Socket. This provides a return for this supply separate from the chassis and prevents large chassis currents.

CRT CIRCUIT

The crt circuit contains the cathode-ray tube and two high-voltage supplies (one for the crt cathode and focus element, the other for the control grid). The circuit also contains the necessary controls and signal input facilities.

Circuit Description — Type 561A

Cathode-Ray Tube

A Tektronix T561 ceramic-envelope cathode-ray tube is used in the Type 561A. The accelerating potential is approximately 3500 volts, developed by about -3300 volts at the cathode and an average deflection plate voltage of about $+200$ volts. With this accelerating potential, the nominal vertical and horizontal deflection factors are 19.5 and 18.4 volts per centimeter respectively.

Deflection blanking of the crt beam is employed in the Type 561A. The crt contains a special set of deflection plates, pins 6 and 7, for this purpose. Both plates are connected to $+125$ volts; however pin 6 is also driven by the right-hand plug-in unit.

During sweep time, or if no plug-in unit is installed, both plates rest at $+125$ volts and permit the beam to pass on to the screen. During sweep retrace, however, pin 6 is driven considerably away from $+125$ volts. This scatters the beam and prevents it from reaching the screen.

High-Voltage Supplies

Energy for both high-voltage supplies is furnished by T801. V800, the primary of T801, and the circuit capacitance (shown by the dotted capacitor symbol on the schematic) form a Hartley oscillator which operates at about 45 kc.

One secondary winding of T801 provides voltage for the crt cathode and focus element. This voltage, rectified by V822, is about -3300 volts at the cathode, and between about -2000 and -3000 volts at the focusing element, depending on the setting of the FOCUS control. (The 6.3-volt crt heater is also elevated to the cathode potential.)

The output of the other secondary winding of T801 is rectified by V832 for the control grid. The grid voltage ranges from -3100 to -3400 volts, depending on the setting of the INTENSITY control. The reference to ground for this supply is determined by the voltage at the junction of diodes D838 and D839. The voltage at this junction, plus the setting of the INTENSITY control, determines the crt bias and therefore the intensity of the display.

Regulation of the high-voltage supplies is accomplished through feedback from the arm of R841. If, due to loading or a change in input voltage, the output of the high-voltage supply changes, a proportionate change occurs at the arm of R841. This change is amplified by V814 and is coupled to the screen grid of V800. A change at the screen of V800 will increase or decrease the amplitude of oscillations in V800. Thus the output voltage of T801 changes in the direction needed to return it to the desired level. The HIGH VOLTAGE control, R841, controls the output voltage by setting the bias on V814B.

Deflection Signals

Signals for the deflection plates are equal in amplitude but opposite in polarity (push-pull) and appear at pins 17 and 21 of the plug-in connector. The effective capacity these signals see at the connector affects the bandpass and phase shift through the plug-in. C760 and C761 (Plug-In

Connectors diagram) are set at the factory for an effective deflection-plate capacity of 16 picofarads for each plug-in.

Intensifying Signals

Two signals may be used to modulate the intensity of the crt display. First, intensifying signals from a two-sweep (delaying-sweep) time-base plug-in unit are applied to the grid supply through terminal 14 of the right-hand Interconnecting Socket. When the overall display intensity is reduced with the INTENSITY control, positive intensifying pulses from a two-sweep time-base unit will brighten any desired portion of the display. Diodes D838 and D839 provide a low-impedance return for the grid supply which reduces intensity modulation caused by normal supply ripple.

Other external intensifying signals can be fed to the crt cathode from the EXT. CRT. CATHODE binding post. Depending on the setting of the INTENSITY control, a negative pulse of 5 volts or more will turn the crt beam on.

Crt Controls

The INTENSITY control, R835, has a range of about 300 volts to control the crt bias and permit changing the intensity of the display.

The FOCUS control, R844, adjusts the focus of the crt by varying the voltage at the focusing anode through a range from about -2000 to -3000 volts.

The ASTIGMATISM control, R864, has a 300-volt adjustment range.

The GEOMETRY control, R865, adjusts the geometry by varying the voltage of the crt isolation shield through a range from $+180$ to $+246$ volts.

CALIBRATOR

The calibrator for the Type 561A Oscilloscope produces a line-frequency amplitude-calibrated square wave.

The 6.3-volt (approximately 18 volts peak-to-peak) ac heater voltage for V884 is applied through C876 to the cathode of V884A, driving that tube into and out of cutoff at the line-frequency rate. The signal at the plate of V884A is then coupled to the grid of V884B to turn that tube on and off. Regenerative feedback from the plate of V884B to the grid of V884A speeds up the switching action of V884A.

The voltage present at the cathode of V884B during the time that V884B is conducting can be set to exactly 100 volts with the CAL. AMPL. adjustment, R871. The voltage divider in the cathode circuit of V884B contains precision resistors to provide an output accuracy of 3% or better at the various settings of the CALIBRATOR control.

Section 4

Maintenance

Introduction

If trouble occurs in the Type 561A Oscilloscope, a fire-step procedure may be employed for repair. First the trouble must be confirmed. Next, the trouble is isolated to a plug-in unit or to the Type 561A. Trouble in the Type 561A is then localized to the Power Supply, Crt Circuit, or Calibrator. Troubleshooting the correct circuit will then determine which components are defective. The defective parts can then be replaced.

Confirmation of Trouble

Improper control settings may, at times, give indications of trouble. Therefore, if trouble is encountered in the instrument, you should be sure that it is not caused by improper front-panel control settings. For example, an improper setting of the SOURCE or COUPLING switch on a time-base unit can produce apparent triggering troubles; an improper setting of the VARIABLE control on an amplifier unit can produce an apparent decrease in sensitivity.

When it has been determined that trouble exists, it must be determined whether it is in one of the plug-in units or in the Type 561A indicator.

Isolating Trouble to Plug-In or Indicator

Isolating trouble to a plug-in unit or to the indicator can be done in one of two ways, depending on whether or not there are spare plug-in units available.

If trouble is found to be in the plug-in unit, refer to the instruction manual for that unit. A plug-in extension (part number 013-034, available from your local Tektronix Field Office) allows the units to be operated while extended out through the front of the oscilloscope opening.

Spare Plug-In Units Available

If more than two plug-in units are available, the easiest way to isolate trouble is to replace the plug-in units one at a time. The faulty unit can then be isolated by noting when proper operation is restored. If plug-in replacement does not correct the trouble, the Type 561A is probably faulty. NOTE: A non-sampling plug-in unit cannot be operated with a sampling plug-in unit.

Spare Plug-In Units Not Available

When spare plug-in units are not available, the crt display will be of great help. Trouble will normally show up as an erroneous display, or as no display at all. Since the crt display will help isolate the trouble, the following procedure is divided according to the type of display.

No Trace Or Spot. If no trace can be obtained on the crt, remove both plug-in units and vary the INTENSITY control. A spot should appear. If no spot appears, the trouble

is in the Type 561A. If a spot does appear when both plug-in units are removed, reinsert each unit separately. After warmup, vary its POSITION control. If the spot or trace cannot be returned to the approximate center of the crt when a single plug-in unit is in the indicator, the trouble is probably in that unit.

Insufficient Vertical Deflection Or Improper Sweep Timing. If the plug-in unit front-panel gain controls do not permit adequate vertical deflection or proper sweep timing, check the low-voltage power supply and voltages at the cathode and grids of the crt (see schematics and Figs. 4-1 and 4-2).

If the power-supply voltages are not correct, remove both plug-in units and check the voltages again. If they still are not correct, the trouble is in the Type 561A indicator. If the power-supply voltages are correct with both plug-in units removed, but incorrect with only one of the two inserted, the trouble is in that unit. If the power supply voltages are correct with both plug-in units removed, but incorrect when either is inserted, the trouble is probably in the power supply of the Type 561A instrument.

Improper Triggering. If external triggering and line triggering are satisfactory, but internal triggering is not, the trouble is probably in the Trigger Pickoff Circuit of the amplifier plug-in unit. If satisfactory triggering cannot be obtained from any of the three sources (external, internal, or line) the trouble is probably in the time-base plug-in unit.

Waveform Distortion. If there is any waveform distortion, but no other indications of malfunction (such as improper sweep timing) the trouble is probably in the vertical plug-in unit.

Localizing Trouble In Type 561A Indicator

If it has been determined that trouble exists in the Type 561A, the location of the trouble can be further localized to the Power Supply, the Crt Circuit, or the Calibrator.

To localize the trouble to either the Power Supply or the Crt Circuit, measure the power-supply voltage at test points [1] through [4], indicated in Fig. 4-1. If incorrect voltages are measured, the trouble is in the Power Supply or the power source. If all of the measured voltages are proper, the trouble is in the Crt Circuit.

Trouble in the Calibrator is indicated by an erroneous output at the CAL. OUT connector.

When it is known which circuit contains the trouble, that circuit can be checked to locate the defective component.

Circuit Troubleshooting

In troubleshooting a circuit, troubles such as broken wires, worn switches, scorched parts, and improperly seated tubes can be found by visual inspection. (Before a scorched part is replaced, the cause of the scorching should be eliminated.)

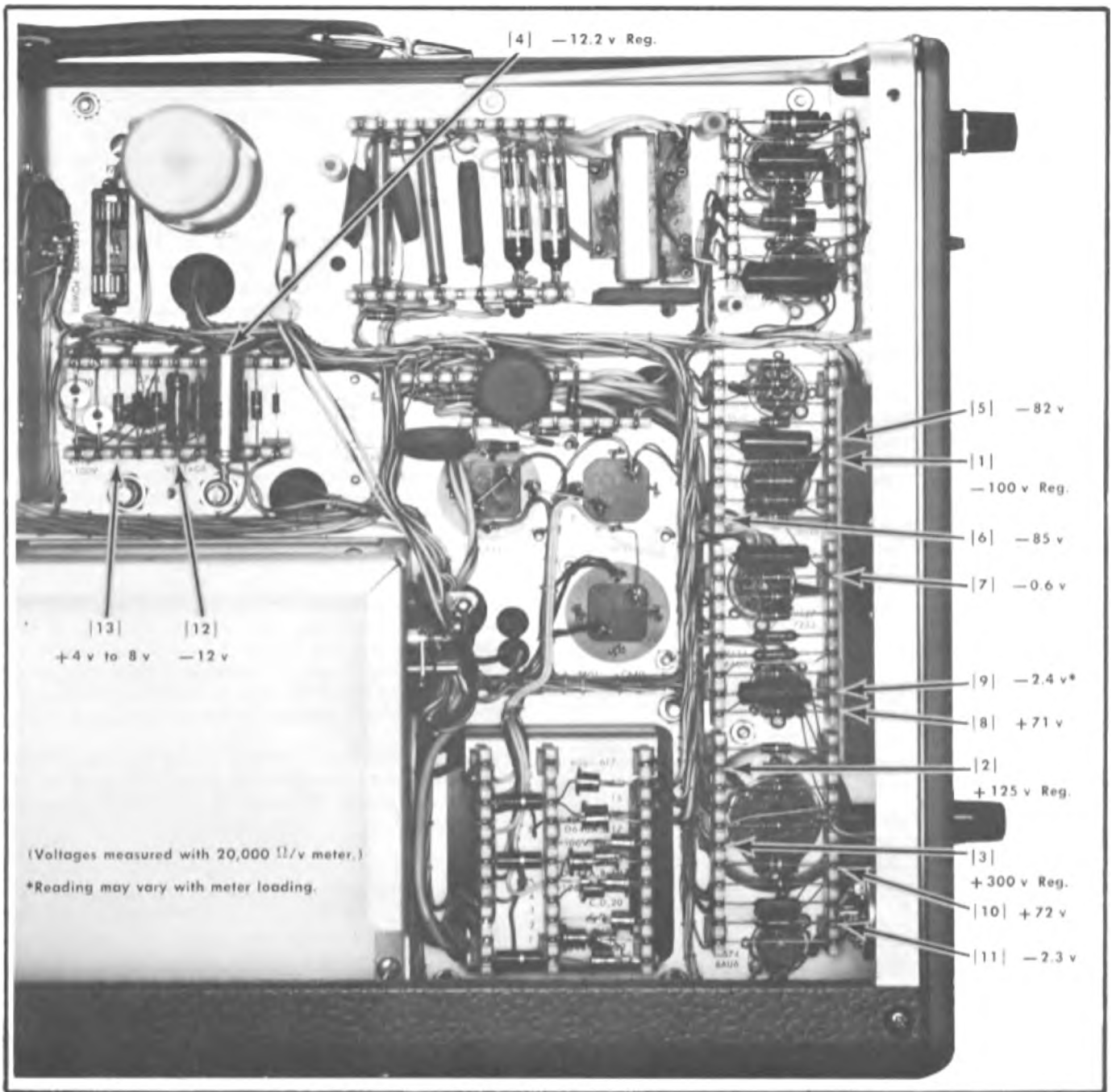


Fig. 4-1. Power-supply test points; [1] through [13]

Tube failure is the most prevalent cause of trouble in Tektronix instruments. Therefore, if a visual check fails to reveal the cause of trouble, all tubes should be checked as the next step. Tubes should be checked by substitution, one at a time. (Tube testers cannot adequately check all parameters.) Be sure to return all good tubes to their original sockets; otherwise the instrument may have to be recalibrated unnecessarily because of different characteristics of the same tube type.

If tube substitution does not correct the trouble, then check the rest of the circuit by voltage and resistance

measurements. Voltages at various points throughout the instrument are indicated on the circuit diagrams and in Figs. 4-1, 4-2 and 4-3. These voltages are typical nominals only and, with the exception of power-supply voltages, may vary considerably from instrument to instrument. Resistance measurements in a circuit will usually be point-to-point checks for which the proper values can be approximated from the schematic diagrams. Table 4-1 may be used as an aid in relating trouble symptoms to their probable cause and the procedure to use to locate the defective component. Voltages listed in the table were obtained with the Type 561A operated with Types 3A1 and 3B1 plug-in units.

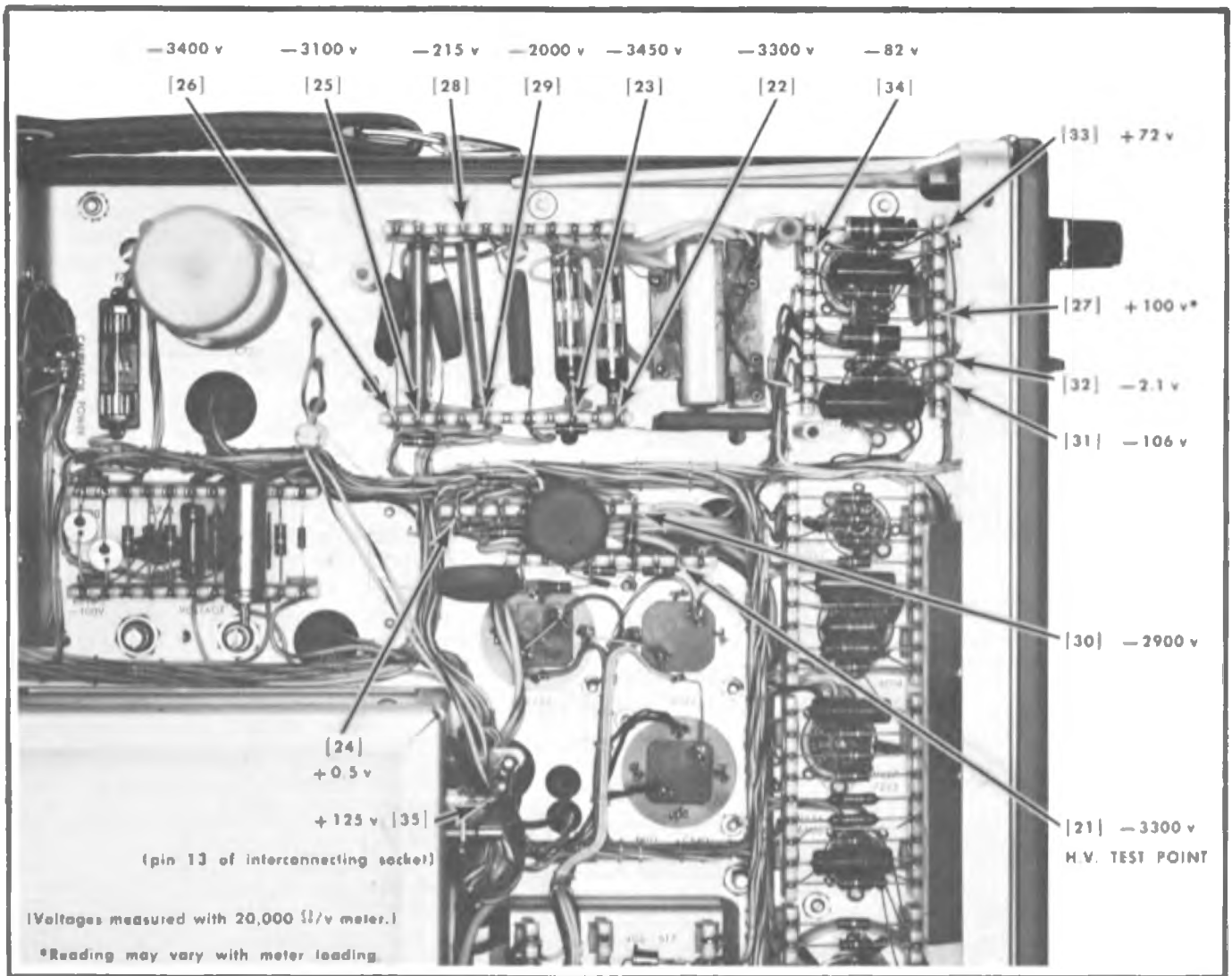


Fig. 4-2. Crt Circuit test points; [21] through [35].

