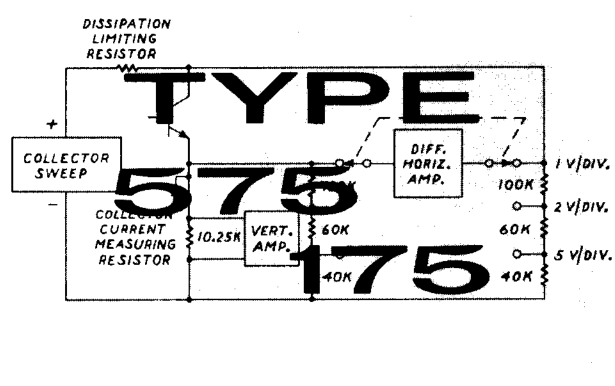
INSTRUCTION MANUAL

TYPE 575 175



Tektronix, Inc.

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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.

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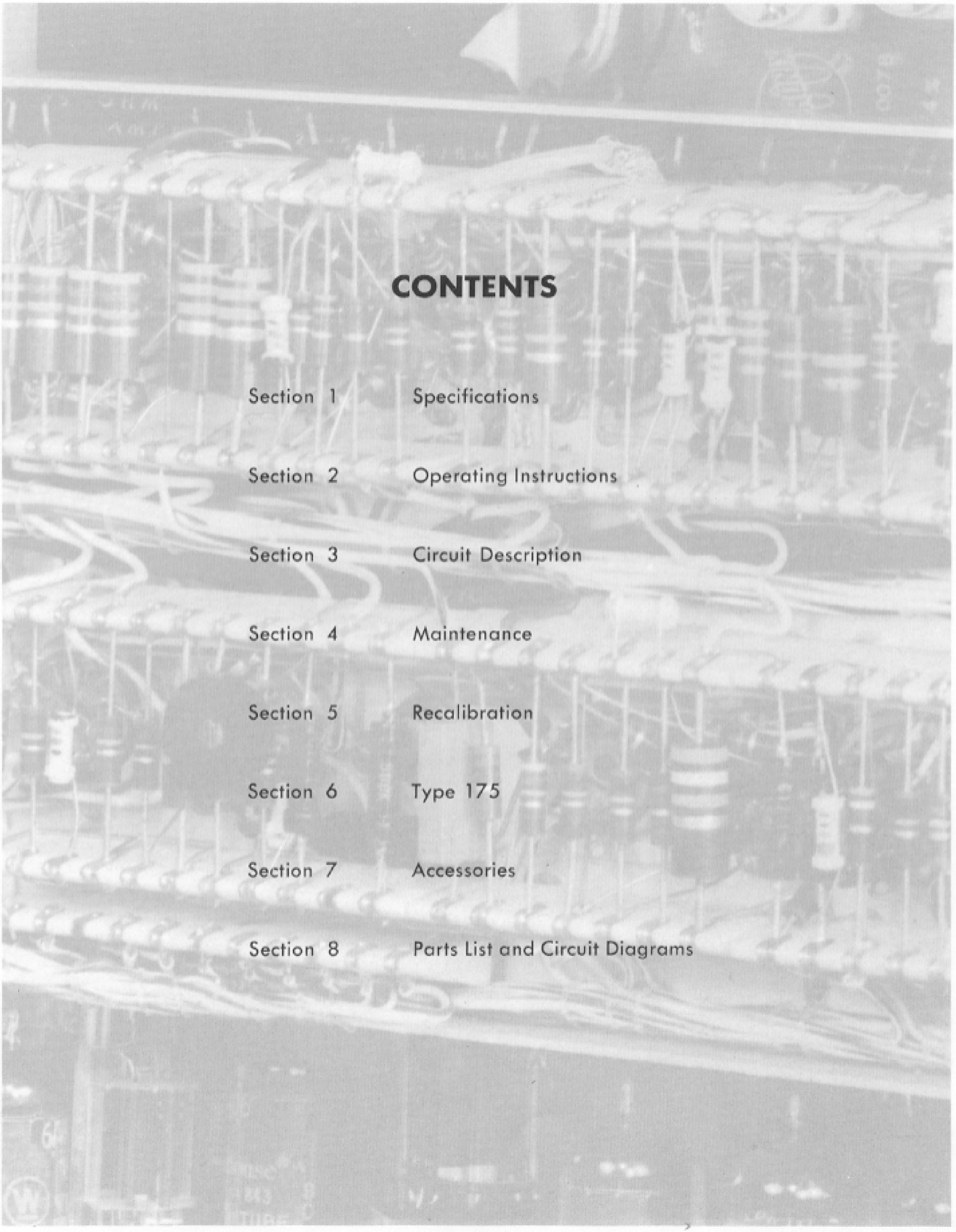
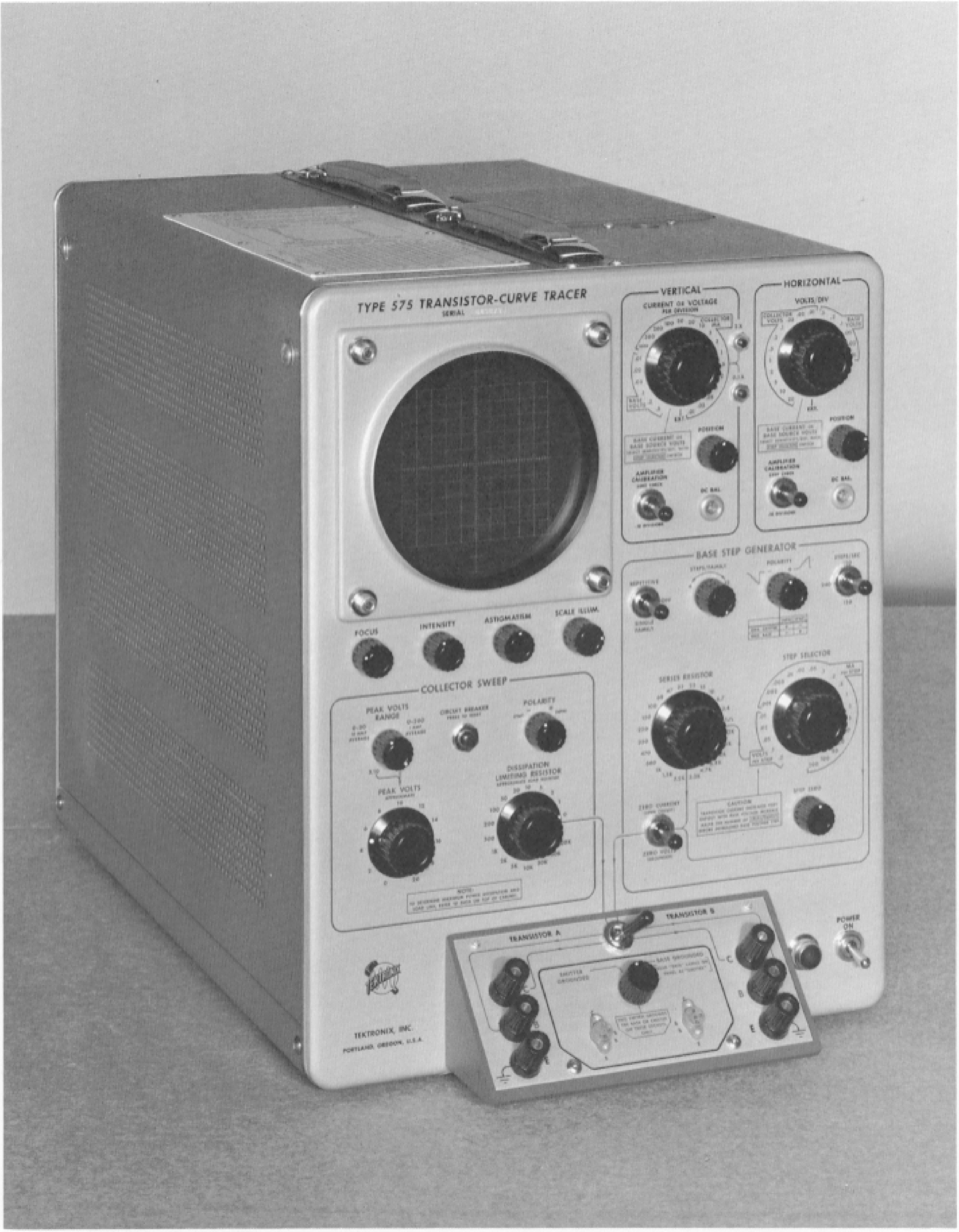
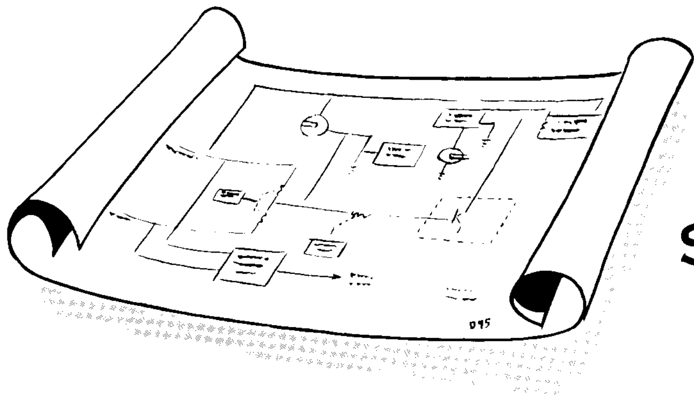


CONTENTS


TYPE 575 TRANSISTOR-CURVE TRACER
VERTICAL
HORIZONTAL
BASE STEP GENERATOR
FOCUS
INTENSITY
ASTIGMATISM
SCALE ILLUM.
COLLECTOR SWEEP
PEAK VOLTS
DISSIPATION LIMITING RESISTOR
SERIES RESISTOR
STEP SELECTOR
TRANSISTOR A
TRANSISTOR B
POWER ON
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.



SECTION 1

SPECIFICATIONS

General Description

The Type 575 Transistor Curve Tracer displays the dynamic characteristic curves of both junction and point-contact transistors on the screen of a 5-inch cathode-ray tube. Several different transistor characteristic curves may be displayed, including the collector family in the common-base and common-emitter configuration. Regulated current or voltage steps are applied to the input of the transistor under test. A rectified sine wave of controllable amplitude is used for the collector sweep. The family of characteristic curves is accurately plotted as either a repetitive or single-family display.

Tolerances and accuracies as stated in Specifications section and the Recalibration Procedure of this manual apply only to Type 575 instruments above serial number 8030.

Operating Specifications

Collector Sweep

0-200 volts minimum peak with 1-ampere current curves.

0-20 volts minimum peak with 20-amperes current curves.

Base Step Generator

Generates 4-12 current- or voltage-steps per family of curves at 120- or 240-steps per second (2- or 4-times power-line frequency) for either repetitive or single-family displays.

17 current-step ranges from 1 μa/step to 200 ma/step ±3%.

5 voltage-step ranges from .01 volt/step to .2 volt/step ±3%, with output impedance adjustable from 1 ohm to 22 thousand ohms ±5%.

Vertical Display

Plots collector current from 0.01 ma/div. to 1000 ma./div. ±3% in 16 calibrated steps. Pushbuttons provide multiplying each current step by 2 or dividing by 10, increasing the current range from 0.001 ma./div. to 2000 ma./div. ±3%.

Plots base voltage from .01 volt/div. to .5 volt/div. ±3% in 6 calibrated steps.

Plots base current or base source volts with sensitivity read from step selector switch ±3%.

Horizontal Display

Plot collector voltage from .01 volt/div. to 20 volt/div. ±3% in 11 calibrated steps.

Plots base voltage from .01 volt/div. to .5 volt/idv. ±3% in 6 calibrated steps.

Plots base current or base source volts with sensitivity read from step collector switch ±3%.

Other Features

Comparison switch permits rapid manual switching between two transistors for comparison tests.

Regulated power supplies and negative-feedback amplifiers assure the accuracy of the calibration and the stability of the display.

Cathode-ray tube is a Tektronix T52P. Accelerating potential is approximately 4 kv. P1 phosphor is supplied unless another phosphor is requested. P2, P7, or P11 phosphors are available at no extra charge.

Differential inputs to both vertical and horizontal amplifiers are available at the rear of the instrument, or at the Type 175 adaptor socket on instruments after S/N 3659. The sensitivity of each channel is .1 volt/div. and the bandpass is approximately 300 kc. The rejection of a common-mode signal is better than 100:1 with a peak-to-peak signal of 10 volts or less.

Mechanical Characteristics

Ventilation—Filtered- forced-air circulation maintains safe operating temperature.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photoetched, anodized front panel, with blue vinyl finished cabinet.

Dimensions—24" long, 13" wide, 16¾' 'high.

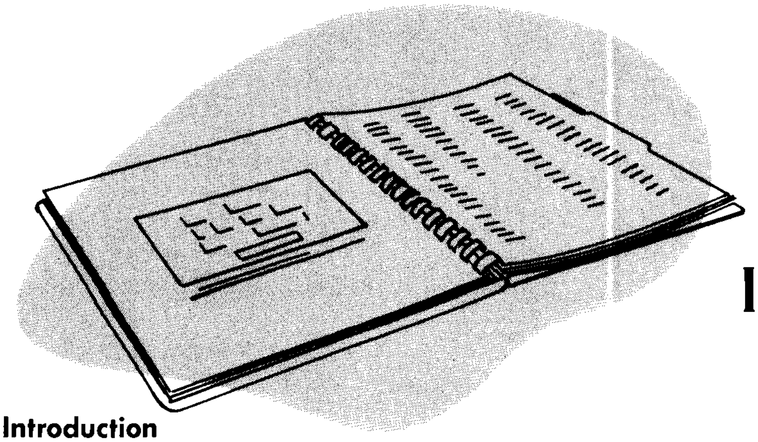
Weight—Approximately 70 lbs.

Power Requirements—105-125 or 210-250 volts, 50-60 cycles; 410 watts maximum at 117 v, 60 cycles, depending upon the type of transistor being tested, 200 watts standby.

Accessories

2—Transistor adapters, long, 013-010.
2—Transistor adapters, short, 013-012.
1—3 to 2-wire adapter, 103-013.
2—2N1381 Transistors, 151-039.
1—3-conductor power cord, 161-010.
1—Green filter, 378-514.
2—Instruction Manuals.

NOTES



SECTION 2

OPERATING INSTRUCTIONS

Introduction

The Type 575 is an extremely versatile instrument that can be used to make several tests on a transistor. Its full utility can only be realized, however, when the operator understands the function of each of the front-panel controls.

The front-panel layout, shown in Fig. 2-1, is quite simple and logical, and can be divided into five main blocks. These blocks contain the controls for the Vertical Amplifier, the Horizontal Amplifier, the Collector Sweep, the Base (or Emitter) Step Generator and Amplifier, and the Transistor Test Panel. The location of each section, as a functional part of the instrument, is shown in Fig. 2-2.

Notice the front panel is in two colors...red and blue. Those parts of the panel etched in red refer to the Collector voltages and currents, and those parts etched in blue refer to the Base voltages and currents. However, when testing a transistor in the common-base configuration, the emitter is stepped with voltage or current; in this case, the blue printing on the front panel refers to the Emitter rather than the Base.

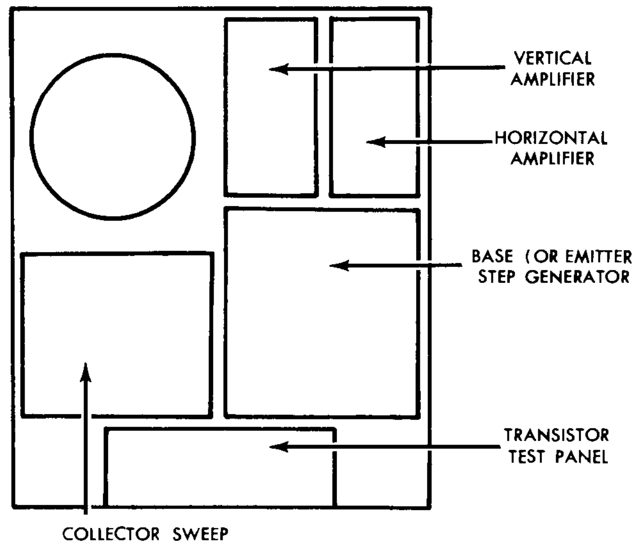


Fig. 2-1. Type 575 front-panel layout. Each section corresponds to a block in the block diagram.

Vertical Block

The Vertical block contains a 24-position Vertical Selector switch which selects the type of signal, and in some cases

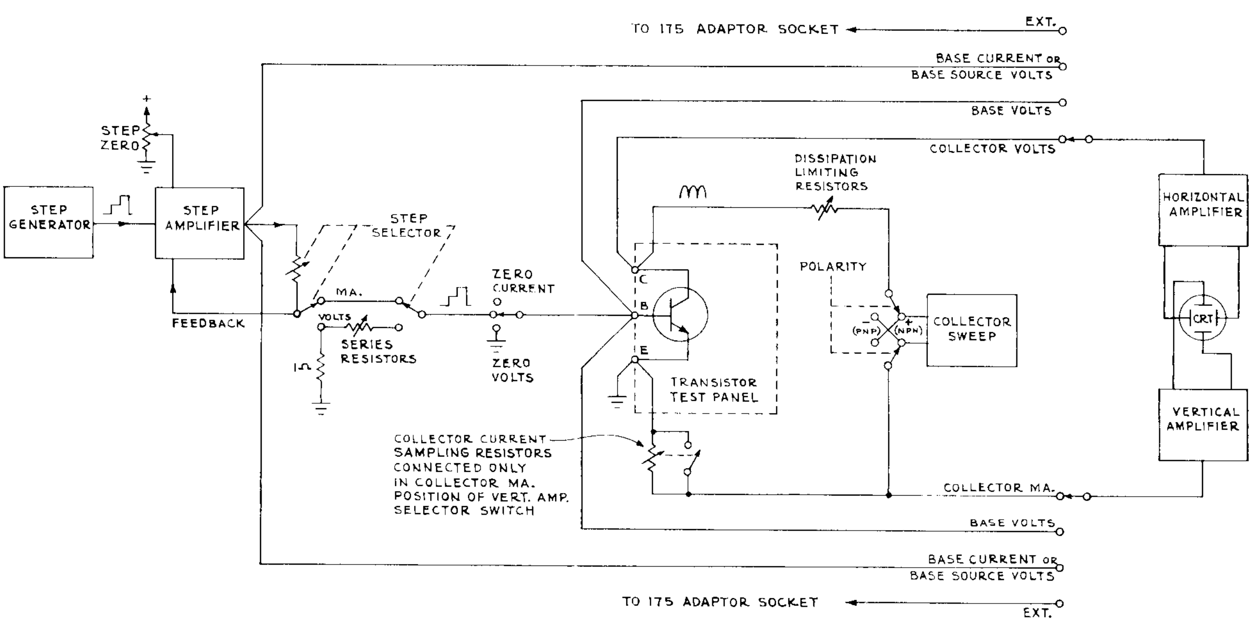


Fig. 2-2. Type 575 functional block diagram.

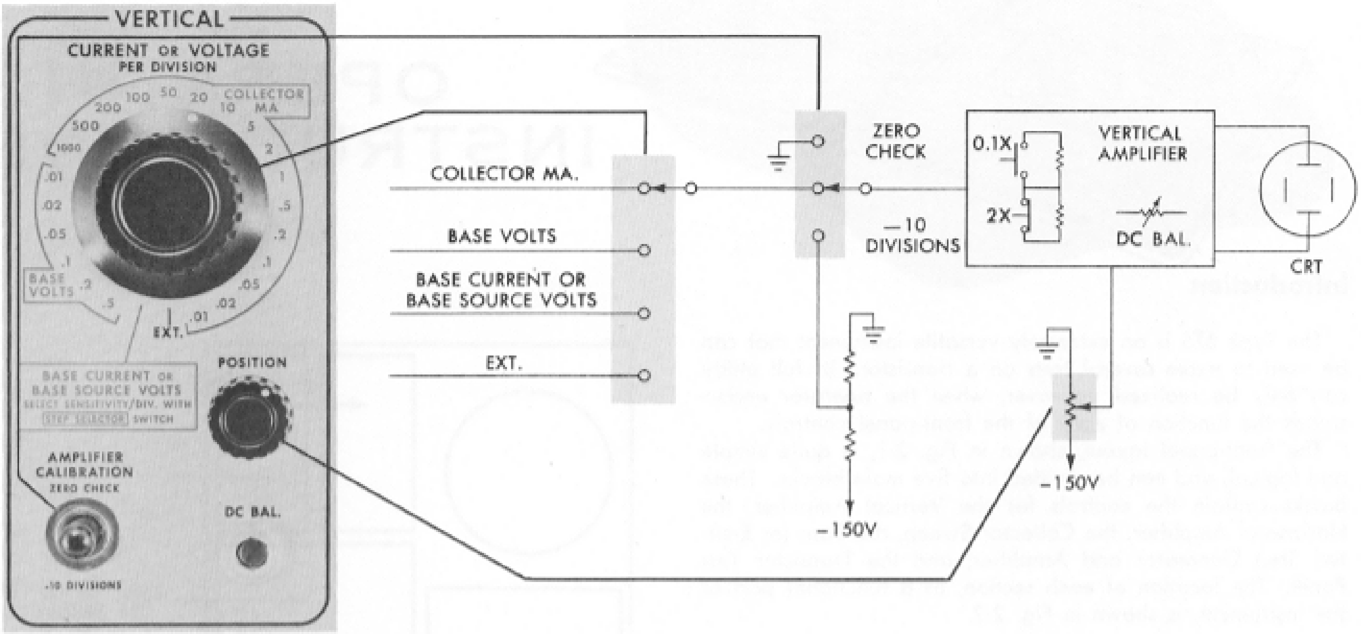


Fig. 2-3. Function of front-panel vertical-block controls.

the amplitude of the signal, fed to the Vertical Amplifier. When the switch is in any of the COLLECTOR MA positions, the collector current of the transistor appears as the Y axis signal, provided the transistor is being tested in the common-emitter (EMITTER-GROUNDED) configuration. The 2X and the 0.1X pushbutton switches provide increased current measurement ranges by multiplying each current step by 2 or dividing by 10.

When testing a transistor in the common-base (BASE GROUNDED) configuration, all of the Base-indicated nomenclature should be read as EMITTER, as explained in the note on the Transistor Test Panel.

When the Vertical Selector switch is in the BASE CURRENT OR BASE SOURCE VOLTS position, either the base current or the base source-voltage is monitored as the Y signal depending on the setting of the STEP SELECTOR switch in the Step Generator section. (In the common-base configuration, this would be either the emitter current or the emitter source-voltage).

In the EXT. position of the Vertical Selector switch, the Y signal must be obtained from an external test point, rather than from the Transistor Test Panel. Two external-input connectors are provided on the rear panel of the instrument, one for normal polarity and one for inverted polarity signals. Or, if preferred, both connectors may be employed for differential input. For instruments with S/N 3660 and up these connections are obtainable through the Type 175 adaptor socket.

The POSITION control is just what the name implies; it positions the trace or display vertically on the crt. The DC BAL. control is adjusted to maintain a state of dc balance between both sides of the Vertical Amplifier. This prevents the display from shifting vertically as the input sensitivity of the amplifier is changed in either the COLLECTOR MA or BASE VOLTS (or EMITTER VOLTS) range.

The AMPLIFIER CALIBRATION switch is used to check the gain setting (calibration) of the Vertical Amplifier. In the ZERO CHECK position both grids of the Input Amplifier are grounded to establish a zero reference on the crt. In the —10 DIVISIONS position, one grid is connected through a divider to a —150-volt supply. If the Amplifier is in proper calibration, the trace will be deflected exactly ten divisions below the zero reference.

Horizontal Block

The controls in the Horizontal block are similar to those in the Vertical block. A 19-position Horizontal Selector switch selects the type of signal, and in some cases the amplitude of the signal fed to the Horizontal Amplifier. When in any of the COLLECTOR VOLTS positions, the voltage applied to the collector of the transistor is the X-axis signal. When in any of the BASE VOLTS positions, the voltage applied to the base of the transistor is the X signal. In the BASE CURRENT OR BASE SOURCE VOLTS position, either the base current or the base source-voltage, depending on the setting of the STEP SELECTOR switch in the Step Generator block, is monitored as the X signal. As explained in conjunction with the Vertical block, the BASE-indicated nomenclature is used when testing transistors in the common-emitter configuration. When the common-base configuration is used, the word 'BASE' on the front-panel should be read as 'EMITTER'.

When the Horizontal Selector switch is in the EXT. position, the function is exactly the same as that explained for the Vertical Selector switch. In addition, the function of the POSITION, DC BAL. and AMPLIFIER CALIBRATION switches is exactly the same as that explained for the Vertical block.

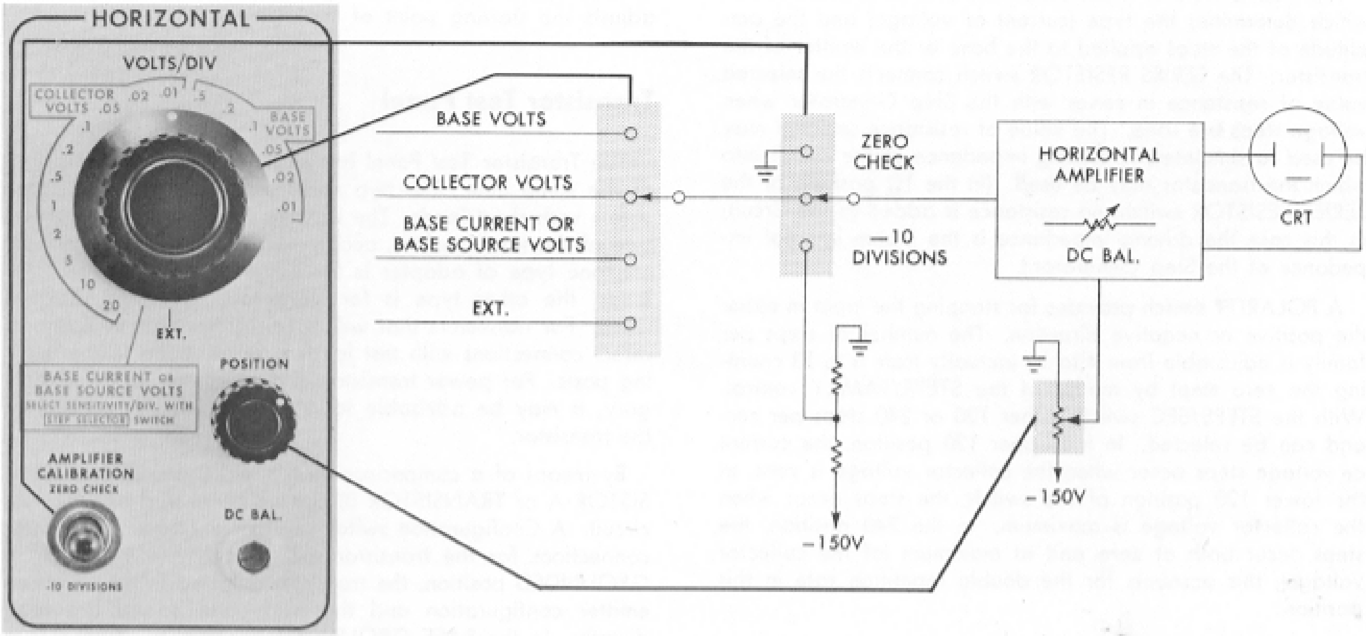


Fig. 2-4. Function of front-panel horizontal-block controls.

Collector Sweep Block

The PEAK VOLTS RANGE switch selects one of two peak voltage ranges for sweeping the collector of the transistor. In the 0-20 position, the peak voltage can be varied between zero and 20 volts by means of the PEAK VOLTS control; in the 0-200 position, the voltage is variable between zero and 200 volts. The POLARITY switch determines whether positive-going or negative-going sweeps are applied to the collector. The DISSIPATION LIMITING RESISTOR switch connects one of the indicated resistance values in series with the collector to limit the collector dissipation and thereby protect the transistor from excessive power dissipation. The value of resistance selected also becomes part of the transistor load, as explained under "Transistor Load Resistance" on the top-panel chart.

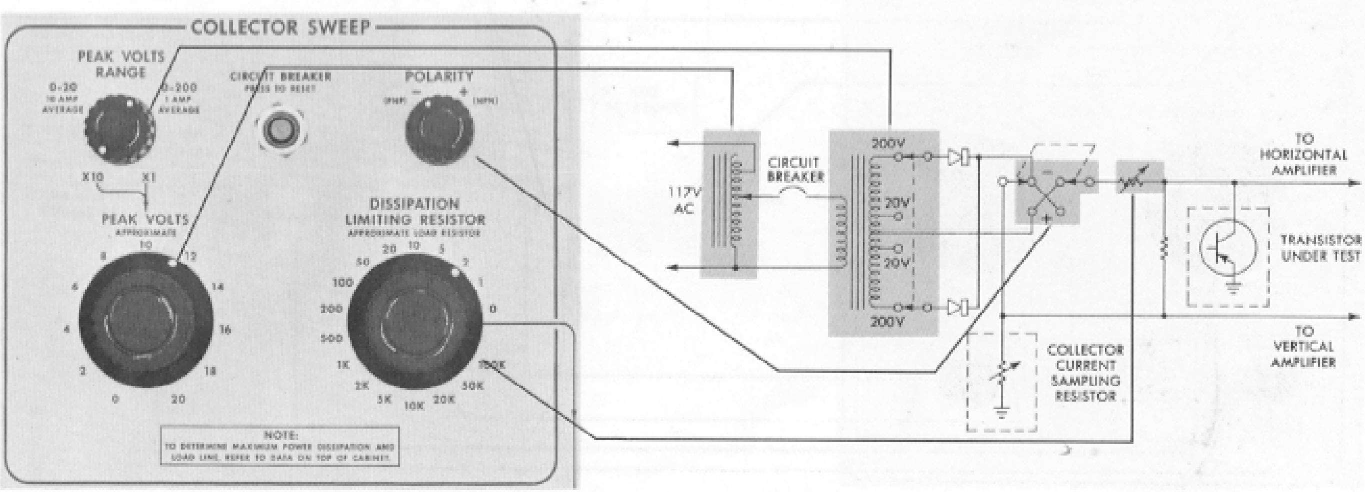


Fig. 2-5. Function of collector-sweep controls.

Step Generator Block

The Step Generator block contains a STEP SELECTOR switch which determines the type (current or voltage) and the amplitude of the steps applied to the base or the emitter of the transistor. The SERIES RESISTOR switch connects the selected value of resistance in series with the Step Generator when voltage steps are used. The value of resistance selected may be used to simulate the driving impedance of the circuit into which the transistor may be used. (In the 1Ω position of the SERIES RESISTOR switch, no resistance is added to the circuit; in this case the driving impedance is the 1-ohm internal impedance of the Step Generator.)

A POLARITY switch provides for stepping the input in either the positive or negative direction. The number of steps per family is adjustable from 4 to 12 (actually from 5 to 13 counting the zero step) by means of the STEPS/FAMILY control. With the STEPS/SEC switch, either 120 or 240 steps per second can be selected. In the upper 120 position, the current or voltage steps occur when the collector voltage is zero; in the lower 120 position of the switch, the steps occur when the collector voltage is maximum. In the 240 position, the steps occur both at zero and at maximum (of the collector voltage); this accounts for the double repetition rate in this position.

A switch is provided on the Step Generator block for selecting either a REPETITIVE or a SINGLE FAMILY display. The REPETITIVE position provides a continuous display for testing a transistor at or below its rated values. The SINGLE FAMILY position will provide a single display each time the spring-loaded switch is depressed. The low duty cycle, in this position of the switch, will permit the operator to test a transistor beyond its ratings without damage.

Another switch is provided for grounding the transistor input for a ZERO VOLTAGE check, or for opening the transistor input for a ZERO CURRENT check. The STEP ZERO control adjusts the starting point of the current or voltage steps.

Transistor Test Panel

The Transistor Test Panel has provisions for two transistors at the same time. The two sockets accept low-power transistors with short leads. The binding posts, located on either side of the small sockets, accept two types of plug-in adapters; one type of adapter is for power transistors with rigid leads, the other type is for transistors with long, flexible leads. For transistors that will not fit either type of adapter, direct connections with test leads may be made to the binding posts. For power transistors that fall into the latter category, it may be advisable to devise a heat sink to protect the transistor.

By means of a comparison switch, either transistor (TRANSISTOR A or TRANSISTOR B) can be connected into the test circuit. A Configuration switch reverses the base and emitter connections *for the transistor sockets only*. In the EMITTER GROUNDED position, the transistor is tested in the common-emitter configuration and the front-panel labels are read directly. In the BASE GROUNDED position, the transistor is tested in the common-base configuration and the BASE labels on the front panel are read as EMITTER.

If it is desired to test a transistor in the common-base configuration, when using the binding posts (with or without the adapters), the base lead must be plugged into the grounded connector marked E and the emitter lead must be plugged into the connector marked B.

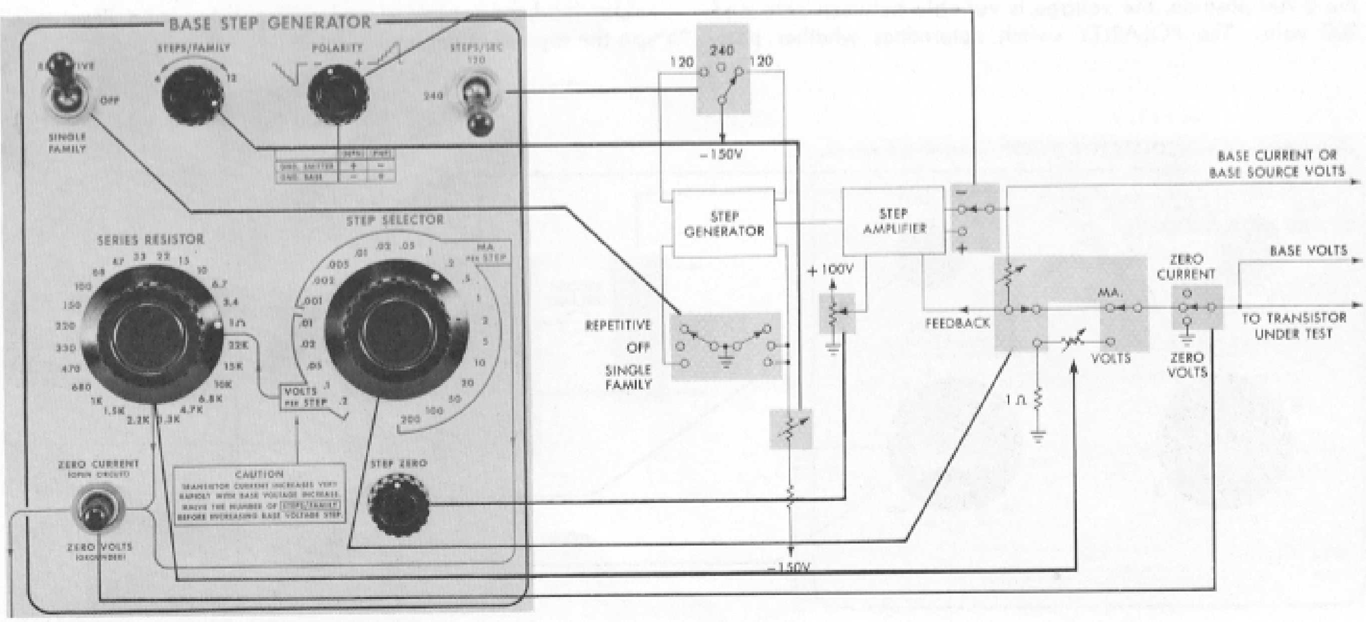


Fig. 2-6. Function of base-step generator controls.

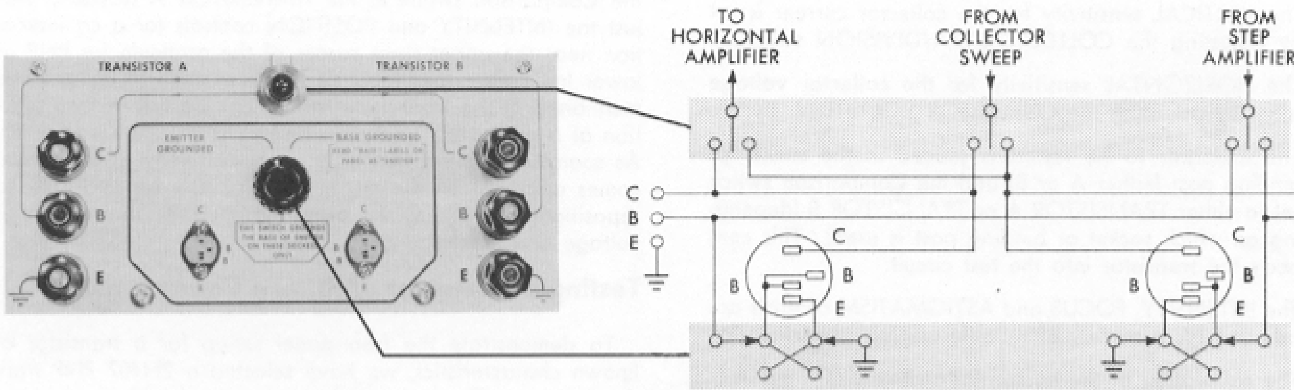


Fig. 2-7. Function of test-panel controls.

Setting Up The Front-Panel Controls

In displaying transistor curves on the Type 575 we are concerned with two considerations. . . properly displaying the curves we wish to interpret, and protecting the transistor under test from damage.

If we know quite a bit about the transistor. . . that is, if we know such factors as the collector dissipation rating, collector current and emitter current ratings, collector-to-base and collector-to-emitter voltage ratings. . . then we can set up the front-panel of the instrument without danger of damaging the transistor. However, if all we know is whether the transistor is an NPN or a PNP, more care must be exercised when setting up the front-panel controls.

The General Procedure that follows is an outline of the steps involved in setting up the front-panel controls to obtain a collector family of curves. Following the General Procedure is a step by step procedure for setting up the controls for a transistor of unknown characteristics, to obtain a collector family, and then a procedure for obtaining a collector family for a transistor of known characteristics.

General Procedure

Indicator Unit

1. The INTENSITY control is turned to mid-scale; this will prevent damage to the crt phosphor when the power is turned on.
2. The POWER switch is turned ON, so that the instrument can be warming up while it is being set up for use.

Test Panel

3. The Configuration switch is set to the EMITTER GROUNDED position (if a common-emitter configuration is desired).
4. The Comparison switch (TRANSISTOR A-TRANSISTOR B) is set to the center position; this prevents the application of any voltage or current to the transistor socket.

Collector Sweep Block

5. The POLARITY switch is set to the proper polarity for an NPN or a PNP transistor.
6. The DISSIPATION LIMITING RESISTOR switch is set to the proper value to prevent excessive collector dissipation.
7. The PEAK VOLTS RANGE and the PEAK VOLTS switches are set for the proper amplitude of collector sweep voltage.

Base Step Generator Block

8. The Display switch is set to REPETITIVE so that we may view a continuous display.
9. The STEPS/FAMILY control is adjusted for the number of curves we wish to display.
10. The POLARITY switch is set to — if the transistor under test is a PNP (since we are in the grounded-emitter configuration), or to + if an NPN transistor (again in the grounded-emitter configuration).
11. The STEPS/SEC. switch is set for the desired step rate of the Base Step Generator (either 120 or 240 steps/second).
12. The STEP SELECTOR is set for the current per step or voltage per step that we wish to apply to the base.

12.(a) If voltage steps are applied to the base of the transistor under test, the proper value of SERIES RESISTOR must be switched into the circuit to limit the base current.

Conclusion

13. The VERTICAL sensitivity for the collector current is set by adjusting the COLLECTOR MA/DIVISION switch.
14. The HORIZONTAL sensitivity for the collector voltage is set by adjusting the COLLECTOR VOLTS/DIV. switch.
15. The transistor to be tested is placed in the socket or binding post (either A or B) and the Comparison switch set to either TRANSISTOR A or TRANSISTOR B (depending on which socket or binding post is used). This connects the transistor into the test circuit.
16. The INTENSITY, FOCUS and ASTIGMATISM controls are adjusted for a display of suitable brightness and clarity.
17. The calibration of the horizontal and vertical amplifiers is checked.
18. The display is properly positioned for interpretation.

Testing a Transistor of Unknown Characteristics

To obtain a collector family for a transistor of unknown characteristics, the following control settings will afford maximum protection. We are assuming that the type of transistor is known (NPN or PNP), and that it is to be tested in the grounded-emitter configuration.

Test Panel

Configuration Switch	EMITTER GROUNDED
Comparison Switch	Centered

Collector Sweep Block

PEAK RANGE VOLTS	0-20
PEAK VOLTS	0
POLARITY	Set according to type of transistor being tested.
DISSIPATING LIMITING RESISTOR	100 K

Base Step Generator Block

Display Switch	REPETITIVE
STEPS/FAMILY	4 (full left)
POLARITY	Set according to type of transistor being tested.
STEPS/SEC.	Any setting
STEP SELECTOR	.001 MA per STEP, or .01 VOLTS per STEP
SERIES RESISTOR	22 K

SERIES RESISTOR switch is not connected in the circuit when STEP SELECTOR switch is in MA per STEP range.

Indicator Unit

VERTICAL	
COLLECTOR MA	.01
HORIZONTAL	
COLLECTOR VOLTS	.01

Place the transistor to be tested in either the socket or binding post on the left side of the Test Panel, and place the Comparison switch in the TRANSISTOR A position. Adjust the INTENSITY and POSITION controls for a crt indication near the upper right corner of the graticule for PNP or lower left corner for NPN. At this time each of the controls mentioned in the front-panel set-up can be adjust, one position at a time, until a suitable display is obtained on the crt. As soon as an indication of a collector family of curves becomes apparent on the crt, it will probably be necessary to reposition the display to properly interpret the values of voltage and current.

Testing a Transistor of Known Characteristics

To demonstrate the front-panel set-up for a transistor of known characteristics, we have selected a 2N407 PNP transistor. Note: The test transistors furnished with your instrument are a similar type.

Test Panel

Comparison Switch	Centered
Configuration Switch	EMITTER GROUNDED

2. Collector Sweep Block

The PEAK VOLTS RANGE and the PEAK VOLTS controls are set for the peak voltage with which we wish to sweep the collector. If we wish this to be 10 volts, the controls are set as follows:

PEAK VOLTS RANGE	0-20
PEAK VOLTS	10
POLARITY	PNP—

The value of the DISSIPATION LIMITING RESISTOR depends on the maximum collector disspation and the collector sweep voltage. The transistor manual states that the maximum collector disspation, for 25° C ambient temperature, is 150 mw. Consulting the RESISTOR SELECTION GRAPH on the instrument, the proper value of resistance, for a collector dissipation of 150 mw and a peak collector voltage of 10 volts, is 200 ohms.

Therefore:

DISSIPATION LIMITING RESISTOR	200

The remainder of the controls are set for the conditions under which we wish to test the transistor.

Base Step Generator Block

Display Switch	REPETITIVE
STEPS/FAMILY	4
POLARITY	—
STEPS/SEC.	240
STEPS SELECTOR	.02 MA per STEP

Indicator Unit

VERTICAL	
COLLECTOR MA	.5
HORIZONTAL	
COLLECTOR VOLTS	1

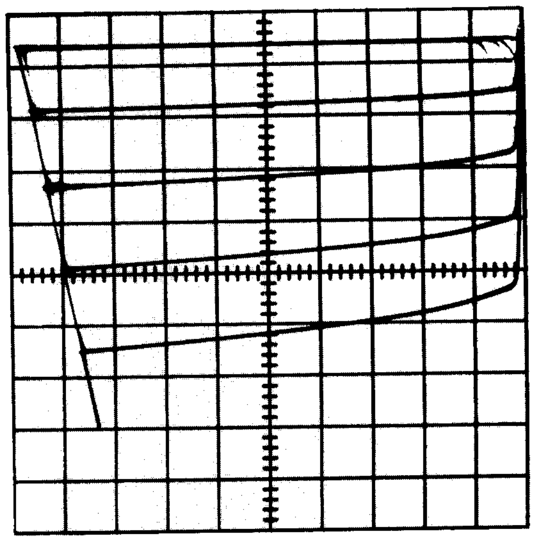


Fig. 2-8. Collector family of curves for a Type 2N407 transistor.

Insert a test transistor into the socket on the left side of the Test Panel, and place the Comparison Switch in the TRANsistor A position. Adjust the INTENSITY, FOCUS and ASTIGMATISM controls for a display of suitable brightness and clarity. The display should then be similar to the collector family shown in Fig. 2-8.

How To Check The Calibration of The Display

Before quantative information is taken from the display, a check should be made to see that the calibration of the vertical and horizontal scales is correct. The stability of the amplifiers is such that the instrument will remain in calibration over long periods of time if there are no component failures. The display must also be properly positioned.

NOTE: When you check the calibration of this instrument, calibrate it, or take information from the display, be sure your eye is at the same level as the line at which you are looking in order to avoid errors due to parallax.

Hold the VERTICAL AMPLIFIER CALIBRATION switch in the ZERO CHECK position and set the horizontal line even with the top line of the 10-division graticule. Next, hold this switch in the —10 DIVISIONS position. The horizontal line should be within 1½ minor divisions of the bottom line of the graticule if the calibration is within tolerance.

Now hold the HORIZONTAL AMPLIFIER CALIBRATION switch in the ZERO CHECK position and set the vertical line even with the extreme right vertical line of the graticule. Next, hold this switch in the —10 DIVISIONS position. The vertical line should move to within 1½ minor divisions of the extreme left vertical line of the graticule.

Since current steps are being fed into the base of the transistor under test, it is sometimes desirable to adjust the STEP ZERO control (BASE STEP GENERATOR) to a point where the first horizontal trace occurs when the base current is zero. To do this, it is necessary to have an open-circuit or zero base-current reference line. Hold the ZERO CURRENT-ZERO VOLTS switch in the ZERO CURRENT position and note precisely where the horizontal trace intersects the vertical center line of the graticule. Now release the ZERO CURRENT switch and adjust the STEP ZERO control so that the top line of the display intersects the vertical center line of the graticule at the same place.

Applying Voltage Steps to the Transistor Input

The control settings used in this display are the same as for the previous display except for the following:

SERIES RESISTOR	1 ohm
STEP SELECTOR	.02 VOLTS PER STEP
VERTICAL COLLECTOR MA	.05 MA PER DIVISION

If a complete and accurate display is desired, the display should be properly positioned by the method outlined in the next two paragraphs.

Hold the amplifier calibration switch (VERTICAL BLOCK) in the ZERO CHECK position and move the trace to the top line of the rectangular graticule. This operation sets the zero collector-current reference. Now depress the ZERO CURRENT-ZERO VOLTS switch (BASE STEP GENERATOR) in order to ground the transistor base. The vertical displacement of the horizontal trace from the zero-current reference indicates the collector current at zero bias with a calibration of .05 ma. per major division.

The STEP ZERO control (BASE STEP GENERATOR) must now be set so that the uppermost curve (zero bias) in the family of curves coincides with the position of the single curve just displayed. The family of curves now on the crt screen is that of collector current versus collector voltage with 20-millivolt steps applied to the transistor base.

Special precautions should be taken when voltage steps are fed to the input of the transistor under test. Since the input resistance of a transistor is quite nonlinear over its operating range, it is important that the number of voltage steps used does not cause excessive base current to flow. There are two controls which influence the maximum base current for a selected value of voltage-step amplitude. One is the STEPS/FAMILY control, which should be set to 4 for an initial test set-up. The other is the SERIES RESISTOR switch, which allows you to insert a protective current-limiting resistor in the transistor input lead. Excessive series resistance will seriously alter the characteristic curves displayed, therefore its effect should be taken into consideration before interpreting curves where voltage steps are being fed into the transistor input.

The SERIES RESISTOR may also be used to simulate driving impedances. When series resistance is used, it may not be possible to make the top curve of the display coincide with the zero-bias curve.

Characteristics of the Base Step Generator

The largest current steps the base generator can supply are 200 ma. each. Since up to 12 steps are available, the maximum current this supply will deliver is therefore 2.4 amperes. Because of necessary restrictions on the size of the power source for the internal transistors used to deliver the current steps, the input characteristics of the power transistor under test must be such that the base to emitter voltage does not exceed 5 volts when the base current is 2.4 amperes.

The minimum source resistance of the step generator in the VOLTS/STEP range of the STEP SELECTOR switch is one ohm (SERIES RESISTOR set at 1 ohm). This is a constant minimum source resistance irrespective of the size of the voltage steps. The source resistance increases as resistance is switched in series by the SERIES RESISTOR switch.

When power transistors are driven into the high base-current region, their input resistance is often low enough to cause the input steps to become non-uniform in size. Under these conditions, it is best to check the uniformity of the voltage steps by displaying the base voltage on either the vertical or horizontal axis. A quick check of generator loading may be made by changing the setting of the SERIES RESISTOR switch from 1 ohm to 3.4 ohms while collector characteristics are being displayed. A radical shift in the position of the trace displaying the highest collector current would indicate a low input resistance and the possiblity of non-uniform voltage input steps in the 1 ohm position.

Functions of Controls and Switches

All descriptions given below presume that the transistor under test is in the grounded-emitter configuration and that the power-line frequency is 60 CPS.

Collector Sweep Block

PEAK VOLTS RANGE. Selects appropriate power source to give collector sweep voltage and current range indicated. Operates in conjunction with PEAK VOLTS control.

PEAK VOLTS APPROXIMATE. Variable autotransformer in the primary of the collector sweep transformer. Operates in conjunction with PEAK VOLTS RANGE.

CIRCUIT BREAKER. Protects the collector sweep circuit from excessive overload currents.

POLARITY. Selects the polarity of the collector sweep to be applied to the transistor under test.

DISSIPATION LIMITING RESISTOR. Selects a protective series resistor for the collector circuit of the transistor under test. This resistance may be used as the collector load resistor to simulate operating conditions of the transistor under test. Refer to chart on top panel.

Base Step Generator Block

REPETITIVE-OFF-SINGLE-FAMILY. In the REPETITIVE position, the Base Step Generator produces stair-step waveforms. A characteristic curve is plotted during each horizontal portion of the stair-step waveform. In the OFF position, the BASE STEP GENERATOR is disabled. The SINGLE FAMILY position is a spring-return position which permits the generation of one stair-step waveform each time the switch handle is depressed.

STEPS/FAMILY. Determines the number of steps in each family of curves.

POLARITY. Selects the polarity of the stair-step waveform to be applied to the transistor under test.

STEPS/SEC. Selects the steps-per-second rate of the Base Step Generator as well as determining whether the steps occur at the beginning or at the end of each curve.

SERIES RESISTOR. This switch functions only when the STEP SELECTOR switch is in the VOLTS PER STEP position. It permits the simulation of the source impedance of the circuit in which the transistor under test is to be used. The SERIES RESISTOR may also be used as a protective device to limit the current that might otherwise be inadvertently applied to the transistor base.

STEP SELECTOR. Selects the magnitude of either voltage or current-per-step to be applied to the transistor under test.

STEP ZERO. The STEP ZERO control permits adjustment of the Step Generator to start on the zero-current or zero-volts curve of the display.

ZERO CURRENT—ZERO VOLTS. In the ZERO CURRENT position, the connection to the base of the transistor under test is broken. The curve displayed shows the open-base characteristic of the transistor. In the ZERO VOLTS position, the base is grounded to permit examination of the zero-bias characteristics.

Vertical Block

CURRENT OR VOLTAGE PER DIVISION. COLLECTOR MA. Selects the collector-current of the transistor under test for the vertical display. Different switch positions within this range change the calibration of the vertical display by changing the value of an internal current-sampling resistance.

2X. Pushbutton switch multiplies each current step by 2.

0.1X. Pushbutton switch divides each current step by 10.

BASE VOLTS. Selects the base voltage of the transistor under test for the vertical display. The sensitivity is determined by the resistance of an attenuator in the vertical amplifier.

BASE CURRENT OR BASE SOURCE VOLTS. Base current is displayed vertically when the STEP SELECTOR switch (BASE STEP GENERATOR) is in the MA PER STEP range. The calibration of the vertical display is that indicated by the STEP SELECTOR switch except that it is also in milliamperes per major division as well as milliamperes per step.

The base-source voltage is displayed vertically when the STEP SELECTOR switch is in the VOLTS PER STEP range. The display is that of the voltage steps which are occuring ahead of the SERIES RESISTOR. The calibration is indicated by the STEP SELECTOR switch except that it is also in volts per major division as well as volts per step.

EXT. This switch position permits the vertical dc amplifier to be driven by an external signal applied through connectors on the back panel of the instrument, or on instruments after S/N 3659 through the pins of the Type 175 adaptor socket. The external signal may be either single-ended or push-pull.

POSITION. This control permits the display to be moved vertically over the entire face of the crt without introducing distortion into the display.

AMPLIFIER CALIBRATION. A three-position switch with two spring-return positions used to check the ZERO position and the calibration of the vertical amplifier.

DC BAL. This control is adjusted to permit changing of the amplifier sensitivity without changing the position of the display.

Horizontal Block

VOLTS/DIV. BASE VOLTS. Selects the base voltage of the transistor under test for the horizontal display. The sensitivity is determined by the resistance of an attenuator.

COLLECTOR VOLTS. Selects the voltage on the collector of the transistor under test for the horizontal display. The various switch positions in this range either change the gain of the horizontal amplifier or introduce attenuation of the collector voltage signal applied to the input of the horizontal amplifier.

BASE CURRENT OR BASE SOURCE VOLTS. The description of this switch position is the same as that given in the VERTICAL BLOCK under the same heading, except that the display is horizontal instead of vertical.

