

# INSTRUCTION MANUAL

Serial Number

9285

002288



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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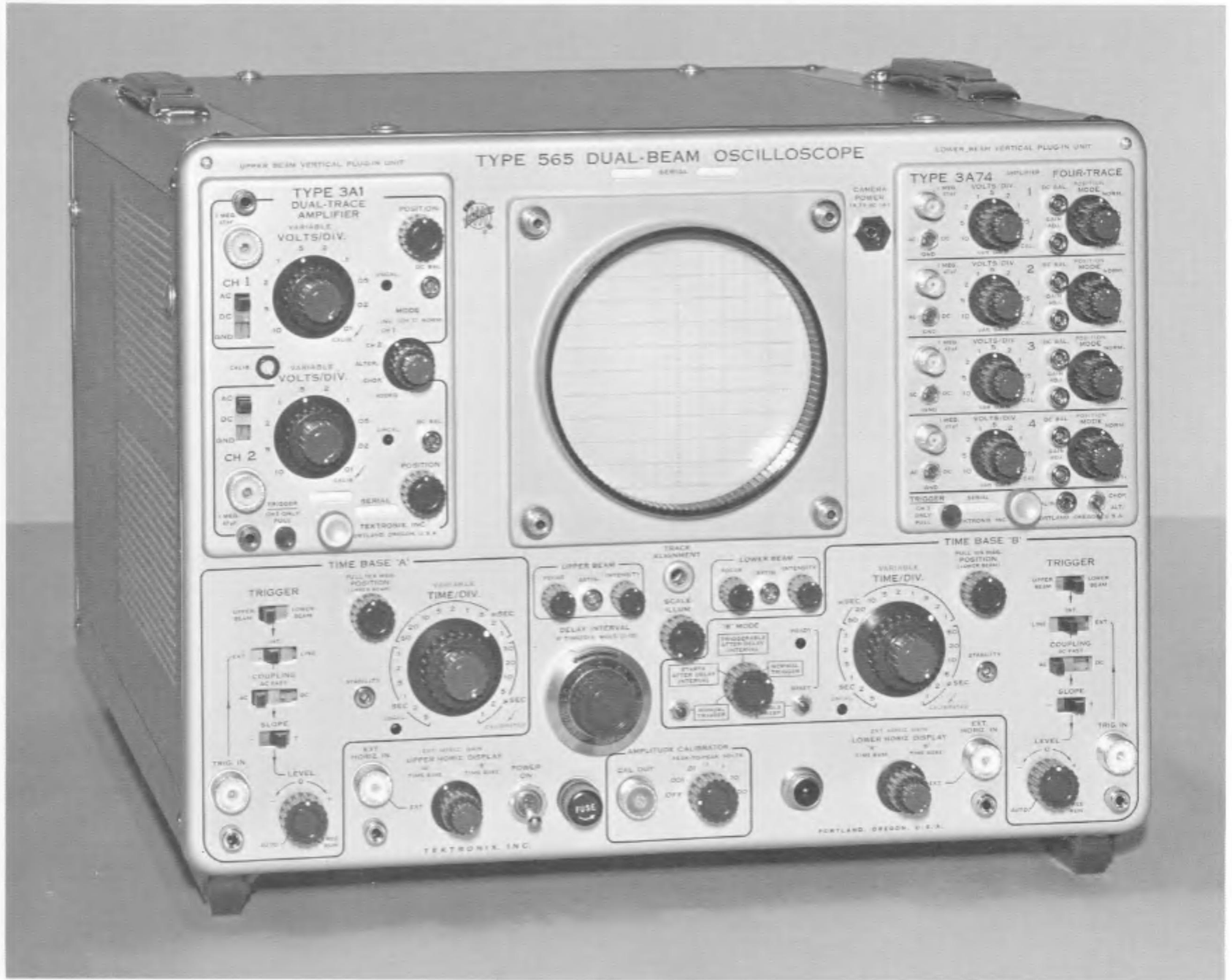
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# SECTION 1

## CHARACTERISTICS

The Type 565 is a dual-beam oscilloscope; essentially two oscilloscopes in one cabinet. Two internal horizontal and two plug-in vertical deflection systems permit independent operation of the two cathode-ray tube (crt) beams. Either of the two time-base generators can control the sweep of either or both of the beams.

Each vertical deflection system utilizes any of the Tektronix non-sampling signal amplifier plug-in units intended for use with 560-Series instruments. The choice of plug-in units depends on the application and those used need not be the same type.

Special circuits in the Type 565 Oscilloscope permit an accurate, continuously variable delay in the presentation of a sweep from 10 microseconds to 50 seconds after receipt of a fast rise triggering impulse. This feature permits expanded observation of a small portion of the normal sweep, accurate measurement of signal jitter, precise time measurement and many other uses.

### VERTICAL DEFLECTION SYSTEM

The characteristics of both vertical channels are those of the plug-in units used. The capacitances of the two vertical deflection plate systems of the cathode-ray tube are equalized to assure uniform plug-in unit high frequency response.

### HORIZONTAL DEFLECTION SYSTEM

#### Sweep Rates—Time Base 'A' and Time Base 'B'

Calibrated sweep rates of 1 microsecond to 5 seconds per division in 21 steps. An uncalibrated control permits sweep rates to be varied continuously between 1 microsecond and about 12 seconds per division.

Sweep rate accuracy (with 10X MAG. turned off):

Upper Beam driven by Time Base 'A' and Lower Beam driven by Time Base 'B'; within 3%.

Both beams driven by Time Base 'A'; Lower Beam sweep rate is accurate within 4%.

Both beams driven by Time Base 'B'; Upper Beam sweep rate is accurate within 4%.

Simultaneous crossed operation not recommended (Upper Beam driven by Time Base 'B' and Lower Beam driven by Time Base 'A').

#### 10X Magnifier—Upper and Lower Beam

Provides a horizontal magnification of X10 of the center 1-centimeter portion of the unmagnified crt display when the internal time base generators provide the horizontal deflection. Extends the fastest sweep rate of either beam to 0.1 microsecond per division. Magnified sweep rates are accurate within 5% except in simultaneous crossed operation.

#### External Horizontal Inputs—Upper and Lower Beams

Deflection Factor—Continuously variable from zero to at least 10 major graticule-divisions deflection per volt.

Maximum Input Voltage—300 volts, rms.

Frequency Response—Dc to at least 350 kc (–3 db) at maximum sensitivity.

Approximate Input Characteristics—Resistance, 100 kilohms.

### TRIGGERING—TIME BASES 'A' and 'B'

#### Trigger Signal Sources

Upper or lower Beam vertical signal, external signals, or power line signal.

#### Triggering Modes

AC, AC Fast, DC, and Automatic.

#### Triggering Signal Requirements

Internal—Depends upon the plug-in unit. Dc to 1-megacycle sinewave; typically, signals which produce 0.3 major graticule division vertical deflection will provide stable triggering with proper setting of the LEVEL control. Above 1-megacycle, increased signal amplitude is required.

External—Dc to 1-megacycle sinewave; less than 1-volt to 15-volts, peak, depending upon the LEVEL control setting. Above 1-megacycle, greater signal voltage is required. (Sweeps will trigger on signals greater than 15 volts peak, but the LEVEL control operates over a range of about + and – 15 volts.)

#### Delayed Sweep

See Section 2, "Starts After Delay Interval".

### CATHODE RAY TUBE (crt)

Type—T5650-2-1 Aluminized.

Phosphor—Type P2 standard; P31 is recommended for fast sweep rate, low duty-cycle applications. P1, P7, and P11, P31 phosphors optional.

#### Internal Unblinking

Dc coupled to blanking deflection plates.

#### External Intensity (Z axis) Modulation — Upper and Lower Beams

Ac coupled to crt control grids through rear panel input jacks. Input time constant depends on INTENSITY control setting and external circuit impedance; typically about 3.5 milliseconds at normal intensity with low external impedance.

## Characteristics — Type 565

Typically, a 10 volt peak-to-peak signal will produce visible intensity modulation.

### Dual Trace Chopped Blanking

Crt circuit permits vertical plug-in units with multi-trace blanking to turn off the display while switching between input channels.

### Useable Viewing Area

10 by 10 centimeters. 10-centimeter total vertical deflection consists of 8 centimeters for each beam with 6 centimeters common to both beams.

### Graticule Markings

Internally marked in 10 vertical and 10 horizontal 1-centimeter (major) divisions. 2-millimeter markings (minor divisions) on the vertical centerline and on the horizontal centerlines of both the Upper and Lower Beam; 4 centimeters from top and bottom.

### Graticule Illumination

Variable edge lighting.

### Alignment

Traces are parallel to one another within  $\frac{1}{4}$  major division per 10 major divisions when both traces are vertically positioned at the center of the crt.

## AMPLITUDE CALIBRATOR

### Output Signal

Square waves at about 1,000 cycles.

### Output Voltage

1 millivolt to 100 volts in decade steps.

### Accuracy

Peak-to-peak amplitude within 3% of indicated voltage as measured between center jack and the shield portion of the CAL. OUT connector. Accuracy is degraded somewhat if CAL. OUT is connected to loads under 1-megohm.

## OTHER CHARACTERISTICS

### Output Signals Available

#### CAUTION

The voltage at the following rear-panel output connectors may exceed  $\pm 100$  volts during instrument turn-on and warm-up:

- LOWER VERT. SIG. OUT
- LOWER HORIZ. SIG. OUT
- UPPER VERT. SIG. OUT
- UPPER HORIZ. SIG. OUT

External devices which could be damaged by this voltage should be disconnected during turn-on and warm-up of the Type 565.

Current drain from the following rear-panel output connectors must not exceed 2 milliamps (total—due to dc level plus signal peak):

### DEL'D TRIG. OUT

A differentiated, positive-going pulse at least 8 volts in amplitude, occurring at the end of the delay interval ('A' TIME/DIV. multiplied by DELAY INTERVAL dial setting). No dc output between pulses.

### 'A' + GATE OUT

An approximate 20-volt peak-to-peak positive-going pulse with same duration as 'A' sweep. No dc output between pulses.

$$R = \frac{20}{2 \times 10^3} = 10K \Omega$$

### 'B' + GATE OUT

An approximate 20-volt peak-to-peak positive-going pulse with same duration as 'B' sweep. No dc output between pulses.

### UPPER and LOWER HORIZ. SIG. OUT

An approximate 5-volt sawtooth when the horizontal deflection is produced by either time-base generator. Output dc level between sweeps is about +1 to +2 volts.

A dc-coupled signal of at least 0.05 volt per major division of horizontal deflection when the deflection is produced by an external signal. Dc level of output signal depends on dc level of input signal. Output voltage swing limited to between about +1 and +15 volts. Dc output with no input is about +2 volts.

### UPPER and LOWER VERT. SIG. OUT

Dc coupled\*. Obtained from the internal triggering signal output of the vertical plug-in unit and therefore depends on plug-in unit in respect to signal amplitude, dc level, and frequency response.

Signal amplitude is typically 2 to 4 volts per major division of displayed signal.

Dc signal level is within about  $\pm 20$  volts when beam is positioned within vertical limits of graticule.

### CAMERA POWER (on front panel)

Front-panel connector providing 6.3 volts ac from power transformer, fused at 1 amp.

### Power Supplies

Electronically regulated for stable operation with as much as  $-10\%$  to  $+7\%$  variation from design-center line voltage. Power supply voltages are available at the AUX. POWER JACK on the rear of the instrument. See Section 2 for power capabilities.

\*Except when using a Type 2A50 Plug-In Unit.

### Line Voltage Requirements

The instrument is wired for the design-center line voltage indicated on a metal tag on the instrument rear panel. Changes can be made in the internal wiring to permit operation with design-center line voltages of 110, 117, 124, 220, 234, or 248 volts. The transformer primary connections for each voltage is indicated on the diagram attached to the power transformer. Fan connections are indicated in Fig. 1-1. The line fuse (on the front panel) is a 6.25 amp slow-blowing type for 110, 117, 124 volts and 3 amp slow-blowing type for 220, 234, and 248 volts.

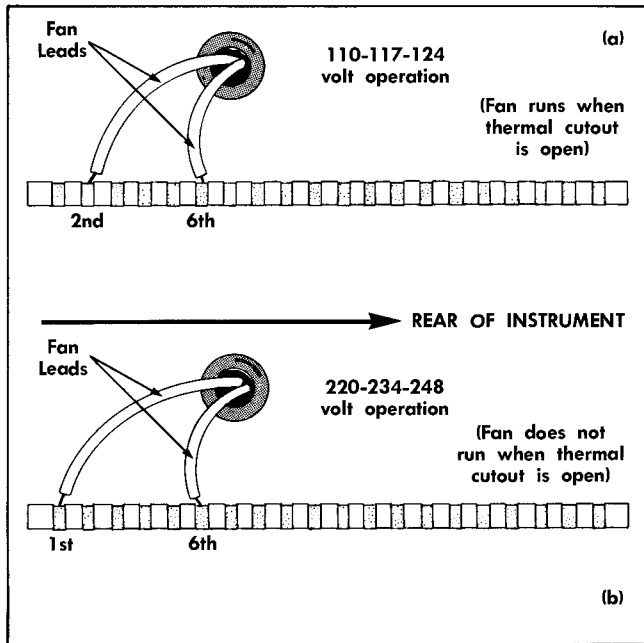


Fig. 1-1. Fan power connections.

### Line Frequency

50 to 60 cycles.

### Power Consumption

Maximum of about 600 watts including plug-in unit power consumption and excluding loads connected to the AUX. POWER JACK.

### Ventilation

Forced filtered air. The self-resetting thermal relay interrupts instrument power in the event of overheating. In instruments equipped with ac fans, the fan will continue to run during thermal interruption if the instrument is wired for design-center line voltages of 125 vac and below.

### Construction

Four-piece, blue vinyl finished cabinet, aluminum-alloy chassis, and photo-etched, anodized front panel.

### Dimensions

Width: 17 inches

Height: 13½ inches

Depth: 23¾ inches

Weight: 62 pounds



# SECTION 2

## OPERATING INFORMATION

### Introduction

This portion of the manual contains general information about the many features of the Type 565 and specific information about the use of each control. The information is intended to help you gain full use of the potentialities of the instrument.

### BRIEF DESCRIPTIONS OF CONTROL AND SWITCH FUNCTIONS

#### NOTE

More complete descriptions of the controls and switches and how to use them is included in the latter portion of this section.

#### UPPER BEAM

These controls and switches are located on the left half of the front panel and affect the upper beam display.

UPPER HORIZ. DISPLAY	(Upper Horizontal Display) Provides selection between 'A' TIME BASE, 'B' TIME BASE, and EXT. (external) signal sources for horizontal deflection of the upper beam.
EXT. HORIZ. GAIN	(External Horizontal Gain) Functions only when the UPPER HORIZ. DISPLAY switch is in the EXT. position. Permits variation of the external horizontal input deflection sensitivity to a maximum of about 0.1 volt per division.
POSITION (Upper Beam)	(Not part of Time Base 'A') Used to move the display horizontally. This is a combination coarse and vernier control. About 55° vernier adjustment is available at any position of the control.
10X MAG.	(Ten-Times Magnifier) Expands a one major division segment of the display to ten times normal width. The segment of the normal display which was positioned at the center of the crt will be displayed. When the 10X MAG. is used, the sweep rate is ten times faster than indicated by the TIME/DIV. switch. 10X MAG. has no effect when an external horizontal input is used.
FOCUS	Adjust in conjunction with the ASTIG. control to obtain sharpest possible trace definition.
ASTIG.	(Astigmatism) Adjusted so the FOCUS control can be set for equally sharp definition of both the horizontal and vertical portions of the display.
INTENSITY	Allows variation of trace brightness.

### LOWER BEAM

These controls and switches are located on the right half of the front panel. They are identical in function to those provided for the upper beam display, but affect only the lower beam display.

#### TIME BASE 'A'

These controls and switches are located on the left half of the front panel and affect only Time-Base 'A'.

#### TRIGGER

(UPPER BEAM) Functions only when the EXT.-INT.-LINE (LOWER BEAM) switch is in the INT. position. Selects between the Upper Beam and Lower Beam vertical channel signals as the source of triggering signal.

EXT.-INT.-LINE (External-Internal-Line) Provides a selection of triggering signal sources: external (EXT.) from TRIG. IN connector; internal (INT.) from either Upper or Lower Beam vertical channel, or a sample of the power line waveform (LINE).

COUPLING (AC-AC FAST-DC) Allows acceptance or rejection of some characteristics of triggering signals. AC rejects dc and very low frequency ac signals. AC FAST rejects signals below about 1 kc. DC accepts all frequencies and dc.

SLOPE (+ -) Determines whether the sweep will trigger on the positive-going or negative-going portion of a signal.

LEVEL (AUTO.-FREE RUN) A three function control. Except at the extreme clockwise and counterclockwise positions, it operates as a triggering LEVEL control. LEVEL selects the amplitude point on the triggering signal at which the sweep will trigger. AUTO. (automatic) overrides the function of the COUPLING switch and LEVEL control and selects AC coupling and '0' level. In the absence of a triggering signal, a reference trace is displayed on the crt (about 50 sweeps per second, maximum). The FREE RUN position provides recurrent sweeps at a rate depending upon the TIME/DIV. switch setting (about 12,000 sweeps per second at one microsecond per division).

STABILITY A screwdriver adjustment which sets the time-base generator susceptibility to pulses from the trigger circuits.

TIME/DIV. (Time Per Division) Selects the rate at which the spot moves across the crt.

VARIABLE An uncalibrated control which provides sweep rates other than those included on

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the TIME/DIV. switch. Rates to less than 0.4 of that indicated by the TIME/DIV. switch can be obtained.

**DELAY INTERVAL** ('A' Time Per Division Multiplied by a figure between one and ten). Used with 'A' TIME/DIV. switch to determine the delay interval between the start of 'A' sweep and the delayed trigger pulse. This pulse is fed to a rear-panel output connector and to the 'B' MODE switch. With the proper setting of the 'B' MODE switch, this pulse can either: (1) start 'B' sweep (STARTS AFTER DELAY INTERVAL) or (2) make 'B' sweep susceptible to trigger pulses (TRIGGERABLE AFTER DELAY INTERVAL).

### TIME BASE 'B'

These controls and switches are located on the right half of the front panel and are identical to those for Time-Base 'A' with the addition of the following:

**'B' MODE** Selects the type of operation that Time Base 'B' will perform. In the NORMAL TRIGGER position, the operation is identical to that of Time Base 'A'. TRIGGERABLE AFTER DELAY INTERVAL and STARTS AFTER DELAY INTERVAL are explained previously under "DELAY INTERVAL".

MANUAL TRIGGER and SINGLE SWEEP function as follows:

- MANUAL TRIGGER** Overrides all TIME BASE 'B' TRIGGER controls. The spot will sweep across the crt once each time the MANUAL TRIGGER button is pushed.
- SINGLE SWEEP** Permits Time Base 'B' to move the spot across the crt once each time the SINGLE SWEEP button is pushed. Pushing the button does not start the sweep; it permits the trigger circuit to do so.

### AMPLITUDE CALIBRATOR

**PEAK-TO-PEAK VOLTS** Selects output voltage delivered to the CAL. OUT connector from the available decade steps, .001 volt to 100 volts. It also permits turning off the Amplitude Calibrator.

### OTHER CONTROLS

- TRACE ALIGNMENT** Used to rotate the crt display to coincide with the graticule markings.
- SCALE ILLUM** (Scale Illumination) Adjusts the brightness of the graticule markings.
- POWER ON** Ac line switch.

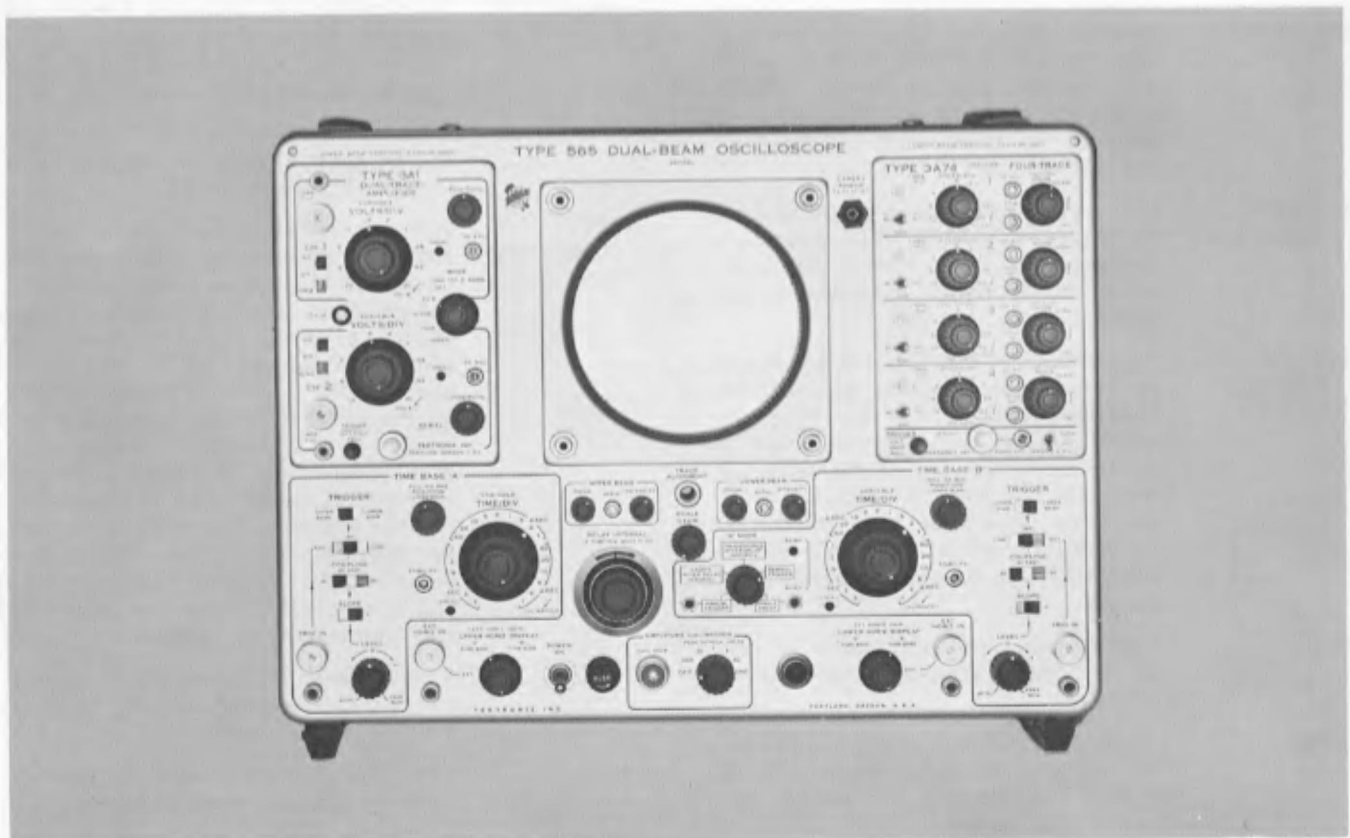


Fig. 2-1. Type 565 Oscilloscope front panel.

## FIRST-TIME OPERATION

The following information is intended to help you prepare your Type 565 Oscilloscope for first-time use. It is also suggested that a quick-check, similar to these steps, be performed each day before beginning measurements. Whenever plug-in units are exchanged, steps 10 and 11 must be checked.

1. Install any general-purpose amplifier plug-in units (e.g. 3A1, 3A2, 2A60, 2A63, 3A75, 3A72, 3A74, etc.).

2. Set Upper and Lower Beam display controls and switches as follows:

INTENSITY	counterclockwise
POSITION (horiz.)	centered
10X MAG.	off (pushed in)
UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE

3. Set the applicable controls and switches on both vertical plug-in units as follows:

VOLTS/DIV.	5
VARIABLE	CALIBRATED
AC-DC-GND.	AC
POSITION (vert.)	centered

4. Set TIME BASE 'A' and TIME BASE 'B' controls and switches as follows:

TIME/DIV.	.2 mSEC
VARIABLE	CALIBRATED
LINE—INT.—EXT.	LINE
LEVEL	AUTO.
STABILITY (screwdriver adjustment)	clockwise

5. Set the remaining controls and switches as follows:

'B' MODE	NORMAL TRIGGER
PEAK-TO-PEAK VOLTS	10

### NOTE

Controls not mentioned may be left in any position.

6. Connect the power cord to the proper voltage source and turn on instrument power.

7. Allow several minutes for the instrument to warm-up. Then, slowly advance the INTENSITY controls to obtain traces of moderate brightness. It may be necessary to re-adjust the vertical POSITION controls.

8. Slowly turn the Time Base 'A' STABILITY control counterclockwise. The upper beam trace should dim and then disappear. Set the STABILITY control in the middle of the "dim" range. Adjust the Time Base 'B' STABILITY control in the same manner.

### NOTE

This setting of the STABILITY control is correct for most applications. However, when the triggering signal frequency is above approximately one

megacycle, it may be necessary to make a slight readjustment to obtain a completely stable display.

9. Connect the CAL. OUT signal to the INPUT connector of both vertical plug-in units. Set the LINE—INT.—EXT. switch in both time-base blocks to INT. Adjust the INTENSITY controls so the vertical lines in the square wave display are just visible.

10. Adjust the FOCUS controls so the vertical and horizontal portions of each display are **equally** focused. Then adjust the ASTIG. controls for **best** focus in the horizontal and vertical portions of each display. Repeat the adjustments, if necessary, until no further improvement can be made.

### NOTE

It may be necessary to touch-up the FOCUS control adjustment whenever a major change is made in the INTENSITY control setting. In some applications, such as those involving low repetition rate signals displayed at fast sweep rates, a very dim display will be obtained. Since better display focus can be obtained when the INTENSITY control is set below maximum, you may wish to use a moderate INTENSITY control setting and a viewing hood. The viewing hood will block external light and make dim displays useable.

11. Use a screw driver to set the gain adjustment on the front panel of the plug-in units so each of the square wave displays is exactly 2 major divisions in amplitude. If you require additional information about this adjustment, see the manual for your particular plug-in unit.

12. Remove the signal input leads. Turn both trigger LEVEL controls fully clockwise. The traces should be parallel to the horizontal graticule lines. If not, adjust the TRACE ALIGNMENT control to remove any tilt.

### NOTE

The TRACE ALIGNMENT control is a screw-driver-adjustment located on the front panel just below the crt. This control permits the operator to easily offset any trace tilt introduced by the earth's magnetic field.

When the preceding steps have been completed, the Type 565 Oscilloscope is ready for use.

### NOTE

It is important that steps 10 and 11 be rechecked each time plug-in units are exchanged in the Type 565.

## USING THE TYPE 565

### Signal Input Connections

Signals to be displayed on the oscilloscope are connected to the input connectors of the vertical plug-in units. The signals within the plug-in unit are then changed to the proper amplitude and used to produce vertical deflection of the electron beams. It is frequently possible to make the input connections with unshielded test leads. This is particularly true when you are observing a high-level, low-

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frequency signal from a low impedance source. When test leads are used, place a ground connection between the oscilloscope chassis and the output "common" terminal of the signal source.

In many applications, unshielded leads are unsatisfactory for making input connections due to the noise pickup resulting from stray magnetic fields. In such cases, shielded cables should be used. The ground conductors of the cable must be connected to the chassis of the oscilloscope and the output "common" terminal of the signal source.

In high-frequency applications, it is usually necessary to terminate the signal source and connecting cable in their characteristic impedance. Unterminated connections may result in reflections in the cables and cause distortion of the displayed waveforms.

In general, a termination resistor connected at the input connector of the plug-in unit will produce satisfactory results. In some cases, however, it may be necessary to terminate cables at both ends. The need for proper terminations increases as frequency increases.

In analyzing the displayed waveforms, you must consider the loading effect of the oscilloscope on the signal source. The input resistance of the vertical plug-in unit is usually adequate to limit low-frequency loading to a negligible value. At high frequencies, however, the input capacitance of the plug-in unit and the distributed capacitance of input cables become important. Capacitive loading at high frequencies may be sufficient to adversely affect both the displayed waveform and operation of the signal source. Both capacitive and resistive loading can usually be limited to negligible values through use of attenuating signal probes.

### Signal Probes

In addition to providing isolation of the oscilloscope from the signal source, an attenuator probe decreases the amplitude of the displayed waveform by the attenuation factor of the probe. Thus, a probe allows you to increase the vertical-deflection factor so high-amplitude signals, beyond the normal limits of the oscilloscope and plug-in combination, may be observed. Signal amplitudes, however, must be limited to the maximum allowable value for the probe used.

Before using a probe, you must check (and adjust if necessary) the probe compensation to be certain the waveform will be correctly displayed. To do this, connect the probe tip to the CAL. OUT connector and obtain a display of about 2 major divisions. Then, if necessary, adjust the probe compensation.

### Horizontal Sweeps

Horizontal sweep signals for the Type 565 Oscilloscope are usually produced by the two time-base generators. Either beam can be deflected by either time base. Or, if desired, both beams may be swept simultaneously by the same time base. The selection of time base is made with the UPPER and LOWER HORIZ. DISPLAY switches.

The sweep rates of the two beams are determined by the settings of the appropriate TIME/DIV. switch. The sweep characteristics of the two time bases are identical. Each

time base provides 21 calibrated sweep rates ranging from 1 microsecond to 5 seconds per division. Uncalibrated VARIABLE TIME/DIV. controls permit continuously variable sweep rates between 1 microsecond and approximately 12 seconds per division.

### Sweep Magnifiers

Signals displayed with either of the two beams can be expanded ten times horizontally by using the appropriate 10X MAG. switch. Magnification is obtained when the 10X MAG. switch is pulled outward. This switch has no effect when the horizontal deflection is produced by external signals. The magnifiers increase the observed sweep rates by 10 times the TIME/DIV. control settings. The true sweep time per division is found by multiplying the settings of the TIME/DIV. controls by 0.1.

The 1-division portion at the horizontal center of the graticule of an unmagnified display is expanded and remains centered in the full 10-division width of the graticule when the magnifier is turned on. Any other 1-division portion of the original unmagnified display can then be observed in magnified form by using the HORIZONTAL POSITION control to position that portion on the crt.

### Sweep Triggering

In most cases, it is desirable for a repetitive signal to produce a stationary display on the crt so that the characteristics of the waveform can be examined in detail. As a necessary condition for this type of display, the start of each sweep must bear a definite, fixed-time relationship to the events in the input signal. In the Type 565 Oscilloscope, this is accomplished by using the displayed signal or another related signal to start (trigger) each single or repetitive sweep.

The four TRIGGER slide switches and the LEVEL control provide complete control over the means of triggering the sweep. Triggering controls for Time Base 'A' and Time Base 'B' are identical. Thus, the following information applies to both.

### Selecting the Triggering Signal Source

The triggering signal for either time base can be obtained from any one of four sources; the Upper Beam vertical amplifier, the Lower Beam vertical amplifier, the power line (via the power transformer), or from an external source.

It is usually convenient to trigger the sweeps internally from either the upper or lower beam vertical signals. This is done by placing the EXT. INT. LINE switch to the INT. position and then setting the UPPER BEAM-LOWER BEAM switch to the appropriate position.

If the displayed signal frequency is related to the power line frequency, the LINE source can be used. This source is particularly useful when the displayed signal will not allow stable internal triggering.

External (EXT.) triggering is often used when signal tracing in amplifiers, phase shift networks, and wave-shaping circuits. The signal from a single point in the circuit can be used to trigger the sweep. It is then possible to observe the



shaping and amplification of the signal at various points in the circuit without resetting the triggering controls.

### Selecting The Triggering Slope

The sweeps can be triggered during either the rising or falling portion of the triggering signal. When the display consists of several cycles of the input signal, either setting of the SLOPE switch may be used. However, if you wish to display less than one full cycle of the input signal, the SLOPE switch will permit you to start the sweep on the desired slope; either rising (+ slope) or falling (— slope).

### Trigger Input Coupling

The trigger COUPLING switch permits you to accept or reject certain properties of triggering signals. Three means of coupling are provided; DC, AC, and AC FAST.

DC coupling allows the trigger circuits to receive signals of all frequencies, and dc levels.

AC coupling rejects the dc component of trigger signals and attenuates ac signals below about 20 cycles.

AC FAST coupling rejects the dc component of trigger signals and ac signals below about 1000 cycles.

In general, the AC position of the COUPLING switch should be used. It will be necessary to use DC coupling for very low frequency triggering signals. AC FAST coupling should be used when triggering internally from multi-trace plug-in units operated in the alternate mode (unless the "Trigger From Channel One Only" feature of the plug-in is being used). Also, if line frequency hum is mixed with a desired high frequency triggering signal, best results may be obtained using AC FAST coupling.

### Use of the LEVEL Control

The LEVEL control has two switch positions (AUTO. and FREE RUN) and a variable mid-region (LEVEL). The function of each is as follows:

**Level** — This function of the control operates except at the clockwise and counterclockwise extremes. The LEVEL control determines the instantaneous voltage level on the triggering signal at which the sweep is triggered. (This instantaneous voltage level can include a dc component if the COUPLING switch is set to DC.) With the SLOPE switch in the + position, adjustment of the LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the positive slope of the triggering signal. Likewise, with the SLOPE switch in the — position, adjustment of the LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the negative slope of the triggering signal.

**Auto.** — Automatic triggering is frequently used for ease of operation. It can be used to observe a large variety of signals with simplicity, requiring no setting of the TRIGGER controls. Automatic triggering is useful for obtaining stable displays of signals in the range from approximately 60 cycles to one megacycle. In AUTO. operation, the trigger SLOPE and source can be selected, but the triggering level and trigger coupling cannot. Each sweep is triggered at the

average voltage level of the ac-coupled triggering signal. In the absence of a triggering signal, the sweep continues to run to provide a convenient reference trace on the crt. The maximum repetition rate of the reference trace sweeps is about 50 sweeps per second and therefore, the trace may not be visible when the fastest sweep rates are used.

**Free Run** — FREE RUN operation produces repetitive sweeps, independent of any triggering signal. These sweeps will provide a reference trace, as does AUTO., but it will have normal intensity at any sweep rate. This method of operation is useful in applications where the device under test requires a trigger or input signal. The appropriate rear panel + GATE OUT, or HORIZ. SIG. OUT signal may be fed to the device to cause its operation. The resulting signals displayed on the crt will be synchronized with the sweep.

### Using the 'B' MODE Switch

The 'B' MODE switch permits operating Time Base 'B' in any of five different ways:

1. Normal Trigger
2. Single Sweep
3. Manual Trigger
4. Starts After Delay Interval
5. Triggerable After Delay Interval

The following paragraphs describe typical procedures used in operating Time Base 'B' in each mode.

#### Normal Trigger

When the 'B' MODE switch is in the NORMAL TRIGGER position, the operation of Time Base 'B' is independent of, but identical to that of Time Base 'A'.

#### Single Sweep

Single Sweep is often used when photographing non-repetitive waveforms and in other applications where the signal varies in amplitude, shape, or time interval. A continuous display of such signals would appear as a jumbled mixture of many different waveforms and would yield little or no useful information.

The Type 565 Oscilloscope permits you to obtain a single-sweep presentation and eliminate all subsequent sweeps so information is clearly recorded without the confusion resulting from multiple traces.

The single sweep function of Time Base 'B' is selected by placing the 'B' MODE switch in the SINGLE SWEEP position. As the change is made from NORMAL TRIGGER mode to SINGLE SWEEP mode, the Time Base remains triggerable. If there is sufficient delay before triggering, the READY lamp will light to show that the time base is "ready" to be triggered. When the time base has been triggered and one sweep is completed, the time base becomes inoperative and the READY lamp will be extinguished. This shows that the single sweep has been initiated.

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The time base can be "reset" to the triggerable condition by pressing the RESET button, located to the right of the 'B' MODE switch. The time base will then be "ready" to produce another single sweep when a suitable triggering signal is applied.

### Manual Trigger

The Manual Trigger mode operates similarly to Single Sweep. The only difference is that Time Base 'B' always begins the sweep when the MANUAL TRIGGER button is pressed.

## STARTS AFTER DELAY INTERVAL

### Introduction

The following information is given in the form of demonstration procedures. They are intended to show some of the various measurements and other operations that can be performed by using the delayed 'B' sweep; the accuracy of those measurements; and the operating procedures involved.

Set the Type 565 controls and switches as follows:\*

TRIGGER (Time Base 'A')	UPPER BEAM
EXT.-INT.-LINE	INT.
COUPLING	AC
SLOPE	+
LEVEL	AUTO.
'A' TIME/DIV.	1 mSEC
'B' TIME/DIV.	.1 mSEC
VARIABLE ('A' & 'B')	CALIBRATED
'B' MODE	STARTS AFTER DELAY INTERVAL
DELAY INTERVAL	5.00
PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	10
UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE
10X MAG. (both)	off (pushed in)
horiz. POSITION (both)	centered
Upper Beam INTENSITY	so both intensity levels in the Upper Beam trace are easily seen
Lower Beam INTENSITY	counterclockwise

Set the controls and switches of both vertical plug-in units\* as follows:

VOLTS/DIV.	5
VARIABLE	CALIBRATED
AC - DC - GND	DC
POSITION	centered

\*Controls not mentioned may be left in any position.

Set the Upper Beam horizontal POSITION so the trace begins precisely at the left-hand edge of the graticule. Notice the position of the intensified segment in the Upper Beam trace.

Now set 'A' TIME/DIV. to .2 SEC and 'B' TIME/DIV. to 20 mSEC. The intensified segment should be at the same position as with the previous sweep rates.

Turn the Lower Beam INTENSITY control for a visible trace. Notice that the Lower Beam trace and the intensified segment in the Upper Beam trace begin at the same time. This display shows that Time Base 'B' produces one sweep during each 'A' sweep. The Time Base 'B' TRIGGER switches and LEVEL control have no effect on the operation.

The Time Base 'A' sweep rate is .2 second per division and the intensified segment begins 5 major divisions after the beginning of the Upper Beam trace. Hence, the Lower Beam Time Base 'B' sweep starts one second after the beginning of the Upper Beam Time Base 'A' sweep (0.2 second per division times 5 divisions equals 1 second).

The number of major divisions between the beginning of the Upper Beam sweep and the beginning of the intensified segment is established by the setting of the DELAY INTERVAL control. Therefore, with any dial setting greater than about 0.50, the time difference between the beginning of the 'A' and 'B' sweeps is the product of the Time Base 'A' sweep rate and the DELAY INTERVAL dial setting.

The following demonstration procedures are intended to show five of the most commonly used applications of the delayed sweep feature. The applications include time measurements which are more accurate than those obtained directly from the crt display, and other operations that can only be performed on oscilloscopes having a delayed sweep feature.

### DEMONSTRATION 1: Measuring time between two pulses, the first of which triggers Time Base 'A'.

Set the controls and switches on the instrument as listed above except as follows:

'A' TIME/DIV.	.1 mSEC
'B' TIME/DIV.	1 $\mu$ SEC

Apply the Amplitude Calibrator signal to the input of both vertical plug-in units. The Upper Beam should display about one cycle of the squarewave signal.

Set the DELAY INTERVAL dial so the falling portion of the squarewave is intensified. Advance the Lower Beam INTENSITY control to obtain a display of normal intensity. The Lower Beam should now display a horizontally expanded version of the signal in the intensified segment of the Upper Beam display.

Set DELAY INTERVAL so the Lower Beam trace starts at about the 50% amplitude level of the squarewave. Multiply the DELAY INTERVAL dial reading (e.g. 5.13) by the 'A' sweep rate. The product is the time duration of the squarewave positive-going half-cycle.

## Accuracy

Accuracy is determined by the combination of all the following factors:

1. The basic accuracy of the Time Base Generator, and therefore, of time measurements, is  $\pm 3\%$ . In measurements made directly from the crt, this means  $\pm 3\%$  of full scale; that is, of the total time represented within the 10 major graticule divisions. However, when the measurement is made by using the sweep delay feature, the accuracy is  $\pm 3\%$  of reading; that is, of the time being measured.

### NOTE

During calibration, the internal DELAY START and DELAY STOP adjustments are set when the Time Base 'A' sweep rate is 1 mSEC per division. Therefore, delay measurements made when using the 1 mSEC per division 'A' sweep rate will generally be most accurate. The delay accuracy obtained at any other 'A' sweep rate, 10  $\mu$ seconds per division or slower, can be increased by calibrating DELAY START and DELAY STOP at that sweep rate. (In so doing, you may wish to verify that all other 'A' sweep rates produce delays that are accurate within 3%). These adjustments do not affect the Time Base 'A' crt sweep rate. See the Calibration Procedure, Section 5, step 10.

2. The effect that the linearity of the Delay Interval system has on the measurement accuracy depends on the DELAY INTERVAL dial setting that is used. The linearity factor, as a percentage of reading, decreases as the dial setting increases. With any dial setting, the inaccuracy due to non-linearity will not exceed 0.5% of full scale delay.

3. Measurements are valid only when DELAY INTERVAL dial settings above 0.50 are used.

4. The triggering point can affect the measurement accuracy since the triggering signal does not rise in zero time. For example, if the sweep is triggered by the first portion of the pulse rise, most of the pulse risetime will be included in the measurement. This is of little concern in measurements, such as the one made in Demonstration 1, where the risetime of the signal is a relatively insignificant percentage of the time being measured. However, as the risetime percentage of the measured time increases, it becomes more important that the triggering point be known. One way to establish a known triggering point is to set the LEVEL control at one end of the range in which a stable, triggered Upper Beam display is obtained. Most of the risetime of the signal will be included in the measurement when:

- 'A' TRIGGER SLOPE is set to + and LEVEL is set to the — end of the "triggering" range (positive-going signals), or
- 'A' TRIGGER SLOPE is set to — and LEVEL is set to the + end of the "triggering" range (negative-going signals).

5. The Time Base 'A' Trigger, Time Base 'A' Generator, Delay Pickoff, and Time Base 'B' Generator circuits typically require a total of about 1.0 to 1.5 microseconds to respond to the signal event which triggers Time Base 'A'. This small delay need not be considered unless it is a significant per-

centage of the time being measured. When necessary, add the circuit delay time to the measured time.

6. The 5, 2, and 1  $\mu$ SEC/DIV A sweep rates generally are not used for measurements such as those described in Demonstration 1.

**Summary**—The method described in Demonstration 1 will provide greatest time measurement accuracy when:

- the internal DELAY START and DELAY STOP adjustments are calibrated at the sweep rate to be used,
- dial settings above 4.0 or 5.0 are used,
- the event triggering Time Base 'A' has a fast rise time, and
- Time Base 'A' sweep rates of 50  $\mu$ SEC/DIV. or slower are used.

**DEMONSTRATION 2:** Measuring time between two pulses of a pulse train, neither of which triggers Time Base 'A'.

Set the controls and switches on the instrument as listed except as follows:

'A' TIME/DIV. .2 mSEC

Apply the Amplitude Calibrator signal to the input of both vertical plug-in units. The Upper Beam should display about two cycles of the squarewave signal. Set the DELAY INTERVAL dial so the squarewave rise located near the center of the Upper Beam display is intensified.

Advance the Lower Beam INTENSITY control to obtain a display of normal intensity. The Lower Beam should now display a horizontally expanded version of the intensified Upper Beam display segment.

Set DELAY INTERVAL so the 50% amplitude level of the squarewave rise intersects the vertical line at the center of the graticule. Note the exact DELAY INTERVAL dial setting (e.g. 5.14). Turn the DELAY INTERVAL dial clockwise until the 50% amplitude level of the squarewave fall intersects the same vertical graticule line used with the previous dial setting. Again note the exact DELAY INTERVAL dial setting.

Subtract the first dial setting from the second. The product of this difference and the Time Base 'A' TIME/DIV. equals the time duration of the squarewave positive-going half-cycle (between the 50% amplitude points).

## Accuracy

Accuracy is determined by the combination of all the following factors:

1. The basic accuracy of the Time Base 'A' generator is the same as described in Demonstration 1.

2. The percentage of error that the Delay Interval system linearity adds to the measurement depends on the numerical difference between the two dial settings used; this error decreases as the numerical difference increases. The amount of time error in the measurement is less than 1% of the full scale delay (1% of ten times the 'A' sweep TIME/DIV.). However, this applies only when the DELAY INTERVAL dial settings are separated by at least 100 minor dial divisions.

NOTE

When the separation between dial settings is one hundred minor dial divisions or less, the desired time measurement can often be made more accurately by direct reading from a magnified crt display. See Demonstration 3; Magnification.

3. Measurements are valid only when DELAY INTERVAL dial settings above 0.50 are used.

4. The accuracy of time measurements made according to Demonstration 2 is independent of the inherent circuit delays and of the triggering point (discussed in Demonstration 1), provided the 'A' LEVEL control setting is the same for each of the two dial readings.

5. The 2 and 1  $\mu$ SEC/DIV. A sweep rates generally are not used in measurements such as those described in Demonstration 2.

**Summary**—The method described in Demonstration 2 can provide a time measurement accuracy within 1% of reading. Accuracy will be greatest when:

- a. the internal DELAY START and DELAY STOP adjustments are calibrated at the sweep rate to be used, and
- b. the numerical difference between the two DELAY INTERVAL dial settings is greatest.

**DEMONSTRATION 3: Magnification**

Complex signals often consist of a number of individual events of different amplitudes. Since the trigger circuits of the Type 565 are sensitive to signal amplitude, a stable display will normally be obtained only when the sweep is triggered by the event having the greatest amplitude. The "Starts After Delay Interval" mode permits the start of a sweep to be delayed for a selected time after the signal event having the greatest amplitude. Any event within the series of events may then be displayed in magnified form as follows:

Set the controls and switches on the Type 565 as listed on page 2-6. Apply the Amplitude Calibrator signal to the input of both vertical plug-in units. The Upper Beam should display several cycles of the squarewave signal. Set the DELAY INTERVAL dial to intensify one of the positive-going pulses.

Advance the Lower Beam INTENSITY control to obtain a display of normal intensity. The Lower Beam display should now contain the same signal information as the intensified Upper Beam trace segment, but horizontally expanded (magnified) ten times.

Increase the Time Base 'B' sweep rate to 1 microsecond per division. Set the DELAY INTERVAL dial so the intensified segment in the Upper Beam trace extends throughout the rise of one of the positive-going pulses. The Lower Beam display now gives X1000 magnification.

Slowly turn the DELAY INTERVAL dial. Note that any portion of the Upper Beam display can be brought into view in magnified form on the Lower Beam display (except for a small portion at the beginning and end of the Upper Beam Display). The DELAY INTERVAL dial indication corresponds to the number of major graticule divisions between the beginning of the Upper Beam trace and the beginning of the intensified trace segment; e.g. 7.00 = 7 major divisions.

Set the Time Base 'B' sweep rate to 10 microseconds per division. Set the DELAY INTERVAL dial so a squarewave rise is centered in the Lower Beam display. Set UPPER HORIZ. DISPLAY to 'B' TIME BASE and turn on the Upper Beam 10X MAG. Set the Upper Beam horizontal POSITION so the squarewave rise is visible in the Upper Beam display. The Lower Beam now gives 100 times magnification and the Upper Beam gives 1000 times magnification of the information that was contained in the intensified segment of the original Upper Beam display.

Both the Upper and Lower Beam display will probably exhibit some horizontal jitter. Part of the jitter is due to a slight inconsistency in the Amplitude Calibrated signal frequency, and part is due to jitter in the delay system. The jitter contributed by the delay system is less than 0.05% of the Time Base 'A' sweep rate (0.05% of 1 millisecond = 0.5 microsecond). With 1000 times magnification, the Upper Beam sweep rate is 1 microsecond per division. Hence, the jitter due to the delay system is less than one-half major division.

**Accuracy**

1. The accuracy of time measurements made from magnified displays such as those described in the foregoing paragraphs, depend solely on the Time Base 'B' sweep rate accuracy ( $\pm 3\%$  with the 10X MAG. off and  $\pm 5\%$  with the 10X MAG. on).

**DEMONSTRATION 4: Delayed Trigger**

Ordinarily, a signal which is to be displayed is also used to trigger the oscilloscope sweeps so a stable display is obtained. In some situations, it may be desirable to reverse this situation. The sweep-related output pulses, available at the rear panel of the Type 565, can be used\* as the input or triggering signals for external devices. The output signal of the external device will then produce a stable display while the oscilloscope sweep free-runs.

To demonstrate one method of performing this operation, proceed as follows:

Set the controls and switches on the Type 565 as listed on page 2-6 except as follows:

'A' TRIGGER source	EXT.
'A' TRIGGER COUPLING	DC
'A' TIME/DIV.	10 $\mu$ SEC
'B' MODE	NORMAL TRIGGER
'B' TRIGGER LEVEL	FREE RUN
DELAY INTERVAL	1.00
INTENSITY (Upper)	normal

Connect: (rear panel and front panel connections)

'B' + GATE OUT	to	'A' TRIG. IN
DEL'D TRIG. OUT	to	INPUT of the Upper Beam plug-in unit

Set 'A' TRIGGER LEVEL mid-way between 'O' and FREE RUN so Time Base 'A' triggers on the rise of the 'B' + GATE OUT signal. The Upper Beam should now display a narrow, positive-going pulse.

\*Output current must not exceed 2 ma peak.

The oscilloscope display that you have established shows a pulse that is available from the Type 565 during each Time Base 'A' sweep. In a practical application, the pulse would not be applied to the vertical input of the oscilloscope, but instead to some external device to be tested. The pulse would serve as the trigger pulse for the external device and the output of the device would be displayed on the oscilloscope. Since the pulse has a known time-relationship to each Time Base 'A' sweep, the output of the device will provide a stable display on the oscilloscope, as though the oscilloscope were triggered in the normal manner.

The set-up described in the foregoing paragraphs permits you to vary the repetition rate of the pulse applied to the external device. To do this, monitor the pulse signal on another oscilloscope and set 'B' TIME/DIV. and VARIABLE for the desired repetition rate. 'A' TIME/DIV. controls only the display sweep rate as long as the Time Base 'A' Sweep rate is at least twice that of Time Base 'B'.

Set 'B' MODE to MANUAL TRIGGER and press the MANUAL TRIGGER push-button. This set-up permits you to produce each DEL'D TRIG. OUT pulse manually.

#### DEMONSTRATION 5: Pulse Generation

The 'B' + GATE OUT signal of the Type 565 can be used as a low-current\*, variable repetition rate, variable duty factor pulse generator in applications where the pulse shape is of secondary importance. To use the Type 565 in this manner, proceed as follows:

Set	
UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE
'B' MODE	STARTS AFTER DELAY INTERVAL
DELAY INTERVAL	about 0.50
LEVEL ('A' and 'B')	FREE RUN

The pulse signal is available at the 'B' + GATE OUT connector on the rear panel. Monitor the signal on another oscilloscope and establish the desired pulse repetition rate by setting the Type 565 'A' TIME/DIV. and VARIABLE. Establish the desired duty factor by setting 'B' TIME/DIV.

The maximum pulse repetition frequency that can be obtained in this manner is about 10 to 12 kc. Maximum duty factor is about 0.6, decreasing with faster sweep rates.

A slight alteration in this set-up will produce a double-pulse generator. To do this, start with a B sweep rate that is at least 5 times faster than the A sweep rate. Set DELAY INTERVAL to about 5.00. Connect a 100 pf capacitor between the center conductors of the A+ GATE OUT and DEL'D TRIG OUT connectors on the rear of the instrument.

The B + GATE OUT pulse will now occur twice during each A sweep; the first beginning as A sweep begins and the second beginning at the end of the delay interval.

The time separation between pulses is controlled by setting DELAY INTERVAL. The minimum separation that can be obtained is a function of the Time Base B Generator hold-off time.

\*Output current must not exceed 2 ma peak.

### Triggerable After Delay Interval

Complex signals often contain a number of individual events of different amplitudes. Since the trigger circuits in the Type 565 are sensitive to signal amplitude, a stable display will normally be obtained only when the sweep is triggered by the event having the greatest amplitude.

The TRIGGERABLE AFTER DELAY INTERVAL feature of the Type 565 provides a means of triggering the sweep by events other than those having the greatest amplitude. The following instructions permit you to demonstrate that Time Base 'B' can be triggered by virtually any event within a series of events.

Set the controls and switches on the instrument as listed except as follows:

Lower Beam INTENSITY	for normal display
Time Base 'B' TRIGGER controls	same settings as Time Base 'A' TRIGGER controls.

Connect the CAL. OUT signal to both the Upper and Lower Beam vertical input connectors. Each beam should present a square wave display.

Turn the DELAY INTERVAL dial about 2 turns in either direction. Notice that both the Lower Beam display and the brightened segment in the Upper Beam display, move smoothly across the crt.

Set the DELAY INTERVAL dial so the brightened segment in the Upper Beam display begins about in the middle of a pulse top. Notice that the Lower Beam display also begins in the middle of a pulse top. Now, set the 'B' MODE switch to the TRIGGERABLE AFTER DELAY INTERVAL position. Notice that the brightened segment in the Upper Beam display has shifted to the next pulse on the right. The Lower Beam display now begins within the rising portion of the pulse.

Now turn the DELAY INTERVAL dial several full turns. The brightened segment in the Upper Beam display should jump from one pulse to the next. In this demonstration, the Lower Beam display appears unchanged because all pulses are identical.

The display is produced in the following manner:

Time Base 'B' produces one sweep for each 'A' sweep. 'B' sweep will begin at some time after the start of 'A' sweep. This time is the total of (1) the Time Base 'A' sweep rate (TIME/DIV.) multiplied by the DELAY INTERVAL dial setting, plus (2) the time between the end of this delay interval and the next event in the signal which can trigger Time Base 'B'.

It is possible that Time Base 'B' might not be triggered until long after Time Base 'A' has completed its sweep. If separate triggering signals are being applied to the two time bases, Time Base 'A' could produce several additional sweeps before Time Base 'B' receives a triggering signal. Because of this, the brightened trace segment could appear at any point on the Upper Beam trace or might not appear at all.

### Delayed Trigger Output

The delayed trigger output pulse is always available at the rear panel connector at the predetermined time during

## Operating Information — Type 565

each sawtooth produced by Time Base 'A', regardless of the 'B' MODE switch setting. This output signal is discussed in greater detail under "Starts After Delay Interval", Demonstration 4.

### External Horizontal Inputs

For special applications, you can deflect either beam horizontally with an externally derived signal. This permits you to use the oscilloscope to plot one function versus another. The maximum bandpass of the horizontal amplifier occurs at the fully clockwise setting of the EXT. HORIZ. GAIN control; dc to at least 350 kc.

To use an external signal for horizontal deflection, connect the signal to either the Upper or Lower Beam EXT. HORIZ. IN connector. Place the appropriate horizontal display switch in the EXT. position. The horizontal deflection factors can be varied by adjusting the EXT. HORIZ GAIN control such that a one volt peak-to-peak signal will produce from zero to at least 10 major graticule divisions of deflection. The 10X MAG. switch has no effect when external horizontal deflection is used.

### Amplitude Calibrator

The amplitude calibrator provides a convenient source of square waves of known amplitude at a frequency of approximately 1 kc. The square waves are used primarily to adjust probe compensation and to verify the amplitude calibration of the oscilloscope vertical deflection systems.

Calibrator square waves are adjustable from 1 millivolt to 100 volts, peak-to-peak, in decade steps. The amplitude is controlled by the setting of the PEAK-TO-PEAK VOLTS switch. The output voltage is accurate within 3% of the PEAK-TO-PEAK VOLTS switch setting when the output is connected to a high-impedance load such as the INPUT connector of a vertical plug-in unit.

When the .001, .01, .1 volt settings of the PEAK-TO-PEAK VOLTS switch are used, it will be necessary to use a coax cable to take the signal from the CAL. OUT connector. The outer conductor of the cable must make good contact with the shield portion of the CAL. OUT connector in order to obtain an accurate output voltage.

## AUXILIARY FUNCTIONS

### Intensity Modulation

The rear panel jacks marked UPPER BEAM CRT GRID and LOWER BEAM CRT GRID permit external signals to vary the intensity of the traces (Z-axis modulation). This feature can be used to refer oscilloscope time measurements to an external timing standard.

In some applications, you may wish to use the VARIABLE TIME/DIV. control at an uncalibrated position to obtain a sweep rate other than those provided by the TIME/DIV. switch. Intensity modulation with time-marker pulses will

permit you to establish and monitor the desired sweep rate. This will eliminate the need for a separate vertical display of a time reference signal.

Fast-rise pulses of short duration are usually used for intensity modulation because they produce an easily interpreted display. When other types of signals are used, it is important to note that sinewaves below 250 cycles will be attenuated due to the ac signal coupling within the instrument. The signal amplitude required for visible trace modulation depends upon the intensity level of the unmodulated trace.

### Graticule

The edge-lighted internal graticule is accurately marked with 10 horizontal and 10 vertical 1-centimeter divisions and 2-millimeter subdivisions marked on the vertical centerline and the two horizontal centerlines. The deflection factors of the crt beams are calibrated to these graticule marks. Thus the marks provide a calibrated scale for making time and voltage measurements.

To protect the bonded plastic faceplate of the internal graticule crt (instruments S/N's 1000-up), always use a scratch shield or plastic light filter in front of the crt. The shield and filter are provided with the instrument. For normal viewing and for photographing the display, use the clear plastic scratch shield. For viewing under bright ambient light conditions, use the light filter to provide better trace-to-screen contrast. When using the light filter, however, be careful not to set the beam intensity so high that it will burn the crt phosphor.

For instruments with external graticules (S/N's below 1000), the color of the graticule illumination may be changed from white to red, or vice versa, by rotating the graticule 180°.

### Trace Photography

Several features of the Type 565 Oscilloscope are particularly important when photographing the crt display. The rubber washers normally installed between the graticule and the bezel should be removed when either the light filter or a camera-mount bezel is installed. When a light filter is used, the graticule should be placed between it and the crt.

On instruments below S/N 1000, there are two pairs of holes in the graticule for the scale illumination pilot lamps. One pair is colored red and will produce red graticule lines when aligned with the pilot lamps. The second pair is clear and will produce white graticule lines. White lines should be used whenever the light filter is installed or when photographs are being taken. In all cases, the side of the graticule that bears the scribed lines should be placed against the crt face.

The CONTRAST control, located inside the instrument at the left side of the High Voltage Power Supply chassis, permits you to control the relative intensity of the intensified trace segment obtained in delayed sweep operation. This control is usually set fully clockwise (greatest contrast) for normal viewing. However, it may require resetting for less contrast while photographs are being taken so all portions of the picture will be properly exposed.

**Aux. Power Jack**

The auxiliary power jack on the rear panel is provided to power future accessories for the Type 565, as well as other devices.

The following is available:

Voltage	Current	Voltage Pin No.	Ground return Pin No.
-100 v dc	40 ma	H	J
+125 v dc	20 ma	B	J
+300 v dc	20 ma	A	J
-12 v dc	10 ma	E	F
6.3 v ac	1 a	C	D
**+420 v dc unreg.	10 ma*	K	J

\*30 ma if the +300 volt supply is not loaded externally.  
 \*\*above s/n 210





# SECTION 3

## CIRCUIT DESCRIPTION

### General

This portion of the Instruction Manual presents a detailed discussion of the Type 565 circuitry operation. This discussion refers to various block diagrams inserted in the text, and to the circuit diagrams in the back of this manual.

### BLOCK DIAGRAM

A functional block diagram of the Type 565 Oscilloscope is shown in Fig. 3-1. The relationship of the circuits in each block to those in other portions of the instrument is discussed in the detailed description of that circuit.

### TIME BASE TRIGGER

#### General

Time Base 'A' Trigger and Time Base 'B' Trigger circuits are identical except for component reference numbers on the schematics. The following circuit description pertains to both circuits, but reference numbers for Time Base 'A' Trigger are used.

For best triggering stability, the Time Base Generator requires a trigger pulse that is representative of the selected triggering signal frequency, but otherwise consistent in amplitude and wave-shape. Available triggering signals often vary in amplitude, waveshape, and frequency, and thus cannot be used directly to trigger the time base. The Trigger circuit is essentially a waveshaping circuit that converts a sample of the input signal into a pulse having a reasonably constant risetime and amplitude. Hence, frequency is the only variable characteristic remaining in the output trigger pulse.

The block diagram, Fig. 3-2, shows the two basic elements of the trigger circuit. The Trigger Input Amplifier amplifies (and when desired, inverts) the incoming triggering signal and applies it to the input grid of the Trigger Multivibrator. The Trigger Multivibrator is essentially a switch that is either on or off, depending on the instantaneous voltage level at its input. Its square wave output is applied to the Time Base Generator where it is differentiated to form positive and negative pulses. The negative pulses trigger the Time Base Generator while the positive pulses are clipped and not used.

For the following description, refer to the Time Base 'A' Trigger schematic in the back of this manual.

#### Trigger Input Amplifier

The TRIGGER source switches are used to select the appropriate trigger signal from one of four sources: upper beam vertical plug-in unit (UPPER BEAM), lower beam vertical plug-in unit (LOWER BEAM), TRIG. IN connector (EXT.), or

line-frequency signal from the power transformer (LINE). The selected signal is then applied to the COUPLING switch. (Information about the automatic mode, AUTO., of trigger operation is given later in this circuit description).

The COUPLING switch permits the operator to accept or reject certain characteristics of the triggering signal. In the DC position, the coupling capacitors are shorted, coupling both dc and ac signals to the Trigger Input Amplifier. In the AC position, C7 and C8 in parallel are placed in the signal path. An RC circuit consisting of C7-C8 and R12 is thus formed which blocks dc and attenuates ac signals below about 20 cycles. In the AC FAST position, C8 alone is placed in the signal path and R12 is placed in parallel with R10. This RC network blocks dc and rejects ac signals below 1000 cycles. The TRIGGER source and COUPLING switches are wired so the AC FAST function is bypassed when the LINE source is used.

The signal from the COUPLING switch is applied to the SLOPE switch through R15-C15. (R15 and C15 prevent high amplitude positive signals from drawing excessive grid current from V24.) The SLOPE switch determines whether or not the triggering signal will be inverted by the Trigger Input Amplifier. When the SLOPE switch is set to —, the signal is applied to the grid of V24A and will not be inverted. For example, a positive-going signal at the grid of V24A will cause a positive-going change in the common cathode circuit. The fixed voltage at the grid of V24B and the positive going change at its cathode reduce the current through V24B. This results in a positive-going change in plate voltage; hence, no inversion.

If the SLOPE switch is in the + position, the signal is applied to the grid of V24B. In this case, V24B inverts the signal in the manner characteristic of a single stage, plate-loaded amplifier.

The SLOPE switch also serves another function, it applies a dc voltage from the LEVEL control to whichever grid of V24 is not connected to the COUPLING switch. (The need for this dc voltage is explained in the Trigger Multivibrator portion of this circuit description. At this point, however, the important consideration is the effect the dc voltage has on the amplified trigger signal at the plate of V24B.)\*

The voltage at the junction of R19 and R20 can be varied between about +15 and —15 volts by adjusting the LEVEL control. This voltage controls the average voltage at the plate of V24B and the triggering signal either adds to or subtracts from that average. Thus, in addition to being an amplifier, the Trigger Input Amplifier is also a voltage comparator. (V24 is a voltage comparator rather than a difference amplifier since R24 and C24 balances the gain of V24A to that of V24B.) This composite signal is applied to the input grid of the Trigger Multivibrator.

The Trigger Multivibrator is disabled unless R47 is grounded. If the UPPER HORIZ. DISPLAY switch, LOWER HORIZ. DISPLAY switch, or 'B' MODE switch is set for a function in which the operation of Time Base 'A' is required, then R47 will be grounded.