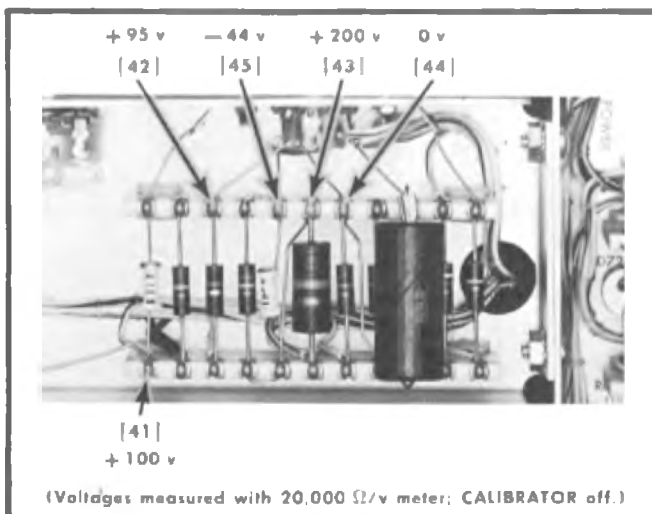


Fig. 4-3. Calibrator test points; [41] through [45].

All signal wiring in the Type 561A is color coded to make circuit tracing easier. In addition, all regulated power supply leads are color coded to follow the standard EIA code. The first color (widest stripe) indicates the first number of the voltage. The second color indicates the second number and the third color (smallest stripe) indicates the multiplier. The voltage is positive if the main color of the wire is white and negative if the main color of the wire is dark. Four colors would be required to indicate all the digits plus a multiplier for the +125-volt leads. To avoid this, the +125-volt leads are coded as +120; that is, brown, red, brown on a white base. A -100-volt lead is coded brown, black, brown on a gray base while +300-volt leads are coded orange, black, brown on white.

The switch wafers shown on the Calibrator diagram are coded to indicate the position of the wafer on the switch. Wafers are numbered from the front of the switch to the rear. The letters F and R indicate whether the front or rear of the wafer is used to perform the particular switching function.

TABLE 4-1

SYMPTOMS	PROBABLE CAUSES	CHECKS TO MAKE
—100-Volt Power Supply		
1. Output voltage slightly higher or lower than normal but regulates with changes in line voltage. (May not regulate over full range of 105 to 125 volts.)	Improper setting of R616. Abnormal voltage across V609. R617 or R618 changed value.	1. Use the —100 V adjustment to try to set the output voltage to normal. 2. Check for regulation with line voltage varied from 105 to 125 volts. Check output ripple voltage. If normal, trouble is corrected. 3. Check for approximately 85 volts across V609 (pin 5 to 7).
2. Output voltage appreciably higher (more negative) than normal. Output voltage does not regulate with changes in line voltage.	Q624 shorted. V609 open. V634B not conducting. V627 shorted. R618, R624 open.	1. Check that V609 is glowing. 2. Check for approximately 85 volts across V609 (pin 5 to 7); if not present, check R612. 3. Check that the heater of V634 is glowing. 4. Check voltage at plate (pin 1) of V634; should be approximately —0.6 volt. Test point [7].
3. Output voltage appreciably lower (less negative) than normal. Output voltage does not regulate with changes in line voltage.	V627 open. V634A not conducting. Low output from rectifier. R619, R617, or R632 open. C616 or C640 shorted.	1. Measure dc voltage across C640A; should be approximately 175 volts. 2. Replace V627 and V634. Output voltage should return to normal. 3. Collector of Q624 should be at about —12 volts.
4. Excessive ripple on output.	C640A, C616, or C640B open.	Check capacitors. Ripple should be 5 mv, peak-to-peak, nominal.
—12.2-Volt Power Supply		
1. Output voltage slightly higher or lower than normal but regulates with changes in line voltage. (May not regulate over full range of 105 to 125 volts.)	—100 V adjustment improperly set. R731 or R732 changed in value.	1. Check output of —100-volt supply. Test point [1]. 2. Check R731 or R732. Use an accurate resistance measuring bridge. 3. Set the output of the —100-volt supply and recheck the output of the —12.2-volt supply. Test point [4].
2. Output voltage appreciably higher (more negative) than normal. Output voltage does not regulate with changes in line voltage.	Q734 or Q744 open. Q757 shorted. R731 open	1. Check base voltage of Q744; should be +4 to +8 volts. Test point [13]. 2. Check Q734 and R731. If R731 is open, Q734 may be shorted. 3. Short between collector and emitter of Q744. The power supply output voltage should drop.
3. Output voltage appreciably lower (less negative) than normal. Output voltage does not regulate with changes in line voltage.	F720 open. Q757 open. Q734 or Q744 shorted. R732 open. C737 shorted. Low output from rectifiers.	1. Check fuse F720. If open, replace. If fuse blows again, proceed to check 2. 2. Check Q744 for short. If shorted, replace. Replace F720. The fuse should not blow. 3. Check for shorts in power supply output. 4. Check Q757 for short. If shorted, this is cause of F720 blowing. 5. Check voltage across C720A; should be approximately 18 volts.

(TABLE 4-1 cont'd)

SYMPTOMS	PROBABLE CAUSES	CHECKS TO MAKE
—12.2-Volt Power Supply (continued)		
4. Excessive ripple on output.	C720A, C720B, or C757.	6. Check D720 and D721, and C720A and C720B. 7. Check voltage across Q734; should be near 13.5 volts. 8. Check voltage across Q744; should be 0.8 volt or less. Check capacitors.
Other Power Supplies		
Symptoms and troubleshooting techniques for the —125- and +300-Volt Power Supplies are similar to those described for the —100- and —12.2-Volt Power Supplies.		
CRT Circuit		
1. No high voltage at crt cathode.	Oscillator not operating. V800 defective. T801 defective. V822 defective. C822 shorted. R849 or R852 open.	1. Check heaters of V822 and V832. If heaters are glowing, the oscillator is operating. 2. Check voltage at plate of V822, test point [22]; should be approximately —3.3 kv. 3. Check R849 and R852. 4. Check V822 and C822. If necessary, check secondary winding of T801. 5. Check plate voltage of V800 (pin 9); should be approximately +400 volts. 6. Check C807, R806, R807, and R804. Also check primary winding of T801.
2. No high voltage at crt control grid.	T801 defective. V832 defective. C830, C832, or C836 shorted. R832, R835, R837, or R834 open.	Check voltage at plate of V832, test point [23]; should be approximately —3.4 kv.
3. High voltage outputs do not regulate with change in line voltage, or cannot be set to proper level.	V814 inoperative. R816, R840, R841, R842, R844, R846, R815, or R803 open. C841, C842, or C803 shorted.	1. Check to see if trace or spot on crt can be focused. 2. Check V814, R815, R803 and C841. 3. Check R816, R840, R841, R842, R844, R846 (test points [27], [28], [29], [30], [31]). 4. Check C803 and C842.
4. Spot or trace does not focus properly.	Incorrect outputs from High Voltage Supplies. R844 defective. R864 defective.	1. Check outputs of both High Voltage Supplies. Test points [22] and [23]. 2. Check R844 and R864.
5. Insufficient display brightness.	Defective crt. Low outputs from High Voltage Supplies. R834 or R835 changed value. Crt blanked.	1. Check outputs from High Voltage Supplies. Test points [22] and [23]. 2. Check R834 and R835. 3. Check crt pins 6 and 7 for approximately +125 v.
6. Trace will not align with horizontal graticule markings.	Defective Beam Rotator Coil L860. R860 or R861 defective.	1. Check R860 and R861. Check physical location of Beam Rotator Coil. Change any defective components. It should be possible to align the trace with the graticule markings. 2. Check L860.

(TABLE 4-1 cont'd)

SYMPTOMS	PROBABLE CAUSES	CHECKS TO MAKE
Calibrator		
1. No output from Calibrator.	V884 defective. Open resistor.	1. Check dc voltage at test point [41]. Voltage will probably be either 0 or +100 volts. If +100 volts, proceed to check 3. If 0 volts, replace V884 and if necessary proceed to check 2. 2. Check plate voltage of V884B, test point [43]; should be approximately +200 volts. 3. Check cathode resistors of V884B. Check for 6.3 vac at the cathode of V884A, test point [44]. 4. Check R883. 5. Check R878 and R879. 6. Check R877 and R876.
2. Incorrect pulse amplitude for all CALIBRATOR switch positions.	Improper setting of R871. Divider resistor in cathode of V884B changed in value.	1. Check setting of CAL. AMPL. control, R871. It should be possible to adjust for correct output. 2. Check resistors in cathode of V884B.

REMOVAL AND REPLACEMENT OF PARTS

Replacement procedures for most parts in the Type 561A are obvious; detailed instructions for their removal are therefore not required. Other parts, however, can best be removed if a definite procedure is followed. Instructions for removing some of these parts are contained in the following paragraphs. Parts-ordering information is included in the Parts List section of this manual.

Whenever a part has been replaced, the calibration of the instrument should be checked and adjusted as necessary.

Cathode-Ray Tube Replacement

To remove the cathode-ray tube, disconnect the four leads connected to the neck of the tube, the tube socket, and loosen the tube clamp. Remove the graticule cover, light reflector, and light shield. Pull the crt straight out through the front panel, being careful not to bend or break the crt neck pins. The rubber gasket and implosion shield can be removed from the crt face after it is out of the instrument.

Install the new crt by the reverse of the preceding procedure. When replacing the implosion shield be sure that the notched side is down. Follow the color-code information on the tube shield when the crt neck pin leads are replaced. When the crt is properly installed, the back of the faceplate is flush with the instrument front panel.

After the crt is replaced, it may be necessary to adjust the ALIGNMENT and HIGH VOLTAGE controls and the deflection plate capacity (C760 and C761). Also give special attention to the calibration of time-base and amplifier plug-in units.

Replacement of Ceramic Terminal Strips

To remove a ceramic terminal strip, unsolder all connections and pry the strip, with yokes attached, out of the chassis (see Fig. 4-4). An alternative method is to use diagonal cutters and cut off one side of each yoke to free the strip, using care not to damage the spacer. After removing the strips, the remainder of each yoke can be easily removed from the chassis with a pair of pliers. The yokes need not be salvaged since new ones are furnished with each strip. However, the spacers may be reused if desired. If new spacers are required, specify the mounting height of the sleeve desired: $\frac{3}{32}$ " , $\frac{3}{16}$ " , or $\frac{3}{8}$ ". When ordering the ceramic strips specify the number of notches and the correct height.

When the old strip and yokes have been removed, insert the replacement parts into the spacer sleeves that are located in the holes of the chassis. If necessary, use a plastic or hard-rubber mallet to seat the yokes firmly into the spacers.

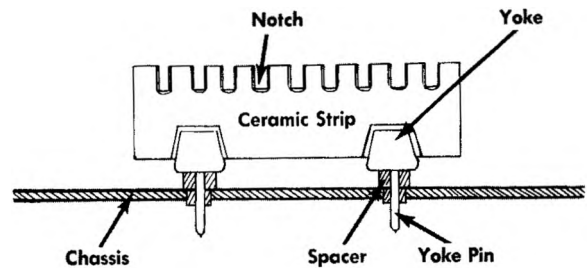


Fig. 4-4. Ceramic terminal strip installation.

Be sure to observe the soldering precautions described in the following paragraph when soldering connections to the new strip.

Soldering Precautions

In the production of Tektronix instruments a special silver-bearing solder is used to establish a bond to the ceramic terminal strips. This bond can be broken by re-

peated use of ordinary tin-lead solder or by applying too much heat. For this reason, we recommend the use of solder containing about 3% silver and a wedge-shaped soldering-iron tip for installing or removing connections from the strips. The silver-bearing solder is locally available in most areas, or it may be purchased directly from Tektronix in one-pound rolls (order by part number 251-514). Occasional use of ordinary solder will not break the bond unless too much heat is applied.

Section 5

Calibration

Introduction

The Type 561A Oscilloscope should be calibrated after each 500 hours of operation, or every six months, whichever occurs first. In addition, the calibration should be checked and adjusted as necessary after replacement of any part.

Normally, the instrument will be calibrated with both plug-in units inserted. When performing a complete calibration, you should calibrate the indicator unit first, then the amplifier unit or units, and then the time-base unit, if one is used. Either or both of the plug-in units can be calibrated separately although the power-supply voltages in the indicator unit should always be checked before calibrating any part of the instrument.

The following equipment is required for a complete calibration of the Type 561A Oscilloscope:

1. Dc voltmeter (sensitivity of at least 5000 ohms per volt), calibrated for an accuracy of $\pm 1\%$ from 0 to 300 volts, and for an accuracy of $\pm 3\%$ at 4000 volts.
2. Variable autotransformer with a rating of at least 250 watts.
3. Accurate rms-reading ac voltmeter with a range of at least 0 to 125 volts (0 to 250 volts for 234-volt instruments).
4. Test oscilloscope with calibrated vertical sensitivity of 50 millivolts per division or better.
5. Capacitance meter capable of a measurement accuracy of 0.1 picofarad or better at 16 picofarads; meter must have guard voltage available. Tektronix Type 130 L-C Meter recommended.

To set up the Type 561A for calibration, insert two plug-in units known to be in proper operating condition. If one is a time-base plug-in unit, adjust its controls so no sweep is produced. Connect the autotransformer to a suitable power source and connect the Type 561A Oscilloscope to the output of the autotransformer. Turn on the equipment and set the output of the autotransformer for the nominal operating voltage of the oscilloscope (117 volts or 234 volts). Allow the equipment to warm up for about 10 minutes.

Power Supply

With the dc voltmeter, measure the output of the -12.2-, -100-, +125-, and +300-volt supplies at pins 16, 23, 15, and 10, respectively, of the plug-in connectors. Set the -100 V adjustment to exactly -100 volts. All other supplies should then be within 3% of their rated values.

Measure the voltage at the HV TEST POINT (Fig. 4-2) on the ceramic terminal strip below the high-voltage shield. Adjust the HIGH VOLTAGE adjustment for a reading of -3300 volts.

Using the test oscilloscope, measure the amount of ripple at the output of each supply. The ripple will be twice the line frequency. With plug-in units inserted, the nominal ripple is 5 millivolts on the -100-volt supply, 10

millivolts on the +125-volt supply, 80 millivolts on the +300-volt supply, and 3 millivolts on the -12.2-volt supply. *Do not attempt to measure ripple on the -3300-volt supply.*

Vary the autotransformer output voltage between 105 and 125 volts (or 210 and 250 volts if the power transformer is wired for 234-volt operation) and check to see that all voltages stay within tolerance over this range.

Calibrator

Set the CALIBRATOR switch to OFF and set the CAL. AMPL. adjustment so the voltage at the cathode of V884B (pin 7) is exactly +100 volts. Calibration of the various settings of the CALIBRATOR switch is not necessary.

Crt Circuit

Check to see that only the face plate of the crt extends beyond the front panel of the instrument. If it does not, loosen the crt clamp screw and move the tube forward by pushing on the tube socket. Then retighten the crt clamp screw.

