INSTRUCTION MANUAL

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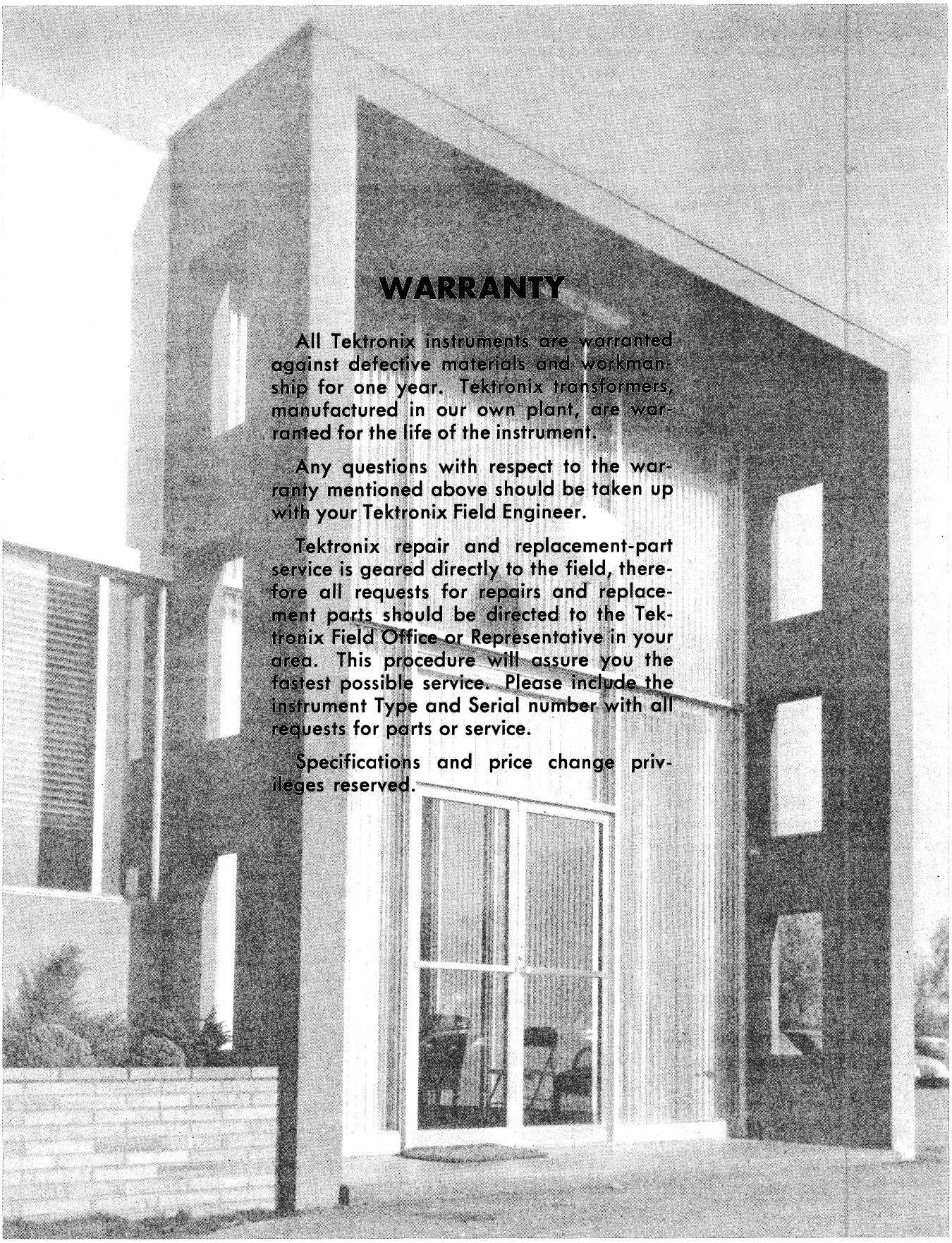


WARRANTY

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.

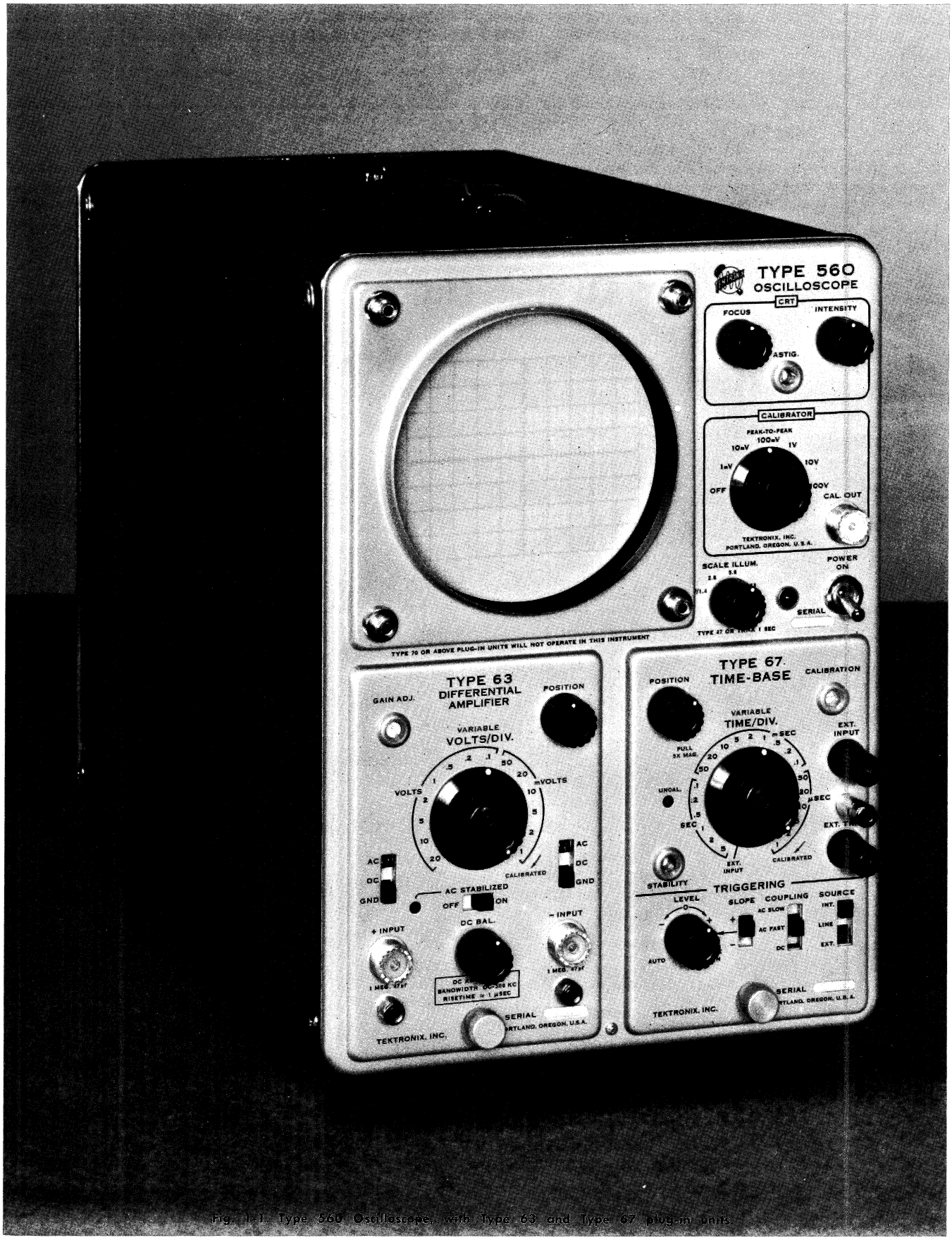


Fig. 1-1. Type 560 Oscilloscope with Type 63 and Type 67 plug-in units.

SECTION 1
GENERAL INFORMATION

INTRODUCTION

The Tektronix Type 560 Oscilloscope, shown in Fig. 1-1, consists of an Indicator Unit and any two of a number of available plug-in units. The Indicator Unit contains a power supply, a cathode-ray tube and associated circuitry, and a calibrator. 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 560 Oscilloscope the degree and type of performance demanded of it by a particular application. The Type 560 Oscilloscope has adequate power capabilities for powering any plug-in unit in the Tektronix 50-60 series. (See the power supply capabilities chart in the Section 2 Circuit Description.)

Section 1 of this manual describes the operation and maintenance of the Type 560 Oscilloscope as a complete unit; that is, with plug-in units inserted. Section 2 contains the circuit description, troubleshooting instructions, and calibration procedures for the Type 560 Indicator Unit only. Separate manuals are provided with each plug-in unit; these manuals have been punched to allow them to be inserted in the same binder with the Type 560 manual.

A parts list and schematic diagrams are contained at the rear of each manual.

PRELIMINARY INFORMATION

Power Requirements

The line transformer in the Type 560 Oscilloscope has been wired for either 117-volt or 234-volt operation; a plate on the rear of the instrument tells you which. An instrument wired for 117-volt operation will operate properly at any line voltage from 105 to 125 volts, at 50 to 60 cps. A 2-amp fast-blowing fuse is required for 117-volt operation.

If you wish to convert your instrument from 117-volt operation to 234-volt operation or vice versa, change the wiring on the line transformer as shown on the power supply schematic. If the instrument is wired for 234-volt operation it will operate properly at any line voltage from 210 to 250 volts, at 50 to 60 cps. A 1-amp slow-blowing fuse is required for 234-volt operation.

Although primarily designed to operate at a line frequency between 50 and 60 cps, the Type 560 Oscilloscope can be operated at any line frequency from 50 cps to about 800 cps. However, slightly higher line voltages are required at the higher frequencies.

OPERATING INSTRUCTIONS

Operation of the Type 560 Oscilloscope with plug-in units is much the same as that of a conventional Tektronix oscilloscope with corresponding vertical and horizontal deflection systems. Full operating instructions for each of the plug-in units are contained in the manual which accompanies it.

CAUTION

Do not allow a sharply focused beam of high intensity to remain at one spot on the screen. It may damage the crt phosphor.

Any of the plug-in units numbered 50 through 69 may be inserted in either opening in the front of the instrument. The unit on the right controls the horizontal deflection of the beam and the one on the left controls the vertical deflection of the beam. Thus, it is possible to change from a horizontal time sweep to a vertical time sweep merely by changing the position of a time-base unit. However, there is no provision for coupling an unblanking pulse from the left-hand unit to the cathode-ray tube, so when a vertical sweep is used, the trace is not blanked between sweeps. X-Y operation is obtained by using amplifier units in both oscilloscope openings. (The right-hand opening is often referred to in the plug-in manuals as the "X-axis" opening; the left-hand opening is referred to as the "Y-axis" opening.)

Intensity modulation of the crt beam is possible through the Z AXIS INPUT terminals (CRT CATHODE and GND.) on the back of the oscilloscope. A positive pulse of about 20 volts amplitude applied to the CRT CATHODE terminal will cut the beam off from normal intensity.

To remove a plug-in unit from the oscilloscope, turn the aluminum knob at the bottom center of the front panel several turns counterclockwise and pull. To insert a unit, push it all the way into the opening and turn the knob clockwise until it is tight. The oscilloscope will not be damaged by having power applied with the units removed; however, it is not recommended that it be left in this condition for extreme periods of time.

When you change a plug-in from one opening to another, you must adjust the gain of the unit to allow for differences in vertical and horizontal deflection sensitivities of the crt. This is done by means of the GAIN ADJ. or the CALIBRATION adjustment on the front panel. The procedure for making the adjustment on each plug-in is described in its manual. Because of different average deflection-plate voltages produced by different units, the sensitivity of the crt may change slightly as the units are changed. Therefore it may be necessary to change the setting of the GAIN ADJ. or CALIBRATION adjustment on a given plug-in when the one in the other opening has been changed. Also, in most cases when plug-in units are changed, the ASTIG. adjustment on the front panel of the Indicator Unit may have to be adjusted. To set the ASTIG. control, display a square wave on the crt and adjust the ASTIG. and FOCUS controls for optimum focus.

REMOVAL AND REPLACEMENT OF PARTS

Procedures required for replacement of most parts in the Type 560 Oscilloscope 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 the removal of some of these parts are contained in the following paragraphs. Parts-ordering information is included in the Parts List at the rear of this manual.

Removal of Side Panels

To remove the side panels of the Type 560 Oscilloscope, loosen the two screwhead fasteners at the top of each side and pull the upper portion of the panels outward. When replacing the panels you must have them hooked over the bottom rails before pushing the upper portion into place.

Replacement of the Cathode-Ray Tube

To remove the cathode-ray tube, first loosen the tube clamp at the base of the tube and disconnect the crt neck leads (see Fig. 2-1). Remove the graticule cover, spacer washers, and graticule. Push the tube forward slightly and pull the tube socket from the tube base. Then pull the tube straight out through the front of the oscilloscope. Be careful not to bend or break the neck pins on the tube shield as you remove the tube.

When replacing the crt, insert it in the crt opening with the horizontal deflection pins up and the vertical deflection plate pins pointing toward the left. Connect the tube socket and replace the graticule, spacer washers, and graticule cover. Push the crt forward so that its face is against the back side of the graticule. Make sure the crt neck pins are centered in the tube shield openings as you tighten the crt base clamp. Reconnect the neck pin wires following the color-code information on the tube shield.

After replacement of the crt, it may be necessary to recalibrate certain portions of the oscilloscope. Special attention should be given to calibration of time-base sweep rates and amplifier sensitivities. It may also be necessary to realign the trace with the graticule by means of the crt alignment knob.

Replacement of Switches

Single wafers are normally not replaced on the switches used in Tektronix oscilloscopes. If one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix, either wired or unwired as desired.

Replacement of Ceramic Terminal Strips

Damaged ceramic terminal strips can sometimes be removed simply by pulling them out by hand. In this case, the spacers can normally be used over. If you cannot pull a ceramic terminal strip out by hand, then cut through the yokes and spacers with a pair of diagonal cutters, either at the base of the strip or on the opposite side of the chassis. (See Fig. 1-2.) Lift the strip away from the chassis and remove the remainder of the yokes and spacers from the chassis holes. This, of course, damages the spacers and new ones must be used with the new terminal strip.

