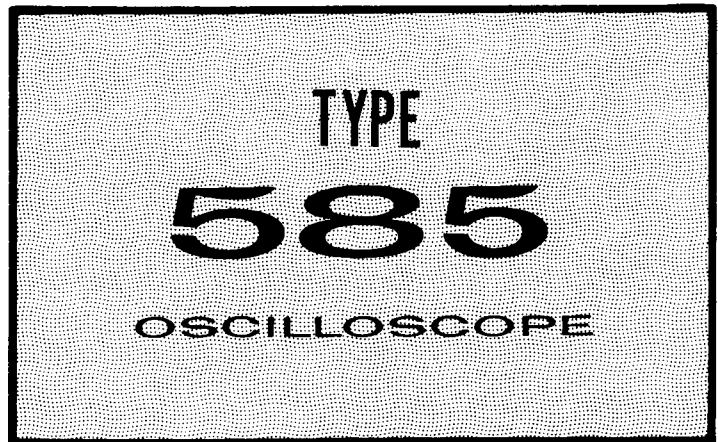


# INSTRUCTION MANUAL

## NOTICE

This oscilloscope has been improved over instruments manufactured before Serial No.2585. The improvements are within the Vertical Amplifier system and are required by the user of plug-in units with type numbers above Type 80. The improvements can be put into any instrument before Serial No. 2585 by ordering Tektronix Field Modification No. 040-275. See your local Tektronix Field Engineer for details and availability.



Tektronix, Inc.

S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix

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## **WARRANTY**

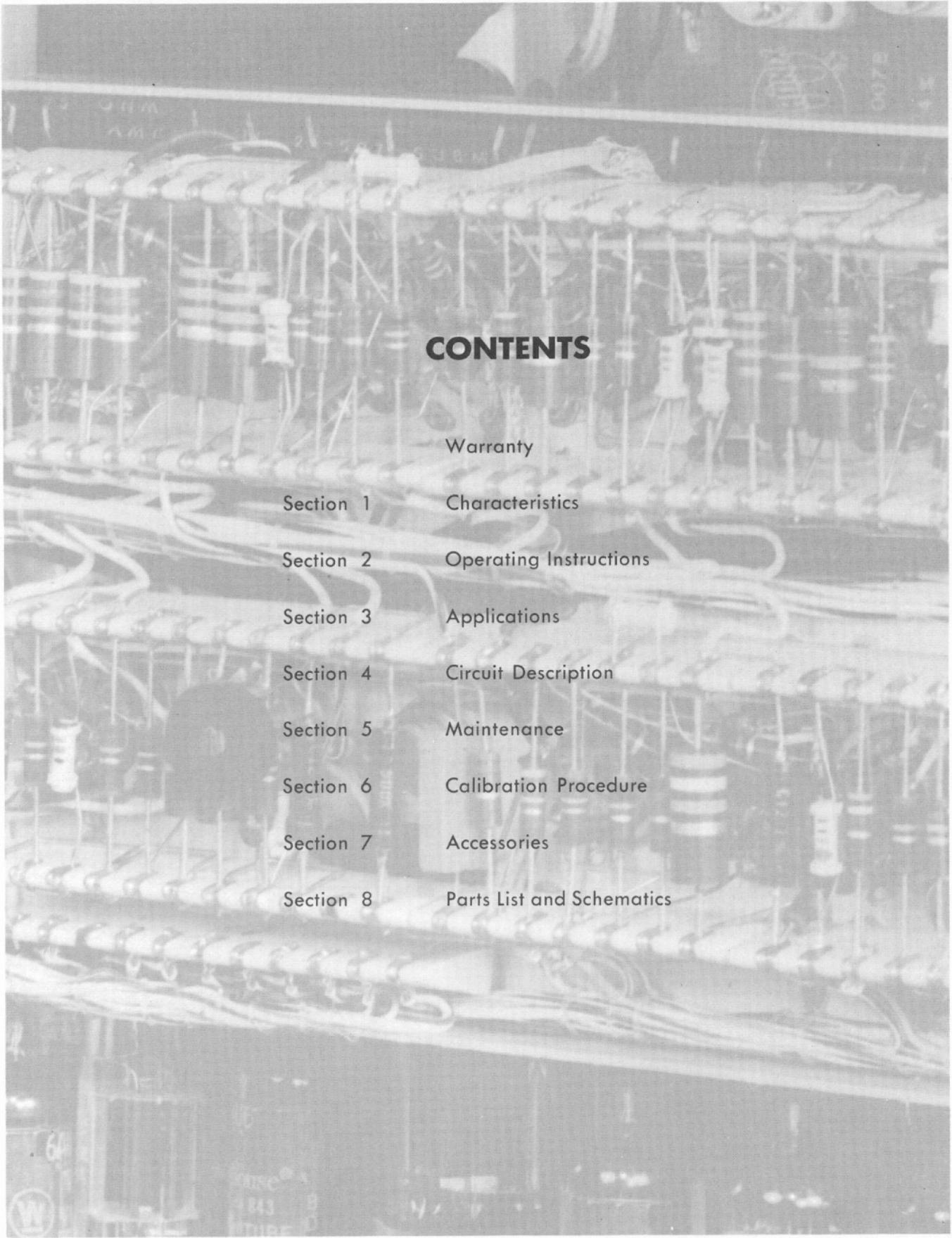
All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

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

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

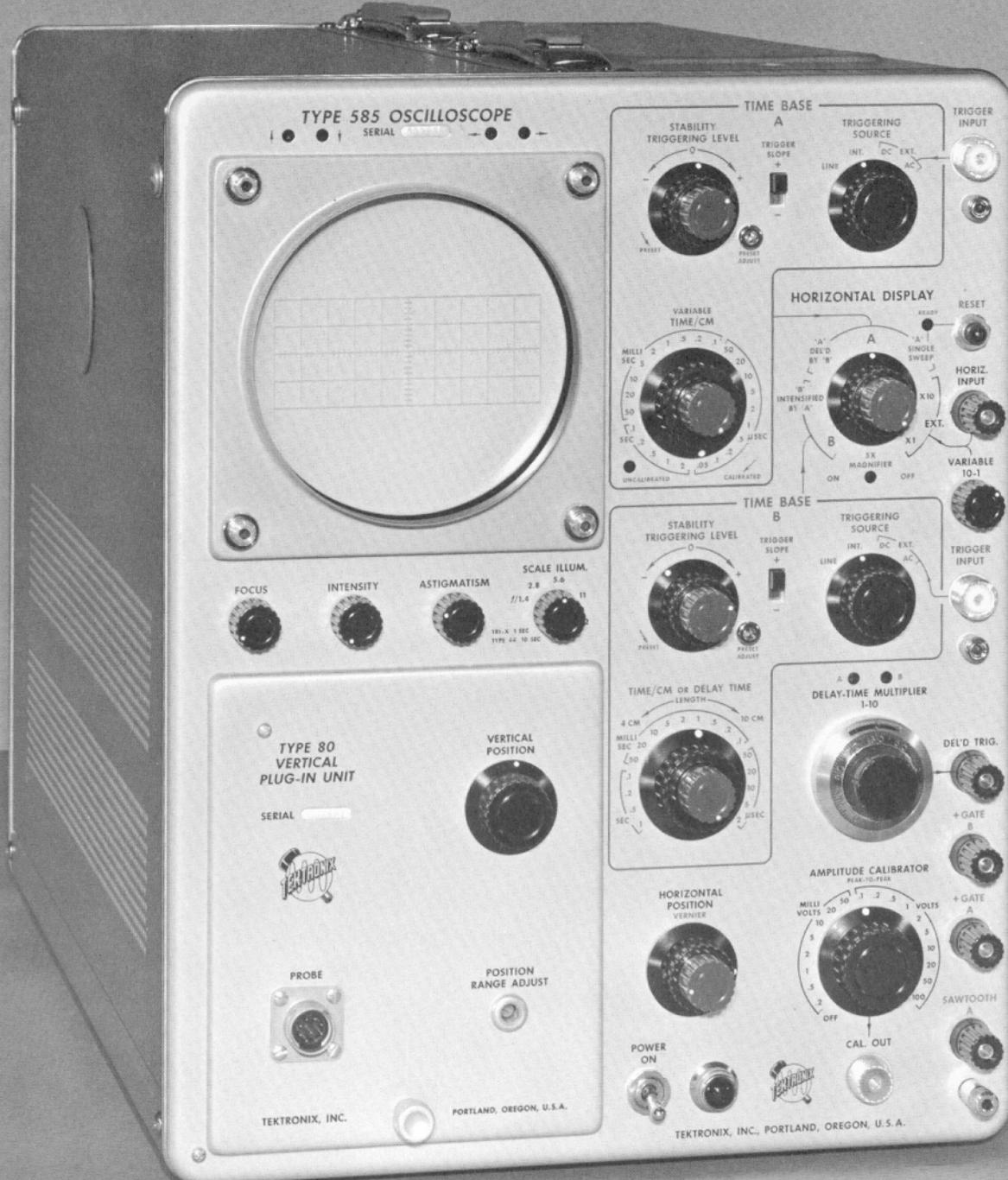
Specifications and price change privileges reserved.

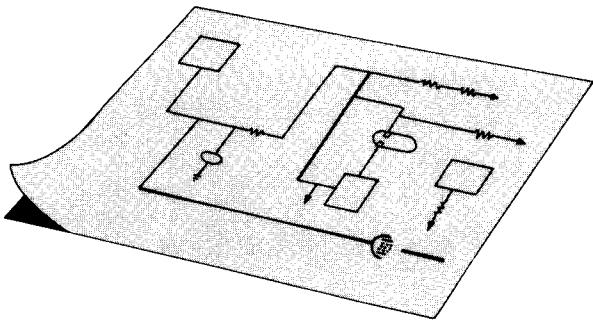
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## **CONTENTS**

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- Section 1 Characteristics
- Section 2 Operating Instructions
- Section 3 Applications
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- Section 5 Maintenance
- Section 6 Calibration Procedure
- Section 7 Accessories
- Section 8 Parts List and Schematics





# CHARACTERISTICS

## General

The Tektronix Type 585 Oscilloscope is a wide range, general purpose laboratory instrument which provides accurate measurements in the dc to approximately 95 megacycle range. Plug-in amplifiers are used in the vertical deflection system, permitting the instrument to be used in many specialized applications. Any of the Tektronix Eighty Series Plug-In Units can be used with the oscilloscope to satisfy many types of wide-band uses. Use of the Type 81 Plug-In Adapter permits use of any of the Tektronix letter series plug-ins for applications involving, among others, dual trace operation, low level signals, differential signals, pulse sampling, and transistor risetime checking. High calibrated sweep rates allow full use of the rise-time capabilities of the instrument.

Special circuits incorporated in the Type 585 Oscilloscope allow accurate, continuously variable delay in the presentation of a sweep from 1 microsecond to 10 seconds after the receipt of a triggering impulse. The delayed sweep feature permits highly magnified displays of a small portion of an undelayed sweep; accurate measurements of waveform time jitter; precise time measurements, as well as many other uses.

## VERTICAL DEFLECTION SYSTEM

Characteristics for the vertical deflection system of the Type 585 Oscilloscope depend upon the plug-in unit and probe used with the instrument. The following characteristics are given for the Type 585 when used with a Type 80 Plug-In Unit and a Type P80 Probe.

istics are given for the Type 585 when used with a Type 80 Plug-In Unit and a Type P80 Probe.

Bandpass <sup>1</sup>	DC to approximately 95 megacycles
Risetime <sup>2</sup>	Better than 3.9 nsec, 10% to 90%, nominally 3.7 nsec.
Vertical Deflection Factor	0.1 volts per centimeter.
Input Characteristics	A function of the individual plug-in or probe used.

<sup>1</sup> Bandpass measured using a Type 80/P80 Probe.

<sup>2</sup> Risetime measured using a Type 84.

## HORIZONTAL DEFLECTION SYSTEM

### Sweep Rates

#### Time Base A

0.05 microseconds (50 nsec) to 2 seconds per centimeter in 24 accurately calibrated steps. An uncalibrated control permits sweep rates to be varied continuously between 50 nsec and approximately 5 seconds per centimeter. Calibrated sweep rates are typically within 2% and in all cases within 3%, of the indicated rate.

#### Time Base B

2 microseconds to 1 second per centimeter in 18 accurately calibrated steps. All sweep rates are typically within 1%, with the .2, .5, and 1 second per centimeter ranges within 3% of the indicated rates.

### Magnifier

Provides a 5 times horizontal expansion of the center 2-centimeter portion of the oscilloscope display. It extends the fastest Time Base A sweep rate to 10 nsec per centimeter with a typical 1% linearity.

### Triggering Modes

#### Time Base A and B

External, Internal, and Line. Triggering SLOPE and LEVEL are adjustable.

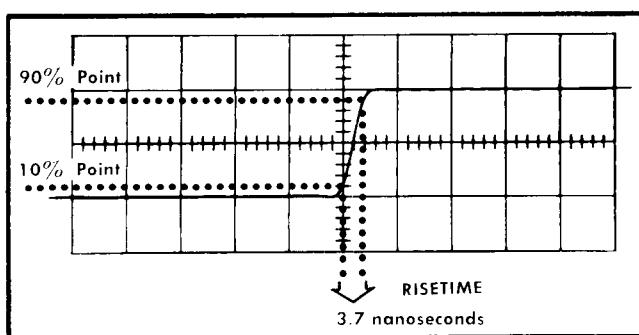


Fig. 1-1. Vertical risetime of the Type 585 Oscilloscope and Type 80 Plug-In combination.

## Characteristics — Type 585

### Triggering Signal Requirements

#### Time Base A

Internal—a signal producing 4 mm of vertical deflection from 15 cps to 10 mc.

a signal producing 1.5 cm of vertical deflection from 10 to 30 mc.

a signal producing 2.5 cm of vertical deflection from 30 to 50 mc.

a signal producing 4.0 cm of vertical deflection from 50 to 100 mc.

#### NOTE

See page 2-9 for operating instructions to synchronize the A sweep with signals of less than 4.0 cm amplitude from 50 mc through 150 mc.

External—a signal of 0.2 volts to 30 volts peak-to-peak. (The A sweep will trigger on larger signals, but the TRIGGERING LEVEL control operates only over a -15 volt to +15 volt range.)

#### Time Base B

Internal—4 mm of crt display through 500 kc, increasing to 2 cm crt display at 4 megacycles.

External—AC or DC: a signal of  $\pm 0.4$  volts through 500 kc, increasing to 1 volt at 1 mc, and 2.5 volts at 2 mc.

### External-Horizontal Signal Input

Deflection Factor—approximately 0.2 to 15 volts per centimeter, continuously variable.

Frequency Response—depends on the amount of deflection. The product of frequency response and deflection in centimeters is approximately 4.8 megacycle centimeters.

Input Characteristics—1 megohm paralleled by approximately 50 pf.

### Delayed Sweep

Sweep delay continuously variable from 1 microsecond to 10 seconds. Actual delay steps within 1% of indicated delay from 2  $\mu$ sec/cm to 0.1 sec/cm; 0.2 sec/cm to 1 sec/cm typically within 1% but never more than 3%. Incremental delay accuracy is within 0.2%.

Jitter—not more than 1 part in 20,000.

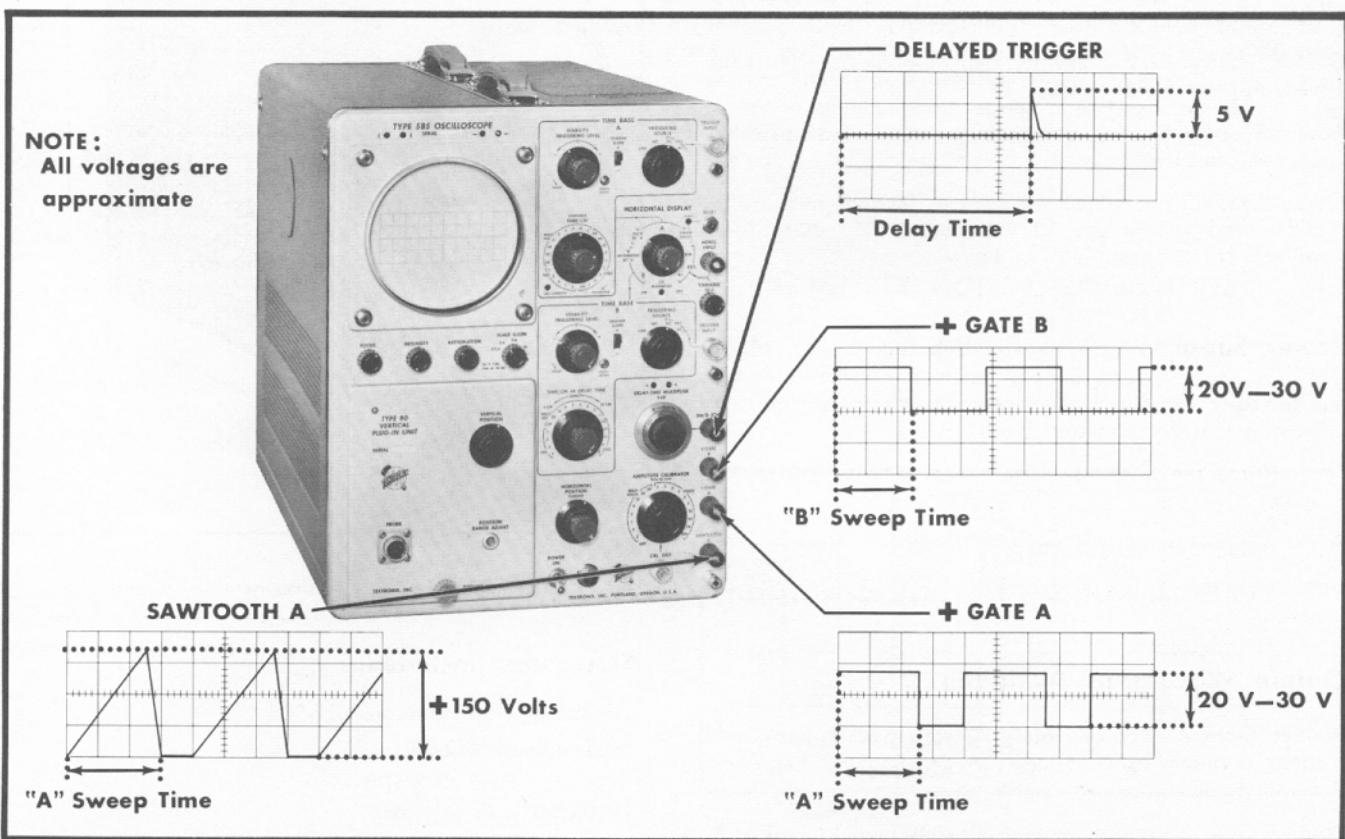


Fig. 1-2. Output waveforms available at the oscilloscope front panel.

## OTHER CHARACTERISTICS

### Cathode-Ray Tube

Type—T581P31; P1, P2, P7, and P11 phosphors optional.  
Other phosphors available on special order.

Unblanking—DC coupled.

Accelerating potential—10,000 volts.

Deflection system—electrostatic. Beam deflected vertically by 6 pairs of distributed deflection plates. Beam deflected horizontally by 1 pair of deflection plates.

Usable viewing area—4 centimeters by 10 centimeters.

Vertical Deflection Factor—4.6 to 5.6 volts per centimeter.  
Horizontal Deflection Factor—18 to 21 volts per centimeter.

### Graticule

Illumination—variable edge lighting.

Markings—marked in 4 vertical and 10 horizontal 1-centimeter divisions with 2-millimeter markings on the center-lines.

### Amplitude Calibrator

Waveform—square-waves at approximately 1 kc.

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

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

Output Loading—33 k load will reduce 100 volts output 2%.  
500 k load will reduce 50 volt output 2%. 100 k load will effect voltages 1 volt or below.

### Power Supplies

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

Line voltage requirements—105 to 125 volts, or 210 to 250 volts.

Power—approximately 630 watts.

Line frequency—50 to 60 cycles.

### Output Waveforms Available

Positive Gate A—approximately 30 volts peak-to-peak with same duration as A sweep. Approximately 200 ohms output impedance.

Positive Gate B—approximately 30 volts peak-to-peak with same duration as B sweep. Approximately 300 ohms output impedance.

Delayed Trigger pulse—approximately 5 volts in amplitude, occurring at end of the delay period.

Sawtooth A—sweep A sawtooth waveform, approximately 150 volts peak-to-peak. Maximum allowable load, 18 k.

## MECHANICAL SPECIFICATIONS

### Ventilation

Forced filtered air. Thermal relay interrupts instrument power in the event of overheating. Will operate satisfactorily up to approximately 120° F ambient air temperature.

### Construction

Aluminum-alloy chassis and three-piece cabinet.

Photo-etched anodized panel, blue vinyl covered textured aluminum.

Dimensions—see Figure 1-3.

Weight—74 pounds.

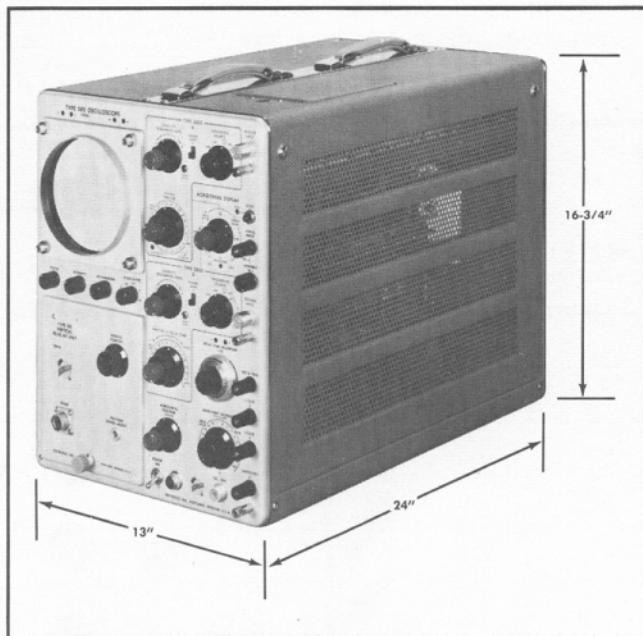
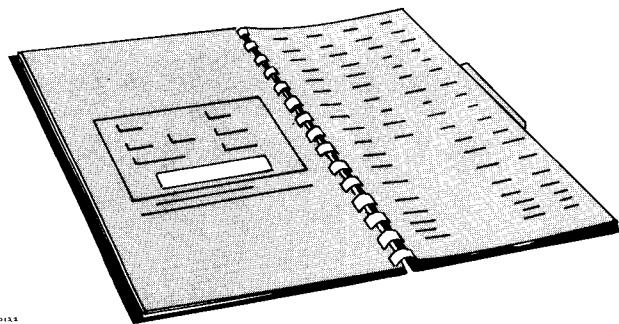


Fig. 1-3. Type 585 Oscilloscope dimensions.

### Accessories Included:

- 2 Binding-post adapters (013-004)
- 1 Test lead (012-031)
- 1 Green Filter (378-514)
- 1 Power cord (161-010)
- 1 Adapter, 3 wire to 2 wire (103-013)
- 2 Instruction Manuals

## NOTES



## OPERATING INSTRUCTIONS

### General Information

The Type 585 Oscilloscope is an extremely versatile instrument which is adaptable to a great number of applications. However, to make use of the full potentialities of the instrument, it is necessary that you understand completely the operation of each control. This portion of the manual is intended to provide you with the basic information you require.

### PRELIMINARY INSTRUCTIONS

#### Cooling

A fan maintains safe operating temperature in the Type 585 by circulating filtered air over the rectifiers and other components. When in operation, the instrument must be placed so that the air intake at the back is clear of any obstruction that might impede the flow of air. Side panels should also be in place for proper air circulation. The air filter should be kept clean in accordance with cleaning instructions found in the Maintenance Section of this Manual.

Under no circumstances should your Type 585 oscilloscope be operated without the fan running. Without the fan, inside temperature of the oscilloscope will rise to a dangerous level in five to ten minutes. In this event, the thermal cutout

switch will disconnect the power and keep it disconnected until the temperature drops to a safe level.

#### Power Requirements

Unless tagged otherwise, this instrument is connected at the factory for operation at 105 to 125 volts, 50 to 60 cycles AC (117 volts nominal.) However, provisions are made for easy conversion to operate at 210 to 250 volts, 50 to 60 cycles (234 volts nominal).

The power transformer has eight primary terminals making possible operation from six different input voltages. The Type 585 can be operated from primary voltages of 110, 117, 124, 220, 234 and 248 volts, 50 or 60 cycles. Figure 2-1 illustrates proper connections to permit operation on any one of the listed voltages.

#### Fan Connections

When connecting the power transformer for operation with a supply voltage of 200 volts or more, be sure to leave the fan wires connected at terminals 1 and 3 of the primary. This is to insure that the fan motor will not be supplied more than 125 volts. Figure 2-2 shows a typical high line voltage connection assuring proper fan operation when the line voltage is 248 volts.

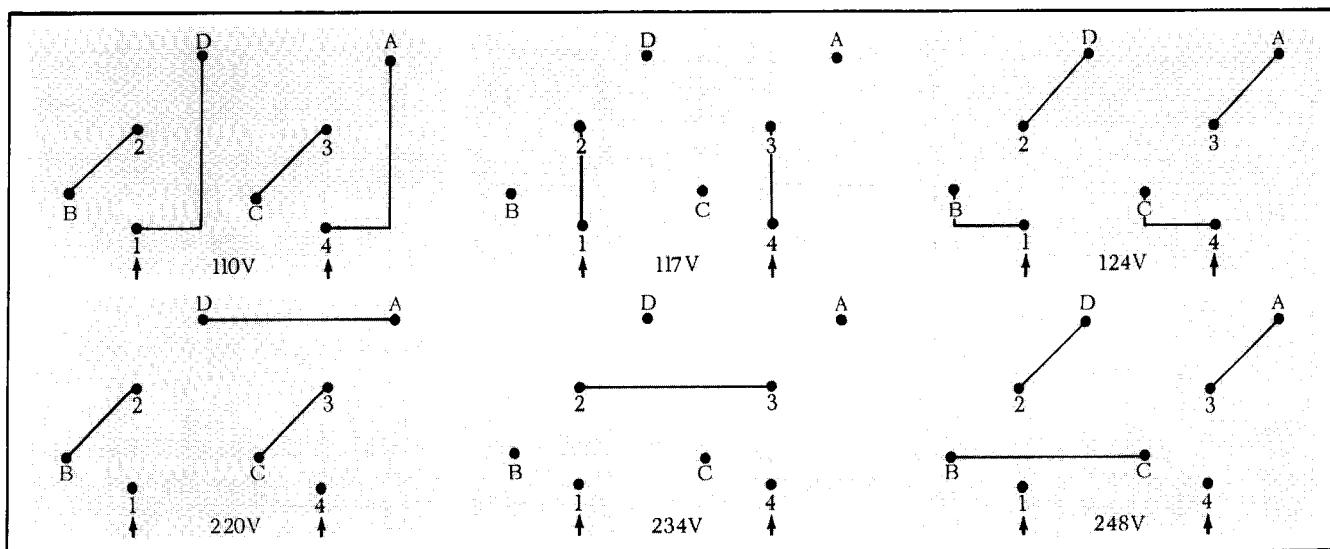


Fig. 2-1. The power transformer has two extra windings permitting nominal primary voltages of 110, 117, 124, 220, 234, 248 volts, 50 or 60 cycle operation.

## Operating Instructions — Type 585

### Fuse Data

Fuse data is silk-screened on the rear panel of the instrument adjacent to the fuse holder. Use only the recommended fuses for maximum over-current protection.

## OSCILLOSCOPE OPERATING INFORMATION

If you are familiar with other Tektronix Oscilloscopes, you should have very little difficulty in understanding the operation of the Type 585. The function of many controls is the same as the function of corresponding controls on other Tektronix instruments.

### Plug-In Units

The Type 585 Oscilloscope is designed to operate with the Tektronix Eighty Series Plug-In Units. In addition, the Type 81 Plug-In Adapter permits use of all of the Tektronix Letter-Series plug-in units. The particular plug-in unit used must be selected to satisfy the application requirements. In selecting the plug-in unit for any particular application, consider the bandpass, sensitivity, the type of input required for that application. The plug-in units now available and those presently under development will satisfy the requirements for most applications.

### Preparation for Use

When the plug-in unit to be used has been selected, insert the unit into the plug-in compartment of the Type 585 oscilloscope and press firmly to insure that the connectors make

proper contact. Tighten the plug-in unit locking control to hold the unit securely in place and turn the oscilloscope INTENSITY control fully counterclockwise. Connect the power cord to the rear of the instrument and to the power line and place the POWER switch in the ON position.

### Time Delay

A time delay relay used in the Type 585 Oscilloscope delays operation of the instrument for approximately 25 seconds after the POWER switch is turned on to allow a brief tube warmup period. The delay allows the tubes sufficient time to heat before the dc operating voltages are applied.

If the ac power is off for only an instant, the normal 25 second delay will occur before the instrument returns to full operation. This delay will occur regardless of whether the ac power is off because of momentary power failure or is turned off with the POWER switch.

### INTENSITY Control

The INTENSITY control is used to adjust the brightness of the oscilloscope display. This permits compensation for changes in brightness resulting from changes in the sweep or triggering rate. The INTENSITY control is rotated clockwise to increase brightness and counterclockwise to decrease brightness. Care must be taken when using the INTENSITY control that the brightness is not turned up to the point where the face of the cathode-ray tube is permanently damaged. If the intensity of the beam is turned up too far, the phosphor on the face of the crt may be burned.

### FOCUS and ASTIGMATISM Controls

The FOCUS and ASTIGMATISM controls operate together to allow a sharp, clearly defined, spot or trace to be obtained. FOCUS adjustments need to be made after each change of the INTENSITY control. For slow sweep rates, proper adjustment of the ASTIGMATISM control will produce a circular spot, then adjust the FOCUS control for as small a spot as possible. For fast sweep rates with low repetition rates that produce a dim trace, best focus can be obtained by looking at the waveform and simultaneously adjusting the ASTIGMATISM and the FOCUS control. There is a maximum setting of the INTENSITY control above which a good focus is not possible. Best definition for all signals will be obtained by using the horizontal center six centimeters of the graticule.

### Graticule and Scale Illumination Control

The graticule used with the Type 585 Oscilloscope is accurately marked with 10 horizontal and 4 vertical 1-centimeter divisions with 2-millimeter markings on the centerlines. These graticule markings in conjunction with the calibrated scale factors of the Type 585 allow time and voltage measurements to be made directly from the oscilloscope crt.

The graticule is illuminated by two lamps located at the top edge of the graticule. This illumination can be controlled so that the graticule markings appear either red or

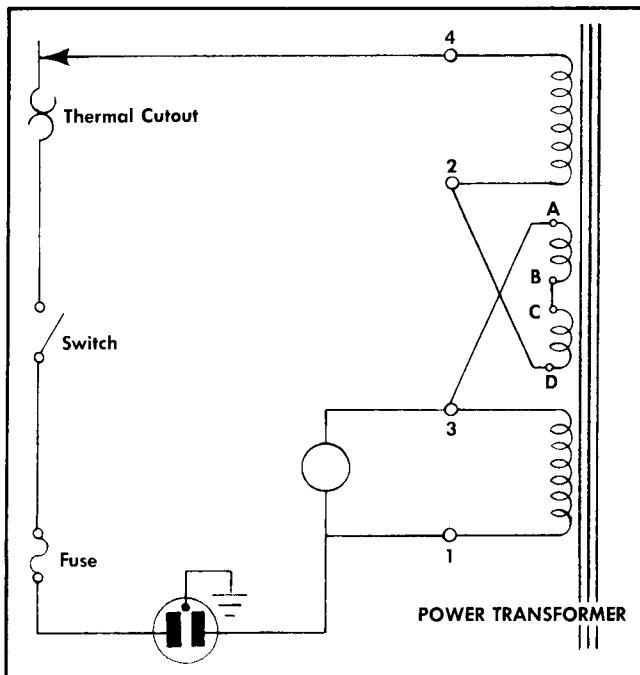


Fig. 2-2. A typical high-voltage fan connection, using as an example the wiring for a 248-volt supply.

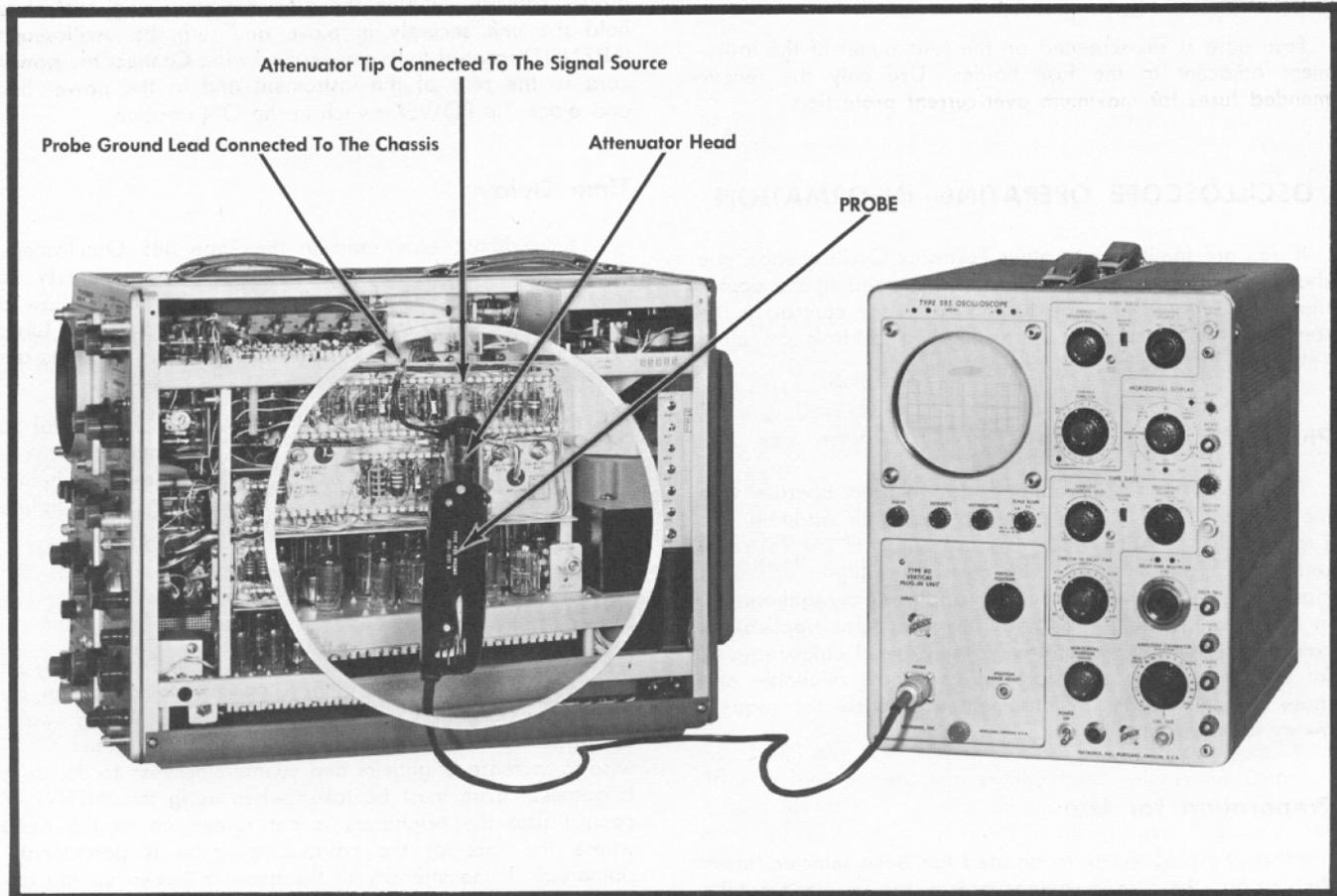


Fig. 2-3. Proper connection of the P80 Probe to a coaxial system including attenuator and termination.

white, as desired. The graticule markings are changed from one color to the other by removing the graticule cover and rotating the graticule through 180° about an axis through the center of the graticule. As a general rule, white graticule markings are superior to red for photographic purposes.

The brightness of the graticule markings is adjusted by the SCALE ILLUM control located just under the oscilloscope crt. Rotating the control clockwise increases the brightness of the markings; rotating the control counterclockwise decreases the brightness.

For convenience in photographic work, the SCALE ILLUM control is marked in **approximate** f-stops. The f-stop numbers are intended for working with 35 mm TRI-X film and Polaroid Type 47 film, with a one second exposure. Polaroid Type 44 requires ten seconds exposure. A few practice shots will help you get consistently good pictures. White graticule markings should be used, and the trace brightness must approximately match that of the graticule markings.

### Positioning Controls

Three controls are used with the Type 585 Oscilloscope to allow the trace to be positioned to any point on the crt. Two of these controls are used to set the horizontal position of the trace. The third control is used to set the vertical position of the trace and is located on the front panel of the plug-in unit used with the oscilloscope.

The two HORIZONTAL POSITION controls move the trace to the right when they are rotated in the clockwise direction and to the left when they are rotated counterclockwise. The combination of the two controls has a total positioning range of approximately 12 centimeters with the sweep magnifier off or approximately 60 centimeters with sweep magnifier on. The black HORIZONTAL POSITION control has approximately three times the range of the red VERNIER control. The fine range of adjustment of the VERNIER control makes this control particularly useful whenever fine horizontal positioning is required, as for example, when the sweep magnifier is used.

The vertical positioning control has sufficient range to allow the trace to be positioned completely off the top or bottom of the crt or to any intermediate point. The trace moves up when the control is rotated clockwise and down when the control is rotated counterclockwise.

Four small indicator lights located just above the crt indicate the position of the spot or trace. When one of these lamps is lit, it indicates that the trace is off-centered in the direction of the arrow. These four lights allow you to position the spot to the center of the crt even though the intensity is so low that the trace is not visible. When the sweep is running, the spot moves from the left to the right and may cause both horizontal lamps to light each time the sweep runs. Also a vertical input signal may cause both vertical lamps to remain lit.

## Input Signal Connections

Input signals to the oscilloscope are carried to the input connector of the Type 80 Plug-In Unit through the P80 high-frequency probe. The Type 585, Type 80 Plug-In Unit and P80 Probe make up a basic DC to 95 megacycle system. The gain of this combination is calibrated with a vertical deflection of 0.1 volts per centimeter at the input to the probe.

### NOTE

A second basic wide-band system includes the Type 82 Dual-Trace Plug-In Unit with a sensitivity of 0.1 volts per centimeter. Special probes are provided with the Type 82, permitting easy connection into any circuit. A higher gain of 0.01 volts per centimeter is available with slightly reduced bandpass. The rest of this manual was written for use of the Type 80 Plug-In and P80 Probe. Most of the conditions apply to the Type 82, except the input resistance and capacitance. See the Type 82 Manual for additional details.

A third system using the Type 81 Plug-In Adapter makes possible the use of all Tektronix Letter-Series plug-in units. When using a Type 81 Plug-In Adapter Unit with a Type K or Type L Plug-In Unit, the system bandpass is dc to 3 db down at 30 Mc.

When using the Type 80 Plug-In Unit with the P80 Probe in cases where the amplitude of the input signal is sufficient to deflect the spot off the screen, the vertical size of the displayed waveform can be reduced to a usable level by using one of the 5 fixed attenuators supplied with the P80 Probe. The attenuators connect directly to the front of the probe and provide attenuation factors of 2, 5, 10, 20, and 50 and vertical deflection factors of from 0.1 volt per centimeter without an attenuator, to 5 volts per centimeter.

The fixed attenuators supplied with the P80 Probe can be used only one at a time. In cases where additional attenuation is required, a standardized attenuator is available that permits the stacking of any one regular attenuator on a standardized attenuator. The standardized attenuator pro-

vides attenuation of 10 when used alone. If the X10 Standardized Attenuator is used with a regular 2-1 attenuator, the total attenuation will then be 20. See the Accessories section of this manual for part numbers and ordering information.

Accuracy of the deflection factors of any of the attenuators or attenuator combinations can be checked by connecting the attenuator tip to the CAL. OUT connector and comparing the resulting deflection against the Amplitude Calibrator voltage.

The calibrated vertical deflection factors and the graticule markings permit accurate voltage measurements to be made directly from the oscilloscope crt. The procedures for making voltage measurements are described in the Applications section of this manual.

When connecting the oscilloscope to the signal source, consider the loading effect produced by the probe on the signal source. At low frequencies the input impedance of the P80 probe is 100 kilohms which in most cases limits the loading effect to a negligible amount. However, as the frequency of the input signal is increased and approaches the upper limit of the oscilloscope passband, the input impedance of the probe drops to about 150 ohms. The loading effect of the probe under these conditions can be considerable, particularly when the input signal is connected from a high impedance source. Loading may be sufficient to adversely affect operation of the signal source.

Loading of the signal source can be reduced through use of an attenuator head on the P80 Probe. However, this also has the effect of reducing the vertical amplitude of the displayed waveform. Consequently, the use of an attenuator head must be a compromise between reducing the loading effect and reducing the signal amplitude. In no way can the loading effect be completely eliminated. You must consider this effect when evaluating information obtained from the oscilloscope. When observing signals from low impedance sources, loading will usually be negligible.

To prevent reflection of high frequency waveforms and resulting waveform distortion, all cables and high frequency signal sources should be terminated in their characteristic

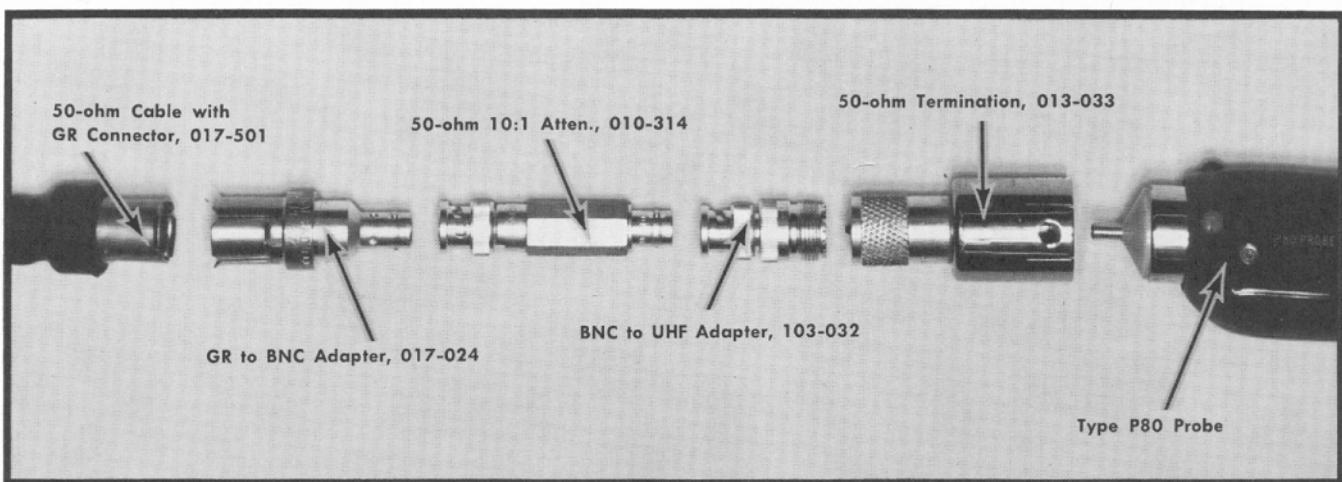


Fig. 2-4. Accessories required to connect a  $50\ \Omega$  system to the Type 80 Probe. The Attenuator is optional.

impedance. This can be done by connecting the proper termination resistor at the input to the probe. Special adapters are available which permit direct connections of the probe to Type N, BNC, UHF, and GR TYPE 874 connectors. See the Accessories section of this manual for part numbers and ordering information.

### Compensating Attenuator Heads

To prevent waveform distortion, attenuator heads must be compensated for high frequency losses. The compensation should be checked each time an attenuator head is used. The adjustment is made by displaying a square wave with a risetime of 0.3 microsecond or faster on the oscilloscope and adjusting the compensation control to eliminate any distortion occurring in the leading edge of the waveform. The 50-1 attenuator head can be successfully compensated using the oscilloscope calibrator with its 1.0 microsecond risetime. The adjustment should be made with the probe input selector in the DC position. The compensation control is a small plastic screw located in the body of the attenuator head near the tip end.

Attenuator compensation is sensitive to pressures applied laterally at the tip. Be sure to apply the probe and attenuator combination to any test point **directly** without side pressure.

### Input Selection

The Input Selector switch on the Type P80 Probe permits input waveforms to be applied either directly to the oscilloscope (dc coupled) or to be applied to the oscilloscope

through a .01  $\mu$ f 150 volt capacitor (ac coupled). The input Selector switch should be placed in the DC position when low frequency waveforms are observed, to prevent distortion and attenuation. The AC position should be used to eliminate large dc components from waveforms applied to the probe. The AC position blocks the dc component of a waveform and permits the variable component of the waveform to be applied to the oscilloscope.

### HORIZONTAL DEFLECTION SYSTEM

The Type 585 Oscilloscope features two independent time base units: Time Base A and Time Base B. Either of the two time bases may be displayed on the crt at any time. Controls affecting Time Base A and Time Base B operation are in the correspondingly labeled blocks on the front panel. The HORIZONTAL DISPLAY switch determines which time base is used and the type of display to be presented. Time Base A is selected when the HORIZONTAL DISPLAY switch is in position A; Time Base B is selected when the switch is in position B.

### Sweep Rates

Time Base A has 24 accurately calibrated sweep rates ranging from 0.05 microsecond to 2 seconds per centimeter. Calibrated sweep rates are obtained only when the VARIABLE TIME/CM control is snapped in the fully clockwise position. The VARIABLE TIME/CM control permits the sweep rate to be varied continuously between 0.05 microsecond and approximately 5 seconds per centimeter. All sweep rates obtained with the VARIABLE TIME/CM controls in any position but fully clockwise are uncalibrated. Uncalibrated sweep rates are indicated when the UNCALIBRATED lamp is lit.

Time Base B has sweep rates ranging from 2 microseconds to 1 second per centimeter in 18 steps. There is no VARIABLE TIME/CM control for Time Base B. The red LENGTH control adjusts the sweep length between approximately 10 and 4 centimeters.

### Triggered Operation

For most uses of the oscilloscope a stable display of some waveform is required. To accomplish this the oscilloscope can be operated so that the horizontal sweep starts at a given point on the displayed waveform. This is known as "triggered" operation. For the present, we will refer to the starting of the sweep, at the left side of the graticule, as "triggering" the sweep.

Triggered operation is useful for observing a waveform which may occur only once, or which may occur at random intervals. For any of these uses, the oscilloscope can be used in such a way that each horizontal sweep is triggered by some waveform other than the one being observed, but which bears a time relationship to the observed waveform.

The waveform used to start the horizontal sweep is called the "triggering signal", whether it is the waveform being observed, or some other waveform. The instructions that follow tell you how to select this signal. They also contain information on triggering according to various modes, depending on the nature of the triggering signal.

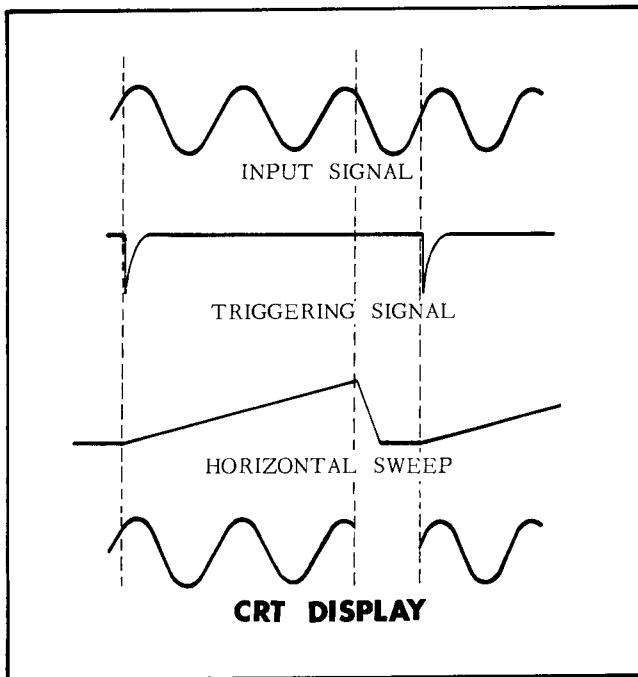


Fig. 2-5. Oscilloscope in triggered sweep operation, waveform ladder diagram showing sequence of operations from input signal, triggering signal, the sweep, and the crt display.

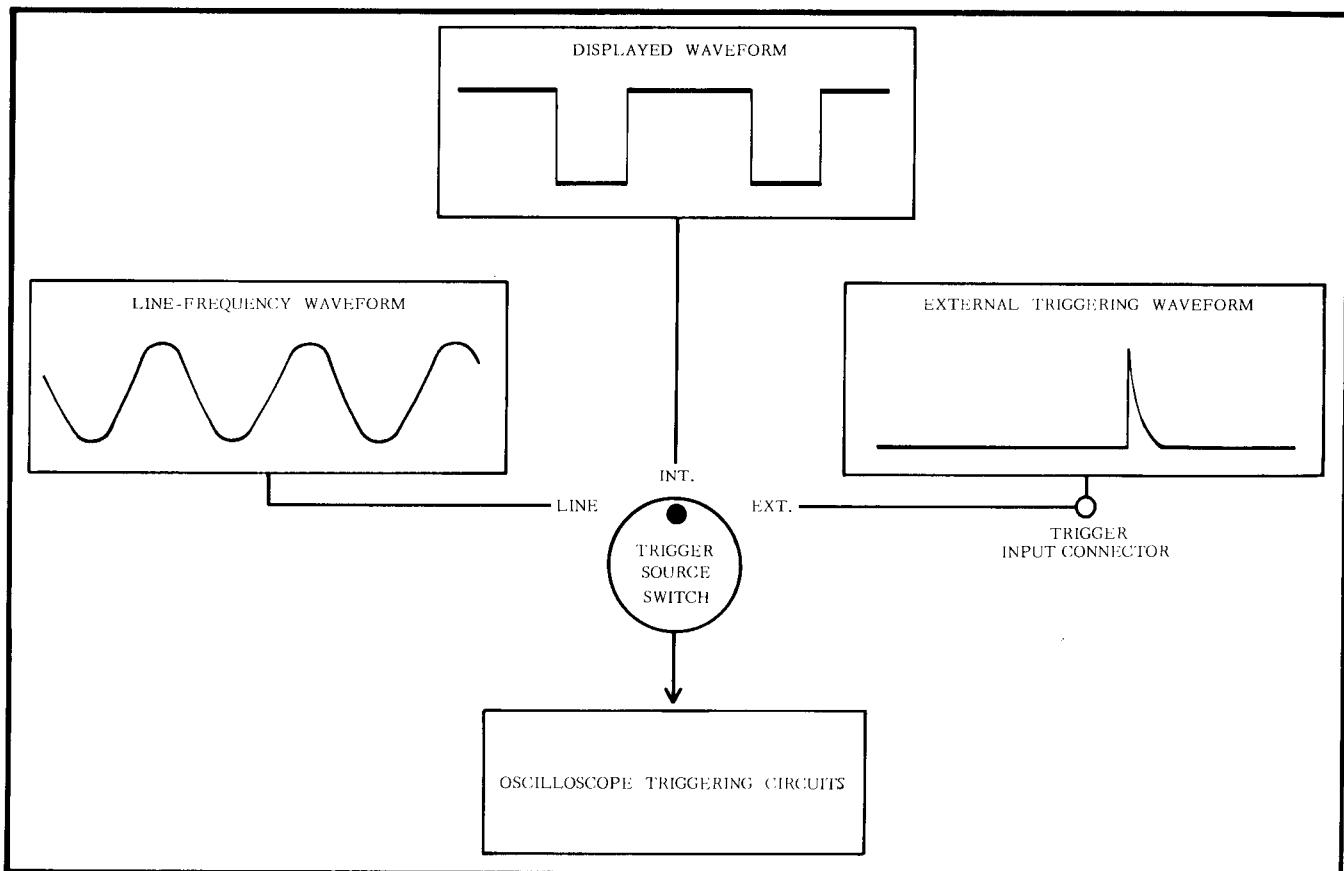


Fig. 2-6. The triggering signal source is selected by the TRIGGERING SOURCE switch.

### Selecting the Triggering Signal

1. To trigger either the Time Base A or B sweep from the waveform being observed, set the appropriate TRIGGERING SOURCE knob to INT.
2. To trigger the sweep from the power-line wave (as in the case when observing a waveform which has a time relationship to the power-line frequency), set the TRIGGERING SOURCE knob to LINE.
3. To trigger the sweep from some external waveform (one having a time relationship to the waveform being observed), connect the source of the triggering signal to the TRIGGER INPUT connector and set the TRIGGERING SOURCE knob to EXT., DC or AC.

When the frequency of the external triggering signal is below about 15 cps, the TRIGGERING SOURCE switch must be placed in the EXT. DC position to obtain stable triggering. Below 15 cps, the coupling circuit in the EXT. AC position attenuates the input signal, thereby making it difficult or impossible to obtain reliable operation. When in doubt, the proper setting of the TRIGGERING SOURCE switch can be chosen by observing which position produces the best triggering. Refer to Fig. 2-6 for a pictorial presentation of the various triggering source options.

### Selecting the Triggering Slope

The horizontal sweep can be triggered on either the rising (+slope) or falling (-slope) portion of the triggering waveform. This is determined by the position of the TRIGGER SLOPE switch. When the switch is in the + position, the sweep is triggered on the rising portion of the triggering waveform; when the TRIGGER SLOPE switch is in the - position, the sweep is triggered on the falling portion of the waveform (see Figure 2-8).

In many applications the triggering slope is not important since triggering on either slope will provide a display which is suitable to the application. However, in other cases, such as pulse risetime or falltime measurements, the triggering slope is very important and must be selected properly if you are to obtain a useful display. To accurately measure the risetime of a pulse it is necessary to trigger the sweep on the rising portion of the waveform. Also, to observe the fall of a pulse it is necessary to trigger the sweep on the falling portion of the waveform. In either case, selection of the wrong triggering slope will make it difficult or impossible to observe the portion of the waveform to be checked.

When displaying sine waves above 50 megacycles the Time Base A trigger circuit may produce a stable display on only one slope. Be sure to try both the + and - positions of the A TRIGGER SLOPE switch for the best triggering.

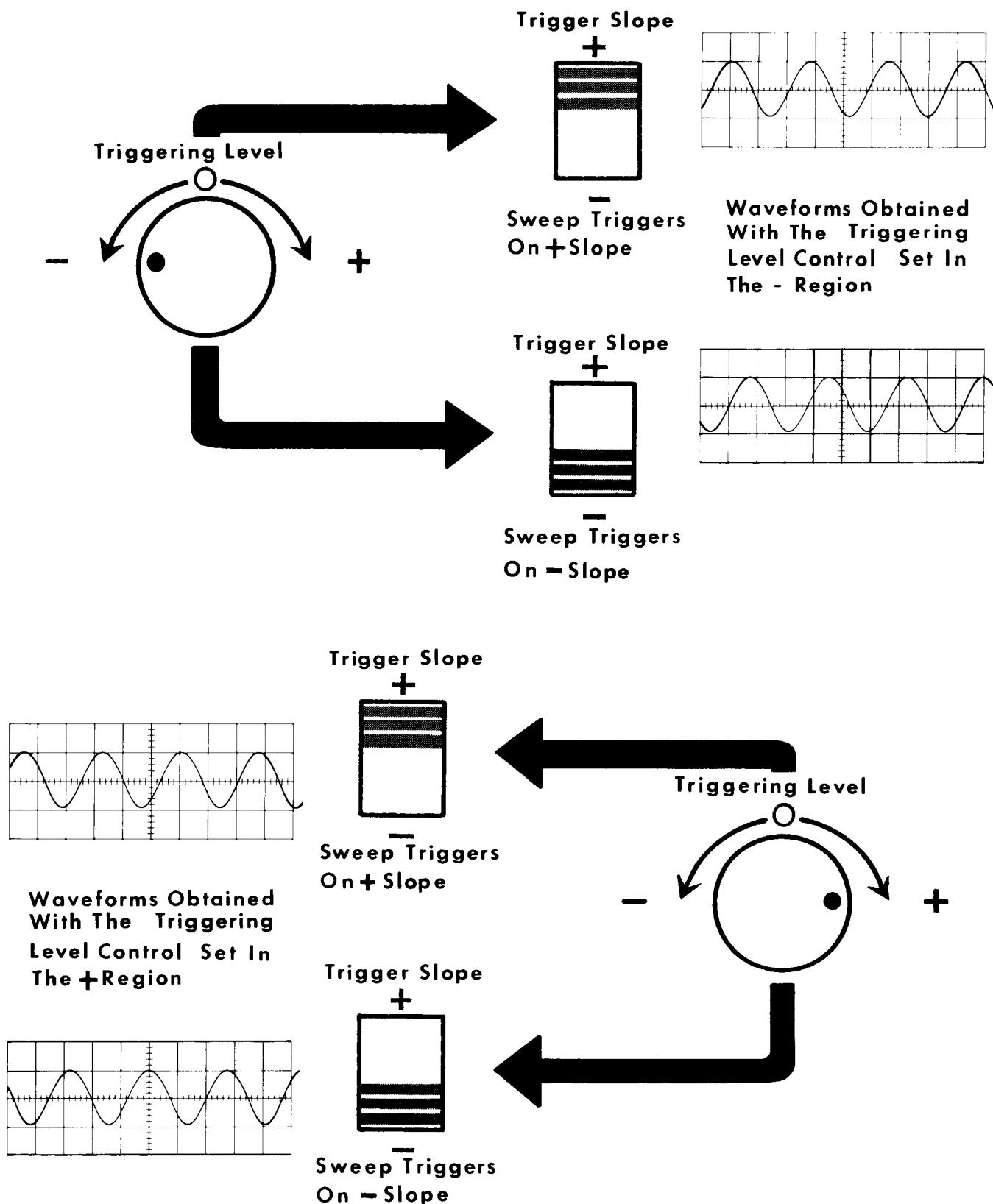


Fig. 2-7. Effects of the TRIGGERING LEVEL and TRIGGER SLOPE controls.