If you are using a time-base unit, set it for a free-running sweep. If you are not using a time-base unit, apply a signal to the right-hand unit to produce a horizontal trace at least 10 centimeters long. Set the FOCUS and ASTIGMATISM controls for the narrowest trace width and position the trace directly behind one of the graticule lines. Adjust the crt ALIGNMENT control as necessary to align the trace with the graticule line.

Crt Geometry

The GEOMETRY adjustment is set to achieve minimum curvature of vertical lines displayed at the edge of the graticule.

Insert a time-base unit into the right-hand opening and a vertical amplifier unit into the left-hand opening of the Type 561A. Connect the output of the Calibrator to the vertical amplifier and adjust the time-base unit to display two to five cycles of the Calibrator signal. Adjust the amplitude and position of the display so the tops and bottoms of the pulses are just visible at the top and bottom of the crt. Then set the GEOMETRY adjustment to eliminate any curvature of the vertical lines located near the edge of the graticule.

Effective Deflection-Plate Capacitance

The effective deflection-plate capacitance of the crt as seen by the plug-in units can be adjusted by means of C760 and C761. This capacitance has been set at the factory to provide a standard effective deflection-plate capacitance of 16 pf. If C760 or C761 has been inadvertently misadjusted, or if the crt has been changed, the effective capacity between one or both pairs of plates may be altered slightly.

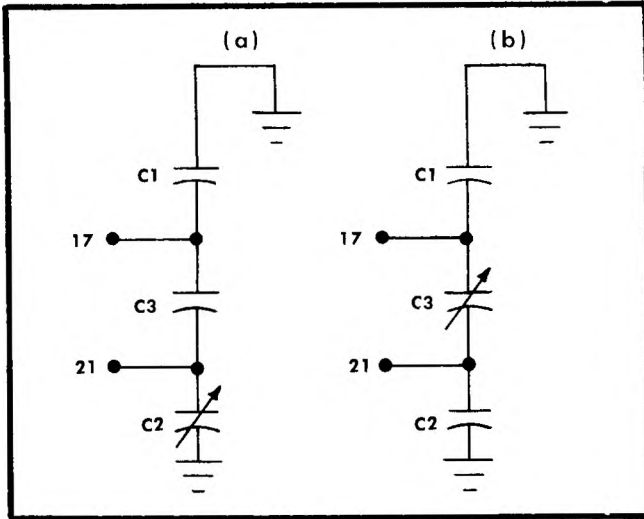


Fig. 5-1. Schematic representation of effective deflection-plate capacity: (a) vertical system; (b) horizontal system.

This has an adverse affect primarily when using a wide bandpass plug-in unit near the upper limit of its bandpass.

Since the effective deflection-plate capacitance of the crt is that capacitance seen by the plug-in unit when the deflection plates are driven push-pull, it cannot be measured directly with a capacitance meter. However, the circuit capacitances which make up the effective deflection plate capacitance of each set of plates can be measured with a capacitance meter. The capacitances may be represented schematically as shown in Fig. 5-1. C1 and C2 in the figure represent the capacitance between each plate and ground. C3 represents the total capacitance between the plates. Since the deflection plates are driven push-pull, the effective deflection-plate capacitance, C_{eff} may be expressed in terms of C1, C2 and C3 as follows:

$$C_{\text{eff}} = \frac{C1 + C2}{2} + 2C3.$$

C1 and C3 are fixed for the vertical system. C2 is adjustable by means of C760. Setting C_{eff} equal to 16 picofarads and solving for C2:

$$C2 = 32 \text{ pf} - (C1 + 4C3).$$

Thus, by measuring C1 and C3, you can determine the desired value of C2 for the vertical system. You can obtain this value by adjusting C760. Proceed as follows:

1. Disconnect the power cord and isolate the oscilloscope from ground.
2. Either plug a spare 24-pin connector into the vertical plug-in connector or insert any spare plug-in unit into the vertical opening and unsolder the leads from terminals 17 and 21 in the unit.
3. Connect the capacitance meter guard voltage to pin 21 of the plug-in connector and measure the capacity between pin 17 and the oscilloscope chassis. This is C1.
4. Connect the guard voltage to the oscilloscope chassis and measure the capacity between pins 17 and 21 of the plug-in connector. This is C3.
5. Substitute the measured values of C1 and C3 into the equation and solve for C2.
6. Connect the guard voltage to pin 17 and measure the capacity between pin 21 and the oscilloscope chassis. This is C2.
7. Adjust C760 until the measured capacity in step 6 equals the value for C2 obtained in step 5.
8. Disconnect the capacitance meter and resolder any unsoldered leads.

C1 and C2 are fixed for the horizontal system, but vary slightly among instruments and between openings of the same instrument. C3 is adjustable by means of C761. Setting C_{eff} equal to 16 picofarads (the factory standard) and rearranging terms:

$$C3 = 8 \text{ pf} - \frac{C1 + C2}{4}.$$

Thus, by measuring C1 and C2, you can determine the desired value of C3. You can obtain this value of C3 by adjusting C761.

Section 6 Accessories

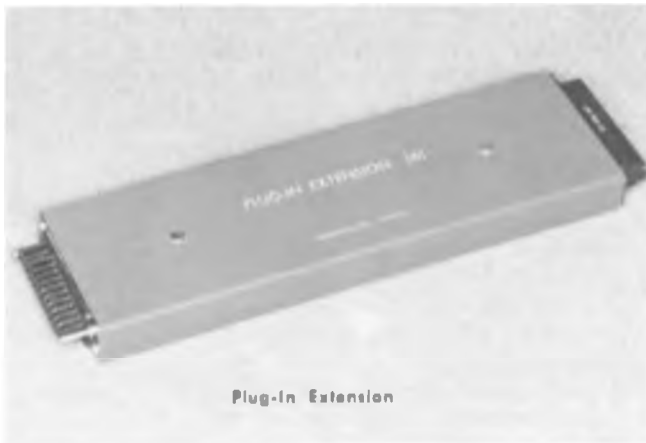
The Type 561A Oscilloscope will fit many measurement applications and systems through use of standard and special accessories listed in this section. Accessories should be ordered by type or part number through your local Tektronix Field Office.

Additional plug-in units and other accessories will be made available as new applications develop. If you are faced with a measurement problem which is not solved adequately by existing Tektronix plug-in units or combinations of plug-in units and amplifiers, consult your local Tektronix Field Engineer.

PLUG-IN EXTENSION

Maintenance of 560-series plug-in units can be made easier by using the Plug-In Extension pictured here. Fits all 560-series indicators and plug-in units except Types 3S76, 3T77, and 6R1.

Order part number 013-034



COAXIAL CONNECTOR ADAPTERS

Some electronic equipment is designed with coaxial connectors different from those provided on Tektronix oscilloscopes. Tables 6-1 and 6-2 list adapters that permit joining many of the modern connector styles to your Tektronix signal amplifier. Also, the adapters may be used to mate other systems using dissimilar coaxial connectors.

**TABLE 6-1
COAXIAL CONNECTOR ADAPTERS**

Description	Part Number
Component test fixture. Intended for use with Type 130 L-C Meter. Fitted with UHF Plug.	013-001
Clip leads fitted with UHF Jack.	013-003
Single Binding Post fitted with UHF Plug.	013-004
Dual Binding Post fitted with UHF Plug.	013-009
P6000 Probe Adapter. Fitting, BNC Plug.*	013-020
BNC Jack to UHF Plug. Fits BNC Plug and UHF Jack.	103-015
UHF Coupling. Jack on each end. Fits UHF Plug on each end.	103-025
UHF T Connector. Fits one UHF Jack to two UHF Plugs.	103-026
UHF Elbow. Fits UHF Jack to UHF Plug. (Not shown)	103-027
BNC Coupling. Jack on each end. Fits BNC Plug on each end.	103-028
BNC Coupling. Plug on each end. Fits BNC Jack on each end.	103-029
BNC T Connector. Fits one BNC Jack to two BNC Plugs.	103-030
BNC Elbow. Fits BNC Jack to BNC Plug.	103-031
BNC Plug to UHF Jack. Fits BNC Jack and UHF Plug.	103-032
Single Binding Post fitted with BNC Plug	103-033

* The BNC Probe Adapter permits connecting a BNC coaxial system to any P6000 or P6017 series probe. If cable requires termination, see Table 6-6 for proper BNC termination unit. Items of Tables 6-1 and 6-2 permit a probe to be fitted to almost any coaxial system.

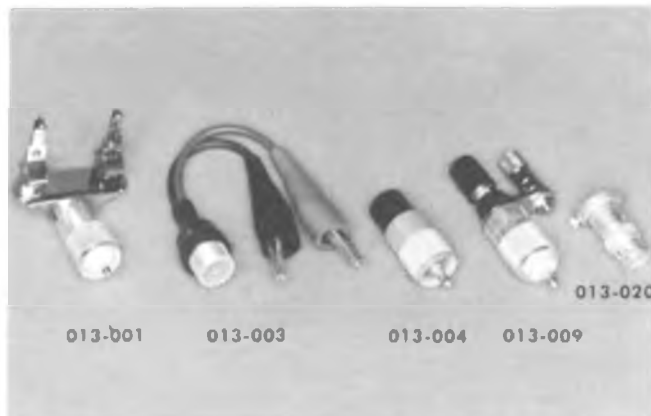
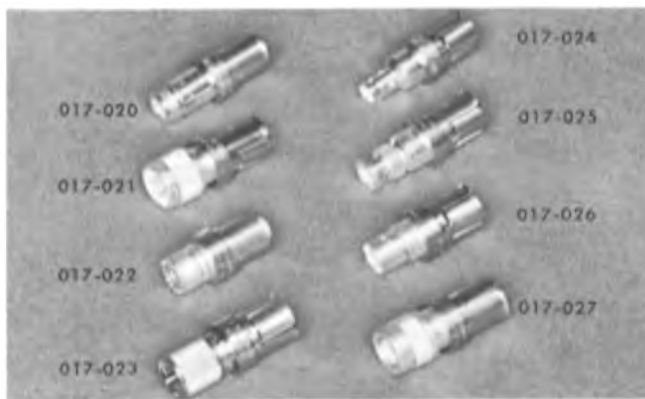


TABLE 6-2
50 Ω GR TYPE 874-Q ADAPTERS

Description	Part Number
Type 874 connector and Type N Jack. (GR Type 874-QNJ) Fits Type N Plug.	017-020
Type 874 connector and Type N Plug (GR Type 874-QNP) Fits Type N Jack	017-021
Type 874 connector and Type UHF Jack. (GR Type 874-QUJ) Fits Type UHF Plug.	017-022
Type 874 connector and Type UHF Plug. (GR Type 874-QUP) Fits Type UHF Jack.	017-023
Type 874 connector and Type BNC Jack. (GR Type 874-QBJ) Fits Type BNC Plug.	017-024
Type 874 connector and Type BNC Plug. (GR Type 874-QBP) Fits Type BNC Jack.	017-025
Type 874 connector and Type C Jack. (GR Type 874-QCJ) Fits Type C Plug.	017-026
Type 874 connector and Type C Plug. (GR Type 874-QCP) Fits Type C Jack.	017-027

* Typical vswr for two connectors, paired, to 2000 megacycles: Type BNC, less than 1.07; Type N, less than 1.04; Type C, less than 1.04.



COAXIAL CABLES

Coaxial cables with several connector styles are listed in Table 6-3. (Signals take nominally 5 nsec to pass through 40" of 50-ohm cable.)



TABLE 6-3
COAXIAL CABLES

Description	Part Number
Two UHF plug connectors. 50 Ω nominal impedance. 42" long. RG-58A/U.	012-001
Two UHF plug connectors. 75 Ω nominal impedance. 42" long. RG-59A/U.	012-002
Two UHF plug connectors. 93 Ω nominal impedance. 42" long. RG-62A/U.	012-003
Two UHF plug connectors. 93 Ω nominal impedance terminated with 93 Ω, 1/2-watt resistor in unpainted end. 42" long.	012-005
Two UHF plug connectors. 170 Ω nominal impedance. 42" long.	012-006
Two UHF plug connectors. 170 Ω nominal impedance. 60" long.	012-034
Two BNC plug connectors. 50 Ω nominal impedance. 42" long. RG-58A/U.	012-057
Two GR 874 connectors. 50 Ω nominal impedance. 80", 10-nsec delay. RG-58A/U.	017-501
Two GR 874 connectors. 50 Ω nominal impedance. 40", 5-nsec delay. RG-8A/U.	017-502
One GR 874 connector, other end pig-tail. 50 Ω nominal impedance. 8", 1-nsec delay. RG-58A/U.	017-503
Two GR 874 connectors. 50 Ω nominal impedance. 160", 20-nsec delay. RG-8A/U.	017-504
Two GR 874 connectors. 50 Ω nominal impedance. 16", 2-nsec delay. RG-58A/U.	017-505



INTERCONNECTING LEADS

Several types of interconnecting leads are listed in Table 6-4. These are valuable when patching between circuits or between panel connectors of Tektronix oscilloscopes.

**TABLE 6-4
INTERCONNECTING LEADS**

Description	Part Number
Type W130B. Black, 30" flexible output lead with banana plug at one end and alligator clip at other.	012-014
Type W130R. Same as Type W130B except colored red.	012-015
Type PC-6B. Black, 6" flexible cord with combination plug and jack banana-type connectors on each end.	012-023
Type PC-6R. Same as Type PC-6B except colored red.	012-024
Type PC-18R. Similar to Type PC-6B except 18" long and colored red.	012-031
Type W531B. Black, 6" flexible cord with plug banana-type connectors on each end.	012-028
Type W531R. Same as Type W531B except colored red.	012-029

SIGNAL AMPLIFIER INPUT CAPACITANCE STANDARDIZER

Standardization of real-time signal amplifier input capacitance is important when exchanging attenuator probes between units. The overall amplifier attenuator plus probe frequency response is degraded if all input time constants are not equal. Standardizer for 1-megohm, 47-pf input plug-in units, 4X attenuation.

Order part number 011-021



47-pf Input Capacitance Standardizer

1000-MEGACYCLE ATTENUATORS AND TERMINATION WITH GR TYPE 874 50-OHM CONNECTORS

The units listed in Table 6-5 provide high fidelity in-line attenuators, or end-line termination. Each unit is fitted with hermaphroditic GR Type 874 connectors for easy connection to other connectors or adapters of the same type. The attenuator vswr is less than 1.1 to 1000 megacycles.

Intended for use with Tektronix Sampling Systems, these high performance T attenuators can be inserted directly into a 50-ohm system. Since the Tektronix Sampling Systems have internal 50-ohm terminations, no in-line termination is required with the attenuators.

Observe the power ratings stamped on the case of each unit. Power dissipation in excess of the rating may destroy the resistance element. Replacement element stock numbers are included in Table 6-5.

If your application requires pulsing attenuators or terminations with voltages above their rms ratings, refer to "Power-Time Relationships", Fig. 3, page 802, 4th Edition I T and T Reference Data for Radio Engineers. The "Power-Time Relationships" chart will aid you in using the attenuators or terminations within their safe power dissipation limits.

**TABLE 6-5
50 Ω GR CONNECTOR ATTENUATORS AND TERMINATIONS**

Description	Part Number
10 X T Attenuator, 1 watt.	Unit: 017-044 Element: 307-064
5 X T Attenuator, 1 watt.	Unit: 017-045 Element: 307-065
2 X T Attenuator, 1 watt.	Unit: 017-046 Element: 307-066
50 Ω End-Line Termination, 2 watts.	Unit: 017-047 Element: 307-077



HIGH FREQUENCY BNC CONNECTOR TERMINATIONS AND ATTENUATORS

Tektronix offers a series of terminating resistors and attenuators, having a BNC Plug on one end and a BNC Jack on the other. The attenuators have a vswr of less than 1.1, when properly terminated, to 100 megacycles. Table 6-6 lists the BNC group.

Any of the BNC terminations and attenuators may be used with a Tektronix 560-series oscilloscope by adding the proper adapter (listed in Table 6-1). For example, to adapt a BNC Plug to a UHF Jack, select part number 103-015.

It is often necessary to terminate a coaxial system when connecting it to the input of an oscilloscope. Proper termination with a resistance equal to the cable characteristic impedance will prevent signal reflections and avoid measurement errors.

If the signal requires attenuation at the oscilloscope input, a 10:1 T attenuator of the correct impedance can be used. However, a T attenuator alone is not a correct cable termination and must be followed by the proper termination resistor.