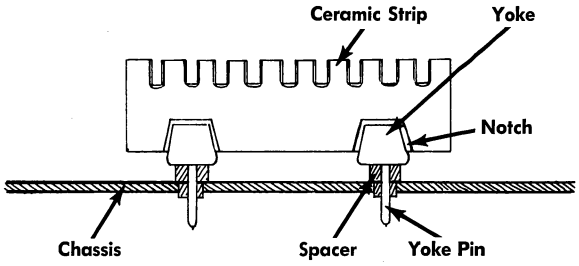


Fig. 1-2. Ceramic terminal strip installation.

To install a new ceramic terminal strip, place the spacers in the chassis holes, insert the yoke pins through the spacers, and press down on the top of the strip to seat the yokes. Use a plastic or hard rubber mallet, if necessary, to seat the yokes firmly. If desired, the extending portion of the yoke pins may be cut off to within about an eighth of an inch of the lower end of the spacers.

When ordering new ceramic strips, be sure to specify the correct height, number of notches, and spacer size. The yokes are supplied already attached to the strips.

Be sure to observe the soldering precautions mentioned in the following paragraph when resoldering connections to the 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 repeated use of ordinary tin-lead solder, or by application of too much heat. For this reason, we recommend the use of a wedge-shaped soldering-iron tip and solder containing about 3% silver for installing or removing parts from the ceramic strips. This solder is locally available in most areas, or it may be purchased directly from Tektronix in one pound rolls (order by Part No. 251-514). Occasional use of ordinary solder is permissible if too much heat is not applied. If you place the soldering-iron tip in the notches of the strip, be careful not to twist or move the iron as this may chip the ceramic.

TROUBLESHOOTING

This part of the manual is intended to help you isolate trouble occurring within the instrument to one of the plug-in units or to the Indicator Unit. After the trouble has been so isolated, you may refer to Section 2 of this manual or to the appropriate plug-in manual for further trouble-shooting information.

If you have more than two plug-in units (one or more spares), the easiest way to isolate a trouble is to replace each plug-in with one that is known to be in proper operating condition. Then, by noting the operation after each is replaced, you can determine which plug-in is faulty. If replacement of either plug-in does not produce proper operation, the trouble is in the Indicator Unit.

Whenever an apparent trouble is encountered, you should first make sure that it is not due to an improper control setting. (For example, improper settings of the SOURCE and COUPLING switches on a time-base unit can produce apparent triggering troubles; an improperly set VARIABLE control can cause an apparent decrease in sensitivity.) Then check the front-panel calibration adjustments. (An improperly set STABILITY adjustment on a time-base unit can cause apparent triggering problems; an improper dc balance setting can cause the trace to be positioned completely off the screen when the POSITION control is set at mid-range.)

When is has been determined that a trouble definitely exists, and that trouble has been isolated to a given circuit within a given unit, perform a complete visual check of that circuit. Some troubles, such as loose wires, faulty switches, and improperly seated tubes, can be found most easily by visual inspection. Check also for scorched parts. You should find and eliminate the cause of the overheating before replacing a scorched part.

Faulty tubes are the most prevalent cause of circuit troubles. Therefore, if a visual check does not reveal the source of the trouble, you should next check all the tubes in the particular circuit. Do this by substituting good tubes for the ones in the circuit; a "tube tester" often will not adequately indicate the suitability of a tube for a given function in a circuit. If there is more than one tube in the suspected circuit, the most satisfactory method of checking them is to replace all of the tubes, and then substitute the original tubes, one at a time, back into the circuit until the faulty tube is discovered. Be sure to return all good tubes to their original sockets; otherwise you may have to recalibrate the circuit unnecessarily because of slightly different characteristics of the tube type.

If tube substitution does not eliminate the trouble, you will have to check the rest of the circuit by voltage and resistance measurements. Some of the voltages in the instrument are given in the schematic diagrams. These voltages are typical nominals only and, with the exception of the power supply voltages, may vary somewhat 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. Whenever possible, to facilitate circuit tracing, the wiring in the Type 560 Oscilloscope is color-coded. For example, the —100-volt bus is coded brown-black-brown; the 125-volt bus is coded brown-red-black on white; and the 300-volt bus is coded orange-black-brown on white.

Switch wafers shown on the schematic diagrams 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 the rear of the wafer is used to perform the particular switching function.

Sometimes it may be necessary to move the plug-in units from one opening to the other in order to gain access to the particular part of the circuit you wish to check. If, for some reason, you do not wish to move the plug-in units to work on them, a plug-in extension (Tek Part No. 013-034) is available which allows the units to be operated while partially extended out through the front of the oscilloscope.

Normally, a trouble in the oscilloscope will be discovered through an erroneous display (or no display at all) on the crt. For this reason, the following troubleshooting information is divided according to the symptoms presented to the operator.

No Spot or Trace

If you are unable to obtain a trace on the screen, pull out both plug-in units and adjust the INTENSITY control. A spot should appear on the screen. If it does not, the trouble is in the Indicator Unit. If a spot does appear when both plug-in units are pulled out, reinsert each separately and adjust its POSITION control. If the spot or trace cannot be returned to the approximate center of the screen when one of the plug-ins is inserted, the trouble is in that unit.

Insufficient Deflection

If the horizontal or vertical deflection cannot be set to the proper value with the GAIN ADJ. or CALIBRATION adjustment on the plug-in front panel, you should first check the power supply voltages at pins 10, 15, 16 and 23 of the plug-in connectors, and the high voltage (—3300 volts) at the cathode of the crt. If these voltages are all within the tolerances shown on the schematic diagram, the trouble is in one of the plug-in units—if there is insufficient vertical deflection, it is in the left-hand unit; if there is insufficient horizontal deflection, it is in the right-hand unit.

If the power supply voltages are not as specified on the schematic diagram, remove one of the plug-ins and check the voltages again. If they still are not as specified, reinsert the plug-in and remove the other and check the voltages again. (The voltages will not be in regulation with both units removed.) If the power supply voltages are still not as specified, the trouble is in the Indicator Unit (or both plug-ins are faulty). If the power supply voltages are correct with one plug-in inserted but incorrect with the other inserted, the trouble is probably in the plug-in that causes the voltages to be incorrect. To troubleshoot the plug-in, check the resistance between ground and pins 10, 15, 16, and 23 of its interconnecting plug. If the resistance measurements at these terminals are not as indicated on the schematic diagram for that plug-in, the trouble is in the plug-in unit. Otherwise, the trouble is in the Indicator Unit.

Improper Sweep Timing

If improper sweep timing is encountered (and cannot be eliminated by adjustment of the front-panel CALIBRATION adjustment on the time-base unit), you should first check the power-supply voltages at the plug-in connectors and the high voltage (—3300 volts) at the crt cathode. If these voltages are as specified on the schematic diagram, the trouble is in the time-base unit. If one or more of these voltages are not as specified, proceed as described in the preceding paragraph.

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 plug-in amplifier. If satisfactory triggering is not obtained from any of the three triggering sources, the trouble probably lies in the time-base plug-in.

Waveform Distortion

If there is an excessive amount of waveform distortion, but no other indications of malfunction (such as improper sweep timing or insufficient deflection), the trouble is in the plug-in which is amplifying the distorted waveform.

CALIBRATION

To maintain a high degree of accuracy and reliability, the Type 560 Oscilloscope and all plug-in units should be calibrated after each 500 hours of operation, or about every six months, whichever is sooner. In addition, the calibration of a unit should be checked and adjusted as necessary after the replacement of any part in the unit.

Procedures for calibrating the Indicator Unit are presented in Section 2 of this manual. Procedures for calibrating the plug-in units are contained in the plug-in manuals.

Normally, you will calibrate the instrument with both plug-in units inserted. When performing a complete calibration, you should calibrate the Indicator Unit first, then the amplifier plug-in unit (or units), and then the time-base plug-in, if one is used.

SECTION 2
INDICATOR UNIT

INTRODUCTION

The Indicator Unit of the Type 560 Oscilloscope contains a power supply, a cathode-ray tube and associated circuitry, and a calibrator.

The power supply provides regulated dc voltages for use throughout the oscilloscope.

The crt circuit contains the necessary controls and adjustments for presenting a sharp trace of desired intensity to display the signals applied to the deflection plates by the plug-in units.

The calibrator produces a line-frequency amplitude-calibrated square wave for use in setting the gain of the amplifier units and the timing of the time-base unit. The settings of the CALIBRATOR switch indicate the peak-to-peak amplitude of the square wave available at the CAL. OUT connector. The negative half-cycle is at ground potential.

The numbered settings of the SCALE ILLUM. control may be used as an approximate exposure guide when you are photographing waveforms on the Type 560 Oscilloscope. The numbers indicate the recommended f-stop for the camera when using the type of film and the exposure time specified on the panel below the control. The graticule should be mounted to produce white lines and the trace should be about the same intensity as the graticule lines for best photographic results. (The graticule lines may be changed from red to white or vice versa simply by removing the graticule cover and rotating the graticule by 180°.)

CIRCUIT DESCRIPTION

Power Supply

T601 is the main power transformer for the Type 560 Oscilloscope. It has two separate primary windings which may be connected in parallel for 117-volt operation or in series for 234-volt operation, as shown on the schematic diagram. A 2-amp fast-blowing type fuse should be used for 117-volt operation; a 1-amp slow-blowing type fuse should be used for 234-volt operation. The power supply is designed to provide proper regulation of all regulated outputs at source voltages between 105 and 125 volts rms or between 210 and 250 volts rms, depending upon whether the power transformer is wired for 117- or 234-volt operation.

TK601 is a thermal cutout switch which shuts off all power to the instrument if the internal temperature exceeds a safe operating limit. TK601 closes automatically when the temperature again drops to a safe operating point; manual reset is not required.

The secondary of T601 has six separate windings. Five of these windings supply 6.3 volts ac to indicator lights and tube filaments in the Indicator Unit and both plug-in units. The other secondary winding provides 170 volts rms to a voltage doubler. The output of the voltage doubler is about 420 volts dc. This 420 volts dc is used as B+ for the oscillator tube, V620, and the +300-volt regulator tubes.

V620, the primary of T620, and part of the secondary of T620 form an Armstrong oscillator circuit which drives T620 at about 25 kc. The outputs of T620 are rectified and filtered to provide regulated dc voltages of −12, +125, −100, and −3400 volts.

Each of the T620 secondary windings bears a fixed turns relationship to the others so that a change in one output effects a proportional change in each of the others. Adjustment and regulation of all of the output voltages, then, are accomplished through adjustment and regulation of just one output, the −100 volts. The −100-volt output is also used as the reference for the +300-volt supply. The reference for the −100-volt supply is the voltage drop across the gas-filled voltage-reference tube, V609. The nature of this tube is such that it maintains a constant voltage drop of about 85 volts across itself regardless of the current through it, within rather wide limits.

Adjustment of the output voltages is accomplished by means of the −100 VOLTS adjustment, R641. Moving the wiper arm of R641 in a positive direction (toward R640) decreases the bias on V634B, allowing more current to flow through the tube. This lowers the voltage at the plate of V634B and, therefore, at the grid of V634A. This, in turn, causes an increase in the voltage at the plate of V634A and the screen of V620. Increasing the screen voltage of V620 increases the plate current of the tube, and thereby increases the amplitude of oscillations in the primary and secondary of T620. This results in a greater output from all of the supplies.

Moving the wiper arm of R641 in a negative direction (toward R642) will have the opposite effect throughout the circuit and will result in a decreased output from all supplies. During calibration, R641 is set so that all of the supplies are within specified tolerances of their nominal values.

Regulation is accomplished in essentially the same manner. A decrease in the source voltage to which the oscilloscope is connected, or a decrease in any of the output voltages (except the +300 volts) due to loading, causes the volts per turn in the secondary of T620 to decrease. This causes the −100-volt supply to drop (move positively) with the resulting rise in the grid voltage of V634B. (The +85 volts at the top of R640 remains constant.) This results in a rise in the screen voltage of V620 and an increase in the amplitude of oscillations, bringing the power supply outputs back to their nominal values. An increase in any of the output voltages (except the +300 volts), whatever the reason, has the opposite effect on the screen voltage of V620 and decreases the amplitude of oscillations in T620. C642 speeds up the response of the regulating circuit to fast changes in output, thereby helping to eliminate ripple.

Regulation of the +300-volt supply is accomplished as follows. R661 and R662 between the +300-volt output and the −100-volt output form a voltage divider which sets the bias on V657B. If the output of the +300-volt supply drops, this will increase the bias on V657B. The resulting decrease in current through V657B causes a rise in the grid voltage of V657A. The cathode follows the grid and brings the +300-volt output back up to its proper level. Likewise, if the +300-volt output rises from its nominal, the grid

of V657B will rise, the grid of V657A will drop, and the +300-volt output will be brought back down to its proper level.

A small sample of the ripple on the +420-volt unregulated line is applied to the screen of V657B through R650. This produces a ripple component at the grid of V657A which is opposite in polarity to the ripple appearing at the plate of V657A. This tends to cancel the ripple on the +300-volt supply. This same circuit also improves the regulation of the +300-volt supply in the presence of line-voltage variation.

D634 and D637 are provided to assure prompt starting of the 25-kc oscillator when an adverse loading situation occurs on one of its outputs, such as a cold vacuum tube heater on the —12-volt supply.

Power Supply Capabilities

The following information is intended to aid you in designing your own plug-in unit for use with the Tektronix Type 560 Oscilloscope. Skeleton plug-in chassis for this purpose and other accessories are shown in the Accessories Section of this manual.

The following charts show current output capabilities of the Type 560 power supplies and current consumption of the available Tektronix Type 50/60 series plug-in units.