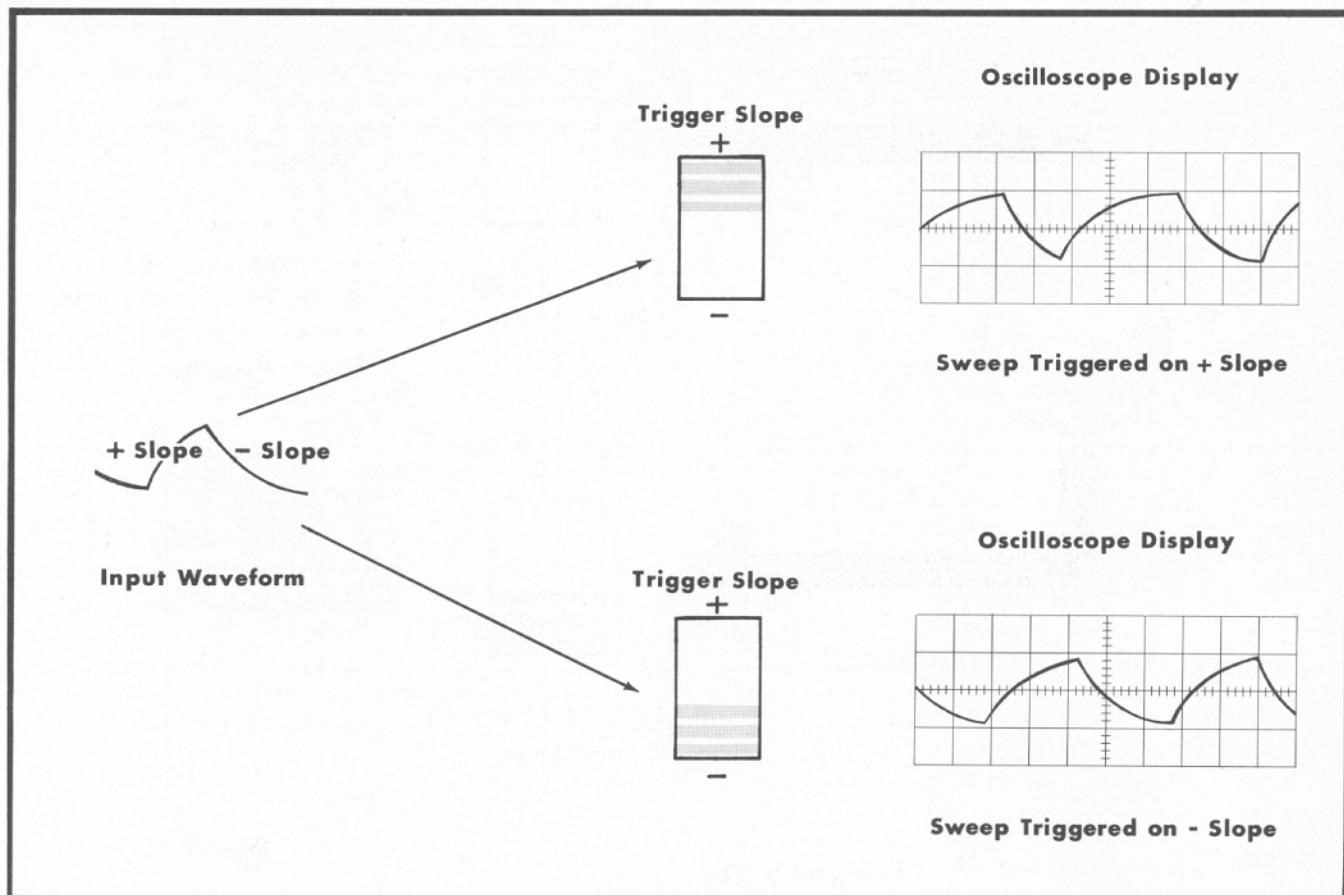


Fig. 2-8. Effects on the oscilloscope display produced by + and — settings of the TRIGGER SLOPE switch.

### Using the STABILITY and TRIGGERING LEVEL Controls

In virtually every triggering application, satisfactory operation can be obtained with the STABILITY control in the fully counterclockwise, PRESET, position. This setting has the advantage that no further adjustment of the STABILITY control is required when switching from one triggering signal to another. However, if it becomes difficult to obtain stable triggering with the STABILITY control at PRESET, it will be

necessary to adjust the control for proper triggering. Also it may be necessary to adjust the PRESET ADJUST control as described in the Calibration section of this manual.

To adjust the STABILITY control, place the TRIGGERING LEVEL control in the fully counterclockwise position. Then rotate the STABILITY control slowly clockwise until a trace appears on the crt. The correct setting is obtained by rotating the control counterclockwise three to five degrees past the point where the trace disappears.

The TRIGGERING LEVEL control determines the point on the triggering waveform where triggering occurs. Rotating the control clockwise causes the sweep to trigger at more positive points on the waveform while rotating the control counterclockwise causes the sweep to trigger at more negative points. Setting the TRIGGERING LEVEL control at 0 will cause the sweep to start at approximately the average-voltage point of the waveform.

The + and — markings for the TRIGGERING LEVEL control should not be confused with similar markings for the TRIGGER SLOPE switch. The markings on the TRIGGER SLOPE switch indicate only whether triggering occurs on the rising or falling portion of the triggering waveform. The markings for the TRIGGERING LEVEL control indicate whether triggering occurs on the upper or lower portion of the waveform.

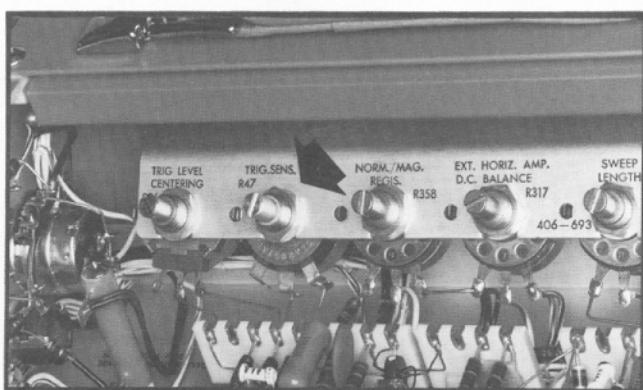


Fig. 2-9. TRIG. SENS. control location.

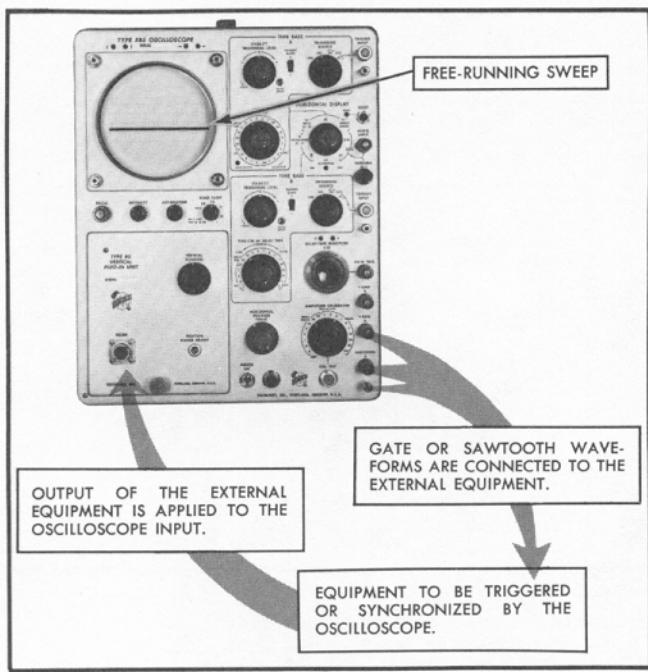


Fig. 2-10. Using the Gate or Sawtooth output waveforms to synchronize or trigger external equipment.

### Time Base A Synchronized High Frequency Operation

If it is necessary to observe a high frequency repetitive waveform, too low in amplitude to produce a stable triggered display, a special adjustment can be made to permit synchronizing the Type 585 with the low level signal. Remove the right side panel of the oscilloscope. Find R47, the TRIG. SENS. control, located right under the forward carrying handle. Note its setting, then rotate it fully clockwise. (Figure 2-9).

With the TRIG. SENS. control fully clockwise, the tunnel diode trigger regenerator will oscillate at certain settings of the front panel TRIGGERING LEVEL control. This mode of operation permits the vertical information to synchronize the tunnel diode oscillation rate and cause the sweep generator to present a stable display. When synchronizing the sweep, place the STABILITY control in its PRESET position, then apply the vertical signal, and rotate the TRIGGERING LEVEL control for a stable presentation.

Note that once the internal TRIG. SENS. control has been rotated clockwise, the tunnel diode trigger regenerator can be made to cause a sweep at some positions of the TRIGGERING LEVEL control in the absence of a triggering signal. It is best to restore the TRIG. SENS. control to its proper triggerable position you previously noted, and as described in the Calibration section of this manual. Replace the right side panel once synchronized operation is completed.

### Free-Running Sweep Operation of either A or B Sweep

In the usual oscilloscope application, the sweep is triggered or synchronized by the input waveform. However,

in some applications it may be more desirable to reverse the process and initiate the input waveform through use of a periodically recurrent waveform from the oscilloscope. In this type of application the sweep is caused to free-run and an output from either the +GATE OUT or SAWTOOTH A front panel connectors is used to trigger or synchronize the input waveform.

The Time Base B may be used as a trigger-rate-generator while the Time Base A is used in its normal fashion.

Either Time Base can be made to free run by rotating its STABILITY control fully clockwise. Under these conditions the sweep runs at a rate determined by the setting of the TIME/CM controls.

In this application it is advisable to place the TRIGGERING SOURCE switch in its EXT. position to prevent the vertical signal from producing any interference or jitter.

In addition to providing the means for triggering or synchronizing an external piece of equipment, a free-running sweep also provides a convenient reference trace on the oscilloscope screen without requiring an input signal. The trace can then be used to establish a voltage reference line.

### Single Sweep Operation

The usual oscilloscope display formed by a repetitive sweep is best for most applications. However, in applications where the displayed waveform is not repetitive or varies in amplitude, shape, or time interval, a repetitive sweep produces a jumbled display. When observing a waveform of this type, it is usually best to use a single sweep presentation.

The Type 585 Oscilloscope permits a single sweep presentation. The single sweep feature is selected by placing the HORIZONTAL DISPLAY switch in the "A" SINGLE SWEEP position. In this position, only Time Base A can produce a single sweep. The RESET button controls the operation of the single sweep.

When the A Sweep STABILITY control is set fully clockwise, a single sweep runs immediately each time the RESET button is depressed. When the STABILITY control is set for triggered operation, the single sweep does not occur when the RESET button is depressed until a triggering signal is applied. Instead the READY lamp lights to indicate that the sweep is ready to be triggered. When a triggering signal occurs, the sweep runs once and the READY light goes out. Each time the RESET button is depressed the procedure is repeated.

When operating the Type 585 in the single sweep mode the apparent brilliance of the crt trace will be less than during repetitive sweep operation. This is due to both the crt phosphor and your eye persistence making a repetitive sweep look brighter than each individual sweep is. In an attempt to increase the single sweep brilliance you may turn up the intensity control too high. There is a point (that varies a bit between different instruments) of maximum intensity above which a good focus can not be obtained. So to get the best writing rate during single sweep work, first be sure that the intensity is within the range permitting small spot size and good focus.

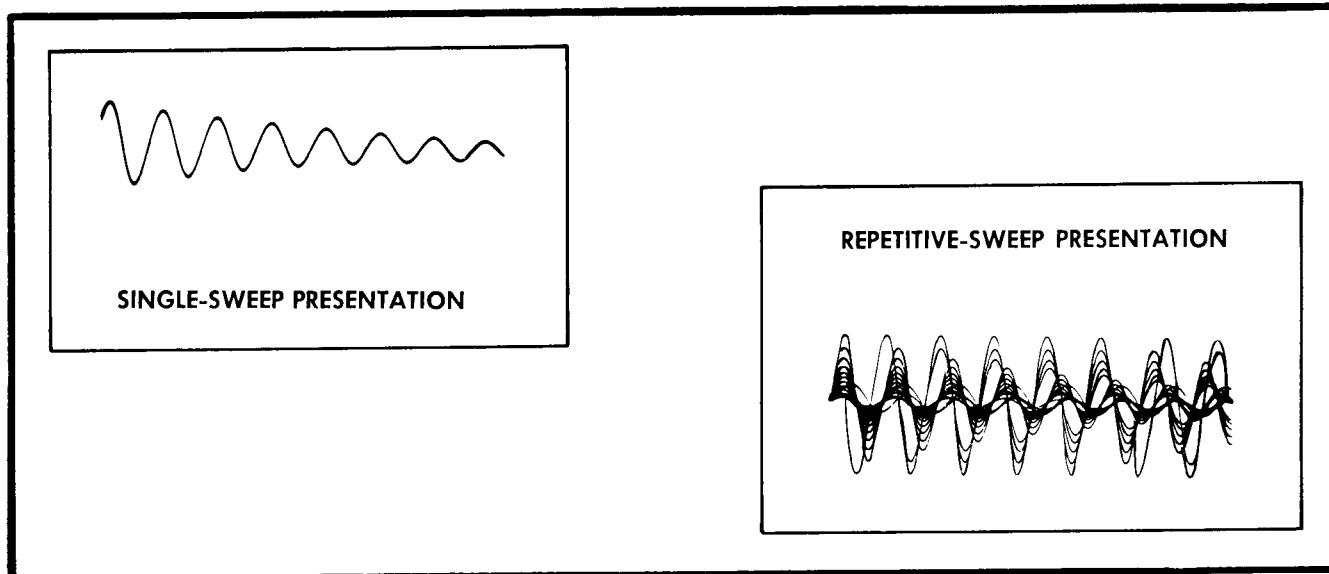


Fig. 2-11. Comparison of single sweep and repetitive sweep presentations of a damped sine wave. Note the jumbled display produced by the repetitive sweep presentation.

### Delayed Sweep

Using the Type 585 Oscilloscope, the start of the horizontal sweep can be delayed for a period of from 1 microsecond to 10 seconds after application of the triggering waveform. This is done through simultaneous use of Time Base A and Time Base B. In this application Time Base B is used to provide the accurate time delay while Time Base A presents a normal horizontal sweep at the end of the delay period. The duration of the sweep delay is controlled by the TIME BASE B TIME/CM or DELAY TIME switch and the DELAY-TIME MULTIPLIER control.

The delayed sweep feature of the Type 585 Oscilloscope can be used in a number of special applications to increase the versatility of the instrument. Such applications include high magnification of a selected portion of an undelayed sweep, accurate time measurements, and accurate measurements of waveform jitter. Also, it is possible to pick off and display any desired line of a television scan or to check pulse-time modulation. The delayed sweep feature is readily adaptable to a great number of other applications.

The delayed sweep feature is selected when the HORIZONTAL DISPLAY switch is in the 'A' DEL'D by 'B' position. The amount of delay occurring after the application of the triggering waveform until the sweep is permitted to run, is indicated directly by the settings of the TIME/CM or DELAY TIME switch and the DELAY-TIME MULTIPLIER control. The settings of the two controls are multiplied together to obtain the actual delay time. For example, if the TIME/CM or DELAY TIME switch is set at 1 MILLISEC and the vernier dial of the DELAY-TIME MULTIPLIER control indicates 6.75, the delay time is 6.75 milliseconds. When this time delay has elapsed, one of two events will occur depending upon the setting of the Time Base A STABILITY control. If the STABILITY control is fully clockwise, the horizontal sweep will occur immediately at the end of the delay period. This is the mode of operation most commonly used because it allows obtaining calibrated, continuously variable delay times.

If the Time Base is adjusted for normal triggered operation, the horizontal sweep does not start at the end of the delay period but waits until a triggering signal is received to the "A" Trigger Circuit. The triggering pulse may be either the input waveform to the oscilloscope, or an externally derived triggering signal. The triggering slope, source, and level can be selected in the same manner as for conventional triggered operation. In this mode of operation, the delay in presentation of the horizontal sweep is not continuously variable but is dependent on both the setting of the delay time controls and the occurrence of the triggering signal. The 'delay plus trigger' mode is used primarily to eliminate jitter from the displayed waveform. Since the sweep is usually triggered by the input waveform, inherent jitter in the waveform is eliminated from start of the display.

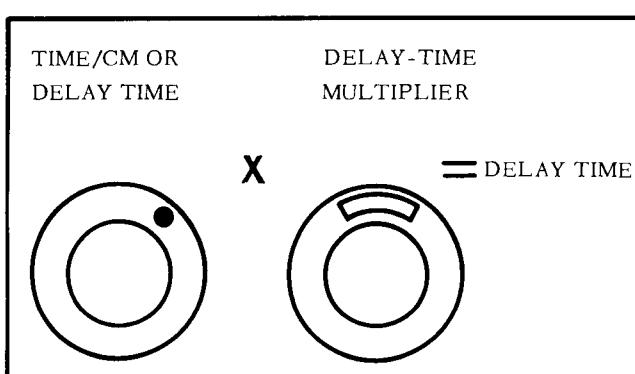


Fig. 2-12. Calculating delay time.

light then goes out. If the sweep is triggered immediately at the completion of the delay time, the READY light may not appear to go on.

When the HORIZONTAL DISPLAY switch is placed in the 'B' INTENSIFIED BY 'A' position, you can obtain a normal sweep presentation using Time Base B. If all other controls are set for delayed sweep operation and the Time Base A TIME/CM switch is set for a faster sweep rate than the Time Base B TIME/CM or DELAY TIME control, a portion of the sweep will be brightened. The start of the brightened portion indicates the start of the delayed sweep and the length of the brightened portion indicates the delayed sweep duration. The start of the brightened portion can be positioned left or right with the DELAY-TIME MULTIPLIER control. The length of the brightened portion can be adjusted with the Time Base A TIME/CM control. Using these two controls it is possible to include any portion of the displayed waveform in the brightened area.

To expand a portion of the Time Base B sweep presentation, adjust the DELAY-TIME MULTIPLIER and Time Base A TIME/CM controls to include the portion you wish to expand in the brightened area. Then place the HORIZONTAL DISPLAY switch in the 'A' DEL'D BY 'B' position. This expands the brightened portion to the full width of the crt. The amount of magnification is the ratio of the Time Base B TIME/CM or DELAY TIME control setting to the Time Base A TIME/CM control setting. For example, if the Time Base B TIME/CM or DELAY TIME switch is set at 1 MILLISEC and the Time Base A TIME/CM switch is set at 1  $\mu$ SEC, the brightened portion of the sweep is magnified horizontally 1,000 times. Using this method, practical sweep magnifications up to approximately 10,000 times are attainable.

At times when using the delayed sweep to obtain high magnification, the trace may appear very dim because of low duty cycle. In many of these cases the intensity cannot be improved sufficiently with the INTENSITY control. However, the intensity can often be increased by using the Time Base B SWEEP LENGTH control to increase the duty cycle. To set the SWEEP LENGTH control, place the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position. Adjust the SWEEP LENGTH control until the sweep stops at a point just past the brightened portion of the trace. Then return the HORIZONTAL DISPLAY switch to the "A" DEL'D BY "B" position.

### Delayed Trigger

A delayed triggering pulse can be obtained from the front panel DEL'D TRIG. connector any time from .05 microseconds to 10 seconds after the start of a sweep. When the oscilloscope is set for delayed sweep operation the delayed trigger occurs at the start of the delayed sweep. The delayed triggering pulse can be used to initiate some event after a known time interval, and when used with the delayed sweep, permits observation of the resulting event.

In the Time Base B, 'B' INTENSIFIED BY 'A', 'A' DEL'D BY 'B', EXT. X1, and EXT. X10 positions of the HORIZONTAL DISPLAY switch, the delayed trigger is controlled by Time Base B. In the other two positions of the HORIZONTAL DISPLAY switch, the delayed trigger is controlled by Time Base A.

To obtain a delayed trigger from either time base, adjust the appropriate time base unit for triggered operation or for free running operation, depending upon the application. The delay is then set with the appropriate TIME/CM control and the DELAY-TIME MULTIPLIER. (See Figure 2-12.) The lights above the DELAY-TIME MULTIPLIER control indicate which time base unit is used to produce the delayed trigger with each setting of the HORIZONTAL DISPLAY switch.

### External Horizontal Input

For special applications the spot can be deflected horizontally by some externally derived waveform allowing the oscilloscope to plot one function versus another.

To use an external horizontal input, connect the externally derived waveform to the HORIZ. INPUT connector and place the HORIZONTAL DISPLAY switch in either X1 or X10 EXT. position. The horizontal deflection factor is continuously variable from approximately 0.2 to approximately 15 volts per centimeter with the VARIABLE 10-1 control and the HORIZONTAL DISPLAY switch.

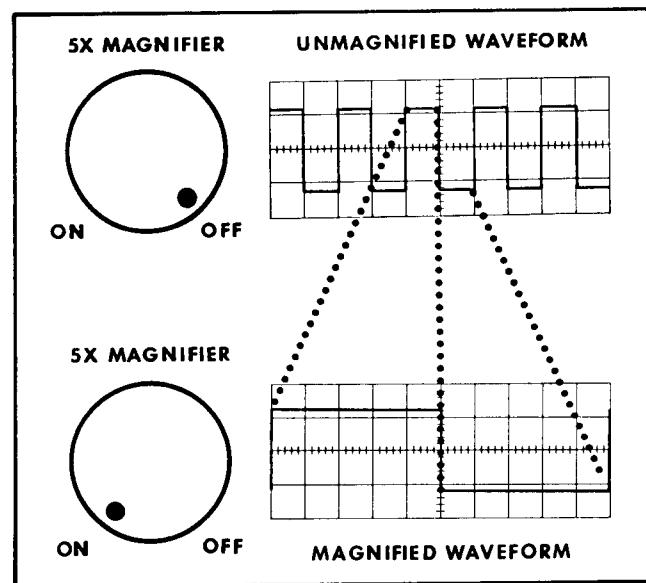


Fig. 2-13. Operation of the sweep magnifier.

### Sweep Magnifier

The sweep magnifier allows any two-centimeter portion of the displayed waveform to be expanded to the full ten-centimeter width of the graticule. This is done by first using the HORIZONTAL POSITION control to move the portion of the display to be expanded to the center of the graticule, then placing the 5X MAGNIFIER switch in the ON position. The 5X MAGNIFIER lamp indicates when the magnifier is on. Any portion of the original unmagnified display can be observed by rotating the HORIZONTAL POSITION controls.

In magnified sweep operation, the sweep rate indicated by the position of the TIME/CM control is divided by 5

## **Operating Instructions — Type 585**

to obtain the actual time required for the spot to move one centimeter. For example, if the TIME/CM control is set at 5 MILLISEC, the actual time per centimeter is 5 milliseconds divided by 5, or 1 millisecond per centimeter. (See Figure 2-13).

### **Output Waveforms**

For external use, the Time Base A sawtooth sweep waveform is available at the SAWTOOTH A connector on the front panel. This positive going waveform starts at about -2 volts and rises linearly to a peak amplitude of about 140 volts. The SAWTOOTH A waveform is dc coupled.

The start and duration of the rising part of the sawtooth coincides with the start and duration of the Time Base A horizontal sweep on the crt. The rate at which the sawtooth rises is determined by the setting of the Time Base A TIME/CM control.

Two positive rectangular waveforms are available at the +GATE A and +GATE B connectors. These waveforms start at ground and rise to about 30 volts. The starting time and duration of each pulse coincides with the starting time and duration of the particular Time Base A or B sweep generator sweep action.

### **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 compensate attenuators or probes and to verify the amplitude calibration of the vertical deflection system of the oscilloscope and plug-in unit.

Calibrator square-waves are adjustable from 0.2 millivolts peak-to-peak to 100 volts peak-to-peak in 18 steps. The amplitude is controlled by the setting of the AMPLITUDE CALIBRATOR switch and is accurate within 3% of the AMPLITUDE CALIBRATOR switch setting, when the output is connected to a high impedance load.

### **Intensity Modulation**

The crt display of the Type 585 Oscilloscope can be intensity modulated by an external signal to display additional information. This is done by disconnecting the grounding bar from the EXTERNAL CRT CATHODE connector at the rear of the instrument and connecting the external signal to the two terminals.

To make very accurate time measurements from the crt display, you may intensity modulate the beam with time markers and make measurements directly from the time markers presented on the crt. A signal of approximately +2 to +25 volts is required to cut off the crt beam from normal intensity. Restore the grounding bar to the EXTERNAL CRT CATHODE connector during normal operation to avoid uneven trace intensity at high sweep rates.

### **Dual-Trace Displays**

When using the Type 81 Plug-In Adapter with a Type CA Plug-In Unit, and the Type 82 Plug-In Unit (without the Type 81) two separate traces may be obtained on the face of the crt. This permits display of two functions simultaneously. Detailed instructions for operating either plug-in unit are contained in the appropriate Instruction Manual.

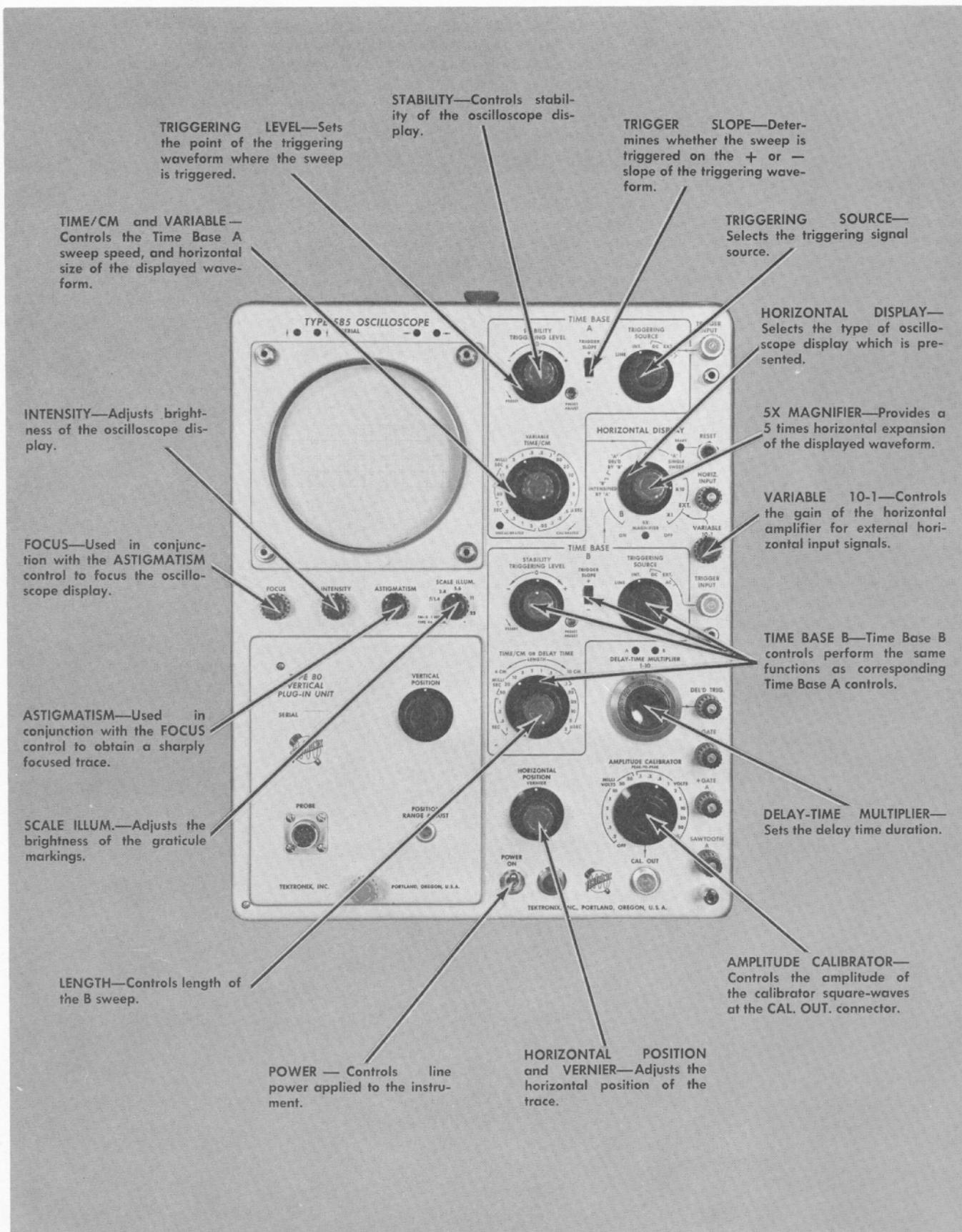
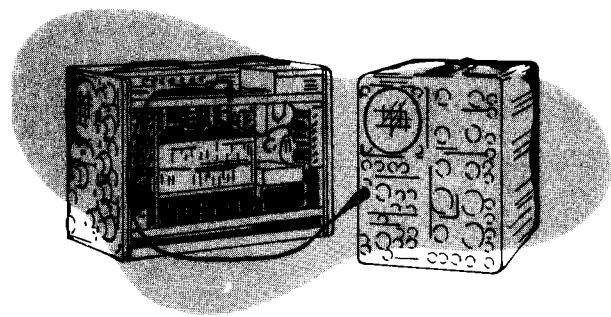


Fig. 2-14. Functions of the front panel controls.

## NOTES

# SECTION 3

## APPLICATIONS



### General

Oscilloscopes are used principally as aids to instrument calibration and for waveform observations in research or new circuit design. Electronic engineers continue to reach into the higher frequencies with greater ease through research of solid state materials, and by the increased band-pass and sensitivity of modern oscilloscopes.

Your Tektronix Type 585 Oscilloscope with Type 80/P80 or Type 82 Plug-In Unit systems, offers basic 100 millivolt sensitivities, with a 3 db response of approximately 95 megacycles, permitting accurate measurements of high frequency, low level signals.

A versatile group of oscilloscope cameras for making permanent records of your waveform observations is presented in the Accessories section of this manual.

### Voltage Measurements

The Type 585 Oscilloscope can be used to measure the voltage of the input waveform by using the calibrated vertical-deflection factors of the instrument and associated plug-in unit. The method used for all voltage measurements is basically the same although the actual techniques vary somewhat depending on the type of voltage measurements: ac-component voltage measurements and instantaneous voltage measurements with respect to some reference potential. Many waveforms contain both ac and dc voltage components. It is often necessary to measure one or both of these components. (see Figure 3-1).

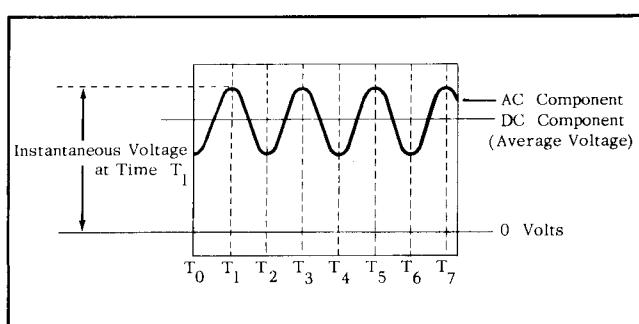


Fig. 3-1. Typical waveform applied to the oscilloscope. Shown are the ac component, dc component, and instantaneous voltage of the waveform.

When making accurate voltage measurements, display the vertical waveform over only the center two centimeters of the graticule for maximum accuracy, avoiding the bottom centimeter where compression is greatest. Also, it is important not to include the width of the trace in your measurements. You should consistently make all measurements from one side of the trace. If the bottom side of the trace is used for one reading, it should be used for all succeeding readings.

When using the Type 81 Plug-In Adapter, the letter series plug-in unit VARIABLE VOLTS/CM control must be in the CALIBRATED position.

### AC Component Voltage Measurements

In Oscilloscope measurements, the ac component of a waveform is usually measured in terms of its peak-to-peak or peak-to-trough value. This type of measurement is most conveniently made by using the graticule to measure the vertical distance between peaks and multiplying this distance by the deflection factor of the oscilloscope. The figure obtained is the actual peak-to-peak voltage. In most cases, the ac component of a waveform can be measured with the probe Input Selector switch in either the AC or DC position. It may be necessary to use the AC position however, in certain applications to prevent the dc component of the waveform from deflecting the trace off the screen. Also to prevent inaccuracies, the DC position should be used when low-frequency measurements are made.

To make a peak-to-peak voltage measurement on the ac component of a waveform, the following method can be used (see Figure 3-2):

1. With the aid of the graticule, measure the vertical distance in centimeters from the positive peak to the negative peak.
2. Multiply the vertical distance between peaks by the vertical sensitivity per centimeter to obtain the indicated voltage.
3. Multiply the indicated voltage by the attenuation factor of any probe or attenuator used to obtain the actual peak-to-peak voltage.

As an example, assume that when using the P80 Probe with a 5-1 attenuator you measure a vertical distance between peaks of 2.1 centimeters. In this case then, 2.1 centimeters multiplied by 0.1 volt per centimeter gives 0.21 volt. This figure multiplied by the attenuation factor of 5 gives the actual peak-to-peak voltage, 1.05 volts.

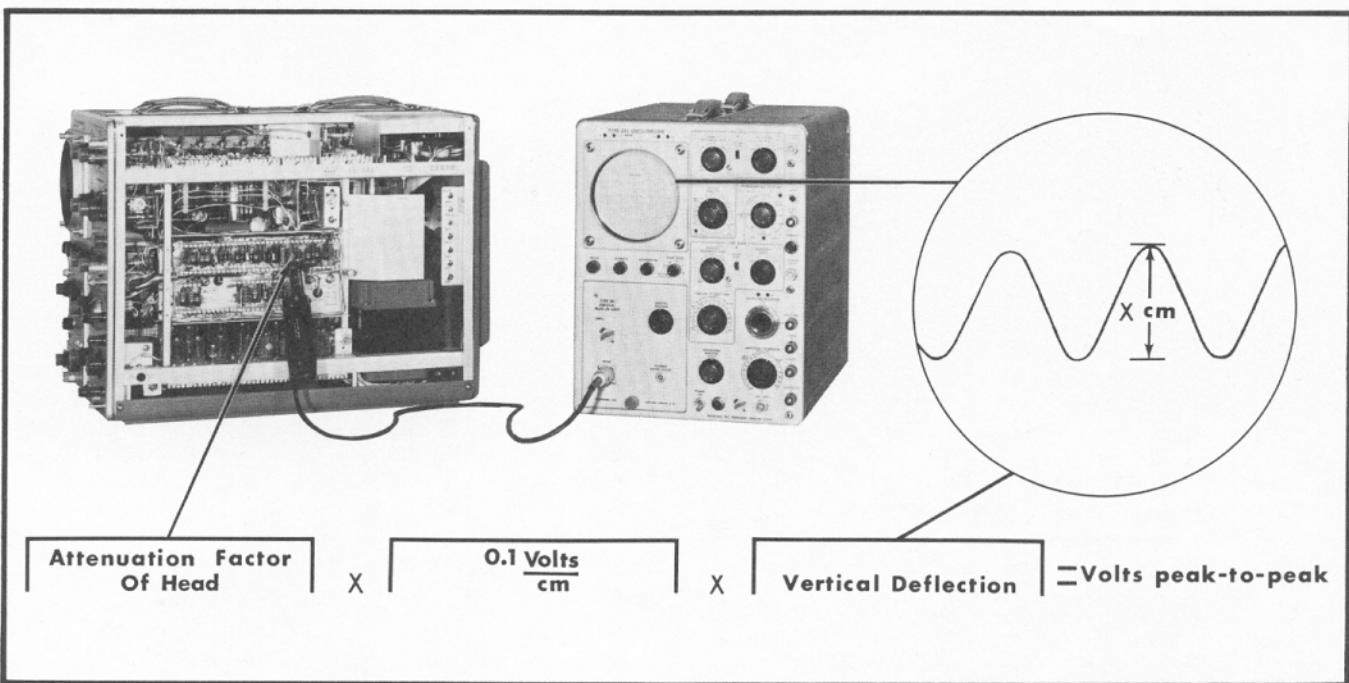


Fig. 3-2. Measuring the peak-to-peak ac component of an applied waveform.

When sinusoidal waveforms are measured, the peak-to-peak voltage obtained can be converted to peak, rms, or average values through the use of standard conversion factors.

### Instantaneous Voltage Measurements

The method used to measure instantaneous voltages is virtually identical to the method described previously for the measurement of the ac component of a waveform. The primary difference is that instantaneous voltage measurements must be made with respect to some reference potential (usually ground). In this type of measurement, the reference potential must be used to first establish a reference line on the graticule. Voltage measurements are then made with respect to this reference line. In this type of measurement, the probe Input Selector switch must be placed in the DC position. The method used to measure instantaneous voltages can also be extended to measurement of the dc component of a waveform since the average voltage of a waveform can be treated as an instantaneous voltage. The dc component of any waveform can therefore be measured if the average voltage can be determined.

In the following procedure, steps are given for establishing the voltage reference line as ground. The same general method may be used to measure voltage with respect to any other potential, so long as that potential is used to establish the reference line. If for example, voltage measurements are to be made with respect to +10 volts, the reference line would be established to correspond to that potential.

To measure an instantaneous voltage with respect to ground perform the following steps (see Figure 3-3):

1. To establish the voltage reference line, select the proper attenuator for the expected signal voltage, clip the probe

ground lead to the chassis, and touch the probe or attenuator tip to an oscilloscope ground terminal or the voltage reference required. Adjust the oscilloscope controls for a free-running sweep. Vertically position the trace to a convenient point on the crt. This point will depend on the polarity and amplitude of the input signal, but should always be chosen so that the trace lies along one of the major divisions of the graticule. If the trace is widened by stray interference, ground the probe body near the tip to reduce the interference. The graticule division corresponding to the position of the trace is the voltage reference line and all voltage measurements must be made with respect to this line. (Do not adjust the vertical positioning control after the reference line has been established.)

2. Remove the probe or attenuator tip from ground and connect it to the signal source. Adjust the triggering controls for a stable display. The probe ground lead should be either coaxial or very short.
3. Using the graticule, measure the vertical distance in centimeters from the point to be measured to the voltage reference line.

4. Multiply the distance measured first by the plug-in sensitivity in volts per centimeter, then by the attenuation factor of the attenuator or probe used.

As an example, assume that when using the P80 Probe with a 10:1 attenuator you measure a vertical distance of 2.5 centimeters between the reference line and the point to be measured. In this case, 2.5 centimeters multiplied by 0.1 volt per centimeter gives 0.25 volt. This figure multiplied by the attenuation factor of 10 gives the instantaneous voltage, 2.5 volts. If the point that is measured is above the reference line, the polarity is positive; if the point is below the reference line, the polarity is negative.

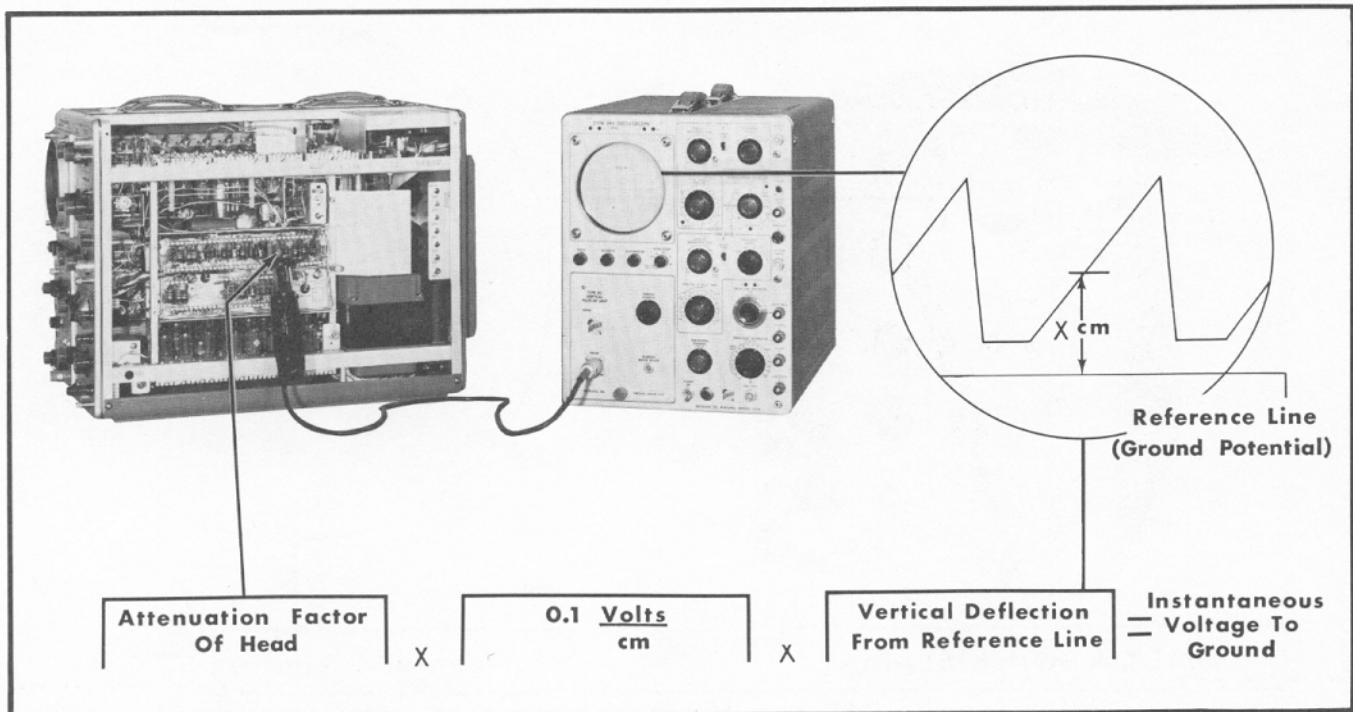


Fig. 3-3. Measuring the instantaneous voltage to ground (or other reference voltage).

## Time Measurements

The calibrated sweep rates of the Type 585 Oscilloscope cause any horizontal distance on the crt to represent a definite known interval of time. Using this feature you can measure accurately the time between two displayed events directly from the crt. One method which produces sufficient accuracy for most applications follows (see Fig 3-4):

1. Using the graticule, measure the horizontal distance between the two displayed events whose time interval you wish to find.
2. Multiply the distance measured by the setting of the appropriate TIME/CM control to obtain the apparent time interval. (The VARIABLE TIME/CM control must be in the CALIBRATED position).
3. Divide the apparent time interval by 5 if the magnifier is on, to obtain the actual time interval.

For example, assume that the TIME/CM switch setting is 1 MILLISEC, the magnifier is on, and that you measure a horizontal distance of 5 centimeters between events. In this example then, 5 centimeters multiplied by 1 millisecond per centimeter gives you an apparent time interval of 5 milliseconds. The apparent time divided by 5 then gives you the actual time interval of 1 millisecond.

## Increased Accuracy Time Measurements

Another method for measuring time intervals involves the use of the intensified sweep feature of the Type 585 Oscilloscope. In this method the HORIZONTAL DISPLAY switch is placed in the "B" INTENSIFIED BY "A" position to brighten

a portion of the trace. The brightened portion of the trace is then used as a continuously variable time marker. The brightened portion of the trace and the DELAY-TIME MULTIPLIER control are used to make the time measurements. This method provides a very high degree of accuracy when care is taken in making the measurements. The method is summarized as follows:

1. Place the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position and adjust the Time Base B triggering controls for a stable display of the input waveform. Adjust the Time Base A STABILITY control for free-running operation.
2. Turn the intensity down until the brightened portion of the trace is easily distinguishable. Adjust the Time Base A TIME/CM control to reduce the brightened area to a small spot or to cover as small a portion of the trace as possible.
3. Using the DELAY-TIME MULTIPLIER control, position the start of the brightened portion to the beginning of the interval you wish to measure. Record the setting of the DELAY TIME MULTIPLIER control.
4. Using the DELAY-TIME MULTIPLIER control, position the start of the brightened portion of the trace to the end of the interval you wish to measure. Again record the setting of the DELAY TIME MULTIPLIER control.
5. Subtract the first DELAY-TIME MULTIPLIER control setting from the second and multiply the result by the setting of the Time Base B TIME/CM or DELAY TIME control. The figure obtained is the time interval between the two events. The figure obtained is within 1% regardless of whether the magnifier is on or off.

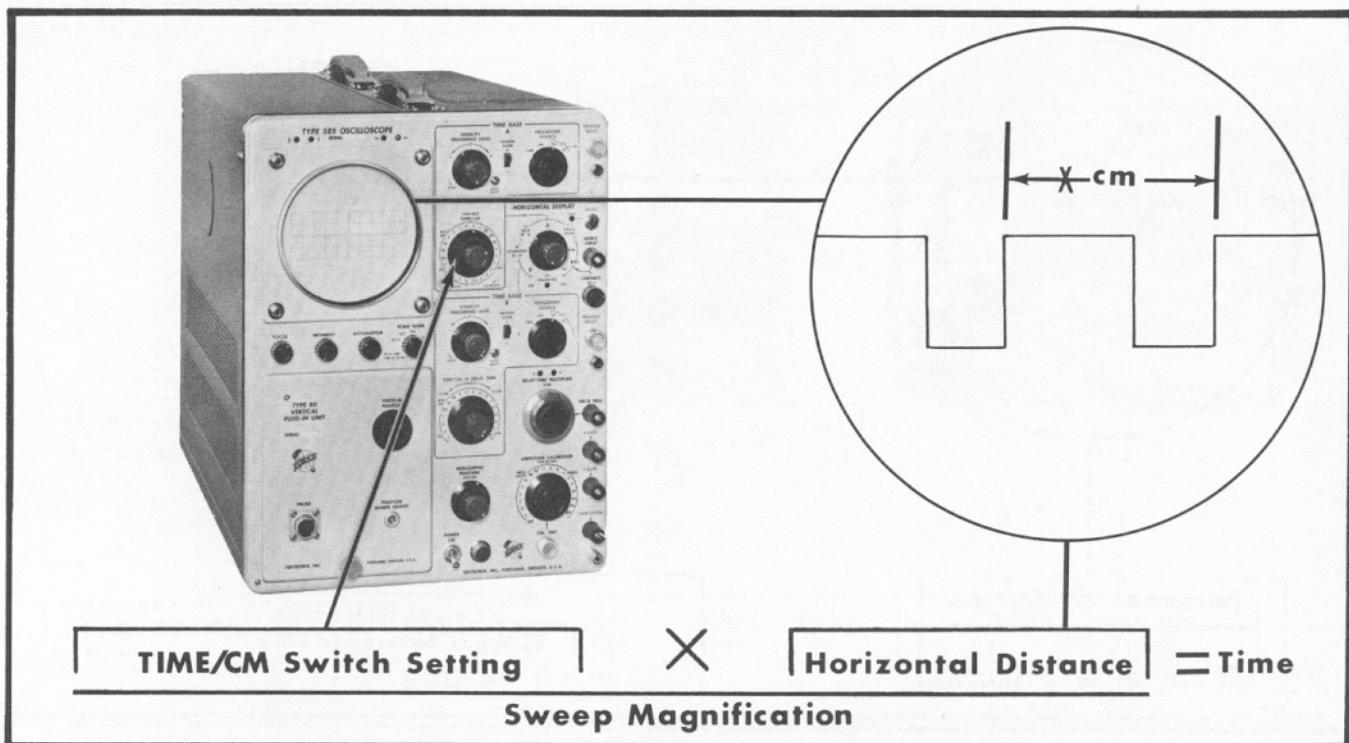


Fig. 3-4. Measuring the time interval between events displayed on the oscilloscope screen.

### Maximum Accuracy Time Measurements

The maximum accuracy method of time measurement involves the delayed sweep feature of the Type 585 Oscilloscope. This method uses the accuracy of only the DELAY-TIME MULTIPLIER dial, with the possibility of an ultimate accuracy of  $\pm 0.2\%$ . In cases where an accuracy of  $\pm 0.2\%$  is required, the Time Base B calibration should be checked on the individual TIME/CM range used, using steps 39 and 40 of the Calibration procedure.

After establishing the accuracy of the Time Base B TIME/CM range to be used, proceed as follows.

1. Complete the time measurement as described in the previous section on Increased Accuracy Time Measurements. Be sure the Time Base A STABILITY control is fully clockwise at free-run.
2. Return the DELAY-TIME MULTIPLIER dial to the beginning of the interval to be measured. Set the HORIZONTAL DISPLAY switch to 'A' DEL'D BY 'B'. With the DELAY-TIME MULTIPLIER dial, horizontally position the beginning of the interval to be measured to the graticule centerline. (The graticule centerline is now the reference point of the crt display for the following measurements.) Record the DELAY-TIME MULTIPLIER dial reading.
3. Set the HORIZONTAL DISPLAY switch to 'B' INTENSIFIED BY 'A', and rotate the DELAY-TIME MULTIPLIER to the end of the interval being measured. Set the HORIZONTAL DISPLAY switch to 'A' DEL'D BY 'B'. With the DELAY-TIME MULTIPLIER dial, horizontally position the end of the interval to the graticule centerline. Record the DELAY-TIME MULTIPLIER dial reading.

4. Subtract the first DELAY-TIME MULTIPLIER dial reading from the second reading and multiply the result by the setting of the Time Base B TIME/CM or DELAY TIME control. The figure obtained can be within  $0.2\%$  of the true time of the measured interval.

### Frequency Measurements

Using one of the three methods described in the previous section, you can measure the period (time required for one cycle) of a recurrent waveform. The frequency of the waveform can then be easily calculated since frequency is the reciprocal of the period. For example, if the period of a recurrent waveform is accurately measured and found to be 0.2 microsecond, the frequency is the reciprocal of 0.2 microsecond, or 5 mc.

At any given oscilloscope sweep rate, the number of cycles of the input waveform that are displayed on 10 centimeters of the crt screen is dependent on the frequency of the input waveform. At a sweep rate of 0.1 microsecond per centimeter, for example, 6 cycles are displayed with a 6 mc input signal, 5 cycles with a 5 mc signal, and 4 cycles with a 4 mc input signal. Frequency can usually be measured faster by the following method than by the one given in the preceding paragraphs.

If you divide the cycles per unit of length by the time required for the input waveform to sweep this unit of length, you get the frequency. For greater accuracy, make your calculations by using the total number of cycles displayed in 10 cm. Since the TIME/CM switch gives time for 1 cm, multiply this setting by 10 to obtain the time required for 10 cm. (See Figure 3-5).

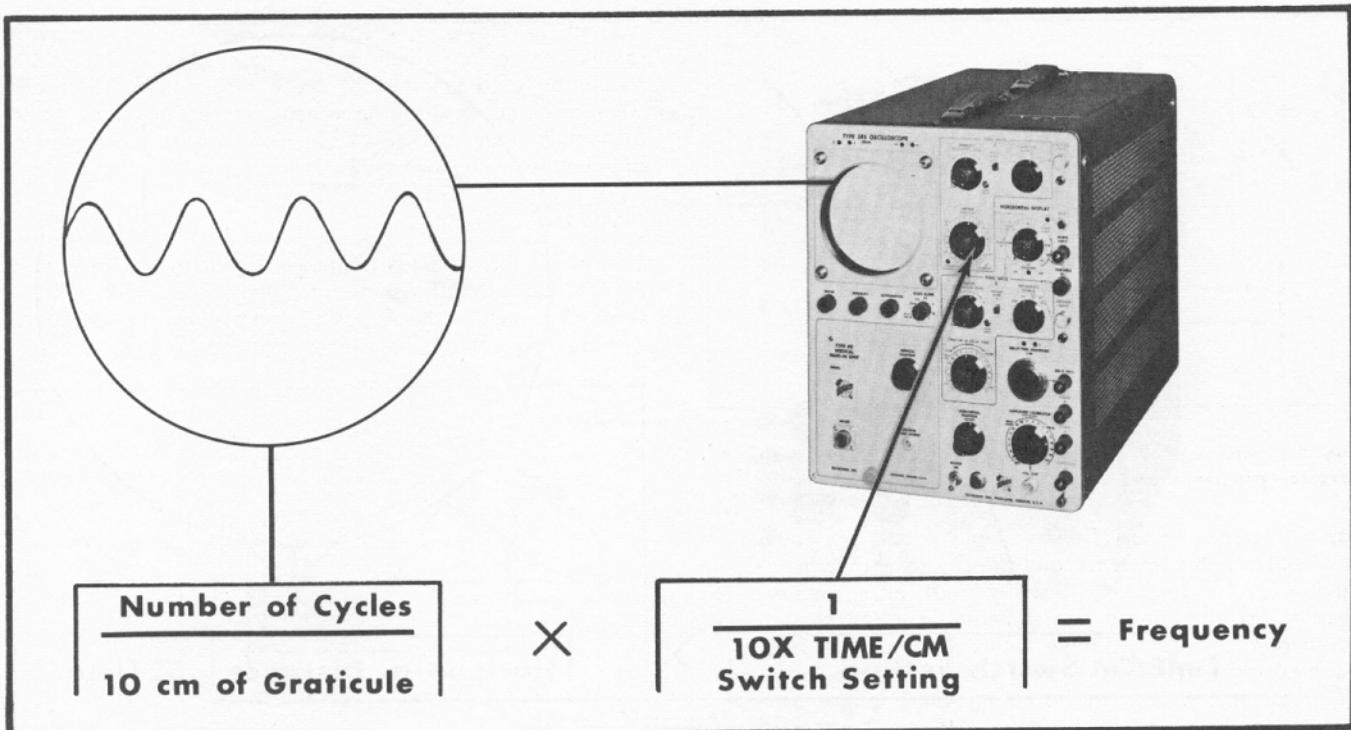


Fig. 3-5. Measuring the frequency of a repetitive input signal.

To obtain the frequency of a repetitive input signal, perform the following steps:

1. Adjust the TIME/CM control to display several cycles of the input waveform. Insure that the VARIABLE TIME/CM control is in the CALIBRATED position.
2. Count the number of cycles of the waveform shown on the 10 centimeters of the graticule.
3. Divide this number by 10 times the TIME/CM switch setting. This gives you the frequency of the input waveform.

For example, assume that when you are using a sweep rate of 50 milliseconds per centimeter, you count 7.2 cycles in 10 centimeters. The frequency is 7.2 cycles divided by 50 milliseconds times 10, or 500 milliseconds. 500 milliseconds is equal to  $500 \times .001$  second, or 0.5 second. 7.2 cycles per  $\frac{1}{2}$  second gives you 14.4 cycles per second.

### Phase Measurements

In many fields of engineering and science, it is frequently necessary to accurately measure the phase angle between two electrical signals. One method for making such measurements involves the use of a cathode ray oscilloscope. In this application phase angle measurements can be made directly from the crt display.

You will recall that a complete cycle of a sinusoidal waveform is 360 degrees. Using this fact it is possible to calibrate the oscilloscope display directly in degrees per centimeter by means of the TIME/CM controls. For example, if the TIME/CM controls are adjusted so that one cycle of the input waveform covers 9 centimeters (see Figure 3-6),

each centimeter then corresponds to 40 degrees. Under this condition the display is calibrated to 40 degrees per centimeter.

It is therefore possible to measure phase angles by: (1) calibrating the display in degrees per centimeter; (2) measuring the displacement between corresponding points on the two phases; and (3) multiplying the displacement by the number of degrees per centimeter. This is the method illustrated in Figure 3-7. Note that the relative amplitude of the two signals does not affect the phase measurement so long as the signals are both centered about the horizontal centerline. It is important to note that the two waveforms shown in the illustration do not appear simultaneously on the oscilloscope screen. The first waveform is displayed and positioned to a convenient reference point. The second waveform is then displayed and compared to this reference point.

Referring to Fig. 3-8, it can readily be seen that the phase angle between the two waveforms is  $360^\circ \times A/B$ . It is apparent that it is not necessary to calibrate the display in degrees per centimeter as long as it is possible to measure A and B accurately. It is particularly important to measure A accurately when the phase angle is less than  $10^\circ$ . The delayed sweep feature provides the means for making these measurements. The phase angle can be found by: (1) measuring A; (2) measuring B; and (3) multiplying A/B by  $360^\circ$ . Here again the relative amplitude of the two waveforms is unimportant as long as the waveforms are centered about the horizontal centerline of the graticule.

When using the Type 585 Oscilloscope for phase measurements, it is necessary to supply an external triggering signal to the oscilloscope. This triggering signal serves, in a sense,

## Applications — Type 585

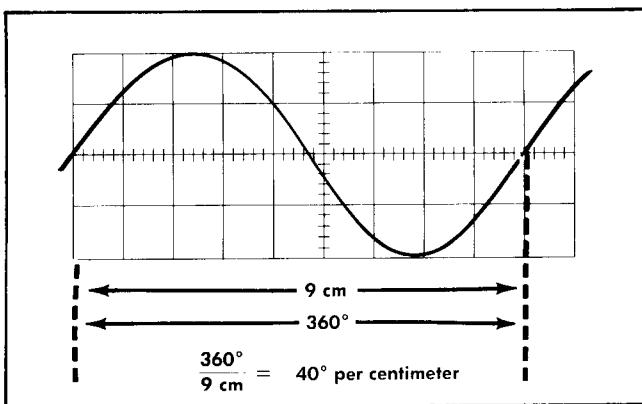


Fig. 3-6. One method for calibrating the oscilloscope display in degrees per centimeter.

as a reference signal. The two input signals are compared indirectly to this reference and directly to each other. Consequently the triggering stability must be maintained to permit accurate phase angle measurements. The external triggering signal must have sufficient amplitude to insure stable triggering. The triggering signal must also be related in frequency to the waveforms on which phase measurements are to be made, however, the actual phase of the triggering signal is not critical. If you so desire, you may use one of the signals to be measured as the external triggering signal. It is essential that once the triggering conditions have been established, they are not changed during any phase measurement.

In phase measurements it is very important that the width of the trace is not included in the measurements. Measurements must consistently be made from either the top or

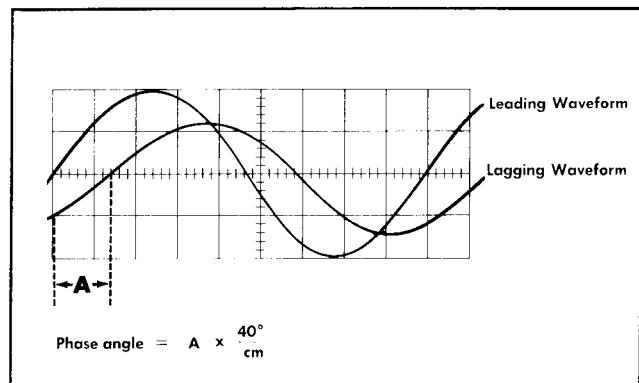


Fig. 3-7. Measurement of the phase angle between two electrical waveforms. It is important to note that the two displayed waveforms do not appear simultaneously on the oscilloscope screen.

bottom of the trace. The height of the display should be made as large as possible to improve accuracy. Accuracy of the measurements also depends to a large extent on how well the waveforms are centered about the horizontal centerline of the graticule. Care should be taken to insure that the waveforms are properly centered.

Two primary methods of phase measurements have been described thus far. Method 1 is somewhat easier than

method 2. However, method 2 provides more accurate results, particularly with small phase angles. Method 1 should be used when moderate accuracy is sufficient and when large numbers of phase measurements are to be made. Method 2 should be used when more precise measurements are required. The two methods are summarized as follows:

### Method 1:

1. Connect the external triggering signal to the Time Base A TRIGGER INPUT connector. Place the HORIZONTAL DISPLAY switch in the A position and adjust the Time Base A triggering controls for stable triggering.

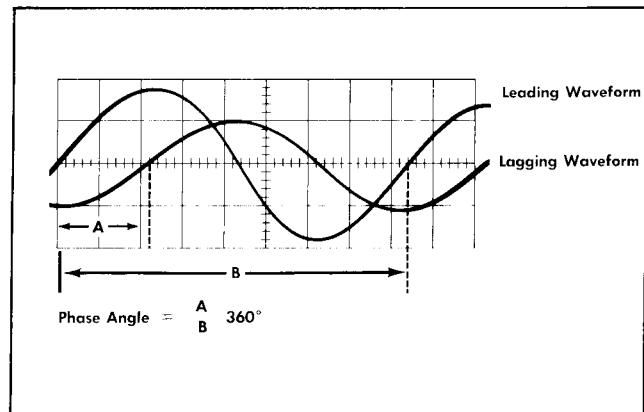


Fig. 3-8. An alternate method for measuring the phase angle between two electrical signals.