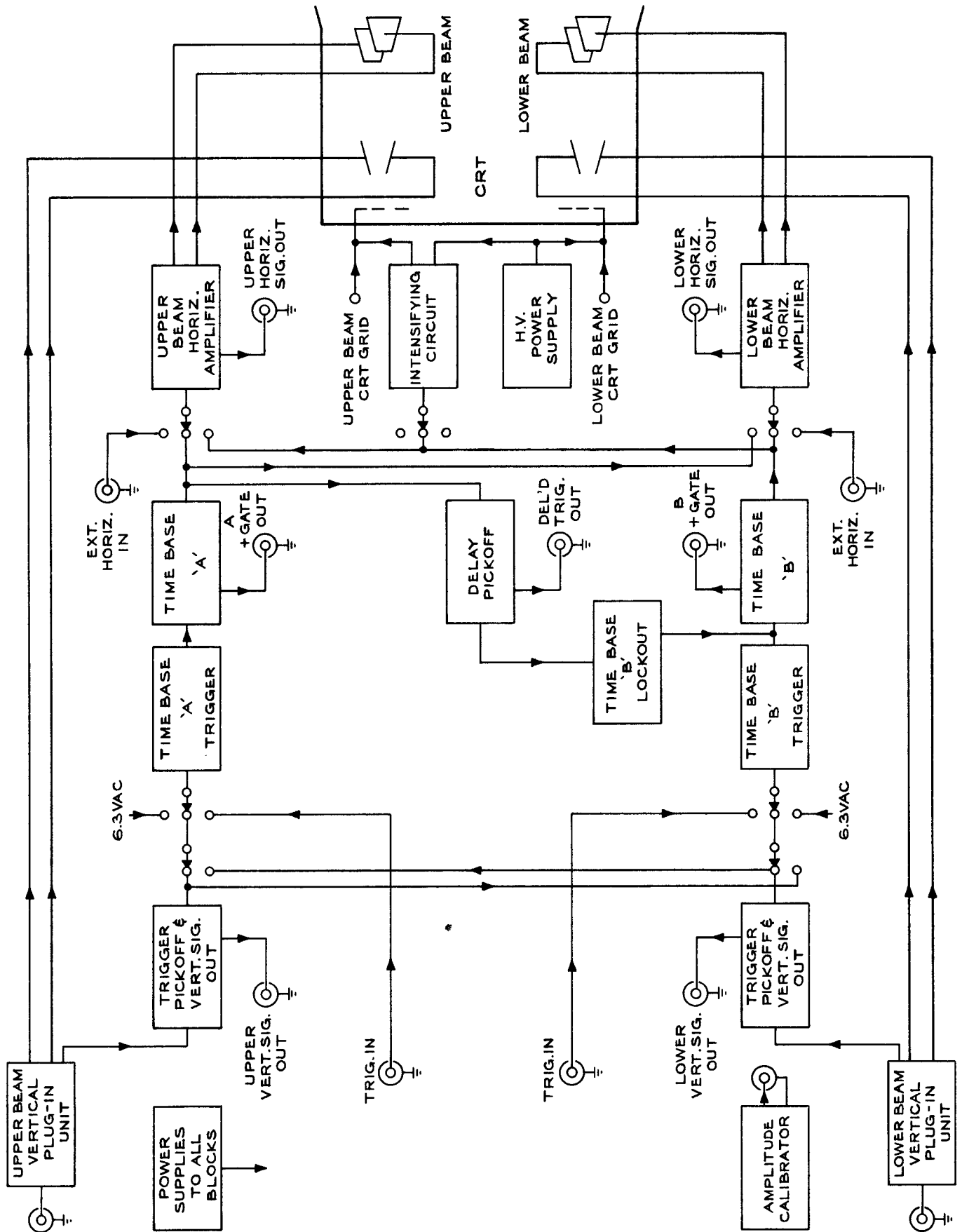


Fig. 3-1. Functional block diagram of the Type 565 Oscilloscope.

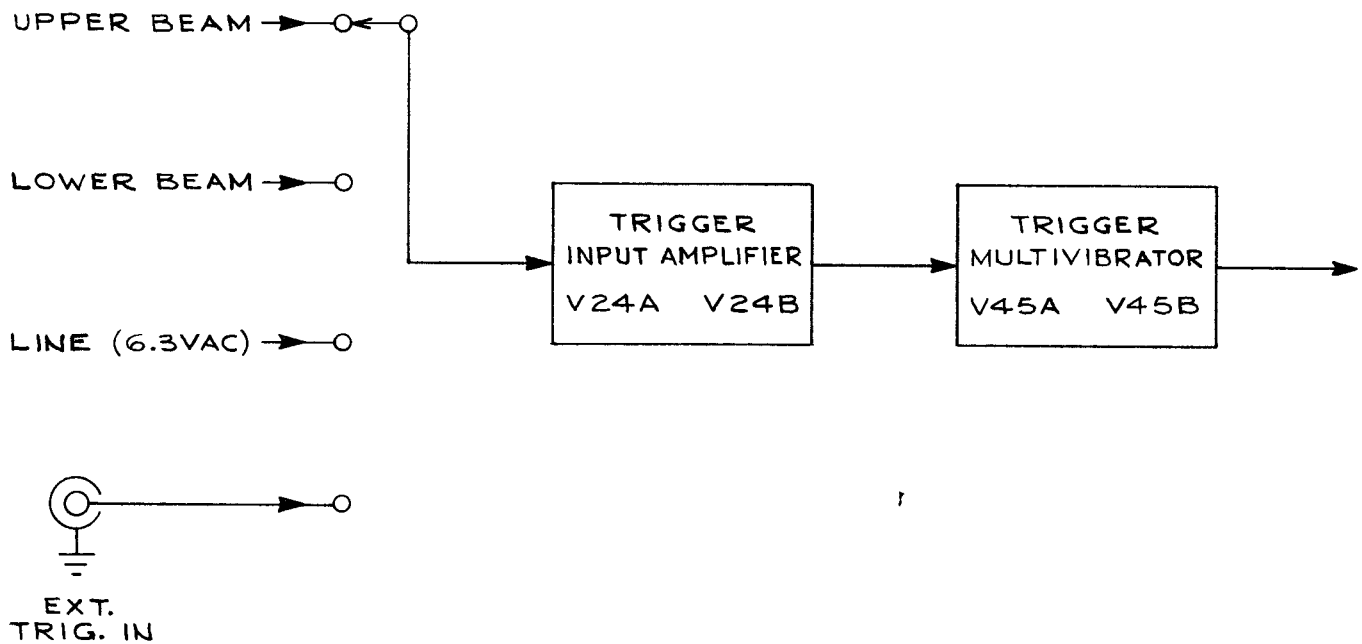


Fig. 3-2. Time Base 'A' Trigger.

### Trigger Multivibrator

The Trigger Multivibrator, V45, is a typical bistable Schmitt circuit. When the voltage at the grid of V45A is above a certain level, V45A conducts and V45B is cut off. In this state, the output voltage at the plate of V45B is +300 volts. When the voltage at the grid of V45A is below a certain level, V45B conducts and V45A is cutoff. The output voltage at the plate of V45B is then about +293 volts. The transition from one state to the other occurs very rapidly, regardless of how slowly the input voltage passes the trip-level. Thus, the output of the Trigger Multivibrator is a square pulse of about 7 volts amplitude. The following example illustrates the sequence of events.

When a negative-going voltage change reaches about +111 volts at the input grid, the plate of V45A rises and carries the grid of V45B with it. V45B is driven into conduction (see Fig. 3-3). Since the cathode resistor R47 is common to both tubes, the conduction of V45B tends to raise the cathode voltage of V45A. This further reduces the current flow through V45A and compounds the original action of the input signal. V45A and V45B rapidly change conduction states; V45A cuts off and V45B conducts. The voltage at the plate of V45B drops sharply. This voltage step is applied to a differentiating network in the Time Base Generator and becomes the negative-going trigger pulse required to start the time base action.

As the input signal continues into the positive-going portion of a cycle, the grid of V45A rises beyond +111 volts to about +113 volts before the Trigger Multivibrator resets to its previous state. This approximate 2 volt difference in switching levels is the hysteresis range of the circuit.

As Fig. 3-3 and the previous description suggest, there are two basic requirements that must be met if the Trigger

Multivibrator is to generate an output pulse. First, the amplified signal at the grid of V45A must have enough amplitude to overcome the hysteresis of the circuit; that is, about 2 volts peak to peak, or more. Second, the signal must be superimposed on a dc voltage that will permit it to cross the upper and lower hysteresis limits of the circuit; that is, about +111 volts and +113 volts. This second requirement is met through the use of the LEVEL control mentioned previously. Figures 3-4 and 3-5 illustrate the consequence of improper LEVEL control adjustment. In both cases, the signal amplitude is adequate to produce triggering, but the dc level of the signal is incorrect.

**Automatic Triggering**—Automatic triggering may be selected by placing the LEVEL control in the AUTO. position. This changes circuit operation as follows:

A section of the AUTO. switch in the input coupling circuit selects AC coupling, regardless of the position of the COUPLING switch, so the average voltage of the triggering signal is reduced to zero. The junction of R19 and R20 is grounded so the amplifier will be balanced.

C31 is inserted between V24B and V45A and the Trigger Multivibrator is converted into an astable or free-running form by providing positive feedback to the input grid. In the absence of an input signal, the multivibrator free-runs at about 50 cps; a frequency determined primarily by C31 and R40. An incoming signal having a frequency greater than about 50 cps will force the multivibrator to run at the signal frequency.

Resistance added in the plate circuit of V45A increases the circuit gain and reduces the hysteresis to considerably less than 2 volts. This permits low amplitude signals to produce stable automatic triggering.

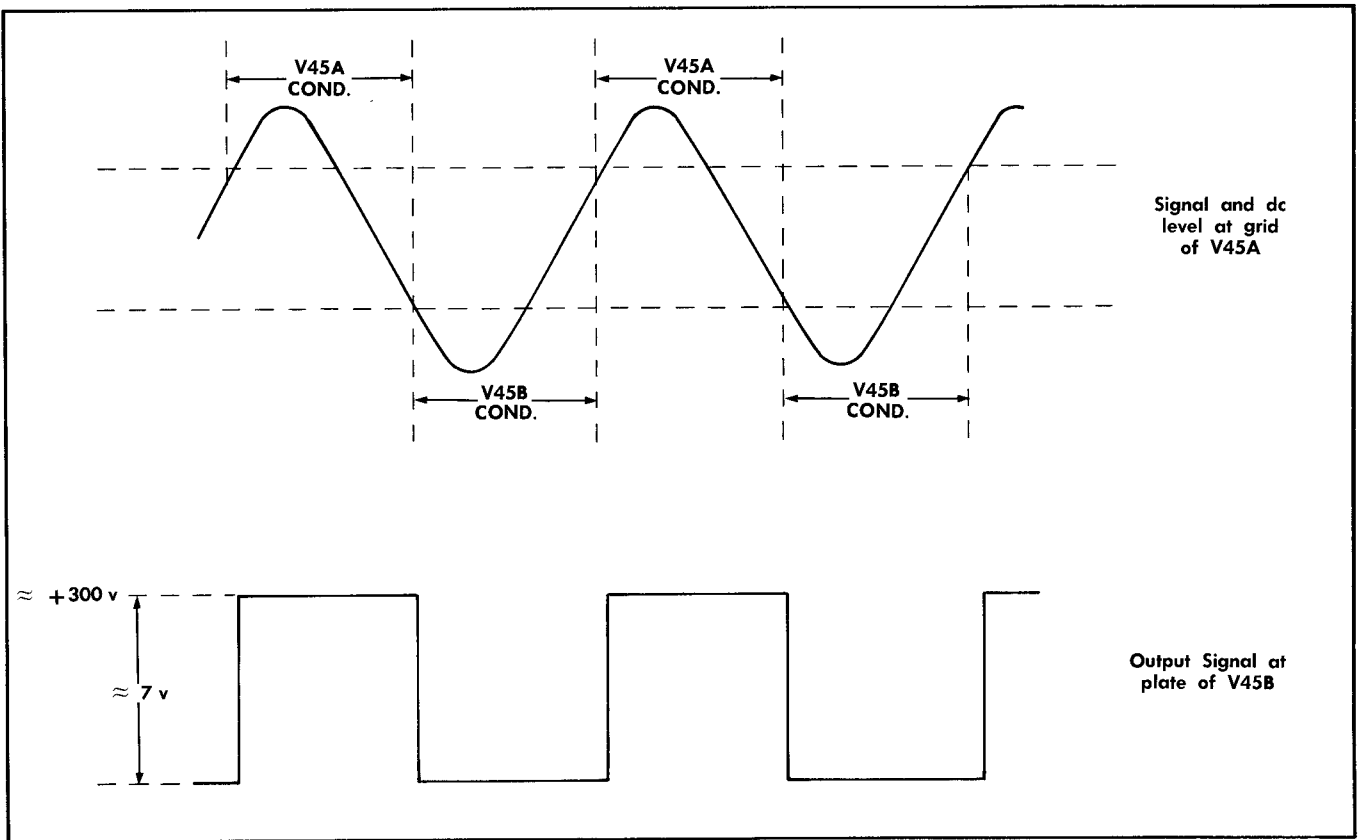


Fig. 3-3. Correct LEVEL control setting.

### TIME BASE GENERATORS

The following description pertains to both time bases, but circuit reference numbers for Time Base 'A' are used. The additional circuitry in Time Base 'B' is described in a later portion of this section under the title "Time Base 'B' Lockout".

The Time Base Generator produces four output signals (see Fig. 3-6):

1. a positive-going sawtooth which can be coupled to either or both horizontal amplifiers by the appropriate setting of the Horizontal Display switches. The sawtooth output is also permanently connected to the Delay Pickoff circuit (Time-Base 'A' only).

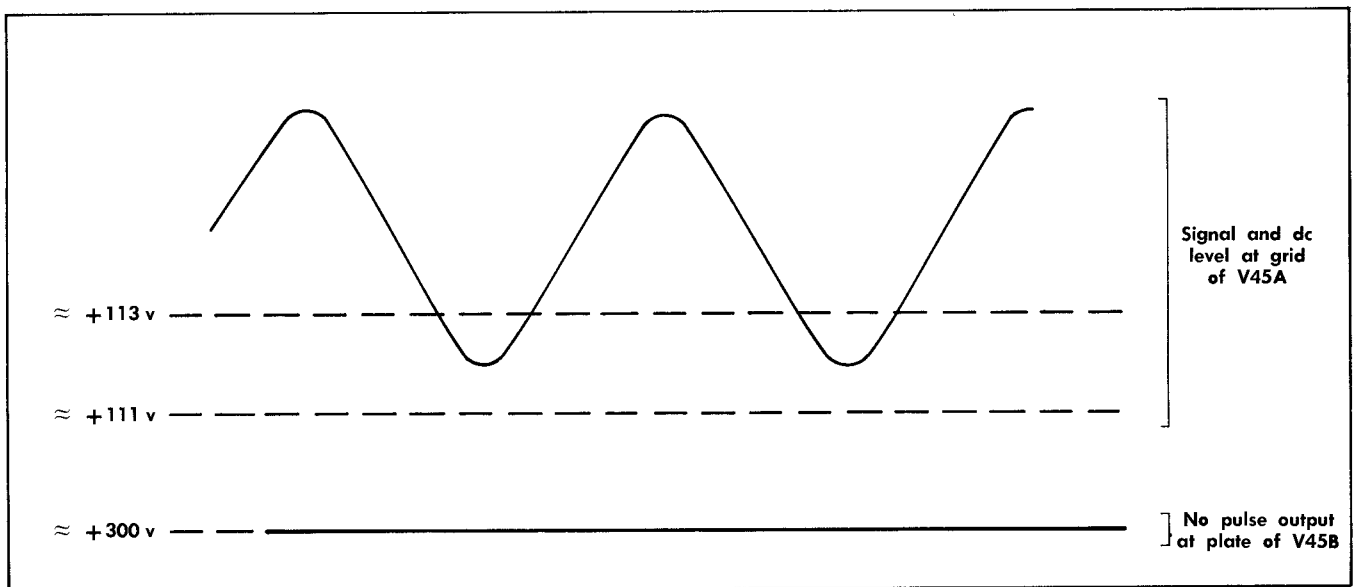


Fig. 3-4. Incorrect LEVEL control setting.

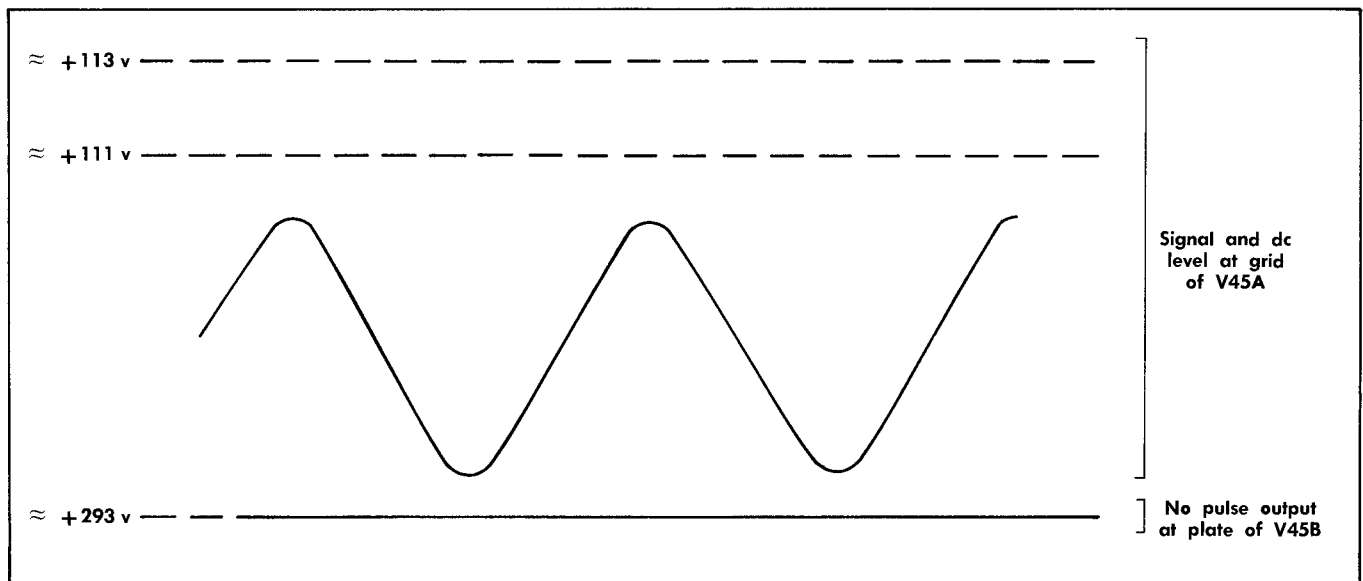


Fig. 3-5. Incorrect LEVEL control setting.

2. a positive-going unblanking pulse having the same duration as the sawtooth rise. Coupled to the Crt Circuit by the Horizontal Display switches to unblank the beam(s) being deflected by Time Base 'A'.
3. a positive-going pulse (+ GATE OUT) having the same duration as the sawtooth rise. Coupled to a rear panel connector for external use.
4. a negative-going multi-trace sync pulse having the same duration as the sawtooth rise. Coupled to the appropriate Vertical Plug-In Unit(s) by the Horizontal Display switches. The trailing edge of the pulse causes multi-trace plug-in units, operating in the alternate mode, to switch channels.

In most applications, each cycle of events is started by a trigger pulse from the Time Base Trigger circuit. However it is also possible to either disable the generator or to make it free run; that is—the end of one cycle will cause the next cycle to begin. The desired mode of operation will be obtained through the appropriate setting of the STABILITY and LEVEL (FREE RUN position) controls. (See Section 2.)

The block diagram, Fig. 3-6, shows the basic elements of the Time Base Generator. The Sweep Gating Multivibrator is an electronic switch which turns the Disconnect Diodes on and off. When the Disconnect Diodes are back-biased, the Miller Runup begins to produce a sawtooth signal. A sample of the sawtooth is fed back to the Sweep Gating Multivibrator through the Holdoff Circuit. When the sawtooth sample reaches a predetermined amplitude, the Sweep Gating Multivibrator resets, switching the Disconnect Diodes on. The Miller Runup then resets, forming the retrace or falling portion of the sawtooth. A sample of the sawtooth retrace is fed back to the Sweep Gating Multivibrator, but is delayed by the Holdoff Circuit. This delay prevents the generator from beginning the next sawtooth until the circuits have stabilized.

In the following detailed circuit description, refer to the Time Base 'A' Generator schematic in the back of the man-

ual. Unless otherwise stated, the STABILITY control is set for triggered operation and the LEVEL control is set to mid-range.

### Quiescent Conditions

In the quiescent state; that is, when the generator is triggerable but no sweep is being generated, the circuit conditions are as follows:

**Sweep Gating Multivibrator**—V135A is conducting and V145A is cut off. The STABILITY control sets the grid voltage of V135A at about  $-50$  volts. The approximate  $+25$  volts at the plate is coupled to the cathode follower, V135B, and divided to about  $-55$  volts at the grid of V145A. Since the grid of V135A is about 5 volts more positive than the grid of V145A, V135A demands all available current from the common cathode circuit. With no current through V145A, its plate voltage is determined by the current through R147 and the disconnect diodes.

The voltage at the cathode of V135B (about  $+35$  volts) is coupled to the Crt Circuit to blank the appropriate beam. This same voltage is divided to about  $-25$  volts and applied to the grid of V193A. Thus, V193A is cut off and the voltage at the 'A' + GATE OUT connector is zero.

**Disconnect Diodes**—V152A and V152B are conducting. V152A clamps the sawtooth output bus (the cathode of V161B) at about  $-3.5$  volts to provide a stable, repeatable, starting voltage for the sawtooth. V152B clamps the grid of V161A at about  $-2.5$  volts.

**Miller Runup**—Since the grid of V161A is clamped at about  $-2.5$  volts, the tube conducts heavily and the plate voltage is about  $+30$  volts. The plate voltage is coupled to the grid of V161B by the voltage divider, B167 and R167. This type of voltage divider reduces the dc level by about 60 volts, but does not attenuate variations of the input voltage.

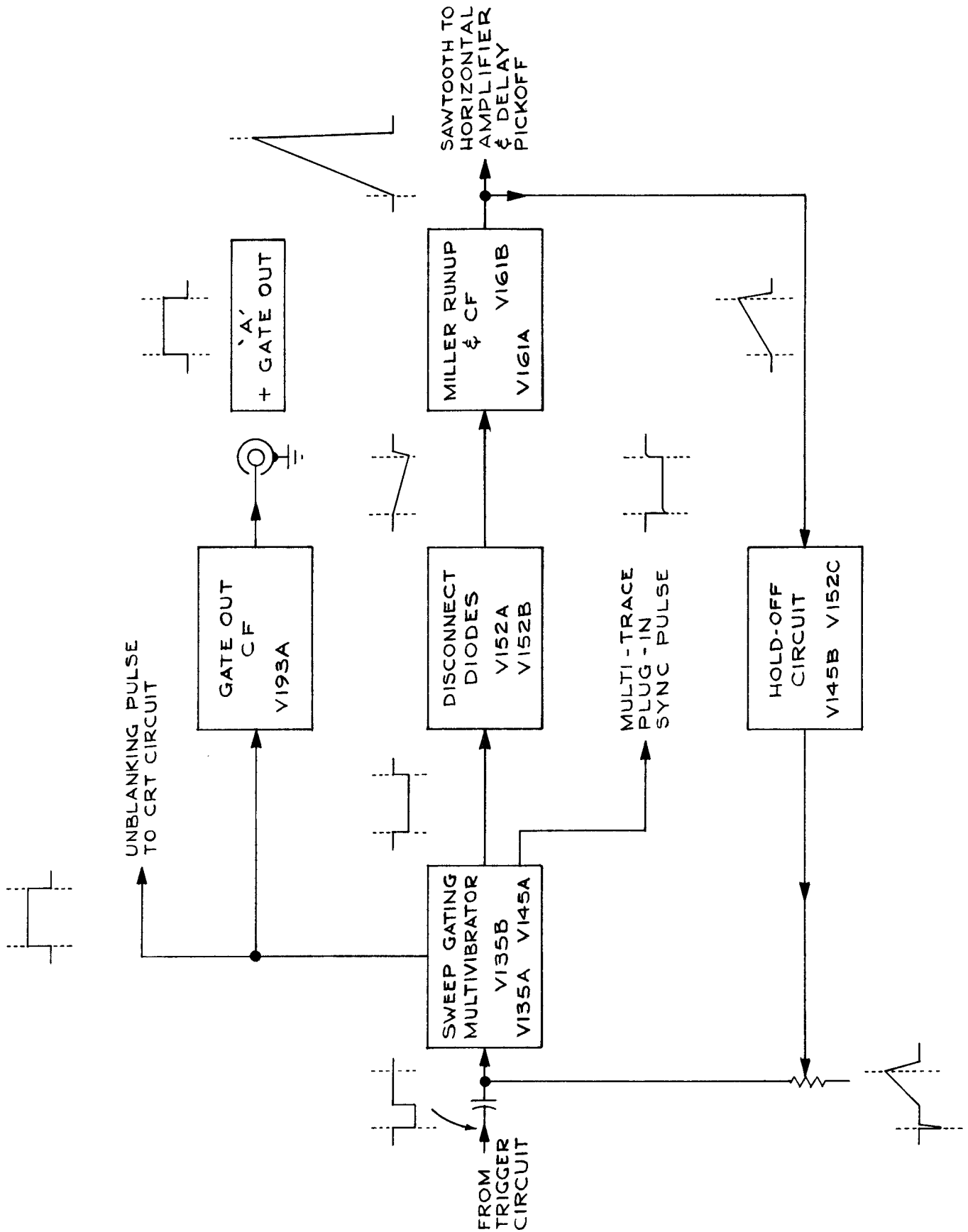


Fig. 3-6. Time Base 'A' Generator.

**Hold-Off Circuit**—V152C is conducting and V145B is cut off. The voltage divider network, R177, R178, and R179, applies about  $-65$  volts to the plate of V152C. Thus V152C conducts through R181 and sets the grid voltage of V145B at about  $-65$  volts. V145B is cut off since its cathode voltage is about  $-50$  volts; the same as the voltage at the grid of V135A.

## Cycle of Operation

When a negative-going pulse is received from the Trigger Circuit at the grid of V135A, the Sweep-Gating Multivibrator switches. Multivibrator action starts by V135A amplifying the trigger pulse. The positive-going pulse at the plate of V135A is coupled to the grid of V145A by the cathode follower, V135B. V145A is driven into conduction, causing a positive-going voltage change in the common cathode circuit. This is positive feedback to the cathode of V135A which further reduces its conduction. Thus, the original action is compounded and the circuit rapidly switches. V145A conducts and V135A is cut off. V145A conducts more heavily than did V135A. Therefore, the common cathode voltage is about 25 volts more positive than it was in the quiescent state, and V135A remains deep in cut off after the trigger pulse has ended.

When V135A cuts off, the voltage at the cathode of V135B rises sharply from about  $+25$  to about  $+128$  volts. This voltage step is coupled to the Crt Circuit and the + Gate Out Cathode Follower. The crt is thus unblanked and the beginning of the plus gate pulse is formed.

With V145A now in conduction, its plate voltage has switched to a new level; about  $-6$  volts. This negative voltage step cuts off conduction in the Disconnect Diodes. The current through the timing resistor, R160, is now diverted and begins to charge the timing capacitor, C160. As the timing capacitor charges, the grid of V161A goes negative. The greatly amplified positive-going change at the plate of V161A is coupled to the grid of V161B through the neon lamp, B167. The neon lamp lowers the dc level of the signal by about 60 volts, but does not reduce the signal amplitude. The cathode of V161B provides the sawtooth output signal plus feedback to two points within the time base generator.

Feedback to the timing capacitor opposes the negative-going change at the grid of V161A. This action persists throughout the period of the sawtooth and limits the total change in grid voltage to less than one volt. Since the voltage drop across the timing resistor is held nearly constant, the current through the resistor is essentially a constant value. This constant current flows into the timing capacitor and the voltage across the capacitor increases at a very linear rate. The rate of rise of the sawtooth is a function of the RC time constant of the timing resistor and capacitor.

An attenuated sample of the positive-going output sawtooth is applied to the plate of V152C in the Hold-Off Circuit. The steady rise in voltage at the cathode of V152C charges the hold-off capacitor while raising the grid voltage on V145B. When the sawtooth has reached about one-half its final amplitude, V145B begins to conduct. As the sawtooth continues to rise, the cathode of V145B and the grid of V135A also rise. V135A will begin to conduct when its grid has risen about 20 volts. The plate voltage on V135A and

the grid voltage on V145A drop and the cathode current no longer required by V145A is assumed by V135A. This positive feedback rapidly drives V135A into heavy conduction and V145A into cut off.

The negative-going voltage step at the cathode of V135B blanks the crt and forms the end of the + Gate Out pulse. The positive going voltage step at the screen grid of V145A is coupled to the appropriate vertical plug-in unit to cause a multi-trace plug-in unit, operating in the "alternate" mode, to switch channels.

When V145A cuts off, its plate voltage rises sharply to about  $-3$  volts and brings V152B into conduction. The grid voltage on V161A rises and its plate voltage drops, carrying the grid and cathode of V161B with it. When the cathode of V161B drops to about  $-3.5$  volts, V152A conducts to clamp the sawtooth output bus at that voltage level.

A sample of the falling voltage at the cathode of V161B is coupled to the plate of V152C, cutting off its conduction. While the hold-off capacitor was charged through the diode, it must discharge through a large resistor, R181. This retarded discharge (holdoff) delays the fall in voltage at the grid (and hence, the cathode) of V145B. The STABILITY control voltage divider network cuts off V145B when its cathode drops to about  $-50$  volts. Thus, V135A is reduced from a state of heavy conduction to its original quiescent (triggerable) state.

Triggerable pulses which may arrive at the grid of V135A while the sweep is in progress have no effect since V135A is already deep in cut off. When V135A is driven into heavy conduction at the peak of the sawtooth, trigger pulses still have no effect because their fixed amplitude is too low to bring V145A out of cut off. The Hold-Off Circuit extends this period of insensitivity and thus blocks the start of the next cycle until the circuits have stabilized. Hold off time is required for stable triggering and is related to the timing capacitor being used. The proper holdoff capacitor is selected by the TIME/DIV. switch (see the Timing Switch schematic).

**Special Component Functions**—C141 assures that the Sweep-Gating Multivibrator will switch rapidly from one conduction state to the other. R187 and R189 isolate the shunt capacitance of the unblanking cables from the Sweep-Gating Multivibrator so its switching speed is not degraded. C165 aids V161B in charging the shunt capacitance in its cathode circuit at the fastest sweep rates. C167 insures that the voltage divider consisting of B167 and R167 will have the proper frequency response. The SWEEP LENGTH control, R178, is set during calibration for the proper sawtooth amplitude. D131 clips the positive-going portion of the triggering signal and C130 bypasses it to ground.

**STABILITY control**—Fig. 3-7 shows the relationship between the voltage at the Sweep-Gating Multivibrator input grid and the sawtooth output of the time base. Normally, the STABILITY control is set near mid-range so the voltage at the Sweep-Gating Multivibrator input grid will be at the level represented by  $E_2$  in Fig. 3-7. This voltage level is about 2 volts above the trip level ( $E_1$ ) required to cause the multivibrator to switch states. An incoming trigger from the Time Base Trigger circuit will drive the grid below the trip level. The multivibrator will immediately switch states and a sawtooth cycle will begin.

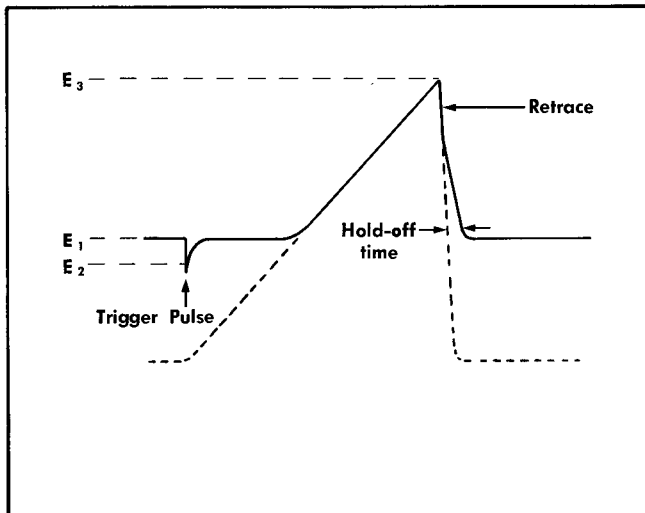


Fig. 3-7. Time and amplitude relationships between the Sweep-Gating Multivibrator input grid signal (solid line) and the time base sawtooth output (dashed line).

When the output sawtooth has reached about one-half of its final amplitude, the Hold-Off Cathode Follower begins to conduct and raises the voltage on the Sweep-Gating Multivibrator input grid. The voltage continues to rise until it reaches the reset level represented by  $E_3$ . At this level, the multivibrator resets to its previous state and the retrace portion of the sawtooth begins. The falling voltage at the input grid of V135A is retarded by the Hold-Off circuit, but finally stabilizes at the quiescent level,  $E_2$ . The entire circuit is then ready for the next trigger pulse.

As you will note from the foregoing description and Fig. 3-7, the stability voltage at the Sweep Gating Multivibrator input grid must be at the correct level for triggered operation to occur. As the STABILITY control is turned counterclockwise, the quiescent voltage will become more positive than  $E_2$ . The amplitude of the trigger pulses will then be insufficient to drive the grid through the trip level  $E_1$ . Since the time base will not operate, this condition is referred to as "lockout". As the STABILITY control is turned clockwise, the voltage becomes more negative than the trip level  $E_2$ , and the Sweep-Gating Multivibrator will switch without waiting for a trigger pulse. As the sawtooth cycle thus initiated carries the input grid of the multivibrator through the retrace and hold-off period, the voltage will again fall below the trip level. Thus, another cycle will be initiated. The sweep generation will repeat without the need for trigger pulses as long as the voltage from the STABILITY control is sufficiently negative. This condition is referred to as "free run" and can also be obtained by setting the LEVEL control to the FREE RUN position (provided UPPER HORIZ. DISPLAY is set to 'A' TIME BASE).

### DELAY PICKOFF

The Delay Pickoff circuit generates a positive-going, differentiated pulse at a predetermined time during each sawtooth produced by Time Base 'A'. The pulse is available at the rear panel for external use and is also coupled to the

'B' MODE switch. The relationship between this pulse and Time Base 'B' is discussed later in this section under "Time Base 'B' Lockout".

Block diagram, Fig. 3-8, shows the four basic sub-circuits in the Delay Pickoff. The sawtooth output of Time Base 'A' is applied to the Difference Amplifier. The Difference Amplifier compares the sawtooth voltage to a variable dc voltage from the DELAY INTERVAL control. If the voltage from the DELAY INTERVAL control is more positive than the instantaneous sawtooth voltage, the Difference Amplifier output will be a low positive voltage. If the sawtooth voltage is the more positive, the output will be a somewhat higher positive voltage. It is important to note that the transition from the lower to the higher output voltage is actually an amplified segment of the input sawtooth as shown on the block diagram.

The Delayed Trigger Multivibrator converts the Difference Amplifier output signal into a fast-rise pulse. This pulse is then differentiated and clipped so only the positive-going pulses appear at the output of the Delayed Trigger Cathode Follower.

The point along the sawtooth rise where the delayed trigger output pulse will occur is determined by the voltage from the DELAY INTERVAL control. If a low voltage is selected, the pulse will occur during the early portion of the rise while the sawtooth voltage is low. If a higher voltage is selected, the pulse will occur at some later time during the rise when the sawtooth voltage is proportionally higher.

The maximum delay that can be obtained is slightly less than the total time duration of the sawtooth rise, which is determined by the setting of the 'A' TIME/DIV. switch. For example, if the 'A' TIME/DIV. switch is set to 1 mSEC, the maximum DELAY INTERVAL dial setting of 10.00 would result in a 10 millisecond delay between the start of the 'A' sawtooth and the delayed trigger pulse output.

The following detailed description refers to the Delay Pickoff schematic in the back of this manual.

### Constant Current Tube

V314B is a constant current source for the Difference Amplifier. The voltage divider formed by R325 and R326 applies about  $-50$  volts to the grid. This stable grid voltage and the high resistance in the cathode circuit force a constant 5 ma to flow through the tube. The Difference Amplifier will conduct this fixed current, either through one tube or shared between the two tubes.

### Difference Amplifier

In the Difference Amplifier, the cathodes of V314A and V324A are connected together. The tube having the more positive control grid voltage will determine the voltage on the cathodes of both tubes. For example, assume that the DELAY INTERVAL control is set to 4.00. The voltage at the grid of V324A will then be about  $+36$  volts. If Time Base 'A' is in the quiescent state, the voltage at the grid of V314A will be about  $-3.5$  volts. Since the grid of V324A is more positive, it will establish the common cathode voltage at about  $+38$  volts. Therefore, V314A is deep into cutoff. V324A conducts and the voltage at its plate is about  $+121$  volts.



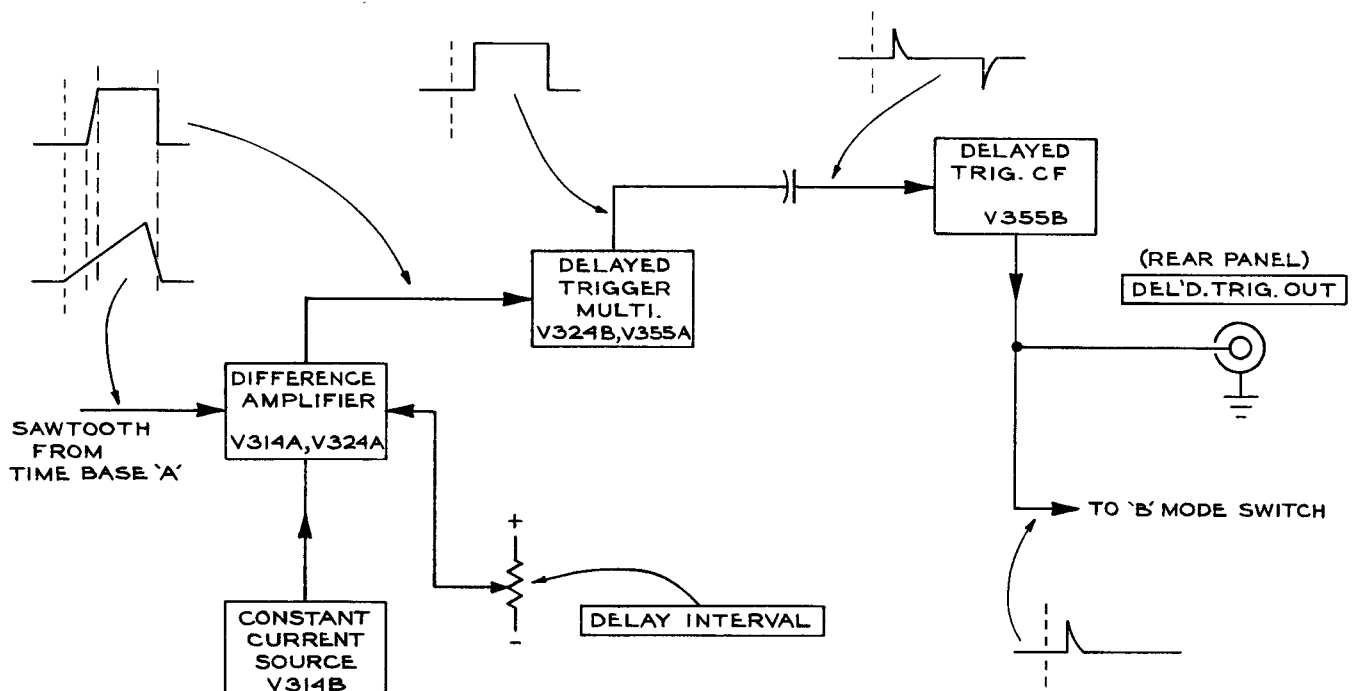


Fig. 3-8. Delay Pickoff.

As V324A cuts off, its plate voltage rises from about +120 volts to about +200 volts. The elapsed time from the beginning to the end of this voltage change depends upon the Time Base 'A' sweep rate; about 2 seconds at 5 seconds per division and about 0.5 microsecond at 1 microsecond per division. The Delayed Trigger Multivibrator (a Schmitt trigger) converts this variable rate of rise into a voltage step of consistently fast risetime which is independent of the Time Base 'A' sweep rate.

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### Delayed Trigger Multivibrator

When the voltage at the plate of V324A is at the lower level (about +120 volts), V324B in the Delayed Trigger Multivibrator is cut off and V355A is conducting. As the voltage at the plate of V324A rises to about +170 volts and V324B begins to conduct, the voltage at the plate of V324B drops slightly, lowering the voltage at the grid of

V355A. This reduces the current through V355A. However, the voltage at the grid of V324B will not permit the common cathode voltage to drop. Hence, the current given up by V355A is immediately assumed by V324B. This reduces the voltage at the plate of V324B still more, compounding the initial action. Thus, the beginning of conduction in V324B causes the Delayed Trigger Multivibrator to rapidly change states; V324B conducts and V355A cuts off. This produces a fast-rise positive-going voltage step at the plate of V355A.

### Delayed Trigger C.F.

The voltage step produced by the Delayed Trigger Multivibrator is differentiated by the network consisting of C354, R354, and R355, and is applied to the grid of V355B. Delayed Trigger Cathode Follower V355B is held near cutoff by R354 and R355. When the delayed trigger pulse appears at the grid, the tube conducts heavily and the pulse is reproduced across R359.

The entire Delay Pickoff circuit resets during the retrace time of the Time Base 'A' sawtooth when the voltage at the plate of V324 drops below about +155 volts. When the differentiated pulse at the grid of V355B subsided, the tube was again near cutoff. Hence, when the negative going reset pulse at the grid of V355B drives the tube deeper into cutoff, very little negative going output signal is produced.

Several important conditions exist at the instant the delayed trigger output pulse occurs:

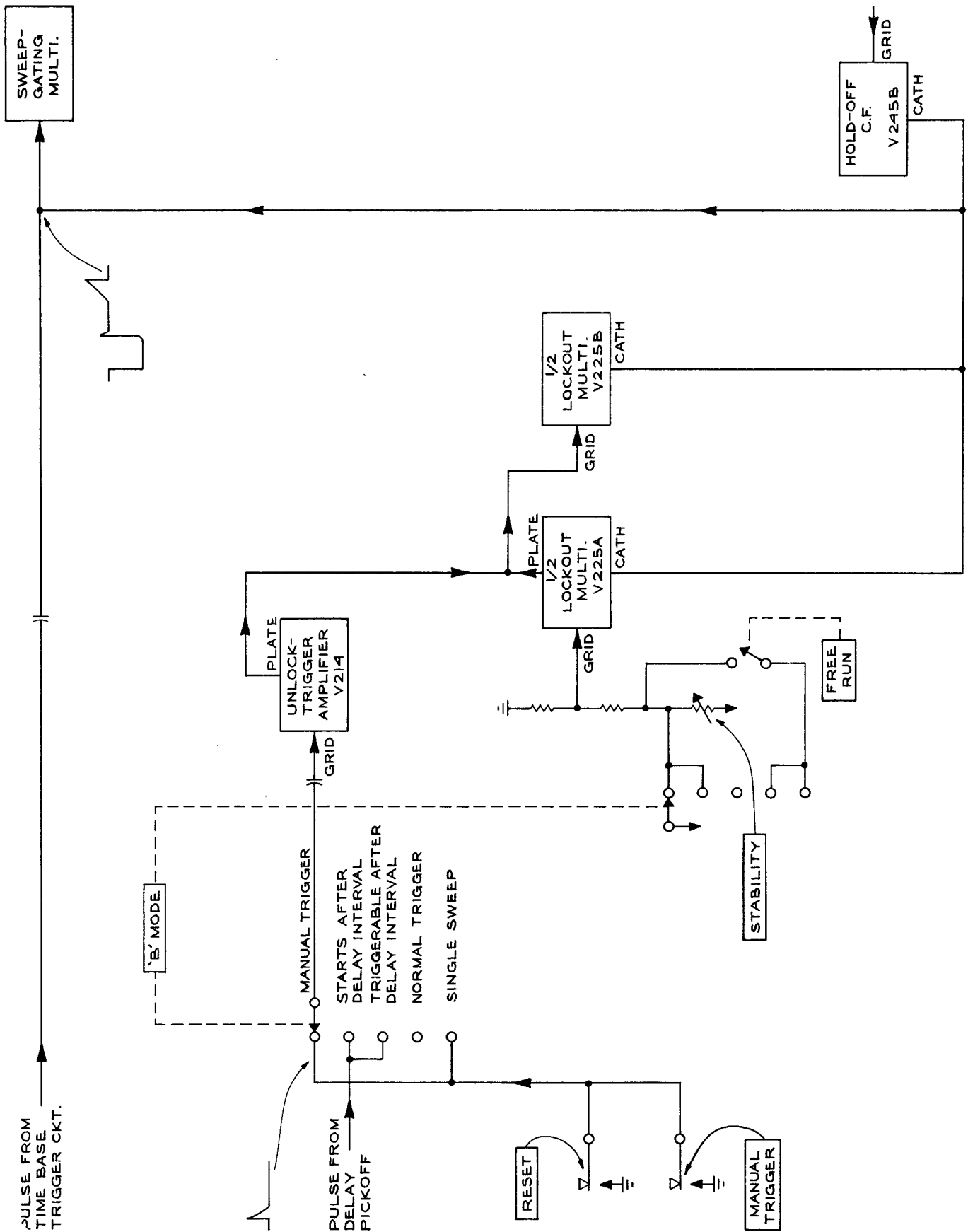


Fig. 3-9. Time-Base 'B' Lockout.

1. The voltage from the DELAY INTERVAL control essentially equals the instantaneous sawtooth voltage.
2. Time Base 'A' trace will have moved as many graticule divisions as the DELAY INTERVAL dial setting (10X MAG. off).
3. The time delay between the start of the 'A' sawtooth and the delayed trigger output pulse will equal the DELAY INTERVAL dial indication times the 'A' TIME/DIV. switch setting.

### TIME BASE 'B' LOCKOUT

As previously mentioned in the description of Time Base 'A', the STABILITY control and FREE RUN switch settings determine whether the time base will be inoperative, triggerable, or will free run. Time Base 'B' operates in exactly the same manner when the 'B' MODE switch is set to NORMAL TRIGGER. However, when the 'B' MODE switch is in any other position, there is one additional factor controlling Time Base 'B'; the Lockout Multivibrator.

The Lockout Multivibrator is a bistable electronic switch. In one state, it permits the STABILITY control or associated switches to have full control of the time base, just as they do in Time Base 'A'. In the other state, the Lockout Multivibrator over-rides the function of these controls and renders the time base inoperative.

At the beginning of a Time Base 'B' sequence, the Lockout Multivibrator holds the time base in the "Time Base

Inoperative" state. A pulse from the Unlock-Trigger Amplifier will switch the multivibrator to the "Time Base Operative" state and Time Base 'B' then either free runs or becomes triggerable. When Time Base 'B' completes one sawtooth, the Lockout Multivibrator resets to the "Time Base Inoperative" state. This sequence repeats for each sawtooth produced by Time Base 'B'.

The following information is closely related to the STABILITY control discussion under "Time Base Generators" in an earlier portion of this section. For better understanding of Time Base 'B' Lockout, the STABILITY control discussion should be read first.

Unless otherwise stated in the following descriptions, the 'B' STABILITY control is set for triggered operation and the 'B' MODE switch places the Lockout Multivibrator into one of the following modes of operation.

### Single Sweep Mode

Refer to the block diagrams, Fig. 3-9 and Fig. 3-10 during the following descriptions. Fig. 3-10 represents the signal at the grid of V235A during one cycle of operation as follows:

1. Before  $t_0$ , V225B conducts during the "Lockout" period and holds the grid of V235A at voltage level  $E_1$ . At this voltage level, the Sweep-Gating Multivibrator cannot be triggered, nor will it free run.

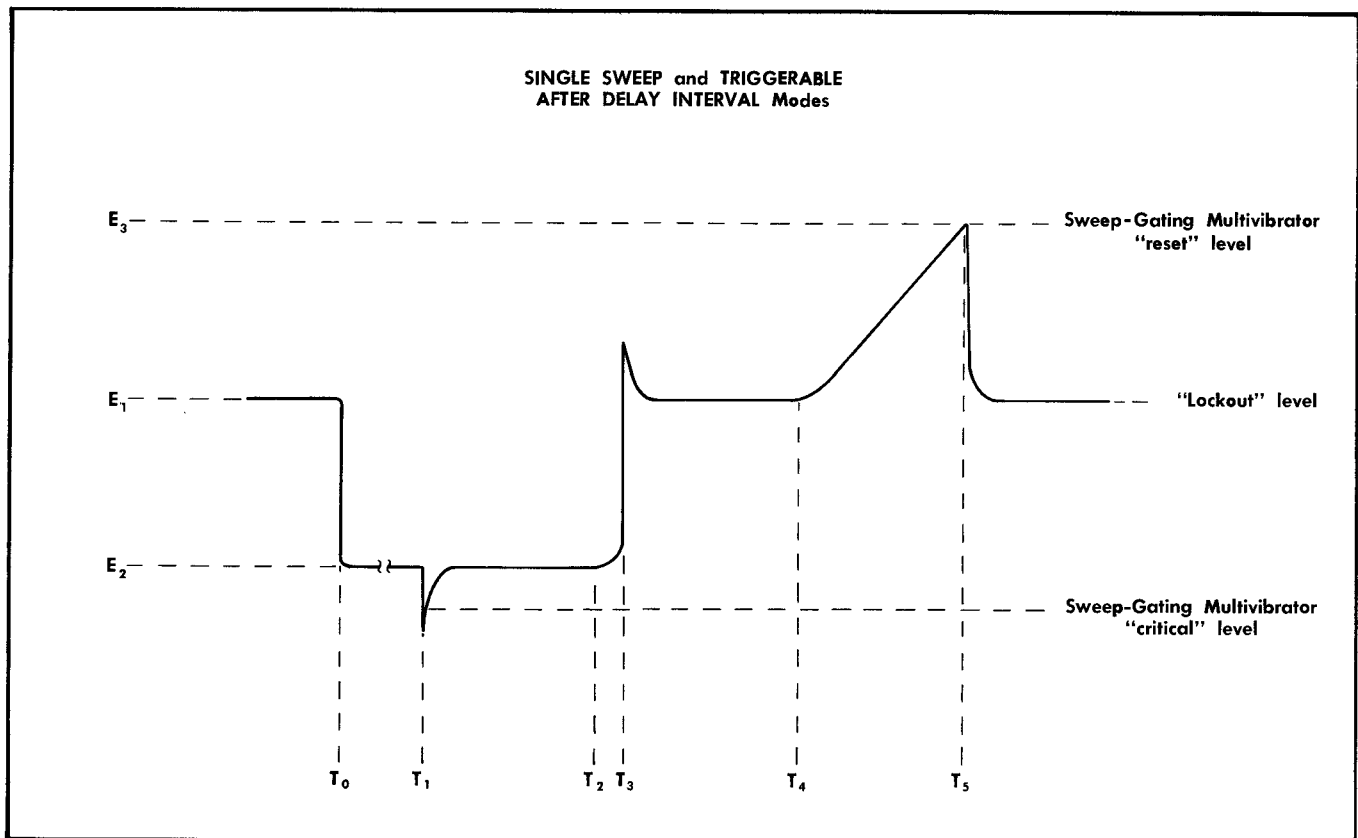


Fig. 3-10. Signal at the grid of V234A.

2. When the Single Sweep RESET button is pushed ( $t_0$ ), V225B cuts off. The grid voltage of V235A drops sharply to the level where V225A conducts.

3. The STABILITY control determines the voltage ( $E_2$ ) that V225A applies to the grid of V235A. The time base is now in the normal quiescent state and only requires a pulse from the Time Base Trigger circuit to start the sawtooth. This could occur immediately or at some indefinite later time.

4. When a trigger pulse is received ( $t_1$ ), the sawtooth cycle will begin.

5. As the sawtooth reaches about one-half its final amplitude, the Hold-Off Cathode Follower, V245B, begins to conduct ( $t_2$ ) and V225A cuts off ( $t_3$ ).

6. As V225A cuts off, V225B again comes into conduction ( $t_3$ ) and raises the grid voltage of V235A to the "Lockout" level ( $E_1$ ). This voltage level is well below the "reset" level of the Sweep-Gating Multivibrator and therefore has no effect on the output sawtooth now in progress.

7. When the output sawtooth reaches about three-fourths its final amplitude, V245B begins to conduct again ( $t_4$ ) and V225B cuts off. The sawtooth feedback raises the grid voltage of V235A to the reset level ( $E_3$ ) and stops the sawtooth ( $t_5$ ) in the normal manner.

8. As V245B continues to conduct, it reproduces part of the sawtooth retrace at the grid of V235A. But as the voltage approaches the "Lockout" level ( $E_1$ ) V225B again conducts and V245B cuts off.

9. The voltage at the grid of V235A is now stable at the "Lockout" level ( $E_1$ ). The cycle is complete and cannot repeat until the Single Sweep RESET button is pushed again.

### Triggerable After Delay Interval Mode

This mode differs from the Single Sweep mode in that the "unlocking" pulse comes from the Delay Pickoff Circuit instead of the RESET push button. Also, the Time Base 'B' LEVEL control FREE RUN function is disconnected.

### Manual Trigger Mode

The differences between this mode and the Single Sweep mode are as follows:

1. The "unlocking" pulse comes from the MANUAL TRIGGER push button instead of the RESET push button.
2. When the voltage drops at  $t_0$  (see Fig. 3-11), it drops to a more negative level ( $E_4$ ) than in the Single Sweep mode. This level is below the "trip" level of the Sweep-Gating Multivibrator. Hence, the sawtooth cycle begins immediately without waiting for a pulse from the Time Base Trigger circuit. This occurs because the 'B' MODE switch by-passes the STABILITY control and causes V225A to conduct at the lower level.

### Starts After Delay Interval Mode

The only difference between this mode and the Manual Trigger mode is that the "unlocking" pulse comes from the Delay Pickoff Circuit instead of the MANUAL TRIGGER push button.

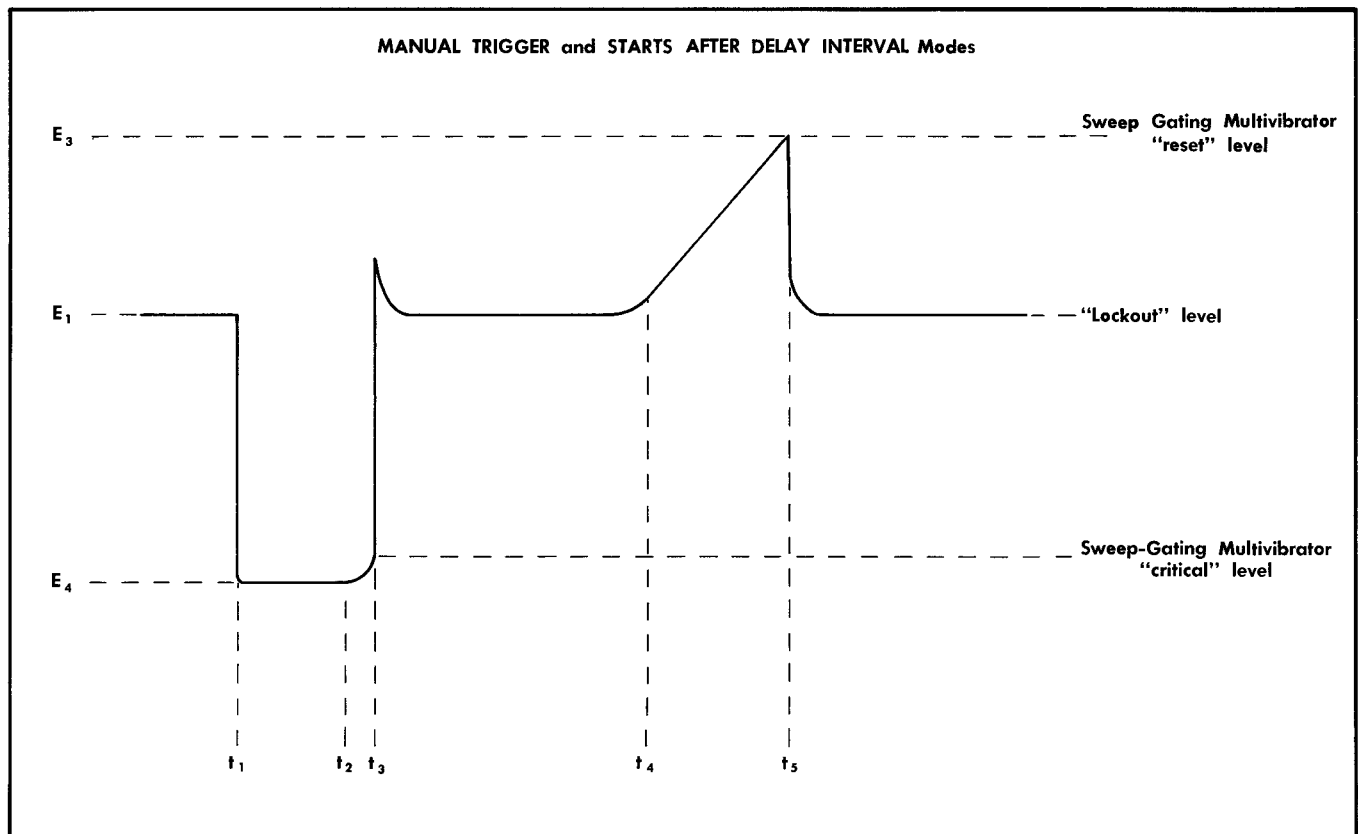


Fig. 3-11. Signal at the grid of V235A.

Refer to the Time Base 'B' schematic in the back of this manual during the following description. For the remainder of this description, the 'B' MODE switch can be assumed to be set at any position except NORMAL TRIGGER.

Since there are two negative feedback paths between V225A and V225B (pin 6 to pin 9 and pin 8 to pin 7), the two tubes cannot conduct at the same time. When the time base is "locked out", V225B conducts and holds the cathodes of V225A and V245B considerably more positive than their grids. Hence, these two tubes are cut off.

The Unlock-Trigger Amplifier, V214, is self-biased near cutoff. The positive-going "unlocking" pulse applied to the control drives V214 into heavy conduction and produces a high amplitude negative-going pulse at the plate. This pulse is applied to the grid of V225B through C223-R223, driving its cathode considerably more negative than the grid of V225A, causing V225A to suddenly conduct. The voltage at the plate of V225A is already low in the presence of the negative-going pulse from the Unlock-Trigger Amplifier. Therefore, V225A conducts as a triode with its screen grid acting as the triode plate. As the pulse at the plate subsides and the plate voltage tends to rise, a greater portion of the cathode current in V225A flows to the pentode plate. Thus, the voltages at the pentode plate of V225A and at the grid of V225B do not rise after the pulse has subsided. V225A remains in conduction and V225B is cut off.

With V225B now conducting, the common cathode voltage is determined by the switches and STABILITY control in the tube's control grid circuit. This is exactly the same condition that exists when the time base is operated in the NORMAL

TRIGGER mode. The time base will either free run or await a trigger pulse, depending upon the switch settings in the grid circuit of V225A.

From this point, the cycle continues to the end of the sawtooth rise as previously described.

At the end of the sawtooth rise, V245B has raised the common cathode voltage so that both V225A and B are cut off. When both tubes are cut off, V225B has the more positive control grid voltage. Hence, as the common cathode voltage goes more negative during the retrace portion of the sawtooth, V225B will come into conduction while V225A is still deep in cutoff. With the cycle completed and V225B conducting, the time base is again "locked out".

The LOCKOUT LEVEL control is adjusted during calibration to set the conduction level of V225B. Whenever V225B conducts, the common cathode voltage should be about half way between the reset and trip voltages of the Sweep-Gating Multivibrator.

The READY lamp lights only when V225B is cut off. The lamp therefore shows the operator whether or not the Sweep Gating Multivibrator is ready to operate.

### HORIZONTAL AMPLIFIER

The Upper and Lower Beam Horizontal Amplifiers are nearly identical. The following descriptions apply to both amplifiers, but the Upper Beam Horizontal Amplifier circuit reference numbers are used.

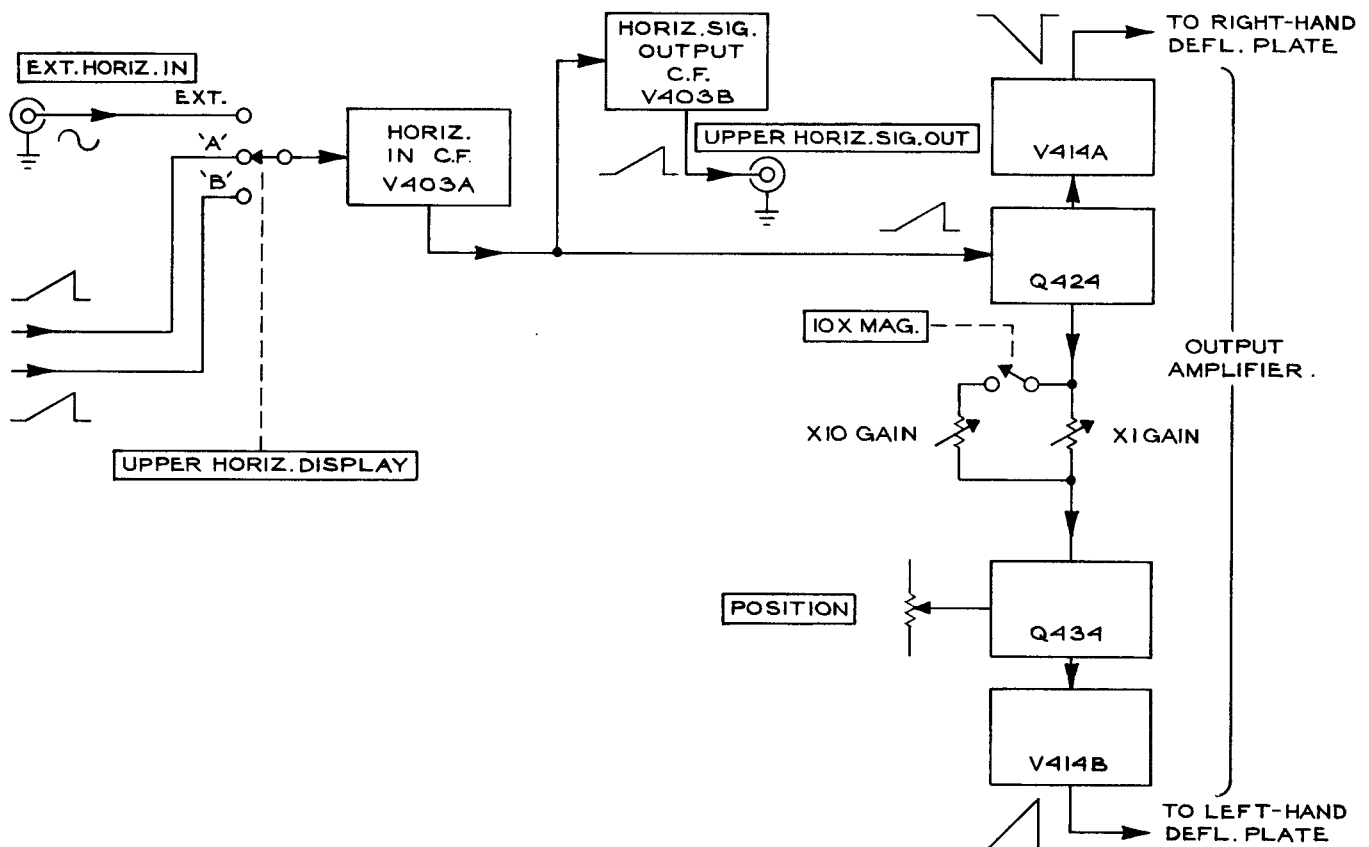


Fig. 3-12. Upper Beam Horizontal Amplifier.

## Circuit Description — Type 565

The Horizontal Amplifier input signals can come from Time Base 'A', Time Base 'B', or from an external source. The appropriate signal is selected by setting the Horizontal Display switch.

Each Horizontal Amplifier has two outputs; a push-pull output connected to one pair of CRT horizontal deflection plates and a single-ended output at the rear panel for external use. The operator can increase the gain of the push-pull portion of the amplifier ten times by turning on the ten times magnifier (10X MAG.).

The block diagram, Fig. 3-12, shows the basic sub-circuits in the Horizontal Amplifier. V403A isolates the amplifier from the signal source and provides a low driving impedance for Q424. V403B isolates the amplifier from any reasonable load impedance connected to the rear panel horizontal signal output connector.

Q424, V414A, Q434, and V414B form a paraphase amplifier. The signal applied to Q424 varies the current through both Q424 and Q434. The current variations pass through V414A and B and produce a high amplitude voltage swing at the amplifier output. When the 10X MAG. switch is closed (pulled out) the resistance between the emitters of the transistors is decreased and the gain is increased ten times. The POSITION control determines the dc average voltage difference between the right and left hand deflection plates.

Refer to the Upper Beam Horizontal Amplifier schematic in the back of the manual during the following description.

When the UPPER HORIZ. DISPLAY switch is in the EXTERNAL position, from zero to 100% of an external signal will be applied to the grid of V403A, depending upon the EXT. HORIZ. GAIN control setting. When UPPER HORIZ. DISPLAY is set to 'A' TIME BASE, an attenuated sawtooth signal from Time Base 'A' is applied to the grid of V403A. The fixed attenuator consists of R971 and R975 as shown on the Horizontal Display Switching schematic. When UPPER HORIZ. DISPLAY is set to 'B' TIME BASE, the signal is an attenuated sawtooth from Time Base 'B'. The Time Base 'B' sawtooth passes through variable attenuator R981, R978, and R979. The UPPER BEAM SWEEP BAL. control, R979, is adjusted during calibration so the Time Base 'B' sawtooth will produce the same sweep rate on the crt as the equivalent Time Base 'A' sawtooth.

The Horizontal Input Cathode Follower, V403A, drives the base of Q424 and the grid of V403B. Since V403B is ahead of the Output Amplifier, the UPPER HORIZ. SIG. OUT is not affected by the 10X MAG. switch or the POSITION control.

The grid voltages on V414A and B are fixed at about +8 volts by the divider, R407-R408. Both tubes operate as grounded-grid amplifiers and their cathodes present a low impedance to the transistor collectors.

The transistors operate as a low impedance paraphase amplifier with degenerative emitter coupling. The resistance between the emitters and their current source, the -100 volt supply, is quite high. Because of this high resistance, the total current through the two transistors (and the tubes) is nearly constant and an input signal only reapportions the current. For example, an increase in current through Q424 is offset by a nearly equal decrease in current through Q434.

Fig. 3-13 shows how the input signal increases current through one transistor while equally decreasing current through the other. The input signal is distributed across the series resistances beginning at the internal emitter resistance of Q424 and ending with the internal emitter resistance of Q434. Since the external circuit is balanced for the two transistors, their internal emitter resistances are equal. Hence, the signal voltages developed across the base-emitter junctions will be equal.