EXT. The description of this switch position is the same as that given in the VERTICAL BLOCK under the same heading, except that the display is horizontal instead of vertical.

POSITION. This control permits the display to be moved horizontally over the entire face of the CRT without introducing distortion into the display.

AMPLIFIER CALIBRATION. A three-position switch with two spring-return positions used to check the ZERO position and the calibration of the horizontal amplifier.

DC BAL. This control adjusts the tube-current balance in the direct-coupled horizontal amplifier to permit changing of the amplifier sensitivity without changing the position of the display.

Test Panel

TRANSISTOR A, TRANSISTOR B. A three-position switch which, in either outside position, connects the two binding posts and the transistor socket indicated to the appropriate circuitry within the instrument. In the center (off) position, it disconnects all power from the transistor, sockets and binding posts.

EMITTER GROUNDED, BASE GROUNDED. A reversing switch in the base and emitter leads of the transistor sockets. It permits small transistors to be rapidly switched between the grounded-emitter and grounded-base configurations. This switch does not reverse binding post connections.

Interpreting Type 575 Curves

The following displays are devoted to some typical transistor displays and their meaning. While no attempt is made to explain transistor terminology and parameters, it is hoped that these diagrams and curves will help the operator to arrive at the desired answer in less time, and perhaps better understand the operation of the instrument in so doing.

The transistor used in most of the following tests is the 2N407 PNP junction transistor. The curves are not necessarily typical of the average 2N407 as a number of different transistors were used in order to best demonstrate certain characteristics. Other curves shown include those for the point contact transistor, Zener diode, gaseous voltage-regulator tube NE2, tetrode transistor, photodiode and phototransistor.

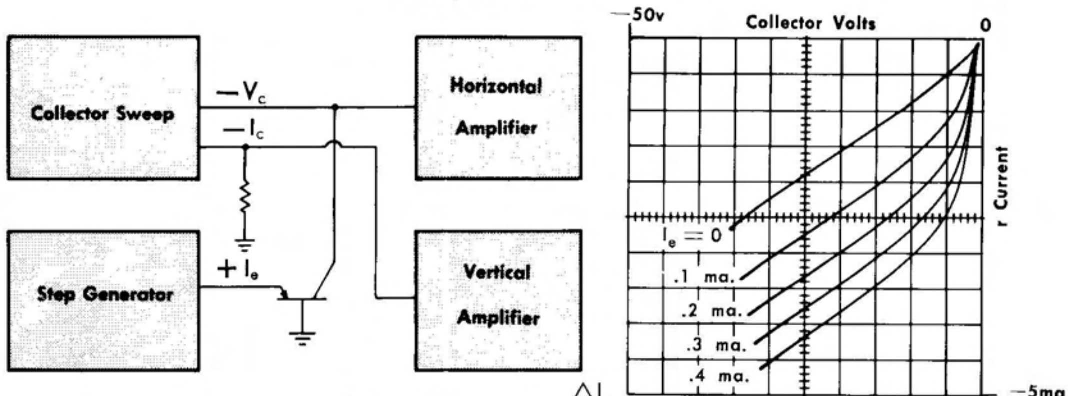
An attempt has been made to portray all of the voltages and currents that appear in transistor specifications; i.e., V_{ce}, V_{be}, V_{cb}, BV_{ce}, BV_{ceo}, I_{co}, I_{cbo}, I_{eo}, etc. Also, since some manufacturers employ the hybrid h parameters while others use the r parameters (as in low-frequency equivalent T circuit), measurements of both types have been included.

Note: The measurements obtained on the Type 575 are valid for low-frequency operation only; other equipment is required for high-frequency testing.

The effects of temperature on transistor operation are very important; this can be noted in the top two curves on page 2-7. The temperature effects can be portrayed with the aid of a thermocouple or heat box, or by means of an oil bath and heating element.

Collector Family

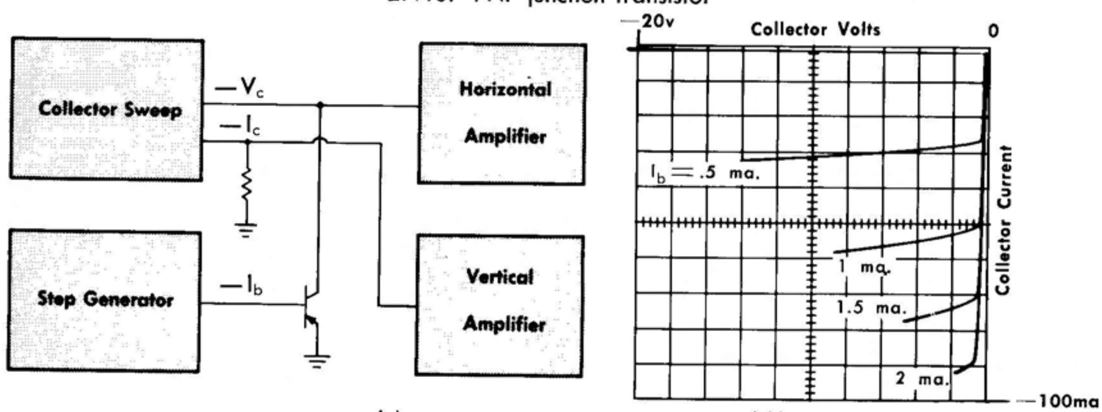
X-Bell point-contact transistor



Note: Alpha (α) $= \frac{\Delta I_c}{\Delta I_e}$ is greater than 1.

Collector Family

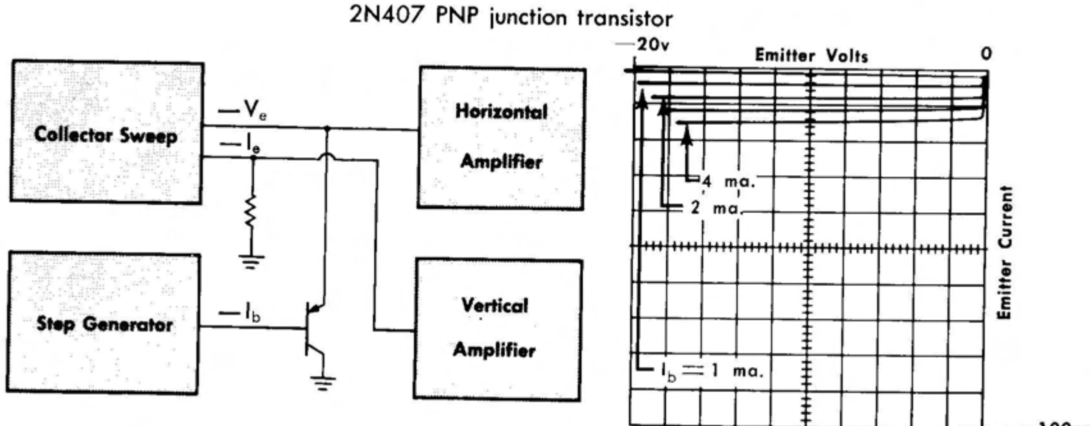
2N407 PNP junction transistor



Beta (β) $= \frac{\Delta I_c}{\Delta I_b} = h_{fe}, h_{FE}$. $r_{22e} = r_e + r_c = \frac{\Delta V_c}{\Delta I_c}$

Inverted Collector Family

2N407 PNP junction transistor



Reverse current transfer ratio $= h_{fc}, h_{FC}$.

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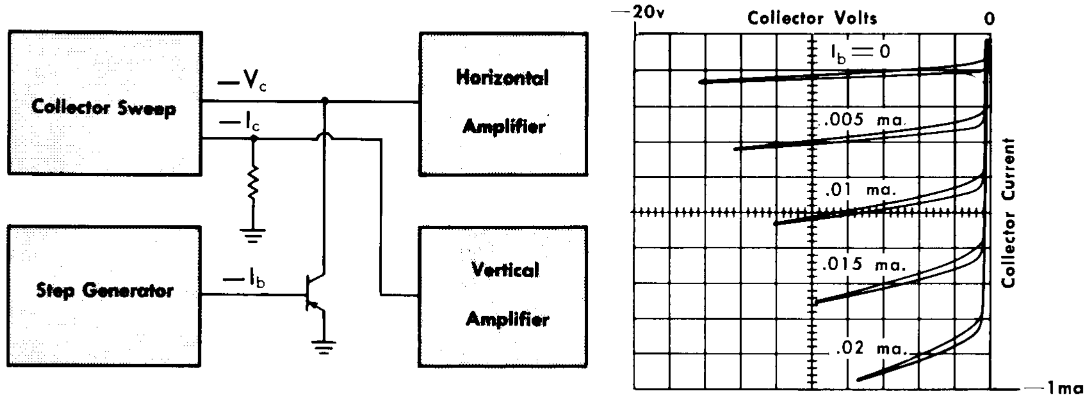
Collector Family . . . Effect of collector to base capacity

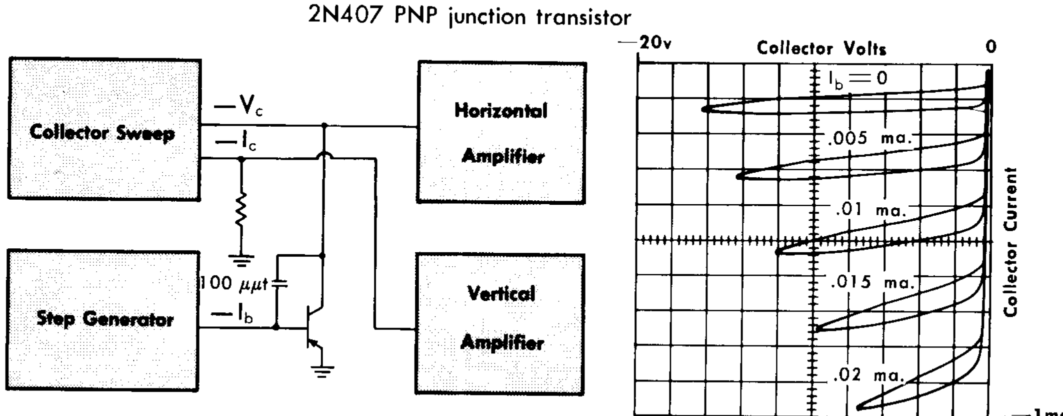
2N407 PNP junction transistor



This effect is most noticeable with high collector voltage and low collector current.

Collector Family . . . External capacity added

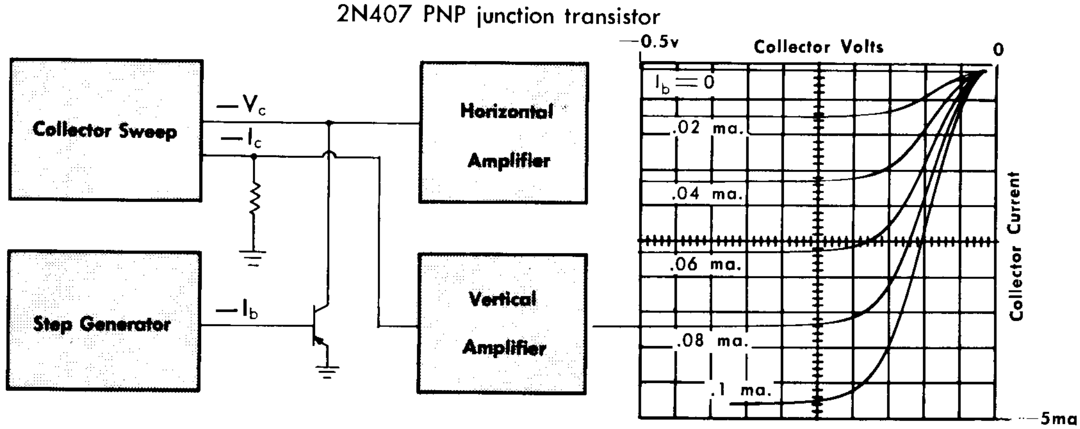
2N407 PNP junction transistor



The added capacity increases the modulation of the base current; this effect is amplified by the transistor.

Collector Family . . . Saturation region

2N407 PNP junction transistor

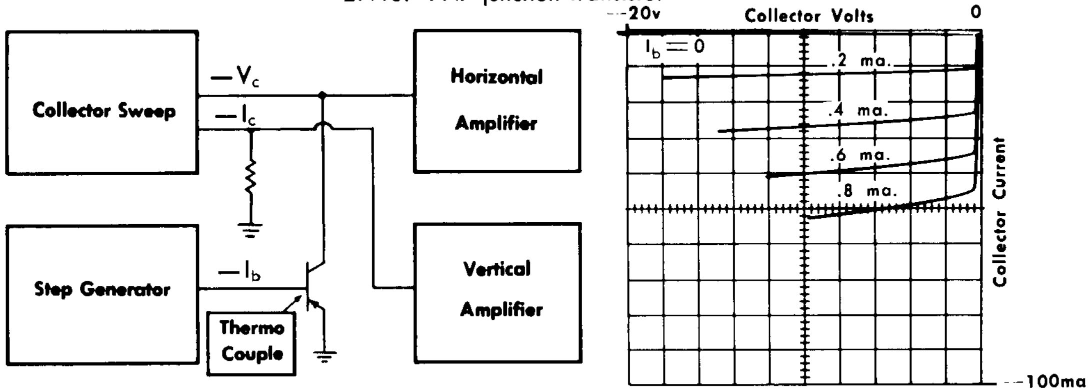


Saturation voltage V_{CE} (SAT), at specified I_b and I_c.

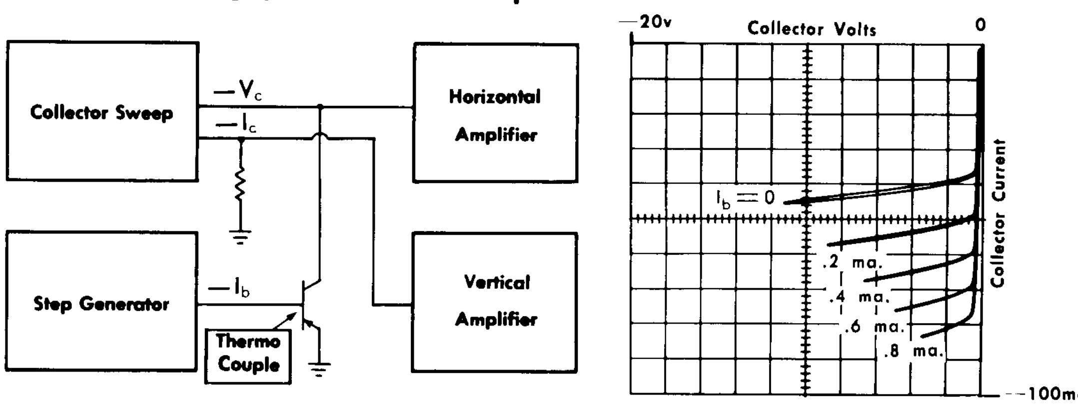
Saturation resistance R_{SC} = slope of I_c-V_c curve at specified I_c.

Collector Family . . . Room temperature (75° F.)

2N407 PNP junction transistor



Above transistor at temperature of 150° F.

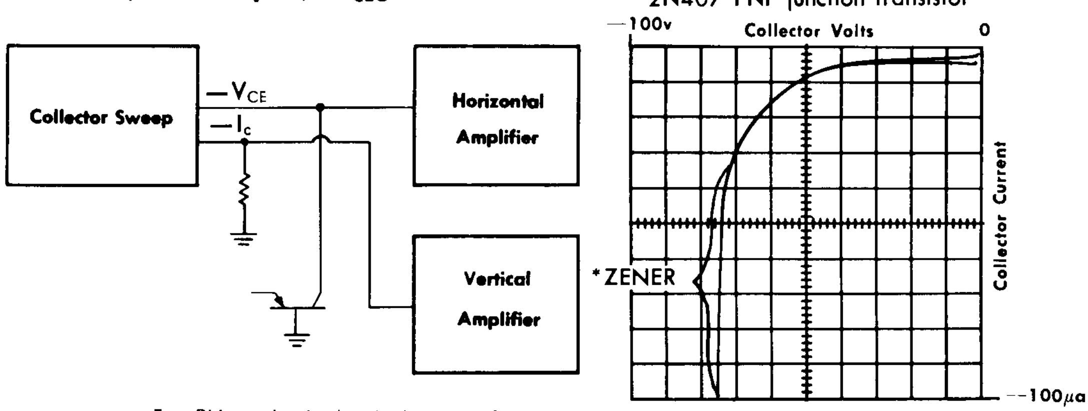


Note increase in leakage current and Beta.

Breakdown Voltage, collector to base (emitter open) BV_{CBO}

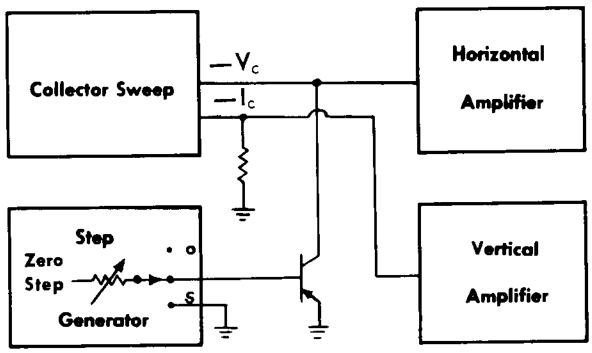
Collector Cutoff Current I_{CO}, I_{CBO}

2N407 PNP junction transistor



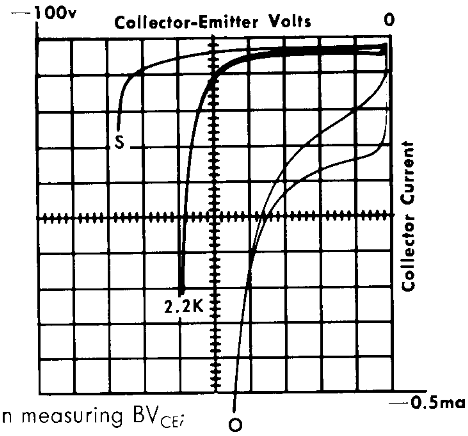
For BV_{CBO} the I_c should be specified; For I_{CBO} the voltage should be specified. Note the Zener* region.

Breakdown Voltage, collector to emitter BV_{CE}, BV_{CEO}, BV_{CER}, BV_{CES}



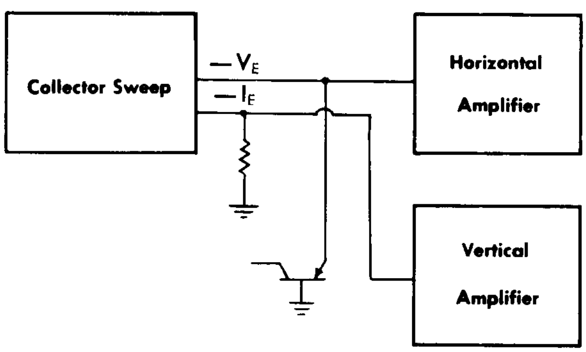
Collector Current I_{CE}, I_{CEO}, I_{CES}

2N407 PNP junction transistor

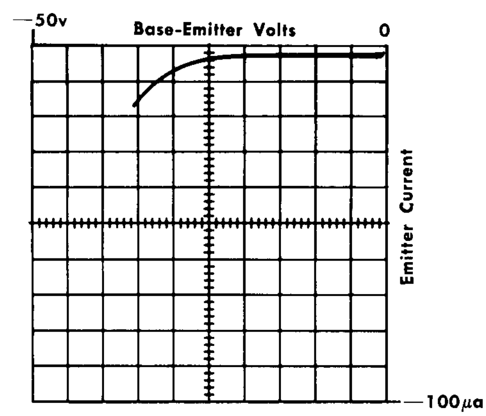


The current should be specified when measuring BV_{CE}; the resistance should be specified when measuring BV_{CER}.

Breakdown Voltage, base to emitter (collector open) BV_{BEO}

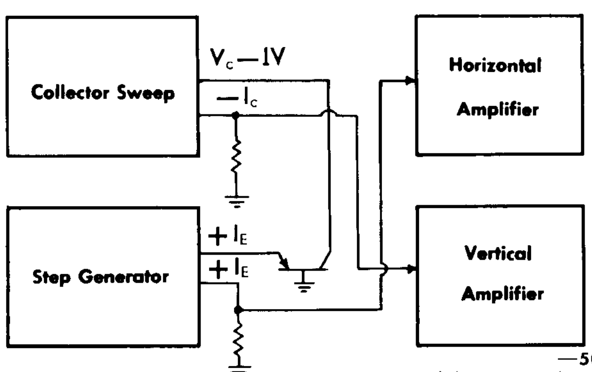


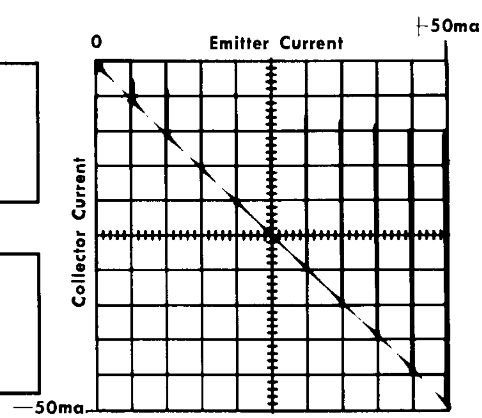
Emitter Current I_{EO}, I_{EBO}.



Alpha Curve, α, h_{21b}, h_{fb}, h_{FB}

2N407 PNP junction transistor

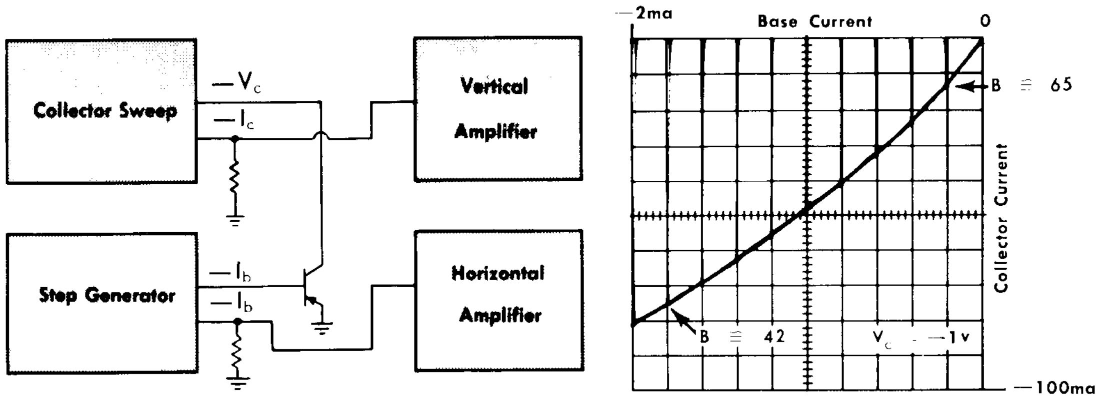




$$h_{fb} = \frac{\Delta I_c}{\Delta I_e};\ h_{FB} = \frac{I_C}{I_E}$$

Forward Current Transfer Ratio, Beta, β, h_{21e}, h_{fe}, h_{FE}

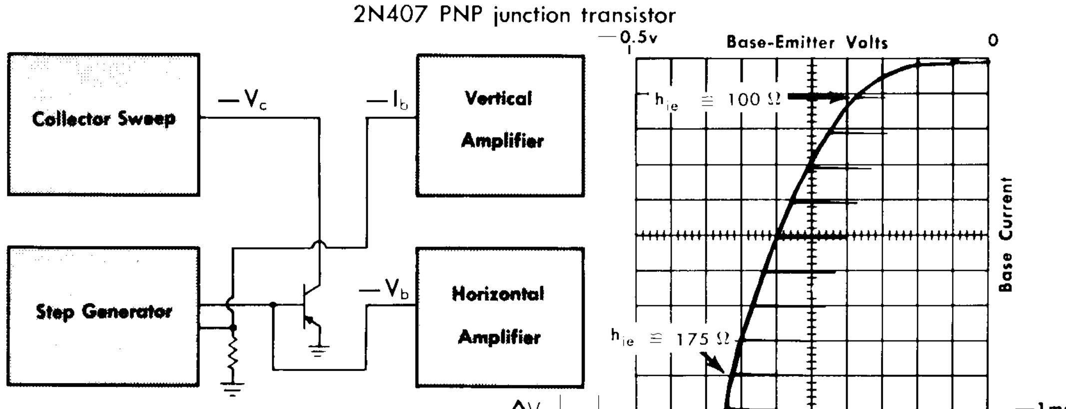
2N407 PNP junction transistor



Note Beta, $h_{fe} = \frac{\Delta I_c}{\Delta I_b}$, decreases at higher currents.

Input Impedance, h_{11e}, h_{ie}

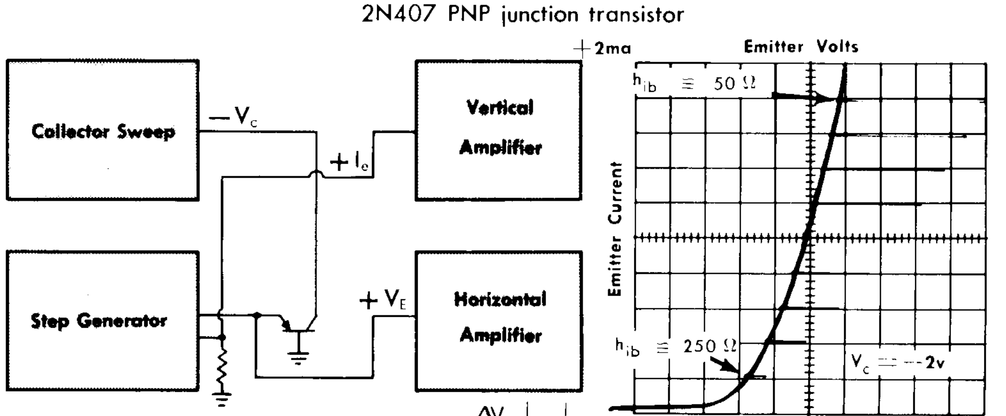
2N407 PNP junction transistor



$h_{ie} = \frac{\Delta V_b}{\Delta I_b} \Big| V_c \Big|$.

Input Impedance, h_{11b}, h_{ib}

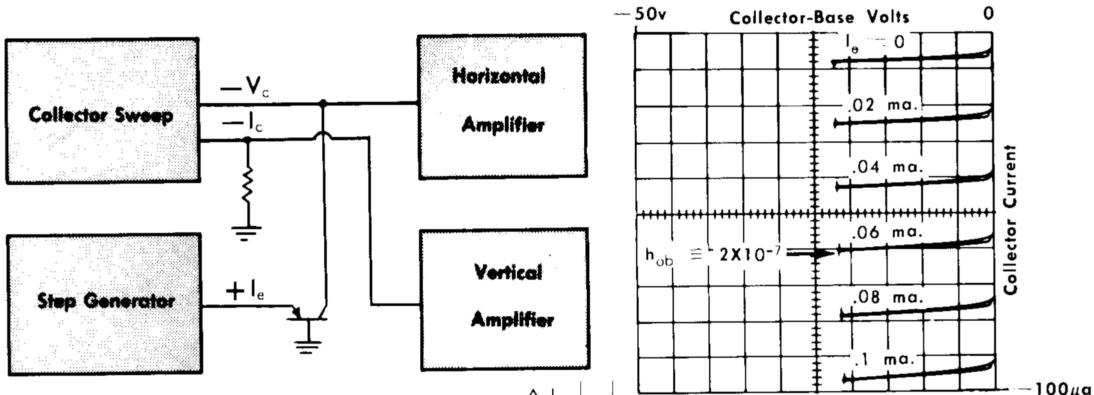
2N407 PNP junction transistor



$h_{ib} = \frac{\Delta V_e}{\Delta I_e} \Big| V_c \Big|$.

Output Admittance, h_{22b}, h_{ob}

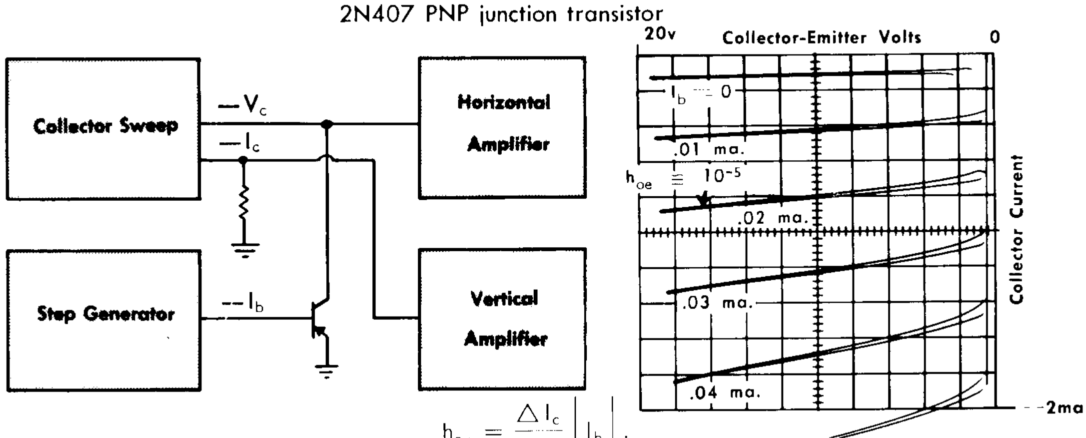
2N407 PNP junction transistor



$$h_{ob} = \frac{\Delta I_c}{\Delta V_c}\bigg|\, I_e \bigg| .$$

Output Admittance, h_{22e}, h_{oe}

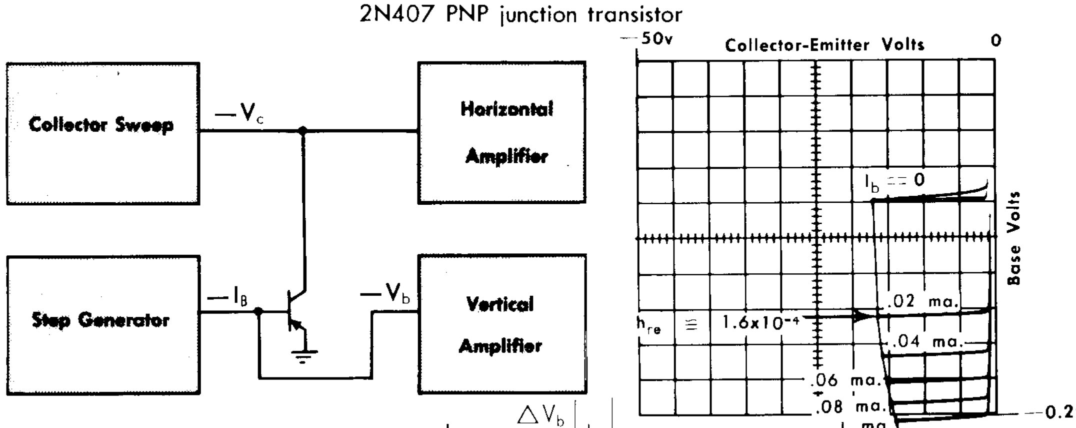
2N407 PNP junction transistor



$$h_{oe} = \frac{\Delta I_c}{\Delta V_c}\bigg|\, I_b \bigg| .$$

Voltage Feedback Ratio, h_{12e}, h_{re}

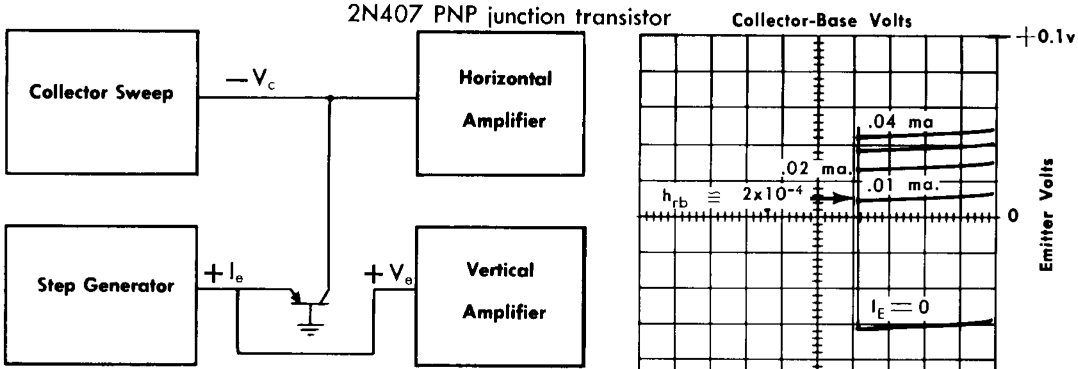
2N407 PNP junction transistor



$$h_{re} = \frac{\Delta V_b}{\Delta V_c}\bigg|\, I_b \bigg| .$$

Voltage Feedback Ratio, h_{12b}, h_{rb}

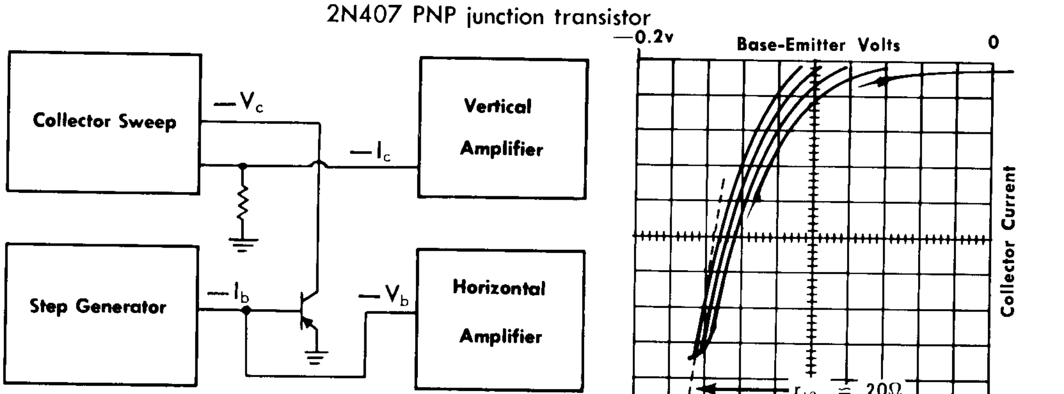
2N407 PNP junction transistor



$$h_{rb} = \left.\frac{\Delta V_e}{\Delta V_c}\right|_{I_e}$$

Reverse Transfer Resistance, r_{12e}

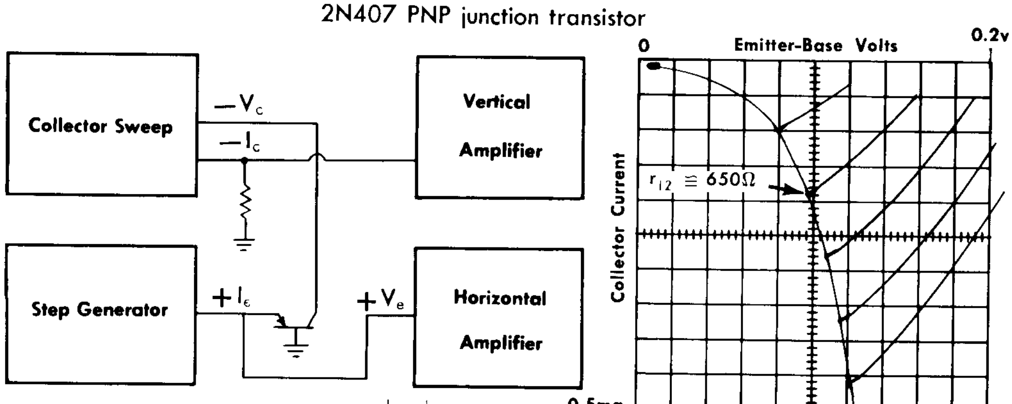
2N407 PNP junction transistor



$$r_{12e} = \left.\frac{\Delta V_b}{\Delta I_c}\right|_{I_b} = r_e. \text{ Slope } = r_{12e}.$$

Reverse Transfer Resistance, r_{12b}

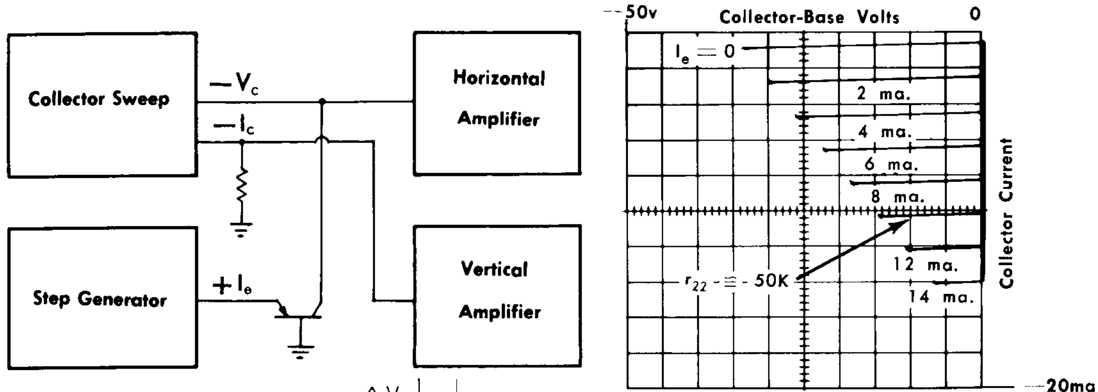
2N407 PNP junction transistor



$$r_{12b} = \left.\frac{\Delta V_e}{\Delta I_c}\right|_{I_e} = r_b. \text{ Slope } = r_{12}.$$

Output Resistance (input open-circuited to ac).

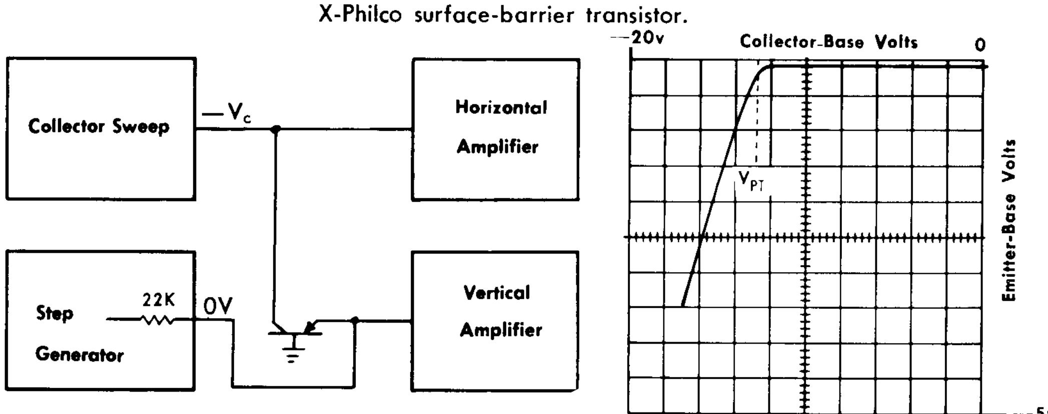
2N407 PNP junction transistor



$$r_{22} = \left. \frac{\Delta V_c}{\Delta I_c} \right| I_e \Big| = r_b + r_c. \quad \text{Slope} = r_{22}.$$

Punch-Through Voltage (V_{PT}) and Floating Potential.

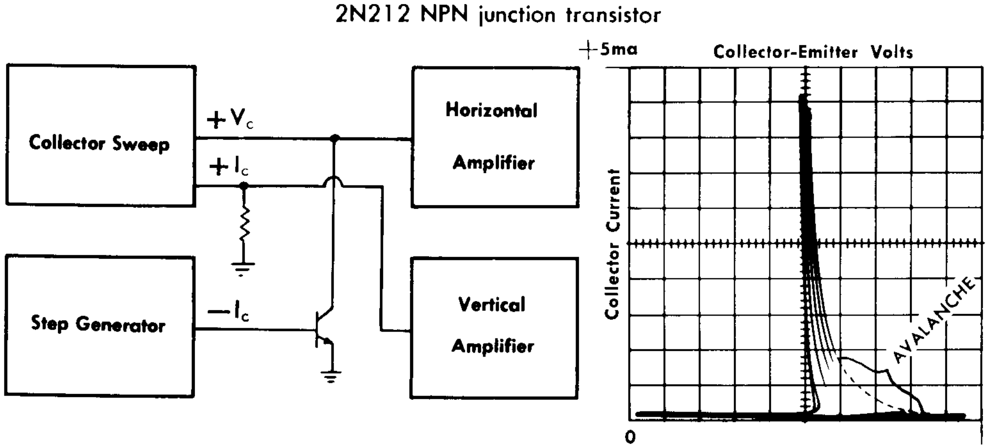
X-Philco surface-barrier transistor.



Note: Punch-through rarely occurs before BV_{CE}. V_{EB} is the floating potential

Back-Biased NPN in Avalanche Mode

2N212 NPN junction transistor

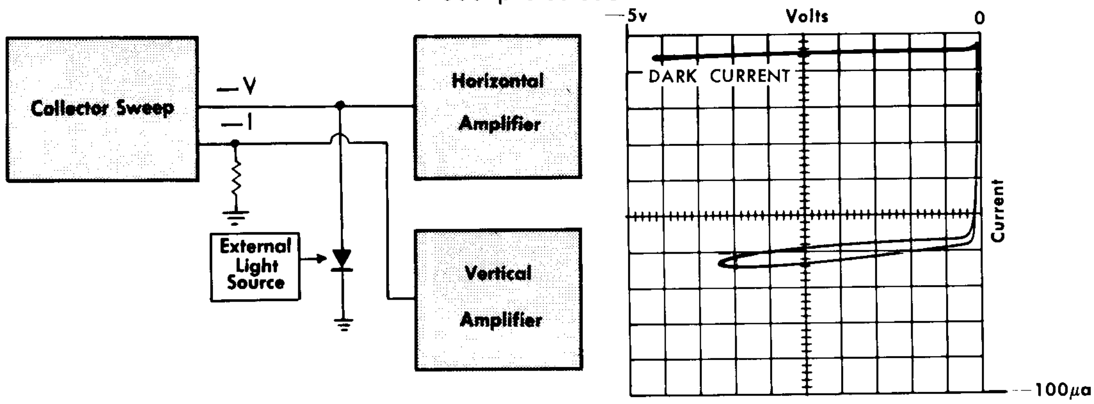


+50v

This is a very fast breakdown as opposed to normal Zener breakdown.

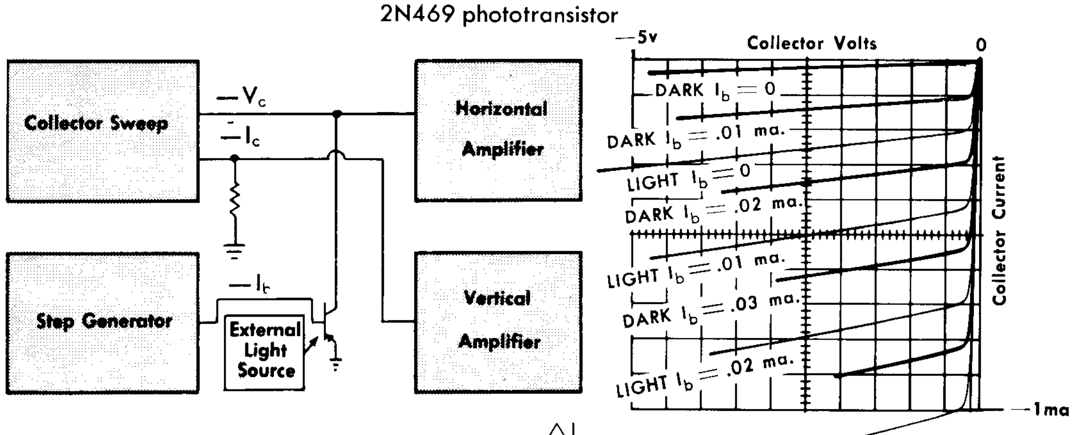
Photodiode, with and without light

TI-800 photodiode



Phototransistor, with and without light

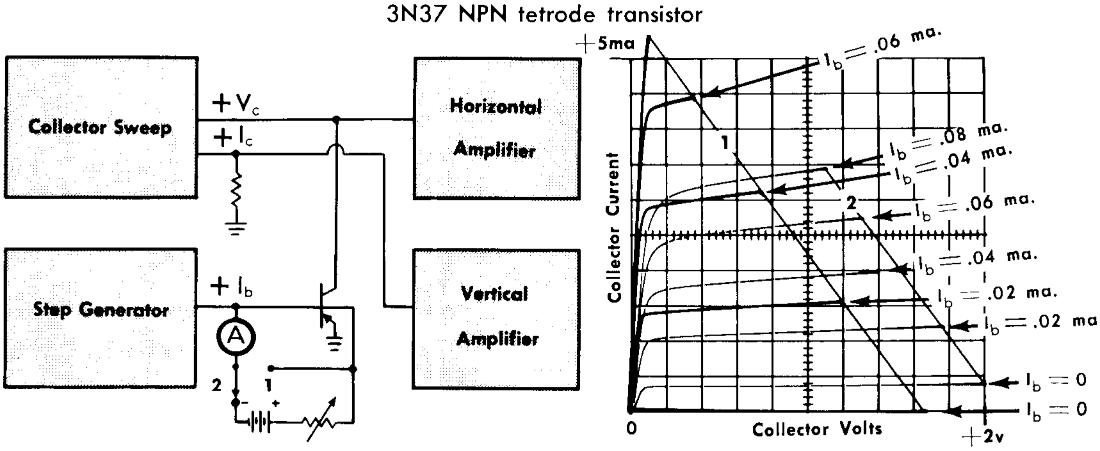
2N469 phototransistor



$h_{fe} = \frac{\Delta I_c}{\Delta I_b}, r_{22}$

Tetrode NPN: Effect of Interbase Bias

3N37 NPN tetrode transistor

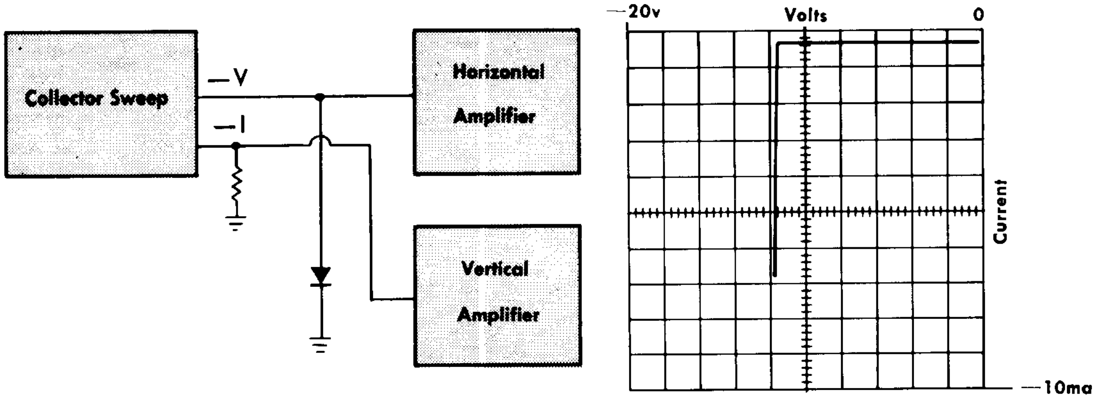


External Battery and Resistor

Note the reduction in Beta with interbase bias.

Zener or Reference Diode, Reverse Biased

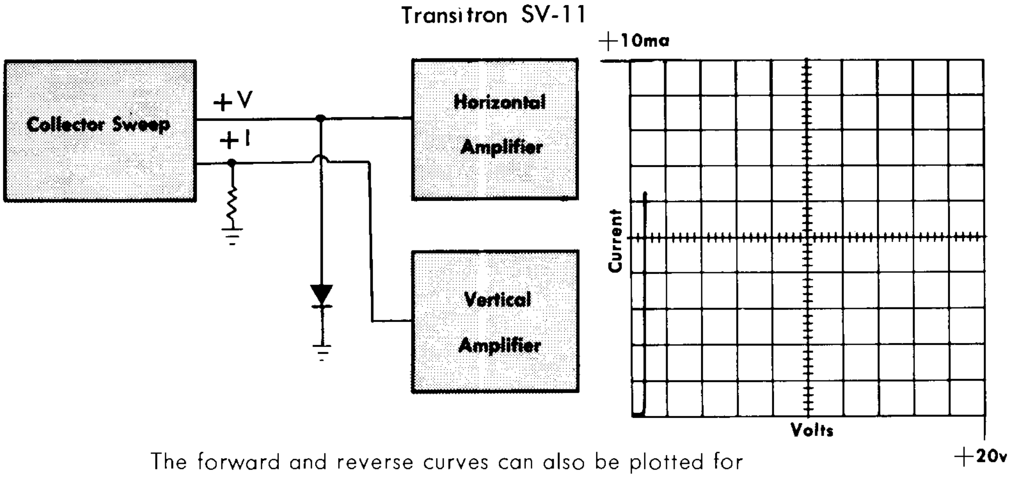
Transitron SV-11



Operating potential (Zener region); Dynamic impedance (slope)

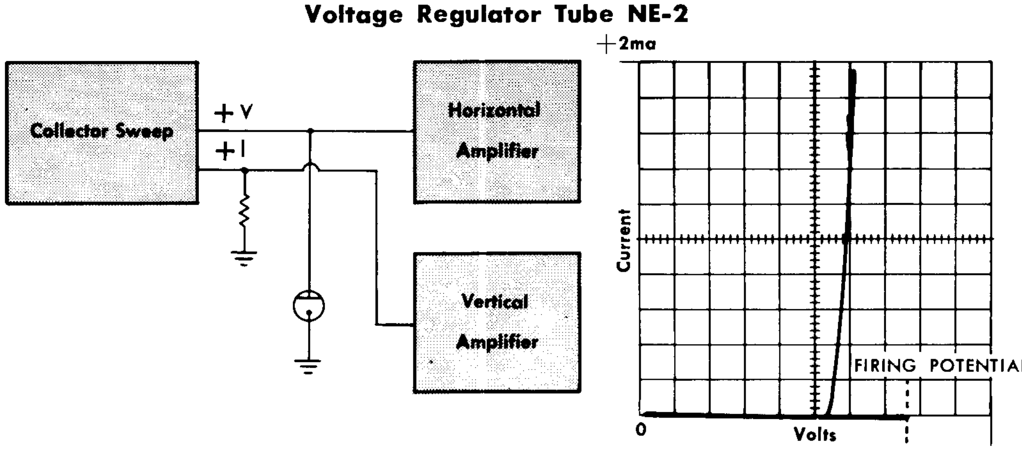
Zener or Reference Diode, Forward Biased

Transitron SV-11



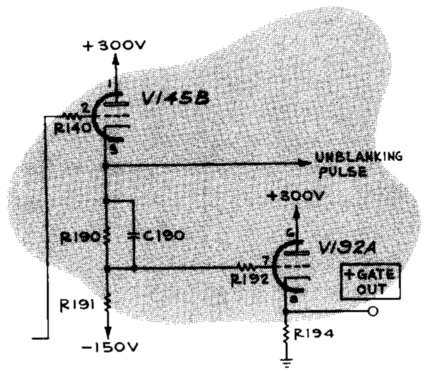
The forward and reverse curves can also be plotted for semiconductor diodes and metallic rectifiers.

Voltage Regulator Tube NE-2



Firing potential, operating potential and dynamic impedance

NOTES



SECTION 3

CIRCUIT DESCRIPTION

Block Diagram

The Block Diagram shows the relationship of the Collector Sweep, the Step Generator, the Step Amplifier, and the CRT Deflection Amplifiers to the transistor under test. The Step Generator is driven by the 60-cycle line voltage and the waveform from the Step Amplifier is applied to the input of the transistor under test. The Collector Sweep Generator supplies the full-wave rectified pulses that are applied to the collector of the transistor. Notice that the pulsations occur at twice the line frequency. The crt deflection amplifiers are shown connected for a display of the transistor I_c - V_c characteristic curves.

The three possible time relationships between waveforms of the Collector Sweep and the Step Generator are shown in Fig. 3-1. In waveform (b), each voltage step begins at a time when the Collector Sweep voltage is zero. In waveform (c), each step begins at a time when the Collector Sweep voltage is at its maximum value. In waveform (d), steps begin both at times when the Collector Sweep voltage is at its maximum value and when it is at its minimum value.

Collector Sweep

The Collector Sweep circuit rectifies the 60-cycle line voltage (full-wave circuit) to produce 120 sweeps per second for the collector of the transistor under test.