Accessories — Type 561A

Observe the power rating stamped on the case of the terminations and attenuators. Power dissipation in excess of the ratings may destroy the resistance element inside the unit. Replacement resistor part numbers are included in Table 6-6. If the resistors are damaged, the unit disassembly can be accomplished simply by unscrewing first the jack end, and then the plug end. Place the new resistors in the unit identically as the old ones were located.

**TABLE 6-6
BNC TO BNC COAXIAL TERMINATIONS AND
ATTENUATORS**

Fittings: One BNC Plug — One BNC Jack

Description	Part Numbers
50 Ω Cable Termination, 1 watt.	Unit: 011-049 Element: 307-078
50 Ω 10:1 T Attenuator, $\frac{1}{2}$ watt.	Unit: 010-314 Elements: 1,318-026 1,318-027 1,319-020
75 Ω Cable Termination, $\frac{1}{2}$ watt.	Unit: 010-315 Element: 1,319-021
75 Ω 10:1 T Attenuator, $\frac{1}{2}$ watt.	Unit: 010-316 Elements: 1,318-028 1,318-029 1,319-022
93 Ω Cable Termination, $\frac{1}{2}$ watt.	Unit: 010-317 Element: 1,319-023
93 Ω 10:1 T Attenuator, $\frac{1}{2}$ watt.	Unit: 010-318 Elements: 1,318-030 1,318-031 1,319-024
50 Ω to 75 Ω Minimum Loss L Attenuator, 1 watt.	Unit: 010-319 Elements: 1,319-025 1,319-026
50 Ω to 93 Ω Minimum Loss L Attenuator, 1 watt.	Unit: 010-320 Elements: 1,319-027 1,319-030



UHF SYSTEM ATTENUATORS AND TERMINATIONS

When working with UHF coaxial systems in the range of 100 megacycles and below, the attenuators listed in Table 6-7 will function properly when terminated with a termination resistor of the same value. Termination resistors listed in Table 6-8 will also perform to 100 mc except where noted.

Replacement resistance elements are listed with the units. To disassemble, remove the four screws from the plug end, unsolder the lead in the plug center conductor and remove the plug. Then the jack can be removed with the resistors attached. Place the new resistors exactly like the old ones were located.



**TABLE 6-7
UHF SYSTEM ATTENUATORS**
Fittings: One UHF Plug — One UHF Jack

Description	Part Numbers
50 Ω 10:1 T Attenuator, 1.5 watts.	Unit: 011-031 Elements: 2,310-138 2,319-048
50 Ω 5:1 T Attenuator, 1.5 watts.	Unit: 011-032 Elements: 2,310-039 2,319-049
75 Ω 10:1 T Attenuator, 1.5 watts.	Unit: 011-033 Elements: 1,310-135 2,319-045 1,309-363
75 Ω 5:1 T Attenuator, 1.5 watts.	Unit: 011-034 Elements: 1,310-134 2,319-044 1,309-362
93 Ω 10:1 T Attenuator, 1.5 watts.	Unit: 011-035 Elements: 1,310-137 2,319-047 1,309-365
93 Ω 5:1 T Attenuator, 1.5 watts.	Unit: 011-036 Elements: 1,310-136 2,310-046 1,309-364
50 Ω to 75 Ω Minimum Loss Attenuator, 1.5 watts.	Unit: 011-041 Replaces: 011-004 Elements: 1,310-140 2,309-366
50 Ω to 93 Ω Minimum Loss Attenuator, 1.5 watts.	Unit: 011-042 Replaces: 011-014 Elements: 1,310-141 2,309-367
50 Ω to 170 Ω Minimum Loss Attenuator, 1.5 watts.	Unit: 011-043 Replaces: 011-005 Elements: 1,309-368 2,319-050

TABLE 6-8
UHF SYSTEM TERMINATIONS
Fittings: One UHF Plug — One UHF Jack

Description	Part Numbers
50 Ω Termination Resistor, 1.5 watts.	Unit: 011-045 Replaces: 011-001 Elements: 2, 309-372
75 Ω Termination Resistor, 1.5 watts.	Unit: 011-046 Replaces: 011-007 Elements: 2, 309-374
93 Ω Termination Resistor, 1.5 watts	Unit: 011-047 Replaces: 011-011 Elements: 2, 309-374
170 Ω Termination Resistor, 0.5 watt. V _{swr} , 1.25 at 30 mc.	Unit: 011-048 Replaces: 011-016 Element: 1, 309-360

PROBES

The most common method of connecting signals to an oscilloscope vertical amplifier is to use a probe of appropriate attenuation. An attenuator probe significantly reduces the loading on the circuit being measured below the loading value of the signal amplifier input terminals. An attenuator probe can be used effectively on either a standard 1-megohm input amplifier, or a Sampling System 50-ohm signal amplifier.

TYPE P6026 Passive Probe—The P6026 Passive Probe is designed for use with 50-ohm input Sampling Systems. Its frequency response is such that it does not alter the frequency response of a 600-megacycla sampling system more than ±3%. Seven attenuators provide attenuation ratios of 5 through 500, either ac or dc coupled.

The P6026 Probe consists of: a GR Type 874 50-ohm connector to probe adapter, a dc-coupled 50-ohm termination, an ac-coupled 50-ohm termination, plus attenuator heads of ×5, ×10, ×20, ×50, ×100, ×200 and ×500, a removable ground clip, and a 50-ohm nominal surge impedance RG-58A/U 10-nsec cable. All attenuators must be used with

the 50-ohm termination either ac- or dc-coupled in order to attain the stated attenuation. It is not possible to stack attenuator heads to obtain other values of attenuation.

The resistors used throughout the P6026 Passive Probe system are ±1% values. Thus the input resistance when using the P6026 with a Tektronix 50-ohm sampling system is within 2%.

All Attenuator Head attenuation ratings are within 2% of that stated on the individual head.

(NOTE: The P6026 will degrade the highest frequency performance of the Type 3S76 Sampling Unit in the form of a slight rounding off of a fast rise pulse. Higher performance probes with fixed attenuation are in the development stage at the time of this printing. Consult your local Tektronix Field Engineer for details.)



TABLE 6-9
PROBE SPECIFICATIONS

Probe and Connector	Cable Length	Atten. Ratio	Input Impedance		Voltage Rating [Max.] †	Part Number	
			Resistance Meg Ω	Capacitance—pf Min. * Max. **		UHF	BNC
P6017-UHF P6022-BNC	42 inch	10	10	14	600	010-038	010-064
	6 foot	10	10	17	600	010-056	010-066
	9 foot	10	10	20	600	010-057	010-067
	12 foot	10	10	23	600	010-058	010-068
P6027-UHF P6028-BNC	42 inch	1	1	67	600	010-070	010-074
	6 foot	1	1	94	600	010-071	010-075
	9 foot	1	1	120	600	010-072	010-076
	12 foot	1	1	146	600	010-073	010-077
P6002-UHF P6005-BNC	42 inch	100	9.1	2.5	2000	010-024	010-029
	6 foot	100	9.1	2.8	2000	010-034	010-050
	9 foot	100	9.1	3.5	2000	010-043	010-051
	12 foot	100	9.1	3.8	2000	010-044	010-052

* When connected to instruments with 20 pf input capacitance.

** When connected to instruments with input capacitance up to 50 pf.

† See derating information.

Accessories — Type 561A

P6017-Series Probes—The P6017-series of probes preserves the transient response of Tektronix 560-series 1-megohm input resistance instruments. The 42-inch cable length P6017 and P6022 Probes provides uniform amplitude response with no overshoot or ringing. Average bandpass characteristics show the P6017 and P6022 Probes, with 42-inch cables, to be down between 0 and 1 db at 30 megacycles. 12-foot cables reduce bandpass to 3 db down between 16 and 20 megacycles.

Voltage derating with frequency for all but the 12-foot cable length probes must be observed. The 42-inch length P6017 and P6022 will operate at 600 volts peak-to-peak to 1.5 mc, dropping to 400 volts peak-to-peak at 3 mc, 200 volts peak-to-peak at 6 mc, 135 volts peak-to-peak at 10 mc, and 90 volts peak-to-peak at 30 mc.

Four interchangeable tips—spring, hooked, pincher, and banana tip—are included with the probe. A 12-inch ground lead is also included.



P6017 Probe

TYPE P6032 Cathode Follower Probe—(Not illustrated) The P6032 Cathode Follower Probe is designed for use with 50-ohm Sampling Oscilloscopes with performance to above 1000 megacycles. The probe has a high impedance dc-coupled input, permitting the use of plug-on attenuator heads with attenuation from 10 to 1000. Ac-coupling is accomplished by the use of a capacitor plug-on head having a low-frequency cutoff of approximately 20 cps.

The P6032 Probe has a cable length of 4½ feet, and is shipped with seven attenuator heads, a capacitor coupler head, and a grounding clip.

Input characteristics are: Dc resistance: 10 megohms.

Input Capacitance			
10X	3.5 pf	100X	1.5 pf
20X	2.6 pf	200X	1.3 pf
50X	1.8 pf	500X	1.3 pf
	1000X		1.3 pf

The cathode follower gain error due to linearity limits is less than 5% over a ±100 mv output voltage range.

Type P6033 Trigger Probe—(Not illustrated) The P6033 Trigger Probe is a trigger-coupling probe for external triggering of Tektronix sampling system timing units. The Type P6033 accepts triggering signals with risetimes as fast as about 1.2 nanosecond, or sine wave frequencies up to about 300 megacycles. When terminated by a 50 Ω external trigger circuit, it provides a nominal 1000 Ω input impedance, minimizing circuit loading.

Voltage rating of the probe with the output dc-coupled is ±15 volts dc or 15 volts rms. When the output is ac coupled, the voltage rating is ±400 volts dc or 15 volts rms.

Three interchangeable tips—pincher, hooked, and banana tip—are included with the probe. A 5-inch and 12-inch ground lead are also included.

Order part number 010-100

100X Probes—Probes having an attenuation ratio of 100 are also listed in Table 6-9. These probes are provided in the event you require very small capacitive loading when measuring signals of high impedance, or if it is necessary to measure voltages higher than 600 volts. They will perform with uniform amplitude response without overshoot or ringing on any of the 560-series signal amplifiers. No voltage vs frequency derating is necessary.

Physical dimensions of the probe body are 7/16 inch in diameter and 3 3/8 inches in length without the tip. The standard cable length is 42 inches.

Four interchangeable tips—spring, hooked, BNC, and banana tip—are included with the probe. A 5-inch and a 12-inch ground lead are also included.

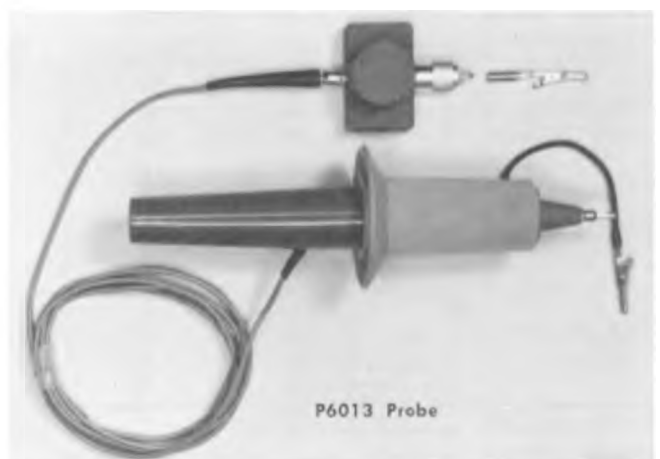
P6013 High Voltage Probe—The P6013 High Voltage Probe provides a means of observing waveforms of high amplitude. Voltage rating for dc and pulses: ±12 kv with proper derating above 100 kc.

Attenuation Ratio—1000.

Frequency Response—Dc to over 30 mc with proper derating.

Input Impedance—100 megohms and 3 pf.

Voltage vs Frequency Derating—±12 kv to 100 kc, dropping to ±5 kv at 1 mc, ±1.5 kv at 10 mc, and ±500 volts at 30 mc.



P6013 Probe

A compensating box at the oscilloscope end of the probe cable enables the P6013 to be properly compensated to any oscilloscope having an input resistance of one megohm and a capacitance of 20 to 47 pf. The probe introduces no ringing or overshoot.

Probe body length is 12 inches, coaxial cable length is 10 feet (up to 25 feet on special order).

Accessories include 2 banana-plug tips, an alligator-clip assembly, and an attached 7½-inch ground lead.

Order part number, 10-ft cable 010-106

P500CF Cathode-Follower Probe—Presents low capacitance with minimum attenuation. Input impedance is 40 megohms paralleled by 4 pf. Gain: 0.8 to 0.85. Input to probe is ac-coupled, limiting its low-frequency response to 5 cps. Amplitude distortion is less than 3% on unidirectional signals to 5 volts. 10X attenuator head is included with probe, and should be used on signals exceeding a few volts to minimize amplitude distortion. With the attenuator head attached, the probe input impedance is approximately 10 megohms paralleled by 2 pf. Probe output level is 11 v positive, making it necessary to use the ac-coupled position of the oscilloscope AC-DC switch. Probe cable is 42" long.

Order part number 010-105



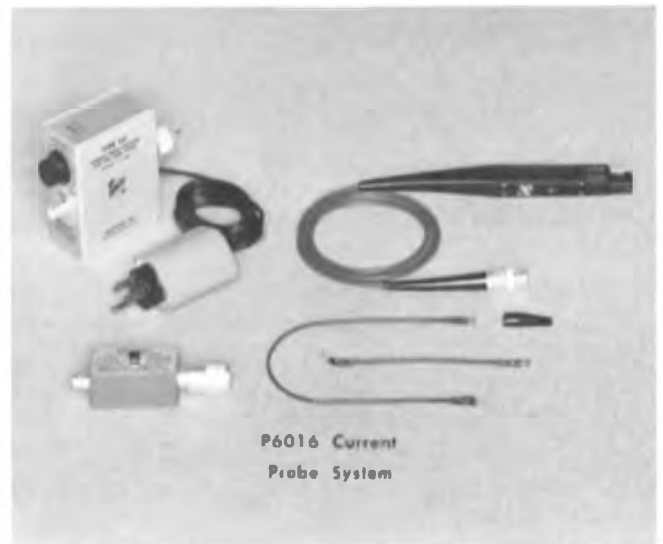
P500CF Probe

P6016 AC Current Probe System—The P6016 Current Probe with the Type 131 Current Probe Amplifier or the Passive Termination constitute an ac current detecting system for use with any oscilloscope. The system provides accurate displays for observation and measurement of ac current waveforms. Current range extends from less than one milliamperere to 15 amperes.

Use of the Current Probe and Amplifier system with any of the 560-series signal amplifiers, other than sampling types, will result in an upper-frequency limit similar to that of the plug-in unit used; this will be less than the upper-frequency limit of the probe system alone.

The long narrow shape and convenient thumb control make the P6016 Current Probe easy to use. Just place probe slot over the conductor and close slide with thumb—no direct electrical connection is required. Wiping action keeps core surfaces clean. Loading introduced is so slight that it can almost always be disregarded. For increased sensitivity, loop the conductor through the probe slot two or three times.

Order part number (Probe only) 010-037



P6016 Current Probe System

Type 128 Probe Power Supply—Probe power supply for the P500CF cathode-follower probe. The Type 128 supplies the necessary plate and heater voltages for one or two probes, making it possible to use P500CF probes with signal amplifiers not equipped with a probe-power outlet.

DC Output Voltages—+120 v regulated, at 25 ma; two +6.3 v unregulated, at 150 ma.

Voltage Ripple—+120-v supply, not more than 5 mv peak-to-peak; +6.3-v supplies, not more than 75 mv peak-to-peak.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 25 watts using two P500CF Probes.

Dimensions—4¾" wide, 7¾" high, 9" overall depth.

Weight—6 lbs.



Type 128

Accessories — Type 561A

P6016 Probe and Type 131 Amplifier

Sensitivity (with 50 mv/div oscilloscope input) 1 ma/div to 1 amp/div in 10 steps. Variable sensitivity control on oscilloscope provides continuous uncalibrated adjustment.

Frequency Range (with 30-mc oscilloscope)—3 db down at 50 cps and approximately 17 mc.

Risetime—20 nsec.

Saturation Ratings—DC, 0.5 amp; AC, 15 amps peak-to-peak decreasing to 8 amps at 400 cps, 400 ma at 50 cps

Order part number (Probe and Amplifier) 015-030

P6016 Probe and Passive Termination

Sensitivity—2 ma/mv and 10 ma/mv.

Frequency Range (with 30-mc oscilloscope)—3 db down at 850 cps (2 ma/mv), 230 cps (10 ma/mv), and 20 megacycles

Risetime—18 nsec.