Fig. 3-13 shows that the base of Q424 goes positive with respect to its emitter while the emitter of Q434 goes positive with respect to its base. Thus, the two transistors see equal, but opposite phase, input signals. The current increases through Q424 and decreases through Q434. These current variations pass through the tubes and develop the output signal across the plate load resistors.

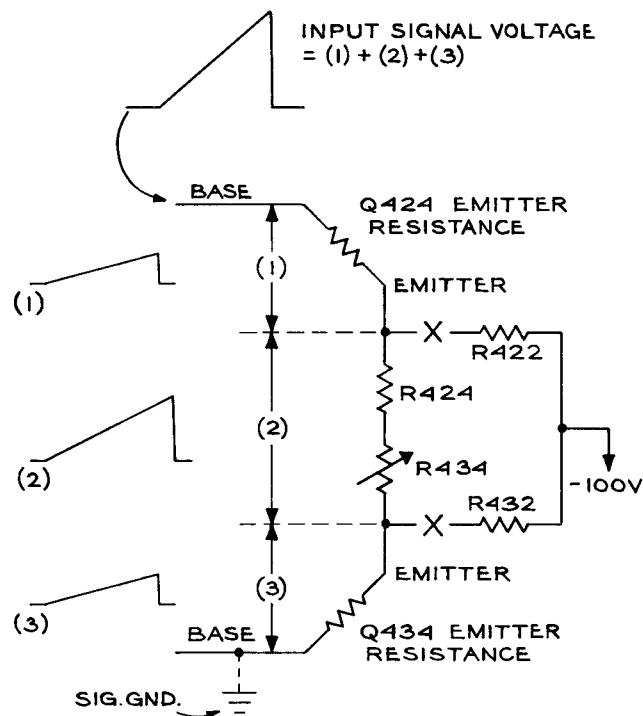


Fig.3-13. Horizontal Output Amplifier paraphase action.

The value of the resistance between the emitters determines the percentage of signal developed across the base-emitter junctions. This degeneration provides control of the amplifier gain.

X1 GAIN, R434, is set during calibration so the beam moves across the crt at the proper rate when the 10X MAG. is turned off. When the 10X MAG. is turned on, the series

combination of R421 and R431 is in parallel with R424 and the X1 GAIN control. The emitter coupling resistance is decreased and the amplifier gain is increased. X10 GAIN is set during calibration so the amplifier gain is exactly ten times greater with the 10X MAG. turned on than with it off.

The current source resistors, R422 and R432, are shown disconnected in Fig. 3-13 to illustrate that the signal changes the total current through them very little. However, due to the signal across the emitter coupling resistance, the current through R432 decreases slightly while it increases slightly through R422.

When the transistor base voltages are equal, the transistor currents should also be equal so the beam will be at the horizontal center of the crt. When the 10X MAG. is turned on, the emitter coupling resistance is small and the current will essentially balance. But, when the 10X MAG. is turned off, the greater resistance can cause a current imbalance, if the two halves of the amplifier are not exactly equal. Hence, the SWP. MAG. REGIS., R433, is adjusted during calibration to balance the current with the 10X MAG. turned off. Then, when the beam is at the center of the crt with the 10X MAG. on, it will remain at the center when the 10X MAG. is turned off.

## LOW VOLTAGE POWER SUPPLIES

### General

The Low Voltage Power Supplies consist of four interdependent, regulated voltage sources. Each supply is capable

of maintaining an accurate dc output voltage having a low percentage of ripple, even though the input line voltage and the output load may vary considerably.

### —100 Volt Supply

When the design-center voltage is applied to the primary of T601, the voltage across secondary terminals 6 and 11 is about 145 volts rms. This voltage is applied to a conventional full-wave bridge rectifier, D612, producing about 200 volts dc across filter capacitor C611. This voltage is then divided between the load and the series regulator tubes. The block diagram Fig. 3-14 shows the basic elements of the circuit which accomplish this division.

The regulator tubes function as a variable resistor in series with the load. In order to maintain a stable voltage across the load, their plate resistance must be changed as required to offset the effect of a change in line voltage or load current. To accomplish this, the output voltage is constantly compared to a fixed reference voltage by the comparator V636. Any error thus detected is amplified and applied to the series regulators. Their plate resistance is thereby changed and the proper output voltage is restored.

Refer to the Power Supply schematic in the back of this manual. The voltage reference tube V639 applies a stable —85 volts to the 'A' grid of a long-tailed difference amplifier V636. This establishes an essentially constant voltage at the common cathodes of both V636A and V636B. A sample of the supply output voltage is obtained from the —100 VOLTS control, R624. (This sample will always be about —85 volts,

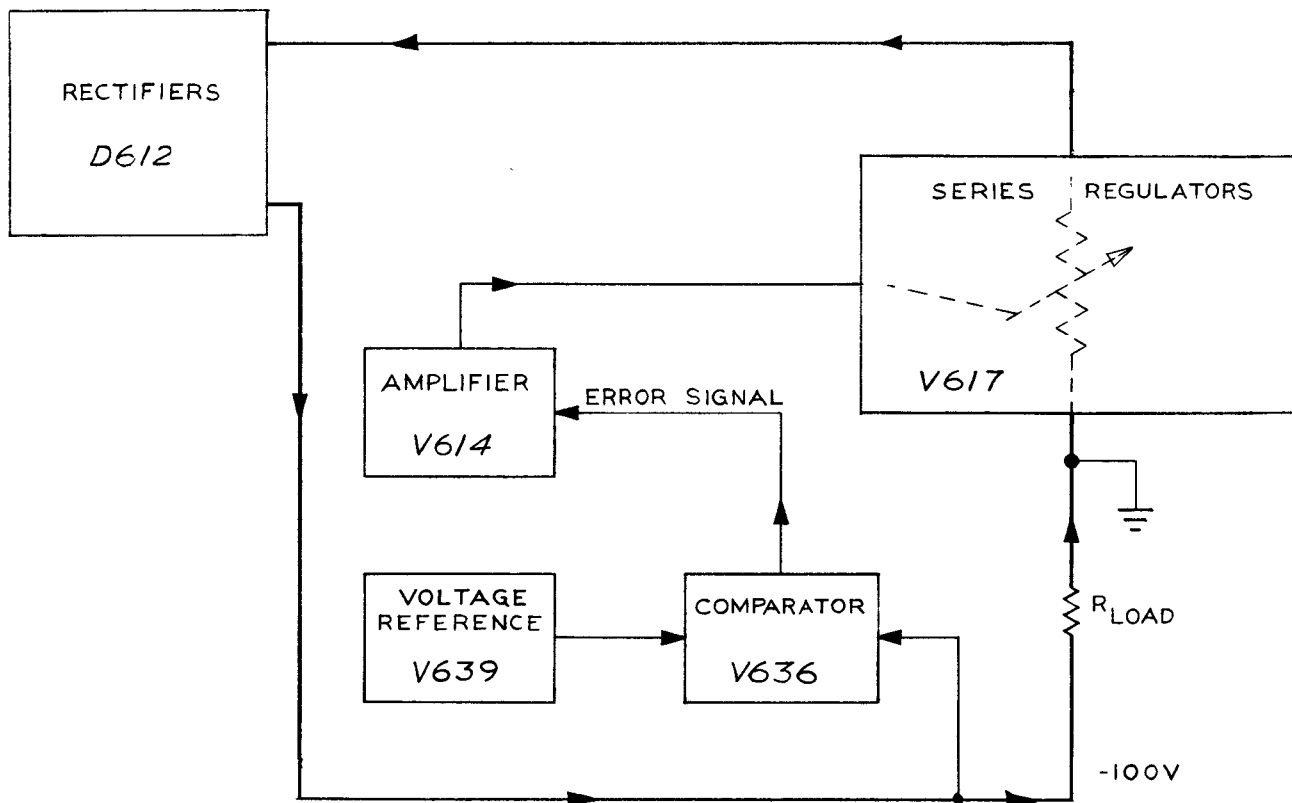


Fig. 3-14. —100-Volt Supply.

## Circuit Description — Type 565

since it is the voltage actually being regulated to match the reference voltage. Since the  $-100$  VOLTS control is set so the sample is 85% of the total voltage across R623, R624 and R625, the total voltage will also be regulated.) If a positive-going change occurs in the output voltage, the grid voltage on V636B changes in the positive direction. The current through V636B increases and its plate voltage drops. This negative-going voltage change is applied to the control grid of amplifier V614. The current through V614 decreases and its plate voltage rises, carrying the grids of V617 and V627 positive. The regulator tubes' plate resistance decreases, therefore increasing the current through the load. This results in an increased voltage drop across the load, thus offsetting the error.

Negative-going changes are corrected in the same way except for error signal polarities. Due to the high gain of the amplifier circuits and their ability to respond quickly, the supply in effect corrects for changing line voltage and load conditions before a significant change can occur in the output voltage.

The dc voltage across C611 bears a substantial amount of ripple. A sample of this ripple is applied to the screen grid of V614. The screen grid acts as a second signal grid and aids in eliminating much of the ripple from the supply output. C636 and C629 also aid in eliminating ripple since they offer less attenuation to ac error signals than do the resistive voltage dividers. C626 lowers the supply output impedance.

R626 and R627 are particularly important elements in the  $-100$  volt supply. It would be impractical to pass all of the current required by the load through the series regulator tubes. Since line voltage and load current variation limits are known, the series regulator tubes need only carry enough current to allow for these variations. Hence, R626 carries a substantial amount of the current required by the circuits within the Type 565. R627 serves the same purpose for each of the vertical plug-in units. Depending on the amount of current required by each type of plug-in unit, the connections within the plug-in will be one of the following:

1. No connection to pin 22 of the plug-in unit interconnecting plug (low current demand).
2. A resistor connected between pins 22 and 9 (moderate current demand).
3. A wire connected between pins 22 and 9 (maximum current demand).

### + 125 Volt Supply

The operation of the  $+125$  volt supply is similar, in most respects, to that of the  $-100$  volt supply.

The  $-100$  volt supply serves as the voltage reference for the  $+125$  volt supply. R673 and R674 are the principle circuit elements that determine the accuracy of the output voltage.

Full-wave rectification of the ac supply voltage is provided by rectifiers D662A and D662B. These two diodes are shared with the  $+300$  volts supply to form half of a full-wave bridge.

### +300 Volt Supply

The only significant difference between the  $+125$  and  $+300$  volt supplies is the  $+420$  volt unregulated output associated with the  $+300$  volt supply. This voltage is used in the oscillator portion of the Crt Circuit.

### -12.2 Volt Supply

R643 and R644 provide the reference voltage at the base of Q644. Any voltage error at the emitter of Q644 is amplified, but not inverted, and applied to the base of Q654. Q654 amplifies and inverts the error signal, providing the necessary drive for the series regulator Q657. C647 and R647 provide phase correction for Q654, thereby stabilizing the regulator.

The  $-12.2$  volt supply does not employ shunt resistors as do the other three supplies. Instead, all load current passes through the series regulator. Fuse F640 protects Q657 from overload. C657 reduces the supply output impedance.

## CRT CIRCUIT

### CAUTION

Always make or break voltmeter connections at any of the high-voltage points in the Crt Circuit (except for the HIGH VOLTAGE TEST POINT) while the instrument is turned off. If a connection is made or broken while the power is on, a small arc may occur which will produce voltage and current transients within the circuit. Such transients can destroy one or more of the semiconductor devices in the Crt Circuit.

### High Voltage Power Supply

The cathode-ray tube (crt) in the Type 565 Oscilloscope requires an accelerating potential of about 4100 volts. Approximately 200 volts of this is supplied by the low-voltage power supply. The remaining 3900 volts comes from the high-voltage power supply.

The high-voltage power supply consists of an oscillator, a step-up transformer, rectifiers, and circuits which regulate the high voltage (see Fig. 3-15). Transformer T801 steps up the oscillator signal to the required amplitude, and V822 rectifies the signal, producing high voltage dc. This voltage is applied to the crt from several points in a high resistance voltage divider which includes the INTENSITY and FOCUS controls.

Refer to the Crt Circuit schematic in the back of this manual. The oscillator is a modified Hartley which operates at a frequency determined by the primary winding inductance and inter-turn capacitance of transformer T801. Oscillator frequency is not critical and is usually between 30 kc and 50 kc. The voltage on the screen grid of V800 determines the amplitude of the oscillator signal, which in turn determines the value of dc high voltage produced. This property of the circuit is used to establish and maintain the correct high voltage;  $-3900$  volts.



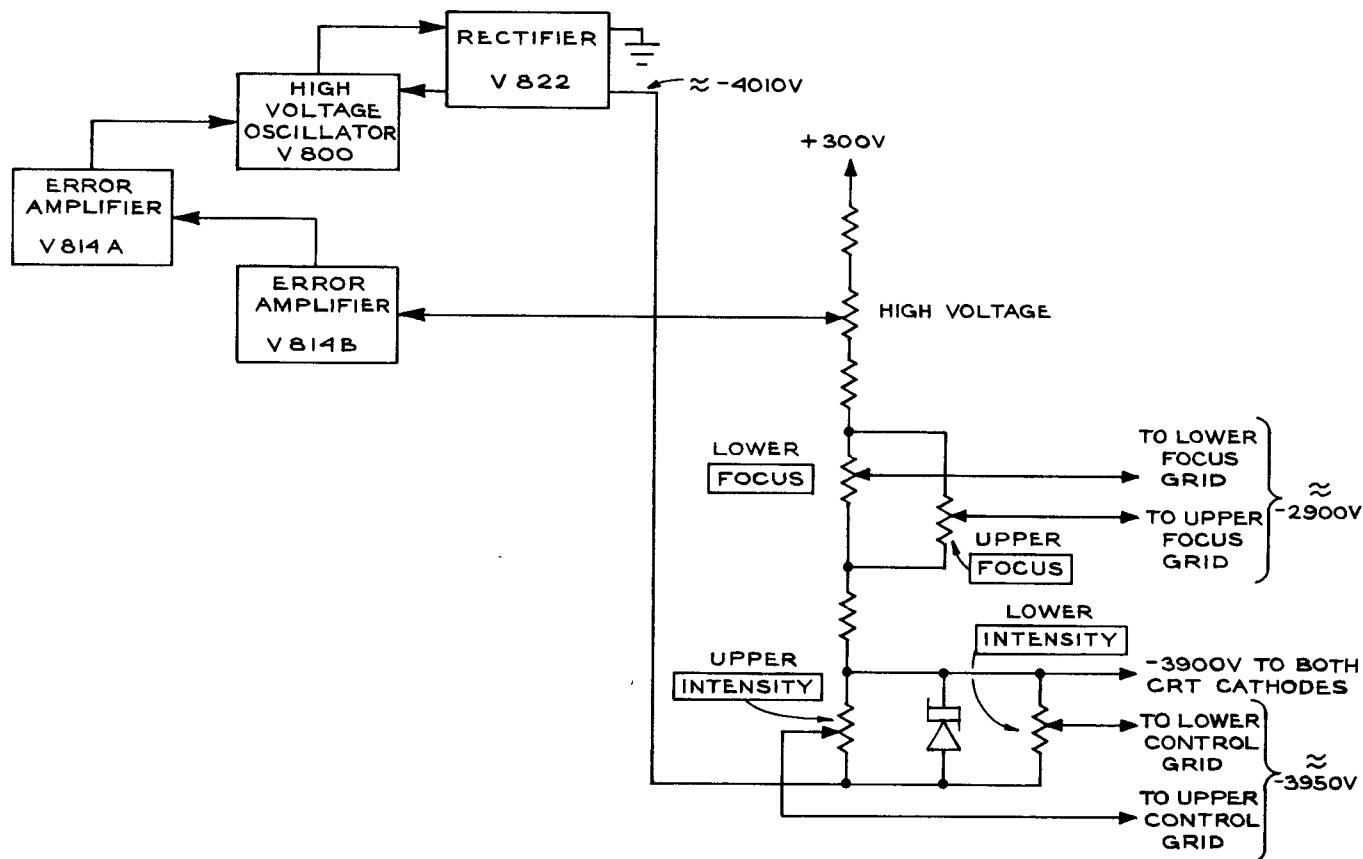


Fig. 3-15. High Voltage Power Supply.

The high voltage is applied to a high resistance voltage divider which includes the INTENSITY, FOCUS, and HIGH VOLTAGE controls. With any particular setting of the HIGH VOLTAGE control, a certain percentage of the total voltage across the voltage divider is applied to the grid of V814B. This grid voltage will always be about  $-103.5$  volts, since it is the voltage actually being regulated. Since the grid voltage is regulated and is a known fraction of the high voltage, the high voltage will also be regulated.

When the voltage at the grid of V814B is  $-103.5$  volts, the voltage at the plate of V814B and the grid of V814A will be about  $-2$  volts. The voltage at the plate of V814A and at the screen of V800 will be about  $+90$  volts. If the high voltage should change, the voltage at the grid of V814B will also change. This change will be amplified by V814B and V814A, thus changing the voltage on the screen of V800. If, for example, the screen voltage is made more positive, the oscillator signal amplitude will increase and a greater dc high voltage will be produced.

Due to C862, the high gain of the error amplifier, and the ability of the circuit to respond quickly, there is rarely any significant variation in the high voltage. This is because the correction for any change begins at nearly the same instant as the change. Thus, a change is stopped and corrected before it can become more significant.

### Intensifying Circuit

The Intensifying Circuit operates only when the TRIGGERABLE AFTER DELAY INTERVAL and STARTS AFTER DELAY

INTERVAL modes of Time Base 'B' are used. Its only function is to dc couple a positive-going pulse to the upper beam CRT control grid. The normal voltage on this grid is about  $-3975$  volts. The positive-going pulse at the control grid will cause a brightened segment within the upper beam trace. (For more information about the purpose of the brightened trace segment, see "Using the 'B' MODE Switch" in Section 2 of this manual.)

The basic elements of the Intensifying Circuit are shown in Fig. 3-16. Pulse Shaper V834 converts the applied unblanking pulse into alternate positive and negative voltage pulses. These pulses actuate the bistable tunnel-diode switch D845 to produce a negative-going turn-on pulse for Current Switch Q843.

When the Current Switch Q843 is open, the floating 11-volt supply does not produce a voltage drop across R849. The voltage on the upper beam crt control grid during this time depends entirely upon the setting of the INTENSITY control. However, when the Current Switch is closed, current through R849 produces a voltage drop that drives the crt grid more positive. This causes a portion of the upper beam trace to be brightened.

For the following portion of the circuit description, refer to the Crt Circuit schematic in the back of this manual.

The LOWER HORIZ. DISPLAY switch provides a choice between three signal sources for unblanking the crt: 'A' Unblanking, 'B' Unblanking, or  $+125$  volts dc. Each of these signals can cause the Intensifying Circuit to operate.

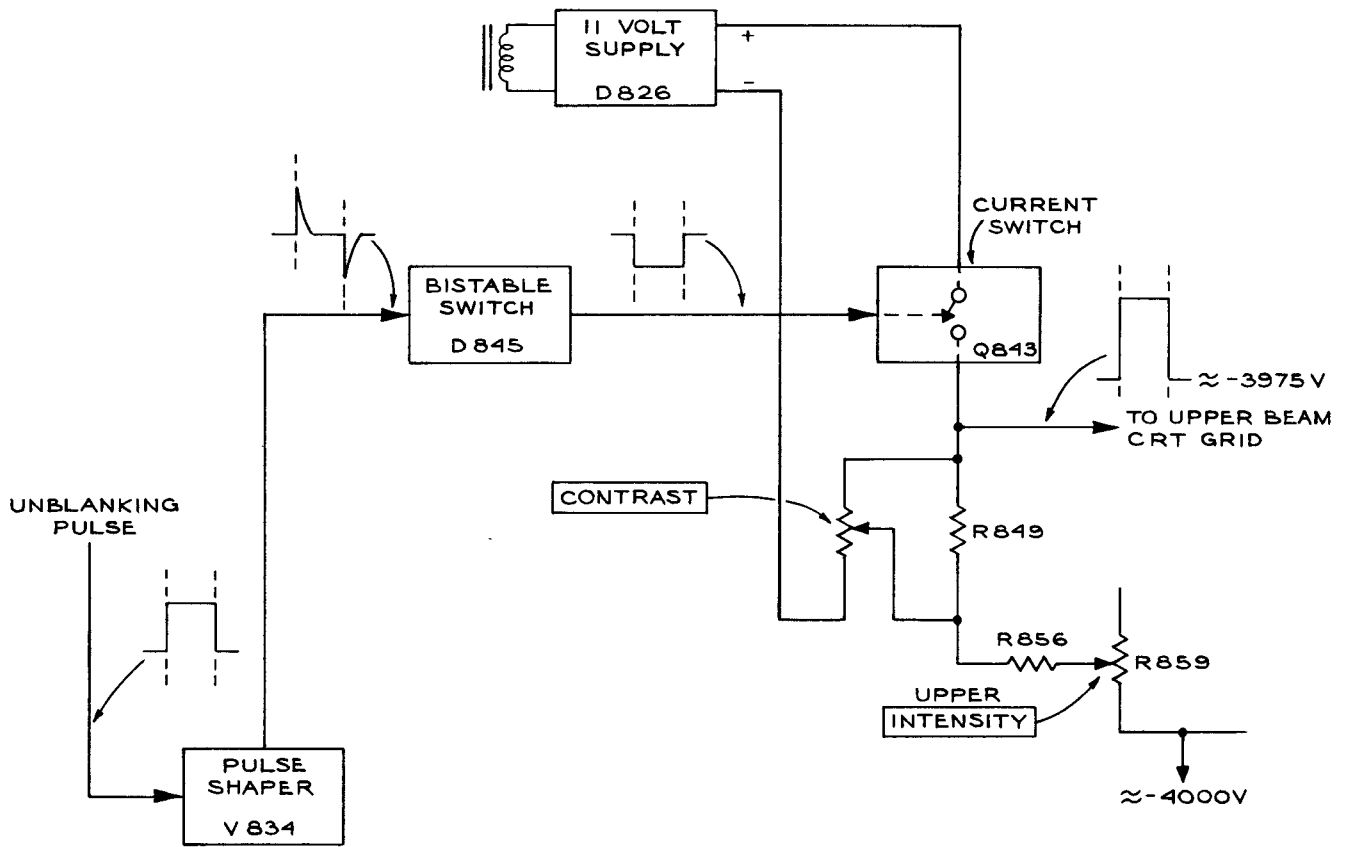


Fig. 3-16. Intensifying Circuit.

However, only the 'B' Unblanking signal will cause the Intensifying Circuit to produce an intensified crt display. Hence, the following description assumes the use of the 'B' Unblanking signal.

If Time Base 'B' is not generating a sweep, the CRT unblanking voltage from the LOWER HORIZ. DISPLAY switch is about +25 volts and V834 is cutoff. When Time Base 'B' is then triggered, the unblanking voltage switches sharply to about +125 volts and V834 conducts heavily. (It is important to note that the circuit operates only with the 'B' MODE switch in the STARTS AFTER DELAY INTERVAL or TRIGGERABLE AFTER DELAY INTERVAL position to provide cathode current for V834.) The sudden surge of current through T841 produces a sharp pulse in the secondary circuit.

The dynamic characteristics of tunnel diode D845 are shown in Fig. 3-17. Prior to the arrival of the pulse, the tunnel diode maintains stable forward conduction at point A on the curve. The voltage across the diode is then about 40 millivolts. This voltage is applied to the base-emitter junction of Q843, but is not sufficient to cause the transistor to conduct. Since there is no current through Q843, there is no voltage drop across R849 and the voltage on the upper beam crt control grid depends only on the setting of the INTENSITY control (usually about -3975 volts at normal trace brightness).

When the pulse is produced in the secondary circuit of T841, the diode is driven through point B on the curve. The diode is unstable at point B and therefore switches rapidly to point C. As the input pulse subsides, the diode is unable

to continue operation at point C because R846 cannot satisfy the diode's simultaneous demands for heavy current and high state voltage. Current then diminishes and the diode assumes stable operation at point D.

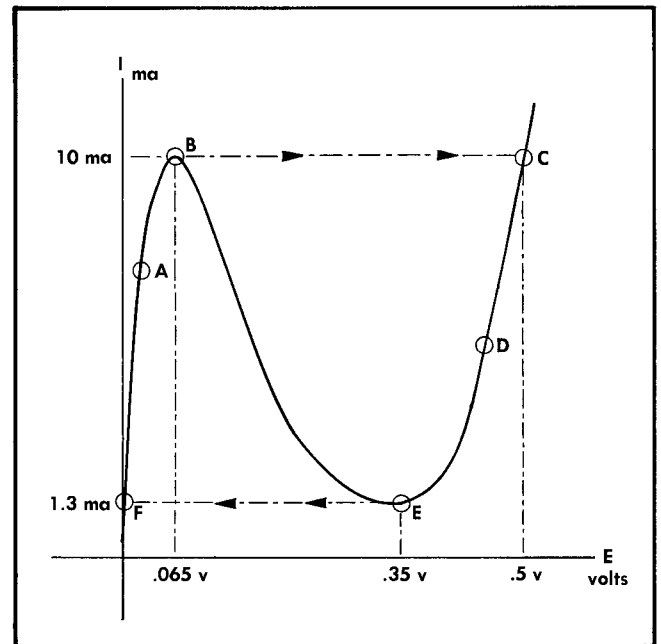


Fig. 3-17. D845 switching characteristics.

With the voltage across the diode now about 400 millivolts, Q843 is turned on. The current path is from the positive end of C828, through Q843, R849, to the CONTRAST control (R848), and to the negative end of C828. The voltage drop thus produced across R849 drives the upper beam crt control grid several volts in the positive direction. This causes an increase in crt beam current and the trace becomes brighter.

When the unblanking pulse ends, V834 is suddenly cut-off, producing a pulse in the secondary circuit with polarity opposite that of the previous pulse. The tunnel diode is driven from operating point D (Fig. 3-17) through point E. The diode is unstable at point E, and therefore switches rapidly to point F. At this point, R846 cannot satisfy the diode's demand for both low current and low state voltage. Therefore, the current increases and the tunnel diode resumes stable operation at point A. The transistor reverts to cut-off, the upper beam crt control grid voltage drops to its previous, more negative value, and the trace dims.

The CONTRAST control provides a means of controlling the amplitude of the intensifying pulse and therefore the amount of brightness increases during the brightened segment of the upper beam trace. This is accomplished in the following manner:

As is true with most switches, transistor Q843 has a very high series resistance when turned off and a very low series resistance when turned on. Therefore, nearly all of the 11-volt supply voltage is dropped across R849 when Q843 is turned off. Hence, by controlling the total voltage across the transistor and resistor, it is possible to control the output pulse amplitude.

The CONTRAST control R848 and R847 form a voltage divider across the 11-volt supply. By turning the CONTRAST control, the operator can vary the voltage across Q843 and R849 between about 2 and 11 volts.

## Unblanking

A trace or spot can be obtained on the crt at all times when an external signal is used for horizontal deflection. However, such is not the case when horizontal deflection is provided by one of the time base generators. When the oscilloscope is used in the latter manner, a blanking signal from the time base generator is applied to the crt. This signal turns off the beam during sweep retrace and holds it off until the next sweep begins.

Each of the two crt electron guns has a deflection plate blanking system. A pair of deflection plates, similar to those used for vertical and horizontal deflection, is placed between the control and focus grids in each gun. One plate in each pair is permanently connected to the +125 volt supply. The second plate can be connected to the +125 volt supply or to one of the time base generators, depending on the setting of the horizontal display switches. The beam is constantly unblanked when the +125 volt (EXT.) switch position is used.

If one of the time base generators provides horizontal deflection for a particular beam, that beam will be alternately blanked and unblanked in the following manner:

Between sweeps, the voltage applied to the crt blanking plate by the time base generator will be about +25 to +30 volts. With the other plate at +125 volts, the beam is

drawn into and absorbed by the more positive plate. Little or no beam current gets past this point. When the time base generator begins a sweep, it quickly increases the voltage on the blanking plate to about +125 volts. Since the blanking plate potentials are then essentially equal, the beam current is released and passes on toward the face of the crt to produce light.

## Multi-trace Chopped Blanking

The Type 565 Oscilloscope can be used with multi-trace plug-in units such as the Type 3A74. When this type of plug-in unit is operated in the "chopped" mode, the display may consist of up to four traces per beam. The plug-in forms the display by switching on each information-channel, one at a time, in a rapidly repeating sequence.

The vertical signal information available at the output of the plug-in during the very short time required to switch channels, is of no value in the display. Hence, this information is blanked out.

A pulse from the plug-in unit is available at pin 24 of the plug-in interconnecting jack when switching from one channel to the next. This pulse is coupled through a dc blocking capacitor to the appropriate crt cathode. The pulse momentarily drives the cathode positive and cuts off the beam current until the plug-in has finished switching to the next channel.

Diodes D892 and D882 are dc restorers. They insure equal trace brightness for the chopped and conventional mode. They permit the crt cathodes to be driven positive by the incoming signal, but prevent the cathodes from being driven more negative than the voltage at the HIGH VOLTAGE TEST POINT; —3900 volts.

## Intergun Shield and Isolation Shield

Proper adjustment of the INTERGUN SHIELD and ISOLATION SHIELD controls insures that (1) a straight line display will appear as a straight line, regardless of its position on the screen, and that (2) a display which is well focused at the center of the screen will also exhibit good focus at the edge of the screen. These controls also affect the deflection sensitivity and scan limits of the crt.

## Trace Alignment

The trace alignment coil surrounds the crt at a point about 6 inches behind the face plate. The plane of the coil is parallel to the plane of the face plate. The TRACE ALIGNMENT control determines the amount and direction of the dc current through the coil. By adjusting this control, the entire display can be rotated a few degrees clockwise or counterclockwise about the axis of the crt.

Display alignment is affected by the earth's magnetic field and may change when the instrument is moved. In such cases, the operator can quickly realign the display with the graticule markings by adjusting the TRACE ALIGNMENT control.

## AMPLITUDE CALIBRATOR

The Amplitude Calibrator generates square waves of an accurate peak-to-peak voltage available in six steps at the CAL. OUT connector. The square wave output is positive-

## Circuit Description — Type 565

going from ground. The frequency is about one kc, rise and fall times are several microseconds, and the duty factor is about 0.5. Because of its intended use, only the peak-to-peak voltage accuracy of the Amplitude Calibrator is given a specific tolerance.

Refer to the block diagram, Fig. 3-18. The Amplitude Calibrator consists of an astable multivibrator, an output cathode follower, and a precision output divider. The multivibrator switches the cathode follower alternately between cutoff and conduction. The cathode follower output voltage is an accurate +100 volts during conduction and zero volts during cutoff. The output divider provides five lower amplitudes from the basic 100 volt square wave. The CAL. OUT voltage is selected by setting the PEAK-TO-PEAK VOLTS switch to the desired value.

Refer to the Amplitude Calibrator schematic diagram in the back of the manual.

V915A and V905 form a conventional astable plate coupled multivibrator. In the multivibrator action, V905 operates as a triode with the screen grid acting as the plate. When V905 conducts, a portion of the cathode current goes to the pentode plate and drops the plate voltage to about -20 volts. This voltage is applied to the grid of V915B. V915B is cutoff and its cathode voltage is zero.

When V905 is cut off, the voltage at its plate is determined by the voltage divider; R909, R910, and R911. The CAL. AMPL. control, R910, is set during calibration so the voltage at the cathode of V915B will be exactly +100 volts when V905 is cut off.

A 0.25 ohm resistor located between the CAL. OUT coax connector and ground is approximately equal to the resistance of the braid of a 42 inch long RG-58A/U coax cable. Its purpose is to cancel any coax braid ground current effects on calibrator voltage accuracy that may exist when the Type 565 AMPLITUDE CALIBRATOR is used as a signal source between the oscilloscope and some other instrument chassis. The ground currents in this case are

usually developed in the ac power line third-wire grounding system when the Type 565 and the other instrument chassis are supplied from different convenience outlets.

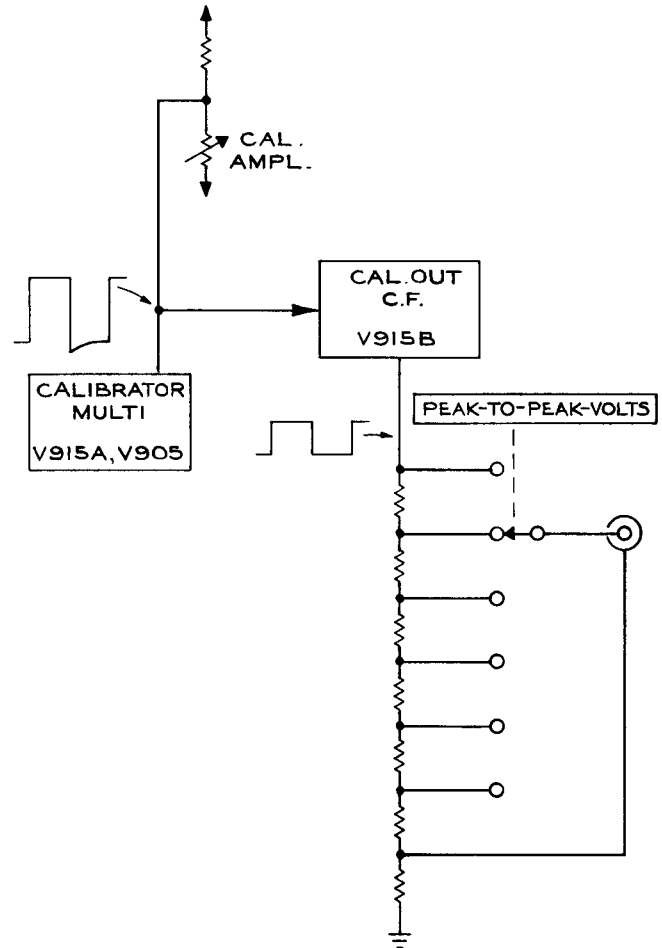


Fig. 3-18. Amplitude Calibrator.

# SECTION 4

## MAINTENANCE

### PREVENTIVE MAINTENANCE

#### Air Filter

##### NOTE

The most important single preventive maintenance item on any air cooled instrument is maintaining a plentiful supply of clean air.

The Type 565 Oscilloscope is cooled by air drawn through a washable, polyurethane-foam filter mounted on the rear of the instrument. If the filter becomes excessively dirty, it will restrict the flow of air into the instrument and may cause overheating.

To insure free passage of air, the instrument must be placed so the air intake is not blocked. The access panels must be in place for proper air circulation. High internal temperatures will not only reduce the life of the instrument components, but may also cause the thermal cutout to open at an important point in an experiment. Any time the thermal cutout opens, the filter should be checked immediately.

The filter should be visually checked every few weeks, and should be cleaned at least every three or four months; more often if required.

The following cleaning procedure is suggested:

1. Flush loose dirt out of filter with a stream of hot water.
2. Prepare a hot water and mild soap or detergent solution. Wash the filter as you would wash a sponge so the adhesive and dirt is loosened and floated off.
3. Rinse filter and let dry.
4. Dip or spray filter with Filter Coat or Handi-Coater. This adhesive is available from the local representative of the Research Products Corporation and from most air conditioner suppliers. Let the filter dry for several hours before installation to prevent the adhesive from draining into the instrument.

#### Fan Motor

The fan motor bushings should be lubricated every three or four months with a few drops of light machine oil (see Fig. 4-1). Failure to lubricate the bushings periodically may cause the fan to slow down or stop, thereby causing the instrument to overheat.

It is also important that you do not over-lubricate the bushings, since excess oil might flow into other parts of the motor. Normal heat transfer would be impaired by the dust which would collect in the exposed oil.

#### Plug-In Shield Removal

The shields in the Upper Beam and Lower Beam plug-in compartments can be removed for better access to the internal components. To remove the shield, loosen the wing-nut fastener located inside the plug-in compartment. Then, lift up on the shield and slide it out of the compartment.

#### Cleaning the Exterior

Loose dust accumulating on the outside of the Type 565 can be removed with a lint-free cloth or a small paint

brush. A paint brush is particularly useful for dislodging dust on and around the front panel controls. A soft cloth, dampened with water and a small amount of keolite, can be used to remove a harder coating of dirt. Abrasive cleansers should not be used.

##### CAUTION

Do not clean any plastic materials with organic chemical solvents such as benzene, acetone or denatured alcohol. These solvents might damage the plastics.

The plastic faceplate of the crt may be cleaned with a soft lint-free cloth dampened in a water solution of soap or detergent. The faceplate and other plastic materials may also be cleaned with alcohols (e.g., isopropanol) that have been denatured.

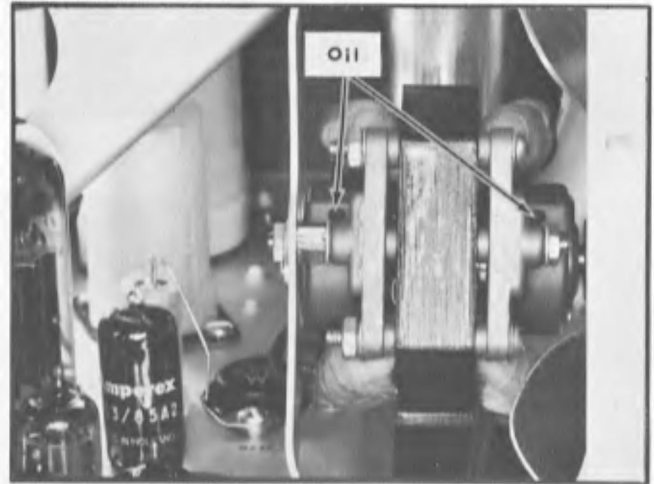


Fig. 4-1. Oiling the fan motor.

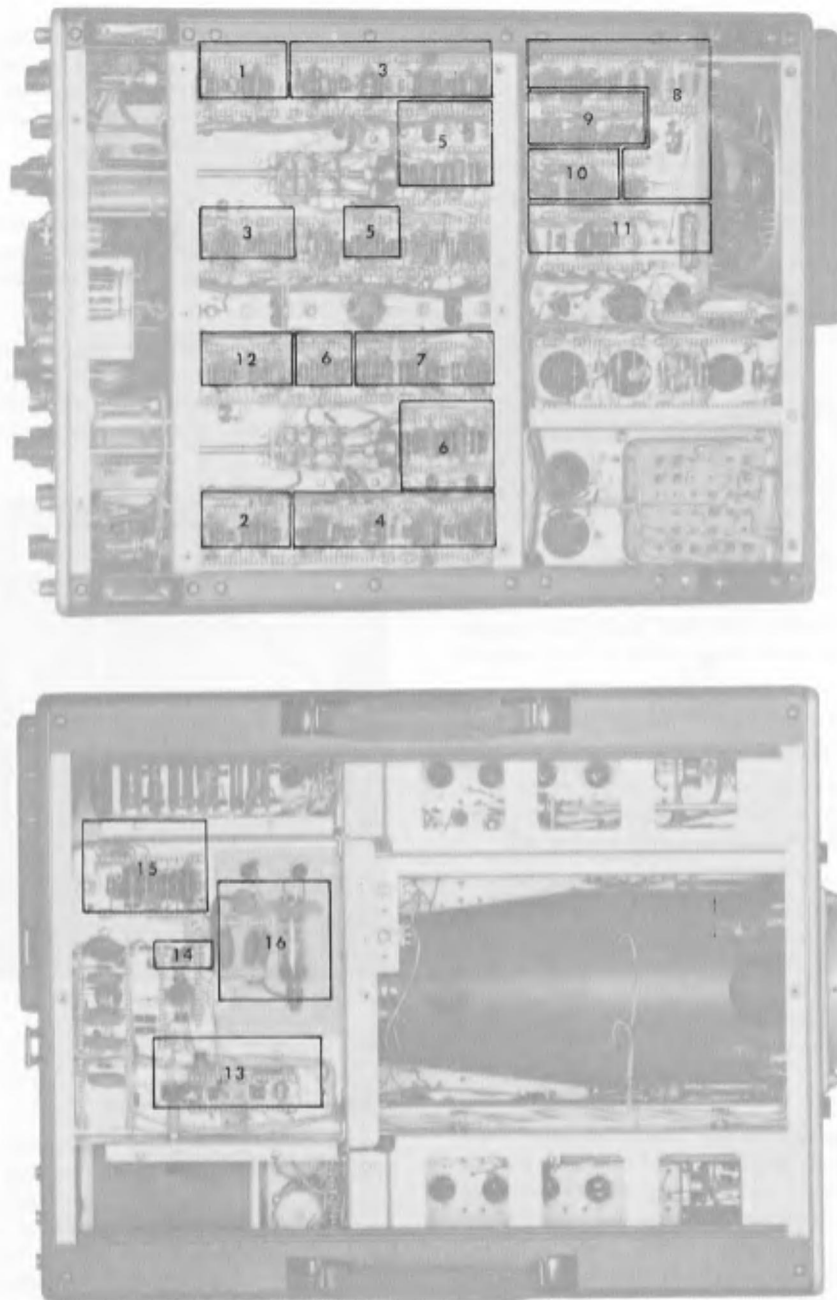
#### Cleaning the Interior

Although air entering the oscilloscope is filtered, some dust may penetrate into the interior of the instrument. This dust should be removed at regular maintenance periods since a heavy accumulation of dust can cause the instrument to overheat. Since some internal adjustments might be disturbed, it is suggested that the instrument interior be cleaned before recalibration.

Perhaps the best way to clean the interior of the instrument is to blow off dust using low velocity compressed air. To prevent damage to components, avoid a high-velocity air stream. Persistent dirt can be removed using a damp cloth or a small paint brush. A cotton-tipped applicator, dampened with alcohol, can be used for cleaning in narrow spaces and for cleaning ceramic strips.

#### Visual Inspection

Many potential and existent troubles can be detected by a visual inspection of the instrument. For this reason, you should perform a complete visual check every time the



- |                                    |                                    |
|------------------------------------|------------------------------------|
| 1. TIME BASE B TRIGGER             | 9. +125 VOLT SUPPLY                |
| 2. TIME BASE A TRIGGER             | 10. +300 VOLT SUPPLY               |
| 3. TIME BASE B GENERATOR           | 11. -12.2 VOLT SUPPLY              |
| 4. TIME BASE A GENERATOR           | 12. AMPLITUDE CALIBRATOR           |
| 5. LOWER BEAM HORIZONTAL AMPLIFIER | 13. INTENSIFYING CIRCUIT           |
| 6. UPPER BEAM HORIZONTAL AMPLIFIER | 14. 11 VOLT SUPPLY                 |
| 7. DELAY PICKOFF                   | 15. OSCILLATOR and ERROR AMPLIFIER |
| 8. -100 VOLT SUPPLY                | 16. -3900 VOLT SUPPLY              |

Fig. 4-2. Major Circuit Locations.

instrument is calibrated or repaired and during other routine maintenance work.

Defects which may be detected visually include such things as loose or broken connections, loose set screws in knobs or shaft couplers, loose or damaged coaxial connectors, improperly seated tubes or transistors, scorched or burned parts, and broken terminal strips. The remedy for most of these troubles is apparent. However, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other, less apparent, defects in the circuit. It is essential that you determine the cause of overheating before replacing heat-damaged parts in order to prevent further damage.

### Tube and Transistor Checks

Periodic checks on the tubes and transistors used in the Type 565 Oscilloscope are not recommended. Tube and transistor testers, in many cases, indicate a defect when the component operates satisfactorily in the circuit, and fail to indicate defects which affect circuit performance.

The true test of tube or transistor useability is whether or not it works properly in the circuit. If it is working correctly, it should not be replaced. Performance of the circuits in the Type 565 is thoroughly checked during recalibration and sub-standard tubes and transistors will usually be detected then.

### Calibration

The Type 565 Oscilloscope is a stable instrument that will provide many hours of trouble-free operation. However, to insure reliable measurements, it is suggested that you recalibrate the instrument after each 1000 hours of operation (or every six months if used intermittently). A complete step-by-step calibration procedure is given in Section 5 of this manual.

## PARTS REPLACEMENT

### Standard Parts

Many of the components used in the Type 565 are standard electronic parts and it is suggested that they be obtained locally since this generally requires less time than to obtain them from the factory. However, replacements for all parts used can be purchased directly from your area Tektronix Field Engineer or Field Office. Before ordering or purchasing parts, be certain to consult the parts list to determine the tolerances and ratings required. The parts list gives the values, tolerances, ratings, and Tektronix part numbers for all electronic and mechanical components used in the instrument.

### Special Parts

In addition to the standard electronic components mentioned in the previous paragraph, special parts are also used in the assembly of the Type 565 Oscilloscope. These parts are manufactured or selected by Tektronix to satisfy particular requirements or are manufactured specially for Tektronix by other companies in accordance with Tektronix specifications. These parts and most mechanical parts should be ordered directly from your Tektronix Field Engineer or Field Office as they are normally difficult or impossible to obtain from other sources.

### Tube Replacement

Tubes should not be replaced unless they actually cause trouble. Whenever tubes are removed, be certain to return them to the same socket unless they are defective. Unnecessary replacement or switching of tubes will often necessitate recalibration of the instrument. If tube replacement is required it is recommended that previously checked, high quality tubes be used. The best way to check tubes is to place them in the circuit and then check for proper operation.

### Crt Replacement

To remove the cathode-ray tube, first remove the side panels from the Indicator Unit. Disconnect the socket from the base of the crt, and the lead clips from the deflection plate pins at the neck of the crt. Be careful not to bend the neck pins. (Do not disconnect the beam-rotation coil leads on the top of the crt shield.) Remove the graticule cover, the scratch shield (or light filter), the eyebrow and the hold-down spring. Loosen the clamp at the neck of the crt and carefully push the tube forward until it can be removed from the front of the instrument.\*

Insert the new crt into the crt shield. Temporarily replace the scratch shield and graticule cover, then screw down the knurled retaining nuts. Position the crt so the graticule lines are parallel to the sides of the oscilloscope and crt faceplate is touching the scratch shield. Tighten the neck clamp.

After the crt is securely in place, connect the base socket and neck clips. The color-code information on the crt shield indicates the order in which the neck-pin leads are to be connected. Remove the graticule cover and scratch shield, install the eyebrow and its hold-down spring, then replace the scratch shield and graticule cover.

After replacement of the crt, it will be necessary to calibrate the crt circuit and check the calibration of the rest of the instrument. Adjust the ALIGNMENT Control before beginning the calibration procedure.

### Replacement of Switches

Single switch wafers are normally not replaced. If one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix either unwired or with the parts wired in place.

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

### 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 (especially when using tin-lead solder) or by excessive heating of the terminal strip with a soldering iron.

\*For an instrument with an external graticule crt (instrument S/N's below 1000), the procedure is essentially the same as that described, except for the references to the eyebrow, etc. When installing a new crt of this type, position it so the brush contact inside the crt shield touches the crt anode contact, and the face of the crt is touching the external graticule.

## Maintenance — Type 565

If you repair Tektronix instruments, it is advisable to have a stock of solder containing about 3% silver. A small supply of this solder is provided with each Type 565 Oscilloscope. The solder spool is mounted inside the instrument, above the power transformer. Additional silver-bearing solder is usually available locally or may be purchased direct from Tektronix in one-pound rolls; order by part number 251-514.

When removing or replacing components mounted on the ceramic strips, you will find that satisfactory results are obtained if you proceed in the manner outlined below.

1. Use a wedge-shaped soldering iron tip about  $\frac{1}{8}$  inch wide. A wedge-shaped tip allows you to apply heat directly to the solder in the terminal without touching the ceramic, thereby reducing the amount of heat required.
2. Wipe the tip clean before use, and then apply enough silver-bearing solder to wet it.
3. Use a hot iron for a short time. A 50 to 75 watt iron having good heat storage and transfer properties is adequate.
4. Avoid putting heavy pressure on the strip with the soldering iron or other tools. Excess pressure may cause the strip to chip or crack.

### Replacing Ceramic Terminal Strips

To replace damaged ceramic strips, first unsolder all connections. Then use a plastic or hard rubber mallet to drive the yokes out of the chassis. This can be done by tapping the ends of the yoke pins which protrude through the chassis. The strip, with the two yokes, can then be removed as a unit. The spacers will probably come out with the yokes. If not, they can be pulled out separately.

Another way of removing a ceramic strip is to use diagonal cutters to cut off one side of the yokes. This method permits the strip to be removed from a difficult area where a mallet cannot be used effectively. The spacers and the remainder of the yokes can be pulled out separately after the strip has been removed. Since replacement strips are supplied with yokes attached, the old yokes need not be salvaged. However, the old spacers can usually be used at least twice before new ones are required.

When the damaged strip and yoke assembly has been removed place the spacers into the holes in the chassis. Then set the ends of the yoke pins into the spacers. Press or tap lightly, directly above the yokes, to drive the yoke pins through the spacers. Be certain that the yoke pins are completely through the spacers. Use a pair of diagonal cutters to cut off the portion of the yoke pin which protrudes through the spacers.

## CORRECTIVE MAINTENANCE

### Troubleshooting Aids

This manual and the Type 565 Oscilloscope contain many features which are intended to speed and simplify maintenance.

The top, bottom, and side panels of the Type 565 can be removed quickly by using either a broad-blade screwdriver or a coin. Turn each corner panel-fastener about two turns counterclockwise to free the panel. The plug-in guide-rail and shield assemblies may also be removed for easier access to tubes and other components. The winged fastener on the upright flange of each assembly must be turned counterclockwise to free the holding pin from the chassis. Then slide the assembly about one inch toward the rear of the instrument and remove.

A block diagram which provides an overall picture of instrument operation is included in the back of this manual. The general area of the instrument occupied by each major circuit is shown in Fig. 4-2.

The schematic diagrams in the back of this manual indicate important operating voltages, signals, and conditions for their measurement. In addition, the schematics contain the component number of each resistor, inductor, capacitor, vacuum tube, transistor, diode, control, and switch. The range of component numbers associated with a particular diagram is given on that diagram.

Nearly all components on the schematics have two identification references. The reference which begins with a letter and ends with a number is a code to the approximate location of the component within the instrument. To locate any component referenced in this manner, refer to the Component Location photographs preceding the schematics. The spaces between the heavy lines across the photographs are numbered in one direction and lettered in the other direction. The component location code on the schematic refers to one numbered and one lettered space. The intersection of the appropriate spaces forms a box which includes the component you wish to locate.

Most components not referenced by a number-letter code will be referenced by one of three two-letter codes: SW, FP, or RP. SW means the component is mounted on a switch. FP means the component is mounted on the back side of the front panel. RP means the component is mounted on the rear panel.

Most of the wire used in the Type 565 is color striped to aid in circuit tracing. The standard EIA color code is used on all regulated low voltage power supply leads as follows:

1. The basic wire color indicates voltage polarity; tan for negative and white for positive.
2. The stripe colors indicate supply voltage. Stripes are read in order of decreasing width.

As an example, the  $-100$  volt supply leads are tan wire (negative) bearing stripes of brown (one), black (zero), and brown (one zero). The  $+125$  volt supply is coded as  $+120$  to avoid four digits. All dc supply and filament leads bear a minimum of 2 stripes.

Switch wafers shown on the circuit diagrams are coded to indicate the physical positions of the wafers on a switch. The number portion of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R indicate whether the front or the rear of the wafer is used to perform the particular switching function.



# SECTION 5

## CALIBRATION

The Type 565 Oscilloscope is a stable instrument which will provide many hours of trouble-free operation. However, to insure measurement accuracy, it is suggested that you recalibrate the instrument after each 1000 hours of operation or every six months if used intermittently. It will also be necessary to recalibrate certain sections of the instrument when tubes, transistors, or other components are replaced (see Table 5-1).

The steps in the following procedure are arranged in the proper order for complete recalibration so as to avoid unnecessary repetition.

### NOTE

The performance standards described in this section of your manual are set up strictly as guides to calibration of your instrument and should NOT be construed as advertised performance specifications. For customer specifications, refer to the "Characteristics" section of the manual.

**Table 5-1**

Circuit	Calibration Step Number*												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Low Volt. Pwr. Sup.	X	X	X	X	X	X	X	X	X	X	X		X
Amplitude Calibrator	X												
Crt Circuit			X		X	X		X	X	X	X	X	X
Time Base 'A' or 'B'				X				X	X	X	X		X
Trigger Circuit 'A' or 'B'							X						
Hor. Amp.-U or L Beam								X	X	X	X		X
Delay Pickoff								X	X	X	X		X

\*The areas marked X in the table show the minimum calibration steps that should be performed after a repair or adjustment in a particular circuit.

### EQUIPMENT REQUIRED

The following equipment is necessary for complete calibration of the Type 565 Oscilloscope:

1. Vertical Amplifier Plug-In Units; Tektronix Series 2A or 3A. Sensitivity (minimum range): 0.2 to 5.0 volts per division. Bandwidth: dc to at least 1 mc (dc to at least 4 mc desirable for step 12). A multi-trace plug-in unit such as the Types 3A1, 3A72, or 3A74 is required for the optional checks in step 13. None of the plug-in units have to be calibrated in order to be used in the calibration of the Type 565 Oscilloscope.

2. Variable autotransformer (e.g. Powerstat or Variac) having a rating of at least 800 volt-amperes and an output voltage range covering the operating range of the instrument under test.

3. An rms-calibrated ac voltmeter having a range of 0-150 volts. (0-300 volts if the instrument is wired for operation above 200 volts.)

4. A conventional dc voltmeter having a sensitivity of at least 20,000 ohms per volt and calibrated for an accuracy of at least 1% at 100, 125, 300, and 12.2 volts, and for an accuracy of at least 5% at 3900 volts.

5. Test oscilloscope, Tektronix Type 561A/2B67/2A63 or equivalent, providing triggered sweeps (internally and externally) and a bandwidth of at least dc to 300 kc. Maximum vertical sensitivity should be at least 0.01 volts/division.

### NOTE

In some troubleshooting applications, you may require a test oscilloscope having greater vertical bandwidth.

6. Precision dc voltmeter having an input impedance of at least 1 megohm and accurate within 1% of reading from 1 millivolt to 100 volts. For step 2.

7. Time mark generator, Tektronix Type 180A or equivalent. Markers required at 1 and 5 seconds, 100, 10, 5, and 1 milliseconds, 500, 100, 50, 10, and 1 microseconds, and 10 megacycle sinewave. 100 kc trigger pulse output required. All outputs must have a time accuracy of at least 0.1%.

8. Constant-amplitude sinewave generator, Tektronix Type 190B or equivalent. Required characteristics; (a) output frequencies of 50 kc, 350 kc, and 2 mc, (b) output voltage adjustable from 0.3 to 1 volt peak to peak, and (c) provisions for maintaining constant amplitude (manually or automatically) with a change in frequency.

9. Capacitance meter, Tektronix Type 130 or equivalent, covering the range from 3 to 10 pf. Must be accurate within 0.3 pf within this range. Must be capable of measuring an in-circuit capacitance while eliminating the effects of environmental capacitances. For step 12.

10. 1X signal probe such as the Tektronix Type P6027 (UHF) or P6028 (BNC).

11. 10X signal probe such as the Tektronix Type P6017 (UHF) or P6006 (BNC).

12. 50Ω termination unit such as Tektronix part number 011-045 (UHF) or 011-049 (BNC).

13. 50Ω 10X attenuator such as Tektronix part number 011-031 (UHF) or 010-314 (BNC).

14. Co-axial tee.

### PRELIMINARY

1. Remove the side, top and bottom access plates from the instrument.

2. Check that the main power, -12.2 volt supply, and Camera Power fuses are the correct values.

3. Set the instrument controls as listed in Table 5-2.

## Calibration — Type 565

4. Connect the instrument and the ac voltmeter to the autotransformer output. Connect the autotransformer to the power line.

5. Turn on the power to all equipment and allow several minutes for warm-up.

6. Adjust the autotransformer output voltage to 117 volts (or the design-center voltage for which the instrument is wired).

### NOTE

Photographs on a fold-out page preceding the schematics in the back of this manual show the location of each calibration adjustment control.

TABLE 5-2

Time Base 'A'	
TRIGGER	UPPER BEAM INT.
COUPLING	AC
SLOPE LEVEL	+
TIME/DIV. VARIABLE	0
STABILITY	.2 mSEC CALIBRATED
10X MAG. horizontal POSITION	ccw off—pushed in centered
Time Base 'B'	
TRIGGER	LOWER BEAM INT.
COUPLING	AC
SLOPE LEVEL	+
TIME/DIV. VARIABLE	0
STABILITY	.2 mSEC CALIBRATED
10X MAG. horizontal POSITION 'B' MODE	ccw off—pushed in centered NORMAL TRIGGER
Upper and Lower Beams	
FOCUS	centered
ASTIG.	centered
INTENSITY	ccw
UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE
EXT. HORIZ. GAIN (both)	cw
Other Controls	
TRACE ALIGNMENT	as is
SCALE ILLUM.	ccw
DELAY INTERVAL	1.00
PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	OFF
CONTRAST (inside instrument above power transformer)	clockwise
POWER	off

### Plug-In Units

VOLTS/DIV. VARIABLE input POSITION	.5 CALIBRATED ac coupled centered
------------------------------------	-----------------------------------

Check that the shorting bars are in place on the crt grid input jacks on the rear panel.

## PROCEDURE

### 1. Low Voltage Power Supply

#### A. Check voltage accuracy.

1. Establish the conditions described in the Preliminary Instructions.

2. Check the voltage accuracy of each supply output with the 20,000  $\Omega$ /volt dc voltmeter according to Table 5-3. The test points are shown in Fig. 5-1.

Table 5-3

supply	tolerance	Maximum peak to peak ripple
-100 v.	-97 to -103 v.	25 mv.
-12.2 v.	-11.7 to -12.6 v.	8 mv.
+125 v.	+121 to +129 v.	15 mv.
+300 v.	+291 to +309 v.	100 mv.

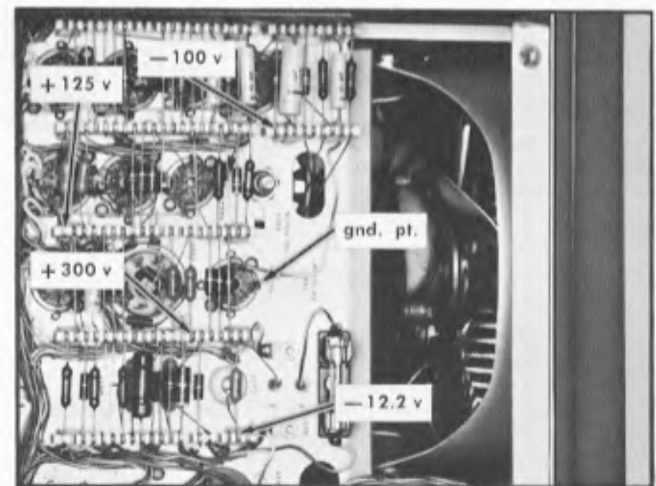


Fig. 5-1. Bottom of oscilloscope showing Power Supply test points.

3. If necessary, adjust the -100 VOLTS control so all supply output voltages are within tolerance.

#### B. Check regulation and ripple

### NOTE

For full-range regulation of the power supplies in the Type 565, the ac line voltage should contain no more than 3% to 5% distortion.

1. Remove the plug-in units.
2. Monitor the regulated output of the —100 volt supply with the dc voltmeter and a test oscilloscope.
3. Slowly increase the output of the variable auto-transformer to 125 vac (or 7% above the design-center line voltage for which the instrument is wired). The dc output voltage should remain essentially constant; typically within 1% of that obtained with design center line voltage. Check that the output ripple remains within the limit given in Table 5-3.

**NOTE**

Ground-loops can cause an erroneous ripple measurement. One way to avoid this is to temporarily disconnect the chassis ground wire in the power cord by using an ungrounded 3 to 2 wire line plug adapter. Then use a ground lead from the signal probe body, grounded at pin 1 of V639 (shown in Fig. 5-1). The probe will then provide the only ground connection between the two instruments.

4. Repeat steps B-1 through B-3 for each supply.
5. Reset the autotransformer for 117 volts output (or the design-center voltage for which the instrument is wired).
6. Install the plug-in units.
7. Reduce the line voltage to 105 volts (or 10% below design-center voltage). The dc output voltage of each supply should remain essentially constant; typically within 1% of that obtained with design-center line voltage. Check that the output ripple remains within the limit given in Table 5-3.
8. Reset the autotransformer for 117 volts output (or design-center).

**2. Amplitude Calibrator**

**A. Adjust CAL. AMPL.**

1. Remove V905 (remove the Upper Beam plug-in shield as described in section 4 to reach this tube).
2. Set PEAK-TO-PEAK VOLTS switch to 100.
3. Connect the precision, high impedance dc voltmeter to the CAL. OUT connector (see Equipment Required, item 6). Use the outside shell of the CAL. OUT connector as the common connection, rather than the chassis of the oscilloscope.
4. Adjust CAL. AMPL. for an exact +100 voltmeter indication.

**NOTE**

With V905 removed, the astable multivibrator is disabled and the voltage at the CAL. OUT connector will be a dc voltage equal to the peak of the normal squarewave.

**B. Check accuracy of calibrator attenuator.**

1. Check the dc output voltage at each setting of the PEAK-TO-PEAK VOLTS switch, using the precision dc

voltmeter. Voltage must be within 3% of the switch indication.

2. Disconnect meter and replace V905.

**C. Check duty factor of output signal.**

1. Reset the PEAK-TO-PEAK-VOLTS switch to 100 volts. Connect a conventional dc voltmeter to the CAL. OUT connector and check for between +40 and +60 volts.

**NOTE**

+ 50 volts is optimum, indicating a 0.5 duty factor. If the voltage is not within the range of 40 to 60 volts, try new tubes.

2. Reset PEAK-TO-PEAK VOLTS to 1.

**3. CRT Circuit (Part 1)**

**CAUTION**

Always make or break voltmeter connections at any of the high-voltage points in the Crt Circuit (except for the HIGH VOLTAGE TEST POINT) while the instrument is turned off. If a connection is made or broken while the power is on, a small arc may occur which will produce voltage and current transients within the circuit. Such transients can destroy one or more of the semi-conductor devices in the Crt Circuit.

**A. Adjust HIGH VOLTAGE.**

1. Set the 20,000  $\Omega$ /volt dc voltmeter for at least —4000 volts full scale and connect it to the HIGH VOLTAGE TEST POINT.
2. Adjust the HIGH VOLTAGE control for a —3900 voltmeter indication.

**B. Check High Voltage Regulation**

1. Monitor the voltage at the HIGH VOLTAGE TEST POINT.
2. Vary the line voltage from 105 to 125 volts (or —10% to +7% of design-center line voltage for which the instrument is wired). Check that the output voltage remains essentially constant through the variation in line voltage; typically within 1% of the voltage obtained with design-center line voltage.
3. Disconnect the meter and reset the line voltage to 117 volts (or design-center).

**4. Time Base Generators (Part 1)**

**A. Adjust both STABILITY controls.**

1. Set controls as follow:
 

LEVEL (A and B)	AUTO.
TRIGGER source (A and B)	LINE
STABILITY ('A' and 'B')	fully clockwise
INTENSITY ('A' and 'B')	as required
vertical POSITION	as required

2. Slowly turn 'A' STABILITY counterclockwise. Upper Beam trace should be bright at first, then dim, and then disappear. Set STABILITY in middle of the 'dim' range.
3. Adjust 'B' STABILITY in the same manner.
4. Reset the TRIGGER source switches in both time bases to INT.

### 5. CRT Circuit (Part 2)

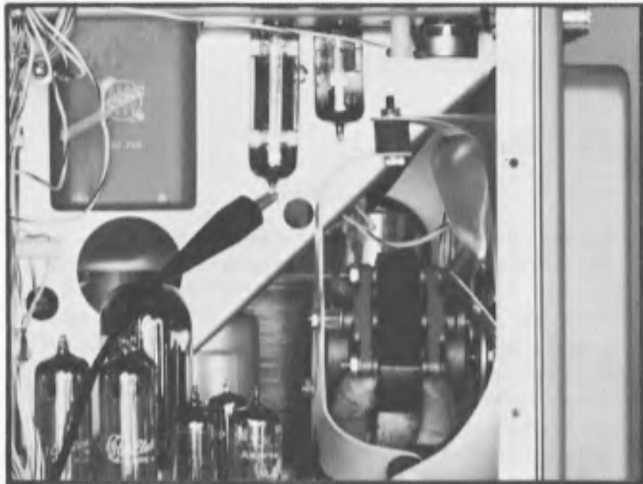


Fig. 5-2. Test lead connected to V800.

#### A. Adjust the high voltage power supply of neutralization, C808.

1. Set controls as follows:
 

'B' TIME/DIV.	.1 mSEC
UPPER HORIZ. DISPLAY	'B' TIME BASE
FOCUS Upper Beam	fully counterclockwise
2. Fasten the alligator clip of a test lead to the glass tip of V800. See Fig. 5-2. Connect the other end of the test lead to the lower beam vertical INPUT.

#### NOTE

The test lead connected to V800 should pick up the radiated high voltage oscillator signal.

3. Reset the lower beam plug-in VOLTS/DIV. as required to obtain a 2 to 4 major division display of the oscillator signal. See Fig. 5-3. Set Upper Beam INTENSITY for a dim display.
4. The Upper Beam display should be a straight, defocused line as in Fig. 5-3. If the trace exhibits alternate light and dark segments as in Fig. 5-4, adjust C808 to minimize this appearance.
5. Disconnect test lead.