2. Connect the first (leading) waveform to the oscilloscope input. Adjust the Time Base A TIME/CM controls so that one cycle of the input waveform covers exactly 9 centimeters. This corresponds to 40 degrees per centimeter.
3. Carefully center the display waveform about the horizontal centerline. Switch on the magnifier and adjust the horizontal position of the trace so that the displayed curve crosses the horizontal centerline at the extreme left marking of the graticule (see Fig. 3-9). Make this adjustment with the black HORIZONTAL POSITION control. The VERNIER HORIZONTAL POSITION control should be placed in the fully clockwise position.
4. Disconnect the first waveform and connect the second (lagging) waveform to the oscilloscope. Switch off the magnifier and using only the VERNIER HORIZONTAL POSITION control, position the curve onto the screen as far

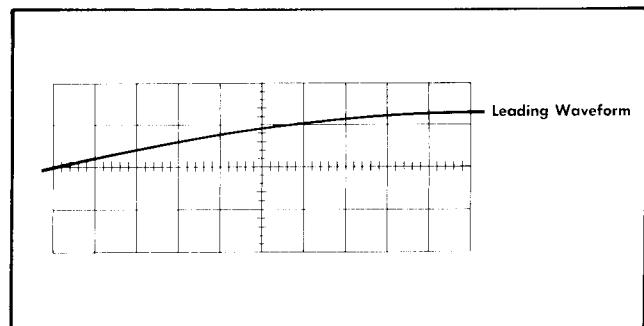


Fig. 3-9. Establishing the reference point with the leading waveform.

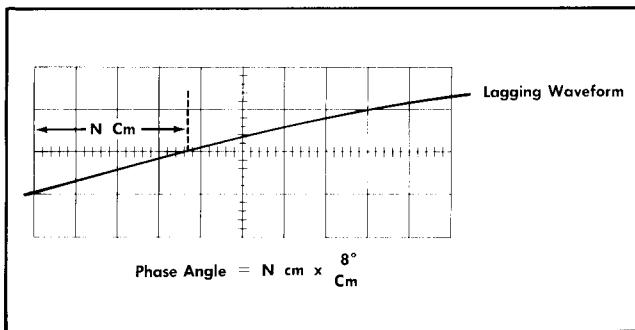


Fig. 3-10. Computing the phase angle. The distance from the reference point established in Fig. 3-9 to the point where the curve crosses the centerline, multiplied by 8° per centimeter is the phase angle.

as possible. Carefully center the waveform vertically about the horizontal centerline. Switch the magnifier back on and rotate the VERNIER HORIZONTAL POSITION control fully clockwise. Without adjusting either the triggering or the black HORIZONTAL POSITION control, measure the distance from the extreme left graticule marking to the point where the curve crosses the horizontal centerline (see Fig. 3-10). This distance multiplied by the number of degrees per centimeter is the phase angle. (For phase angles up to 80° the measurement should be made with the magnifier on for maximum accuracy. With the magnifier off, the scale calibration is 8 degrees per centimeter. For phase angles greater than 80°, measurements must be made with the magnifier off. With the magnifier off, the scale calibration is 40 degrees per centimeter. When phase angles are measured with the magnifier off, step 3 must be repeated with the magnifier off.)

#### Method 2:

1. Place the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position. Turn off the magnifier. Rotate the Time Base A STABILITY control fully clockwise. Connect the external triggering signal to the time Base B TRIGGER INPUT connector and adjust the Time Base B triggering controls for stable operation.
2. Connect the first (leading) waveform to the oscilloscope input. Adjust the Time Base B TIME/CM control so that approximately 2 or 3 (or if more than 2 or 3, as few as possible) cycles are displayed on the screen. Set the Time Base A TIME/CM controls for a sweep approximately 20 times as fast as Time Base B.
3. Center the waveform exactly about the horizontal centerline. Adjust the DELAY-TIME MULTIPLIER control so that the start of the brightened portion of the trace is at the point where the curve crosses the horizontal centerline the second time (see Fig. 3-11). Place the HORIZONTAL DISPLAY

switch in the "A" DEL'D BY "B" position. Adjust the DELAY-TIME MULTIPLIER control so that the sweep starts at the horizontal centerline of the graticule. Record the setting of the DELAY TIME MULTIPLIER control.

4. Place the HORIZONTAL DISPLAY switch at "B" INTENSIFIED BY "A". Adjust the DELAY-TIME MULTIPLIER control so that the start of the brightened portion of the trace is at the point where the curve crosses the horizontal centerline the fourth time. Place the HORIZONTAL DISPLAY switch at "A" DEL'D BY "B" and adjust the DELAY-TIME MULTIPLIER control so that the trace starts at the horizontal center-

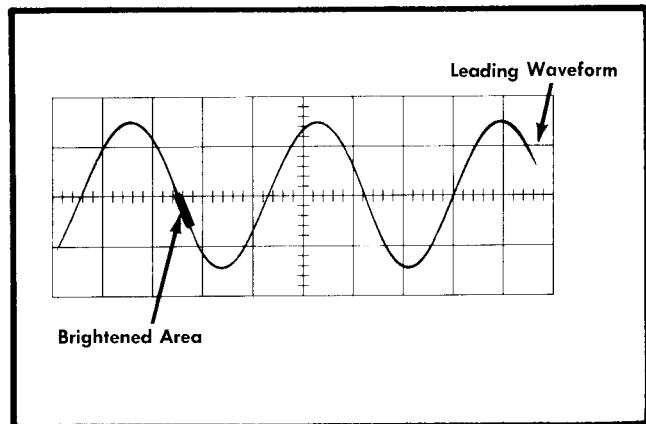


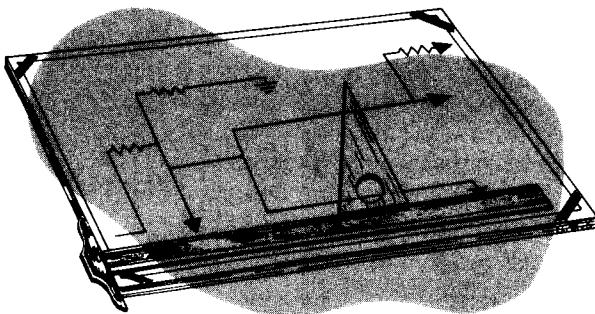
Fig. 3-11. Setting the start of the brightened area at the horizontal centerline using the leading waveform.

line of the graticule. Record the setting of the DELAY TIME MULTIPLIER control. Subtract the setting of the DELAY TIME MULTIPLIER control obtained in step 3 from that obtained in this step. The number obtained is the dimension B shown in Fig. 3-8.

5. Disconnect the first waveform and connect the second (lagging) waveform to the oscilloscope input. Place the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position. Center the displayed waveform exactly about the horizontal centerline of the graticule. Adjust the DELAY-TIME MULTIPLIER control clockwise from the final setting of step 4 until the start of the brightened portion of the trace is at the point where the curve next crosses the horizontal centerline of the graticule (see Fig. 3-11). Place the HORIZONTAL DISPLAY switch at "A" DEL'D BY "B". Adjust the DELAY-TIME MULTIPLIER control so that the start of the trace is at the horizontal centerline of the graticule. Record the setting of the DELAY-TIME MULTIPLIER control. Subtract the setting of the DELAY-TIME MULTIPLIER control obtained in step 4 from that obtained in this step. The figure obtained is the dimension A shown in Fig. 3-8.

6. Using the value of A from step 5 and the value of B from step 4, calculate the phase angle from the relationship, phase angle =  $(360^\circ)(A/B)$ .

## NOTES



## SECTION 4

# CIRCUIT DESCRIPTION

### General

This portion of the Instruction Manual presents a detailed discussion of the Type 585 Oscilloscope's circuit operation. This discussion is keyed to various block diagrams inserted with the text and to detailed circuit diagrams contained at the back of this manual. It is assumed a Type 80 Plug-In Unit and P80 Probe are used.

### Instrument Operation

The simplified block diagram of Figure 4-1 illustrates the interrelation of the various circuits composing the Type 585 Oscilloscope. The input signal to the oscilloscope is connected through the probe to the input connector of the plug-in unit. The output signal from the plug-in unit is then applied to the vertical amplifier of the oscilloscope. The output of the vertical amplifier system is used to drive the vertical deflection plates of the crt.

A Trigger Pickoff circuit in the Vertical Amplifier applies a sample of the input waveform to the two Time-Base Trigger circuits. This waveform sample can then be used to trigger a sweep by a Time-Base Generator. In addition, an external waveform or a line frequency waveform can be used to trigger a sweep.

Signals of widely varying shapes and amplitudes are applied to the Time-Base Trigger circuits. The Trigger Regenerators in turn produce constant amplitude output pulses which are used to start a Time-Base Generator at the proper instant of time. This insures a stable display of the input waveform.

The output pulses from two Trigger circuits may be applied to their respective Time-Base Generators to initiate an output sweep waveform. The selected sawtooth waveform is then amplified by the Horizontal Amplifier and applied to the horizontal deflection plates of the crt.

When an external sweep waveform is used, the waveform is connected through the HORIZ. INPUT connector to the External Horizontal Amplifier. The output signal of the External Horizontal Amplifier is then amplified by the Horizontal Amplifier and applied to the crt horizontal deflection plates to produce the desired horizontal deflection.

Sawtooth waveforms from the two time base generators are available to be applied to the delay pickoff circuit. This circuit utilizes one sawtooth waveform at a time to generate a delayed trigger pulse after an adjustable delay time. This delayed triggering pulse is available at the front panel DEL'D TRIG. connector. When the sawtooth waveform

from the Time Base B sweep generator is used to produce the delayed trigger, the delayed trigger may be used to trigger the Time Base A Sweep Generator circuit. The delayed trigger is then used to initiate a delayed sweep by Time Base A.

The Amplitude Calibrator produces a square wave output waveform which can be used to check the deflection factor of the vertical deflection system. The Amplitude Calibrator voltage is also used to compensate attenuator probes.

There are six regulated low voltage power supplies used in the Type 585 Oscilloscope. These power supplies provide the operating voltages for all circuits except the cathode-ray tube. Operating voltages for the crt are provided by a separate high voltage power supply contained in the crt circuit. In addition to the high voltage power supply, the crt circuit contains the controls and circuitry which affect the crt display.

### VERTICAL DEFLECTION SYSTEM

#### General

The Type 585 vertical deflection system can be driven by any of the 80 Series plug-in units, or by the Type 81 Plug-In Adapter with any Tektronix letter series plug-in unit.

Input signals to the oscilloscope are applied directly to the Type P80 Probe, when using a Type 80 Plug-In Unit, or either to a probe or directly into a 1 megohm input of the Type 82 Dual-Trace Plug-In Unit. The output of a plug-in unit is then applied through the interconnecting plug to the Delay-Line Driver stage of the oscilloscope Vertical Amplifier. The signal traverses the Delay-Line Driver stage and is returned to the plug-in for termination. The plug-in units provide positioning voltages permitting the trace to be positioned vertically on the crt.

The input resistance and capacitance of each plug-in unit (or probe) input connector is discussed in the manual for the unit in use. In all cases, consider the oscilloscope input as a potential load on the signal source, the degree depending upon the signal source impedance, the plug-in input characteristics, and the frequency being measured.

#### Delay-Line Driver

The Delay-Line Driver Stage is a balanced distributed amplifier consisting of seven push-pull triode sections. Use

**Circuit Description — Type 585**

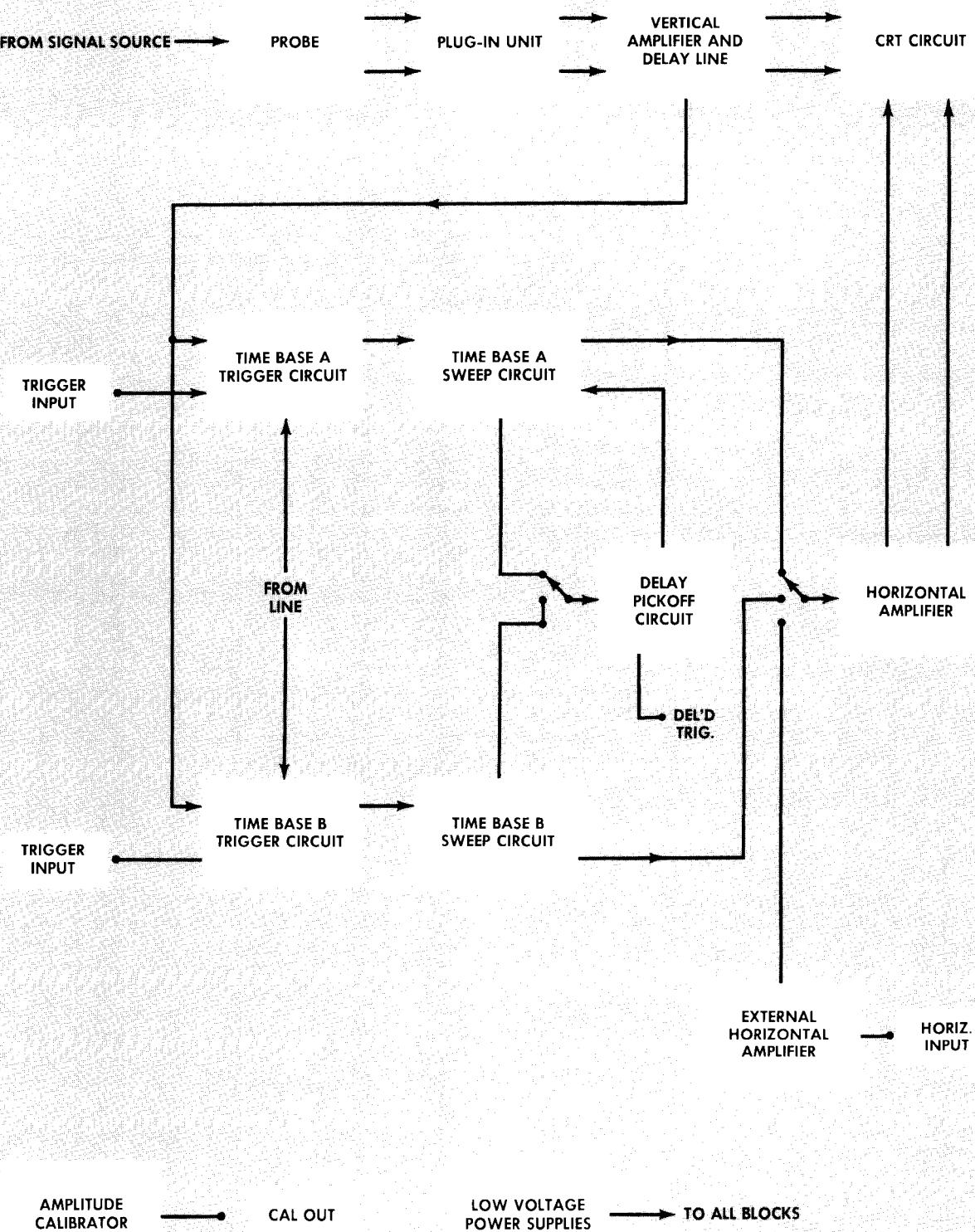


Fig. 4-1. Type 585 Oscilloscope simplified block diagram.

of the distributed amplifier principle permits amplification of frequencies much higher than conventional amplifier systems; dc coupling allows amplification of signals down to dc. All triode sections are neutralized to prevent spurious oscillations. Gain of the overall vertical amplifier is set in the Delay-Line Driver Stage cathode lead by means of the VERT. GAIN ADJ. control, R1015.

### **Stabilization of the Delay-Line Driver Stage**

Overall distributed amplifier stabilization involves many details normally disregarded in lower bandpass systems. The Type 585 vertical distributed amplifier has been stabilized by several special methods.

As the push-pull signals enter the grid lines of the Delay-Line Driver stage they pass through a toroidal pulse transformer, T1014. T1014 serves to open the common-mode grid oscillation path to aid in the stabilization of the amplifier. (The "common-mode oscillatory path" applies to the characteristic of distributed amplifiers that they sometimes oscillate with all grids in phase, and all plates of the opposite phase.) Another toroid, T1046, located in the plate lines at V1044, also aids in stabilizing the amplifier to prevent common-mode oscillation.

Additional stabilization is provided by capacitive neutralization of each section, with the fourth section adjustable to allow for minor differences in tube and stray capacitances.

The signal velocity of propagation is identical in the grid and plate lines of the Delay-Line Driver stage. Since the amplifier is paraphase, the cathodes must exhibit a similar velocity of propagation. This is provided by placing small ferrite beads around one of the leads of each cathode coupling capacitor.

Finally, the shield between triode halves of each 6DJ8 has a 150-ohm resistor to ground to reduce the shield Q and increase the isolation between plates at high frequencies.

### **Plate Line Termination**

The Delay-Line Driver Stage plate line is a 186-ohm balanced line terminated at each end. In instruments below Serial No. 2585, the termination resistors are not adjustable.

The reverse termination resistors, R1008-R1011 and R1009-R1012, are above the required 93-ohms each (186-ohms in series). The amplifier tubes' parallel plate resistance brings the value down to 93-ohms each, 186-ohm total.

In Instruments after Serial No. 2585, the reverse termination has been improved permitting more accurate adjustment of the termination and minimizing reflections to an optimum amount.

The fact that the reverse termination is adjustable and quite closely matches the line impedance, makes it unnecessary to make the termination at the other end of the plate line adjustable.

The Delay Line Driver plate line sends its output signal through the fixed delay line, through the Output Amplifier grid lines, and is terminated at the far end of the Output Amplifier grid line. Current and Voltage supplied to the Delay Line Driver stage is supplied at the far end of the

Output Amplifier grid line and is carried to the tubes V1014 through V1074 via the fixed delay line.

### **DC Shift Compensation**

A common fault of most high current dc coupled amplifiers is temporary instability following a sudden current change called DC Shift. This has been compensated in the Type 585 Oscilloscope. The DC Shift compensation network is located next to the plate load resistors at the input end of the Delay-Line Driver stage. R1004, C1004 and R1005 make up the compensating time constant to effectively cancel the DC Shift effect. The DC Shift compensation is not adjustable.

### **Trigger Pickoff**

At the output of the Delay-Line Driver stage a push-pull tetrode amplifier receives signals for the triggering circuit. Tubes V1084 and V1094, amplify and invert the vertical signal and drive two cathode followers that drive both Time-Base Trigger circuits and the vertical Beam Position Indicator Amplifiers. The Trigger Pickoff circuit is a wide bandpass amplifier capable of sending frequencies to the Time-Base A Trigger circuit that are considerably above the vertical amplifier 3 db point. Two 1000 ohm resistors, R1086 and R1096, isolate the stray capacitance loading of the leads to the Time Base B chassis from the Time Base A leads.

### **Delay Line**

The push-pull output of the Delay-Line Driver stage is applied through a 186-ohm balanced delay line to the Output stage. The delay line is a specially braided line which delays application of the vertical signal to the deflection plates until the crt has been unblanked and the horizontal sweep started. This delay allows the leading edge of fast rising pulses to be displayed as much as 60 nseconds after the sweep is started. The delay line does not require adjustment because of the nature of its construction.

### **Vertical Amplifier Output Stage**

The Output stage is a distributed amplifier consisting of five triode sections driven by the signal from the delay line. This stage is similar to the Delay-Line Driver stage with all triodes neutralized to prevent oscillations. The major difference is that each stage has an adjustable compensating capacitor between opposing plates permitting the transient response to be adjusted. Toroidal pulse transformers (1) at the input to the grid line and (2) in the output leads to the grids of the output pentode amplifier, open the common mode oscillatory circuits aiding stabilization. The output of the distributed amplifier is applied to a push-pull power output stage which supplies the necessary power to drive the vertical deflection plates of the cathode-ray tube.

In instruments before Serial No. 2585 the Output Stage plate line reverse termination was fixed. After Serial No. 2585 it has been made adjustable. Step 45A of the Calibration Procedure details the proper adjustment procedure. This change, with the Delay Line Driver changes is avail-

## Circuit Description — Type 585

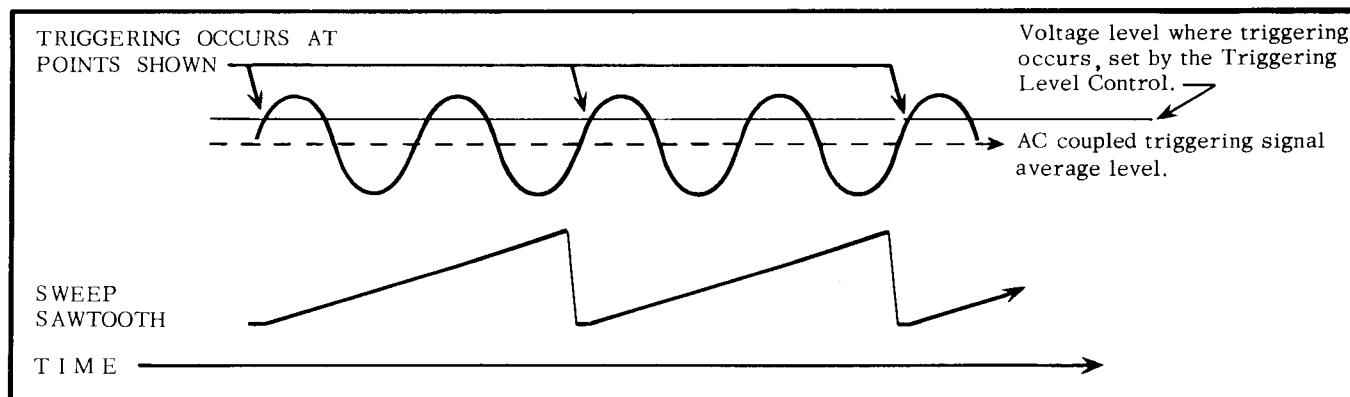


Fig. 4-2. Operation of the trigger circuit. As the triggering signal voltage exceeds the predetermined triggering level, a sweep begins.

able for instruments before Serial No. 2585 as Tektronix Field Modification No. 040-275, and is required in order for proper operation of Plug-In Units with numbers above Type 81. See your local Tektronix Field Engineer for details and availability.

### Cathode-Ray Tube

Six pairs of distributed vertical deflection plates are used in the cathode-ray tube. This arrangement of distributed plates permits the necessary crt sensitivity while at the same time reducing objectionable effects of capacitance between the plates. The deflection plate lines are constructed so that the velocity of the deflection waveform through the line is essentially the same as the velocity of the electrons passing through the plates.

### TIME-BASE A TRIGGER CIRCUIT

#### General

Triggering signals from the line, TRIGGER INPUT connector, and Trigger Pickoff circuit of the vertical amplifier can be individually connected to the input of the Time-Base A Trigger circuit. The triggering signal selected by the TRIGGERING SOURCE switch is then connected to the control grids of the Trigger Difference Amplifier stage V24 and V34.

The Trigger Difference Amplifier is supplied push-pull signals from the internal Trigger Pickoff circuit, but single-ended signals from the LINE or EXT. sources.

#### Instruments with a Vacuum Tube Trigger Regenerator

The Trigger Difference Amplifier is used to control the operation of the Trigger Regenerator multivibrator. The TRIGGERING LEVEL control establishes the operating point of the Trigger Difference Amplifier by determining the dc voltage applied to one grid of the amplifier. By controlling

the operating point of the difference amplifier with the TRIGGERING LEVEL control it is possible to determine at which voltage level of the triggering waveform, triggering occurs.

The amplifier triggering pulses from the difference amplifier are applied through a cathode follower to the input of the trigger multivibrator circuit. The trigger multivibrator is a monostable Schmitt Trigger Circuit which switches when the output of the difference amplifier reaches a certain level. When the multivibrator switches, an output pulse is applied from the multivibrator to the sweep circuit. This pulse is relatively constant in amplitude regardless of the amplitude of the original triggering signal. After application of the pulse to the sweep circuit, the multivibrator resets to await the next triggering signal.

#### Instruments with a Tunnel Diode Trigger Regenerator

The Trigger Difference Amplifier stage is used to control the operation of the tunnel diode Trigger Regenerator circuit. The TRIGGERING LEVEL control establishes the operating point of the Trigger Difference Amplifier by determining the dc voltage applied to one of its grids. By controlling the operating point of the Trigger Difference Amplifier with the TRIGGERING LEVEL control it is possible to determine at which voltage level of the triggering waveform, triggering occurs. (See Figure 4-2).

#### Trigger Difference Amplifier

The Trigger Difference Amplifier is essentially a current control of the tunnel diode Trigger Regenerator circuit. As the plate current of V34 increases with positive going grid signals, the tunnel diode will switch.

#### Trigger Regenerator

The tunnel diode Trigger Regenerator output is an almost rectangular waveform of approximately 0.45 volt peak-to-peak. It is dc coupled to the base of the Trigger Amplifier Q44 where it is inverted and amplified. The amplified

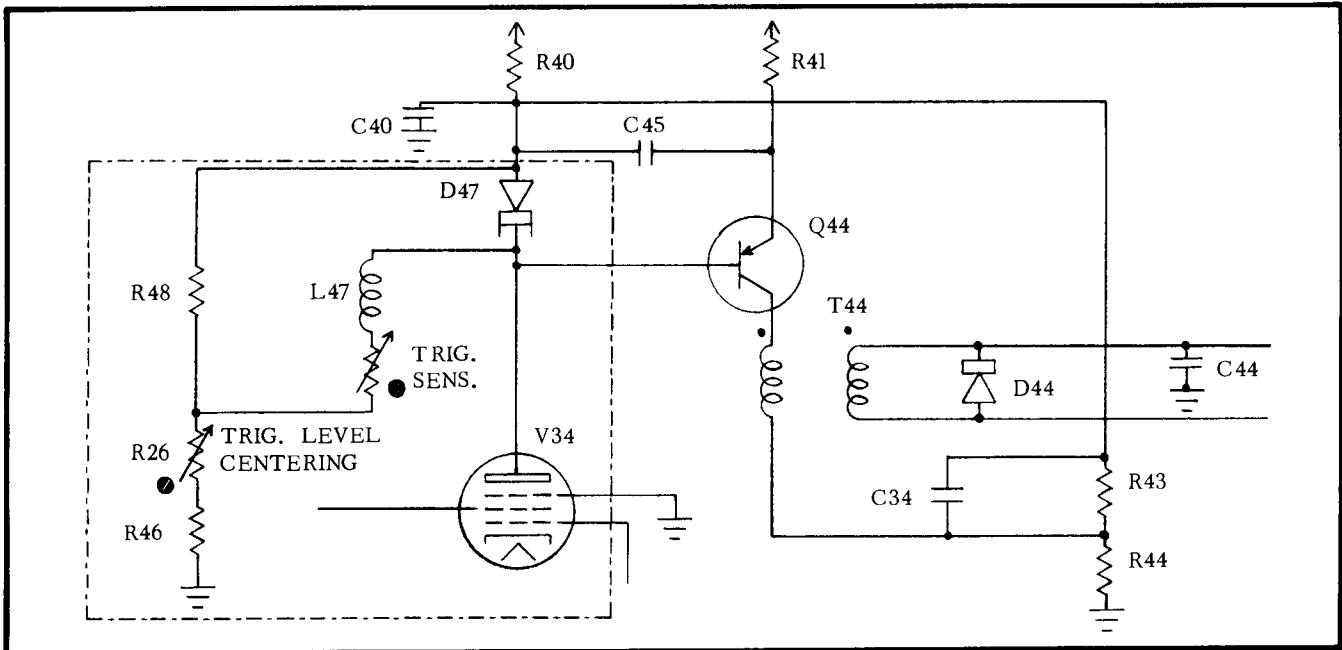


Fig. 4-3. Tunnel diode Trigger Regenerator diagram.

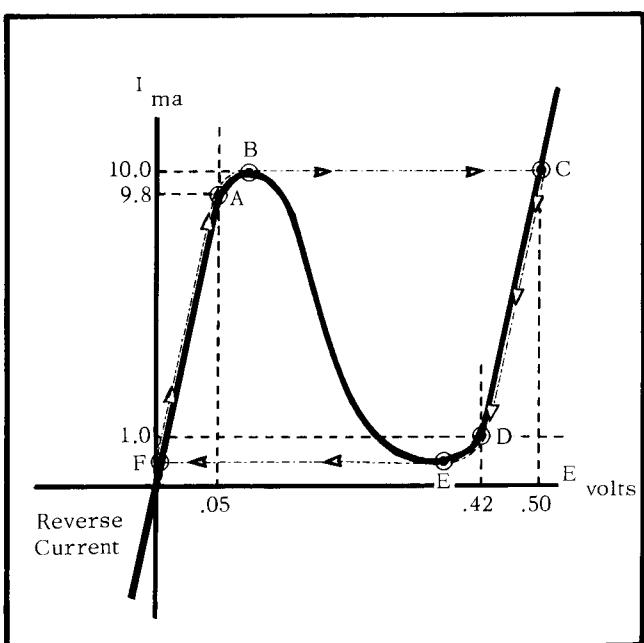


Fig. 4-4. Tunnel Diode, D47, characteristics.

signal from Q44 is coupled to the Sweep-Gating Multivibrator by the small toroidal pulse transformer T44. T44 inverts and differentiates the tunnel diode waveform such that negative triggering pulses of about 7 volts are applied to the Sweep-Gating Multivibrator. (See Figure 4-6). Diode D44 reduces the positive voltage excursion of T44 output voltage from 7 volts to about 4 volts, sufficient to prevent triggering jitter. Capacitor C44 assures a low impedance path to ground for the triggering pulse on the low side of T44 secondary.

### Tunnel Diode Operation

The theory of operation of tunnel diodes is beyond the scope of this manual. Theory concerning the curves and data presented may be obtained from appropriate reference material.\*

The tunnel diode Trigger Regenerator diagram is shown in Fig. 4-3.

The tunnel diode D47 dynamic characteristics are presented in Figure 4-4. You may also wish to refer to the Time-Base A Trigger diagram during the following discussion.

The tunnel diode static operating point is represented by point A of Figure 4-4 and is established when the TRIGGERING LEVEL control is at 0. (The grid voltages of V24 and V34 are both at ground potential). With the Trigger Difference Amplifier balanced, the plate current of V34 is about 3.8 ma. According to Figure 4-4 the tunnel diode resting current will then be 9.8 ma with the additional current flowing through L47, R47, R26 and R46.

If the plate current of V34 is increased to 4.0 ma by either the application of a signal to the Trigger Difference Amplifier, or by rotation of the TRIGGERING LEVEL control, the tunnel diode current can be increased to point B of Figure 4-4 where it will switch at a very rapid rate to point C. It is the high impedance to high frequencies of L47 that permits the tunnel diode to switch to point C rather than to some lower current portion of the curve between points C and D. As current through L47 slowly changes, the current of the tunnel diode slowly drops to point D. The rate at which the tunnel diode current drops to point D is controlled by the L/R time constant of L47 and the circuit resistance in parallel with it. The actual time taken for the tunnel diode current to reach point D is about 0.5  $\mu$ second.

\* General Electric Tunnel Diode Manual

## Circuit Description — Type 585

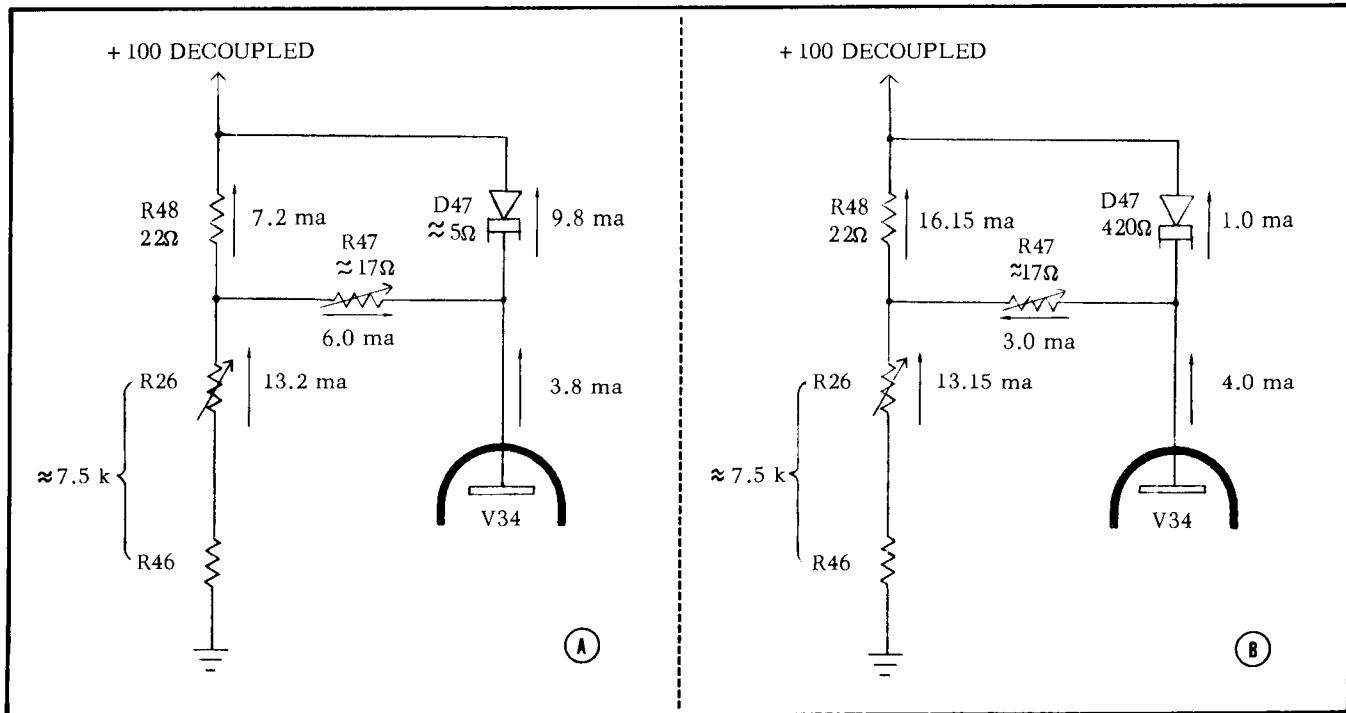


Fig. 4-5. Basic Tunnel Diode Static Currents. (A.) D47 conditions as at point A of Figure 4-4. (B.) D47 conditions as at point D of Figure 4-4.

If the plate current of V34 is maintained at 4.0 ma the tunnel diode current will remain at point D. Either by the rotation of the TRIGGERING LEVEL control or by a signal, the tunnel diode current can be reduced to point E where it will switch rapidly to point F. Again L47 has a voltage impressed across it such that its L/R time constant will soon permit the tunnel diode current to return to point A. The time from point F to point A is about 0.3  $\mu$ second.

From the above description you can see that the tunnel diode has two possible stable states, point A at about  $5\Omega$  resistance, and point D at about  $420\Omega$  resistance. It is the slow change in current of the shunt system around the tunnel diode, controlled by L47, that prevents the tunnel diode Trigger Regenerator system from triggering the Sweep-Gating Multivibrator circuit at too high a rate. If the rate of the negative trigger pulses sent to the Sweep-Gating Multivibrator exceed about 1.3 megacycles, unstable triggering can result.

Two partial diagrams show the current paths for both tunnel diode static conditions. Figure 4-5a shows approximate current values for static condition A of Figure 4-4, and Figure 4-5b shows approximate current values for static condition D of Figure 4-4. In both cases L47 is not included because its dc resistance is insignificant for this purpose.

### Trigger Amplifier Q44

The base of the transistor Trigger Amplifier Q44 is dc coupled from the cathode of D47 while the emitter is ac coupled from the anode of D47. Since the emitter of Q44 is returned to its positive supply voltage through a large

degenerative resistor (long-tailed), the collector current will increase at the time D47 switches, but will return to its original value as soon as C45 charges. The collector current of Q44 will drop to its original value even if D47 remains at its D state indefinitely. As soon as D47 switches from E to A, the collector current of Q44 will decrease until C45 again changes its charge, and Q44 will then stay at its original static current value as long as D47 remains at point A. The collector current pulses of Q44 are never longer than about 0.3  $\mu$ second.

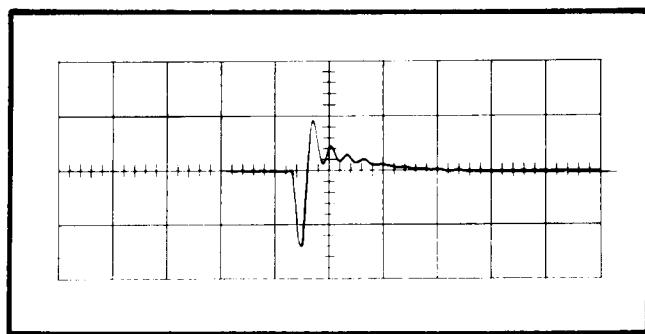


Fig. 4-6. Output pulse of T44. 5 volts per cm. .1  $\mu$ sec per cm.

### TIME-BASE B TRIGGER CIRCUIT

#### General

Triggering signals from the line, TRIGGER INPUT connector, and Trigger Pickoff circuit of the vertical amplifier

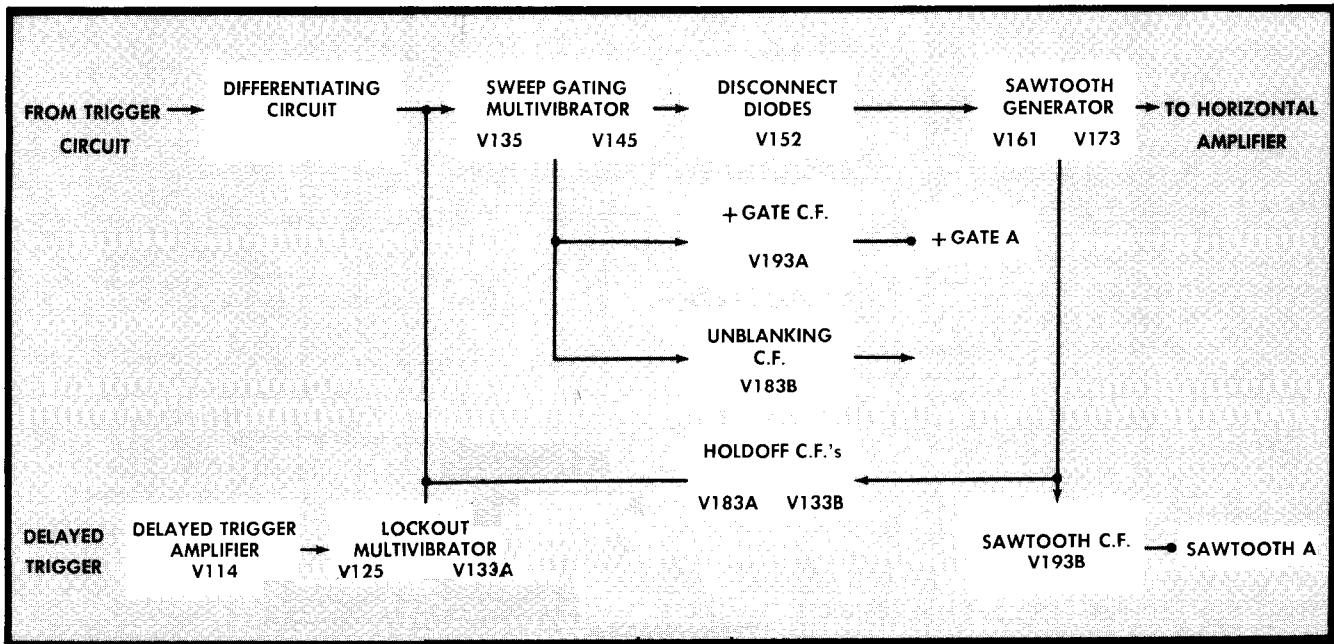


Fig. 4-7. Time Base Generator A block Diagram.

can be individually connected to the input of the Time-Base B Trigger circuit. The operation of the Trigger Amplifier and Trigger Regenerator is essentially identical with other Tektronix delaying sweep oscilloscopes.

An amplified triggering signal from the Trigger Amplifier, V74A and V74B, is applied to the Trigger Regenerator multivibrator. The Trigger Regenerator is a monostable Schmitt circuit which switches when the output of the trigger difference amplifier reaches a certain level. When the multivibrator switches, a negative output pulse is applied to the 'B' Sweep Gating multivibrator to initiate a sweep. The pulse is relatively constant in amplitude regardless of the original triggering signal amplitude. After application of the pulse to the sweep circuit, the trigger regenerator resets to await the next triggering signal.

The TRIG. LEVEL CENTER control, R78, permits an adjustment of the output voltage level of the Trigger Amplifier. This assures that the Trigger Amplifier output signal will lie in the center of the Trigger Regenerator input hysteresis voltage range when the Trigger Amplifier grids are both zero volts to ground.

## TIME-BASE GENERATOR A

### General

The Time-Base Generator A block diagram of Figure 4-7 and the Time-Base Generator A diagram at the back of this manual should be used during the following discussion.

The output pulses from the A Trigger Regenerator system previously discussed are applied to the grid of V135A, the

input triode of the Sweep-Gating Multivibrator V135A, V135B and V145. The Sweep-Gating Multivibrator is a Schmitt Gating circuit acting as an electronic switch for the Time-Base Generator circuit. When the negative triggering pulse is received, the Sweep-Gating Multivibrator switches, cutting off the Disconnect Diodes V152A and B and allowing the Miller-Runup sweep generator circuit to operate. A positive going square wave output of the Sweep-Gating Multivibrator is taken from the cathode of V135B and is connected through the Unblanking Cathode Follower V183B to the crt to unblank the tube. The unblanking signal is employed only in the INTERNAL SWEEP and SINGLE SWEEP positions of the HORIZONTAL DISPLAY switch. Another positive going square wave output of the Sweep-Gating Multivibrator is connected through the +GATE Output Cathode Follower V193A to the +GATE OUT connector on the front panel.

The sawtooth voltage used by the Horizontal Amplifier to move the crt electron beam across the face of the crt is also available at the front panel at the SAWTOOTH A terminal. Cathode follower V193B isolates the internal sawtooth voltage circuit from external loading. Maximum external load of 18K is permissible.

For persons experienced with Tektronix time-base generator systems, the Type 585 Time-Base Generators are nearly identical with those found in any of the 530 or 540 series instruments. The major difference is that the Type 585 Time Base A Miller Runup circuit fastest rate of rise has been increased by a factor of 2. This requires doubling the static current of V161 and slightly altering the associated circuitry.

## Circuit Description — Type 585

### Sweep-Gating Multivibrator

The Sweep-Gating Multivibrator operates as a bistable circuit. In the quiescent state V135A is conducting and its plate is down at about +35 volts. This cuts off V145 through cathode follower V135B and the divider R141-R143, by taking the grid of V145 about 12 volts below its cathode which rests at about -60 volts. With V145 cutoff, its plate is held at about -3 volts with respect to ground by conduction of Disconnect Diodes V152A and B through R147 and R148. The greater amount of diode current of about 5 ma flows through V152A with smaller amounts of current flowing through V152B. Conduction of the lower diode V152B through the Timing Resistor R160 then clamps the control grid of the Miller tube V161 at about -2.9 volts. Conduction through diode V152A places the Time-Base Generator output voltage at about -10 volts.

### Miller Runup Circuit

The quiescent state of the Miller Runup circuit, including V161 and V173, is determined by a dc network between plate and grid of V161. This network consists of the neon glow tube B167, the Runup C.F. V173, the Disconnect Diodes V152A and B, and R151. The purpose of this network is to establish the voltage at the plate of V161 at a value such that it will operate linearly during its runup period. The quiescent plate voltage is about +31 volts.

### Sweep Generation

If the STABILITY and TRIGGERING LEVEL controls are adjusted for triggered operation, a negative trigger pulse drives the grid of V135A below cutoff (below about -70 volts) forcing the Sweep-Gating Multivibrator into its other state in which V145 is the conducting tube. Diode D134 and R133 hold the plate of V135A solidly at +100 volts preventing triggered pulses from being amplified, coupled to the crt unblanking waveform, and intensity modulating the display. As V145 conducts, its plate drops to about -7.5 volts, cutting off the Disconnect Diodes V152A and B. Any spiking that may occur during this transition is attenuated by the network C150-R150. Since R151 is in series with the transition of the plate of V145 and diode V152A, C151 is used as a speed-up capacitance to assure V152A being cut off at the same time V152B is cut off.

With the Disconnect Diodes cut off, the grid of the Miller Runup tube V161 and the cathodes of the Runup C.F. V173 are free to seek their own voltages. Current through the Timing Resistor R160 then starts V161 control grid toward -150 volts. The plate voltage of V161 begins to rise by an amount equal to the drop in grid voltage times the gain of the stage, carrying with it the grid and cathodes of V173. This raises the voltage at the top of Timing Capacitor C160, which in turn pulls up on the grid of V161 and prevents it from dropping more than about a volt during about a 150 volt rise of the plate.

The Timing Capacitor charging current is then equal to the current through the Timing Resistor. Since the voltage at the grid of the Miller Runup tube remains essentially constant, the voltage drop across the Timing Resistor also remains essentially constant. This provides a constant source of current for charging the Timing Capacitor C160. By this action C160 charges linearly, and the voltage at the

cathodes of V173 rises linearly. Any departure from a linear rise in voltage at this point will produce a change in voltage at the grid of the Miller Runup tube in a direction to correct for the error.

### Timing Switch

The linear rise in voltage at the cathode of V173 is used as the sweep time-base. Timing Capacitor C160 and Timing Resistor R160 are selected by the TIME/CM switch SW160. R160 determines the current that charges C160. By means of the TIME/CM switch both the size of the capacitor being charged and the charging current can be selected to cover a wide range of sawtooth slopes (sweep rates). For high sweep rates bootstrap capacitor C165 helps supply current to charge the stray capacitance at the plate of the Miller Runup tube. This permits the plate voltage to rise linearly at the required rate.

If uncalibrated sweep rates are desired, the VARIABLE TIME/CM (red knob) control may be turned away from the CALIBRATED position. This control, R160Y, varies the sweep rate over a 2½ to one range. Switch 160B is ganged with the VARIABLE control in such a way that the UNCALIBRATED light comes on when the control is turned away from the CALIBRATED position.

### Sweep Length

The sweep rate, the rate at which the spot moves across the face of the crt, is determined by the timing circuit C160 and R160. The length of the sweep, the distance the spot moves across the face of the crt, however, is determined by the setting of the SWP. LENGTH control R176. The sweep sawtooth voltage increases the voltage at the grid and cathode of V183A and at the grid and cathode of V133B. As the voltage at the cathode of V133B rises, the voltage at the grid of V135A will rise. When the voltage at this point is sufficient to bring V135A out of cutoff (about -50 volts), the Sweep-Gating Multivibrator circuit will revert to its original state with V135A conducting and V145 cut off. The voltage at the plate of V145 rises, carrying with it the voltage at the diode plates of V152A and B. The diodes then conduct and provide a discharge path for C160 through R151, R147 and R148, and through the resistance of the cathode circuit of V173. The plate voltage of the Miller Runup tube now falls linearly under feedback conditions essentially the same as when it generated the sweep portion of the waveform except for a reversal of direction. The resistance through which C160 discharges is much less than that of the Timing Resistor through which it charged. The capacitor current for this period will therefore be much larger than during the sweep portion, and the plate of the Miller Runup tube will return rapidly to its quiescent voltage. This produces the retrace portion of the sweep sawtooth during which time the crt beam returns rapidly to its starting point. The unblanking voltage drops turning off the crt beam current during retrace.

### Holdoff

The Holdoff circuit prevents the Time-Base Generator from being triggered during the retrace interval. That is, the Holdoff circuit allows a finite time for the Time-Base

circuits to reach a steady-state condition after the completion of a sweep.

During the trace portion of the sweep sawtooth, the Hold-off Capacitor C180 charges through V183A, as a result of the rise in voltage at the cathode of V183A. At the same time the grid of V135A is being pulled up by V133B, until V135A comes out of cutoff and starts conducting, initiating the retrace. At the start of the retrace interval C180 starts discharging through the Holdoff Resistor R181. The time constant of this circuit is long enough, however, so that during the retrace interval (and for a short period of time after the completion of the retrace) C180 holds the grid of V135A high enough so that it cannot be triggered. However, when C180 discharges to the point where V133B is cut off, it loses control over the grid of V135A which returns to the level established by the STABILITY control somewhere between about -58 and -70 volts. The holdoff time required is determined by the size of the Timing Capacitor. For this reason the TIME/CM switch changes the time constant of the Holdoff circuit simultaneously with the change of Timing Capacitors. (In the  $\mu$ SEC positions of the TIME/CM switch R181 is shunted by either R180A or R180B, shown on the Timing Switch diagram.)

## Stability Control

The operational mode of the Time-Base Generator is determined by the setting of the STABILITY control R110. By means of this control the sweep can be turned off, free run, or adjusted for triggered operation. The STABILITY control, through cathode follower V125, regulates the grid level of V135A. (V133A is inoperative during A SWEEP operation.)

For triggered operation, the STABILITY control is adjusted so that the grid of V135A is at about -64 volts, just negative enough to prevent the Sweep-Gating Multivibrator from free running. Adjusted in this manner a sweep can only be produced when an incoming negative trigger pulse drives the grid of V135A below cutoff, about -66 volts.

Moving the arm of the STABILITY control toward ground, (ccw rotation), but not so far as to actuate the PRESET switch, will raise the grid level of V135A to about -58 volts and prevent the Sweep-Gating Multivibrator from being triggered. This action turns off the sweep. Moving the arm toward -150 volts (cw) drops the grid of V135A to the point where the discharge of the Holdoff Capacitor C180 can switch the multivibrator. Adjusted in this manner, the Sweep-Gating Multivibrator will free-run and produce a recurrent sweep.

When the STABILITY control is turned full ccw to the PRESET position, R111 is switched out of the circuit and R111 is switched in. This control, a front-panel screwdriver adjustment labeled PRESET ADJUST, provides a fixed dc voltage for the grid of V135A. When properly adjusted, PRESET operation can be used for most triggering applications. When triggering may be difficult, however, the manual STABILITY control R110 should be used.

## Lockout Multivibrator Modes of Operation

The Lockout Multivibrator is placed into operation by only three positions of the seven position HORIZONTAL DISPLAY

switch. These modes of operation are: 1. 'A' SINGLE SWEEP, 2. 'A' DEL'D BY 'B', and 3. 'B' INTENSIFIED BY 'A'. The detailed operation of the Lockout multivibrator is explained for the 'A' SINGLE SWEEP mode, with the other two modes presented as variations of the first.

### 1. 'A' Single Sweep

When the HORIZONTAL DISPLAY switch is in the 'A' SINGLE SWEEP position, plate voltage is applied to V133A which then operates in conjunction with V125 as a bistable Lockout Multivibrator.

In the first stable state that exists after the completion of a sweep, V125 is cut off and V133A is conducting. In this state, the divider between the plate of V125 and the grid of V133A sets the common bus cathode voltage of the Lockout Multivibrator and consequently the grid voltage of V135A. The Lockout Level control R125 is adjusted to set the grid of V135A a little less negative than -55 volts so that the Sweep-Gating Multivibrator cannot be triggered; this "locks out" the sweep.

The front panel push-button labeled RESET permits the Lockout Multivibrator to switch, unlocking the sweep generator for a single sweep. Depressing the RESET button applies a positive voltage pulse to the grid of V114. V114 inverts and amplifies the pulse and applies it to the grid of V133A placing V125 in conduction. The STABILITY control again has control of the grid of V135A, and should a negative trigger pulse come from the triggering circuitry, a sweep can occur. The RESET switch functions as follows: when open, C103 is charged to about -20 volts. The drop across R104 is essentially zero volts. As the RESET button is depressed, grounding the switch side of C103, the opposite side rises to about +8 volts. The plate of V114 drops about -17 volts from ground (clamped there by D122), cutting off V135A and resetting the Lockout Multivibrator until a single sweep occurs.

Depending on the adjustment of the STABILITY control, a sweep can now be produced in one of two ways. If the STABILITY control is turned clockwise, the grid of V135A can be pulled down below about -70 volts causing the Sweep-Gating Multivibrator to switch to its other state and initiate a sweep. If the STABILITY control is adjusted for triggered operation, the sweep will be initiated by the first negative trigger pulse to arrive at the grid of V135A via T44.

As the sweep begins, the rising sawtooth voltage pulls up the cathode of V133B by the holdoff action previously described. As the cathodes of the Lockout Multivibrator follow the cathode of V133B up, V125 cuts off and V133A conducts; immediately raising the common cathode bus potential from about -64 to about -53 volts. As the sawtooth voltage continues to rise, the cathode of V133B catches the cathode of V135A and carries the common cathode bus voltage up to about -48 volts causing V135A to conduct to revert the Sweep-Gating Multivibrator, and terminate the sweep. (See Figure 4-8).

As the Holdoff Capacitor C180 discharges, the cathodes of the Lockout Multivibrator start to fall. The grid level of V133A is such that this tube comes out of cutoff first, holding the common cathode bus at the locked out voltage level of about -53 volts. As V133A conducts, its plate drops, extinguishing the READY light. A new sweep cannot be initiated until the RESET button is again depressed.

## Circuit Description — Type 585

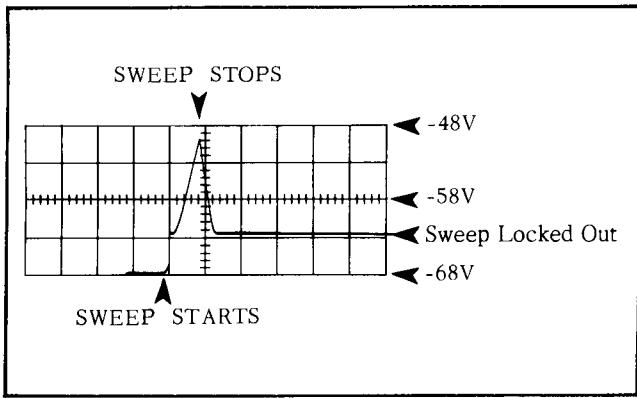


Fig. 4-8. Single-Sweep Waveform.

### 2. 'A' DEL'D BY 'B'

When the HORIZONTAL DISPLAY switch is placed in the 'A' DEL'D BY 'B' position, the Lockout Multivibrator, V125 and V133A, serves the same function as when the HORIZONTAL DISPLAY switch is at 'A' SINGLE SWEEP. However, instead of the Lockout Multivibrator receiving the unlocking pulse from the front panel RESET button, it receives the pulse from the Delay Pickoff circuitry. A positive pulse of about 5 to 7 volts is delivered to the grid of V144 from the Delay Pickoff circuit each time that Time-Base B generates a sweep.

With the HORIZONTAL DISPLAY switch in the 'A' DEL'D BY 'B' position, the Time-Base A sweep generator system will be permitted to operate only during a sweep of the Time-Base B sweep generator. The permission to operate occurs at a time determined by the Time Base B TIME/CM or DELAY TIME control multiplied by the setting of the DELAY-TIME MULTIPLIER control. The actual operation is determined by the STABILITY control, whether it is in a triggerable or free-run state.

The crt display is that of the Time Base A sweep generator.

### 3. "'B' INTENSIFIED BY 'A'

When the HORIZONTAL DISPLAY switch is placed in the 'B' INTENSIFIED BY 'A' position, the operation of the Lockout Multivibrator is identical with operation as in 'A' DEL'D BY 'B'. However, the Horizontal Amplifier receives a different signal.

The crt presentation is that of the Time-Base B sweep generator. If the Time-Base A sweep generator is caused to generate a sweep, the sawtooth voltage is not seen on the crt. Time-Base A presents only its crt unblanking signal to the crt circuit to intensify the portion of the display where the delayed action of Time-Base A occurs. (See Fig. 4-9).

## Unblanking

The Sweep Gating Multivibrator provides a positive gate pulse coincident with each sweep to unblank the cathode ray tube. The output of the Unblanking Cathode Follower V183B rests at about +55 volts during periods of no sweep,

and rises to about +105 volts to gate on the crt beam during a sweep. The unblanking waveform goes directly to the HORIZONTAL DISPLAY switch, and is connected to the crt circuit in all positions except Time-Base B.

## + GATE A

The Sweep Gating Multivibrator positive gate waveform used by the Unblanking C.F. is also used by the front panel terminal +GATE A. The control grid of V193A rests at about -20 volts during periods of no sweep, and rises to about +20 volts during a sweep. The output waveform therefore operates between ground and about +20 to +30 volts.

## TIME-BASE GENERATOR B

Time-Base Generator B is very similar to Time-Base Generator A except its maximum sweep rate is not as fast and it does not have the delayed sweep and single sweep circuitry.

The Sweep Gating Multivibrator, V235A, V235B and V245, performs the same function as in Time-Base A. The Disconnect Diodes require less pull-down current of V245, therefore the pentode serves adequately.

Time-Base Generator B has a closer tolerance linearity specification of 0.1% deviation from a true sawtooth output waveform each 10% of its total change. This then requires higher gain of the Miller Integrator (V261) than in Time-Base A. The increased gain is accomplished by using a higher plate load resistor for V261. The grid of the Miller Tube does not move more than about 0.4 volt during a sweep. Thus the voltage gain of the Miller Integrator is about 400.

The output sawtooth voltage of Time-Base Generator B goes directly to the HORIZONTAL DISPLAY switch. The Delay Pickoff circuit receives the 'B' sawtooth in all positions except Time-Base A, and 'A' SINGLE SWEEP. The Horizontal Amplifier receives the sawtooth in Time-Base B and 'B' INTENSIFIED BY 'A' positions.

The Unblanking C.F. V293A output is connected directly to the HORIZONTAL DISPLAY switch. The signal is coupled to the crt circuit in the Time-Base B and 'B' INTENSIFIED BY 'A' positions. The signal rests at about +40 volts during periods of no sweep, and rises to about +90 volts to gate the crt beam on during a sweep. Note that the Time-Base B unblanking pulse amplitude is about 15 volts lower in amplitude than the unblanking pulse of Time-Base A. This difference permits the Time-Base A unblanking pulse to brighten a part of the trace that indicates 'B' INTENSIFIED BY 'A'.

## Alternate-Trace Sync A

Synchronizing pulses for alternate-trace plug-in preamplifiers are supplied via D142 and the differentiating network C154-R154. Both positive and negative sharply differentiated output pulses are applied from C154-R154 to the plug-in unit. Only the positive pulses are used by the plug-in unit alternate-trace switching circuitry.

The quiescent voltage at the junction of D142 and C154 is approximately -3 volts. The quiescent voltage on the other side of D142 is about -3.1 volts. As the Sweep-Gating Multivibrator switches and V145 plate drops to about -7.5 volts, D142 conducts. The plug-in side of C154 then drops about -2 volts (less than the -4.5 volts possible due to additional circuit capacitance loading the output of C154). The charge on C154 rapidly stabilizes at -7.5 volts, and remains there until the Sweep-Gating Multivibrator terminates the sweep. At this time, the plate of V145 rises very rapidly momentarily cutting D142 off. Cutting off D142 disconnects the capacitance of the dual trace switching circuitry at the time that any loading capacitance would slow the action of Disconnect Diodes V152A and B. The positive pulse from C154-R154 switches the alternate-trace plug-in unit from one trace to the next trace. (See the instruction manual for the alternate-trace plug-in unit in use.)

### Alternate-Trace Sync B

Synchronizing pulses for alternate-trace plug-in preamplifiers are supplied from the screen grid circuit of V245. As the plate current of V245 increases or decreases, the screen voltage as developed across L249 decreases or increases accordingly. Only the positive pulse is used by the alternate-trace plug-in unit.

At the end of each Time-Base B sweep, a positive pulse of about 15 volts is developed across R254 and sent directly to the HORIZONTAL DISPLAY switch. The pulse from Time-Base B is presented to the plug-in interconnecting plug only when the HORIZONTAL DISPLAY switch is in the Time-Base B or 'B' INTENSIFIED BY 'A' positions.

## HORIZONTAL AMPLIFIER

### General

The input to the Horizontal Amplifier is selected from waveforms applied from either Time-Base Generator A, Time-Base Generator B or the External Horizontal Amplifier.