The primary voltage of T702 is variable from 0 to 140 volts rms by the variable autotransformer T701 (PEAK VOLTS control). The secondary of T702 provides output voltages up to 20 volts and 200 volts, peak, depending on the setting of the PEAK VOLTS control and the PEAK VOLTS RANGE switch SW706. The collector-supply primary is protected by a circuit breaker, set to trip within 30 seconds at 1.2 ampere rms current but to hold on a rms current of 1 ampere. The turns ratio of the transformer for the 20-v range is such that a maximum peak current of 15 amperes is available with 1 ampere rms in the primary. Because the current pulses for transistors are not sinusoidal nor of constant amplitude, and their duty cycle is dependent upon the characteristics of the device being tested, it is difficult to say what maximum collector-current curves can be plotted. Generally, a family of collector-current curves can be plotted to 20 amperes or more

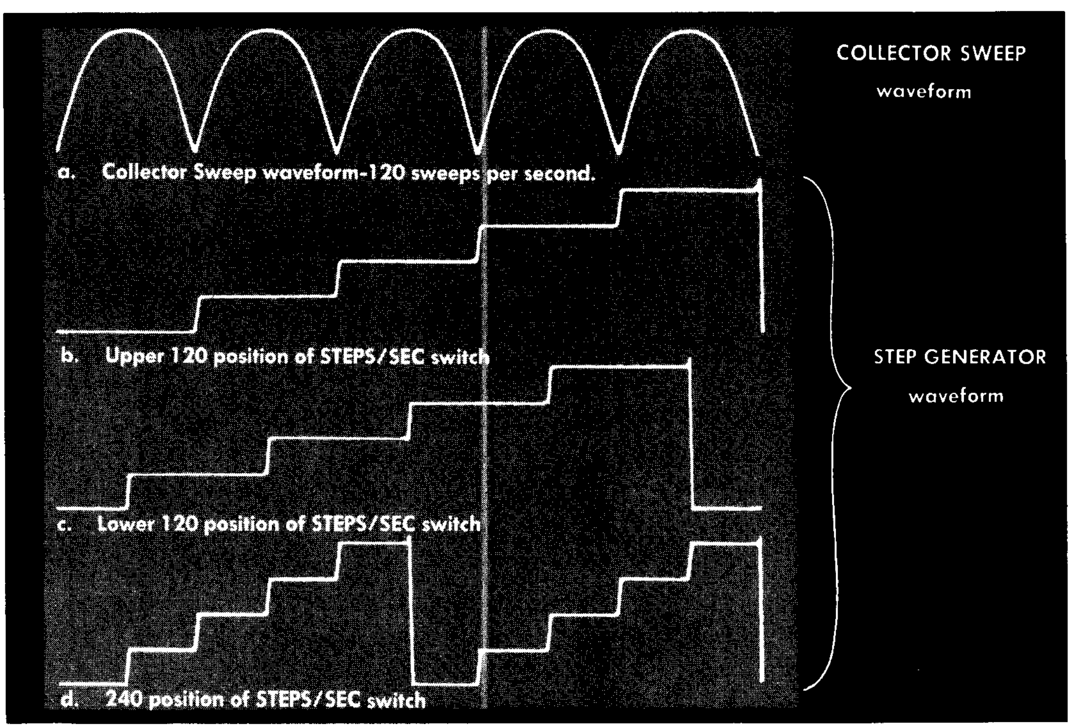


Fig. 3-1. The time relationship between waveforms of the Collector Sweep circuit and the Step Generator.

when the transistors have a beta of 8 or greater. When checking diodes, you will notice that the waveform of current pulses is such that a curve of approximately 15 amperes maximum is drawn.

By means of the PEAK VOLTS RANGE switch, each set of rectifier diodes is connected in parallel for the 0-20 volt range, or in series for the 0-200 volt range. The polarity of the output sweeps is determined by the POLARITY switch SW708. The DISSIPATION LIMITING RESISTOR switch SW710 connects the desired value of resistance in series with the collector to protect the transistor.

To compensate for the stray-circuit-capacitance charging current through the Current Sampling Resistor, a sample of the collector sweep voltage is applied through the cathode-follower V733 to the top of the Current Sampling Resistor. Capacitors C706 and C735 are used to balance the circuit capacitances.

Step Generator

The circuit diagram of the Step Generator may be considered in two sections: the pulse-generator section (left side) which develops rectangular pulses from the sine-wave input, and the staircase-generator section which uses these pulses to develop a staircase waveform. V171 is the "heart" of the Step Generator and its operation will be described first.

Staircase Generator

The staircase waveform is generated by increasing the charge on a capacitor by equal steps and then discharging the capacitor after the desired number of steps has been generated. A simplified example is shown in Fig. 3-2. When the switch is closed the voltage will rise at the normal RC charging rate as in curve A. If the switch is closed in a series of short, equal intervals, a staircase waveform like that of waveform B is produced. It is a very poor staircase waveform because the steps become progressively smaller as the voltage across the capacitor increases. To achieve a series of equal-amplitude steps, the capacitor charging current, and hence the voltage across the resistor, must be kept constant.

The diagram of Fig. 3-3 shows a method of achieving this end. It is called the Miller integrator. With the switch in position 1, the plate of the pentode is at +100 volts, the quiescent output voltage, and the charge on C177 is 101.5 volts.

When the switch is moved to position 3, C177 charges through R1 and the grid of V171 tends to become more negative. But since a negative signal on the control grid reduces the plate current, the plate voltage increases, raising the voltage at the top of C177. The coupling of this positive change at the top of C177 to the control grid almost completely cancels the negative-going tendency of the control grid. Since the dc gain of the pentode stage is very high, the plate-voltage change is always very large compared to the voltage change that occurs on the grid.

When the switch is moved to position 1, the charging process stops and the tube returns to its initial condition, discharging C177 to 101.5 volts.

Waveform A of Fig. 3-3 is the output waveform which results from moving the switch from position 2 to position 3 at a regular rate. Note that this staircase waveform has steps which are of equal amplitude, since C177 is charged at the same rate whenever the switch is in position 3. Waveform B is the corresponding grid waveform.

The circuit of Figure 3-4 is a modification of the one in Fig. 3-3, the only changes being the addition of a cathode follower between the plate of the pentode and the top of C177 and an additional switch position which permits the coupling of negative-going pulses to the bottom of C177.

With the switch in position 1, the plate of the pentode is again at +100 volts; however, the output terminal (top of C177) will be about ground potential.

With the switch in position 4, and with no input pulses fed into diodes V172A and V172B, the output voltage is constant since the electrical path through C177 is incomplete. When

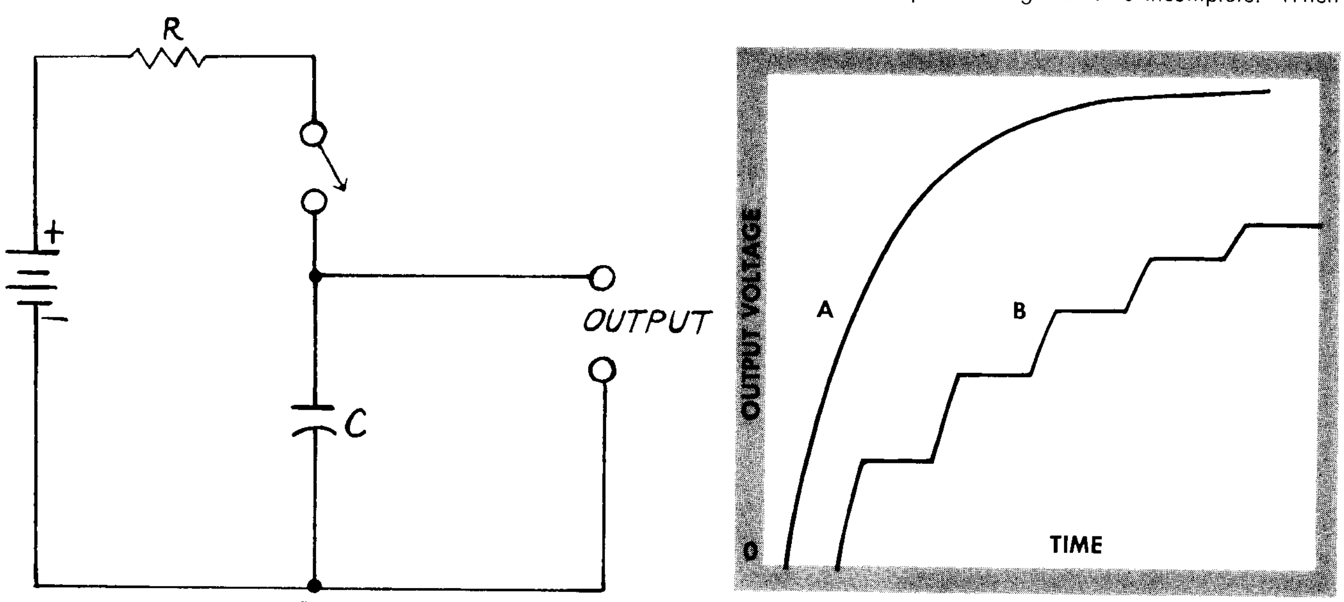


Fig. 3-2. Basic circuit (a) for generating a step waveform (waveform B in (b).

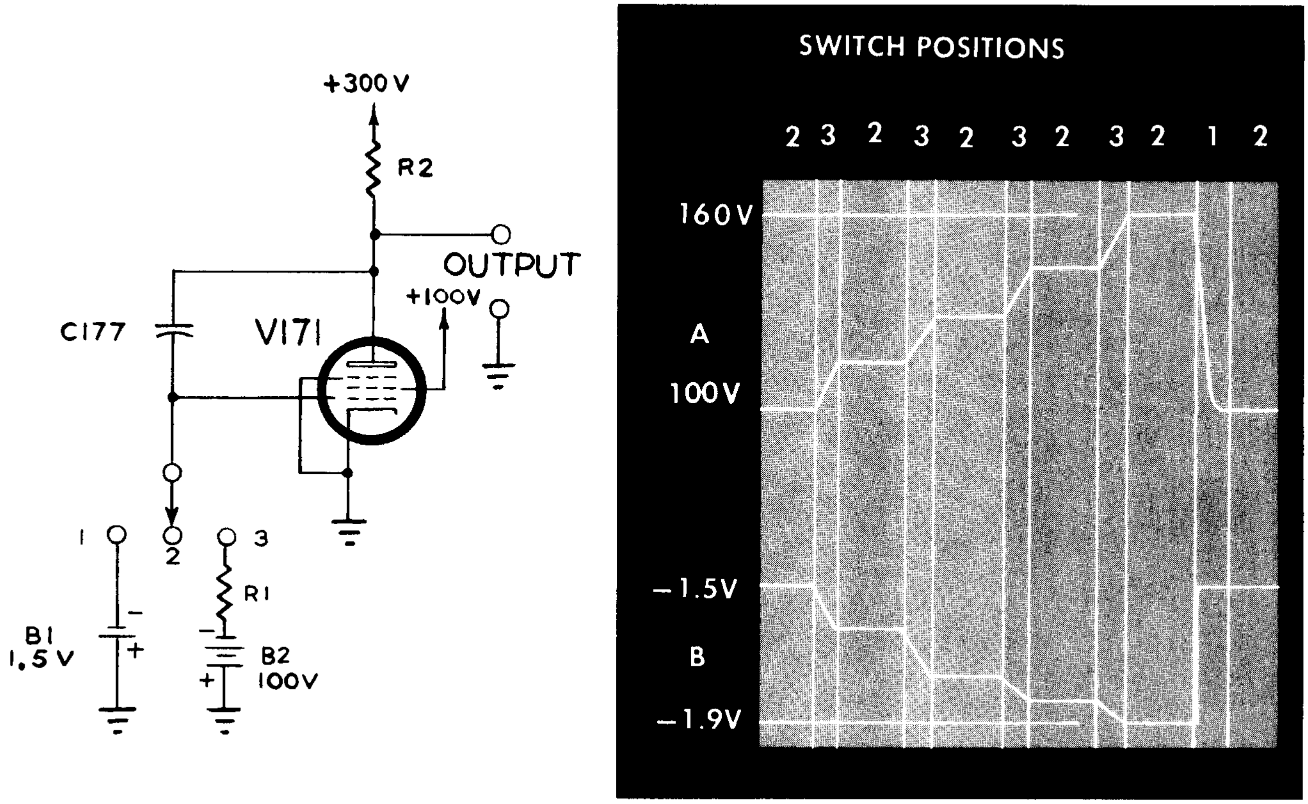


Fig. 3-3. The basic Miller Integrator circuit and the resulting plate and grid waveforms for linear step operation.

a negative pulse is fed to the cathode of V172A, C142 transfers a quantity of its charge to C177. As the negative input pulse returns to its base level, V172A stops conducting. V172B, however, begins to conduct heavily to restore the charge on C142.

Because the Miller integrator keeps the voltage at the bottom of C177 nearly constant, the same quantity of charge is transferred to C177 with each pulse. The voltage steps occuring at the output are equal, because the voltage across a capacitor is directly proportional to its charge.

The changing charge on C142 is an important part of the generation of steps. On waveform C, point "a" (between negative pulses) shows the left end of C142 to be +150 volts. Waveform B shows that at the same time, the junction of diodes V172A and V172B is near ground. The charge on C142, then, must be about 150 volts. As a negative pulse begins, the left end of C142 is driven negatively toward +50 volts. As the right end of C142 tries to follow, V172A provides a current path for C177 and its charge is increased as shown on waveform A. Since the capacity of C177 is about 7 times as large as that of C142, the increase in voltage across C177, 15 volts is equal to 1/7 of the decrease in voltage across C142. Because the Miller integrator keeps the bottom of C177 at a constant voltage, the 15-volt step occurs at the output and not at the grid of V171.

Repetitive Triggering

The circuit of Fig. 3-5 is used to show the operation of the Schmitt Trigger and the Hold-Off Cathode Follower. Their action provides a repetitive display, since they cause C177 to be discharged and then permit the formation of steps to proceed again in the same manner as described previously.

For our purposes, we think of the Schmitt Trigger as a voltage-activated switch. In its operation, the entire current through R156 in the cathode circuit is shifted from one section of V155 to the other. When one side of V155 conducts the other side is cut off.

Typical conditions for conduction are as follows: when the grid voltage of V155A is above —42 volts, V155A conducts; when the grid voltage of V155A is below —58 volts, V155B conducts. When the grid voltage of V155A is within the range from —42 to —58 volts, either tube section may conduct, but not both sections. The output of the trigger circuit is at the plate of V155B. The voltage at this plate switches between zero (V155B cut off) and a negative voltage (V155B conducting).

When V155B is conducting, the diodes V152A and V152B are cut off because their plate voltages are more negative than their cathodes. This condition permits the staircase generator to generate a stairstep waveform as described previously. As the output stairstep waveform rises, the cathode voltage of V143B follows. When the cathode voltage (and the grid voltage of V155A) reaches —42 volts, the Schmitt trigger will switch to its other stable state; that is, V155A will be conducting and V155B will be cutoff.

When V155B is not conducting, its plate voltage will be at ground potential, permitting diodes V152A and V152B to conduct. As V152B conducts, the grid of V171 is clamped at ground potential causing the plate voltage to fall rapidly.

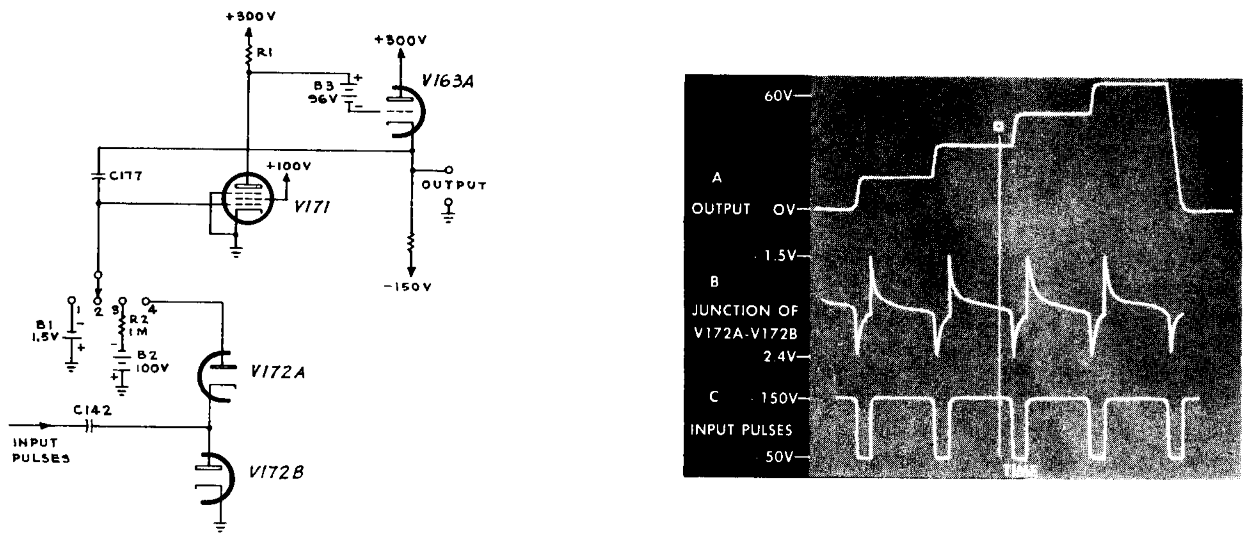


Fig. 3-4. Modification of Fig. 3-3.

As the plate voltage of V171 falls, the cathode voltage of V163A also falls, discharging C177. The cathode of V163A is prevented from going below ground potential by conduction of V152A. Because the Miller tube grid is clamped at ground potential by V152B, its plate voltage will quickly reach an equilibrium condition.

As the cathode voltage of V163A falls, so do the voltages at the cathode of V143B and the grid of V155A. If they go more negative than —58 volts, V155A will be cutoff, V155B will conduct, V152B will no longer clamp the grid of the Miller tube, and the stepping process will be resumed.

Note that the cathode circuit of V143B consists of a resistor shunted by a capacitor. If V143B is driven below cutoff, the rate of fall of the cathode voltage will be limited by the discharge rate of C186 through R186. This time-delay circuit affects only relatively fast negative-going signals; positive-going signals are not delayed. C180 emphasizes rapid changes in the output signal at the grid of V143B, and tends to compensate for the loading effect of C186 in the positive direction.

The time delay in the negative direction is necessary to allow C177 to be discharged to the point where the output voltage of the Step Amplifier has fallen to the base level before the Schmitt trigger reverts and permits the stepping process to be resumed.

Single-Family Triggering

On the circuit diagram of the Step Generator, notice the section of switch SW145 which is shown near C143B. In the OFF position of SW145, a voltage divider formed by R184 and R186 fixes the grid voltage of V155A to keep it in conduction. As a result, V155B is cutoff, disabling the Staircase Generator.

The display of a single family of curves requires that the Schmitt trigger change to its other conduction state long enough for the desired number of steps to be generated, then revert to the OFF position condition. To start the generation of one stairstep waveform, the top of C146 is grounded by depressing SW145 to the SINGLE FAMILY position. This drops the grid of V155A about 50 volts, causing the trigger circuit to change to its other state (V155B conducting).

When V155B conducts, V171 is no longer clamped and the staircase generator is ready to generate a series of voltage steps. When the desired number of steps has been generated, V143B acts in the usual way to bring V155A into conduction again.

Pulse Generator

The circuit diagram of the step Generator shows the split-load phase inverters, V104A and V124A, driven by sine waves at the power-line frequency. The single angle between these signals is adjusted to 90 degrees by the RC networks R102/C102 and R122/C122. The resulting waveforms, A and B, are shown in Fig. 3-6; the voltages are approximate. The output of each phase inverter is rectified to produce a pulsating dc waveform (C) (D) at a frequency of 120 cps. The rectified outputs of the phase inverters are fed into two pentodes (V104B and V124B) having a common plate-

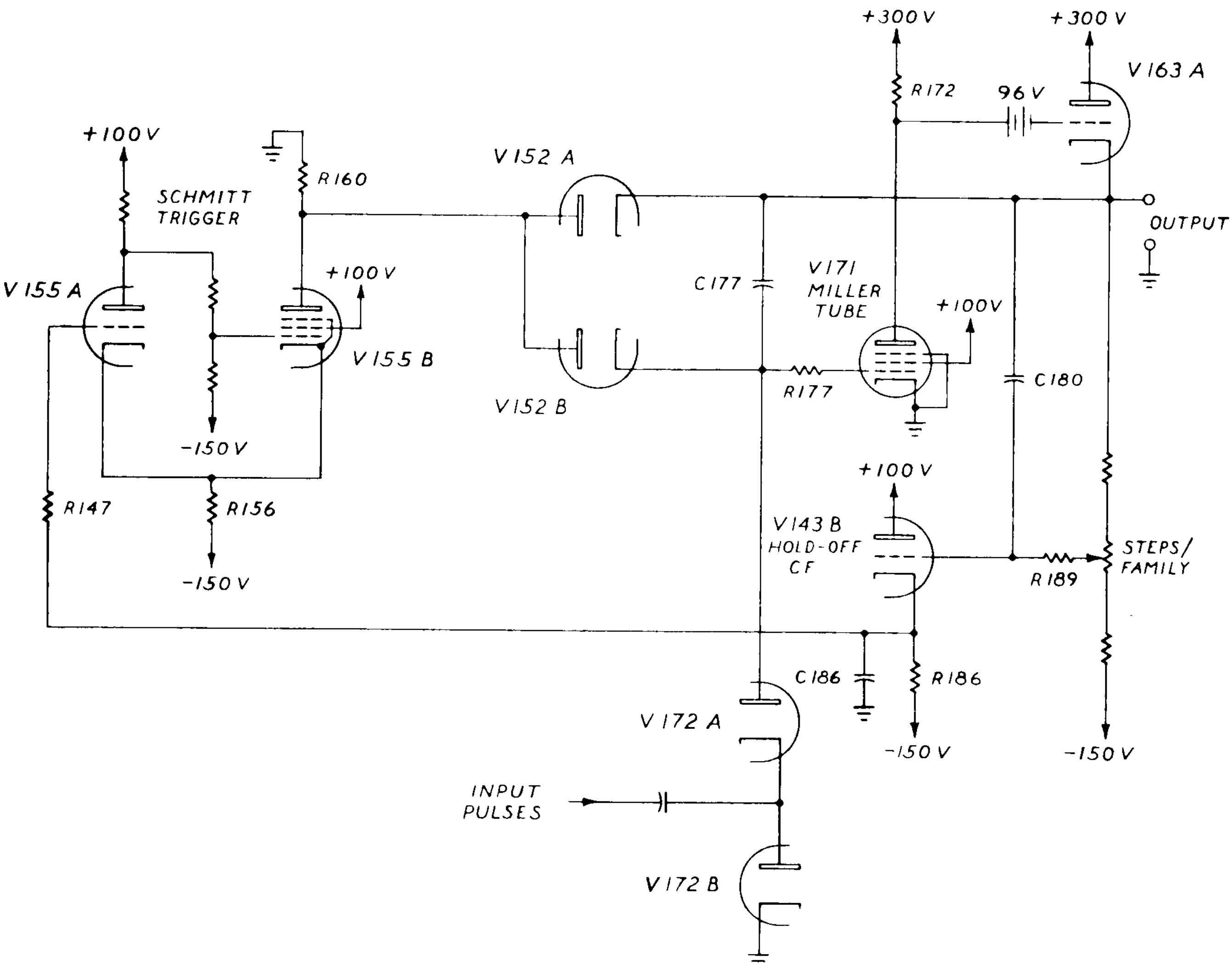


Fig. 3-5. The complete stairstep generator.

load resistor. The voltage at the common plate swings between the plate-supply voltage and ground because the voltage at the input grids drive the tubes from below cutoff to saturation. The frequency of these pulses is 240 per second (or 4 times power-line frequency). The first negative-going pulse is extra wide because the pulse generator is disabled by the clamping action of V163B during the time V155B is cut off. A cathode follower (V143A) provides a low-impedance output.

The upper limit of the pulses appearing at the cathode of V143A, determined by the setting of the VOLTS/STEP ADJ, is 150 volts. The lower limit, determined by R142/R143 is 50 volts.

Each negative-going pulse applied to the left side of C142 causes C142 to partially discharge into C177. C142 recharges through diode V172B as the input pulse returns to 150 volts. The voltage across C177 increases 15 volts with each transfer of charge. The action of the Miller integrating circuit causes this voltage increase to appear at the top of C177. The voltage at the bottom of C177 remains almost constant.

Between pulses, C177 has no discharge path and the voltage at the output of the Step Generator remains constant.

After the trigger has reverted to its initial state (V155B conducting), V163B and V152B no longer conduct and another staircase waveform is generated in response to the pulses applied to the left of C142.

Fig. 3-7 illustrates the sequence of events occuring in the generation of a staircase waveform. Voltages shown are approximate.

Step Amplifier

The voltage gain of the Step Amplifier is less than one, but the current gain is several thousand. The functions of the Step Amplifier are as follows:

1. It permits selection of the size of the output steps (current or voltage).

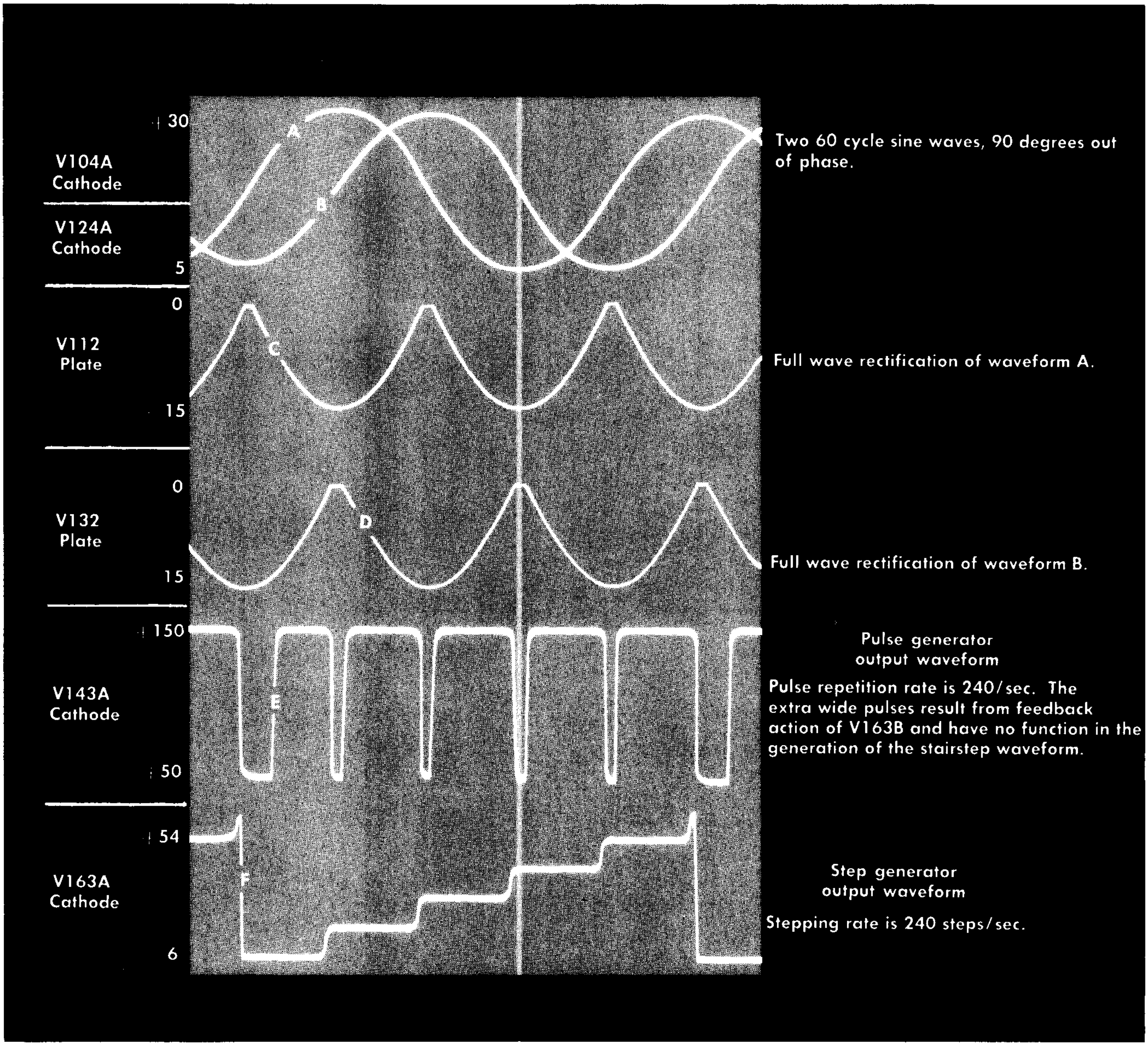


Fig. 3-6. Time relationships between the Step Generator output waveform at key points in the pulse generator section.

2. It regulates the size of the output steps (within limits) to the value chosen by means of the STEP SELECTOR switch.

3. It provides either a positive-going or a negative-going output waveform.

Figure 3-8 illustrates the role of the Step Amplifier in providing either *voltage* or *current* steps to the input of PNP transistor.

The two positions shown on SW246, the STEP SELECTOR switch, correspond to the volts-per-step and ma-per-step ranges.

The Step Amplifier consists of three functional units; a current-regulated power supply, a power-transistor output stage, and an amplifier with a voltage gain of about one.

Output Stage

A transistorized power output stage is used to deliver the output current of the Step Amplifier because of the relatively large regulated currents which must sometimes be applied to the input of the transistor under test. Since the Step Amplifier must furnish high current of either polarity, a floating power supply is used in the output stage.

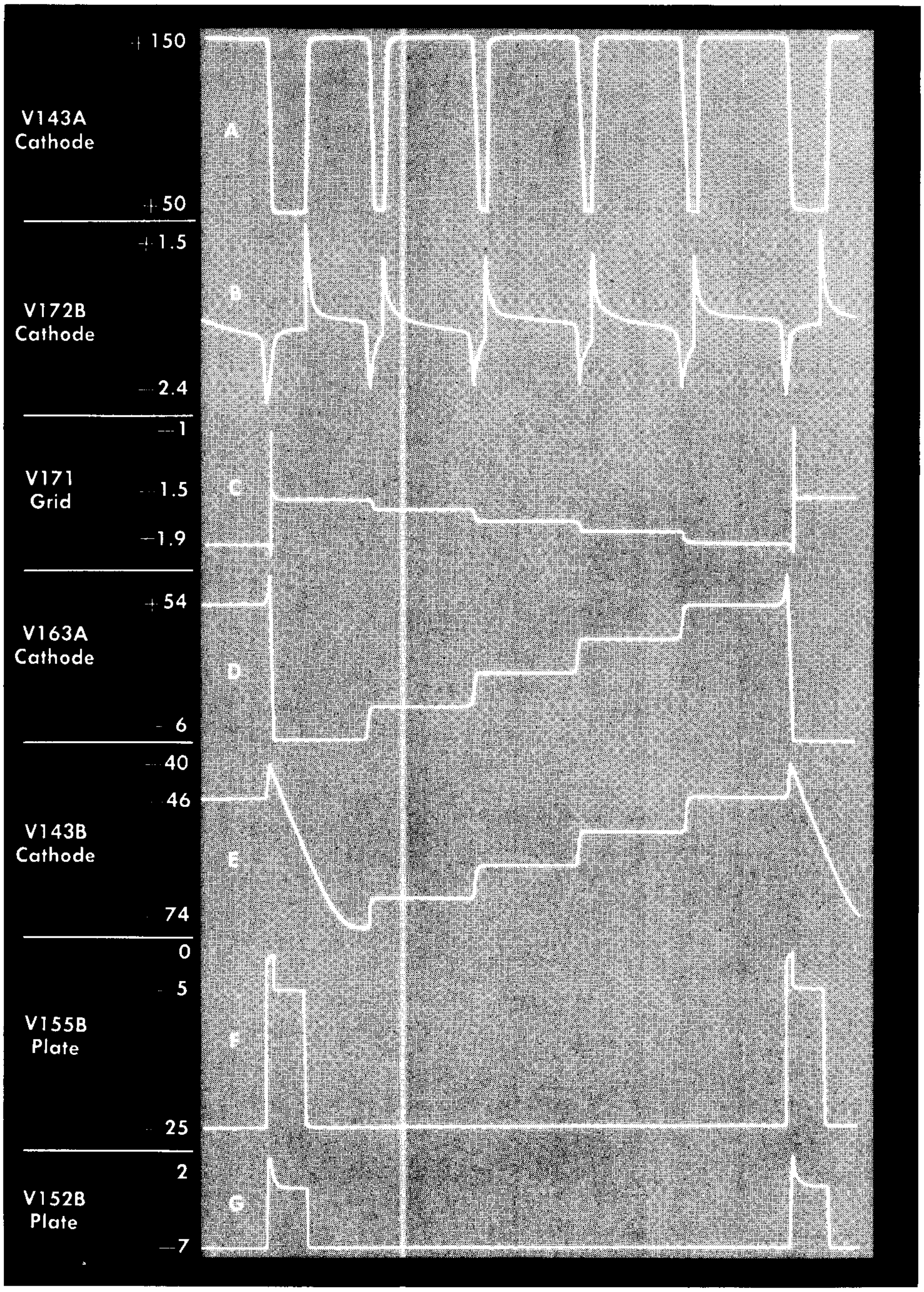


Fig. 3-7. Time relationships between the Step Generator output waveforms (D) and waveforms at key points in the step generator section.

Fig. 3-9(a) is a diagram of a transistor operating as an emitter follower. Fig. 3-9(b) is the vacuum-tube equivalent of the same circuit. Note that in both cases the output signal is *in phase with* the input signal. The average value of the output voltage may be set to zero by proper biasing of the input.

Fig. 3-10 shows how an *out-of-phase* signal centered around ground can be obtained with the same general configuration. Note that only the ground point has been moved. The transistor is no longer operating as an emitter follower, but as an ordinary voltage amplifier. The 100-ohm resistor is now the collector load resistor.

The approximate positive and negative limits of the no-load output voltage of Fig. 3-10 can be determined by considering the transistor as a switch which is either opened or closed. When the switch is closed (emitter and collector shorted), the output voltage must be +15 volts. When the

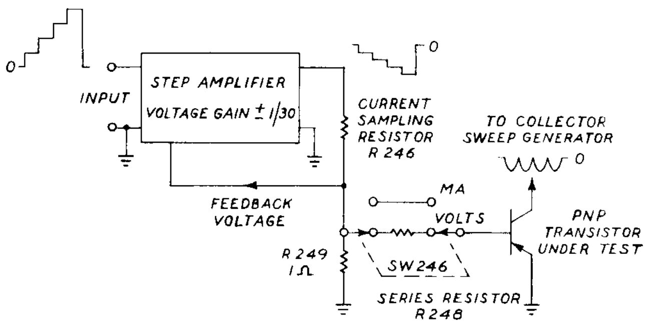


Fig. 3-8. The Step Amplifier furnishes either current or voltage steps to the input of the transistor under test.

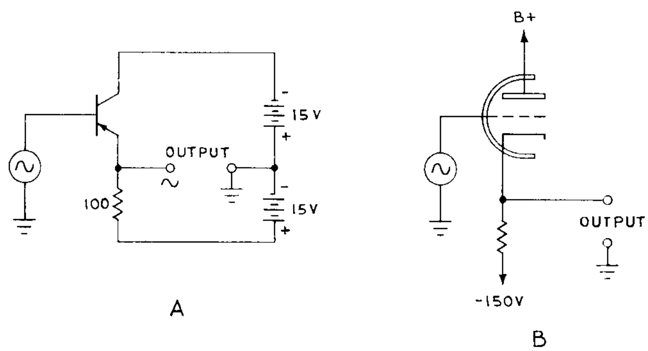


Fig. 3-9. The emitter-follower (a) operates the same as the cathode-follower (b).

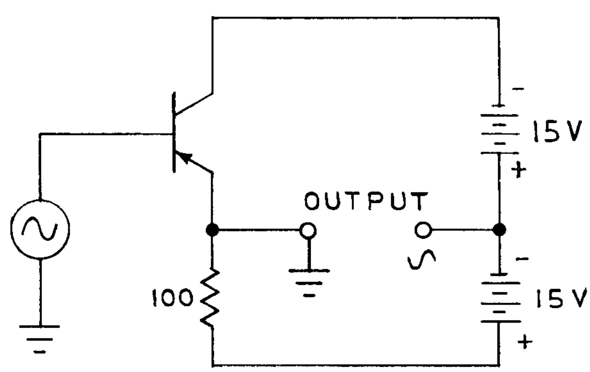


Fig. 3-10. By switching the output connections, the emitter-follower of Fig. 3-9 (a) becomes a collector-loaded amplifier.

switch is open (no current through the collector), the no-load output voltage must be —15 volts.

The circuits of Fig. 3-9 (a) and Fig. 3-10 have maximum-current limitations which are different. The circuit of Fig. 3-9 (a) can supply much more current in the *negative* direction, (making the ungrounded end of the load resistance negative) than it can supply in the positive direction (through the 100-ohm resistor).

By the same method, it can be shown that the circuit of Fig. 3-10 can supply much more current in the *positive* direction than in the negative direction.

Since the path of the higher current through the load in both circuits was always through the upper battery, the upper battery must be able to deliver more current than that which is required of the lower one.

The drawing of Fig. 3-11 shows the electron-current flow through the circuit components as the Step Generator drives a load resistance in the negative direction. The lower battery supplies only the current which flows through the 100-ohm resistor. The upper battery must supply current to the load as well.

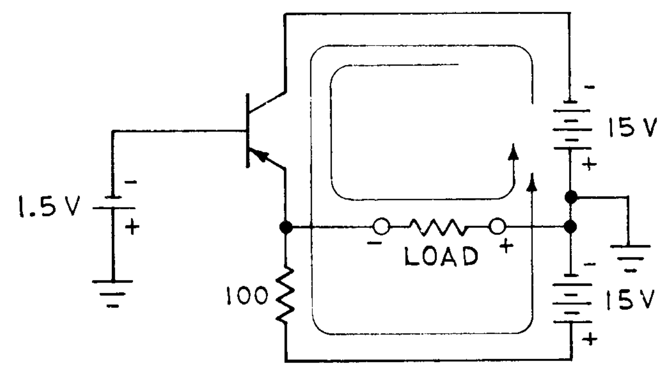


Fig. 3-11. Electron flow through the transistor V253 circuit when negative-going steps are required.

Figure 3-12 is a simplified diagram of the output circuit of the Step Amplifier. Note that the load resistance across the output circuit is always the current-sampling resistor in series with either a 1-ohm resistor (voltage steps) or the input of the transistor under test (current steps). The feedback paths go directly to vacuum-tube grids and do not load the output circuit.

The maximum current the Step Amplifier will deliver to an external load is 2.4 amperes of either polarity (ma-per-

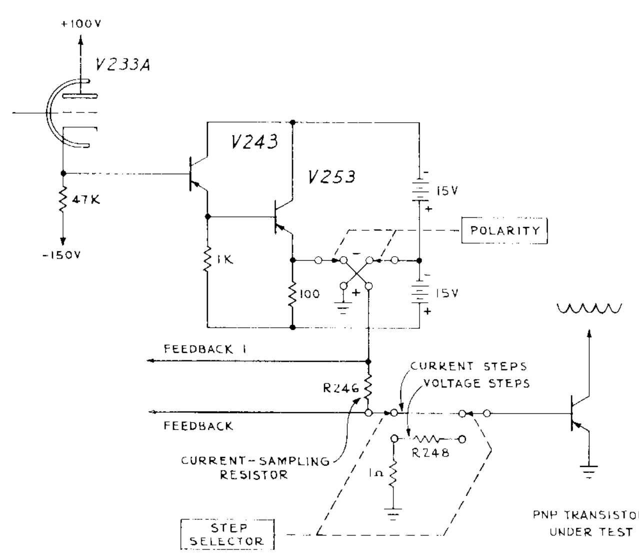


Fig. 3-12. Simplified diagram of the output circuit of the Step Amplifier.

step positions of the STEP SELECTOR switch). However, the characteristics of the external load must be such that the voltage drop across the external load resistance is no more than 5 volts when the current through it is 2.4 amperes. At lower currents, however, the 5-volt figure may be exceeded.

The simplified diagrams of Fig. 3-13 and 3-14 show the operation of the entire Step Amplifier when delivering current steps to the input of the transistor under test. Current regulation is accomplished by maintaining a constant voltage drop across R246 for each step of the input voltage from the Step Generator. That is, each time the input voltage is stepped 15 volts, the voltage drop across R246 should change 1/30 of 15 volts, or 0.5 volt, and remain at the new voltage for the duration of the step. This will provide steps of constant current proportional to the input voltage steps.

It would be a simple matter to maintain a constant voltage across R246, proportional to the input steps, if the voltage at the lower end of R246, (that is, the voltage at the input to the resistor under test) were constant. In other words, if we fix the voltage at the lower end of R246 at some potential, say ground, the voltage across R246 would remain constant for the duration of each of the input steps, and would change only when the input voltage steps from one level to the next.

However, the lower end of R246 is connected to the input of the transistor under test and not to a fixed reference. When the collector sweep voltage is applied to the collector of the transistor the voltage at the input of the transistor will change and the voltage at the lower end of R246 will change. In order to maintain a constant voltage, the voltage at the upper end of R246 must change the same amount and in the same direction as the voltage at the lower end. To accomplish this action the +1 Amplifier and the feedback loops couple any voltage change at the lower end of R246 to the difference amplifier V214-V224 which in turn, through the cathode-follower V233A and the output amplifier V243- V253, produces the same voltage change at the top of R246. Fig. 3-13 shows the circuit configuration when the POLARITY switch is set for a negative output. The operation of the circuit will be explained in two parts; first, to show how the voltage at the top of R246 changes in proportion to the input steps, and second, to show how the voltage at the top of R246 changes as a result of any voltage change at the bottom of R246.

Assume the input voltage changes from 0 to +15 volts (1 step). This tends to make the voltage at the grid of V214 go in the positive direction, and the plate voltage to go in the negative direction. The voltage at both the grid and cathode of the cathode-follower V233A goes in the negative direction, following the plate of V214. Q243 is an emitter-follower, so its emitter goes in the negative direction carrying with it the base of Q253. Since Q253 is also connected as an emitter-follower, for negative-polarity operation, its emitter and hence the voltage at the top of R246 goes in the negative direction.

A positive step at the input will therefore produce a negative step at the top of R246. This negative step also appears at the lower end of R203, since this point is connected to the top of R246. This means that as the top of R202 goes positive the lower end of R203 goes negative. The amplifier and feedback network therefore acts as a "teeter-totter" circuit that pivots about the junction of R202-R203; the grid of V214 is at virtual ground, or zero, potential.

Since the top of R203 is at ground potential, the change in voltage across R246, due to an input step, is equal to the change in voltage across R203. R202 and R203 make up a

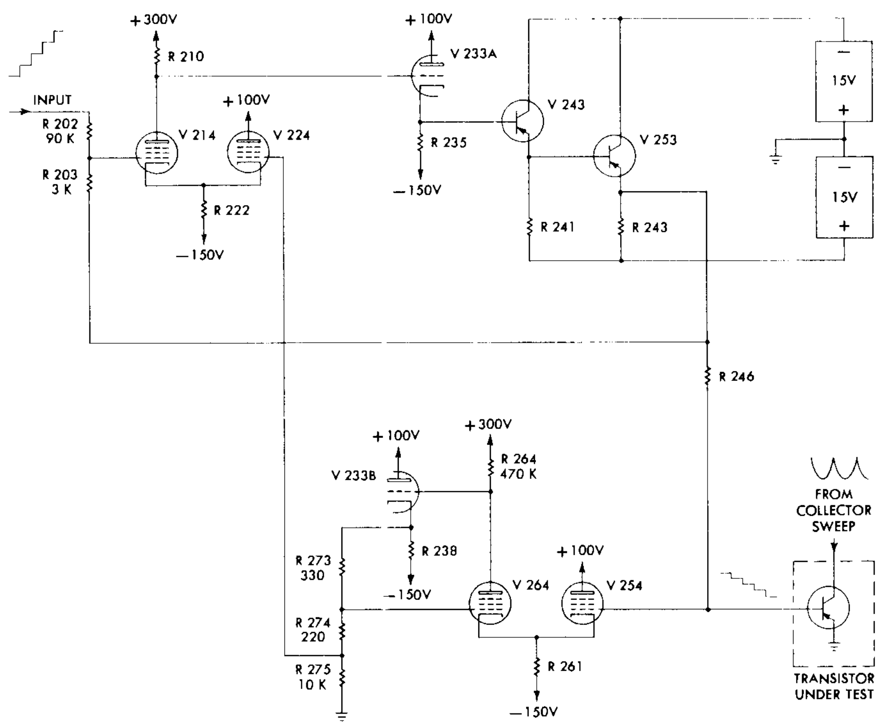


Fig. 3-13. Simplified diagram of the Step Amplifier for negative-going current steps.

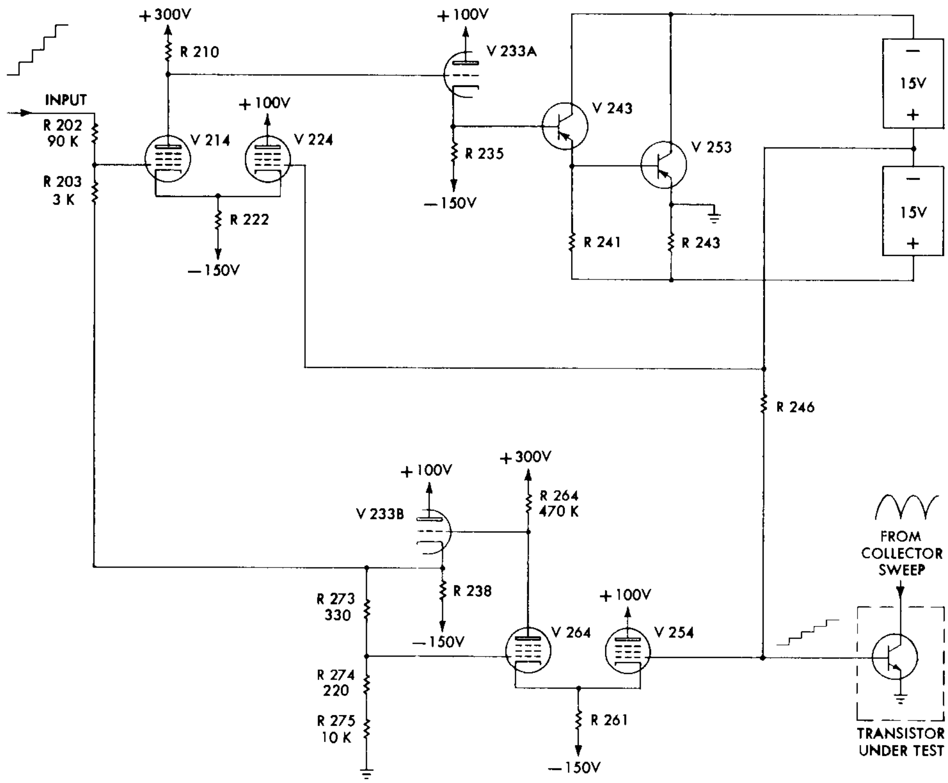


Fig. 3-14. Simplified diagram of the Step Amplifier for positive-going current steps.

30 to 1 divider; a 15-volt step in the positive direction at the top of R202 will therefore produce a 0.5-volt step in the negative direction across R246.

If the voltage at the lower end of R246 changes, the voltage at the top of R246 must change the same amount and in the same direction. This will insure that the voltage drop across R246 is proportional only to the input step voltage.

The +1 Amplifier is a feedback amplifier whose gain is just slightly greater than unity. The input impedance of this circuit is very high, so that it does not load the input of the transistor under test.

Let us assume that the voltage at the lower end of R246, and hence at the grid of V254, goes in the positive direction. This will cause the cathodes of V254 and V264 to go in the positive direction. The voltage at the plate of V264 will then go up carrying with it the voltage at the grid and cathode of V233B. Because the gain of the circuit is slightly greater than unity the change in voltage at the cathode of V233B will be slightly greater than that at the lower end of R246, but will be of the same polarity.

The output of V233B is applied to a divider consisting of R273, R274 and R275. One tap on the divider couples almost all of the output voltage back to the grid of V264. This causes the grid of V264 to move in the same direction as its cathode, and hence reduces the gain of the stage to just slightly greater than unity. The gain of the +1 Amplifier is therefore relatively independent of tube characteristics and is determined almost entirely by the ratio of R273 to R274 + R275.

The resistance values in the divider are chosen so that the change in voltage at the top of R275 is the same as that at the grid of V254 (the lower end of R246). This positive-going voltage at the top of R275 is then applied to the grid of V224, and the cathodes of V224 and V214 go in the positive direction. This causes the voltage at the plate of V214 to go up, and since there is no polarity shift in V233A or the emitter-followers, the voltage at the top of R246 will go up. Thus, the voltage at the top of R246 follows any voltage change that may occur at its lower terminal. This prevents any change in the voltage at the input of the transistor under test from affecting the current through R246, and provides for steps of constant current into the input of the transistor.

If voltage steps are desired, R249 (not shown on Fig. 3-13) is connected between R246 and ground. The current steps through R246 and R249 then produce voltage steps across R249 which are coupled through the series resistor R248 (not shown) to the input of the transistor under test.

When negative steps are required, the voltage steps at the top of R246 must be reversed in polarity from those at the input (positive-going steps are always applied to the input of the Step Amplifier). The 180-degree shift in signal polarity is accomplished in V214, since this stage is a plate-loaded amplifier. And, since V233A is a cathode-follower and the transistors are connected as emitter-followers, the polarity shift in V214 satisfies the circuit requirements.

When positive-going steps are required at the top of R246, however, the output of V214 must be reversed in polarity. This is accomplished by reversing the output and ground terminals in the Q253 circuit. Q253 is connected in the common emitter configuration, as shown in Fig. 3-14, and the load resistor R243 is connected into the collecter circuit. With this configuration V253 is a collector-loaded amplifier and will produce a 180-degree shift in the signal polarity. This will put voltage steps at the top of R246 in phase with input steps (positive-going steps).

To compensate for the additional shift in signal polarity, the grids of the difference amplifier V214-V224 must be switched insofar as the feedback loops are concerned. That is, the grid of V224 is now connected to the top of R246 and the grid of V214 is connected through R203 to the divider at the output of the +1 Amplifier. Notice, in Fig. 3-14, that the grid circuit of V214 is connected to the top of the divider at the output of the +1 Amplifier, while in Fig. 3-13 the grid circuit of V224 is connected to a tap on the divider.

Since the gain of the +1 Amplifier is just slightly greater than 1, the voltage at the cathode of V233B is slightly greater than that at the grid of V254. The voltage applied to the difference amplifier from the +1 Amplifier must be equal to the amount of correction needed to keep the voltage across R246 constant. The resistance values in the divider at the output of the +1 Amplifier are such that the voltage drop across R275 is the same as the voltage at the grid of V254. This satisfies the requirements of the circuit, in Fig. 3-13, where the feedback is applied directly to the grid of V224. In Fig. 3-14, the feedback is applied to the grid of V214 through R203, and, since there is a voltage drop across R203, the voltage at the output of the +1 Amplifier must exceed the required feedback voltage by an amount equal to this drop. For positive-polarity signals, therefore, the voltage at the output of the +1 Amplifier must exceed the voltage at the grid of V254 by an amount equal to the drop across R203.

CRT Deflection Amplifiers

The diagram of the Vertical and Horizontal Amplifiers include a simplified diagram of most of the switching related to these amplifiers. The purpose of the simplified diagram is to help you understand the relationships between the Vertical and Horizontal Amplifiers and other parts of this instrument. Accordingly, this discussion will include switching information.

The circuits of the Vertical and Horizontal Amplifiers are quite similar. Both consist of three difference amplifiers in cascade. A difference amplifier, or cathode-coupled phase inverter, rejects any signal applied to both input grids, responding only to a voltage difference between the input grids. The gain of the difference amplifiers in the Type 575 is stabilized by negative-feedback paths from the plates of the output amplifier to the opposite cathodes of the input stage.

The ranges of the VERTICAL and HORIZONTAL switches are shown in capital letters. Only a few of the positions in the COLLECTOR MA, BASE VOLTS, and COLLECTOR VOLTS ranges are shown. In the following paragraphs, the signal paths to the Vertical and Horizontal Amplifiers will be traced for each range of the corresponding switch.

Collector MA Display

Collector current is displayed on the vertical axis only. The collector current is proportional to the voltage drop across a current-sampling resistance. This voltage is fed directly to the control grid of V454, the other input to the vertical amplifier being grounded. One volt must be developed across the current-sampling resistance to cause a full-scale vertical deflection of ten major divisions. In all switch positions within the COLLECTOR MA range, the Vertical Amplifier works at a reduced constant gain. This reduced gain, one-tenth of maximum, is accomplished by inserting a resistance of about 10K ohms, R447 in parallel with R432B, between the cathodes of the input stage. R432B is located on the detailed switching diagram.

Base Volts

In the BASE VOLTS position of the VERTICAL switch, the control grid of V454 is grounded and a signal from the base of the transistor under test is fed to the control grid of V444. The sensitivity of the Vertical Amplifier is varied by changing the resistance between the cathodes of V454 and V444.

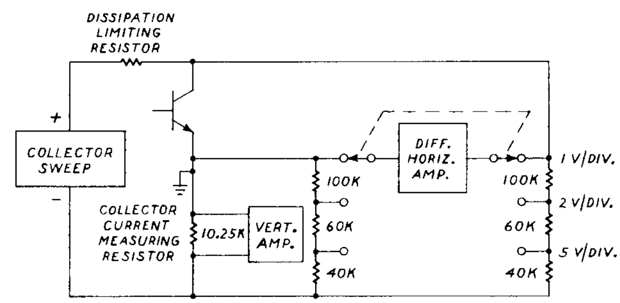


Fig. 3-15. With this configuration an accurate display of collector current (Vert. Amp.) and collector voltage (Horiz. Amp.) is obtained.

Collector Volts Display

The diagram of Fig. 3-15 shows the method used to solve the problem of presenting an accurate display of both collector current and collector voltage at the same time. Discussion of this diagram does not necessarily apply to corresponding parts of the Type 575. Note that two attenuators are used and that the horizontal display of collector voltage is obtained by using the common-mode rejection feature of the Horizontal Amplifier. As shown in Fig. 3-15, the Horizontal Amplifier amplifies only the voltage difference existing between its input grids.

Also note that the true current-sampling resistance is made up of the 10.25-K resistor and the attenuator in parallel with it.

Low-Voltage Power Supply

Plate and filament power for the Type 575 is furnished by a single power transformer T601. The primary windings may be connected in parallel for 105- to 125-volt operation, or in series for 210- to 250-volt operation.