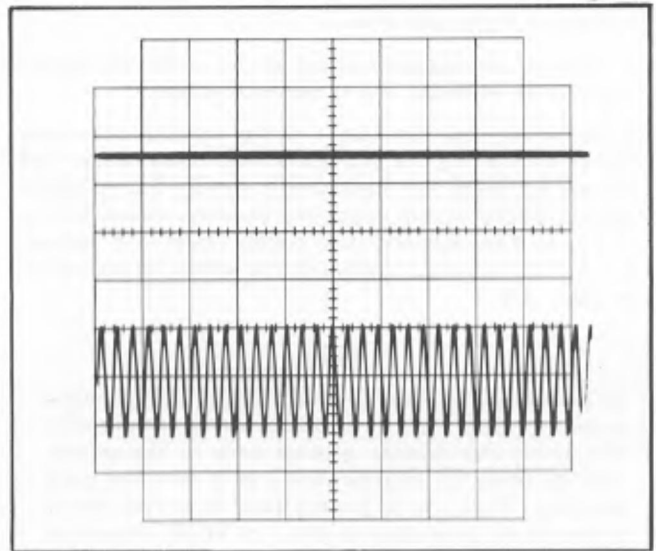


Fig. 5-3. Display appearance with C808 correctly adjusted.

#### B. Adjust FOCUS and ASTIG.

1. Set controls as follows:
 

'B' TIME/DIV.	.5 mSEC
VOLTS/DIV. (upper and lower)	.5
PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	1
2. Connect CAL. OUT to both vertical INPUT connectors.
3. Adjust FOCUS and ASTIG. controls of both beams to obtain sharp display definition.

#### NOTE

A recommended adjustment technique is described in Section 2, step 10 of "First Time Operation".

4. Disconnect the signal inputs.

#### C. Adjust ISOLATION SHIELD and INTERGUN SHIELD

#### NOTE

The ISOLATION SHIELD and INTERGUN SHIELD controls must be properly set so:

- a. portions of a display near the edge of the crt will be free from distortion,
- b. the Upper Beam will scan to within 1.8 to 2 major divisions of the bottom edge of the graticule (and vice versa for the Lower Beam),
- c. the crt vertical deflection sensitivity will be between about 17.4 and 19.6 volts per major division, and
- d. the overall display focus will be best.

Both of the first two characteristics are checked during adjustment.

1. Apply 50 microsecond time markers to the vertical inputs of both beams.

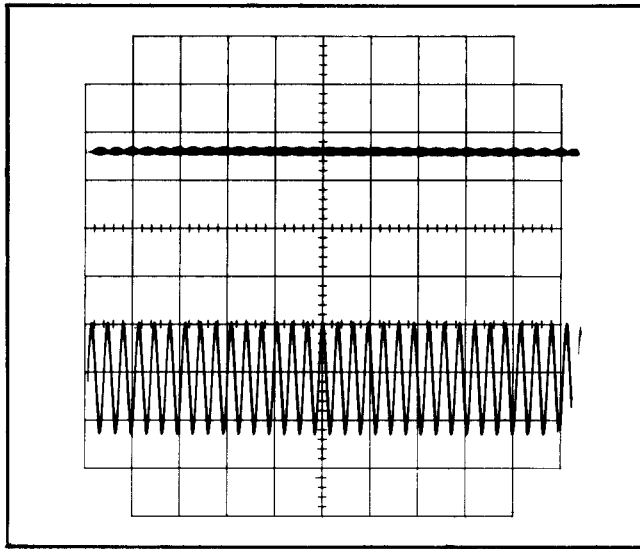


Fig. 5-4. Display appearance with C808 grossly misadjusted.

2. Set controls as follows:

VOLTS/DIV. (both plug-in units)	.2
'B' TIME/DIV.	20 $\mu$ SEC
INTENSITY (Lower Beam)	ccw
INTENSITY (Upper Beam)	as required
FOCUS (Upper Beam)	as required

3. Set Upper Beam vertical POSITION so the base of the waveform is off the crt as far as possible without bringing the tips of the waveform onto the crt. The display should consist of vertical lines only representing the falling portion of the time-markers as shown in Fig. 5-5.

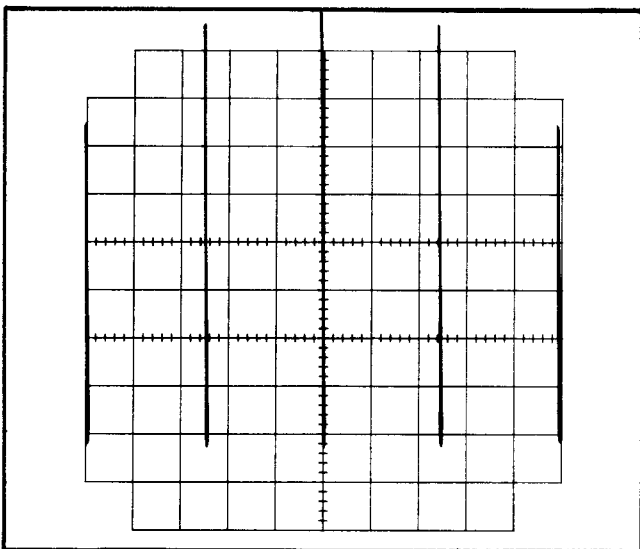


Fig. 5-5. ISOLATION SHIELD and INTERGUN SHIELD adjustments display showing falling portion of time-marker pulse.

4. Set Upper Beam horizontal POSITION so a display line is under the graticule center-line.

5. Adjust TRACE ALIGNMENT (on front panel) so the time-marker fall and graticule centerline are parallel.

6. Set 'B' VARIABLE TIME/DIV. and upper beam horizontal POSITION so there is one vertical display line under each major graticule line. The display should be similar to that shown in Fig. 5-6.

7. Check the vertical display lines near the right and left edges of the graticule. The lines should be reasonably straight and parallel to the graticule lines as shown in Fig. 5-6. Also check that the display extends at least 4 major divisions below the upper graticule centerline.

8. If necessary, adjust ISOLATION SHIELD and INTERGUN SHIELD to produce straight lines that are parallel with the graticule lines.

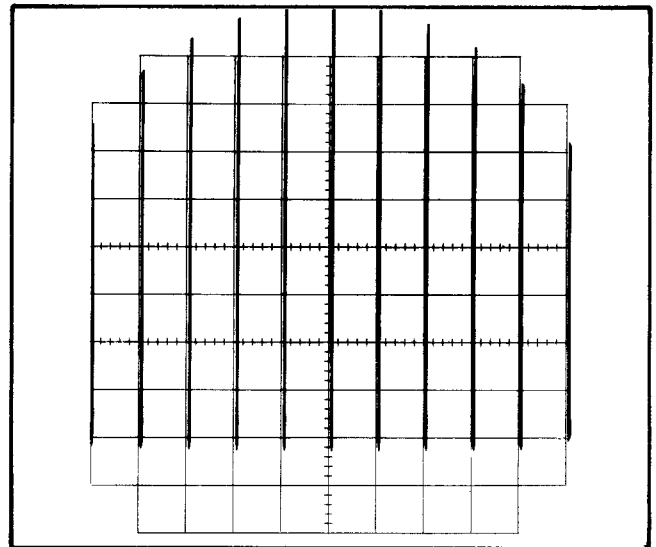


Fig. 5-6. ISOLATION SHIELD and INTERGUN SHIELD properly adjusted.

NOTE

Reset FOCUS, ASTIG. 'B' VARIABLE TIME/DIV., and horizontal POSITION after each small adjustment of the ISOLATION SHIELD and INTERGUN SHIELD controls.

There is generally more than one combination of settings for ISOLATION SHIELD and INTERGUN SHIELD that appears to provide satisfactory results. For best overall display focus, use the combination where ISOLATION SHIELD is set nearest its counterclockwise extreme.

9. Set upper beam INTENSITY fully counterclockwise. Set lower beam INTENSITY for a normal display. Set Lower Beam vertical position as in step C-3. Check the lower beam display for the proper characteristics described in Step C-7.

## Calibration — Type 565

10. If necessary, readjust ISOLATION SHIELD and INTER-GUN SHIELD slightly to equalize the appearance of the upper and lower beam displays.

11. Disconnect all input signals.

12. Reset controls as follows:

TIME/DIV. ('A' and 'B')	.5 mSEC
VARIABLE	CALIBRATED
UPPER HORIZ. DISPLAY	'A' TIME BASE
VOLTS/DIV. (Upper and Lower Beam)	.5
vertical POSITION (Upper and Lower Beam)	center
INTENSITY (Upper and Lower Beam)	normal

### D. Adjust TRACE ALIGNMENT

1. Vertically position both traces to their respective graticule centerlines.
2. Set both FOCUS controls for sharply defined traces.
3. Adjust TRACE ALIGNMENT (located on the front panel) so the traces are equally parallel with the graticule lines.

### E. Check crt vertical deflection sensitivity.

1. Set the dc voltmeter for a full scale range of at least 60 volts and connect it across the crt vertical deflection leads of either beam.
2. Set the appropriate vertical POSITION control for a zero voltmeter indication.
3. Note the exact trace position.
4. Move the trace either up or down exactly 3 centimeters.
5. The meter should now indicate between 52 and 59 volts dc.

#### NOTE

If the voltage is not between 52 and 59 volts, recheck steps 3-A and 5-C.

## 6. Vertical Deflection System (Part 1)

### A. Adjust gain of both plug-in units.

1. Set controls as follows:

TRIGGER LEVEL ('A' and 'B')	AUTO.
PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	1

2. Connect CAL. OUT to the vertical input of both beams. Both beams should exhibit a stable, automatically triggered display of the Amplitude Calibrator signal.

#### NOTE

It may be necessary to touch-up the FOCUS and ASTIG. control settings before proceeding.

3. Adjust the gain of each plug-in unit for the proper amount of vertical deflection. (If necessary, see the plug-in unit manual for additional information.)

4. Disconnect the input signals.

## 7. Time Base Trigger ('A' and 'B')

### A. Check voltage requirement for high frequency external triggering.

1. Set controls as follows:

TRIGGER source ('A' and 'B')	EXT.
LEVEL ('A' and 'B')	FREE RUN
TIME/DIV. ('A' and 'B')	20 $\mu$ SEC

2. Connect the constant amplitude signal generator to upper beam vertical INPUT as shown in Fig. 5-7.

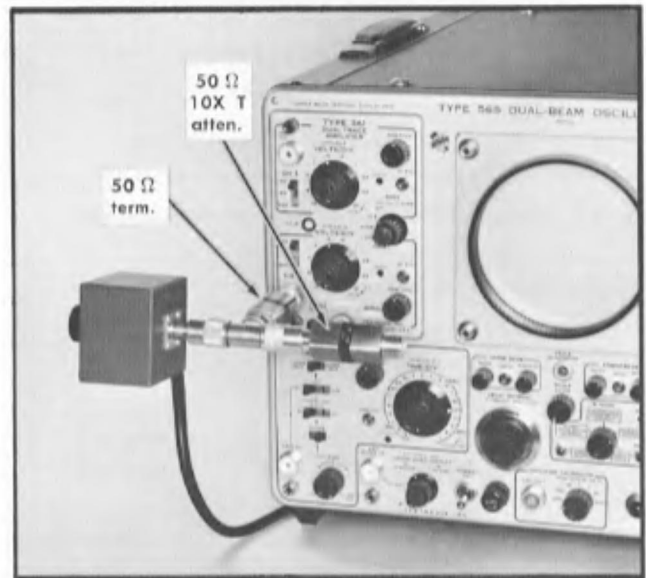


Fig. 5-7. Establishing triggering test signal amplitude.

3. Set generator so the display indicates 0.5 volt peak-to-peak output at 50 kc.

4. Move signal input to 'A' TRIG. IN as shown in Fig. 5-8.

5. Connect a patch cord between the 10X attenuator and the upper beam vertical INPUT as shown in Fig. 5-8.

6. Check that with SLOPE set to either + or - Time Base 'A' can be triggered by adjusting the LEVEL control.

7. Repeat steps A-4 through A-6 for Time Base 'B' and Lower Beam.

8. Set controls as follows:

LEVEL ('A' and 'B')	FREE RUN
---------------------	----------

9. Return the signal connection to upper beam vertical INPUT as shown in Fig. 5-7.

10. Increase signal amplitude to 1 volt peak-to-peak.

11. Set 'A' and 'B' TIME/DIV. to 1  $\mu$ SEC.

12. Move signal connection to 'A' TRIG. IN with a patch cord to upper beam vertical INPUT as shown in Fig. 5-8.



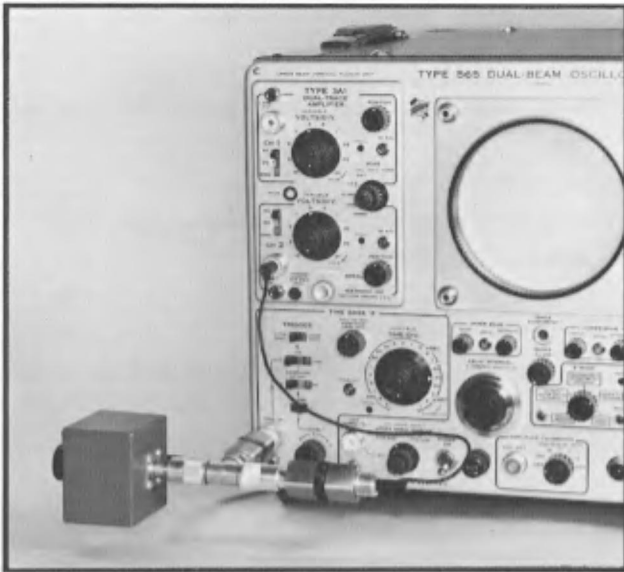


Fig. 5-8. Triggering test with vertical signal picked-off.

13. Without changing signal amplitude, increase signal frequency to 2 mc.
14. Check that with SLOPE set to either + or -, Time Base 'A' can be triggered by adjusting the LEVEL control.

**NOTE**

It may be necessary to readjust the STABILITY control slightly for stable triggering.

15. Repeat steps A-12 and A-14 for Time Base 'B' and Lower Beam.
16. Disconnect all signal inputs.

**B. Check Trigger Input Amplifier balance**

1. Set controls as follows:
 

TRIGGER source ('A' and 'B')	INT.
LEVEL ('A' and 'B')	0
TIME/DIV. ('A' and 'B')	.5 mSEC
VOLTS/DIV. (Upper and Lower Beams)	.5
PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	1
2. Connect CAL. OUT to vertical INPUT of both beams. Each beam should present a display of the Amplitude Calibrator signal.
3. Ground the junction of the 6.8 kΩ and 22 kΩ resistors on each LEVEL control switch as shown in Fig. 5-9. Both displays should remain on the crt.
4. Turn upper beam vertical VARIABLE VOLTS/DIV. to reduce the vertical deflections to 1.5 major divisions.

**NOTE**

If the display disappears, the two halves of the Trigger Input Amplifier tube are probably dc unbalanced. Try a new tube.

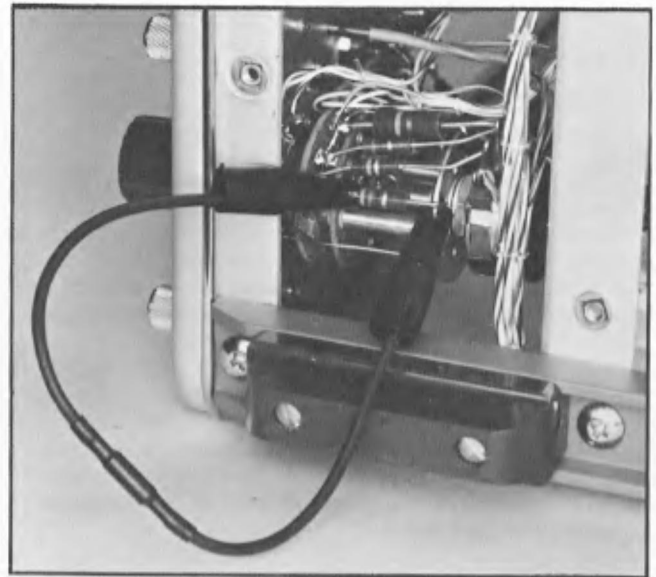


Fig. 5-9. Grounding the junction of the 6.8 kΩ and 22 kΩ resistors.

5. Check that the display is retained with the TRIGGER SLOPE switch set to either + or -.
6. Repeat steps B-4 and B-5 for Time Base 'B' Trigger and Lower Beam.
7. Remove the ground clips previously installed.

**C. Check minimum internal triggering signal requirements.**

1. Set controls as follows:

LEVEL ('A' and 'B')	FREE RUN
VOLTS/DIV. (Upper and Lower)	2

**NOTE**

Each beam should present a free-running display of the Amplitude Calibrator signal.

2. Set upper and lower vertical VARIABLE VOLTS/DIV. for 1.5 minor divisions display amplitude on each beam.
3. Check that a stable Upper Beam display of the Amplitude Calibrator signal can be obtained with 'A' TRIGGER SLOPE set to either + or -, by adjusting 'A' LEVEL control.

**NOTE**

The amount of internal triggering signal available to the Trigger Circuit depends on the type of plug-in unit used. With some plug-in units, it may be necessary to use more than 1.5 minor divisions display amplitude for this and the following checks.

4. Repeat step C-3 for Time Base 'B' Trigger.
5. Set controls as follows:
 

TRIGGER COUPLING ('A' and 'B')	AC FAST
--------------------------------	---------

## Calibration — Type 565

6. Repeat step C-3 for both Time Bases.

7. Set controls as follows:

TRIGGER COUPLING ('A' and 'B')	DC
LEVEL ('A' and 'B')	O

8. The displays will probably disappear. Slowly turn the upper beam vertical POSITION control, first one direction and then the other. You should be able to obtain a stable triggered display at some particular setting of the POSITION control. The vertical position of the display should be near the appropriate graticule center-line.

### NOTE

Proper results in this check usually depend on the plug-in unit. Most plug-in units have an internal adjustment that affects the dc level of the output triggering signal. See the Calibration Procedure in the plug-in unit manual.

9. Set 'A' TRIGGER SLOPE to its opposite positions and repeat step C-8.

10. Repeat steps C-8 and C-9 for Time Base 'B' Trigger and Lower Beam.

11. Set controls as follows:

LEVEL ('A' and 'B')	AUTO.
---------------------	-------

12. Check that a triggered display is obtained with the SLOPE switches ('A' and 'B') set to either + or —.

13. Disconnect the input signals.

### D. Check LINE Triggering

1. Set controls as follows:

TIME/DIV. ('A' and 'B')	2 mSEC
TRIGGER source ('A' and 'B')	LINE
VOLTS/DIV (Upper and Lower Beams)	1
VARIABLE	CALIBRATED

2. Vertically position the traces to their respective graticule center-lines.

3. Connect a 10X signal probe to the upper beam vertical INPUT and monitor terminal No. 13 on the power transformer, T601.

4. Check that a triggered display of the power line signal is obtained with 'A' SLOPE set to either + or —.

5. Repeat steps D-3 and D-4 for lower beam and Time Base B.

6. Disconnect the probe from the instrument.

7. Reset controls as follows:

TRIGGER ('A' and 'B')	INT.
source	
COUPLING	AC
SLOPE	+

## 8. Horizontal Amplifiers—Upper and Lower Beams

### A. Check Horizontal Input Cathode-Follower grid current.

1. Set controls as follows:

INTENSITY (both)	traces barely visible
UPPER HORIZ. DISPLAY	EXT.
LOWER HORIZ. DISPLAY	EXT.
horizontal POSITION (both)	to center spots

2. Turn upper beam EXT. HORIZ. GAIN from end to end and check that the upper beam spot does not move more than 1.5 major divisions.

### NOTE

If spot movement is greater than 1.5 major divisions, try a new tube (V403 in Upper Beam Horizontal Amplifier, V453 in Lower Beam). It may be necessary to try several new tubes before finding one that is satisfactory. Allow several minutes warmup time for a new tube before rechecking the grid current.

3. Repeat step A-2 for lower beam.

4. Reset controls as follows:

UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE

### B. Adjust X1 GAIN.

1. Set controls as follows:

TIME/DIV. ('A' and 'B')	1 mSEC
VOLTS/DIV. (Upper and Lower Beams)	2
INTENSITY (both)	as required

2. Apply 1-millisecond time markers to the vertical input of both beams. Each beam should exhibit a triggered display of the input signal.

3. Horizontally position each trace so the second marker peak from the left end coincides with the graticule line that is one major division from the left edge.

4. Adjust the X1 GAIN in each Horizontal Amplifier for one time marker per major division. *Upper: R43A*  
*Lower: R48A*

### Adjustment Aids

The following hints should help you to obtain the best results in checking and adjusting the Time Base sweep rates:

It is quite difficult to detect small sweep rate errors on the order of 1 or 2% unless the measurement is made using most of the graticule width. It is therefore recommended that the sweep rates be checked using the center 8 major graticule divisions and the middle 80% of the trace as shown in Fig. 5-10. With the measurement taken over a distance of 8 major or 40 minor divisions, a 1.2 minor division error would indicate a 3% sweep rate error as shown in Fig. 5-10.





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4. Repeat step G-3 for lower beam.
5. Disconnect the signal inputs and reset the EXT. HORIZ. GAIN control to the clockwise position.

### H. Check EXT. HORIZ. IN frequency response — both beams.

1. Connect the constant amplitude signal generator to upper beam EXT. HORIZ. IN connector.
2. Set generator output frequency to about 50 kc.
3. Set generator output amplitude to produce a horizontal line on upper beam that is exactly 6 major divisions long.
4. Without disturbing the generator output amplitude increase the output frequency to 350 kc.
5. The line on the upper beam should now be at least 4.2 major divisions long.

#### NOTE

The 4.2 major divisions represents a 3 db decrease in response at 350 kc from 6 major divisions at 50 kc. If the amplifier does not have adequate response, try new transistors (Q424 and Q434 in upper beam; Q474 and Q484 in lower beam).

#### IMPORTANT

If you replace or transpose transistors, it will be necessary to repeat steps 8-B through 8-H for the affected amplifier.

6. Repeat steps H-1 through H-5 for lower beam.
7. Disconnect the input signal.
8. Reset controls as follows:
 

UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE

## 9. Time Base Generators (Part 2)

### A. Adjust SWEEP LENGTH ('A' and 'B')

1. Vertically position the traces to their respective center-lines.
2. Horizontally position the traces so they begin at the left edge of the graticule.
3. Adjust 'A' SWEEP LENGTH so the upper beam trace extends one-half major division past the right edge of the graticule.
4. Repeat step A-3 for 'B'.

### B. Check VARIABLE TIME/DIV. and UNCAL. lamp ('A' and 'B')

1. Set controls as follows:
 

TIME/DIV. ('A' and 'B')	1 mSEC
-------------------------	--------

2. Apply 10 millisecond time markers to the vertical INPUT of both beams. Each display should consist of two time marks; one at the right and one at the left edge of the graticule.

3. Turn 'A' VARIABLE TIME/DIV. fully counterclockwise. There should be less than 4 major divisions between time marks and the UNCAL lamp beside the control should be lighted.

4. Repeat step B-3 for 'B'.

5. Reset both VARIABLE TIME/DIV. controls to CALIBRATED. The UNCAL. lamps should not be lighted.

### C. Check 'A' and 'B' sweep rates — .1 mSEC through 5 SEC per division.

1. Check the fixed sweep rates of both Time Base Generators as listed in Table 5-4. The maximum allowable error in all cases is  $\pm 1.2$  minor divisions in 8 major divisions ( $\pm 3\%$ ). (See Adjustment Aids in step 8-B.)

#### NOTE

Time Base 'A' crt display sweep rates are checked in this step. Delay Interval accuracy, which also depends on Time Base 'A' is checked in a later step.

#### CAUTION

To prevent crt phosphor damage at the slower sweep rates, increase the display amplitude and position the base of the waveform downward out of view. The INTENSITY control may then be set so the short duration time markers are easily seen.

TABLE 5-4

'A' and 'B' TIME/DIV.	Time Mark Generator Output	Markers Per Division
1 mSEC	1 millisecond	1
2 mSEC	1 millisecond	2
5 mSEC	5 millisecond	1
10 mSEC	10 millisecond	1
.1 SEC	100 millisecond	1
1 SEC	1 second	1
2 SEC	1 second	2
5 SEC	5 second	1
.1 mSEC	100 microsecond	1

### D. Adjust 'A' and 'B' fast sweep rates.

1. Connect a 100 kc (10 microsecond) trigger signal from the time mark generator to the TRIG. IN connector of each time base.
2. Set controls as follows:
 

TRIGGER SOURCE ('A' and 'B')	EXT.
------------------------------	------
3. Adjust the fast sweep rates of each time base according to the information on Table 5-5.

TABLE 5-5

'A' and 'B' TIME/DIV.	Time Mark Generator Output	Adjust		Markers Per Division
		'A'	'B'	
10 μSEC	10 microsecond	C160C	C260C	1
1 μSEC	1 microsecond	C160A	C260A	1

**E. Check fastest magnified sweep rate accuracy.**

1. Set controls as follows:  
10X MAG. (Upper and Lower Beam) on (pulled out)
2. Apply 10 mc sine waves from the time mark generator to both plug-in units. Use external 10 microsecond trigger pulses as in step 9-D.
3. Check for one cycle per major division ( $\pm 5\% = \pm 2$  minor divisions in 8 major divisions).
4. Disconnect the input signals.
5. Reset the controls as follows:  
10X MAG (Upper and Lower Beam) off  
TRIGGER source ('A' and 'B') INT.

**F. Adjust Time Base 'B' LOCKOUT LEVEL.**

1. Set controls as follows:  
'A' TIME/DIV. 1 mSEC  
'B' TIME/DIV. .5 mSEC  
'A' LEVEL FREE RUN  
'B' LEVEL O  
'B' MODE STARTS AFTER DELAY INTERVAL  
INTENSITY (Upper Beam) so both intensity levels of the Upper Beam trace are easily seen.
2. Turn LOCKOUT LEVEL fully clockwise. Each beam should display a trace on the crt, but the LOWER BEAM trace should be considerably shorter than normal.
3. Turn LOCKOUT LEVEL counterclockwise just far enough to bring the Lower Beam trace to normal length. Check by over-adjusting and returning to the point where the trace begins to shorten.

**G. Check the remaining lockout modes for proper operation.**

1. Set the 'B' MODE to TRIGGERABLE AFTER DELAY INTERVAL. The Lower Beam trace should disappear.
2. Set both LEVEL controls to AUTO. and Amplitude Calibrator PEAK-TO-PEAK VOLTS to 1.
3. Connect CAL. OUT to the vertical INPUT of both beams. Both beams should present stable displays.
4. Turn DELAY INTERVAL several turns. The Lower Beam display should remain stable. The brightened segment in the Upper Beam trace should step from pulse to pulse; one step for about one revolution of the dial.

NOTE

If the brightened segment moves smoothly rather than by steps, try readjusting the 'B' STABILITY control slightly.

5. Disconnect the signal input.
6. Set 'B' MODE to MANUAL TRIGGER and 'B' TIME/DIV. to 20 mSEC.
7. Check that the Lower Beam sweeps once each time the MANUAL TRIGGER button is pushed.
8. Set 'B' MODE to SINGLE SWEEP and 'B' LEVEL to 0.
9. Push the RESET button. The Lower Beam should not sweep, but the READY lamp should light.

NOTE

It may be necessary to reset the 'B' STABILITY control slightly more counterclockwise for proper operation.

10. Set 'B' LEVEL to AUTO. The Lower Beam should sweep once and the READY lamp should extinguish.

**10. Delay Pickoff**

**A. Adjust DELAY START and DELAY STOP**

1. Set controls as follows:  
'A' TIME/DIV. 1 mSEC  
'B' TIME/DIV. 10 μSEC  
'B' MODE STARTS AFTER DELAY INTERVAL  
DELAY INTERVAL 1.00
2. Apply 1 millisecond time markers to the upper and lower beam vertical inputs.
3. Set 'A' TRIGGER LEVEL near the counterclockwise end of the range in which a stable Upper Beam display is obtained. Do not use automatic triggering.

IMPORTANT

The 'A' LEVEL control setting established in step A-3 must not be changed during the remainder of step A nor throughout step B.

4. Set the Upper Beam INTENSITY low enough so the brightened spot in the Upper Beam display is easily seen. Set the Lower Beam INTENSITY high enough so the Lower Beam trace can be seen.
5. With DELAY INTERVAL set to 1.00, adjust DELAY START to position the brightened spot within the time marker which is one major division from the left end of the Upper Beam display. The Lower Beam should then provide an expanded display of this marker.
6. Refine the DELAY START adjustment so the rising portion of the marker is within one major division of the left end of the Lower Beam display.
7. Set DELAY INTERVAL to 9.00.

## Calibration — Type 565

- Adjust DELAY STOP to position the brightened spot within the time marker which is nine major divisions from the left end of the Upper Beam display.
- Refine the DELAY STOP adjustment so the rising portion of the marker is within one major division of the left end of the Lower Beam display.
- Repeat steps A-5 through A-9 until no further improvement can be made.

### B. Check DELAY INTERVAL linearity.

- Use the same signal and control settings as in Step A. Set DELAY INTERVAL near 2.0 so the rising portion of the marker is one-half major division from the left end of the Lower Beam display. The DELAY INTERVAL dial should then be within 5 minor dial divisions of 2.00.
- In the same manner, check the dial accuracy at each major digit; 3.00 through 8.00. In each case, the dial should be within 5 minor divisions of the correct indication.

### C. Check delay jitter.

- Set 'B' TIME/DIV. to 1  $\mu$ SEC.
- Apply 500 microsecond time markers to the Upper and Lower Beam vertical inputs.
- If necessary, adjust 'A' LEVEL for a stable upper beam display.
- Set DELAY INTERVAL near 1.0 to position a marker at the center of the crt on the Lower Beam.
- Check that the marker displayed on the lower beam jitters horizontally less than 0.5 major division. Do not include slow drift in the measurement.
- Set DELAY INTERVAL near 9.0 to position a marker at the center of the crt on the Lower Beam.
- Check as in step C-5.
- Retain the present signal connections and control settings for the next step.

## 11. Time Base 'A'

### A. Check 'A' sweep rates against DELAY INTERVAL

- Set controls as follows:

'A' TIME/DIV.	2 mSEC
'B' TIME/DIV.	20 $\mu$ SEC

- Apply 1 millisecond time markers to the Upper and Lower Beam vertical inputs. Set 'A' LEVEL in the middle of the range where a stable, triggered Upper Beam display is obtained.
- Set Lower Beam horizontal POSITION so the Lower Beam display begins 4 major divisions from the left edge of the graticule.
- Set DELAY INTERVAL near 1.00 so the marker that is one major division from the left end of the Upper Beam display is within the brightened segment. The Lower Beam should then provide an expanded display of this marker.

- Refine the DELAY INTERVAL dial setting so the peak of the marker on the Lower Beam is at the horizontal center of the graticule.
- Note the exact DELAY INTERVAL dial setting.

### IMPORTANT

The setting of the 'A' LEVEL control must not be changed during steps A-4 through A-9.

- Set DELAY INTERVAL near 9.00 so the marker that is nine major divisions from the left end of the Upper Beam display is within the brightened segment.
- Refine the DELAY INTERVAL dial setting so the peak of the marker on the Lower Beam is at the horizontal center of the graticule.
- Note the exact DELAY INTERVAL dial setting.
- Subtract the first reading (step A-5) from the second reading (step A-8). The difference must be 8.00,  $\pm 24$  minor dial divisions ( $\pm 3\%$ ).
- Use steps A-3 through A-9 to check the remaining 'A' sweep rates according to Table 5-6.

### NOTE

Reduce the display brightness to avoid crt phosphor damage when the slower sweep rates are used. The brightness of the intensified Upper Beam trace segment can be reduced independently by resetting the CONTRAST control. (The CONTRAST control is located inside the instrument above the power transformer.) Return the CONTRAST control to the fully clockwise position when the slow sweep rate checks are completed.

TABLE 5-6

'A' TIME/DIV.	'B' TIME/DIV.	Time Mark Generator Output
5 mSEC	50 $\mu$ SEC	5 millisecond
10 mSEC	.1 mSEC	10 millisecond
.1 SEC	5 mSEC	100 millisecond
1 SEC	50 mSEC	1 second
2 SEC	50 mSEC	1 second
5 SEC	.2 SEC	5 second
.1 mSEC	1 $\mu$ SEC	100 microsecond
* 50 $\mu$ SEC	1 $\mu$ SEC	50 microsecond
* 5 $\mu$ SEC	1 $\mu$ SEC	5 microsecond

\*These 'A' sweep rates are adjustable. If necessary, adjust C160C for 50  $\mu$ SEC and C160A for 5  $\mu$ SEC for best results. Also see step 9-D. The Lower Beam display and the brightened segment in the Upper Beam display will each include two or three time markers. Use the marker at the left end of each display.

### NOTE

The DELAY INTERVAL dial readings obtained at the fastest 'A' sweep rates will be slightly smaller numbers due to the inherent time displacement caused by Time Base 'A' Trigger.

- Disconnect the input signals.

## 12. Vertical Deflection System (Part 2)

### Deflection-Plate Capacitance

The effective deflection-plate capacitance of the cathode-ray tube, as seen by the plug-ins, can be adjusted by means of C741 and C751. These capacitors have been set at the factory to provide an effective deflection-plate capacitance of 14 picofarads. If C741 or C751 has been inadvertently misadjusted, or if the cathode-ray tube has been changed, the effective capacitance between one or both pairs of plates may be altered slightly. This will affect vertical response only if you are using a wide-band amplifier plug-in (such as the Type 3A1) near the limit of its bandpass. If the proper response cannot be obtained throughout the bandwidth of a wide-band amplifier, the effective deflection-plate capacitance may not be the proper value.

Since the effective deflection-plate capacitance of the cathode-ray tube is that capacitance seen by the plug-in when the plates are driven push-pull, it cannot be measured directly with a capacitance meter. However, the individual circuit capacitances which make up the effective deflection plate capacitance can be measured with a meter. These capacitances are schematically represented as shown in Fig. 5-11. C1 and C2 represent the capacitance from each deflection plate to ground and C3 represents the capacitance between the deflection plates. The variable capacitor is part of the capacitance of C3. Since the deflection plates are driven push-pull, the effective deflection-plate capacitance,  $C_{eff}$ , may be expressed in terms of C1, C2 and C3 as follows:

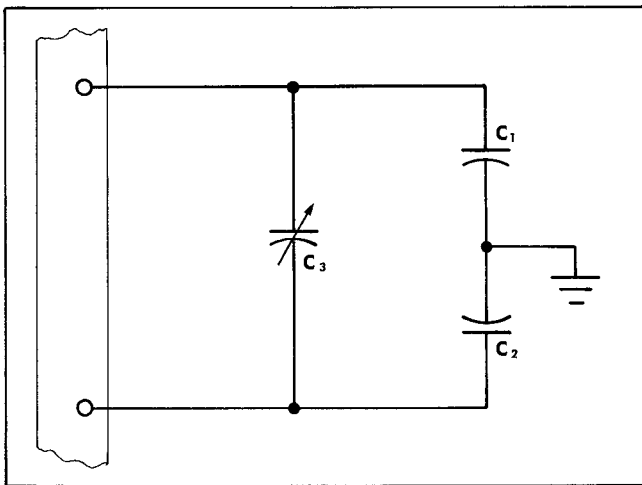


Fig. 5-11. Schematic representation of the crt effective deflection plate capacitances.

$$C_{eff} = \frac{C1 + C2}{2} + 2C3. \quad \text{Eq. (1)}$$

Setting  $C_{eff}$  equal to 14.3 picofarads (the factory value) and rearranging terms, we obtain:

$$C3 = 7\text{pf} - \frac{C1 + C2}{4} \quad \text{Eq. (2)}$$

Thus, by measuring C1 and C2 we can determine the desired value for C3 which we can then set with the variable capacitor.

### A. Adjust the effective crt Upper Beam deflection-plate capacitance.

1. Disconnect the power cord and isolate the oscilloscope from ground.
2. Connect the capacitance meter guard voltage to pin 21 and measure the capacitance between pin 17 and the oscilloscope chassis — this is C1.
3. Connect the capacitance meter guard voltage to pin 17 and measure the capacitance between pin 21 and the oscilloscope chassis—this is C2.
4. Substitute the measured capacitance values into equation (2) and solve for C3.
5. Connect the guard voltage to the oscilloscope chassis and measure the capacitance between pins 17 and 21.
6. Adjust C741 until the measured capacitance equals the value of C3 obtained in step 4.

#### NOTE

Now that you have set the effective crt Upper Beam deflection-plate capacitance, C751 of the Lower Beam can easily be set by the use of a wide-band amplifier such as the Type 3A1. If you have such an amplifier, proceed with the following steps to set the deflection-plate capacitance of the Lower Beam. If you do not have an amplifier with a bandwidth to at least 4 megacycles, you can complete the calibration by applying steps 1 through 6 to C751.

7. Insert a Type 3A1 (or other amplifier with a bandwidth to at least 4 megacycles) in the Upper Beam opening of the oscilloscope. Turn on the oscilloscope.
8. Calibrate the amplifier according to the Calibration procedures in the plug-in manual. Good square wave response is particularly important. The plug-in unit calibration will be valid, even though the calibration of the oscilloscope is not yet complete.
9. Install the calibrated plug-in unit in the Lower Beam opening.
10. Apply to the vertical INPUT connector the same square wave signal that was used during the high frequency compensation of the plug-in unit.
11. Adjust the Lower Beam deflection-plate capacitor (C751) for best square-wave display.

#### NOTE

The calibrated wide-band amplifier can now be used as a calibrating unit for the deflection-plate capacitances of other 560-series Oscilloscopes. This eliminates the need of repeating the entire procedure for each instrument to be calibrated. Simply insert the calibrated plug-in in each opening to be calibrated, apply the same square-wave signal used in calibrating the plug-in and adjust the deflection-plate capacitor for best square wave display.

### 13. Functional Checks

#### A. Check rear panel output signals.

1. Set controls as follows:

'A' TIME/DIV.	1 mSEC
VARIABLE	CALIBRATED
'A' TRIGGER	UPPER BEAM INT.
COUPLING	AC
SLOPE	+
LEVEL	AUTO.
'B' TIME/DIV.	.2 mSEC
VARIABLE	CALIBRATED
'B' MODE	STARTS AFTER DELAY INTERVAL
DELAY INTERVAL	1.00
10X MAG. (both)	off
UPPER HORIZ. DISPLAY	'A' TIME BASE
LOWER HORIZ. DISPLAY	'B' TIME BASE
PEAK-TO-PEAK VOLTS	10
Plug-In Units (both)	
VOLTS/DIV.	5

Remaining controls set as required.

2. Connect CAL. OUT to the Upper and Lower Beam vertical inputs.

3. Use coaxial cable to connect the 'A' + GATE OUT (rear panel) to the vertical input of a test oscilloscope.

4. Check the output signal for the characteristics described in Section 1 of this manual.

5. Move the 'A' + GATE OUT signal connection from the vertical input to the external trigger input of the test oscilloscope. Use this signal to trigger the test oscilloscope while checking the remaining six rear panel output signals.

6. Disconnect the rear panel output signals.

#### B. Check CONTRAST control operation.

1. Use the same display and control settings as in step A.

2. Set the Upper Beam INTENSITY so the unintensified portion of the display is barely visible.

3. Check that the CONTRAST control will vary the intensity of the brightened display segment.

4. Reset the CONTRAST control fully clockwise.

#### C. Check intensity modulation operation.

1. Set the 'B' MODE switch to NORMAL TRIGGER. Set the remaining Time Base 'B' controls the same as those in Time Base 'A'.

2. Set both INTENSITY controls so the displays are barely visible.

3. Remove the shorting bars from the rear panel CRT GRID input jacks.

4. Connect CAL. OUT to both of the CRT GRID input jacks (red jacks only) in addition to the vertical inputs.

5. Check that the bottom of each display is considerably dimmer than the top (vice versa with signal inverting plug-in units).

6. Disconnect the rear panel signal connections and replace the shorting bars.

#### D. Check Alternate Sweep operation. (optional)

##### NOTE

This check cannot and need not be made unless you have a multi-trace plug-in unit such as the Types 3A1, 3A2, 3A72, or 3A74.

1. Disconnect the signal from the Lower Beam vertical input only.

2. Install a multi-trace plug-in unit in the Lower Beam compartment.

3. Set the multi-trace plug-in unit controls for alternate trace operation.

4. Check that the appropriate number of traces is obtained on the Lower Beam.

5. Set LOWER HORIZ. DISPLAY to 'A' TIME BASE. Repeat step D-4.

6. Disconnect the input signal.

#### E. Check Chopped Mode blanking. (optional)

##### NOTE

This check cannot and need not be made unless you have a multi-trace plug-in unit.

1. Set controls as follows:

LOWER HORIZ. DISPLAY	'B' TIME BASE
'B' TRIGGER source	LOWER BEAM
Plug-In Unit	for chopped mode operation
INTENSITY	normal brightness

2. Increase the sweep rate so the individual segments of the trace are one to two major divisions long.

3. Check that the Lower Beam display is blanked during the time that the plug-in unit switches channels.

4. Repeat steps E-1 through E-3 for the Upper Beam.

#### F. Check SCALE ILLUM. operation.

1. Check that the SCALE ILLUM. control operates properly and that both scale illumination lamps are good.

# SECTION 6

## PARTS LIST AND SCHEMATICS

### PARTS ORDERING INFORMATION

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 Tektronix Field Office will contact you concerning any change in part number.

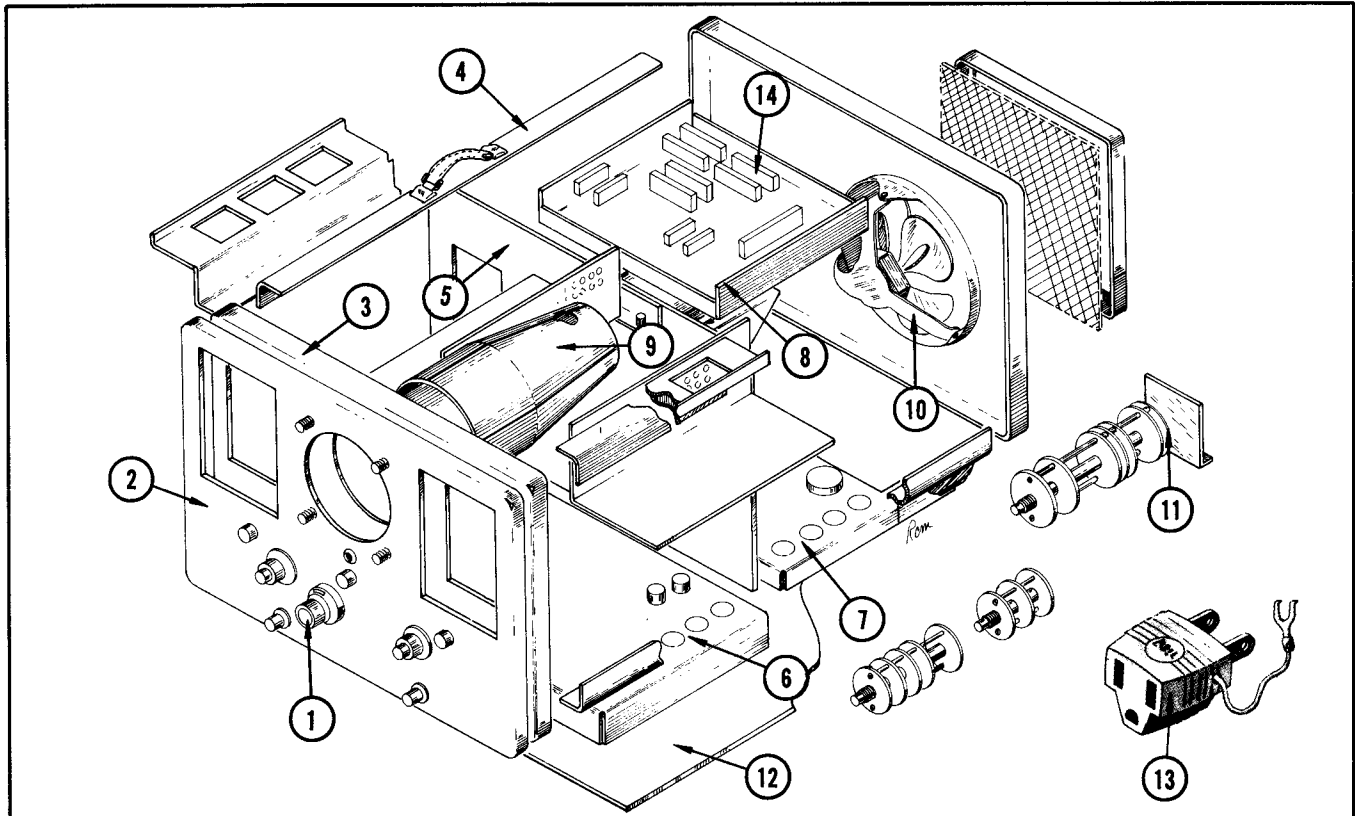
### ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10 <sup>6</sup> )
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10 <sup>-6</sup>
cm	centimeter	n	nano, or 10 <sup>-9</sup>
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10 <sup>-12</sup>
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10 <sup>9</sup>	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10 <sup>12</sup>
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10 <sup>3</sup> )	w/	with
kc	kilocycle	w/o	without
m	milli, or 10 <sup>-3</sup>	WW	wire-wound
mc	megacycle		

### SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

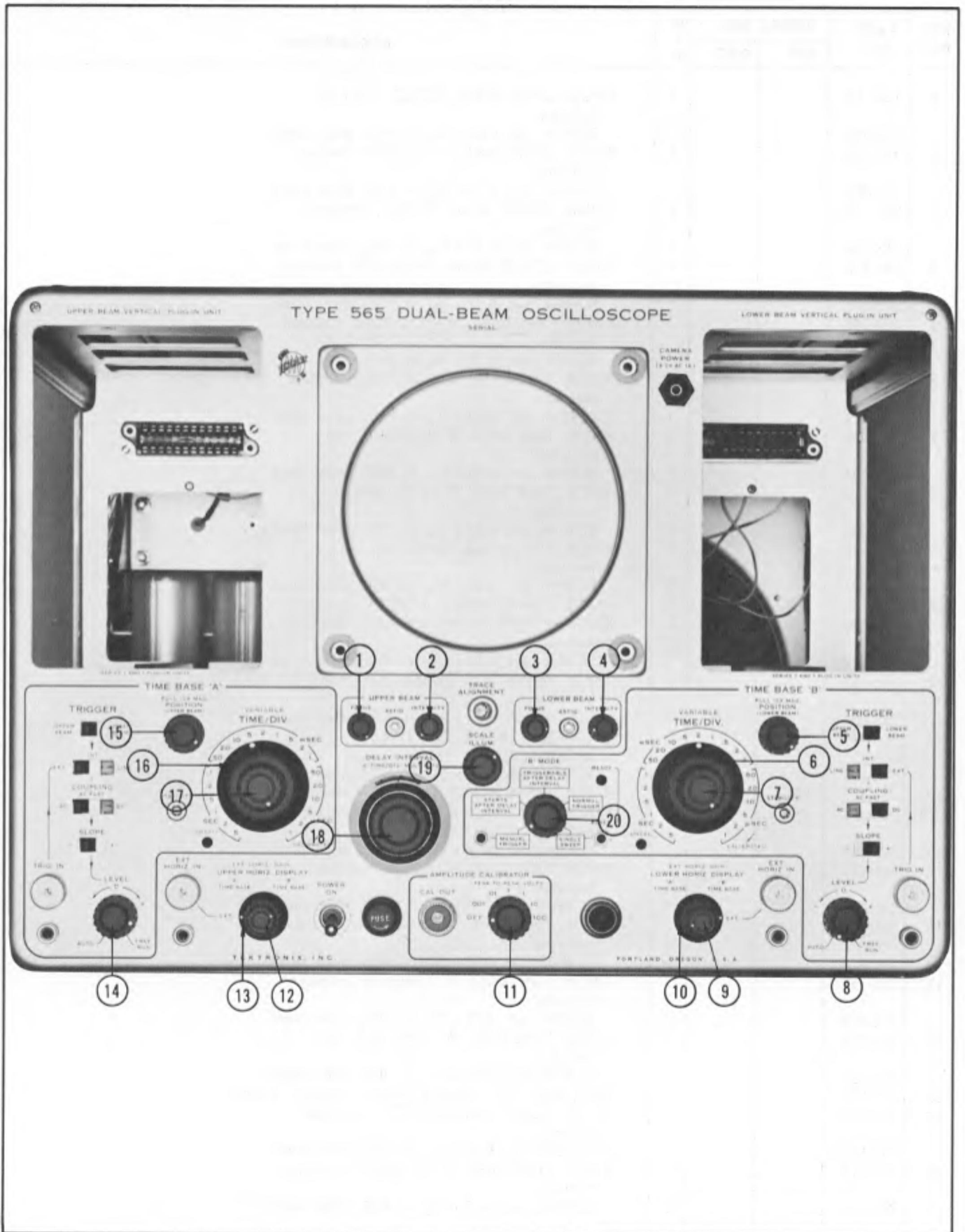
LOCATOR



REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	PG. 6-3				KNOBS
2	PG. 6-5				FRONT
3	PG. 6-7				SUBPANEL
4	PG. 6-10				FRAME GROUP
5	PG. 6-13				SUPPORT GROUP
6	PG. 6-16				SWEEP CHASSIS
7	PG. 6-18				POWER CHASSIS
8	PG. 6-21				HIGH VOLTAGE CHASSIS
9	PG. 6-24				CATHODE RAY TUBE SHIELD
10	PG. 6-25				FAN MOTOR
11	PG. 6-26 & 6-29				SWITCHES
12	PG. 6-30				CABINET
13	PG. 6-31				ACCESSORIES
14	PG. 6-32				CERAMIC STRIPS



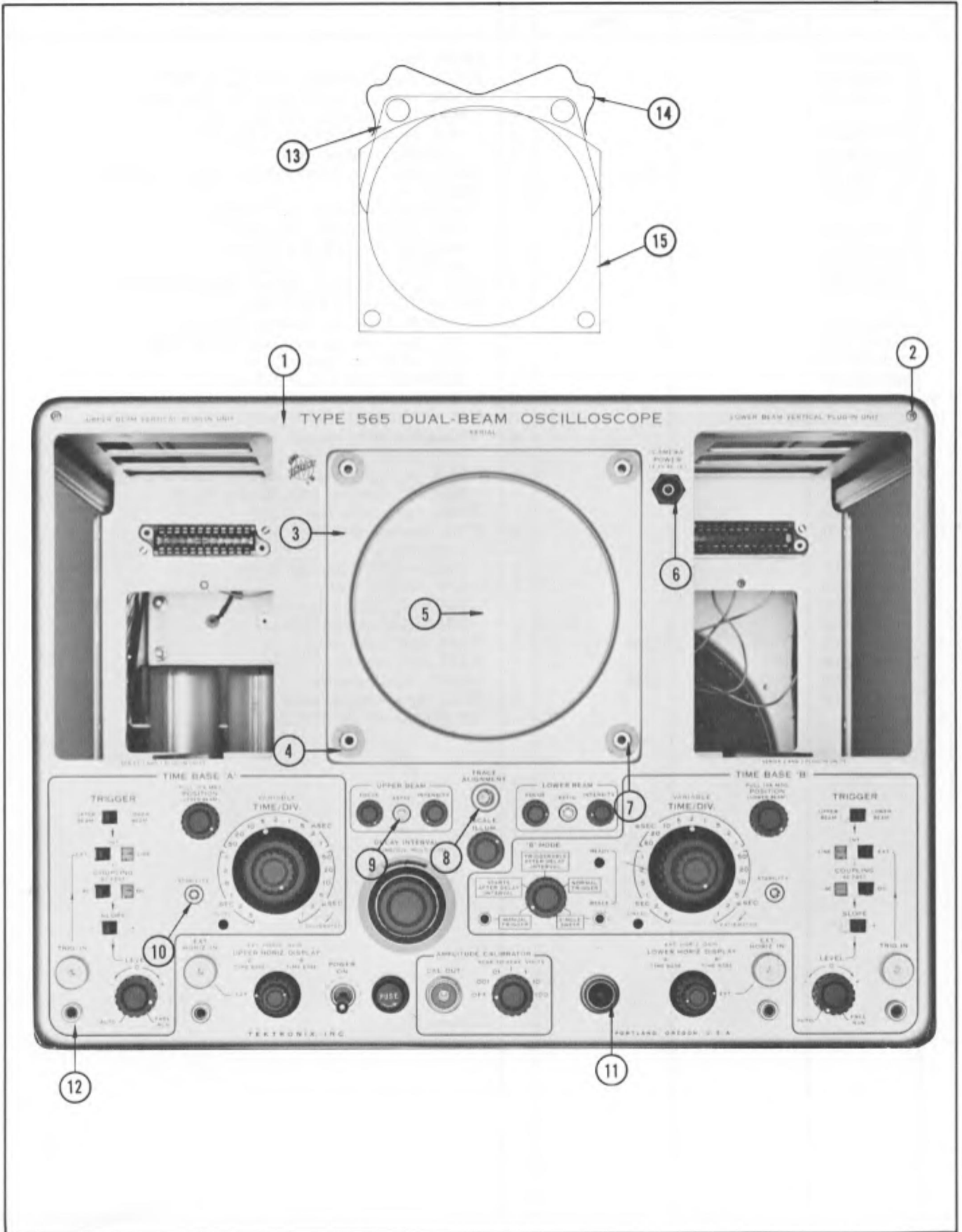
KNOBS



**KNOBS**

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	366-153			1	KNOB, UPPER BEAM, FOCUS, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
2	213-004 366-153			1 1	KNOB, UPPER BEAM, INTENSITY, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
3	213-004 366-153			1 1	KNOB, LOWER BEAM, FOCUS, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
4	213-004 366-153			1 1	KNOB, LOWER BEAM, INTENSITY, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
5	213-004 366-148			1 1	KNOB, TIME BASE 'B', POSITION, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
6	213-004 366-144			1 1	KNOB, TIME BASE 'B' TIME/DIV., charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
7	213-004 366-038			1 1	KNOB, TIME BASE 'B' VARIABLE, red Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
8	213-004 366-113			1 1	KNOB, TIME BASE 'B' LEVEL, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
9	213-004 366-140			1 1	KNOB, EXT. HORIZ. GAIN, red Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
10	213-004 366-175 366-250	101 680	679	1 1 1	KNOB, LOWER HORIZ. DISPLAY, charcoal KNOB, LOWER HORIZ. DISPLAY, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
11	213-004 366-113			1 1	KNOB, AMPLITUDE CALIBRATOR, PEAK TO PEAK VOLTS, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
12	213-004 366-140			1 1	KNOB, EXT. HORIZ. GAIN, red Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
13	213-004 366-175 366-250	101 680	679	1 1 1	KNOB, UPPER HORIZ. DISPLAY, charcoal KNOB, UPPER HORIZ. DISPLAY, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
14	213-004 366-113			1 1	KNOB, TIME BASE 'A' LEVEL, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
15	213-004 366-148			1 1	KNOB, TIME BASE 'A' POSITION, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
16	213-004 366-144			1 1	KNOB, TIME BASE 'A' TIME/DIV., charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
17	213-004 366-038			1 1	KNOB, TIME BASE 'A', VARIABLE, red Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
18	213-004 331-091			1 1	DIAL, Duo Dial, without brake, charcoal knob
19	366-148			1	KNOB, SCALE ILLUMINATION, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
20	213-004 366-113			1 1	KNOB, TIME BASE 'B', 'B' MODE, charcoal Includes: SCREW, set, 6-32 x 3/16 in. HSS, allen head
	213-004			1	SCREW, set, 6-32 x 3/16 in. HSS, allen head

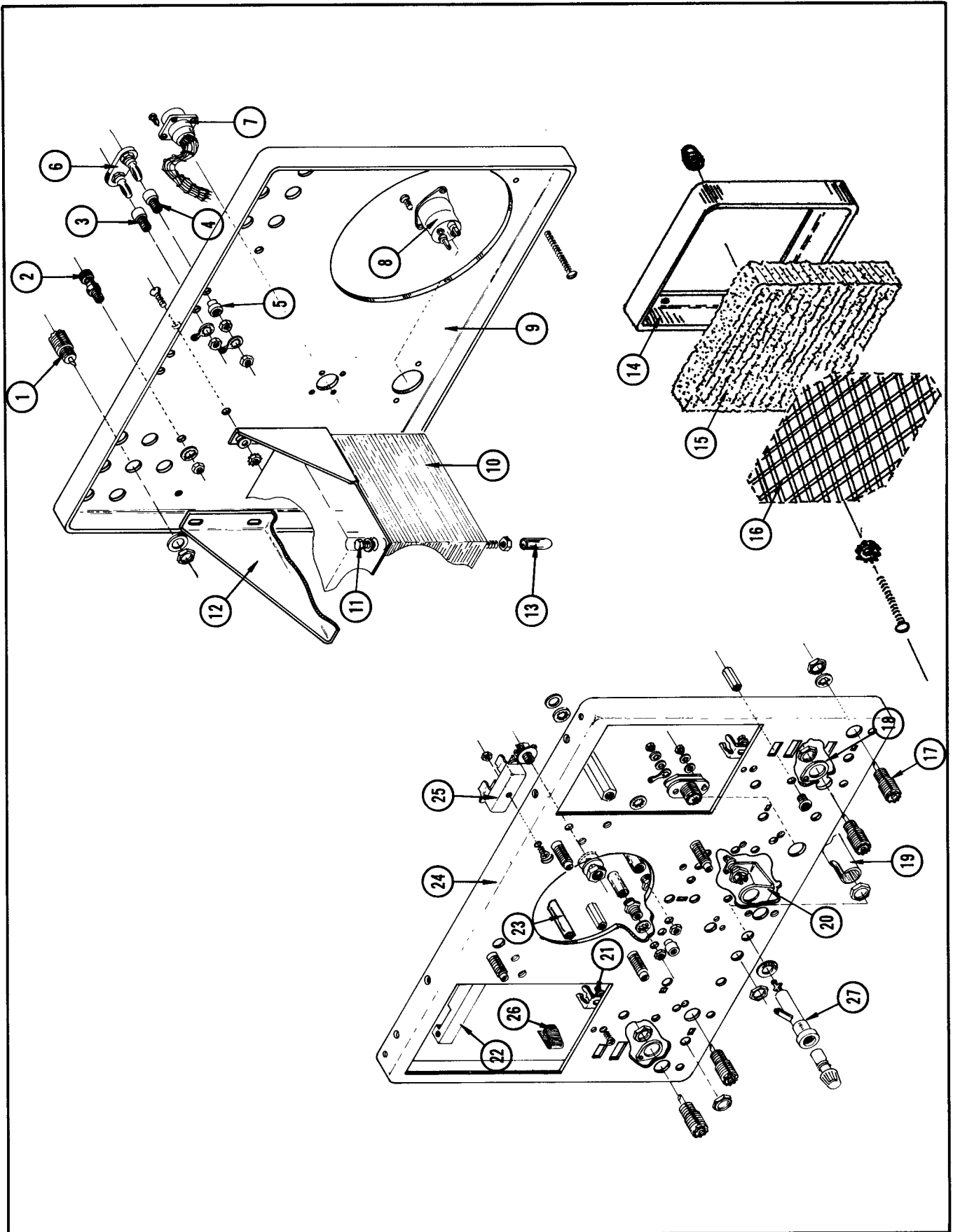
FRONT



FRONT

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	333-0671-00			1	PANEL front
2	213-0088-00			2	SCREW, thread forming, 4-40 x 1/4 in. PHS
3	200-0382-00			1	COVER, graticule with ornamental ring, black
				-	Mounting Hardware: (not included)
4	210-0424-00			4	NUT, knurled, 3/8-24 x 9/16 x 3/16 in.
	210-0816-00			4	WASHER, graticule, stud
5	331-0047-00	101	999X	1	GRATICULE, 5 in. 10 cm vertical x 10 cm horizontal
6	136-0094-00			1	SOCKET, fini-jax
				-	Mounting Hardware: (not included)
	210-0572-00			1	NUT, insulating, hex, 5/16 x 9/16 in.
	210-0902-00			1	WASHER, flat .470 ID x 2 1/32 in.
	210-0913-00			1	WASHER, 1/4 ID x 5/8 in. OD
7	355-0043-00			4	STUD, 3/8-32 x 10-32 in. internal thread (replacement)
8				-	POT MOUNTING HARDWARE:
	210-0012-00			2	LOCKWASHER, pot internal 3/8 x 1/2 in.
	210-0574-00			1	NUT, hex, bushing, hex rod, 1 3/4 in. long
	210-0207-00			1	LUG, solder, pot plain, 3/8 in.
	358-0010-00			1	BUSHING, 3/8-32 x 9/16 x .412 in.
9	358-0075-00			2	BUSHING, mini pot mounting
10				-	POT MOUNTING HARDWARE:
	210-0010-00			2	LOCKWASHER, internal #10
	210-0223-00			1	LUG, solder 1/4 in. hole, lock round perimeter
	210-0471-00			1	NUT, pot, mini, hex, 1/4-32 x 5/16 inch. dia.
	358-0054-00			1	BUSHING, banana jack, 1/4-32 x 1 3/32 in.
11	378-0518-00			1	JEWEL, light, pilot, red
12	129-0035-00			4	POST, binding, assembly
				-	Consisting of:
	210-0011-00			1	LOCKWASHER, internal 1/4 in.
	200-0103-00			1	CAP, binding post
	210-0455-00			1	NUT, hex, 1/4-28 x 3/8 x 3/32 in.
	355-0507-00			1	STEM, binding post adapter
13	387-0917-00	X1000	1369	1	PLATE, light reflector
	386-0212-00	1370		1	PLATE, light reflector
14	214-0433-00	X1000	1369	1	SPRING, light reflector
	354-0262-00	1370		1	RING, light reflector plate
15				-	SEE STANDARD ACCESSORIES PAGE

SUBPANEL GROUP



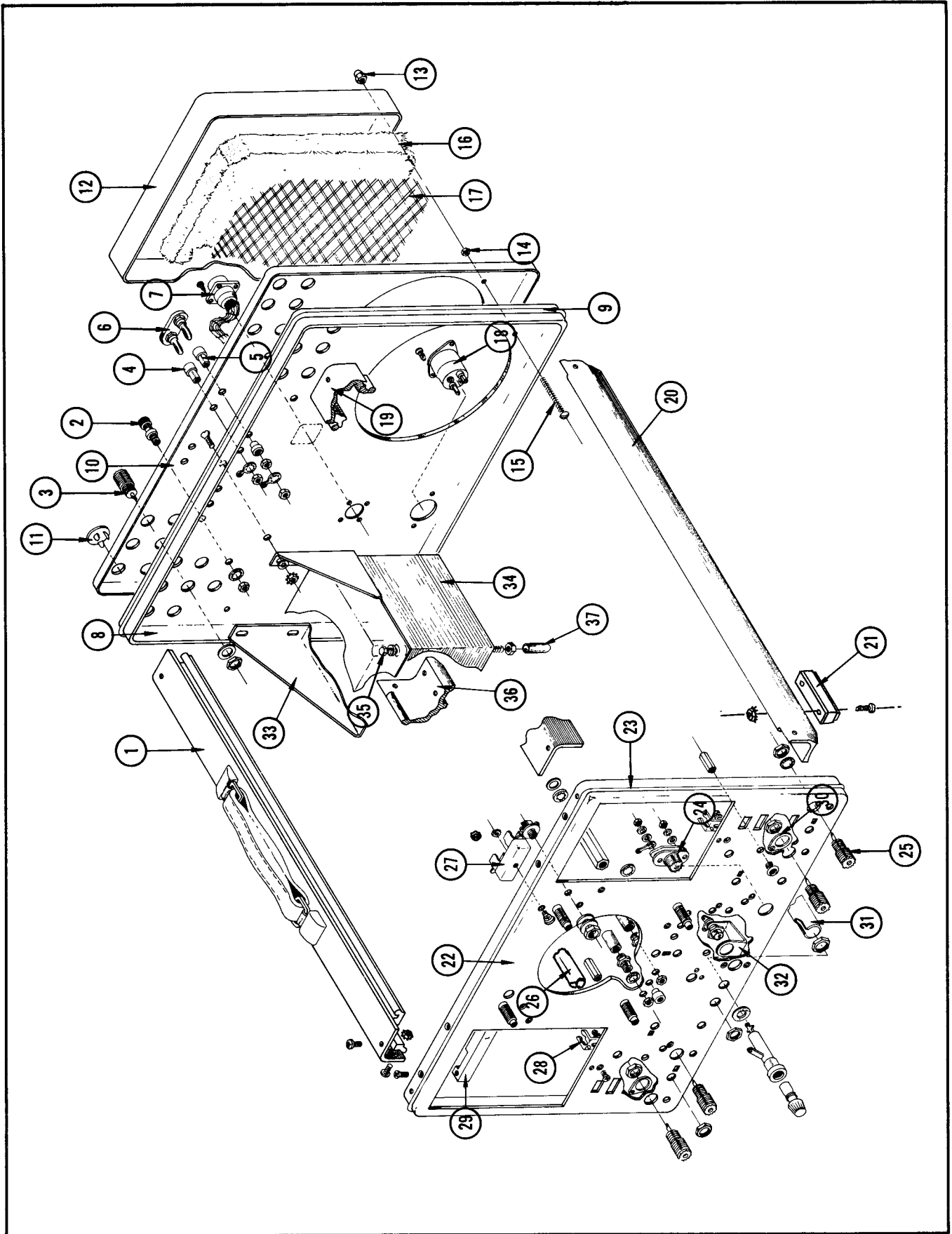
SUBPANEL GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	131-0081-00	101	389	7	CONNECTOR, contact, UHF
	131-0126-00	390		7	CONNECTOR, 1 contact, BNC
2	129-0035-00			2	POST, binding, assembly
	200-0103-00			-	each includes:
	210-0011-00			1	CAP, binding, post
	210-0455-00			1	LOCKWASHER, internal, 1/4 in.
	355-0507-00			1	NUT, hex, 1/4-28 x 3/8 x 3/32 in.
3	136-0140-00			1	STEM, binding post adapter
	210-0223-00			2	SOCKET, banana jack
	210-0455-00			-	Mounting Hardware for each: (not included)
4	136-0139-00			1	LUG, solder
	210-0455-00			1	NUT, hex, 1/4-28 x 3/8 x 3/32 in.
	210-0223-00			2	SOCKET, banana jack, with molded red nylon cap
	210-0455-00			-	Mounting Hardware for each: (not included)
	210-0898-00			1	LUG, solder
5	210-0898-00			2	NUT, hex, 1/4-28 x 3/8 x 3/32 in.
6	134-0012-00			1	WASHER, insulating, red 3/8 dia.
7	179-0677-00			2	PLUG, plated, banana, male
	213-0088-00			1	CABLE, harness, auxiliary power plug
	131-0150-00			-	Mounting Hardware: (not included)
8	129-0041-00			4	SCREW, thread forming #4 x 1/4 in. PHS
	200-0185-00			1	CONNECTOR, chassis mount
	205-0014-00			-	connector includes:
	210-0003-00			1	POST, ground
	210-0551-00			1	COVER, motor base
	211-0015-00			1	SHELL, mounting
	214-0078-00			2	LOCKWASHER, external, #4
	377-0041-00			2	NUT, hex, 4-40 x 1/4 inch
	213-0104-00			1	SCREW, 4-40 x 1/2 inch RHS
	387-0661-00			2	PIN, connecting
9	210-0010-00			1	INSERT, black urea
	210-0564-00			-	Mounting Hardware: (not included)
10	210-0812-00			2	SCREW, thread forming, 6-32 x 3/8 in. THS
	212-0540-00			1	PLATE, rear, subpanel
11	406-0851-00			-	TRANSFORMER MOUNTING HARDWARE:
	210-0457-00			4	LOCKWASHER, internal #10
12	210-0804-00			4	NUT, hex, 10-32 x 3/8 x 1/8 in. thick double chamfered
	212-0040-00			4	WASHER, fiber #10
13	200-0372-00			4	SCREW, 10-32 x 4 1/2 in. hex HS
				1	BRACKET, alum.
				-	Mounting Hardware: (not included)
				4	NUT, keps, 8-32 x 1 1/32 in.
				4	WASHER, flat, 8S x 3/8 in.
				4	SCREW, 8-32 x 3/8 in. FHS, 100° CSK
				2	CAP, protector for #10 screw