The dc-coupled Horizontal Amplifier consists of the Input Cathode-Follower (CF) stage followed by the Driver CF stage that drives the paraphase Output Amplifier. The Output Amplifier then drives separate Output CF's that drive the crt horizontal deflection plates. The CF Capacitance Driver tube in the cathode circuit of the left-hand deflection plate Output CF pulls the cathode of the Output CF rapidly down during a sweep. The gain of the Output Amplifier is controlled by negative feedback applied from the left Output CF to a frequency compensated network between the Input CF and the Driver CF. The negative feedback is modified for 5X sweep magnification.

### Input Circuit

The positive-going sawtooth voltages produced by the Time-Base Generator circuits are coupled through a frequency-compensated voltage divider to the grid of the Input CF V343A. The input divider has a 1.5 to 1 attenua-

tion ratio. The small time-constant network C340-R340 improves the start of the waveform at the fastest sweep rates. The two positioning controls, HORIZONTAL POSITION R333 and VERNIER R338, affect the beam position by altering the dc level at the grid of V343A. The VERNIER position control can move the spot about 2 centimeters while the HORIZONTAL POSITION control can move the spot from about the center of the crt screen to well off the left edge. These limits apply when the HORIZONTAL DISPLAY switch is in the INTERNAL SWEEP position. Because of their low resistance, an adjustment of the positioning controls does not alter the attenuation of the divider network.

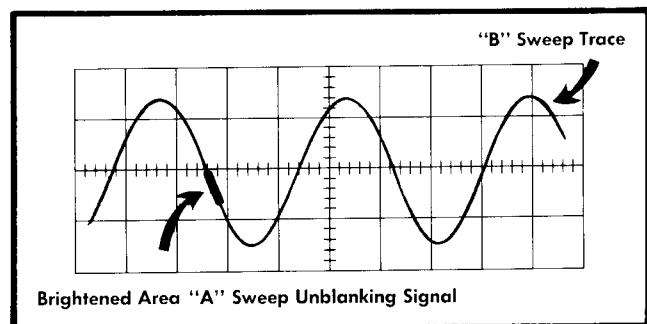


Fig. 4-9. 'B' INTENSIFIED BY 'A' operation.

### Driver Cathode Follower

Signals from the cathode of V343A pass either through the input portion of the feedback circuit or straight into the grid of the Driver CF V343B. The Driver CF eliminates possible loading of the feedback network by the grid of V364A during high positive sawtooth voltages. The low output impedance of the Driver CF drives the grid of V364A assuring no distortion of the linear sawtooth sweep voltage.

With the 5X MAGNIFIER switch SW347B in the OFF position, the grid of the Driver CF V343B receives the positive going sawtooth voltage from the center of feedback divider network R348, R349, R355 and R356. The amplitude of the sawtooth voltage as it leaves the cathode of V343A is reduced by a factor of five by the negative going sawtooth voltage applied at the top of R355. With the 5X MAGNIFIER switch SW347B in the ON position, or with the HORIZONTAL DISPLAY switch in either external horizontal input position, R348 and R349 are switched out of the circuit, and the total signal voltage from the cathode of V343A is applied to the grid of the Driver CF. Part of the feedback circuit remains connected between the left deflection plate Output CF cathode and the grid of the Driver CF, but essentially no feedback action occurs due to the low impedance of the Input CF cathode.

The NORM/MAG. REGIS. control, R358, is used to eliminate any voltage drop across R348 and R349 (5X MAGNIFIER OFF) when the crt beam is at the center of the screen. It has no appreciable effect with the 5X MAGNIFIER ON. Thus when the two centimeters of display at the center of the screen are to be magnified, the display will be expanded symmetrically about the center of the crt when the 5X MAGNIFIER switch is turned ON.

## Circuit Description — Type 585

A MAGNIFIER neon glow lamp is located on the front panel immediately below the HORIZONTAL DISPLAY switch; circuitry for the lamp is shown with the 5X MAGNIFIER switching detail of the Horizontal Amplifier diagram.

## Output Stage

The Output Amplifier stage V364A-V384A is a parapass amplifier with output from both plates. Cathode followers V364B-V384B provide high-impedance, low-capitance loads which help to maintain the gain of the stage constant over the sweep range of the instrument. The Output CF's also provide the necessary low-impedance output to drive the capacitance of the horizontal deflection plates. Bootstrap capacitors C364 and C384 improve the response at the fastest sweep rates by supplying additional current from the Output CF stage to charge and discharge the stray capacitance in the plate circuit of the Output Amplifier.

## Capacitance Driver

At the fastest sweep rates the current through the left-hand deflection plate Output CF tube is too small to discharge the stray capacitance in the cathode circuit at the required rate. Additional current to discharge the stray capacitance is provided by the gated pentode V398 connected in the cathode circuit of V364B. This permits the cathode of V364B to run down at the required rate. A similar current boost is not required for V384B since this tube is the positive-sawtooth cathode follower and the cathode runs down during the retrace when speed and linearity are not important.

Because the plate current of a pentode is fairly constant over a large range of plate voltage, the current through V398 will remain nearly constant even though its plate falls about 150 volts due to the negative sweep sawtooth waveform.

The additional current required for fastest sweep rates is obtained by applying a positive flat-topped pulse to the grid of pentode V398 during the period of the sweep. The pulse is derived by differentiating the positive-going sawtooth from the cathode of V384B with C390 and R390. The

pulse amplitude is proportional to the slope of the sawtooth, and thus proportional to the sweep rate. The pulse first becomes noticeable when the sawtooth voltage at the cathode of V384B exceeds the rate of about 1.6 volts/ $\mu$ second.

## External Horizontal Amplifier

The External Horizontal Amplifier is a cathode coupled circuit providing the necessary gain to drive the horizontal amplifier from external signals. An input attenuator and a gain control provide horizontal deflection factors between approximately 0.2 and 15 volts per centimeter.

A front-panel binding post labeled HORIZ. INPUT couples externally-derived signals to the Horizontal Amplifier circuit when the HORIZONTAL DISPLAY switch is in either of the EXT. positions. A preamplifier stage, V314 amplifies the external signals before applying them to the input attenuator of the Horizontal Amplifier. The position of the HORIZONTAL DISPLAY switch determines whether the signal is directly coupled to the grid circuit of V314A, or whether a 10:1 frequency-compensated attenuator is connected in the signal path. In either case the input resistance is 1 megohm paralleled by approximately 47 picofarads.

The External Horizontal Preamplifier V314 is a cathode-coupled amplifier. V314A is a cathode-follower and V314B is a grounded-grid amplifier stage. The VARIABLE 10:1 control provides a means for adjusting the gain over a 10 to 1 range. The Ext. Horiz. DC. Bal. control R317 adjusts the dc level of V314B grid so that its cathode is at the same voltage as the cathode of V314A under no signal conditions. With the cathodes at the same voltage there is no current through the variable attenuator control R314. By this arrangement an adjustment of the VARIABLE 10:1 gain control does not change the dc level at the plate of V314B and therefore does not affect the positioning of the crt beam.

## Delay Pickoff Circuit

### General

A sawtooth waveform from either Time Base Generator is applied to the input of the delay pickoff comparator cir-

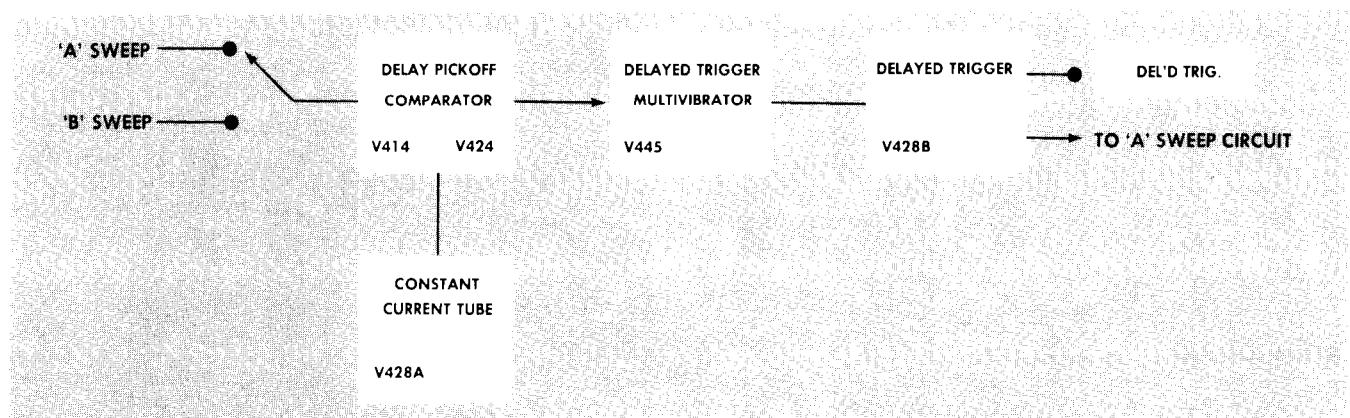


Fig. 4-10. Delay Pickoff Circuit block diagram.

cuit. (See Fig. 4-11.) This circuit is a difference amplifier which compares the voltage level of the input sawtooth against a fixed voltage obtained from the DELAY TIME MULTIPLIER control. When the voltage level of the input sawtooth waveform reaches a certain level, as determined by the setting of the DELAY TIME MULTIPLIER, the output of the comparator circuit triggers the Delayed Trigger Multivibrator. The Delayed Trigger Multivibrator then initiates the delayed trigger which is applied through a differentiating circuit to the delayed trigger cathode follower. Outputs from the delayed trigger cathode follower are applied to the DEL'D TRIG. connector on the front panel and to the HORIZONTAL DISPLAY switch. Delayed trigger pulses are connected to the 'A' sweep circuit when the HORIZONTAL DISPLAY switch is in the positions 'B' INTENSIFIED BY 'A', and 'A' DEL'D BY 'B'.

### Difference Amplifier

The Difference Amplifier V414 and V424 receives the sweep sawtooth from the Time Base indicated by the neon lamps directly above the DELAY-TIME MULTIPLIER dial.

The Difference Amplifier permits a time selection of any rate sawtooth voltage. (The accuracy decreases above 2  $\mu$ sec/cm). The time selection is based upon the position of the DELAY-TIME MULTIPLIER dial, setting the voltage at the grid of V424. Thus a voltage comparison becomes a time selection because the sawtooth voltage is changing at a definite rate. Assume that the sawtooth input to the comparator difference amplifier was moving at a rate of 15 volts per millisecond (TIME/CM = 1 MILLISEC/CM). Then if the DELAY-TIME MULTIPLIER dial was set to 2.0 (2.0 is equal to 30 volts of a 150 volt sawtooth) the delay pickoff would generate a delayed trigger 2 milliseconds after the sawtooth started.

To permit the Difference Amplifier to have the dynamic range of 150 volt grid signals it is necessary to establish a constant cathode current. A second reason for a very constant cathode current is that the Difference Amplifier output voltage must always go between the same limits regardless of which portion of the sawtooth is amplified.

### Constant Current Tube

The normal long-tailed cathode resistor found in many Tektronix amplifier circuits provides a relatively constant current for a tube with limited grid voltage swing. Thus the constant current system of the Difference Amplifier must be improved since the grid signals have a 150 volt amplitude. Triode V428A grid rests at -100 volts and its cathode is then long-tailed to the -150 volt supply. R428 assures that the cathode current of V428A will remain essentially at 5 milliamps. Thus the plate can move over a wide voltage range without appreciable current change in the system. The triode plate resistance changes as the plate-to-cathode voltage changes, thus assuring a constant-current cathode circuit for the Difference Amplifier.

### Delayed Trigger Multivibrator

The Delayed Trigger Multivibrator receives a dc coupled signal from the Difference Amplifier. With the sawtooth at a voltage below the time-selection point, the grid voltage of V445A rests at about +190 volts. Shortly after the saw-

tooth has passed the time-selection point, the grid rests at the +225 volt supply. It is within this 30 volt range that the 4 volt hysteresis limits of the Delayed Trigger Multivibrator exist. The multivibrator flips as the input voltage rises to about +210 volts. V445B is held in conduction during the quiescent state of the Delayed Trigger Multivibrator. As the grid of V445A is carried positive, causing it to conduct, the plate of V445B rises sharply from about +330 volts to +350 volts. The output square wave is then differentiated by C454 and the combined resistance of R454 and R455.

### Delayed Trigger C.F.

The grid of V428B rests at -4.5 volts, holding the tube at cut-off. As the output of the Delayed Trigger Multivibrator switches positive, the differentiated pulse takes V428B out of cut-off, and delivers about a 5 to 7 volt pulse to the DEL'D TRIG terminal and the HORIZONTAL DISPLAY switch.

A waveform ladder diagram is presented in Figure 4-11 showing the sequence of operation throughout one complete sawtooth.

## LOW-VOLTAGE POWER SUPPLIES

### General

The low-voltage power supplies produce all operating voltages for the oscilloscope with the exception of parts of the crt circuit. These power supplies produce regulated voltages of -150, +100, +225, +350, and +500 volts and two unregulated outputs of +180 and +340 volts. In addition a separate transistorized power supply provides regulated +12.6 volts for filaments of tubes in either the P80 Probe, or in the Type 81 Plug-In Adapter, and other 80 series plug-in units.

Each of the power supplies operates in a similar manner. A sensing circuit compares a sample of the output voltage against a fixed reference voltage. Any error in the output voltage produces an error signal which is amplified and applied to the series regulator tube(s), causing the series regulators to compensate for the error and return the voltage to normal.

Reference voltage for the -150-volt supply is obtained from a gas filled voltage regulator tube. Reference voltages for the other regulated power supplies, except the filament supply, are obtained from the output of the -150-volt supply. Consequently, operation of the regulated power supplies is dependent on operation of the -150-volt supply. The output voltages of all the regulated power supplies can be changed slightly by adjusting the output of the -150-volt supply.

### Power Transformer

Plate and filament power for the tubes in the Type 585 is furnished by a single power transformer, T601. The primary has two equal windings which may be connected in parallel for 117-volt operation, or in series for 234-volt

## Circuit Description — Type 585

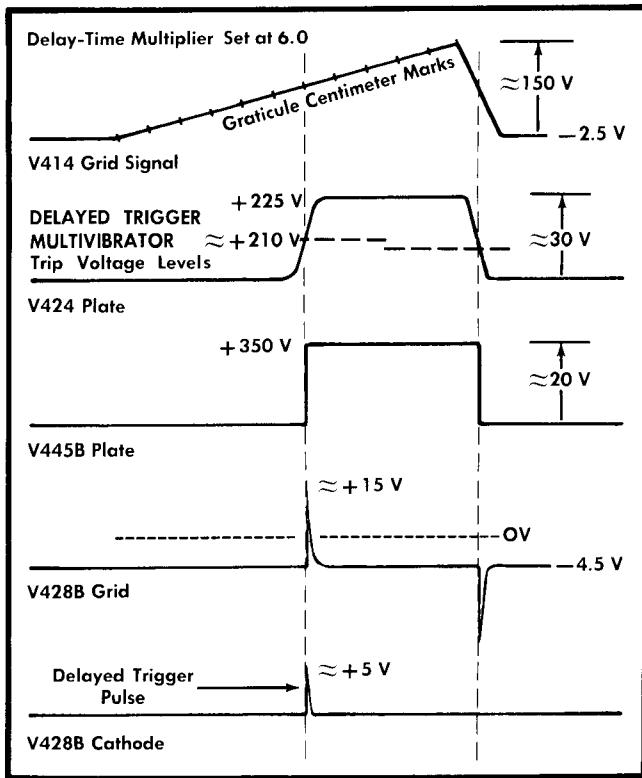


Fig. 4-11. Waveform ladder diagram of the Delay-Time Multiplier circuit operation.

operation. The power supply will maintain regulation over line voltage ranges of 105 to 125 volts, or 210 to 250 volts, rms, 50-60 cycles, when the line voltage has less than about 3 to 5% distortion of the waveform peaks. All Type 585 power transformers, after serial number 310 are provided with two 6% Boost-Buck windings to permit primary turns adjustment to suit slightly different line voltages from those just mentioned. Refer to Figures 2-1 and 2-2 for additional details.

### **—150-Volt Supply**

Reference voltage for the —150-volt supply is furnished by a gas diode voltage-reference tube V609. This tube, which has a constant voltage drop, establishes a fixed potential of about —87 volts at the grid of V624A, one-half of a difference amplifier. The grid voltage for the other half of the difference amplifier, V624B, is obtained from a divider consisting of R615, R616, and R617. The —150 ADJ. control R616 determines the percentage of total output voltage that appears at the grid of V624B and thus determines the total voltage across the divider. This control is adjusted so that the output voltage is —150 volts,  $\pm 2\%$ .

If line-voltage or load fluctuations tend to change the output voltage, an error signal is produced between the two grids of the difference amplifier. The error signal is amplified in V624B and V634 and applied to the grids of the series tubes V627, V637 and V647. The resulting change in voltage at the plates of the series tubes corrects the

—150-volt bus back to its original value. Capacitors C617 and C628 improve the ac gain of the feedback loop to increase the rate of response of the regulator circuit to sudden changes in output voltage and to reduce ripple.

A small amount of unregulated bus ripple is coupled to the screen of V634 through R637. The phase of the amplified ripple voltage at the plate of V634 is such as to cancel most of the ripple on the —150-volt bus.

### **+ 100-Volt Supply**

Reference for the +100-volt supply is a voltage located at a point near ground potential obtained from a divider R650-R651. V664 essentially compares the reference voltage to ground. Any voltage change at the +100-volt output is amplified and inverted in polarity by V664 and applied to the grid of series regulator V677A correcting the output voltage. Capacitor C650 improves the ac gain of this circuit and helps to eliminate ripple.

A small sample of the unregulated bus ripple appears at the screen of V664 through R667. This produces a ripple component at the grid of series regulator V677A that is opposite in polarity to the ripple at the plate. This tends to cancel the ripple at the cathode and hence on the +100-volt bus. This same circuit also improves the regulation in the presence of line-voltage variations.

### **+ 225-Volt Supply**

The +225-volt supply source is the secondary windings between terminals 5 and 7 and terminals 10 and 14 of T601, part of a two-voltage supply. Diodes D702 A and B serve as full-wave rectifiers for the +225-volt supply, with their center lead connected to the +180-volt unregulated supply. Voltage from the full-wave rectifier system is added to the +180-volt unregulated lead to provide sufficient voltage for the +325-volt unregulated lead and the +225-volt regulated supply.

Reference for the +225-volt supply is a voltage located at a point near ground obtained from the divider R680-R681. V684A essentially compares the reference voltage to ground. Any voltage changes at the +225-volt output produces an error voltage between the grids of the difference amplifier V684. The error signal is amplified in both V684 and V694, and coupled to the grids of series regulators V677B and V737A. The voltage change at the cathode of V677B and V737A, due to the regulator action, is opposite in polarity to the original error signal keeping the output voltage constant. The unregulated output of about +325 volts is used by the oscillator of the crt high-voltage supply. It is unnecessary to regulate this voltage as the crt supply has its own regulator circuit.

### **+ 350-Volt Supply**

The +350-volt supply source is at the common connection between Diodes D732 A and B. These diodes are part of a full-wave bridge rectifier system.

The negative lead of the +350-volt rectifiers is connected to the +180-volt unregulated bus of the +100-volt power supply. Thus both the +225-volt and +350-volt regulated supplies are elevated on the +180-volt unregulated bus.

Good engineering practice does not permit using a semiconductor two diode full-wave rectifier system because line voltage transients can exceed the peak inverse voltage rating of the diodes. Thus an advantage of the two voltage system, as used with the +225-volt and +350-volt regulated supplies, is that capacitor C730 protects all diodes from high peak inverse voltage transients.

Reference for the +350-volt supply is a voltage located at a point near ground obtained from the divider R710-R711. V724 essentially compares the reference voltage to ground. The operation of the regulated circuit is the same as that described for the +100-volt supply.

### +500-Volt Supply

Rectified voltage from terminals 20 and 21 of T601 is added to the regulated +350-volt supply to furnish power for the +500-volt regulator. Reference for the +500-volt supply is a voltage located at a point near +350 volts obtained from the divider R740-R741. V754 essentially compares this voltage to the +350-volt supply. The regulator action of this circuit is the same as that described for the +100-volt supply.

### +12.6-Volt Supply

A transistorized +12.6-volt dc regulator supplies voltage for use within plug-in units of the Type 585 Oscilloscope.

Rectified voltage from terminals 33 and 34 of T601 is used both by the Time Delay Relay K600 with K601, and by the +12.6-volt Regulator.

Reference voltage for the +12.6-volt supply is at the center point of four resistors in series-parallel between the +100-volt supply and ground, R781 A and B, and R782-R783. The reference voltage is applied directly to the base of amplifier Q774 where it is essentially compared to the +12.6-volt bus. Emitter follower Q793 provides current gain to correction signals amplified by Q774, controlling the Collector-to-Emitter resistance of Q797 to maintain the proper voltage of the +12.6-volt supply lead.

The +12.6-Volt Supply voltage tolerance is not as rigid as the other regulated supplies, and its output may go as high as +13.25 volts under small load conditions.

In order for the +12.6-volt supply to warm up tube heaters before the Time-Delay Relay closes, a special turn-on voltage is applied to the base of Q774 via R780 from the +180-volt unregulated supply.

To protect the power transistors in the event Q774 is removed from its socket, diode D792 will clamp the base of Q793 to the +20-volt unregulated supply. Otherwise the base of Q793 would rise toward the +180-volt unregulated bus and damage both itself and Q797.

### Time-Delay

A Time-Delay relay K600, in conjunction with relay K601, delays the application of power supply voltages to the oscilloscope tubes for about 15 to 45 seconds. This delay allows the tubes to warm up before operating potentials are applied.

## CRT CIRCUIT

### Cathode-Ray Tube Control Circuits

The INTENSITY control R826 varies the voltage at the grid of the crt to control the beam current. The FOCUS control R856 varies the voltage at the focusing anode to focus the trace. The ASTIGMATISM control R864 varies the voltage at the astigmatism anode to adjust principally the spot vertical dimension. The GEOM. ADJ. R861 varies the field the beam encounters as it passes from the vertical plates to the horizontal plates to control the linearity at the extremes of deflection. The VERT. SHIELD VOLTS ADJ. control R860 permits minor changes of crt deflection sensitivities and linearity.

### High-Voltage Supply

A 60-kc modified Hartley oscillator furnishes power for the three power supplies that provide accelerating potentials for the crt. The main components in the oscillator circuit are the pentode V800 and the primary of T801 tuned by C808.

A half-wave rectifier V862 provides -1350 volts for the crt cathode. V862 supply is the reference supply, and is the only one of the three that is firmly regulated. A half-wave voltage tripler circuit, V832, V842 and V852, provides +8650 volts for the post deflection accelerator anode. The two supplies provide a total accelerating voltage of 10,000 volts. Both supplies are referenced to the +100-volt regulated supply through the decoupling filter R801-C801.

A floating half-wave rectifier V822 furnishes bias voltage of -1450 volts for the crt grid. This floating grid supply, independent of the cathode supply, allows dc-coupled unblanking to the crt grid. All three supplies employ capacitor-input filters.

Reference for the -1350-volt cathode supply is a voltage near -150 volts obtained from a tap on the divider network R840 through R844. The resistance ratio of the divider is determined by the setting of R840 labeled HV. ADJ. The reference voltage is essentially compared to -150 volts by V814B. When R840 is properly adjusted, the voltage at the HV ADJ. Test Point will be -1350 volts.

If variations in load change the voltage on the -1350-volt bus, an error signal will exist between the grid and cathode of V814B. The error signal will be amplified by V814B and V814A; the plate of V814A varies the screen voltage of the oscillator tube V800, thereby controlling its output.

The +8650-volt supply and the negative bias supply are regulated indirectly, as the output voltage of all three supplies is proportional to the output of the oscillator circuit.

## Circuit Description — Type 585

### Unblanking

As mentioned previously, dc-coupled unblanking is accomplished by employing separate power supplies for the grid and cathode of the crt. Unblanking pulses from the Time-Base Generators control the crt grid through cathode followers V183B, V293A and the floating grid supply. (V183B is diagrammed with the Time-Base Generator A and V293A is diagrammed with the Time-Base Generator B).

At the fastest sweep rates the stray capacitance of the floating crt grid supply makes it difficult for the crt grid to rise fast enough to unblank the crt in the required time. An isolation network composed of R827, R828 and C828, C829 isolates that capacitive loading. By this arrangement the fast leading edge of the unblanking pulse is coupled through C828 and C829 to the grid of the crt. For short duration unblanking pulses, at the fastest sweep rates, the power supply itself is not appreciably affected.

Longer unblanking pulses at slow sweep rates, charge the stray capacitance in the circuit through R827. This pulls up the floating supply and holds the crt grid at the unblanked potential for the duration of the unblanking pulse.

### Amplitude Calibrator

The AMPLITUDE CALIBRATOR is a square-wave generator producing an output at approximately 1 kc which is avail-

able at the front panel CAL. OUT connector. Multivibrator, V875 and V885A, is connected to switch the cathode follower, V885B, between cutoff and conduction.

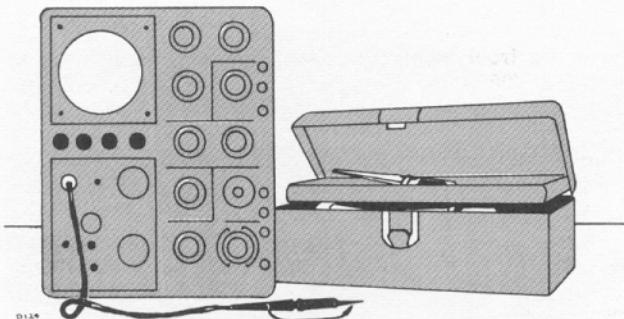
During the negative portion of the multivibrator output waveform the grid of V885B is driven well below cutoff and its cathode rests at ground potential. During the positive portion of the waveform V875 is cut off and its plate rests slightly below +100 volts. The voltage at the plate of V875 and grid of V885B when V875 is cut off, is determined by the setting of the CAL. ADJ. control R879.

Cathode-follower V885B has a precision, tapped divider for its cathode resistor. When the CAL. ADJ. control is properly adjusted, the cathode of V885B is at +100 volts when V875 is cut off. By means of the tapped divider R885 through R893 and a second 1000 to 1 divider R896-R897, output voltage steps are available from 0.2 millivolts to 100 volts. C885, connected between the cathode of V885B and ground, corrects the output waveforms for a slight overshoot.

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 585 AMPLITUDE CALIBRATOR is employed 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 585 and the other instrument chassis are supplied from different convenience outlets.

## SECTION 5

# MAINTENANCE



### General

This section of the Type 585 Manual contains information regarding Preventive Maintenance, Soldering, Removal and Replacement of Parts, and Troubleshooting information. It is through use of the Troubleshooting information and the Calibration Procedure that practically all troubles can be corrected, allowing continuing operation of the oscilloscope.

### PREVENTIVE MAINTENANCE

#### Air Filter

Care must be taken to assure free ventilation for the Type 585 in order to prevent instrument overheating. To assure free passage of air, the instrument must be placed so the air intake is not blocked, and the filter must be kept clean. Moreover, the side panels and bottom cover must be in place for proper air circulation; do not remove the covers except during maintenance.

A washable "E-Z KLEEN" filter is used at the air intake for the instrument. Under normal operating conditions the filter should be inspected, and cleaned if necessary, every three to four months. More frequent inspection is required when the operating conditions are more severe. (See the Accessories Section of this manual for disposable air filters).

The following cleaning instructions are issued by the filter manufacturer:

- (1) If grease or dirt load is light, remove filter from installation and rap gently on hard surface to remove loose dirt. Flush remaining dirt or grease out of filter with a gentle stream of hot water or steam; flush from clean side.
- (2) If load is too heavy for treatment described in (1), prepare mild soap or detergent solution in pan or sink deep enough to cover filter when laid flat. Agitate filter up and down in solution until grease or dirt is loosened and floated off.
- (3) Rinse filter and let dry.
- (4) Spray the filter with fresh Filter Coat (Tek Part Number 006-580) or Handi-Coater. Let dry from 2 hours to overnight before reinstalling. These products are available from the local representative of the Research Products Corporation, and some air-conditioner suppliers.
- (5) Use of oil or kerosene not recommended.

#### Fan Motor

The fan motor bearings should be lubricated every three or four months with a few drops of light machine oil (see Fig. 5-1). Failure to lubricate the bearings periodically will cause the fan to slow down or stop, thereby causing the instrument to overheat. If your oscilloscope is equipped with a dc fan motor—modification number 101—and if it operates throughout the working day, we suggest that you oil the bearings lightly once a month.

You should check the condition of the brushes of dc fans every other month since their life expectancy is approximately six months under conditions of daily use.

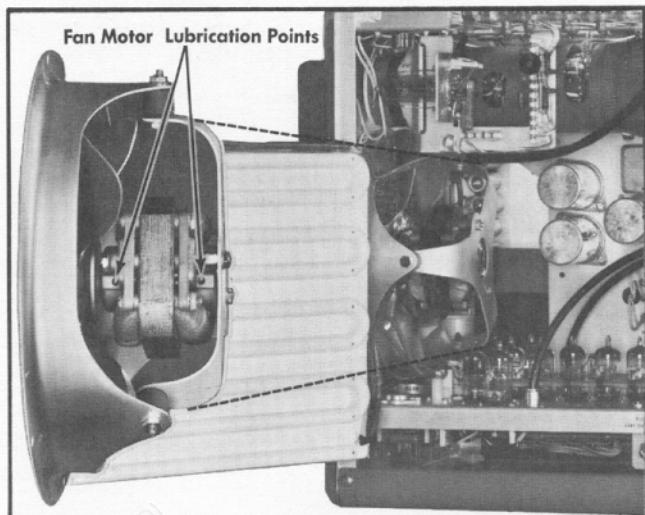


Fig. 5-1. Location of fan motor lubrication points.

#### Recalibration

The Type 585 is a stable instrument and will provide many hours of trouble-free operation. To insure the reliability of measurements obtained we suggest that its calibration be checked after each 500 hours of operation, or at least every six months if used intermittently. A check of the calibration also provides a means for checking the operation of each circuit. Minor operational deficiencies that are not apparent in normal use are often detected during a calibration check.

## Visual Inspection

You should visually inspect the entire oscilloscope every few months for possible circuit defects. These defects may include such things as loose or broken connections, damaged binding posts, improperly seated tubes, scorched wires or resistors, missing tube shields, or broken terminal strips. For most visual troubles the remedy 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.

## Soldering and Ceramic Strips

Many of the components in your Tektronix instrument are mounted on ceramic terminal strips. The notches in these strips are lined with a silver alloy. Repeated use of excessive heat, or use of ordinary tin-lead solder will break down the silver-to-ceramic bond. One application of tin-lead solder will not break the bond if excessive heat is not applied.

If you are responsible for the maintenance of a large number of Tektronix instruments, or if you contemplate frequent parts changes, we recommend that you keep on hand a stock of solder containing about 3% silver. This type of solder is used frequently in printed circuitry and should be readily available from radio-supply houses. If you prefer, you can order the solder directly from Tektronix in one pound rolls. Order by Tektronix part number 251-514.

Because of the shape of the terminals on the ceramic strips it is advisable to use a wedge-shaped tip on your soldering iron when you are installing or removing parts from the strips. Fig. 5-2 will show you the correct shape for the tip of the soldering iron. Be sure to file smooth all surfaces of the iron tip to be tinned. This prevents solder from building up on rough spots where it will quickly oxidize.

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.

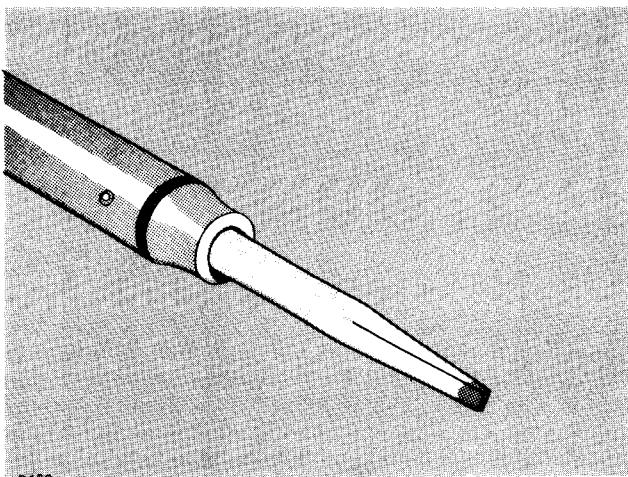


Fig. 5-2. Soldering iron tip properly shaped and tinned.

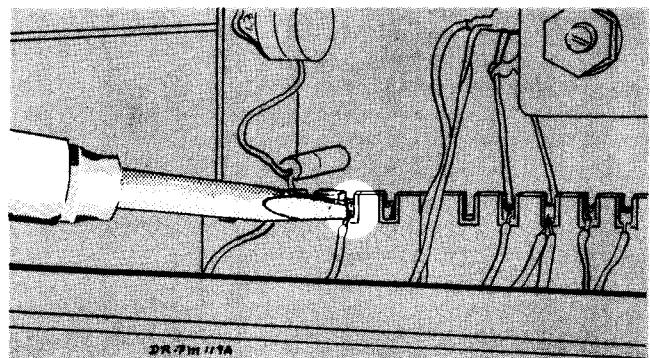


Fig. 5-3. Correct method of applying heat in soldering to a ceramic strip.

1. Use a soldering iron with a 50 to 75-watt rating.
2. Prepare the tip of the iron as shown in Fig. 5-2.
3. Tin only the first  $\frac{1}{16}$  to  $\frac{1}{8}$  inch of the tip. For soldering to ceramic terminal strips tin the iron with solder containing about 3% silver.
4. Apply one corner of the tip to the notch where you wish to solder (see Fig. 5-3).
5. Apply only enough heat to make the solder flow freely.
6. Do not attempt to completely fill the notch on the strip with solder; instead, apply only enough solder to cover the wires adequately, and to form a slight fillet on the wire as shown in Fig. 5-4.

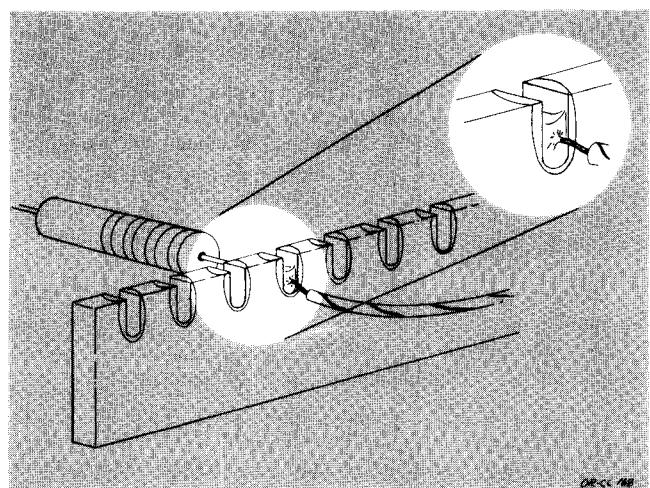


Fig. 5-4. A slight fillet of solder is formed around the wire when heat is applied correctly.

In soldering to metal terminals (for example, pins on a tube socket) apply the iron to the part to be soldered as shown in Fig. 5-5. Use only enough heat to allow the solder to flow freely along the wire so that a slight fillet will be formed.

## General Soldering Considerations

When replacing wires in ceramic terminal strip notches, clip the ends neatly as close to the solder joint as possible. In clipping the end of wires, take care the end removed does not stay within the oscilloscope and cause a short circuit.

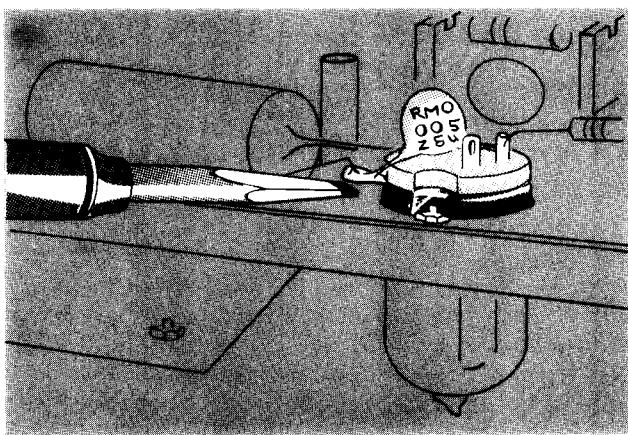


Fig. 5-5. Soldering to a terminal. Note the slight fillet of solder—exaggerated for clarity—formed around the wire.

Occasionally you will wish to hold a bare wire in place as it is being soldered. A handy device for this purpose is a short length of wooden dowel, with one end shaped as shown in Fig. 5-6. In soldering to terminal pins mounted in plastic rods or coil forms it is necessary to use some form of "heat sink" to avoid melting the plastic. A pair of long-nosed pliers (see Fig. 5-7) makes a convenient tool for this purpose.

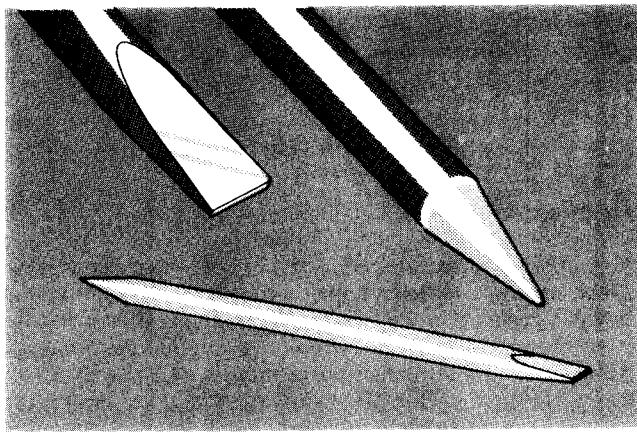


Fig. 5-6. A soldering aid constructed from a  $\frac{1}{4}$  inch wooden dowel.

## Ceramic Strips

Two distinct types of ceramic strips have been used in Tektronix instruments. The earlier type is mounted on the chassis by means of #2-56 bolts and nuts. The later type

is mounted with snap-in, plastic fittings. Both styles are shown in Fig. 5-8.

To replace ceramic strips which bolt to the chassis, screw a #2-56 nut onto each mounting bolt, positioning the bolt so that the distance between the bottom of the bolt and the bottom of the ceramic strip equals the height at which you wish to mount the strip above the chassis. Secure the nuts to the bolts with a drop of red lacquer or glyptal. Insert the bolts through the holes in the chassis where the original strip was mounted, placing a #2 starwasher between each nut and the chassis. Place a set of #2 flatwashers on the protruding ends of the bolts, and fasten them firmly with another set of #2-56 nuts. Place a drop of red lacquer or glyptal over each of the second set of nuts after fastening.

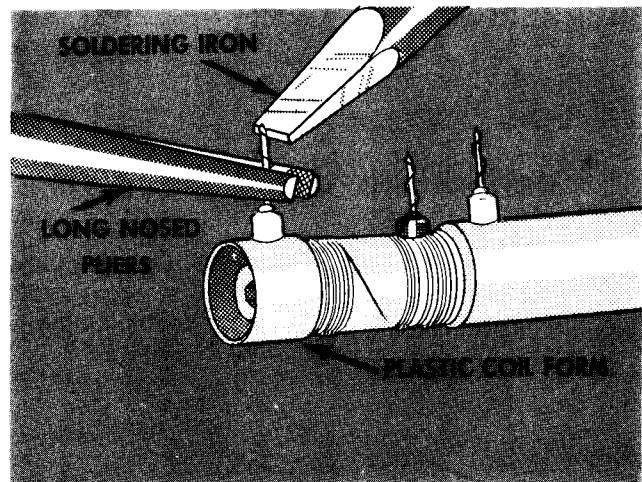


Fig. 5-7. Soldering to a terminal mounted in plastic. Note the use of the long-nosed pliers between the iron and the coil form to absorb the heat.

To replace strips which mount with snap-in plastic mountings, first remove the original fittings from the chassis by simply pulling them directly away from the chassis. Assemble the mounting yoke on the ceramic strip. (It may be already mounted.) Insert the spacer into the mounting holes in the chassis. Carefully force the yoke pin into the spacer. Snip off the portion of the yoke pin which protrudes below the nylon collar on the reverse side of the chassis.

### NOTE

Considerable force may be necessary to push the yoke pins into the nylon collars. Be sure that you apply this force to the portion of the ceramic strip directly above the plastic mounting yoke. Take care not to spread the yoke, or the strip may be loose after installation.

## REMOVAL AND REPLACEMENT OF PARTS

### General Information

Instructions for the removal of certain parts are contained in the following paragraphs. Because of the nature of the

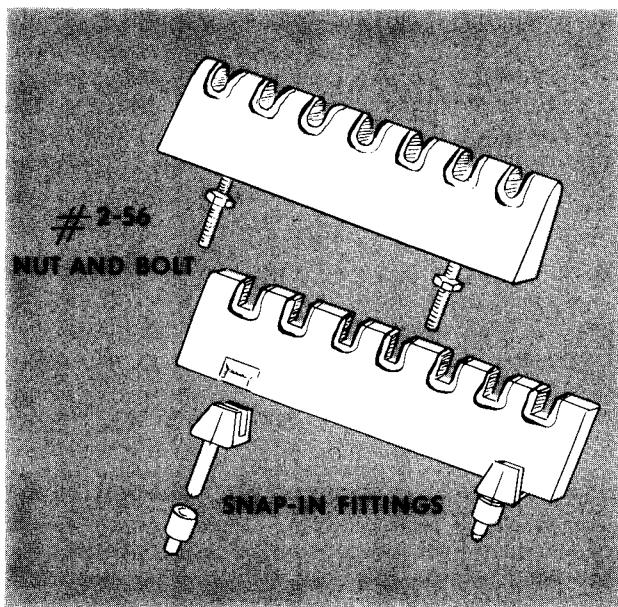


Fig. 5-8. Two types of ceramic strip mountings.

Type 585, replacement of certain parts will require that you recalibrate portions of the oscilloscope in order to insure the proper operation of the instrument. Refer to the Calibration Procedure section of this manual when replacing precision or adjustable parts.

### Removal of Panels

The panels of the Type 585 Oscilloscope are held in place by coin slotted fasteners. To remove the side panels, use a screwdriver or coin to rotate the fasteners two or three turns counterclockwise; then pull the upper portion of the panels outward from the carrying handles. To remove the bottom panel, lay the instrument on its side, rotate the fasteners two or three turns counterclockwise, and pull off the panel. Panels are replaced by reversing the order of their removal.

### Replacement of the Cathode-Ray Tube

**CAUTION:** When replacing a cathode-ray tube, wear both a plastic face guard and leather gloves. These items will protect the operator in case of an implosion and flying glass.

To remove the cathode-ray tube, first carefully remove all leads connected to the neck of the tube. Loosen the mounting clamp located near the socket, then disconnect the tube socket.

Carefully slip the new crt in place past the in-place high voltage connector. Be careful, since if a neck pin strikes a sharp edge, the seal can be broken and a new crt required. When the crt is in place, the leads can be properly connected to the neck pins of the tube by using the color code information provided on the tube shield. Place the

graticule over the crt face with the scribed lines on the inside, toward the crt face. Then place the four rubber washers (if provided) over the four graticule mounting studs. Replace the bezel and secure it in place with the four knurled nuts. After replacement of the crt, it may be necessary for you to recalibrate certain portions of the oscilloscope. Special attention should be given to calibration of the sweep, the vertical deflection factor, and the GEOMETRY control. Horizontal trace alignment is easily accomplished by adjustment of the red knob located under the crt socket, immediately under V1284. Be careful not to rotate the crt far enough to short any neck connections to ground.

In the graticule replacement procedure above, if you use a Tektronix camera mounting bezel, do not replace the four rubber washers between it and the graticule.

### Replacement of Switches

Methods for removal of defective switches are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the Type 585. If one wafer is defective the entire switch should be replaced. Switches can be ordered from Tektronix either wired or unwired as desired.

### Tube Replacements

Care should be taken both in preventive and corrective maintenance that tubes are not replaced unless they are actually defective. Many times during routine maintenance it will be necessary for you to remove tubes from their sockets. It is important that these tubes be returned to the same sockets unless they are actually defective. Unnecessary replacement or switching of tubes will many times necessitate recalibration of the instrument. If tubes do require replacement, it is recommended that they be replaced by previously checked high quality tubes. The best way to check tubes is by placing them in the circuit and checking for proper operation.

## REPLACEMENT PARTS

### Standard Parts

Replacements for all parts used in the Type 585 Oscilloscope can be purchased directly through your area Tektronix Field Engineer or Field Office. However, since many of the components are standard electronic parts, they can generally be obtained locally in less time than is required to obtain them from the factory. Before ordering or purchasing parts, be sure to consult the parts list to determine the tolerances and ratings required. The parts list gives the values, tolerances, ratings, and Tektronix part numbers for all 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 585 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 Tektronix. They are normally difficult or impossible to obtain from other sources. All parts may be obtained through your area Tektronix Field Engineer or Field Office.

## TROUBLESHOOTING

### Troubleshooting Procedure

This section of the manual contains information for troubleshooting the Type 585 Oscilloscope. Before attempting to troubleshoot the instrument, however, make sure that any apparent trouble is actually due to a malfunction within the instrument and not to improper control settings or to a faulty plug-in unit or probe. Instructions for the operation of the Type 585 and general information concerning plug-in operation, are contained in the Operating Instructions section of this manual. Operating instructions for a specific plug-in unit or probe will be found in the manual for that unit.

When vertical system troubles exist, to determine that the oscilloscope is at fault, the plug-in unit may be replaced with another known to be in good operating condition. If the trouble is still apparent, it is almost a certainty that the oscilloscope is at fault. However, should the trouble appear to have been corrected by replacing the plug-in unit, the trouble most likely lies within the original plug-in unit and not the oscilloscope.

Tube failure is the most prevalent cause of circuit failure. For this reason, the first step in troubleshooting any circuit in the instrument is to check for defective tubes, first by looking for dark heaters, and then replacement by direct substitution. Do not depend on tube testers to indicate the suitability of a tube for certain positions within the instrument. The criterion for usability of a tube is whether or not it works satisfactorily. Be sure to return all good tubes to their original sockets; if this procedure is followed less recalibration of the instrument will be required upon completion of the servicing.

When replacing any tube in the instrument, check first to see that components through which the tube draws current have not been damaged. Shorted tubes will sometimes overload and damage components. These can generally be located by visual inspection. If no damaged components are apparent, and if tube replacement does not restore operation, it will be necessary to make measurements or other checks within the circuit to locate the trouble.

The component number of each electrical part is shown on the circuit diagrams. The following chart lists the component numbers associated with each circuit.

- All numbers ..... Time-Base Trigger A and B
- less than 100 ..... Time-Base Trigger A and B
- All 100 numbers ..... Time-Base Generator A and Timing Switch A
- All 200 numbers ..... Time-Base Generator B and Timing Switch B

All 300 numbers .....	Horizontal Amplifier and External Horizontal Amplifier
All 400 numbers .....	Delay Pickoff
All 600 and 700 numbers .....	Low-Voltage Power Supply, and Regulated Heater Supply
All 800 numbers .....	CRT Circuit and High-Voltage, plus Amplitude Calibrator
All 1000 numbers .....	Vertical Amplifier Delay-Line Driver
All 1100 numbers .....	Power supply decoupling networks for vertical amplifier and plug-ins
All 1200 numbers .....	Vertical Amplifier Output Stage
All 8000 numbers .....	Type 80 Plug-In Unit and P80 Probe

Switch wafers shown on the schematic diagrams are coded to indicate the position of the wafer on the switches. 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.

## CIRCUIT TROUBLESHOOTING

Although the Type 585 is a complex instrument, it can be thought of as consisting of nine main circuits, in addition to the Calibrator circuit. These are the:

1. Low-Voltage Power Supply
2. CRT Circuit and High-Voltage Power Supply
3. Vertical Amplifier and Delay Line
4. Time-Base Trigger Circuit A
5. Time-Base Trigger Circuit B
6. Time-Base Generator A
7. Time-Base Generator B
8. Delay Pickoff
9. Horizontal Amplifier

The first circuit to check, for practically any type of trouble, is the Low-Voltage Power Supply. Because of the circuit configurations employed, it is possible for an improper power supply voltage to affect one circuit more than the others. For example, if the gain of the Vertical Amplifier should decrease slightly, while the other circuits appear to be functioning normally, this could be due to an improper supply voltage and not to any condition originating in the Vertical Amplifier. In cases of this type, valuable time can be saved by checking the power supply voltages first.

On the other hand, the crt display can often be used to isolate trouble to one particular circuit when trouble exists in that circuit. If there is no vertical deflection, for example, when the intensity and horizontal deflection appear to be

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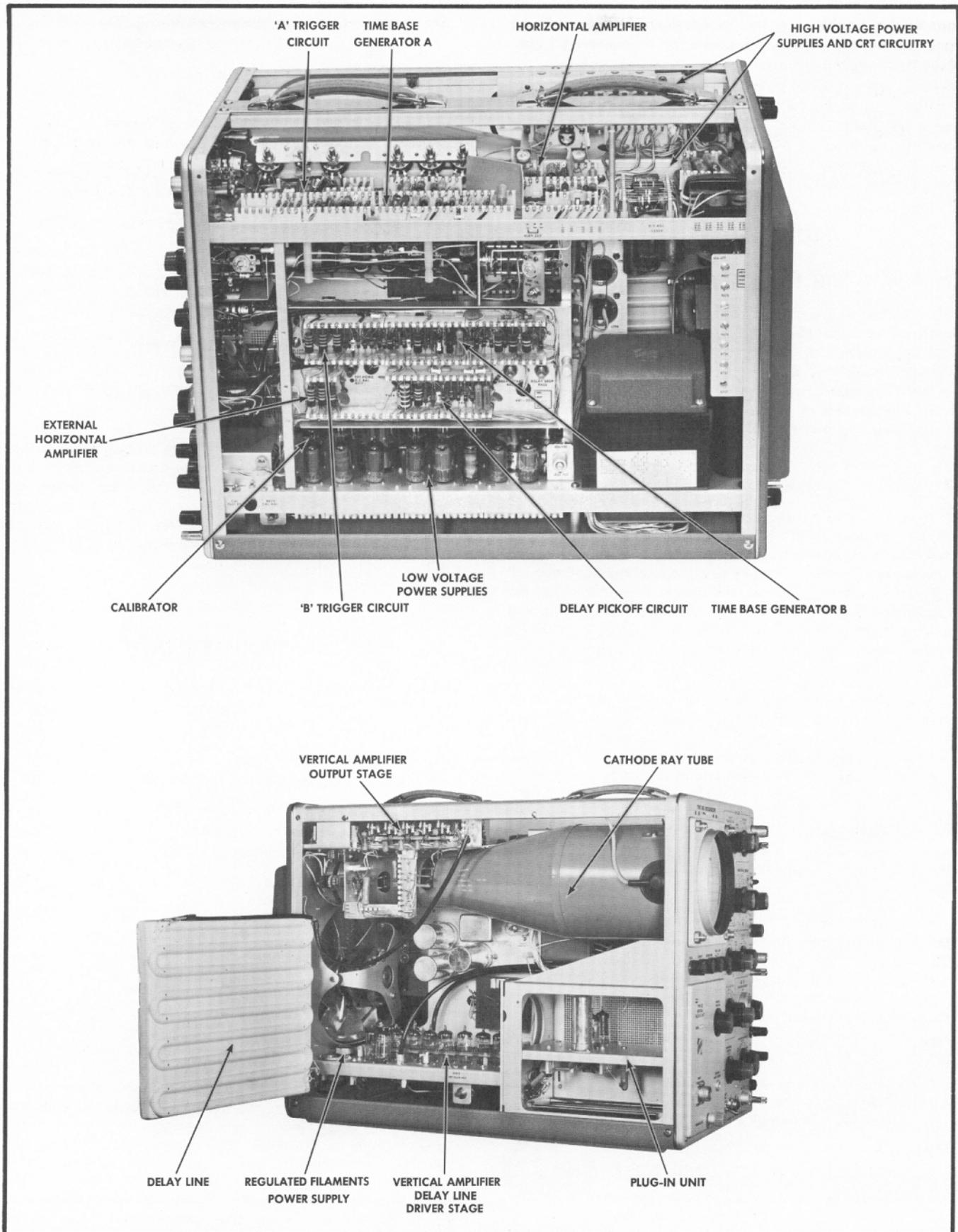


Fig. 5-9. Physical location of circuits which compose the Type 585 Oscilloscope.

normal, the trouble can be: open signal connections, no signal source, the plug-in, the probe, or even loose crt connections.

The material that follows contains information for troubleshooting each circuit for various types of troubles. A method is described, in some instances, for locating the stage in which the trouble may be originating; once the stage at fault is known, the component(s) causing the trouble can be located by voltage and resistance measurements or by substitution. In certain other instances the information is more specific and the trouble can be traced to a particular component.

### Front-Panel Checks

The following front-panel checks will help you to isolate the trouble in an instrument to a given circuit. However, the interrelation between circuits is such that it is not always possible to isolate the trouble exactly using these checks. If you are unfamiliar with the instrument, these front-panel checks should prove helpful in looking for the trouble.

Before attempting any of the following front-panel checks make sure that the plug-in installed in the instrument is operating correctly. If the pilot lamp fails to light when the POWER switch is turned to the ON position, and if the fan fails to operate, turn to the section on troubleshooting the Low-Voltage Power Supply. If the pilot light and fan operate but the Time-Delay Relay fails to operate with an audible "click" in less than one minute, you should also consult the section on Troubleshooting the Low-Voltage Power Supply.

With a Type 84 Plug-In Test Unit installed, and the pilot light and fan both operating, allow the oscilloscope to run for several minutes.

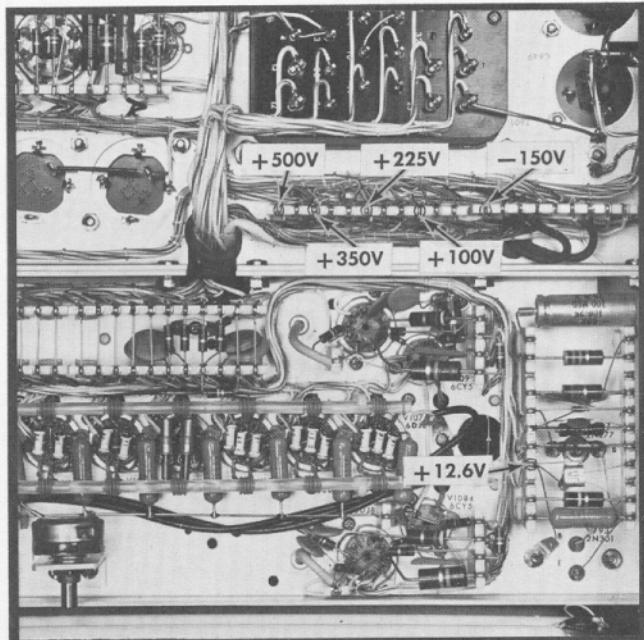


Fig. 5-10. Location of power supply test points underneath the scope.

Set the front-panel controls as follows:

'A' STABILITY	fully clockwise
'A' TRIGGERING LEVEL	0
'A' TRIGGERING SOURCE	INT.
'A' TRIGGER SLOPE	+
'A' TIME/CM	5 MILLISEC
'A' VARIABLE (TIME/CM)	fully clockwise
HORIZONTAL DISPLAY	A
'B' STABILITY	counterclockwise, but not PRESET
FOCUS	mid-range
INTENSITY	fully counterclockwise
ASTIGMATISM	mid-range
SCALE ILLUMINATION	mid-range
HORIZONTAL POSITION	mid-range
VERNIER	mid-range

Other controls may be left at any setting.

Set the Type 84 front-panel controls as follows:

LOAD	NORM.
DISPLAY SELECTOR	CAL. (2 CM) AND ALT. SYNC
VERTICAL POSITION	mid-range

Other Type 84 controls may be left at any setting.

With the Type 84 controls as above, there should be two traces, two centimeters apart on the crt. It may be necessary to readjust the VERTICAL POSITION control to bring both traces in view.

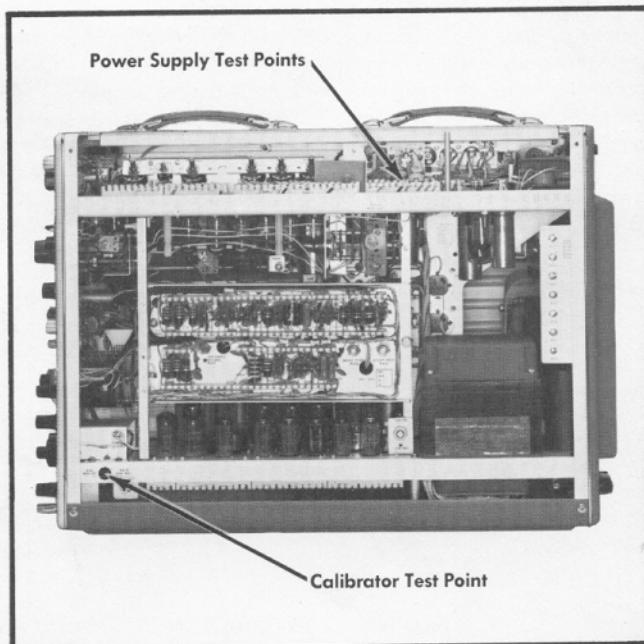


Fig. 5-11. Calibrator and power supply test points.

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A second check is then to set the Type 84 DISPLAY SELECTOR switch to EXT. INPUT and patch into the EXT. INPUT connector .2 VOLTS of Calibrator signal. It will be necessary now to turn the Type 585 STABILITY control into the triggerable region and adjust the TRIGGERING LEVEL control for a stable display.

If either of the tests made so far does not produce a display as described, turn to the section on troubleshooting the vertical amplifier. If the first test above does not produce two traces, (but the second test permits a proper display of the Calibrator waveform), check the Time-Base Generator dual-trace sync pulse source, and step 24 of the Calibration Procedure. If no Calibrator waveform appears in the second test, turn to Troubleshooting the AMPLITUDE CALIBRATOR.

Additional troubles are discussed below in relation to using a TU-3 or Type 80 Plug-In Unit for this initial trouble test.

If you are using a TU-3 Test-Load Plug-In Unit set the INPUT SELECTOR toggle switch to the SIGNAL position and the oscilloscope AMPLITUDE CALIBRATOR switch to the .2 VOLTS position. (If using a Type 80 Plug-In, set the AMPLITUDE CALIBRATOR switch to .2 VOLTS, and apply the CAL. OUT signal to the P80 Probe.)

Using a patch cord which introduces no attenuation, connect the CAL. OUT connector to the INPUT connector of the TU-3 Plug-In. Advance the INTENSITY control to mid-range, or to the position where a trace normally appears.

If no spot is evident check the Beam-Position Indicator lamps. If the spot is off the screen vertically turn the VERTICAL POSITION control from one extreme position to the other, watching the face of the crt as you do so. If the spot does not appear, and operation of the VERTICAL POSITION control has no effect on the Beam-Position Indicator lamps turn to the section on Troubleshooting the Vertical Amplifier.

If the display which appears consists only of a horizontal line, you may check the operation of the calibrator by disconnecting the end of the patch cord from the CAL. OUT connector and grasping the end between your fingers. A series of sloping vertical lines (power line pickup) appearing on the crt indicates that the Vertical Amplifier is operating and that the AMPLITUDE CALIBRATOR is probably inoperative. See the section on Troubleshooting the AMPLITUDE CALIBRATOR for the remedy.