The three regulated supplies furnish voltages of —150-volts, +100 volts and +300 volts. The +300-volt supply also has an unregulated output of about +400 volts for the oscillator tube in the high-voltage supply for the crt.

Reference voltage for the —150-volt, full-wave power supply is established by a voltage-regulator tube V649. This tube, which has a constant voltage drop of about 85 volts, is connected between the —150-volt bus and the grid circuit of V644A, one-half of a difference amplifier. The grid potential for the other half of the difference amplifier, V644B, is obtained from a divider consisting of R662, R664 and R666. The —150-V ADJ, R664, determines the percentage of total voltage appearing at the grid of V644B and thus determines the total voltage across the divider. When this control is properly set, the output voltage is exactly —150-volts.

The operation of the circuit can be explained by assuming the output voltage tends to change. For example, assume the loading on the supply tends to make the output voltage go more negative. The voltage at the grid of V644A will go negative the same amount as the output, since the voltage across the voltage-regulator tube is always constant. The voltage at the grid of V644B will go negative only a proportionate amount, however, since this grid obtains its voltage from the divider, an error voltage will then exist between the two grids of the difference amplifier, which will be in a direction to make less current go through the left side and more current through the right side.

The voltage at both the plate of V644B and the grid of V657 will then go in the negative direction, which will cause the voltage at the plate of V657 to go in the positive direction. The change in voltage at the plate of V657, which will be in a direction to compensate for the change in the output voltage, is coupled through the rectifier to the output and forces the output voltage back to its established value of —150 volts.

C644 and C655 improve the ac response of the feedback loop, thereby increasing the response of the circuit to sudden changes in output voltage.

The +100-volt supply uses silicon rectifiers in a full-wave bridge circuit. Reference voltage for this supply is obtained from the regulated —150-volt supply. The voltage divider R636-R638 establishes a voltage of essentially zero at the grid of V624. (The actual voltage at this grid is equal to the bias required by the tube). If the loading should tend to change the output voltage, an error signal will exist at the grid of V624. The error signal will be amplified and inverted in polarity, and will appear at the grids of the parallel cathode-followers V627A and V627B. The cathodes will follow the grids and will force the output voltage back to its established value of +100 volts. C630 improves the response of this circuit to sudden changes in output voltage.

A small sample of the unregulated bus ripple will appear at the screen grid of V624 through R624. The ripple signal appearing at the screen (which acts as an injector grid) will produce a ripple component at the grids of V627 which will be opposite in polarity to the ripple appearing at the plates of V627. This tends to cancel the ripple at the cathodes, thereby reducing the ripple on the 100-volt bus. The same circuit also improves the regulation of the supply in the presence of line-voltage variations.

The operation of the regulator circuit in the +300-volt supply is the same as that in the +100-volt supply.

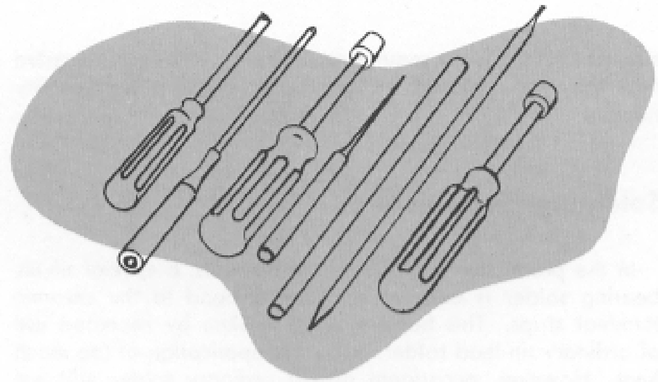
CRT Circuit

A 30-kc Hartley oscillator circuit furnishes energy for the two half-wave power supplies that provide accelerating potentials for the crt. The main components of the oscillator circuit are V810 and the primary of T801 tuned by C809.

V812 supplies about +2400 volts for the post-deflection accelerating helix. V822 supplies about —1850 volts to a divider to provide the grid and cathode potentials. The other end of the divider is connected to the regulated +300-volt bus. The —1700 V ADJ control R816 determines the total resistance in the divider and hence the total voltage across the divider. When this control is properly set, the voltage at the test point will be exactly —1700 volts.

The accelerating potentials are kept constant by regulating the supplies by comparing a sample of the negative high voltage to the regulated —150-volt supply. This sample of the negative high voltage is obtained from a tap on the divider (the junction of R816 and R818) and is applied to the grid of an amplifier V804A. The cathode of this tube is connected to the —150-volt regulated supply. If the negative supply tends to drift, an error signal appears at the grid of V804A. The error signal is amplified by V804A and V804B, and produces a change in the screen voltage at the oscillator tube. This varies the amplitude of the oscillator output in a direction to compensate for the change in output voltage.

The positive high-voltage supply is regulated indirectly, as the output of both supplies is proportional to the oscillator output.



SECTION 4

MAINTENANCE

PREVENTIVE MAINTENANCE

Air Filter

The Type 575 Transistor-Curve Tracer is cooled by air drawn into the instrument through a washable filter constructed of adhesive-coated aluminum wool. If this filter is allowed to become dirty, it will restrict the flow of air and may cause the instrument to overheat. You should inspect, and clean if necessary, the filter every three months. If the filter is damaged, you should replace it as soon as possible to prevent dust being drawn into the instrument.

To remove the loose dirt in the filter, rap the filter gently on a hard surface. Then wash the filter briskly with hot soapy water. After rinsing and drying thoroughly, coat the filter with "Handi-Koter" or "Filtercoat", products of the Research Products Corporation. These products are generally available from air-conditioner suppliers.

Fan Motor

To protect the fan motor bearings, they should be lubricated every three or four months with a few drops of light machine oil.

Visual Inspection

You should visually inspect the entire instrument every few months for possible circuit defects. These defects may include loose or broken connections, damaged binding posts, improperly seated tubes, scorched or burned parts, or broken terminal strips as well as many others. For most of these troubles, the remedy is apparent, but particular care must be taken when scorched or burned components are detected. Burned parts are often the result of other, less apparent, defects in the circuit. Therefore, it is essential that you determine the cause of overheating before replacing damaged parts in order to prevent damage to the new components.

Recalibration

The Type 575 is a stable instrument, and will provide many hours of trouble-free operation. To insure the reliability of measurements made with the Type 575 however, we suggest that you recalibrate the instrument after each 500 hours of operation (or every six months if used intermittently). A complete step-by-step procedure for recalibrating the instrument is presented in the Recalibration section of this manual.

REMOVAL AND REPLACEMENT OF PARTS

The procedures required for replacement of most parts in the Type 575 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. Because of the nature of the instrument, replacement of certain parts will require that you recalibrate portions of the instrument in order to insure proper operation. Refer to the Recalibration section of this manual.

Removal of Panels

The panels of the Type 575 are held in place by small screwhead fasteners. To remove the side panels, use a screwdriver to rotate the fasteners approximately two turns counterclockwise; then pull the upper portion of the panels outward from the carrying handles. To remove the bottom panel, lay the instrument on its side, rotate the fasteners two turns

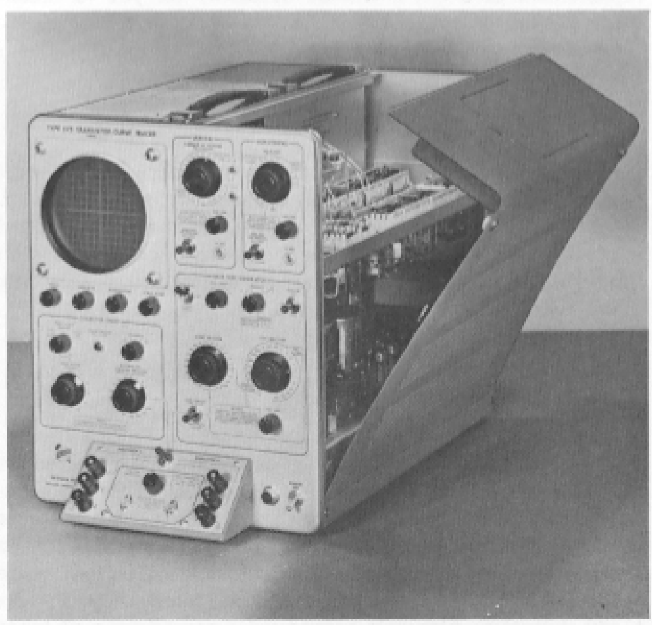


Fig. 4-1. Removal of the instrument side panels.

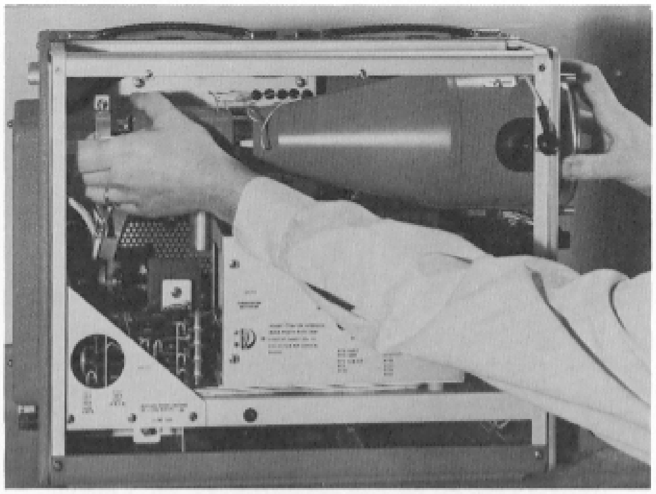


Fig. 4-2. The method used to remove or replace the cathode-ray tube.

counterclockwise, and pull off the panel. In order to prevent damage to the finish of the side panels, you should remove them before laying the instrument on its side. The bottom panel should then be removed last. Panels are replaced by reversing the order of their removal.

Replacement of Cathode-Ray Tube

To remove the cathode-ray tube, first disconnect the tube socket and all leads connected to the neck of the tube. Loosen the tube clamp at the base of the crt and remove the graticule cover. Pull the crt straight out through the front panel. When the new crt is in place, the leads may be properly connected to the neck of the tube by following the color code information provided on the tube shield. After replacement of a crt, it will be necessary for you to recalibrate the instrument.

Replacement of Switches

Methods for removal of defective switches are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the Type 575 and if one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix either wired or unwired as desired.

Tube Replacement

Care should be taken both in preventive and corrective maintenance that tubes are not replaced unless they are actually causing a definite circuit malfunction. Many times during routine maintenance it will be necessary for you to remove tubes from their sockets. It is important that these tubes be returned to the same sockets unless they are actually defective. Needless replacement or switching of tubes will many times cause unnecessary recalibration of the instrument. If tubes do require replacement, it is recommended that they be replaced by previously checked high-quality tubes.

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 may be broken by repeated use of ordinary tin-lead solder, or by the application of too much heat. However, occasional use of ordinary solder will not break the bond if too much heat is not applied.

It is advisable that you have a stock of solder containing about 3% silver if you frequently perform work on Tektronix instruments. This type of solder is used quite often in printed circuitry and should be readily available. It may also be purchased directly from Tektronix in one-pound rolls (order by part number 251-514).

Because of the shape of the terminals on the ceramic terminal strips, you may wish to use a wedge-shaped tip on your soldering iron. A tip such as this allows you to apply heat directly to the solder in the terminals and reduces the amount of heat required. It is important to use as little heat as is possible.

REPLACEMENT PARTS

Standard Parts

Replacements for all parts used in the Type 575 Transistor-Curve Tracer can be purchased directly from Tektronix at current net prices. However, since most of the components are standard electronic parts, they can generally be obtained locally in less time than is required to obtain them from the factory. Before ordering or purchasing parts, be sure to consult the parts list to determine the tolerance required. The parts list gives the values, tolerances, and Tektronix part numbers of all components used in the instrument.

Special Parts

In addition to the standard parts used in the instrument, special parts are used also. These parts are manufactured or specially selected by Tektronix, or are made especially for Tektronix by other manufacturers. Special parts and most mechanical parts should be ordered directly from Tektronix since they will normally be difficult or impossible to obtain from other sources. Special parts may be obtained either from the factory or from the local Tektronix Field Engineering Office.

Since the production of your instrument, some of the Tektronix manufactured components may have been superseded by improved components. The part numbers of these new components will not be listed in your manual. Your Tektronix Field Engineering Office has a knowledge of these changes and may call you if a change in your purchase order is necessary.

Replacement information sometimes accompanies the improved component to aid in its installation.

Parts Ordering Information

You will find a serial number on the frontispiece of this manual. This is the serial number of the instrument for which this manual was prepared. Be sure that the number on the manual matches the serial number of the instrument when ordering parts from this manual.

Each part in this instrument has been assigned a 6-digit Tektronix part number. This number, together with a description of the part, will be found in the parts list. When ordering parts, be sure to include both the description of the part and the part number. For example, a certain resistor would be ordered as follows: R160A, 100 k, 1/2 w, Fixed, Precision, 1%, part number 309-045, for Type 575 Transistor-Curve Tracer, serial number ________. When parts are ordered in this manner, we are able to fill your orders promptly, and delays that might result from transposed numbers in the part number are avoided.

NOTE

Always include the instrument TYPE and SERIAL NUMBER in any correspondence concerning this instrument.

TROUBLESHOOTING

General Information

This section is included to provide you with information about the Type 575 Transistor-Curve Tracer that will enable you to more efficiently troubleshoot the instrument in the event of equipment failure. During troubleshooting work, you should correlate information contained in this section with information obtained from other sections of this manual. We have not attempted to give detailed step-by-step procedures for finding the cause of specific troubles, but rather have attempted to outline a general troubleshooting guide. This guide provides a means for determining the probable defective circuit or part from the symptoms observed rather than from detailed voltage or resistance measurements.

Although the 575 is a complex instrument, it can conveniently be thought of as consisting of a number of interrelated basic circuits as shown in the block diagram contained in the diagram section of the manual. Each of these circuits performs a specific part of the overall circuit operation required to display transistor characteristic curves on the face of the crt. If any one of these circuits should fail, a definite symptom of this failure will be apparent. By investigating the possible causes of this symptom by means of systemized circuit checks, it is possible to determine which circuit or circuits are at fault. After determining which circuit is defective, additional checks will allow you to isolate the trouble to a particular part.

Separate schematic diagrams of each circuit are contained in the rear portion of this manual together with a block diagram which provides an overall picture of instrument operation. The reference designation of each electronic component of the instrument is shown on the circuit diagrams as well as important voltages and waveforms. These voltages and waveforms may be used during troubleshooting work to isolate the cause of the trouble. The following chart lists the reference designations associated with each circuit.

100 series	Step Generator
200 series	Step Amplifier
300 series	Horizontal Amplifier
400 series	Vertical Amplifier
600 series	Low Voltage Power Supply
700 series	Collector Sweep Circuit
800 series	CRT Circuit

Switch wafers shown on the schematic diagrams are coded to indicate the position of the wafer on the actual switches. The number portion of the code refers to the wafer numbers on the switch assembly, wafers being numbered from the front of the switch to the rear, and the letters F and R indicate whether the front or the rear of the wafer is used to perform the particular switching function. Photographic details of these switches are also shown on the same foldout page as the corresponding circuit diagram. These photographs are provided as parts location guides.

All wiring used in the 575 is color coded to facilitate circuit tracing. In addition, primary power, filament, and regulated power-supply output leads are distinguished by specific color codes. All regulated power-supply output leads follow the standard RETMA code. The —150 volt bus wire is coded brown-green-brown; the +300 volt bus is coded orange-black-brown; and the +100 volt bus is coded brown-black-brown. The widest stripe identifies the first color of the code.

Circuit Isolation

Before proceeding with detailed troubleshooting of the instrument, make sure that an apparent trouble is actually due to a malfunction within the instrument and not due to improper control settings. Instructions for the operation of the insrument are contained in the Operating Instructions section of this manual. If, after reviewing the Operating Instructions, you determine that control settings are not at fault, you should next check the calibration of the instrument according to the procedure contained in the Recalibration section of the manual.

A calibration check will not only allow you to correct any troubles due to improper calibration, but will also enable you to isolate the defective circuit should an actual trouble exist. If a trouble exists in the instrument, you will reach an adjustment or check while going through the recalibration procedure where you obtain an abnormal indication. From the adjustment or check where the trouble first appears and from the indications obtained, you will be able to determine which circuit is defective and also in many cases which portion of the defective circuit is at fault.

When you have determined which circuit is defective, you can then refer to the Circuit Troubleshooting information that follows where procedures are given for troubleshooting the individual circuits. If you recognize immediately which circuit is at fault when a trouble appears, you can proceed directly to the Circuit Troubleshooting information without using the recalibration procedure to isolate the defective circuit. In such cases, however, you must be certain that the trouble cannot be corrected by recalibration before using the Circuit Troubleshooting information.

For any type of trouble the power supplies should be checked as one of the first steps in the troubleshooting procedure. Correct operation of every circuit in the instrument depends on proper output voltages from the regulated power supplies. Due to the circuit configuration employed in the Type 575, it is possible for an incorrect power supply voltage to affect one circuit more than the others. When all but one circuit is operating properly, there is a tendency to overlook the power supply as a source of the trouble and to concentrate on the circuit where the trouble apparently exists. In cases of this type, valuable time can be saved by checking the power supplies first. The power supplies may be checked using Step 1 of the recalibration procedure.

WARNING

Be careful of power supply voltages. Under certain conditions, they can be dangerous to human life. Outputs of the Low Voltage power supply are particularly dangerous due to their high current capabilities. When working on the instrument with the power on, you should work with only one hand at a time, being careful that the other hand does not touch the metal frame to the instrument. If possible stand on an insulated surface and use insulated tools and probes.

Circuit Troubleshooting

This portion of the Troubleshooting Procedure contains information for locating a defective stage within a given circuit. Once the stage at fault is known, the component(s) causing the trouble can be located by tube and component substitution, voltage and resistance measurements, or by short and continuity checks.

Tube failure is the most prevalent cause of circuit failure. For this reason, the first step in troubleshooting any circuit is to check for defective tubes, preferably by direct substitution. Do not depend on tube testers to adequately indicate the suitability of a tube for use in the instrument. The crierion for usability of a tube is whether or not it works satisfactorily in the instrument. Be sure to return any tubes found to be good to their original sockets. If this procedure is followed, less recalibration of the instrument will be required upon completion of the servicing.

If the replacement of a defective tube does not correct the trouble, then check that components which are associated with the tube have not been damaged. Shorted tubes will often overload plate-load and cathode resistors. These components can usually be checked by a visual inspection of the circuit. If no damaged components are apparent, however, it will be necessary to make measurements or other checks within the circuit to locate the trouble.

Troubleshooting The Low-Voltage Power Supply

Proper operation of every circuit in the Type 575 depends on proper operation of the Low-Voltage Power Supply. The regulated voltages must be within their specified tolerances for the instrument to remain within calibration.

For no output voltage

If the pilot lamps and the fan do not operate when the power switch is turned on, check the power switch, the line fuse, and the line voltage. If your instrument is wired for 234-volt operation, also check the thermal cutout switch. (In an instrument wired for 117-volt operation, the fan will run even though the thermal cutout switch may be open). If the fuse is not blown and the line voltage is correct, check the primary windings of the power transformer.

If the pilot lamp and the fan operate correctly, the primary circuit of the power transformer may be assumed to be operating normally. The trouble then lies somewhere in the secondary circuits.

When only one of the outputs of the Low-Voltage Power Supply is zero, the trouble is probably due to a defective rectifier, series regulator, or power transformer secondary winding. To determine which circuit element is defective, measure the secondary voltage of the transformer and the voltage at the output of the rectifier. The cause of the trouble can be determined by the voltage readings obtained.

For failure of a power supply to regulate at the proper voltage

If any one or all of the supplies fail to regulate at the proper voltages, first check the line voltage. The supplies are designed to regulate between 105 and 125 volts (or 210 and 250 volts) with the design center at 117 volts (or 234 volts), rms. Improper line voltage may cause abnormal operation of one or all of the power supplies.

The +100- and +300-volt power supplies are dependent upon the —150-volt power supply for regulation, and consequently a change in the regulation point of all the supplies is indicative of a defective —150-volt supply. If the output voltage of the —150-volt power supply is off only a small amount, it may be possible to readjust the —150 ADJ control for the proper voltage. In any event it will be necessary to recalibrate the instrument when the trouble is corrected and the output voltages are again normal.

In case a single power supply should fail to regulate at the proper voltage check the following:

1. Line voltage
2. Transformer secondary voltage
3. Output voltage of the rectifier
4. Tubes
5. Loading

Important power supply voltages are marked on the power supply schematic diagram. These voltages may be used to perform checks on the power supply operation. One cause of improper regulation by a power supply is incorrect loading. To check power supply loading, shut off the power and check the resistance of the power supply output bus to ground. The −150-volt bus should measure approximately 6 kilohms, the +100-volt bus approximately 90 ohms, and the +300-volt bus approximately 17 kilohms.

If none of the preceding checks determine the cause of the trouble, the improper regulation is probably due to a change in value of one or more of the resistors or capacitors composing the voltage divider networks. The resistance networks in the grid circuits of V604, V624, and V644 are particularly critical since they determine the output voltage of their respective power supplies. Use resistance checks to isolate the defective part or parts.

The following information may be used as a quick index to troubleshooting the Low-Voltage Power Supply.

If the output voltage is high with excessive ripple, check:

1. For high line voltage.
2. The amplifier tubes (V604, V624, and V644).
3. For insufficient loading.

If the output voltage is high with normal ripple, check:

1. For proper resistance values in the dividers (R613 and R617; R636 and R638; and R662, R664, and R666).

If the output voltage is low with excessive ripple, check:

1. For low line voltage.
2. The series regulator tube (V607, V627, or V657).
3. For excessive loading.
4. Open or leaky filter capacitors.
5. Rectifiers (V602, SR620, or V642).

If the output voltage is low with normal ripple, check:

1. The resistance values in the dividers.
2. The capacitors shunting the dividers.

If the output voltage is normal with excessive ripple, check:

1. Filter capacitors at the output of the rectifiers and at the output of the power supplies.
2. AC bypass capacitors in the grid circuits of the regulator amplifiers.
3. Regulator amplifier screen grid circuits.

Troubleshooting the CRT Circuit

If no high voltage is available from either the positive or the negative high voltage power supplies, the trouble is probably due either to a defective oscillator stage (V810) or high voltage transformer (T801). The oscillator can quickly be checked by placing a neon bulb in the field of the high voltage transformer, T801. If the bulb glows, the oscillator is operating and the trouble is probably located in the secondary windings of T801. It is unlikely that both rectifier tubes (V812 and V822) would simultaneously be defective but the possibility should not be ignored.

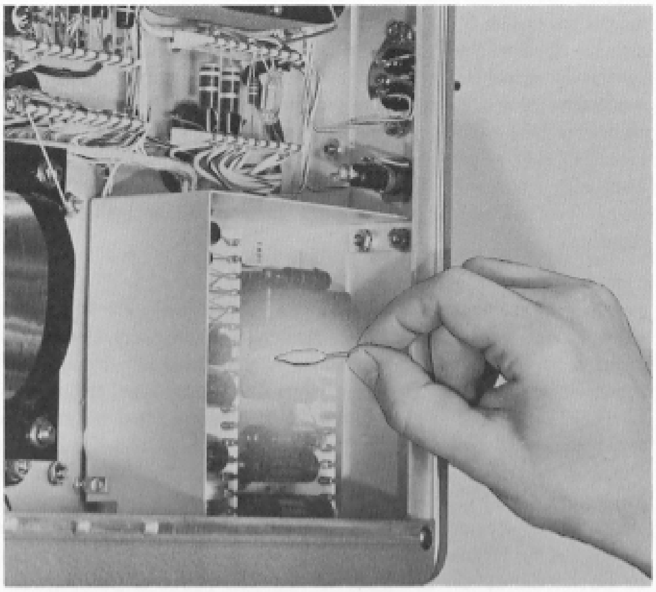


Fig. 4-3. Checking operation of the high voltage oscillator by the placement of a neon bulb in the field of the high voltage transformer.

If the neon bulb does not glow in the transformer field, the oscillator is not operating. In such a case the oscillator tube, V810 and the regulator tube, V804 should be checked by substitution. If this does not correct the trouble, check all components of the oscillator circuit including the high voltage transformer.

If unregulated voltage is obtained from both high voltage power supplies, (a lack of regulation is indicated if the display changes size and becomes defocused as the intensity setting is changed or as the line voltage is varied between 105 and 125 volts) the regulator tube, V804 and the oscillator tube, V810 should be checked by replacement. The voltage divider containing the INTENSITY and FOCUS controls can also cause a lack of regulation if one or more of the resistors is defective. However, if the voltage divider is at fault, the trouble will also result in a badly defocused and distorted display or no display at all, thereby giving a more direct indication of this type of trouble.

If both high voltage power supplies are operating correctly and the FOCUS and INTENSITY voltage divider is normal, the trouble can only be the cathode-ray tube or the ASTIGMATISM and GEOM ADJ controls. The ASTIGMATISM and GEOM ADJ controls can easily be checked by voltage readings. If the entire circuit checks out properly and the trouble still exists, replace the cathode-ray tube.

Troubleshooting the Horizontal Amplifier

Troubles occuring in the horizontal amplifier can generally be classified as either amplifier unbalance or as abnormal gain. These two troubles wil be discussed separately in the following paragraphs.

Amplifier unbalance is indicated if one or more of the following conditions exist: if the beam is deflected off the face of the crt, if the POSITION control does not have sufficient range to move the beam completely across the face of the crt, or if the trace shifts horizontally as the VOLTS/DIV switch is rotated. When the unbalance is slight, as in the case where the trace shifts horizontally as the VOLTS/DIV switch is rotated, it can usually be corrected by readjusting the DC BAL control. When the unbalance is more pronounced, however, it will be necessary to determine which stage is producing the unbalance and to make the necessary repairs.

If the unbalance occurs in all positions of the VOLTS/DIV switch one of the amplifier stages is probably at fault. To determine which stage is producing the unbalance, a short jumper can be used. If the beam is deflected off the face of the crt due to an unbalanced amplifier, the beam should return to the face of the crt when the jumper is placed between the horizontal deflection plates at the neck of the tube. The stage causing the unbalance can then be found by jumpering successively between corresponding points on opposite sides of the horizontal amplifier. As you short between the points, in turn, you should see the beam return to the screen as each connection is made. When you reach a point where the spot does not return to the screen, the stage immediately following that point is at fault, unless the feedback networks from the plates of the output stage to the cathodes of the input stage are defective. The unbalance will usually be caused by a defective tube or resistor.

Abnormal gain troubles will generally be either insufficient gain or no output. The gain of the amplifier in each position of the VOLTS/DIV switch can be checked by means of the calibration voltage applied to the amplifier by the AMPLIFIER CALIBRATION switch. Using this switch you should obtain 10 divisions of horizontal deflection regardless of which position the VOLTS/DIV switch is in. If, when using the calibration voltage, abnormal gain occurs only in certain positions of the VOLTS DIV switch, the resistors switched between the cathodes of V344 and V354 in these positions should be checked.

It is possible that the operation of the amplifier will appear normal using the calibration voltage but abnormal when the amplifier is used in displaying transistor curves. In such a case one or more of the attenuator resistors are probably defective.

If the gain is abnormal in all positions of the VOLTS/DIV switch when using the calibration voltage, at least one of the amplifier stages is defective. If the gain is only slightly abnormal, the amplifier may be recalibrated for the correct gain using the procedure given in the Recalibration section. If the error in gain is more pronounced or if there is no output, you should check the tubes first. Then check for components which will affect the gain of both sides of the amplifier without unbalancing the amplifier, such as common cathode resistors.

Troubleshooting the Vertical Amplifier

Troubles which may occur in the vertical amplifier are much the same as those which occur in the horizontal amplifier since the two amplifiers are virtually identical. Therefore the same general troubleshooting techniques may be applied to the vertical amplifier as were described for the horizontal amplifier. There is one difference between the two amplifiers however, that is worthy of note. That is the location of the collector sweep current sampling resistors in the vertical amplifier. The current sampling resistors must conduct the entire collector current of the transistor under test. Consequently, if one of the resistors is open no collector current will flow when the CURRENT OR VOLTAGE PER DIVISION switch is in any position where the open resistor is part of the series string composing the current sampling resistor.

Since some of the current sampling resistors have a very small value of resistance and must remain within close tolerances, it is impossible to check some of these resistors without a precision ohmmeter. If you find it necessary to check the value of one of these resistors, it will be necessary for you to use a resistance bridge or other suitable device.

Troubleshooting the Step Generator

For purposes of troubleshooting, the step generator can be divided into two parts. One portion (pulse generator, of the circuit generates a continuous train of positive pulses which are applied to the other half of the circuit. The second portion (stairstep generator) of the circuit then utilizes these pulses to generate the output stairstep voltage waveform. When a trouble occurs in the step generator, the trouble can many times be isolated to either the pulse generator or to the stairstep portions of the step generator by checking the output waveform with the STEPS/SEC switch in the 240 position.

Troubles which affect either the number of steps per second or the amplitude of the steps will generally be located in the pulse generator section. Troubles which affect the number of steps per family or cause a variation in the amplitude of the steps will generally be located in the stairstep generator section. If no output at all results, the trouble may be in either the pulse generator or the stairstep generator.

A trouble can be isolated to either the pulse generator or stairstep generator portions of the step generator by means of the following check. Place the STEPS/SEC switch in the 240 position, remove tube V163, and connect the input of a test oscilloscope to pin 3 of V143A. On the test oscilloscope you should observe a train of positive pulses of approximately 115 volts peak amplitude occuring at a 240 cycle rate. If this indication is normal, the trouble is located in the stairstep generator section of the step generator. However, if this indication is abnormal, either in amplitude or in repetition rate, the trouble is located in the pulse generator portion of the step generator. Tube V163 should be replaced as soon as this check is complete. Troubleshooting techniques for the pulse generator and stairstep generator sections of the step generator are discussed separately in the following paragraphs.

Pulse Generator

The best way to troubleshoot the pulse generator is to trace the signal flow through the circuit using a test oscilloscope. Checking the outputs of the full wave rectifier circuits is a good place to start. The waveforms at the output of the rectifier circuits (V112 and V123) are given on the schematic diagram of the step generator. If the outputs of either or both full wave rectifier circuits are abnormal, it will be necessary for you to trace the signal back toward the secondary of transformer T601 in order to determine the exact cause of the trouble. If the outputs of the rectifiers are normal, you should then check the waveform at the plates of the pulse shaper tubes, V104B and V124B. This should be done after disabling the pulse gating circuit by removing tube V163. The pulses at the plates of V104B and V124B should occur at either a 120 or 240 cycle rate depending upon the position of the STEPS/SEC switch. If the waveform is normal check V143A and its cathode circuit. Replace V163 at the completion of this check.

Stairstep Generator

If a trouble in the stairstep generator section results in no output from the step generator, a clue to the cause of the trouble can be obained by measuring the plate voltage of the integrator tube, V171. Usually when no output is obtained from the step generator, the voltage at the plate of V171 is either approximately 35 volts or more than 250 volts. These conditions are discussed separately in the following paragraphs.

If the voltage at the plate of the integrator tube, V171 is approximately 35 volts, the tube is not being allowed to perform its normal step-up action. This may result from defective coupling diodes (V172A or V172B), improper operation of the Schmitt trigger circuit (V155A and V155B), or an open resistor in the cathode circuit of V143B.

The coupling diodes may be checked by removing tube V163 and observing the waveform at the control grid of V171. Under these conditions the waveform should be a series of sharp negative spikes approximately 6 volts in amplitude. The coupling diodes are operating correctly if the spikes are present. If the spikes disappear when V163 is replaced in its socket, the Schmitt trigger circuit is not in the condition which allows the integrator circuit to perform its step-up action (V155A cutoff and V155B conducting). If R186, in the cathode circuit of V143B is not open, the trouble probably is V155B or its associated circuitry.

If the plate voltage of the integrator tube is more than 250 volts with the STEPS/FAMILY control fully clockwise, the tube is cut off. If this is the case, rotate the STEPS/FAMILY control fully counterclockwise and momentarily ground the control grid of V171. If the voltage at the plate of V171 drops and remains at a lower level, the trouble is that the disconnect diodes (V142A and V142B) are not conducting to reset the integrator tube. Tube V152 is probably at fault in such a case.

If the voltage at the plate of V171 does not decrease and remain lower after the control grid is momentarily grounded, but instead remains at about 275 volts, the integrator tube is not being reset. Since practically any stage in the stairstep generator can produce this condition it is necessary to make additional checks to determine the exact cause of the trouble. It is necessary to check each stage individually by means of voltage checks at important points in the circuit. The integrator stage should be checked first however.

With approximately 275 volts at the plate of V171, the cathode of V163A should be at about 215 volts. If this voltage is incorrect, check V163A and its grid and cathode circuits. If the voltage at the cathode of V163A is correct, the stage is probably operating correctly and you should then check the voltage at the cathode of V143B with the STEPS/FAMILY control fully clockwise. The voltage should be approximately −40 volts. If the voltage is not correct, check V143B and the cathode circuit of V163A. If the voltage at the cathode of V143B is correct, the stage is probably operating normally and you should then check V155A and its grid and cathode circuits for troubles which may not allow the tube to conduct. If V155A is conducting, (this can be determined by measuring the plate voltage of V155A. . . if the tube is conducting, this voltage should be less than 50 volts) the trouble then must be V163B or its associated circuitry.

If it is impossible to obtain the correct number of steps in each stairstep waveform, the trouble will probably be located in the cathode circuit of V163A. If the cathode circuit of V163A is normal, you must then check the resistors in the plate circuit of V155A and the grid circuit of V155B.

Adjusting The Step Amplifier

A trouble occuring in any stage in the step amplifier can produce virtually the same symptoms as a trouble occuring in any other stage. For this reason, it is probably best to troubleshoot the circuit by checking each stage individually. This may be done if the following procedure is used.

The +1 Amplifier (V254, V264, and V233B) should be checked first. This can be done by placing the POLARITY switch in the — position and grounding the control grid of V254 by placing a jumper from the junction of R251 and R246 to ground. Under these conditions, the cathode voltage of V233B should be zero. (It may be necessary to adjust the ±ADJ control to obtain this voltage.) If the cathode voltage of V233B is correct, the +1 Amplifier circuit is probably operating normally. You should, however check resistor R238 in the cathode circuit of V233B before proceeding to the next circuit check.

NOTE

You should leave the grid of V254 grounded during the circuit checks made on the remainder of the step amplifier.

If the cathode voltage of V233B is other than zero volts when the grid of V254 is grounded, the +1 Amplifier is defective. The trouble can be isolated either to cathode follower V233B or to the difference amplifier (V254 and V264) by measuring the voltages at the control grid of V264 and V233B. The voltage at the grid of V264 should be approximately the same as the voltage at the cathode of V233B if the cathode circuit of V233B is normal. If the grid voltage of V233B is approximately zero, but the cathode voltage is not, V233B should be replaced. If the grid voltage of V233B is not approximately zero, the difference amplifier stage is defective. In the latter case, it will be necessary to make additional voltage and resistance checks to determine the exact cause of the trouble.

With the POLARITY switch in the — position, the grid of V224 is maintained at ground potential by the +1 Amplifier. This causes the step amplifier to function as a voltage-regulated power supply with the stairstep voltage waveform from the step generator serving as the reference voltage. Under

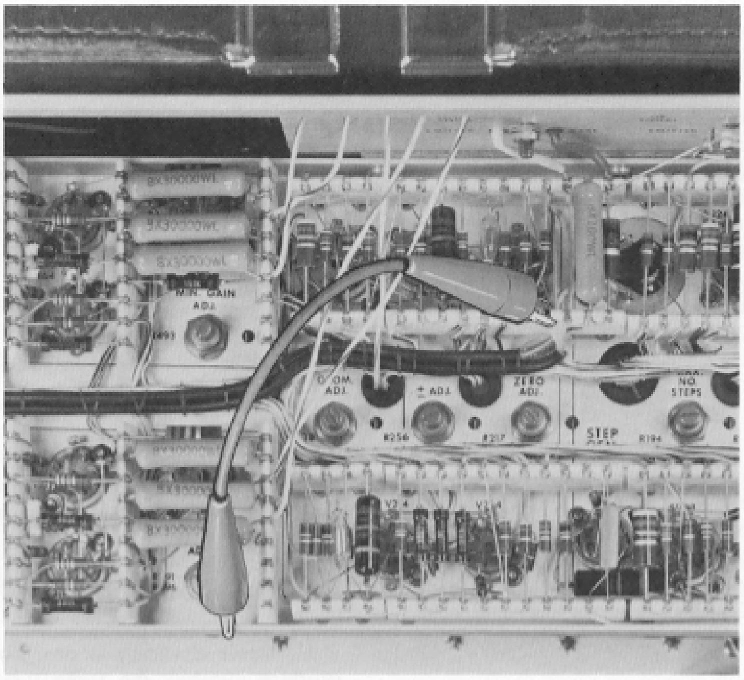


Fig. 4-4. Grounding the junction of resistors R251 and R246 to check operation of the Step Amplifier Circuit.

these conditions, if the circuit is operating correctly the voltage across R246 should increase from zero by .5 volts per step regardless of the position of the STEP SELECTOR switch. This means that with 12 steps in a family, the last step should bring this total voltage drop across R246 to 6 volts. This voltage can be observed on a test oscilloscope connected to the ungrounded side of R246. If the circuit operates properly in all but one or two positions of the STEP SELECTOR switch, you should check the resistors peculiar to these positions.

If you place the BASE STEP GENERATOR switch in the OFF position, no output should be obtained from the amplifier and the voltage measured at the ungrounded side of R246 should be zero. (It may be necessary to adjust the STEP ZERO and ZERO ADJ controls to obtain zero voltage). Also, adjustment of either the STEP ZERO or ZERO ADJ controls should change the voltage slightly across R246 if the circuit is working properly.

If you obtain an abnormal voltage across R246 under these conditions, you can locate the defective stage by using the STEP ZERO control to generate a signal voltage. The change in voltage produced by the STEP ZERO control can then be traced through the remainder of the circuit. When the circuit is operating normally, the voltage change at each point in the circuit is in the order of one volt as the STEP ZERO control is rotated between its limits. When the circuit is not operating properly, the voltage change will be much greater, however, making it relatively easy to trace the voltage shift through the circuit. When a point in the circuit is reached where the voltage does not change as the STEP ZERO control is rotated, this will locate the defective stage.

If adjustment of the STEP ZERO control produces more than approximately a one-volt change in the voltage across R246, resistor R203 should be checked. A large voltage change at the output of the circuit when the STEP ZERO control is rotated is indicative that the feedback circuit is not operating.

If the entire circuit appears to operate correctly except that the top of the stairstep waveform at the output is flattened off so that one or more of the steps is eliminated, the rectifiers for both power supplies in the step amplifier must be checked. With a stairstep waveform of 12 steps, a maximum of 2.4 amperes must be supplied by the power supply. If the power supply is unable to supply the required current, the last steps of each waveform will simply be eliminated and the upper portion of the waveform will be flattened off.

If the circuit appears to be operating correctly except that the voltage steps across R246 are more or less than the .5 volts which is normal, resistors R202 and R203 must be checked. The ratio of these two resistors controls the amplitude of the output steps from the step amplifier.

Troubleshooting the Collector Sweep Circuit

If a trouble occurs in the collector sweep circuit, it will generally result in either current flow through the current measuring resistor under no load conditions, insufficient output voltage, or insufficient output current. If both insufficient output voltage and current occur simultaneously the trouble is probably a defective rectifier.

A small amount of current flow through the current measuring resistor with no load on the output of the circuit is generally due to failure of V733 or to a misadjustment of C706 or C735. See Fig. 4-5. The circuitry of V733 is designed to eliminate current flow through the current measuring resistor resulting from current flowing in the output capacitance of the collector sweep circuit. Consequently, if V733 should fail, current flows through the current measuring

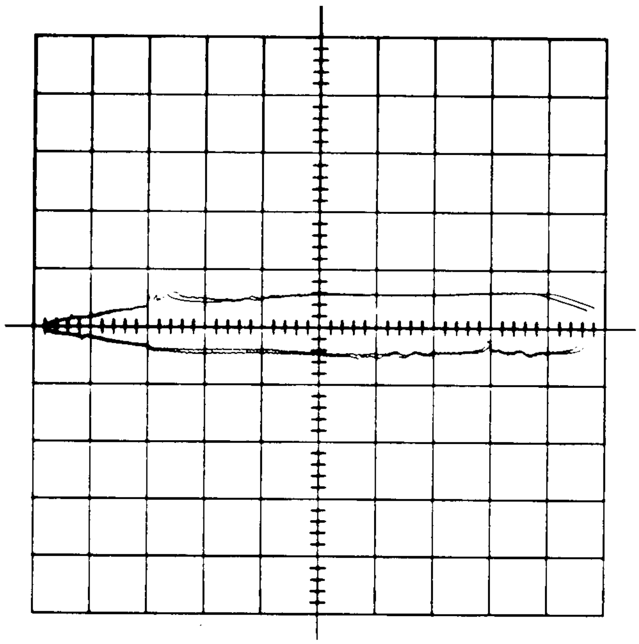


Fig. 4-5. The waveform resulting from a failure of V733.

This waveform shows collector current displayed vertically and collector voltage displayed horizontally. The CURRENT OR VOLTAGE PER DIVISION switch is in the .01 COLLECTOR MA position, the VOLTS/DIV switch is in the 20 COLLECTOR VOLTS position, and the PEAK VOLTS control is set for 200 volts output.

resistor and produces a small amount of vertical deflection on the face of the crt. This trouble is most evident when the PEAK VOLTS control is set for 200 volts and the CURRENT OR VOLTS PER DIVISION switch is set in the .01 COLLECTOR MA position.

The cause of insufficient or no output voltage may be determined by checking the voltages and waveforms at various points throughout the circuit using the information contained on the schematic diagram. Since this is an unregulated circuit, the line voltage should be checked first. Voltage checks at the output of the rectifiers should be made with a load on the output of the collector sweep circuit. A satisfactory load can be obtained by placing the DISSIPATION LIMITING RESISTOR switch in the 100 position and grounding terminal C on the Transistor Mounting Plate. The load then can be switched in and out as desired through use of the transistor selector switch.

CAUTION

When the dissipation resistors are used as a load for the collector sweep circuit, the peak collector sweep voltage should not be adjusted higher than 70 volts to prevent damage to the dissipation resistors.

It is best to perform the necessary voltage and waveform checks on the collector sweep circuit with the PEAK VOLTS RANGE switch in the 0-200 position. In this position the entire secondary winding of transformer T702 is utilized and the rectifiers are switched into a series connection. This makes it easier to detect troubles resulting from a defective secondary winding on T702 or from a defective rectifier.

If the circuit is unable to supply the specified currents, one or more of the rectifiers is probably at fault. However, if no current can be obtained from the circuit the trouble then is probably an open current measuring resistor. These resistors are shown on the schematic diagram of the Horizontal Amplifier.

NOTES

SECTION 5
RECALIBRATION PROCEDURE

NOTE

Tolerances and accuracies as stated in Specifications section and the Recalibration Procedure of this manual apply only to Type 575 instruments above serial number 8030.

INTRODUCTION

The following equipment is required for the complete calibration of your instrument.

1. A voltmeter which measures dc voltage in the range from 100 to 1700 volts with an accuracy of 3%.
2. Dc voltmenter such as the Fluke Model 803 or the Electro Instruments Model Eitronic 880. Required characteristics: Input resistance at least 1 megohm. Accuracy at least ±1% of reading between 0.1 volt and 5 volts.
3. A variable-voltage transformer capable of supplying 6.5 amperes at 105 to 125 volts, rms.
4. An oscilloscope capable of displaying a low-frequency waveform with an amplitude of about 10 mv, peak-to-peak.
5. A resistance bridge capable of measuring resistances from 1 ohm to 500 kilohms. The resistance bridge accuracy must be capable of insuring that the resistor is within 1% of its proper value.
6. A small, non-metallic screwdriver.

NOTE

Steps 5 and 6 should be performed in the sequence given. Other steps may be performed in any sequence.

Unless otherwise stated, all adjustments are to be made at design center line voltage (117 v).

1. Checking the Step Selector Switch

Connect the resistance bridge between the wire running from the STEP SELECTOR switch to the POLARITY switch and the wire running from the front wafer to the middle wafer on top of the STEP SELECTOR switch. Read resistance values as shown in Table 5-1, and record percentage error at each position of the STEP SELECTOR switch.

2. Checking the Series Resistor Switch

Set the STEP SELECTOR switch to .01 VOLTS/STEP and Transistor Selector Switch to TRANSISTOR A. Connect the resistance bridge between binding posts B and E on the left side of the test panel. Compare each resistance value on the SERIES RESISTOR switch with the resistance reading of the resistance bridge (±5%). There is approximately 0.1 Ω resistance in series with the SERIES RESISTOR switch which may make the lower resistance readings appear slightly high. The 0.1 Ω of resistance is made up of wiring and switch contact resistance.

TABLE 5-1

STEP SELECTOR (MA PER STEP)	Resistance ±1%
.001	500 k
.002	250 k
.005	100 k
.01	50 k
.02	25 k
.05	10 k
.1	5 k
.2	2.5 k
.5	1 k
1	500 Ω
2	250 Ω
5	100 Ω
10	50 Ω
20	25 Ω
50	10 Ω
100	5 Ω
200	2.5 Ω

3. Checking the Dissipation Limiting Resistor Switch

Connect the resistance bridge between binding post C on the left side of the test panel and the white-brown-red wire on top of the Collector Sweep POLARITY switch. Set the Collector Sweep POLARITY switch between detents. Measure the resistance in each position at the DISSIPATION LIMITING RESISTOR switch. Each measured resistance should agree with the value indicated (±5%).

4. Power Supply

All voltage test points are brought out to pin jacks on the sides of the lower deck.

a. Turn the instrument on and allow a ten minute warm-up period. After the ten minute warm-up period, connect the precision voltmeter between the junction of R302 and R303 and ground (these resistors are located on the Horizontal VOLTS/DIV switch). Adjust —150 V Adj for exactly —5 v as read on the voltmeter. Measure the voltages and record the percentage of error at the other resistor junctions on the voltage divider (see Table 5-2). These errors will be taken into account when calibrating the vertical and horizontal amplifiers.

TABLE 5-2

Measure between ground and junction of:	Correct reading in volts
R303 and R304	—2
R304 and R305	—1
R305 and R306	—0.5
R306 and R307	—0.2
R307 and R308	—0.1

The accuracy of the entire instrument is no better than the accuracy with which this adjustment is made. Check voltage at —150 V TEST PT for —150 volts ±3%. Use an oscilloscope to check for ripple on this supply as the line voltage is changed through the range from 105-125 volts. Normal ripple is 10 millivolts, peak-to-peak.

b. In the same manner, check regulation and ripple of the +100-volt and +300-volt supplies. The output voltage of both supplies should be within 3% of the nominal value. The ripple on the +100-volt supply is normally 10 millivolts, peak-to-peak. The ripple on the +300-volt supply is normally 25 millivolts, peak-to-peak.

c. Set the output of the high-voltage supply to —1700 volts with the —1700 ADJ control. The control and jack are located on the left side of the lower deck. Defocus the crt beam and turn the INTENSITY control fully clockwise. Change the power line voltage from 105 volts to 125 volts and check the —1700-volt supply for constant output voltage. Then turn the INTENSITY control fully ccw and again check for constant output voltage as the line voltage is changed from 105 to 125 volts. Now reset the line voltage to the design center voltage (117 v).

5. DC Balance

When the DC BAL control is properly set, the trace on the crt will not shift appreciably as the corresponding Vertical or Horizontal control is moved through the BASE VOLTS range. (AMPLIFIER CALIBRATION in ZERO CHECK position.)

a. Horizontal Amplifier

Set controls as follows:

BASE STEP GENERATOR	OFF
Horizontal	.5 BASE VOLTS
INTENSITY	Usable level

Hold the AMPLIFIER CALIBRATION switch in the ZERO CHECK position as you make the following adjustments.

Move the spot to the center of the graticule with the two positioning controls. Switch the Horizontal control to .01 BASE VOLTS and move the spot back to the center of the graticule with the DC BAL control. If the spot cannot be moved to the center, it will be necessary to match the input tube (V344, V354) by trial and error. Normally, the spot can be positioned off either side of the CRT screen with the DC BAL control.

Readjust the DC BAL control until the spot does not shift appreciably as the Horizontal control is moved between .5 and .01 BASE VOLTS.

b. Vertical Amplifier

The procedure for adjusting the vertical DC BAL control is the same as that used for adjusting the horizontal DC BAL control.

6. Differential Balance

When the differential balance control is properly adjusted, equal signals applied to both grids will not appear between the plates of the input tubes and therefore will not be amplified by succeeding stages.

Set controls as follows:

Vertical	EXT.
Horizontal	EXT.
PEAK VOLTS RANGE	0-20
PEAK VOLTS	5
Transistor Selector Switch	TRANSISTOR A

Connect all four external inputs together (rear panel). On instruments above S/N 3659 pins E, F, H, and J, of the Type 175 adapter socket must be tied together for this adjustment. Run a wire from the external inputs to the binding post marked "C" on the left side of the test panel. Position the trace on the central area of the graticule. On instruments below serial number 2765 the DIFF BAL controls are the miniature potentiometers mounted on ceramic terminal strips below the Vertical and Horizontal selector switches. Instruments above serial number 2764 have the DIFF BAL controls mounted on a small bracket just behind the front panel on the right side of the instrument. Adjust the DIFF BAL controls so that only a spot remains on the face of the CRT.

Slowly turn the PEAK VOLTS control from 5 to 0 and watch the spot. If it changes into a line which is longer than four spot diameters as you rotate the PEAK VOLTS control, it will be necessary to select input tubes which have more similar characteristics. When you change input tubes, repeat the DC BAL procedure before attempting to adjust the differential balance. After a satisfactory differential balance has been attained, repeat the DC BAL procedure. Remove your test leads.

7. CRT Alignment

Set controls as follows:

PEAK VOLTS RANGE	0-20
Vertical	1 COLLECTOR MA
Horizontal	.5 COLLECTOR VOLTS

Adjust the PEAK VOLTS and Horizontal POSITION controls for a horizontal trace of about 10 major divisions. Center the trace with the Vertical POSITION control. The trace and the graticule line should coincide.

CRT Adjustment S/N 101-1620

If the trace and graticule line do not coincide over the length of the graticule, loosen the crt base clamp and rotate the tube with the alignment ring. When the trace and the graticule line are in coincidence, push the tube forward so that it rests snugly against the graticule. Then tighten the crt base clamp. Recheck the alignment after tightening the clamp to be sure it didn't move while the clamp was being tightened.

CRT Adjustment S/N 1620-up

Loosen the clamp at the base of the crt and push the crt against the graticule, then tighten the clamp. Now with the red knob, near the bottom of the clamp, rotate the crt until the trace runs parallel to the horizontal lines of the graticule.

8. Vertical Gain

The controls to be adjusted in this step set the gain of the Vertical Amplifier to a value which results in a trace deflection of 10 divisions when the appropriate internal calibrating voltage is fed into the input grids (AMPLIFIER CALIBRATION switch).

a. Switch the Base Step Generator off and set the STEP SELECTOR to .01 VOLTS PER STEP. Set the Vertical switch to 1000 COLLECTOR MA. Hold the vertical AMPLIFIER CALIBRATION switch in the ZERO CHECK position and move the spot or trace directly behind the fifth line above the center of the graticule. Now press down the AMPLIFIER CALIBRATION switch lever to the —10 DIVISIONS position. If the vertical MIN GAIN ADJ control is properly set, the trace will move to the fifth line below the center of the graticule, plus or minus the recorded error of the —1 volt measurement at the junction or R304 and R305, which was recorded in step 4.

If the adjustment is not properly set, alternately adjust the Vertical POSITION control and the vertical MIN GAIN ADJ control until exactly 10 divisions of deflection, plus or minus the error of —1 volt measurement taken in step 4, is obtained as the AMPLIFIER CALIBRATION switch is changed from the ZERO CHECK to the —10 DIVISIONS position.

b. Now set the Vertical switch to .01 BASE VOLTS and adjust the MAX GAIN ADJ control for 10 divisions of deflection in the manner described in part (a) of this step considering the error at the —0.1 volt measurement instead of the —1 volt measurement which was taken in step 4.

The MAX GAIN ADJ control is a miniature potentiometer mounted on the Horizontal switch. Since there is interaction between the MAX GAIN ADJ and the MIN GAIN ADJ controls, it is now necessary to recheck the calibration in the 1000 COLLECTOR MA position and recalibrate in both the 1000 COLLECTOR MA and .01 BASE VOLTS positions if necessary. Then check the calibration in the other positions of the Horizontal switch in the same manner.

9. Horizontal Gain

The controls to be adjusted in this step set the gain of the Horizontal Amplifier to a value which results in a trace deflection of 10 divisions when the appropriate internal calibrating voltage is fed into the input grids (AMPLIFIER CALIBRATION switch).

a. Set the Horizontal switch to .5 BASE VOLTS. Hold the horizontal AMPLIFIER CALIBRATION switch in the ZERO CHECK position and position the spot directly behind the right-hand edge of the graticule. Now press down the AMPLIFIER CALIBRATION switch to the —10 DIVISIONS position. If the horizontal MIN GAIN ADJ control is properly set, the spot will move directly behind the left edge of the graticule. If not, aternately adjust the horizontal MIN GAIN ADJ and the Horizontal POSITION control until the deflection is exactly 10 divisions, plus or minus the recorded error of the —1 volt measurement in step 4.

b. Now set the Horizontal switch to .01 BASE VOLTS and adjust the MAX GAIN ADJ control for 10 divisions of deflection in the same way as described in part (a) of this step, considering the recorded error of the —0.1 volt measurement in step 4. The MAX GAIN ADJ control is a miniature potentiometer mounted on the Horizontal switch. Since there is interaction between the MAX GAIN ADJ and the MIN GAIN ADJ controls, it is now necessary to recheck the calibration of the .5 BASE VOLTS range and recalibrate both the .5 and .01 BASE VOLTS positions if necessary. Then check the calibration in the other positions of the Horizontal switch by the same method.