Type 50/60 Series Plug-In Power Requirements

	Voltages				
Plug-In Type	—100 volt	—12 volt	+125 volt	+300 volt	Filament 6.3 vac
50	30 ma	365 ma	2 ma	16 ma	0.8 amp
51	35 ma	———	17 ma	19 ma	2.93 amps
59	31 ma	———	12 ma	18 ma	1.2 amps
60	18 ma	300 ma	18 ma	18 ma	1.3 amps
63	45 ma	365 ma	6 ma	22 ma	0.9 amp
67	55 ma	———	35 ma	25 ma	3.1 amps

Type 560 Oscilloscope Power Capability

Terminal No.	Supply	Current/Plug-In	Total Current	Watts
23	—100 volts	50 ma	100 ma	*10 w
5	—12 volts	350 ma	700 ma	8 w
15	+125 volts	28 ma	56 ma	7 w
10	+300 volts	0 to 25 ma	50 ma	——
			Total	25 w
	AC Power at Line Frequency			
1 and 2	6.3 volts rms	5 amps	———	
7 and 8	117 volts rms	5 amps (117-volt line connection only). VA rating of ac transformer must not be exceeded on 234-volt line connection.		

*** The wattage shown for the —100-volt supply may be exceeded (up to 25 watts) providing the —12-volt or the +125-volt supply is not operating at full capacity and that the combined power output (of the —100-, —12-, and +125-volt supplies) does not exceed 25 watts. Also, the —100-volt supply must have a minimum load (at least 20% of full load) at all times in order to regulate properly.**

CRT Circuit

The cathode-ray tube supplied with the Type 560 Oscilloscope is a Tektronix Type T503P2. P1, P7, P11, and other phosphors are available on special order. The accelerating potential is approximately 3475 to 3500 volts, provided by a potential of about —3300 volts on the crt cathode and about +175 volts on the aquadag coating. The nominal horizontal and vertical deflection factors are approximately 19 and 23 volts per centimeter, respectively, at this accelerating potential.

The high-voltage source for the crt cathode is the —3400 volts at the plate of V692 in the power supply. Voltage drops across R849, R847, and (when the crt is conducting) R854 place the cathode at approximately —3300 volts with respect to ground. One-half the drop across R847 and R849 plus the drop across R854 is the bias on the tube, which varies from about 20 volts at maximum intensity to

about 75 volts at minimum intensity. The FOCUS adjustment operates in the range from about —2100 to about —2800 volts with respect to ground (about +500 to +1200 volts with respect to the cathode).

Deflection-plate unblanking is used in the Type 560 Oscilloscope cathode-ray tube. Two special deflection plates are mounted in the crt gun structure for this purpose. As long as the potential on the two plates is about equal, the electron beam will not be deflected toward either and will pass through the gun to the crt screen. Normally, the voltage on each plate is about +125 volts. If one of the plates is at a significantly different potential than the other, the electron beam will be deflected and absorbed by one of the plates and the accelerating anode; therefore, the screen will be blanked.

The voltages on the unblanking plates can be controlled only by the plug-in unit in the right-hand opening of the Indicator Unit. In conventional operation, a time-base unit in the right-hand opening will hold the plates at different potentials between each sweep so that the retrace of the electron beam will not be observed. Once the time-base unit starts its sweep, it returns each plate to about the same potential and the electron beam is allowed to pass through to the crt screen. If other than a time-base unit is in the right-hand opening (or no plug-in at all), the plates will be held at the same potential and the crt will be continuously unblanked.

C760 and C761 (shown on the Plug-In Connectors schematic) provide the means of adjusting the effective capacity of the deflection plates (not the unblanking deflection plates), as seen by each plug-in in the instrument. (The "effective" deflection-plate capacity is the capacity seen by the plug-ins at terminals 17 and 21 of the plug-in connectors when the two terminals are driven by equal voltages of opposite phase, which is the case in all units with a push-pull output.) This capacity affects the bandpass of a plug-in and the phase shift adjustments. C760 and C761 are adjusted at the factory to provide an effective deflection-plate capacity of 16 picofarads between both pairs of deflection plates. The procedure for adjusting this capacity to the correct value, if needed, is described in the Calibration section of this manual.

Calibrator

The calibrator for the Type 560 Oscilloscope produces a line-frequency amplitude-calibrated square wave.

In the line-frequency calibrator, 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 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 switch.

TROUBLESHOOTING

General maintenance and troubleshooting information is contained in Section 1 of this manual. In the following discussion it is assumed that you have read that information and have definitely isolated a trouble to the Indicator Unit by the procedures described there.

The first step in troubleshooting the Indicator Unit is to measure the power-supply voltages, both at the outputs of the supplies (see Fig. 2-1) and at pins 10, 15, 16, and 23 of the interconnecting plugs. (Two plug-in units known to be in proper operating condition, or which have been checked for proper resistance between the interconnecting plugs and ground, should be inserted. If one of the plug-ins is a time-base unit, its TIME/DIV. switch should be set to EXT. INPUT.) Checking each of the voltages at both places will pinpoint any broken wires in the circuit. If the outputs of all of the supplies are correct (as shown on the schematic diagram), but trouble still exists in the Indicator Unit, the trouble is probably in the crt circuit, in the —3400-volt supply, or in the crt itself. In this case, check the voltages and resistances in the crt circuit. If they are all as indicated on the crt schematic diagram, the crt is faulty and must be replaced.

If all of the voltages are correct except the +300 volts, the trouble is in the +300-volt regulating circuit.

If the +300-volt supply is at or near +100 volts and the others are at or near zero, the oscillator is not oscillating. This can be due to a bad oscillator circuit or to excessive loading of one of the supplies. (Excessive loading of the —12-, —100-, or +125-volt supplies can prevent the oscillator from oscillating.) First change V620 and V634. If this does not eliminate the trouble, check the continuity of T620, the resistance of R621, R623, and R626, and check to see if C621 or C626 is shorted. If all of these components are good, the trouble is probably an overload.

To isolate the overload supply, disconnect D682, D672, V692, and D683 in that order, checking to see if the oscillator is oscillating after each disconnection. The most probable cause of this trouble is a shorted power diode. As you disconnect each diode, do not reconnect the one previously disconnected. After each disconnection, check to see if the oscillator is oscillating. This can be done by checking the voltage on the remaining connected supplies, by checking for heater glow in V692, or by holding a neon bulb near V692 (it will glow if the oscillator is operating properly). When you have disconnected the overload supply, the oscillator should start oscillating. Then locate the cause of overloading by resistance checks and parts replacement.

If, when you measure the voltages at the interconnecting plug, you find that the —12-, —100-, and +125-volt outputs are all reduced by approximately the same proportion, but are not at zero, the trouble is either an overloaded supply or a faulty regulator circuit. Check the voltage at the screen of V620. If it is more than about +50 volts, the regulator is trying to regulate so the trouble is an overloaded supply. In this case, disconnect the diodes as described in the previous paragraph to locate the faulty supply. If the screen voltage of V620 is significantly below +37 volts, the trouble is probably in the regulator circuit. Change V634. If this does not eliminate the trouble, check

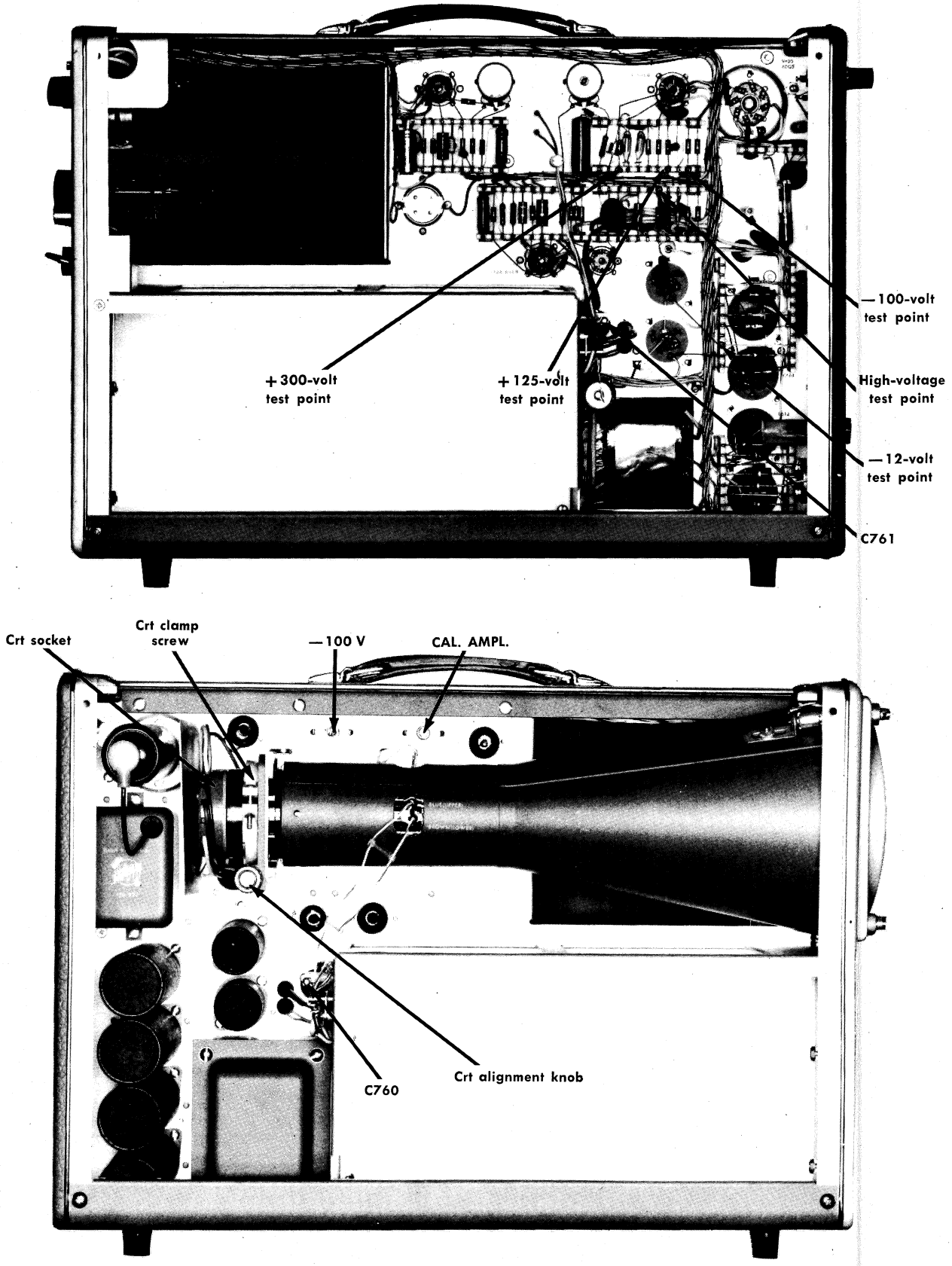


Fig. 2-1. Type 560 Indicator Unit, right and left side views.

the rest of the circuit by voltage and resistance measurements. (The regulator voltages given on the power supply schematic diagram are average values; they will vary considerably with the loading on the supplies.)

If all of the power supply voltages are high, the trouble is probably a faulty V609 or a faulty regulator circuit. Check the voltage at the plate (pin 5) of V609. If it is about +85 volts, the trouble is in the regulator circuit.

CALIBRATION

The following equipment is required for a complete calibration of the Type 560 Oscilloscope Indicator Unit:

1. Dc voltmeter (sensitivity of at least 5000 ohms per volt), calibrated for an accuracy of 1% or better from 0-300 volts, and for an accuracy of 3% or better 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 0-125 volts (0-250 for 234-volt operation).

4. Capacitance meter capable of a measurement accuracy of 0.1 picofarad or better at 16 picofarads; meter must have a guard voltage available. Tektronix Type 130 L-C Meter recommended.

To set up the Type 560 for calibration, insert two plug-in units known to be in proper operating condition into the oscilloscope. If one plug-in is a time-base unit, set its TIME/DIV. switch to EXT. INPUT. Connect the autotransformer to a suitable power source and connect the Type 560 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 or 234).

Allow the equipment to warm up for about 5 minutes.

Power Supply

With a minimum load of at least one plug-in unit, measure the output of the +300-, +125-, −12-, and −100-volt supplies at pins 10, 15, 16, and 23, respectively, of either plug-in connector. Set the −100 VOLTS adjustment (Fig. 2-1) so that all of the supplies are within the tolerances shown on the schematic diagram.

NOTE

Changing the setting of the −100 VOLTS adjustment will probably change the calibration of both plug-in units. For this reason, you should not change its setting unless necessary to bring the supply outlets to the proper level, or unless you intend to perform a complete calibration of the entire instrument and plug-in units.

Cathode-Ray Tube

Check to see that the face of the cathode-ray tube rests snugly against the graticule. If it does not, loosen the crt clamp screw (Fig. 2-1) and move the tube forward by pushing on the tube socket. Then tighten 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, apply a signal to the right-hand plug-in to produce a horizontal trace at least 10 divisions long. Position the trace directly behind the horizontal centerline of the graticule. Adjust the crt alignment knob (Fig. 2-1) as necessary to align the trace with the graticule line.

Calibrator

Set the CALIBRATOR switch to OFF, and set the CAL. AMPL. adjustment (Fig. 2-1) so that the voltage at the cathode (pin 7) of V884B is exactly +100 volts. Calibration of the various settings of the CALIBRATOR switch is not necessary.

Effective Deflection-Plate Capacity

The effective deflection-plate capacity of the cathode-ray tube, as seen by the plug-in units, can be adjusted by means of C760 and C761. This capacity has been set at the factory to provide a standard effective deflection-plate capacity of 16 picofarads for all instruments. If C760 or C761 has been inadvertently misadjusted, or if the cathode-ray tube has been changed, the effective capacity between one or both pairs of plates may be altered slightly. This is of consequence only if you are using a wide-band amplifier (such as the Type 60) near the limit of its bandpass or if you are using two amplifiers for X-Y phase comparison. If proper response cannot be obtained throughout the bandwidth of a wide-band amplifier, or if X-Y phase measurements differ when the amplifier plug-in units are interchanged between openings, the effective deflection-plate capacity is probably not at the proper value at one or both plug-in connectors.