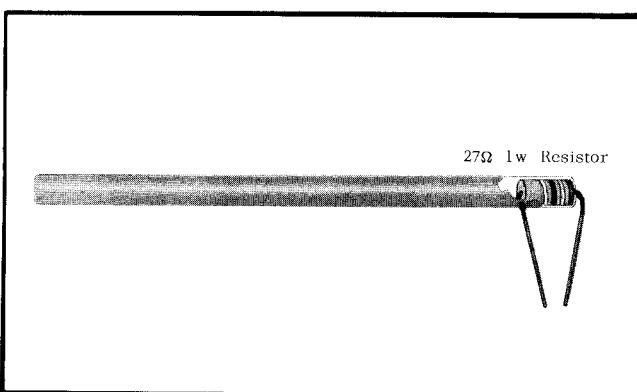


Fig. 5-12. 27-ohm shorting resistor. Part Number 003-002.

If the operation of the VERTICAL POSITION control causes the vertical Beam-Position Indicator lamps to indicate the display can be centered vertically, rotate the HORIZONTAL POSITION control from one extreme position to the other. If the horizontal Beam-Position Indicator lamps indicate the display remains off screen refer to the section on Troubleshooting the Horizontal Amplifier.

If both sets of Beam-Position lamps indicate that the display is centered, but no display is observed, CAUTIOUSLY advance the INTENSITY control. Watch for a display to appear on the screen. If no display is seen or if the display is of low intensity or defocused but otherwise normal, refer to the section on Troubleshooting the CRT Circuit.

## TROUBLESHOOTING THE VERTICAL AMPLIFIER

### No Spot or Trace Visible on CRT

If all power supply voltages are normal, and the crt is known to be good, failure to obtain a spot or trace on the screen will be due to improper deflection-plate voltages. This condition is caused by a dc unbalance in either or both of the deflection amplifier circuits or by a loose crt lead.

To determine which circuit is at fault, adjust the Time-Base A controls for a free-running sweep at 1 MILLISEC/CM (STABILITY control fully clockwise) and set the INTENSITY control to midrange. Using a screwdriver with an insulated handle, CAREFULLY short the vertical deflection plates together at the neck pins on the crt. These are the pins marked BLUE (UPPER) and BROWN (LOWER). Be careful not to short either pin to the metal shield around the crt. If the dc unbalance is being produced in the vertical deflection circuit the trace will appear at or near the center of the crt when the vertical deflection plates are shorted together. If the trace does not appear, however, the trouble does not lie in the vertical circuit and the dc balance of the horizontal circuit can be checked in a like manner after first stopping the sweep.

If it is determined that the vertical deflection circuit is unbalanced, the next step is to check the system for the fault. This is accomplished in a manner similar to the shorting procedure used to find the crt electrical center. It is best to guard against common-mode oscillations by performing the shorting operation using a  $27\Omega$  1-watt resistor. Figure 5-12 illustrates a satisfactory method of holding the shorting resistor for use in the following procedure.

1. Use the shorting resistor to short the grids of V1284, located on a two-terminal ceramic strip at its socket. If the trace appears, V1284 and circuit is good.
2. Connect the shorting resistor between the grid lines of the Output Stage near V1214. The grid lines are wound with green colored wire. If the trace appears, all tubes and circuitry from this point to the crt are good.
3. Connect the shorting resistor between the plate lines of the Delay-Line Driver stage. The plate lines are wound with red wire. If the trace appears, the Delay Line is not open.
4. Connect the shorting resistor between the grid lines of the Delay-Line Driver stage. If the trace appears, the

vertical amplifier is good and the trouble lies within either the plug-in unit or the probe. If available, another plug-in unit or probe should be substituted for the suspected unit.

During the shorting procedure, if one of the distributed amplifiers is proven at fault, it is unlikely that just one non-conducting tube could be responsible. Each tube draws only a small portion of the total plate current. If a tube has shorted, excessive current may damage resistors or other parts. A visual inspection will probably reveal the damaged part(s).

### Insufficient or No Vertical Deflection

Insufficient deflection indicates a change in the gain characteristics of the Vertical Amplifier. If only a slight change in deflection is apparent, the circuit can normally be recalibrated for gain. In this event, refer to the Calibration Procedure section of this manual.

If the change in deflection is more pronounced, or if there is no deflection at all, the tubes should first be checked by substitution. Then check for components which can affect the gain of the circuit but not the dc balance. Such components are the common cathode resistors; the Gain Adj. control; common screen resistors, and common plate-load resistors.

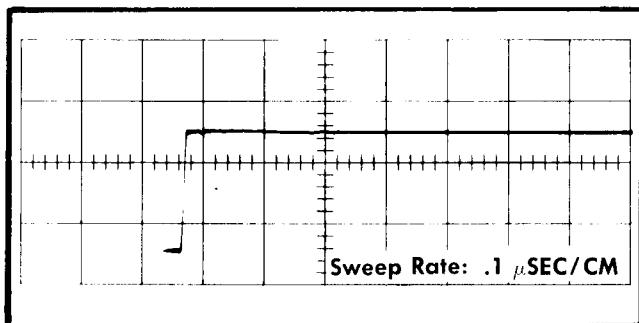


Fig. 5-13. Correctly compensated Type 585 and P80 Probe, using Type 107 Square-Wave Generator.

### Waveform Distortion

In instruments before Serial No. 2585, it is normal to see a small amount of internally caused waveform distortion of a high-frequency nature. With the improvements as of Serial No. 2585, the irregularities in transient response have been minimized to an extent that the vertical amplifier will respond to a distortion-free function with less than 1% overshoot or ringing.

It is normal for a small amount of amplitude compression to occur in the lower centimeter of the crt graticule. If compression is severe, refer to step 13 of the Calibration Procedure to make the necessary corrections.

With the Type 84 Plug-In Test Unit in place, turn its DISPLAY SELECTOR to PULSER, operate the Type 585 "A" sweep at  $.05 \mu\text{SEC}/\text{CM}$ , use a viewing hood in a lighted room,

adjust the Type 84 PULSER AMPLITUDE for  $+2 \text{ cm}$  of display, permitting a view of the oscilloscope's transient response. If other than a clean step-function is presented on the crt, calibration of the vertical amplifier is indicated. Calibration can require tube balancing, replacement, and/or high-frequency adjustments. See the Calibration Procedure including steps 7 through 16 and steps 45 and 46.

If this check is being made without a Type 84, but is being done with a Type 80/P80 combination, do the following:

A distortion-free positive step function, having a rise-time of 3 nseconds or less, may be used to observe the high-frequency characteristics of the oscilloscope/plug-in/probe combination. The output from a Tektronix Type 107 is illustrated in Figure 5-13. The photograph was taken with a standard Type 585 Oscilloscope with Type 80 Plug-In Unit and P80 Probe. The P80 Probe was connected to the Type 107 through a  $50 \Omega$  terminating adapter (Tek number 013-033). The termination was connected directly to the Type 107 output connector. The Type 107 was modified by substituting a 6AK5 in place of the output 6AU6. The change to the 6AK5 reduces (may eliminate) about 3% normal overshoot in the output of the Type 107.

Figure 5-13 shows the waveform obtained with a properly adjusted system. The slight dip in amplitude about 25 noseconds after the rise appears in most Type 585 Oscilloscopes before Serial No. 2585. It is due to a slight, unavoidable, mismatch located at the junction between the delay line and the Output stage. The small bump 240 nanoseconds after the rise is the result of reflections at the input end of the Delay Line. Depending upon the impedance differences that may occur at this point, your instrument will either not show a bump, show a rise or show a dip. Both problems have been corrected by Modification No. 040-275 beginning with Serial No. 2585.

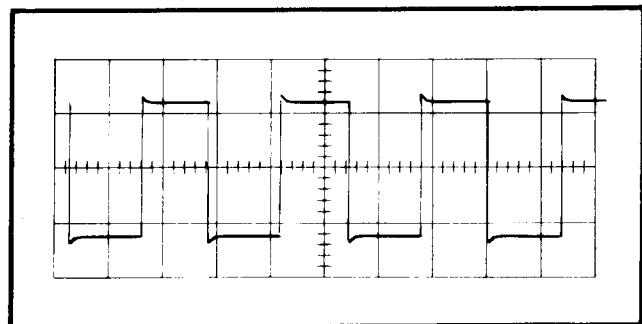


Fig. 5-14. 20 kc waveform from a Type 105, showing effect of over peaking R8018 within the P80 Probe.

Figure 5-14 illustrates a 20 kc waveform from a Tektronix Type 105 Square-Wave Generator. The photograph illustrates the time-area affected by the high frequency compensations of the P80 Probe and L8085 within the Type 80 Plug-In Unit. Figure 5-14 shows the result of over peaking R8018 within the P80 Probe. See the Calibration Procedure section of this manual for correct adjustment procedure, step 45B.b.

An overshoot at the leading edge of a fast-rise square-wave may also result from cathode interface impedance in

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one or more of the amplifier tubes. The output dual-pentode amplifier V1284 is particularly prone to develop cathode interface. The 6939 tube used in early instruments very often developed cathode interface after just a few hours of operation. A superior replacement is an Amperex 7699. The 7699 can also develop cathode interface, but they are much less likely to do so than the 6939.

To check for cathode interface, display a fast-rise square wave. It will be necessary to use a variable line voltage autotransformer between the power line and the Type 585. Adjust the line voltage to a value between 120 and 125 volts and observe the waveform carefully. Then reduce the line voltage to a value between 105 and 110 volts. After a short period of time the amplifier tube's cathode temperatures will lower, increasing any cathode interface effect. If cathode interface is present, it will show up as increased overshoot at the leading edge of the square wave at low line voltages. If interface is present, first replace the output amplifier V1284. If this does not correct the overshoot, a general search for the cathode interface effected tubes must follow. Replace vertical amplifier tubes one at a time with new tubes until the bad ones are found. After finding the defective tube(s), it may be necessary to readjust the high-frequency compensations of either the Output Vertical Amplifier or the P80 Probe and Type 80 Plug-In Unit. See the Calibration Procedure step 45a.

## TROUBLESHOOTING THE TIME-BASE A TRIGGER CIRCUIT

### Unstable Triggering

If the display of a repetitive waveform cannot be made stable, the sweep generator may not be receiving proper triggering signals. If the trace can be turned off and on with STABILITY control, the sweep generator is capable of being triggered. This indicates the trigger circuitry is not functioning properly.

Trouble can be anywhere from the Trigger Pickoff circuit on the Delay-Line Driver chassis to the grid circuit of the Sweep Gating Multivibrator.

To determine if the trouble is within the Time-Base Trigger circuit, and not the Trigger Pickoff circuit, the internal LINE triggering signal can be used. Figure 5-15 illustrates three waveforms within the tunnel diode Time-Base Trigger circuit when the triggering signal is the line frequency. The test oscilloscope used to take the waveforms of Figure 5-15 was a Tektronix Type 543A with Type K Plug-In Unit and P6000 10X Probe.

Should the Time-Base Trigger circuit not be functioning properly, the trouble probably lies within the Trigger Pickoff amplifier and cathode follower system. A visual inspection will aid to find burned components. Tube substitution should be tried first when no burned parts are evident. A possible cause of unstable triggering is heater-cathode leakage in a Trigger Pickoff tube. Also voltage measurements can aid in finding the problem. Voltages at important points in the Trigger Pickoff circuit are part of the Vertical Amplifier Delay-Line Driver stage diagram.

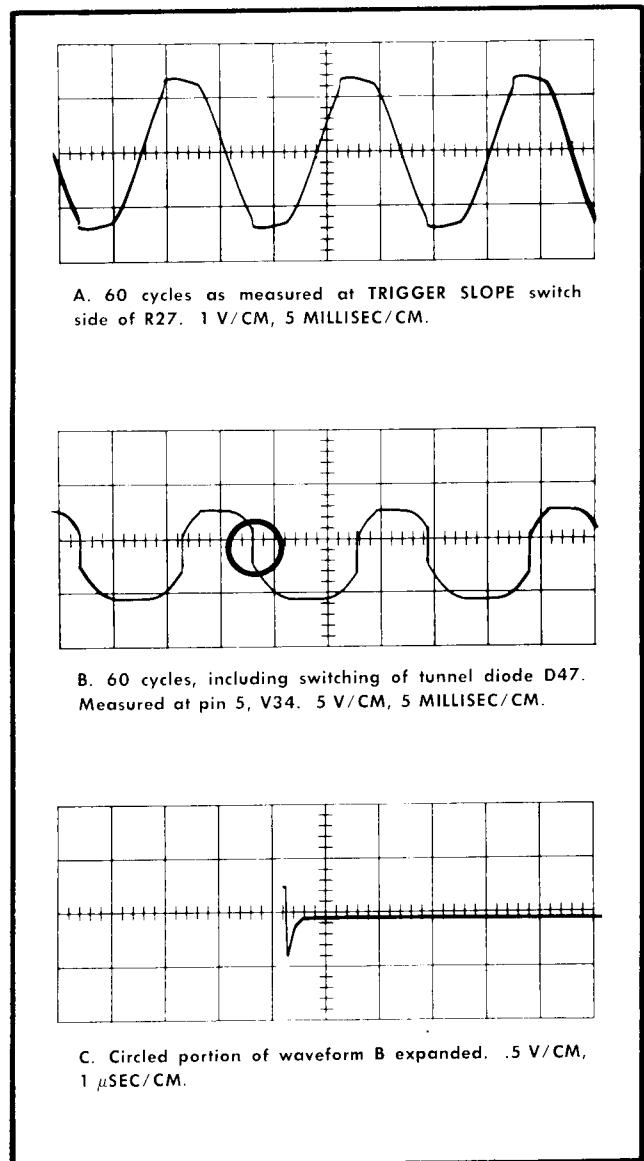


Fig. 5-15. Trigger Circuit waveforms when using LINE triggering. TRIGGER SLOPE switch set to +.

Refer to the circuit description of the Trigger Regenerator, Page 4-4, for additional voltage-current relationships within the Time-Base Trigger circuit.

## TROUBLESHOOTING THE TIME-BASE A GENERATOR

### No Horizontal Sweep

If the Time-Base Generator is not producing a sawtooth sweep voltage when the STABILITY control is adjusted for a free-running sweep, some defect in the generator is holding the Miller circuit. Depending on the on-off states of the Disconnect Diodes V152, the Miller circuit may be held at either the high end or the low end of the sawtooth. The

manner in which it is held may be determined by measuring the voltage at the SAWTOOTH A binding post. If the Miller circuit is held at the high end of the sawtooth the voltage at the front-panel binding post may measure about +300 volts; if held at the low end, the voltage at this point will measure anywhere between ground and -20 volts, depending on the cause. If it rests at -20 volts, the trouble probably is non-conduction of V152A, and it should be replaced. It can also mean that R151 is open.

If the Miller circuit is held at the high voltage end of the sawtooth, replace V152 as it can mean both heaters are open. Or replace the Miller tube V161 as its heaters can be open or its cathode can have low emission and give the same effect. Usually if V161 is not conducting, B167 will be glowing brightly.

In the event the front panel SAWTOOTH A jack voltage rests at +350, there is probably a grid to plate short within V173; replace it. When this occurs, B167 glows brightly at the electrode attached to pin 6 of V161. If this reverse conduction condition is permitted to continue for longer than about 15 minutes it may be necessary to replace B167 with a new neon glow tube. The reason for this is that B167 may be unstable thereafter.

If the heater of V173 is open, both neon glow tubes will be glowing brightly and there will be no sweep.

If all tubes have been checked, then check for open plate and cathode resistors in the Sweep Gating Multivibrator circuit, the Hold-Off circuit and the Runup CF circuit. Also check that the STABILITY control can vary the voltage at the grid of V135A.

### Nonlinear Sweep

A nonlinear sweep voltage will be generated if the current charging the Timing Capacitor C160 does not remain constant. If the nonlinearity occurs at all sweep rates a defective Miller tube is the probable cause. If the nonlinearity occurs only at certain sweep rates a leaky Timing Capacitor is the probable cause but the Miller tube should not be overlooked. A defective bootstrap capacitor C165 can cause the sweep to be nonlinear at the faster sweep rates. If the sweep appears linear in all but the 1 and 2 SEC/CM rates, or if the spot moves to a point near the center of the crt and stops there, there is likely heater-cathode leakage in V152B and it should be replaced.

### Insufficient Horizontal Deflection

If the horizontal trace starts at the left side of the graticule, but retraces before reaching the right side, the Hold-Off circuit is causing V135A to revert the sweep too soon. If the trace cannot be expanded to the full width of the graticule with the SWP. LENGTH control R176, check the resistance values in the cathode circuit of V173.

## TROUBLESHOOTING THE HORIZONTAL AMPLIFIER

### No Spot or Trace Visible on CRT

To determine whether the Horizontal Amplifier is in a state of dc unbalance, short the horizontal deflection plates

together at the neck pins of the crt in the manner explained for troubleshooting the Vertical Amplifier. The horizontal deflection plates are marked RED (LEFT) and GREEN (RIGHT). The INTENSITY control should be set to mid-range. If a spot appears when the horizontal deflection plates are shorted together (it may be necessary to adjust the VERTICAL POSITION control), the trouble lies in the Horizontal Amplifier.

### CAUTION

Do not permit the spot to remain on the crt at this setting of the INTENSITY control. Either reduce the intensity until the spot is just visible, or remove the short from the horizontal deflection plates.

The procedure for troubleshooting the Horizontal Amplifier is similar to that explained for troubleshooting the Vertical Amplifier for unbalance. The shorting strap can be moved from deflection plates back toward the Input Amplifier stage, until a point is reached where the trace does not appear. When the stage at fault is determined, check for defective tubes and components associated with that stage.

### Insufficient or No Horizontal Deflection

If the gain of the Horizontal Amplifier decreases from normal, the trace will not extend from the left to the right side of the graticule. In addition, the timing will no longer correspond to the calibrated value indicated by the TIME/CM switch. (This is to distinguish insufficient sweep caused by trouble in the Horizontal Amplifier from that caused by a trouble in the Time-Base Generator, e.g., an improper adjustment of the SWP. LENGTH control. In the latter case the trace will be shortened but the timing will not be affected.)

If the change in gain is slight, as indicated by improper timing and a slightly decreased sweep, the amplifier can usually be recalibrated. Since the gain of the Horizontal Amplifier affects the timing of the sweep, care must be taken to insure that the gain adjustments are accurately made. Be sure to refer to the Calibration Procedure if it is necessary to adjust the gain of the Horizontal Amplifier.

If the decrease in gain of the Horizontal Amplifier is more pronounced, or if there is no sweep at all (in which case only a spot will be visible on the horizontal axis), check for defective components which can affect the gain but not the dc balance. In addition to the tubes, such components are the common cathode resistors and controls.

## TROUBLESHOOTING TIME-BASE B TRIGGER AND SWEEP CIRCUITS

By following the circuit description of various Time-Base A and Time-Base B circuits, you will note a great similarity in most. Therefore it is felt that the preceding troubleshooting procedures for Time-Base A trigger and sweep circuits is adequate for a guide when problems exist with the Time-Base B system. The exception of course is that the HORIZONTAL DISPLAY switch must be in the B position.

## TROUBLESHOOTING THE DELAYED TRIGGER CIRCUIT

When no delayed trigger is present at the front panel DEL'D TRIG connector, the Delay Pickoff circuit has probably failed. However, before attempting to repair the Delay Pickoff circuit, be sure that the 'A' or 'B' sweep circuits are working correctly and that a sawtooth voltage is being presented to the Delay Pickoff system. Also, turn the DELAY-TIME MULTIPLIER dial away from zero. A properly calibrated Delay Pickoff circuit may not deliver any output pulse during the first minor division of rotation at the zero end of the helidial.

An excellent aid to calibration of the Delay Pickoff circuit is a Tektronix Type Z Plug-In Unit used in the test oscilloscope. The Type Z will permit accurate dc measurement of waveforms several hundred volts from ground. Refer to the Delay Pickoff diagram for waveform and voltage measurements.

The first defect to look for is bad tubes, followed by voltage measurements, and then look for burned or broken parts.

Check to see that the two grids of the input difference amplifier can be made to be at the same voltage, either by sweep sawtooth application or by rotating the DELAY-TIME MULTIPLIER dial. With the two grids at the same voltage value, then the plate of V424 should rest near +200 volts.

If the difference amplifier is functioning correctly check to see if the multivibrator is functioning. It should switch from conduction of V445B to conduction of V445A when the grid of V445A rises past about +210 volts. It should switch back to conduction of V445B when the grid of V445A drops past about +205 volts.

Another possible trouble, if the multivibrator is functioning properly, is the output cathode follower can be held either in heavy cutoff or heavy conduction by a component failure in its grid or cathode circuit.

## TROUBLESHOOTING THE LOW-VOLTAGE POWER SUPPLY

Proper operation of every circuit in the Type 585 including the plug-in unit, depends on proper operation of the Low-Voltage Power Supply. The regulated dc voltages must remain within their specified tolerances for the instrument and plug-in unit to retain their calibration.

### WARNING

Exercise care in checking the power supply. Because of their high current capabilities and low impedance, the Low-Voltage supplies can produce more harmful shocks than the high-voltage supply in the crt circuit.

### Open Primary Circuit (Dead Circuit)

If the pilot lamp and the fan do not come on when the power is turned on, check the source of power and the power cord connections. Check the fuse at the rear of

the instrument. If the fuse is blown replace it with one of the proper value and turn the instrument on again. If the new fuse blows immediately, check the power transformer for shorted primary or secondary windings. Also check for a shorted rectifier. If the new fuse does not blow until the time-delay relay has activated (a "click" can be heard), check for a shorted condition in the regulator circuits and excess loading on one or more supply.

If the fuse is good, check for an open connection to the power transformer. If your instrument is wired for 234-volt operation, check for an open Thermal Cutout Switch, the resistance of this switch is about  $0.1\ \Omega$ . (If your instrument is wired for 117-volt operation, the fan will come on even though the Thermal Cutout Switch is open.)

If both the fan and pilot lamp come on, the power transformer is operating normally.

### Incorrect Output Voltage

Test points for checking the Low-Voltage Power Supply including the +12.6-volt supply, are located on the right side of the instrument, underneath the Power Supply and Delay-Line Driver chassis (see Fig. 5-10). The voltage for each test point (except the +12.6-volt supply) is also silk-screened on the lip of the chassis adjacent to the ceramic strip on the top right side in front of the shield covering the high voltage transformer (see Fig. 5-11). Each regulated bus is identified by a color-coded wire. The +12.6-volt bus is coded black and red on a white wire. The -150-volt bus is coded brown, green and brown on a black wire; the +100-volt bus is coded brown, black and brown on a white wire; the +225-volt bus is coded red, red and brown on a white wire; the +350-volt bus is coded orange, green and brown on a white wire; and the +500-volt bus is coded green, black and brown on a white wire.

If any of the supplies fail to regulate, the first thing to check is the line voltage. The supplies are designed to regulate at a line voltage between 105 and 125 volts with the design center at 117 volts, or between 210 and 250 volts with the design center at 234 volts, rms, 50-60 cycle single phase ac.

If the line voltage is the correct value and waveshape (peaks are not distorted), the next step is to remove the plug-in unit and measure the resistance between each regulated bus and ground. The following resistance values are approximate minimum readings; the actual resistance between each bus and ground will generally be higher than the values indicated here.

REGULATED BUS	APPROX. MINIMUM RESIST. TO GROUND. No Plug-In Unit.
-150 v	3 k
+100 v	2.5 k
+225 v	12 k
+350 v	25 k
+500 v	35 k
+12.6 v	5-10 $\Omega$

If the resistance values between the regulated buses and ground check out, check the series regulator tubes. Then

make sure that the line voltage is set near the design center for your instrument (117 or 234 v) and check the rms voltage across the secondary winding for each supply; the nominal value of each secondary voltage is indicated on the circuit diagram. If the secondary voltages are all correct, check the operation of the bridge rectifiers. This can be done by measuring the rectified voltage at the input to each regulator. These values are also indicated on the circuit diagram. Then check for off-value resistors, especially in the reference dividers, and for open or leaky capacitors.

The material that follows may be used as a quick index for troubleshooting the regulator circuits:

- If the output voltage is high with excessive ripple, check:
- For high line voltage.
  - For open voltage-regulator tube, V609.
  - The amplifier tubes in the regulator circuits, V664, etc.
  - For insufficient loading.

If the output voltage is high with normal ripple, check for proper resistance values in reference dividers, refer to the diagram to determine the location of the resistors involved. Since these are generally precision resistors ( $\pm 1\%$  tolerance) the use of a good bridge is recommended in checking the value.

If the output is low with excessive ripple, check:

- For low line voltage.
- For shorted voltage-regulator tube, V609.
- The amplifier tubes in the regulator circuits, V664, etc.
- For excessive loading.
- Open or leaky filter capacitors.
- Defective rectifiers.

If the output is low with normal ripple, check:

- The resistance values in the reference dividers.
- The capacitors across the dividers.

**IMPORTANT:** If any components in the -150-volt supply are changed, or if the setting of the -150 Adj. control is changed, it will be necessary to check the calibration of the instrument.

## TROUBLESHOOTING THE AMPLITUDE CALIBRATOR

If the output square wave is not nearly symmetrical (the positive portion has a duration considerably different from that of the negative portion or vice versa), the two tubes in the Multivibrator circuit are not being held cutoff for equal periods. This will normally be caused by a defective tube. If tube replacement does not correct the waveform the circuit components must be checked. The pentode in the Multivibrator is held cutoff for an interval determined by the discharge of C871 and the triode is held cutoff for an interval determined by the discharge of C874. A change in the value of either capacitor, or in the value of the resistors through which they discharge, could produce an asymmetrical waveform.

In addition, the time needed for these capacitors to discharge a given amount is affected by the potential toward which they discharge; this would be the voltage at the plate of the triode in the case of C871, and the voltage at the screen of the pentode in the case of C874. Since these voltages are affected by the value of R870 and R875, these resistors should be checked. The resistors in the plate circuit of the pentode should also be checked, since they will affect the plate-to-screen ratio of the pentode.

## Incorrect Output Voltage

The amplitude of the output square wave is determined almost entirely by the plate circuit of V875. The accuracy of square wave voltages less than 100 volts is determined by the resistance values in the divider in the cathode-follower stage. A quick check of the +100-volt maximum output value can be made by turning off the AMPLITUDE CALIBRATOR and measuring the voltage at the CAL. TEST PT. (see Figs. 5-9 and 5-11). If the test point does not measure exactly +100 volts, the CAL. OUT voltages will not be correct.

The CAL. ADJ. control R879 will vary the voltage at the test point over about a 5-volt range. If this voltage cannot be set to exactly +100 volts, and if the tubes have been replaced, then check to be sure V875 is completely cut-off.

## TROUBLESHOOTING THE CRT CIRCUIT

The intensity, focus, geometry and calibration of the crt display depend on proper operation of the three high-voltage supplies in the crt circuit.

### No Spot or Trace

If the low-voltage power supply is operating normally, but no spot or trace is visible on the crt, the trouble could be a defective crt, a defect in the crt cathode circuit including the -1350-volt supply, or an unbalanced dc condition in either or both of the deflection amplifiers. In the latter case the dc unbalance is producing improper positioning voltages and the beam is deflected off the crt screen.

To determine which circuit is at fault, turn the ASTIGMA-TISM control fully counterclockwise, then turn the INTENSITY control clockwise. If a flare (dimly lit diffused area of the crt face) is observed on the crt, one of the deflection amplifiers is probably at fault; the procedure for troubleshooting these circuits precedes in this section. If no flare is observed with the INTENSITY control turned fully clockwise, the trouble will either be due to a defective crt or to an inoperative cathode supply circuit (V820 rectifier circuit). The cathode supply can be checked by measuring the voltage at the HV. Adj. Test Point. (Fig. 5-16). This test point is accessible through a hole in the shield at the top rear of the instrument. The voltage at this point should be -1350 volts, although it will vary with the setting of the HV Adj. control R811. If a voltage reading near -1350 volts is obtained, turn the instrument off and remove the shield covering the test point. Then measure the resistance of R847, the 27-k resistor connected to the test point. If this resistor is not open a defective crt is indicated.

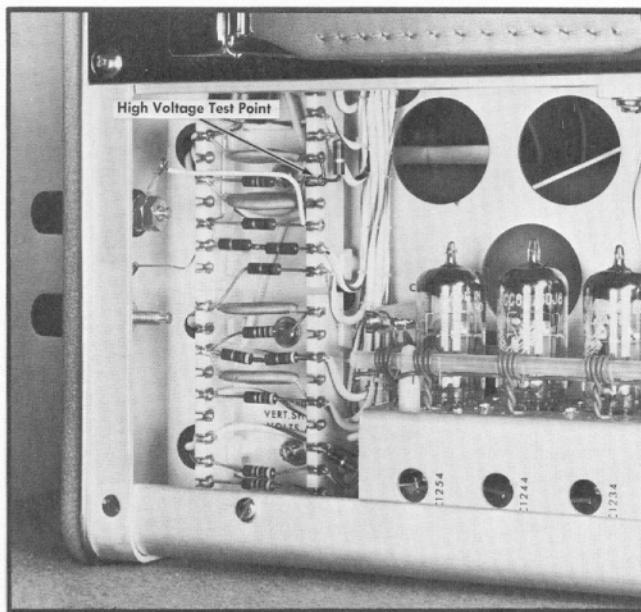


Fig. 5-16. Location of the high voltage test point.

If the voltage at the HV Adj. Test Point is zero or abnormally low, replace the Oscillator tube V800 and the Error-Signal Amplifier tube V814. If this does not restore operation the Oscillator circuit should be checked.

A quick check on the operation of the Oscillator circuit can be made by observing the heater glow in the 5642 rectifier tubes, located under the shield at the upper right rear of the instrument. These tubes are visible through the opening in the side of the shield. If no heater glow is visible the Oscillator circuit is inoperative. This could be due to an open transformer T801, or to a defective component in the circuit of V800 or V814.

If heater glow is visible in the rectifier tubes, the Oscillator circuit is operating. If the heater glow appears to be dim, however, the output of the Oscillator may be insufficient for proper operation. A more accurate check on the Oscillator may be made by removing the shield covering the high-voltage transformer and measuring the bias at the grid of V800. This can be measured at the junction of the 100-k resistor R806 and the 0.01- $\mu$ f capacitor

C806. R806-C806 are located on the ceramic terminal strip near the post that supports the front of the shield. The voltage at this point should measure about -65 volts.

#### **WARNING**

Do not let your hand or body touch the chassis when making this check. Secondary reactions to an otherwise harmless shock might result in a painful injury.

If the Oscillator circuit is operating properly, but the voltage of the HV Adj. Test Point does not measure in the vicinity of -1350 volts, the 5642 rectifier tube V862 is most likely defective.

#### **Abnormal Intensity**

If a trace is visible on the crt, the intensity of the trace may be used to identify trouble in either the negative bias supply or the positive anode supply.

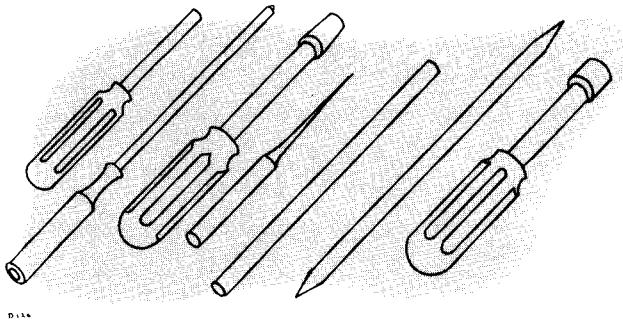
If the trace is excessively bright, and does not change as the INTENSITY control is adjusted, check the negative bias supply including the lead to pin 3 on the crt socket. Check for a defective rectifier tube V822, an open supply winding or a filament winding, an open resistor including the INTENSITY control, or a shorted or leaky capacitor. If trouble is not found in any of these components, a defective crt is indicated.

If the intensity of the trace is extremely low, check for an inoperative positive supply. Also check the anode connection to the crt, including R836 and C836.

If the accelerating potentials appear to be too high, as evidenced by decreased deflection sensitivity, check the Error-Signal Amplifier circuit.

If a badly distorted trace or spot is visible on the crt, check the Geom. Adj. control R861 and its connection to the neck pin on the crt. Also check the ASTIGMATISM control R864 and its connection to the crt base socket. If the FOCUS control has no effect on the trace, check this control (R856) and its connection to the crt base socket.

**IMPORTANT:** If any components in the Oscillator, Error-Signal Amplifier or -1350-volt cathode supply circuit are changed, or if the setting of the HV Adj. control is changed, it will be necessary to check the calibration of the instrument. In particular, sweep rates and vertical deflection factors should be checked.



## SECTION 6

# CALIBRATION PROCEDURE

### General

The Type 585 Oscilloscope is a stable instrument and should not require frequent calibration. However, it will be necessary to recalibrate certain parts of the instrument when tubes or components are changed, and periodic recalibration is desirable from the standpoint of preventive maintenance.

In the instructions that follow, the steps are arranged in the proper sequence for full calibration. Each numbered step contains the information necessary to make one adjustment. In some steps, two or more adjustments are included when these adjustments interact or when they can be made easily without many changes in front-panel control settings. If a complete recalibration is not necessary, you may perform individual steps, PROVIDING that the steps performed do not affect other adjustments. It is most important that you are fully aware of the interaction of adjustments. Generally speaking, the interaction of controls will be apparent in the schematic diagrams. If you are in doubt, check the calibration of the entire section on which you are working.

If you make any adjustments on the power supplies, you will have to check the calibration of the entire instrument. In particular the sweep rates and vertical deflection factors must be checked.

### 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.

### EQUIPMENT REQUIRED

The following equipment is necessary for a complete recalibration of the Type 585 oscilloscope:

1. A dc voltmeter having a sensitivity of at least  $5000 \Omega/v$  with corrected readings accurate to at least 1% at 12.6, 100, 150, 225, 350 and 500 volts, and at least 3% at 1350 volts. Portable multimeters should be regularly checked against an accurate standard and corrected readings noted, where necessary, at the above listed voltages. BE SURE YOUR METER IS ACCURATE.
2. An accurate rms-reading ac voltmeter, having a range of 0-150 volts. (0-250 or 0-300 for 234-volt operation).

3. Variable line-voltage auto-transformer (e.g. Powerstat or Variac) having a rating of at least 7.5 amperes for 117 volts and 4 amperes for 234 volts.

4. Time-mark Generator, Tektronix Types 180, 180A, or equivalent, having markers at 1, 5, 10, 50, 100, 500  $\mu$ sec; 1, 5, 10, 50, 100, 500 msec; 1 and 5 sec; sine-wave outputs of 10 mc and 50 mc; all having an accuracy of at least 1%. A coaxial output cable is required with the time-mark generator.

5. Square-Wave Generator, Tektronix Type 107 or equivalent, having a risetime of no more than 3 nseconds, and a frequency of approximately 450 kc. The top of the square wave must be free of overshoot and wrinkles. (See Waveform Distortion discussion in Maintenance Section page 5-9).

6. In place of the Type 107, a cleaner and flatter-topped square pulse can be obtained from either a Type 109 or Type 110 Pulse Generator. When using a Type 109 or Type 110, additional accessories are required as follows: a  $50 \Omega$  Charge Line of at least 40-nsec electrical length (two 120" cables, Part No. 017-504), a  $50 \Omega$  output cable (40" cable, Part No. 017-502), a 10:1 T Attenuator (Part No. 017-044), and a P80/ $50 \Omega$  Adapter to be modified as noted below this list of test equipment.

7. Square-Wave Generator, Tektronix Type 105 or equivalent, having a risetime of no more than 13 nseconds, a frequency of 20 kc to 25 kc, and a variable output amplitude from 0.4 volt to 10 volts.

8. Tektronix Type 80 Plug-In Unit.

9. Tektronix Type P80 Probe including 5X and 50X attenuator heads, plus a Probe Adapter, (Tektronix Part No. 013-017).

10. If the Type 107 Square-Wave Generator of item 5 above is used, include a  $50 \Omega$  P80 Terminating Adapter with a UHF plug connector, (Tektronix Part No. 017-041).

11. Low-Capacitance Recalibration Tools: See Recalibration Tools in the Accessories Section of the manual.

Additional Tools: A three-inch screwdriver, a 0.050" allen wrench, 3/32" allen wrench (or a pointed tool).

12. Clip-lead adapter (013-003) and a 1 k,  $1/2$  w composition resistor.

13. A  $27 \Omega$  resistor as illustrated in Figure 5-12 on page 5-8.

14. For calibration of instruments before serial number 2585, and still unmodified for use with a Type 82 Dual-Trace Plug-In Unit, it is desirable, but not necessary, to have a TU-3 Test Load Plug-In Unit. See the instruction manual of the

## Calibration Procedure — Type 585

TU-3 for some of its uses. Or in the event you do not have a TU-3, but do have a TU-1 or TU-2 and a Type 81 Plug-In adapter, they can be used in place of the TU-3.

15. For calibration of instruments after Serial No. 2585 (and for those before 2585 that have been modified for use of a Type 82 Dual-Trace Plug-In Unit), it is necessary to have a Type 84 Plug-In Test Unit. The Type 84 permits standardizing the Type 585 Vertical Amplifier transient response for proper interchange of various wide-band plug-in units.

16. Test Oscilloscope, Tektronix Type 541 with a Type K Plug-In Unit or equivalent, providing triggered sweeps and a bandpass of at least dc to 30 mc.

17. In the event the calibration of the Type 585 must be done in a brightly lighted room, a crt viewing hood (such as Tektronix Part No. 016-001) will be necessary while adjusting the vertical amplifier high-frequency compensations. Or the newer polarized viewing hood can be used at all times to increase the display contrast in a lighted room. (Tektronix Part No. 016-035.)

### NOTE

The modification of the P80/50 Ω Adapter mentioned in item 6 above consists of adding two 100 Ω 5% ½ watt carbon composition resistors as a 50 Ω Termination. The picture on the left side of Fig. 6-1 shows where a hole was drilled in the adapter, filed clean of chrome, and the termination soldered to ground. The picture on the right side of Fig. 6-1 shows the internal resistor layout and method of soldering them to the center conductor. This modification places a 50 Ω termination as close to the input to the probe as possible, making the adapter satisfactory for proper cable termination.

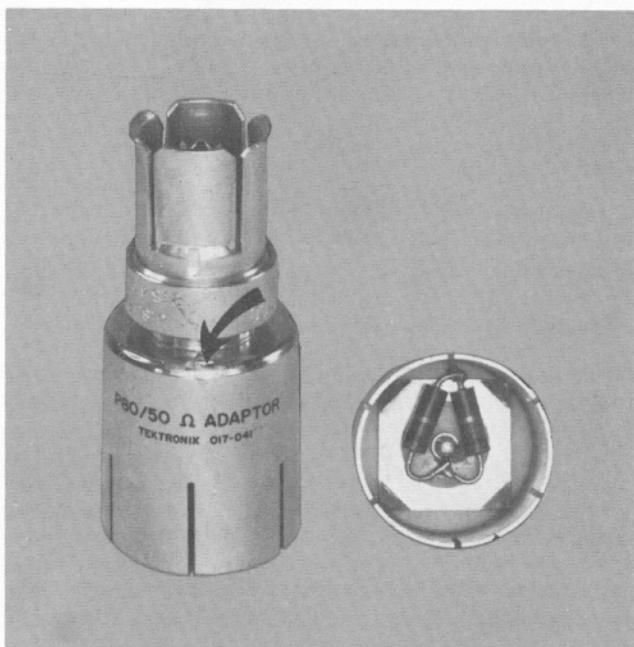


Fig. 6-1. Modified P80/50 Ω Adapter, Part No. 017-041.

## PRELIMINARY

Remove the side and bottom covers from the instrument to be calibrated and install a Type 84 Plug-In Test Unit. For instruments before Serial No. 2585, and if they are unmodified for using a Type 82 Dual-Trace Plug-In Unit, install either a TU-3 Test Load Unit or the Type 80 Plug-In Unit with P80 Probe.

Set the front-panel controls as follows:

INTENSITY	fully counterclockwise
STABILITY (A and B)	counterclockwise, but not PRESET
TRIGGER SLOPE A	+
TRIGGERING SOURCE A	INT.
TIME/CM A	.5 MILLISEC
VARIABLE (TIME/CM A)	CALIBRATED (clockwise)
HORIZONTAL DISPLAY	A
AMPLITUDE CALIBRATOR	OFF
HORIZONTAL POSITION	midrange

Controls not listed above may be left in any position.

Check the rear panel of the instrument to be sure the metal strap between CRT CATHODE and GND. binding posts is in place. Connect the instrument and ac meter to the autotransformer output and turn on all equipment. Check the delay time of the time delay relay (see Fig. 6-5). The relay armature should pull-in with a "click" sound after 15 to 45 seconds time has elapsed. Adjust the autotransformer to the design-center voltage for which your instrument is wired (117 or 234 v.) and allow at least 5 minutes warmup before making any adjustments.

## PROCEDURE

### 1. Low-Voltage Power Supplies (using a type 80).

Measure the output voltage of the -150 v, +100 v, +225 v, +350 v, and +500 v regulated supplies at the points indicated on the bottom view, Fig. 6-2. Be sure your meter is accurate. The output voltage of the -150 v supply must be between -147 v and -153 v, and the other regulated supplies must be within 2% of their rated values. You should be able to set the -150 ADJ. control (see Fig. 6-2) so that all of these voltages are within the specified tolerance. Bear in mind that the calibration of the entire instrument is affected by changes in the power supply voltages. Don't adjust the -150 ADJ. control unless one or more of the supplies is actually out of tolerance.

Measure the output voltage of the +12.6 v regulated supply at the point indicated in Fig. 6-2. The output voltage must be within 5% of the rated value when the P80 Probe tube heater is drawing current. Under normal conditions it may go only as high as +13 v at no load and high line voltage.

To check the above supplies for proper regulation, vary the autotransformer voltage between 105 v and 125 v (or from 210 v to 250 v). All of the regulated voltages should remain essentially constant.

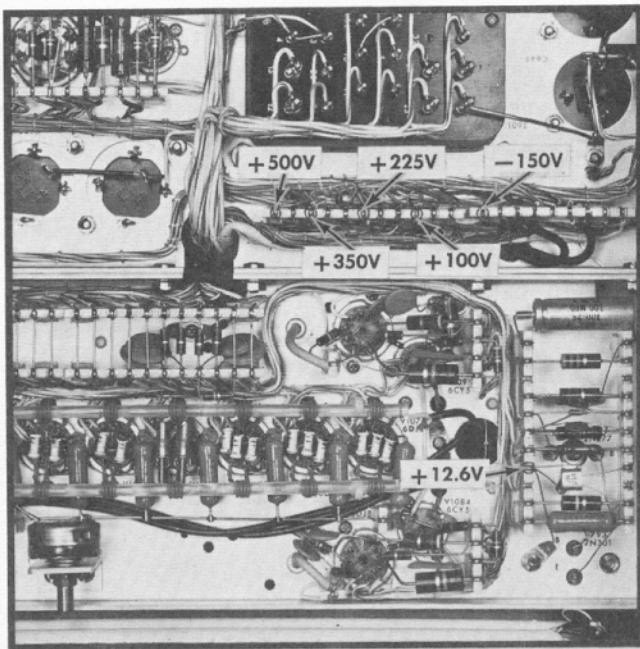


Fig. 6-2. Location of Power Supply Test Points (Bottom View).

The ripple measured with a test oscilloscope at the Power-Supply check points, should be under about 5 mv for the  $-150\text{ v}$  and  $+225\text{ v}$  supplies; about 15 mv or lower for the  $+100\text{ v}$  supply; about 30 mv or lower for the  $+350$  and  $+500\text{ v}$  supplies; and 4 mv to 15 mv for the  $+12.6\text{ v}$  supply. When measuring ripple voltages, the AMPLITUDE CALIBRATOR should be turned off and the sweeps should not be running. Use a coaxial cable and clip-lead adapter, Tektronix Part No. 013-003, to connect between the test oscilloscope and test points. If oscillations occur on the waveforms, connect the 1 k resistor in series between the coax center conductor and the test point. After you have completed the ripple measurements, disconnect the cable from the Type 585 and the test oscilloscope.

## 1B. Low-Voltage Power Supplies (Using a Type 84 or TU-3)

When using a Type 84 or Type TU-3 Test Load Plug-In Unit, power supply regulation and ripple measurements should be made under two conditions. Once when the line voltage is at 125 volts and the TU-3 LOAD switch is at LOW. Again when the line voltage is at 105 volts and the TU-3 LOAD switch is at HIGH. The limits of voltage and approximate values of ripple previously mentioned in this step apply.

## 2. AMPLITUDE CALIBRATOR Adjustment

The CAL. ADJ. R879 control should be set to provide exactly  $+100$  volts at the CAL. TEST PT. when the AMPLITUDE CALIBRATOR switch is in the OFF position. Under these conditions, the CAL. OUT voltages should be within 3% of the front-panel readings.

To make this adjustment connect the voltmeter between the CAL. TEST PT. jack and ground (see Fig. 6-3), turn the

AMPLITUDE CALIBRATOR switch to the OFF position, and adjust the CAL ADJ. R879 control for a reading of exactly  $+100$  volts. To assure suitable symmetry of the calibrator waveform, a voltmeter reading at this point should be not less than 45 v nor more than 55 v when the calibrator is turned on. Readings outside this range are generally caused by unbalanced multivibrator tubes (V875 or V885A).

## 3. High-Voltage Power Supply Adjustment

The adjustment of the crt high-voltage supply determines the total accelerating potential on the crt, and thus affects the deflection sensitivity and writing rate.

Connect the voltmeter between ground and high-voltage check point (see Fig. 6-4), and set the H.V. ADJ.  $-1350\text{ v}$  control (see Fig. 6-3) for a meter reading of exactly  $-1350\text{ v}$ . If your meter has a full scale reading of 1200 v, you may connect the positive meter lead to the  $-150\text{ v}$  supply, and set the H.V. ADJ. control for a meter reading of  $-1200\text{ v}$ . Disconnect the voltmeter.

## 4. CRT Alignment

If the crt has been replaced, or if, due to considerable instrument handling, the trace does not align with the graticule, you should make this adjustment before proceeding with the calibration.

Rotate the STABILITY control clockwise to free-run the sweep and turn the INTENSITY control clockwise to obtain a normal-intensity trace. (If oscillations appear on the screen instead of the normal trace, refer to step 11 before proceeding). Position the trace directly behind the center horizontal graticule line. If the trace and graticule line do not coincide over the width of the graticule, note the amount of misalignment. Check for a red knob near the crt base. If one is present, turn it to align the trace with the graticule line. If no knob is present, turn off the power with the front-panel switch. Unlatch the delay line and swing it out. Remove V1284 and loosen the crt base clamp (see Fig. 6-5). With the left hand carefully rotate the crt and socket in the direction which will align the trace with the centerline. While rotating the crt, push it forward until it rests snugly against the graticule. Plug tube V1284 into its socket and turn on the power. If the trace and graticule center line are not in alignment, repeat the procedure. When the trace and graticule center line are in alignment, tighten the crt base clamp and relatch the delay line. Newer instruments have the red crt rotating knob. Do not loosen the crt base clamp when aligning with the knob.

## 5. Graticule Alignment

To check the alignment of the graticule, position a free-running trace upward until the trace dims and disappears, and then downward until the trace again dims and disappears. The graticule should be located such that the trace will go as far above as below the scribed graticule area.

To align the graticule, remove the graticule cover and loosen the set screw which holds the nylon cam located in the lower left corner of the graticule. Rotate the cam with a  $\frac{3}{32}\text{ inch}$  allen wrench or a pointed tool and position the

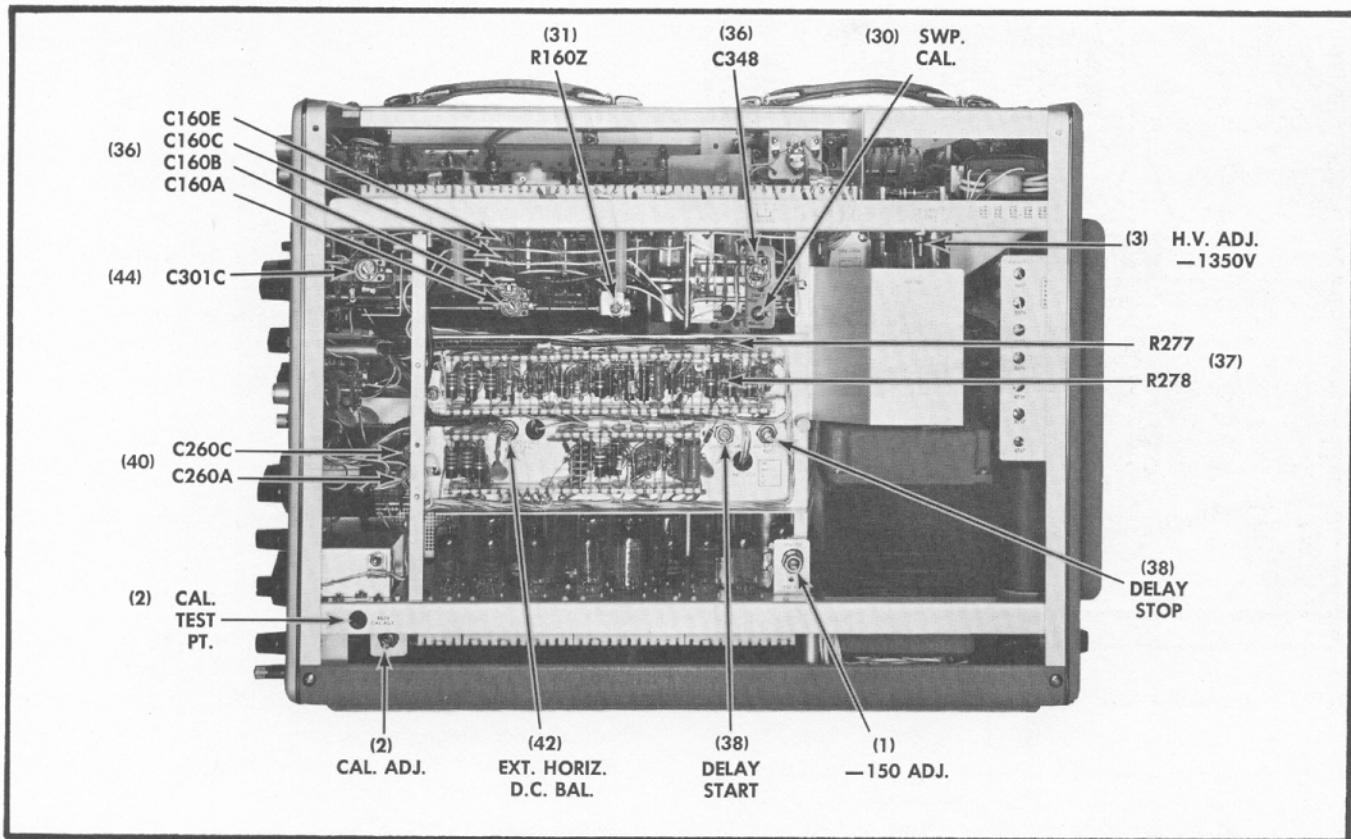


Fig. 6-3. Location of Type 585 Oscilloscope internal adjustment controls.

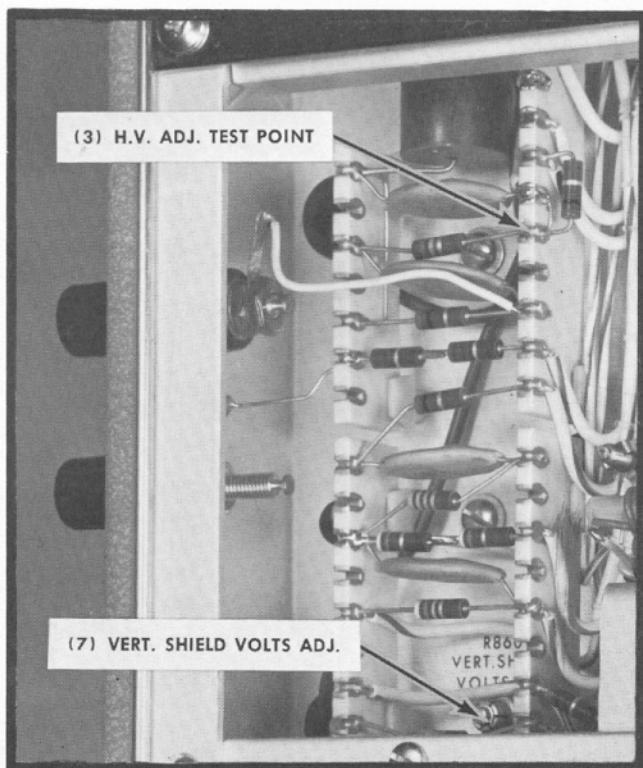


Fig. 6-4. Top view of the Type 585 Oscilloscope showing the location of high voltage point and Vert. Shield Volts Adj. control.

graticule until the horizontal centerline coincides with the imaginary line on the crt face midway between the points at the top and bottom of the screen where the trace disappears. While holding the cam with the tool, tighten the set screw. Replace the graticule cover.

## 6. Check High-Voltage Power Supply Regulation

To check for proper regulation, defocus the trace with the FOCUS and ASTIGMATISM controls and turn the INTENSITY control fully clockwise. Vary the autotransformer voltage between 105 v and 125 v (or from 210 v to 250 v). If the power supply is regulating, the trace will not show any signs of blooming. (Blooming is when the display changes size as the supply voltage changes.) Set the autotransformer control for a voltage reading of 117 v (234 v), turn down the intensity, and focus the trace.

## 7. Vertical Shield Volts Adjustment

Make this adjustment only when replacing the crt.

Connect a dc voltmeter from the center terminal of the VERT. SHIELD VOLTS ADJ. control (see Fig. 6-4) to the chassis. Set the shield voltage at +300 volts. Complete step #8 now, and then return to complete the adjustment of the VERT. SHIELD VOLTS ADJ. control.

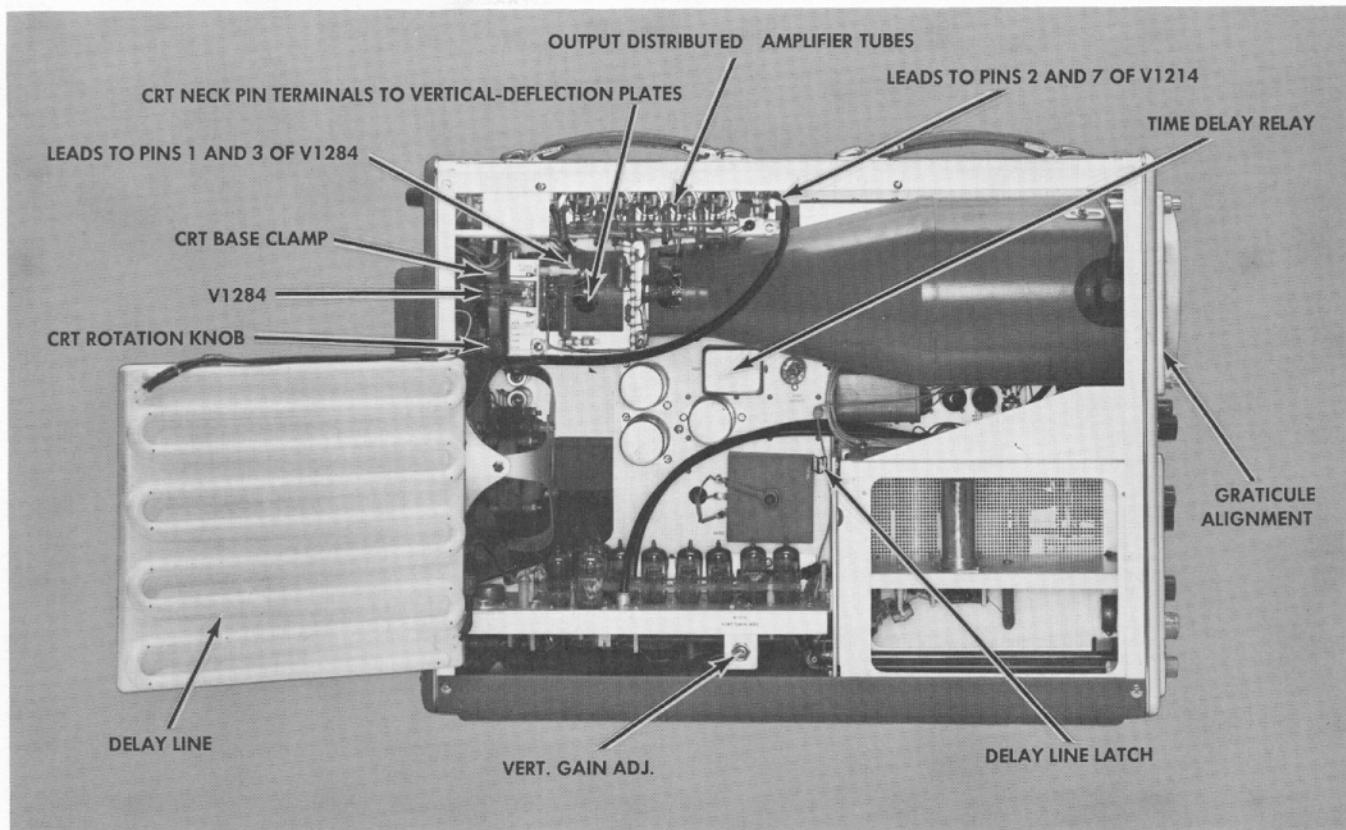


Fig. 6-5. Left side view of the Type 585 Oscilloscope, before Serial No. 2585, showing the location of important items.

Having adjusted the GEOMETRY control as in step 8, set the CALIBRATOR signal to produce one centimeter of deflection. Free run the sweep by turning the STABILITY control fully clockwise. With the position control, slowly position the trace to the top of the screen and to the bottom of the screen. If the VERT SHIELD VOLTS ADJ. control is properly set the trace will not change focus at either the top or bottom of the crt graticule. If it does change focus, as evidenced by a change in line thickness, readjust the VERT. SHIELD VOLTS ADJ. control to correct it. Also, while positioning the trace up and down there should not be more than a total of about 1.5 millimeters change in sensitivity. The VERT. SHIELD VOLTS ADJ. control affects both the focus and compression/expansion of the crt vertical sensitivity. It is best not to adjust the VERT. SHIELD VOLTS ADJ. control more than  $\pm 15$  volts from the previously set +300 volts.

## 8. CRT Geometry

The geometry of the crt display is adjusted by means of the GEOMETRY control. To achieve optimum linearity, vertical lines are displayed on the crt and the GEOMETRY control is adjusted for minimum curvature of the lines.

Set the front-panel Time-Base A controls as follows:

TRIGGER SLOPE	+ or -
TRIGGERING SOURCE	INT.

TIME/CM	.5 MILLISEC
VARIABLE	CALIBRATED (clockwise)
HORIZONTAL DISPLAY	A

Connect 500  $\mu$ sec markers from the Type 180A to the P80 Probe (see NOTE below) through the probe adapter (013-017) and 5X attenuator head. Position the base line of the timing comb downward so it is not visible. Adjust the GEOMETRY control (see Fig. 6-6) for straightest possible vertical lines running parallel to the left and right edges of the graticule. It is normal for the vertical lines to bend in the areas above and below the graticule scribed lines. See Fig. 6-7. Disconnect the P80 Probe from the Type 180A.

### NOTE

The AMPLITUDE CALIBRATOR may be used for step 8, but due to the low intensity of the vertical lines, the adjustment is somewhat more difficult. The P80 Probe AC-DC switch should be set at DC when using the AMPLITUDE CALIBRATOR.