Saturation Ratings—DC, 0.5 amp; AC at 2 ma/mv, 15 amps peak-to-peak decreasing to 8 amps at 1.5 kc, 4 amps at 850 cps; at 10 ma/mv, 15 amps peak-to-peak decreasing to 5 amps at 400 cps, 2.5 amps at 230 cps.

Order part number (Probe and Termination) 011-044

RECALIBRATION TOOLS

The tools shown are handy, and in some cases necessary, for the recalibration of Tektronix instruments. All of the tools except the assembly 003-007 are available through most radio and electronic parts suppliers.

- 003-001 Jaco No. 125 insulated screwdriver with 7" shank and metal bit. This tool is useful for hard-to-reach adjustments
- 003-000 Jaco No. 125 insulated screwdriver. This tool is similar to 003-001 but has a 1½" shank.
- 003-003 Walsco No. 2519 insulated alignment tool. This double ended tool is useful for adjusting variable inductors.
- 003-004 Walsco No. 2503, ¼" insulated hexagonal wrench. This tool is useful for tightening variable inductor lock nuts.
- 003-006 (Not pictured) Insulated alignment tool suitable for adjusting small capacitors.
- 003-007 Tektronix recalibration tool assembly. This 4-unit tool assembly provides most of the necessary tools for adjusting variable inductors in Tektronix instruments.
- 003-301 Walsco No. 2543 double-ended 0.1" hexagonal wrench. This tool is useful for adjusting variable inductors with hexagonal cores.

Alignment tool kit: contains the following tools.

003-001	003-004	003-308
003-000	003-006	003-309
003-003	003-307	003-310

Order part number for kit 003-500

CAMERAS

Type C-12 Camera

Interchangeable Lens—Lens easily changed by loosening two adjustable locknuts. Lenses available are f/1.5, f/1.9, and f/4.5. Object-to-image ratios include 1:1, 1:0.9, 1:0.7, 1:0.5.

Interchangeable Back—Accepts all standard Grafflok accessories. Backs may be interchanged without refocusing.

Binocular Viewing—Orthogonal and undistorted over full 8 × 10 cm area.

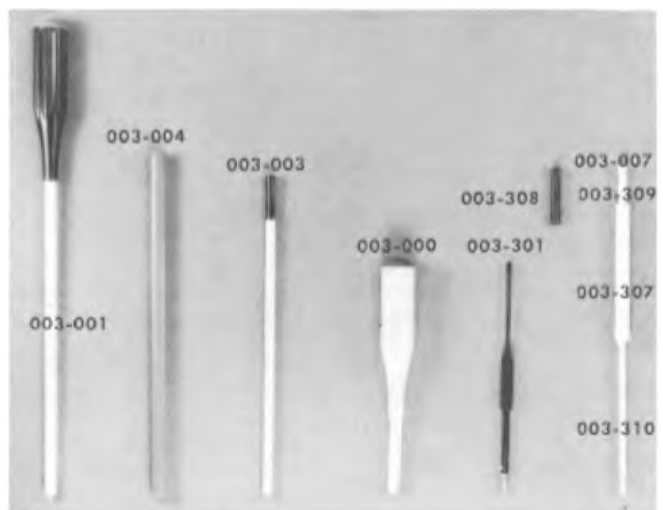
Hinge Mounting—Camera swings away from crt for full visibility, lifts easily out of hinge fittings.

Rotating and Sliding Backs—Rotation through 90° steps. Horizontal or vertical movements of back through five positions.

Standard C-12 Camera shipped with f/1.9 Oscillo-Raptor lens having 1:0.9 object-to-image ratio, focusing 4 × 5 Grafflok back, and Polaroid roll-film back.



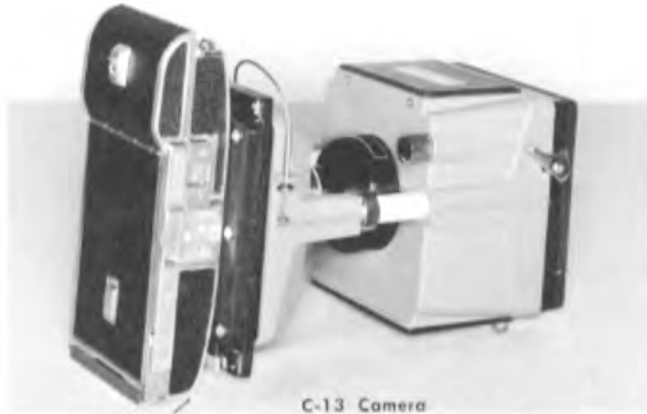
C-12 Camera



Type C-13 Camera

Same style as the C-12 except that it does not have the binocular viewing feature. Standard lens supplied with the C-13 Camera is an $f/4.5$ Oscillo-Amaton which has an object-to-image ratio of 1:0.7. Other lenses currently available from Tektronix will fit the C-13.

Other features of the C-13 Camera are similar to those of the C-12.



C-13 Camera

Type C-19 Camera

Same style as the C-12 Camera except that it is constructed without a beam-splitting mirror to permit maximum light from the oscilloscope screen to reach the camera lens. This feature in conjunction with the fast $f/1.5$ lens supplied with the camera make the C-19 particularly suitable for applications requiring extremely high writing rates. Other lenses currently available from Tektronix may be used with the C-19.

Binocular viewing of a 5 cm high by 10 cm wide screen area permits the oscilloscope display to be observed while being photographed.

Other features of the C-19 Camera are similar to those of the C-12.



C-19 Camera

AUXILIARY DEVICES

Type 105 Square-Wave Generator

Risetime—13 nsec, with 50-ohm termination.
 Frequency Range—25 cycles to 1 mc, continuously variable.
 Frequency Meter—Direct reading, accurate within 3% of full scale.
 Output Amplitude—0 to 100 v maximum, 0 to 15 v across 93-ohm load.



Type 105

Type 107 Square-Wave Generator

Risetime—Less than 3 nsec with 50-ohm internal termination.
 Frequency Range—400 kc to 1 mc, uncalibrated.
 Output Amplitude—0.1 v to 0.5 v, with 50-ohm terminated cable.



Type 107

Accessories — Type 561A

Type 109 Pulse Generator

Pulse Risetime—Less than 0.25 nsec.

Pulse Length—Minimum of approximately 0.5 nsec to a maximum of 40 nsec at internal repetition rate. An accessory (shipped with the Type 109) permits generation of long pulses at half the internal rate that tilt down about 10% in 400 nsec.

Pulse Repetition Rate—Internally adjusted to be between 550 and 720 cycles.

Output Impedance—50 ohms.

Alternate Pulses—Unequal charge lines can be used to produce alternate pulses of different time durations.

External Charge voltage permits alternate pulses of different amplitudes and/or polarity.



Type 109

Pulse Repetition Rate—10 pps to 100 kc in 4 ranges with continuously variable control.

Pulse Amplitude—More than ± 5 volts.

Pretrigger Pulse Characteristics—10 volts, 250-nsec duration, half-amplitude risetime about 4 nsec.

Pulse Delay—Continuously variable from 30 to 250 nsec after pretrigger pulse.

Output Impedance—50 ohms.



Type 111

Type 110 Pulse Generator and Trigger Takeoff

Pulse Risetime—Less than 0.25 nsec.

Pulse Length—Minimum of 0.5 nsec to 300 nsec at half rep rate.

Pulse Output Impedance—50 ohms.

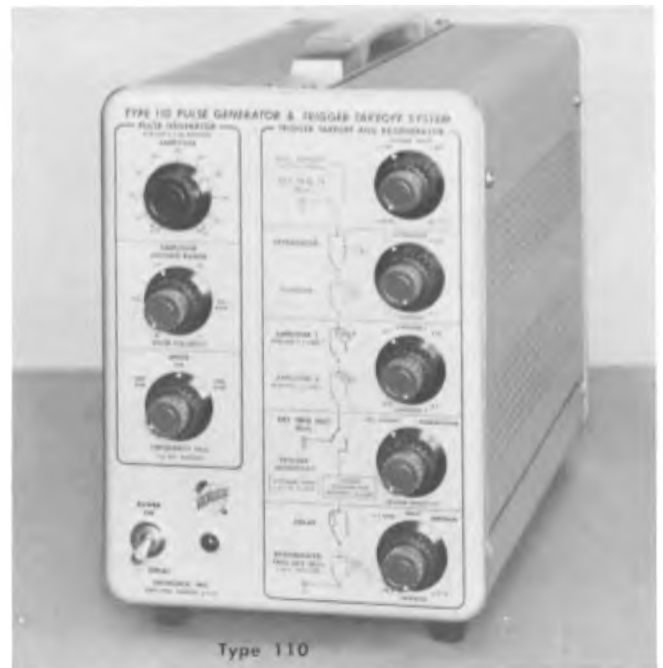
Pulse Repetition Rate—Nominally 720 pulses/sec.

Trigger Systems—50-ohm impedance. Takeoff system where signal is patched into a "loop-through" arrangement and a portion of signal used as a trigger signal. Regenerated trigger system with trigger output ± 10 -v amplitude, 225 nsec duration, 4-nsec 50% risetime, count down from approximately 100 mc.

Type 111 Pretrigger Pulse Generator

Risetime—0.5 nsec for positive pulse, slightly longer for negative pulse.

Pulse Duration—2 nsec minimum, 100 nsec maximum at low rep rates decreasing to 20 nsec at 100-kc rep rate (obtained with external charge line).



Type 110

Type 130 L-C Meter

Guard Voltage—Permits measuring an unknown capacitance while eliminating the effects of other capacitances from the measurements.

Five Ranges—Microhenries: 0 to 3, 10, 30, 100, 300. Picofarads: 0 to 3, 10, 30, 100, 300.

Accuracy—Within 3% of full scale.



Type 130

Type 180A Time-Mark Generator

Time-Marks—1, 5, 10, 50, 100, 500 μ sec; 1, 5, 10, 100, 500 msec; 1, 5 seconds.

Three Sine-Wave Frequencies—5 mc, 10 mc, and 50 mc.

Six Trigger-Rate Frequencies—1, 10, 100 cycles and 1, 10, 100 kc.

Temperature-Stabilized Crystal—Provides stability of 3 ppm over 24-hour period.



Type 180A

Type 181 Time-Mark Generator

Time-Marks—1, 10, 1000, and 10,000 μ sec, plus 10-mc sine wave.

1-Mc Crystal Controlled Oscillator—Accurate within 0.03%.



Type 181

Type 190B Constant-Amplitude Signal Generator

Output Frequency—350 kc to 50 mc, continuously variable, 50-kc reference signal.

Output Amplitude—40 mv to 10 v peak-to-peak, continuously adjustable.

Amplitude Variation—Less than 2% from 50 kc to 30 mc; less than 5% from 30 mc to 50 mc.

Harmonic Content—Typically less than 5%.



Type 190B

Accessories — Type 561A

Type 1121 Amplifier

Voltage Gain—100 with 9 calibrated attenuator steps to provide net gain from 100 to 0.2.

Frequency Response—5 cycles to 17 mc, decreasing slightly with increase in attenuator setting.

Risetime—21 nsec.

Maximum Output Voltage— ± 1 v in terminated 93-ohm cable.

NOTICE

If you have measurement situations that do not respond to the conventional attack, call Tektronix at your local Field Office. The composite experience of 350 man-years at Field Engineering, solving problems similar to yours, is available to you as a Tektronix Customer. The Field Engineer responsible for your area is always looking for a new challenge.



Section 7

Parts List and Schematics

ABBREVIATIONS

Cer.	Ceramic	p	Pico, or 10^{-12}
Comp.	Composition	PMC	Paper, metal cased
EMC	Electrolytic, metal cased	Poly.	Polystyrene
EMT	Electrolytic, metal tubular	Prec.	Precision
f	Farad	PT	Paper, tubular
F & I	Focus and Intensity	PTM	Paper, tubular, moulded
G	Giga, or 10^9	S/N	Serial number
GMV	Guaranteed minimum value	T	Turns
h	Henry	TD	Toroid
K or k	Kilohms, or kilo (10^3)	Tub.	Tubular
M or meg	Megohms, or mega (10^6)	v	Working volts DC
μ	Micro, or 10^{-6}	Var.	Variable
m	Milli, or 10^{-3}	w	Watt
n	Nano, or 10^{-9}	w/	With
Ω	Ohm	WW	Wire-wound

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number.

000X Part removed after this serial number.

*000-000 Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, also reworked or checked components.

Use 000-000 Part number indicated is direct replacement.

HOW TO ORDER PARTS

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

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

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

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part Number	Description	S/N Range
BULBS			
B601	150-001	Incandescent, G.E. #47	Graticule Light
B602	150-001	Incandescent, G.E. #47	Graticule Light
B603	150-018	Incandescent, G.E. #12	Pilot Light
B856	150-025	Neon, NE-2	
B857	150-025	Neon, NE-2	

CAPACITORS

Tolerance $\pm 20\%$ unless otherwise indicated.

Tolerance of all electrolytic capacitors are as follows (with exceptions):

3 V — 50 V = -10% , $+250\%$
 51 V — 350 V = -10% , $+100\%$
 351 V — 450 V = -10% , $+50\%$

C611	285-510	.01 μf	MT		400 v
C616	285-510	.01 μf	MT		400 v
C640A,B	*290-060	160 $\mu f \times 10 \mu f$	EMC		350 v
C642A,B	*290-061	160 $\mu f \times 10 \mu f$	EMC		350 v
C644	*290-133	2 x 125 μf	EMC		350 v
C650	285-510	.01 μf	MT		400 v
C667	290-002	8 μf	EMT		450 v
C670	use 285-511	.01 μf	PTM		600 v
C720	290-166	2 x 2000 μf	EMC		25 v
C732	290-099	100 μf	EMT		15 v
					X6360-up
C737	283-026	.2 μf	Disc Type		25 v
C757	290-015	100 μf	EMT		25 v
C760	281-027	.7-3 pf	Tub.	Var.	
C761	281-027	.7-3 pf	Tub.	Var.	
C801	283-006	.02 μf	Disc Type		600 v
C803	283-000	.001 μf	Disc Type		500 v
C807	285-502	.001 μf	MT		1000 v
C822	283-071	.0068 μf	Disc Type		5000 v
C830	283-036	.0025 μf	Disc Type		6000 v
C832	283-036	.0025 μf	Disc Type		6000 v
C837	283-036	.0025 μf	Disc Type		6000 v
C841	285-519	.047 μf	MT		400 v
C842	283-071	.0068 μf	Disc Type		5000 v
C853	283-036	.0025 μf	Disc Type		6000 v
C876	290-025	6.25 μf	EMT		300 v
C878	281-523	100 pf	Cer.		350 v
C884	281-524	150 pf	Cer.		500 v
C897	283-000	.001 μf	Disc Type		500 v

Parts List — Type 561A

DIODES

Ckt. No.	Tektronix Part Number	Description	S/N Range
D640A,B,C,D	152-047	Silicon 1N2862	
D642A,B,C,D	152-047	Silicon 1N2862	
D644A,B,C,D	152-047	Silicon 1N2862	
D720	152-035	Silicon 1N1563A	
D721	152-035	Silicon 1N1563A	
D838	152-008	Germanium T12G	5501-5788
	152-047	Silicon MR187	5789-up
D839	152-061	Silicon 6061	5501-5788
	152-047	Silicon MR187	5789-up
D852	152-061	Silicon 6061	5501-5780X

FUSES

F601	159-023	2 Amp 3AG Slo-Blo 117-v oper. 50-60 cycle
F601	159-019	1 Amp 3AG Slo-Blo 234-v oper. 50-60 cycle
F720	159-023	2 Amp 3AG Slo-Blo

INDUCTORS

L860	*108-255	Beam Rotator on form 176-069
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RESISTORS

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R601	311-055	50 Ω	Var.	WW	SCALE ILLUM.
R602	308-142	30 Ω	3 w	WW	5%
R609	302-106	10 meg	1/2 w		
R610	302-104	100 k	1/2 w		
R611	302-102	1 k	1/2 w		
R612	302-272	2.7 k	1/2 w	Var.	WW
R616	311-015	10 k		WW	—100 V
R617	308-186	80 k	1/2 w	WW	1%
R618	308-226	10 k	1/2 w	WW	1%
R619	302-224	220 k	1/2 w		
R624	302-473	47 k	1/2 w		
R625	302-222	2.2 k	1/2 w		
R626	302-184	180 k	1/2 w		
R627	302-102	1 k	1/2 w		
R628	308-176	4 k	20 w	WW	5%
R632	302-102	1 k	1/2 w		
R633	302-473	47 k	1/2 w		
R635	301-302	3 k	1/2 w		5%
R640	304-100	10 Ω	1 w		
R642	304-100	10 Ω	1 w		