Since the effective deflection-plate capacity of the cathode-ray tube is that capacity seen by the plug-in units when the deflection plates are being driven push-pull, it cannot be measured directly with a capacitance meter.

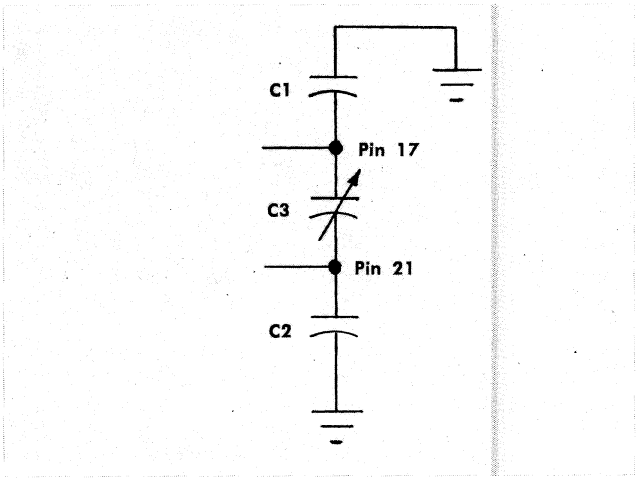


Fig. 2-2. Schematic representation of effective deflection-plate capacity.

However, the circuit capacitances which make up the effective deflection-plate capacity at each set of plates can be measured with a capacitance meter. The capacitances may be represented schematically as shown in Fig. 2-2. C1 and C2 in the figure represent the capacity from each deflection plate to ground. C3 represents the capacity between the plates, plus the adjustable capacity of C760 or C761. Since the deflection plates are driven push-pull, the effective deflection-plate capacity, C_{eff}, may be expressed in terms of C1, C2, and C3 as follows:

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

C1 and C2 are fixed, but vary slightly among instruments and between openings of the same instrument. C3 is adjustable by means of C760 or C761. Setting C_{eff} equal to 16 picofarads (the factory standard) and rearranging terms, we obtain:

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

Thus, by measuring C1 and C2, we can determine the desired value of C3. We can obtain this value of C3 by adjusting C760 or C761.

To properly set the effective deflection-plate capacity, proceed as follows:

1. Disconnect the power cord and isolate the oscilloscope from ground.

2. Either plug a blank 24-pin connector into the left-hand plug-in connector or insert any plug-in unit into the left-hand 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 pin 17 and measure the capacity between pin 21 and the oscilloscope chassis. This is C2.

5. Substitute the measured values of C1 and C2 into the equation and solve for C3.

6. Connect the guard voltage to the oscilloscope chassis and measure the capacity between pins 17 and 21 of the plug-in connector.

7. Adjust C760 (Fig. 2-1) until the measured capacity in step 6 equals the value of C3 obtained in step 5.

8. Disconnect the capacitance meter and resolder any unsoldered leads.

9. Repeat steps 1 through 8, applying them to the right-hand opening and adjusting C761 (Fig. 2-1) instead of C760.

SECTION 3

ACCESSORIES

The Type 560 Tektronix Oscilloscope will fit many measurement applications 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 or Representative. Complete, up-to-date price information is also available through your local Field Office or Representative.

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 Field Engineer or Representative.

SIGNAL AMPLIFIER PLUG-IN UNITS FOR THE 560 SERIES OSCILLOSCOPES

The Type 560 Oscilloscope is designed to use any of the Tektronix plug-in units numbered 50 through 69. The Type 561/565/567 series of oscilloscopes will accept plug-in units numbered 50 through 79. The basic difference between the Type 560 and other 560-series oscilloscopes is the amount of power available from the indicator power supplies.

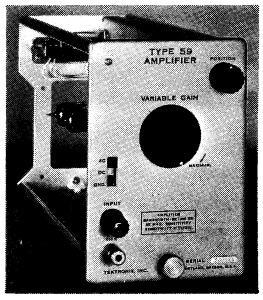
Tables 3-1 and 3-2 list all plug-in units currently available from 50 through 69, and their general characteristics. Probes are not included with the plug-in units and should be ordered separately. Probes satisfactory for use with the plug-in units are listed in Tables 3-7 and 3-8.

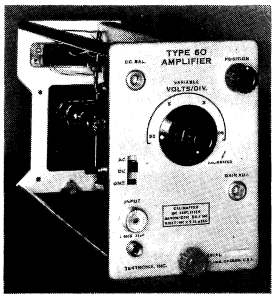
TABLE 3-1

AMPLIFIER PLUG-IN UNITS FOR TYPE 560 OSCILLOSCOPE

General Description	Type	3-db Frequency Response	Input	Calibrated Deflection Factors
Basic, AC-Coupled	50	15 cps to 200 kc	1 meg Ω	1 mv/div
Basic, DC-Coupled	59	Dc to 400 kc	250 k	Approximately 1 v/div
General Purpose	60	Dc to 1 mc	1 meg Ω, 47 pf	50 mv/div to 50 v/div in 4 calibrated steps
Low-Level AC Differential	61*			50 μv/div
High-Gain DC Differential	63	Dc to 300 kc each channel	1 meg Ω, 47 pf each channel	1 mv/div to 20 v/div in 14 calibrated steps. Differential rejection ratio up to 2000:1

*** In development stage at time of printing.**





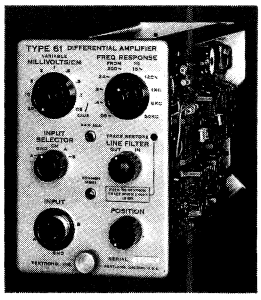
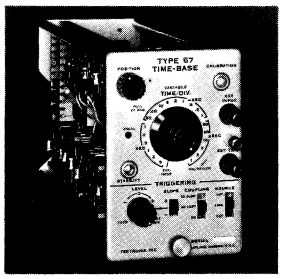
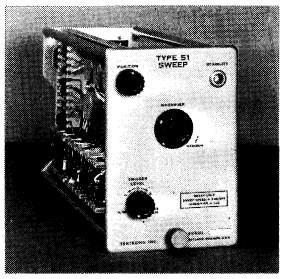


TABLE 3-2
TIME-BASE PLUG-IN UNITS
FOR TYPE 560 OSCILLOSCOPE

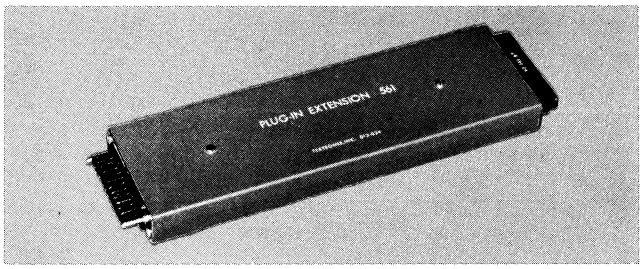
General Description	Type	Calibrated Sweep Range	Sweep Magnifier
Simplified Time-Base	51	5 msec/div	Variable, approximately 1X to 20X
Basic Time-Base	67	1 μsec/div to 5 sec/div in 21 calibrated steps	5X

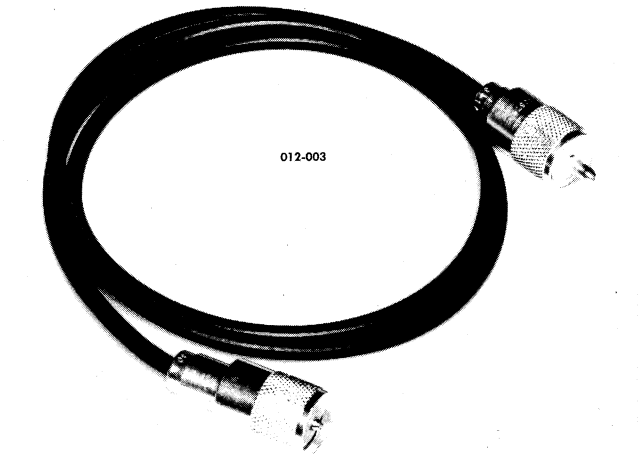




PLUG-IN EXTENSION

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.
Part number 013-034





COAXIAL CABLES

Coaxial cables with UHF connectors are listed in Table 3-3.

TABLE 3-3

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, ½-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

INTERCONNECTING LEADS

Several types of interconnecting leads are listed in Table 3-4. These are valuable when patching between circuits or between panel connectors of Tektronix oscilloscopes.

TABLE 3-4

INTERCONNECTING LEADS

Description	Part Number
Type W13OB. Black, 30" flexible output lead with banana plug at one end and alligator clip at other.	012-014
Type W13OR. Same as Type W13OB 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

UHF SYSTEM ATTENUATORS

When working with UHF coaxial systems, the attenuators listed in Table 3-5 will function properly when terminated with a termination resistor of the same value. Termination resistors are listed in Table 3-6.

TABLE 3-5
UHF SYSTEM ATTENUATORS
Fittings: One UHF Plug-One UHF Jack

Description	Part Number
50 Ω 10:1 T Attenuator, 1.5 watts.	011-031
50 Ω 5:1 T Attenuator, 1.5 watts.	011-032
75 Ω 10:1 T Attenuator, 1.5 watts.	011-033
75 Ω 5:1 T Attenuator, 1.5 watts.	011-034
93 Ω 10:1 T Attenuator, 1.5 watts.	011-035
93 Ω 5:1 T Attenuator, 1.5 watts.	011-036
50 Ω to 75 Ω Minimum Loss Attenuator	011-041 Replaces 011-004
50 Ω to 93 Ω Minimum Loss Attenuator	011-042 Replaces 011-014
50 Ω to 170 Ω Minimum Loss Attenuator	011-043 Replaces 011-005

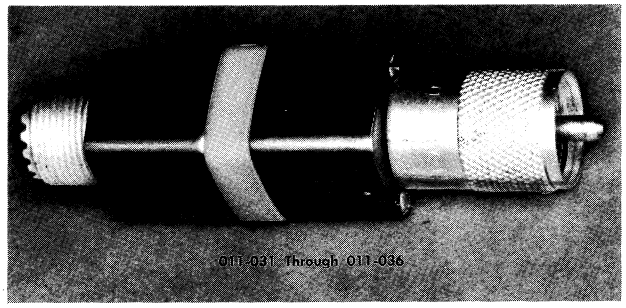
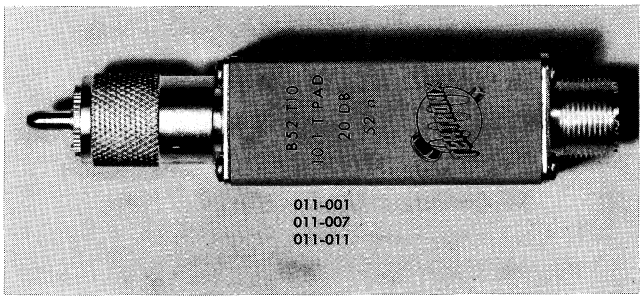


TABLE 3-6
UHF SYSTEM TERMINATIONS
Fittings: One UHF Plug-One UHF Jack

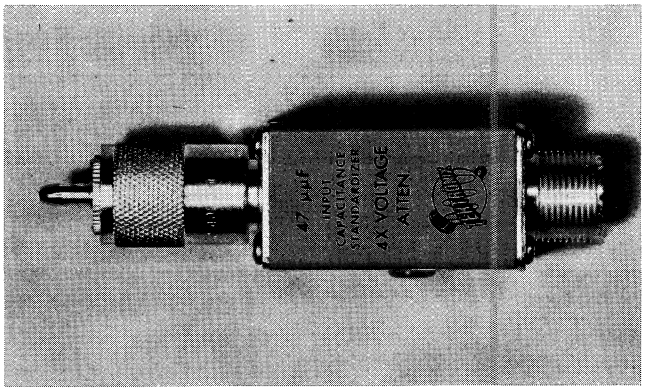
Description	Part Number
52 Ω Terminating Resistor, 1.5 watts	011-001
75 Ω Terminating Resistor, 1.5 watts	011-007
93 Ω Terminating Resistor, 1.5 watts	011-011



SIGNAL AMPLIFIER INPUT CAPACITANCE STANDARDIZER

Standardization of 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 47-pf (input capacitance) plug-in units; 4X attenuation: Part number 011-021



PROBES

The most common method of connecting signals to a signal 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.

Several probe types are listed in Tables 3-7 and 3-8.

P6017-Series Probes—The P6017-series of probes preserves the transient response of Tektronix 560-series instruments. The 42-inch cable length of P6017 Probes provides uniform amplitude response with no overshoot or ringing. Average bandpass characteristics show the P6017 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.

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

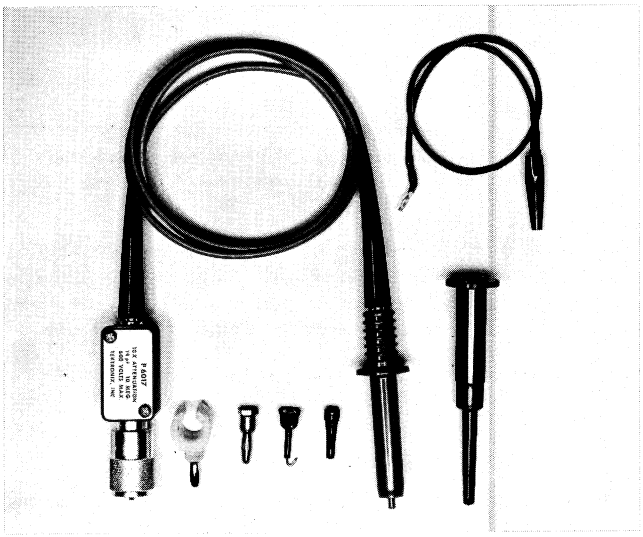


TABLE 3-7
P6017-SERIES PROBE SPECIFICATIONS

Probe and Connector	Cable Length	Atten. Ratio	Input Impedance			Voltage Rating (Max.)	Part Number
			Resistance Meg Ω	Capacitance—pf Min.*	Max.**		
P6017-UHF	42 in.	10	10	14	14	600	010-033
	6 ft.	10	10	17	17	600	010-056
	9 ft.	10	10	20	20	600	010-057
	12 ft.	10	10	23	23	600	010-058
P6027-UHF	42 in.	1	1	67	94	600	010-070
	6 ft.	1	1	94	120	600	010-071
	9 ft.	1	1	120	147	600	010-072
	12 ft.	1	1	146	173	600	010-073

* When connected to instruments with 20-pf input capacitance.
** When connected to instruments with input capacitance up to 50 pf.