## 9. Check for Cathode Interface

Connect the P80 Probe directly to the OUTPUT connector of the Type 107 through the terminating adapter 013-033. Set the Type 107 to approximately 400 kc (APPROXIMATE FREQUENCY control counterclockwise). Place the Type 585 "A" TIME/CM switch at .5  $\mu$ SEC and adjust the Type 107 amplitude control for a waveform presentation about

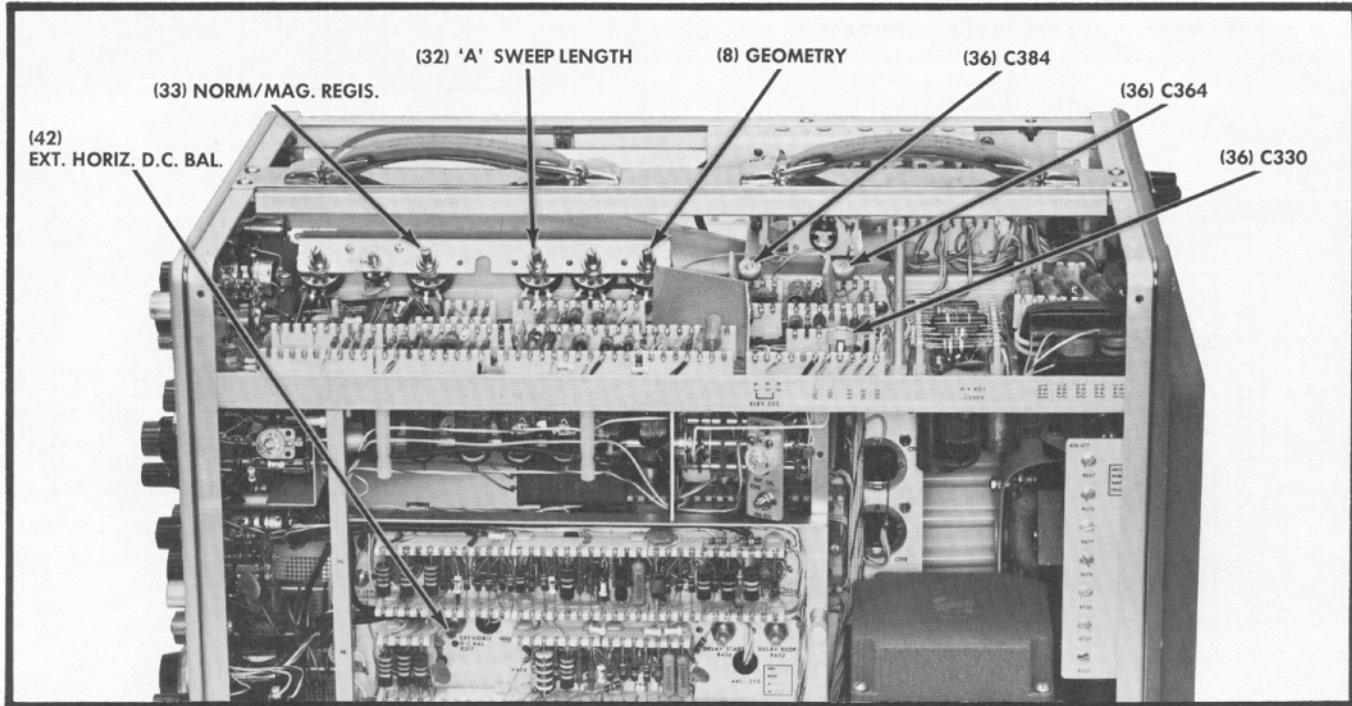


Fig. 6-6. Top view of the Type 585 Oscilloscope with vacuum tube trigger regenerator showing the location of internal adjustment controls.

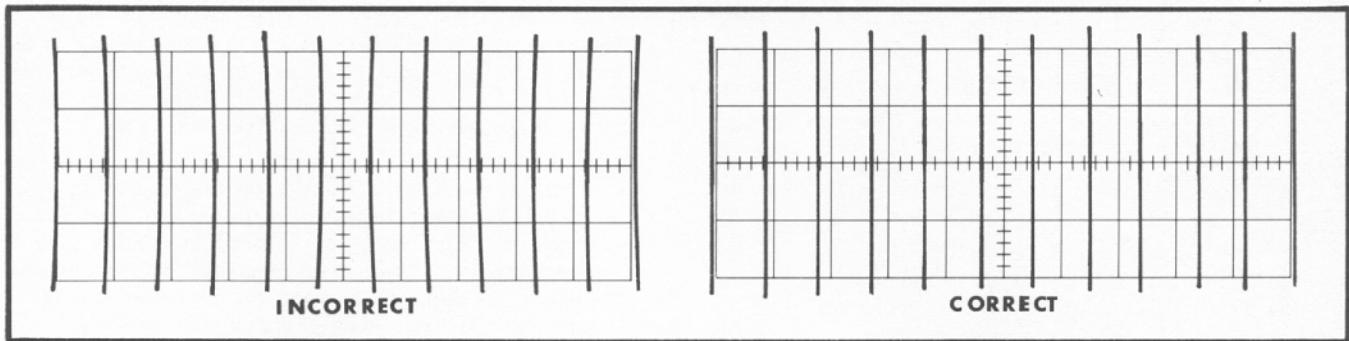


Fig. 6-7. Adjustment of the GEOMETRY control.

2 centimeters high. Set the power line autotransformer between 120 v and 125 v. Note the leading edge of the waveform carefully. Then rotate the autotransformer to between 105 v and 110 v and watch the crt presentation for any changes. If there is cathode interface the leading edge of the square-wave will increase in amplitude in the form of either a spike or tilt. Or the change in waveshape may appear as a reduction in gain of low frequencies, by the rise remaining a constant amplitude and the flat portion reducing its amplitude. If your instrument has a 6939 in the V1284 socket, it should be replaced with an Amperex 7699. The 7699 has a passive cathode sleeve and will probably not exhibit interface. If replacing V1284 with a new 7699 does not completely eliminate the interface effect, it will be necessary to replace some 6DJ8 tubes also. If your instrument has been operating between 200 and 1000 hours, it will be wise to replace all 6DJ8's, because even though you find the defective tubes, it is almost certain that the remaining old tubes will not operate long without interface.

After replacing any tubes for cathode interface, be sure to do steps 10 through 12.

## 10. Check Bias on Distributed Amplifier Tubes

### NOTE

The check to be described here is important, and will assist you with step 11 and the total vertical amplifier balance. Excessive vertical compression can sometimes be attributed to improper bias of one or more vertical amplifier tubes. It is important that the bias measured in both halves of each 6DJ8 be within about 0.1 volt of each other. A tube with bias lower than recommended will contribute more to vertical compression or expansion. The vertical system balance and compression or expansion will remain stable longer if the measurements of bias and balance are made with tubes

that have been operating in the instrument for at least 10 hours. Tubes of the entertainment type drift a little during the first hours of life. Aging new tubes in the instrument on the test bench can increase the time between required recalibration periods of the Type 585.

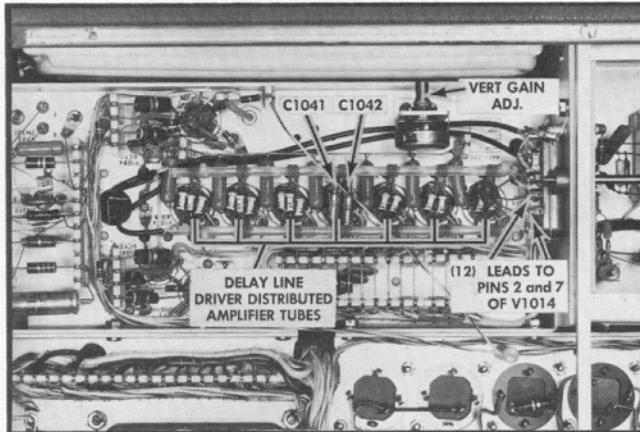


Fig. 6-8. Bottom View of driver distributed amplifier.

Rotate the VERT. GAIN ADJ. control (see Fig. 6-8) fully clockwise. Short the vertical deflection plates together at the neck pins on the crt. (Be careful not to short the plates to the crt shield.) When the vertical-deflection plates are shorted, the trace will appear at the electrical center of the crt. Remove the short and vertically position the trace to coincide with the electrical center.

Lay the oscilloscope on its right side. The bias on each tube in the Delay Line Driver stage (see Fig. 6-8), measured from each grid to cathode, should be about 0.35 volt. (Both grid and cathode of these tubes are at about +50 volts. Use a voltmeter that can be elevated safely.) Connect the dc voltmeter between pin 8 (cathode pins 3 and 8 are connected together) and pin 2 (grid) to measure the bias on the first half of the tube V1014. Then move the voltmeter lead from pin 2 to pin 7 to measure the bias on the second half of the tube. Move the voltmeter connections successively to each Delay Line Driver tube.

The bias on each tube in the Output Amplifier stage (see Figs. 6-9 and 6-10), measured from each grid to cathode will be approximately 0.75 volt. Keep the trace at the crt electrical center and connect the dc voltmeter between pin 8 (cathode pins 3 and 8 are connected together) and pin 2 (grid) to measure the bias on the first half of the tube V1214. Move the voltmeter lead from pin 2 to pin 7 to measure the bias on the second half of the tube. Move the voltmeter connections successively to each tube in the Output Amplifier stage.

## 11. Check Vertical Oscillations

When the delay line is either in the latched position or is opened outward, no oscillations should appear on the crt screen. If oscillations occur when displaying 2 cm of calibrator signal, adjust the neutralizing capacitors, C1041 and C1042 (see Fig. 6-8), for no oscillations. Use a plastic, low capacity tool.

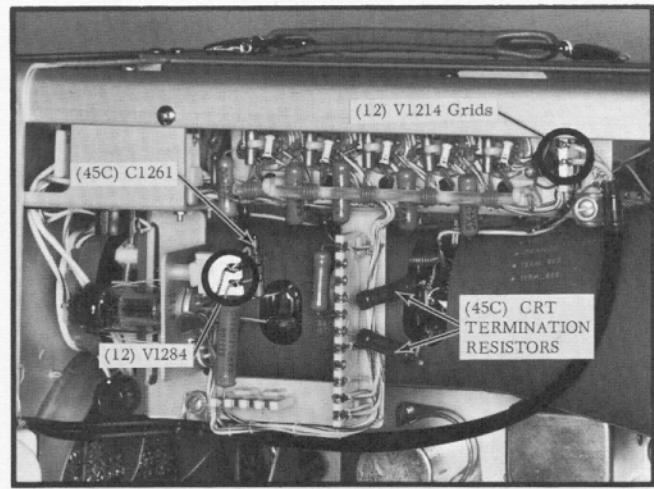


Fig. 6-9. Locations of grid shorting points described in step 12; before Serial No. 2585.

## 12. Check Vertical Amplifier Balance

Using a  $27\Omega$  shorting resistor such as is pictured in Figure 5-14, carefully short pin 1 to pin 3 of V1284 at the location shown in Figure 6-10. Observe electrical center shift. Next, short pin 2 to pin 7 of V1214 (Fig. 6-10). The trace should not shift from the electrical center more than 0.5 cm in either case. Carefully short pin 2 to pin 7 of V1014 at the location shown in Figure 6-8. The trace should not shift more than 0.5 cm. (If using a TU-3, the last shorting operation is done by pushing the ZERO REFERENCE button.)

### NOTE

If the total vertical system unbalance is over 0.5 cm as you short the grid lines of the Delay Line Driver stage, it will be necessary to find the tube(s) causing the unbalance. Lay the oscilloscope on its right side. Using a clip lead and a small insulated handle screwdriver as pictured in Figure 6-11, electrically turn off the vertical amplifier tubes a pair at a time using the following procedure.

### How to turn off each vertical amplifier dual 6DJ8 without removing it from the socket.

- A. In the Delay Line Driver stage the cathodes of all tubes are at about +52 volts. Thus if the voltage at pins 3 and 8 (the cathodes) can be elevated above the grid voltage, the tubes will be biased to cutoff. This can be done by elevating the cathodes to +100 volts. With a clip lead attached to the metal part of an insulated handle screwdriver, touch the screwdriver tip to the cathode end of R1013. Then touch the other end of the clip lead to the +100-volt supply as pictured in Figure 6-11. Repeat with all tubes in the Delay Line Driver stage. If more than half the tubes are unbalanced in the direction of a major unbalance, replacing one or two of them with tubes unbalanced oppositely will probably correct the problem.

Calibration Procedure — Type 585

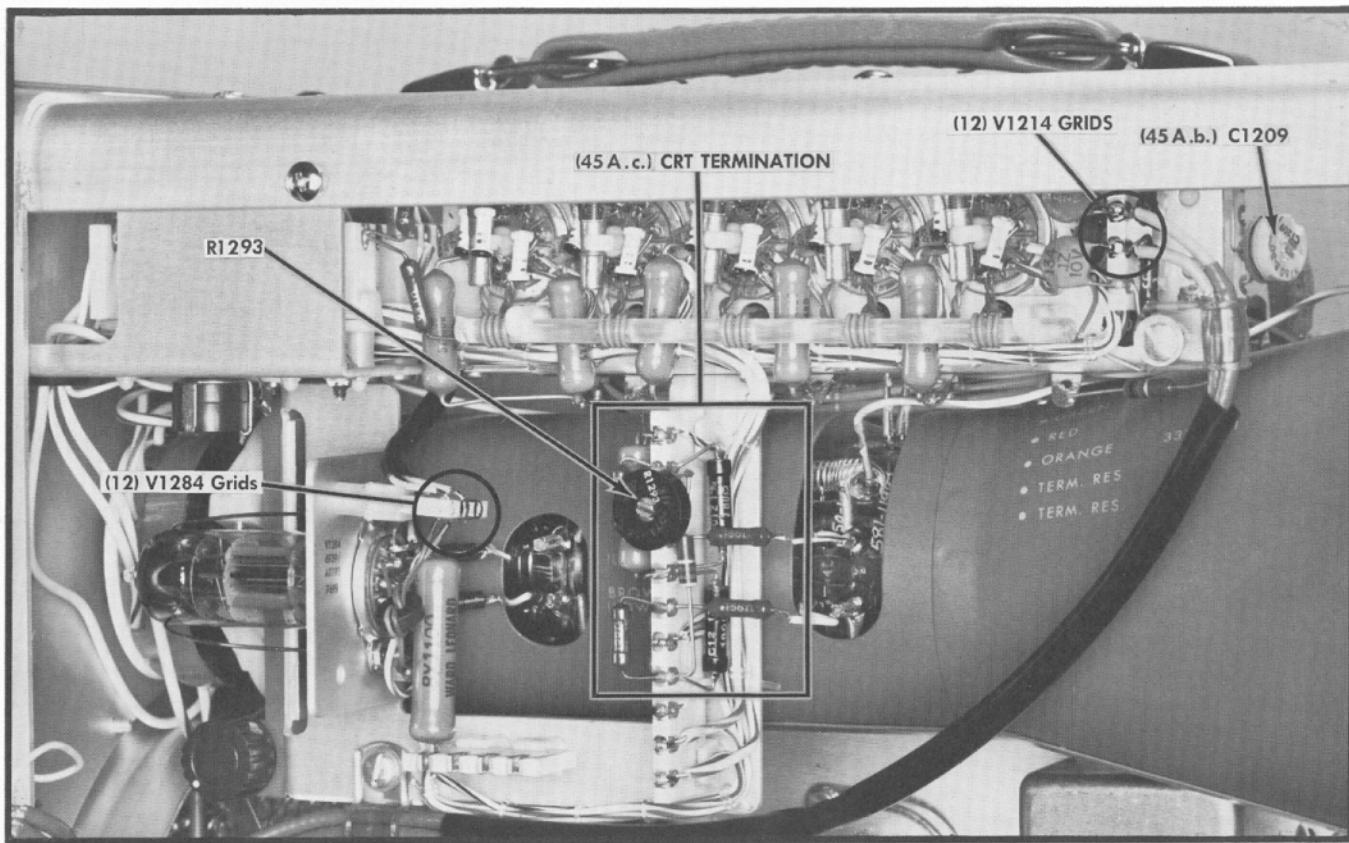


Fig. 6-10. Left rear side view of the Type 585 Oscilloscope, after Serial No. 2585, showing changes in vertical system.

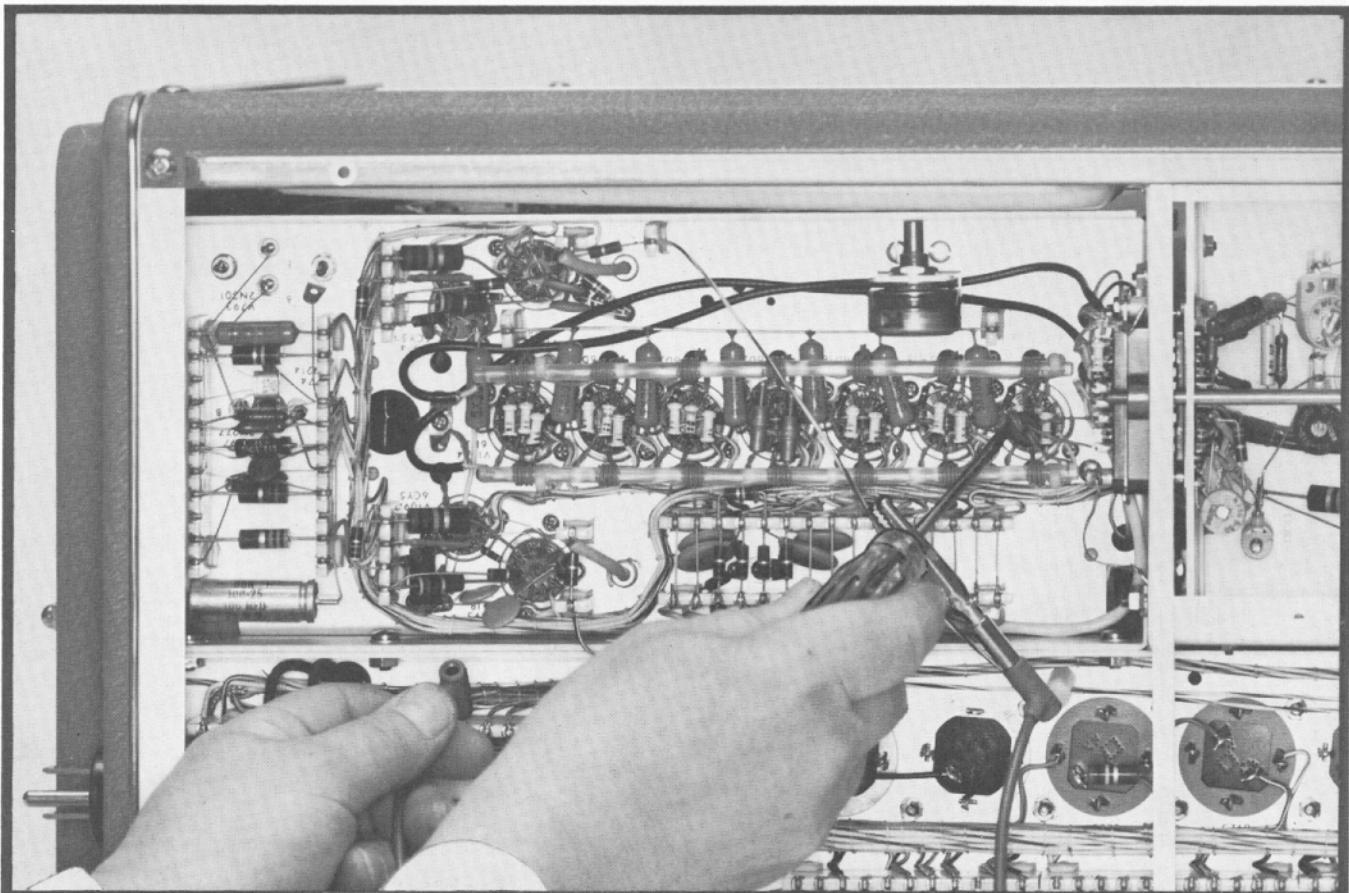


Fig. 6-11. Elevating cathodes of V1014 by applying +100 v to R1013. Be very careful to avoid grounding +100 v supply.

- B. In the Output Amplifier stage the cathodes of all tubes are at about +100 volts. These tubes can be placed in cutoff if the cathodes are elevated to +225 volts. Place the tip of the screwdriver at the cathode end of R1213. Then touch the other end of the clip lead to the +225-volt supply as pictured in Figure 6-12. Repeat with all 6DJ8 tubes through V1254. Replace those that contribute heavily to the system unbalance, and recheck.

### 13. Check Vertical Compression or Expansion

Display exactly one cm of AMPLITUDE CALIBRATOR signal. Center the display initially about the graticule horizontal center line. Then moving the display up and down, measure any changes in apparent sensitivity. The signal should not be compressed or expanded more than about 1 mm at either the top or bottom of the graticule. The total expansion and/or compression must not exceed 1.5 mm.

A major cause of vertical compression or expansion is the output 7699 tube V1284; sometimes it is caused by incorrect vertical amplifier tube bias. The crt vertical shield voltage can be changed a minor amount to slightly alter the crt vertical linearity. Therefore it may be possible to establish a balance between the crt vertical shield voltage adjustment (step 7) and the geometry adjustment (step 8) that will

permit both proper focusing and compression or expansion better than that described above. When changing either the crt shield voltage or GEOMETRY control setting, check for proper focus and small spot size, and recalibrate the VERT GAIN ADJ. as in step 16.

### 14. Check DC Shift

To check the low frequency shift that is characteristic of dc coupled amplifiers, with no signal present position the trace just off the graticule in either vertical direction. Connect the 27-ohm shorting resistor to the grid lines of the Delay Line Driver stage. (Or push the ZERO REFERENCE button of the TU-3). The trace will move suddenly to the electrical center of the system. After the trace stops in the center of the graticule, it should not drift over 1 mm. If it does, either C1004 has changed value and needs replacing, or there are bad 6DJ8 tubes within the vertical system.

### 15. Check Vertical Drift

Vary the line voltage autotransformer from 105 v to 125 v. From the stable trace position at 105 v to a possible new stable position at 125 v, the trace should not drift more than 2 mm. If it does, check for old vertical tubes.

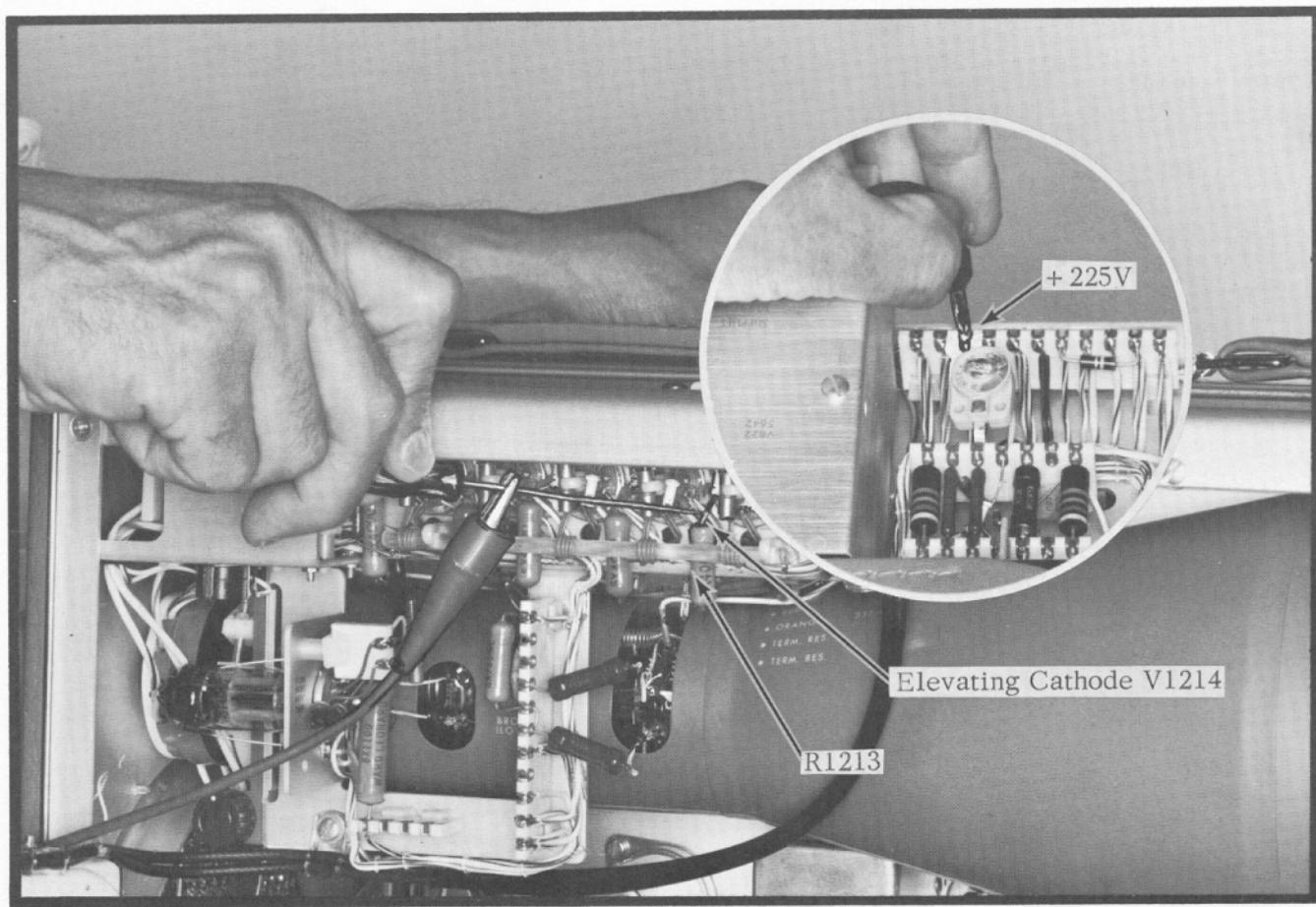


Fig. 6-12. Elevating cathodes of V1214 by applying + 225 v to R1213. Be very careful to avoid grounding + 225 v supply. Shows oscilloscope before Serial No. 2585. Cathode resistors in instruments after Serial No. 2585 are in the same location.

## 16. Set Vertical Gain

a. In instruments after Serial No. 2585, and those modified to use a Type 82 Dual-Trace Plug-In Unit, place the Type 84 in the plug-in cell. Free-run the sweep at .1 MILLISEC/CM. Place the Type 84 DISPLAY SELECTOR to CAL. (2 cm) and ALT, SYNC. Two traces should appear two centimeters apart. If the traces are not two centimeters apart, adjust the Type 585 VERT. GAIN ADJ. control until they are just two centimeters apart. Place the Type 84 DISPLAY SELECTOR switch to EXT. INPUT.

b. In instruments before Serial No. 2585, place the oscilloscope in the upright position. Set the AMPLITUDE CALIBRATOR control at .2 VOLTS and connect the P80 Probe to the CAL. OUT connector. (Use Adapter 013-017). Leave the TIME/CM control at .5 MILLISEC and adjust the VERT. GAIN ADJ. control (see Fig. 6-8) for a deflection of exactly two centimeters. Turn the AMPLITUDE CALIBRATOR off.

### NOTE

Two types of Time-Base A triggering circuitry are presented in this manual. The "A" set of trigger circuit adjustments that follow, applies to those instruments with a vacuum tube multivibrator Trigger Regenerator. The "B" set of trigger circuit adjustments applies to those instruments with a tunnel diode Trigger Regenerator.

The trigger circuit adjustments that follow must be made in the sequence given. Controls not mentioned in a particular step are either assumed to have been adjusted during a previous step, or are not important.

## 17A. "A" Triggering Level Control Zero Set

Set the HORIZONTAL DISPLAY switch at A. Place the TRIGGERING SOURCE switch at INT, and the TRIGGER

SLOPE switch at +. The STABILITY control can be at any position except PRESET.

(Use either a sensitive voltmeter or the test oscilloscope for this step).

Set the test oscilloscope controls as follows: vertical VOLTS/CM switch at .05 VOLTS, AC-DC input selector switch at DC, triggering controls at +LINE and AUTO., and the TIME/CM switch at 2 MILLISEC. Center the trace on the test oscilloscope for a zero reference.

Connect a 10X probe from the test oscilloscope to the junction of R13 and R14 (see Fig. 6-13). Adjust the Type 585 'A' TRIGGERING LEVEL control to position the trace on the test oscilloscope at the zero reference line. If necessary, loosen the TRIGGERING LEVEL knob and set it at the zero position and tighten the knob. Check for exact zero setting of the knob by observing the test oscilloscope trace for no vertical shift when the probe is disconnected and connected a few times at the junction. Leave the TRIGGERING LEVEL control set at zero during the following adjustments. Disconnect the 10X probe from the test point.

## 18A. "A" Trigger Sensitivity and Trigger Level Centering

Having previously adjusted the TRIGGERING LEVEL control as in step 17A, connect a clip-lead jumper from the junction of R13-R14 to ground to maintain an exact ground reference. See Figure 6-13.

With no triggering signal present, set the Type 585 'A' TIME/CM switch to .5 MILLISEC, and the STABILITY control to its triggerable position. (The STABILITY control triggerable position is about 5 degrees counterclockwise from its free-run point).

Now set the TRIGGERING SOURCE switch to LINE. A trace should appear. Set the INTENSITY control so the trace is visible, but not bright. With a screwdriver, adjust the internal TRIG. SENS. control counterclockwise (see Fig. 6-13) until the trace brightens noticeably. At this point the TRIGGER REGENERATOR is oscillating. Note the position of the TRIG. SENS. control, then rotate it to the midpoint between this position and the counterclockwise end of rotation.

Set the TIME/CM switch to 50  $\mu$ SEC. Set the TRIGGERING SOURCE switch to INT. Connect the P80 Probe to the CAL. OUT connector through adapter 013-017. Set the AMPLITUDE CALIBRATOR to .2 VOLTS. Switching the TRIGGER SLOPE switch back and forth between + and -, adjust the TRIG LEVEL CENTERING control for a display like Figure 6-14. The adjustment is correct when the sweep starts at the center graticule line for both + and - settings of the TRIGGER SLOPE switch.

Reduce the AMPLITUDE CALIBRATOR signal to 20 MILLIVOLTS. Set the TIME/CM switch to .5 MILLISEC. Recheck the TRIG LEVEL CENTERING to be certain the trigger system functions properly in both + and - TRIGGER SLOPE.

The final adjustments of the two controls, TRIG. SENS and TRIG. LEVEL CENTERING should permit stable triggering on both + and - TRIGGER SLOPE with a 20 MILLIVOLT input signal, but NOT with a 10 MILLIVOLT signal.

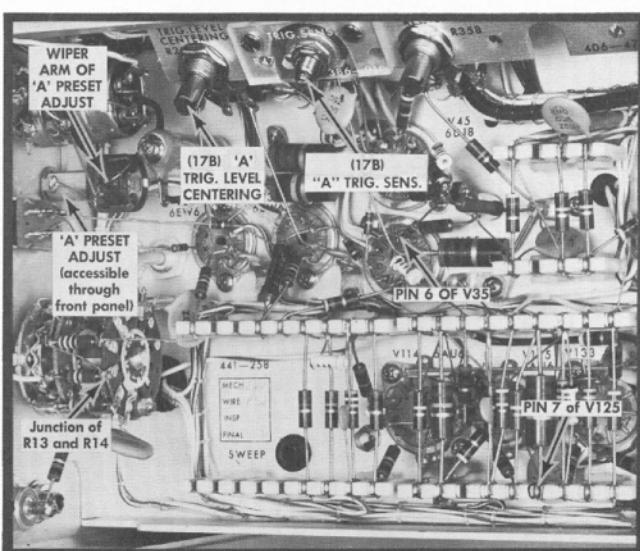


Fig. 6-13. Top view of an oscilloscope with vacuum tube Trigger Regenerator, showing the location of the triggering adjustments and test points.

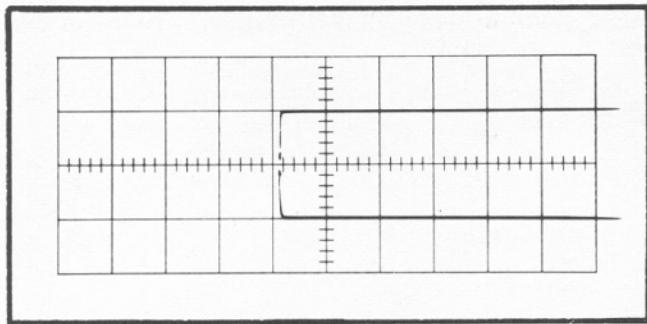


Fig. 6-14. Double exposure showing typical results of both + and -INT triggering when TRIG LEVEL CENTERING control is properly adjusted.

The vacuum tube Trigger Regenerator is known as a "fail-bad" circuit. As the multivibrator tubes gain drops with age, the system will trigger more easily, finally reaching the point of oscillation. Thus it is important that the vacuum tube Trigger Regenerator sensitivity be adjusted as above for stable triggering with a signal of 20 MILLIVOLTS, and not as sensitive as possible.

### 17B. 'A' Triggering Level Control Zero Set

This step is identical with 17A, except the zero reference voltage is measured in current production instruments at the junction of R14-R15. See Figure 6-15. In the first few instruments with tunnel diode Trigger Regenerators, the zero reference voltage is measured at the junction of R13-R14 just as in instruments with vacuum tube Trigger Regenerator.

### 18B. 'A' Trigger Sensitivity and Trigger Level Centering.

Having previously adjusted the TRIGGERING LEVEL control zero set, connect a clip-lead jumper from the junction of R14-R15 to ground to maintain an exact ground reference.

With no triggering signal present, set the Type 585 'A' TIME/CM switch to .5 MILLISEC, and the STABILITY control to its triggerable position. (The STABILITY control triggerable position is about 5 degrees counterclockwise from its free-run position.)

Set the TIME/CM switch to .5 MILLISEC, and the AMPLITUDE CALIBRATOR to 50 MILLIVOLTS. Connect the P80 Probe to the CAL. OUT connector via a probe adapter (013-017). Adjust the TRIG LEVEL CENTERING control so a trace is properly triggered on both + and - TRIGGER SLOPE. Reduce the AMPLITUDE CALIBRATOR to 20 MILLIVOLTS. Adjust the TRIG. SENS. control, and if necessary touch up the TRIG LEVEL CENTERING control, so that a trace is properly triggered on both + and - TRIGGER SLOPE. Reduce the AMPLITUDE CALIBRATOR to 10 MILLIVOLTS. The trace should NOT be able to be triggered at either + or - TRIGGER SLOPE. If a stable display appears, slightly reduce the TRIG. SENS. control and recheck the operation at 20 MILLIVOLTS.

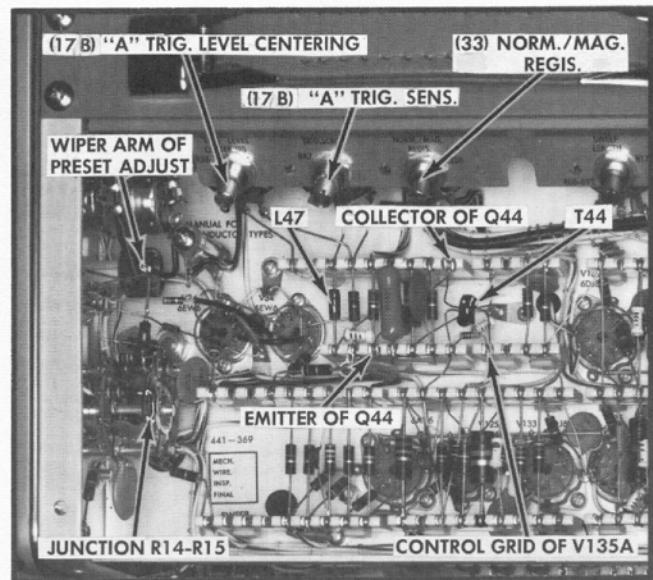


Fig. 6-15. Top view of an oscilloscope with tunnel diode Trigger Regenerator, showing the location of the trigger adjustments and test points.

### 19. Preset Stability (all serial numbers)

With the display and control settings as in step 18A or 18B, switch the STABILITY control into its PRESET position. With a small screwdriver, set the PRESET control midway between the point where the sweep cannot be triggered and the unstable point of freerun. This setting is midrange in the triggerable area of the PRESET control.

### 20. Check Trigger Circuit Sensitivity

The oscilloscope should trigger in a stable manner with an AMPLITUDE CALIBRATOR signal level of 20 MILLIVOLTS into the P80 Probe, and externally, either AC or DC, at .2 VOLTS. It should not trigger at 10 MILLIVOLTS into the P80 Probe, nor at .1 VOLTS externally. (Same values apply when using a TU-3 or a Type 84.)

### 21. Check Line Trigger

Set the TRIGGERING SOURCE switch to LINE. Turn the SCALE ILLUM. control fully counterclockwise. Set the TIME/CM switch at 2 MILLISEC. With the P80 Probe connected to the hot lead of one of the graticule lamps, turn up the SCALE ILLUM. control until the amplitude of the display is about 2 centimeters high. The TRIGGERING LEVEL control should produce a sweep over about one half its total rotation.

### 22. Check 'A' Trigger Delay

When the tunnel diode triggering system is operating properly, a fast-rise square wave should rise at least 60 noseconds after the start of the sweep. To check it, connect the P80 Probe to a Type 107 through the terminating adapter

## Calibration Procedure — Type 585

013-033, and obtain a stable display with the TIME/CM switch at .05  $\mu$ SEC with the MAGNIFIER ON. With the TRIGGERING LEVEL control set at its zero, the sweep should be visible 60 nseconds before the start of the rise of the Type 107 waveform. If there is significantly less time before the rise, replace Q44, the TRIGGER AMPLIFIER. If you do not have an Amperex OC171 or a 2N1516 on hand, a 2N544 will operate satisfactorily providing about 40 to 50 nseconds of sweep before the rise of the Type 107 waveform. (Remember, when operating the sweep at 10 nSEC/CM, it is usually inaccurate for the first 40 nseconds.)

In instruments with the vacuum tube Trigger Regenerator, you should see about 40 nseconds of sweep before the rise of the Type 107 waveform.

### 23. Lock-Out Level Adj.

Test Oscilloscope Settings:

TIME/CM	1 MILLISEC
VOLTS/CM	1 Volt
INPUT SELECTOR	DC
SWEEP	free run (stability fully clockwise)

Type 585 Settings:

TIME/CM	.5 MILLISEC
HORIZ. DISPLAY	A
STABILITY CONTROL	Counterclockwise, Not PRESET
TRIGGERING LEVEL CONTROL	at "O"

No Vertical input signal

Connect the test scope 10X probe to the common junction of R130, pin 7 of V125; pin 3 of V133A and pin 8 of V133B. (See Fig. 6-16)

Position the trace on the test oscilloscope so that it is at the graticule center. Rotate the 'A' STABILITY control on the Type 585 so that its trace free runs. Back the STABILITY

control counterclockwise so that the trace just extinguishes. Note the position of the trace on the test oscilloscope. Turn the HORIZONTAL DISPLAY switch on the Type 585 to the 'A' SINGLE SWEEP position. Note the new position of the trace on the test oscilloscope. This position should be 9 to 11 volts more positive than the original setting when the Type 585 HORIZONTAL DISPLAY switch was in the INTERNAL SWEEP position. (10 volts = 1 cm on test oscilloscope.) If the difference is not 9 to 11 volts, rotate the LOCKOUT LEVEL control until the test oscilloscope shows a 9 to 11 volt difference.

To check the operation of the single sweep circuit, return the HORIZONTAL DISPLAY switch to the A position. Feed .2 VOLTS of calibrator signal into the P80 Probe. Properly trigger the display while switching the TRIGGER SLOPE switch from + to -. Remove the calibrator signal, turn the HORIZONTAL DISPLAY switch to 'A' SINGLE SWEEP and press the RESET button. The READY lamp should light. While observing the Type 585 crt, connect the P80 Probe to the CAL. OUT jack. A single sweep should occur and the READY lamp should go out.

### 24. Alternate-Trace Trigger Test

The Type 585 Time-Base "A" Generator provides triggering pulses for operation of alternate-trace plug-in units. The Type 84 Plug-In Test Unit (and the TU-3 Test Load Plug-In Unit) is designed to test for the presence of the triggering pulses.

**With instruments before Serial No. 2585**, place the TU-3 in the plug-in cell. Set the TIME/CM switches of both Time-Bases "A" and "B" to 10  $\mu$ SEC. Set the HORIZONTAL DISPLAY switch to "A". Free-run the "A" Sweep by turning the STABILITY control fully clockwise. Switch the TU-3 NORMAL-ALTERNATE SWEEPS switch to ALTERNATE SWEEPS. Switch the INPUT SELECTOR switch to SIGNAL. Two traces should now appear that are about 2 centimeters apart. Turn the HORIZONTAL DISPLAY switch to "B". Free-run the "B" sweep by turning the STABILITY control fully

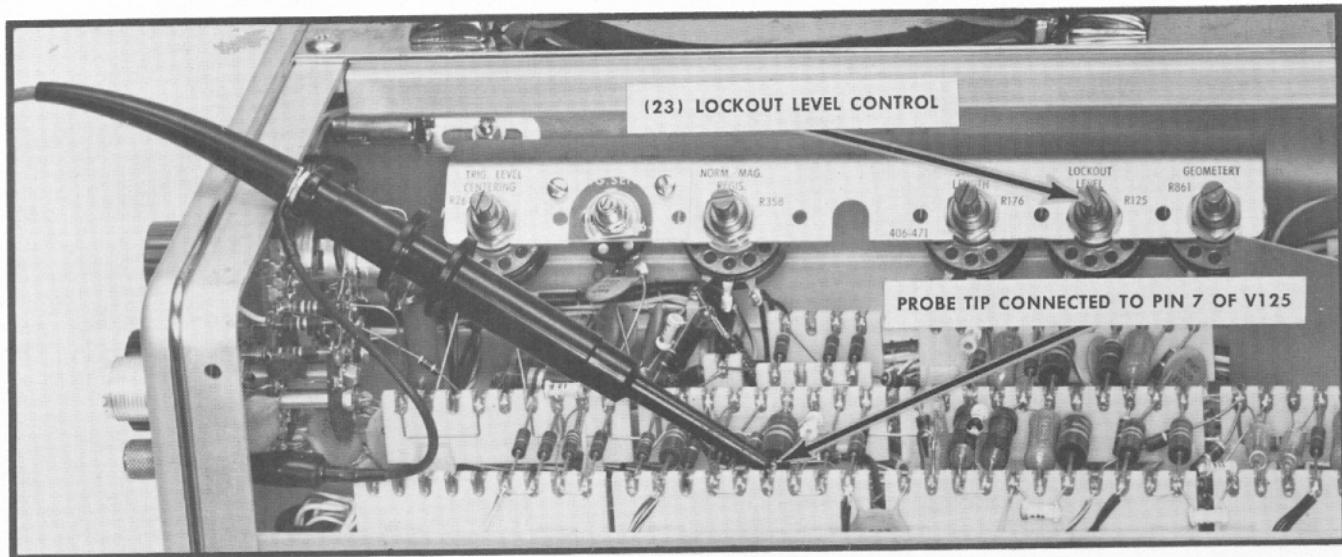


Fig. 6-16. Proper test scope connection for making the Lock-out Level Adjustment.

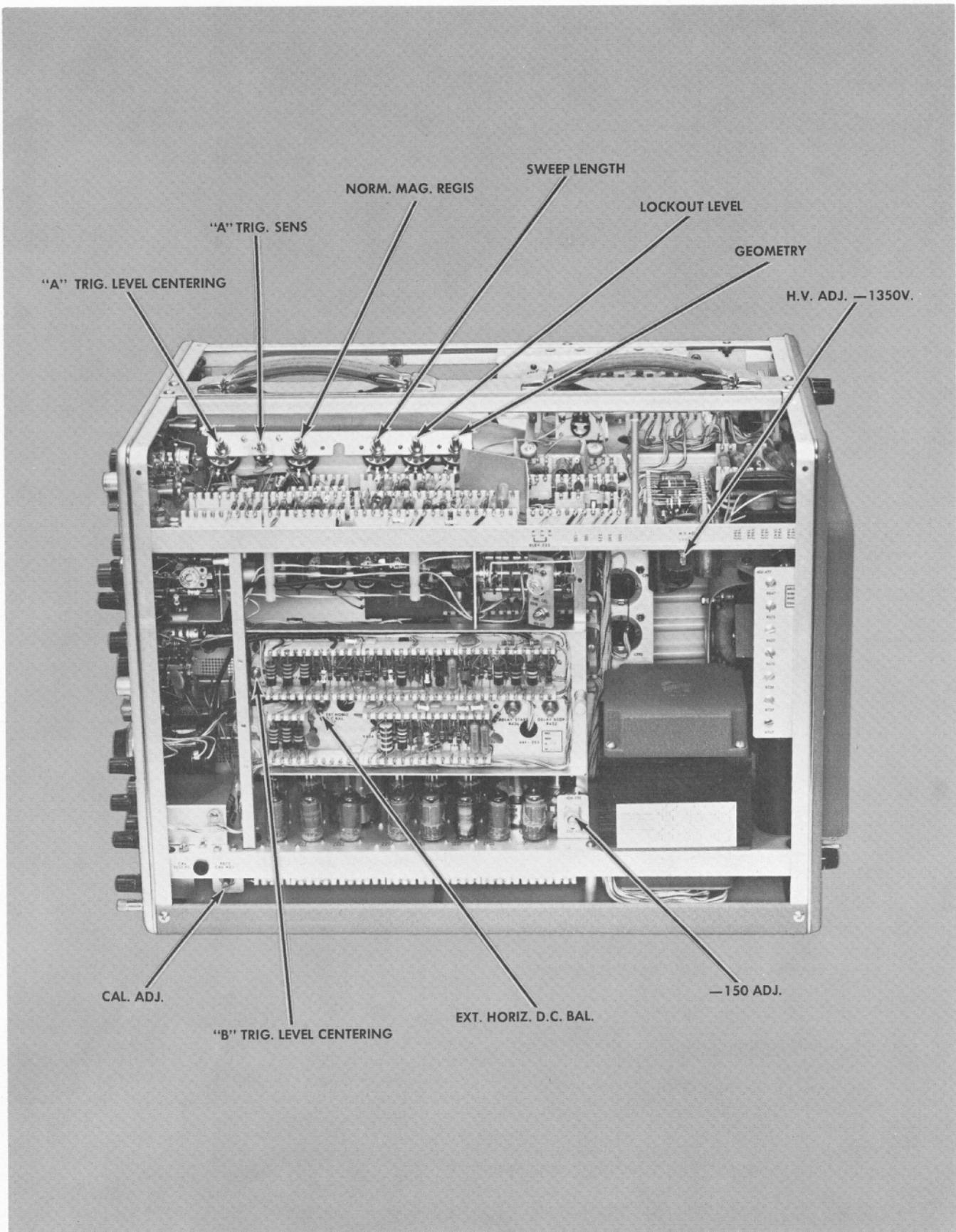


Fig. 6-17. Right side view of the oscilloscope showing the location of the 'B' TRIG. LEVEL CENTERING adjustments and test points.

## Calibration Procedure — Type 585

clockwise. Two traces should appear. Two traces should appear in the following positions of the HORIZONTAL DISPLAY switch: A, B, 'B' INTENSIFIED BY 'A', 'A' DEL'D BY 'B', and in the 'A' SINGLE SWEEP position when the RESET button is pressed repeatedly.

**With instruments after Serial No. 2585,** place the Type 84 in the plug-in cell. Set the HORIZONTAL DISPLAY switch to "A", and the TIME/CM controls of both time-bases to .1 MILLISEC. Free-run the "A" Sweep by turning the STABILITY control fully clockwise. Switch the Type 84 DISPLAY SELECTOR to CAL. (2 CM) and ALT. SYNC. There should be two centimeters vertical distance between two traces.

In case you have a Type 81 Plug-In Adapter and a TU-2 Test Load Plug-In Unit, the same tests can be made for the alternate-trace triggering pulses. Or you may use a Type 81 Plug-In Adapter and a Type CA Plug-In Unit to make the same tests.

If two traces do not appear with the above tests, check diode D142 and its associated circuitry near V145 in the Time-Base Generator A, or L249, C254, and R254 near V245 of the Time-Base Generator B.

### 25. 'B' Triggering Level Control Zero Set

Set the HORIZONTAL DISPLAY switch at B. Place the 'B' TRIGGERING SOURCE switch at INT. and the TRIGGER SLOPE switch to +. The STABILITY control can be at any position except PRESET.

(Use either a sensitive voltmeter or the test oscilloscope for this step.)

Set the test oscilloscope controls as follows: vertical VOLTS/CM switch at .05 VOLTS, AC-DC input selector switch at DC, triggering controls at LINE and AUTO., and the TIME/CM switch at 2 MILLISEC. Center the trace on the test oscilloscope for a zero reference.

Connect a 10X probe from the test oscilloscope to the junction of R64 and R65 (see Fig. 6-17). Adjust the Type 585 'B' front panel TRIGGERING LEVEL control to position the trace on the test oscilloscope at the zero reference line. If necessary, loosen the TRIGGERING LEVEL knob and set it at the zero position then tighten the knob. Check the exact zero setting of the control by observing the test oscilloscope trace for no vertical shift when the probe is disconnected and connected a few times at the junction. Leave the TRIGGERING LEVEL control set at zero during the following trigger adjustments. Disconnect the 10X probe from the test point.

### 26. 'B' Trigger Level Centering

Having previously adjusted the TRIGGERING LEVEL control as in step 25, connect a clip-lead jumper from the junction of R64 and R65 to ground to maintain an exact ground reference. Set the STABILITY control to its triggerable position about 5 degrees counterclockwise from a free-run sweep.

The 'B' Trigger Level Centering control not only permits a balanced, stable, triggerable sweep, but also affects the sensitivity of the 'B' Trigger Circuit.

Set the AMPLITUDE CALIBRATOR to 50 MILLIVOLTS. Connect the P80 Probe to the CAL. OUT jack via the adapter 013-017, or if using a TU-3 with the INPUT SELECTOR at SIGNAL, connect the 50 MILLIVOLT calibrator signal to the TU-3 INPUT jack.

Switching the TRIGGER SLOPE switch between + and -, adjust the 'B' TRIG. LEVEL CENTERING control for a stable display. (See Fig. 6-17.)

Reduce the CALIBRATOR signal to 20 MILLIVOLTS. The display should disappear. If the display remains, readjust the TRIG. LEVEL CENTERING control until you obtain a stable display at 50 MILLIVOLTS, and no display at 20 MILLIVOLTS calibrator signal.

### 27. 'B' Preset Stability

With the display and control settings as in step 25, switch the STABILITY control into its PRESET position. With a small screwdriver, adjust the PRESET control midway between the point where the sweep cannot be triggered and the unstable point of free-run. This setting is midrange in the triggerable area of the PRESET control.

### 28. Check 'B' External Trigger Operation

With the TRIGGERING SOURCE switch in EXT., the sweep should be triggered in either AC or DC by .5 VOLTS calibrator signal. Check both + and - TRIGGER SLOPE. The sweep should not be triggered by .2 VOLTS calibrator signal in EXT.

#### NOTE

In the time-base generator calibration instructions that follow, all of the adjustments, with the exception of Steps 32, 33, 35, and 37 interact to some degree. For this reason it is important that you make the adjustments in the proper sequence.

### 29. Magnifier Gain

Set the Type 585 Oscilloscope controls as follows:

HORIZONTAL DISPLAY	B
TRIGGER SLOPE (B)	+
TRIGGERING SOURCE (B)	INT.
TIME/CM (B)	1 MILLISEC
5X MAGNIFIER	OFF

Connect the P80 Probe through a 50X attenuator head and proper adapter to the MARKER OUT connector on the Type 180A. Set the Type 180A for one millisecond and 100 microsecond markers output. Adjust the 'B' triggering controls for a stable display of one tall and five short markers per centimeter. Turn the 5X MAGNIFIER ON. Adjust the MAG. GAIN ADJ. control (see Fig. 6-18) to display one large marker every 5 cm and two small markers every cm. Position the display horizontally to observe the linearity over the entire sweep length. Check to see that the 5X MAGNIFIER indicating lamp is lighted.

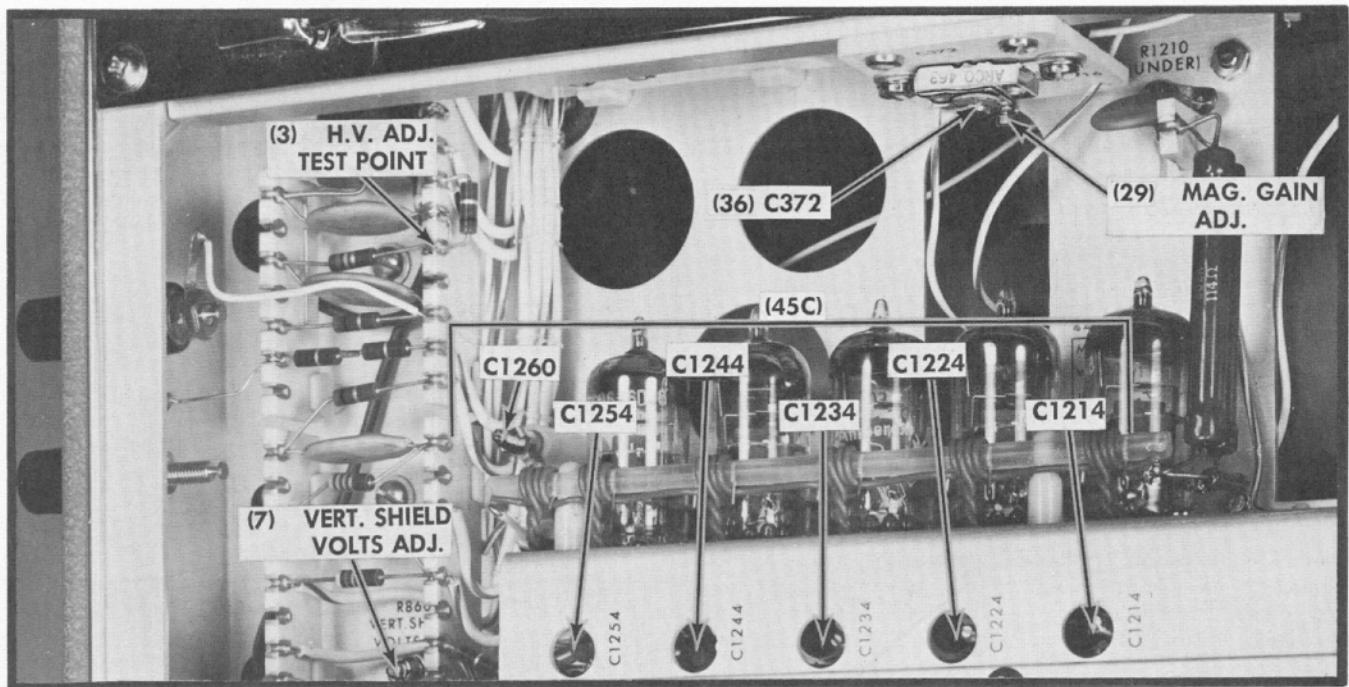


Fig. 6-18. Top view of the oscilloscope showing the location of internal adjustments. Before Serial No. 2585.

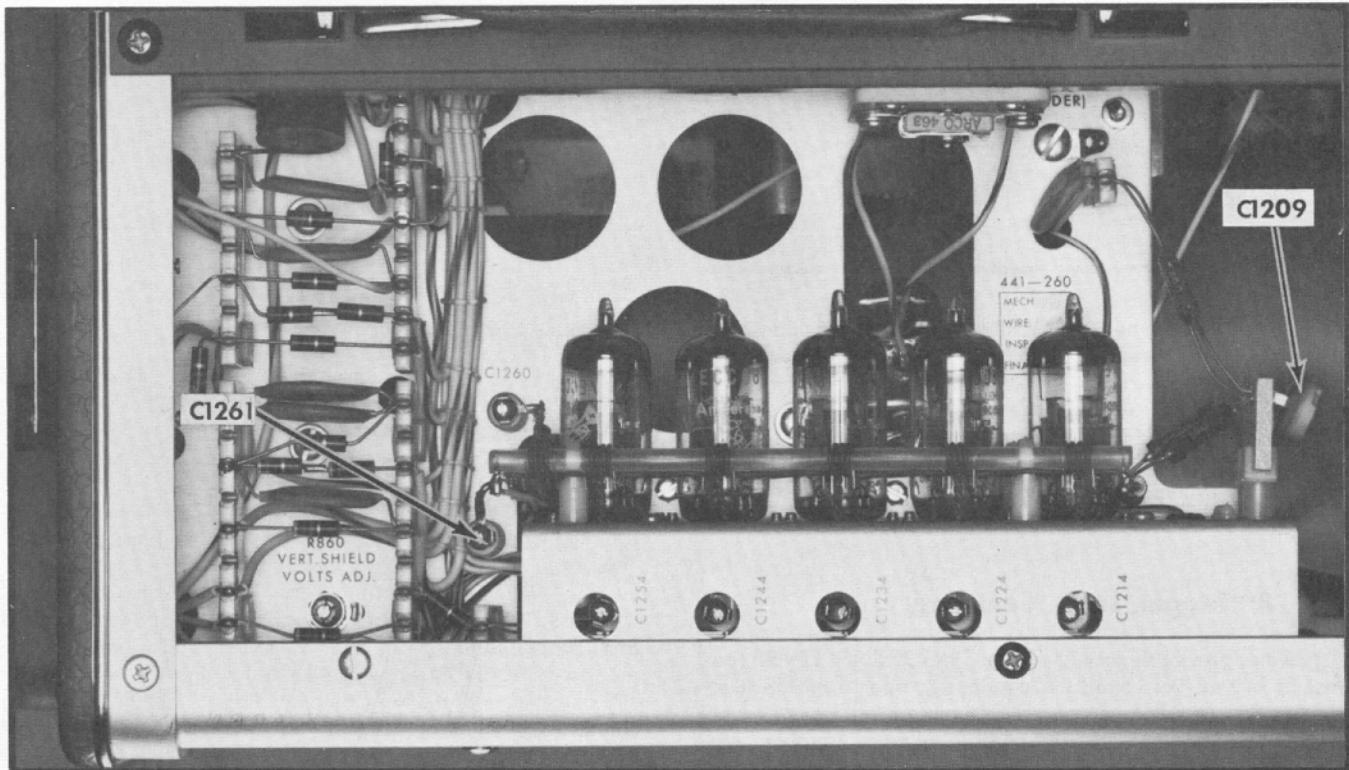


Fig. 6-19. Top view of the oscilloscope showing the location of internal adjustments. After Serial No. 2585.

## Calibration Procedure — Type 585

### NOTE

To calibrate the time-base circuits accurately all timing adjustments are made on the basis of time markers or sine waves appearing between the 1-cm and 9-cm vertical graticule lines.

## 30. Sweep Calibration

With the 5X MAGNIFIER OFF, apply only 1 millisecond markers from the Type 180A and adjust the 'B' triggering controls for a stable display. Position the trace to begin at the left edge of the graticule. Adjust the SWP. CAL. control (see Fig. 6-13) for one time-marker per cm from the 1-cm line to the 9-cm line.

## 31. Adjust Time Base A to Time Base B

Set the HORIZONTAL DISPLAY switch at A and the 'A' TIME/CM switch at 1 MILLISEC. Rotate the 'A' VARIABLE control to its calibrated position and adjust the triggering controls for a stable display. Adjust R160Z (see Fig. 6-3) for the same timing as that obtained for the 'B' sweep in step 30 above,  $\pm 0.5\%$ .