## SUBPANEL GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
14	380-0037-00			1	HOUSING, air filter
	- - - - -			-	Mounting Hardware: (not included)
	210-0402-00			2	NUT, cap, hex, 8-32 x 5/16 in.
	210-0458-00			2	NUT, keps, 8-32 x 1 1/32 in.
	212-0031-00			2	SCREW, 8-32 x 1 1/4 in. BHS
15	378-0022-00			1	FILTER, air
16	378-0762-00			1	SCREEN, filter
17	131-0081-00	101	389	4	CONNECTOR, 1 contact, UHF
	131-0126-00	390		4	CONNECTOR, 1 contact, BNC
18	210-0241-00			2	LUG, ground
19	200-0237-00	101	729X	1	COVER, insulating fuse holder
20	136-0026-00			1	SOCKET, light
21	352-0039-00			2	HOLDER, plug-in
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0004-00			1	LOCKWASHER, internal #4
	210-0406-00			1	NUT, hex, 4-40 x 3/16 in.
	211-0025-00			1	SCREW, 4-40 x 3/8 in. FHS
22	384-0604-00			2	ROD, spacer, plug-in
	- - - - -			-	Mounting Hardware for each: (not included)
	211-0541-00			2	SCREW, 6-32 x 1/4 in. FHS, 100° CSK
23	352-0008-00	101	1759	3	HOLDER, neon bulb, single, black plastic
	352-0067-00	1760		3	HOLDER, neon bulb, single, gray plastic
	378-0541-00	X1760		3	FILTER, lens, neon indicator light
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0406-00			1	NUT, hex, 4-40 x 3/16 in.
	211-0031-00	101	1759	1	SCREW, 4-40 x 1 inch, FHS
	211-0109-00	1760		1	SCREW, 4-40 x 7/8 inch, FHS
24	387-0665-00			1	PLATE, subpanel, front
25	352-0031-00			1	HOLDER, fuse, 3AG
	- - - - -			-	Mounting Hardware: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 in.
	211-0559-00			1	SCREW, 6-32 x 3/8 in. FHS 100° CSK
26	344-0095-00	X530		2	CLIP, ground
	- - - - -			-	mounting hardware for each: (not included w/clip)
	211-0538-00			1	SCREW, 6-32 x 5/16 FHS phillips
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
27	352-0002-00			1	HOLDER, fuse, assembly
	- - - - -			-	holder includes:
	352-0010-00			1	HOLDER, fuse
	200-0582-00			1	CAP, fuse
	210-0873-00			1	WASHER, rubber
	- - - - -			1	NUT, fuse holder

FRAME GROUP





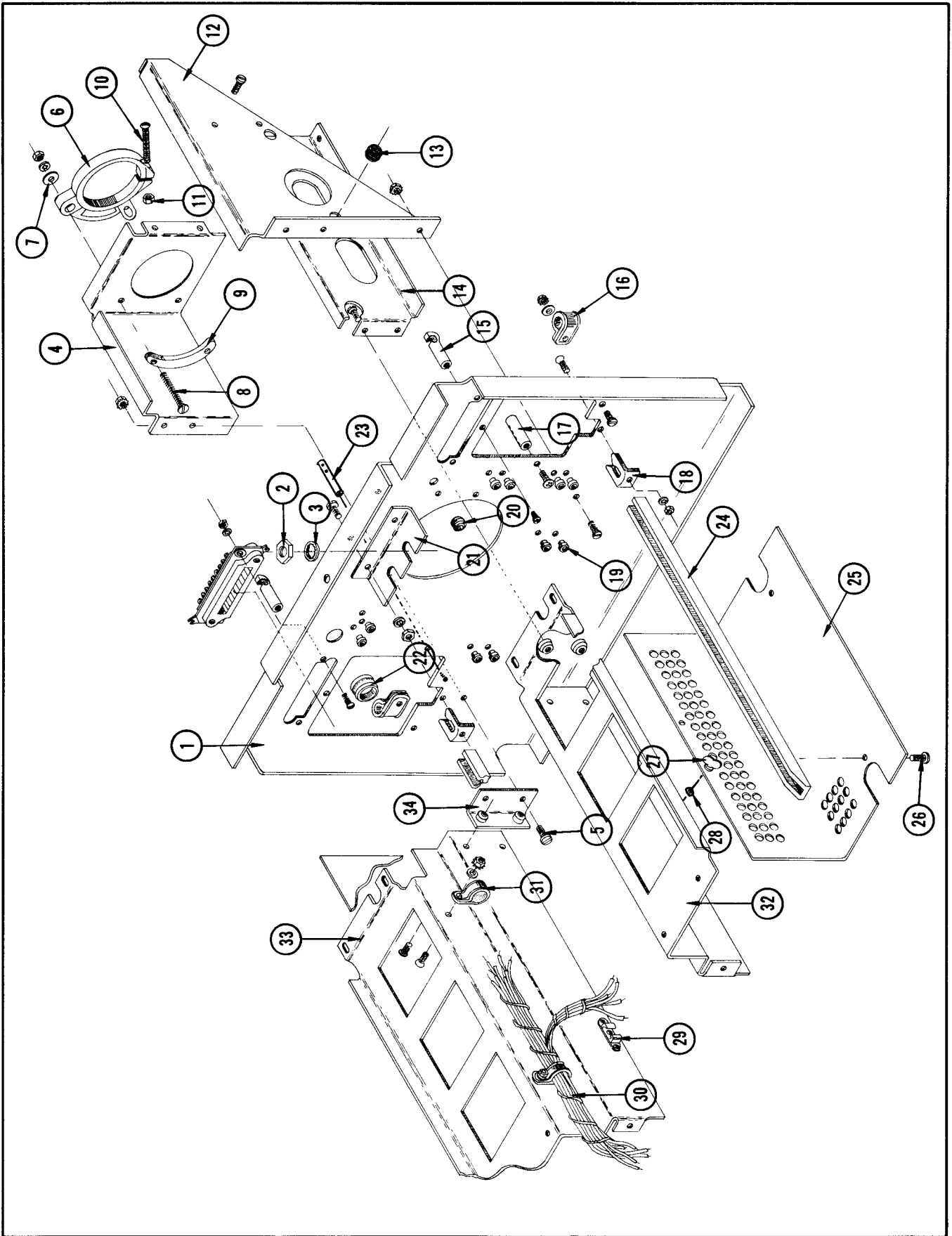
## FRAME GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	381-0195-00			1	BAR, top left, with handle
	343-0073-00			-	Includes:
	367-0011-00			2	CLAMP, cover
	210-0458-00			1	HANDLE, blue vinyl coated fabric
	212-0039-00			-	Mounting Hardware: (not included)
2	129-0035-00			4	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
	200-0103-00			4	SCREW, 8-32 x 3 <sup>8</sup> / <sub>8</sub> in. THS
	210-0011-00			2	POST, binding assembly
	210-0455-00			-	Consisting of:
	355-0507-00			1	CAP, binding, post
3	131-0081-00	101	389	1	LOCKWASHER, internal 1 <sup>4</sup> / <sub>4</sub> in.
	131-0126-00	390		1	NUT, hex, 1 <sup>4</sup> / <sub>4</sub> -28 x 3 <sup>8</sup> / <sub>8</sub> x 3 <sup>3</sup> / <sub>32</sub> in.
4	136-0140-00			1	STEM, binding post adapter
	210-0223-00			7	CONNECTOR, 1 contact, UHF
	210-0455-00			7	CONNECTOR, 1 contact, BNC
5	136-0139-00			2	SOCKET, banana jack, with molded nylon charcoal cap
	210-0223-00			-	Mounting Hardware for each: (not included)
	210-0455-00			1	LUG, solder, 1 <sup>4</sup> / <sub>4</sub> in. hole lock round perimeter
	210-0898-00			1	NUT, hex, 1 <sup>4</sup> / <sub>4</sub> -28 x 3 <sup>8</sup> / <sub>8</sub> x 3 <sup>3</sup> / <sub>32</sub> in.
6	134-0012-00			2	SOCKET, banana jack with molded nylon red cap
7	179-0677-00			-	Mounting Hardware for each: (not included)
	213-0088-00			1	LUG, solder, 1 <sup>4</sup> / <sub>4</sub> in. hole lock round perimeter
8	387-0661-00			2	NUT, hex, 1 <sup>4</sup> / <sub>4</sub> -28 x 3 <sup>8</sup> / <sub>8</sub> x 3 <sup>3</sup> / <sub>32</sub> in.
9	354-0156-00			1	WASHER, insulating, red, 3 <sup>8</sup> / <sub>8</sub> dia.
10	387-0668-00			2	PLUG, banana, male, twin 3 <sup>4</sup> / <sub>4</sub> in. apart
11	134-0067-00			1	CABLE, harness, auxiliary power plug
12	380-0037-00			-	Mounting Hardware (not included)
13	210-0402-00			4	SCREW, thread forming #4 x 1 <sup>4</sup> / <sub>4</sub> in. PHS
14	210-0458-00			1	PLATE, subpanel, rear
15	212-0031-00			-	plate includes:
16	378-0022-00			1	RING, ornamental
17	378-0762-00			1	PLATE, rear overlay
18	131-0150-00			6	PLUG
	213-0104-00			1	HOUSING, air filter
	381-0194-00			-	Mounting Hardware: (not included)
19	343-0073-00			2	NUT, cap, hex, 8-32 x 5 <sup>1</sup> / <sub>16</sub> in.
	367-0011-00			2	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
	210-0458-00			2	SCREW, 8-32 x 1 <sup>1</sup> / <sub>4</sub> in. RHS
	212-0039-00			1	FILTER, air
	122-0103-00			1	FILTER, screen
	210-0458-00			1	CONNECTOR, chassis mount, 3 wire motor base (see subpanel view)
	212-0039-00			-	Mounting Hardware: (not included)
	212-0075-00			2	SCREW, thread forming, 6-32 x 3 <sup>8</sup> / <sub>8</sub> in. THS
20	210-0458-00			1	BAR, top right
	212-0039-00			-	Includes:
	212-0075-00			2	CLAMP, cover
				1	HANDLE, blue vinyl coated fabric
				-	Mounting Hardware: (not included)
				4	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
				4	SCREW, 8-32 x 3 <sup>8</sup> / <sub>8</sub> in. THS, phillips
				1	ANGLE, rail, bottom right
				-	Mounting Hardware: (not included)
				4	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
				3	SCREW, 8-32 x 3 <sup>8</sup> / <sub>8</sub> in. THS, phillips
				1	SCREW, 8-32 x 1 <sup>4</sup> / <sub>4</sub> inch THS, phillips

FRAME GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
21	348-0042-00	101	1219	4	FOOT, gray
	348-0052-00	1220		4	FOOT, molded, anti-slide
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0458-00			2	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
	210-0071-00			2	SCREW, 8-32 x 1 in. Fil HS
22	387-0665-00			1	PLATE, subpanel, front
	- - - - -			-	plate includes:
	354-0156-00			1	RING, ornamental
23	131-0064-00	101	389	1	CONNECTOR, 1 contact, UHF
24	131-0279-00	390		1	CONNECTOR, 1 contact, BNC
	- - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0224-00			1	LUG, solder, #10 non-locking
	210-0406-00			2	NUT, hex, 4-40 x 3 <sup>1</sup> / <sub>16</sub> in.
	210-0812-00			2	WASHER, #10
	211-0025-00			1	SCREW, 4-40 x 3 <sup>8</sup> / <sub>8</sub> in. FHS, 100° CSK
	406-0244-00			1	BRACKET, nylon, coax insulating
25	131-0081-00	101	389	4	CONNECTOR, 1 contact, UHF
	131-0126-00	390		4	CONNECTOR, 1 contact, BNC
26	352-0008-00			3	HOLDER, neon bulb, single
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0406-00			1	NUT, hex, 4-40 x 3 <sup>1</sup> / <sub>16</sub> in.
	211-0031-00			1	SCREW, 4-40 x 1 in. FHS
27	352-0031-00			1	HOLDER, fuse, 3AG
	- - - - -			-	Mounting Hardware: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0407-00			1	NUT, hex, 6-32 x 1 <sup>4</sup> / <sub>4</sub> in.
	211-0559-00			1	SCREW, 6-32 x 3 <sup>8</sup> / <sub>8</sub> in. FHS 100° CSK
28	352-0039-00			2	HOLDER, plug-in chassis
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0004-00			1	LOCKWASHER, internal #4
	210-0406-00			1	NUT, hex, 4-40 x 3 <sup>1</sup> / <sub>16</sub> in.
	211-0025-00			1	SCREW, 4-40 x 3 <sup>8</sup> / <sub>8</sub> in. FHS
29	384-0604-00			2	ROD, spacer
	- - - - -			-	Mounting Hardware for each: (not included)
	211-0541-00			2	SCREW, 6-32 x 1 <sup>4</sup> / <sub>4</sub> in. FHS, 100° CSK
30	210-0241-00			2	LUG, ground
31	200-0237-00			1	COVER, insulating fuse holder
32	136-0026-00			1	SOCKET, light, with jewel
33	406-0851-00			1	BRACKET
	- - - - -			-	Mounting Hardware: (not included)
	210-0478-00			4	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
	210-0804-00			4	WASHER, flat, 8S x 3 <sup>8</sup> / <sub>8</sub> in.
	212-0040-00			4	SCREW, 8-32 x 3 <sup>8</sup> / <sub>8</sub> in. FHS, 100° CSK
34	- - - - -			-	TRANSFORMER MOUNTING HARDWARE:
	210-0010-00			4	LOCKWASHER, internal #10
	210-0564-00			4	NUT, hex, 10-32 x 3 <sup>8</sup> / <sub>8</sub> x 1 <sup>8</sup> / <sub>8</sub> in. thick double chamfered
	210-0812-00			4	SCREW, 10-32 x 4 <sup>1</sup> / <sub>2</sub> in. hex HS
35	212-0540-00			4	WASHER, fiber #10
36	122-0103-00			1	ANGLE, rail, bottom left
	- - - - -			-	Mounting Hardware: (not included)
	210-0458-00			4	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
	212-0039-00			3	SCREW, 8-32 x 3 <sup>8</sup> / <sub>8</sub> in. THS
	212-0075-00			1	SCREW, 8-32 x 1 <sup>4</sup> / <sub>4</sub> inch THS
37	200-0372-00			2	CAP, protection for #10 screw

SUPPORT GROUP



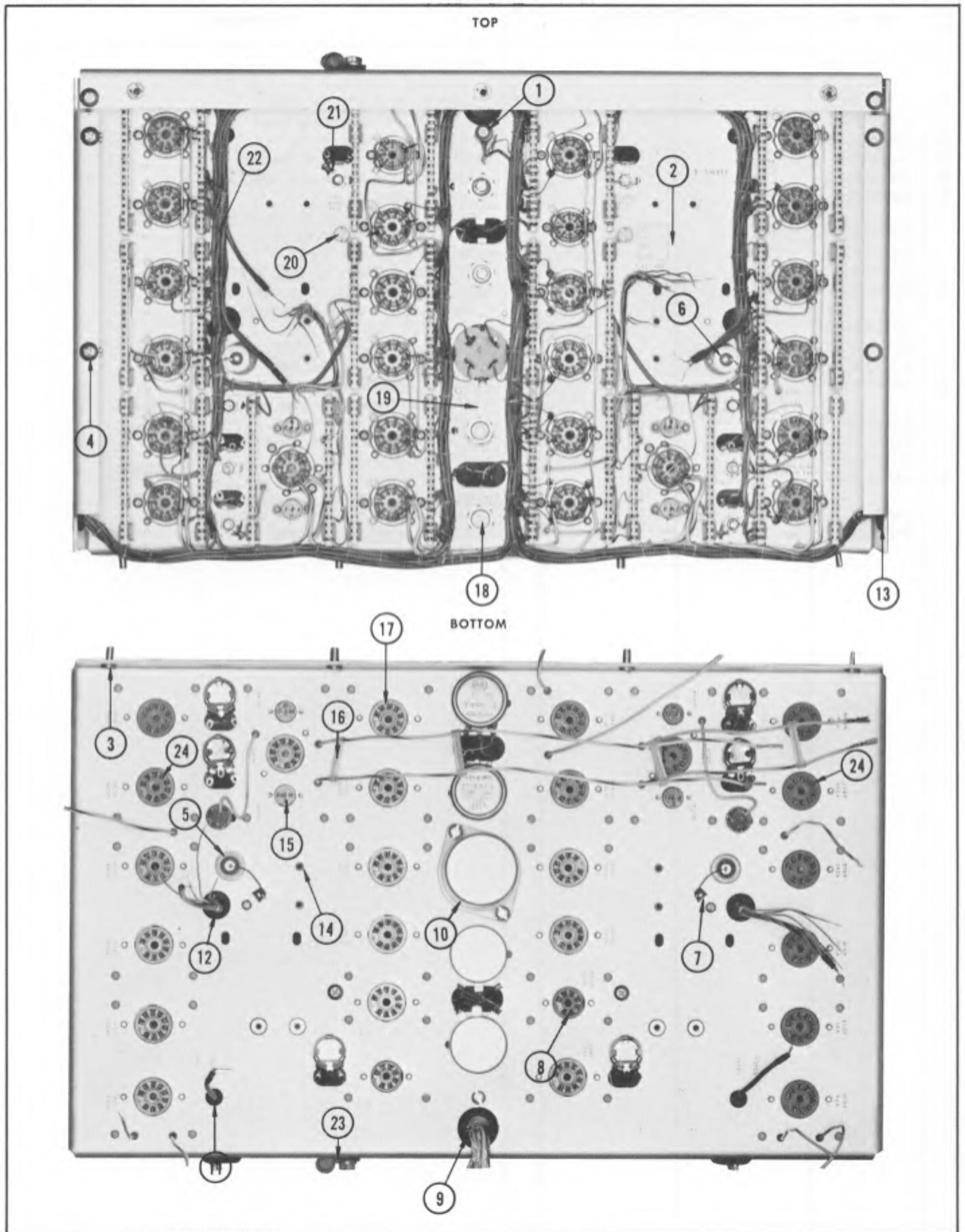
## SUPPORT GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	387-0664-00			1	PLATE, bulkhead
-	-			-	POT MOUNTING HARDWARE:
2	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
3	210-0840-00			1	WASHER, flat
4	406-0826-00			1	BRACKET, CRT Rotator
-	-			-	Mounting Hardware: (not included)
5	210-0458-00			5	NUT, keps, 8-32 x 1 1/32 in.
5	212-0004-00			5	SCREW, 8-32 x 5/16 in. BHS
6	354-0147-00	101	479	1	RING, clamping
6	354-0212-00	480		1	RING, clamping
-	-			-	ring includes:
7	124-0160-00	X480		1	STRIP, liner, CRT clamp
-	-			-	Mounting Hardware: (not included)
7	210-0949-00			2	WASHER, 9/64 ID x 1/2 OD
8	211-0576-00			2	SCREW, 6-32 x 7/8 inch socket head cap
9	214-0411-00			1	NUT, adjusting securing, with 2 6-32 in. tapped holes
10	211-0560-00			1	SCREW, 6-32 x 1 inch RHS
11	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
12	387-0702-00			1	PLATE, gusset
-	-			-	Mounting Hardware: (not included)
13	210-0458-00			3	NUT, keps, 8-32 x 1 1/32 in.
13	212-0004-00			5	SCREW, 8-32 x 5/16 in. BHS
13	212-0040-00			1	SCREW, 8-32 x 3/8 in. FHS, 100° CSK
13	348-0004-00			1	GROMMET, rubber, 3/8 in.
14	406-0825-00			1	BRACKET, transformer
-	-			-	Mounting Hardware: (not included)
15	210-0458-00			1	NUT, keps, 8-32 x 1 1/32 in.
15	212-0004-00			2	SCREW, 8-32 x 5/16 in. BHS
15	212-0040-00			1	SCREW, 8-32 x 3/8 in. FHS, 100° CSK
15	352-0015-00			2	HOLDER, nylon for coil form
-	-			-	Mounting Hardware for each: (not included)
16	213-0045-00			1	SCREW, thread forming, 4-40 x 5/16 in. PHS
16	343-0005-00			2	CLAMP, cable
-	-			-	Mounting Hardware for each: (not included)
17	210-0457-00			1	NUT, keps, 6-32 x 5/16 in.
17	210-0803-00			1	WASHER, flat, 6L x 3/8 in.
17	211-0510-00			1	SCREW, 6-32 x 3/8 in. BHS
17	385-0138-00			1	ROD
-	-			-	Mounting Hardware: (not included)
18	213-0041-00			1	SCREW, thread forming, 6-32 x 3/8 in. THS
18	352-0039-00			2	HOLDER, plug-in, chassis, nylon
-	-			-	Mounting Hardware for each: (not included)
19	210-0004-00			1	LOCKWASHER, internal #4
19	210-0406-00			1	NUT, hex, 4-40 x 3/16 in.
19	211-0025-00			1	SCREW, 4-40 x 3/8 in. FHS
19	348-0031-00			10	GROMMET, polypropylene, 1/4 in. dia.
20	348-0002-00			1	GROMMET, rubber, 1/4 in.
21	406-0821-00			1	BRACKET, pot, CRT control
-	-			-	Mounting Hardware: (not included)
22	210-0006-00			2	LOCKWASHER, internal #6
22	210-0419-00			2	NUT, hex, 6-32 x 1/4 in.
22	211-0507-00			2	SCREW, 6-32 x 5/16 in. BHS
22	348-0012-00			1	GROMMET, rubber, 5/8 in.
23	385-0135-00			1	ROD
-	-			-	Mounting Hardware: (not included)
24	213-0041-00			1	SCREW, thread forming, 6-32 x 3/8 in. THS
24	351-0054-00			2	GUIDE, rail, track plug-in

## SUPPORT GROUP

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
25	337-0517-00			2	SHIELD, plug-in
	- - - - -			-	Mounting Hardware for each: (not included)
26	211-0503-00			2	SCREW, 6-32 x 3/16 in. BHS
27	214-0122-00			2	FASTENER, 1/4 turn, wing head
28	210-0907-00			2	WASHER, retaining, 1/4 in.
29	214-0205-00			2	RECEPTACLE, for 1/4 turn fastener
30	179-0655-00			1	CABLE, harness, focus and intensity
31	343-0005-00			4	CLAMP, cable
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0006-00			1	LOCKWASHER, internal #6
	210-0457-00			1	NUT, keps, 6-32 x 5/16 in.
	211-0559-00			1	SCREW, 6-32 x 3/8 in. FHS, 100° CSK
32	406-0853-00			1	BRACKET, plug-in housing, right side
	- - - - -			-	Mounting Hardware: (not included)
	210-0804-00			4	WASHER, flat, 8S x 3/8 in.
	211-0538-00			3	SCREW, 6-32 x 5/16 in. FHS, 100° CSK
	212-0004-00			4	SCREW, 8-32 x 5/16 in. BHS
33	406-0852-00			1	BRACKET, plug-in housing, left side
	- - - - -			-	Mounting Hardware: (not included)
	210-0804-00			4	WASHER, flat, 8S x 3/8 in.
	211-0538-00			3	SCREW, 6-32 x 5/16 in. FHS, 100° CSK
	212-0004-00			4	SCREW, 8-32 x 5/16 in. BHS
34	406-0849-00			2	BRACKET, corner
	- - - - -			-	Mounting Hardware for each: (not included)
	210-0458-00			2	NUT, keps, 8-32 x 11/32 in.
	212-0004-00			2	SCREW, 8-32 x 5/16 in. BHS

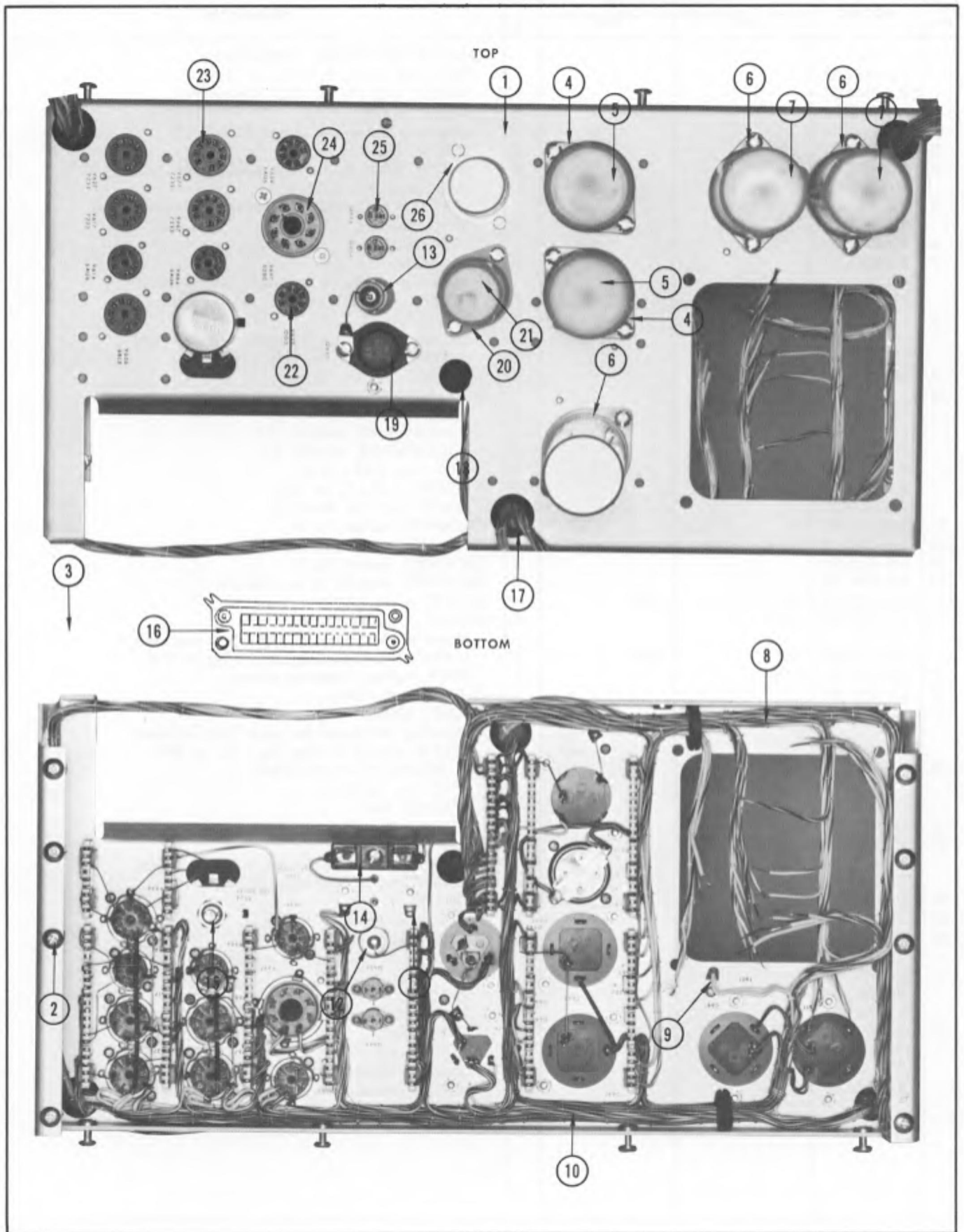
SWEEP CHASSIS



## SWEEP CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	- - - - -			-	RESISTOR MOUNTING HARDWARE:
	210-0478-00			1	NUT, hex, alum. $\frac{5}{16} \times 2\frac{1}{32}$ in. long
	211-0544-00			1	SCREW, 6-32 x $\frac{3}{4}$ in. THS, phillips slot
2	441-0438-00			1	CHASSIS, sweep
	- - - - -			-	Mounting Hardware: (not included)
3	212-0023-00			4	SCREW, 8-32 x $\frac{3}{8}$ in. BHS
4	212-0039-00			8	SCREW, 8-32 x $\frac{3}{8}$ in. THS, phillips slot
	210-0478-00			8	NUT, keps, 8-32 x $1\frac{1}{32}$ in.
5	- - - - -			-	CAPACITOR MOUNTING HARDWARE
	354-0068-00			1	RING, securing
6	200-0422-00			1	COVER, capacitor
7	210-0201-00			2	LUG, solder, SE4
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			1	SCREW, 5-32 x $\frac{3}{16}$ in. PHS, phillips slot
8	136-0008-00			2	SOCKET, STM7G
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			2	SCREW, 5-32 x $\frac{3}{16}$ in. PHS, phillips slot
9	348-0012-00			3	GROMMET, rubber, $\frac{5}{8}$ in.
10	- - - - -			-	CAPACITOR MOUNTING HARDWARE:
	432-0044-00			1	BASE, capacitor mounting
	210-0005-00			2	LOCKWASHER, external #6
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x $\frac{1}{4}$ in.
	211-0514-00			2	SCREW, 6-32 x $\frac{3}{4}$ in. BHS
	386-0253-00			1	PLATE, capacitor mounting
11	348-0002-00			2	GROMMET, rubber, $\frac{1}{4}$ in.
12	348-0004-00			2	GROMMET, rubber, $\frac{3}{8}$ in.
13	348-0005-00			2	GROMMET, rubber, $\frac{1}{2}$ in.
14	348-0031-00			18	GROMMET, snap-in, $\frac{1}{4}$ in. diameter
15	136-0095-00	101	1189	4	SOCKET, 4 pin transistor
	136-0181-00	1190		4	SOCKET, 3 pin transistor
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0113-00	101	1189	2	SCREW, thread forming, 2-32 x $\frac{5}{16}$ in. RHS
	354-0234-00	1190		1	RING, locking, transistor socket
16	344-0047-00			3	CLIP, deflection plate
17	136-0015-00			22	SOCKET, STM9G
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			2	SCREW, thread forming, $\frac{5}{32} \times \frac{3}{16}$ in. PHS
18	- - - - -			-	POT MOUNTING HARDWARE:
	210-0413-00			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-0840-00			1	WASHER, flat
19	210-0207-00			2	LUG, pot, plain, $\frac{3}{8}$ in.
20	385-0138-00			2	ROD
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0041-00			1	SCREW, thread forming, 6-32 x $\frac{3}{8}$ in. THS
21	210-0223-00			2	LUG, solder
22	179-0654-00			1	CABLE harness, sweep chassis
23	343-0003-00			1	CLAMP, cable
	- - - - -			-	Mounting Hardware: (not included)
	210-0457-00			1	NUT, keps, 6-32 x $\frac{5}{16}$ in.
	210-0803-00			1	WASHER, flat, 6L x $\frac{3}{8}$ in.
	211-0507-00			1	SCREW, 6-32 x $\frac{5}{16}$ in.
24	136-0015-00	101	1019	2	SOCKET, STM9G
	136-0044-00	1020		2	SOCKET, 7 pin
	- - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x $\frac{3}{16}$ inch PHS

POWER CHASSIS





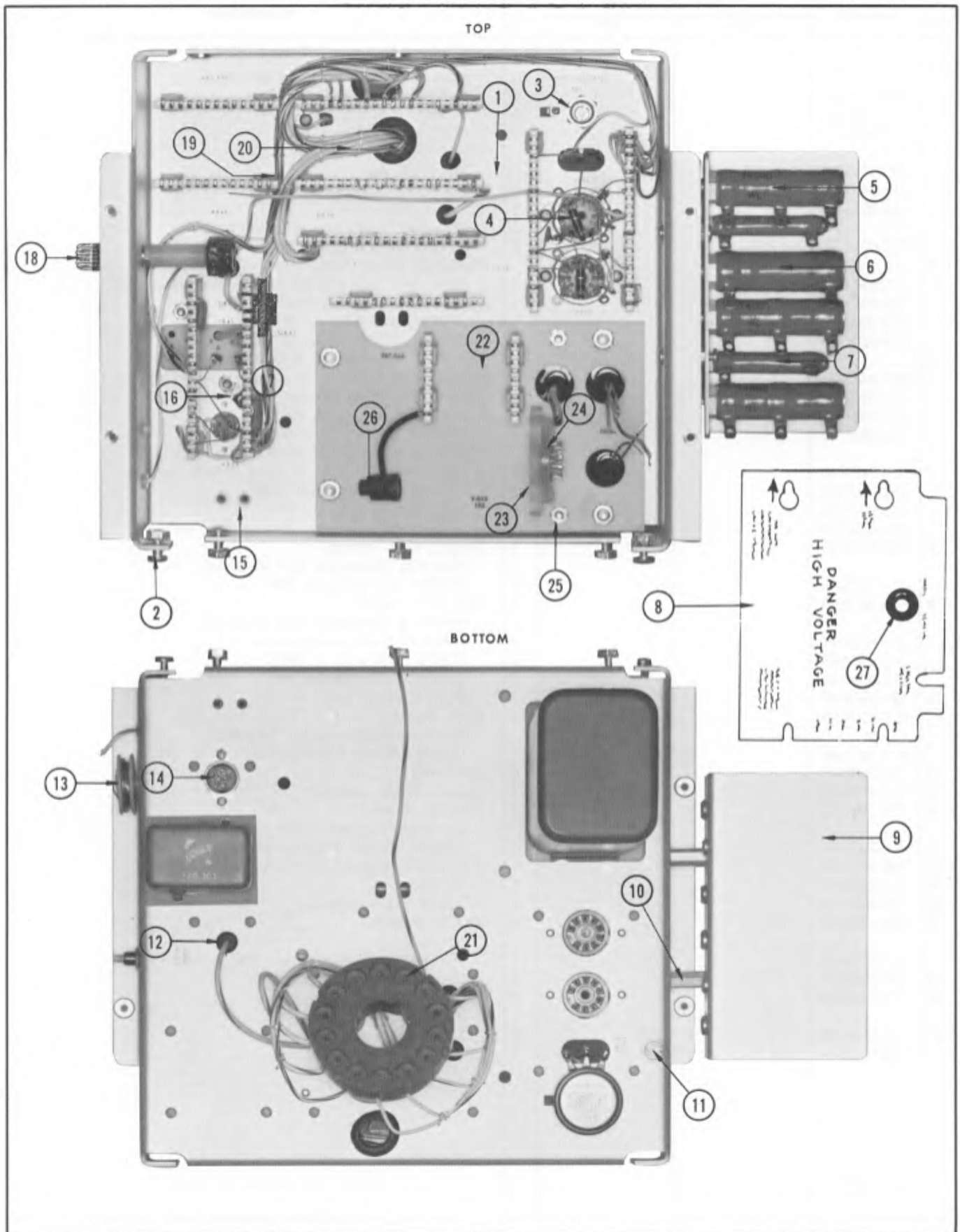
## POWER CHASSIS

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	441-439			1	CHASSIS, power supply Mounting Hardware: (not included)
	210-458			8	NUT, keps, 8-32 x 1 <sup>1</sup> / <sub>32</sub> in.
2	211-039			6	SCREW, 8-32 x 3 <sup>3</sup> / <sub>8</sub> in. THS
3	212-040			4	SCREW, 8-32 x 3 <sup>3</sup> / <sub>8</sub> in. FHS, 100° CSK
4	- - - -			-	CAPACITOR MOUNTING HARDWARE:
	210-005			2	LOCKWASHER, external #6
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1 <sup>1</sup> / <sub>4</sub> in.
	211-514			2	SCREW, 6-32 x 3 <sup>3</sup> / <sub>4</sub> in. BHS
	386-254			1	PLATE, capacitor mounting
	432-044			1	BASE, capacitor mounting
5	200-260			1	COVER, capacitor
6	- - - -			-	CAPACITOR MOUNTING HARDWARE:
	210-005			2	LOCKWASHER, external #6
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1 <sup>1</sup> / <sub>4</sub> in.
	211-514			2	SCREW, 6-32 x 3 <sup>3</sup> / <sub>4</sub> in. BHS
	386-254			1	PLATE, capacitor mounting
	432-044			1	BASE, capacitor mounting
7	200-261			1	COVER, capacitor
8	179-653	101	149	1	CABLE harness, power supply
	179-714	150		1	CABLE harness, power supply
9	210-201			3	LUG, solder
10	179-656			1	CABLE, harness, AC
11	210-202			3	LUG, solder
12	- - - -			-	CAPACITOR MOUNTING HARDWARE:
	354-068			1	RING, securing
13	200-422			1	COVER, capacitor
14	352-031			1	HOLDER, fuse, 3AG, Mounting Hardware: (not included)
	210-006			1	LOCKWASHER, internal #6
	210-407			1	NUT, hex, 6-32 x 1 <sup>1</sup> / <sub>4</sub> in.
	211-510			1	SCREW, 6-32 x 3 <sup>3</sup> / <sub>8</sub> in. BHS
15	- - - -			-	POT MOUNTING HARDWARE:
	210-413			1	NUT, hex, 3 <sup>3</sup> / <sub>8</sub> -32 x 1 <sup>1</sup> / <sub>2</sub> in.
	210-840			1	WASHER, flat
16	131-148			2	CONNECTOR, chassis mount, 24 contact, female Mounting Hardware for each: (not included)
	210-004			2	LOCKWASHER, internal #4
	210-013			2	SCREW, 4-40 x 3 <sup>3</sup> / <sub>8</sub> in. RHS
	210-406			2	NUT, hex, 4-40 x 3 <sup>3</sup> / <sub>16</sub> in.
	210-803			2	WASHER, flat, 6L x 3 <sup>3</sup> / <sub>8</sub> in.
17	348-012			3	GROMMET, 5 <sup>5</sup> / <sub>8</sub> in.
18	348-005			1	GROMMET, 1 <sup>1</sup> / <sub>2</sub> in.
19	- - - -			-	DIODE MOUNTING HARDWARE:
	211-510			2	SCREW, 6-32 x 3 <sup>3</sup> / <sub>8</sub> in. BHS
20	- - - -			-	CAPACITOR MOUNTING HARDWARE:
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x 1 <sup>1</sup> / <sub>4</sub> in.
	211-534			2	SCREW, 6-32 x 5 <sup>5</sup> / <sub>16</sub> in. PHS, with lockwasher
	386-252			1	PLATE, capacitor mounting
21	200-256				COVER, capacitor,
22	136-008			4	SOCKET, STM7G Mounting Hardware for each: (not included)
	213-044			2	SCREW, thread forming, 5 <sup>5</sup> / <sub>32</sub> x 3 <sup>3</sup> / <sub>16</sub> in. PHS

POWER CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
23	136-0015-00			5	SOCKET, STM9G
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			2	SCREW, thread forming, 5/32 x 3/16 in. PHS
24	136-0011-00			1	SOCKET, STM8 ground
	- - - - -			-	Mounting Hardware: (not included)
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 in.
	211-0538-00			2	SCREW, 6-32 x 5/16 in. FHS, 100° CSK
25	136-0095-00	101	1189	2	SOCKET, 4 pin transistor
	136-0181-00	1190		2	SOCKET, 3 pin transistor
	- - - - -			-	Mounting Hardware for each: (not included)
	213-0113-00	101	1189	2	SCREW, thread forming, 2-32 x 5/16 in. RHS
	354-0234-00	1190		1	RING, locking, transistor socket
26	- - - - -			-	CAPACITOR MOUNTING HARDWARE:
	210-0006-00			2	LOCKWASHER, internal #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 in.
	211-0534-00			2	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	386-0253-00			1	PLATE, capacitor mounting

HIGH VOLTAGE CHASSIS



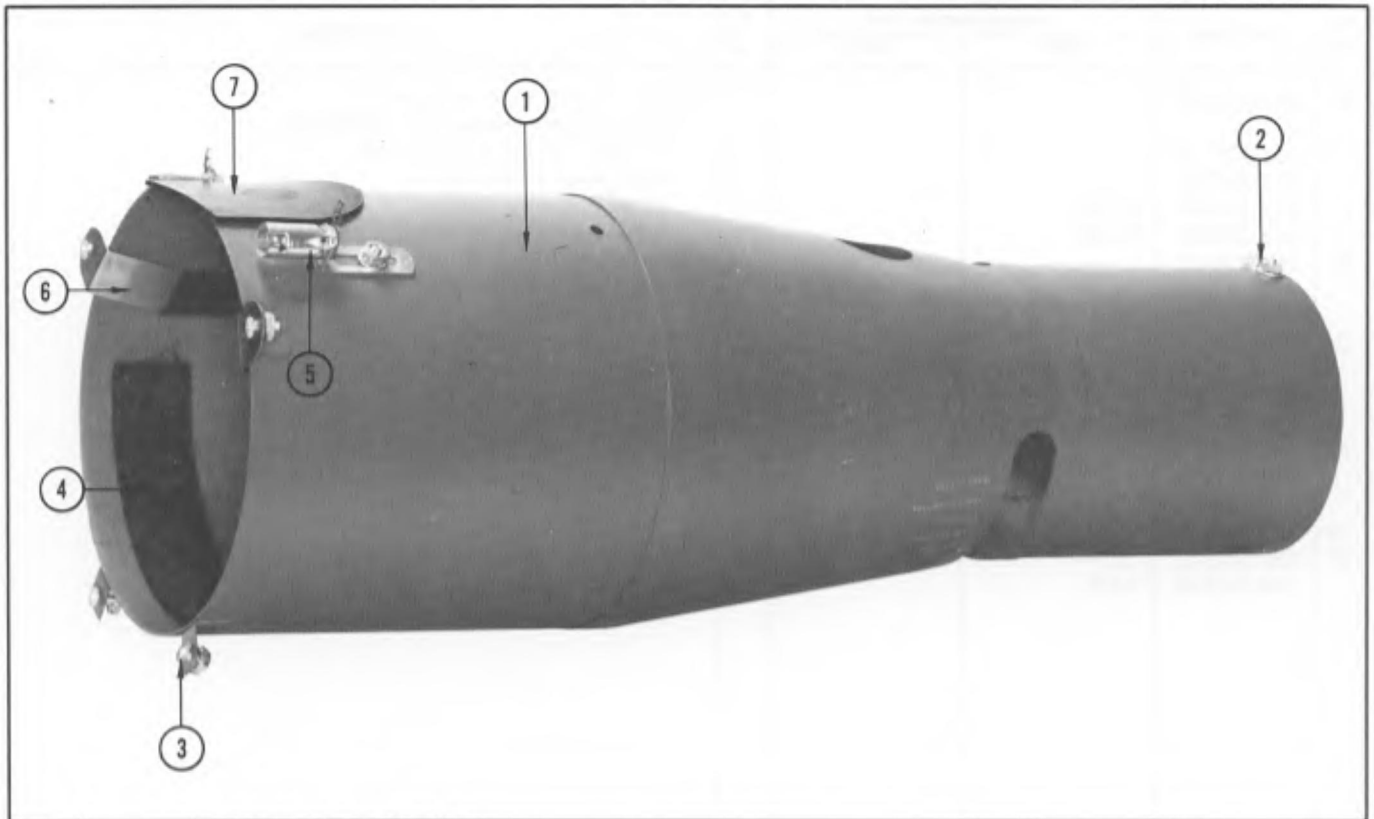
HIGH VOLTAGE CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	441-0437-00			1	CHASSIS, high voltage
-	-			-	Mounting Hardware: (not included)
	212-0002-00			2	SCREW, 8-32 x 1/4 in. FHS
2	212-0023-00			4	SCREW, 8-32 x 3/8 in. BHS
	210-0457-00			5	NUT, keps, 8-32 x 1 1/32 in.
3	-			-	POT MOUNTING HARDWARE:
	210-0840-00			1	WASHER, flat
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 in.
4	136-0015-00			2	SOCKET, STM9G
-	-			-	Mounting Hardware: (not included)
	213-0044-00			2	SCREW, 5-32 x 3/16 in. PHS
5	-			-	RESISTOR MOUNTING HARDWARE:
	210-0462-00			1	NUT, hex, 8-32 x 1/2 in. 25 w resistor mounting
	210-0808-00			1	WASHER, centering resistor, 25 w
	212-0004-00			1	SCREW, 8-32 x 5/16 in. BHS
	212-0037-00			1	SCREW, 8-32 x 1 1/4 in. Fil HS
6	-			-	RESISTOR MOUNTING HARDWARE:
	210-0462-00			1	NUT, hex, 8-32 x 1/2 in. 25 w resistor mounting
	210-0809-00			1	WASHER, center resistor, 25 w
	212-0001-00			1	SCREW, 8-32 x 1/4 in. BHS
	212-0037-00			1	SCREW, 8-32 x 1 1/4 in. Fil HS
7	-			-	RESISTOR MOUNTING HARDWARE:
	210-0478-00			1	NUT, hex, 5/16 x 2 1/32 in. long, 5-10 w res. mtg.
	210-0601-00			1	EYELET, tapered barrel, 5-10 w
	211-0507-00			1	SCREW, 6-32 x 5/16 in. BHS
	211-0553-00			1	SCREW, 6-32 x 1 1/2 in. RHS, phillips slot
8	337-0516-00			1	SHIELD, high voltage
-	-			-	Mounting Hardware: (not included)
	211-0503-00			4	SCREW, 6-32 x 3/16 in. BHS
9	406-0850-00			1	BRACKET, resistor
-	-			-	Mounting Hardware: (not included)
	210-0006-00			2	LOCKWASHER, internal #6
	211-0504-00			2	SCREW, 6-32 x 1/4 in. BHS
	211-0507-00			2	SCREW, 6-32 x 5/16 in. BHS
10	384-0519-00			2	ROD, spacing, hex
11	385-0134-00			1	ROD, delrin
-	-			-	Mounting Hardware (not included)
	213-0041-00			1	SCREW, thread forming, 6-32 x 3/8 in. THS
12	348-0002-00			3	GROMMET, 1/4 in.
13	214-0210-00			1	SPOOL, solder assembly
14	136-0101-00			1	SOCKET, 5 pin
-	-			-	Mounting Hardware: (not included)
	213-0055-00			2	SCREW, thread forming, 2-56 x 3/16 in. PHS
15	348-0031-00			3	GROMMET, snap-in, 1/4 diameter
16	210-0202-00			1	LUG, solder
17	136-0095-00			1	SOCKET, 4 pin transistor
18	366-0153-00			1	KNOB, charcoal
-	-			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 in. HSS, allen head
19	179-0673-00			1	CABLE, harness, high voltage
20	179-0676-00			1	CABLE, harness, CRT socket
-	-			-	Includes:
21	136-0141-00	101	629	1	SOCKET, 14 pin, CRT
	136-0178-00	630		1	SOCKET, 14 pin, CRT

## HIGH VOLTAGE CHASSIS

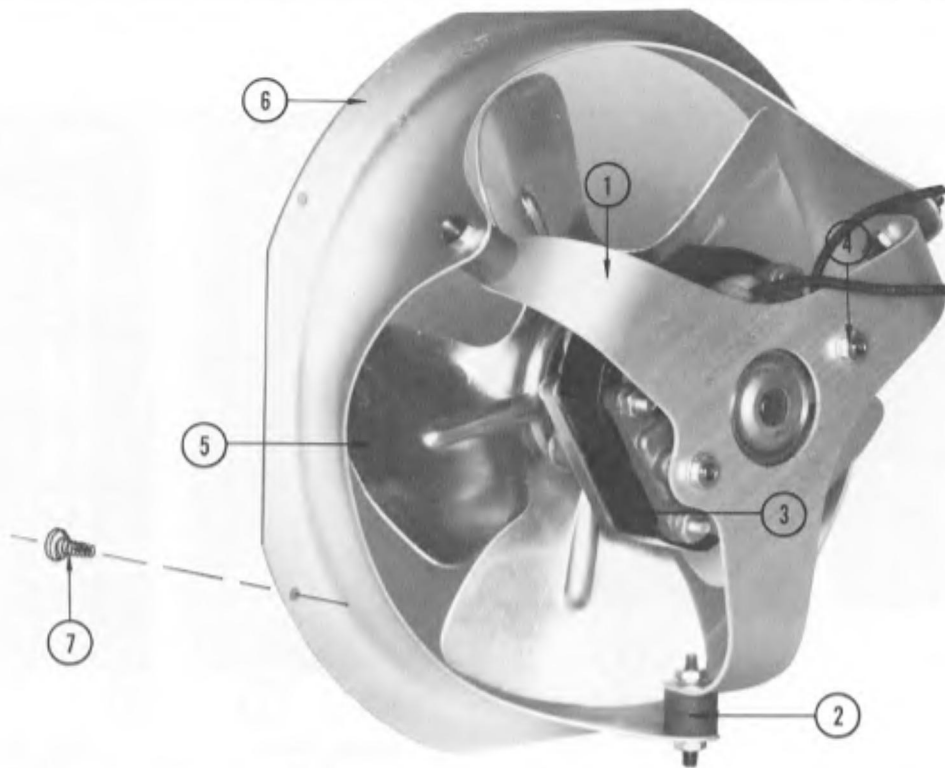
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
22	387-0666-00			1	PLATE, board, high voltage
	- - - - -			-	Mounting Hardware: (not included)
	166-0029-00			4	SPACER, 1/4 OD x 1/8 in. long
	210-0457-00			4	NUT, keps 6-32 x 5/16 in.
	210-0006-00	X1150		1	LOCKWASHER, internal, #6
	210-0203-00	X1150		1	LUG, solder, SE 6, long
23	352-0043-00			1	HOLDER, socket, high voltage rectifier tube
	- - - - -			-	Mounting Hardware: (not included)
	211-0038-00			2	SCREW, 4-40 x 5/16 in. FHS, 100° CSK
24	136-0074-00			1	SOCKET, 9 pin, UHF miniature
	- - - - -			-	Mounting Hardware: (not included)
	354-0109-00			1	RING, socket retaining
	211-0040-00			2	SCREW, 4-40 x 1/4 in. BHS nylon
25	- - - - -			-	TRANSFORMER MOUNTING HARDWARE:
	210-0407-00			2	NUT, hex, 6-32 x 1/4 in.
	210-0006-00			2	LOCKWASHER, internal #6
26	131-0142-00			1	CONNECTOR, cable end, vacuum tube
27	348-0005-00	101	1449	1	GROMMET, rubber, 1/2 inch
	348-0063-00	1450		1	GROMMET, plastic, 1/2 inch

CRT SHIELD



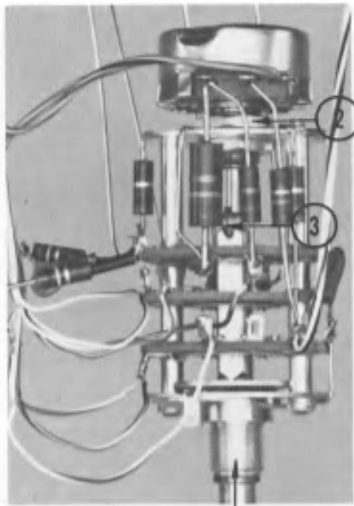
REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	337-282			1	SHIELD, CRT, blue vinyl Mounting Hardware: (not included)
2	210-457			6	NUT, keps, 6-32 x 5/16 in.
	210-803			2	WASHER, 6L x 3/8 in.
	211-507			2	SCREW, 6-32 x 5/16 in. BHS
3	211-538			4	SCREW, 6-32 x 5/16 in. FHS, 100° CSK
4	124-022			1	STRIP, felt
5	136-035			2	SOCKET, graticule light Mounting Hardware for each: (not included)
	210-457			1	NUT, keps, 6-32 x 5/16 in.
	210-803			1	WASHER, 6L x 3/8 in.
	211-507			1	SCREW, 6-32 x 5/16 in.
6	406-239			2	BRACKET
7	387-734			1	PLATE, anode hole cover

## FAN



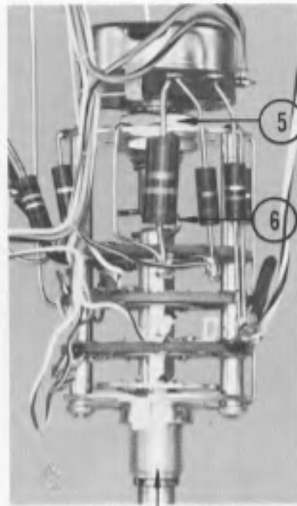
REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	635-431			1	Fan Motor Assembly
1	426-047			1	Consisting of: MOUNT, fan motor, 7 in.
	210-008			3	Mounting Hardware: (not included)
	210-409			3	LOCKWASHER, internal #8
				3	NUT, hex, 8-32 x 5/16 in.
2	348-008			3	SHOCKMOUNT, rubber, solid round
3	147-001			1	MOTOR, fan, 34 w. 1500 RPM, 115 volt
					Mounting Hardware: (not included)
	210-010			3	LOCKWASHER, internal #10
4	210-410			2	NUT, hex, 10-32 x 5/16 in.
	355-044			2	STUD, 10-32 x 27/16 in.
5	369-007			1	FAN
					Mounting Hardware: (not included)
	213-005			1	SCREW, set, 8-32 x 1/8 in. HSS, allen head
6	354-172			1	RING, fan
					Mounting Hardware: (not included)
7	213-104			4	SCREW, thread forming, 6-32 x 3/8 in. THS

SWITCHES



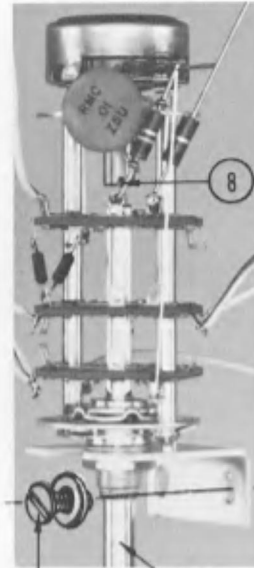
1

TRIGGER LEVEL "A"



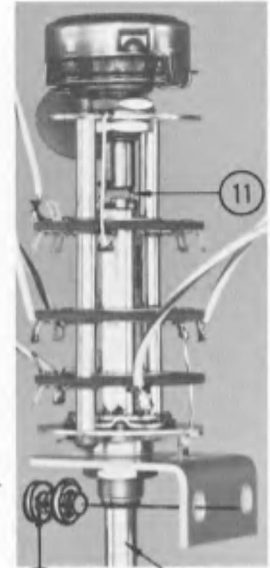
4

TRIGGER LEVEL "B"



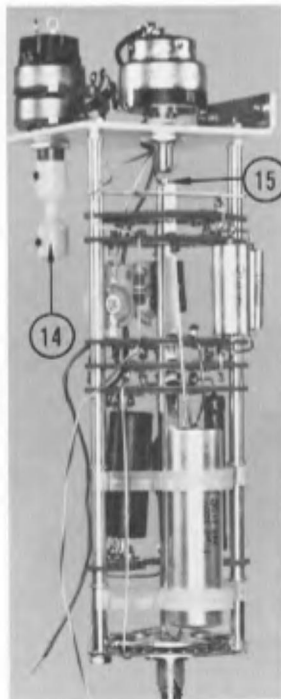
9

LOWER HORIZ.  
DISPLAY



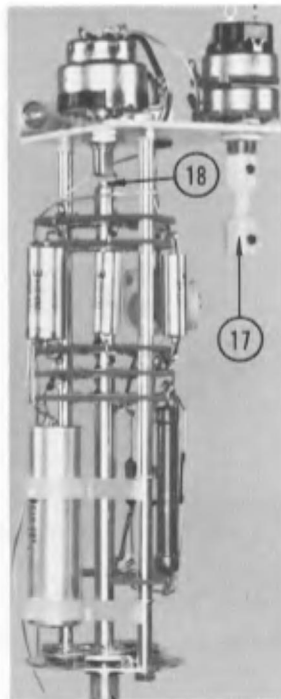
12

UPPER HORIZ.  
DISPLAY



13

TIME/DIV. "A"



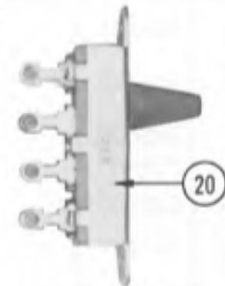
16

TIME/DIV. "B"



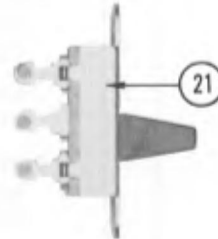
19

'B' MODE  
MANUAL TRIGGER  
AND 'B' MODE  
RESET



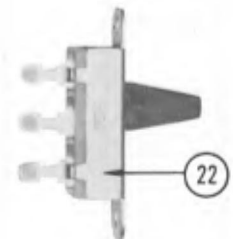
20

TRIGGER COUPLING  
AC FAST AC DC  
AND TRIGGER  
INT. EXT. LINE



21

TRIGGER SLOPE



22

TRIGGER  
UPPER BEAM  
LOWER BEAM



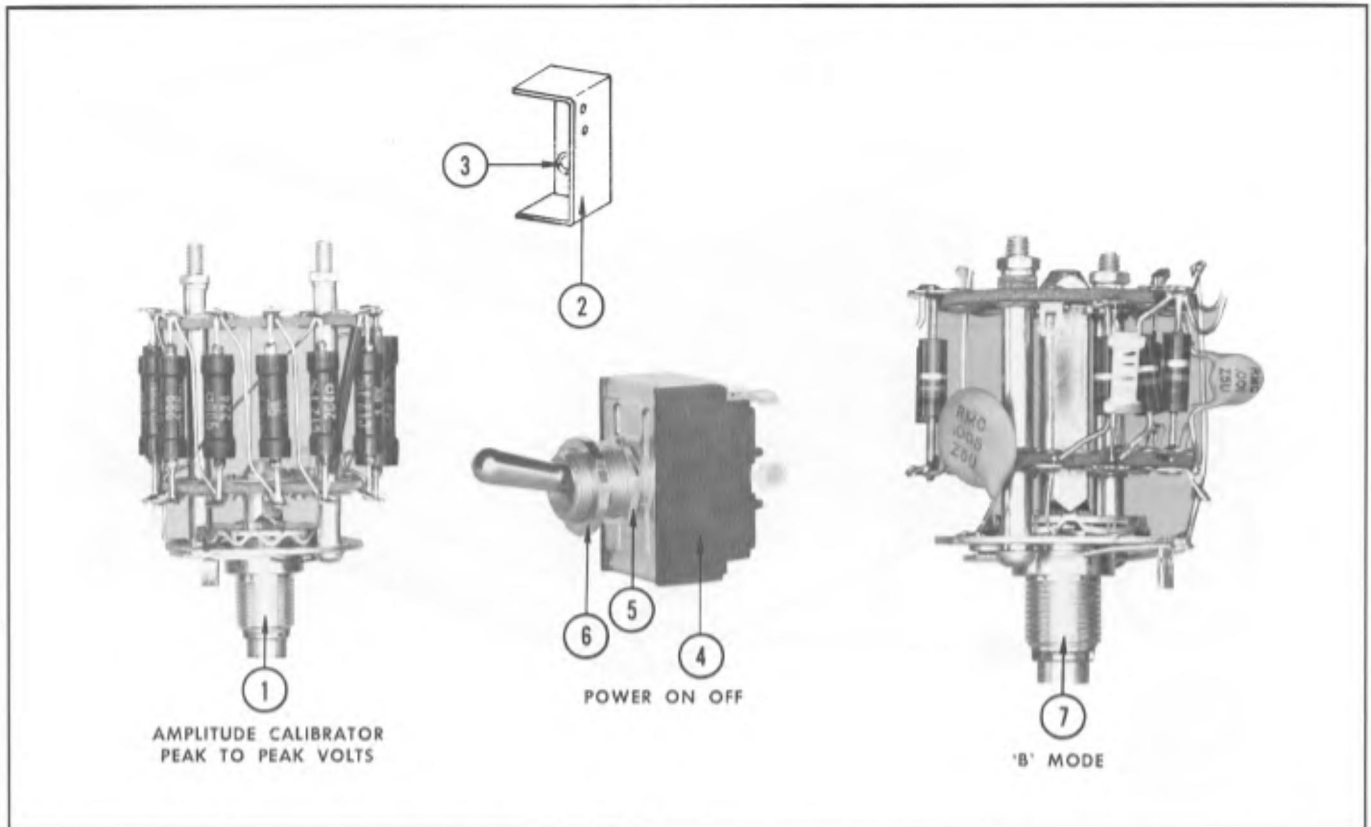
## SWITCHES

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	262-508			1	SWITCH, TRIGGER LEVEL "A", wired Includes: CABLE harness
	179-659			1	LOCKWASHER, internal $\frac{3}{8} \times \frac{1}{2}$ in.
	210-012			1	
2	210-413			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
3	376-014			1	COUPLING, pot, wire steel
	260-466			1	SWITCH, TRIGGER LEVEL "A", unwired Mounting Hardware: (not included)
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
4	210-840			1	WASHER, flat
	262-509			1	SWITCH, TRIGGER LEVEL "B", wired Includes: CABLE harness
	179-660			1	LOCKWASHER, pot, internal $\frac{3}{8} \times \frac{1}{2}$ in.
5	210-413			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
6	376-014			1	COUPLING, wire steel
	260-466			1	SWITCH, TRIGGER LEVEL "B", unwired Mounting Hardware: (not included)
	210-413			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
7	210-840			1	WASHER, flat
	262-511	101	209	1	SWITCH, LOWER HORIZ. DISPLAY, wired
	262-543	210		1	SWITCH, LOWER HORIZ. DISPLAY, wired Includes: LOCKWASHER, pot, internal $\frac{3}{8} \times \frac{1}{2}$ in.
8	210-012			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-413			3	WASHER, flat
	210-840			1	
9	376-014			1	COUPLING, wire steel
	384-263			1	ROD, extension
	406-819			1	BRACKET, alum.
10	260-468			1	SWITCH, LOWER HORIZ. DISPLAY, unwired Mounting Hardware: (not included)
	210-803			2	WASHER, flat, 6L x $\frac{3}{8}$ in.
	211-507			2	SCREW, 6-32 x $\frac{5}{16}$ in. BHS
11	262-510	101	209	1	SWITCH, UPPER HORIZ. DISPLAY, wired
	262-542	210		1	SWITCH, UPPER HORIZ. DISPLAY, wired Includes: LOCKWASHER, pot, internal $\frac{3}{8} \times \frac{1}{2}$ in.
	210-012			2	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
12	210-413			3	WASHER, flat
	210-840			1	
	376-014			1	COUPLING, wire steel
13	384-263			1	ROD, extension
	406-819			1	BRACKET, alum.
	260-467			1	SWITCH, UPPER HORIZ. DISPLAY, unwired Mounting Hardware: (not included)
14	210-803			2	WASHER, flat
	211-507			2	SCREW, 6-32 x $\frac{5}{16}$ in. BHS
	262-506	101	149	1	SWITCH, TIME/DIV. "A", wired
15	262-537	150		1	SWITCH, TIME/DIV. "A", wired Includes: LOCKWASHER, internal #6
	210-006			1	LOCKWASHER, pot, internal $\frac{3}{8} \times \frac{1}{2}$ in.
	210-012			2	LUG, solder
16	210-202			1	LUG, solder
	210-207			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-413			3	NUT, hex, 5-40 x $\frac{1}{4}$ in.
17	210-449			2	

SWITCHES

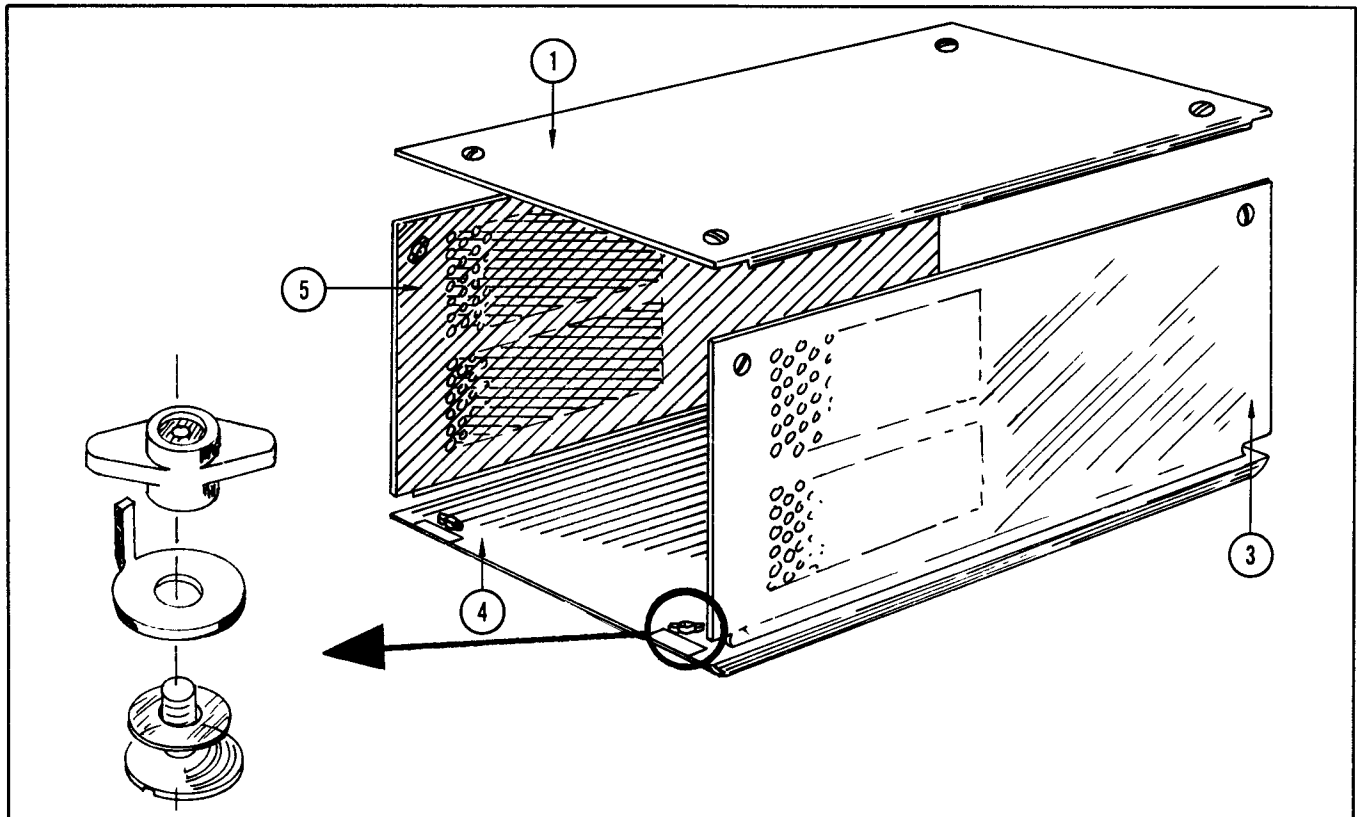
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
13	(cont'd)				
	348-0003-00			1	GROMMET, 5/16 in.
14	376-0011-00			1	COUPLING, insulated, molded nylon assembly
	376-0014-00			1	COUPLING, wire steel
15	384-0262-00			1	ROD, extension
	406-0820-00			1	BRACKET, alum.
	210-0413-00			-	Mounting Hardware: (not included)
	210-0840-00			1	NUT, hex, 3/8-32 x 1/2 in.
	262-0520-00			1	WASHER, flat
16				1	SWITCH, TIME/DIV "B", wired
	210-0006-00			-	Includes:
	210-0012-00			1	LOCKWASHER, internal #6
	210-0202-00			2	LOCKWASHER, pot, internal 3/8 x 1/2 in.
	210-0207-00			1	LUG, solder
	210-0413-00			1	LUG, solder
	210-0413-00			3	NUT, hex, 3/8-32 x 1/2 in.
	210-0449-00			2	NUT, hex, 5-40 x 1/4 in.
	348-0003-00			1	GROMMET, 5/16 in.
17	376-0011-00			1	COUPLING, insulated, molded nylon assembly
	376-0014-00			1	COUPLING, wire, steel
18	384-0262-00			1	ROD, extension
	406-0823-00			1	BRACKET, alum.
	210-0413-00			-	Mounting Hardware: (not included)
	210-0840-00			1	NUT, hex, 3/8-32 x 1/2 in.
	260-0247-00			1	WASHER, flat
19				2	SWITCH, "B" MODE MANUAL TRIGGER & "B" MODE RESET, unwired
	210-0583-00			-	Mounting Hardware for each: (not included)
	210-0940-00			2	NUT, hex, 1/4-32 x 5/16 in. thick
	260-0450-00			2	WASHER, 1/4 ID x 3/8 inch OD
20				2	SWITCH, TRIGGER COUPLING AC FAST & TRIGGER INT. EXT LINE
	210-0004-00			-	Mounting Hardware for each: (not included)
	210-0406-00			2	LOCKWASHER, internal #4
	260-0447-00			2	NUT, hex, 4-40 x 3/16 in.
21				2	SWITCH, TRIGGER SLOPE — +
	210-0004-00			-	Mounting Hardware for each: (not included)
	210-0406-00			2	LOCKWASHER, internal #4
	260-0449-00			2	NUT, hex, 4-40 x 3/16 in.
22				2	SWITCH, TRIGGER UPPER BEAM LOWER BEAM
	210-0004-00			-	Mounting Hardware for each: (not included)
	210-0406-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 in.