100X Probes—Probes having an attenuation ratio of 100 are listed in Table 3-8. These probes are provided in the event you require very small capacitance 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.

Physical dimensions of the probe body are $\frac{7}{16}$ inch in diameter and $3\frac{5}{8}$ 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.

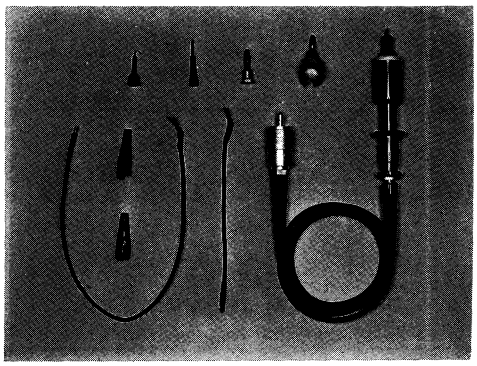


TABLE 3-8
100X PROBE SPECIFICATIONS

Probe and Connector	Cable Length	Atten. Ratio	Input Impedance			Voltage Rating (Max.)	Part Number
			Resistance Meg Ω	Capacitance—pf Min.*	Max.**		
P6002-UHF	42 in.	100	9.1	2.5	2.8	2000	010-024
	6 ft.	100	9.1	2.8	3.25	2000	010-034
	9 ft.	100	9.1	3.5	4.0	2000	010-043
	12 ft.	100	9.1	3.8	4.0	2000	010-044

* When connected to instruments with 20-pf input capacitance.
** When connected to instruments with input capacitance up to 50 pf.

Type P6014 High-Voltage Probe—This new probe provides a means of observing waveforms of high amplitudes. Dc amplitudes to 12 kv or short pulses with peak amplitudes to 25 kv can be measured without damage to the probe.

Attenuation Ratio—1000.

Frequency Response—Dc to over 30 mc.

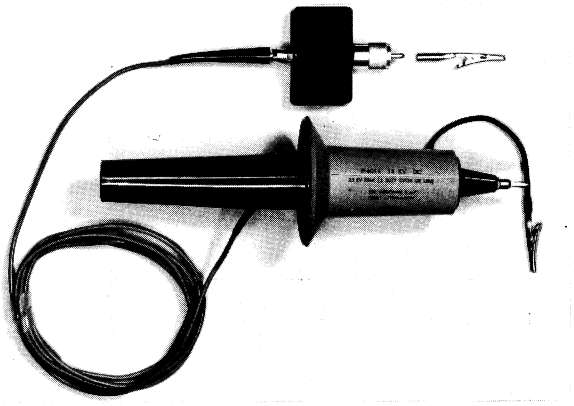
Input Impedance—10 megohms and 3 pf.

Pulse Rating—10% or less duty cycle for 25 kv pulses, with maximum pulse duration of 0.1 sec.

A compensating box at the oscilloscope end of the probe cable enables the P6014 to be properly compensated to any oscilloscope having an input 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.

The probe includes 2 banana-plug tips, an alligator-clip assembly, and an attached $7\frac{1}{2}$-inch ground lead.
Part number 010-025



CATHODE-RAY TUBES

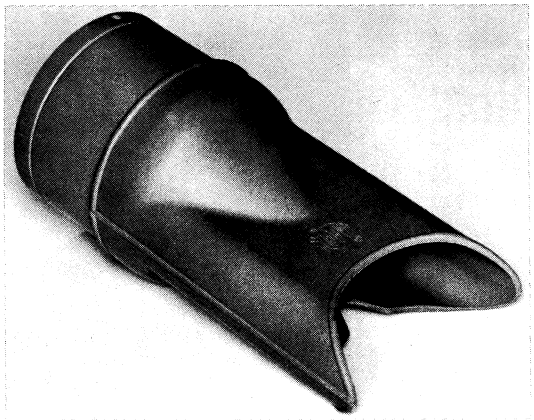
The Type 560 Indicator crt is normally provided with P2 Phosphor. P1, P7, P11, or P31 Phosphors supplied at no additional charge on special request.

CRT for Type 560 Indicator, T503P2: Part number .. 154-265

CRT VIEWING HOOD

Valuable for use in brightly lighted rooms, a special Tektronix crt viewing hood eliminates bothersome ambient light.

Viewing Hood: Part number 016-001

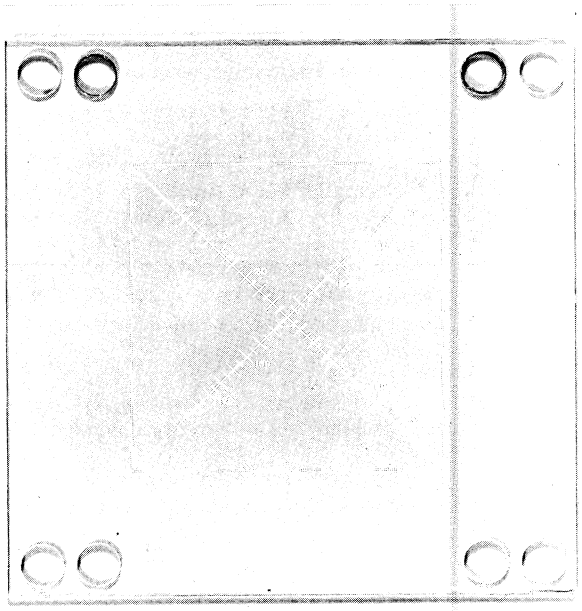


CRT GRATICULES

The graticule shipped with the Type 560 Oscilloscope has the part number 331-056.

In addition, a special graticule for making X-Y phase measurements using Lissajous patterns is available on special order.

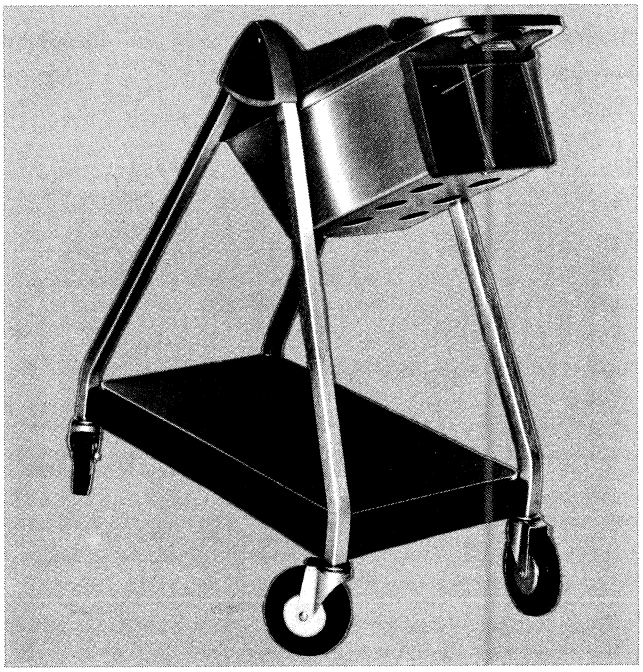
Phase Measurement Graticule: Part number 331-057



OSCILLOSCOPE TABLE

The Tektronix Type 201 Scope-Mobile® provides a mobile support for medium-size oscilloscopes or other electronic instruments. Designed for the busy engineer, the easily adjustable (through nine 4.5° steps) tray places the instrument at desk height or at any convenient angle for optimum viewing. Mounted on 5-inch rubber tired wheels, the Scope-Mobile table is easily moved around the work area. An optional plug-in carrier makes it convenient to store extra oscilloscope plug-in units (560/561 series), keeping them dust-free and minimizing the possibility of damage. Order plug-in carrier separately as part number ..... 014-007.

® **Registered trademark, Tektronix, Inc.**



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. Tools marked with a ✔ are necessary for recalibration of 560-series instruments.

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.

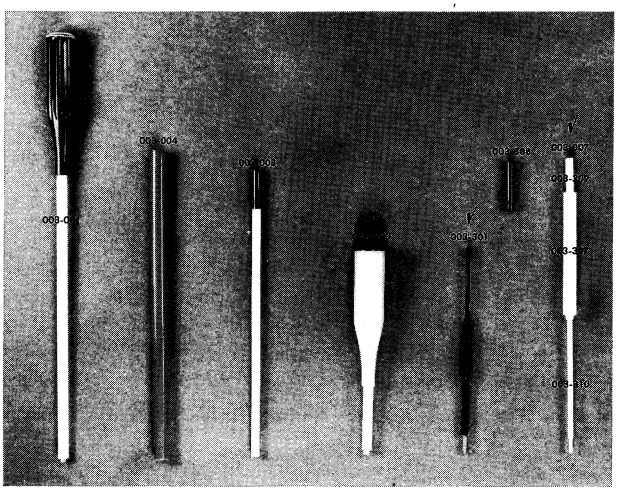
003-007 Tektronix recalibration tool assembly. This 4-unit tool assembly provides most of the necessary tools for adjusting variable inductors in Tektronix instruments.

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

Part No. 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, or f/4.5. Object-to-image ratios include 1:1, 1:0.9, 1:0.7, 1:0.5.

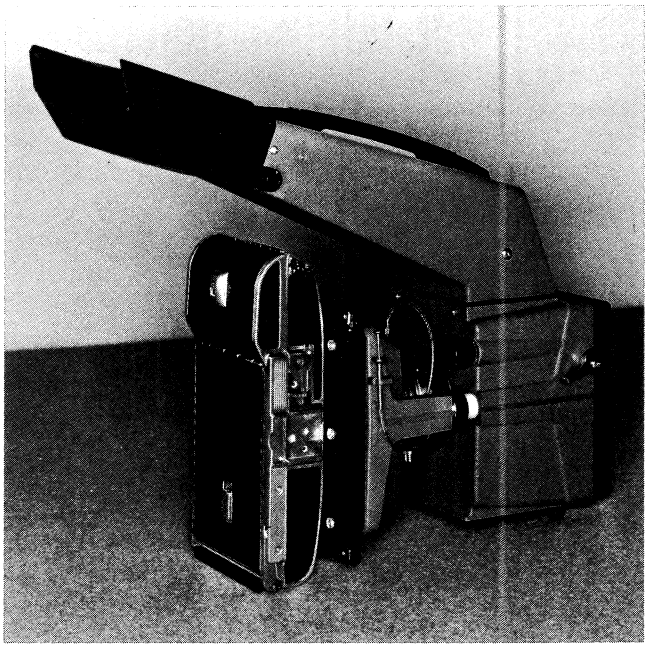
Interchangeable Back—Accepts all standard Graflok accessories. Backs may be interchanged without refocusing.

Binocular Viewing—Orthogonal and undistored over full 8 x 10 cm area.

Hinge Mounting—Camera swings away from crt screen 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.

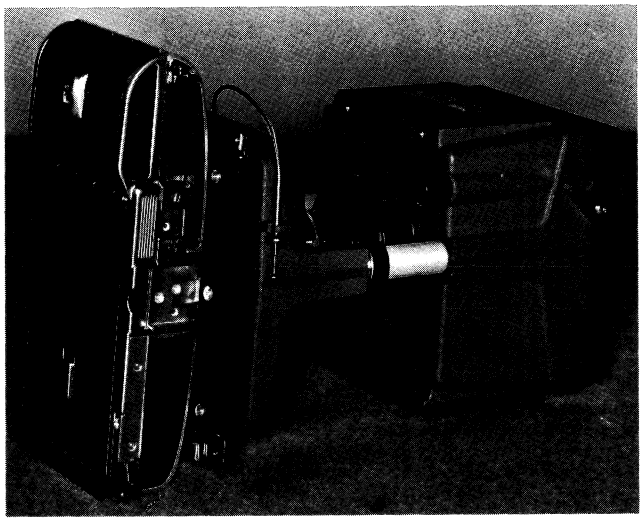
Standard C-12 Camera shipped with f/1.9 Oscillo-Raptar lens having 1:0.9 object-to-image ratio, focusing 4 x 5 Graflok back, and Polaroid roll-film back.



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.



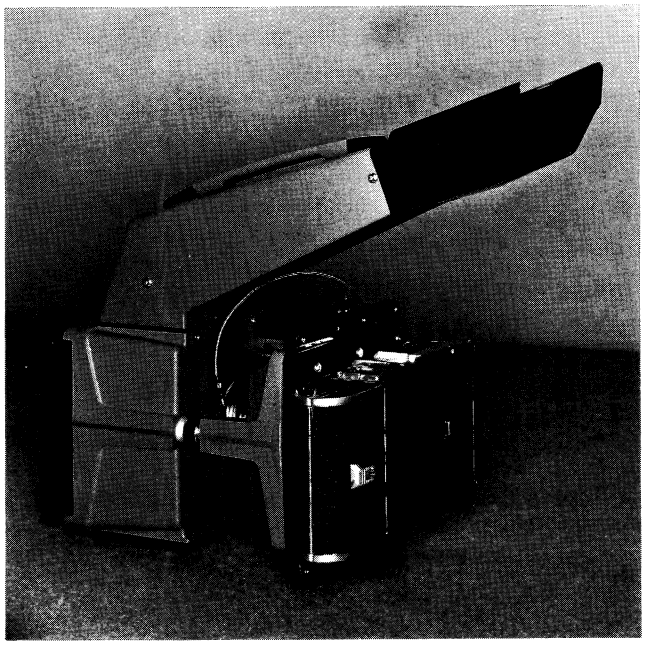
Type C-19 Camera*

Same style as the C-12 Camera except that is it 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.