## 32. Sweep Length A

With the controls and display remaining as given in Step 31, adjust the SWEEP LENGTH control (see Fig. 6-7) for a sweep length of 10.5 centimeters.

## 33. Sweep Magnifier Registration

With the 5X MAGNIFIER switch at the ON position, horizontally position the display so the first time marker is directly behind the center vertical graticule line. Set the 5X MAGNIFIER switch to OFF and adjust the NORM/MAG.

REGIS. control (see Fig. 6-15) so the first marker again falls behind the vertical centerline. You may use the AMPLITUDE CALIBRATOR signal as shown in Figure 6-20.

To check the sweep magnifier registration at the center of the display, horizontally position the fifth large time marker behind the vertical centerline and place the 5X MAGNIFIER switch to ON and then to OFF. The time marker should remain stationary at the graticule centerline.

## 34. Check Time Base A Sweep Rates—1 MILLISEC/CM through 2 SEC/CM

With the same operating conditions as in step 31, check the sweep rates and timing accuracy ( $\pm 3\%$ ) according to the information provided in Table 6-1. As noted above, the checks are made from the 1-cm line to the 9-cm line of the graticule.

TABLE 6-1

TIME/CM	TYPE 180	MARKERS DISPLAYED
.1 MILLISEC	100 MICROSECONDS	1/cm
.2 MILLISEC	100 MICROSECONDS	2/cm
.5 MILLISEC	500 MICROSECONDS	1/cm
1 MILLISEC	1 MILLISECOND	1/cm
2 MILLISEC	1 MILLISECOND	2/cm
5 MILLISEC	5 MILLISECONDS	1/cm
10 MILLISEC	10 MILLISECONDS	1/cm
20 MILLISEC	10 MILLISECONDS	2/cm
50 MILLISEC	50 MILLISECONDS	1/cm
.1 SEC	100 MILLISECONDS	1/cm
.2 SEC	100 MILLISECONDS	2/cm
.5 SEC	500 MILLISECONDS	1/cm
1 SEC	1 SECOND	1/cm
2 SEC	1 SECOND	2/cm

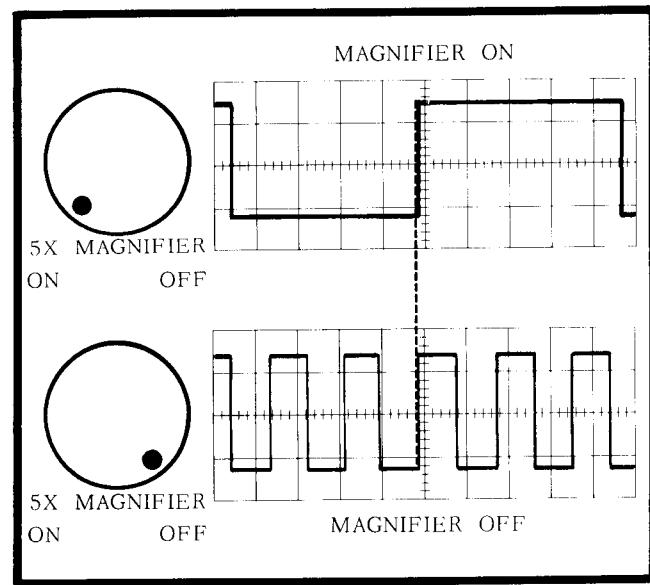


Fig. 6-20. Adjustment of the NORM/MAG. REGIS control.

## 35. Check 'A' VARIABLE (TIME/CM) Control and Uncalibrated Neon

The VARIABLE control provides for a complete range of control between the calibrated TIME/CM steps. To check the operation of this control, set the TIME/CM switch at 1 MILLISEC-CALIBRATED and apply 5 MILLISECOND markers. The display will be one time marker for each 5 cm. Next, turn the VARIABLE control fully counterclockwise. The display should now consist of 1 or more markers every 2 cm. Check to see that the UNCALIBRATED neon indicator lamp lights in all positions of the VARIABLE control except when switched to the CALIBRATED position.

## 36. Adjust Time Base A Sweep Rates—50 μSEC/CM through .01 μSEC/CM

Set the 'A' TIME/CM switch at .1 MILLISEC. Apply 10 MICROSECOND markers from the Type 180A and adjust the triggering controls for a stable display. Turn the 5X MAGNIFIER switch to ON and horizontally position the

trace so that the beginning time marker is aligned with the center graticule line. Then set the TIME/CM switch at 50  $\mu$ SEC and check for horizontal shift of the beginning marker. If shift occurs, adjust C330 (see Fig. 6-7) until the beginning marker of both the .1 MILLISEC and 50  $\mu$ SEC positions occur at the same point.

Turn the 5X MAGNIFIER switch to OFF, the TIME/CM switch to 10  $\mu$ SEC and position the display to start at the left vertical graticule line. Place the TRIGGERING SOURCE switch at EXT. AC and connect 100 KC triggers from the Type 180A to the TRIGGER INPUT connector through a coax cable. Proceed with the following adjustments.

TABLE 6-2

TIME/CM	TYPE 180A	Adjust	Observe
10 $\mu$ SEC	10 MICROSEC	*C160E	1 marker/cm
1 $\mu$ SEC	1 MICROSEC	*C160C	1 marker/cm
.5 $\mu$ SEC	1 MICROSEC	*C160B	1 marker/2 cm Position 2nd marker to 2nd line on graticule
.1 $\mu$ SEC	10 MC	*C348	1 cycle/cm
.1 $\mu$ SEC 5X MAG.—ON	50 MC	**C384 and **C364	1 cycle/cm
.05 $\mu$ SEC 5X MAG.—ON	50 MC	*C160A and †C372	1 cycle/2 cm

\* See Fig. 6-3 for location of adjustment.

\*\* See Figure 6-7.

† See Fig. 6-18.

The following instructions will aid you in making the timing adjustments of Table 6-2.

Due to the interaction between C160B and C348 these adjustments must be repeated to obtain correct timing. Adjust C384 and C364 in equal increments or equal capacitance settings when making these adjustments.

Adjust C160A for correct timing over the center portion of the sweep length. Before adjusting C372, first horizontally position the display until the start coincides with the left edge of the graticule. Adjust C372 for accurate timing from the 4th to the 6th cm horizontal length of the display. Adjust the TRIGGERING LEVEL control to align the sine waves with the vertical graticule lines. Recheck the accuracy of all the timing adjustments listed in Table 6-2 and check the timing of all the intermediate ranges. Use 10 KC triggers from the Type 180A to obtain a stable display when checking the 50  $\mu$ SEC/CM sweep rate. After completing this step, disconnect the cable from the TRIGGER INPUT connector.

### 37. Set Time Base B Sweep Length

Place the HORIZONTAL DISPLAY switch at B and the 'B' TIME/CM switch at .5 MILLISEC. With no signal being applied from the Type 180A, rotate the 'B' STABILITY control clockwise to obtain a free-running sweep. Rotate the LENGTH control and check that the sweep length changes between approxi-

mately 3.5 and 10.5 centimeters. If the sweep length range is incorrect, substitute resistance values for R277 and R278 (see Fig. 6-3) which will allow you to obtain the proper range. R277 is normally between 10 k and 18 k, R278 is usually between 47 k and 270 k.

### 38. Set Delay Start and Delay Stop Adjustments

Set the HORIZONTAL DISPLAY switch at 'B' INTENSIFIED BY 'A'.

Apply 500 microsecond markers from the Type 180A.

Set the 'A' TIME/CM switch at 50  $\mu$ SEC.

Set the 'B' TRIGGER SLOPE switch at +.

Set the 'B' TIME/CM switch at .5 MILLISEC and get a stable display.

Set the 'A' STABILITY control fully clockwise.

Set the 'A' TRIGGERING SOURCE switch to INT.

With the above setup some portion of the display should be intensified. Adjust the intensity control for satisfactory contrast.

#### a. First Order Adjustment.

Set the DELAY-TIME MULTIPLIER dial at 1.00 and adjust the DELAY START control (see Fig. 6-3) until the brightened portion starts with the rise of the first marker one centimeter from the start of the trace. Now set the DELAY-TIME MULTIPLIER dial to 9.00 and adjust the DELAY STOP control (see Fig. 6-3) until the brightened portion starts with the rise of the ninth time marker nine centimeters from the start of the trace. It may be necessary to repeat these two adjustments until a satisfactory setting is obtained for both controls.

#### b. Second Order Adjustment

Set the HORIZONTAL DISPLAY switch to 'A' DEL'D BY 'B'. The display magnification will give resolution so the individual turns of the controls are obvious as they are adjusted. If the correct adjustment of either the DELAY START or DELAY STOP control falls between two wires of the control, adjust it so the total rise of the time marker is visible rather than part way up the rise.

Work between the 1.00 and 9.00 of the DELAY-TIME MULTIPLIER dial, touching up the fine adjustment of the DELAY START and DELAY STOP controls until the waveform total rise is visible at the start of the trace in each case.

### 39. Check Time Base B Sweep Rates—.2 MILLISEC/CM through 1 SEC/CM

Time-Base B timing accuracy and linearity is to be adjusted and measured using the DELAY-TIME MULTIPLIER with the HORIZONTAL DISPLAY switch at 'B' INTENSIFIED BY 'A'.

When checking the timing of any range other than the .5 MILLISEC range of the TIME BASE B sweep (TABLE 6-3), first adjust the DELAY-TIME MULTIPLIER control so that the start of the brightened portion of the trace is at the 1-cm

## Calibration Procedure — Type 585

marker of the graticule. Then observe or record the number of minor divisions that the DELAY-TIME MULTIPLIER control is offset from the 1.00 position. (This apparent error is time taken for the trigger circuit to start the 'A' sweep; it can be as much as 15 minor divisions on the higher sweep ranges.)

Next adjust the DELAY-TIME MULTIPLIER control until the start of the brightened portion of the trace is at the 9-cm marker on the graticule. Observe the number of minor divisions that the control is offset from 9.00. The difference between the offset readings must not be more than  $\pm 9$  minor divisions for sweep rates from .2 MILLISEC/CM through .1 SEC/CM (excluding .5 MILLISEC/CM) and not more than  $\pm 27$  minor divisions for sweep rates from .2 SEC/CM through 1 SEC/CM. For example, if the dial offset at the 1-cm marker reads —2 minor divisions from 1.00 and —4 minor divisions from 9.00, the difference between the offset readings is 2 minor divisions.

Out of tolerance timing errors can usually be corrected by replacing an R260 timing resistor in the .2, .5 and 1 SEC ranges, or a C260 capacitor if several ranges are out of tolerances between 10 and .2 MILLISEC. Be sure to use proper tolerance replacement parts.

TABLE 6-3

TYPE 180A	'A' TIME/CM		Markers Displayed
	'A' TIME/CM	'B' TIME/CM	
100 MICROSEC	.5 $\mu$ SEC	.2 MILLISEC	2/cm
500 MICROSEC	10 $\mu$ SEC	.5 MILLISEC	1/cm
1 MILLISEC	20 $\mu$ SEC	1 MILLISEC	1/cm
1 MILLISEC	50 $\mu$ SEC	2 MILLISEC	2/cm
5 MILLISEC	.1 MILLISEC	5 MILLISEC	1/cm
10 MILLISEC	.2 MILLISEC	10 MILLISEC	1/cm
10 MILLISEC	.5 MILLISEC	20 MILLISEC	2/cm
50 MILLISEC	1 MILLISEC	50 MILLISEC	1/cm
100 MILLISEC	2 MILLISEC	.1 SEC	1/cm
100 MILLISEC	5 MILLISEC	.2 SEC	2/cm
500 MILLISEC	10 MILLISEC	.5 SEC	1/cm
1 SECOND	20 MILLISEC	1 SEC	1/cm

## 40. Adjust Time Base B Sweep Rates—.1 MILLISEC/CM through 2 $\mu$ SEC

Apply 50 microsecond markers from the Type 180A.

Set the 'A' TIME/CM switch at 1  $\mu$ SEC.

Set the 'B' TIME/CM switch at 50  $\mu$ sec.

Place the HORIZONTAL DISPLAY switch at 'B' INTENSIFIED BY 'A'.

Adjust the DELAY-TIME MULTIPLIER control to place the start of the brightened portion of the trace at the 1-cm marker.

Place the HORIZONTAL DISPLAY switch at 'A' DEL'D BY 'B' and adjust the DELAY-TIME MULTIPLIER control so that the leading edge of the time marker is at the start of the trace. Record the DELAY-TIME MULTIPLIER control setting.

Adjust the DELAY-TIME MULTIPLIER control exactly 8.00 divisions higher (the dial will be near 9.00) than the recorded position near 1.00. The trace should begin with the rise of the time marker. If not, adjust C260C (see Fig. 6-3) until the trace begins at the leading edge of the time marker.

It may be necessary to repeat the procedure a few times to make the difference readings of the DELAY-TIME MULTIPLIER dial the same at both 1.00 and 9.00. This procedure completes line one of Table 6-4 below.

Using the same procedure as just outlined, do the timing as in line two of Table 6-4. Start by placing the 'A' TIME/CM control at .1  $\mu$ SEC and the 'B' TIME/CM control at 5  $\mu$ SEC. Apply 5 microsecond markers from the 180A. Make the adjustment of C260A as carefully as you did the adjustment of C260C.

Check the timing and the DELAY-TIME MULTIPLIER dial difference readings for the rest of the 'B' sweep rates as listed in Table 6-4.

TABLE 6-4

TYPE 180A	'A' TIME/CM	'B' TIME/CM	Adjust or Check
50 MICROSEC	.1 $\mu$ SEC	50 $\mu$ SEC	Adjust *C260C
5 MICROSEC	.1 $\mu$ SEC	5 $\mu$ SEC	Adjust *C260A
1 MICROSEC	.05 $\mu$ SEC	2 $\mu$ SEC	Check Timing**
10 MICROSEC	.2 $\mu$ SEC	10 $\mu$ SEC	Check Timing**
10 MICROSEC	.5 $\mu$ SEC	20 $\mu$ SEC	Check Timing**
100 MICROSEC	2 $\mu$ SEC	.1 MILLISEC	Check Timing**

\* See Fig. 6-3 for location of adjustment.

\*\* Difference between DELAY-TIME MULTIPLIER dial offset reading at 1-cm and 9-cm points should not be more than  $\pm 9$  minor divisions.

## 41. Check 'A' Delayed by 'B' Triggering Jitter

At high magnification factors with the 'A' DEL'D BY 'B' function, it is important that the triggering jitter from the 'B' Sweep Generator be only a minor part of the display.

Set the HORIZONTAL DISPLAY switch at 'B' INTENSIFIED BY 'A'.

Set the 'A' TIME/CM control at 1  $\mu$ SEC.

Set the 'A' STABILITY control fully clockwise.

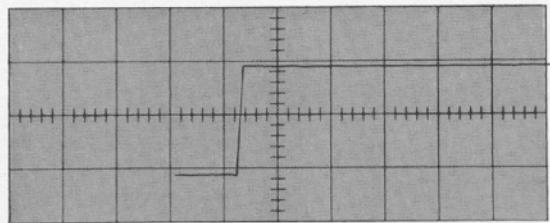
Set the 'B' TIME/CM control at 1 MILLISEC.

Display 1 millisecond markers from the Type 180A.

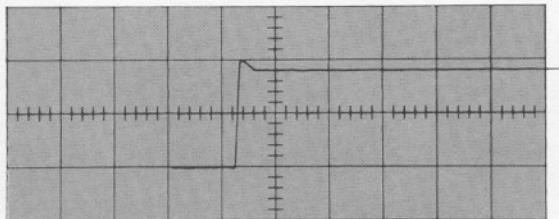
Set the DELAY-TIME MULTIPLIER dial so that the brightened portion of the sweep coincides with the 1 centimeter graticule line.

Switch the HORIZONTAL DISPLAY switch to 'A' DEL'D BY 'B' position, turn up the INTENSITY and refocus for a sharp trace and observe the horizontal jitter of the display. The jitter should not be greater than 2 millimeters. Repeat the procedure with the DELAY-TIME MULTIPLIER at 9. The horizontal jitter should not be greater than 4 millimeters.

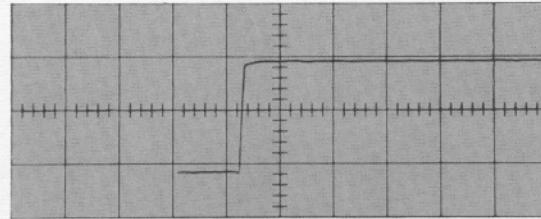
The above specifications are easy to meet with new tubes. If the jitter is greater than the above, three tubes are the



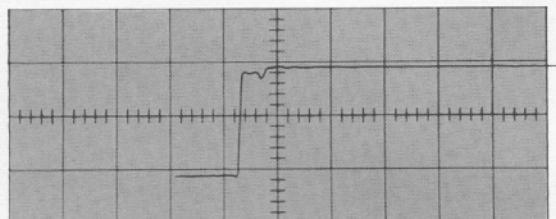
a. Properly adjusted vertical.



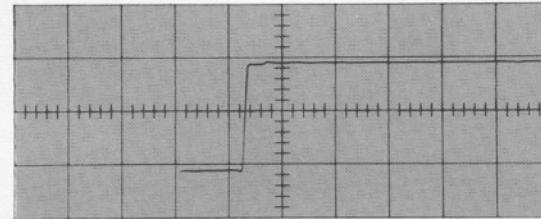
b. R1293 maladjusted.



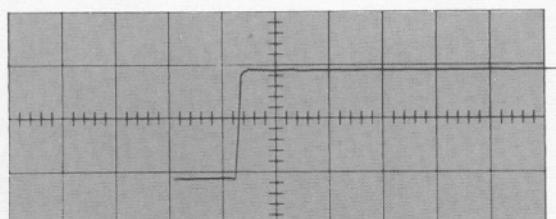
c. R1293 maladjusted.



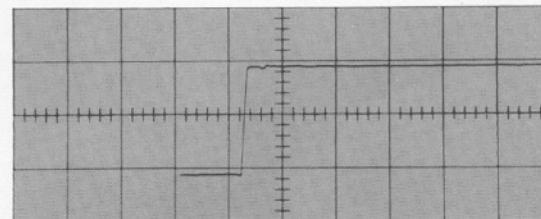
d. C1209 maladjusted.



e. C1006 maladjusted.



f. C1260 maladjusted.



g. C1214 maladjusted.

Fig. 6-21. Type 585 vertical amplifier response waveforms. All taken at sweep rate of .05  $\mu$ sec/cm, using a Type 84 pulser.

## Calibration Procedure — Type 585

probably cause. First replace the 12AL5 Disconnect Diodes V252 on the 'B' sweep chassis. If this does not reduce the jitter to an acceptable level, replace the two 6AU6 Delay Pickoff input amplifier tubes V414 and V424. After replacing V414 and V424 it will be necessary to recalibrate the Delay Start and Delay Stop controls as in step 38.

### 42. Adjust External Horizontal DC Balance

Connect the P80 Probe through a 50X attenuator head and probe adapter to the SAWTOOTH A connector. Set the HORIZONTAL DISPLAY switch at EXT. X1 and connect a jumper lead from the HORIZ. INPUT connector to ground. Place the 'A' TIME/CM at 2 MILLISEC. Check to see that the 'A' STABILITY control is set for free-running sweep. Horizontally position the vertical free-running sweep to the center of the graticule. Adjust the EXT. HORIZ. D.C. BALANCE control (see Fig. 6-3) for no horizontal shift of the trace while rotating the VARIABLE 10-1 control.

### 43. Check Horizontal Input Deflection Factor

With conditions as in Step 42 above, connect the HORIZ. INPUT to the CAL. OUT connector. Set the AMPLITUDE CALIBRATOR switch at .2 VOLTS and rotate the VARIABLE 10-1 control fully clockwise. Connect a second jumper lead from the HORIZ. INPUT connector to the 'A' TRIGGER INPUT connector. Set the 'A' TRIGGERING SOURCE switch at EXT. AC. Adjust the triggering controls to obtain a stable display. At least 1.2 centimeters of horizontal deflection must be displayed to indicate an adequate deflection factor.

Horizontally position the display to start at the first vertical graticule line. Increase the AMPLITUDE CALIBRATOR output to 2 VOLTS. Adjust the VARIABLE 10-1 control for exactly 10 cm of horizontal deflection and leave the control at this position until you have completed Step 44. Now place the HORIZONTAL DISPLAY switch at EXT. X10. Increase the AMPLITUDE CALIBRATOR output to 20 VOLTS. The horizontal deflection should again be ten centimeters (attenuator accuracy  $\pm 3\%$ ).

### 44. Adjust External Horizontal Input Compensation

With the same conditions as in Step 43, set the AMPLITUDE CALIBRATOR to 5 VOLTS. Horizontally position the display to the center of the graticule and adjust C301C (see Fig. 6-3) for approximately the same waveform shape as obtained in the EXT. X1 position. Place the HORIZONTAL DISPLAY switch at A and disconnect the jumper leads. Place the TRIGGERING SOURCE switch at the INT. position.

### 45A. Adjust Vertical System High-Frequency Compensations

(Instruments after Serial No. 2585. See step 45B for instruments before Serial No. 2585).

#### a. Check Vertical Gain

With the Type 84 Plug-In Test Unit in place, recheck the vertical amplifier gain as in step 16a.

#### b. Check the Vertical System High Frequency Compensations

This step is a check on the transient response of the vertical amplifier. It can be considered a standardization check or adjustment. Adjustments may need to be made when the crt is replaced.

1. Set the Type 585 oscilloscope TIME/CM to .05  $\mu$ SEC. The TRIGGER SLOPE to + and the TRIGGERING SOURCE to INT. Install a crt viewing hood if working in a lighted room.

Set the Type 84 DISPLAY SELECTOR switch to PULSER and adjust the PULSER AMPLITUDE control for a stable display of about +2 centimeters. It may be necessary to turn the PULSER FREQUENCY knob for a stable display.

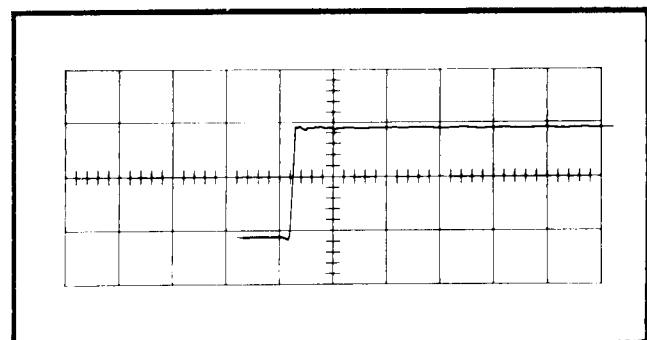


Fig. 6-22. Transient response waveform of Type 585 with Type 80/P80. Signal from modified Type 107 (see text). Oscilloscope Serial No. was above 2585, and vertical was previously standardized using a Type 84 Plug-In Test Unit. Text describes method of improving the waveform (step 45A, c. 1 through 3) for flatter waveform top following the rise. Sweep rate: .05  $\mu$ SEC/CM.

The display should be similar to Fig. 6-21a, with no more than one trace width of overshoot or ringing.

2. The b through g parts of Fig. 6-21, indicate the effect upon the display for each of the indicated controls as described in 3 below. Checking your display with the waveforms showing the effect of each control can save valuable time when adjustments are required. **All adjustments interact to some degree** and should be made in the sequence that follows.

3. All adjustments described here are actually impedance matching adjustments. If the impedance of one section of a distributed amplifier does not match the impedance of the previous or following section, there will be an instantaneous change in gain as the signal passes the mismatched section. The result is a change in amplitude of the signal, shown as a bump or dip on the crt squarewave display.

Begin the check of the vertical amplifier transient response by comparing the crt presentation with the waveform of Fig. 6-21a. The seven pictures show that all adjustment controls affect the leading edge of the waveform for about 25 nseconds. Any variations in amplitude in the square-wave shape more than 25 nseconds from the leading edge, are not adjustable.

If adjustments are required due to crt replacement (Fig. 6-21b or c indicates a crt impedance mismatch), the first adjust-

ment will be R1293 (see Fig. 6-19), permitting a correction of the mismatch and maybe even making additional adjustments unnecessary.

If adjustments are required due to replacement of tubes in the output vertical amplifier, the waveform will probably have a small dip or pip as in Fig. 6-21f. Adjust capacitors C1214 through C1254 and C1260 as needed.

If the system rise-time (see step 46) is longer than 3.7 to 3.9 noseconds, (10% to 90% part) improve it by adjusting C1260 and C1261. Remember that all adjustments interact, and it may be necessary to adjust R1293 and then C1260 and C1261. Include any geometry vertical tilt measured in Step 8.

If there have been a number of delay line driver tubes replaced, there may be a need to adjust C1006, as illustrated in Fig. 6-21d.

After any adjustment in the controls just discussed, check the risetime (step 46) before assuming the system is functioning properly.

The left end of the Vertical Amplifier Output Stage schematic shows R1207 is a selected part. Its purpose is to put C1209 "in range" so it can be used for proper adjustment. If there is no resistor in your instrument, and C1209 cannot be properly adjusted, but the waveform looks best at maximum capacitance, it will then be necessary to add a few ohms of R1207 series resistance. (C1209 increases in capacitance to lower the display, see Figs. 6-10 and 6-21b). R1207 maximum allowable resistance is 33 ohms. Use a 1/2 watt carbon composition resistor for this purpose.

This completes the transient response standardization of the Type 585, permitting it to be used with any 80 Series Plug-In units.

#### c. Check the High-Frequency Compensations of the Type 80 Plug-In Unit (after Type 80 Serial No. 3390)

The calibration procedure for proper adjustment of the Type 80/P80 transient response is found in the Type 80 Plug-In Unit instruction manual.

#### NOTE

In the event you do not intend to use a Type 82 Dual Trace Plug-In Unit, or higher numbered 80 Series Plug-In Units, it may be proper to slightly improve the overall system transient response when using the Type 80/P80 combination. If the procedure that follows is used and if at a later date a Type 82 Dual-Trace Plug-In unit is to be used, it will be necessary to restandardize the main-unit vertical transient response with a Type 84 Plug-In Test Unit as in 45A.b above.

1. Upon receipt of a Type 585 with a Serial No. above 2585, and with a Type 80/P80 above Serial No. 3390, the oscilloscope and plug-in will perform properly and will be within transient response specifications. Figure 6-22 illustrates a typical waveform of a Type 107 Square-Wave Generator when the P80 Probe was connected directly to the Type 107 output through a UHF to P80 50  $\Omega$  Termination Adapter (013-033). (The output tube of the Type 107 has been changed to a 6AK5 for the picture.)

The small amount of irregularity at the leading edge of the waveform of Fig. 6-22 can be reduced by the following:

2. Carefully follow the Type 80/P80 calibration procedure in the Type 80 instruction manual to assure that it is adjusted properly.

3. Now it is possible to reduce any irregularities at the top of the leading edge by adjustments in the Output Vertical Amplifier Stage as in 45A.b above. This operation alters the main-unit vertical transient response standardization, and should not be done if the oscilloscope is to be used with other than the Type 80/P80.

#### 45B. Adjust Vertical System High-Frequency Compensations (instruments before Serial No. 2585)

To determine the performance of the vertical amplifier and to make the adjustments proceed as follows using TIME-BASE A:

##### a. Check Vertical Gain

Check the vertical gain of the oscilloscope by connecting the P80 Probe (AC-DC switch at DC) through the probe adapter (013-017) to the CAL. OUT connector. Set the AMPLITUDE CALIBRATOR switch at .2 VOLTS and the TIME/CM switch at .5 MILLISEC. Adjust the triggering controls for a stable display. The vertical deflection should be exactly two centimeters.

##### b. Check Type 80 and P80 Probe High-Frequency Compensations

Connect the P80 Probe (dc coupled) to the Type 105 through the terminating adapter 013-033. Set the OUTPUT AMPLITUDE of the Type 105 to produce a 2 cm display. Set its frequency between 20 kc and 25 kc. Set the Type 585 'A' TIME/CM switch at 10  $\mu$ SEC and adjust the triggering for a stable display. The display should be a good clean square wave with a level top.

The adjustment procedure involves L8085 within the plug-in unit and R8018 located on the side of the P80 Probe. Adjust the two controls for the flattest possible top on the displayed square wave. It is probable that you will have to work back and forth between the two controls to establish the correct response. Try each one first to get a feel for its effect. L8085 time constant begins to control the level of the square wave about 2  $\mu$ seconds after the leading edge, and R8018 time constant controls the level of the square wave from the leading edge for about 2  $\mu$ seconds. (See Figure 6-23.) R8018 also affects the dc level of the crt presentation and during adjustment of it you may need to readjust the POSITION RANGE ADJUST control on the front of the Type 80 Plug-In Unit.

##### c. Adjust Output Distributed Amplifier High-Frequency Compensations

Connect the P80 Probe directly to the OUTPUT connector of the Type 107 through the terminating adapter 013-033. Set the 107 to approximately 400 kc. Or if you do not have a Type 107 but do have either a Type 109 or Type 110, connect the P80 Probe to a 50 ohm output cable through the

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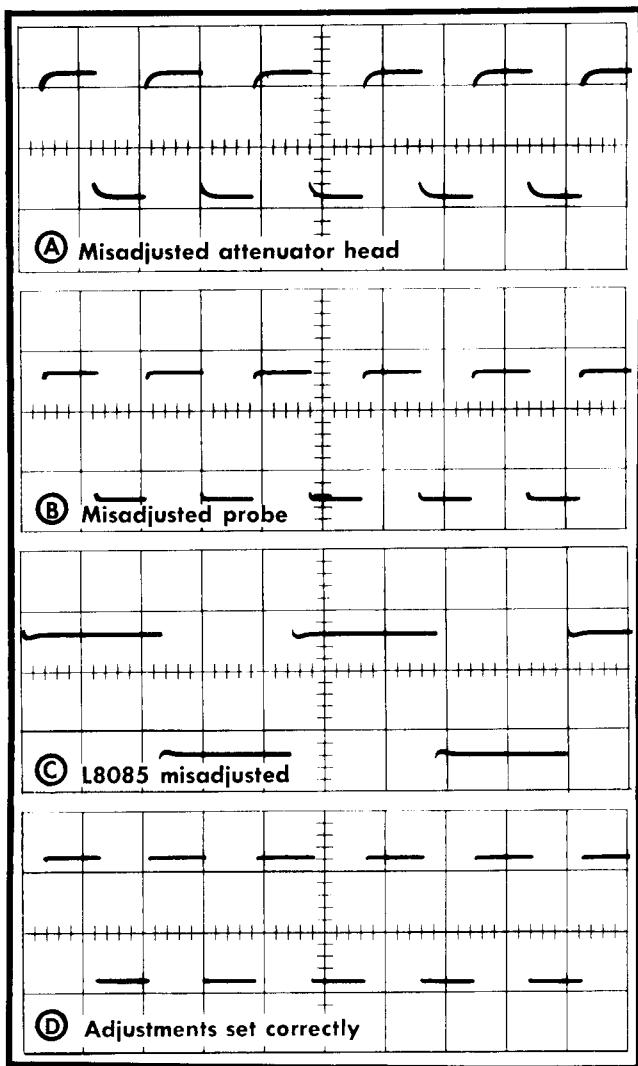


Fig. 6-23. Effects caused by misadjustment of the (A) attenuator head, (B) probe or (C) L8085. Waveform (D) is obtained when all three adjustments are set correctly. Oscilloscope before Serial No. 2585. Type 80 before Serial No. 3390.

terminating adapter 013-033, and a BNC 50  $\Omega$  10:1 Attenuator, part number 010-314. This combination requires two BNC adapters, part numbers 017-024 and 103-032, to permit using the BNC attenuator. Figure 2-6 pictures the proper connections and accessories when using a Type 110. Attach two 20 nsec 50  $\Omega$  cables in series to the CHG. LINE 1 and CHG. LINE 2 connectors of the Type 110 to produce an 80 nsec long pulse. Set the pulse amplitude at about 2½ volts. (See the instruction manual of the Type 110 for additional operating information.)

Place the 'A' TIME/CM switch at .05  $\mu$ SEC and the 5X MAGNIFIER at OFF. Adjust the triggering controls for a stable display with the TRIGGER SLOPE switch at +. Check the vertical amplifier signal-carrying leads from V1284 to the crt, for parallel spacing, and the leads from R1286-R1287 to the crt at an angle as shown in Figure 6-10. Adjust the variable capacitors, C1214 through C1261 (see Figs. 6-10 and 6-18), for minimum wrinkles and best level of the flat top of the displayed waveform. During the adjustments

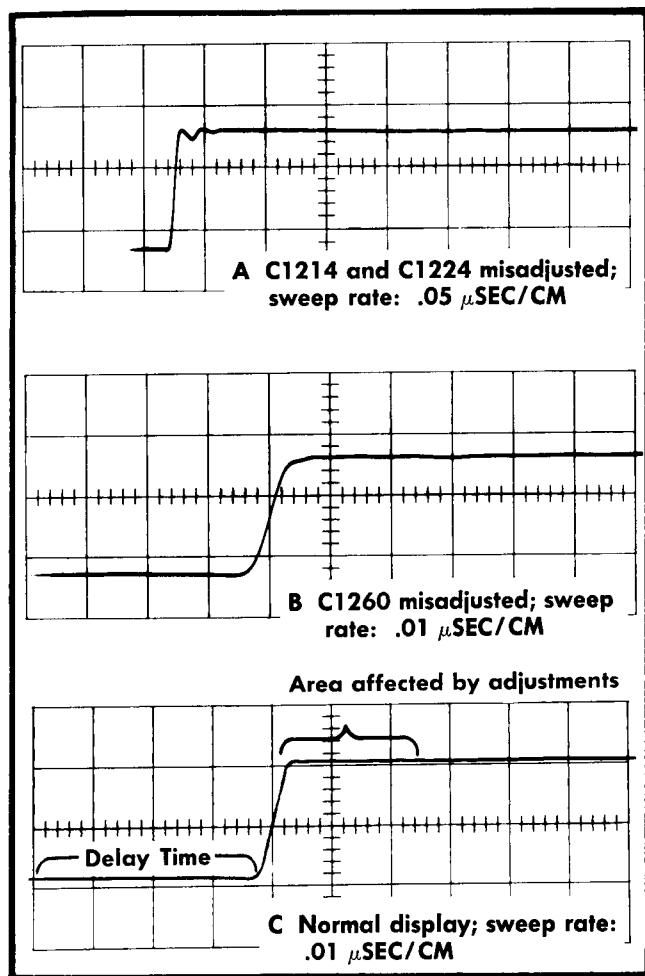


Fig. 6-24. Waveforms obtained using a modified Type 107 (see text) when adjusting the output distributed amplifier high-frequency compensations. Oscilloscope before Serial No. 2585.

keep the display so that its top is one centimeter above the center line. To check the appearance of the displayed waveforms at another sweep rate, leave the TIME/CM switch at .05  $\mu$ SEC, place the 5X MAGNIFIER switch at ON. The general appearance of the Type 107 waveform is shown in Fig. 6-24, and the Type 110 waveform is shown in Fig. 6-25.

The procedure for adjusting the variable capacitors for high-frequency compensation involves adjusting each capacitor for minimum distortion of the first 12 to 15 nseconds of the top of the square wave displayed on the screen. In particular, the high-frequency adjustments effect three characteristics of the displayed waveform: minimum slope of the top of the waveform, minimum irregularities on the top of the waveform, and fastest possible risetime without overshoot.

### 46. Check Risetime

A risetime check on the displayed waveform gives a very good check on the completeness of your adjustments. To proceed with this step connect the P80 Probe and terminating adapter directly to the Type 107, or continue to use the

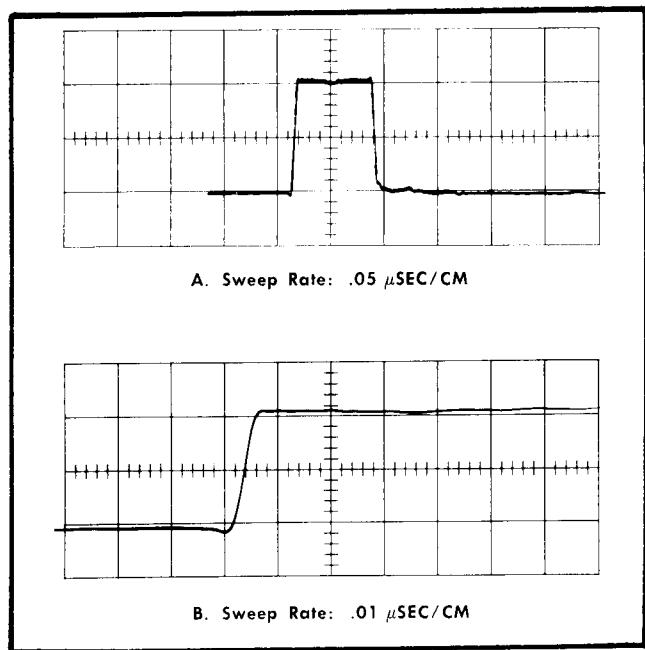


Fig. 6-25. Appearance of Type 110 output waveform on properly adjusted Type 585 Oscilloscope before Serial No. 2585.

Type 110 as connected in step 45B.c. Adjust the pulse amplitude control for exactly 2 centimeters of vertical deflection. Set the 'A' TIME/CM control to .05  $\mu$ SEC and the MAGNIFIER at ON. Under these conditions the time for the pulse

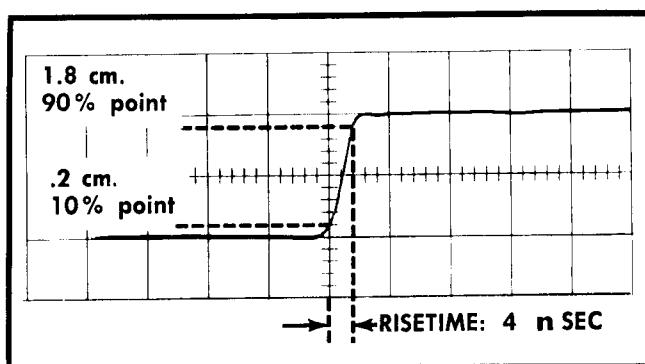


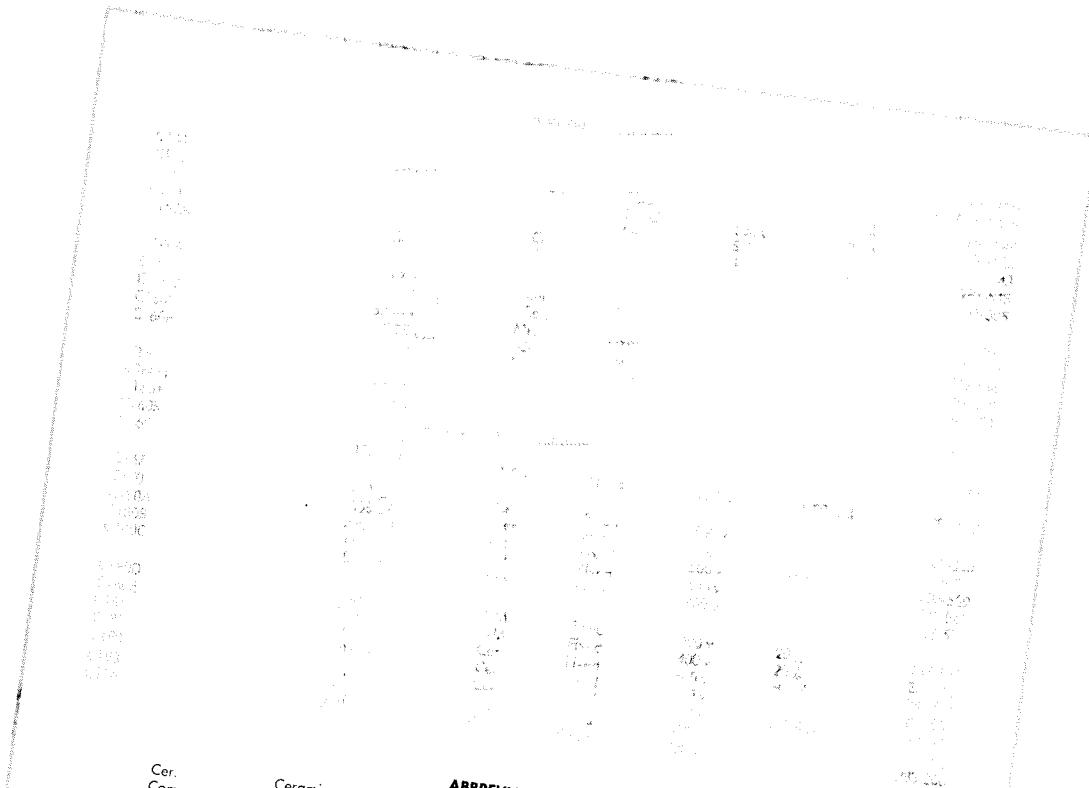
Fig. 6-26. Measurement of vertical risetime; sweep rate; .01  $\mu$ SEC/CM. This risetime measurement is a combination of the risetimes of the Type 107 Square-Wave Generator and Type 585 Oscilloscope before Serial No. 2585.

to rise from 0.2 to 1.8 centimeters (the 10% to 90% points) should be not longer than 4 nanoseconds. To make this measurement accurately, first use the TRIGGERING LEVEL control to position the waveform as far to the right as possible from where the sweep starts. Then use the HORIZONTAL POSITION control so that the center vertical line of the graticule passes through the rising portion of the waveform 0.2 centimeters from the bottom of the rise. Measure the horizontal distance between the 0.2 and 1.8 centimeter points shown in Figure 6-26. Multiply the horizontal distance measured by 10 nanoseconds per centimeter to obtain the risetime interval.

## NOTES

# PARTS LIST and

# DIAGRAMS



Cer.  
Comp.  
EMC  
f  
G  
GMV  
h  
K or k  
M/Cer.  
M or meg  
 $\mu$   
 $\mu\mu$   
m

Ceramic  
Composition  
Electrolytic, metal cased  
Farad  
Giga, or  $10^9$   
Guaranteed minimum value  
Henry  
Kilohms or kilo ( $10^3$ )  
Mica or Ceramic  
Megohms or mega ( $10^6$ )  
Micro. or  $10^{-6}$   
Micromicro or  $10^{-12}$   
milli or  $10^{-3}$

## ABBREVIATIONS

n	Nano or $10^{-9}$
$\Omega$	ohm
p	Pico or $10^{-12}$
PTB	Paper, "Bathtub"
PMC	Paper, metal cased
Poly.	Polystyrene
Prec.	Precision
PT	Paper Tubular
T	Terra or $10^{12}$
v	Working Volts DC
Var.	Variable
w	Watt
WW	Wire-wound

## SPECIAL NOTES AND SYMBOLS

- + and up
- † Approximate serial number.
- X000 Part first added at this serial number.
- 000X Part removed after this serial number.
- \* 000-000 Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, also reworked or checked components.
- (Mod. w/J) Simple replacement not recommended. Modify to value for later instruments and change other parts to match.



MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

## **HOW TO ORDER PARTS**

Replacement parts are available through your local Tektronix Field Office.

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

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

# PARTS LIST

## Tektronix Part No.

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

### Bulbs

		Tektronix Part Number
B129	Neon, Type NE-2	150-002
B160W	Neon, Type NE-2	150-002
B167	Neon, Type NE-2	150-002
B171	Neon, Type NE-2	150-002
B267	Neon, Type NE-2	150-002
B271	Neon, Type NE-2	150-002
B347	Neon, Type NE-2	150-002
B386	Neon, Type NE-2	150-002
B397	Neon, Type NE-2	150-002
B398	Neon, Type NE-2	150-002
B434A	Neon, Type NE-2	150-002
B434B	Neon, Type NE-2	150-002
B601	Incandescent, # 47	150-001
B602	Incandescent, # 47	150-001
B603	Incandescent, # 47	150-001
B1088	Neon, Type NE-2	150-002
B1098	Neon, Type NE-2	150-002

### Capacitors

C1	.01 $\mu$ f	Cer.	Fixed	500 v	283-002
C2	.02 $\mu$ f	Cer.	Fixed	600 v	283-006
C4	.001 $\mu$ f	Cer.	Fixed	500 v	283-000
C6	.01 $\mu$ f	Cer.	Fixed	500 v	283-002
C7	.01 $\mu$ f	Cer.	Fixed	150 v	283-003
C21	.005 $\mu$ f	Cer.	Fixed	500 v	283-001
C22	.001 $\mu$ f	Cer.	Fixed	500 v	283-000
C25	101-1423X	.001 $\mu$ f	Cer.	500 v	283-000
C31	101-1070X	.005 $\mu$ f	Cer.	500 v	283-001
C34	101-1070X	.005 $\mu$ f	Cer.	500 v	283-001
C40	X1071-up	.005 $\mu$ f	Cer.	500 v	283-001
C43	101-1070	.005 $\mu$ f	Cer.	500 v	283-001
C43	1071-up	.01 $\mu$ f	Cer.	1000 v	283-013
C44	101-699	27 $\mu\mu$ f	Cer.	500 v	±5.4 $\mu\mu$ f
C44	700-1070	12 $\mu\mu$ f	Cer.	500 v	281-513
C44	1071-up	150 $\mu\mu$ f	Cer.	500 v	±1.2 $\mu\mu$ f
C44					281-505
C44					281-524
C45	X1071-up	1000 $\mu\mu$ f	Cer.	500 v	281-536
C47	101-1070X	.005 $\mu$ f	Cer.	500 v	283-001
C51		.01 $\mu$ f	Cer.	500 v	283-002
C52		.02 $\mu$ f	Cer.	600 v	283-006
C54		.001 $\mu$ f	Cer.	500 v	283-000

**Capacitors (continued)**

						Tektronix Part Number
C56		.01 $\mu\text{f}$	Cer.	Fixed	150 v	283-003
C57		.01 $\mu\text{f}$	Cer.	Fixed	150 v	283-003
C74	924-up	.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C76	924-up	.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C78		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C87		22 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 4.4 \mu\mu\text{f}$ 281-510
C101	101-1070X	.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C102	101-1070X	22 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 2.2 \mu\mu\text{f}$ 281-511
C103	X1071-up	.01 $\mu\text{f}$	Cer.	Fixed	500 v	283-002
C105		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C109		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C116		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C120		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C123	101-1148	10 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$ 281-504
C123	1149-up	6.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-541
C129		.01 $\mu\text{f}$	Cer.	Fixed	500 v	283-002
C131	101-1070X	27 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 5.4 \mu\mu\text{f}$ 281-513
C134		10 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$ 281-504
C138		.01 $\mu\text{f}$	Cer.	Fixed	500 v	283-002
C141		5.6 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 10\%$ 281-544
C150		82 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 8.2 \mu\mu\text{f}$ 281-528
C151		270 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 10\%$ 281-543
C154		270 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 10\%$ 281-543
C160A		1.5-7 $\mu\mu\text{f}$	Cer.	Var.		281-005
C160B		3-12 $\mu\mu\text{f}$	Cer.	Var.		281-007
C160C		4.5-25 $\mu\mu\text{f}$	Cer.	Var.		281-010
C160D		82 $\mu\mu\text{f}$	Mica	Fixed	500 v	5% 283-534
C160E		4.5-25 $\mu\mu\text{f}$	Cer.	Var.		281-010
C160F		82 $\mu\mu\text{f}$	Mica	Fixed	500 v	5% 283-534
C160G		.001 $\mu\text{f}$	Mylar			*291-008
C160H		.01 $\mu\text{f}$				
C160J		.1 $\mu\text{f}$				
C160K		1 $\mu\text{f}$				
				Mylar Timing Series		$\pm 1/2\%$ *291-007
C160L	715-up	270 $\mu\mu\text{f}$	Cer.	Fixed	500 v	10% 281-543
C161		2.2 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 0.5 \mu\mu\text{f}$ 281-500
C163	X3763-up	.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C165		100 $\mu\mu\text{f}$	Cer.	Fixed	350 v	$\pm 20 \mu\mu\text{f}$ 281-523
C167		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C170		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C180A		180 $\mu\mu\text{f}$	Mica	Fixed	500 v	10% 283-509
C180B		.0022 $\mu\text{f}$	PTM	Fixed	400 v	285-543
C180C		.022 $\mu\text{f}$	PTM	Fixed	400 v	285-515
C180D		.1 $\mu\text{f}$	PTM	Fixed	400 v	285-526
C180E		.1 $\mu\text{f}$	PTM	Fixed	400 v	285-526
C181		39 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 3.9 \mu\mu\text{f}$ 281-516
C187		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C190		12 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 0.6 \mu\mu\text{f}$ 281-508
C193		.01 $\mu\text{f}$	Cer.	Fixed	500 v	283-002
C196		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000

**Capacitors (continued)**

Tektronix  
Part Number

C197	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C221	47 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 9.4 \mu\mu\text{f}$	281-518
C234	10 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$	281-504
C241	3.3 $\mu\mu\text{f}$	Cer.	Fixed		$\pm .25 \mu\mu\text{f}$	281-534
C250	39 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 3.9 \mu\mu\text{f}$	281-516
C254	.01 $\mu\text{f}$	Cer.	Fixed	500 v		283-002
C260A	3-12 $\mu\mu\text{f}$	Cer.	Var.			281-007
C260B	39 $\mu\mu\text{f}$	Mica	Fixed	500 v	5%	283-533
C260C	7-45 $\mu\mu\text{f}$	Cer.	Var.			281-012
C260D	101-1089	470 $\mu\mu\text{f}$	Manufactured by Tektronix			
C260D	1090-up	480 $\mu\mu\text{f}$				
C260E		.00505 $\mu\text{f}$				
C260F		.0505 $\mu\text{f}$				
C260G		.505 $\mu\text{f}$				
C267	.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C280A	22 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 4.4 \mu\mu\text{f}$	281-510
C280B	470 $\mu\mu\text{f}$	Cer.	Fixed		$\pm 94 \mu\mu\text{f}$	281-525
C280C	.0047 $\mu\text{f}$	PTM	Fixed	400 v		285-506
C280D	.047 $\mu\text{f}$	PTM	Fixed	400 v		285-519
C280E	.047 $\mu\text{f}$	PTM	Fixed	400 v		285-519
C295	1.5 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 0.5 \mu\mu\text{f}$	281-526
C295	15 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-509
C301C	7-45 $\mu\mu\text{f}$	Cer.	Var.			281-012
C301E	330 $\mu\mu\text{f}$	Cer.	Fixed	500 v	10%	281-546
C301H	12 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1.2 \mu\mu\text{f}$	281-506
C320	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C330	4.5-25 $\mu\mu\text{f}$	Cer.	Var.			281-010
C331	10 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$	281-504
C336	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C340	10 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$	281-504
C343	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C347	.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C348	3-12 $\mu\mu\text{f}$	Cer.	Var.			281-007
C355	1.5 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 0.5 \mu\mu\text{f}$	281-526
C356	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C364	3-12 $\mu\mu\text{f}$	Cer.	Var.			281-036
C372	9-180 $\mu\mu\text{f}$	Mica	Var.			281-023
C380	6.25 $\mu\text{f}$	EMT	Fixed	300 v		290-000
C384	3-12 $\mu\mu\text{f}$	Cer.	Var.			281-036
C390	4.7 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 1 \mu\mu\text{f}$	281-501
C393	.047 $\mu\text{f}$	PTM	Fixed	400 v		285-519
C397	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C421	.01 $\mu\text{f}$	Cer.	Fixed	500 v		283-002
C426	.005 $\mu\mu\text{f}$	Cer.	Fixed	500 v		283-001
C444	22 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 4.4 \mu\mu\text{f}$	281-510
C454	47 $\mu\mu\text{f}$	Cer.	Fixed	500 v	$\pm 9.4 \mu\mu\text{f}$	281-518
C457	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C601	.02 $\mu\text{f}$	Cer.	Fixed	150 v		283-004
C610	.01 $\mu\text{f}$	PTM	Fixed	400 v		285-510

**Capacitors (continued)**

					Tektronix Part Number
C617		.01 $\mu$ f	PTM	Fixed	285-510
C628		.01 $\mu$ f	PTM	Fixed	285-510
C640		125 $\mu$ f	EMC	Fixed	290-044
C648		.01 $\mu$ f	Cer.	Fixed	283-002
C649		2 x 40 $\mu$ f	EMC	Fixed	290-040
C650		.01 $\mu$ f	PTM	Fixed	285-510
C670	101-3762	150 $\mu$ f	EMC	Fixed	290-048
C670	3763-up	2 x 125 $\mu$ f	EMC	Fixed	290-132
C671	101-3762	150 $\mu$ f	EMC	Fixed	290-048
C671	3763-up	200 $\mu$ f	EMC	Fixed	290-176
C679A,B,C		3 x 10 $\mu$ f	EMC	Fixed	290-033
C680		.01 $\mu$ f	PTM	Fixed	285-510
C688		.01 $\mu$ f	PTM	Fixed	285-510
C700		125 $\mu$ f	EMC	Fixed	290-045
C710	101-279	.01 $\mu$ f	PTM	Fixed	285-510
C710	280-up	.01 $\mu$ f	PTM	Fixed	285-511
C730		125 $\mu$ f	EMC	Fixed	290-044
C740		.01 $\mu$ f	PTM	Fixed	285-510
C760A,B		2 x 40 $\mu$ f	EMC	Fixed	290-042
C770		.005 $\mu$ f	Cer.	Fixed	283-001
C771		.005 $\mu$ f	Cer.	Fixed	283-001
C774		.005 $\mu$ f	Cer.	Fixed	283-001
C775	101-3762X	.005 $\mu$ f	Cer.	Fixed	283-001
C782		.01 $\mu$ f	Cer.	Fixed	283-003
C783	X3763-up	15 $\mu$ f	EMC	Fixed	290-135
C786		100 $\mu$ f	EMT	Fixed	290-015
C790	101-3762	2000 $\mu$ f	EMC	Fixed	290-112
C790	3763-up	4500 $\mu$ f	EMC	Fixed	290-178
C791	101-3762	2000 $\mu$ f	EMC	Fixed	290-112
C791	3763-up	4500 $\mu$ f	EMC	Fixed	290-178
C792	101-3762	2000 $\mu$ f	EMC	Fixed	290-112
C792	3763-up	4500 $\mu$ f	EMC	Fixed	290-178
C793	101-619	.1 $\mu$ f	Cer.	Fixed	283-009
C793	620-up	.1 $\mu$ f	Cer.	Fixed	283-012
C801		.047 $\mu$ f	PTM	Fixed	285-519
C802		2 x 20 $\mu$ f	EMC	Fixed	290-037
C803		.001 $\mu$ f	PTM	Fixed	285-501
C806		.01 $\mu$ f	PTM	Fixed	285-510
C808		.001 $\mu$ f	PTM	Fixed	285-501
C819	X1540-up	.1 $\mu$ f	Cer.	Fixed	283-012
C820	101-1089	.0068 $\mu$ f	Cer.	Fixed	285-508
C820	1090-up	.01 $\mu$ f	Cer.	Fixed	283-011
C821		.01 $\mu$ f	Cer.	Fixed	283-011
C827		.01 $\mu$ f	Cer.	Fixed	283-011
C828	X1540-up	.01 $\mu$ f	Cer.	Fixed	283-011
C829	X1540-up	.001 $\mu$ f	Cer.	Fixed	283-000
C831	101-1089	.0068 $\mu$ f	PTM	Fixed	285-508
C831	1090-up	.01 $\mu$ f	Cer.	Fixed	283-011
C832	101-739	.0068 $\mu$ f	PTM	Fixed	283-034
C832	740-up	.005 $\mu$ f	Cer.	Fixed	283-034
C833	101-606	.00047 $\mu$ f	PTM	Fixed	281-556
C833	607-up	500 $\mu$ uf	Cer.	Fixed	281-556
C834	101-606	.00047 $\mu$ f	PTM	Fixed	281-556
C834	607-up	500 $\mu$ uf	Cer.	Fixed	281-556
C836		500 $\mu$ uf	Cer.	Fixed	281-556

**Capacitors (continued)**

						Tektronix Part Number
C841		.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C842	101-1089	.0068 $\mu\text{f}$	PTM	Fixed	3,000 v	285-508
C842	1090-up	.01 $\mu\text{f}$	Cer.	Fixed	2,000 v	283-011
C845		.01 $\mu\text{f}$	Cer.	Fixed	2,000 v	283-011
C848		.01 $\mu\text{f}$	Cer.	Fixed	2,000 v	283-011
C871		330 $\mu\mu\text{f}$	Mica	Fixed	500 v	283-518
C874		330 $\mu\mu\text{f}$	Mica	Fixed	500 v	283-518
C885		27 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-513
C897		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1004		250 $\mu\text{f}$	EMT	Fixed	6 v	290-111
C1006	X2585-up	3.12 $\mu\mu\text{f}$	Cer.	Var.		281-036
C1010	101-3762X	.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C1011		1.8 $\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1012		1.8 $\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1013		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1014		.68 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-537
C1021		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1022		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1023		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1024		.68 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-537
C1031		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1032		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1033		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1034		1 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-538
C1041		.7-3 $\mu\mu\text{f}$	Tub.	Var.		281-027
C1042		.7-3 $\mu\mu\text{f}$	Tub.	Var.		281-027
C1043		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1044		1 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-538
C1051		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1052		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1053		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1054		1.5 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-529
C1061		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1062		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1063		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1064		1.5 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-529
C1071		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1072		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1074		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1075	101-2584X	1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v	281-557
C1080		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1082		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1084		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C1088		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C1090		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1092		.001 $\mu\text{f}$	Cer.	Fixed	500 v	283-000
C1094		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C1098		.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001
C1101		.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C1102	X3763-up	8 $\mu\text{f}$	EMC	Fixed	400 v	290-002
C1103		.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C1105		.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C1106	X3763-up	.5 $\mu\text{f}$	MPT	Fixed	400 v	285-537
C1107		.02 $\mu\text{f}$	Cer.	Fixed	600 v	283-006
C1204	101-2584	.005 $\mu\text{f}$	Cer.	Fixed	500 v	283-001

### Capacitors (continued)

							Tektronix Part Number
C1204	2585-up	.01 $\mu\text{f}$	Cer.	Fixed	150 v	Selected	283-003
C1205	101-2584	.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C1205	2585-3762	.1 $\mu\text{f}$	Cer.	Fixed	10 v		283-023
C1205	3763-up	.01 $\mu\text{f}$	Cer.	Fixed	150 v	Selected	283-003
C1209	X2585-up	8-50 $\mu\mu\text{f}$	Cer.	Var.			281-022
C1210		.02 $\mu\text{f}$	Cer.	Fixed	600 v		283-006
C1211		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1212		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1213		.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C1214		7.3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1221		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1222		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1223		.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C1224		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1231		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1232		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1233		.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C1234		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1241		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1242		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1243		.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C1244		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1251		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1252		1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1255	X2585-up	1.8 $\mu\mu\text{f}$	Cer.	Fixed	500 v		281-557
C1253		.001 $\mu\text{f}$	Cer.	Fixed	500 v		283-000
C1254		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1258		.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C1260		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1261		.7-3 $\mu\mu\text{f}$	Tub.	Var.			281-027
C1283		.005 $\mu\text{f}$	Cer.	Fixed	500 v		283-001
C1285		.02 $\mu\text{f}$	Cer.	Fixed	600 v		283-006

### Diodes

D44	X1071-up	Germanium Diode		152-008
D47	X1071-up	STD615 Tunnel Diode	Use	152-102
D122		Germanium Diode		152-008
D131	830-1070X	Germanium Diode		152-008
D134	X2262-up	Germanium Diode		152-025
D142		Germanium Diode		152-008
D642A,B,C,D		Silicon Diode		152-047
D672A,B,C,D		Silicon Diode		152-047
D702A,B		Silicon Diode		152-047
D732A,B		Silicon Diode		152-047
D762A,B,C,D		Silicon Diode		152-047
D792	101-3762	Germanium Diode T12G		152-008
D792A,B,C,D,	X3763-up	Silicon Diode Assy		152-113
D793	3763-up	Germanium Diode T12G		152-008

\* Even though the diodes may be different in physical size they are direct electrical replacements for the diodes in your instrument.