RESISTORS (Cont'd)

Ckt. No.	Tektronix Part Number		Description			S/N Range
R644	304-100	10 Ω	1 w			5501-5562X
R650	309-101	330 k	1/2 w	Prec.	1%	
R651	309-162	250 k	1/2 w	Prec.	1%	
R652	302-102	1 k	1/2 w			
R653	302-225	2.2 meg	1/2 w			
R654	302-474	470 k	1/2 w			
R657	302-684	680 k	1/2 w			
R658	302-273	27 k	1/2 w			
R659	302-333	33 k	1/2 w			
R663	302-102	1 k	1/2 w			
R664	302-102	1 k	1/2 w			
R666	308-176	4 k	20 w	WW	5%	
R667	308-176	4 k	20 w	WW	5%	
R670	309-156	1.024 meg	1/2 w	Prec.	1%	
R671	309-053	333 k	1/2 w	Prec.	1%	
R672	302-102	1 k	1/2 w			
R673	302-105	1 meg	1/2 w			
R677	304-224	220 k	1 w			
R678	302-394	390 k	1/2 w			
R679	302-333	33 k	1/2 w			
R731	309-104	2.05 k	1/2 w	Prec.	1%	
R732	310-115	15 k	1 w	Prec.	1%	
R734	302-334	330 k	1/2 w			
R735	302-272	2.7 k	1/2 w			
R737	302-151	150 Ω	1/2 w			
R744	308-231	220 Ω	3 w	WW	5%	
R754	302-471	470 Ω	1/2 w			
R759	302-104	100 k	1/2 w			
R770	302-564	560 k	1/2 w			
R781	316-470	47 Ω	1/4 w			X5900-up
R782	316-470	47 Ω	1/4 w			X5900-up
R783	316-470	47 Ω	1/4 w			X5900-up
R784	316-470	47 Ω	1/4 w			X5900-up
R801	306-681	680 Ω	2 w			
R802	302-562	5.6 k	1/2 w			
R803	306-273	27 k	2 w			
R804	302-101	100 Ω	1/2 w			5501-5949X
R806	302-104	100 k	1/2 w			
R807	302-472	4.7 k	1/2 w			
R813	302-101	100 Ω	1/2 w			
R815	302-474	470 k	1/2 w			
R816	302-102	1 k	1/2 w			
R831	302-104	100 k	1/2 w			
R832	302-106	10 meg	1/2 w			X5950-up
R833	311-314	2 meg		Var.	INTENSITY	
R834	302-105	1 meg	1/2 w			
R835	310-591	30 meg	2 w	Prec.	5%	
R836	302-223	22 k	1/2 w	(Nominal value)		
R837	302-471	470 Ω	1/2 w			X5789-up
R838	301-242	2.4 k	1/2 w		5%	

Parts List — Type 561A

RESISTORS (Cont'd)

Ckt. No.	Tektronix Part Number		Description			S/N Range
R839	302-104	100 k	1/2 w			
R840	301-125	1.2 meg	1/2 w			
R841	311-042	2 meg		Var.		5% HIGH VOLTAGE
R842	310-595	12 meg	2 w		Prec.	5% FOCUS
R844	311-313	5 meg		Var.		
R846	302-225	2.2 meg	1/2 w			
R849	302-223	22 k	1/2 w			
R851	302-104	100 k	1/2 w			
R852	302-273	27 k	1/2 w			
R853	302-471	470 Ω	1/2 w			X5789-up
R854	302-105	1 meg	1/2 w			
R860	311-317	2 x 1 k		Var.		ALIGNMENT
R861	302-680	68 Ω	1/2 w			
R862	302-823	82 k	1/2 w			
R863	302-823	82 k	1/2 w			
R864	311-206	250 k		Var.		ASTIGMATISM
R865	311-115	100 k		Var.		GEOMETRY
R870	301-393	39 k	1/2 w			5%
R871	311-315	20 k		Var.		CAL. AMPL.
R872	301-154	150 k	1/2 w			5%
R873	302-103	10 k	1/2 w			
R876	301-153	15 k	1/2 w			5%
R877	301-183	18 k	1/2 w			5%
R878	301-564	560 k	1/2 w			5%
R879	301-124	120 k	1/2 w			5%
R883	305-223	22 k	2 w			5%
R885	309-121	9.5 k	1/2 w		Prec.	1%
R886	309-119	6.375 k	1/2 w		Prec.	1%
R887	309-117	2.1 k	1/2 w		Prec.	1%
R888	309-116	1.025 k	1/2 w		Prec.	1%
R889	309-113	610 Ω	1/2 w		Prec.	1%
R890	309-073	200 Ω	1/2 w		Prec.	1%
R891	309-112	100 Ω	1/2 w		Prec.	1%
R892	309-067	60 Ω	1/2 w		Prec.	1%
R893	309-066	40 Ω	1/2 w		Prec.	1%
R896	309-045	100 k	1/2 w		Prec.	1%
R897	309-112	100 Ω	1/2 w		Prec.	1%
R898	309-112	100 Ω	1/2 w		Prec.	1%
R899	*308-090	1/4 Ω	1 w		WW	

SWITCHES

	Unwired	Wired		
SW601	260-014		Toggle	POWER ON
SW870	*260-253	*262-497	Rotary	CALIBRATION
SW854	260-449		Slide	EXT. CRT CATHODE

THERMAL CUTOUT

Ckt. No.	Tektronix Part Number	Description	S/N Range
TK601	260-071	Thermal Cutout 155°	

TRANSFORMERS

T601	*120-280	L. V. Power
T801	*120-275	H. V. Power

TRANSISTORS

Q624	151-087	J3138
Q734	151-040	2N1302
Q744	151-042	2N1378
Q757	151-046	2N1529

ELECTRON TUBES

V609	154-291	OG3
V627	154-307	7233
V634	154-187	6DJ8
V654	154-022	6AU6
V667	154-020	6AS7G
V674	154-022	6AU6
V800	154-167	6CZ5
V814	154-046	12BH7
V822	154-051	5642
V832	154-051	5642
V859	*154-400	T561 CRT P01 Standard Phosphor
V884	154-278	6BL8

MECHANICAL PARTS LIST

	Tektronix Part Number
Adapter, power cord, 3 wire to 2 wire	103-013
Bar, $\frac{3}{16} \times \frac{1}{2} \times 1\frac{3}{4}$, with 2 8-32 tapped holes	381-073
Bar, top support, w/handle	381-182
Bracket, nylon, coax. insul.	406-244
Bracket, plug-in housing, right	406-607
Bracket, plug-in housing, left	406-608

Mechanical Parts List (continued)

	Tektronix Part Number
Bracket, transformer	406-617
Bracket, low-capacity pot mounting, delrin	406-635
Bracket, parallax adj.	406-730
Bushing, aluminum, $\frac{3}{8}$ -32 x $\frac{9}{16}$ x .412	358-010
Bushing, binding post, charcoal	358-169
Cable, harness, chassis indicator	179-663
Cable, harness, F & I	179-664
Cable, harness, 110 v	179-665
Cable, harness, calibrator	179-666
Cap, fuse	200-015
Cap, pot, polyethylene	200-247
Chassis, calibrator	441-445
Chassis, indicator	441-446
Clamp, cable	343-001
Clamp, cable	343-005
Clamp, tube, top hat style	343-074
Clip, deflection plate, poly.	344-047
Connector, chassis mt.	131-064
Connector, chassis mt. 24 contact, female	131-148
Connector, chassis mt. 3-wire motor base, male	131-150
Cover, insulation, fuse holder	200-237
Cover, 9-pin cable socket	200-249
Cover, capacitor	200-261
Cover, pot	200-269
Cover, trim and graticule assembly	200-426
Filter, light, green plexi.	378-534
Grommet, rubber, $\frac{5}{16}$	348-003
Grommet, rubber, $\frac{1}{2}$	348-005
Grommet, rubber, $\frac{3}{4}$	348-006
Grommet, rubber, $\frac{5}{8}$	348-012
Grommet, poly. snap-in	348-031
Guide, rail track, plug-ins	351-038
Holder, fuse	352-010
Holder, nylon, for coil form, $\frac{3}{16}$ x $\frac{3}{4}$ lg. tapped 4-40	352-015

Mechanical Parts List (continued)

	Tektronix Part Number
Holder, single fuse	352-031
Holder, coil form, CRT, poly. black	352-044
Holder, reflector shield	352-049
Knob, small, charcoal	366-113
Knob, large charcoal	366-117
Lockwasher, #4 int.	210-004
Lockwasher, #6 int.	210-006
Lockwasher, #8 ext.	210-007
Lockwasher, #8 int.	210-008
Lockwasher, #10 int.	210-010
Lockwasher, pot int. $\frac{3}{8} \times \frac{1}{2}$	210-012
Lockwasher, int. $\frac{3}{8} \times \frac{11}{16}$	210-013
Lug, solder, SE 4	210-201
Lug, solder, SE 6 w/2 wire holes	210-202
Lug, solder, SE 10, long	210-206
Lug, solder, pot, $\frac{3}{8}$ plain	210-207
Lug, solder, #10 non-locking, $\frac{7}{8}$ " long	210-224
Nut, hex, 4-40 x $\frac{3}{16}$	210-406
Nut, hex, 6-32 x $\frac{1}{4}$	210-407
Nut, hex, 8-32 x $\frac{5}{16}$	210-409
Nut, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$	210-413
Nut, hex, $\frac{15}{32}$ -32 x $\frac{9}{16}$	210-414
Nut, hex, $\frac{3}{8}$ -32 x $\frac{1}{2} \times \frac{7}{16}$	210-421
Nut, hex, brass, 1-72 x $\frac{5}{32}$	210-438
Nut, hex, 10-32 x $\frac{3}{8} \times \frac{1}{8}$ thick	210-445
Nut, keps, 6-32 x $\frac{5}{16}$	210-457
Nut, keps, 8-32 x $\frac{11}{32}$	210-458
Nut, hex, 8-32 x $\frac{1}{2} \times \frac{23}{64}$, resistor mtg.	210-462
Nut, switch, $\frac{15}{32}$ -32 x $\frac{5}{64}$, 12 sided	210-473
Nut, hex, $\frac{3}{8}$ -32 x $\frac{1}{2} \times \frac{11}{16}$	210-494
Nut, hex, 10-32 x $\frac{3}{8} \times \frac{1}{8}$	210-564
Nut, graticule cover, $\frac{3}{8}$ alum. bar x $\frac{15}{32}$ long	210-571
Nut, adj. securing, w/2 6-32 tapped holes	214-207

Mechanical Parts List (continued)

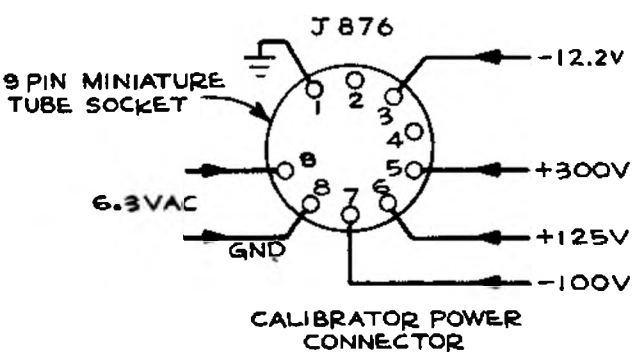
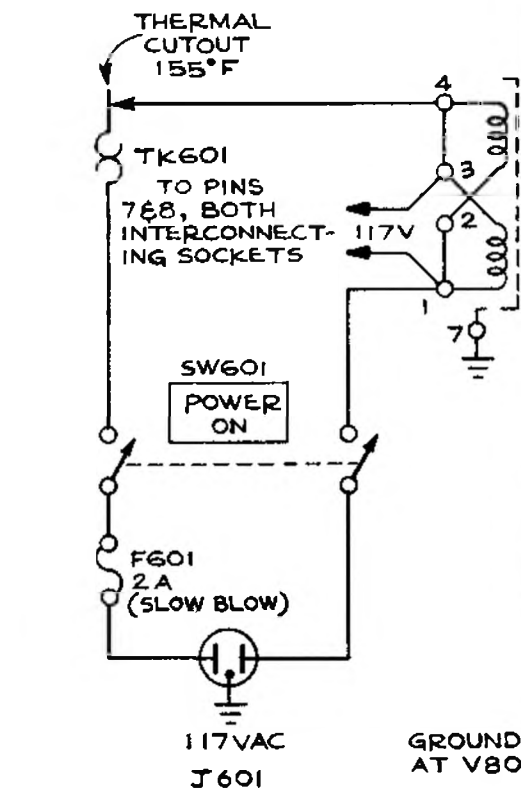
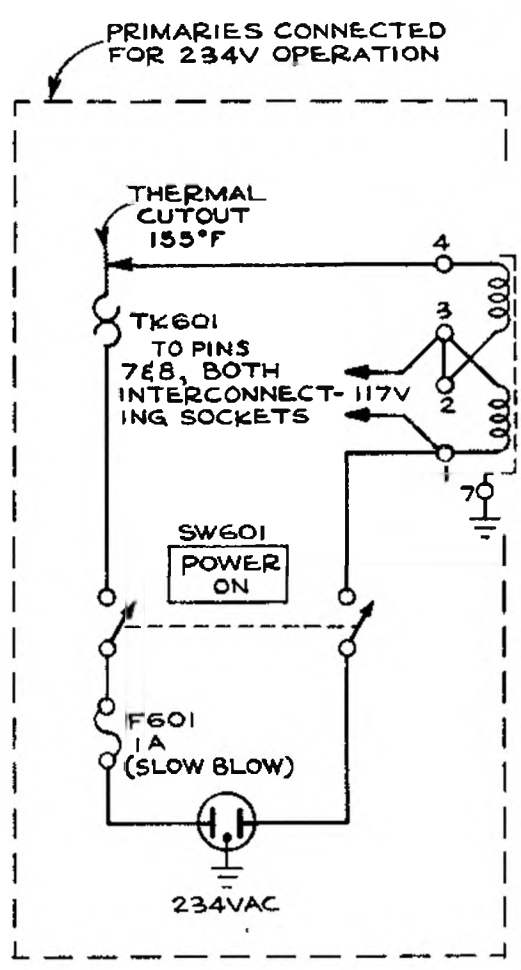
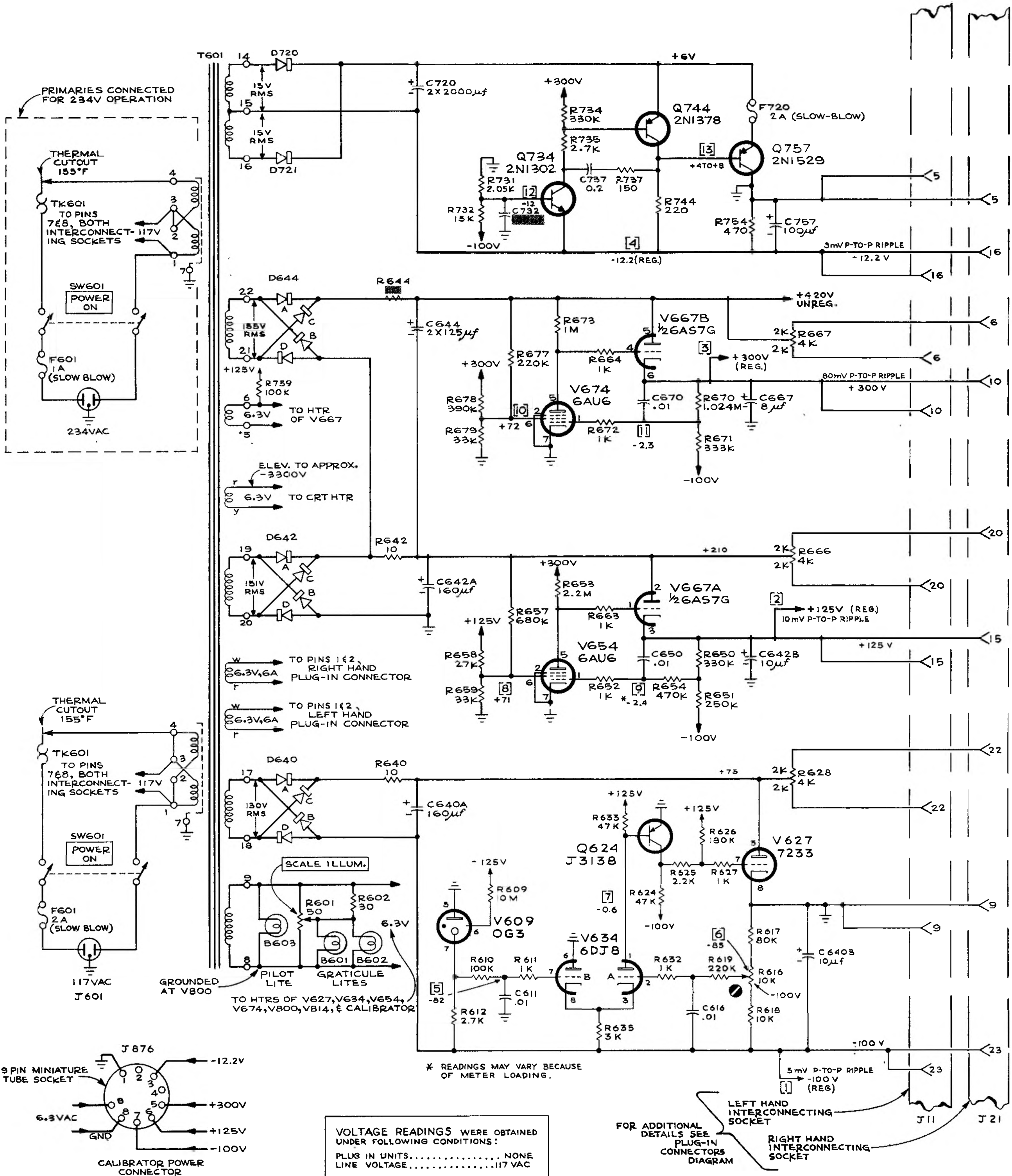
	Tektronix Part Number
Panel, front	333-710
Plate, ground, plated, open end	386-427
Plate, bottom cabinet	387-294
Plate, cabinet side	387-300
Plate, gusset	387-352
Plate, front subpanel	387-681
Plate, rear subpanel	387-682
Plate, rear overlay	387-683
Post, binding, 5-way charcoal	129-063
Ring, locking switch	354-055
Ring, clamping w/2 mounting ears	354-147
Rod, $\frac{5}{16} \times 2$, both ends tapped 6-32	385-097
Rod, $\frac{1}{4} \times 2$, both ends tapped 6-32	385-124
Rod, $\frac{5}{16} \times 2\frac{1}{4}$, one end $\frac{3}{8}$ " mounting hole	385-137
Rod, spacer bar $\frac{5}{16} \times \frac{5}{16} \times 3\frac{1}{8}$ long	385-163
Screw, 4-40 x $\frac{5}{16}$ BHS	211-011
Screw, 4-40 x $\frac{1}{2}$ BHS	211-014
Screw, 4-40 x $\frac{5}{16}$ PHS w/lockwasher	211-033
Screw, 6-32 x $\frac{5}{16}$ BHS	211-507
Screw, 6-32 x $\frac{3}{8}$ BHS	211-510
Screw, 6-32 x $\frac{5}{8}$ BHS	211-513
Screw, 6-32 x $\frac{3}{4}$ BHS	211-514
Screw, 6-32 x $\frac{5}{16}$ PHS w/lockwasher	211-534
Screw, 6-32 x $\frac{5}{16}$ FHS phillips	211-538
Screw, 6-32 x $\frac{1}{4}$ FHS phillips	211-541
Screw, 6-32 x $\frac{5}{16}$ THS phillips	211-542
Screw, 6-32 x $\frac{5}{16}$ RHS	211-543
Screw, 6-32 x $\frac{3}{8}$ FHS phillips	211-559
Screw, 6-32 x $\frac{7}{8}$ socket head cap	211-576
Screw, 8-32 x $\frac{5}{16}$ BHS	212-004
Screw, 8-32 x $\frac{3}{8}$ BHS	212-023
Screw, 8-32 x $1\frac{3}{4}$ FHS	212-037