SWITCHES



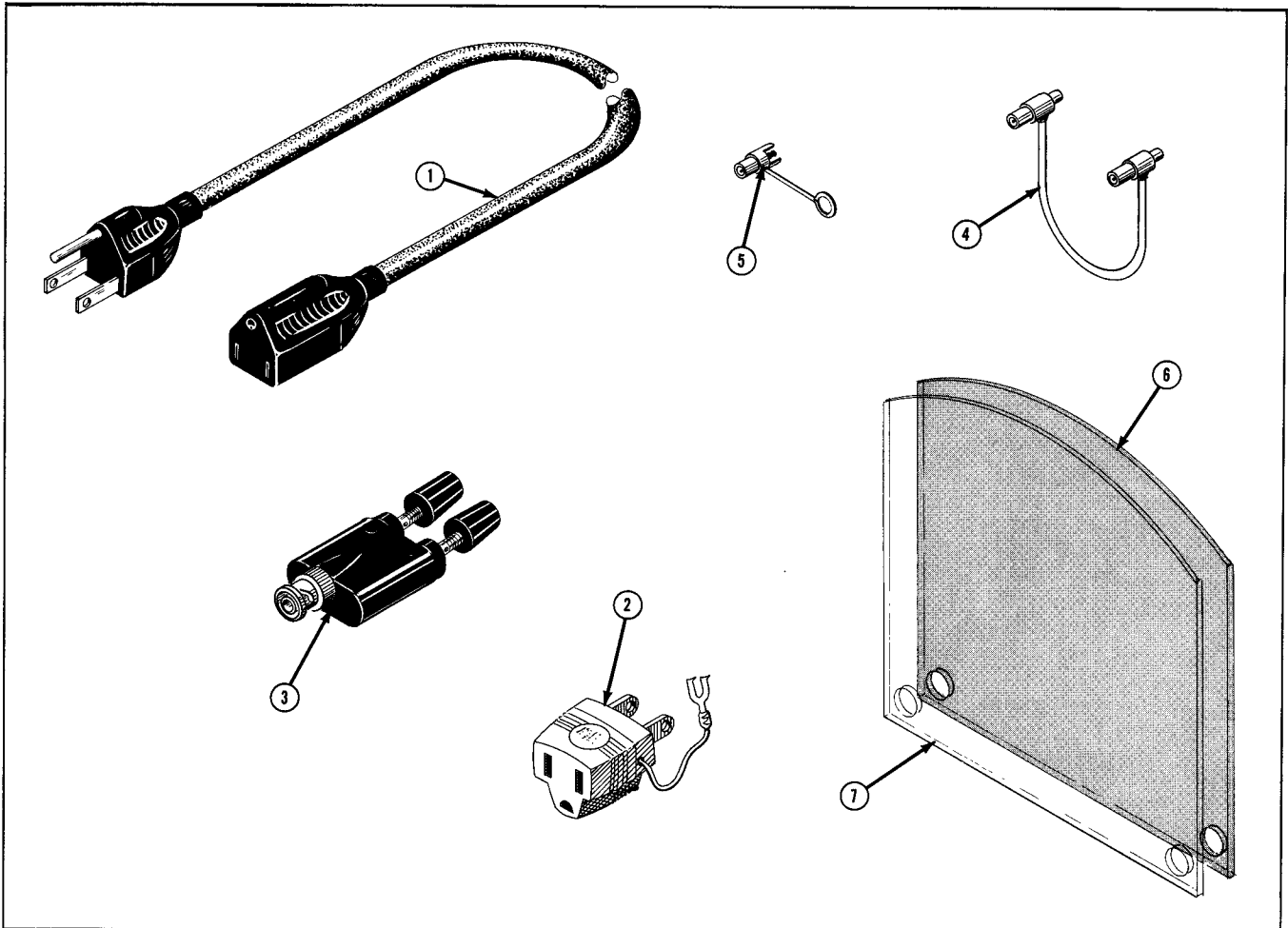
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	262-0512-00			1	SWITCH, AMPLITUDE CALIBRATOR, PEAK TO PEAK VOLTS, wired
	260-0234-00			1	SWITCH, AMPLITUDE CALIBRATOR, PEAK TO PEAK VOLTS, unwired
	210-0413-00			1	Mounting Hardware: (not included)
	210-0840-00			1	NUT, hex, 3/8-32 x 1/2 in.
2	337-0513-00			1	WASHER, flat
	210-0004-00			1	SHIELD, calibrator switch
	210-0406-00			2	Mounting Hardware: (not included)
	348-0004-00			2	LOCKWASHER, internal #4
3	260-0276-00			2	NUT, hex, 4-40 x 3/16 in.
4	210-0414-00			1	GROMMET, 3/8 in.
	210-0473-00			1	SWITCH, POWER ON-OFF, toggle
	210-0902-00			1	Mounting Hardware: (not included)
	354-0055-00			1	NUT, hex, 15/32-32 x 9/16 in.
5	262-0507-00			1	NUT, 15/32-32 x 5/64 in., 12 sided
	260-0465-00			1	WASHER, flat
	210-0413-00			1	RING, locking, switch
	210-0840-00			1	SWITCH, 'B' MODE, wired
				1	Includes:
				1	SWITCH, 'B' MODE, unwired
				1	Mounting Hardware: (not included)
				1	NUT, hex, 3/8-32 x 1/2 in.
				1	WASHER, flat

CABINET



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	387-491			1	PLATE, cabinet top, 20 <sup>1</sup> / <sub>16</sub> x 13 <sup>5</sup> / <sub>16</sub> x 1/4 in. blue vinyl Includes: 105-007 4 STOP, steel, 7/32 ID x 2 <sup>1</sup> / <sub>32</sub> OD 210-480 4 NUT, latch, nylon cabinet fastener, large with insert 210-847 4 WASHER, nylon 213-114 4 SCREW, fastening, steel, 1/2 x 7/16 x 8-32 in.
3	387-662			1	PLATE, cabinet side, right, alum. 1/4 x 9 <sup>29</sup> / <sub>32</sub> x 20 <sup>1</sup> / <sub>16</sub> in. blue vinyl Includes: 105-007 2 STOP, steel, 7/32 ID x 2 <sup>1</sup> / <sub>32</sub> OD 210-480 2 NUT, latch, nylon cabinet fastener, large with insert 210-847 2 WASHER, nylon 213-114 2 SCREW, fastening, steel, 1/2 x 7/16 x 8-32 in.
4	387-490			1	PLATE, cabinet bottom, 20 <sup>1</sup> / <sub>16</sub> x 14 <sup>5</sup> / <sub>32</sub> x 7/32 in. blue vinyl Includes: 105-007 4 STOP, steel, 7/32 ID x 2 <sup>1</sup> / <sub>32</sub> OD 210-480 4 NUT, latch, nylon cabinet fastener, large with insert 210-847 4 WASHER, nylon 213-114 4 SCREW, fastening, steel, 1/2 x 7/16 x 8-32 in.
5	387-663			1	PLATE, cabinet side, left, alum. 1/4 x 9 <sup>29</sup> / <sub>32</sub> x 20 <sup>1</sup> / <sub>16</sub> in. blue vinyl Includes: 105-007 2 STOP, steel, 7/32 ID x 2 <sup>1</sup> / <sub>32</sub> OD 210-480 2 NUT, latch, nylon cabinet fastener, large with insert 210-847 2 WASHER, nylon 213-114 2 SCREW, fastening, steel, 1/2 x 7/16 x 8-32 in.

STANDARD ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	161-0010-00			1	CORD, power
2	103-0013-00			1	ADAPTER, 3 to 2 wire
3	013-0009-00	101	389	2	ADAPTER, dual binding post, UHF
	103-0035-00	390	1279X	2	ADAPTER, dual binding post, BNC
4	012-0031-00	101	1279	1	CORD, patch
	012-0087-00	1280		2	CORD, patch
5	012-0092-00	X1280		1	JACK, BNC — post
6	378-0514-00	101	999	1	FILTER, light
	378-0545-00	1000	1369	1	FILTER, light
	378-0546-00	1370	1389	1	FILTER, light, smoke gray (installed)
	378-0567-00	1390		1	FILTER, light, smoke gray (installed)
7	387-0918-00	X1000		1	PLATE, implosion shield
- -	070-0269-00			2	MANUAL, instruction



# ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
<b>Bulbs</b>			
B160W	Use 150-027	Neon, NE-23	UNCALIBRATED 101-1759
B160W	150-0030-00	Neon, NE-2V	UNCALIBRATED 1760-up
B167	Use 150-027	Neon, NE-23	
B171	Use 150-027	Neon, NE-23	
B229	Use 150-027	Neon, NE-23	READY 101-1759
B229	150-0030-00	Neon, NE-2V	READY 1760-up
B260W	Use 150-027	Neon, NE-23	UNCALIBRATED 101-1759
B260W	150-0030-00	Neon, NE-2V	UNCALIBRATED 1760-up
B267	Use 150-027	Neon, NE-23	
B271	Use 150-027	Neon, NE-23	
B603	150-001	Incandescent, G.E. #47	Pilot Light
B605	150-001	Incandescent, G.E. #47	Graticule Light 101-999
B605	150-031	Incandescent, G.E. #44	Graticule Light 1000-up
B606	150-001	Incandescent, G.E. #47	Graticule Light 101-999
B606	150-031	Incandescent, G.E. #44	Graticule Light 1000-up
B814	150-0027-00	Neon, NE-23	X1360-up

## Capacitors

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

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

3 V — 50 V =  $-10\%$ ,  $+250\%$

51 V — 350 V =  $-10\%$ ,  $+100\%$

351 V — 450 V =  $-10\%$ ,  $+50\%$

C7	285-511	.01 $\mu$ f	PTM	600 v		
C8	281-523	100 pf	Cer.	350 v		
C15	283-000	.001 $\mu$ f	Disc Type	500 v		
C20	283-003	.01 $\mu$ f	Disc Type	150 v		
C24	281-546	330 pf	Cer.	500 v	10%	
C31	283-001	.005 $\mu$ f	Disc Type	500 v		
C37	281-573	11 pf	Cer.		10%	101-209
	281-511	22 pf	Cer.	500 v	10%	210-up
C47	283-002	.01 $\mu$ f	Disc Type	500 v		X309-up
C57	285-511	.01 $\mu$ f	PTM	600 v		
C58	281-523	100 pf	Cer.	350 v		
C65	283-000	.001 $\mu$ f	Disc Type	500 v		
C70	283-003	.01 $\mu$ f	Disc Type	150 v		
C74	281-546	330 pf	Cer.	500 v	10%	
C81	283-001	.005 $\mu$ f	Disc Type	500 v		
C87	281-573	11 pf	Cer.		10%	101-209
	281-511	22 pf	Cer.	500 v	10%	210-up
C97	283-002	.01 $\mu$ f	Disc Type	500 v		X309-up
C110	281-518	47 pf	Cer.	500 v		101-209
	281-513	27 pf	Cer.	500 v	10%	210-up
C130	283-000	.001 $\mu$ f	Disc Type	500 v		

Capacitors (Cont'd)

Ckt. No.	Tektronix Part No.		Description			S/N Range
C134	281-504	10 pf	Cer.	500 v	10%	101-209X
C141	281-504	10 pf	Cer.	500 v	10%	101-209
	281-558	18 pf	Cer.	500 v		210-249
	281-501	4.7 pf	Cer.	500 v	±1 pf	250-up
C147	281-525	470 pf	Cer.	500 v		101-209X
C150	281-536	.001 μf	Cer.	500 v		X210-2029
C150	283-0028-00	0.0022 μf	Disc Type	50 v		2030-up
C160A	281-007	3-12 pf	Cer.	Var.		
C160B	283-534	82 pf	Mica	500 v	5%	
C160C	281-010	4.5-25 pf	Cer.	Var.		
C160D	*295-068	.001 μf	Timing Series			
C160E		.01 μf				
C160F		.1 μf				
C160G		1 μf				
C160V	290-008	20 μf	EMT	150 v		X150-up
C165	281-523	100 pf	Cer.	350 v		
C167	283-000	.001 μf	Disc Type	500 v		
C181	281-509	15 pf	Cer.	500 v	10%	101-209X
C190	281-544	5.6 pf	Cer.	500 v	10%	
C202	281-510	22 pf	Cer.	500 v		
C203	283-000	.001 μf	Disc Type	500 v		
C205	283-000	.001 μf	Disc Type	500 v		
C209	283-001	.005 μf	Disc Type	500 v		
C215	283-000	.001 μf	Disc Type	500 v		
C223	281-504	10 pf	Cer.	500 v	10%	
C229	283-001	.005 μf	Disc Type	500 v		
C231	281-518	47 pf	Cer.	500 v		101-209
	281-513	27 pf	Cer.	500 v		210-up
C234	281-504	10 pf	Cer.	500 v	10%	101-209X
C241	281-504	10 pf	Cer.	500 v	10%	101-209
	281-558	18 pf	Cer.	500 v		210-249
	281-501	4.7 pf	Cer.	500 v	±1 pf	250-up
C247	281-525	470 pf	Cer.	500 v		101-209X
C250	281-536	.001 μf	Cer.	500 v		X210-2029
C250	283-0028-00	0.0022 μf	Disc Type	50 v		2030-up
C260A	281-007	3-12 pf	Cer.	Var.		
C260B	283-534	82 pf	Mica	500 v	5%	
C260C	281-010	4.5-25 pf	Cer.	Var.		
C260D	*295-068	.001 μf	Timing Series			
C260E		.01 μf				
C260F		.1 μf				
C260G		1 μf				
C265	281-523	100 pf	Cer.	350 v		
C267	283-000	.001 μf	Disc Type	500 v		
C281	281-509	15 pf	Cer.	500 v	10%	101-209
	281-501	4.7 pf	Cer.	500 v	±1 pf	210-249



## Capacitors (Cont'd)

Ckt. No.	Tektronix Part No.		Description		S/N Range
C281	281-509	15 pf	Cer.	500 v	10% 250-2029X
C290	281-541	6.8 pf	Cer.	500 v	10% 101-209
	281-503	8 pf	Cer.	500 v	±0.5 pf 210-659
	281-544	5.6 pf	Cer.	500 v	10% 660-up
C315	283-002	.01 $\mu$ f	Disc Type	500 v	
C321	283-057	.1 $\mu$ f	Disc Type	200 v	
C326	283-002	.01 $\mu$ f	Disc Type	500 v	
C344	281-506	12 pf	Cer.	500 v	10%
C354	281-518	47 pf	Cer.	500 v	
C357	283-002	.01 $\mu$ f	Disc Type	500 v	
C402	283-002	.01 $\mu$ f	Disc Type	500 v	
C410	283-002	.01 $\mu$ f	Disc Type	500 v	
C443	290-145	10 $\mu$ f	EMT	50 v	
C452	283-002	.01 $\mu$ f	Disc Type	500 v	
C460	283-002	.01 $\mu$ f	Disc Type	500 v	
C464	281-538	1 pf	Cer.	500 v	
C493	290-145	10 $\mu$ f	EMT	50 v	
C611	290-169	400 $\mu$ f	EMC	250 v	
C626	Use 290-006	2 x 15 $\mu$ f	EMC	350 v	
C629	285-572	.1 $\mu$ f	PTM	200 v	
C632	285-604	.01 $\mu$ f	PTM	400 v	
C636	285-604	.01 $\mu$ f	PTM	400 v	
C640	290-086	2000 $\mu$ f	EMC	30 v	
C641	290-086	2000 $\mu$ f	EMC	30 v	
C647	283-026	.2 $\mu$ f	Disc Type	25 v	
C657	290-015	100 $\mu$ f	EMT	25 v	
C661	290-169	400 $\mu$ f	EMC	250 v	
C672	285-604	.01 $\mu$ f	PTM	400 v	
C676A,B	290-010	2 x 20 $\mu$ f	EMC	450 v	
C681	290-169	400 $\mu$ f	EMC	250 v	
C692	285-604	.01 $\mu$ f	PTM	400 v	
C705	283-002	.01 $\mu$ f	Disc Type	500 v	
C715	283-002	.01 $\mu$ f	Disc Type	500 v	
C741	281-027	.7-3 pf	Tub.	Var.	
C751	281-027	.7-3 pf	Tub.	Var.	
C761	290-110	20 $\mu$ f	EMT	150 v	
C762A,B,C,D	290-096	4 x 10 $\mu$ f	EMC	450 v	
C763	290-110	20 $\mu$ f	EMT	150 v	
C802	285-527	.1 $\mu$ f	MPT	600 v	
C803	283-000	.001 $\mu$ f	Disc Type	500 v	
C806	285-502	.001 $\mu$ f	MT	1000 v	
C808	281-007	3-12 pf	Cer.	Var.	
C810	283-021	.001 $\mu$ f	Disc Type	5000 v	
C823	283-036	.0025 $\mu$ f	Disc Type	6000 v	
C824	283-036	.0025 $\mu$ f	Disc Type	6000 v	
C828	290-026	5 $\mu$ f	EMT	25 v	
C831	281-506	12 pf	Cer.	500 v	10%
C832	283-002	.01 $\mu$ f	Disc Type	500 v	
C841	283-001	.005 $\mu$ f	Disc Type	500 v	

Parts List—Type 565

Capacitors (Cont'd)

Ckt. No.	Tektronix Part No.		Description		S/N Range
C857	283-033	.001 $\mu$ f	Disc Type	6000 v	
C861	283-006	.02 $\mu$ f	Disc Type	600 v	
C862	283-033	.001 $\mu$ f	Disc Type	6000 v	
C868	283-057	.1 $\mu$ f	Disc Type	200 v	
C877	283-033	.001 $\mu$ f	Disc Type	6000 v	
C884	283-033	.001 $\mu$ f	Disc Type	6000 v	
C885	281-0530-00	100 pf	Cer.	500 v	10% X1555-up
C891	283-033	.001 $\mu$ f	Disc Type	6000 v	101-1549
C891	283-0101-00	4700 pf	Cer.	6000 v	+80%—20% 1550-up
C894	283-033	.001 $\mu$ f	Disc Type	6000 v	
C901	283-518	330 pf	Mica	500 v	10%
C904	283-518	330 pf	Mica	500 v	10%
C915	281-513	27 pf	Cer.	500 v	

Diodes

D131	152-008	Germanium T12G			
D152	use *152-0249-00	Silicon, Assembly			X1020-up
D231	152-008	Germanium T12G			
D252	use *152-0249-00	Silicon, Assembly			X1020-up
D315	152-037	Zener 1.5M200Z	200 v		101-448X
D405	152-008	Germanium T12G			
D408	152-008	Germanium T12G			
D455	152-008	Germanium T12G			
D458	152-008	Germanium T12G			
D612A,B,C,D	*152-047	Silicon Replaceable by 1N2862			101-1969
D612A,B,C,D	152-0066-00	Silicon 1N3194			1970-up
D642	152-035	Silicon 1N1563A			
D652	152-035	Silicon 1N1563A			
D662A,B	*152-048	Silicon Replaceable by 1N2864			
D682A,B	*152-048	Silicon Replaceable by 1N2864			
D826	152-008	Germanium T12G			
D832	152-008	Germanium T12G			
D834	*152-061	Silicon Tek Spec			
D845	152-098	Tunnel TD4	10 MA		
D868	152-039	Zener 1.5M110Z	110 v		
D882	*152-061	Silicon Tek Spec			
D892	*152-061	Silicon Tek Spec			
D932	*152-061	Silicon Tek Spec			
D942	*152-061	Silicon Tek Spec			

Fuses

F601	159-011	6.25 Amp 3AG Slo-Blo	117 v oper.
F601	159-005	3 Amp 3AG Slo-Blo	234 v oper.
F606	159-022	1 Amp 3AG Fast-Blo	
F640	159-023	2 Amp 3AG Slo-Blo	

## Inductors

Ckt. No.	Tektronix Part No.	Description	S/N Range
L414	108-204	3.9 mh	
L444	108-204	3.9 mh	
L464	108-204	3.9 mh	
L494	108-204	3.9 mh	
L626	276-0507-00	Core, Ferramic Suppressor	X1620-up
L870	*108-158	Beam Rotor on form 276-047	

## Resistors

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

R4	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R10	302-104	100 k	$\frac{1}{2}$ w		
R12	302-105	1 meg	$\frac{1}{2}$ w		
R15	302-474	470 k	$\frac{1}{2}$ w		
R16	301-512	5.1 k	$\frac{1}{2}$ w		5%
R17	311-034	500 k		Var.	LEVEL
R18	303-223	22 k	1 w		5%
R19	302-223	22 k	$\frac{1}{2}$ w		
R20	302-682	6.8 k	$\frac{1}{2}$ w		
R22	302-151	150 $\Omega$	$\frac{1}{2}$ w		
R23	302-151	150 $\Omega$	$\frac{1}{2}$ w		
R24	301-512	5.1 k	$\frac{1}{2}$ w		5%
R25	301-512	5.1 k	$\frac{1}{2}$ w		5%
R28	303-123	12 k	1 w		5%
	305-113	11 k	2 w		5%
R31	302-224	220 k	$\frac{1}{2}$ w		
R32	302-224	220 k	$\frac{1}{2}$ w		
R33	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R34	302-122	1.2 k	$\frac{1}{2}$ w		101-209
	302-102	1 k	$\frac{1}{2}$ w		210-up
R35	302-272	2.7 k	$\frac{1}{2}$ w		101-209
	301-182	1.8 k	$\frac{1}{2}$ w		5%
R37	309-101	330 k	$\frac{1}{2}$ w		Prec. 1%
	309-125	300 k	$\frac{1}{2}$ w		Prec. 1%
R39	309-056	390 k	$\frac{1}{2}$ w		Prec. 1%
	309-101	330 k	$\frac{1}{2}$ w		Prec. 1%
R40	302-225	2.2 meg	$\frac{1}{2}$ w		101-209
	302-335	3.3 meg	$\frac{1}{2}$ w		210-up
R41	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R43	302-182	1.8 k	$\frac{1}{2}$ w		101-209
	302-122	1.2 k	$\frac{1}{2}$ w		210-up
R47	303-223	22 k	1 w		5%
	305-153	15 k	2 w		5%
R54	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R60	302-104	100 k	$\frac{1}{2}$ w		
R62	302-105	1 meg	$\frac{1}{2}$ w		

Parts List—Type 565

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R65	302-474	470 k	1/2 w			
R66	301-512	5.1 k	1/2 w			
R67	311-034	500 k		Var.	5%	LEVEL
R68	303-223	22 k	1 w		5%	
R69	302-223	22 k	1/2 w			
R70	302-682	6.8 k	1/2 w			
R72	302-151	150 Ω	1/2 w			
R73	302-151	150 Ω	1/2 w			
R74	301-512	5.1 k	1/2 w		5%	
R75	301-512	5.1 k	1/2 w		5%	
R78	303-123	12 k	1 w		5%	101-209
	305-113	11 k	2 w		5%	210-up
R81	302-224	220 k	1/2 w			
R82	302-224	220 k	1/2 w			
R83	302-101	100 Ω	1/2 w			
R84	302-122	1.2 k	1/2 w			101-209
	302-102	1 k	1/2 w			210-up
R85	302-272	2.7 k	1/2 w			101-209
	301-182	1.8 k	1/2 w		5%	210-up
R87	309-101	330 k	1/2 w		Prec.	101-209
	309-125	300 k	1/2 w		Prec.	1% 210-up
R89	309-056	390 k	1/2 w		Prec.	1% 101-209
	309-101	330 k	1/2 w		Prec.	1% 210-up
R90	302-225	2.2 meg	1/2 w		Prec.	101-209
	302-335	3.3 meg	1/2 w			210-up
R91	302-101	100 Ω	1/2 w			
R93	302-182	1.8 k	1/2 w			101-209
	302-122	1.2 k	1/2 w			210-up
R97	303-223	22 k	1 w		5%	101-209
	305-153	15 k	2 w		5%	210-up
R126	301-183	18 k	1/2 w		5%	
R127	301-153	15 k	1/2 w		5%	
R129	311-170	20 k		Var.	STABILITY	
R131	301-472	4.7 k	1/2 w		5%	
R132	302-101	100 Ω	1/2 w			
R134	309-121	9.5 k	1/2 w		Prec.	1% 101-209X
R135	309-121	9.5 k	1/2 w		Prec.	1% 101-209
	310-115	15 k	1 w		Prec.	1% 210-up
R136	306-393	39 k	2 w			
R137	302-101	100 Ω	1/2 w			
R141	309-176	43.4 k	1/2 w		Prec.	1%
R143	309-290	21.5 k	1/2 w		Prec.	1%
R144	303-103	10 k	1 w		5%	101-209
	303-822	8.2 k	1 w		5%	210-up
R146	302-101	100 Ω	1/2 w			

## Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R147	302-182	1.8 k	1/2 w			101-209
	302-102	1 k	1/2 w			210-249
	301-132	1.3 k	1/2 w		5%	250-up
R148	302-683	68 k	1/2 w			101-209X
R148	302-0683-00	68 k	1/2 w			X2030-up
R149	302-472	4.7 k	1/2 w			
R150	302-681	680 $\Omega$	1/2 w			X210-2029
R150	302-0391-00	390 $\Omega$	1/2 w			2030-up
R160A	309-148	1 meg	1/2 w		Prec.	1%
R160B	309-148	1 meg	1/2 w		Prec.	1%
R160C	309-377	3 meg	1/2 w		Prec.	1%
R160D	309-095	10 meg	1/2 w		Prec.	1%
R160E	309-095	10 meg	1/2 w		Prec.	1%
R160F	310-505	30 meg	2 w		Prec.	1%
R160V	302-102	1 k	1/2 w			X150-up
R160W	302-104	100 k	1/2 w			
R160X	302-103	10 k	1/2 w			
R160Y†	311-108	20 k		Var.	WW	VARIABLE
R161	302-101	100 $\Omega$	1/2 w			
R164	304-333	33 k	1 w			
R165	304-333	33 k	1 w			
R167	302-105	1 meg	1/2 w			
R168	302-473	47 k	1/2 w			
R177	303-153	15 k	1 w			
R178	311-171	5 k		Var.		5% SWEEP LENGTH
R179	301-682	6.8 k	1/2 w			5%
R181	302-475	4.7 meg	1/2 w			
R187	302-472	4.7 k	1/2 w			
R189	302-272	2.7 k	1/2 w			
R190	302-154	150 k	1/2 w			
R191	302-184	180 k	1/2 w			
R192	302-101	100 $\Omega$	1/2 w			
R194	302-682	6.8 k	1/2 w			
R201	302-102	1 k	1/2 w			
R202	302-223	22 k	1/2 w			
R203	302-156	15 meg	1/2 w			
R205	302-394	390 k	1/2 w			
R206	302-684	680 k	1/2 w			
R207	302-101	100 $\Omega$	1/2 w			
R209	302-154	150 k	1/2 w			
R215	301-183	18 k	1/2 w			5% 101-209
	301-203	20 k	1/2 w			5% 210-up
R216	301-153	15 k	1/2 w			
R217	311-170	20 k		Var.		5% STABILITY
R220	302-101	100 $\Omega$	1/2 w			
R221	302-124	120 k	1/2 w			
R222	302-104	100 k	1/2 w			

† Concentric with SW160Y. Furnished as a unit.

Parts List—Type 565

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R223	302-154	150 k	1/2 w			
R224	302-473	47 k	1/2 w			
R225	311-088	100 k	.2 w	Var.		LOCKOUT LEVEL
R226	302-334	330 k	1/2 w			
R227	302-101	100 Ω	1/2 w			
R228	302-183	18 k	1/2 w			
R229	302-103	10 k	1/2 w			
R230	302-123	12 k	1/2 w			
R231	301-472	4.7 k	1/2 w		5%	
R232	302-101	100 Ω	1/2 w			
R234	309-121	9.5 k	1/2 w		Prec.	1% 101-209X
R235	309-121	9.5 k	1/2 w		Prec.	1% 101-209
	310-115	15 k	1 w		Prec.	1% 210-up
R236	306-393	39 k	2 w			
R237	302-101	100 Ω	1/2 w			
R241	309-176	43.4 k	1/2 w		Prec.	1%
R243	309-290	21.5 k	1/2 w		Prec.	1%
R244	303-103	10 k	1 w			5% 101-209
	303-822	8.2 k	1 w			5% 210-up
R246	302-101	100 Ω	1/2 w			
R247	302-182	1.8 k	1/2 w			101-209
	302-102	1 k	1/2 w			210-249
	301-132	1.3 k	1/2 w			5% 250-up
R248	302-683	68 k	1/2 w			101-209X
R248	302-0683-00	68 k	1/2 w			X2030-up
R249	302-472	4.7 k	1/2 w			
R250	302-681	680 Ω	1/2 w			X210-2029
R250	302-0391-00	390 Ω	1/2 w			2030-up
R260A	309-148	1 meg	1/2 w		Prec.	1%
R260B	309-148	1 meg	1/2 w		Prec.	1%
R260C	309-377	3 meg	1/2 w		Prec.	1%
R260D	309-095	10 meg	1/2 w		Prec.	1%
R260E	309-095	10 meg	1/2 w		Prec.	1%
R260F	310-505	30 meg	2 w		Prec.	1%
R260V	302-0102-00	1 k	1/2 w			X2060-up
R260W	302-104	100 k	1/2 w			
R260X	302-103	10 k	1/2 w			
R260Y†	311-108	20 k		Var.	WW	VARIABLE
R261	302-101	100 Ω	1/2 w			
R264	304-333	33 k	1 w			
R265	304-333	33 k	1 w			
R267	302-105	1 meg	1/2 w			
R268	302-473	47 k	1/2 w			
R277	303-153	15 k	1 w			5%
R278	311-171	5 k		Var.		SWEEP LENGTH
R279	301-682	6.8 k	1/2 w			5%
R281	302-475	4.7 meg	1/2 w			
R287	302-272	2.7 k	1/2 w			

† Concentric with SW260Y. Furnished as a unit.

## Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R288	302-153	15 k	1/2 w			X660-up
R289	302-472	4.7 k	1/2 w			
R290	302-154	150 k	1/2 w			
R291	302-184	180 k	1/2 w			
R292	302-101	100 $\Omega$	1/2 w			
R294	302-682	6.8 k	1/2 w			
R311	302-101	100 $\Omega$	1/2 w			
R315	304-153	15 k	1 w			101-448
	305-123	12 k	2 w		5%	449-up
R316	305-473	47 k	2 w		5%	X449-up
R321	302-101	100 $\Omega$	1/2 w			
R323	302-104	100 k	1/2 w			
R324	302-153	15 k	1/2 w			
R325	302-104	100 k	1/2 w			
R326	302-104	100 k	1/2 w			
R327	302-101	100 $\Omega$	1/2 w			
R328	302-103	10 k	1/2 w			
R331	308-206	7.5 k	5 w	WW	5%	
R332	311-012	5 k	Var.	WW	DELAY STOP	101-209
	311-015	10 k	Var.	WW		210-up
R333	311-318	30 k	Var.	WW	DELAY INTERVAL	
R336	311-141	2 k	Var.	WW	DELAY START	
R341	302-101	100 $\Omega$	1/2 w			
R343	302-272	2.7 k	1/2 w			
R344	309-091	120 k	1/2 w	Prec.	1%	
R346	309-340	165 k	1/2 w	Prec.	1%	
R347	305-153	15 k	2 w		5%	
R351	302-101	100 $\Omega$	1/2 w			
R353	302-332	3.3 k	1/2 w			
R354	302-103	10 k	1/2 w			
R355	302-184	180 k	1/2 w			
R357	302-470	47 $\Omega$	1/2 w			
R359	302-102	1 k	1/2 w			
R401	311-026	100 k		Var.	EXT. HORIZ. GAIN	
R402	302-104	100 k	1/2 w			
R403	302-101	100 $\Omega$	1/2 w			
R405	304-223	22 k	1 w			101-269
	302-393	39 k	1/2 w			270-up
R407	302-153	15 k	1/2 w			101-209
	304-153	15 k	1 w			210-up
R408	use 302-122	1.2 k	1/2 w			
R410	302-101	100 $\Omega$	1/2 w			
R411	302-102	1 k	1/2 w			
R412	302-333	33 k	1/2 w			101-209
	304-333	33 k	1 w			210-up
R414	308-213	25 k	7 w	WW	5%	
R416	302-275	2.7 meg	1/2 w			
R421	309-319	50 $\Omega$	1/2 w	Prec.	1%	

Parts List—Type 565

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R422	305-223	22 k	2 w			5%
R424	309-085	995 Ω	1/2 w		Prec.	2%
R431	311-169	100 Ω	1/2 w	Var.		X10 GAIN
R432	305-183	18 k	2 w			5%
R433	311-065	7 k	2 w	Var.		SWP. MAG. REGIS.
R434	311-256	300 Ω	.2 w	Var.		X1 GAIN
R441	304-153	15 k	1 w			
R442	302-393	39 k	1/2 w			101-269
	302-273	27 k	1/2 w			270-up
R443A } †	311-320	1 k		Var.		POSITION
R443B }		200 Ω				
R444	308-213	25 k	7 w		WW	5%
R451	311-026	100 k		Var.		EXT. HORIZ. GAIN
R452	302-104	100 k	1/2 w			
R453	302-101	100 Ω	1/2 w			
R455	304-223	22 k	1 w			101-269
	302-393	39 k	1/2 w			270-up
R457	302-153	15 k	1/2 w			101-209
	304-153	15 k	1 w			210-up
R458	use 302-122	1.2 k	1/2 w			
R460	302-101	100 Ω	1/2 w			
R461	302-102	1 k	1/2 w			
R462	304-333	33 k	1 w			
R464	308-213	25 k	7 w		WW	5%
R466	302-275	2.7 meg	1/2 w			
R471	309-319	50 Ω	1/2 w		Prec.	1%
R472	305-223	22 k	2 w			5%
R474	309-085	995 Ω	1/2 w		Prec.	1%
R481	311-169	100 Ω		Var.		X10 GAIN
R482	305-183	18 k	2 w			5%
R483	311-065	7 k	2 w	Var.		SWP. MAG. REGIS.
R484	311-256	300 Ω	.2 w	Var.		X1 GAIN
R491	304-153	15 k	1 w			
R492	302-393	39 k	1/2 w			101-269
	302-273	27 k	1/2 w			270-up
R493A } ††	311-320	1 k		Var.		POSITION
R493B }		200 Ω				
R494	308-213	25 k	7 w		WW	5%
R604	311-055	50 Ω		Var.	WW	SCALE ILLUM. 101-999
R604	311-377	25 Ω		Var.	WW	SCALE ILLUM. 1000-up
R606	308-142	30 Ω	3 w		WW	5% 101-999X
R610	306-100	10 Ω	2 w			
R613	302-683	68 k	1/2 w			
R614	302-104	100 k	1/2 w			
R615	302-224	220 k	1/2 w			
R616	302-105	1 meg	1/2 w			
R617	302-183	18 k	1/2 w			
R618	302-682	6.8 k	1/2 w			

† Concentric with SW443. Furnished as a unit.

†† Concentric with SW493. Furnished as a unit.



## Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description		S/N Range
R619	302-102	1 k	1/2 w		
R620	302-102	1 k	1/2 w		
R621	302-560	56 Ω	1/2 w		
R622	302-560	56 Ω	1/2 w		
R623	309-323	75 k	1/2 w	Prec.	1%
R624	311-015	10 k		Var.	WW —100 VOLTS
R625	309-121	9.5 k	1/2 w	Prec.	1%
R626	308-037	1 k	25 w	WW	5%
R627	308-176	4 k	20 w	WW	5%
R628	302-224	220 k	1/2 w		
R629	302-102	1 k	1/2 w		
R631	302-153	15 k	1/2 w		
R632	302-104	100 k	1/2 w		
R634	302-274	270 k	1/2 w		101-149
	302-564	560 k	1/2 w		150-up
R636	302-335	3.3 meg	1/2 w		
R637	302-125	1.2 meg	1/2 w		
R638	302-106	10 meg	1/2 w		
R639	302-272	2.7 k	1/2 w		
R643	309-104	2.05 k	1/2 w	Prec.	1%
R644	310-115	15 k	1 w	Prec.	1%
R645	302-334	330 k	1/2 w		
R646	302-272	2.7 k	1/2 w		
R647	302-151	150 Ω	1/2 w		
R654	308-218	150 Ω	3 w	WW	5%
R657	304-471	470 Ω	1 w		
R660	306-100	10 Ω	2 w		
R663	302-273	27 k	1/2 w		
R664	302-333	33 k	1/2 w		
R665	302-684	680 k	1/2 w		
R666	302-225	2.2 meg	1/2 w		
R667	302-102	1 k	1/2 w		
R668	302-102	1 k	1/2 w		
R669	302-102	1 k	1/2 w		
R670	308-223	35 Ω	3 w	WW	5%
R671	308-223	35 Ω	3 w	WW	5%
R672	302-474	470 k	1/2 w		
R673	309-101	330 k	1/2 w	Prec.	1%
R674	309-162	250 k	1/2 w	Prec.	1%
R676	308-086	1.2 k	10 w	WW	5%
R677	308-176	4 k	20 w	WW	5%
R680	306-100	10 Ω	2 w		
R683	302-154	150 k	1/2 w		
R684	302-333	33 k	1/2 w		
R685	302-154	150 k	1/2 w		

Parts List—Type 565

Resistors (Cont'd.)

Ckt. No.	Tektronix Part No.		Description		S/N Range
R686	302-105	1 meg	1/2 w		
R687	302-102	1 k	1/2 w		
R688	302-102	1 k	1/2 w		
R689	302-102	1 k	1/2 w		
R690	308-075	100 Ω	3 w	WW	
R691	308-075	100 Ω	3 w	WW	
R693	309-341	1.05 meg	1/2 w	Prec.	1%
R694	309-139	333 k	1/2 w	Prec.	1%
R696	308-020	3 k	10 w	WW	5%
R697	308-176	4 k	20 w	WW	5%
R701	302-105	1 meg	1/2 w		
R702	302-101	100 Ω	1/2 w		
R703	302-101	100 Ω	1/2 w		
R705	302-470	47 Ω	1/2 w		
R707	302-333	33 k	1/2 w		
R709	302-333	33 k	1/2 w		
R711	302-105	1 meg	1/2 w		
R712	302-101	100 Ω	1/2 w		
R713	302-101	100 Ω	1/2 w		
R715	302-470	47 Ω	1/2 w		
R717	302-333	33 k	1/2 w		
R719	302-333	33 k	1/2 w		
R761	302-470	47 Ω	1/2 w		
R762A	302-470	47 Ω	1/2 w		
R762B	302-470	47 Ω	1/2 w		
R762C	302-470	47 Ω	1/2 w		
R762D	302-470	47 Ω	1/2 w		
R763	302-470	47 Ω	1/2 w		
R765	302-151	150 Ω	1/2 w		
	309-211	150 Ω	1/2 w	Prec.	1% 101-209 210-up
R766	302-151	150 Ω	1/2 w		
	309-211	150 Ω	1/2 w	Prec.	1% 101-209 210-up
R769	302-102	1 k	1/2 w		
R781	302-470	47 Ω	1/2 w		
R782	302-470	47 Ω	1/2 w		
R783	302-470	47 Ω	1/2 w		
R784	302-470	47 Ω	1/2 w		
R802	304-471	470 Ω	1 w		
R803	305-223	22 k	2 w		5%
R804	302-101	100 Ω	1/2 w		
R806	302-683	68 k	1/2 w		
R807	302-682	6.8 k	1/2 w		
R810	302-105	1 meg	1/2 w		
R811	302-101	100 Ω	1/2 w		
R814	302-474	470 k	1/2 w		

## Resistors (Cont'd)

Ckt. No.	Tektronix Part No.		Description		S/N Range
R821	307-034	8.2 $\Omega$	$\frac{1}{2}$ w		
R824	302-104	100 k	$\frac{1}{2}$ w		
R826	302-101	100 $\Omega$	$\frac{1}{2}$ w		
R831	302-334	330 k	$\frac{1}{2}$ w		
R832	302-394	390 k	$\frac{1}{2}$ w		
R834	302-121	120 $\Omega$	$\frac{1}{2}$ w		
R835	302-564	560 k	$\frac{1}{2}$ w		
R836	302-154	150 k	$\frac{1}{2}$ w		
R839	301-132	1.3 k	$\frac{1}{2}$ w		5% 101-219
	301-561	560 $\Omega$	$\frac{1}{2}$ w		5% 220-up
R841	302-330	33 $\Omega$	$\frac{1}{2}$ w		
R844	302-102	1 k	$\frac{1}{2}$ w		
R846	301-242	2.4 k	$\frac{1}{2}$ w		5%
R847	302-471	470 $\Omega$	$\frac{1}{2}$ w		
R848	311-335	2.5 k		Var.	CONTRAST
R849	302-682	6.8 k	$\frac{1}{2}$ w		
R850	302-102	1 k	$\frac{1}{2}$ w		X470-up
R852	311-032	250 k		Var.	INTERGUN SHIELD
R854	311-068	500 k	.2 w	Var.	ASTIG. (Upper)
R855	311-254	5 meg	.2 w	Var.	FOCUS (Upper)
R856	302-225	2.2 meg	$\frac{1}{2}$ w		
R858	302-105	1 meg	$\frac{1}{2}$ w		
R859	311-254	5 meg	.2 w	Var.	INTENSITY (Upper)
R860	304-185	1.8 meg	1 w		101-469
	304-155	1.5 meg	1 w		470-up
R861	311-042	2 meg		Var.	HIGH VOLTAGE
R862	306-275	2.7 meg	2 w		X470-up
R863	306-335	3.3 meg	2 w		X470-up
R864	use *050-146	Replacement Kit			101-469
	306-355	3.3 meg	2 w		470-up
R865	306-275	2.7 meg	2 w		X470-up
R866	304-185	1.8 meg	1 w		
R867	304-225	2.2 meg	1 w		
R868	302-275	2.7 meg	$\frac{1}{2}$ w		
R870	311-228	2 x 10 k		Var.	ALIGNMENT
R871	308-217	5.5 k	5 w		5% WW
R872	311-032	250 k		Var.	ISOLATION SHIELD
R874	311-068	500 k	.2 w	Var.	ASTIG. (Lower)
R875	311-254	5 meg	.2 w	Var.	FOCUS (Lower)
R876	302-225	2.2 meg	$\frac{1}{2}$ w		
R877	302-105	1 meg	$\frac{1}{2}$ w		
R878	302-275	2.7 meg	$\frac{1}{2}$ w		
R879	311-254	5 meg	.2 w	Var.	INTENSITY (Lower)
R881	302-104	100 k	$\frac{1}{2}$ w		
R882	302-223	22 k	$\frac{1}{2}$ w		
R883	302-102	1 k	$\frac{1}{2}$ w		
R884	302-471	470 $\Omega$	$\frac{1}{2}$ w		
R885	302-105	1 meg	$\frac{1}{2}$ w		
R892	302-223	22 k	$\frac{1}{2}$ w		
R893	302-102	1 k	$\frac{1}{2}$ w		
R894	302-471	470 $\Omega$	$\frac{1}{2}$ w		

Parts List—Type 565

Resistors (Cont'd)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R895	302-105	1 meg	1/2 w			
R900	302-154	150 k	1/2 w			
R901	301-275	2.7 meg	1/2 w		5%	
R902	302-102	1 k	1/2 w			
R904	301-435	4.3 meg	1/2 w		5%	
R905	302-393	39 k	1/2 w			
R906	302-102	1 k	1/2 w			
R908	302-333	33 k	1/2 w			
R909	302-822	8.2 k	1/2 w			101-209
	301-472	4.7 k	1/2 w		5%	210-up
R910	311-171	5 k		Var.		CAL. AMPL. 101-209
	311-153	10 k		Var.		210-up
R911	302-333	33 k	1/2 w			101-209
	303-123	12 k	1 w		5%	210-up
R913	302-101	100 Ω	1/2 w			
R915	310-066	18 k	1 w		Prec.	1%
R916	309-030	1.8 k	1/2 w		Prec.	1%
R917	309-235	9 k	1/2 w		Prec.	1%
R918	309-236	900 Ω	1/2 w		Prec.	1%
R919	309-238	90 Ω	1/2 w		Prec.	1%
R920	309-096	10 Ω	1/2 w		Prec.	1%
R923	309-237	204 Ω	1/2 w		Prec.	1%
R929	*308-090	.25 Ω	1 w		WW	
R951	302-471	470 Ω	1/2 w			101-209X
R953	302-471	470 Ω	1/2 w			101-209X
R961	302-471	470 Ω	1/2 w			101-209X
R963	302-471	470 Ω	1/2 w			101-209X
R971	309-041	60 k	1/2 w		Prec.	1%
R972	309-264	69.5 k	1/2 w		Prec.	1%
R975	318-045	3.92 k	1/8 w		Prec.	1%
R978	318-045	3.92 k	1/8 w		Prec.	1%
R979	311-331	1 k		Var.		UPPER BEAM SWEEP BAL
R981	309-264	69.5 k	1/2 w		Prec.	1%
R982	309-041	60 k	1/2 w		Prec.	1%
R985	318-045	3.92 k	1/8 w		Prec.	1%
R988	318-045	3.92 k	1/8 w		Prec.	1%
R989	311-331	1 k		Var.		LOWER BEAM SWEEP BAL

Switches

Unwired Wired

SW4	260-449	Slide	TRIGGER (Upper Beam Lower Beam)
SW5	260-450	Slide	TRIGGER (Ext.-Int. Line)
SW10	260-450	Slide	TRIGGER (Coupling)
SW15	260-447	Slide	TRIGGER (Slope)
SW17	260-466 *262-508	Rotary	TRIGGER (Level A)

## Switches (Cont'd)

Ckt. No.	Tektronix Part No.		Description	S/N Range	
	Unwired	Wired			
SW49	260-467	*262-510	Rotary	UPPER HORIZ. DISPLAY	101-209 210-up
	260-467	*262-542	Rotary	UPPER HORIZ. DISPLAY	
SW54	260-449		Slide	TRIGGER (Upper Beam Lower Beam)	
SW55	260-450		Slide	TRIGGER (Ext.-Int. Line)	
SW60	260-450		Slide	TRIGGER (Coupling)	
SW65	260-447		Slide	TRIGGER (Slope)	
SW67	260-466	*262-509	Rotary	TRIGGER (Level B)	
SW99	260-468	*262-511	Rotary	LOWER HORIZ. DISPLAY	101-209 210-up
	260-468	*262-543	Rotary	LOWER HORIZ. DISPLAY	
SW160	260-464	*262-506	Rotary	TIME/DIV A	101-149 150-up
	260-464	*262-537	Rotary	TIME/DIV A	
SW160Y†	311-108				
SW201	260-247		Push Button	MANUAL TRIGGER	
SW203	260-247		Push Button	RESET	
SW230	260-465	*262-507	Rotary	B MODE	
SW260	260-464	*262-520	Rotary	TIME/DIV B	
SW260Y††	311-108				
SW443†††	311-320			10X MAG. (Upper Beam)	
SW493††††	311-320			10X MAG. (Lower Beam)	
SW601	260-276		Toggle	POWER ON	
SW900	260-234	*262-512	Rotary	PEAK-TO-PEAK VOLTS (Amplitude Calibrator)	

## Thermal Cutout

TK601      Use 260-208      Thermal Cutout 133°F

## Transformers

T601	*120-287	L.V. Power	
T801	*120-288	H.V. Power	
T841	use *050-082	Replacement Kit	101-219
	*120-305	Toroid 2T TD90	220-up

## Transistors

Q424	151-058	RT5204	
Q434	151-058	RT5204	
Q474	151-058	RT5204	
Q484	151-058	RT5204	
Q644	151-040	2N1302	101-1829
Q644	151-0072-00	2N1308	1830-up
Q654	151-042	2N1378	
Q657	151-046	2N1529	
Q843	151-010	2N404	

†Concentric with R160Y. Furnished as a unit.

††Concentric with R260Y. Furnished as a unit.

†††Concentric with R443. Furnished as a unit.

††††Concentric with R493. Furnished as a unit.

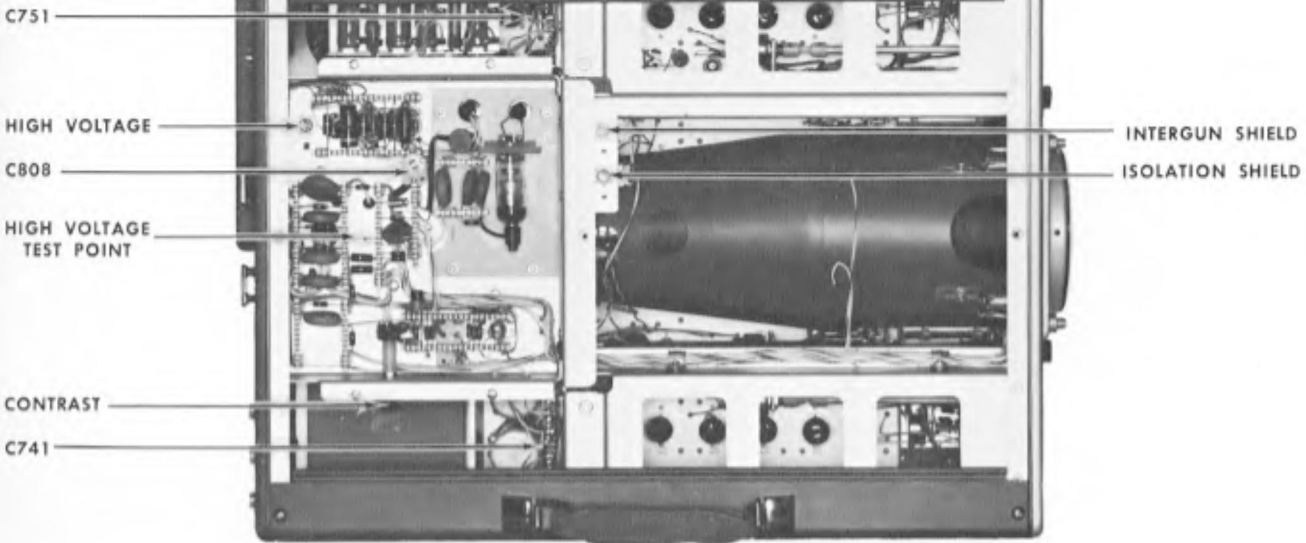
Parts List—Type 565

Electron Tubes

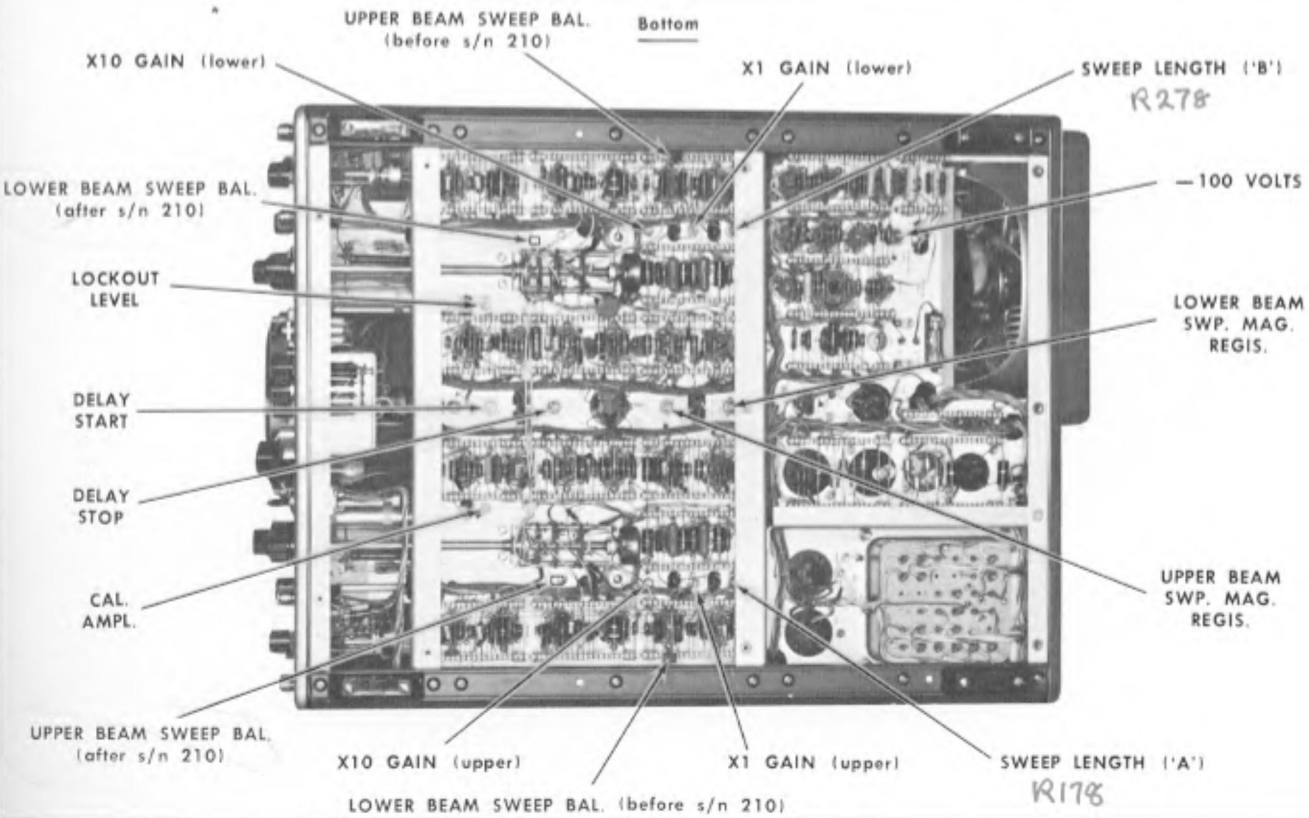
Ckt. No.	Tektronix Part No.	Description	S/N Range
V24	154-187	6DJ8	
V45	154-187	6DJ8	
V74	154-187	6DJ8	
V95	154-187	6DJ8	
V135	154-187	6DJ8	
V145	154-278	6BL8	
V152	154-232	6BC7	101-1019
V152	Use 154-453	6BJ7	1020-up
V161	154-078	6AN8	
V193	154-187	6DJ8	
V214	154-022	6AU6	
V225	154-278	6BL8	
V235	154-187	6DJ8	
V245	154-278	6BL8	
V252	Use 154-453	6BJ7	101-1019
V252	150-016	6AL5	1020-up
V261	154-078	6AN8	
V314	154-278	6BL8	
V324	154-278	6BL8	
V355	154-187	6DJ8	
V403	154-039	12AT7	
V414	154-187	6DJ8	
V453	154-039	12AT7	
V464	154-187	6DJ8	
V614	154-022	6AU6	
V617	154-307	7233	
V627	154-307	7233	
V636	154-278	6BL8	
V639	154-291	0G3	
V664	154-022	6AU6	
V667	154-307	7233	
V677	154-307	7233	
V684	154-022	6AU6	
V697	154-056	6080	
V703	154-039	12AT7	
V713	154-039	12AT7	
V800	154-167	6CZ5	
V814	154-187	6DJ8	
V822	154-005	1X2B	
V834	154-323	6CW4	
V859	*154-358	T5650-2 CRT Standard Phosphor	101-999
V859†	Use *154-0477-00	T5650-2-1 CRT Standard Phosphor	1000-1369
V859	*154-0477-00	T5650-2-1 CRT Standard Phosphor	1370-up
V905	154-022	6AU6	
V915	154-039	12AT7	

†S/N 1000-1369 add \*050-0246-00 Kit.