10. Phase A, Phase B, and Geometry

The PHASE A and PHASE B controls adjust the time relationship between the Collector Sweep and the Step Generator so that switching between steps occurs at a time when the collector sweep voltage is either at a maximum, at a minimum, or both.

The GEOM ADJ control is used to adjust the voltage on one of the crt elements to give the best trace linearity. Set controls as follows:

Veritcal	.1 COLLECTOR MA
Horizontal	BASE CURRENT OR BASE SOURCE VOLTS
Base Step Generator	REPETITIVE
STEP SELECTOR	.01 VOLTS/STEP
STEPS/SEC	120 lower
Collector Sweep POLARITY	Minus
PEAK VOLTS RANGE	0-20
PEAK VOLTS	10
DISSIPATION LIMITING RESISTOR	10 k
Transistor Selector Switch	TRANSISTOR B
Base Step Generator POLARITY	

Short binding posts C and E on the TRANSISTOR B side of the test panel. Position the display so that the tops and bottoms of the vertical lines are within the graticule area. Adjust the Phase B control for a display like that of Fig. 5-1.

Now set the STEPS/SEC switch to the upper 120 position and adjust the STEPS/FAMILY control for a stable display.

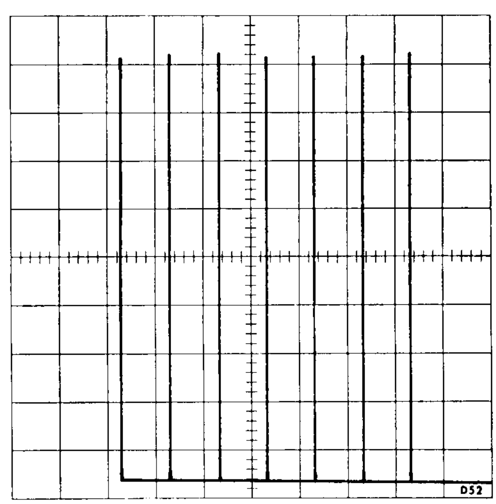


Fig. 5-1. Typical display resulting from proper adjustment of the Phase B control.

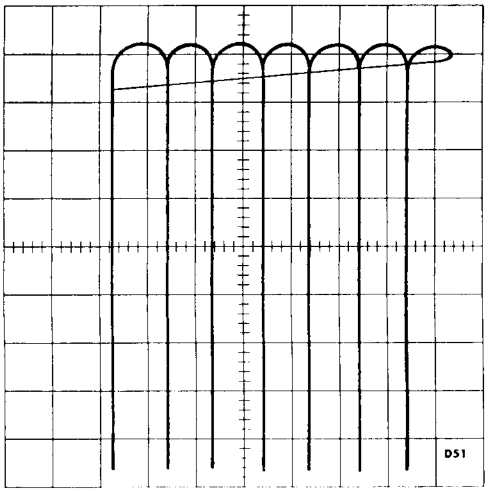


Fig. 5-2. Typical display resulting from the proper adjustment of the Phase A control.

Adjust the Phase A control for a display similar to that of Fig. 5-2. Return STEPS/SEC control to 240.

Move the Vertical control to .05 COLLECTOR MA and position the resulting display so that only the vertical lines of the trace are visible. Adjust the STEPS/FAMILY control so that there is one vertical section of the trace for each vertical line of the graticule. Adjust the GEOM ADJ control for minimum curvature of the vertical lines which are within the area enclosed by the graticule.

11. Zero Adj, ± Adj, and Volts/Step Adj

The ZERO ADJ control sets the voltage at the base of the stairstep waveform to a value which is the same in both positions of the Base Step Generator POLARITY switch.

The ±ADJ control is used to set the voltage at the base of the output stairstep waveform to zero.

The VOLTS/STEP ADJ control is used to set the amplitude of the voltage steps occurring across the current determining resistor of the Step Amplifier (R246).

Set:

STEP ZERO	Midrange

Position the display so the last trace to the right is in the center of the graticule. When the Base Step Generator POLARITY switch is changed to the plus position, the centered trace should not move. If it does, set the ZERO ADJ control for a symmetrical display around this trace as the Base Step Generator POLARITY switch is changed from one position to the other.

Now hold the horizontal AMPLIFIER CALIBRATION switch in the ZERO CHECK position and move the trace to a point directly behind the center vertical graticule line. Then release the switch and move the same trace behind the center vertical line with the ±ADJ control.

The STEP ZERO front-panel control should move the display approximately one-half of a major division each side of the centerline.

Position the display toward the center of the graticule and turn the STEPS/FAMILY control fully clockwise. With the POLARITY switch set in the minus position, set the VOLTS/STEP ADJ for one trace per major division. Remove shorting strap.

12. Adjusting the Collector Sweep Balance

The Collector Sweep Balance capacitors are used to cancel the effects of stray capacitance in the Collector Sweep wiring so that no current flows through the collector current sampling resistors when the Collector Sweep is not loaded.

Set the controls as follows:

Vertical	.01 COLLECTOR MA
Horizontal	20 COLLECTOR VOLTS
PEAK VOLTS RANGE	0-200
PEAK VOLTS	Fully clockwise
Collector Sweep POLARITY	Minus
Transistor Selector Switch	TRANSISTOR B

Use a non-metallic screwdriver to make the following adjustments. Press 0.1X button and adjust C735 (behind POWER switch) for minimum trace separation. Switch Collector Sweep POLARITY to plus, press 0.1X button and adjust C706 (collector sweep power-supply chassis) for minimum trace separation.

13. Min. No. Steps and Max. No. Steps

These controls determine the upper and lower limits of the STEPS/FAMILY control.

Vertical	1 COLLECTOR MA
Horizontal	.01 BASE VOLTS
Base Step Generator	REPETITIVE
STEP SELECTOR	.01 VOLTS/STEP

Turn the STEPS/FAMILY control fully counterclockwise and adjust MIN. NO. STEPS for 5 dots. Next, turn the STEPS/FAMILY control fully clockwise and adjust MAX. NO. STEPS for 13 dots. There is some interaction between these controls, so it may be necessary to repeat both adjustments.

14. Check the Step Selector Switch and set the +Step Adj (SN 4270-up)

Set controls as follows:

Vertical	1000 COLLECTOR MA
Horizontal	.01 BASE VOLTS
STEP SELECTOR	.01 VOLTS/STEP
Base Step Generator	REPETITIVE
PEAK VOLTS	0
Base Step Generator POLARITY	—

Check for one dot per division ±2% and note percentage of error. Change POLARITY to + and adjust +STEP ADJ for exactly the same display as was seen when the POLARITY switch was in the minus position.

15. Checking Vertical Collector ma/div Switch

Set controls as follows:

Horizontal	20 COLLECTOR VOLTS
Vertical	.01 MA/STEP
STEP SELECTOR	.01 MA/STEP
Base Step Generator	REPETITIVE
POLARITY	—
PEAK VOLTS	0
DISSIPATION LIMITING RESISTOR	0

Short binding posts C and B on right side of test panel together and switch Transistor Selector Switch to TRANSISTOR B.

Note a display of one dot per division ±1% minus the percent of error recorded in step 1 (Table 5-1) for the .01 MA PER STEP position of the STEP SELECTOR switch. Do this procedure for each of the corresponding positions of the CURRENT OR VOLTAGE PER DIVISION section of the Vertical switch and the MA PER STEP section of the STEP SELECTOR switch. The 500 and 1000 COLLECTOR MA positions of the Vertical switch should be checked with the STEP SELECTOR at 50 and 100 MA PER STEP respectively, and with the 0.1X button depressed.

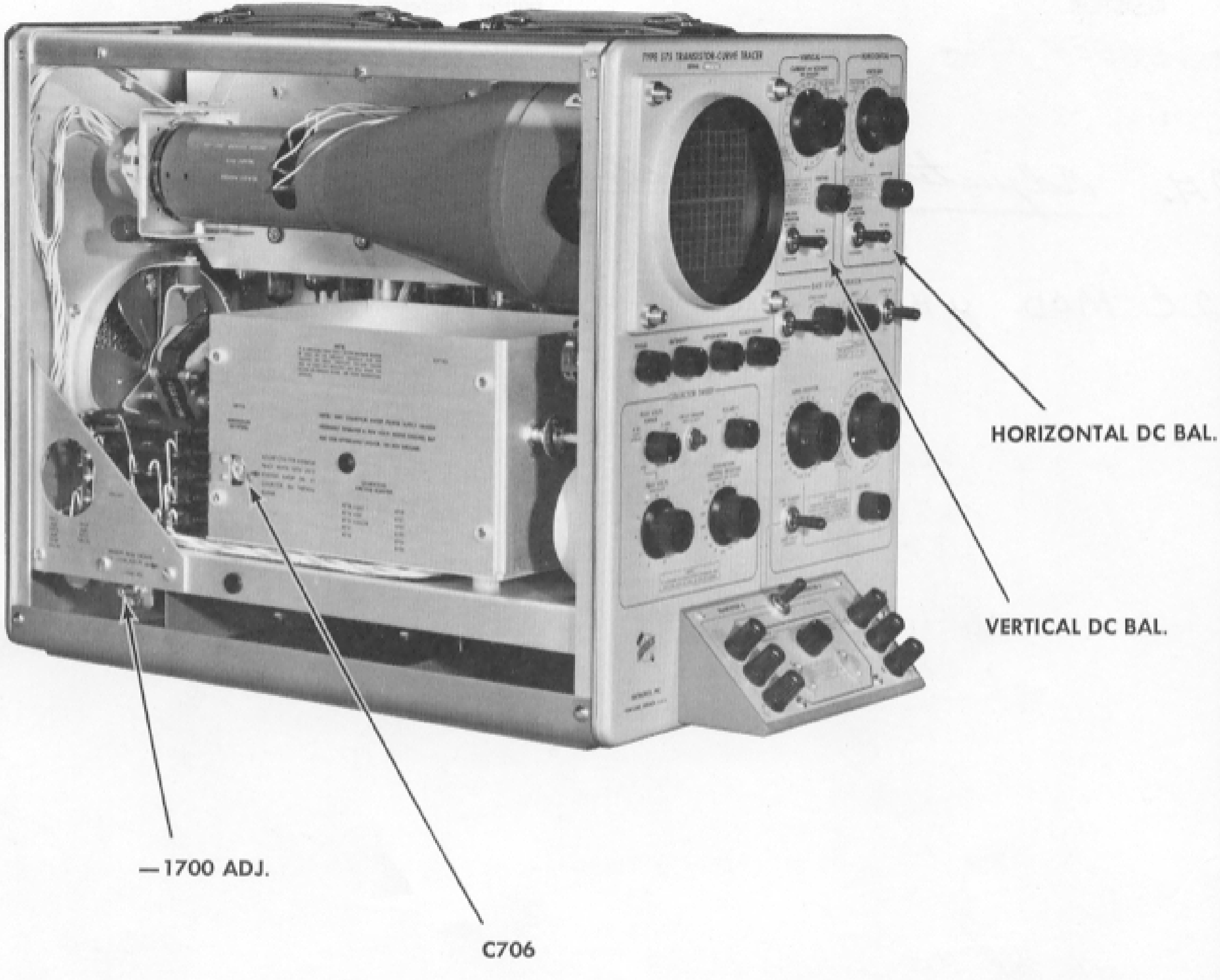


Fig. 5-3 Left Side View

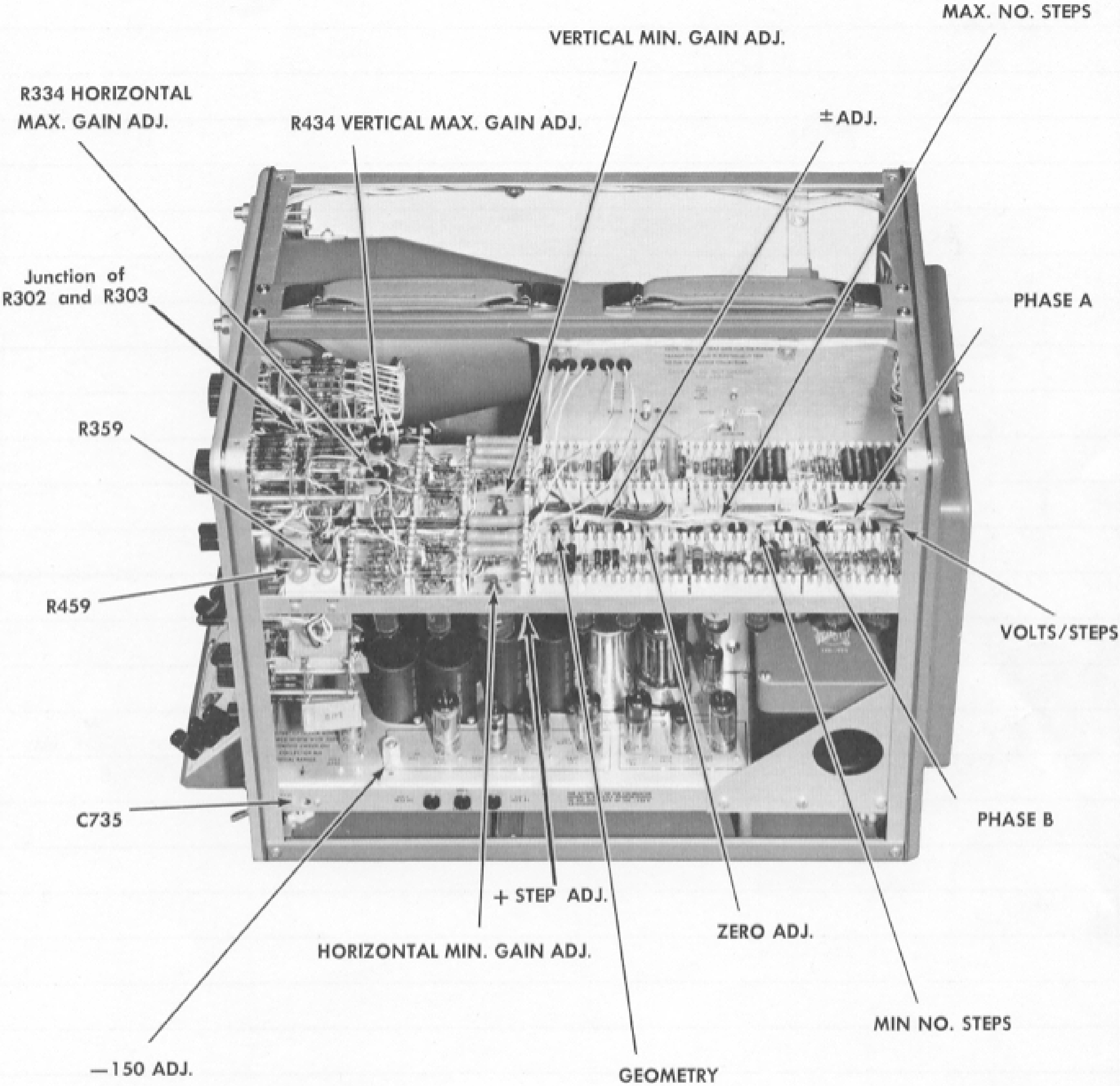
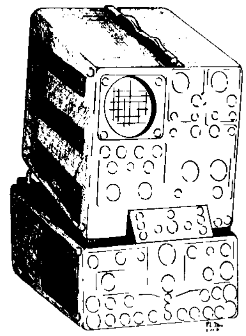


Fig. 5-4 Right Side View

NOTES



SECTION 6

TYPE 175

GENERAL DESCRIPTION

The Type 175 Transistor-Curve Tracer High-Current Adapter enables the Type 575 Transistor-Curve Tracer to plot and display the characteristic curves of high-power transistors. Basically the Type 175 High Current Adapter contains a Collecter Sweep circuit and a Step Amplifier which are used in place of those in the Type 575. These circuits are capable of handling peak collector curents om more than 200 amperes and base currents up to 12 amperes. The Type 175 also contains the necessary voltage-dropping and current-sampling resistors for translating these high currents and voltages into deflection voltages suitable for display on the Type 575 crt.

The Step Generator and the Horizontal and Vertical Amplifiers in the Type 575 perform the same functions when the Type 175 is used with the Type 575 as when the Type 575 is used by itself.

ACCESSORIES

2 Instruction Manual
2 Black output leads, 012-014
2 Red output leads, 012-015
1 Interconnecting cable, 012-042
2 Red test cable, 012-043
2 Black test cable, 012-044
1 575 Adapter cable, 012-045
2 Blue test leads, 012-056
1 3 to 2-Wire adapters, 103-013
1 3-conductor power cord, 161-010
1 3-conductor power cord, 20", 161-014

INSTALLATION INSTRUCTIONS

If your Type 575 Transistor-Curve Tracer has not been modified for use with the Type 175 High-Current Adapter, it will be necessary for you to do so before the two can be operated together. The following instructions tell you how to make this modification and how to mount the Type 575 on top of the Type 175 to make a convenient operating unit.

Modification

Drill five holes in the upper left corner (facing the instrument from the rear) of the rear panel according to the dimensions shown in Fig. 6-1. Mount the Type 175 interconnecting plug and harness in the holes and connect the wires as shown in Fig. 6-2 and Fig. 6-3.

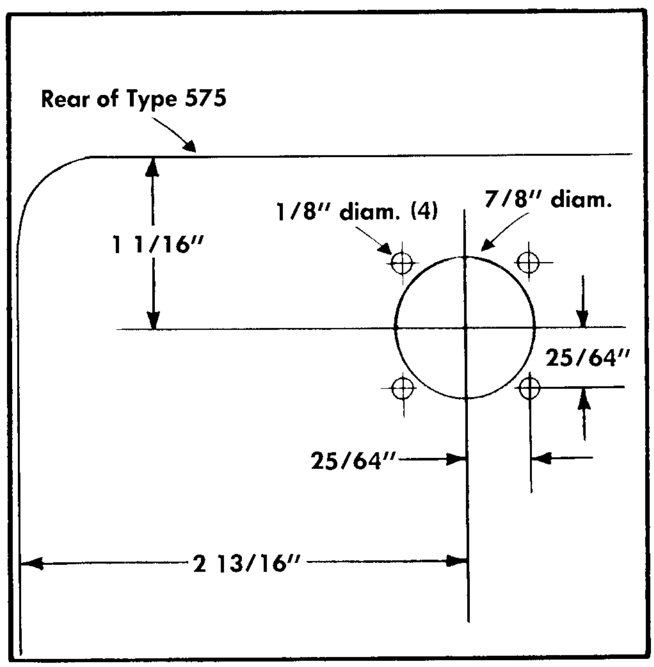


Fig. 6-1. Location and dimensions of holes for mounting interconnecting plug in Type 575.

Mounting

Remove the two cabinet bolts from the bottom front of the instrument and replace them with the two hinge bolts provided in the modification kit (see Fig. 6-4). If necessary, enlarge the holes in the Type 575 with a 3/16-inch drill. Set the Type 575 on top of the Type 175 so that the hinge bolts fall into the sockets in the front mounting feet on the Type

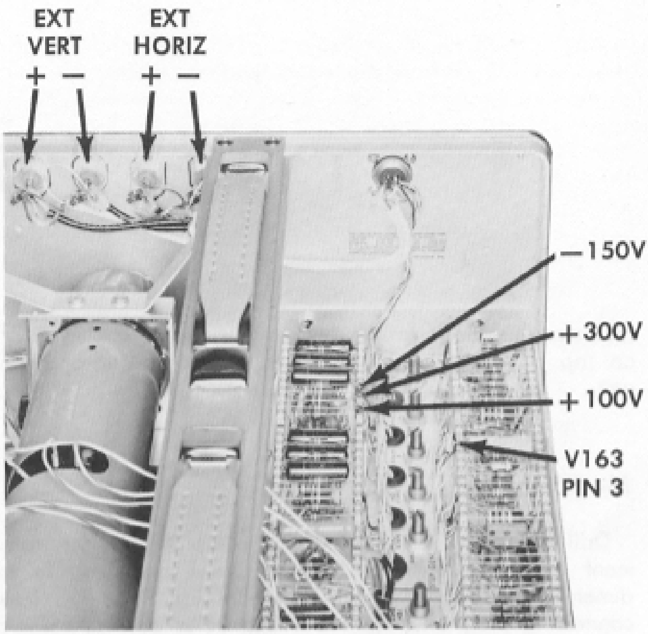


Fig. 6-2. Wiring connections to interconnecting plug in Type 575 (schematic).

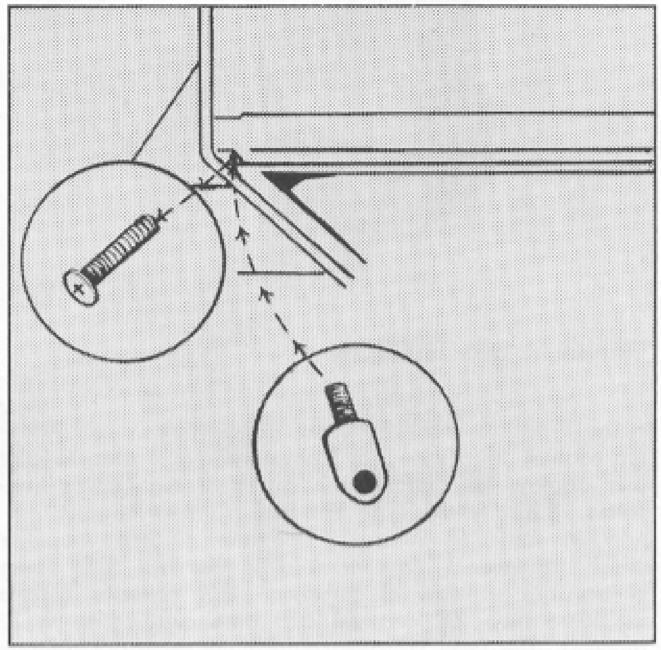


Fig. 6-4. Replacing cabinet bolts with hinge bolts in Type 575.

175. Insert the two 10-32 x 1¼" bolts through the holes in the mounting feet and the hinge bolts to hold the Type 575 securely in place. Note that the rear of the Type 575 can be raised for more convenient viewing. (See Fig. 6-5).

OPERATING INSTRUCTIONS

Operation of the Type 175 High-Current Adapter with the Type 575 Transistor-Curve Tracer is essentially the same as operation of the Type 575 by itself. The only major difference is that the transistor connections are made at the Type 175 instead of the Type 575 and the front-panel controls of the Type 175 take the place of some of the front-panel controls of the Type 575.

The following instructions deal only with those parts of the operating procedure which are unique to combined operation; it is assumed that the operator is already familiar with the operation of the Type 575 by itself.

To operate the two instruments together, the interconnecting cable must be connected and the VERTICAL CURRENT

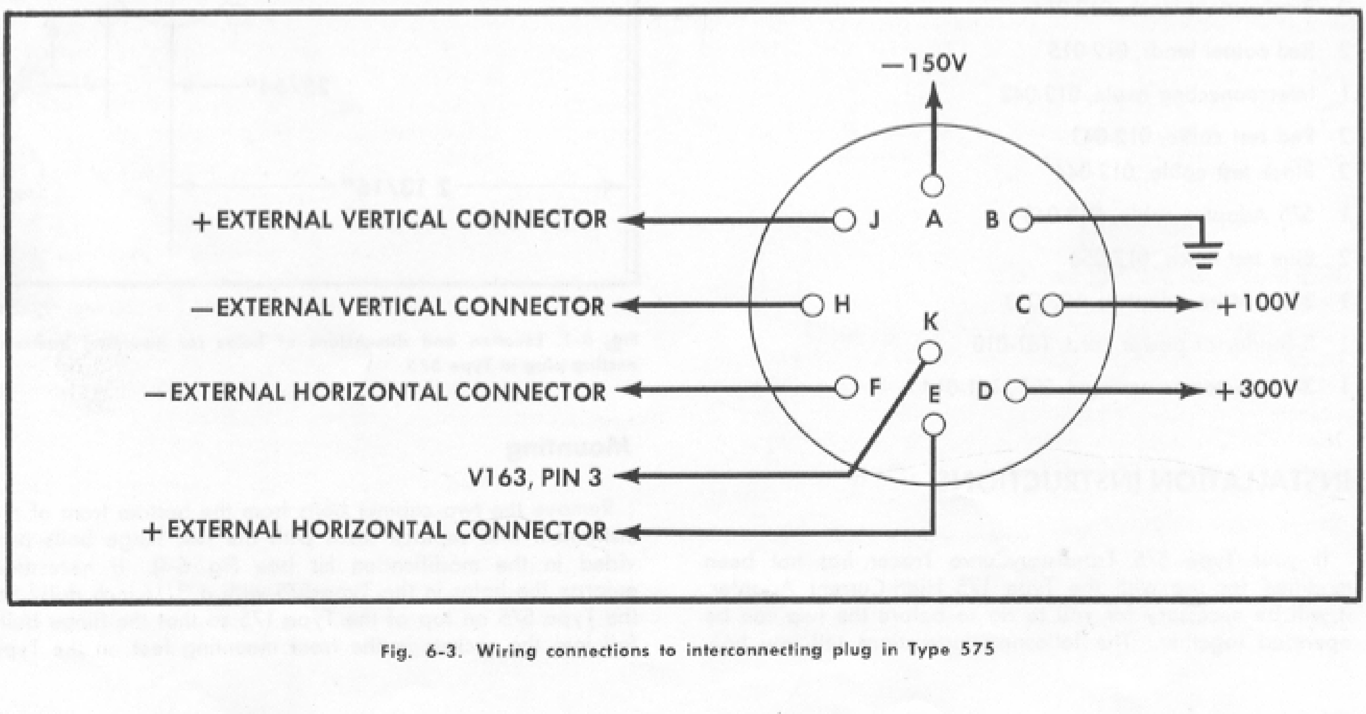


Fig. 6-3. Wiring connections to interconnecting plug in Type 575

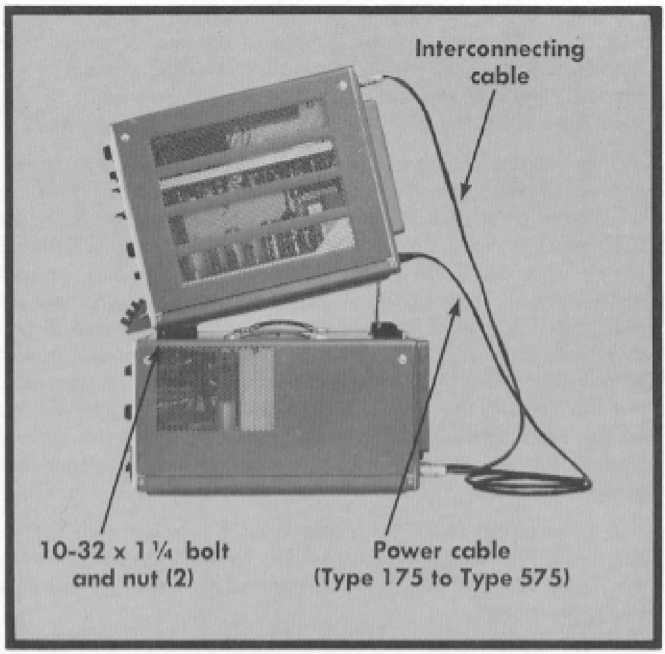


Fig. 6-5. Type 575 tilt-mounted on Type 175.

OR VOLTAGE PER DIVISION and the HORIZONTAL VOLTS/DIV. switches on the Type 575 must be set to EXT. For convenience, power to the Type 575 can be obtained from the POWER TO TYPE 575 connector on the rear of the Type 175. In this case, power to both instruments will be controlled by the Type 175 POWER ON switch. However, if it is intended that the Type 575 will be used frequently without the Type 175, it may be connected independently to its own power source, if desired. It is not recommended to have power applied to the Type 175 when the Type 575 is turned off.

A discussion of the front-panel controls of the Type 175 and their relationship to the front-panel controls of the Type 575 follows. With the VERTICAL CURRENT OR VOLTAGE PER DIVISION and HORIZONTAL VOLTS/DIV. switches on the Type 575 set to EXT., all other controls on the Type 575 whose functions are duplicated by controls on the Type 175 have no effect on the operation of the instruments.

VERTICAL DISPLAY Switch

The VERTICAL DISPLAY switch on the Type 175 takes the place of the VERTICAL CURRENT OR VOLTAGE PER DIVISION switch on the Type 575, except that there is no provisions for displaying base volts vertically on the Type 175. The VERTICAL DISPLAY switch selects the amplitude of the signal fed to the Vertical Amplifier of the Type 575. This signal is proportional to the collector current flowing through the transistor under test.

The POSITION control, AMPLIFIER CALIBRATION switch, and DC. BAL. adjustment in the VERTICAL block of the Type 575 perform exactly the same functions as they do without the Type 175.

COLLECTOR SWEEP Block

All of the controls in the COLLECTOR SWEEP block of the Type 175 perform the same functions, except for range of operation, as the corresponding controls on the Type 575. On the Type 175, there is no DISSIPATION LIMITING RESISTOR switch; the 300-ohm resistor inserted in series with the collector of the transistor in one of the PEAK VOLTS RANGE switch positions is the only dissipation limiting resistor available in the Type 175. If you wish to insert additional external dissipation limiting resistors, connect them in series with the collector of the transistor under test. With these additional resistors inserted in the circuit, it will be necessary to use test leads connected to the V_{ce} EXT. INPUT terminals, as described in the discussion of the Transistor Test Panel, for accurate presentation of collector-to-emitter voltages.

BASE STEP GENERATOR Block

All of the controls in the BASE STEP GENERATOR block of the Type 175 perform the same functions, except for range of operation, as the corresponding controls on the Type 575. The Display Selector switch (REPETITIVE-SINGLE FAMILY), the STEP/FAMILY control, and the STEPS/SEC. switch on the Type 575 perform the same functions as they do without the Type 175.

Transistor Test Panel

The Transistor Test Panel of the Type 175 is basically the same as that of the Type 575. Special connectors and cables are provided for high-current applications and for elimination of measurement errors due to voltage drops in high-current-carrying leads.

As with the Type 575 panel, the collector, base, and emitter connections are made to the binding posts C, B and E, respectively. If a peak collector current of more than about 25 amperes is expected, connect the collector and emitter to the large C and E terminals on the Type 175 through the high-current test cables provided.

With long leads to the collector and emitter of high-current transistors, or with dissipation limiting resistors inserted in series with a transistor, the voltage drop in the leads themselves may be enough to introduce a significant error into the voltage across the transistor as seen by the oscilloscope. This problem can be eliminated by connecting test leads from the collector and emitter of the transistor under test to the red and black V_{ce} EXT. INPUT terminals, respectively. These test leads are essentially non-current-carrying and provide a more accurate indication to the Horizontal Amplifier of the voltage at the transistor itself.

Also, the voltage drop in a high-current-carrying emitter lead can cause some loss in the base-drive voltage at the transistor, thereby making each base step less than that indicated by the setting of the STEP SELECTOR switch. (This applies only when the STEP SELECTOR is in one of the VOLTS/STEP positions.) For this reason, when high-current transistors are being tested with voltage steps at the base, you should remove the strap between the two REMOTE VOLTAGE-DRIVE GROUND REFERENCE binding posts and connect a lead from the ungrounded post to the emitter lead of the transistor itself.

CIRCUIT DESCRIPTION

Block Diagram

Fig. 6-6 shows a simplified circuit diagram of the Type 175 connected to the Type 575 for plotting collector current versus collector-to-emitter voltage of an NPN transistor. Most of the switching has been omitted from this diagram.

Overall operation of the unit is as follows: The step output from the Type 575 Step Generator is applied through pin K of the interconnecting plug to the Step Amplifier in the Type 175. The Type 175 Step Amplifier applies the steps to the base of the transistor under test while the Type 175 Collector Sweep circuit sweeps the collector voltage from zero to a peak voltage determined by the setting of the Type 175 controls. The time relationship between the collector sweeps and the base steps is the same as in the Type 575 alone. The number of steps per family and the number of steps per second are determined by the setting of the Type 575 controls. Polarity of the steps is determined by the Type 175.

The voltage drop across R415 is proportional to the current through it. This voltage is applied through pins H and J of the interconnecting plug to the Vertical Amplifier of the Type 575. The voltage difference between the switch arms of R315 and R316 is proportional to the collector-to-emitter voltage across the transistor. This voltage is applied through pins E and F of the interconnecting plug to the Horizontal Amplifier of the Type 575. (Both the VERTICAL CURRENT OR VOLTAGE PER DIVISION and the HORIZONTAL VOLTS/DIV. switches of the Type 575 are in the EXT. position for operation with the Type 175 Adaptor.

Collector Sweep

The Collector Sweep circuit in the Type 175 is essentially the same as that in the Type 575 except for current and voltage capabilities. Full-wave rectification of the 60-cycle line voltage produces 120 sweeps per second from 0 to 20 or 0 to 100 volts peak. These sweeps may be applied as either positive-going or negative-going voltages to the collector of either of two transistors under test by means of switch-actuated relays.

The Collector Sweep circuit is capable of supplying peak currents of over 200 amperes through the transistor under test at the 0-to-20 volt range of the PEAK VOLTS RANGE switch and over 40 amperes in the 0-to-100 volt range. The circuit breaker in the primary circuit of T702 is nominally rated at 8 amperes rms, but is capable of carrying considerably higher currents for short periods of time. The primary voltage of T702 is variable between zero and line voltage by means of the PERCENT OF PEAK VOLTS RANGE control. This provides a maximum average input power rating of about 1 kilowatt. Again, peak power can surpass this average by several times for short periods.

In one of the 0-100 positions of the PEAK VOLTS RANGE switch, a 300-ohm resistor (R720) is inserted in series with the output of T702 as a dissipation limiting resistor. Additional limiting resistors may be added externally, if desired (see Operating Instructions, "Collector Sweep Block".)

The internal resistance of the Collector Sweep circuit, exclusive of the current-sampling resistor (R415) and R720, is 0.03 ohm when the PEAK VOLTS RANGE switch is in the 0-20 position, and 0.5 ohm when the PEAK VOLTS RANGE switch is in the 0-100 position. Because of this low internal impedance, it is possible, in the more sensitive positions of the VERTICAL DISPLAY switch and with the C and E terminals shorted or nearly shorted, to dissipate enough power within the Type 175 to cause damage to the components. For this reason, the VERTICAL DISPLAY switch should always be in such a position that the maximum collector-current signal does not exceed a maximum amplitude of about five screen diameters.

A counterpart for V733 in the Type 575 is not required in the Type 175 because currents due to stray capacitance in the Type 175 are negligible compared to the high currents being measured.

Step Amplifier

The Step Amplifier in the Type 175 is virtually the same as that of the Type 575. The only significant differences are the use of 20-volt floating power supplies in place of 15-volt power supplies and the use of four parallel-connected transistors in the output stage. (The output of the 20-volt supplies is actually about 25 volts at nominal line voltage.) The Type 175 is capable of supplying a maximum base current of 12 amperes whereas the Type 575 supplies a maximum base current of only about 2.4 amperes.

The 20-volt supplies for the Step Amplifier are shown on the Power Supply schematic diagram. Diode-connected transistors are used in the negative supply to handle the additional current which must flow through that supply.

R244R and R244S reduce the transients which appear at the base of the transistor under test whenever the STEP SELECTOR switch is moved from one position to the next. They are shorted out except when the switch is between positions.

MAINTENANCE

General maintenance information, such as filter cleaning, parts replacement and ordering, and general troubleshooting instructions is the same for the Type 175 as for the Type 575. Therefore, the following information is concerned only with specific troubleshooting procedures for the Type 175 Step Amplifier and Collector Sweep circuit and the associated switches.

Troubleshooting the Step Amplifier

Troubleshooting the Step Amplifier of the Type 175 can be accomplished by the same procedures as for the Type 575 (note, however, that in some cases corresponding parts

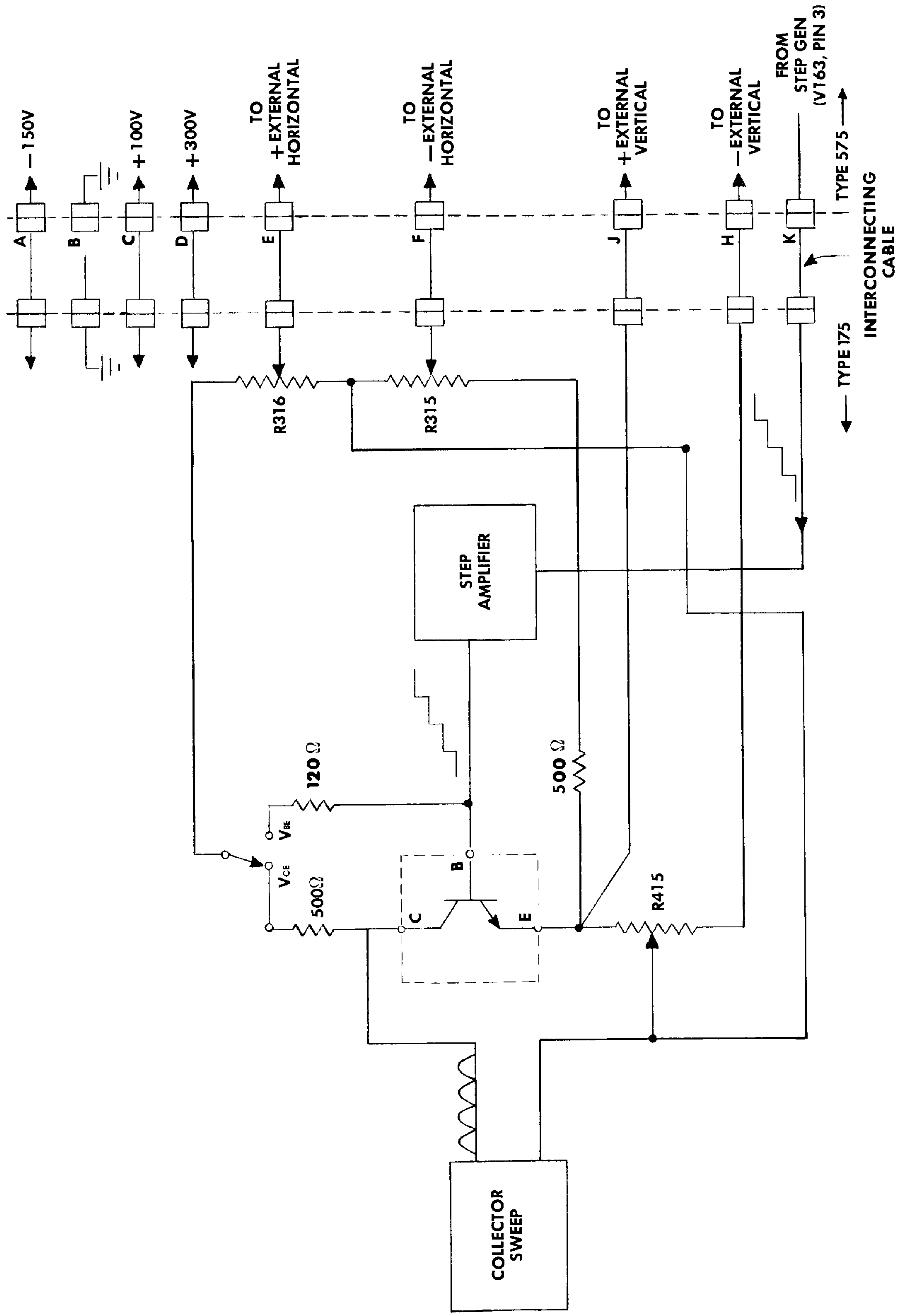


Fig. 6-6. Simplified circuit diagram of Type 175 Transistor-Curve Tracer High-Current Adapter.

are numbered differently). As with the Type 575, the voltage drop across the current-sampling resistor (R244 in the Type 175, R246 in the Type 575 should increase from zero by 0.5 volt steps regardless of the position of the STEP SELECTOR switch. The maximum current which must be supplied by the Step Amplifier power supplies in the Type 175 is 12 amperes as compared to 2.4 amperes in the Type 575. Note also that the Type 175 Step Amplifier has a VOLTS/STEP ADJ. adjustment at its input, the setting of which can affect the amplitude of the signal throughout the circuit.

Troubleshooting the Collector Sweep Circuit

The cause of insufficient or no output voltage from the Collector Sweep circuit can be isolated by continuity checks through the circuit. Verification of sufficient output can be made by measurements described later in the procedure for checking the resistors of the VERTICAL DISPLAY switch.

Checking Switch Resistance

The following procedures tell you how to check the resistors in the HORIZONTAL DISPLAY, STEP SELECTOR, VERTICAL DISPLAY, and SERIES RESISTANCE switches of the Type 175 for proper values. Since the Type 575 and the Type 175 are essentially self-checking, this can be done by measurements observed on the screen of the Type 575. In each measurement, the faulty resistor can be determined by comparing the position of the switch in which a faulty indication is obtained with the appropriate schematic diagram. To perform the measurements, you will need four precision (1%) resistors of the following values and ratings: 100 ohms, 1 watt; 2 ohms, 50 watts; 0.05 ohms, 1000 watts; and 10 ohms, 500 watts. These resistors will be referred to in the procedure by their resistance values only.

Throughout the procedures, the Type 175 and Type 575 should be connected together for combined operation, as described under Operating Instructions, and turned on, unless otherwise noted. For a complete checkout of all switches, the procedures should be performed in the order presented. If you merely wish to check the operation of one of the switches, you may check it separately as long as you realize that, in these procedures, an off-value resistor in the HORIZONTAL DISPLAY switch can make any of the other switches (except the SERIES RESISTANCES switch) appear faulty.

HORIZONTAL DISPLAY and STEP SELECTOR Switches.

To check the resistors associated with the HORIZONTAL DISPLAY and STEP SELECTOR switches, proceed as follows:

1. Connect the resistor designated in the first column of Table 1 between the E and B binding posts to the TRANSISTOR A side of the Transistor Test Panel of the Type 175.

2. Set the STEP SELECTOR and HORIZONTAL DISPLAY switches to the positions shown in the second and third columns of the table.

3. Set the Transistor Selector switch to TRANSISTOR A and the STEPS/FAMILY control (on the Type 575) fully clockwise. The display on the Type 575 screen should contain the number of dots per division shown in the fourth column of the table.

4. Continue in like manner down the table, inserting the proper resistor and setting the controls as designated, and check for the proper number fo dots per division in the display for each measurement. (Remove the resistor for the last five measurements on the table.)

If an incorrect display first occurs in the second, fourth, sixth, of eighth measurement of the table, the trouble is in

TABLE !

Resistor (between E and B posts)	STEP SELECTOR switch	HORIZONTAL DISPLAY switch (BASE V_{be})	Dots per division
100 Ω	1 MA/STEP	.1	1
100 Ω	1 MA/STEP	.2	2
100 Ω	2 MA/STEP	.2	1
100 Ω	2 MA/STEP	.5	5 dots per 2 divisions
100 Ω	5 MA/STEP	.5	1
100 Ω	5 MA/STEP	1	2
100 Ω	10 MA/STEP	1	1
100 Ω	10 MA/STEP	2	2
100 Ω	20 MA/STEP	2	1
2 Ω	50 MA/STEP	.1	1
2 Ω	100 MA/STEP	.2	1
2 Ω	200 MA/STEP	.5	5 dots per 4 divisions
2 Ω	500 MA/STEP	1	1
2 Ω	1000 MA/STEP	1	1 dot per 2 divisions
open	.02 VOLTS/STEP	.1	5
open	.05 VOLTS/STEP	.1	2
open	.1 VOLTS/STEP	.1	1
open	.2 VOLTS/STEP	.2	1
open	.5 VOLTS/STEP	.5	1

the corresponding position of the HORIZONTAL DISPLAY switch. An incorrect display in any of the other measurements indicates that the trouble is in the corresponding position of the STEP SELECTOR switch. A small consistent error at all positions of both switches indicates a need for adjustment of the internal VOLTS/STEP ADJ. adjustment (see Calibration). If the dots are consistently farther apart in the VOLTS/STEP positions of the STEP SELECTOR switch than in the MA/STEP positions, this indicates that R246 has increased in value or the wiring resistance of the circuit has increased. Conversely, if the dots are consistently closer together in the VOLTS/STEP position of the STEP SELECTOR switch than in the MA/STEP positions, this indicates that R246 has decreased in value or has become shorted.

HORIZONTAL DISPLAY Switch (COLLECTOR V_{ce} Positions) After you have verified the accuracy of all the BASE V_{be} positions of the HORIZONTAL DISPLAY switch, proceed as follows to check the resistors associated with the COLLECTOR V_{ce} positions of the switch:

1. Set the Transistor Selector switch to TRANSISTOR A, the PEAK VOLTS RANGE switch to 0-20, and the PERCENT OF PEAK VOLTS RANGE control to 0.

2. Set the HORIZONTAL DISPLAY switch to 2 COLLECTOR V_{ce}.

3. Rotate the PERCENT OF PEAK VOLTS RANGE control clockwise until you obtain exactly 10 divisions of horizontal deflection on the screen.

4. Set the HORIZONTAL DISPLAY switch to 5 COLLECTOR V_{ce}. There should be four divisions (±2%) of horizontal deflection on the screen.

5. Return the PERCENT OF PEAK VOLTS RANGE control to 0.

6. Set the PEAK VOLTS RANGE switch to 0-100 and the PERCENT OF PEAKS VOLTS RANGE control for exactly 10 divisions of horizontal deflection.

7. Set the HORIZONTAL DISPLAY switch to 10 COLLECTOR V_{ce}. There should be five divisions (±2%) of horizontal deflection on the screen.

(The remaining COLLECTOR V_{ce} positions of the HORIZONTAL DISPLAY switch use the same resistors as the BASE V_{ce} positions which were checked previously.)

VERTICAL DISPLAY Switch. In checking the resistance in the VERTICAL DISPLAY switch, the output of the Collector Sweep circuit is applied across an externally connected resistor at each setting of the VERTICAL DISPLAY switch. The voltage across the resistor is displayed as horizontal deflection and the current through the resistor is displayed as vertical deflection. The slope of the line displayed, as the Collector Sweep output sweeps between zero and a selected maximum voltage, should indicate the value of the external resistance. Any deviation from the proper slope indicates an off-value current sampling resistor (assuming that the resistances in the HORIZONTAL DISPLAY switch as measured previously are all correct).

To check the resistances in the VERTICAL DISPLAY switch, proceed as follows:

1. Set the PERCENT OF PEAK VOLTS RANGE control to 0.

2. Set the COLLECTOR SWEEP POLARITY switch on the Type 175 to +.

3. Connect the resistor designated in Column A of Table II between the large C and E terminals on the TRANSISTOR A side of the transistor Test Panel of the Type 175 using the high-current test cables.

4. Connect test leads from the ends of the resistor to the V_{ce} EXT. INPUT binding posts on the same side of the Transistor Test Panel.

5. Set the Transistor Selector switch to TRANSISTOR A.

6. Set the PEAK VOLTS RANGE, VERTICAL DISPLAY, and HORIZONTAL DISPLAY switches on the Type 175 to the positions designated in columns B, C, and D of Table II.

7. Adjust the POSITION controls on the Type 575 to position the spot to the lower left corner of the graticule.

8. Rotate the PERCENT OF PEAK VOLTS RANGE control clockwise until you obtain the horizontal deflection specified in column E of the table. The slope of the line (Δ vertical deflection divided by Δ horizontal deflection) should be within 2% of that specified in column F.

NOTE

In the first measurement, you may not be able to obtain the full 10 divisions of horizontal deflection before the circuit breaker actuates. However, if the slope of the displayed lines is correct, the measurement may be considered to be within tolerance. If the circuit breaker does actuate, return the PERCENT OF PEAK VOLTS RANGE control to 0 and wait one minute for the heating element in the breaker to cool before resetting it.

9. Return the PERCENT OF PEAK VOLTS RANGE control to 0 after each measurement.

10. Continue in like manner down the table, inserting the proper resistor and setting the controls as designated, and check for adequate deflection and proper slope on the Type 575 screen. If any of the slopes are not correct, or if adequate horizontal deflection cannot be obtained, make a note of it (whether the slope is greater or less than specified) and go on to the next measurement.

If the slope is correct for the first few measurements in Table II, but is incorrect for the remaining measurements, this indicates that one of the current-sampling resistors has changed in value. It will generally be the resistor associated with the VERTICAL DISPLAY switch position at which the incorrect slope first occurred as you progressed down the table. If the slope is greater than specified, the resistor has increased in value; if the slope is less than specified, the resistor has decreased in value.

Insufficient horizontal deflection in the fifth and/or seventh measurements of the table (1 and 2 positions of the VERTICAL DISPLAY switch, respectively) indicates that the internal resistance of the Collector Sweep circuit itself has increased beyond its proper value. In this case, check T702 and the associated rectifier diodes as described in the paragraph on Troubleshooting the Collector Sweep Circuit.

TABLE II

A Resistor	B PEAK VOLTS RANGE	C VERTICAL DISPLAY	D HORIZONTAL DISPLAY (V_{ce})	E Horizontal Deflection	F Slope
0.05 Ω	0-20	20	1	10 div.	1.00
0.05 Ω	0-20	10	.5	10 div.	1.00
0.05 Ω	0-20	5	.2	10 div.	0.80
0.05 Ω	0-20	2	.1	10 div.	1.00
10 Ω	0-100	1	10	9.9 div.	1.00
10 Ω	0-100	.5	5	10 div.	1.00
10 Ω	0-20	.2	2	9.1 div.	1.00
10 Ω	0-20	.1	1	10 div.	1.00
10 Ω	0-20	.05	.5	10 div.	1.00
10 Ω	0-20	.02	.2	10 div.	1.00
10 Ω	0-20	.01	.1	10 div.	1.00
10 Ω	0-20	.005	.1	5 div.	2.00

SERIES RESISTANCE switch. To check the resistance in the SERIES RESISTANCE switch, proceed as follows:

1. Turn the Type 175 off.
2. Set the Transistor Selector switch to TRANSISTOR A.
3. Set the STEP SELECTOR switch to .02 VOLTS/STEP.
4. Measure the resistance between the E and B binding posts of the TRANSISTOR A side of the Transistor Test Panel at each setting of the SERIES RESISTANCE switch. In each case, the resistance should be within 5% of that indicated by the setting of the switch.

CALIBRATION

There are only four internal adjustments in the Type 175 High-Current Adaptor: the ZERO ADJ., the ±ADJ., and the VOLTS/STEP ADJ. (See Fig. 6-7). They all perform the same functions as the corresponding adjustments in the Type 575. They should be adjusted only after the Type 575 has been properly calibrated.

To properly set the internal adjustments of the Type 175, proceed as follows:

1. Set the front-panel controls as follows:

HORIZONTAL DISPLAY (Type 175)	.1 V_{be}
Display Switch (Type 575)	REPETITIVE
POLARITY (Type 175 Base Step Generator	—
STEP SELECTOR (Type 175)	.1 VOLTS PER STEP
STEP ZERO (Type 175)	midrange
Transistor Selector switch	TRANSISTOR B

2. Position the display so the last dot to the right is in the center of the graticule.

3. Set the ZERO ADJ. adjustment in the Type 175 so that this dot does not move as the Type 175 Base Step Generator POLARITY switch is switched from one position to the other. (The other dots will shift from one side to the other as the POLARITY is switched.) Leave the POLARITY switch in the — position when you are finished with this step.

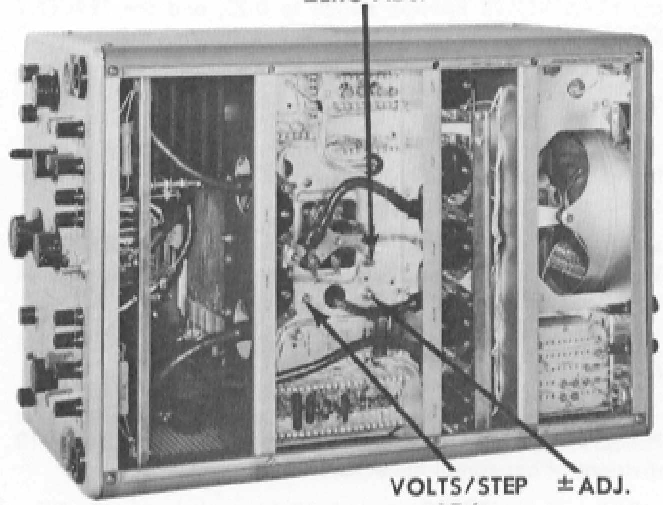


Fig. 6-7. Bottom of Type 175, showing internal adjustments.

4. Hold the HORIZONTAL AMPLIFIER CALIBRATION switch in the ZERO CHECK position, and position the dot directly behind the center vertical graticule line.

5. Release the switch and set the ± ADJ. adjustments so that the last dot to the right is directly behind the center vertical graticule line.

6. Set the STEP SELECTOR switch to .5 VOLTS PER STEP and repeat steps 2 through 5 until both the ZERO ADJ. and the ±ADJ. are properly set.

7. Set the STEP SELECTOR switch to .1 VOLTS PER STEP and turn the STEPS/FAMILY control on the Type 575 fully clockwise.

8. Position the display of dots so that it extends across the graticule.

9. Set the VOLTS/STEP adjustment on the Type 175 for one dot per majjor graticule division. This adjustment must be done in the minus position of the POLARITY switch.