Mechanical Parts List (continued)

	Tektronix Part Number
Screw, 8-32 x $\frac{3}{8}$ THS	212-039
Screw, 8-32 x $\frac{3}{8}$ FHS phillips	212-040
Screw, 6-32 x $\frac{3}{8}$ THS phillips, thread cutting	213-041
Screw, 5-32 x $\frac{3}{16}$ PHS phillips, thread cutting	213-044
Screw, 4-40 x $\frac{5}{16}$ PHS phillips, self-tapping	213-045
Screw, #6 x $\frac{3}{8}$ THS phillips, thread forming	213-104
Screw, 2-32 x $\frac{5}{16}$ RHS, phillips, thread forming	213-113
Shield, power switch	337-398
Shield, F & I	337-528
Shield, HV	337-529
Shield, CRT	337-530
Shield, implosion	337-539
Shield, reflector	337-540
Socket, STM7G	136-008
Socket, STM8, molded	136-013
Socket, STM9	136-014
Socket, STM9G	136-015
Socket, graticule light w/ground lug	136-035
Socket, light w/#14 L red jewel assembly	136-047
Socket, 4 pin transistor	136-095
Socket, 9 pin cable end	136-099
Socket, CRT assembly	136-133
Spacer, .063 nylon, molded ceramic strip	361-007
Spacer, .313 nylon, molded ceramic strip	361-009
Spool, solder assembly	214-210
Strap, transformer mounting	346-001
Strip, ceramic, $\frac{3}{4}$ x 9 notches, clip mounted	124-090
Strip, ceramic, $\frac{3}{4}$ x 11 notches, clip mounted	124-091
Stud, 8-32 x $4\frac{1}{2}$ long	355-070
Tag, voltage rating 50-800 cycle (s/n 5501-5788)	334-650
Tag, voltage rating 50-400 cycle (s/n 5789-up)	334-661
Tag, metal serial no. insert	334-679
Tube, spacer, .180 x $\frac{1}{4}$ x $\frac{1}{8}$	166-029
Tube, spacer, .180 x $\frac{1}{4}$ x $\frac{3}{8}$	166-033

Mechanical Parts List (continued)

	Tektronix Part Number
Washer, steel, $6L \times \frac{3}{8} \times .032$	210-803
Washer, brass, resistor centering	210-808
Washer, #10 fiber	210-812
Washer, steel, $.390 \times \frac{9}{16} \times .020$	210-840
Washer, brass, $\frac{5}{32} \times \frac{1}{2} \times \frac{1}{16}$ thick	210-858
Washer, rubber, $\frac{1}{2} \times 1\frac{1}{16} \times \frac{3}{64}$ for fuse holder	210-873
Washer, steel, $.470 \times 2\frac{1}{32} \times .030$ thick	210-902
Washer, insulating, $.035 \times 1.440 \times .900$	210-952



VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:
 PLUG IN UNITS..... NONE
 LINE VOLTAGE..... 117 VAC

FOR ADDITIONAL DETAILS SEE PLUG-IN CONNECTORS DIAGRAM
 LEFT HAND INTERCONNECTING SOCKET
 RIGHT HAND INTERCONNECTING SOCKET

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH RED TINT BLOCKS

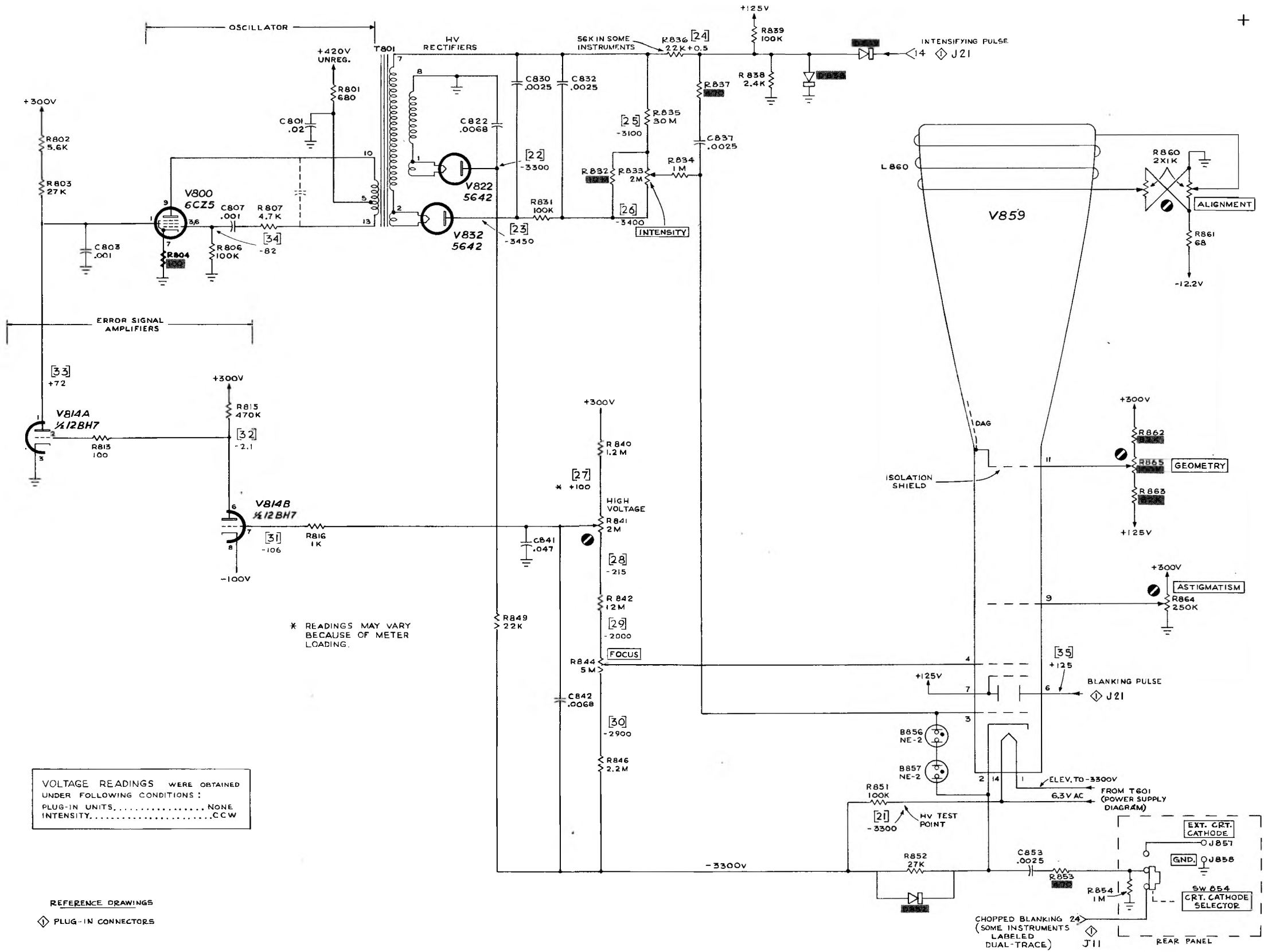
07-27-62

POWER SUPPLY

CIRCUIT NUMBERS 600 THRU 759

TYPE 561A OSCILLOSCOPE

A

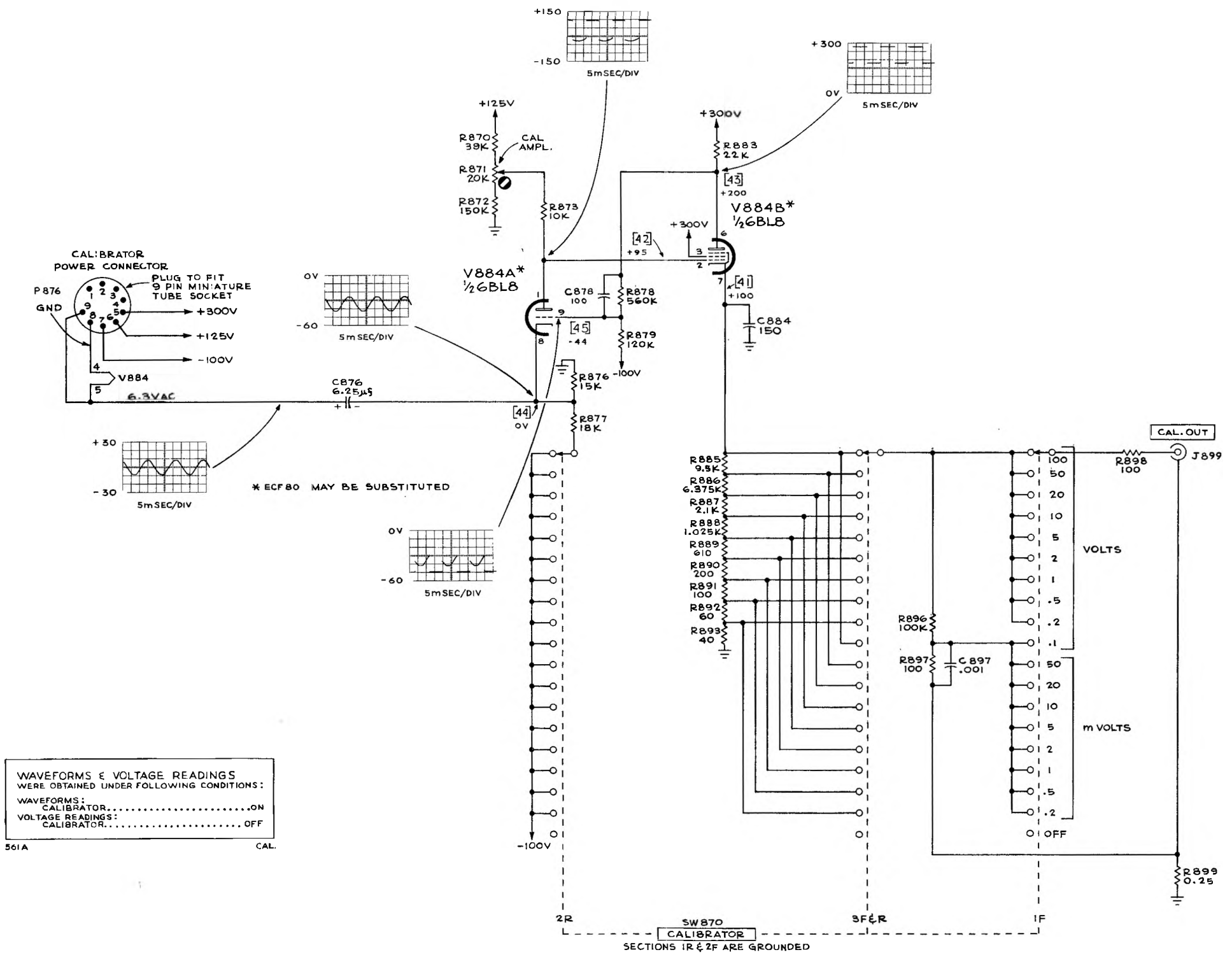


VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:
 PLUG-IN UNITS..... NONE
 INTENSITY..... CCW

REFERENCE DRAWINGS
 ◆ PLUG-IN CONNECTORS

* READINGS MAY VARY BECAUSE OF METER LOADING.