*** When ordering your camera, please specify the oscilloscope(s) it is to be used with.**



AUXILIARY DEVICES

Type BE510 Bezel

Type BE510 Bezel for mounting other than Tektronix cameras on Tektronix 5" oscilloscopes. Dimensions: 5⅞" square; ring ⅞" deep, diameter 5⅝" outside, 5⅛" inside. Die-case construction, wrinkle finish, felt lined. Not useable on Type RM561.

Gray, part number 014-001A

Blue, part number 014-001B

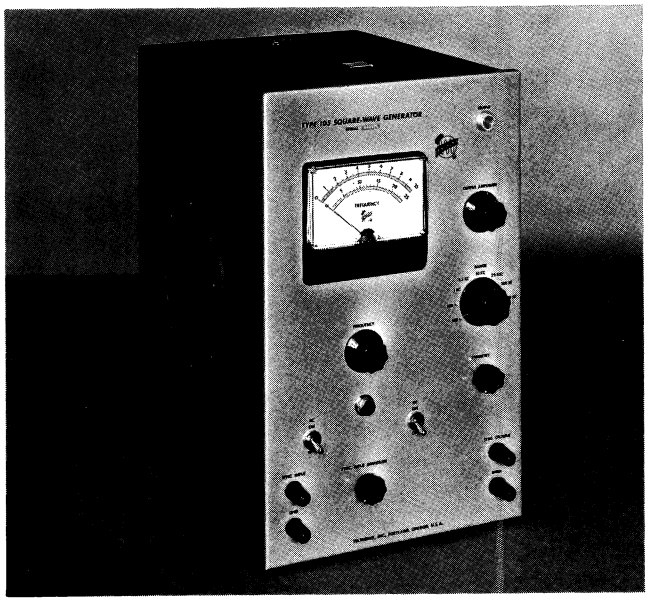
Type 105 Square-Wave Generator

Risetime—13 nsec, with 52-ohm external 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 122 Low-Level Preamplifier

Voltage Gain—1000.

Frequency Response—0.16 cycle to 40 kc maximum.

Rejection Ratio—80 to 100 db for in-phase signals.

Noise Level—4 μv rms maximum.

Output Voltage—20 v maximum (peak-to-peak).

Input Impedance—10 megohms paralleled by approximately 50 pf.

Battery powered, if desired.

Type 123 Preamplifier

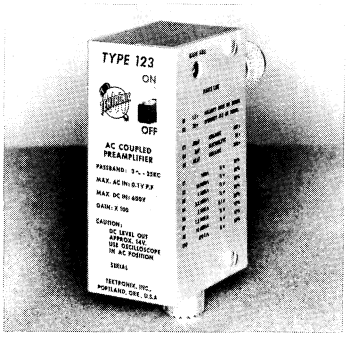
Frequency Response—Within 2% from 15 cycles to 6 kc. Within 3 db from 3 cycles to 25 kc.

Voltage Gain—100.

Hum-Free—Powered by miniature batteries.

Compact—3⅝" high, 1½" wide, 2¼" deep.

Weight—10 ounces.



Type 125 Power Supply

Provides power for one to four Type 122 Amplifiers. Electronic voltage regulation improves drift stability.

Type 126 Power Supply

Provides operating power for one Type 161, 162, 163, or 360.

Electronic Voltage Regulation.

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.
Micromicrofarads: 0 to 3, 10, 30, 100, 300.

Accuracy—Within 3% of full scale.

Type 160A Power Supply

Large Load Capacity—Provides operating power for four to six 161, 162, 163 Units plus a 360 Indicator Unit.

Electronic Voltage Regulation.

Type 161 Pulse Generator

Variable-Amplitude—Positive or negative pulse from 0 to 50 v.

Positive Gate—50 v amplitude.

Output Characteristics—

Duration: calibrated, continuously variable, 10 μsec to 0.1 sec.

Delay: continuously variable, 0 to 100% of triggering sawtooth waveform.

Risetime: less than 0.5 μsec.

Ⓐ

Type 162 Waveform Generator

Output Waveforms — Positive pulse, positive gate, and negative-going sawtooth.

Output Characteristics—

Repetition Rate: 0.1 cycle to 10 kc for recurrent operation.

Duration: pulse 10 μsec to 0.05 sec; gate and sawtooth, 100 μsec to 10 sec.

Amplitude—Pulse and gate, 50 v. Sawtooth, +150 v to +20 v.

Type 163 Fast-Rise Pulse Generator

Variable-Amplitude Positive Pulse—0 to 25 v.

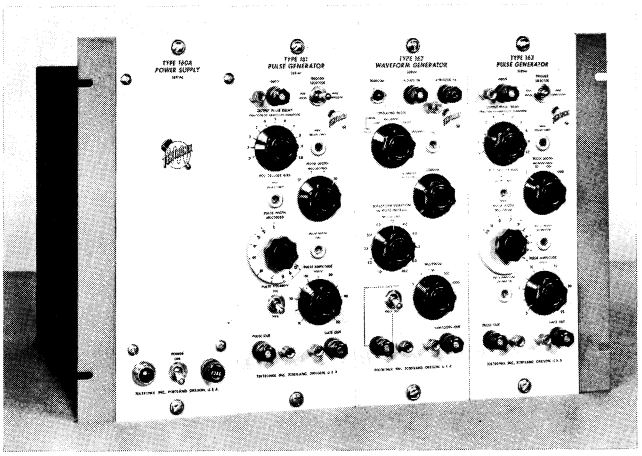
Fixed-Amplitude Positive Gate—25 v.

Output Characteristics—

Risetime: less than 0.2 μsec.

Duration: calibrated, continuously variable, 1 μsec to 10,000 μsec.

Delay—Continuously variable to 100% of triggering sawtooth duration.



Type 180A Time-Mark Generator

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

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

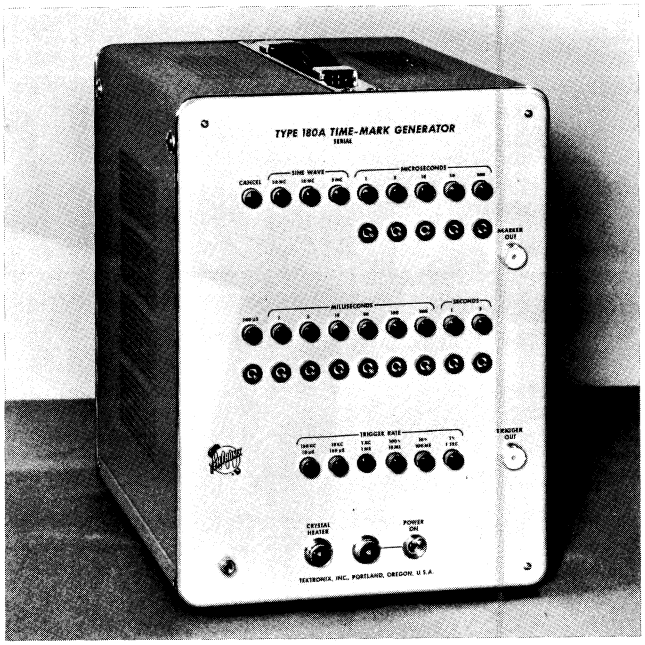
Six Trigger-Rate Frequencies—1, 10, 100 cycles and 1, 10, 100 kc.

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

Type 181 Time-Mark Generator

Time-Marks—1, 10, 100, 1000, and 10,000 microseconds, plus 10-mc sine wave.

1-mc Crystal Controlled Oscillator is accurate within 0.03%.



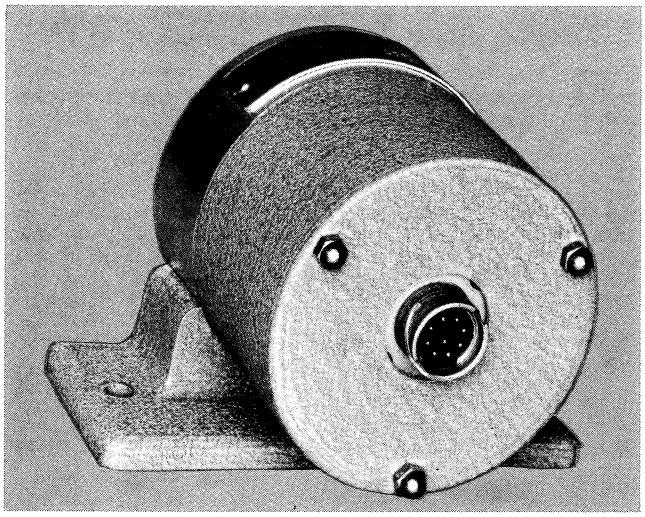
Rotan System

Designed to study rotation-associated phenomena in machinery, the Type 182B Angle-Encoding Transducer and Type 183B Rotation Analyzer adapt an oscilloscope to provide horizontal trace deflection proportional to angular displacement of a rotating shaft. Transduced data, such as velocity, pressure, acceleration or vibration provides vertical trace deflection.

Three Marker Tracks—1-, 10-, and 360-degree intensity-marker and trigger pulses.

Output Voltages—Marker pulses not less than 10 v, trigger not less than 7 v.

Angular Velocity—Essentially zero to 20,000 rpm.



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 1121 Amplifier

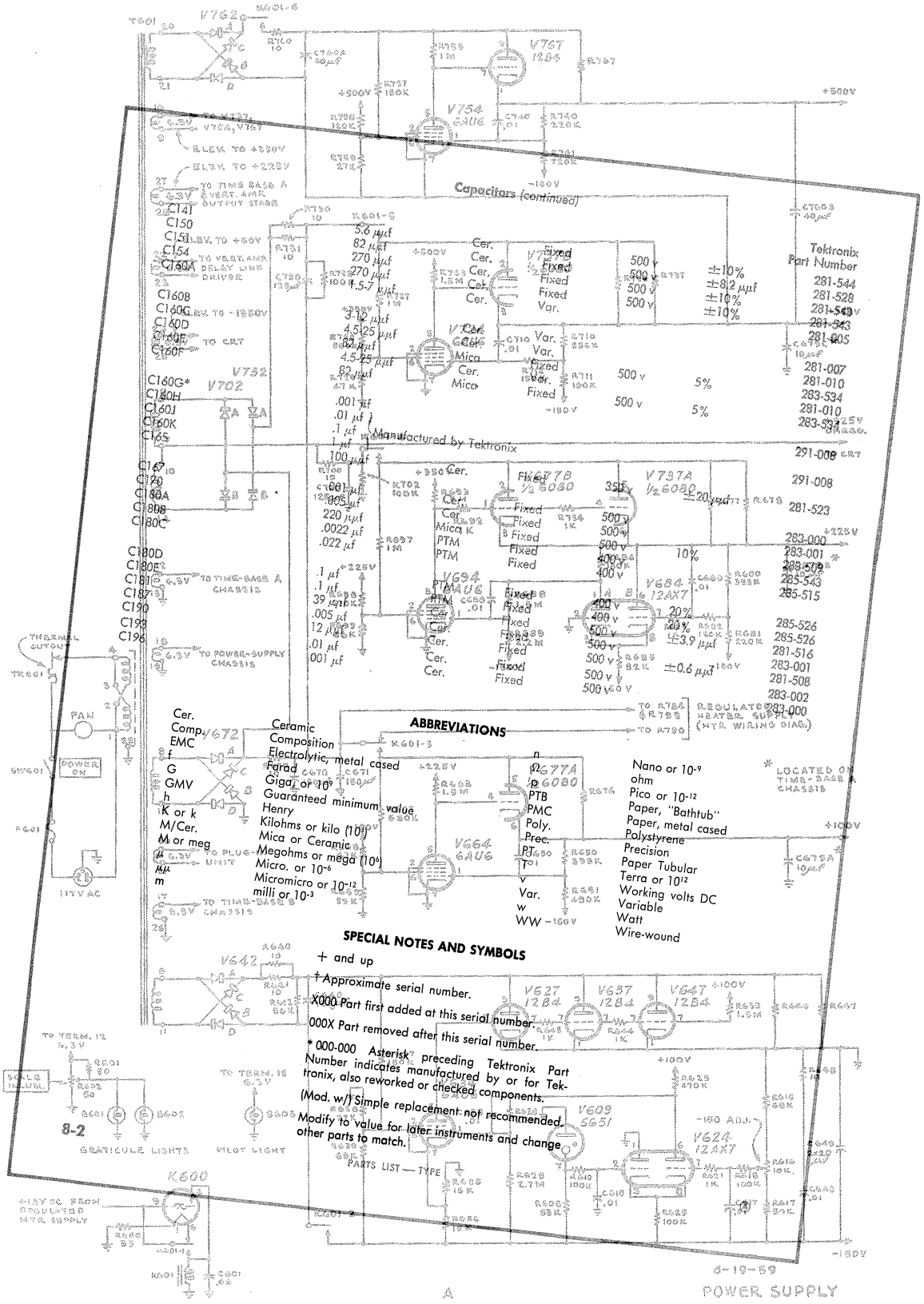
Voltage Gain—100 with 9 calibrated attenuator steps to provide net gain from 100 to 0.2.

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.

PARTS LIST *and* DIAGRAMS



HOW TO ORDER PARTS

Replacement parts are available through your local Tektronix Field Office.

Improvements in Tektronix instruments are incorporated as soon as available. Therefore, when ordering a replacement part it is important to supply the part number including any suffix, instrument type, serial number, plus a modification number where applicable.

If the part you have ordered has been improved or replaced, your local Field Office will contact you if there is a change in part number.

PARTS LIST

Values are fixed unless marked **Variable.**

Bulbs

Ckt. No.	Tektronix Part No.	Description	S/N Range
B601	150-001	Incandescent #47 GE Graticule Light	
B602	150-001	Incandescent #47 GE Graticule Light	
B603	150-018	Incandescent #12 GE Pilot Light	
B631	150-002	NE-2	
B632	150-002	NE-2	

Capacitors

Tolerance ±20% unless otherwise indicated.