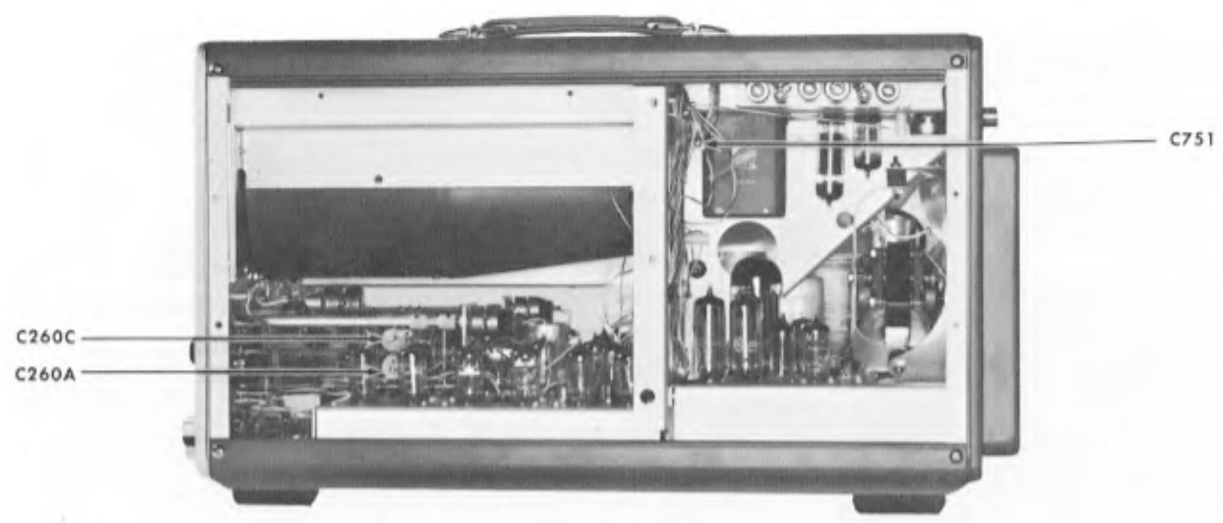
Top



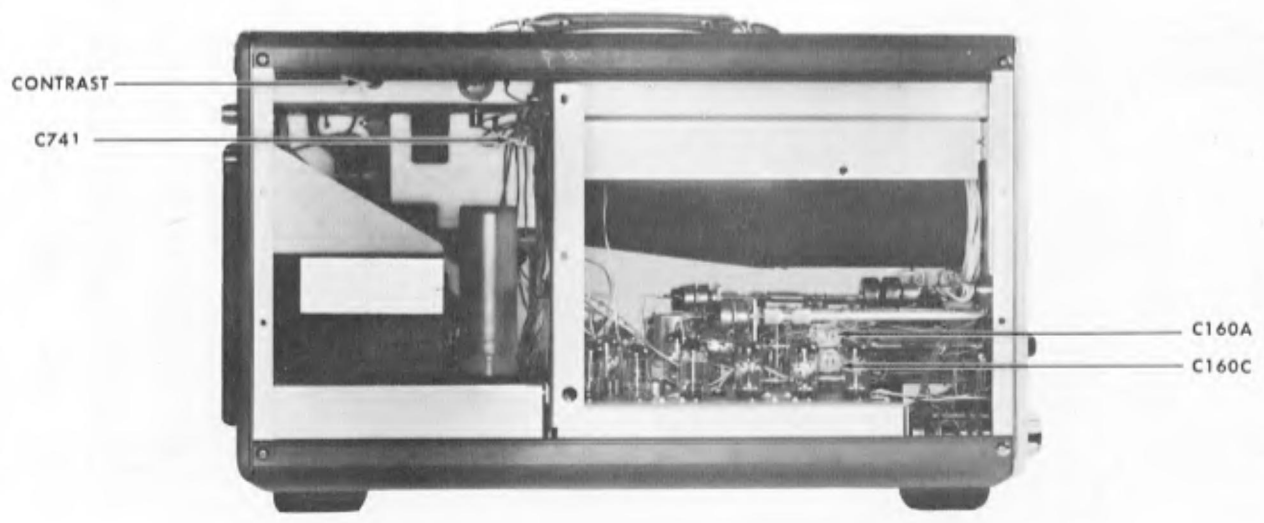
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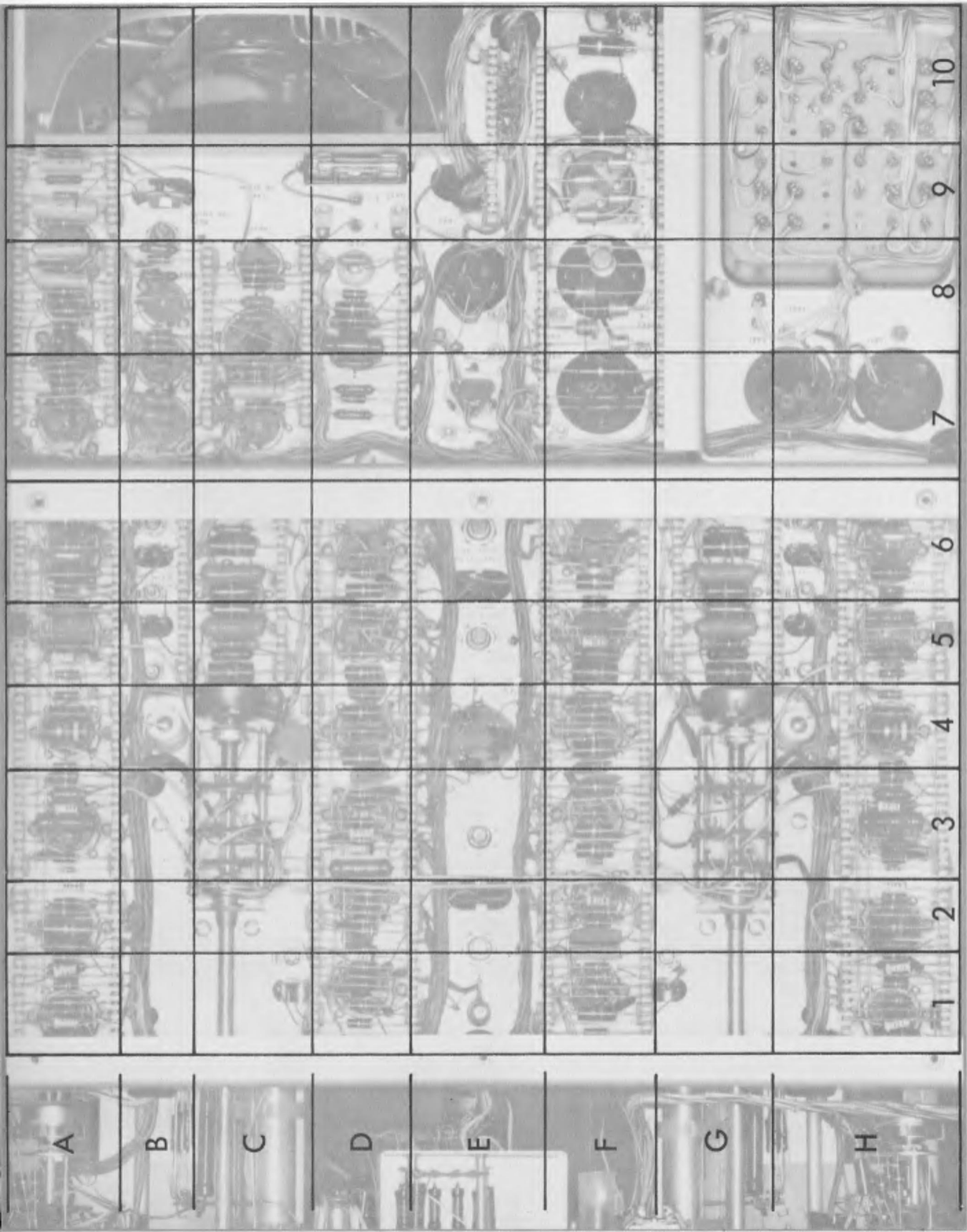
Right  
Side

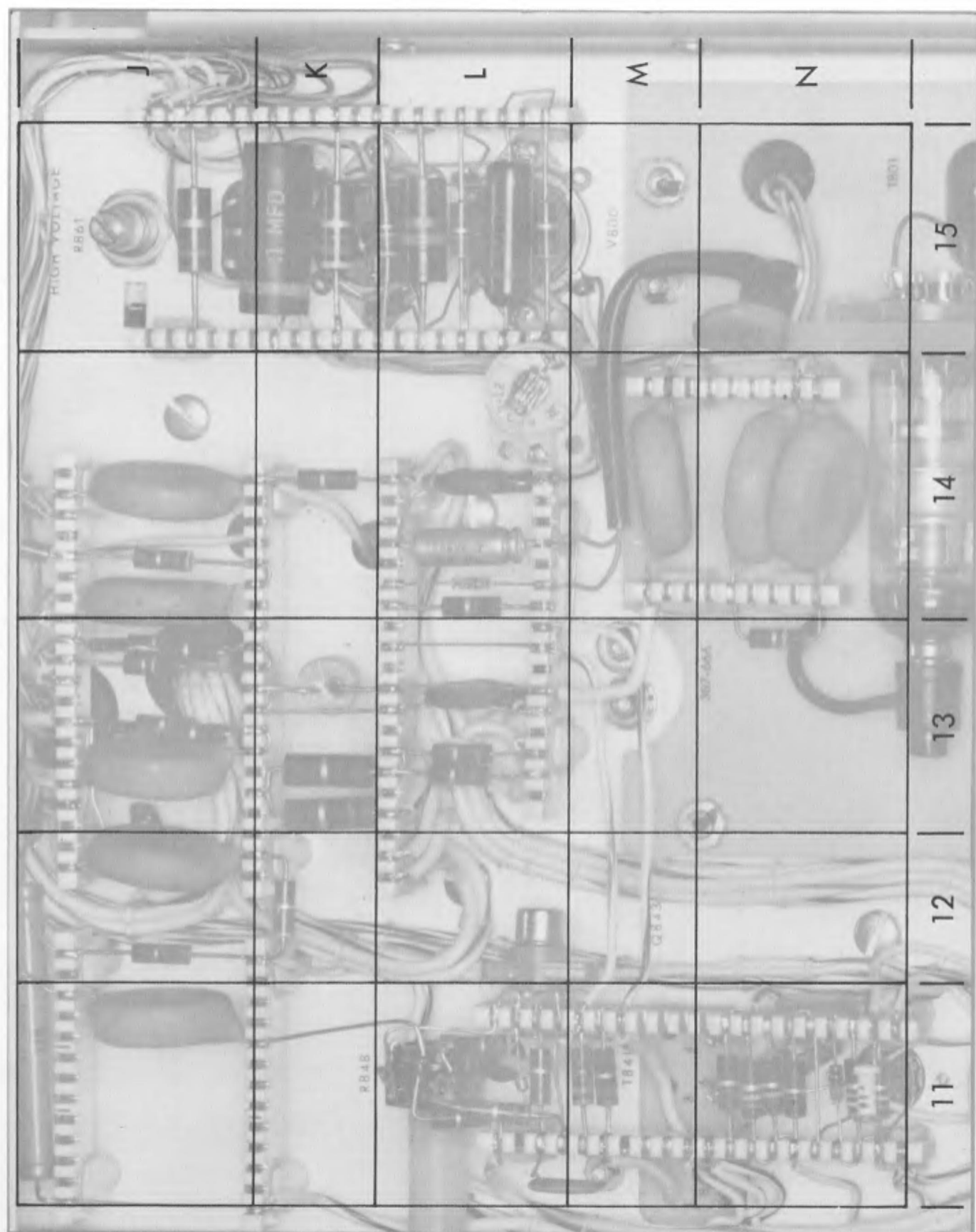


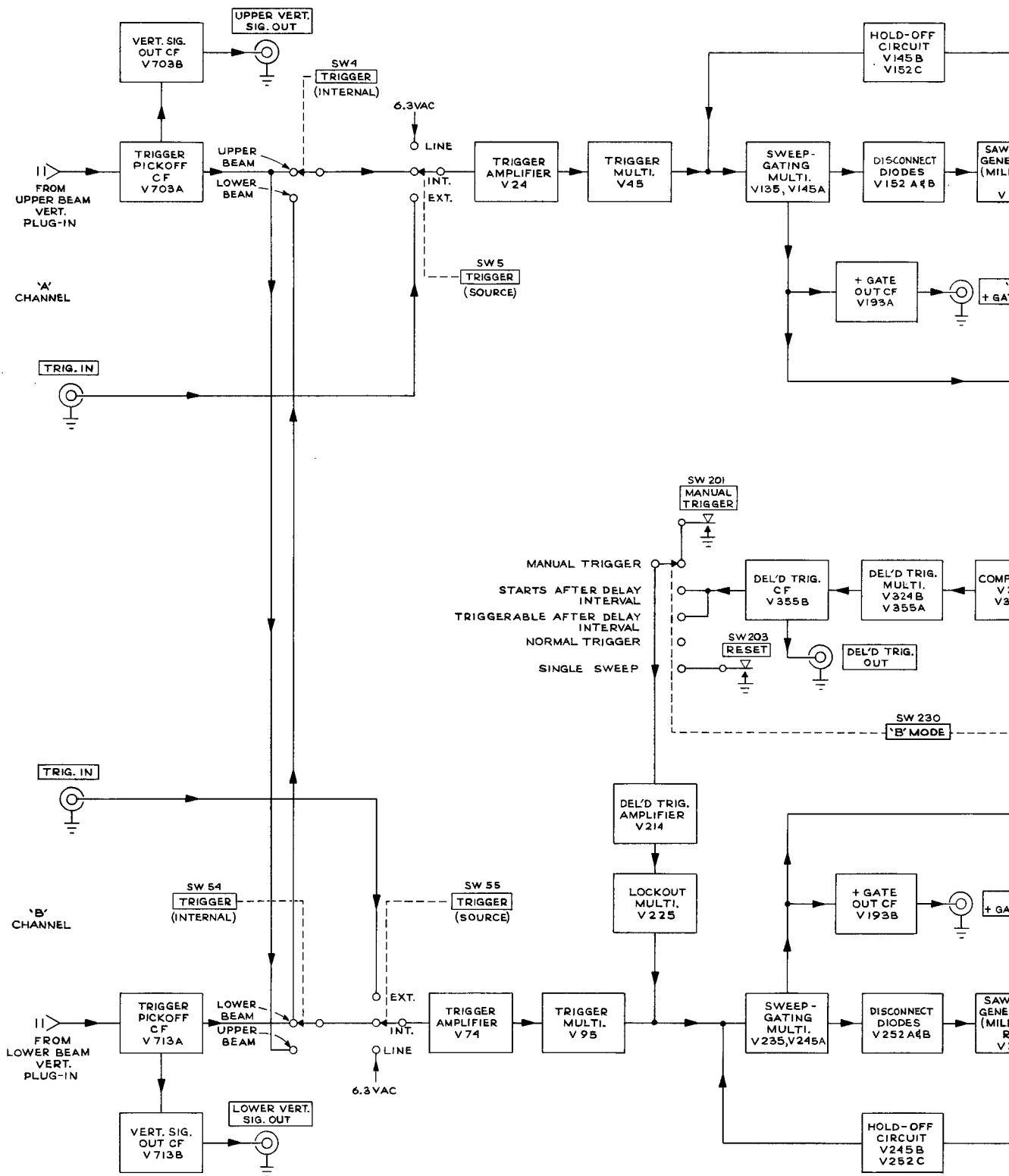
Left  
Side



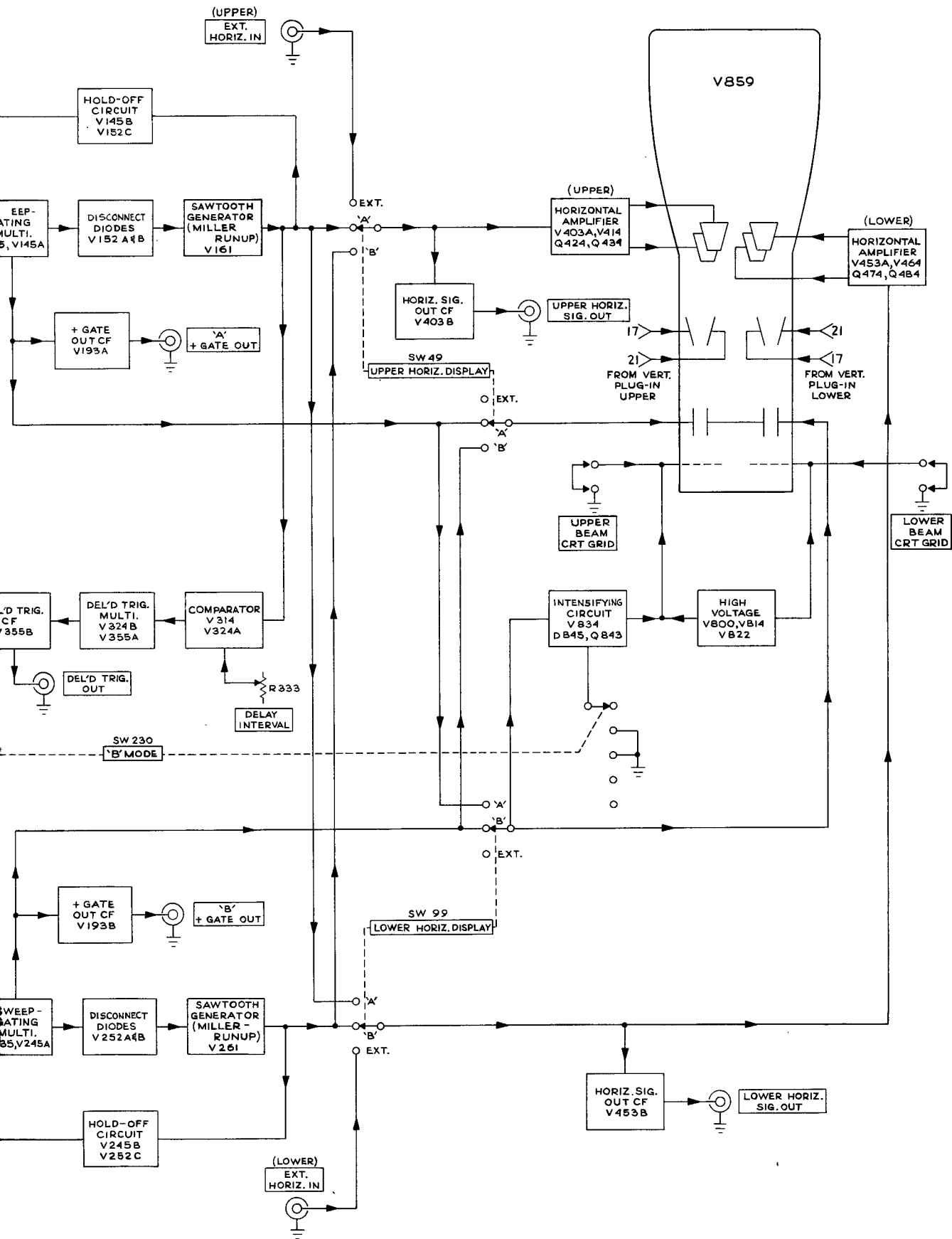








TYPE 565 OSCILLOSCOPE



CMD  
763

BLOCK DIAGRAM

**IMPORTANT:**

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

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

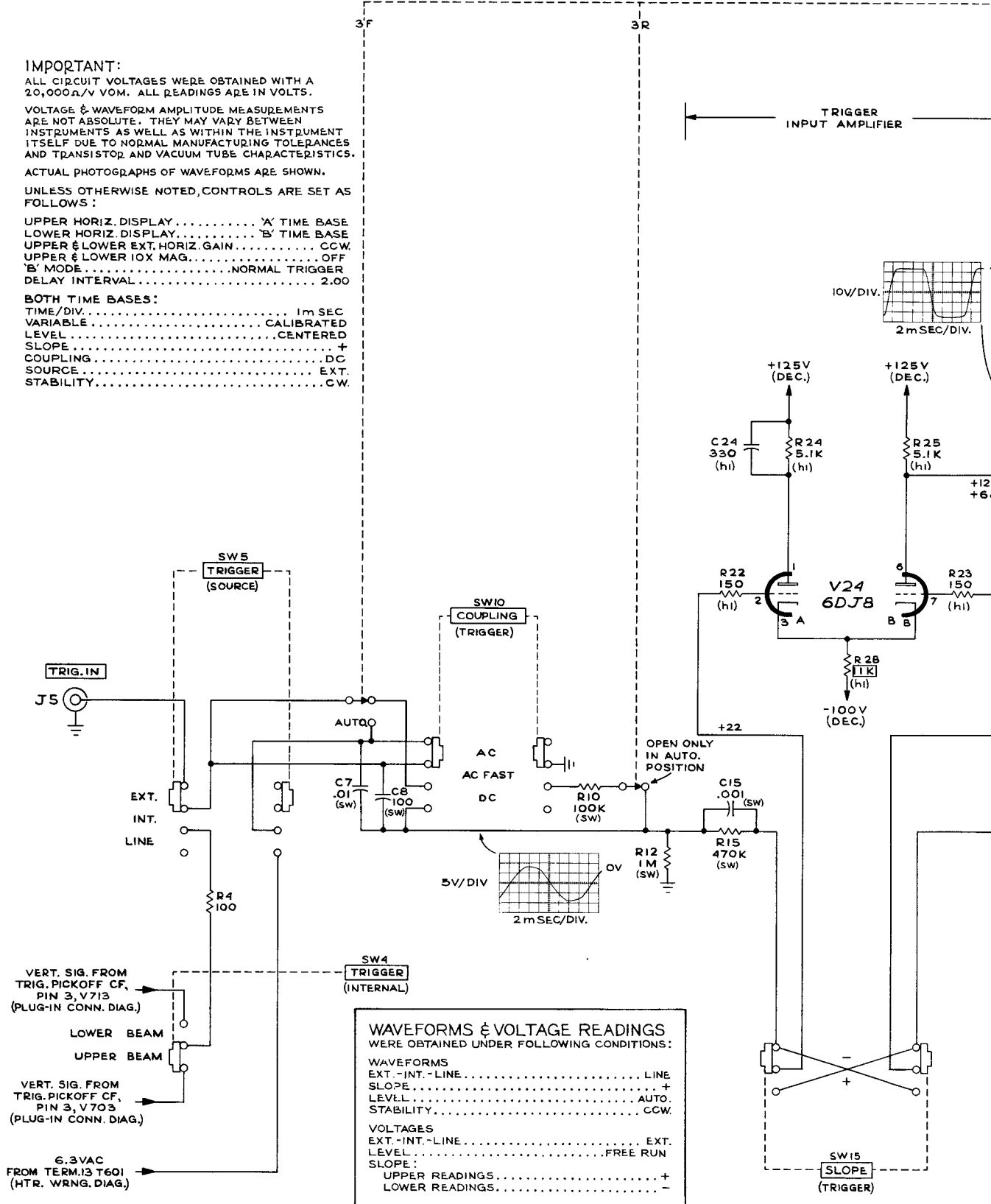
ACTUAL PHOTOGRAPHS OF WAVEFORMS ARE SHOWN.

UNLESS OTHERWISE NOTED, CONTROLS ARE SET AS FOLLOWS:

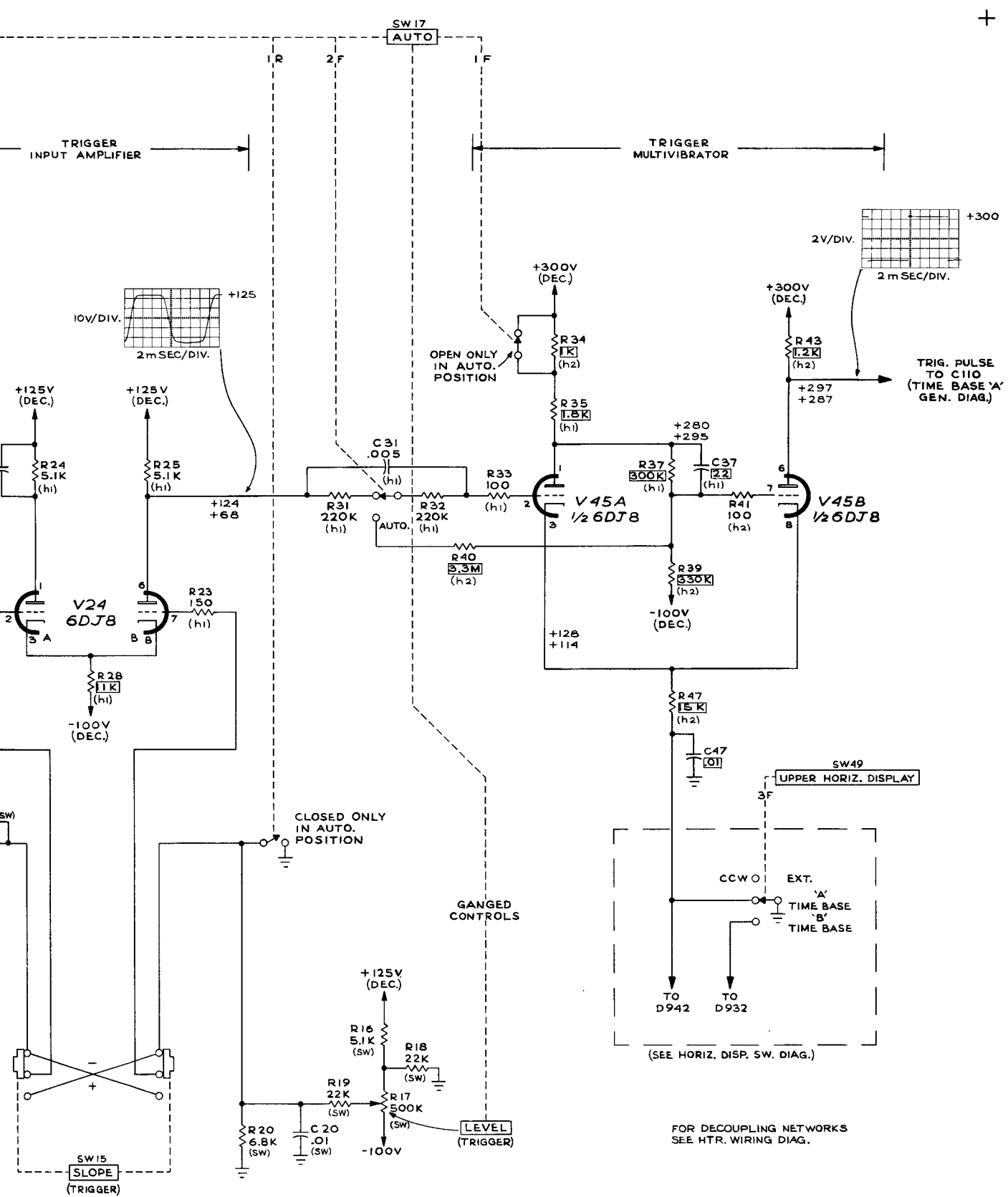
UPPER HORIZ. DISPLAY..... 'A' TIME BASE  
 LOWER HORIZ. DISPLAY..... 'B' TIME BASE  
 UPPER & LOWER EXT. HORIZ. GAIN..... CCW  
 UPPER & LOWER 10X MAG..... OFF  
 'B' MODE..... NORMAL TRIGGER  
 DELAY INTERVAL..... 2.00

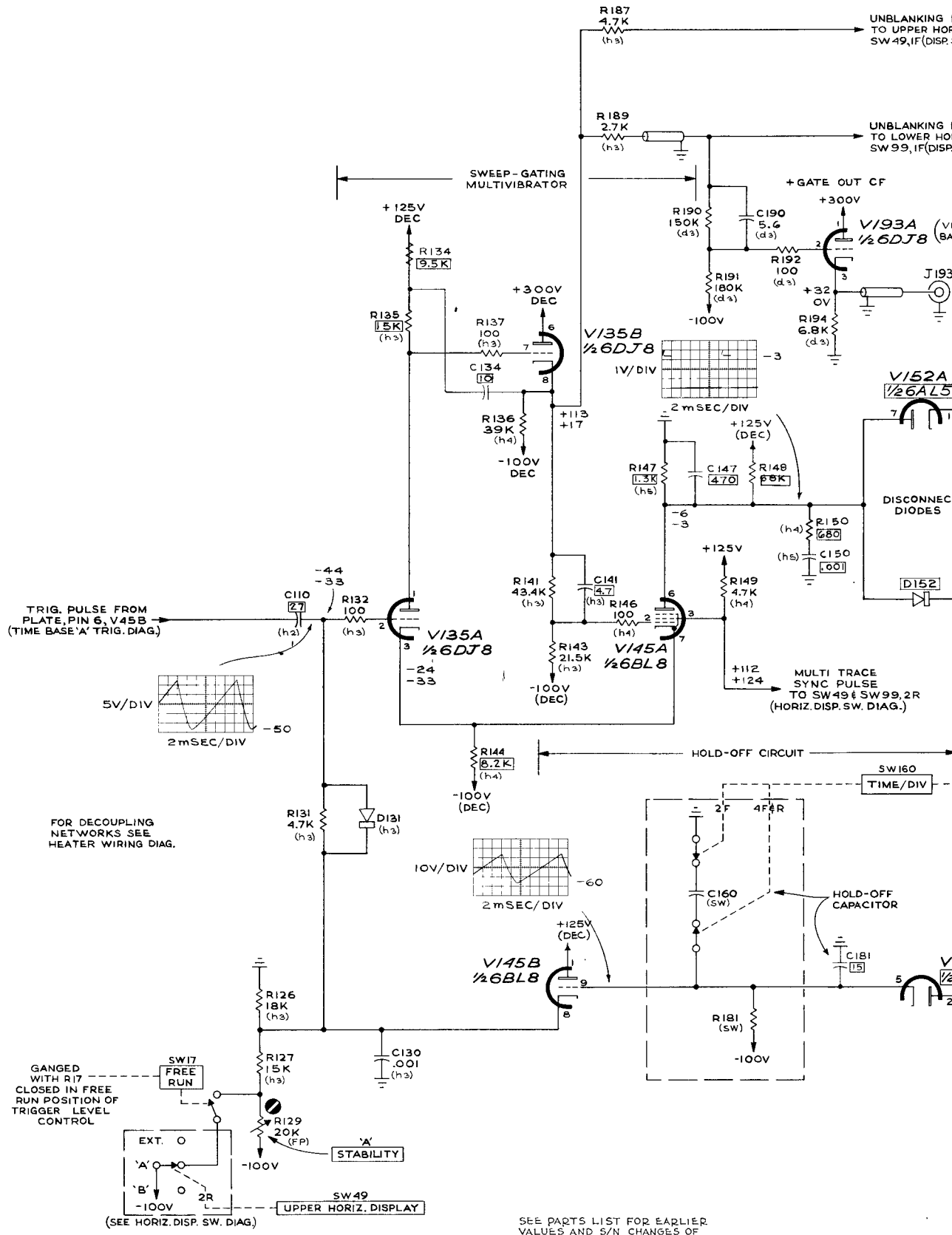
**BOTH TIME BASES:**

TIME/DIV..... 1m SEC  
 VARIABLE..... CALIBRATED  
 LEVEL..... CENTERED  
 SLOPE..... +  
 COUPLING..... DC  
 SOURCE..... EXT.  
 STABILITY..... CW.



TYPE 565 OSCILLOSCOPE





TYPE 565 OSCILLOSCOPE

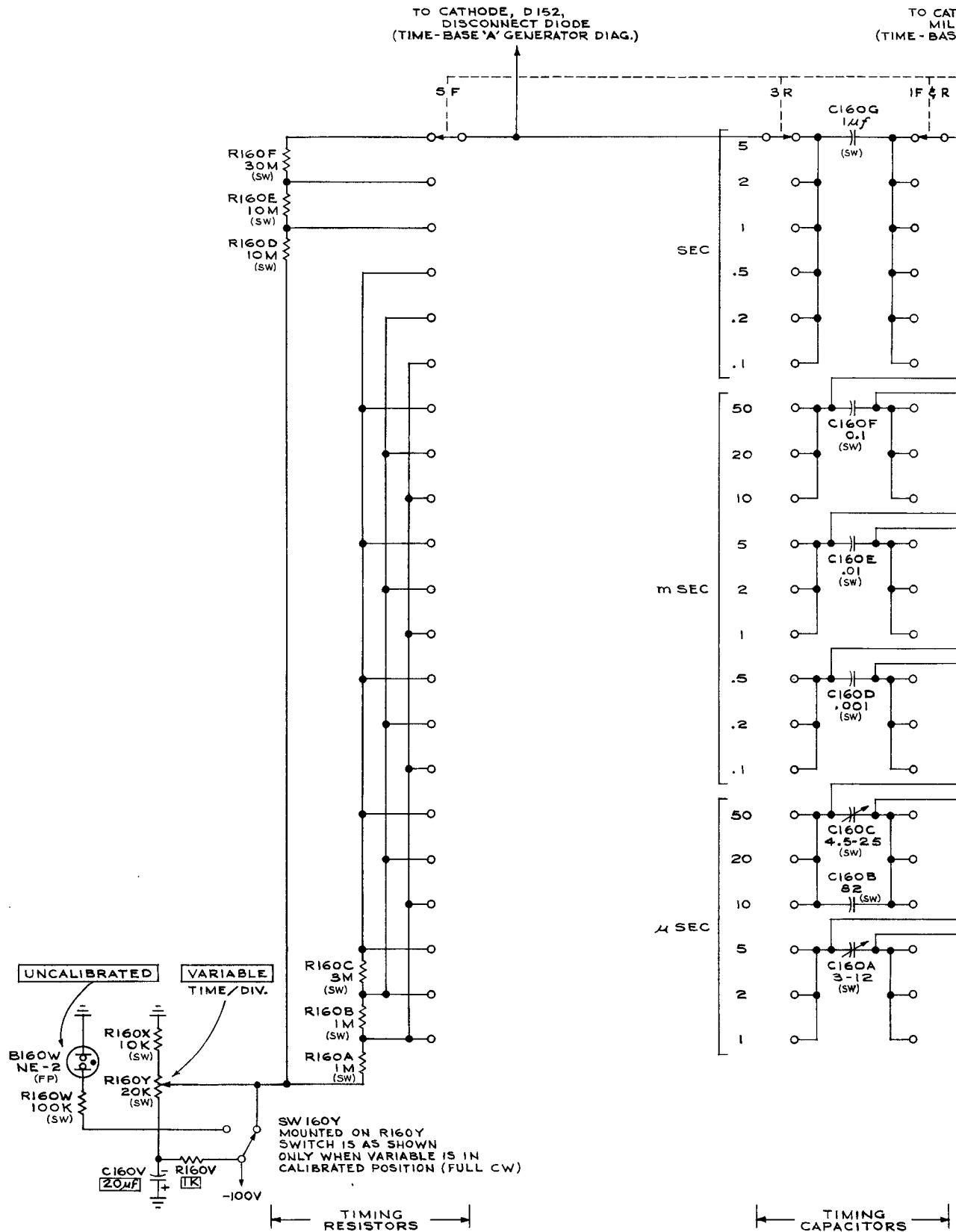
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

+

C





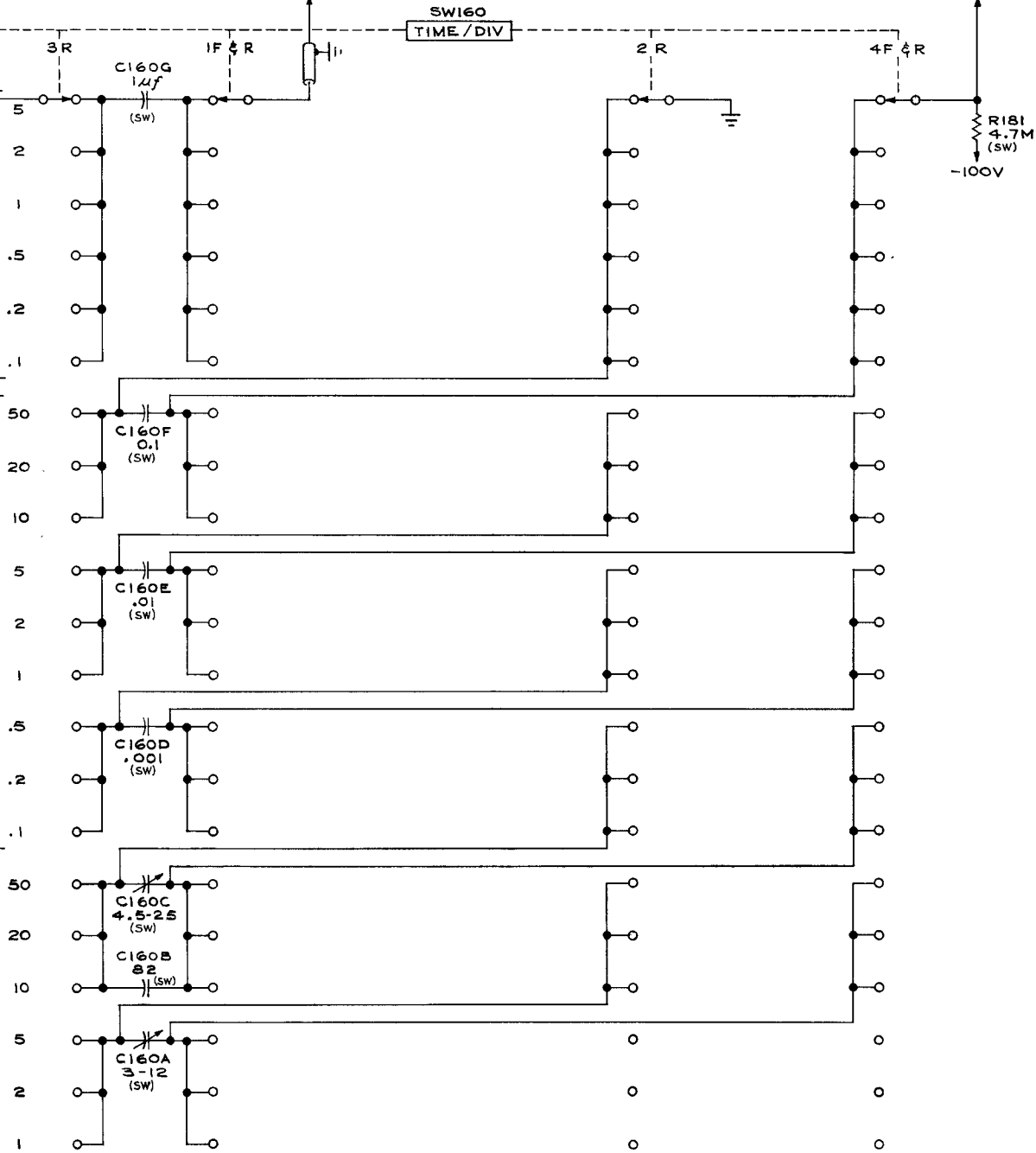


SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE.

+

TO CATHODE, PIN 1, V152A  
MILLER RUNUP CF  
(TIME-BASE 'A' GENERATOR DIAG.)

TO GRID, PIN 9, V145B  
HOLD-OFF CF  
(TIME-BASE 'A' GENERATOR DIAG.)

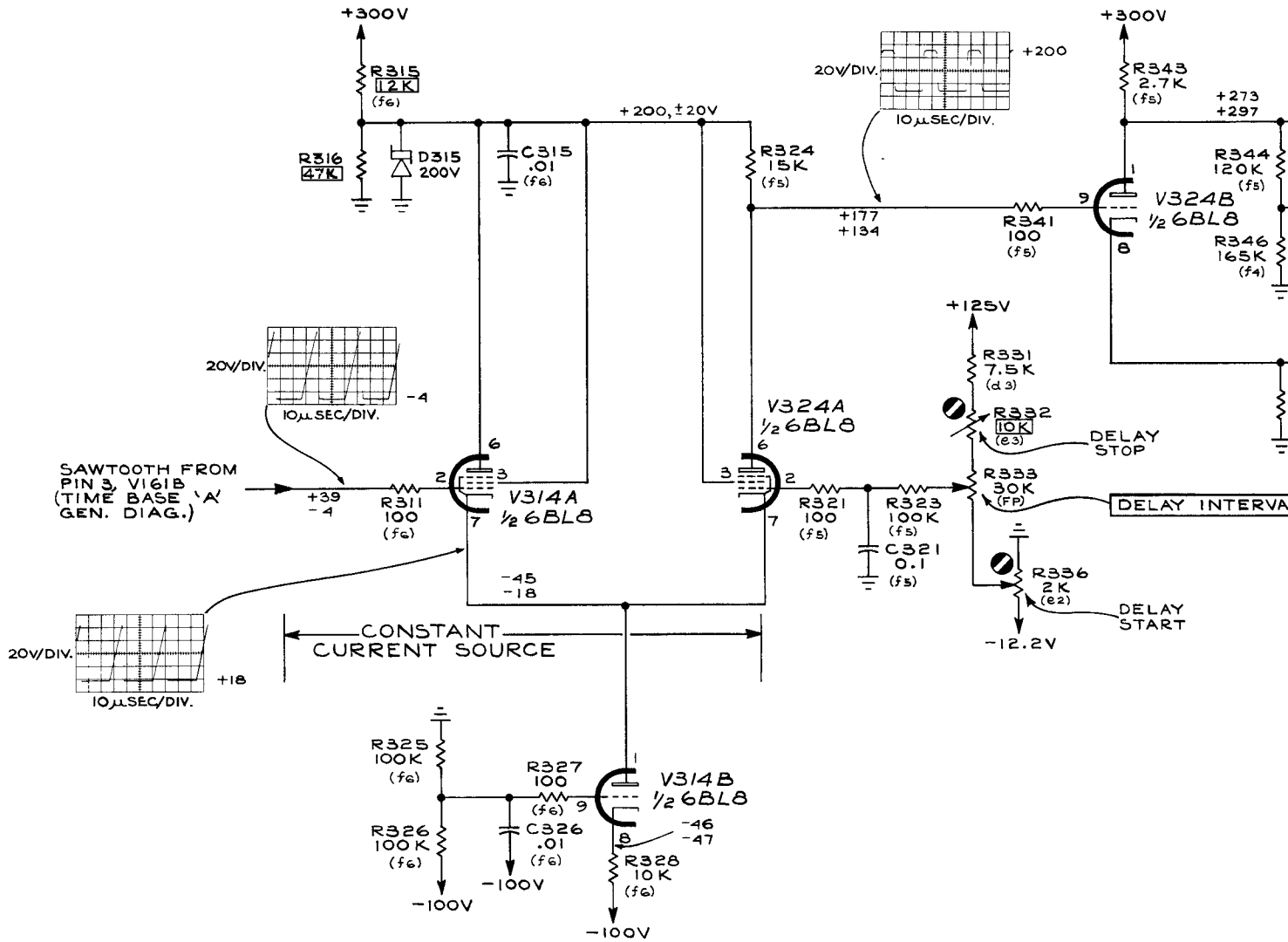


TIMING CAPACITORS

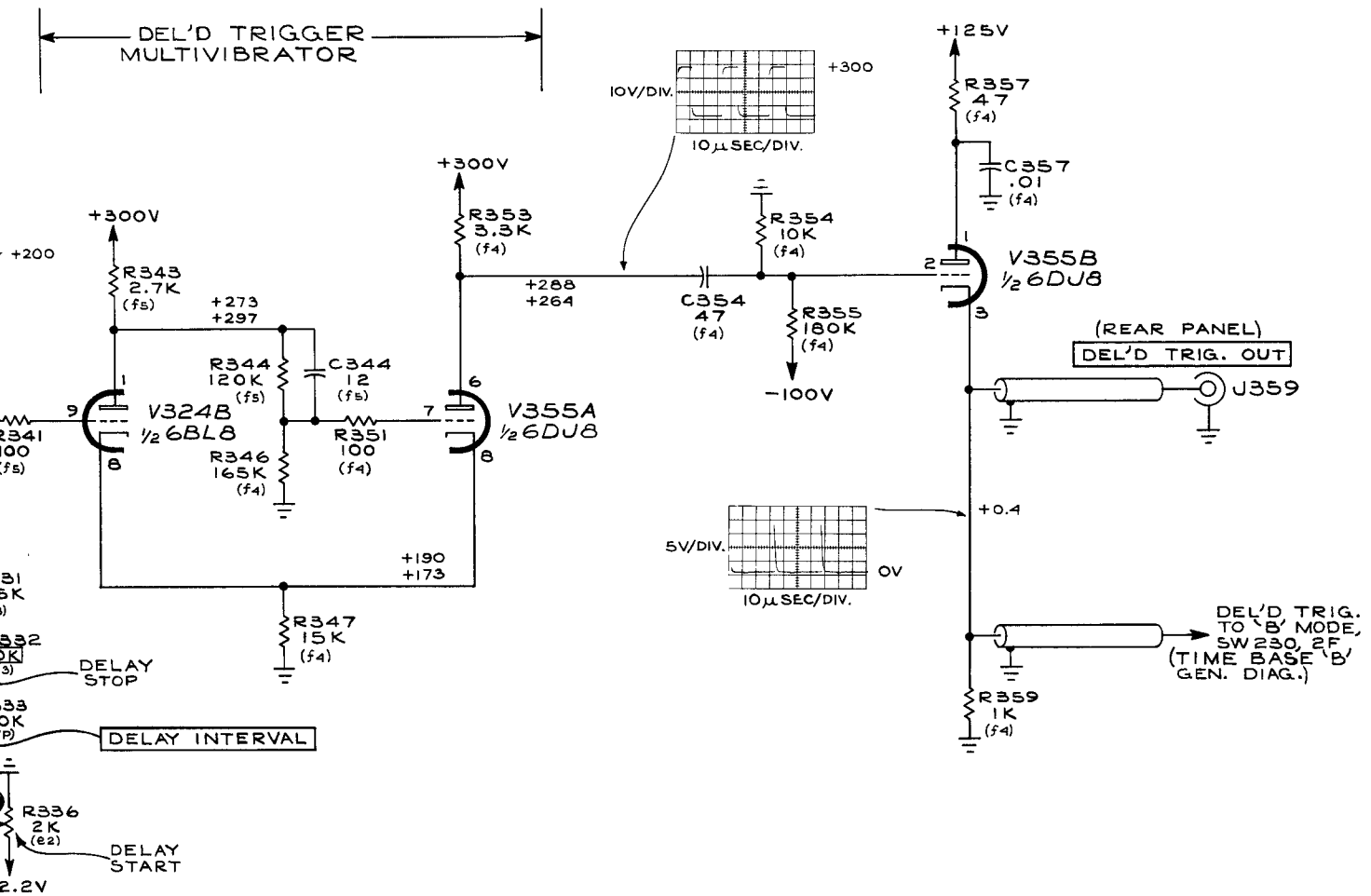
HOLD-OFF CAPACITORS

B

MRH  
365  
TIME-BASE 'A' TIMING SWITCH



+



**WAVEFORMS & VOLTAGE READINGS**  
 WERE OBTAINED UNDER FOLLOWING CONDITIONS :

WAVEFORMS  
 'A' STABILITY.....CW.  
 'A' TIME/DIV..... 1 μ SEC

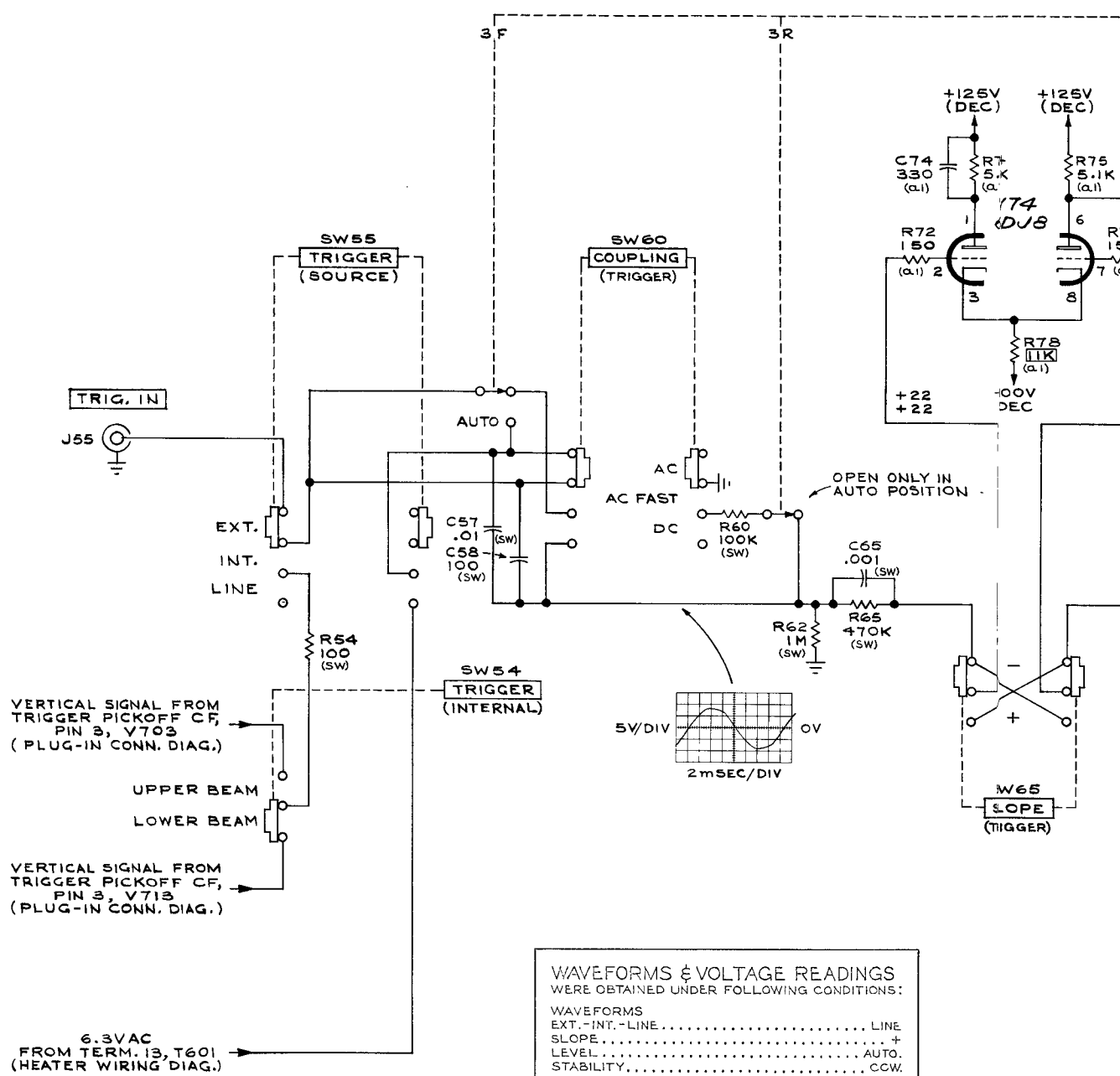
VOLTAGES  
 'A' TIME/DIV ..... 1 μ SEC  
 'A' STABILITY:  
 UPPER READINGS..... CW.  
 LOWER READINGS..... CCW.

(SEE IMPORTANT NOTE ON TIME BASE 'A' TRIG. DIAG.)

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

PLM  
 1163  
**DELAY PICKOFF**  
 CIRCUIT NUMBERS  
 300 THRU 359

TRIGGER INPUT AMPLIFIER



**WAVEFORMS & VOLTAGE READINGS**  
 WERE OBTAINED UNDER FOLLOWING CONDITIONS:

WAVEFORMS  
 EXT.-INT.-LINE ..... LINE  
 SLOPE ..... +  
 LEVEL ..... AUTO.  
 STABILITY ..... CCW.

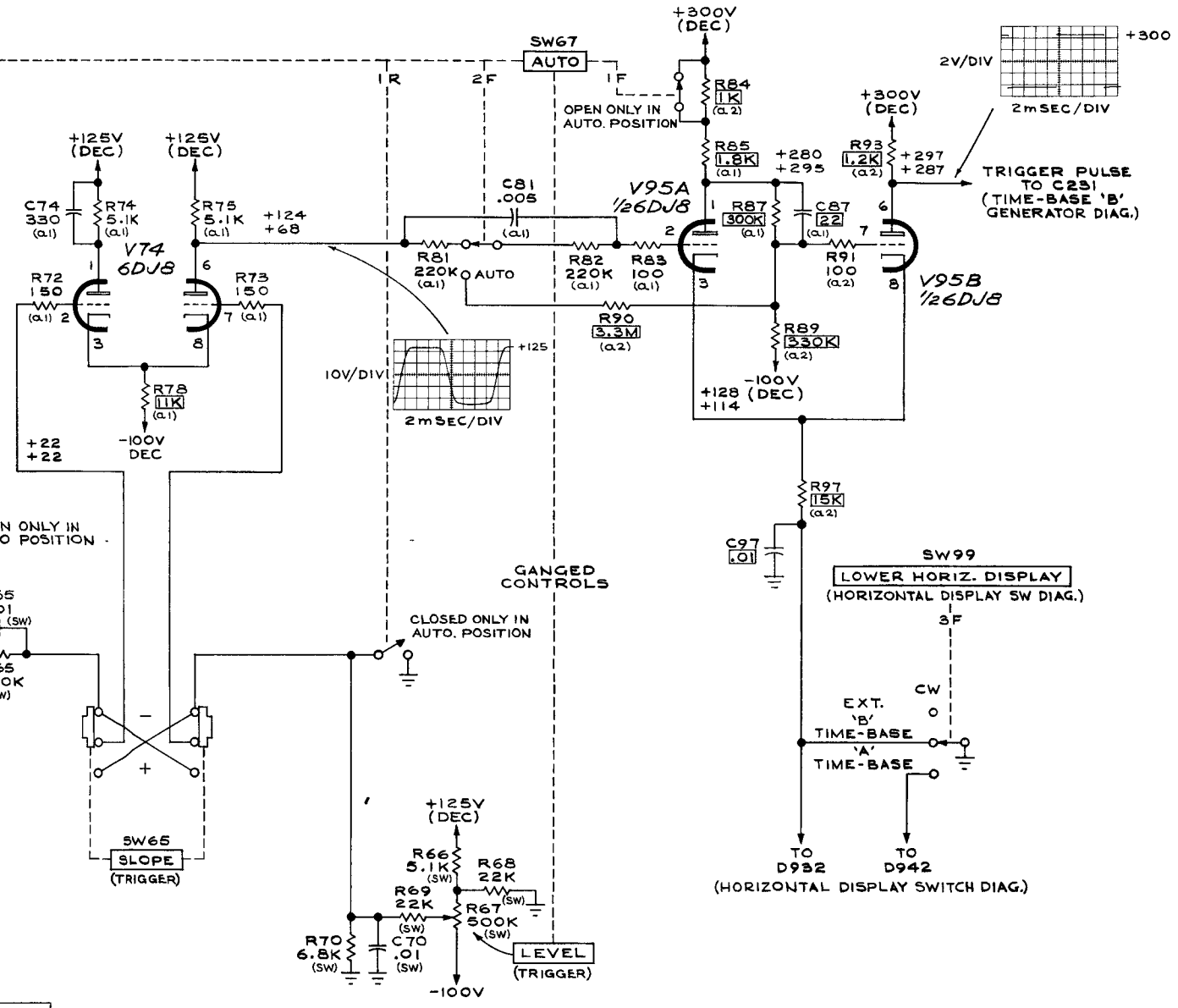
VOLTAGES  
 EXT.-INT.-LINE ..... EXT.  
 LEVEL ..... FREE RUN  
 SLOPE +  
 UPPER READINGS ..... +  
 LOWER READINGS ..... -

(SEE IMPORTANT NOTE ON TIME BASE 'A' TRIGGER DIAGRAM.)

+

TRIGGER INPUT AMPLIFIER

TRIGGER MULTIVIBRATOR



INGS  
ITIONS:

... LINE  
... +  
... AUTO.  
... CCW.

... EXT.  
... RUN

... +  
... -

E 'A'

NOTE:  
FOR DECOUPLING NETWORKS  
SEE HEATER WIRING DIAGRAM

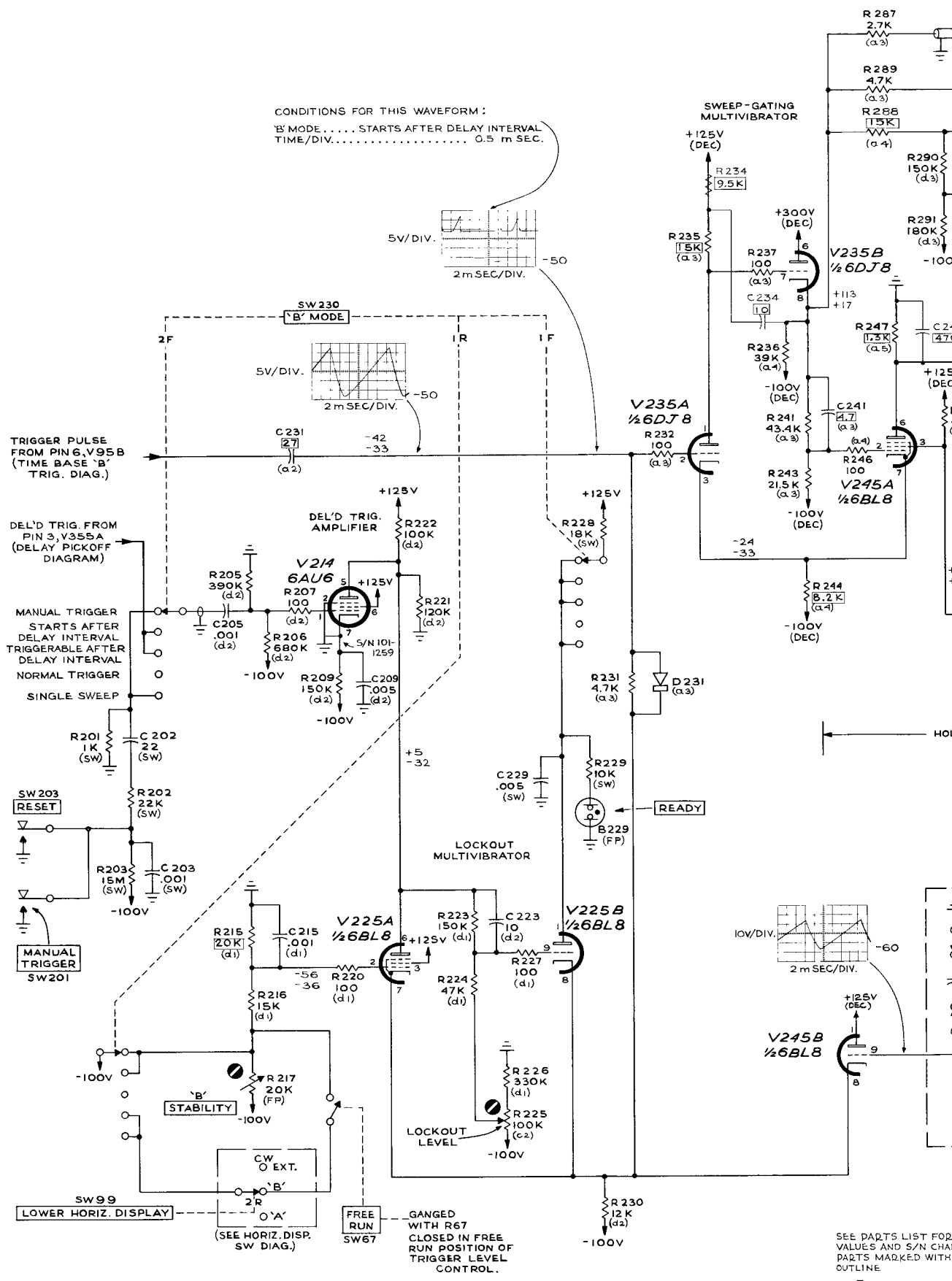
SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

MRH  
763

TIME BASE 'B' TRIGGER

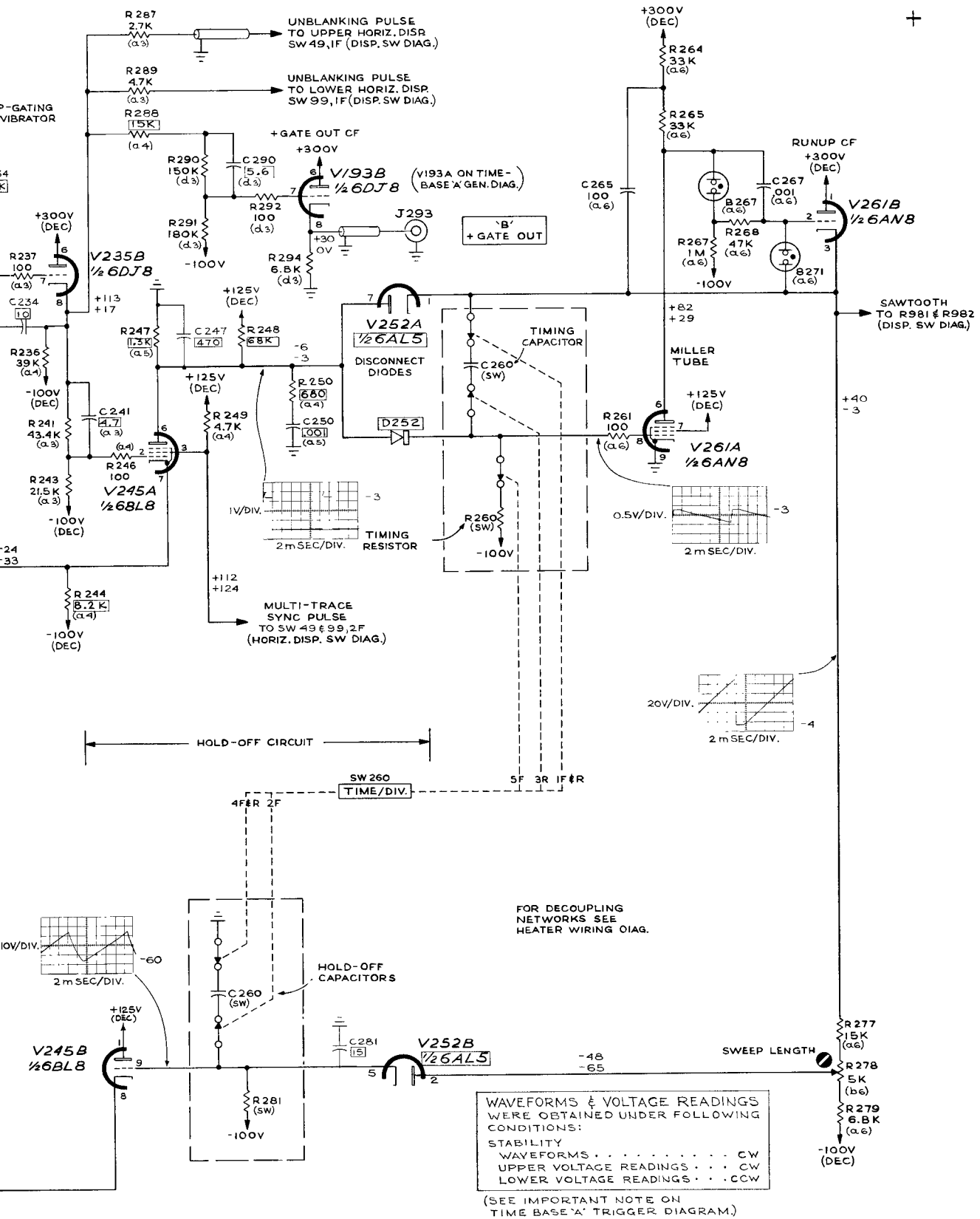
CIRCUIT NUMBERS  
50 THRU 99

A



TYPE 565 OSCILLOSCOPE

+

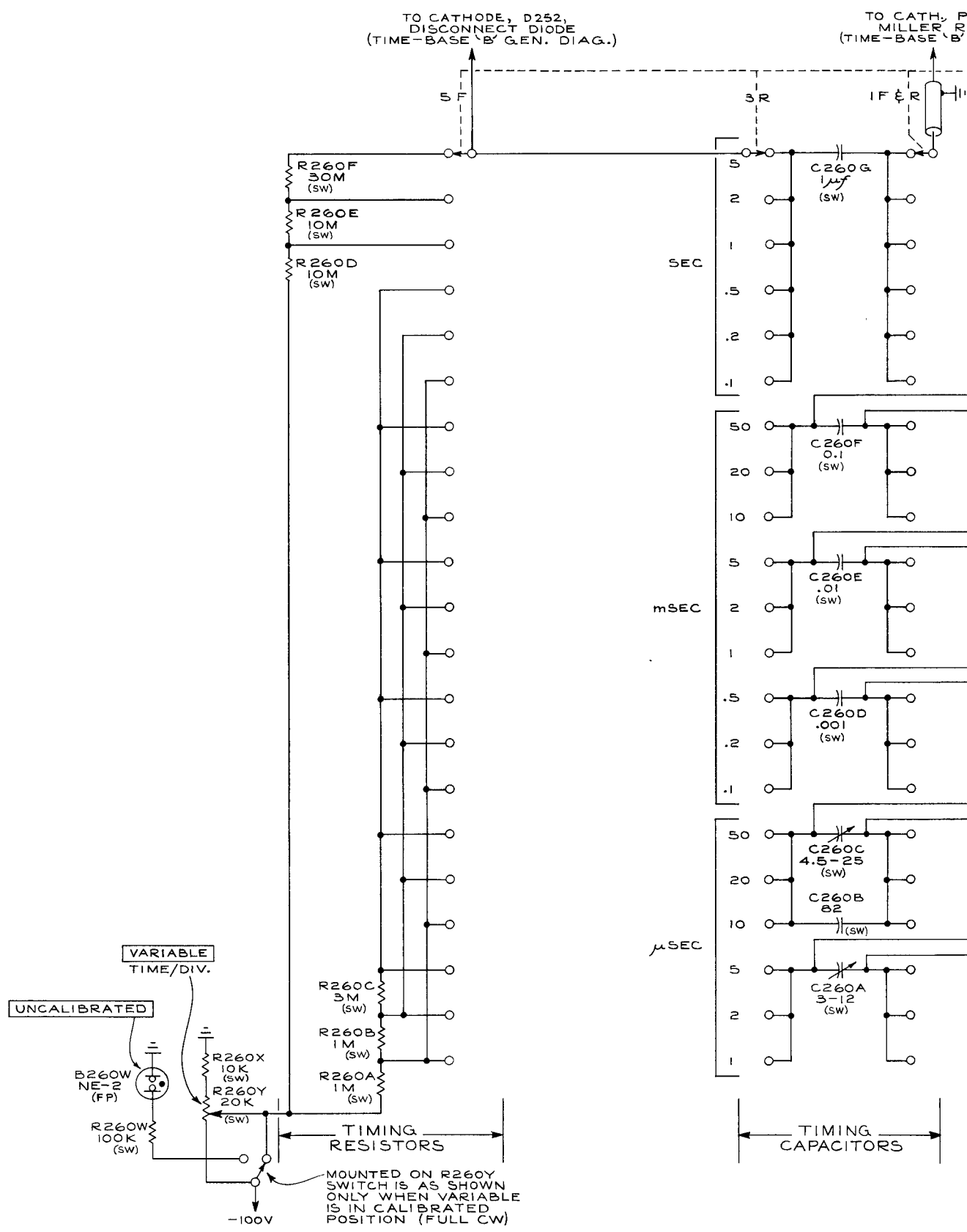


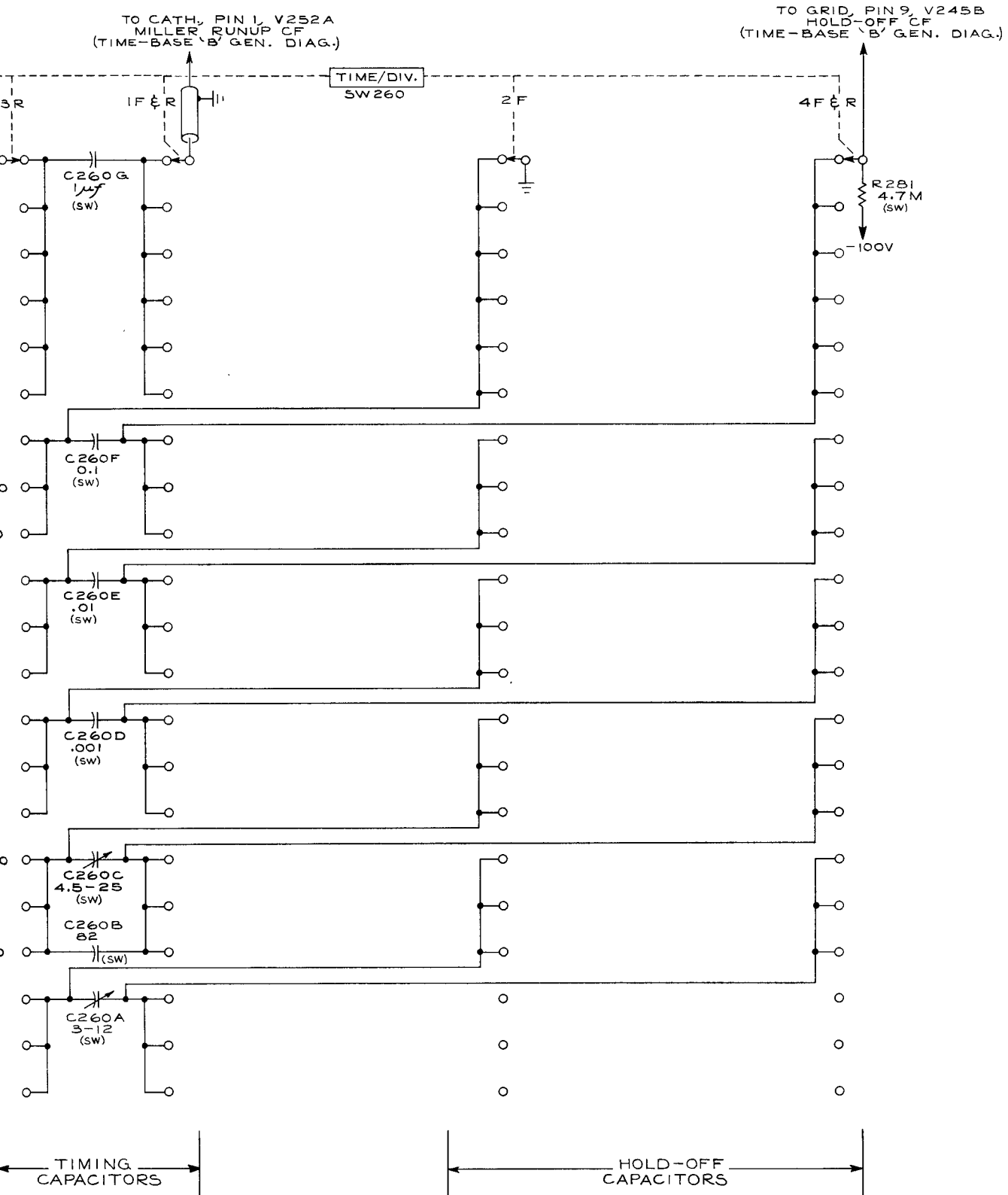
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