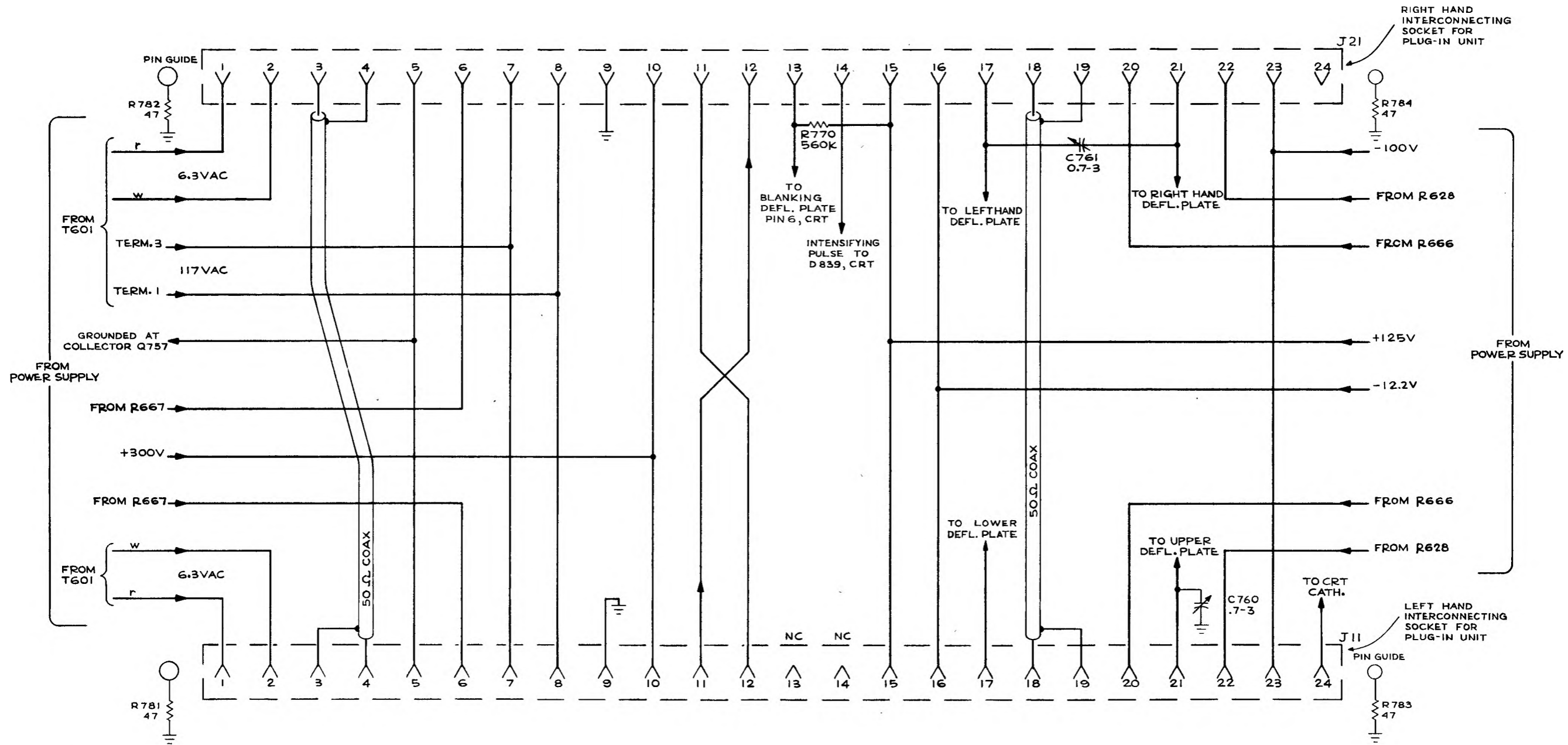
CRT CIRCUIT
 CIRCUIT NUMBERS 800 THRU 869



WAVEFORMS & VOLTAGE READINGS
 WERE OBTAINED UNDER FOLLOWING CONDITIONS:
 WAVEFORMS: CALIBRATOR.....ON
 VOLTAGE READINGS: CALIBRATOR.....OFF

561A CAL.

SECTIONS 1R & 2F ARE GROUND



MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

MOD 6860

Type 561A - Tent S/N 7860

Type RM561A - Tent S/N 5280

Connectors Change to Chassis Mtg.

BNC 131-279

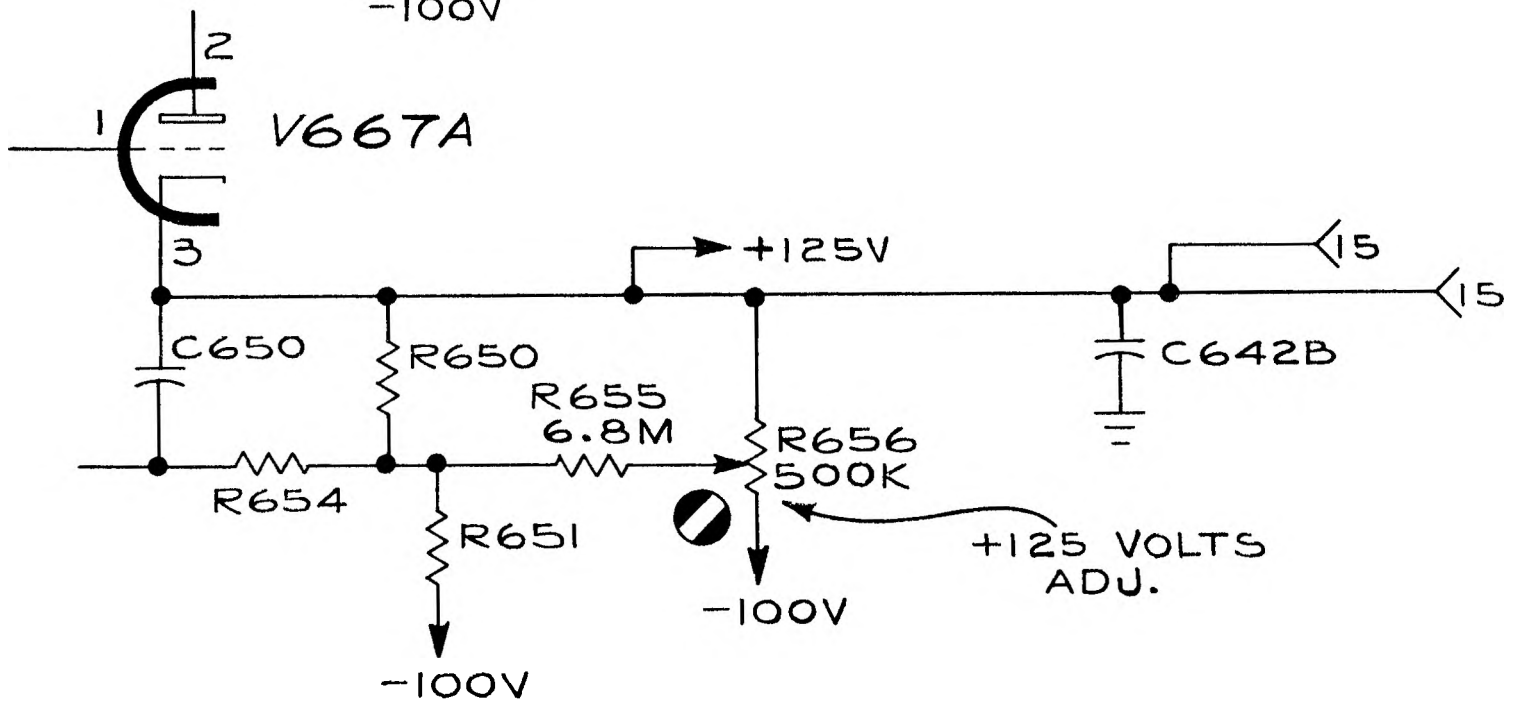
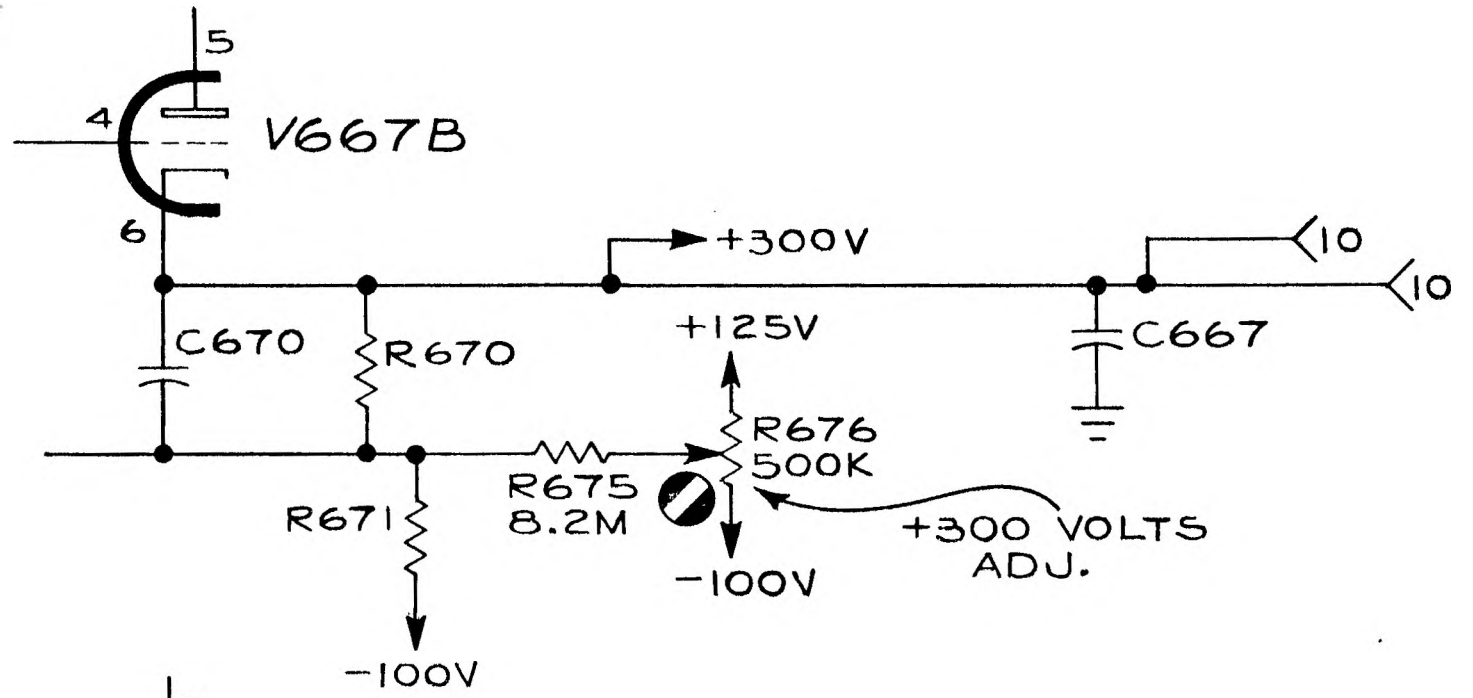
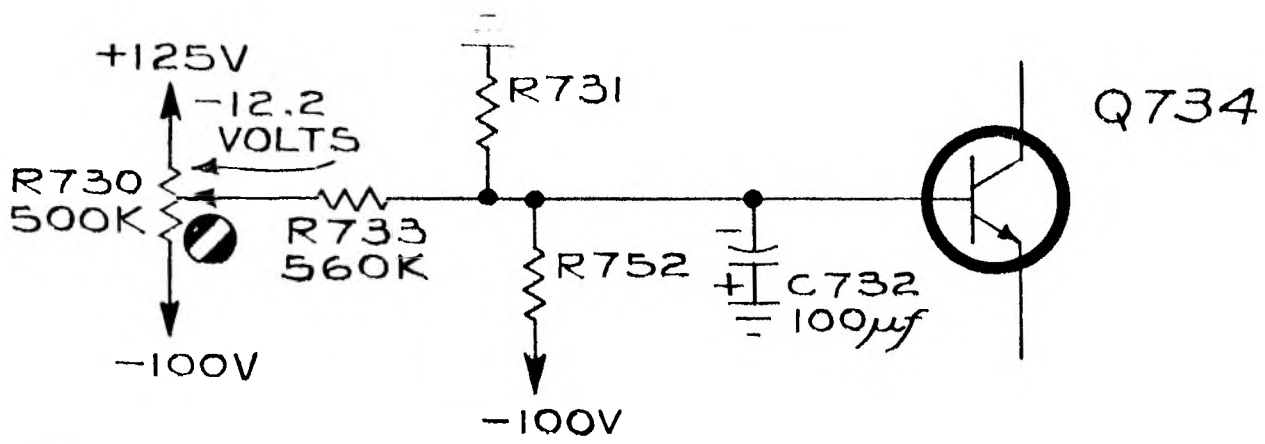
TYPES 561A-210C, 561A,
MOD 7052
Tent S/N 7750

R835	Change to a series unit consisting of				
	3	5.6m	2w	10%	306-565
and	2	6.8m	2w	10%	306-685
R842	Change to a series unit consisting of				
	2	2.7m	2w	10%	306-275
and	2	3.3m	2w	10%	306-335

TYPE 561A - 561A,210C
MOD 6467 - Tent S/N 6630 (47)

R655	Add	6.8m	1/2w			302-685
R656	Add	500k	Pot.	Comp	Var	311-068
R675	Add	8.2m	1/2w			302-825
R676	Add	500k	Pot.	Comp.	Var	311-068
R730	Add	500k	Pot.	Comp.	Var	311-068
R733	Add	560k	1/2w			302-564

As per schematic attached.

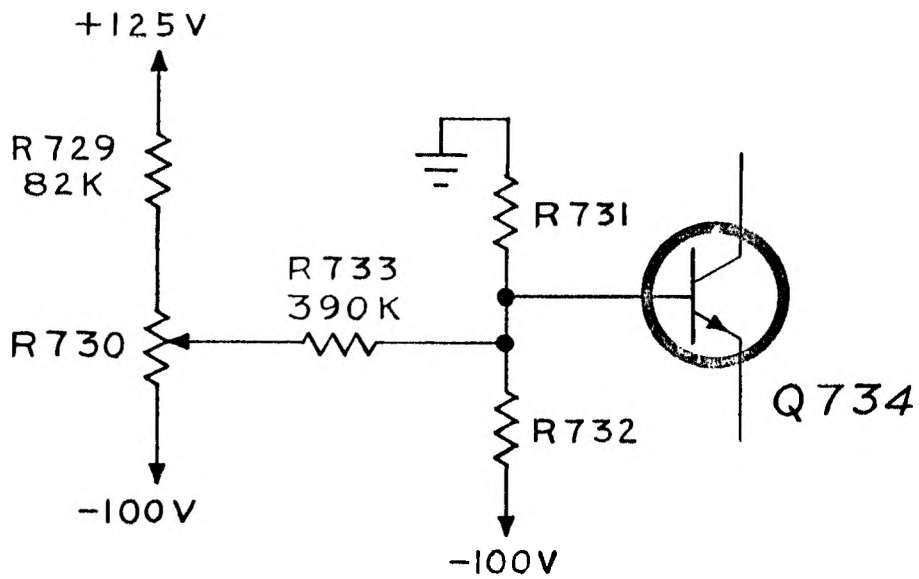


PLM
11/62
PART. PWR. SPLY. DIAG.

TYPE 561A - RM561A
Mod 6936 - 561A - Tent S/N 7490
Mod 6936 - RM561A - Tent S/N 5160

R733	Change to	390k	1/2w	5%	301-394
R729	Add	82k	1/2w	10%	302-823

As per schematic below,



**INSTRUCTIONS FOR REPLACING GLASS CRT'S
WITH ONE OF THE FOLLOWING CERAMIC CRT'S:**

Part No. 154-0613-00/02/03, 154-0614-00/02/03

TYPE T5032 CRT REPLACEMENT

For the following Tektronix Oscilloscopes:

<u>Type</u>	<u>Serial Number</u>
561A	5001-12399*
561A	12400-up
RM561A	101-105: 5001-6885*
RM561A	6886-up
567	101-749
567	1999-3195
RM567	101-228
RM567	1999-up
568/R568	B010100-B130589

*This is applicable in the above indicated SN range of instruments if 050-0214-00, 050-0214-01, 050-0214-02 or 050-0214-03 has been installed.

This provides instructions for replacing the old style T5032 glass CRT (either internal or external graticule) with the style T5611 ceramic CRT. See the list below for the proper replacement CRT part number:

<u>Type T5032 Glass CRT</u>	<u>New Type T5611 Ceramic CRT</u>
154-0454-00	154-0613-00
154-0455-00	154-0613-02
154-0456-00	154-0613-03
154-0449-00	154-0613-00
154-0373-00	154-0614-00
154-0374-00	154-0614-02
154-0375-00	154-0614-03
154-0376-00	154-0614-00

NOTE 1: If the serial number of the instrument is above those listed, or if this has been installed, disregard the instructions as the T5611 CRT is a direct replacement.

INSTALLATION INSTRUCTIONS.

- () 1. Remove the four graticule nuts, graticule cover (or Bezel if present) light filter (if used) light guide and retainer spring (if present).
- () 2. Disconnect the deflection plate connectors from the neck pins on the CRT.
- () 3. Remove the CRT socket connector and loosen the clamp at the base of the CRT.
- () 4. Remove the CRT.
- () 5. Remove the CRT cushions, 4 (for Type 561A, RM561A, 567, RM567) or 6 (Type 568, R568) from the inside of the CRT shield.
- () 6. Install the new CRT. Complete the installation by performing steps 1, 2 and 3 in reverse order.

THIS COMPLETES THE INSTALLATION.

- () Recalibrate your instrument according to the Calibration Section of your Instruction Manual.
- () Please put this information in your Instruction Manual for future reference.