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

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

C611*	290-133	2 x 125 μf	EMC		350 v	
C612*	290-133	2 x 125 μf	EMC		350 v	
C620	285-591	.0047 μf	PTM		600 v	5%
C621	283-001	.005 μf	Discap		500 v	GMV
C626	283-002	.01 μf	Discap		500 v	GMV
C631	283-001	.005 μf	Discap		500 v	GMV
C642	285-526	0.1 μf	PTM		400 v	
C657	290-002	8 μf	EMT		450 v	
C661	285-501	.001 μf	PTM		600 v	
C672*	290-119	2 x 100 μf	EMC		50 v	
C674*	290-119	2 x 100 μf	EMC		50 v	
C682A,B*	290-133	2 x 125 μf	EMC		350 v	
C684A,B*	290-133	2 x 125 μf	EMC		350 v	
C692	283-034	.005 μf	Discap		4000 v	
C760	281-027	.7-3 μμf	Tub.	Var.		
C761	281-027	.7-3 μμf	Tub.	Var.		
C847	283-034	.005 μf	Discap		4000 v	
C851	283-006	.02 μf	Discap		600 v	
C856	283-034	.005 μf	Discap		4000 v	
C876	290-000	6.25 μf	EMT		300 v	
C878	281-523	100 μμf	Cer.		350 v	
C884	281-524	150 μμf	Cer.		500 v	

Diodes

D611	152-048	Silicon Diode	1N2864
D612	152-048	Silicon Diode	1N2864
D634	152-047	Silicon Diode	1N2862 (or equal)
D637	*153-007	Silicon Diode	Checked
D672	152-051	Silicon Diode	1N1124
D682	*153-007	Silicon Diode	Checked
D683	*153-007	Silicon Diode	Checked

Fuses

Ckt. No.	Tektronix Part No.	Description	S/N Range
F601	159-023	2 Amp Slo-Blo for 117 V operation 50-60 cycle	
F601	159-019	1 Amp Slo-Blo for 234 V operation 50-60 cycle	

Inductors

L674	108-205	1 mh				
L684	108-205	1 mh				
L685	108-205	1 mh				

Resistors

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

R601	311-055	50 Ω	2 w	Var.	WW	SCALE ILLUM
R602	308-142	30 Ω	3 w		WW	5%
R605	306-100	10 Ω	2 w			
R606	306-100	10 Ω	2 w			
R609	306-333	33 k	2 w			
R611	304-154	150 k	1 w			
R612	304-154	150 k	1 w			
R621	302-104	100 k	1/2 w			
R623	302-472	4.7 k	1/2 w			
R626	308-054	10 k	5 w		WW	5%
R628	302-331	330 Ω	1/2 w			
R630	302-101	100 Ω	1/2 w			
R631	302-104	100 k	1/2 w			
R633	302-334	330 k	1/2 w			
R634	302-564	560 k	1/2 w			
R635	302-104	100 k	1/2 w			
R636	302-563	56 k	1/2 w			
R637	302-564	560 k	1/2 w			
R640	309-049	150 k	1/2 w		Prec.	1%
R641	311-187	20 k	1/4 w			—100 Volts
R642	309-340	165 k	1/2 w		Prec.	1%
R643	302-105	1 meg	1/2 w			
R650	304-394	390 k	1 w			
R651	302-473	47 k	1/2 w			
R653	302-105	1 meg	1/2 w			
R654	302-102	1 k	1/2 w			
R657	308-054	10 k	5 w		WW	5%
R658	302-104	100 k	1/2 w			
R659	302-154	150 k	1/2 w			
R660	302-104	100 k	1/2 w			
R661	309-330	319 k	1/2 w		Prec.	1%
R662	309-356	103 k	1/2 w		Prec.	1%
R685	308-053	8 k	5 w		WW	5%
R692	307-056	4.3 Ω	1/2 w			5%
R770	302-564	560 k	1/2 w			
R771	302-564	560 k	1/2 w			
R840	304-824	820 k	1 w			
R841	304-824	820 k	1 w			
R842	304-824	820 k	1 w			
R844	311-041	1 meg	1/2 w	Var.		FOCUS

Resistors *(continued)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R845	302-474	470 k	½ w			
R847	311-242	200 k	½ w	Var.		INTENSITY
R849	302-223	22 k	½ w			
R851	302-155	1.5 meg	½ w			
R852	302-155	1.5 meg	½ w			
R854	302-223	22 k	½ w			
R855	302-104	100 k	½ w			
R856	302-104	100 k	½ w			
R860	302-224	220 k	½ w			
R862	302-104	100 k	½ w			
R864	311-206	250 k	¼ w	Var.		ASTIGMATISM
R870	301-364	360 k	½ w			5%
R871	311-224	50 k		Var.		CAL. AMPL.
R872	301-154	150 k	½ w			5%
R873	302-103	10 k	½ w			
R876	301-433	43 k	½ w			5%
R877	301-473	47 k	½ w			5%
R878	301-564	560 k	½ w			5%
R879	301-114	110 k	½ w			5%
R883	305-223	22 k	2 w			5%
R885	310-066	18 k	1 w		Prec.	1%
R886	309-030	1.8 k	½ w		Prec.	1%
R887	309-072	180 Ω	½ w		Prec.	1%
R888	309-064	20 Ω	½ w		Prec.	1%
R890	309-030	1.8 k	½ w		Prec.	1%
R891	309-072	180 Ω	½ w		Prec.	1%
R892	309-064	20 Ω	½ w		Prec.	1%
R898	302-101	100 Ω	½ w			
R899	*308-090	.25 Ω	1 w		WW	

Switches

	Unwired	Wired	
SW601	260-014		Toggle POWER ON
SW870	*260-394	*262-415	Rotary CALIBRATOR
TK601	260-120		Thermal Cutout 137°F ±5°

Transformers

T601	*120-221	LV Power
T620	*120-222	HV Power

Electron Tubes

V609	154-291	OG3
V620	154-317	6DQ5
V634	154-260	6GE8/7734
V657	154-260	6GE8/7734
V692	154-051	5642
V859	*154-265	T503P2 CRT Standard Phosphor
V884	154-278	6BL8

Type 560
Mechanical Parts List

	Tektronix Part Number
BAR, ALUM. 3/16 x 1/2 x 1 3/4	381-073
BAR, ALUM., TOP SUPPORT w/handle (see handle)	381-182
BASE, CRT ROTATOR, ALUM. DIECAST	432-022
BRACKET, PHOSPHOR BRONZE CRT SPRING	406-239
BRACKET, CRT SUPPORT 3 1/4 x 3 1/32 x 3/4	406-368
BRACKET, PLUG-IN HOUSING, RIGHT	406-658
BRACKET, PLUG-IN HOUSING, LEFT	406-659
BUSHING, 3/8-32 x 9/16 x .412	358-010
BUSHING, NYLON INSUL. (for binding post)	358-036
BUSHING, COAX CONNECTOR	358-097
CABLE HARNESS, CHASSIS	179-533
CAP, FUSE 3AG	200-015
CAP, INSULATION (for fuse holder)	200-237
CAP, POT INSULATION, PLASTIC	200-238
CAP, POT INSULATION 1" dia. x .390 high	200-247
CHASSIS	441-378
CLAMP, CABLE, PLASTIC 3/4"	343-008
CLAMP, TUBE, TOP HAT	343-074
CLIP, DEFLECTOR PLATE	344-047
CONNECTOR, DUAL BINDING POST	013-009
CONNECTOR, CHASSIS MT., COAX, UHF	131-081
CONNECTOR, CHASSIS MT., 24-contact, female	131-148
CONNECTOR, CHASSIS MT., 3-wire motor base	131-150
CORD, POWER, 16 gauge, 8 ft., 3-wire	161-010
COVER, GRATICULE	200-025
GRATICULE	331-056
GROMMET, RUBBER 5/16"	348-003
GROMMET, RUBBER 1/2"	348-005
GROMMET, RUBBER 3/4"	348-006
GROMMET, POLY 1/4"	348-031
GUIDE, RAIL TRACK, PLUG-IN	351-038
HANDLE (part of 381-182, top support bar)	367-011
HOLDER, FUSE 3AG	352-010
HOLDER, NYLON, COIL FORM	352-015

Mechanical Parts List *(continued)*

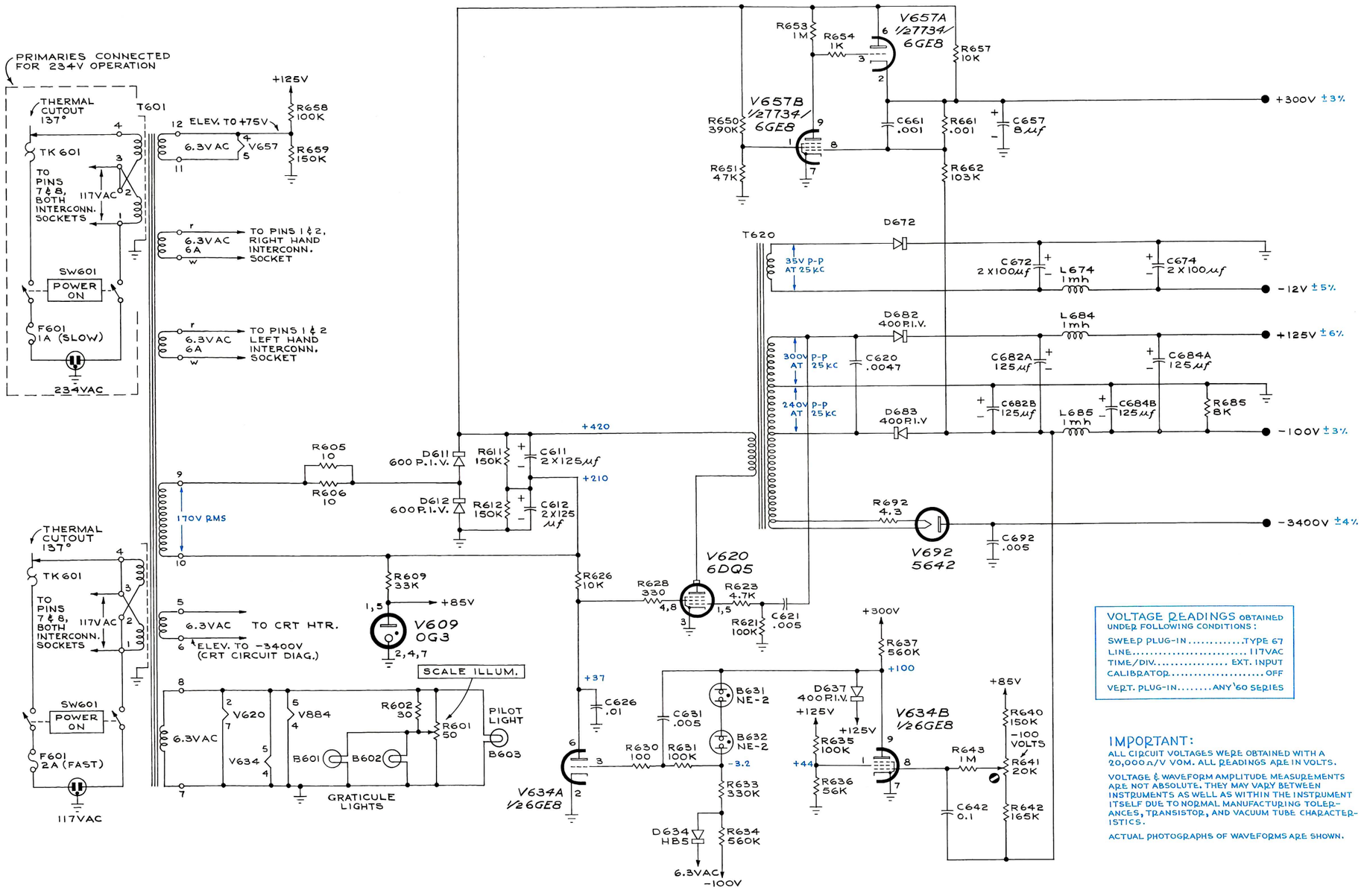
	Tektronix Part Number
KNOB, SMALL RED	366-032
KNOB, LARGE BLACK	366-042
KNOB, SMALL BLACK	366-044
LOCKWASHER #4 Int	210-004
LOCKWASHER #6 Int	210-006
LOCKWASHER #8 Ext	210-007
LOCKWASHER #8 Int	210-008
LOCKWASHER #10 Int	210-010
LOCKWASHER 3/8 x 1/2, Int, Pot	210-012
LOCKWASHER 3/8 x 11/16, Int	210-013
LUG, SOLDER SE4	210-201
LUG, SOLDER SE6 w/2 holes	210-202
LUG, SOLDER SE10	210-206
LUG, SOLDER 3/8 (pot)	210-207
LUG, SOLDER #10 non-locking 7/8" long	210-224
LUG, GROUND 15/16 long	210-241
NUT, HEX 4-40 x 3/16	210-406
NUT, HEX 6-32 x 1/4	210-407
NUT, HEX 8-32 x 5/16	210-409
NUT, HEX 10-32 x 5/16	210-410
NT, HEX 3/8-32 x 1/2	210-413
NUT, HEX 10-32 x 3/8	210-445
NUT, KEP 6-32 x 5/16	210-457
NUT, KEP 8-32 x 11/32	210-458
NUT, SWITCH 15/32-32 x 5/64	210-473
NUT, HEX 3/8-32 x 1/2 x 11/16	210-494
NUT, HEX 21/32 x 2 1/2 CRT Rotator	210-503
PANEL, FRONT	333-631
PLATE, BRASS, 9/16 x 1 9/32	386-427
PLATE, SUBPANEL	387-291
PLATE, CABINET BOTTOM	387-294
PLATE, CABINET SIDE	387-300
PLATE, GUSSET, 4 3/4 x 5 19/32	387-352
PLATE, OVERLAY, REAR	387-357
PLATE, SUBPANEL, REAR	387-413
POST, BINDING, 5-way (ass'y of stem and cap)	129-036