CIRCUIT NUMBERS 966  
200 THRU 299 CMD

TIME BASE 'B' GENERATOR

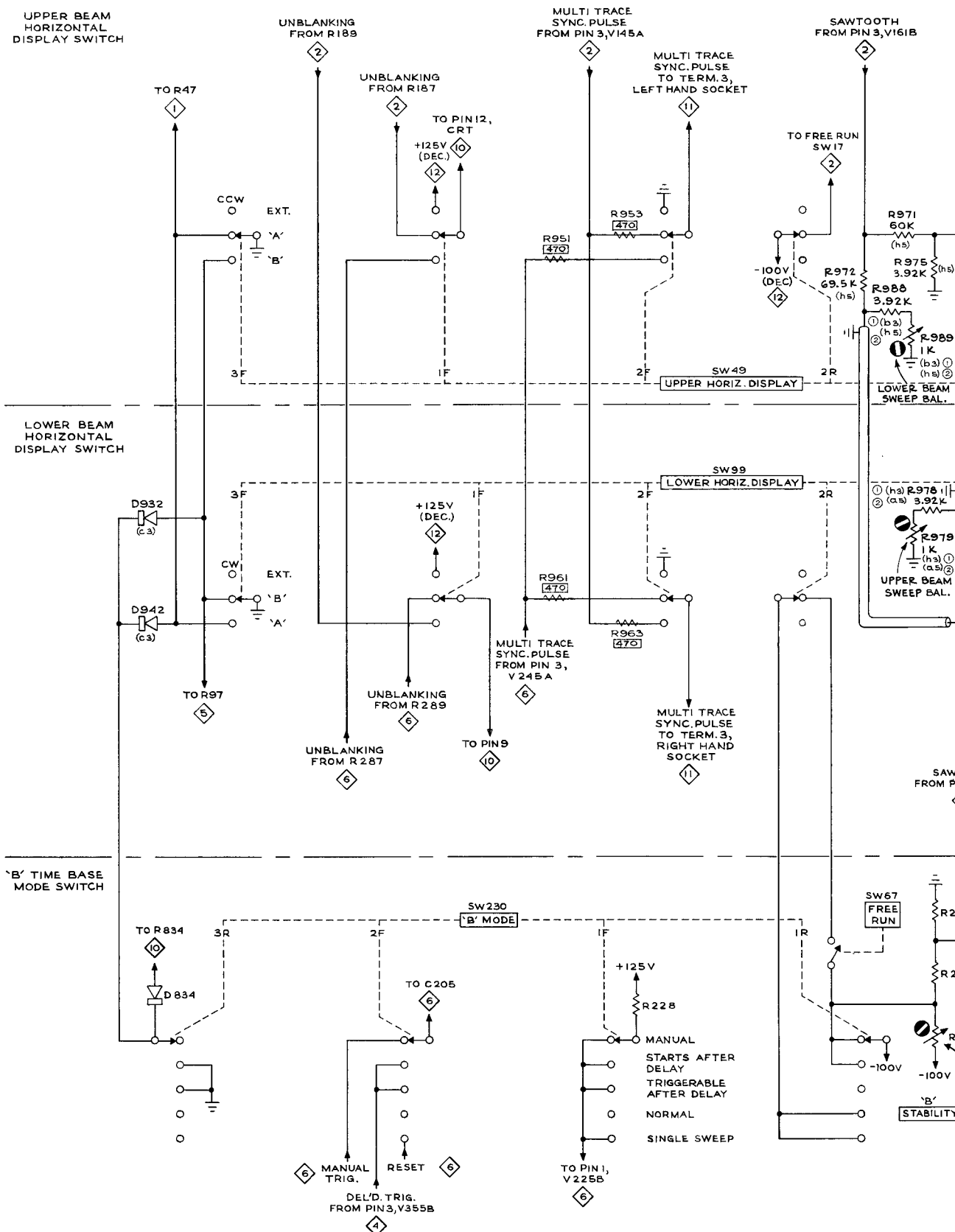






B

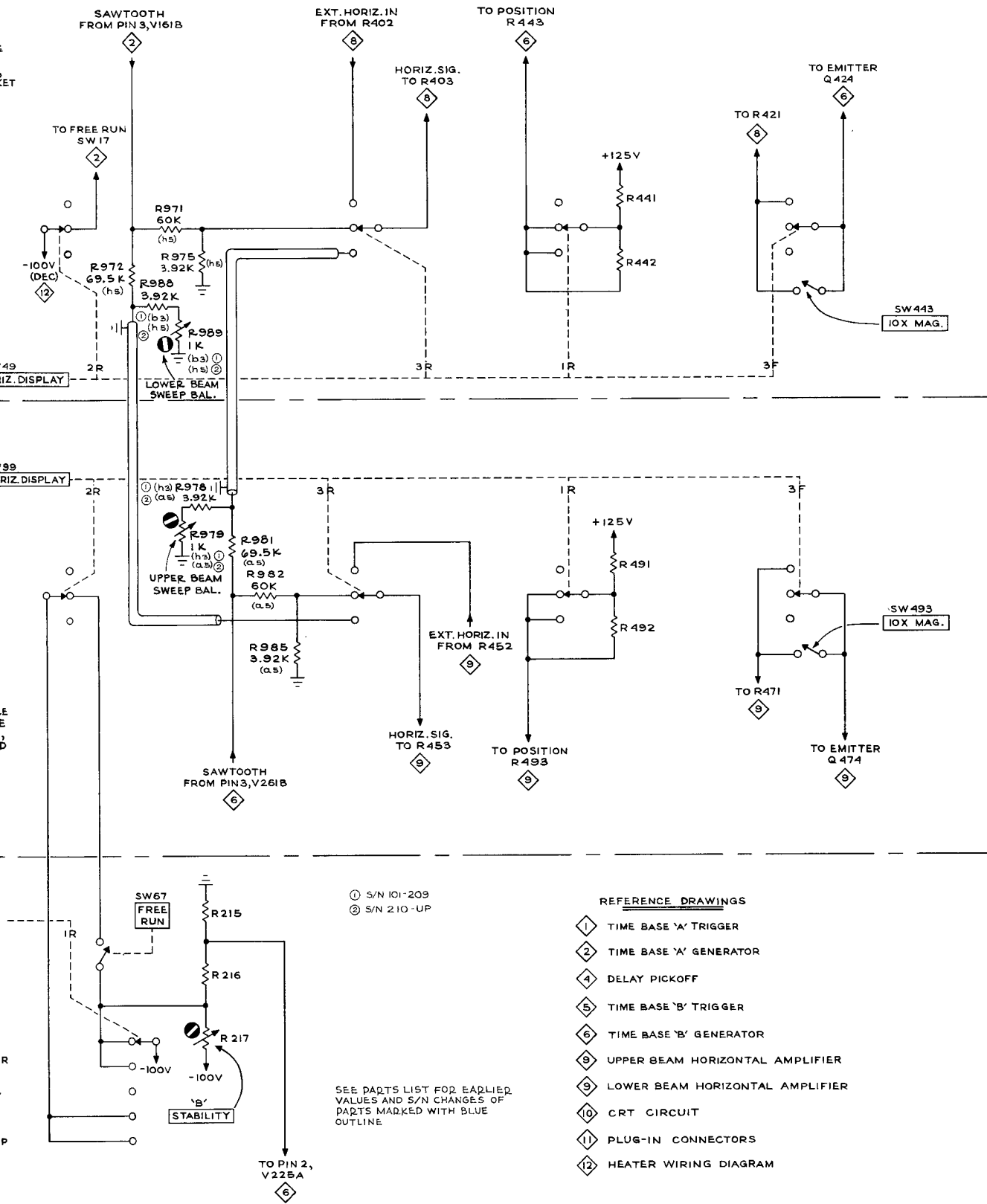
PLM  
365  
TIME-BASE 'B' TIMING SWITCH



TYPE 565 OSCILLOSCOPE

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① S/N 101-209  
 ② S/N 210-UP

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

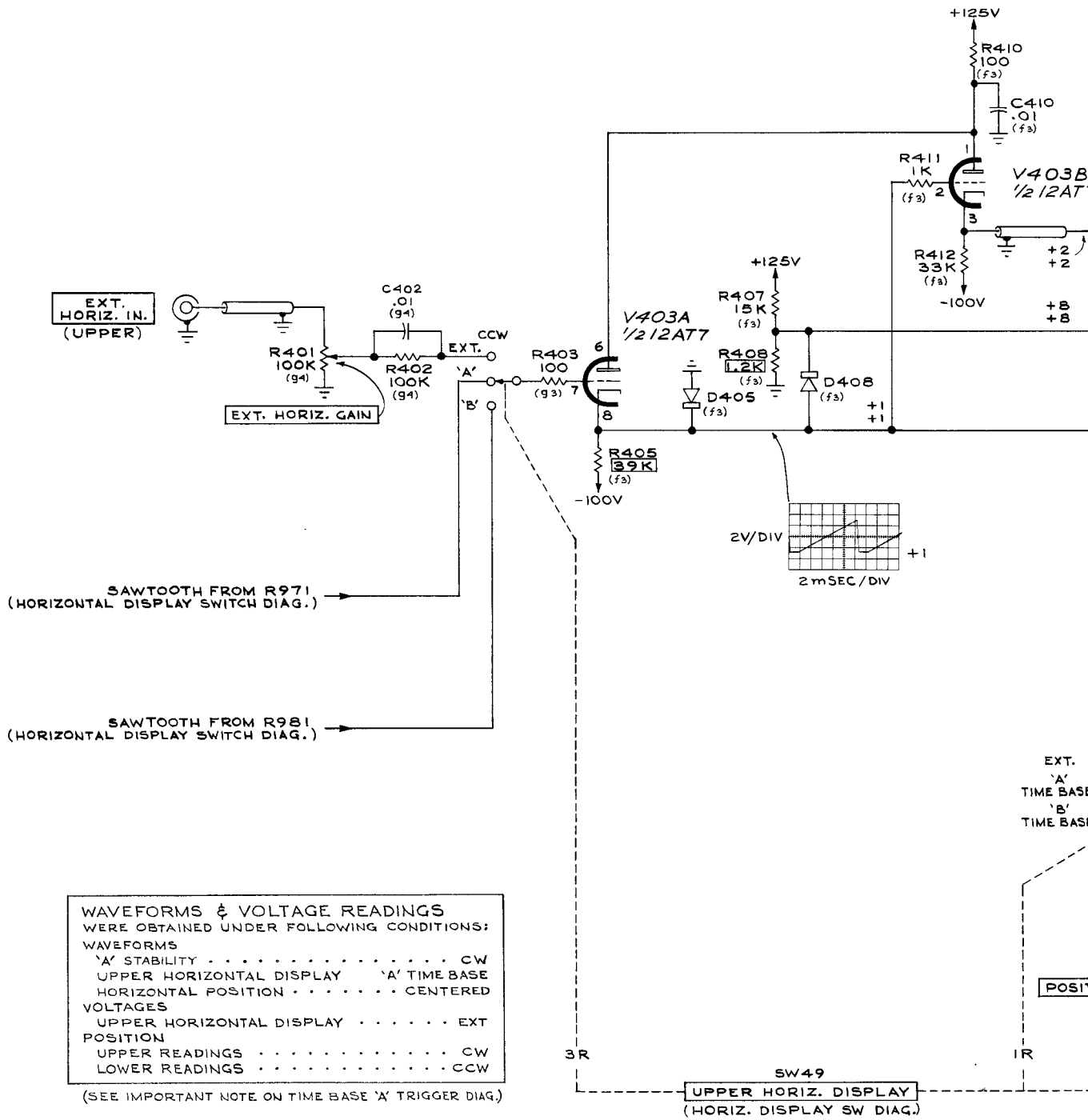
REFERENCE DRAWINGS

- ① TIME BASE 'A' TRIGGER
- ② TIME BASE 'A' GENERATOR
- ④ DELAY PICKOFF
- ⑤ TIME BASE 'B' TRIGGER
- ⑥ TIME BASE 'B' GENERATOR
- ⑧ UPPER BEAM HORIZONTAL AMPLIFIER
- ⑨ LOWER BEAM HORIZONTAL AMPLIFIER
- ⑩ CRT CIRCUIT
- ⑪ PLUG-IN CONNECTORS
- ⑫ HEATER WIRING DIAGRAM

CIRCUIT NUMBERS  
 930 THRU 999

CMO  
 265

HORIZONTAL DISPLAY SWITCHING



WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

WAVEFORMS

'A' STABILITY . . . . . CW

UPPER HORIZONTAL DISPLAY 'A' TIME BASE

HORIZONTAL POSITION . . . . . CENTERED

VOLTAGES

UPPER HORIZONTAL DISPLAY . . . . . EXT

POSITION

UPPER READINGS . . . . . CW

LOWER READINGS . . . . . CCW

(SEE IMPORTANT NOTE ON TIME BASE 'A' TRIGGER DIAG.)

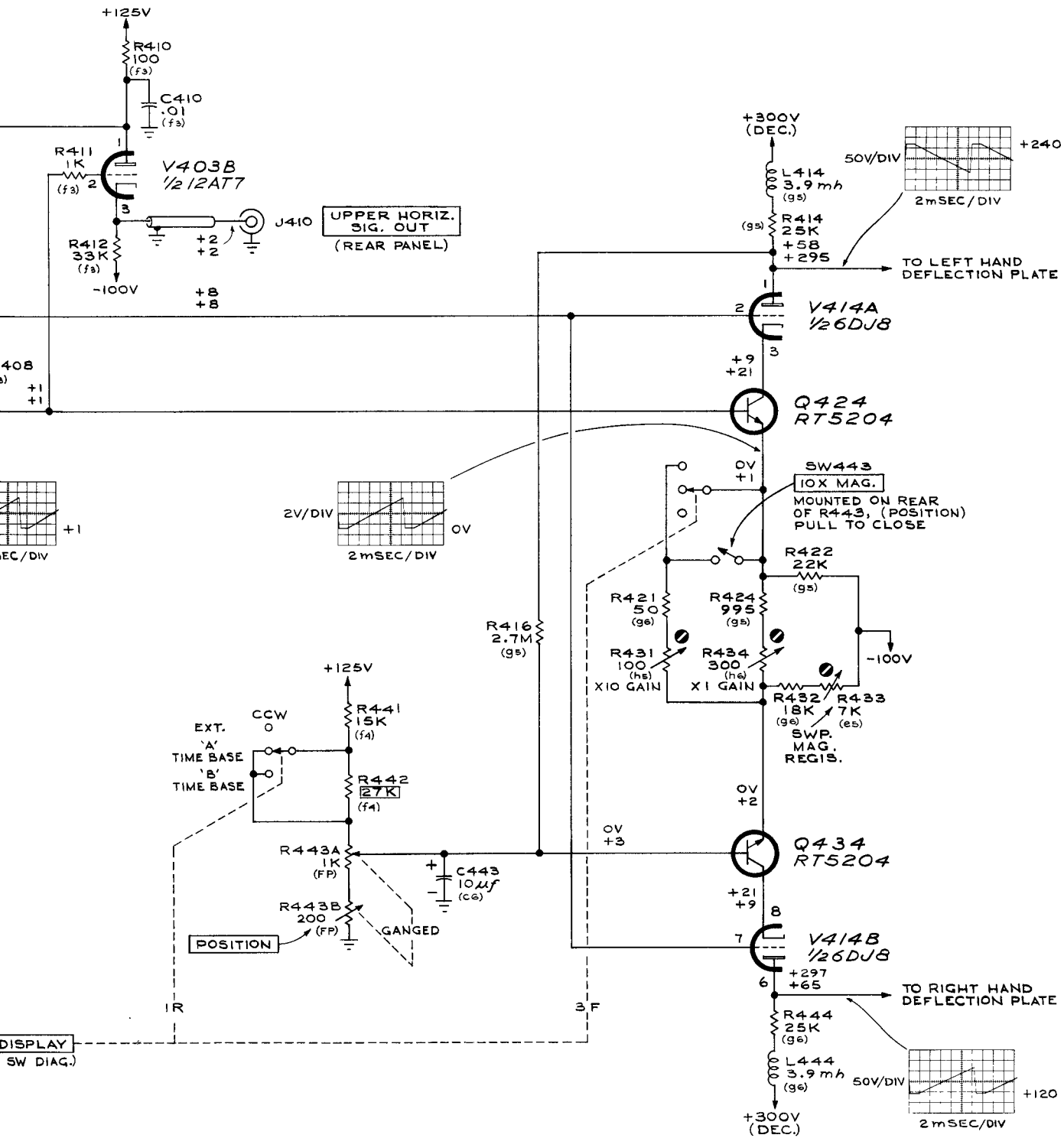
NOTE:  
FOR DECOUPLING NETWORK  
SEE HEATER WIRING DIAGRAM.

+

+

HORIZONTAL SIGNAL OUT CF

OUTPUT AMPLIFIER



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

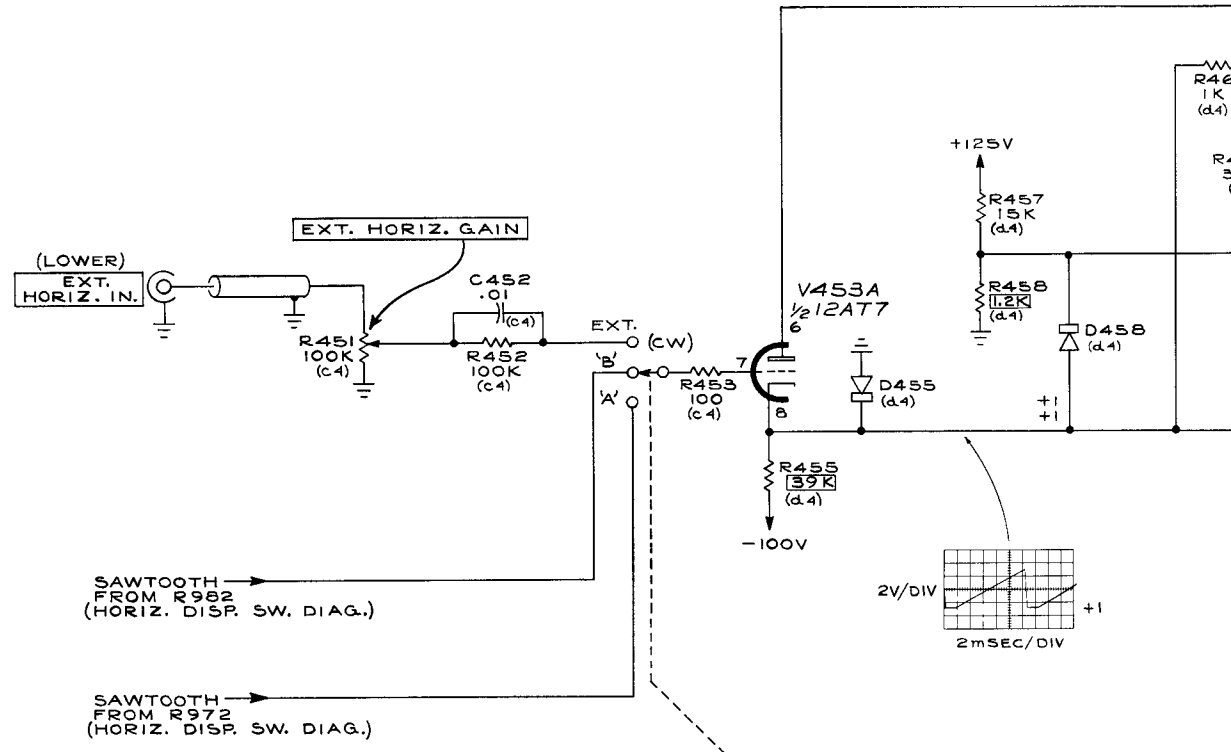
MRH  
763

UPPER BEAM HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS  
400 THRU 449

A

HORIZ. INPUT  
CF



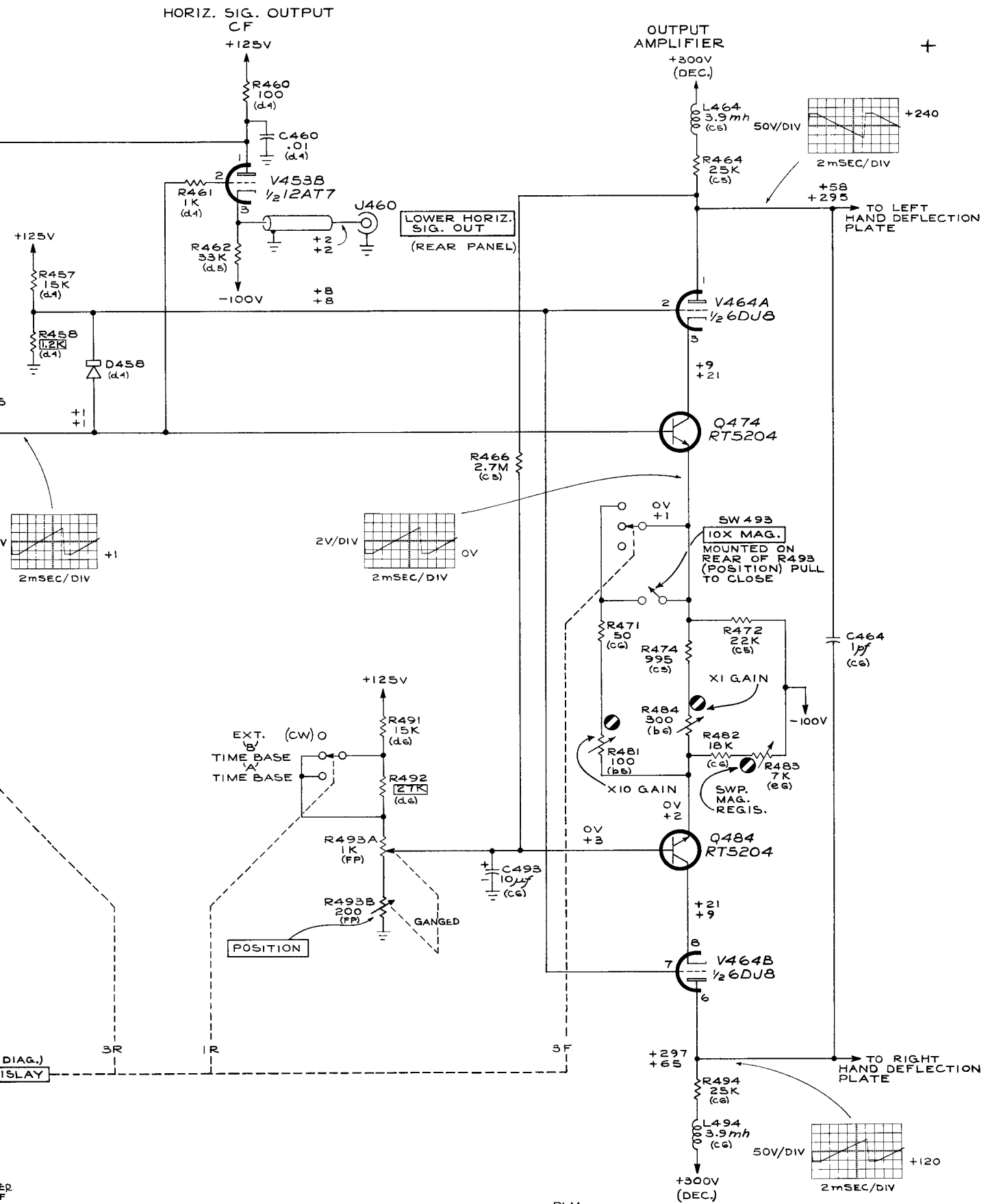
NOTE:  
FOR DECOUPLING NETWORK SEE  
HEATER WIRING DIAGRAM.

WAVEFORMS & VOLTAGE READINGS  
WERE OBTAINED UNDER FOLLOWING CONDITIONS:  
WAVEFORMS  
 'B' STABILITY . . . . . CW  
 LOWER HORIZONTAL DISPLAY . . 'B' TIME BASE  
 HORIZONTAL POSITION . . . . . CENTERED  
 VOLTAGES  
 LOWER HORIZONTAL DISPLAY . . . . . EXT  
 POSITION  
 UPPER READINGS . . . . . CW  
 LOWER READINGS . . . . . CCW

(SEE IMPORTANT NOTE ON TIME BASE 'A' TRIGGER DIAG.)

(HORIZ. DISP SW. DIAG.)  
LOWER HORIZ. DISPLAY  
SW 99

SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

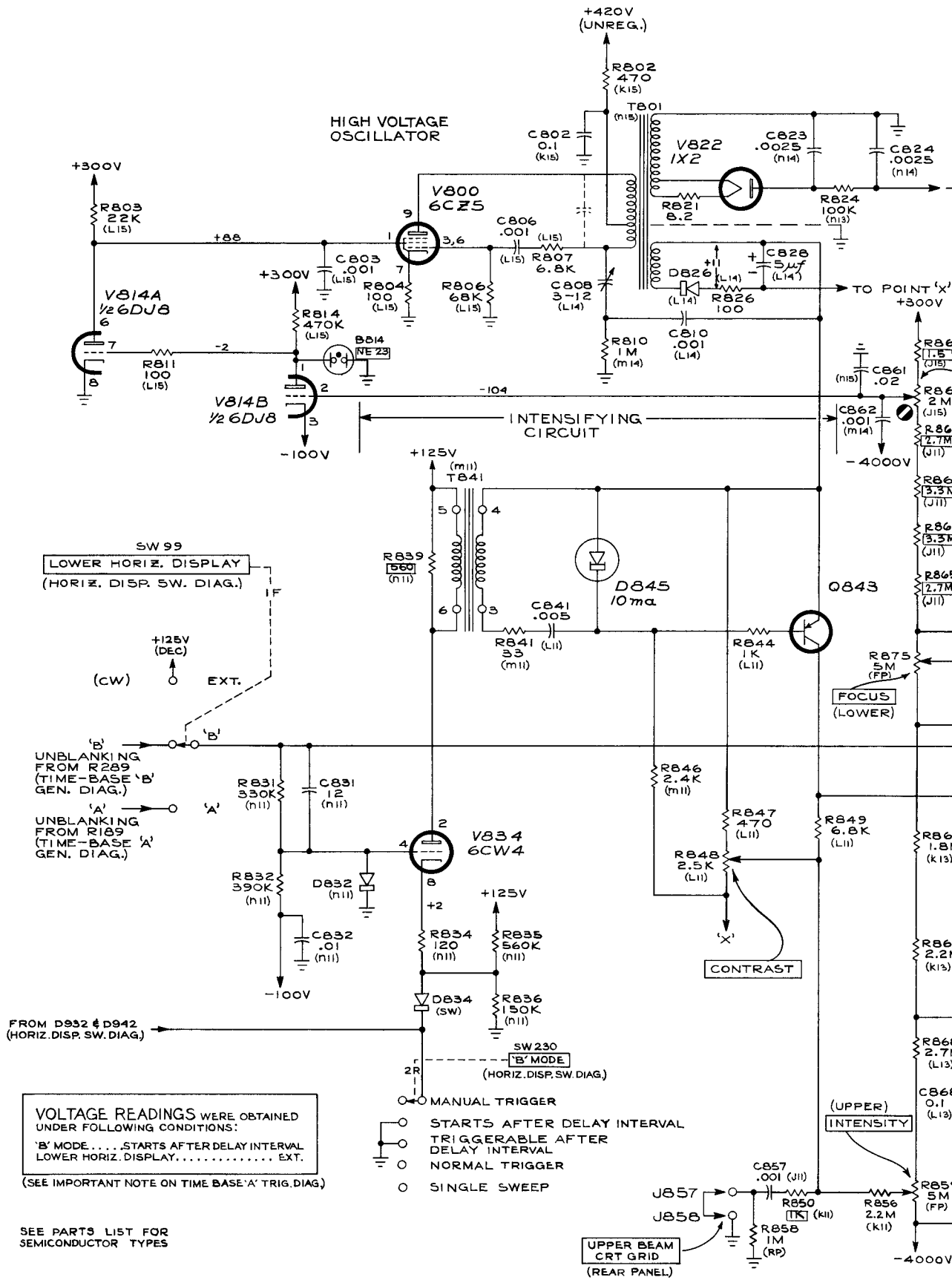


A

LOWER BEAM HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS 450 THRU 499

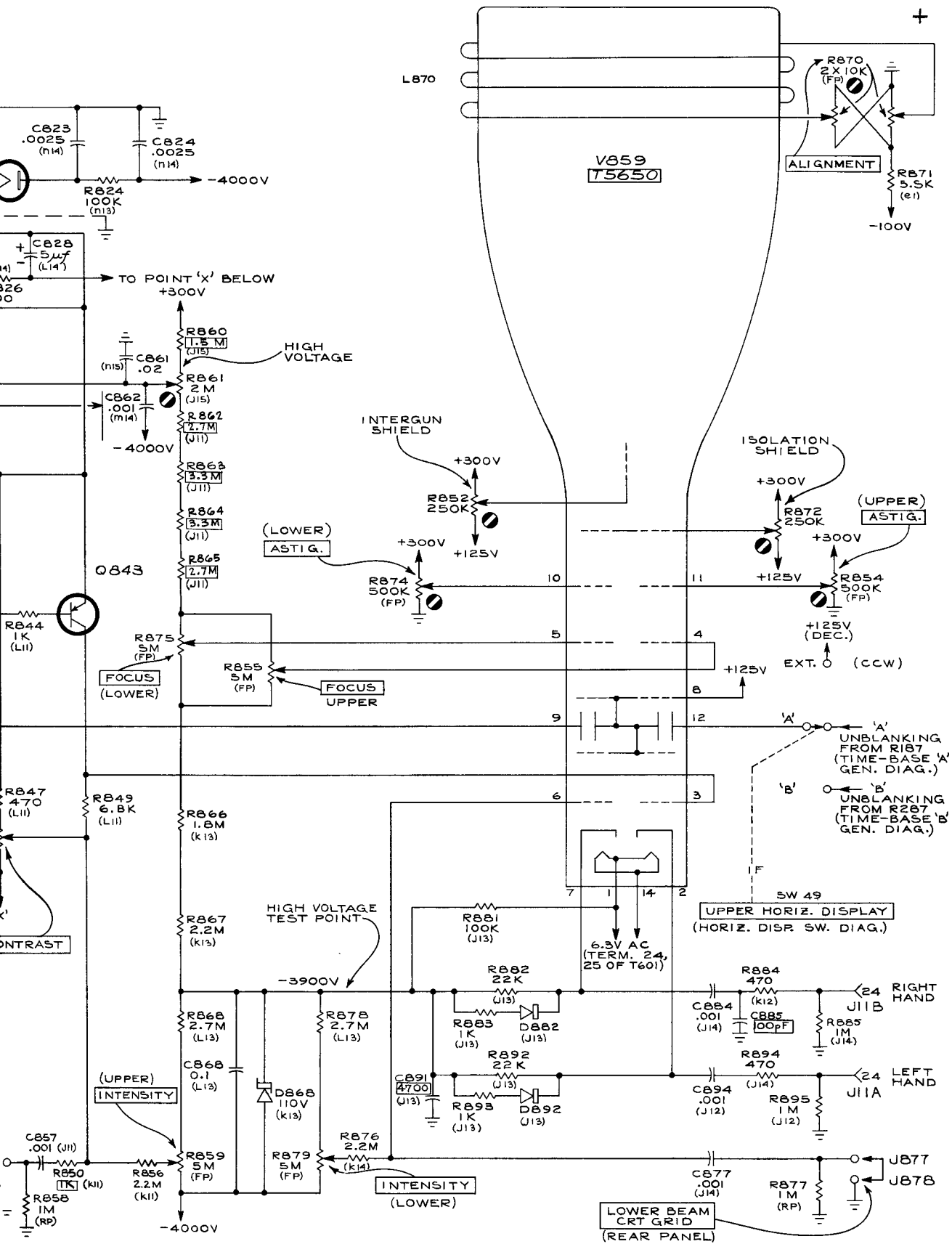




VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:  
 'B' MODE . . . STARTS AFTER DELAY INTERVAL LOWER HORIZ. DISPLAY. . . . . EXT.  
 (SEE IMPORTANT NOTE ON TIME BASE 'A' TRIG. DIAG.)

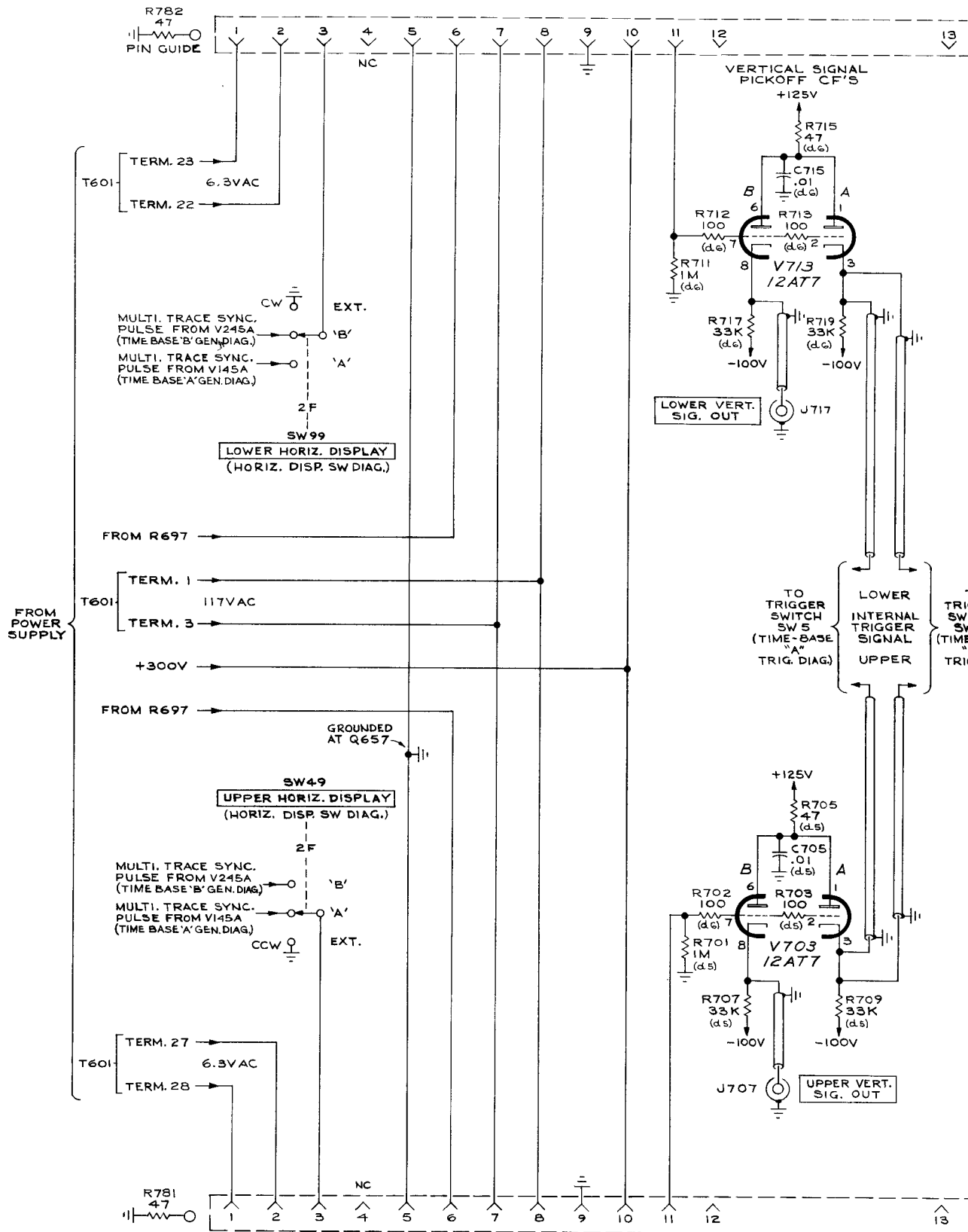
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

TYPE 565 OSCILLOSCOPE

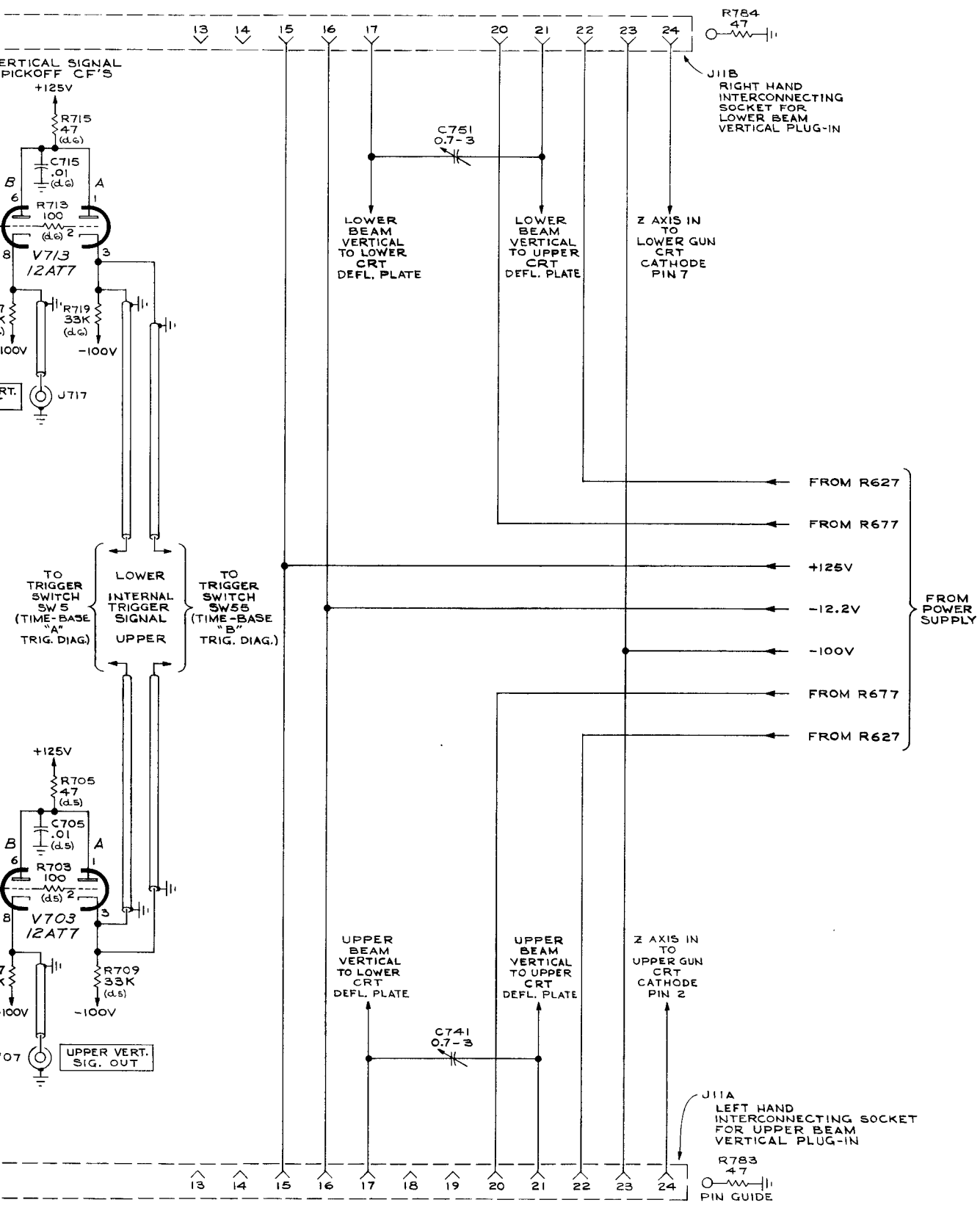


PLM  
166  
**CRT CIRCUIT**  
CIRCUIT NUMBERS  
800 THRU 899

SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE



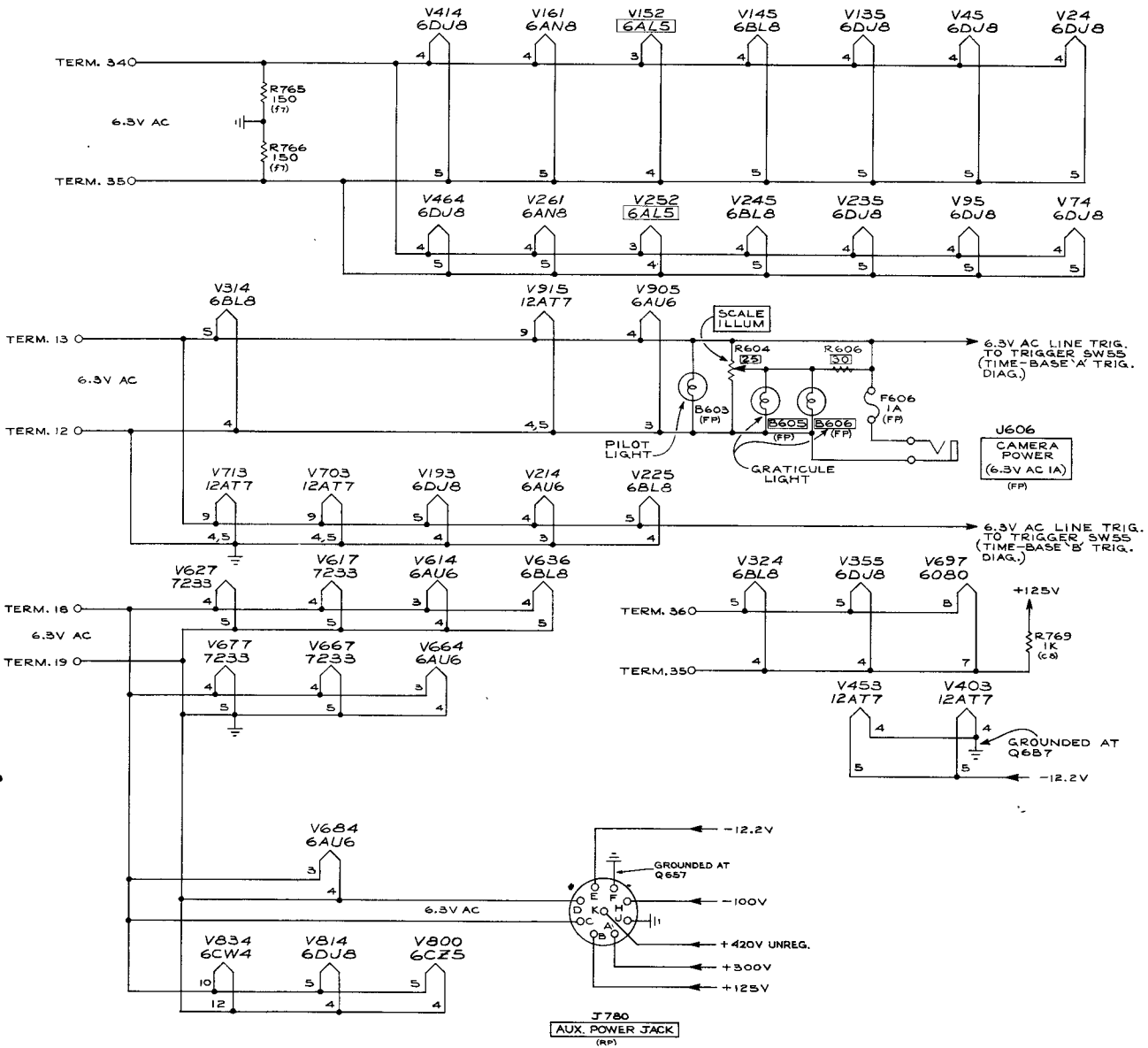
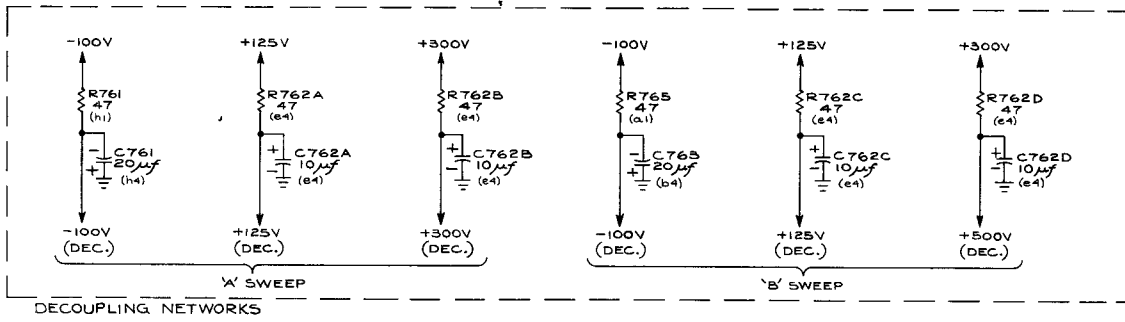
TYPE 565 OSCILLOSCOPE



MR4  
763

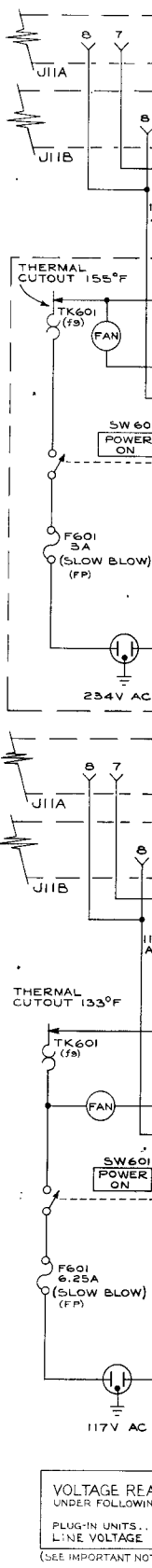
A

PLUG-IN CONNECTORS

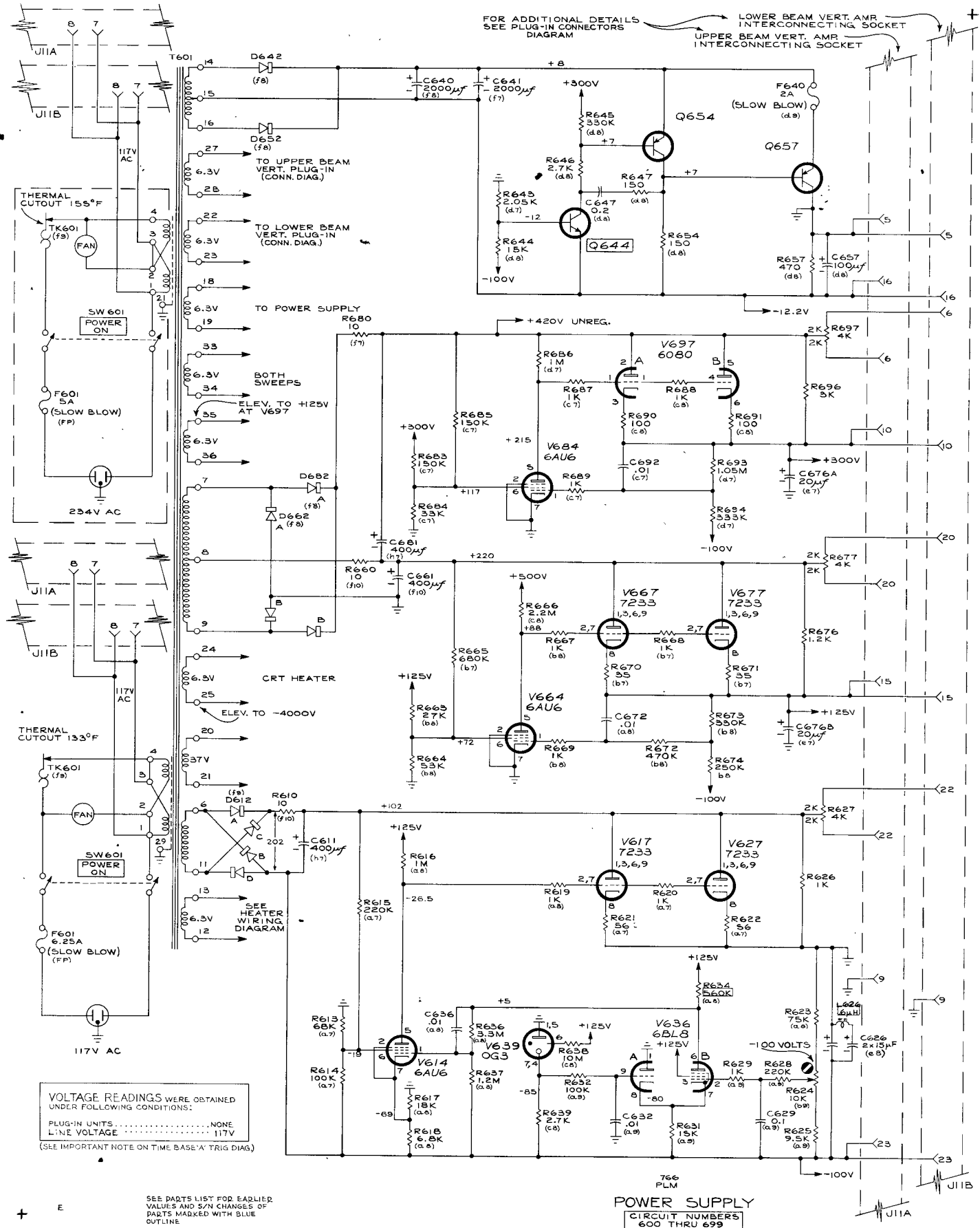


TYPE 565 OSCILLOSCOPE

HEATER WIRING



VOLTAGE READING UNDER FOLLOWING PLUG-IN UNITS... LINE VOLTAGE (SEE IMPORTANT NOT...)

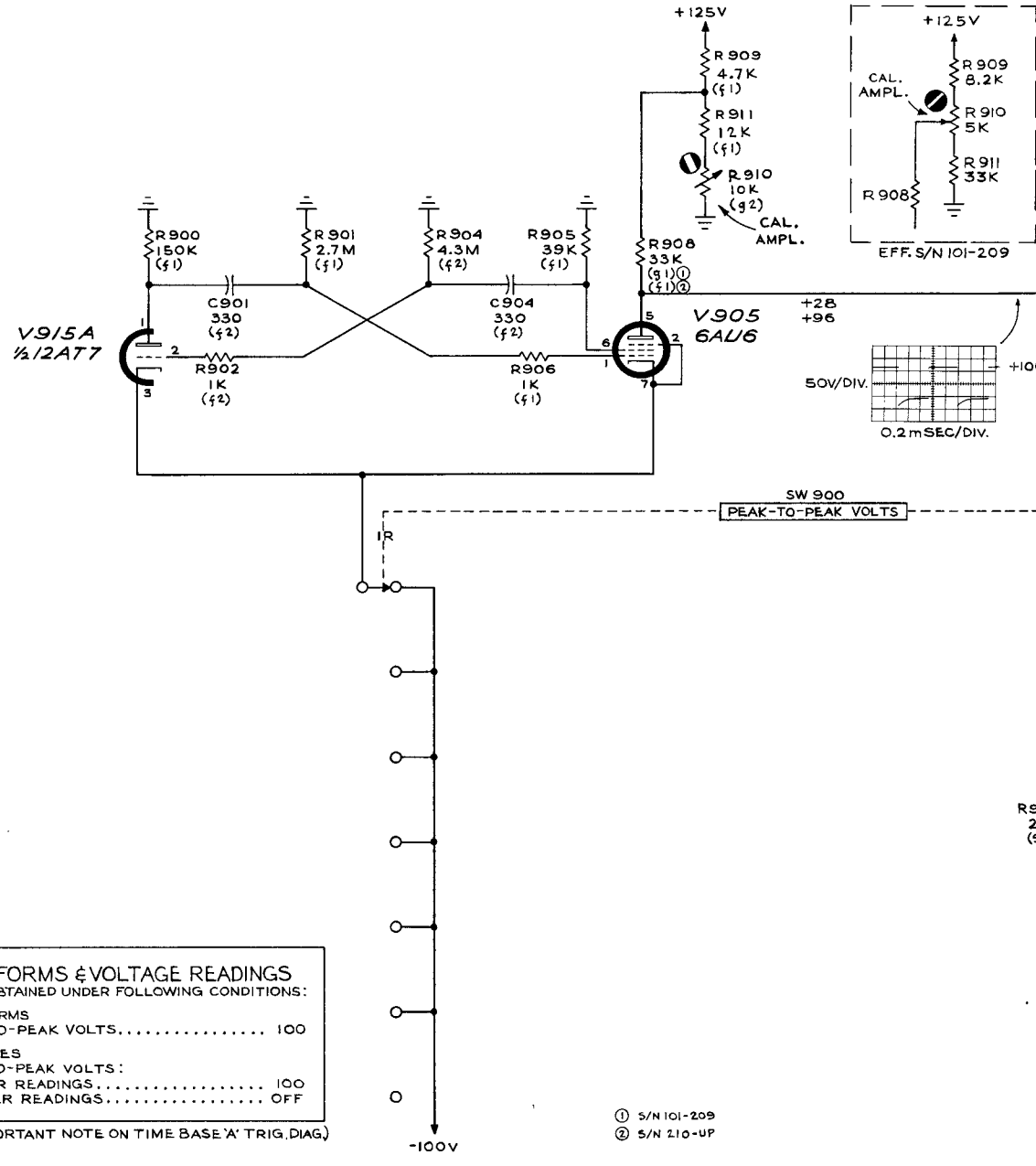


VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:  
 PLUG-IN UNITS ..... NONE  
 LINE VOLTAGE ..... 117V  
 (SEE IMPORTANT NOTE ON TIME BASE 'A' TRIG DIAG.)

SEE PARTS LIST FOR EARLIER VALUES AND S/W CHANGES OF PARTS MARKED WITH BLUE OUTLINE

POWER SUPPLY  
 CIRCUIT NUMBERS  
 600 THRU 699

CALIBRATOR  
MULTIVIBRATOR



**WAVEFORMS & VOLTAGE READINGS**  
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

WAVEFORMS  
PEAK-TO-PEAK VOLTS..... 100

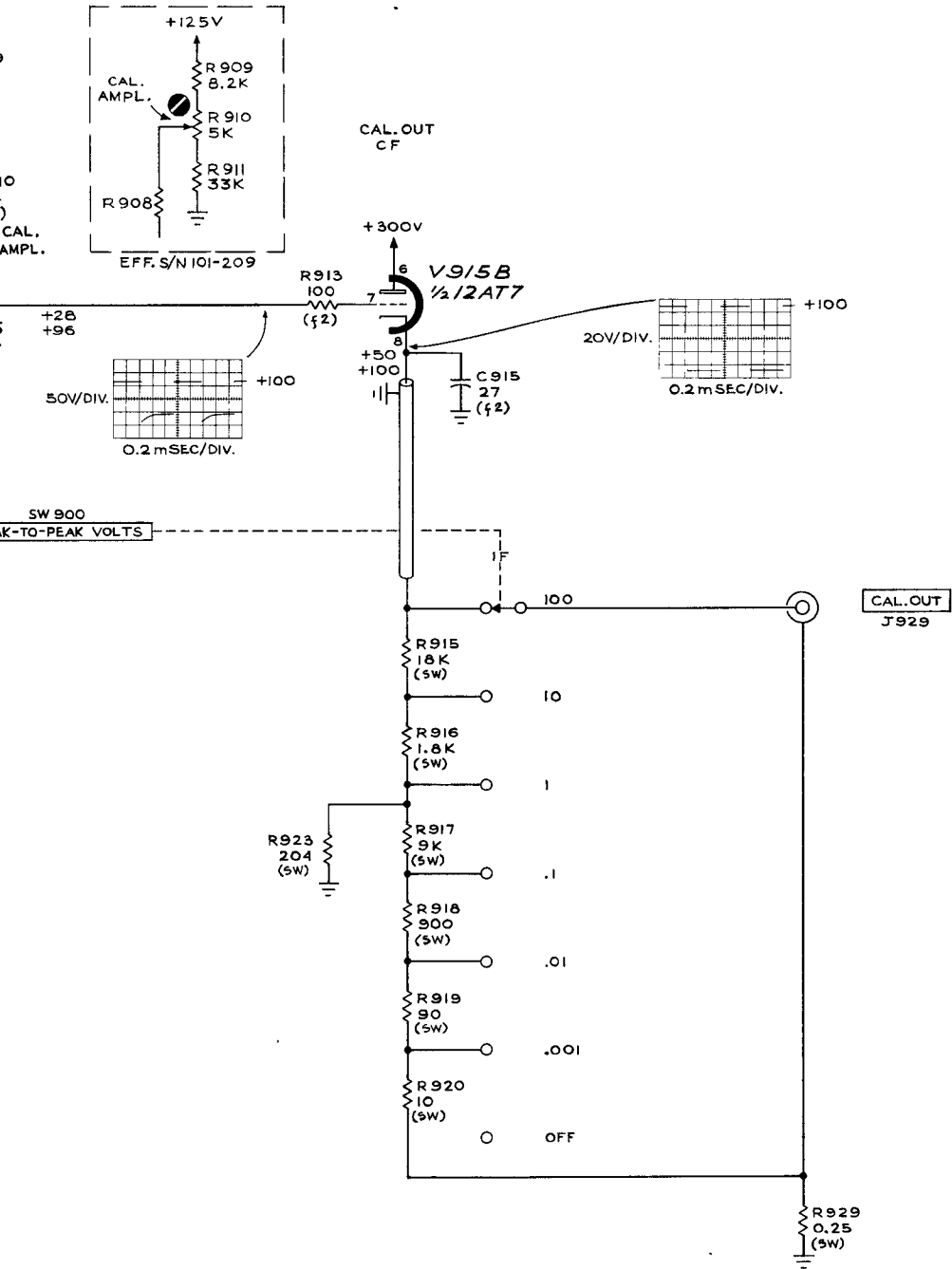
VOLTAGES  
PEAK-TO-PEAK VOLTS:  
UPPER READINGS..... 100  
LOWER READINGS..... OFF

(SEE IMPORTANT NOTE ON TIME BASE 'A' TRIG. DIAG.)

SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

+

+



ST FOR EARLIER  
/N CHANGES OF  
D WITH BLUE

CIRCUIT NUMBERS  
900 THRU 929

CMD  
763

A

### AMPLITUDE CALIBRATOR



## **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 565/RM565    TENT SN 2030

PARTS LIST CORRECTION

CHANGE TO:

C150, C250            283-0028-00            .0022  $\mu$ F            Discap            50 V

R150, R250            302-0391-00            390  $\Omega$             1/2 W            10%

TYPE 565/R565 TENT SN 1970

PARTS LIST CORRECTION

CHANGE TO:

D612A,B,C,D 152-0066-00 Silicon

TYPE 565/RM565

PARTS LIST CORRECTION

CHANGE TO:

Q644

151-0072-00

SN1308

PARTS LIST CORRECTION

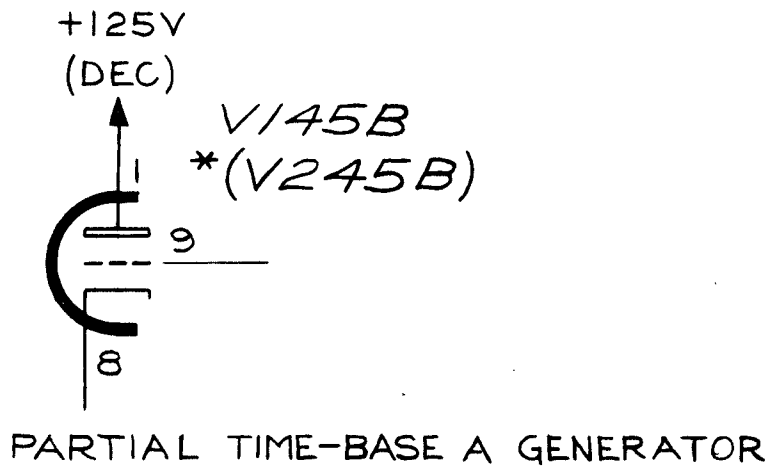
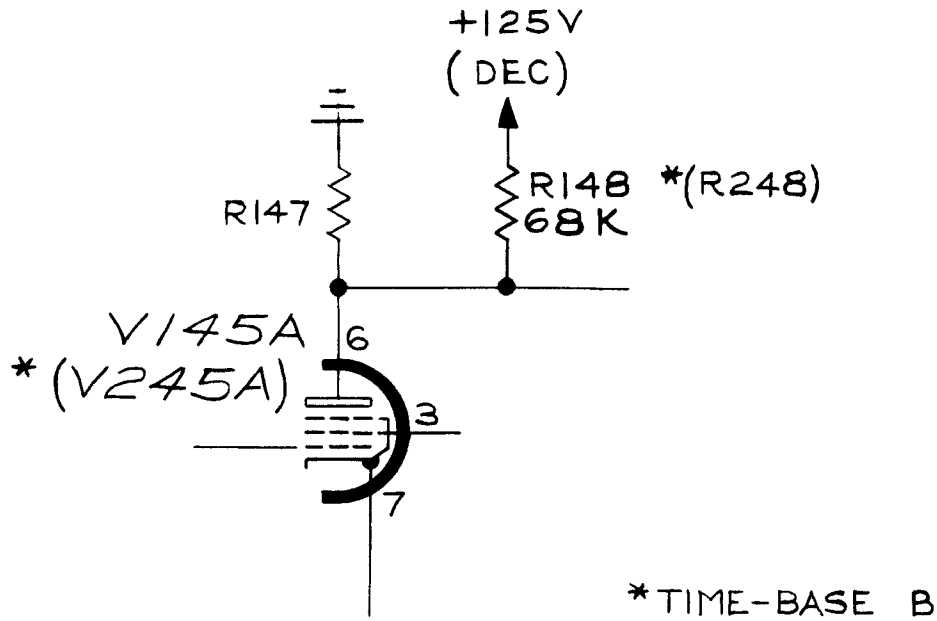
ADD:

R148/R248                      302-0683-00                      68 kΩ                      1/2 W                      10%

DELETE:

C281                                  281-0509-00                      15 pF                      500 V                      10%

SCHEMATIC CORRECTION



PARTS LIST CORRECTION

ADD:

R260V

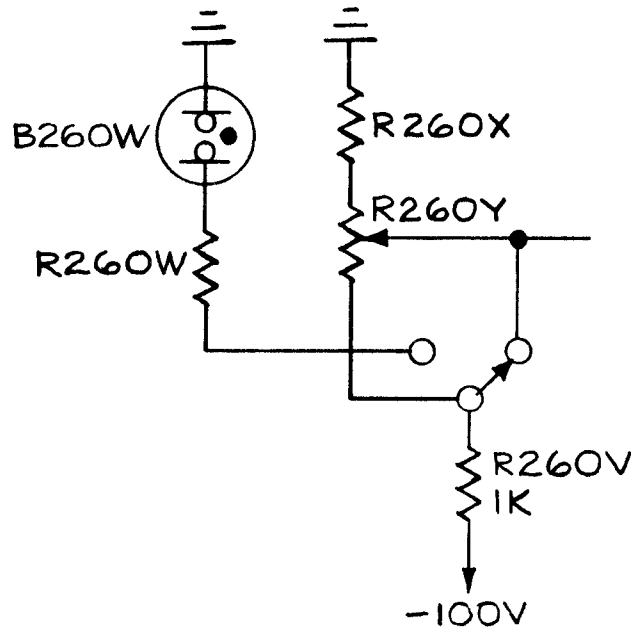
302-0102-00

1 k $\Omega$

1/2 W

10%

SCHEMATIC CORRECTION



PARTIAL TIME-BASE B TIMING SWITCH DIAGRAM