10. Adjusting +Step Adj. (SN 240 and up)

Set the controls as follows:

HORIZONTAL	0.1 BASE VOLTS
VERTICAL	100 COLLECTOR MA
STEP SELECTOR	1 MA/STEP
POLARITY	MINUS

Connect a 1 K precision resistor between terminals B and E on the right side of the test panel and move the lever switch to the TRANSISTOR B position. There should now be a display of approximately one dot per ten major divisions. Check the distance between the dots and turn POLARITY switch to the plus position. With the +Step Adj., move the dots so that the same spacing as the minus position is obtained.

With the +Step Adj. it will be possible to maintain the same amount of voltage per step in both the plus and minus positions of the POLARITY switch. The standardizing is measured in the 1 MA/STEP position of the STEP SELECTOR with a 1 K resistor from the Step Amplifier to ground.

PARTS LIST *and* DIAGRAMS

ABBREVIATIONS

Cer.	Ceramic	n	Nano or 10^{-9}
Comp.	Composition	Ω	ohm
EMC	Electrolytic, metal cased	p	Pico or 10^{-12}
f	Farad	PTB	Paper, "Bathtub"
G	Giga, or 10^{9}	PMC	Paper, metal cased
GMV	Guaranteed minimum value	Poly.	Polystyrene
h	Henry	Prec.	Precision
K or k	Kilohms or kilo (10^{3})	PT	Paper Tubular
M/Cer.	Mica or Ceramic	T	Terra or 10^{12}
M or meg	Megohms or mega (10^{6})	v	Working volts DC
μ	Micro. or 10^{-6}	Var.	Variable
$\mu\mu$	Micromicro or 10^{-12}	w	Watt
m	milli or 10^{-3}	WW	Wire-wound

SPECIAL NOTES AND SYMBOLS

+ and up

† Approximate serial number.

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.

(Mod. w/) Simple replacement not recommended. Modify to value for later instruments and change other parts to match.

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

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.

PARTS LIST

Type 575

Bulbs

		Tektronix Part Number
B174	Neon, NE-23	Use 150-027
B231	Neon, NE-23	Use 150-027
B266	Neon, NE-23	Use 150-027
B601	Incandescent, #47	150-001
B602	Incandescent, #47	150-001
B603	Incandescent, #47	150-001
B826	Neon, NE-23	Use 150-027
B827	Neon, NE-23	Use 150-027

Capacitors

Values fixed unless marked variable.

Tolerance ±20% unless otherwise indicated.

C102		.047 μf	PTM	400 v		285-519
C103		.001 μf	Cer.	500 v		281-536
C105		.047 μf	PTM	400 v		285-519
C108		.047 μf	PTM	400 v		285-519
C122		.047 μf	PTM	400 v		285-519
C123		.001 μf	Cer.	500 v	10%	281-536
C128		.047 μf	PTM	400 v		285-519
C130		.047 μf	PTM	400 v		285-519
C142		.0015 μf	Mica	500 v	10%	283-535
C145		.005 μf	Cer.	500 v		283-001
C146		470 μμf	Cer.	500 v		281-525
C153		12 μμf	Cer.	500 v	10%	281-505
C165		470 μμf	Cer.	500 v		281-525
C177		.01 μf	Polystyrene	300 v	5%	Use *291-038
C180		470 μμf	Cer.	500 v		281-525
C186		.022 μf	PTM	400 v		285-515
C213		.005 μf	Cer.	500 v		283-001
C232		.001 μf	PTM	600 v		285-501
C240		2000 μf	EMC	20 v		Use 290-029
C241		2000 μf	EMC	20 v		Use 290-029
C242		2000 μf	EMC	20 v		Use 290-029
C243		2000 μf	EMC	20 v		Use 290-029
C244		150 μf	EMC	150 v		Use 290-018
C267		.001 μf	PTM	600 v		285-501
C361		47 μμf	Cer.	500 v	10%	281-519
C380	X8030-up	100 pf	Cer.	350 v		281-523
C381	X8030-up	100 pf	Cer.	350 v		281-523
C391		47 μμf	Cer.	500 v		281-518
C396		47 μμf	Cer.	500 v		281-518
C461		47 μμf	Cer.	500 v	10%	281-519
C480	X8030-up	100 pf	Cer.	350 v		281-523

Capacitors *(continued)*

							Tektronix Part Number
C481	X8030-up	100 pf	Cer.		350 v		281-523
C602		2 x 20 μf	EMC		450 v		Use 290-010
C611A,B		2 x 20 μf	EMC		450 v		Use 290-010
C613		.01 μf	PTM		400 v		285-510
C620		125 μf	EMC		350 v		Use 290-016
C630		.01 μf	PTM		400 v		285-510
C641		2 x 20 μf	EMC		450 v		Use 290-010
C644		.01 μf	PTM		400 v		285-510
C655		.01 μf	PTM		400 v		285-510
C666		2 x 20 μf	EMC		450 v		Use 290-010
C706		4.5-25 μμf	Cer.	Var.			281-010
C730		4.7 μμf	Cer.				281-501
C734	101-195	82 μμf	Mica		500 v	5%	283-534
	196-723	120 μμf	Mica		500 v	10%	283-507
	724-up	82 μμf	Mica		500 v	5%	283-534
C735	101-723	7-45 μμf	Cer.	Var.			281-012
	724-up	20-125 μμf	Cer.	Var.			281-028
C802		.001 μf	PTM		600 v		285-501
C808		.01 μf	PTM		600 v		285-511
C809		.001 μf	PTM		600 v		285-501
C811		.047 μf	PTM		600 v	10%	285-520
C812	101-2389	.0068 μf	PTM		3000 v		285-508
	2390-up	.01 μf	Cer.		2000 v		283-011
C813	101-1942	.015 μf	PTM		3000 v		285-513
	1943-up	.01 μf	Cer.		2000 v		283-011
C815	101-2389	.0068 μf	PTM		3000 v		285-508
	2390-up	.005 μf	Cer.		4000 v		283-034
C816		.022 μf	PTM		600 v		285-516
C818	101-2389	.0068 μf	PTM		3000 v		285-508
	2390-up	.01 μf	Cer.		2000 v		283-011

Diodes

D241 A,B	X4930-up	Silicon	IN3209	152-088
D241 C,D	X4930-up	Silicon	IN2862	152-047
D620 A,B,C,D	X4930-up	Silicon	IN2862	152-047

Fuses

F240	X8030-up	5 Amp Fast-Blo w/pig tails	159-053
F241	X8030-up	5 Amp Fast-Blo w/pig tails	159-053
F601	101-232	4 Amp Fast-Blo	Use 159-005
F601	233-up	4 Amp Slo-Blo (117 volt operation)	Use 159-027
F601	101-3809	1.6 Amp Slo-Blo (234 volt operation)	159-003
F601	3810-up	2 Amp Slo-Blo (234 volt operation)	159-023
F702	101-860X	1 Amp Fast-Blo	159-022

Inductors

			Tektronix Part Number
L734†	X4820-up	Ferraamic Suppressor	276-517
L735†	X4820-up	Ferramic Suppressor	276-517

Rectifiers

SR241	101-4929X	Selenium Rectifier Stack 8-500 ma plates	*106-043
SR620	101-4929X	Full-wave bridge, 5-250 ma plates/leg	*106-044
GR706		6 germanium rectifier cells, each cell rated at .5 amp., 300 v peak inverse	*106-034

Resistors

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

R102		20 k	2 w	Var.	WW	Phase Adj. A	Use 311-151
R103	101-536	1 meg	½ w			5%	301-105
	537-up	680 k	½ w				302-684
R105		10 k	1 w				304-103
R107		12 k	½ w				302-123
R108		47 k	1 w				304-473
R110		150 k	½ w				302-154
R111		150 k	½ w				302-154
R113		10 meg	½ w				302-106
R114		10 meg	½ w				302-106
R116		27 k	½ w				302-273
R117		10 k	½ w				302-103
R122		250 k	2 w	Var.	Comp	Phase Adj. B	311-032
R123		1 meg	½ w			5%	301-105
R125		10 k	1 w				304-103
R127		12 k	½ w				302-123
R128		47 k	1 w				304-473
R130		150 k	½ w				302-154
R131		150 k	½ w				302-154
R133		10 meg	½ w				302-106
R134		10 meg	½ w				302-106
R135	X8030-up	1 meg	½ w		Prec.	1%	323-481
R136	101-8029	1 meg	½ w				302-105
R136	8030-up	200 k	½ w		Prec.	1%	323-414
R138	101-8029	1 meg	½ w				302-105
R138	8030-up	499 k	½ w		Prec.	1%	323-452
R139	101-8029	100 k	2 w	Var.	Comp.	Volts/Step Adj.	311-026
R139	8030-up	50 k	2 w	Var.	WW	Volts/Step Adj.	311-218
R140		1 k	½ w				302-102
R142	101-8029	47 k	½ w				302-473
R142	8030-up	46.4 k	½ w		Prec.	1%	324-356
R143	101-8029	47 k	2 w				306-473
R143	8030-up	49.9 k	1 w		Prec.	1%	324-356
R145		10 meg	½ w				302-106
R146		10 k	½ w				302-103

† Two turns of number 26 wire on Ferramic Suppressor.

							Tektronix Part Number
R147		10 k	½ w				302-103
R148		1 k	½ w				302-102
R150		18 k	½ w				302-183
R151		180 k	½ w				302-184
R153		120 k	½ w			5%	301-124
R154		100 k	½ w			5%	301-104
R156	101-633	27 k	½ w				302-273
	634-up	27 k	1 w				304-273
R158		1 k	½ w				302-102
R160		10 k	½ w				302-103
R164		47 k	½ w				302-473
R165		100 k	½ w				302-104
R167		4.7 k	½ w				302-472
R168	101-8029	100 k	½ w				302-104
R168	8030-up	56 k	½ w				302-563
R172	101-319	100 k	½ w				Use 304-104
	320-up	100 k	1 w				304-104
R173	X342-up	100 k	½ w				302-104
R174		1.5 meg	½ w				302-155
R175		1 k	½ w				302-102
R176	X342-8029	1 k	½ w				302-102
R176	8030-up	2.2 k	½ w				302-222
R177		1 k	½ w				302-102
R179		47 k	2 w				306-473
R180		33 k	½ w				302-333
R182		50 k	2 w	Var.	Comp.	Min No. Steps	311-023
R184		220 k	½ w			5%	301-224
R186		390 k	½ w			5%	301-394
R188		1 k	½ w				302-102
R189		100 k	½ w				302-104
R190		20 k	2 w	Var.	Comp.	STEPS/FAMILY	311-018
R194		50 k	2 w	Var.	Comp.	Max. No. Steps	311-023
R196		22 k	½ w				302-223
R202		90 k	½ w		Prec.	1%	309-195
R203		3 k	½ w		Prec.	1%	309-182
R204	101-4269	68 Ω	½ w				302-680
R204	4270-up	200 Ω		Var.		+STEP ADJ.	311-158
R206		600 k	½ w		Prec.	1%	309-004
R207	101-150	500 k	2 w	Var.	Comp.	STEP ZERO	Use 311-026
	151-up	100 k	2 w	Var.	Comp.		311-026
R210		470 k	½ w				302-474
R213		4.7 k	½ w				302-472
R215		47 k	½ w				302-473
R216	101-579	22 k	½ w				302-223
	580-up	4.7 k	½ w				302-472
R217		20 k	2 w	Var.	Comp.	Zero Adj.	311-018
R218		47 k	½ w				302-473
R222		150 k	½ w				302-154
R224		1 k	½ w				302-102
R231		1.5 meg	½ w				302-155

						Tektronix Part Number
R232		100 k	½ w			302-104
R235		47 k	1 w			304-473
R238	101-6629	47 k	½ w			302-473
R238	6630-up	47 k	1 w			304-473
R241		1 k	2 w			306-102
R243		100 Ω	8 w	WW	5%	308-110
R245	X1089-8029X	.05 Ω	5 w	WW		308-136
R246A		500 k	½ w	Prec.	1%	309-003
R246B		250 k	½ w	Prec.	1%	309-109
R246C		100 k	½ w	Prec.	1%	309-045
R246D		50 k	½ w	Prec.	1%	309-090
R246E		25 k	½ w	Prec.	1%	309-193
R246F		10 k	½ w	Prec.	1%	309-100
R246G		5 k	½ w	Prec.	1%	309-159
R246H		2.5 k	½ w	Prec.	1%	309-181
R246J		1 k	½ w	Prec.	1%	309-115
R246K		500 Ω	½ w	Prec.	1%	309-179
R246L		250 Ω	½ w	Prec.	1%	309-178
R246M		100 Ω	½ w	Prec.	1%	309-112
R246N	101-102	50 Ω	½ w	Prec.	1%	Use *310-542
	103-up	50 Ω	8 w	Prec.	1%	*310-542
R246P	101-102	25 Ω	½ w	Prec.	1%	Use *310-543
	103-up	25 Ω	8 w	Prec.	1%	*310-543
R246Q	101-102	10 Ω	½ w	Prec.	1%	Use *310-544
	103-1141	10 Ω	8 w	Prec.	1%	*310-544
	1142-1319	9.94 Ω	8 w	Mica		*310-544
	1320-up	9.97 Ω	8 w	Mica	1%	*310-544
R246R	101-102	5 Ω	3 w	Prec.	1%	Use *310-545
	103-1141	5 Ω	8 w	Prec.	1%	*310-545
	1142-1319	4.94 Ω	8 w	Mica		*310-545
	1320-up	4.97 Ω	8 w	Mica	1%	*310-545
R246S	101-1141	2.5 Ω	8 w	Mica	1%	*310-537
	1142-1319	2.44 Ω	8 w	Mica		*310-537
	1320-up	2.47 Ω	8 w	Mica	1%	*310-537
R247R	X8030-up	4.7 k	¼ w			316-472
R247S	X8030-up	2.2 k	¼ w			316-222
R247T	X8030-up	1 k	¼ w			316-102
R247U	X8030-up	470 Ω	¼ w			316-471
R247V	X8030-up	180 Ω	¼ w			316-181
R248A		22 k	½ w		5%	301-223
R248B		15 k	½ w		5%	301-153
R248C		10 k	½ w		5%	301-103
R248D		6.8 k	½ w		5%	301-682
R248E		4.7 k	½ w		5%	301-472
R248F		3.3 k	½ w		5%	301-332
R248G		2.2 k	½ w		5%	301-222
R248H		1.5 k	½ w		5%	301-152
R248J		1 k	½ w		5%	301-102
R248K		680 Ω	½ w		5%	301-681

								Tektronix Part Number
R248L		470 Ω	½ w				5%	301-471
R248M		330 Ω	½ w				5%	301-331
R248N		220 Ω	½ w				5%	301-221
R248P		150 Ω	½ w				5%	301-151
R248Q		100 Ω	½ w				5%	301-101
R248R		68 Ω	½ w				5%	301-680
R248S		47 Ω	½ w				5%	301-470
R248T		33 Ω	½ w				5%	301-330
R248U		22 Ω	½ w				5%	301-220
R248V		15 Ω	½ w				5%	301-150
R248W		3.3 Ω	1 w				5%	307-015
R248X		3.3 Ω	1 w				5%	307-015
R248Y		2.4 Ω	2 w	Mica Plate			5%	*310-536
R249		1 Ω	4 w	Mica Plate			½%	*310-535
R251		1 k	½ w					302-102
R254		47 k	½ w					302-473
R255	101-579	22 k	½ w					302-223
	580-up	4.7 k	½ w					302-472
R256		20 k	2 w	Var.	Comp.	±Adj.		311-018
R257		47 k	½ w					302-473
R261		150 k	½ w					302-154
R264		470 k	½ w					302-474
R266		1.5 meg	½ w					302-155
R267		100 k	½ w					302-104
R273		330 Ω	½ w				5%	301-331
R274		220 Ω	½ w				5%	301-221
R275		10 k	½ w				5%	301-103
R300		1 meg	½ w					302-105
R301		1 meg	½ w					302-105
R302	101-6054	116 k	½ w		Prec.	¼%		use *050-065
R302	6055-up	116 k	½ w		Prec.	½%		309-405
R303	101-6054	2.4 k	½ w		Prec.	¼%		use *050-065
R303	6055-up	2.4 k	½ w		Prec.	½%		309-409
R304	101-6054	800 Ω	½ w		Prec.	¼%		use *050-065
R304	6055-up	800 Ω	½ w		Prec.	½%		309-408
R305	101-6054	400 Ω	½ w		Prec.	¼%		use *050-065
R305	6055-up	400 Ω	½ w		Prec.	½%		309-407
R306	101-6054	240 Ω	½ w		Prec.	¼%		use *050-065
R306	6055-up	240 Ω	½ w		Prec.	½%		309-406
R307	101-6054	80 Ω	½ w		Prec.	¼%		use *050-065
R307	6055-up	80 Ω	½ w		Prec.	½%		309-400
R308	101-6054	80 Ω	½ w		Prec.	¼%		use *050-065
R308	6055-up	80 Ω	½ w		Prec.	½%		309-400
R312		10 k	½ w		Prec.	1%		309-100
R313		10 k	½ w		Prec.	1%		309-100
R314		20 k	½ w		Prec.	1%		309-153
R315		60 k	½ w		Prec.	1%		309-041
R316		100 k	½ w		Prec.	1%		309-045
R317		200 k	½ w		Prec.	1%		309-051
R320		10 k	½ w		Prec.	1%		309-100

Resistors *(Cont'd)*

								Tektronix Part No.
R321		10 k	½ w		Prec.	1%		309-100
R322		20 k	½ w		Prec.	1%		309-153
R323		60 k	½ w		Prec.	1%		309-041
R324		100 k	½ w		Prec.	1%		309-045
R325		200 k	½ w		Prec.	1%		309-051
R328		32.31 k	½ w		Prec.	1%		309-194
R329		11.480 k	½ w		Prec.	1%		309-192
R330		4.535 k	½ w		Prec.	1%		309-191
R331		1.063 k	½ w		Prec.	1%		309-180
R332	X148-up	2 k	½ w		Prec.	1%		309-098
R333	101-147	808 Ω	½ w		Prec.	1%	Use	309-030
	148-up	1.8 k	½ w		Prec.	1%		309-030
R334		500 Ω	.1 w	Var.	Comp.	Max. Gain Adj.		311-056
R335		560 k	½ w			5%		301-564
R337		2 x 100 k	2 w	Var.	Comp.	POSITION		311-028
R338		560 k	½ w			5%		301-564
R340		1 k	½ w					302-102
R343	101-8029	680 k	½ w			5%		301-684
R343	8030-up	470 k	½ w			5%		301-474
R344		200 k	½ w			5%		301-204
R345		3.3 meg	½ w					302-335
R346		300 k	½ w		Prec.	1%		309-125
R347		60 k	½ w		Prec.	1%		309-041
R348		300 k	½ w		Prec.	1%		309-125
R350		1 k	½ w					302-102
R353	101-8029	680 k	½ w			5%		301-684
R353	8030-up	470 k	½ w			5%		301-474
R354		200 k	½ w			5%		301-204
R355	101-6629	47 k	½ w					302-473
R355	6630-up	100 k	½ w					302-104
R356	101-6629	5 k	2 w	Var.	Comp.	D.C. BAL.		311-011
R356	6630-up	10 k		Var.	Comp.	DC BAL		311-191
R357	101-6629	47 k	½ w					302-473
R357	6630-up	100 k	½ w					302-104
R358	101-6629	22 k	½ w					302-223
R358	6630-up	10 k	½ w					302-103
R359		200 k	.1 w	Var.	Comp.	Diff. Bal.		311-106
R360		1 k	½ w					302-102
R361		47 k	½ w					302-473
R364	101-8029	33 k	½ w					302-333
R364	8030-up	120 k	½ w					302-124
R366	101-8029	68 k	2 w					306-683
R366	8030-up	82 k	2 w					306-823
R370		1 k	½ w					302-102
R374	101-8029	33 k	½ w					302-333
R374	8030-up	120 k	½ w					302-124
R377	101-8029X	15 k	½ w					302-153
R379	X8030-up	120 k	½ w					302-124
R380	101-8029	1 k	½ w					302-102
R380	8030-up	120 k	½ w					302-124

Resistors *(continued)*

							Tektronix Part No.
R381	101-8029	1 k	½ w				302-102
R381	8030-up	120 k	½ w				302-124
R382	X8030-up	120 k	½ w				302-124
R384		30 k	8 w		WW	5%	308-105
R385		30 k	8 w		WW	5%	308-105
R387		30 k	8 w		WW	5%	308-105
R389		47 k	½ w				302-473
R390		800 k	½ w		Prec.	1%	309-110
R391		100 k	2 w	Var.		Min Gain Adj.	311-028
R393		680 k	½ w				302-684
R395		800 k	½ w		Prec.	1%	309-110
R396		100 k	2 w	Var.		Furnished with R391	
R397		47 k	½ w				302-473
R400		1 meg	½ w				302-105
R401		1 meg	½ w				302-105
R402A		.1 Ω					
R402B		.1 Ω					
R402C		.3 Ω					
R402D		.5 Ω					
R406A		1 Ω					
R406B		3 Ω					
R408A		5 Ω					
R408B		10 Ω					
R408C		30 Ω					
R408D		35 Ω					
R412A		15 Ω					
R412B		100 Ω					
R414A		300 Ω					
R414B		502 Ω					

R402 thru R414 supplied as a unit, #308-109, with lifetime warranty on exchange basis.

R416	101-232	1.01 k	1 w		Prec.	1%	310-081
	233-792	1.015 k	1 w		Prec.	½%	310-060
	793-up	1.008 k	1 w		Prec.	½%	310-062
R417	101-792	3.108 k	½ w		Prec.	½%	use 309-196
	793-up	3.053 k	½ w		Prec.	½%	309-198
R418	101-792	5.398 k	½ w		Prec.	½%	use 309-197
	793-up	5.193 k	½ w		Prec.	½%	309-199
R420	X263-793X	180 k	½ w				302-184
R421	X263-793X	120 k	½ w				302-124
R428		32.31 k	½ w		Prec.	1%	309-194
R429		11.48 k	½ w		Prec.	1%	309-192
R430		4.535 k	½ w		Prec.	1%	309-191
R431		1.063 k	½ w		Prec.	1%	309-180
R432	X148-up	2 k	½ w		Prec.	1%	309-098
R432A	X861-up	20.83 k	½ w		Prec.	1%	309-245
R432B	X861-up	11.48 k	½ w		Prec.	1%	309-192
R433	101-147	808 Ω	½ w		Prec.	1%	Use 309-030
	148-up	1.8 k	½ w		Prec.	1%	309-030
R434		500 Ω	.1 w	Var.	Comp.	Max. Gain Adj.	311-056
R435		560 k	½ w			5%	301-564
R437		2 x 100 k	2 w	Var.	Comp.	POSITION	311-028
R438		560 k	½ w			5%	301-564

							Tektronix Part Number
R440		1 k	½ w				302-102
R443	101-8029	680 k	½ w			5%	301-684
R443	8030-up	470 k	½ w				301-474
R444		200 k	½ w			5%	301-204
R445		3.3 meg	½ w				302-335
R446		300 k	½ w		Prec.	1%	309-125
R447		60 k	½ w		Prec.	1%	309-041
R448		300 k	½ w		Prec.	1%	309-125
R450		1 k	½ w				302-102
R453	101-8029	680 k	½ w			5%	301-684
R453	8030-up	470 k	½ w			5%	301-474
R454		200 k	½ w			5%	301-204
R455	101-6629	47 k	½ w				302-473
	6630-up	100 k	½ w				302-104
R456	101-6629	5 k	2 w	Var.	Comp.	D.C. BAL.	311-011
R456	6630-up	10 k		Var.	Comp.	D.C. BAL,	311-191
R457	101-6629	47 k	½ w				302-473
R457	6630-up	100 k	½ w				302-104
R458	101-6629	22 k	½ w				302-223
R458	6630-up	10 k	½ w				302-103
R459		200 k	.1 w	Var.	Comp.	Diff. Bal.	311-106
R460		1 k	½ w				302-102
R461		47 k	½ w				302-473
R464	101-8029	33 k	½ w				302-333
R464	8030-up	120 k	½ w				302-124
R466	101-8029	68 k	2 w				306-683
R466	8030-up	82 k	2 w				306-823
R470		1 k	½ w				302-102
R474	101-8029	33 k	½ w				302-333
R474	8030-up	120 k	½ w				302-124
R477	101-8029X	15 k	½ w				302-153
R479	X8030-up	120 k	½ w				302-124
R480	101-8029	1 k	½ w				302-102
R480	8030-up	120 k	½ w				302-124
R481	101-8029	1 k	½ w				302-102
R481	8030-up	120 k	½ w				302-124
R482	X8030-up	120 k	½ w				302-124
R484		30 k	8 w		WW	5%	308-105
R485		30 k	8 w		WW	5%	308-105
R487		30 k	8 w		WW	5%	308-105
R490		800 k	½ w		Prec.	1%	309-110
R491	101-1279	100 k	½ w		Prec.	1%	309-045
	1280-1351	78 k	½ w		Prec.	1%	309-168
	1352-up	100 k	½ w		Prec.	1%	309-045
R493		250 k	2 w	Var.	Comp.	Min Gain Adj.	Use 311-032
R495		800 k	½ w		Prec.	1%	309-110
R496		150 k	½ w		Prec.	1%	309-049
R498	101-1279	100 k	½ w		Prec.	1%	309-045
	1280-1351	78 k	½ w		Prec.	1%	309-168
	1352-up	100 k	½ w		Prec.	1%	309-045
R601		50 Ω		Var.	WW	SCALE ILLUM.	311-055
R603		270 k	1 w				304-274
R604		33 k	½ w			5%	301-333

					Tektronix Part Number
R606	1 meg	½ w			302-105
R607	1 k	½ w			302-102
R609	1 k	½ w			302-102
R611	4.5 k	10 w	WW	5%	308-021
R613	1 meg	½ w	Prec.	1%	309-014
R617	490 k	½ w	Prec.	1%	309-002
R621	33 k	½ w			302-333
R622	33 k	½ w			302-333
R624	470 k	½ w			302-474
R626	1.5 meg	½ w			302-155
R627	1 k	½ w			302-102
R628	1 k	½ w			302-102
R630	1 k	½ w			302-102
R632	470 k	½ w			302-474
R634	750 Ω	20 w	WW	5%	308-030
R636	333 k	1 w	Prec.	1%	310-056
R638	490 k	1 w	Prec.	1%	310-057
R642	33 k	½ w			302-333
R644	470 k	½ w			302-474
R646	1 k	½ w			302-102
R648	100 k	½ w		5%	301-104
R649	1.5 k	½ w		5%	301-152
R650	33 k	½ w			302-333
R652	2.2 meg	1 w			304-225
R654	1 k	½ w			302-102
R655	1 k	½ w			302-102
R656	470 k	½ w			302-474
R660	2.5 k	10 w	WW	5%	308-018
R662	50 k	½ w	Prec.	1%	309-090
R664	10 k	2 w	WW	—150 V Adj.	311-015
R666	68 k	½ w	Prec.	1%	309-042
R710	1 Ω	55 w	WW	5%	308-097
R711	1 Ω	55 w	WW	5%	308-097
R712A	3 Ω				
R712B	5 Ω	55 w	WW	5%	308-099
R712C	10 Ω				
R712D	30 Ω				
R716A	50 Ω	55 w	WW	5%	308-098
R716B	50 Ω				
R718A	50 Ω				
R718B	300 Ω	55 w	WW	5%	308-100
R718C	500 Ω				
R720	1 k	5 w	WW	1%	308-072
R721	3 k	5 w	WW	5%	308-062
R722	5.1 k	2 w		5%	305-512
R723	10 k	1 w			304-103
R724	30 k	1 w		5%	303-303
R725	51 k	1 w		5%	303-513
R730	1 meg	½ w	Prec.	1%	309-014
R731	100 Ω	½ w			302-101
R732	1 meg	½ w	Prec.	1%	309-014
R737	100 k	1 w			304-104

Resistors *(continued)*

						Tektronix Part Number
R802	82 k	1 w				304-823
R805	470 k	½ w				302-474
R808	47 k	½ w				302-473
R809	1.5 k	½ w				302-152
R811	1 k	1 w				304-102
R812	27 k	½ w				302-273
R814	2.2 meg	½ w				302-225
R816	2 meg	2 w	Var.	Comp.	—1700 V Adj.	311-042
R818	3.9 meg	2 w				306-395
R820	3.3 meg	2 w				306-335
R822	2 meg	2 w	Var.	Comp.	FOCUS	311-043
R824	1.5 meg	2 w				306-155
R826	2 meg	2 w	Var.	Comp.	INTENSITY	311-043
R828	27 k	½ w				302-273
R834	50 k	2 w	Var.	Comp.	ASTIG.	311-023
R838	100 k	2 w	Var.	Comp.	Geom. Adj.	311-026

Switches

				Wired	Unwired
SW114		Lever	STEPS/SEC		260-195
SW145		Lever	SINGLE FAMILY, REPETITIVE, OFF		260-190
SW240	101-1088	Rotary	Base Step Gen. POLARITY		Use *050-021
	1089-up	Rotary	Base Step Gen. POLARITY		260-258
SW246		Rotary	STEP SELECTOR	*262-135	*260-182
SW248		Rotary	SERIES RESISTOR	Use *262-673	*260-183
SW249		Lever	ZERO VOLTS-ZERO CURRENT	*262-164	*260-196
SW305	101-821	Rotary	HORIZONTAL VOLTS/DIV.	Use *050-104	*260-184
	822-3659	Rotary	HORIZONTAL VOLTS/DIV.	Use *050-104	*260-184
	3660-6054	Rotary	HORIZONTAL VOLTS/DIV	Use *050-104	260-184
	6055-up	Rotary	HORIZONTAL VOLTS/DIV	*262-494	*260-184
SW340		Lever	Horiz. AMP. CAL.	*262-165	*260-198
SW405	101-792	Rotary	VERTICAL VOLTS/DIV. or CURRENTS/DIV.	*262-138	*260-185
	793-821	Rotary	VERTICAL VOLTS/DIV. or CURRENT/DIV.	Use *050-162	*260-185
	822-860	Rotary	VERTICAL VOLTS/DIV. or CURRENTS/DIV.	*262-189	*260-243
	861-3659	Rotary	VERTICAL VOLTS/DIV. or CURRENTS/DIV.	*262-202	*260-243
	3660-up	Rotary	VERTICAL VOLTS/DIV. or CURRENT/DIV	*262-417	*260-243
SW432A	X861-up	SPST Push	(Normally closed)		260-248
SW432B	X861-up	SPST Push	(Normally open)		260-247
SW440		Lever	Vertical AMP. CAL.		260-198
SW601		Toggle	POWER		260-134
SW602	X861-up	Circuit Breaker	0.8 amp		260-249
SW706		Rotary	PEAK VOLTS RANGE		*260-180
SW708		Rotary	Collector Sweep POLARITY		*260-179
SW710		Rotary	DISSIPATION LIMITING RESISTOR	*262-134	*260-181
SW730	101-5909	Lever	TRANSISTOR A—TRANSISTOR B		Use *050-070
SW730	5910-up	Lever	TRANSISTOR A—TRANSISTOR B		260-463
SW735		Rotary	BASE GROUNDED—EMITTER GROUNDED		*260-189

Thermal Cut-out

TK601	Thermal Cut-out, off at 128°	Use *120-0095-01

Transformers

T601	L.V. Power		Use *120-0095-01
T701	Variable-voltage	PEAK VOLTS	120-089
T702	Collector Sweep		*120-094
T801	CRT Supply		*120-093

Electron Tubes

			Tektronix Part Number
V104		6AN8	154-078
V112		6AL5	154-016
V124		6AN8	154-078
V132		6AL5	154-016
V143		12AT7	154-039
V152		6AL5	154-016
V155		6AN8	154-078
V163		6AN8	154-078
V171		6AU6	154-022
V172		6AL5	154-016
V214 † } V224 † }		12AU6, checked	Use *157-050
V233		12AU7	154-041
V254 † } V264 † }		12AU6, checked	Use *157-050
V344 † } V354 † }		12AU6, checked	Use *157-050
V364		6AU6	154-022
V374		6AU6	154-022
V384		6CG7	154-134
V444 † } V454 † }		12AU6, checked	Use *157-050
V464		6AU6	154-022
V474		6AU6	154-022
V484		6CG7	154-134
V602		6BW4	154-119
V604		6AU6	154-022
V607		12B4	154-044
V624		6AU6	154-022
V627		6080	154-056
V642		6BW4	154-119
V644		6AN8	154-078
V649		5651	154-052
V657		12B4	154-044
V733		6AU6	154-022
V804		12AU7	154-041
V810		6AQ5	154-017
V812		5642	154-051
V822		5642	154-051
V859††	101-1351	T0520-1 CRT Standard Phospher	*154-093
V859	1352-up	T0520-1 CRT Standard Phosphor	*154-093

Transistors

Q243	2N2148	Use 151-137
Q253	2N277	151-002

† Selected pair. Furnished as a unit.
†† S/N 101-1351 add *050-218 Kit

Mechanical Parts List
Type 575

	Tektronix Part Number
AIR FILTER	378-011
AIR FILTER HOUSING SN 101-2265	380-008
AIR FILTER HOUSING SN2266-up	380-018
ANGLE, FRAME, TOP LEFT	122-036
ANGLE, FRAME, 3/4 x 3/4 x 11 1/2	122-038
ANGLE, FRAME, BOTTOM SN 101-2265	122-037
ANGLE, FRAME, BOTTOM SN 2266-up	122-073
BAKELITE STRIP, HEAT SINK INSULATOR	124-082
BAR, RETAINING w/2 8-32 tapped holes	381-073
BAR, TOP SUPPORT	Use 381-206
BINDING POST, 5-WAY FLUTED CAP	129-036
BINDING POST, SHORT STEM	129-040
BRACKET, POT	406-023
BRACKET, PHOSPHOR BRONZE, CRT SPRING	406-239
BRACKET, RIGHT FILTER HOUSING STIFFENER	406-295
BRACKET, RECTIFIER SELENIUM SN 101-4929	406-299
BRACKET, RECTIFIER SILICON SN 4930-up	406-815
BRACKET, FILTER HOUSING STIFFENER	406-302
BRACKET, MINIPOT 1/2 x 2 1/4 x 1/2	406-330
BRACKET, CRT SUPPORT	406-368
BRACKET, CRT SHIELD MOUNTING	406-514
BRACKET, MINIPOT .040 x 3/4 x 5/8	406-576
BRACKET, MINIPOT MOUNTING 1 1/2 x 1 13/64	406-619
BUSHING 3/8-32 x 9/16 x .412	358-010
BUSHING 3/8-32 x 13/16 x .252, panel	358-029
BUSHING, NYLON, BINDING POST INSULATOR	358-036
CABINET SIDE, RIGHT SN 101-530	386-677
CABINET SIDE, RIGHT SN 531-2265	386-783
CABINET SIDE, RIGHT SN2266-up	387-087
CABINET SIDE, LEFT SN 101-530	386-706
CABINET SIDE, LEFT SN 531-2265	386-773
CABINET SIDE, LEFT SN 2266-up	387-091
CABINET BOTTOM SN 101-2265	386-620
CABINET BOTTOM SN2266-up	387-089
CABLE, 575 ADAPTOR SOCKET SN 101-3659X	012-045
CABLE, COAX 75 Ω MINIATURE	175-026
CABLE HARNESS, POWER	179-168
CABLE HARNESS, STEP GENERATOR SN 101-4269	179-169
CABLE HARNESS, STEP GENERATOR SN 4270-up	179-620
CABLE HARNESS, F & I	179-171
CABLE HARNESS, CURRENT	179-173
CABLE HARNESS, CAL SWITCH	179-174
CABLE HARNESS, 110 VOLTS	179-175
CABLE HARNESS, EXT. INPUT & ADAPTOR SOCKET ASS'Y SN 101-3659	179-176

		Tektronix Part Number
CABLE HARNESS, EXT. INPUT & ADAPTOR SOCKET ASS'Y	SN 3660-up	179-534
CABLE HARNESS, VOLTAGE SAMPLING		179-180
CABLE HARNESS, COLLECTOR SWEEP/DISSIPATION SWITCH		179-240
CABLE HARNESS, SOCKET ADAPTOR	SN X2828-up	179-485
CERAMIC STRIP 3/4 x 4 notches, clip-mounted		124-088
CERAMIC STRIP 3/4 x 7 notches, clip-mounted		124-089
CERAMIC STRIP 3/4 x 9 notches, clip-mounted		124-090
CERAMIC STRIP 3/4 x 11 notches, clip-mounted		124-091
CHASSIS, POWER		441-161
CHASSIS, STEP. GEN. AMP		441-162
CHASSIS, SWEEP COLLECTOR		441-193
CLAMP, CABLE 1/4" plastic		343-003
CLAMP, CABLE 5/16" plastic		343-004
CLAMP, CABLE 3/8" plastic		343-013
CLAMP, CABLE 5/8" plastic		343-042
CLAMP, CABLE #20 wire for neon bulbs		343-043
CONNECTOR, 3-TERMINAL TRANSISTOR ADAPTOR (wire lead)		Use 013-069
CONNECTOR, 3-TERMINAL TRANSISTOR ADAPTOR (2-pin bases		Use 013-070
CONNECTOR, CHASSIS MT.		131-038
CONNECTOR, CABLE 51 1/2" ANODE		131-088
CONNECTOR, CHASSIS MT., 3-wire male	SN 101-3659	131-102
CONNECTOR, CHASSIS MT., 3-wire male	SN 3660-up	131-150
CRT ANODE AND PLATE COVER ASS'Y		200-112
CRT SHIELD		337-088
CRT ROTATOR	SN 1620-4928	Use 050-063
CRT ROTATOR RING	SN 4929-up	354-178
CRT CLAMPING ROTATOR RING		354-103
CRT ROTATOR BASE, BLACK		432-022
CRT CONTACT SLUG		134-031
COUPLING, FIBER, 2-screw		376-003
EYELET, TAPERED BARREL		210-601
FAN MOTOR		147-001
FAN BLADE 5 1/2"		369-001
FAN MOTOR MOUNT		426-046
FAN RING		354-051
FELT STRIP 1/8 x 1 x 5 3/4		124-068
FOOT, RUBBER, black 1/2"		348-031
FUSE CAP		200-015
FUSE HOLDER		352-010
GRATICULE LAMP SOCKET		136-001
GRATICULE COVER		200-382

	Tektronix Part Number
GRATICULE	331-028
GRATICULE LIGHT FILTER, GREEN	378-514
GRATICULE LIGHT SHIELD	337-187
GROMMET, RUBBER 1/4"	348-002
GROMMET, RUBBER 3/8"	348-004
GROMMET, RUBBER 1/2"	348-005
GROMMET, RUBBER 3/4"	348-006
GROMMET, RUBBER 1/2 x 1/2, round	348-008
GROMMET, RUBBER 5/8"	348-012
GROMMET, RUBBER 1/4"	348-020
JACK PANEL	Use 432-030
JEWEL PILOT LIGHT SOCKET	136-025
JEWEL, PILOT LIGHT	378-518
KNOB, SMALL RED	366-032
KNOB, SMALL BLACK	366-033
KNOB, LARGE BLACK 1.375 OD	366-042
KNOB, LARGE BLACK 1.625 OD	366-060
KNOB, SMALL BLACK 2 dots 180° apart	366-069
LOCKWASHER #2 INT	210-001
LOCKWASHER #4 INT	210-004
LOCKWASHER #6 INT	210-006
LOCKWASHER #8 EXT	210-007
LOCKWASHER #8 INT	210-008
LOCKWASHER #10 EXT	210-009
LOCKWASHER #10 INT	210-010
LOCKWASHER POT INT	210-012
LOCKWASHER 3/8 x 11/16 INT	210-013
LOCKWASHER .472 x .480 ID Shakeproof	210-021
LUG, SOLDER, SE4	210-201
LUG, SOLDER, SE6 w/2 wire holes	210-202
LUG, SOLDER, SE8	210-205
LUG, SOLDER SE10, long	210-206
LUG, SOLDER, POT plain	210-207
NUT, CAP 8-32 x 5/16	210-402
NUT, HEX 2-56 x 3/16	210-405
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
NUT, HEX 3/8-32 x 1/2	210-413

	Tektronix Part Number
NUT, HEX $^{15}/_{32}$-32 x $^{9}/_{16}$	210-414
NUT, KNURLED, GRATICULE	210-424
NUT, HEX 1-72 x $^{5}/_{32}$ pot.	210-438
NUT, HEX $^{1}/_{2}$ x $^{5}/_{8}$, $^{3}/_{8}$-32 Int. thread	210-444
NUT, HEX 10-32 x $^{3}/_{8}$ Cad. plated	210-445
NUT, HEX 5-40 x $^{1}/_{4}$	210-449
NUT, KEPS 6-32 x $^{5}/_{16}$	210-457
NUT, KEPS 8-32 x $^{11}/_{32}$	210-458
NUT, HEX 8-32 x $^{1}/_{2}$ x $^{23}/_{64}$, 25 w resistor mtg.	210-462
NUT, SWITCH, 12-sided	210-473
NUT, HEX 6-32 x $^{5}/_{16}$ x .194 body, 5-10 w resistor mtg.	210-478
NUT, HEX $^{3}/_{8}$-32 x $^{1}/_{2}$ x $^{11}/_{16}$	210-494
NUT, CRT ROTATOR	210-502
NUT, HEX $^{21}/_{32}$ x 2$^{1}/_{2}$, tapped 6-32 both ends	210-503
NUT, HEX $^{3}/_{8}$-27 x $^{1}/_{2}$	210-505
NUT, HEX 10-32 x $^{3}/_{8}$ x $^{1}/_{8}$	210-564
PANEL, FRONT SN101-860	333-329
PANEL, FRONT SN 861-up	333-527
PANEL, JACK PLATE	333-386
PLATE, JACK PLATE BOTTOM	386-480
PLATE, TRANSISTOR HEAT SINK	386-652
PLATE, SWEEP COLLECTOR	386-656
PLATE, TEST SPACING	386-670
PLATE, REAR OVERLAY SN 101-2265	386-659
PLATE, REAR OVERLAY SN 2266-3659	387-092
PLATE, REAR OVERLAY SN 3660-up	387-376
PLATE, ADAPTOR HOE COVER SN101-2827X	387-207
POWER CORD ADAPTOR, 3-wire to 2-wire	103-013
POWER CORD, 8 ft., 3-wire	161-010
RING, LOCKING SWITCH	354-055
ROD, EXTENSION $^{1}/_{4}$ x 3$^{1}/_{8}$	384-158
ROD, SPACING $^{3}/_{8}$ x 1$^{5}/_{16}$, tapped 10-32 both ends	384-535
ROD, NYLON $^{5}/_{8}$ x $^{3}/_{8}$	385-101
ROD, $^{3}/_{8}$ x 2$^{15}/_{16}$ tapped 6-32 both ends	385-112
SCREW 4-40 x $^{3}/_{16}$ BHS	211-007
SCREW 4-40 x $^{1}/_{4}$ BHS	211-008
SCREW 4-40 x $^{5}/_{8}$ RHS	211-016
SCREW 4-40 x $^{5}/_{16}$ Pan HS w/lockwasher	211-033
SCREW 4-40 x $^{5}/_{16}$ FHS Phillips	211-038
SCREW 2-26 x $^{5}/_{16}$ RHS	211-062
SCREW 6-32 x $^{1}/_{4}$ BHS	211-504

	Tektronix Part Number
SCREW 6-32 x 5/16 BHS	211-507
SCREW 6-32 x 3/8 FHS	211-509
SCREW 6-32 x 3/8 BHS	211-510
SCREW 6-32 x 1/2 FHS	211-511
SCREW 6-32 x 5/8 BHS	211-513
SCREW 6-32 x 3/4 BHS	211-514
SCREW 6-32 x 5/8 FHS	211-522
SCREW 6-32 x 5/16 Pan w/lockwasher	211-534
SCREW 6-32 x 3/8 Truss HS, Phillips	211-537
SCREW 6-32 x 5/16 RHS	211-543
SCREW 6-32 x 3/4 Truss HS, Phillips	211-544
SCREW 6-32 x 1 1/2 RHS Phillips	211-553
SCREW 6-32 x 1 RHS	211-560
SCREW 6-32 x 3/8 Hex socket FH Cap	211-561
SCREW 8-32 x 1/4 BHS	212-001
SCREW 8-32 x 5/16 BHS	212-004
SCREW 8-32 x 1 BHS	212-020
SCREW 8-32 x 1 1/4 RHS	212-031
SCREW 8-32 x 1 3/4 FHS	212-037
SCREW 8-32 x 3/8 Truss HS, Phillips	212-039
SCREW 8-32 x 3/8 100° FHS, Phillips	212-040
SCREW 10-32 x 3/8 100° FHS	212-506
SCREW 10-32 x 3 HHS	212-511
SCREW 10-32 x 1 3/4 HHS	212-517
SCREW 10-32 x 3 1/4 HHS	212-524
SCREW, SET 6-32 x 1/8 HHS	213-020
SCREW 10-32 x 4 1/2 HHS	212-546
SCREW, THREAD CUTTING 4-40 x 1/4 PHS, Phillips	213-035
SCREW, THREAD CUTTING 6-32 x 3/6 Truss HS, Phillips	213-041
SCREW, THREAD CUTTING 5-32 x 3/16 Pan HS, Phillips	213-044
SCREW, THREAD FORMING 6-32 x 3/8 THS	213-104
SHIELD, SOCKET	337-004
SHIELD, TUBE, 7-pin, 2 1/4" high	337-128
SHIELD, SWEEP COLLECTOR 5 1/2 x 8 15/16	337-182
SHIELD, HV	337-183
SHIELD, SWEEP COLLECTOR 5 1/2 x 6 1/8 x 9	337-189
SHOCK MOUNT 1/2" x 1/2" high	348-008
SOCKET, STM7G	136-008
SOCKET, SHIELDED, W/O CENTER PIN	136-010
SOCKET, STM8, ground	136-011
SOCKET, STM9G	136-015
SOCKET, STM14, mica 14-pin	136-019
SOCKET, TIP JACK, black nylon	136-037
SOCKET, 4-PIN TRANSISTOR	136-095
SPACER .125 ID x 3/16 OD x 1/4	166-025

	Tektronix Part Number
SPACER .125 ID x 3/16 OD x 3/8	166-026
SPACER .180 ID x 1/4 OD x 1/4	166-031
SPACER .196 ID x 5/16 OD x 1/8	166-084
SPACER NYLON .188 HIGH	361-008
SPACER, 3/8 NYLON, FOR CERAMIC STRIP	361-009
STUD, STEEL, 2 inches under shoulder	355-044
STUD, STEEL, 10-32 thread, 2¼" down	355-049
SUBPANEL, REAR SN 101-3659	386-649
SUBPANEL, REAR SN 3660-up	387-374
SUBPANEL, FRONT	386-650
TAG, VOLTAGE RATING, see 334-650, 65, 654, 655.	334-649
TUBING, BLACK PLASTIC #20	162-504
WASHER, STEEL	210-021
WASHER, 6L x 3/8 x .032	210-803
WASHER, 10S x 7/16 x .032	210-805
WASHER, RESISTOR CENTERING, 25 w	210-809
WASHER, RUBBER WAN 13-20	210-816
WASHER, .390 ID x 9/16 OD x .020	210-840
WASHER, 1/2 ID x 5/8 OD x .020	210-845
WASHER, BAKELITE #8 shouldered	210-859
WASHER, NYLON	210-869
WASHER, RUBBER, FUSE HOLDER	210-873
WASHER, .470 ID x 21/32 OD x .030	210-902
WASHER, RED FIBER	210-906
WASHER, WAVY PHOSPHOR BRONZE	210-914
WIRE, CRT LEAD .96 ft. w/pin connector, white-brown	175-586
WIRE, CRT LEAD 1.38 ft. w/pin connector, white-orange	175-589
WIRE, CRT LEAD .96 ft., white green w/pin connector, white-brown	175-592
WIRE, CRT 1.00 ft., whiteblue w/pin connector, white-orange	175-594
WIRE, CRT LEAD .96 ft., white red w/pin connector	175-595

PARTS LIST
Type 175

Bulbs

		Tektronix Part Number
B231	Neon, NE-2	150-0027-00
B266	Neon, NE-2	150-0027-00
B601	Incandescent #47	150-001

Capacitors

Values fixed unless marked Variable.

Tolerance ±20% unless otherwise indicated.

C232	.001 µf	PTM	600 v	285-501
C238	.015 µf	PTM	400 v	285-512
C267	.001 µf	PTM	600 v	285-501
C620	2000 µf	EMC	30 v	290-0086-00
C621	20,000 µf	EMC	30 v	290-131
C650	6.25 µf	EMT	300 v	290-025
C653	6.25 µf	EMT	300 v	290-025

Fuses

F601	3 Amp	3 AG	Slo-Blo	117 V oper.	50-60 cycle	159-005
F601	1.6 Amp	3 AG	Slo-Blo	234 V oper.	50-60 cycle	159-003
F602	3 Amp	3 AG	Slo-Blo	117 V oper.	50-60 cycle	159-005
F602	1.6 Amp	3 AG	Slo-Blo	234 V oper.	50-60 cycle	159-003

Resistors

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

R201		15 k		Var.		Volts/Step Adj.	311-112
R202		82 k	½ w		Prec.	1%	309-043
R203		3 k	½ w		Prec.	1%	309-182
R204	101-239	68 Ω	½ w				302-680
R204	240-up	200 Ω		Var.		+Step Adj.	311-158
R206		600 k	½ w		Prec.	1%	309-004
R207		100 k		Var.		STEP ZERO	311-026
R210		500 k	½ w		Prec.	1%	Use 309-140
R215		47 k	½ w				302-473
R216		4.7 k	½ w				
R217		20 k		Var.		Zero Adj.	311-018
R218		47 k	½ w				302-473
R222		150 k	½ w				302-154
R224		1 k	½ w				302-102
R231		1.5 meg	½ w				302-155
R232		100 k	½ w				302-104
R233		1 k	½ w				302-102
R235		22 k	2 w				306-223
R238		1.5 k	½ w				302-152
R241		500 Ω	5 w			1%	308-071
R242A-D		0.25 Ω	1 w		WW		(4) *308-090

							Tektronix Part Number
R243A,B		125 Ω	25 w		WW	5%	(2) 308-035
R244A		0.5 Ω	50 w	Base Step			*308-182
R244B		1.25 Ω	20 w				
R244C		2.5 Ω	10 w				
R244D		5 Ω	8 w		Prec.	1%	*310-569
R244E		12.5 Ω	4 w		Prec.	1%	*310-576
R244F		500 Ω	½ w		Prec.	1%	309-179
R244G		250 Ω	½ w		Prec.	1%	309-178
R244H		100 Ω	½ w		Prec.	1%	309-112
R244J		50 Ω	½ w		Prec.	1%	309-128
R244K		25 Ω	½ w		Prec.	1%	309-177
R244L		10 Ω	4 w		Prec.	1%	*310-570
R244M		5 Ω	8 w		Prec.	1%	*310-569
R244N		2.5 Ω	10 w	Furnished with R244A,B,C			*308-182
R244P		1 Ω	25 w				
R244Q		0.5 Ω	50 w				
R244R		1 k	½ w				302-102
R244S		1 k	½ w				302-102
R245A		1 k	½ w		Prec.	1%	309-115
R245B		500 Ω	½ w		Prec.		
R245C		200 Ω	½ w		Prec.	1%	309-073
R245D		100 Ω	½ w		Prec.	1%	309-112
R245E		50 Ω	½ w		Prec.	1%	309-128
R245F		19.5 Ω	4 w		Prec.	1%	*310-574
R245G		9.5 Ω	4 w		Prec.	1%	*310-573
R245H		4.5 k	8 w		Prec.	1%	*310-575
R245J		1.5 Ω	8 w		Prec.	1%	*310-572
R245K		.5 Ω	8 w		Prec.	1%	*310-571
R246		.478 Ω	8 w	Furnished with R244A,B,C			*308-182
R251		1 k	½ w				302-102
R254		47 k	½ w				302-473
R255		4.7 k	½ w				302-472
R256		20 k		Var.		±Adj.	311-018
R257		47 k	½ w				302-473
R261		150 k	½ w				302-154
R264	101-179	470 k	½ w				Use 309-140
R264	180-up	500 k	½ w			1%	309-140
R266		1.5 meg	½ w				302-155
R267		100 k	½ w				302-104
R268		1 k	½ w				302-102
R269		47 k	1 w				304-473
R273		430 Ω	½ w			5%	301-431
R274	101-179	100 Ω	½ w				Use 301-101
R274	180-up	100 Ω	½ w			5%	301-101
R275	101-179	10 k	½ w				Use 309-121
R275	180-up	9.5 k	½ w		Prec.	1%	309-121
R315A		1.11 k	½ w		Prec.	1%	309-284
R315B		1.11 k	½ w		Prec.	1%	309-284
R315C		3.37 k	½ w		Prec.	1%	309-320
R315D		5.64 k	½ w		Prec.	1%	309-321
R315E		11.480 k	½ w		Prec.	1%	309-192
R315F		34.5 k	½ w		Prec.	1%	309-038
R315G		54 k	½ w		Prec.	1%	309-322
R316A		1.11 k	½ w		Prec.	1%	309-284

Resistors *(continued)*

					Tektronix Part Number
R316B	1.11 k	½ w	Prec.	1%	309-284
	3.37 k	½ w	Prec.	1%	309-320
R316D	5.64 k	½ w	Prec.	1%	309-321
R316E	11.48 k	½ w	Prec.	1%	309-192
R316F	34.5 k	½ w	Prec.	1%	309-038
R316G	54 k	½ w	Prec.	1%	309-322
R415A	10 Ω				
R415B	5 Ω				
R415C	3 Ω	Current Measuring			*308-181
R415D	1 Ω				
R415E	0.5 Ω				
R415F	0.3 Ω				
R415G	0.1 Ω				
R415H	.05 Ω				
R415J	.03 Ω	Current Measuring Shunt			*308-180
R415K	.01 Ω				
R415L	.005 Ω				
R415M	.005 Ω				
R501	500 Ω	10 w	WW		*308-183
R502	500 Ω	10 w	WW		*308-183
R506	500 Ω	10 w	WW		*308-183
R507	500 Ω	10 w	WW		*308-183
R510	120 Ω	5 w	WW	5%	308-163
R650	47 Ω	½ w			302-470
R653	47 Ω	½ w			302-470
R720	300 Ω	50 w	Furnished with R415A,D		*308-181
R740	100 Ω	½ w			302-101

Diodes

D610	1N1563A	152-035
D611	1N1563A	152-035
D616	1N1563A	152-035
D617	1N1563A	152-035
D620	1N1563A	152-035
D621	1N1563A	152-035
D710	45L10	152-028
D711	45L10	152-028
D716	TR351	152-029
D717	TR351	152-029

Transistors

Q233	2N250	151-018
Q243A	2N277	151-002
Q243B	2N277	151-002
Q243C	2N277	151-002
Q243D	2N277	151-002
Q620	2N554	151-034
Q621	2N554	151-034

Switches

			Tektronix Part Number Wired	Unwired
SW241		BASE POLARITY		*260-365
SW244		STEP SELECTOR	*262-382	*260-363
SW245		SERIES RESISTANCE	*262-383	*260-355
SW247		ZERO CURRENT; ZERO VOLTS		*260-339
SW315		HORIZONTAL DISPLAY; VOLTS/DIV.	*262-384	*260-364
SW510	393-up	TRANSISTOR SELECTOR		260-0636-00
SW510	101-392	TRANSISTOR SELECTOR		Use *050-0208-00
SW415		VERT. DISP; COLLECTOR CURRENT/DIV.		*260-338
SW601		POWER ON		260-199
SW603		115V Relay, SPST 20 amp		148-015
SW630		COLLECTOR SWEEP POLARITY		*260-366
SW701		CIRCUIT BREAKER		*260-337
SW720		PEAK VOLTS RANGE		*260-367
SW721		12V Relay, SPST 100 amp		148-014
SW731		12V Relay, SPST 100 amp		148-014
SW732		12V Relay, SPST 100 amp		148-014
SW735		12V Relay, SPST 100 amp		148-014
SW736		12V Relay, SPST 100 amp		148-014
SW741		12V Relay, SPST 100 amp		148-014
SW742		12V Relay, SPST 100 amp		148-014

Thermal Cutout

TK601	Thermal Cutout 123°	260-246

Transformers

T601	Base Step Power	*120-196
T701	Variable Auto	*120-189
T702	Collector Power	*120-197

Electron Tubes

V214 †, V224 †	6AU6 checked	Use 157-059
V233	6DJ8	154-187
V254 †, V264 †	6AU6 checked	Use 157-059

† Furnished as a unit.