Mechanical Parts List *(continued)*

	Tektronix Part Number
RING, LOCKING SWITCH	354-055
RING, CRT ROTATOR SECURING	354-078
RING, CRT CLAMPING (ass'y of 210-502 and 354-079)	354-103
ROD, NYLON 5/16 x 1 3/4	385-060
ROD, DELRIN 5/16 x 2 1/4	385-137
SCREW 4-40 x 1/2 BHS	211-014
SCREW 2-56 x 1/2 RHS	211-034
SCREW 4-40 x 5/8 FHS	211-035
SCREW 6-32 x 1/2 BHS	211-504
SCREW 6-32 x 5/16 BHS	211-507
SCREW 6-32 x 3/8 BHS	211-510
SCREW 6-32 x 1/2 BHS	211-511
SCREW 6-32 x 5/16 Pan HS w/lockwasher	211-534
SCREW 6-32 x 3/8 Truss HS Phillips	211-537
SCREW 6-32 x 5/16 FHS 100° CSK Phillips	211-538
SCREW 6-32 x 5/16 RHS	211-543
SCREW 6-32 x 1 RHS	211-560
SCREW 6-32 x 3/8 Hex Socket FH Cap	211-561
SCREW 8-32 x 3/8 BHS	212-023
SCREW 8-32 x 3/8 Truss HS Phillips	212-039
SCREW 8-32 x 3/8 FHS 100° CSK Phillips	212-040
SCREW, THREAD CUTTING 4-40 x 1/4 PHS Phillips	213-035
SCREW, THREAD CUTTING 6-32 x 3/8 Truss HS Phillips	213-041
SCREW, THREAD CUTTING 5-32 x 3/16 Pan HS Phillips	213-044
SCREW, THREAD CUTTING 6-32 x 5/16 Pan HS Phillips	213-054
SHIELD, GRATICULE LIGHT	337-187
SHIELD, CRT	337-384
SHIELD, F & I	337-387
SHIELD, POWER SWITCH	337-398
SHIELD, HV 2 1/2 x 7 x 1 1/8	337-445
SHIELD, CRT 3 x 4 1/4 x 1/2	337-446
SPACER TUBE .180 ID x 1/4 OD x 1/8 long	166-029
SPACER TUBE .180 ID x 1/4 OD x 1 23/32	166-099
SPACER TUBE .180 ID x 1/4 OD x 7/32	166-107
SPACER, CERAMIC STRIP	361-009
SOCKET, STM7G	136-008

Mechanical Parts List *(continued)*

	Tektronix Part Number
SOCKET, STM8 molded	136-013
SOCKET, STM9G	136-015
SOCKET, GRATICULE LIGHT w/ground lug	136-035
SOCKET, LIGHT RED JEWEL ASS'Y	136-047
SOCKET, CRT, ASSEMBLY	136-118
STRIP, FELT 1 x 8	124-022
STRIP, CERAMIC 3/4 x 7 clip-mounted	124-089
STRIP, CERAMIC 3/4 x 11 clip-mounted	124-091
STUD, STEEL, CRT ROTATOR	355-049
STUD, STEEL, 8-32 x 4 1/2 long	355-070
TAG, VOLTAGE RATING 105-125, 50-60 cycle	334-650
TAG, SERIAL NUMBER INSERT	334-679
WASHER, STEEL, 6L x 3/8	210-803
WASHER, STEEL, 10S x 7/16	210-805
WASHER, FIBER, #10 shouldered	210-813
WASHER, RUBBER, Wan 13-20	210-816
WASHER, STEEL, .390 ID x 9/16 ID	210-840
WASHER, RUBBER, 1/2 ID x 11/16 OD (for fuse holder)	210-873
WASHER, STEEL, .470 ID x 21/32 OD	210-902
WASHER, MICA, .196 ID x .625 OD	210-909



VOLTAGE READINGS OBTAINED UNDER FOLLOWING CONDITIONS:

SWEEP PLUG-IN.....TYPE 67
LINE.....117VAC
TIME/DIV.....EXT. INPUT
CALIBRATOR.....OFF
VERT. PLUG-IN.....ANY '60 SERIES

IMPORTANT:

ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000 Ω/V VOM. ALL READINGS ARE IN VOLTS.

VOLTAGE & WAVEFORM AMPLITUDE MEASUREMENTS ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES, TRANSISTOR, AND VACUUM TUBE CHARACTERISTICS.

ACTUAL PHOTOGRAPHS OF WAVEFORMS ARE SHOWN.

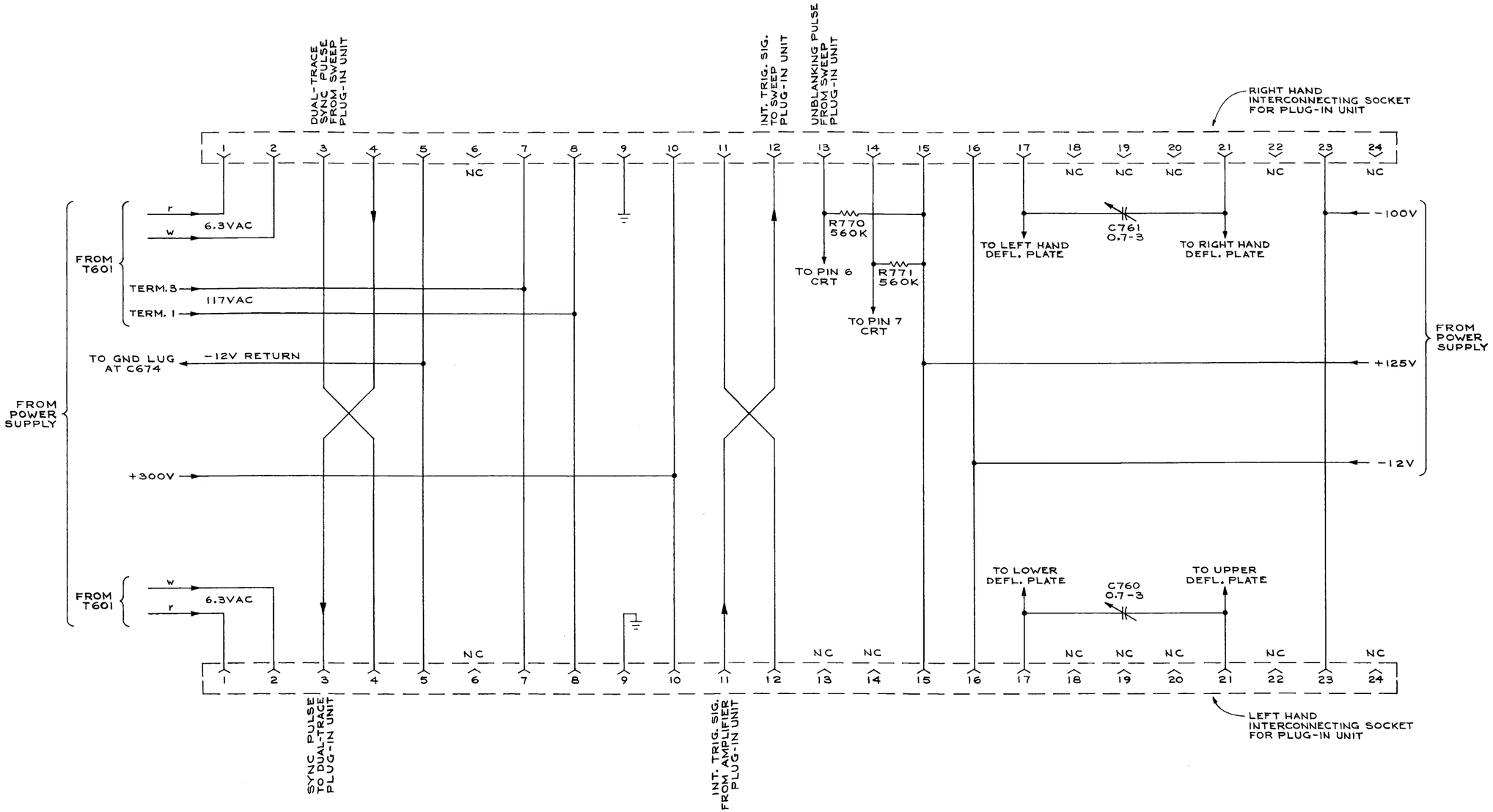
MRH
7-6-61

POWER SUPPLY

CIRCUIT NUMBERS 601 THRU 699

TYPE 560 OSCILLOSCOPE

A



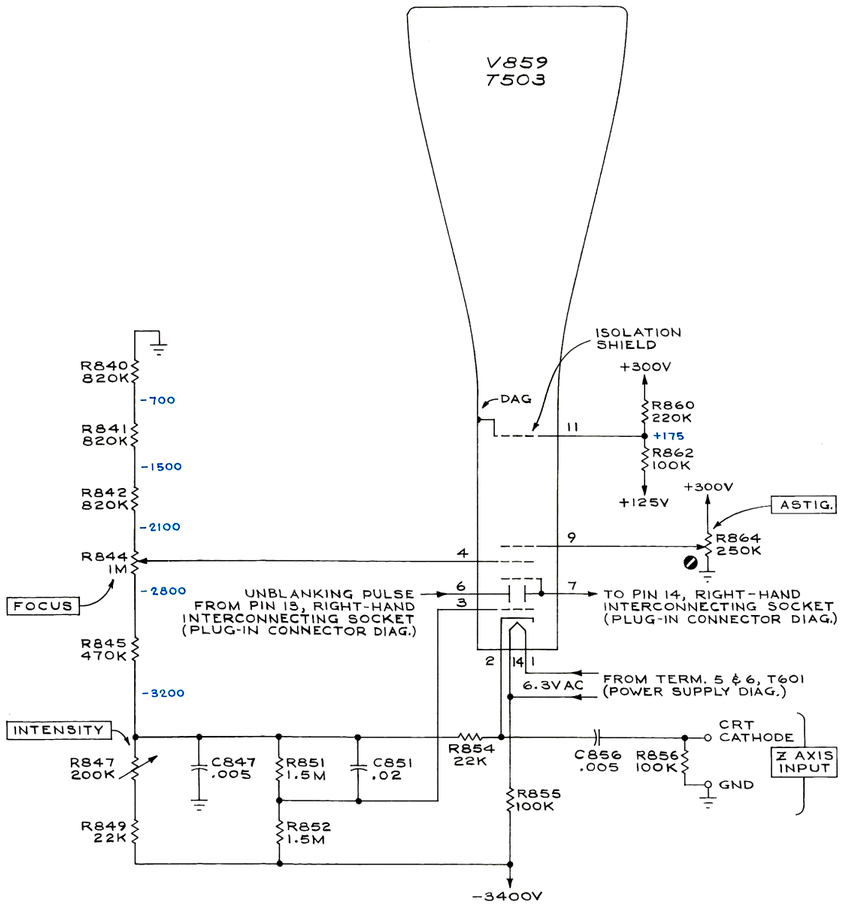
TYPE 560 OSCILLOSCOPE

A

MRH
7-7-61

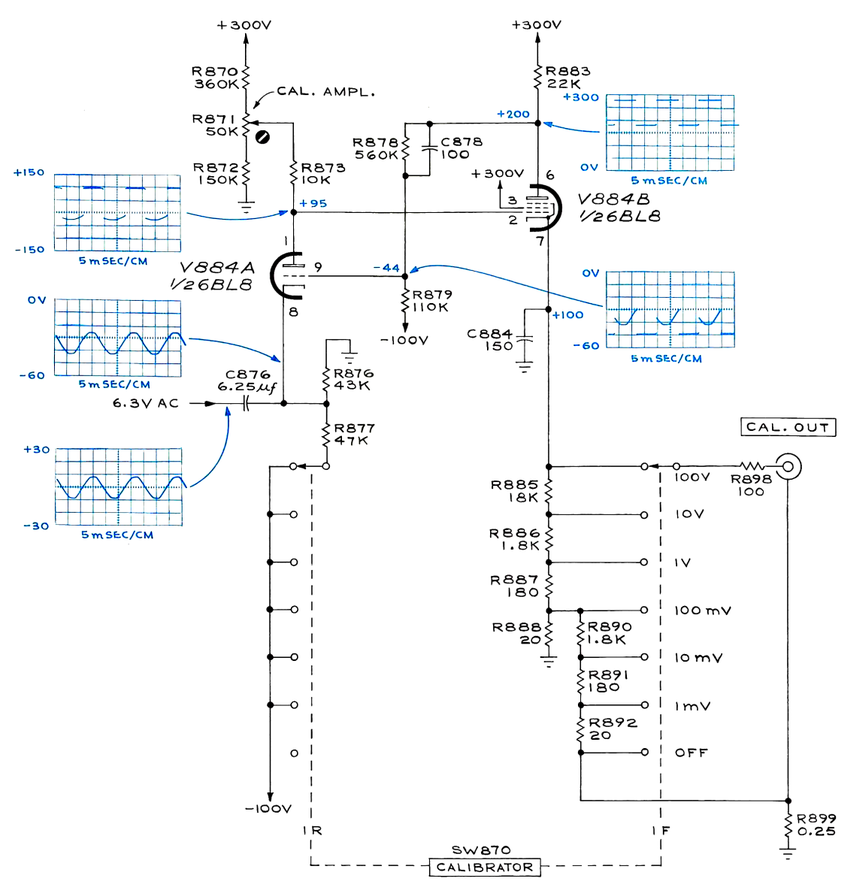
PLUG-IN CONNECTORS

CIRCUIT NUMBERS
760 THRU 779



VOLTAGE READINGS TAKEN UNDER THE FOLLOWING CONDITIONS:
INTENSITY.....CCW
CRT

NOTE:
ALSO SEE IMPORTANT NOTE ON POWER SUPPLY DIAG.



WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
WAVEFORMS:
CALIBRATOR ..... ON
VOLTAGE READINGS:
CALIBRATOR ..... OFF
560 CAL

MRH
7-10-61

TYPE 560 OSCILLOSCOPE

CRT CIRCUIT & CALIBRATOR

CIRCUIT NUMBERS 840 THRU 899

A

560 CRT & CALIBRATOR
840 THRU 899