Type 175
Mechanical Parts List

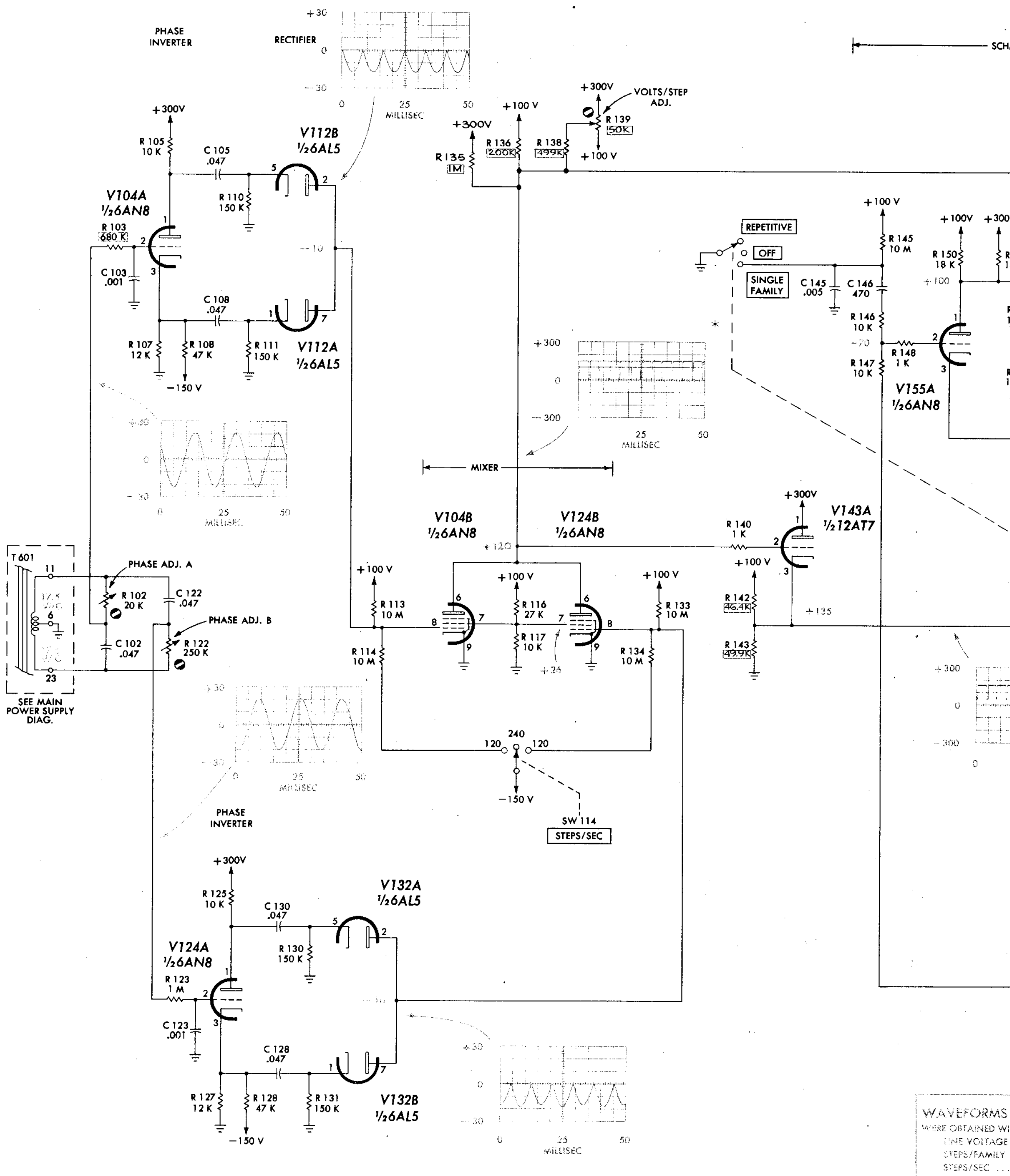
	Part Number Tektronix
ADAPTER, POWER CORD	103-013
ANGLE, FRAME, BOTTOM RAIL RIGHT, BLUE VINYL	122-087
ANGLE, FRAME, BOTTOM RAIL LEFT, BLUE VINYL	122-088
BAR, $3/16 \times 1/2 \times 1\,3/4$ W/2 8-32 HOLES	381-073
BAR, TOP SUPPORT W/HANDLE	Use 381-209
BAR, TOP CENTER SUPPORT	381-179
BAR, SPACER, RELAY, $1/8 \times 3/4 \times 13\,15/16$	381-180
BAR, SPACER, RELAY, $1/8 \times 3/4 \times 5\,1/8$ W/4 $7/32$ HOLES	381-181
BOLT, HINGE 10-32 x $3/8$	214-152
BRACKET, MINIPOT, .040 x $3/4 \times 5/8 \times 3/8$ (X240-up)	406-576
BRACKET, TRANSFORMER, LOWER	406-605
BRACKET, RESISTOR MOUNTING	406-641
BRACKET, HEAT SYNC.	406-645
BRACKET, RESISTOR SUPPORT, RIGHT	406-660
BRACKET, RESISTOR SUPPORT, LEFT	406-661
BUSHING, NYLON FOR 5-WAY BINDING POST	358-036
CABLE, HARNESS, SWEEP	179-477
CABLE, HARNESS, TRANSISTOR MOUNTING PLT.	179-478
CABLE, HARNESS, 110 V	179-479
CABLE, HARNESS, CURRENT RESISTOR	179-480
CABLE, HARNESS, POWER	179-481
CABLE, HARNESS, STEP SELECTOR	179-482
CABLE, HARNESS, SUB-PANEL	179-484
CAP, FUSE	200-015
CHASSIS, SWEEP	441-330
CHASSIS, POWER	441-331
CLAMP, CABLE, $1/2$ PLASTIC	343-006
CLAMP, #20 WIRE FOR NEON BULBS	343-043
CLAMP, CAP. MOUNTING	343-066
CLAMP CAP. .031 x $9/16 \times 3\,1/16$	343-067
CONNECTOR, CHASSIS MOUNTED, 3 WIRE MOTOR BASE ASS'Y	131-150
EYELET, TAPERED BARREL	210-601
FAN, 7" W/RUBBER BUSH.	369-007
FILTER, AIR (101-339)	050-087
FILTER, AIR (340-up)	378-022

	Tektronix Part Number
FILTER, SCREEN (X340-up)	378-762
FOOT, INST. SUPPORT, BLACK NYLON $1\frac{1}{4} \times 2\frac{7}{16}$	348-033
FOOT, FLIP STAND SUPPORT	348-034
FOOT, INST. SUPPORT, BLACK NYLON $1\frac{1}{4} \times 2\frac{7}{16}$ W/1 HOLE ADDED	348-035
GROMMET, RUBBER, $\frac{1}{2}$	348-005
GROMMET, RUBBER, $\frac{3}{4}$	348-006
GROMMET, RUBBER $\frac{1}{2} \times \frac{1}{2}$	348-008
GROMMET, RUBBER $\frac{5}{8}$	348-012
HOLDER, FUSE	352-010
HOUSING, AIR FILTER	380-023
KNOB, LARGE BLACK, 1.375, W/$\frac{1}{4}$ HOLE PART WAY	366-042
KNOB, SMALL BLACK, $\frac{1}{4}$ HOLE PART WAY	366-044
KNOB, LARGE BLACK, 1.625, W/$\frac{1}{4}$ HOLE PART WAY	366-060
KNOB, LARGE BLACK, ASS'Y, 1.625, $\frac{1}{4}$ HOLE PART WAY	366-111
KNOB, LARGE BLACK, 4108, $\frac{1}{4}$ HOLE PART WAY	366-120
LOCKWASHER, INT. #4	210-004
LOCKWASHER, INT. #6	210-006
LOCKWASHER, EXT. #8	210-007
LOCKWASHER, INT. #8	210-008
LOCKWASHER, EXT. #10	210-009
LOCKWASHER, INT. #10	210-010
LOCKWASHER, INT., $\frac{1}{4}$	210-011
LOCKWASHER, INT, POT., $\frac{3}{8} \times \frac{1}{2}$	210-012
LOCKWASHER, INT., $\frac{3}{8} \times \frac{11}{16}$	210-013
LOCKWASHER, $\frac{1}{4} \times \frac{1}{4}$ SPLIT SPRING	210-016
LOCKWASHER, STEEL #5	210-017
LUG, SOLDER, SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER, SE8	210-205
LUG, SOLDER, SE10, LONG	210-206
LUG, SOLDER, POT, PLAIN, $\frac{3}{8}$	210-207
LUG, SOLDER, $\frac{5}{16}$	210-217
LUG, SOLDERLESS, RING	210-247
MOTOR, FAN, $\frac{1}{4}$" DIA.	147-001
MOUNT, FAN MOTOR 7"	426-047
NUT, HEX, 8-32 x $\frac{5}{16}$	210-402
NUT, HEX, 4-40 x $\frac{3}{16}$	210-406
NUT, HEX, 6-32 x $\frac{1}{4}$	210-407

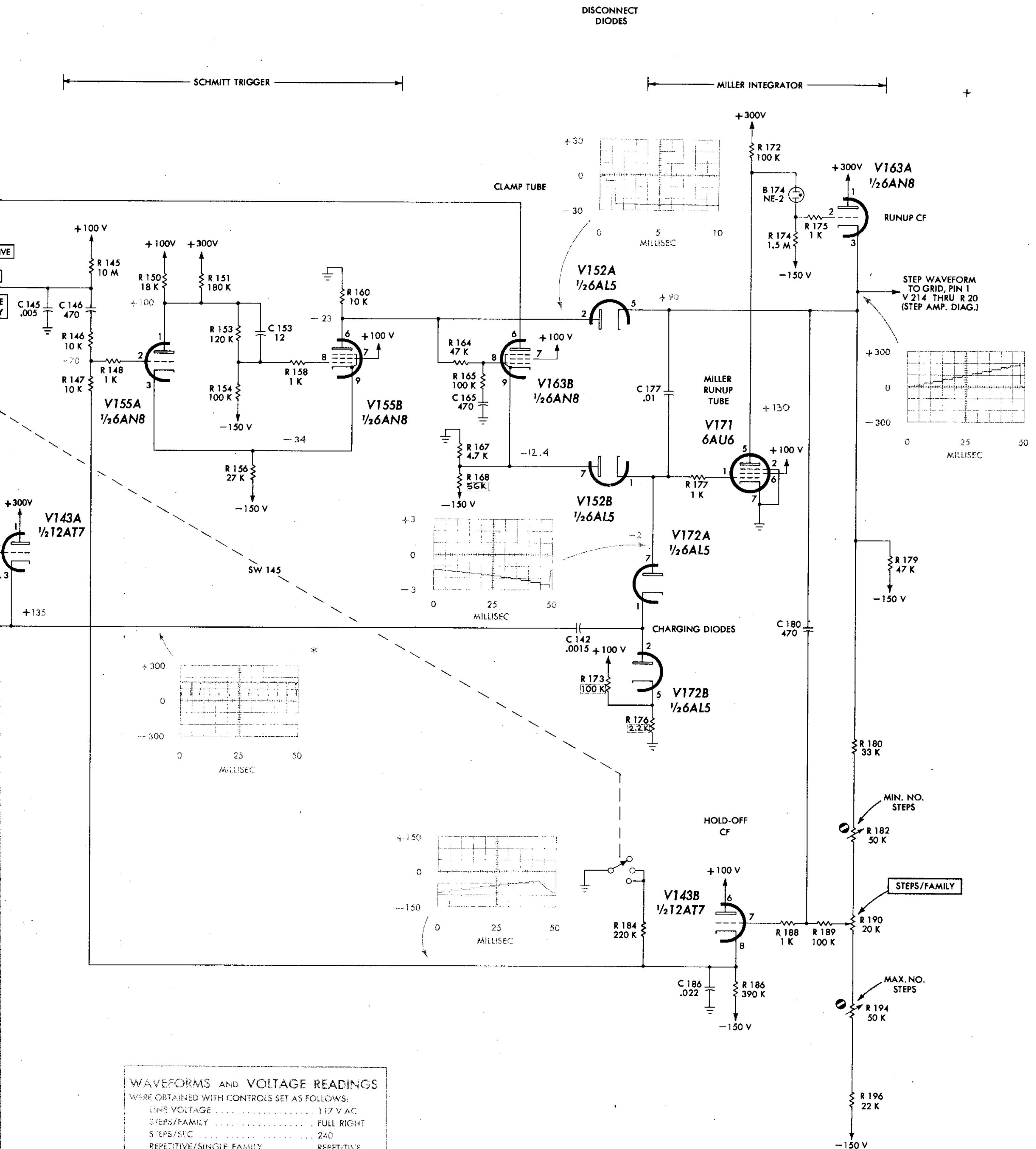
	Tektronix Part Number
NUT, HEX, 8-32 x 5/16	210-409
NUT, HEX, 10-32 x 5/16	210-410
NUT, HEX, 1/4-20 x 7/16	210-411
NUT, HEX, 3/8-32 x 1/2	210-413
NUT, HEX, 10-32 x 3/8 x 1/8	210-445
NUT, HEX, 5-40 x 1/4	210-449
NUT, HEX, 1/4-28 x 3/8-3/32	210-455
NUT, KEPS, 6-32 x 5/16	210-457
NUT, KEPS, 8-32 x 11/32	210-458
NUT, HEX, 8-32 x 1/2 x 23/64 (25 W. RESISTOR MOUNTING)	210-462
NUT, 12 SIDED, 15/32-32 x 5/64	210-473
NUT, HEX, 6-32 x 5/16 x .194 (5-10 W. RESISTOR MOUNTING)	210-478
NUT, HEX, 3/8-27 x 1/2	210-505
NUT, HEX, 5/16-24 x 1/2 x 3/16	210-524
NUT, HEX 10-32 x 3/8 x 1/8 STAINLESS	210-564
PANEL, FRONT	333-597
PLATE, .040 x 9/16 x 19/32	386-427
PLATE, TRANSISTOR, INSUL. (MICA.)	386-978
PLATE, SUB-PANEL, FRONT	387-273
PLATE, TRANSISTOR MOUNTING	387-274
PLATE, DIODE MOUNTING	387-275
PLATE, SUB-PANEL, REAR	387-276
PLATE, CABINET SIDE, RIGHT, BLUE VINYL	387-277
PLATE, TOP COVER, BLUE VINYL	387-278
PLATE, CABINET BOTTOM, BLUE VINYL	387-279
PLATE, CABINET SIDE LEFT, BLUE VINYL	387-280
PLATE, SWITCH .032 x 25/16	387-742
PLATE, OVERLAY, REAR, BLUE VINYL	387-281
POST, BINDING, 5-WAY ASS'Y BLACK	129-036
POST, TERMINAL, TRANSISTOR MOUNTING	129-049
POST, BINDING, 5-WAY ASS'Y, BLUE	129-054
POST, BINDING, 5-WAY ASS'Y, RED	129-055
RING, LOCKING SWITCH	354-055
RING, FAN	354-104
ROD, HEX, 3/8 x 23/4 W/6-32 & 8-32 TAPPED HOLES	385-103
SCREW, 4-40 x 3/8 BHS	211-012

	Tektronix Part Number
SCREW, 6-32 x 1/4 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 3/4 BHS	211-514
SCREW, 6-32 x 7/8 BHS	211-516
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 3/4 TRUSS HS, PHILLIPS	211-544
SCREW, 8-32 x 1/4 BHS	212-001
SCREW, 8-32 x 5/16 BHS	212-004
SCREW, 8-32 x 1/2 BHS	212-008
SCREW, 8-32 x 5/8 BHS	212-010
SCREW, 8-32 x 3/4 FHS, 100°	212-011
SCREW, 8-32 x 3/8 BHS	212-023
SCREW, 8-32 x 3 RHS	212-029
SCREW, 8-32 x 1 1/4 RHS	212-031
SCREW, 8-32 x 3/4 BHS	212-033
SCREW, 8-32 x 1 3/4 FHS	212-037
SCREW, 8-32 x 3/8 THS, PHILLIPS	212-039
SCREW, 8-32 x 3/8 FHS, 100°, PHILLIPS	212-040
SCREW, 8-32 x 3 3/4 HHS	212-077
SCREW, 10-32 x 3/8 BHS	212-507
SCREW, 10-32 x 1/2 BHS	212-508
SCREW, 10-32 x 5/16 BHB	212-518
SCREW, 10-32 x 1 1/4 HHS	212-520
SCREW, 10-32 x 3 1/4 HHS	212-524
SCREW, 10-32 x 3 3/4 HHS	212-543
SCREW, 10-32 x 5/16 FHS, 100°	212-560
SCREW, 1/4-20 x 1/2 HHS	213-001
SCREW, 6-32 x 3/8 TRUSS HS, PHILLIPS	213-041
SCREW, 5-32 x 3/16 PAN H STEEL, PHILLIPS, THREAD CUTTING	213-044
SCREW, #4 x 1/4 PHS, PHILLIPS	213-088
SCREW, 6-32 x 3/8 THREAD FORMING THS	213-104
SOCKET, STM7G	136-008
SOCKET, STM9G	136-015
SOCKET, LIGHT W/GREEN JEWEL	136-027

	Tektronix Part Number
SOCKET, GROUNDING TYPE, 3 COND.	136-036
SOCKET, 9 PIN AMPH.	136-077
SOCKET, RECEPTACLE, RED	136-083
SOCKET, RECEPTACLE, BLACK	136-084
SPACER, NYLON, $^1/_{16}$, FOR CERAMIC STRIP	361-007
SPACER, NYLON, $^5/_{16}$, FOR CERAMIC STRIP	361-009
SPACER, SWITCH $^5/_8$ x $^{33}/_{64}$ x .130	361-048
SPACER, ALUM. $^5/_8$ x .18 ID	166-037
STRAP, RELAY CONNECTING, .065 x 1$^1/_4$ x $^3/_8$ x 1$^3/_{16}$	346-016
STRAP, RELAY, .065 x 2$^3/_4$ x $^1/_2$ x 2$^1/_8$	346-017
STRAP, TRANSFORMER, $^5/_8$ x 5$^1/_2$	346-018
STRAP, CABLE, .065 x $^7/_8$ x 2$^3/_4$	346-019
STRAP, RELAY, CONNECTING, .065 x $^1/_4$ x 11$^{13}/_{16}$ x $^9/_{16}$	346-020
STRAP, EMITTER COUPLING, .065 x $^3/_8$ x $^{15}/_{16}$ x 13$^1/_2$	346-021
STRAP, CABLE TIE, WHITE NYLON	346-024
STRIP, CERAMIC, $^3/_4$ x 7 NOTCHES, CLIP MOUNTED	124-089
STRIP, CERAMIC, $^3/_4$ x 9 NOTCHES, CLIP MOUNTED	124-090
STRIP, CERAMIC, $^7/_{16}$ x 11 NOTCHES, CLIP MOUNTED	124-106
STUD, 10-32 x 2$^7/_{16}$ W/2" SHOULDER	355-044
TAG, VOLTAGE RATING	334-649
TAG, S/N INSERT	334-679
WASHER, STEEL, 8S x $^3/_8$ x .032	210-804
WASHER, STEEL, 10S x $^7/_{16}$ x .036	210-805
WASHER, BRASS (25 W. RESISTOR CENTERING)	210-809
WASHER, FIBER #6	210-811
WASHER, FIBER, $^1/_8$ x $^1/_4$	210-823
WASHER, STEEL, .390 x $^9/_{16}$ x .020	210-840
WASHER, STEEL, FLAT $^5/_8$ x $^1/_2$ x .020	210-845
WASHER, BAKELITE, .129 x $^1/_2$ x $^3/_8$ (TRANSISTOR MOUNTING)	210-900
WASHER, STEEL, .470 x $^{21}/_{32}$ x .030	210-902



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



WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117 V AC
STEPS/FAMILY	FULL RIGHT
STEPS/SEC	240
REPETITIVE/SINGLE FAMILY	REPETITIVE

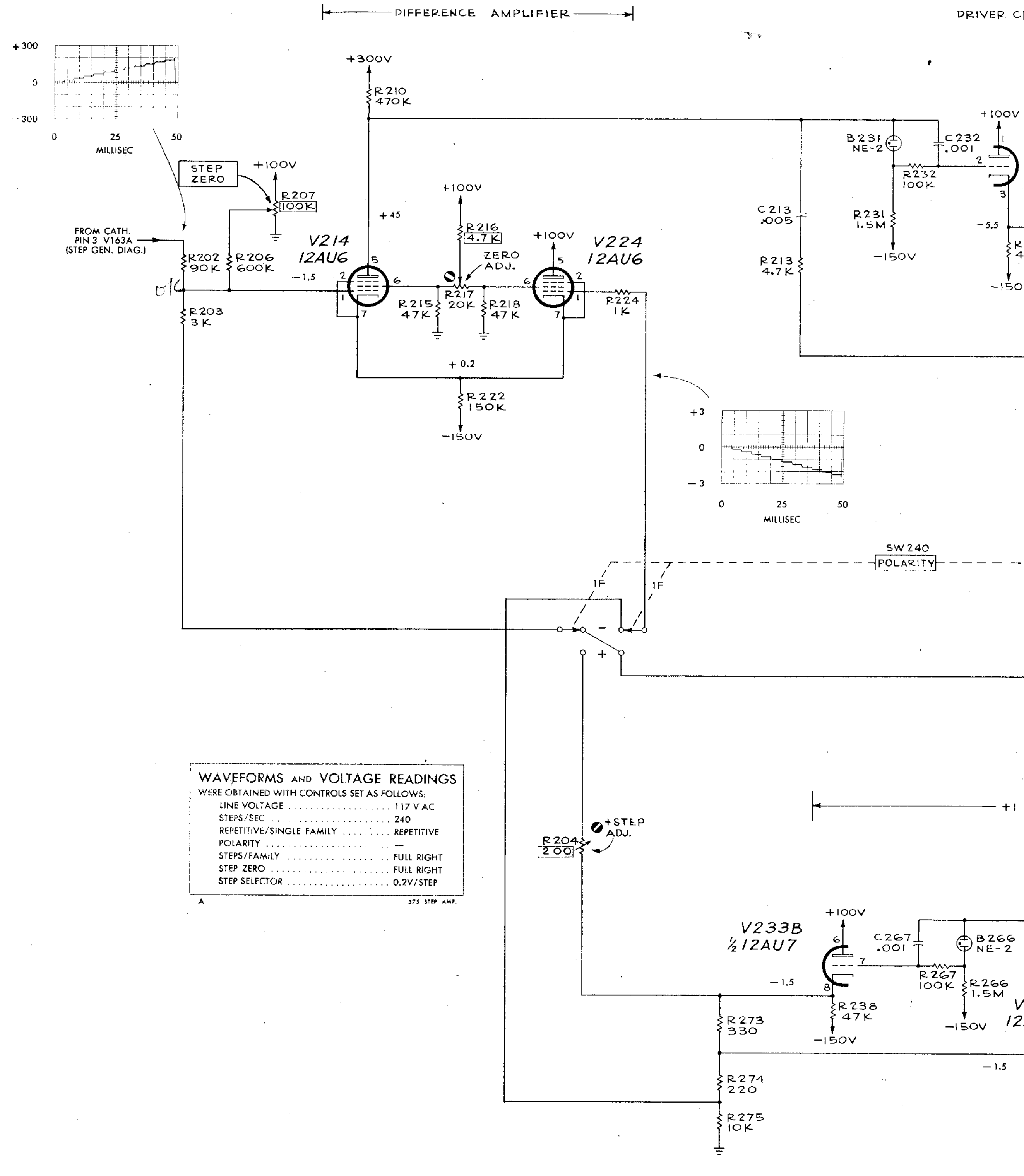
NOTE:
WAVEFORMS MARKED WITH ASTERISK
WERE OBTAINED WITH V163 REMOVED

A 575 STEP GEN.

D.B.L.
964

AB₁

STEP GENERATOR

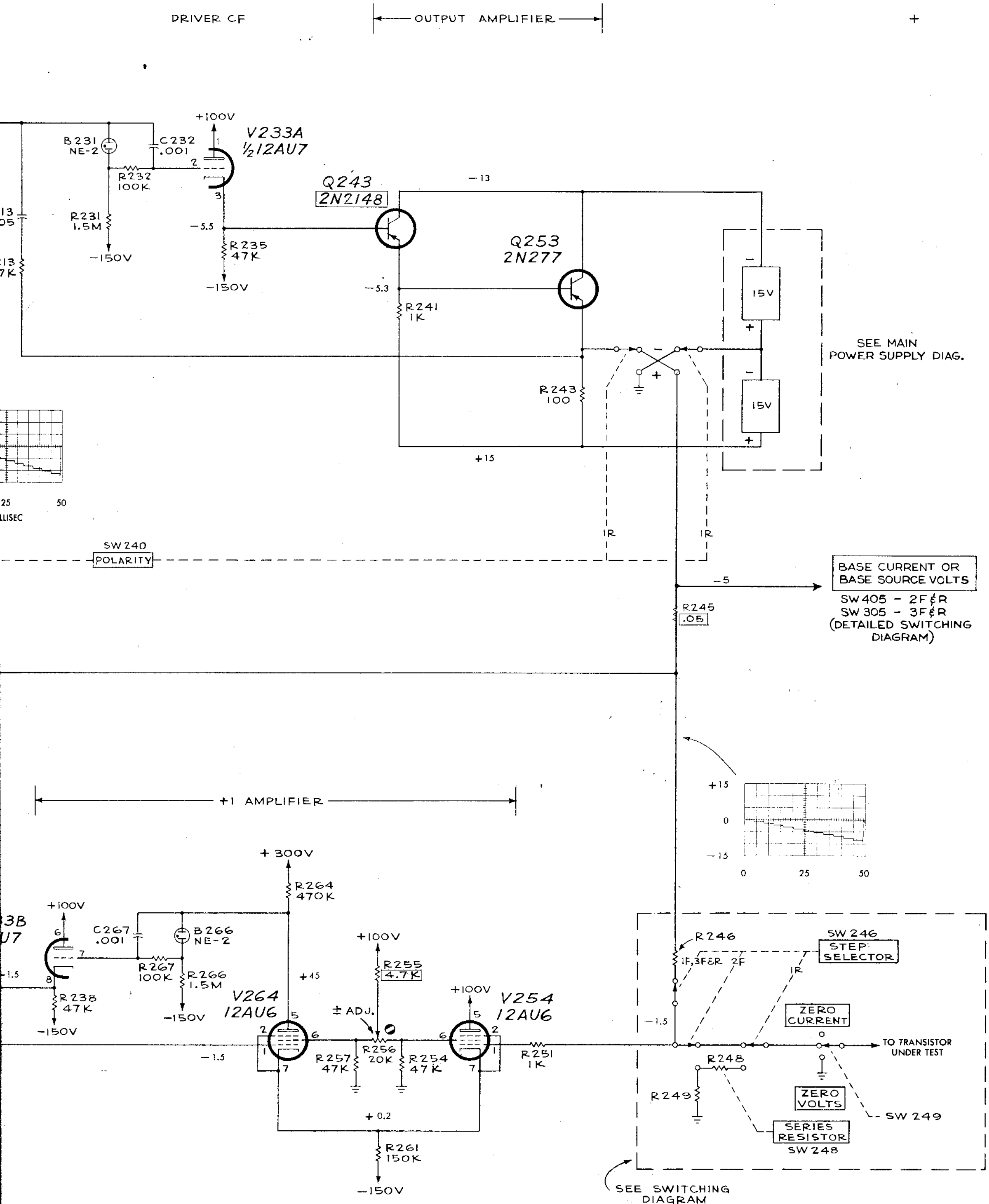


WAVEFORMS AND VOLTAGE READINGS
WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117 V AC
STEPS/SEC	240
REPETITIVE/SINGLE FAMILY	REPETITIVE
POLARITY	—
STEPS/FAMILY	FULL RIGHT
STEP ZERO	FULL RIGHT
STEP SELECTOR	0.2V/STEP

A 575 STEP AMP.

AD

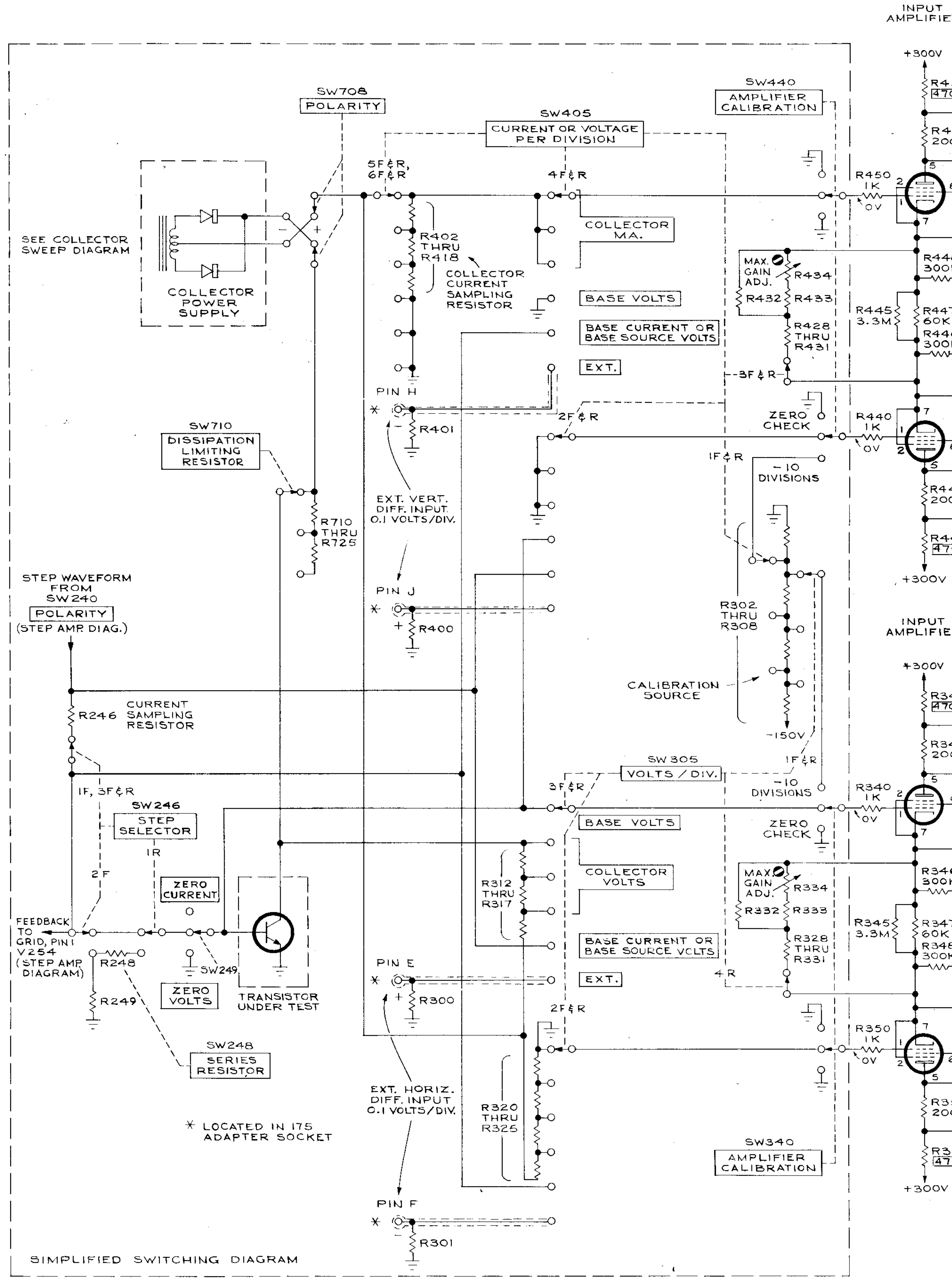


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

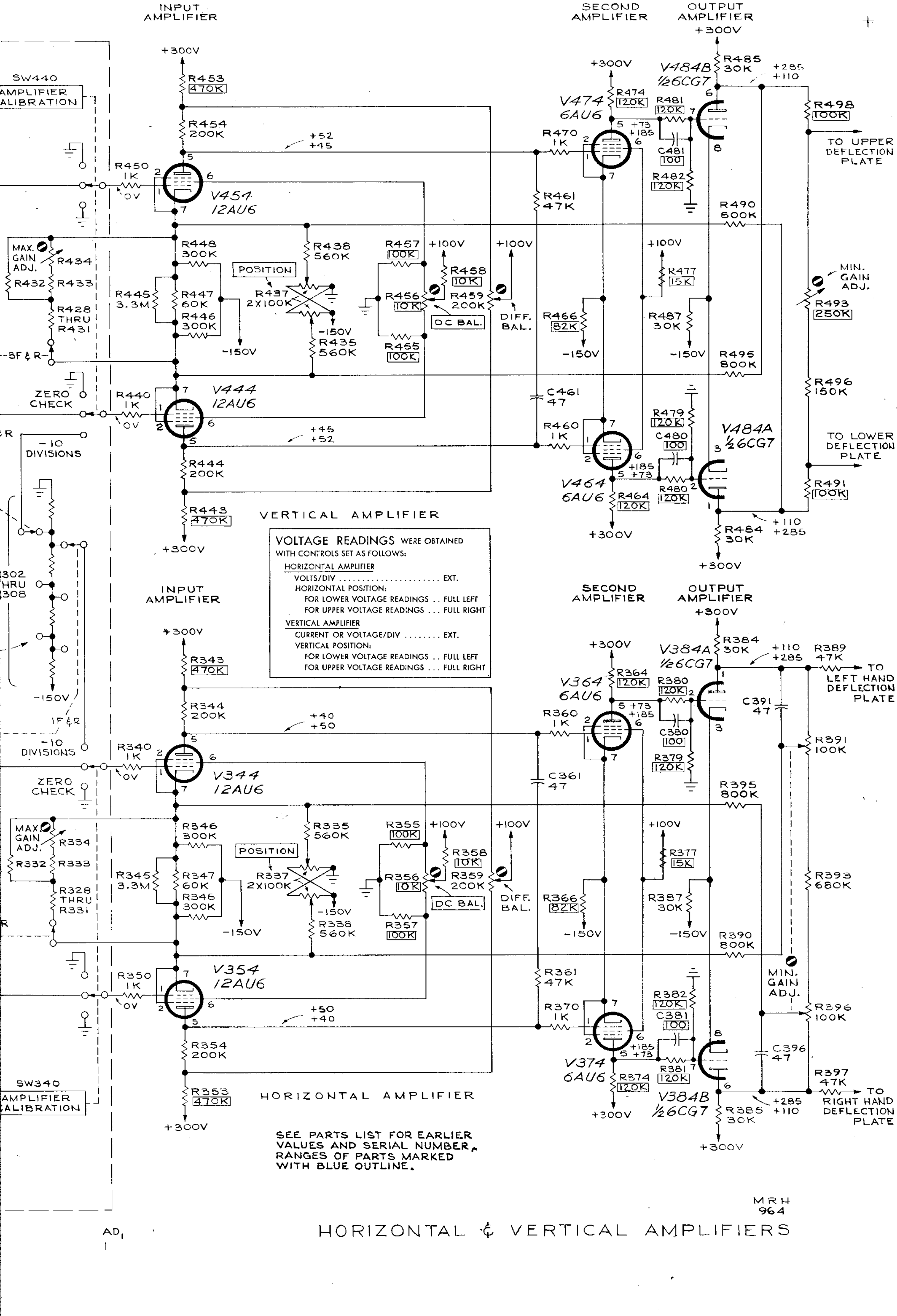
GAB 764

AD

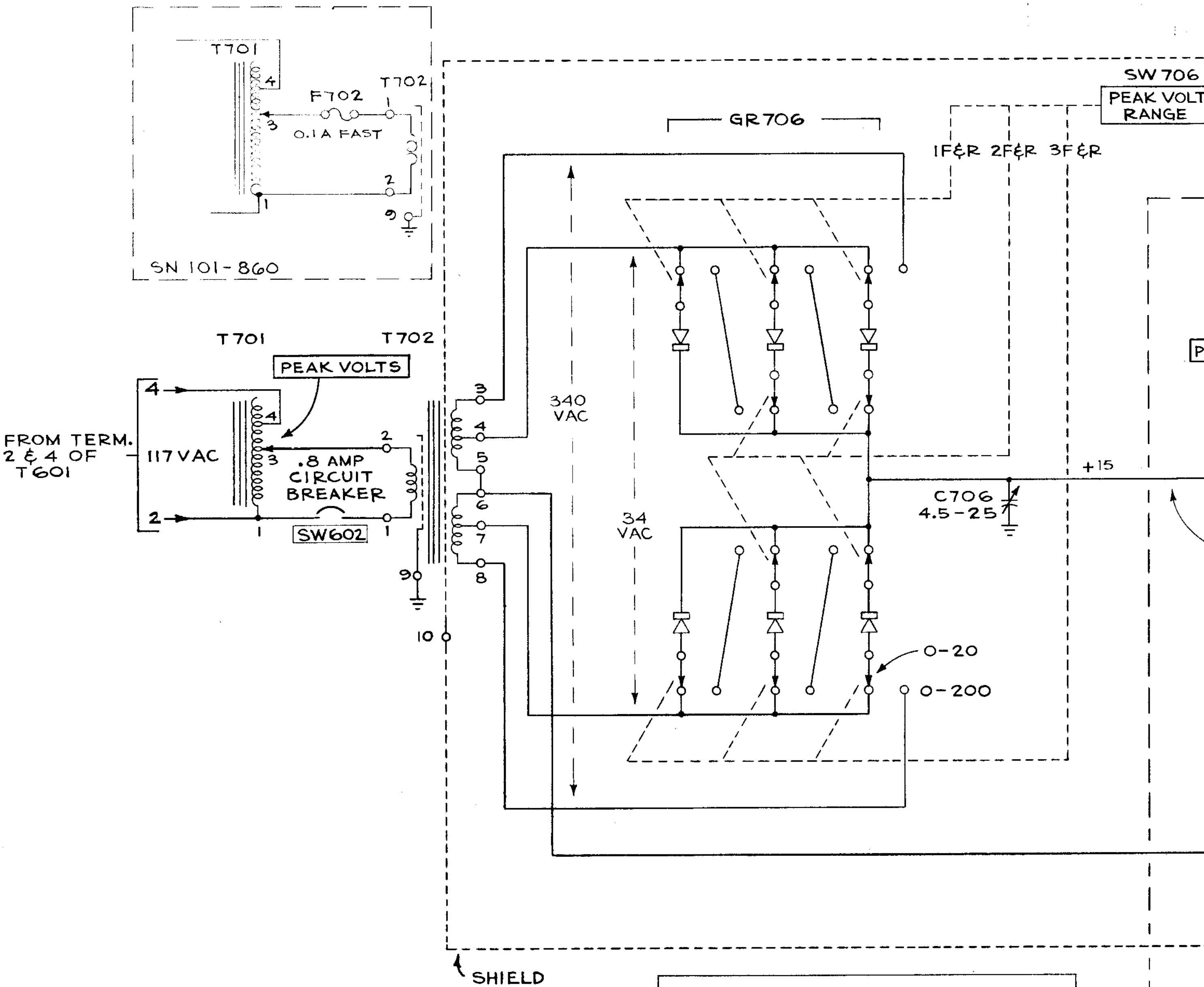
STEP AMPLIFIER



SIMPLIFIED SWITCHING DIAGRAM



HORIZONTAL & VERTICAL AMPLIFIERS



VOLTAGE READINGS WERE OBTAINED
WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117 V AC
PEAK VOLTS RANGE	0-20
PEAK VOLTS	FULL RIGHT
POLARITY	+
DISSIPATION LIMITING RESISTOR	0
TRANSISTOR SELECTOR	OFF

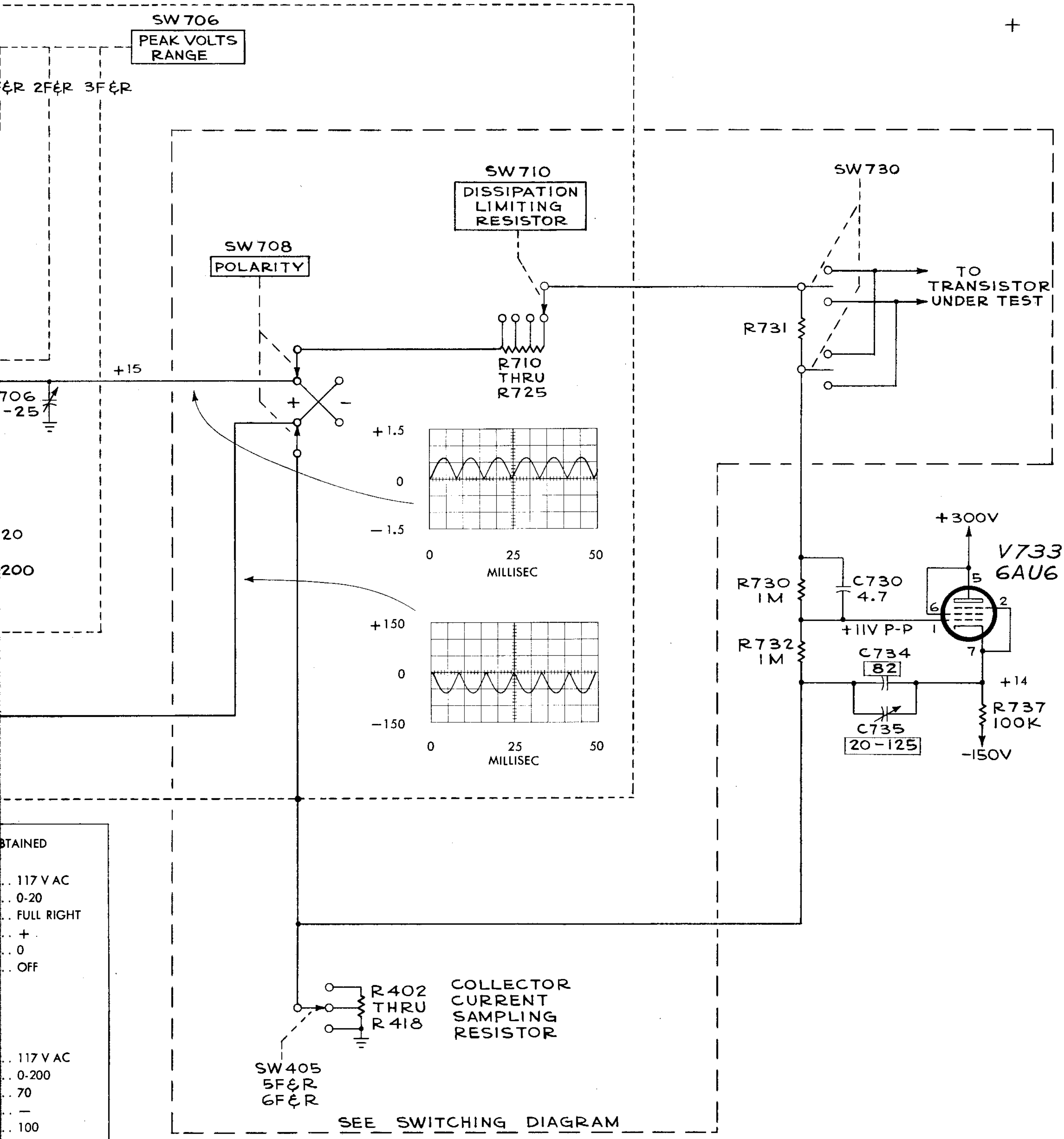
WAVEFORMS WERE OBTAINED
WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117 V AC
PEAK VOLTS RANGE	0-200
PEAK VOLTS	70
POLARITY	—
DISSIPATION LIMITING RESISTOR	100
CURRENT OR VOLTAGE/DIV	100 MA
TRANSISTOR SELECTOR	TRANSISTOR A
TERMINAL C	GROUNDED

A 575 COLL. SWP.

TYPE 575 TRANSISTOR-CURVE TRACER

AB2



TAINED

.. 117 V AC
.. 0-20
.. FULL RIGHT
.. +
.. 0
.. OFF

.. 117 V AC
.. 0-200
.. 70
.. —
.. 100
.. 100 MA
.. TRANSISTOR A
.. GROUNDED

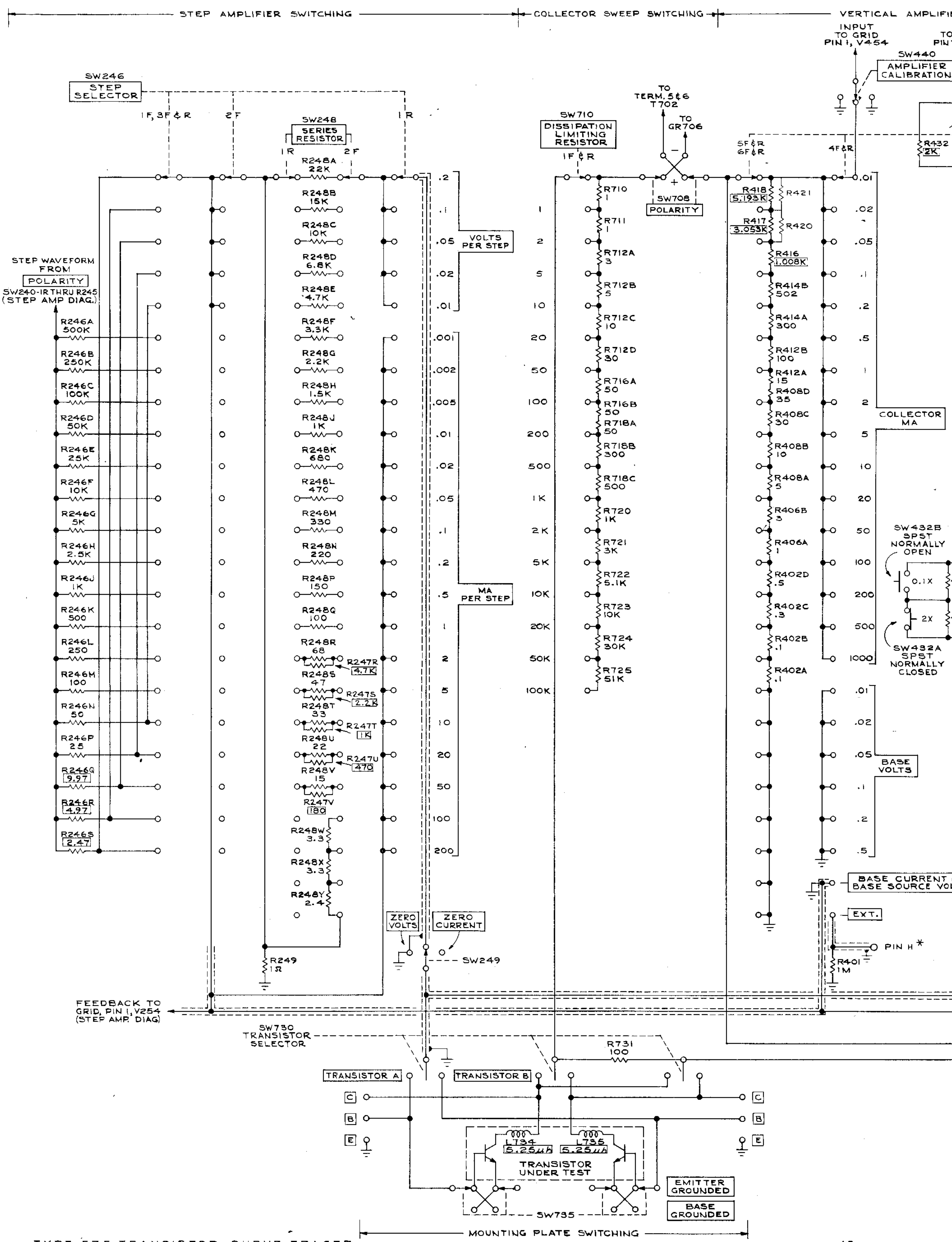
575 COLL. SWP.

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

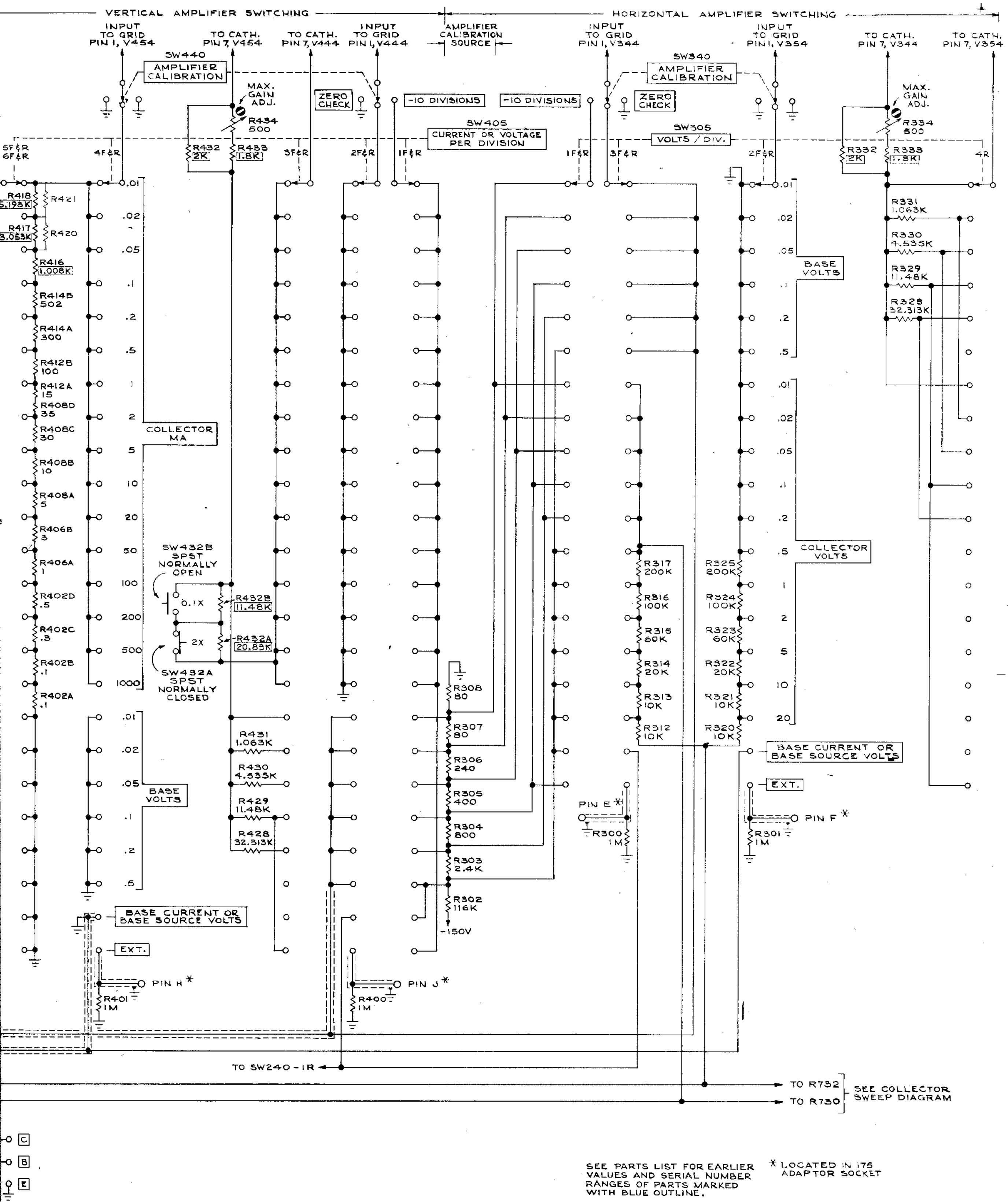
GAB 964

AB2

COLLECTOR SWEEP


STEP AMPLIFIER SWITCHING
COLLECTOR SWEEP SWITCHING
VERTICAL AMPLIFI
SW246 STEP SELECTOR
SW248 SERIES RESISTOR
SW710 DISSIPATION LIMITING RESISTOR
SW708 POLARITY
SW440 AMPLIFIER CALIBRATION
INPUT TO GRID PIN 1, V454
TO TERM. 5&6 T702
TO GR706
VOLTS PER STEP
MA PER STEP
COLLECTOR MA
BASE VOLTS
STEP WAVEFORM FROM POLARITY SW240-1R THRU R245 (STEP AMP DIAG.)
SW432B SPST NORMALLY OPEN
SW432A SPST NORMALLY CLOSED
BASE CURRENT
BASE SOURCE VO
EXT.
PIN H *
ZERO VOLTS
ZERO CURRENT
SW249
FEEDBACK TO GRID, PIN 1, V254 (STEP AMP. DIAG.)
SW730 TRANSISTOR SELECTOR
TRANSISTOR A
TRANSISTOR B
TRANSISTOR UNDER TEST
EMITTER GROUNDED
BASE GROUNDED
SW735
MOUNTING PLATE SWITCHING

AE



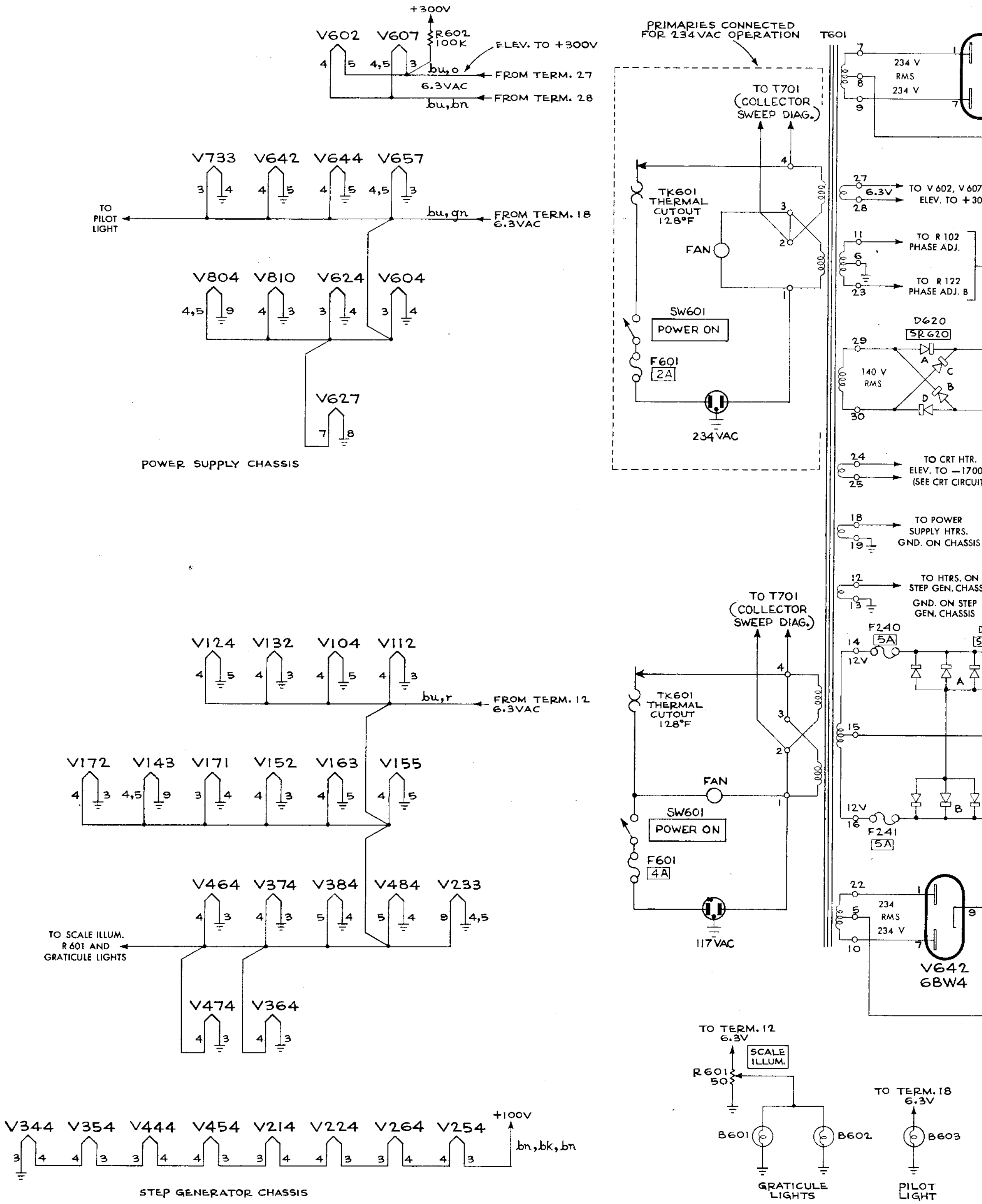
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

* LOCATED IN 175 ADAPTOR SOCKET

MRH
764

AE

DETAILED SWITCHING DIAGRAM

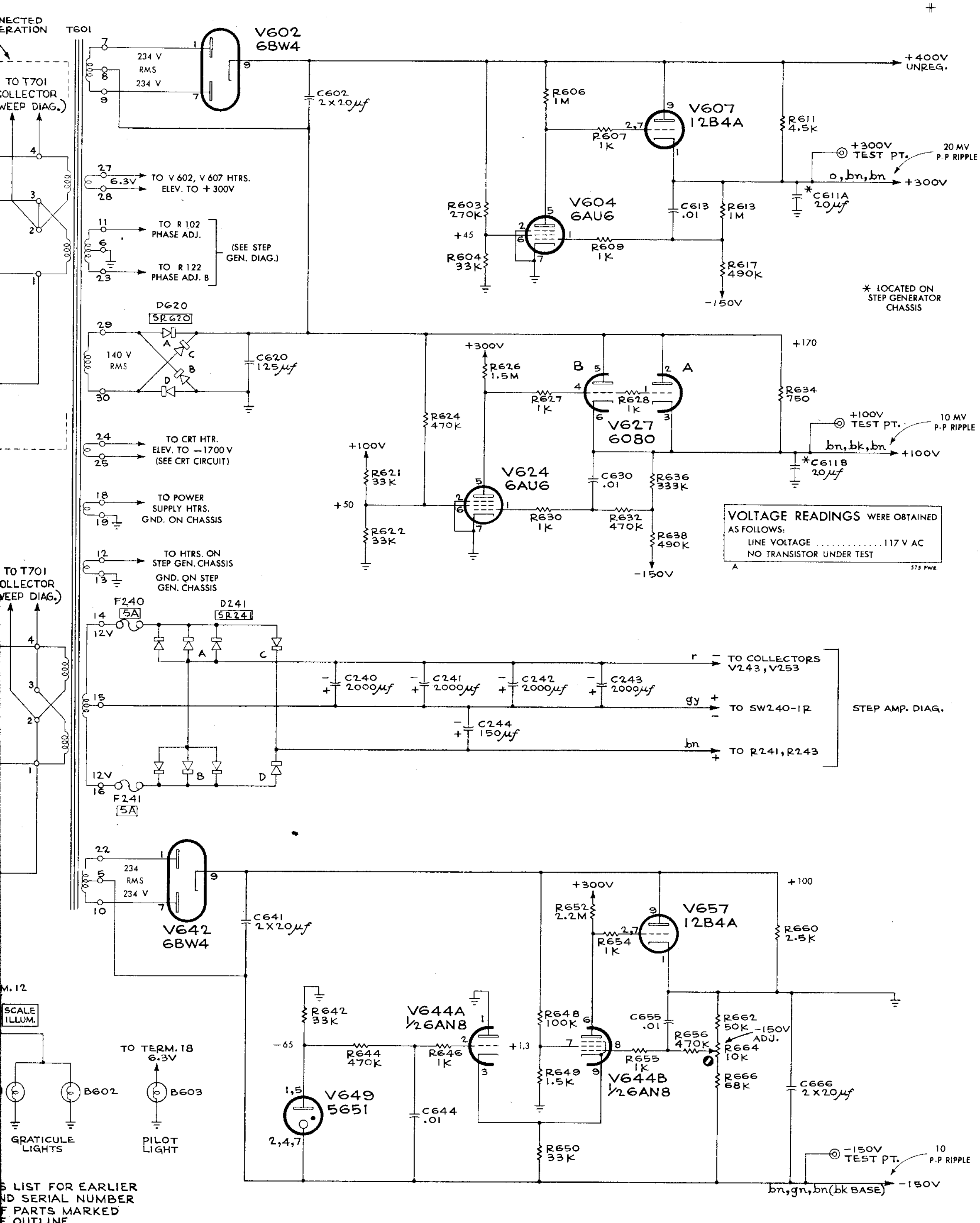


HEATER WIRING

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

TYPE 575 TRANSISTOR-CURVE TRACER

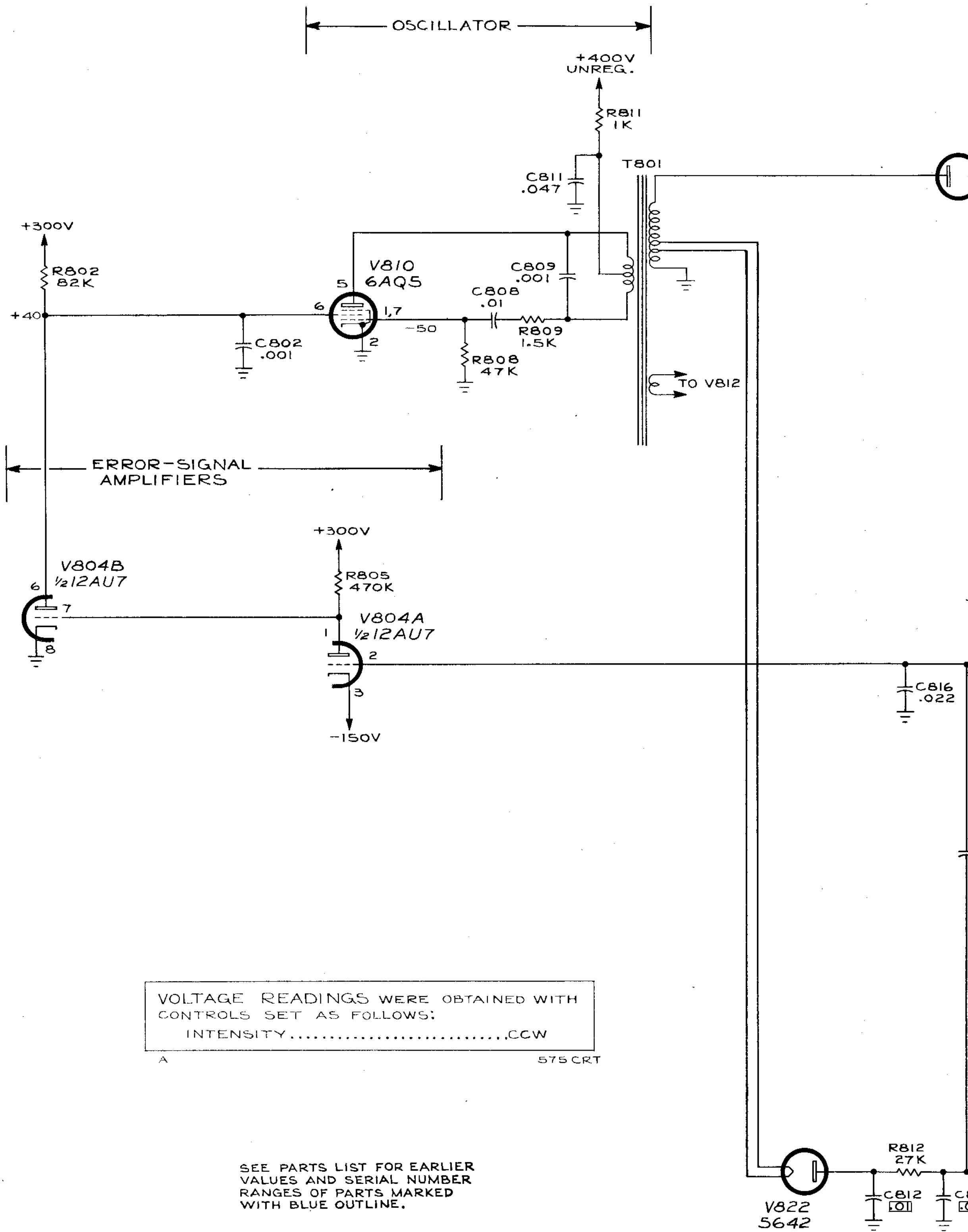
AE



AE

MAIN POWER SUPPLY

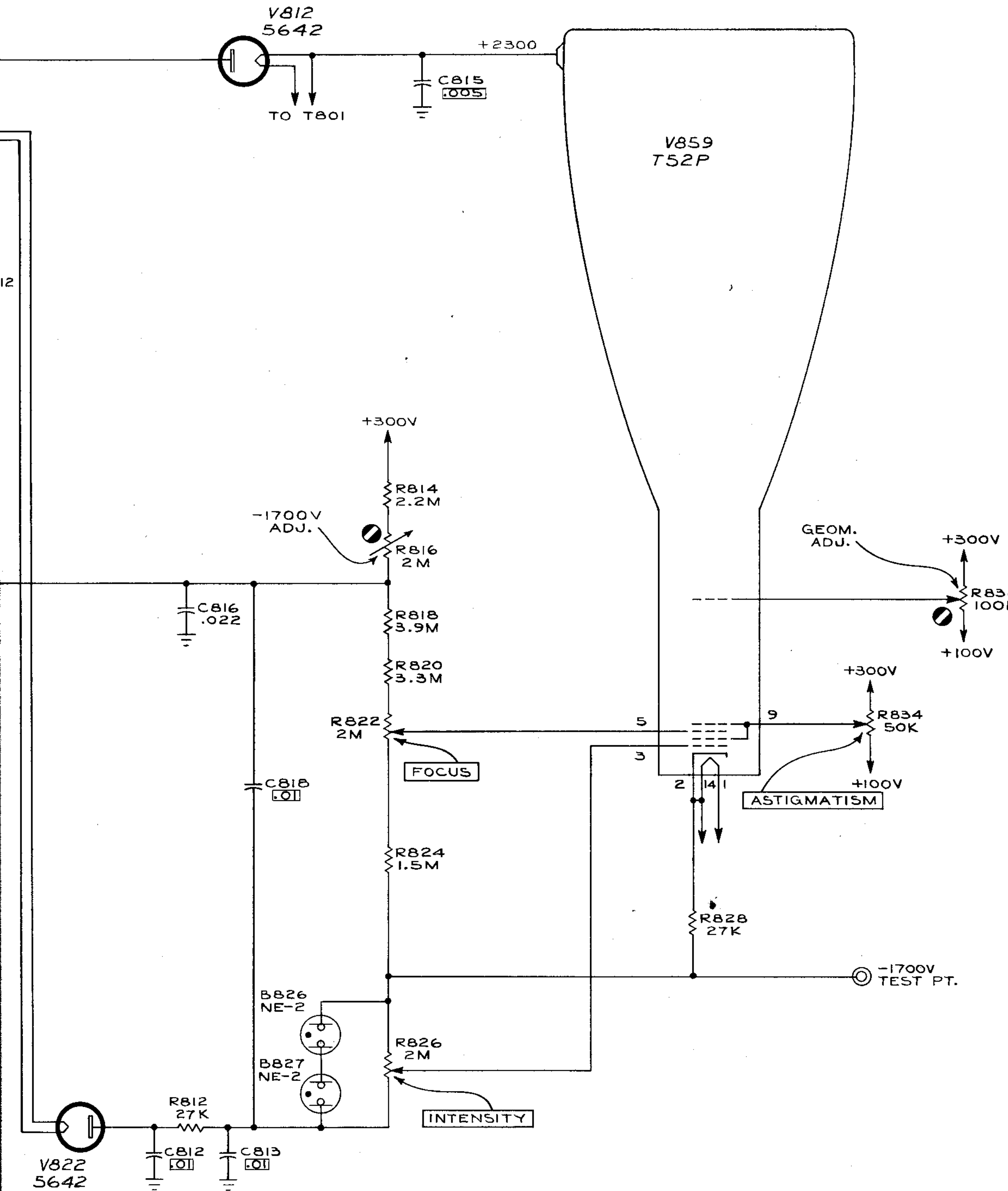
T.D.B. 764



VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
INTENSITY..........................CCW

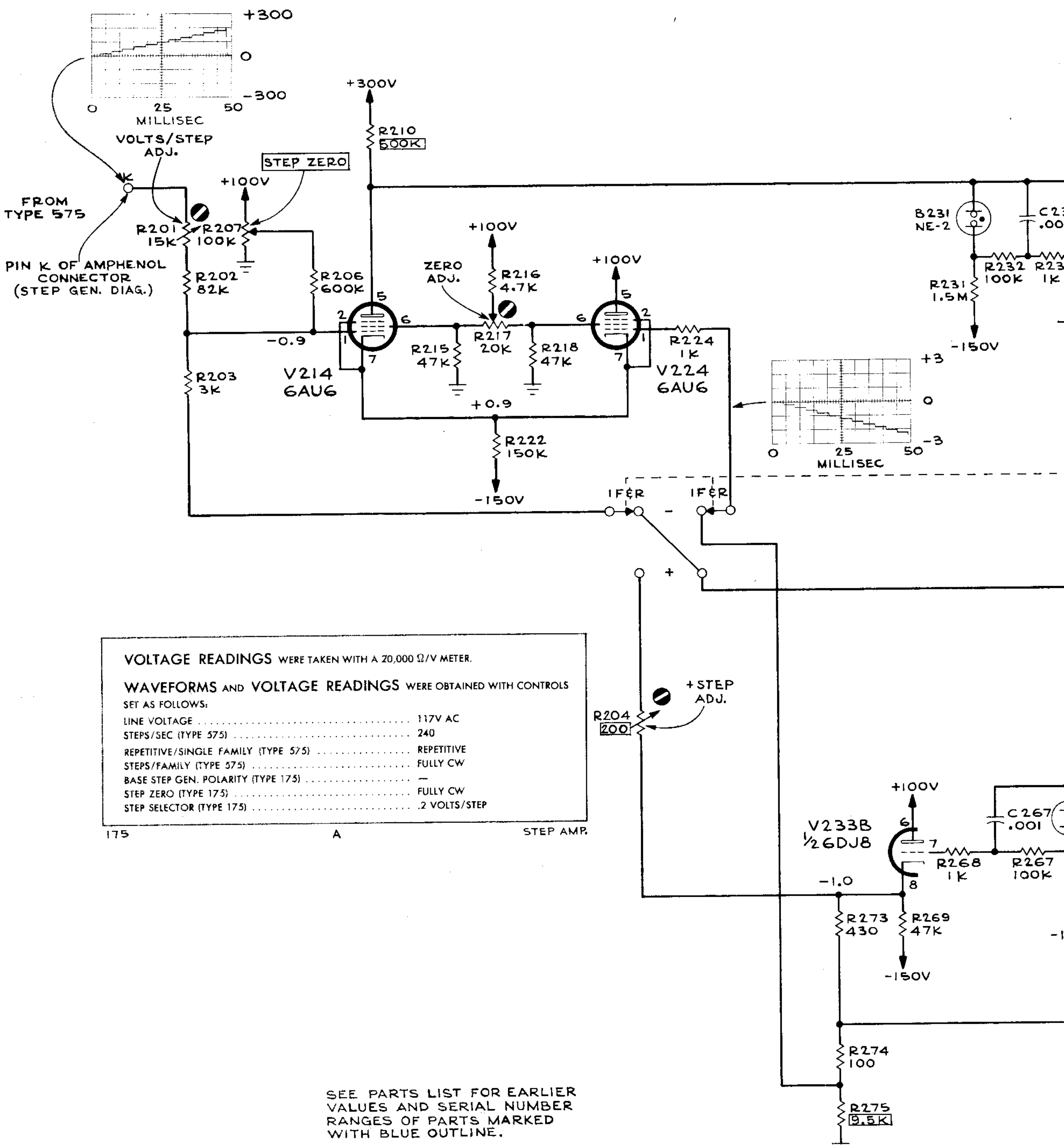
A 575 CRT

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



AB1

PLM
664
CRT CIRCUIT



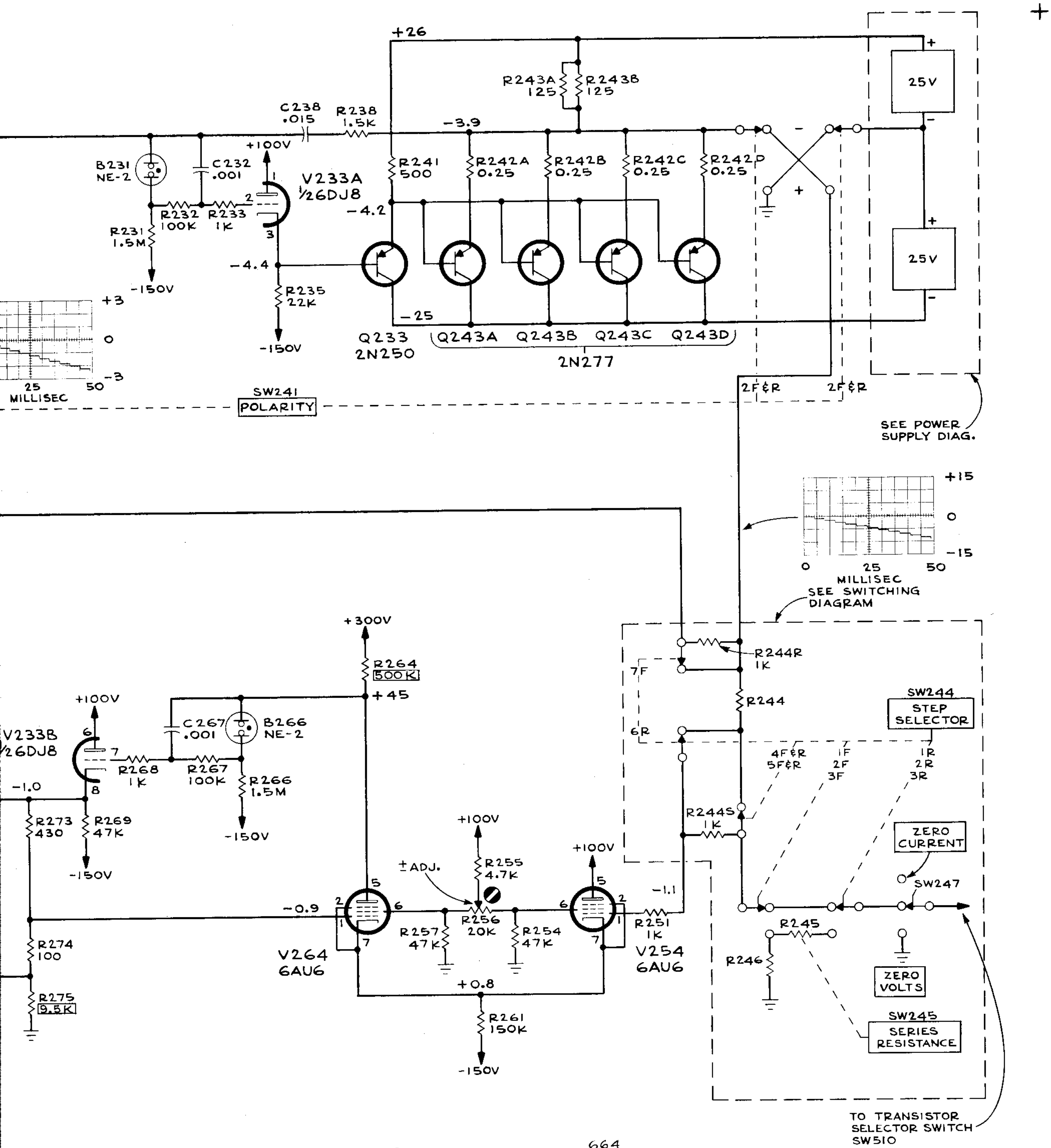
VOLTAGE READINGS WERE TAKEN WITH A 20,000 Ω/V METER.

WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117V AC
STEPS/SEC (TYPE 575)	240
REPETITIVE/SINGLE FAMILY (TYPE 575)	REPETITIVE
STEPS/FAMILY (TYPE 575)	FULLY CW
BASE STEP GEN. POLARITY (TYPE 175)	—
STEP ZERO (TYPE 175)	FULLY CW
STEP SELECTOR (TYPE 175)	.2 VOLTS/STEP

175 A STEP AMP.

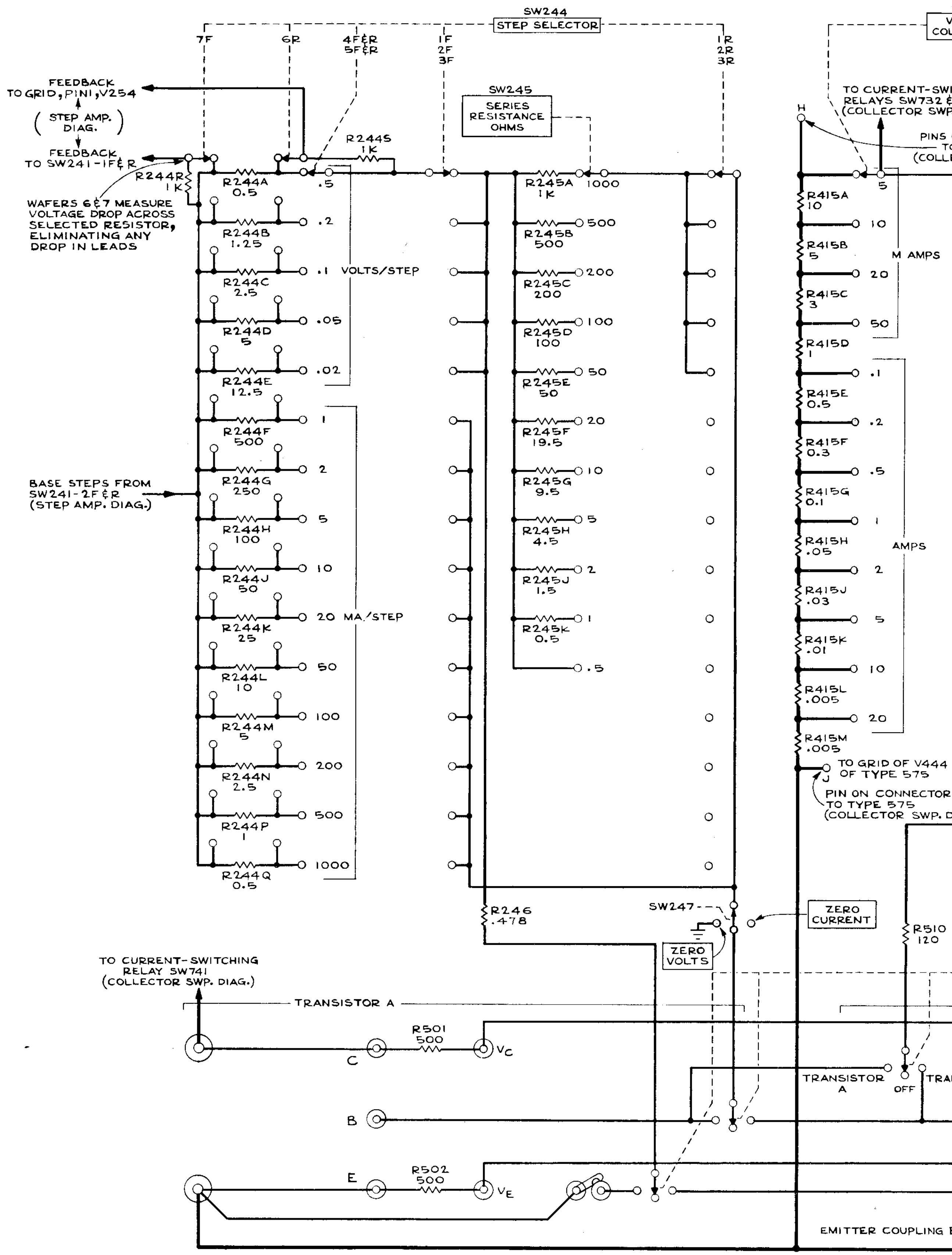
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.



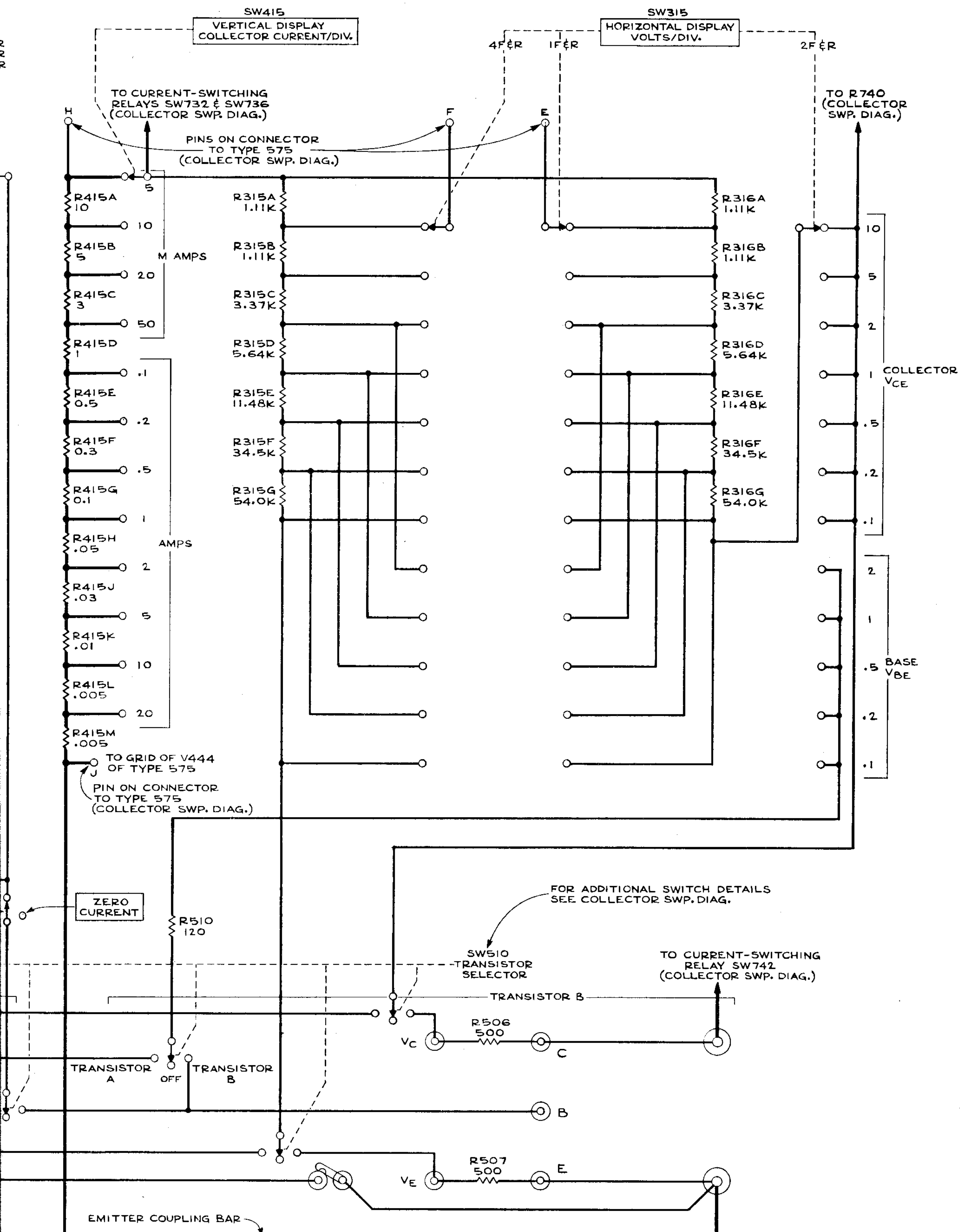
664
TP

STEP AMPLIFIER

PTOR C2



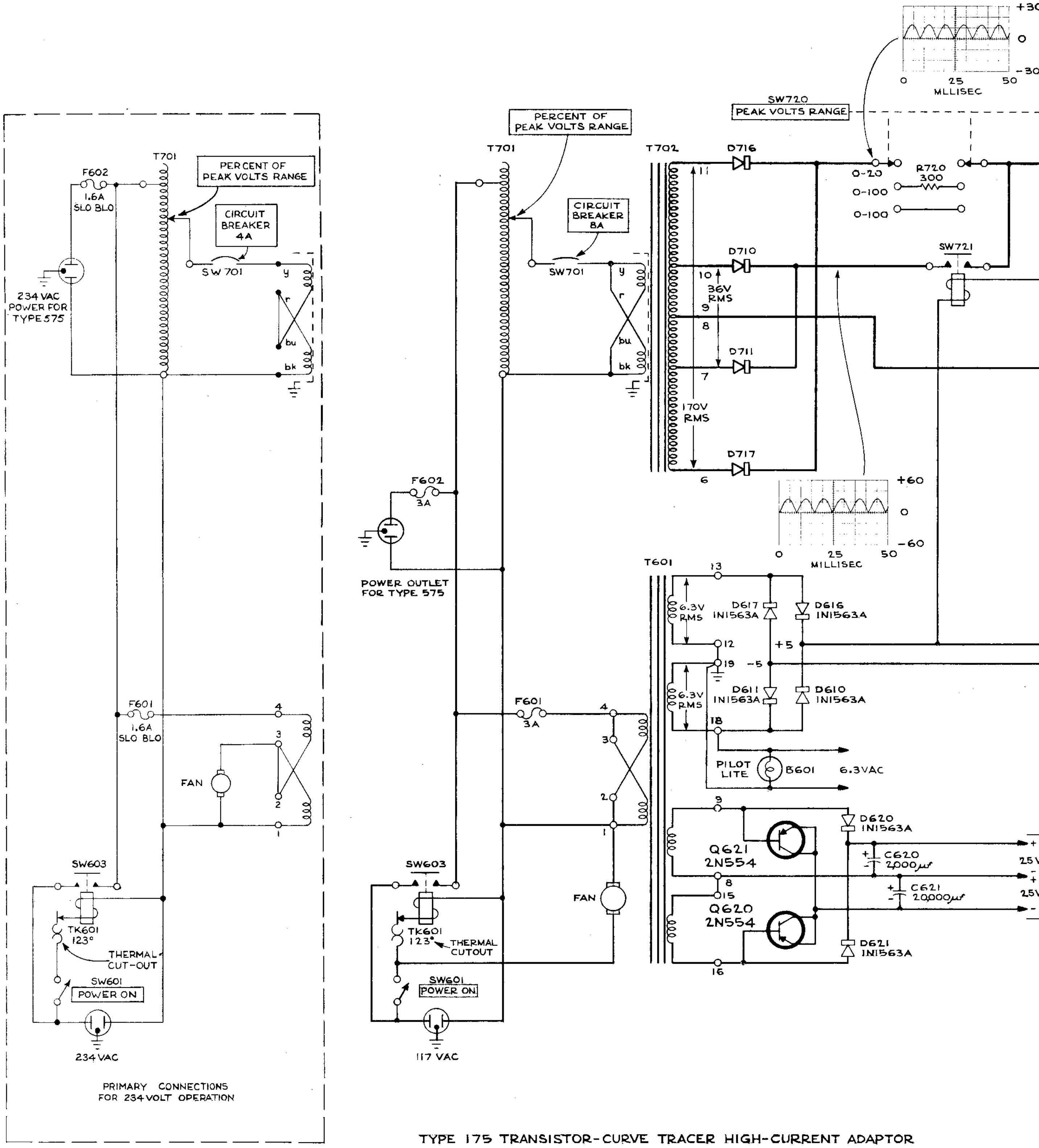
TYPE 175 TRANSISTOR-CURVE TRACER HIGH-CURRENT ADAPTOR



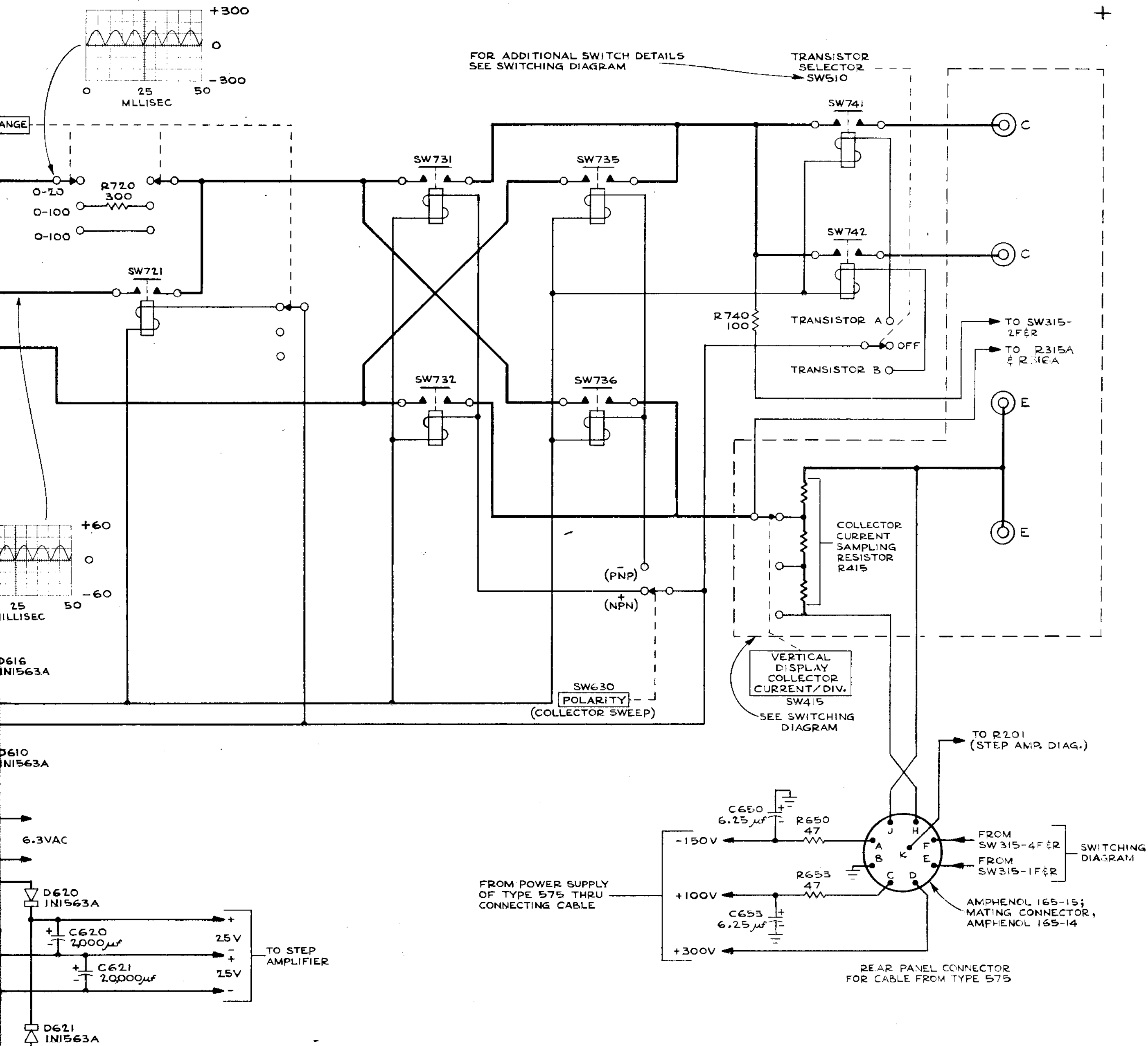
03-21-62

SWITCHING DIAGRAM

A 3



TYPE 175 TRANSISTOR-CURVE TRACER HIGH-CURRENT ADAPTOR



WAVEFORMS AND VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

LINE VOLTAGE	117 V
PERCENT OF PEAK VOLTS RANGE	FULLY CW

175 A COLLECTOR SWP. & POWER

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.

TYPE 175 - TENT. S/N 393

PARTS LIST CORRECTION

CHANGE TO:

SW510	TRANSISTOR SELECTOR	*260-636

M6983/664

SECTION 1 SPECIFICATIONS

Base Step Generator (Page 1-1, Paragraph 3)

CHANGE TO:

5 voltage-step ranges from .01 volt/step to .2 volt/step ±3%, with output impedance adjustable from 1 ohm to 22 thousand ohms ±10%, plus 0.1 ohm (wiring and switch contact resistance).

SECTION 5 RECALIBRATION PROCEDURE

2. Checking the Series Resistor Switch (Page 5-1, Line 6)

CHANGE TO:

(±10%)

9. Horizontal Gain (Page 5-3, Paragraph a.)

CHANGE TO:

Last sentence should read as follows:

If not, alternately adjust the horizontal MIN GAIN ADJ and the Horizontal POSITION control until the deflection is exactly 10 divisions.

Type 175 Tent. S/N 570

PARTS LIST CORRECTION

Change to:

Q233	151-0137-00	2N2148

MODIFICATION KIT

SILICON RECTIFIER

For Tektronix Type 575 Transistor-Curve Tracer
Serial numbers 101-4929

040-0223-00

DESCRIPTION

This modification replaces the selenium rectifiers with silicon rectifiers. Silicon rectifiers offer more reliability and longer life.

The following selenium rectifiers are replaced: SR241 (part number 106-0043-00); SR620 (106-0044-00).

Publication:
Instructions for 040-0223-00
March 1966

Supersedes:
December 1965

PARTS LIST

Quantity		Description	Part Number
1 ea		Assembly, silicon rectifier, consisting of:	
	2 ea	Strip, cer, 3/4 x 7 notches, clip-mounted	124-0089-00
	6 ea	Diode, silicon, 500-750 mA 400 PIV	152-0066-00
	2 ea	Diode, silicon 15 A 100 PIV	152-0088-00
	2 ea	Fuse, w/pigtail, 5 A fast-blo	159-0053 00
	1 ea	Lug, solder, SE4, w/2 wire holes	210-0201-00
	1 ea	Grommet, rubber, 1/4"	348-0002-00
	4 ea	Spacer, nylon-molded, 0.156	361-0008-00
	1 ea	Bracket, silicon rectifier mounting	406-0815-00
	1 ea	Wire, #20 solid, 4 in. white-red	(175-0510-00)
3 ea		Washer, flat, 6L x 3/8	210-0803-00
3 ea		Screw, 6-32 x 5/16 PHS, Phillips	211-0507-00
2 ea		Screw, 4-40 x 1/4 PHS, thread-forming type B, Phillips	213-0088-00
1 ea		Spool, w/3 ft. silver-bearing solder	214-0210-00

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

( ) 1. Remove the air filter from the rear of the instrument.

( ) 2. Remove the six screws which hold the fan ring to the rear panel and move the fan assembly to one side. Do not unsolder the two fan motor leads.

( ) 3. Unsolder all the wires from the selenium rectifier stacks, SR241 and SR620, located behind the fan motor.

( ) Unsolder the two wires from the thermal cutout, mounted on the selenium rectifier bracket.

( ) 4. Remove the selenium rectifiers and brackets from the instrument.

NOTE: One of the nuts holding a bracket to the chassis is under the high voltage shield and can be removed with the use of a needle-nose pliers.

( ) 5. Remove the thermal cutout from the selenium rectifier bracket and install it on the silicon rectifier bracket (from kit), using the 4-40 x 1/4 thread-forming screws from the kit.

NOTE: Mount the solder lug between the screw head and the thermal cutout (see Fig 1, step 5).

( ) 6. Mount the silicon rectifier assembly (from kit), as shown in Fig 1. Use the 6-32 x 5/16 PHS screws and #6 flat washers (from kit), placing a flat washer under each screw head. (Insert screws from bottom of chassis.)

( ) 7. Wire the silicon rectifier assembly, as shown in Fig 2.

( ) Resolder the wires, unsoldered in step 3, to the thermal cutout.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Replace the air filter, removed in step 1, and the fan assembly, displaced in step 2.

( ) Turn the instrument on and check the power supplies for proper voltages and regulation.

NOTE: If adjustments are made to the power supply, it will be necessary to check the calibration of the instrument.

( ) Place the Manual insert page in your Instruction Manual.

JT:cet

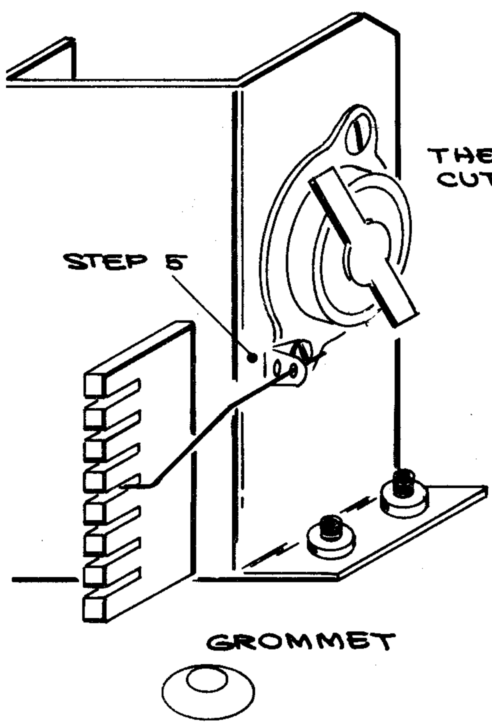


Fig 1

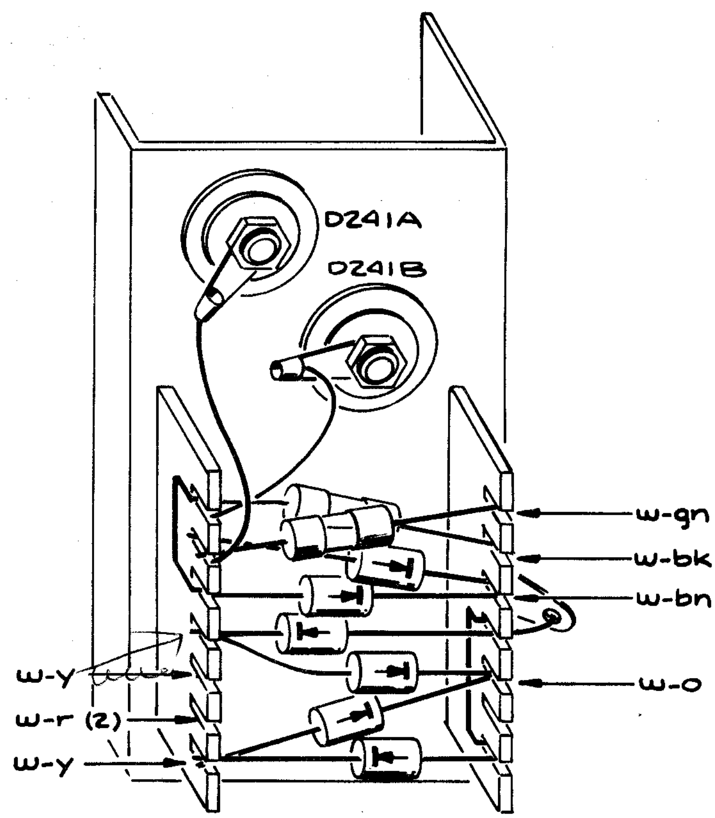
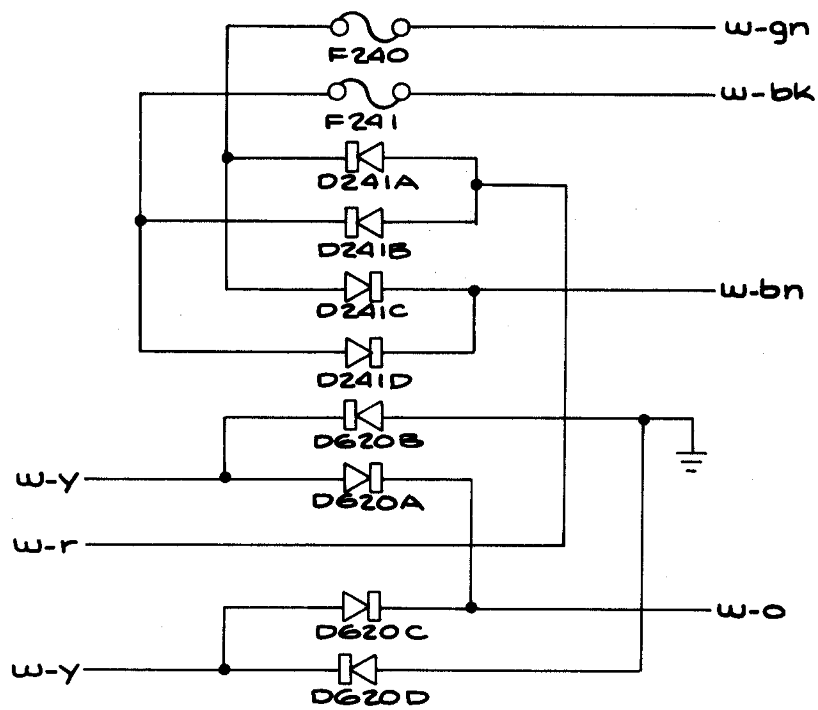


Fig 2
(See wiring schematic on following page.)


w-gn
F240
w-bk
F241
D241A
D241B
w-bn
D241C
D241D
D620B
w-y
D620A
w-r
D620C
w-o
w-y
D620D

SILICON RECTIFIER

Type 575 -- s/n 101-4929

Installed in Type 575 s/n _______ Date _______

GENERAL INFORMATION

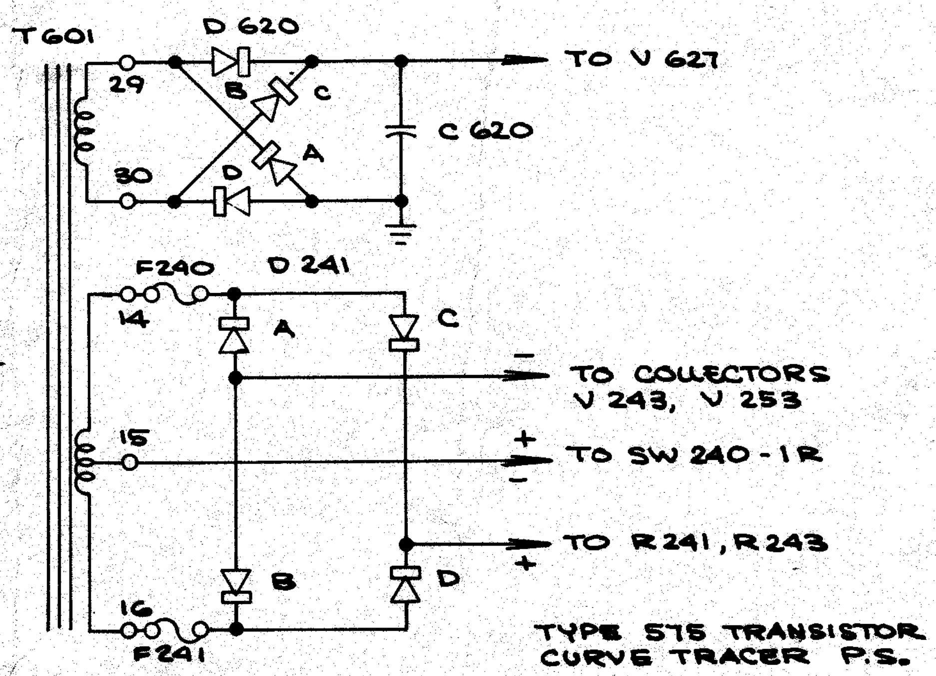
This modification replaces the selenium rectifiers with silicon rectifiers. Silicon rectifiers offer more reliability and longer life.

ELECTRICAL PARTS LIST

Only new parts listed.

Ckt. No.	Part Number	Description		
		DIODES		
D241A, B	152-0088-00	15 A	100 PIV	silicon
D241C, D	152-0066-00	500-750 mA	400 PIV	silicon
D620A, B, C, D	152-0066-00	500-750 mA	400 PIV	silicon
		FUSES		
F240	159-0053-00	5 A	fast-blo	w/pigtail
F241	159-0053-00	5 A	fast-blo	w/pigtail

SCHEMATIC



040-0223-00