### Fuse

F601		7 amp 3AG Slo-Blo (for 60-cycle operation) 117 v oper.	Use	159-036
		6.25 amp 3AG Slo-Blo (for 50-cycle operation) 117 v oper.		159-011
		4 amp 3AG Slo-Blo (for 60-cycle operation) 234 v oper.	Use	159-027
		3 amp 3AG Slo-Blo (for 50-cycle operation) 234 v oper.		159-005
F1210	{ X3763-up	.15 Fast-blo/Pig tails		159-049

### Relays

K600		Amperite 6N045T		148-002
K601		Relay		148-012

### Inductors

Tektronix  
Part Number

L4	X1071-up	.15 $\mu$ h				*108-220
L12	X1071-up	.15 $\mu$ h				*108-220
L47	X1071-up	3.2 $\mu$ h				*108-088
L249		245 $\mu$ h		Fixed		*108-174
L424		280 $\mu$ h		Fixed		*108-015
L914	101-2584	Delay Line			Use	*040-275
L914	2585-up	Delay Line				108-246
L1013		Ferramic Suppressor			Use	276-528
L1014		Plate Coil 8 sec.,				*108-196
L1015		Grid Coil 7 sec.,				*108-197
L1023		Ferramic Suppressor			Use	276-528
L1024		Plate Coil 8 sec.,				*108-196
L1025		Grid Coil 7 sec.,				*108-197
L1033		Ferramic Suppressor			Use	276-528
L1043		Ferramic Suppressor				Use 276-528
L1053		Ferramic Suppressor				Use 276-528
L1063		Ferramic Suppressor				Use 276-528
L1083	X1071-up	.45 $\mu$ h				*108-221
L1093	X1071-up	.45 $\mu$ h				*108-221
L1214		Plate Coil, 6 sec.,				*108-198
L1215		Grid Coil, 5 sec.,				*108-199
L1224		Plate Coil 6 sec.,				*108-198
L1225		Grid Coil, 5 sec.,				*108-199
L1280	101-2584	.3 $\mu$ h		Fixed		*108-182
L1280	2585-up	.1 $\mu$ h		Fixed		*108-250
L1281	101-2584	.3 $\mu$ h		Fixed		*108-182
L1281	2585-up	.1 $\mu$ h		Fixed		*108-250
L1282		.2 $\mu$ h		Fixed		*108-181
L1283		.2 $\mu$ h		Fixed		*108-181
L1286	101-2584	.5 $\mu$ h		Fixed		*108-170
L1286	2585-up	.45 $\mu$ h		Fixed		*108-221
L1287	101-2584	.5 $\mu$ h		Fixed		*108-170
L1287	2585-up	.45 $\mu$ h		Fixed		*108-221

### Resistors

R1	X1087-up	1.8 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-185
R2		100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R3		470 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-474
R4		100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R7	X1850-up	47 $\Omega$	$\frac{1}{4}$ w	Fixed	Comp.	10%	316-470
R12		1 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-105
R13	101-1070	390 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-394
R13	1071-1849	360 k	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-364
R13	1850-up	22 k	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-223
R14	101-1070	47 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-473
R14	1071-1849	22 k	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-223
R14	1850-up	82 k	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-823
R15	101-1849	270 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-274
R15	1850-up	470 k	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-474
R16	X1071-1849X	56 k	1 w	Fixed	Comp.	5%	303-563
R17*		2 x 100 k		Var.	Comp.		311-096
R18	X1071-1849X	56 k	1 w	Fixed	Comp.	5%	303-563
R20		47 $\Omega$	$\frac{1}{4}$ w	Fixed	Comp.	10%	316-470
R21		47 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-470

\*R17, R110 concentric with SW110. Furnished as a unit.

**Resistors (continued)**

							Tektronix Part Number
R22	101-1423X	68 k	1/2 w	Fixed	Comp.	10%	302-683
R23	101-1423X	2.7 k	1 w	Fixed	Comp.	10%	304-272
R24	X2262-up	8.2 k	1 w	Fixed	Comp.	10%	304-822
R25	101-1423	68 k	1/2 w	Fixed	Comp.	10%	302-683
R25	1424-2261	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R25	2262-up	8.2 k	2 w	Fixed	Comp.	10%	306-822
R26	101-1423	10 k		Var.	Comp.		311-016
R26	1424-up	5 k		Var.	Comp.		311-011
R27		47 Ω	1/4 w	Fixed	Comp.	10%	316-470
R28		12 k	8 w	Fixed	WW	5%	308-069
R29	101-1070X	4.535 k	1/2 w	Fixed	Prec.	1%	309-191
R30	101-1070X	100 Ω	1/4 w	Fixed	Comp.	10%	316-101
R31	101-1070X	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R32	101-1070X	10 k	2 w	Fixed	Comp.	10%	306-103
R33	101-1070X	47 Ω	1/4 w	Fixed	Comp.	10%	316-470
R34	101-1070X	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R35	101-1070X	470 Ω	1/2 w	Fixed	Comp.	5%	301-471
R36	101-1070X	8.2 k	2 w	Fixed	Comp.	10%	306-822
R40	101-1070	47 Ω	1/4 w	Fixed	Comp.	10%	316-470
R40	1071-up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R41	101-1070	1.8 k	1/2 w	Fixed	Prec.	1%	309-030
R41	1071-up	68 k	1/2 w	Fixed	Comp.	10%	302-683
R42	101-1070X	100 Ω	1/4 w	Fixed	Comp.	10%	316-101
R43	101-1070	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R43	1071-up	6.8 k	1/2 w	Fixed	Comp.	10%	302-682
R44	101-273	13.23 k	1/2 w	Fixed	Prec.	1%	309-035
R44	274-699	11.48 k	1/2 w	Fixed	Prec.	1%	309-192
R44	700-1070	28.05 k	1 w	Fixed	Prec.	1%	310-067
R44	1071-up	22 k	1 w	Fixed	Comp.	10%	304-223
R45	101-699	7.3 k	1/2 w	Fixed	Prec.	1%	309-120
R45	700-1070X	16.69 k	1/2 w	Fixed	Prec.	1%	309-231
R46	101-1070	8.2 k	2 w	Fixed	Comp.	10%	306-822
R46	1071-1423	Selected					
R46	1424-up	6 k	5 w	Fixed	WW	5%	308-052
R47	101-1070	500 Ω	.2 w	Var.	Comp.	20%	311-066
R47	1071-1423	20 Ω	.2 w	Var.	Comp.	20%	311-236
R47	1424-up	30 Ω	.2 w	Var.	WW	5%	311-238
R48	X1071-up	22 Ω	1/2 w	Fixed	Comp.	5%	301-220
R52		100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R53		470 k	1/2 w	Fixed	Comp.	10%	302-474
R54		100 k	1/2 w	Fixed	Comp.	10%	302-104
R62		1 meg	1/2 w	Fixed	Comp.	10%	302-105
R63		390 k	1/2 w	Fixed	Comp.	10%	302-394
R64		47 k	1/2 w	Fixed	Comp.	10%	302-473
R65		270 k	1/2 w	Fixed	Comp.	10%	302-274
R67*		2 x 100 k		Var.	Comp.		311-096
R72		100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R73		100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R74	X924-up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R75		33 k	2 w	Fixed	Comp.	10%	306-333
R76	X924-up	47 Ω	1/2 w	Fixed	Comp.	10%	302-470

\*R67 concentric with R210, SW210. These components furnished as a unit.

**Resistors (continued)**

Tektronix  
Part Number

R78		500 Ω	.2 w	Var.	Comp.	20%	311-066
R79		33 k	2 w	Fixed	Comp.	10%	306-333
R83		100 Ω	½ w	Fixed	Comp.	10%	302-101
R85	101-509	3.3 k	½ w	Fixed	Comp.	5%	301-332
R85	510-up	1.8 k	½ w	Fixed	Comp.	5%	301-182
R87		100 k	½ w	Fixed	Comp.	10%	302-104
R88		270 k	½ w	Fixed	Comp.	10%	302-274
R91		100 Ω	½ w	Fixed	Comp.	10%	302-101
R93		1.2 k	½ w	Fixed	Comp.	10%	302-122
R96		33 k	2 w	Fixed	Comp.	10%	306-333
R101		22 meg	½ w	Fixed	Comp.	10%	302-226
R102	101-1070X	22 k	½ w	Fixed	Comp.	10%	302-223
R103	X1071-up	1.5 meg	½ w	Fixed	Comp.	10%	302-155
R104	X1071-up	47 Ω	½ w	Fixed	Comp.	10%	302-470
R105		390 k	½ w	Fixed	Comp.	10%	302-394
R106		1 meg	½ w	Fixed	Comp.	10%	302-105
R107		100 Ω	½ w	Fixed	Comp.	10%	302-101
R108	X1071-up	1 k	½ w			10%	302-102
R109		220 k	½ w	Fixed	Comp.	10%	302-224
R110*		100 k		Var.	Comp.		311-096
R111	101-1209	100 k	.2 w	Var.	Comp.	±20%	311-088
R111	1210-up	200 k	.2 w	Var.	Comp.		311-219
R114	101-2261	470 k	½ w	Fixed	Comp.	5%	301-474
R114	2262-up	560 k	½ w	Fixed	Comp.	5%	301-564
R115	101-2261	100 k	½ w	Fixed	Comp.	5%	301-104
R115	2262-up	150 k	½ w	Fixed	Comp.	5%	301-154
R116	101-2261	120 k	½ k	Fixed	Comp.	5%	301-124
R116	2262-up	220 k	½ w	Fixed	Comp.	5%	301-224
R119		100 Ω	½ w	Fixed	Comp.	10%	302-101
R120		47 Ω	½ w	Fixed	Comp.	10%	302-470
R122		68 k	1 w	Fixed	Comp.	10%	304-683
R123		330 k	½ w	Fixed	Comp.	10%	302-334
R124		330 k	½ w	Fixed	Comp.	10%	302-334
R125		50 k		Var.	Comp.		311-023
R126		100 k	½ w	Fixed	Comp.	10%	302-104
R127		100 Ω	½ w	Fixed	Comp.	10%	302-101
R128		12 k	½ w	Fixed	Comp.	10%	302-123
R129		10 k	½ w	Fixed	Comp.	10%	302-103
R130		22 k	2 w	Fixed	Comp.	10%	306-223
R131	101-1070X	1 k	½ w	Fixed	Comp.	10%	302-102
R132	101-1070X	47 Ω	½ w	Fixed	Comp.	10%	302-470
R133	X2262-up	100 k	½ w	Fixed	Comp.	10%	302-104
R134		6 k	3 w	Mica Plate		1%	*310-555
R137		47 Ω	½ w	Fixed	Comp.	10%	302-470
R138		100 Ω	½ w	Fixed	Comp.	10%	302-101
R141		45 k	1 w	Fixed	Prec.	1%	310-093
R143		33 k	1 w	Fixed	Prec.	1%	310-070
R144		8 k	5 w	Fixed	WW	5%	308-053
R146		47 Ω	½ w	Fixed	Comp.	10%	302-470
R147		10 k	½ w	Fixed	Comp.	10%	302-103
R148		18 k	1 w	Fixed	Comp.	10%	304-183
R149		47 Ω	½ w	Fixed	Comp.	10%	302-470
R150		270 Ω	½ w	Fixed	Comp.	10%	302-271

\*R17, R110 concentric with SW110. Furnished as a unit.

**Resistors (continued)**

						Tektronix Part Number
R151	1 k	1/2 w	Fixed	Comp.	10%	302-102
R152	680 Ω	1/2 w	Fixed	Comp.	10%	302-681
R153	33 k	.2 w	Fixed	Comp.	10%	306-333
R154	1 k	1/2 w	Fixed	Comp.	10%	302-102
R160A	100 k	1/2 w	Fixed	Prec.	1%	309-045
R160B	200 k	1/2 w	Fixed	Prec.	1%	309-051
R160C	500 k	1/2 w	Fixed	Prec.	1%	309-003
R160D	1 meg	1/2 w	Fixed	Prec.	1%	309-014
R160E	2 meg	1/2 w	Fixed	Prec.	1%	309-023
R160F	5 meg	1/2 w	Fixed	Prec.	1%	309-087
R160G	10 meg	1 w	Fixed	Prec.	1%	310-107
R160H	10 meg	1 w	Fixed	Prec.	1%	310-107
R160T	X830-up	56 k	1 w	Fixed	Comp.	10%
R160V	X830-up	1 meg	1/2 w	Fixed	Comp.	10%
R160W		100 k	1/2 w	Fixed	Comp.	10%
R160X	10 k	1/2 w	Fixed	Comp.	10%	302-103
R160Y	20 k		Var.	WW	20%	311-108
R160Z	500 Ω	.2 w	Var.	Comp.	20%	311-066
R163	X3763-up	47 Ω	1/2 w	Fixed	Comp.	10%
R165		20 k	8 w	Fixed	WW	5%
R166		15 k	5 w	Fixed	WW	5%
R167	1.5 meg	1/2 w	Fixed	Comp.	10%	302-155
R168	47 k	1/2 w	Fixed	Comp.	10%	302-473
R170	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R171	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R172	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R173	470 Ω	1/2 w	Fixed	Comp.	10%	302-471
R174	8 k	5 w	Fixed	WW	5%	308-053
R176	2 k		Var.	Comp.		311-008
R178	3 k	5 w	Fixed	WW	5%	308-062
R180A	470 k	1/2 w	Fixed	Comp.	10%	302-474
R180B	4.7 meg	1/2 w	Fixed	Comp.	10%	302-475
R181	4.7 meg	1/2 w	Fixed	Comp.	10%	302-475
R183	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R186	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R187	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R189	56 k	2 w	Fixed	Comp.	10%	306-563
R190	47 k	1/2 w	Fixed	Comp.	10%	302-473
R191	100 k	1/2 w	Fixed	Comp.	10%	302-104
R192	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R193	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R194	4.7 k	1 w	Fixed	Comp.	10%	304-472
R196	100 k	1/2 w	Fixed	Comp.	10%	302-104
R197	47 Ω	1/2 w	Fixed	Comp.	10%	302-470
R199	100 k	1 w	Fixed	Comp.	10%	304-104
R210*	100 k		Var.	Comp.		311-096
R211	101-1209	100 k	.2 w	Var.	Comp.	Use 311-219
R211	1210-1479	200 k	.2 w	Var.	Comp.	Use 311-110
R211	1480-up	100 k	.5 w	Var.	Comp.	311-110
R214		100 k	1/2 w	Fixed	Comp.	10%
R215		27 k	1/2 w	Fixed	Comp.	5%
R216		39 k	1/2 w	Fixed	Comp.	10%
R221		100 Ω	1/2 w	Fixed	Comp.	10%
R230		22 k	1 w	Fixed	Comp.	10%
R232		100 Ω	1/2 w	Fixed	Comp.	10%

\*R210 concentric with R67, SW210. Furnished as a unit.

### Resistors (continued)

Tektronix  
Part Number

R233	5.6 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-132
R234	5 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-159
R235	270 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-274
R237	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R241	33 k	1 w	Fixed	Prec.	1%	310-070
R243	30 k	1 w	Fixed	Prec.	1%	310-072
R244	15 k	5 w	Fixed	WW	5%	308-108
R246	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R247	2.2 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-222
R248	47 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-473
R250	2.7 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-272
R254	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R260A	404 k	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-567
R260B	606 k	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-568
R260C	1.01 meg	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-571
R260D	4.04 meg	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-575
R260E	6.06 meg	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-576
R260F	10.1 meg	$\frac{1}{2}$ w	Fixed	Prec.	$\pm\frac{1}{4}\%$	312-577
R264	220 k	2 w	Fixed	Comp.	10%	306-224
R267	1.5 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-155
R268	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R271	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R274	15 k	2 w	Fixed	Comp.	10%	306-153
R276	101-149	10 k	2 w	Var.	Comp.	10%
R276	150-up	10 k	2 w	Var.	Comp.	10%
R277**	{ selected					
R278**						
R279	12 k	2 w	Fixed	Comp.	10%	306-123
R280	1.2 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-125
R281	4.7 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-475
R282	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R283	101-279	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%
R283	280-up	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%
R291	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R293	82 k	2 w	Fixed	Comp.	10%	306-823
R295	39 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-393
R296	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R297	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R299	10 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-103
R300	47 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-470
R301C	900 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-111
R301E	111 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-046
R303	1 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-105
R311	101-679	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%
R311	680-up	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%
R313	33 k	2 w	Fixed	Comp.	10%	306-333
R314	101-919	10 k	Var.	Comp.	10%	311-147
R314	920-up	15 k	2 w	Var.	Comp.	20%
R315	33 k	2 w	Fixed	Comp.	10%	306-333
R317	100 k		Var.	Comp.		311-026

\*\*Selected to provide correct sweep length.

### Resistors (continued)

						Tektronix Part Numbers
R319		220 k	1/2 w	Fixed	Comp.	10% 302-224
R320		3.3 k	1/2 w	Fixed	Comp.	10% 302-332
R321		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R324	101-919	22 k	2 w	Fixed	Comp.	10% 306-223
R324	920-up	27 k	2 w	Fixed	Comp.	10% 306-273
R330		1.5 meg	1/2 w	Fixed	Prec.	1% 309-017
R332		3.5 meg	1/2 w	Fixed	Prec.	1% 309-086
R333 *		100 k		Var.	Comp.	311-149
R336		12.1 meg	1/2 w	Fixed	Prec.	1% 309-268
R338 *		200 k		Var.	Comp.	311-149
R340		2.7 k	1/2 w	Fixed	Comp.	10% 302-272
R341		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R343		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R345		47 k	2 w	Fixed	Comp.	10% 306-473
R348		50 k	.2 w	Var.	Comp.	20% 311-125
R349	101-169	143 k	1/2 w	Fixed	Prec.	1% 309-092
R349	170-up	174 k	1/2 w	Fixed	Prec.	1% 309-151
R351		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R353		47 k	2 w	Fixed	Comp.	10% 306-473
R355		400 k	1 w	Fixed	Prec.	1% 310-094
R356		400 k	1 w	Fixed	Prec.	1% 310-094
R357		22 k	1/2 w	Fixed	Comp.	10% 302-223
R358		20 k		Var.	Comp.	311-018
R361		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R364		3-15 k	5 w	Mica Plate		*310-558
R366		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R372		2.5 k	.2 w	Var.	Comp.	±20% 311-120
R374		8 k	5 w	Fixed	WW	5% 308-053
R375		8 k	5 w	Fixed	WW	5% 308-053
R380		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R381		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R384		3-15 k	5 w	Mica Plate		*310-558
R386		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R387		39 k	2 w	Fixed	Comp.	10% 306-393
R388		39 k	2 w	Fixed	Comp.	10% 306-393
R390		2.2 k	1/2 w	Fixed	Comp.	10% 302-222
R391		47 Ω	1/2 w	Fixed	Comp.	10% 302-470
R393		390 Ω	1/2 w	Fixed	Comp.	10% 302-391
R396		470 k	1/2 w	Fixed	Comp.	10% 302-474
R397	101-399	820 k	1/2 w	Fixed	Comp.	10% 302-824
R397	400-up	1.5 meg	1/2 w	Fixed	Comp.	10% 302-155
R398	101-399	820 k	1/2 w	Fixed	Comp.	10% 302-824
R398	400-up	1.5 meg	1/2 w	Fixed	Comp.	10% 302-155
R399		470 k	1/2 w	Fixed	Comp.	10% 302-474
R410		1 meg	1/2 w	Fixed	Comp.	10% 302-105
R411		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R415		47 k	1/2 w	Fixed	Comp.	10% 302-473
R416		12 k	1/2 w	Fixed	Comp.	10% 302-123
R421		100 Ω	1/2 w	Fixed	Comp.	10% 302-101
R424		10 k	1/2 w	Fixed	Comp.	10% 302-103

\* R333 and R338 are concentric. Furnished as a unit.

**Resistors (continued)**

Tektronix  
Part Number

R425	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R426	47 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-473
R427	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R428	10 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-103
R431	10 k	5 w	Fixed	WW	5%	308-054
R432	10 k		Var.	WW		311-015
R433	30 k		Var.	Helipot		311-022
R434	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R436	2 k		Var.	WW	$\pm 5\%$	311-141
R437	15 k	5 w	Fixed	WW	5%	308-108
R441	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R443	2.7 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-272
R444	95 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-044
R446	150 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309-049
R447	39 k	2 w	Fixed	Comp.	10%	306-393
R451	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R453	3.3 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-332
R454	10 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-103
R455	270 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-274
R456	100 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-101
R457	47 $\Omega$	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-470
R458	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R459	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R600	33 $\Omega$	2 w	Fixed	Comp.	10%	Use 306-330
R601	30 $\Omega$	3 w	Fixed	WW	5%	
R602	50 $\Omega$		Var.	WW		311-055
R608	33 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-333
R610	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R615	68 k	1 w	Fixed	Prec.	1%	310-054
R616	10 k		Var.	WW		311-015
R617	50 k	1 w	Fixed	Prec.	1%	310-086
R618	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R621	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R623	470 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-474
R625	100 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-104
R628	2.7 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-275
R629	2.7 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-275
R633	1 meg	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-105
R635	15 k	1 w	Fixed	Comp.	10%	304-153
R636	15 k	1 w	Fixed	Comp.	10%	304-153
R637	150 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-154
R638	27 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-273
R639	68 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-683
R640	10 $\Omega$	2 w	Fixed	Comp.	10%	306-100
R641	10 $\Omega$	2 w	Fixed	Comp.	10%	306-100
R642	56 k	1 w	Fixed	Comp.	10%	304-563
R643	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R644	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R646	8 k	5 w	Fixed	WW	5%	308-053
R647	1 k	25 w	Fixed	WW	5%	308-037

**Resistors (continued)**

						Tektronix Part Number	
R648	10 Ω	½ w	Fixed	Comp.	10%	302-100	
R650	333 k	1 w	Fixed	Prec.	1%	310-056	
R651	490 k	1 w	Fixed	Prec.	1%	310-057	
R663	1.5 meg	½ w	Fixed	Comp.	10%	302-155	
R667	680 k	½ w	Fixed	Comp.	10%	302-684	
R668	47 k	½ w	Fixed	Comp.	10%	302-473	
R669	39 k	½ w	Fixed	Comp.	10%	302-393	
R670	10 Ω	1 w	Fixed	Comp.	10%	304-100	
R676	2 k	25 w	Fixed	WW	5%	308-065	
R677	101-1239	1.5 k	25 w	WW	5%	308-040	
R677	1240-up	400 Ω	20 w	Fixed	WW	5%	308-029
R678	101-1239	1.5 k	25 w	Fixed	WW	5%	308-040
R678	1240-up	400 Ω	20 w	Fixed	WW	5%	308-029
R680	333 k	1 w	Fixed	Prec.	1%	310-056	
R681	220 k	1 w	Fixed	Prec.	1%	310-055	
R682	120 k	½ w	Fixed	Comp.	10%	302-124	
R683	1 k	½ w	Fixed	Comp.	10%	302-102	
R685	82 k	1 w	Fixed	Comp.	10%	304-823	
R686	180 k	½ w	Fixed	Comp.	10%	302-184	
R688	1.5 meg	½ w	Fixed	Comp.	10%	302-155	
R689	2.2 meg	½ w	Fixed	Comp.	10%	302-225	
R692	1 k	½ w	Fixed	Comp.	10%	302-102	
R693	1.5 meg	½ w	Fixed	Comp.	10%	302-155	
R697	1 meg	½ w	Fixed	Comp.	10%	302-105	
R698	270 k	½ w	Fixed	Comp.	10%	302-274	
R699	56 k	½ w	Fixed	Comp	10%	302-563	
R700	10 Ω	1 w	Fixed	Comp.	10%	304-100	
R702	100 k	2 w	Fixed	Comp.	10%	306-104	
R710	101-1239	236 k	1 w	Fixed	WW	1%	308-083
R710	1240-up	237 k	1 w	Fixed	Prec.	1%	310-124
R711	101-1239	100 k	½ w	Fixed	WW	1%	Use 309-334
R711	1240-up	100 k	½ w	Fixed	Prec.	1%	309-334
R712	150 k	½ w	Fixed	Comp.	10%	302-154	
R723	1.5 meg	½ w	Fixed	Comp.	10%	302-155	
R727	1 meg	½ w	Fixed	Comp.	10%	302-105	
R728	560 k	½ w	Fixed	Comp.	10%	302-564	
R729	47 k	½ w	Fixed	Comp.	10%	302-473	
R730	10 Ω	1 w	Fixed	Comp.	10%	304-100	
R731	10 Ω	1 w	Fixed	Comp.	10%	304-100	
R732	100 k	1 w	Fixed	Comp.	10%	304-104	
R734	1 k	½ w	Fixed	Comp.	10%	302-102	
R736	2 k	25 w	Fixed	WW	5%	308-065	
R737	2.4 k	20 w	Fixed	WW	5%	308-068	
R740	220 k	1 w	Fixed	Prec.	1%	310-055	
R741	720 k	1 w	Fixed	Prec.	1%	310-059	
R753	1 meg	½ w	Fixed	Comp.	10%	302-105	
R757	150 k	½ w	Fixed	Comp.	10%	302-154	
R758	120 k	½ w	Fixed	Comp.	10%	302-124	
R759	27 k	½ w	Fixed	Comp.	10%	302-273	
R760	10 Ω	½ w	Fixed	Comp.	10%	302-100	
R767	3 k	8 w	Fixed	WW	5%	308-113	
R770	100 k	½ w	Fixed	Comp.	10%	302-104	
R772	100 k	½ w	Fixed	Comp.	10%	302-104	
R773	100 k	½ w	Fixed	Comp.	10%	302-104	

**Resistors (continued)**

Tektronix  
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R780	101-3762	33 k	1 w	Fixed	Comp.	10%	304-333
R780	3763-up	30 k	1 w	Fixed	Comp.	5%	303-303
R781A,B		30 k	½ w	Fixed	Prec.	1%	309-154
R782		2.5 k	½ w	Fixed	Prec.	1%	309-181
R783	101-3762	22 k	½ w	Fixed	Comp.	10%	302-223
R783	3763-up	16 k	½ w	Fixed	Comp.	5%	301-163
R784		100 k	1 w	Fixed	Comp.	10%	304-104
R785	X3763-up	10 k			Comp.		311-017
R786		270 Ω	1 w	Fixed	Comp.	10%	304-271
R791AD	X3763-up	20 Ω	5 w		WW	5%	308-123
R791BC	X3763-up	10 Ω	10 w		WW	5%	308-175
R793		10 k	5 w	Fixed	WW	10%	308-054
R794	X3998-up	33 Ω	½ w	Fixed	Comp.	10%	302-330
R801		1 k	½ w	Fixed	Comp.	10%	302-102
R802		390 Ω	2 w	Fixed	Comp.	10%	306-391
R803		56 k	2 w	Fixed	Comp.	10%	306-563
R806		100 k	½ w	Fixed	Comp.	10%	302-104
R807		1 k	½ w	Fixed	Comp.	10%	302-102
R814		470 k	½ w	Fixed	Comp.	10%	302-474
R818	X1540-up	1.8 meg	½ w	Fixed	Comp.	10%	302-185
R819	X1540-up	1.8 meg	½ w	Fixed	Comp.	10%	302-185
R820		47 k	½ w	Fixed	Comp.	10%	302-473
R824		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R825		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R826		1 meg	2 w	Var.	Comp.		311-041
R827		33 k	½ w	Fixed	Comp.	10%	302-333
R828		1 meg	½ w	Fixed	Comp.	10%	302-105
R829	X1540-up	18 k	½ w	Fixed	Comp.	10%	302-183
R836		1 meg	½ w	Fixed	Comp.	10%	302-105
R840		2 meg		Var.	Comp.		311-042
R841		2.2 meg	½ w	Fixed	Comp.	10%	302-225
R842		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R843		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R844		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R845		10 k	½ w	Fixed	Comp.	10%	302-103
R847		27 k	½ w	Fixed	Comp.	10%	302-273
R848		1 meg	½ w	Fixed	Comp.	10%	302-105
R853		2.2 meg	½ w	Fixed	Comp.	10%	302-225
R854		2.2 meg	½ w	Fixed	Comp.	10%	302-225
R856		2 meg		Var.	Comp.		311-043
R857		1 meg	½ w	Fixed	Comp.	10%	302-105
R860		100 k	.2 w	Var.	Comp.	±20%	311-088
R861		100 k		Var.	Comp.		311-026
R862		47 k	½ w	Fixed	Comp.	10%	302-473
R863		47 k	½ w	Fixed	Comp.	10%	302-473
R864		50 k		Var.	Comp.		311-023
R870		150 k	½ w	Fixed	Comp.	10%	302-154
R871		2.7 meg	½ w	Fixed	Comp.	10%	302-275
R872		1 k	½ w	Fixed	Comp.	10%	302-102
R874		3.9 meg	½ w	Fixed	Comp.	10%	302-395
R875		68 k	½ w	Fixed	Comp.	10%	302-683
R876		1 k	½ w	Fixed	Comp.	10%	302-102
R878		33 k	1 w	Fixed	Comp.	10%	304-333
R879		10 k		Var.	Comp.		311-016
R880		100 k	½ w	Fixed	Comp.	10%	302-104

**Resistors (continued)**

						Tektronix Part Number
R883	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R885	9.5 k	1/2 w	Fixed	Prec.	1%	309-121
R886	6.375 k	1/2 w	Fixed	Prec.	1%	309-119
R887	2.1 k	1/2 w	Fixed	Prec.	1%	309-117
R888	1.025 k	1/2 w	Fixed	Prec.	1%	309-116
R889	610 Ω	1/2 w	Fixed	Prec.	1%	309-113
R890	200 Ω	1/2 w	Fixed	Prec.	1%	309-073
R891	100 Ω	1/2 w	Fixed	Prec.	1%	309-112
R892	60 Ω	1/2 w	Fixed	Prec.	1%	309-067
R893	40 Ω	1/2 w	Fixed	Prec.	1%	309-066
R896	100 k	1/2 w	Fixed	Prec.	1%	309-045
R897	100 Ω	1/2 w	Fixed	Prec.	1%	309-112
R898	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R899	1/4 Ω	Manufactured by Tektronix				308-090
R1004	700 Ω					309-083
R1005	700 Ω					309-083
R1007	X2585-up					302-150
R1008	101-2584					309-071
R1008	2585-up					309-172
R1009	101-2584	78 Ω	1/2 w	Fixed	Prec.	1%
R1009	2585-up	142 Ω	1/2 w	Fixed	Prec.	1%
R1009	2585-up	78 Ω	1/2 w	Fixed	Prec.	1%
R1010	101-3762X	10 Ω	1/2 w	Fixed	Comp.	10%
R1011	X2585-up	60 Ω	1/2 w	Fixed	Prec.	1%
R1012	X2585-up	60 Ω	1/2 w	Fixed	Prec.	1%
R1013		3 k	5 w	Fixed	WW	5%
R1015		500 Ω		Var.	Comp.	311-005
R1017		150 Ω	1/4 w	Fixed	Comp.	10%
R1023		3 k	5 w	Fixed	WW	5%
R1027		150 Ω	1/4 w	Fixed	Comp.	10%
R1033		3 k	5 w	Fixed	WW	5%
R1037		150 Ω	1/4 w	Fixed	Comp.	10%
R1043		3 k	5 w	Fixed	WW	5%
R1047		150 Ω	1/4 w	Fixed	Comp.	10%
R1053		3 k	5 w	Fixed	WW	5%
R1057		150 Ω	1/4 w	Fixed	Comp.	10%
R1063		3 k	5 w	Fixed	WW	5%
R1066		100 Ω	1/2 w	Fixed	Comp.	10%
R1067		150 Ω	1/4 w	Fixed	Comp.	10%
R1073		3 k	5 w	Fixed	WW	5%
R1076		100 Ω	1/2 w	Fixed	Comp.	10%
R1077		150 Ω	1/4 w	Fixed	Comp.	10%
R1079		8.2 k	2 w	Fixed	Comp.	10%
R1080		15 k	1/2 w	Fixed	Comp.	10%
R1081		1.8 k	Manufactured by Tektronix			310-533
R1082		100 Ω				302-101
R1083	101-1070X	47 Ω				316-470
R1084		4.7 k				304-472
R1085		12 k				302-123
R1086		1 k				302-102
R1087		220 k	1/2 w	Fixed	Comp.	10%
R1088B		33 k	1/4 w	Fixed	Comp.	10%
R1088A		1 meg	1/2 w	Fixed	Comp.	10%
R1089		470 k	1/2 w	Fixed	Comp.	10%
R1090		47 k	1/2 w	Fixed	Comp.	10%
R1091		1.8 k	1/2 w	Fixed	Prec.	1%
R1092		100 Ω	1/2 w	Fixed	Comp.	10%
R1093	101-1070X	47 Ω	1/4 w	Fixed	Comp.	10%
R1094		4.7 k	1 w	Fixed	Comp.	10%
R1095		12 k	1/2 w	Fixed	Comp.	10%

**Resistors (continued)**

Tektronix  
Part Number

R1096	1 k	1/2 w	Fixed	Comp.	10%	302-102	
R1097	220 k	1/2 w	Fixed	Comp.	10%	302-224	
R1098A	1 meg	1/2 w	Fixed	Comp.	10%	302-105	
R1098B	33 k	1/4 w	Fixed	Comp.	10%	316-333	
R1101	10 Ω	1/2 w	Fixed	Comp.	10%	302-100	
R1103	10 Ω	1/2 w	Fixed	Comp.	10%	302-100	
R1105	10 Ω	1/2 w	Fixed	Comp.	10%	302-100	
R1107	10 Ω	1/2 w	Fixed	Comp.	10%	302-100	
R1202	100 Ω	1/2 w	Fixed	Comp.	10%	302-101	
R1203	100 Ω	1/2 w	Fixed	Comp.	10%	302-101	
R1204	101-2584	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R1204	2585-up	4 Ω Selected	1/2 w	Fixed	Prec.	1%	309-060
R1205	101-2584	10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R1205	2585-3762	3 Ω	1/2 w	Fixed	Prec.	1%	309-059
R1205	3763-up	4 Ω Selected	1/2 w	Fixed	Prec.	1%	309-060
R1207	X2585-up	Selected nominal value	15 ohms			302-150	
R1208	101-859	114 Ω	2 w	Fixed	Prec.	1%	310-560
R1208	860-2584	104 Ω	2 w	Fixed	Prec.	1%	310-560
R1208	2585-up	60 Ω	1/2 w	Fixed	Prec.	1%	309-067
R1209	101-859	114 Ω	2 w	Fixed	Prec.	1%	310-560
R1209	860-2584	104 Ω	2 w	Fixed	Prec.	1%	310-560
R1209	2585-up	60 Ω	1/2 w	Fixed	Prec.	1%	309-067
R1210		500 Ω	20 w	Fixed	WW	5%	308-096
R1211	101-859	1.19 k	1/2 w	Fixed	Prec.	1%	309-133
R1211	860-2584	2.51 k	1/2 w	Fixed	Prec.	1%	309-133
R1211	2585-up	1.8 k	1/2 w	Fixed	Prec.	1%	309-030
R1212	X2585-up	40 Ω	1/2 w	Fixed	Prec.	1%	309-066
R1213		4 k	5 w	Fixed	WW	5%	308-051
R1214	X2585-up	40 Ω	1/2 w	Fixed	Prec.	1%	309-066
R1217		150 Ω	1/4 w	Fixed	Comp.	10%	316-151
R1223		4 k	5 w	Fixed	WW	5%	308-051
R1227		150 Ω	1/4 w	Fixed	Comp.	10%	316-151
R1233		4 k	5 w	Fixed	WW	5%	308-051
R1237		150 Ω	1/4 w	Fixed	Comp.	10%	316-151
R1243		4 k	5 w	Fixed	WW	5%	308-051
R1247		150 Ω	1/4 w	Fixed	Comp.	10%	316-151
R1253		4 k	5 w	Fixed	WW	5%	308-051
R1256		93.1 Ω	1/2 w	Fixed	Prec.	1%	309-266
R1257		150 Ω	1/4 w	Fixed	Comp.	10%	316-151
R1258		10 Ω	1/2 w	Fixed	Comp.	10%	302-100
R1259		93.1 Ω	1/2 w	Fixed	Prec.	1%	309-266
R1260	X2585-up	15 Ω	1/4 w	Fixed	Comp.	10%	316-150
R1282		1.1 k	8 w	Fixed	WW	5%	308-146
R1283		1 k	3 w	Fixed	WW	20%	308-077
R1285		750 Ω	5 w	Fixed	WW	5%	308-067
R1286	101-2584	453 Ω	1 w	Fixed	Prec.	1%	310-120
R1286	2585-up	156 Ω	1/2 w	Fixed	Prec.	1%	309-175
R1287	101-2584	453 Ω	1 w	Fixed	Prec.	1%	310-120
R1287	2585-up	156 Ω	1/2 w	Fixed	Prec.	1%	309-175
R1288	X2585-up	156 Ω	1/2 w	Fixed	Prec.	1%	309-175
R1289	X2585-up	156 Ω	1/2 w	Fixed	Prec.	1%	309-175
R1290	X2585-up	180 Ω	1/2 w	Fixed	Prec.	1%	309-072
R1291	X2585-up	180 Ω	1/2 w	Fixed	Prec.	1%	309-072
R1292	X2585-up	470 Ω	1/2 w	Fixed	Comp.	1%	302-471
R1293	X2585-up	5 k	.1 w	Var.		311-074	

### **Switches**

			Tektronix Part Number
			Unwired      Wired
SW10	101-1070	TRIGGERING SOURCE "A"	*260-259 *262-227
SW10	1071-1849	TRIGGERING SOURCE "A"	*260-259 *262-385
SW10	1850-up	TRIGGERING SOURCE "A"	*260-259 *262-427
SW20		TRIGGER SLOPE	260-212
SW60		TRIGGERING SOURCE "B"	*260-259 *262-227
SW70		TRIGGER SLOPE	260-212
SW101		RESET SWITCH	260-017
SW110		PRESET SWITCH	311-096
SW160		TIME/CM "A"	*260-268 *262-226
SW210		PRESET SWITCH	311-096
SW260		TIME/CM "B"	*260-260 *262-208
SW301		HORIZONTAL DISPLAY FRONT	*260-262 262-235
SW347		HORIZONTAL DISPLAY REAR 5X MAG	260-263 *262-225
SW601		POWER ON	260-134
SW870		AMPLITUDE CALIBRATOR	*260-253 *262-207

### **Selenium Rectifiers**

SR792	101-3762X	Selenium Ass'y	*106-058
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### **Transformers**

T44	X1071-up	Toroid Bifilar 4T	120-198
T601	101-345	POWER	Use *120-141
T601	346-up	POWER	*120-141
T801		CRT SUPPLY	*120-036
T1014		TOROID	*120-132
T1214		TOROID	*120-132
T1284		TOROID	*120-132
T1046		TOROID	*120-148

### **Transistors**

Q44	X1071-up	OC171 Transistor	151-031
Q774		Transistor 2N214	151-004
Q793		Transistor 2N301	151-001
Q797		Transistor 2N277	151-002

### **Thermal Cutout**

TK601		Thermal Switch	260-246
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### **Vacuum Tubes**

V24		6EW6	154-212
V34		6EW6	154-212
V35	101-1070X	6DJ8/6922	154-187
V45	101-1070X	6DJ8/6922	154-187
V74		6DJ8/6922	154-187
V95		6DJ8/6922	154-187
V114		6AU6	154-022
V125		6AU6	154-022
V133		6DJ8/6922	154-187
V135		6DJ8/6922	154-187

**Vacuum Tubes (continued)**

		Tektronix Part Number
V145	6DJ8/6922	154-187
V152	6AL5	154-016
V161	6CL6	154-031
V173	6DJ8/6922	154-187
V183	6DJ8/6922	154-187
V193	6DJ8/6922	154-187
V233	6DJ8/6922	154-187
V235	6DJ8/6922	154-187
V245	6AU6	154-022
V252	12AL5 Checked	Use *157-075
V261	12AU6	154-040
V283	6DJ8/6922	154-187
V293	6DJ8/6922	154-187
V314	6DJ8/6922	154-187
V343	6DJ8/6922	154-187
V364	6DJ8/6922	154-187
V384	6DJ8/6922	154-187
V398	6CL6	154-031
V414	6AU6	154-022
V424	6AU6	154-022
V428	6DJ8/6922	154-187
V445	6DJ8/6922	154-187
V609	5651	154-052
V624	12AX7	154-043
V627	12B4	154-044
V634	6AU6	154-022
V637	12B4	154-044
V647	12B4	154-044
V664	6AU6	154-022
V677	6080	154-056
V684	12AX7	154-043
V694	6AU6	154-022
V724	6AU6	154-022
V737	6080	154-056
V754	6AU6	154-022
V767	12B4	154-044
V800	6AU5	154-021
V814	12AU7	154-041
V822	5642	154-051
V832	5642	154-051
V842	5642	154-051
V852	5642	154-051
V859	T581 (CRT) P31	*154-354
V862	5642	154-051
V875	6AU6	154-022
V885	12AU7	154-041
V1014	6DJ8/6922	154-187
V1024	6DJ8/6922	154-187
V1034	6DJ8/6922	154-187
V1044	6DJ8/6922	154-187

**Vacuum Tubes (continued)**

		Tektronix Part Number
V1054	6DJ8/6922	154-187
V1064	6DJ8/6922	154-187
V1074	6DJ8/6922	154-187
V1083	6DJ8/6922	154-187
V1084	6CY5	154-207
V1093	6DJ8/6922	154-187
V1094	6CY5	154-207
V1214	6DJ8/6922	154-187
V1224	6DJ8/6922	154-187
V1234	6DJ8/6922	154-187
V1244	6DJ8/6922	154-187
V1254	6DJ8/6922	154-187
V1284	101-638	154-209
V1284	639-up	154-281
	6939	
	AX-193/7699	

# Type 585

## Mechanical Parts List

		Tektronix Part Number
ANGLE, FRAME, RIGHT BOTTOM	SN 101-942	122-050
ANGLE, FRAME, EXTRUDED, RIGHT BOTTOM (BLUE VINYL)	SN 943-3479	122-071
ANGLE, FRAME, EXTRUDED, RIGHT BOTTOM (BLUE VINYL)	SN3480-up	122-104
ANGLE, FRAME, LEFT BOTTOM	SN 101-942	122-051
ANGLE, FRAME, EXTRUDED, LEFT BOTTOM (BLUE VINYL)	SN 943-3479	122-070
ANGLE, FRAME, EXTRUDED, LEFT BOTTOM (BLUE VINYL)	SN3480-up	122-105
ANGLE, FRAME, EXTRUDED, LEFT TOP		122-059
BAR, $\frac{3}{8} \times 10\frac{7}{32}$ , SWIVEL SUPPORT		381-063
BAR, $\frac{3}{8} \times 9\frac{13}{16}$ , SWIVEL SUPPORT		381-064
BAR, RETAINING, $\frac{3}{16} \times \frac{1}{2} \times 1\frac{3}{4}$		381-073
BAR, SUPPORT $\frac{1}{4} \times \frac{1}{4} \times 11\frac{1}{32}$	SN 101-3479X	381-107
BAR, TOP CHANNEL	SN 101-942	use 381-208
BAR, TOP CHANNEL, (BLUE VINYL)	SN 943-up	381-208
BAR, ALUM. TRANSFORMER SUPPORT	SN 3480-up	381-212
BASE, CRT ROTATOR, $2\frac{3}{4} \times 3\frac{3}{16} \times \frac{9}{16}$	SN 600-up	432-022
BOLT, SPADE		214-034
BRACKET, POT, $.063 \times 1 \times 1\frac{3}{16} \times \frac{1}{2}$		406-018
BRACKET, POT, $.080 \times 1 \times 1\frac{1}{2} \times \frac{1}{2}$		406-022
BRACKET, POT, —150 ADJ., $.080 \times 1 \times 1\frac{1}{2} \times \frac{1}{2}$		406-108
BRACKET, CRT SPRING, PHOS. BRONZE		406-239
BRACKET, COAX INSUL., $.160 \times \frac{3}{4} \times 1\frac{3}{8}$		406-244
BRACKET, GROUND CLIP, PHOS. BRONZE		406-245
BRACKET, TIME/CM SWITCH		406-449
BRACKET, MAG. SWITCH		406-450
BRACKET, HORIZ. DISPLAY SWITCH		406-451
BRACKET, CRT SUPPORT	SN 101-599	406-469
BRACKET, CRT SUPPORT	SN 600-up	406-527
BRACKET, POT, $.080 \times 3\frac{1}{2} \times 8\frac{1}{4}$	SN 1071-1473	406-471
BRACKET, WIREWOUND RESISTOR MTG.		406-477
BRACKET, TIME/CM, $.063 \times 3\frac{21}{32} \times 1$ W/2 214-049	SN 180-up	406-497
BRACKET, POT, $.080 \times 2\frac{1}{8} \times 8\frac{1}{2}$ W/45° ANGLE	SN 1424-up	406-692
BRACKET, V.A. SUPPORT	SN 3480-up	406-827
BUSHING, BINDING POST, NYLON		358-036
BUSHING, BANANA JACK		358-054
CABLE HARNESS, 110 VOLT RECT.		179-305
CABLE HARNESS, 110 VOLT POWER		179-306
CABLE HARNESS, POWER		179-315
CABLE HARNESS, POWER	SN 101-400	179-317
CABLE HARNESS, RECTIFIER	SN 401-3762	179-382
CABLE HARNESS, RECTIFIER	SN 3763-up	179-728

**Mechanical Parts List (continued)**

		Tektronix Part Number
CABLE HARNESS, DELAY SW. #1	SN 101-923	179-318
CABLE HARNESS, DELAY SW.	SN 924-up	179-434
CABLE HARNESS, V. A.	SN 101-3762	179-329
CABLE HARNESS, V. A.	SN 3763-up	179-731
CABLE HARNEES, F & I #1	SN 101-3762	179-330
CABLE HARNESS, F & I #1	SN 3763-up	179-729
CABLE HARNESS, VERT. OUTPUT	SN 101-3762	179-331
CABLE HARNESS, VERT. OUTPUT	SN 3763-up	179-732
CABLE HARNESS, F & I #2	SN 101-3762	179-332
CABLE HARNESS, F & I #2	SN 3763-up	179-730
CABLE HARNESS, SWEEP	SN 101-1070	179-316
CABLE HARNESS, SWEEP	SN 1071-1423	179-494
CABLE HARNESS, SWEEP	SN 1424-1849	179-523
CABLE HARNESS, SWEEP	SN 1850-3762	179-564
CABLE HARNESS, SWEEP	SN 3763-up	179-734
CAM, NYLON, $\frac{3}{8}$ " x .150		401-004
CAN, RELAY COVER		202-012
CAP, FUSE		200-015
CHASSIS, POWER		441-238
CHASSIS, DELAY SWEEP		441-253
CHASSIS, SWEEP	SN 101-1423	441-258
CHASSIS, SWEEP	SN 1424-up	441-369
CHASSIS, V. A.	SN 101-400	441-259
CHASSIS, V. A.	SN 401-up	441-288
CHASSIS, F & I		441-260
CHASSIS, TRIGGER SUB.	SN 1071-up	441-347
CLAMP, CABLE, $\frac{1}{8}$ " PLASTIC		343-001
CLAMP, CABLE, $\frac{3}{16}$ " PLASTIC		343-002
CLAMP, CABLE, $\frac{5}{16}$ " PLASTIC		343-004
CLAMP, CABLE, $\frac{7}{16}$ " PLASTIC		343-005
CLAMP, CABLE, $\frac{1}{2}$ " PLASTIC		343-006
CLAMP, CABLE, $\frac{3}{4}$ " PLASTIC	X3763-up	343-008
CLAMP, CABLE, $\frac{3}{8}$ " PLASTIC	SN 437-up	343-013
CLAMP, CRT, STAINLESS STEEL	SN 101-599	343-034
CLAMP, CABLE, $\frac{5}{16}$ ", HALF, PLASTIC		343-042
CLAMP, #20 WIRE FOR NEON BULBS		343-043
CLIP, SPRING TYPE, LARGE		344-014
CLIP, D. L. RETAINING, BRONZE		344-025
CONNECTOR, 16 CONTACT, FEMALE		131-018
CONNECTOR, CRT CABLE		131-049

**Mechanical Parts List (continued)**

Tektronix  
Part Number

CONNECTOR, CHASSIS MT., COAX (CAL OUT)	131-064
CONNECTOR, CHASSIS MT., COAX, 1 CONTACT FEMALE (UHF)	131-081
CORD, POWER	161-010
CONNECTOR, CHASSIS MT., 3 WIRE, MALE (TEK MOTOR BASE)	131-102
CONNECTOR, CABLE, ANODE ASS'Y	131-086
COUPLING, 1" W/2 TAPPED HOLES	376-007
COUPLING, POT	376-014
COVER, GRATICULE	200-382
COVER, CRT ANODE & PLATE ASS'Y	200-112
FAN BLADE	369-007
FASTENER, HORIZ. AMP.	214-008
FILTER, AIR	378-011
FILTER, LIGHT, GREEN PLEXIGLAS	378-514
GRATICULE, 5"	331-034
GROMMET, RUBBER, $\frac{1}{4}$	348-002
GROMMET, RUBBER, $\frac{5}{16}$	348-003
GROMMET, RUBBER, $\frac{3}{8}$	348-004
GROMMET, RUBBER, $\frac{1}{2}$	348-005
GROMMET, RUBBER, $\frac{3}{4}$	348-006
GROMMET, RUBBER, $\frac{5}{8}$	348-012
HINGE, $1\frac{1}{16} \times 8\frac{1}{16}$	214-003
HOLDER, NEON BULB, DOUBLE	352-006
HOLDER, NEON BULB, SINGLE	352-008
HOLDER, FUSE	352-010
HOUSING, AIR FILTER (BLUE WRINKLE) SN 101-942	380-008
HOUSING, AIR FILTER (BLUE VINYL) SN 943-up	380-018
JEWEL, RED PILOT LIGHT	378-518
KNOB, SMALL RED, .694 DIA., $\frac{3}{16}$ HOLE PART WAY SN 600-up	366-032
KNOB, SMALL BLACK, $\frac{1}{4}$ HOLE PART WAY	366-033
KNOB, SMALL RED, $\frac{1}{8}$ HOLE PART WAY	366-038
KNOB, SMALL RED, .780 DIA., $\frac{3}{16}$ HOLE PART WAY	366-039
KNOB, LARGE BLACK, 1.375, $\frac{1}{4}$ HOLE THRU	366-040
KNOB, LARGE BLACK, 1.375, $\frac{1}{4}$ HOLE PART WAY	366-042
KNOB, LARGE BLACK, 1.375, $1\frac{7}{64}$ HOLE THRU	366-046
KNOB, LARGE BLACK, 1.625, $\frac{1}{4}$ HOLE THRU	366-058
KNOB, LARGE BLACK, 1.625, $\frac{1}{4}$ HOLE PART WAY	366-060

**Mechanical Parts List (continued)**

	Tektronix Part Number
LOCKWASHER, INT. #4	210-004
LOCKWASHER, EXT. #6	210-005
LOCKWASHER, INT. #6	210-006
LOCKWASHER, EXT. #8	210-007
LOCKWASHER, INT. #8	210-008
LOCKWASHER, EXT. #10	210-009
LOCKWASHER, INT. #10	210-010
LOCKWASHER, INT. $\frac{1}{4}$	210-011
LOCKWASHER, INT., POT, $\frac{3}{8} \times \frac{1}{2}$	210-012
LOCKWASHER, INT., $\frac{3}{8} \times \frac{11}{16}$	210-013
LOCKWASHER, #5, SPRING	210-017
LUG, SOLDER, SE4	210-201
LUG, SOLDER, SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER, SE6, LONG	210-203
LUG, SOLDER, DE6	210-204
LUG, SOLDER, SE8	210-205
LUG, SOLDER, SE10, LONG	210-206
LUG, SOLDER, POT PLAIN, $\frac{3}{8}$	210-207
LUG, SOLDER, $\frac{1}{4}$ " HOLE	210-223
LUG, SOLDER, #10 NON-LOCKING	210-224
LUG, SOLDER, SE8, LONG	210-228
MOUNT, FAN MOTOR 7"	426-047
NUT, CAP, HEX, 8-32 $\times \frac{5}{16}$	210-402
NUT, HEX, 4-40 $\times \frac{3}{16}$	210-406
NUT, HEX, 6-32 $\times \frac{1}{4}$	210-407
NUT, HEX, 8-32 $\times \frac{5}{16}$	210-409
NUT, HEX, 10-32 $\times \frac{5}{16}$	210-410
NUT, HEX, $\frac{3}{8}$ -32 $\times \frac{1}{2}$	210-413
NUT, HEX, $\frac{15}{32}$ -32 $\times \frac{9}{16}$	210-414
NUT, KNULED, GRATICULE	210-424
NUT, HEX, $\frac{3}{8}$ -32 $\times \frac{1}{2}$	210-444
NUT, HEX, 10-32 $\times \frac{3}{8} \times \frac{1}{8}$	210-445
NUT, HEX, $\frac{1}{4}$ -28 $\times \frac{3}{8} \times \frac{3}{32}$	210-455
NUT, KEPS, 6-32 $\times \frac{5}{16}$	210-457
NUT, KEPS, 8-32 $\times \frac{11}{32}$	210-458
NUT, HEX, 8-32 $\times \frac{1}{2} \times \frac{23}{64}$ (25 w RESISTOR MTG.)	210-462

**Mechanical Parts List (continued)**

Part Number  
Tektronix

NUT, HEX, $\frac{1}{4}$ -32 x $\frac{5}{16}$ x $\frac{19}{32}$ (MINIATURE POT)	210-471
NUT, 12 SIDED, $\frac{15}{32}$ -32 x $\frac{5}{64}$ (SWITCH)	210-473
NUT, HEX, 6-32 x $\frac{5}{16}$ x .194 (5-10 w RESISTOR MTG.)	210-478
NUT, CRT ROTATOR SECURING	210-503
PANEL, FRONT	333-483
PLATE, PLUG-IN HOUSING, BACK, $.125 \times 5\frac{11}{16} \times 6\frac{1}{16}$	386-355
PLATE, BAKELITE, $\frac{3}{32} \times 2\frac{3}{4} \times 5\frac{1}{4}$	386-358
PLATE, CONNECTING, $.040 \times \frac{9}{16} \times 1\frac{17}{32}$	386-374
PLATE, SWITCH MTG., $.064 \times 1\frac{5}{16} \times 2\frac{5}{16}$ SN 101-179	386-450
PLATE, PLUG-IN HOUSING, SIDE, $.063 \times 9\frac{1}{8} \times 6\frac{7}{16}$	386-566
PLATE, CABINET BOTTOM, $.050 \times 20\frac{3}{8} \times 10\frac{43}{64}$ (BLUE WRINKLE) SN 101-942	386-597
PLATE, CABINET BOTTOM (BLUE VINYL) SN 943-3479	387-061
PLATE, CABINET BOTTOM (BLUE VINYL) SN 3480-up	387-478
PLATE, MICA, TRANSISTOR INSUL., $.002 \times 1.562$ DIA.	386-689
PLATE, CABINET SIDE, LEFT (BLUE WRINKLE) SN 101-942	386-736
PLATE, CABINET SIDE (BLUE VINYL) SN 943-up	387-077
PLATE, CABINET SIDE, RIGHT W/BOX (BLUE WRINKLE) SN 101-942	386-770
PLATE, CABINET SIDE W/BOX (BLUE VINYL) SN 943-up	387-076
PLATE, MICA, TRANSISTOR INSUL., $.002 \times 1 \times 1.531$	386-786
PLATE, SUB PANEL, FRONT	386-888
PLATE, SILICON RECT. MTG., $.080 \times 11\frac{5}{8} \times 11\frac{1}{2}$	386-906
PLATE, PLEXIGLAS, POT. INSUL., $.100 \times \frac{3}{4} \times 1\frac{5}{8}$ SN 1071-1423	386-910
PLATE, REAR OVERLAY (BLUE WRINKLE) SN 101-942	386-911
PLATE, REAR OVERLAY (BLUE VINYL) SN 943-up	387-093
PLATE, REAR SUB PANEL	386-912
PLATE, MAIN GAIN ADJ., WHITE STYRENE, $1\frac{5}{16} \times 1\frac{5}{8}$	386-916
PLATE, AIR DEFLECTOR, $.040 \times 4\frac{1}{4} \times 4\frac{15}{16}$	386-921
PLATE, BACK, CRT SOCKET	387-344
PLUG, CRT CONTACT	134-031
POST, BINDING, BLACK, FLUTED	129-036
POST, BINDING, METAL, LONG	129-051
POST, BINDING, METAL, SHORT	129-053
RING, SECURING, $.335 \times .145 \times .025$	354-048
RING, LOCKING SWITCH, $\frac{23}{32} \times 1\frac{5}{32}$	354-055
RING, FAN	354-074
RING, CRT ROTATOR SECURING SN 600-3049	050-063
RING, CRT ROTATOR SECURING SN 3050-up	354-178

**Mechanical Parts List (continued)**

	Tektronix Part Number
RING, CLAMPING	354-103
ROD, ALUM., SPACING, $\frac{1}{4} \times 3\frac{1}{8}$ , TAPPED 6-32 BOTH ENDS	384-135
ROD, STEEL EXTENSION, $\frac{1}{8} \times 8\frac{7}{16}$	384-162
ROD, STEEL EXTENSION, $\frac{1}{8} \times 5\frac{5}{8}$	384-180
ROD, NYLON CAP. MTG., $\frac{5}{16} \times 1$	384-542
ROD, NYLON CAP., $\frac{5}{16} \times \frac{3}{4}$ , TAPPED 6-32 THRU SN 101-2239	385-013
ROD, NYLON $\frac{5}{16} \times 1\frac{15}{16}$ , TAPPED 6-32 THRU W/PIN SN 2240-up	385-071
ROD, ALUM., TRANSFORMER SUPPORT SN 3480-up	384-599
ROD, ALUM., ROUND, $\frac{3}{8} \times 2$ , TAPPED 8-32 BOTH ENDS	385-072
ROD, ALUM., ROUND, HEX, $\frac{1}{4} \times 7\frac{1}{16}$	385-080
ROD, NYLON, $\frac{5}{16} \times 1\frac{5}{8}$	385-129
ROD, DELRIN, $\frac{5}{16} \times 1\frac{15}{16}$	385-135
ROD, DELRIN, $\frac{5}{16} \times 1\frac{9}{16}$	385-138
ROD, ALUM., HEX, $\frac{3}{8} \times \frac{5}{8}$ SN 437-up	385-142
SCREW, 4-40 $\times \frac{3}{16}$ BHS	211-007
SCREW, 4-40 $\times \frac{1}{4}$ BHS	211-008
SCREW, 4-40 $\times \frac{5}{16}$ BHS	211-011
SCREW, 4-40 $\times \frac{3}{8}$ RHS	211-013
SCREW, 4-40 $\times \frac{1}{2}$ BHS	211-014
SCREW, 4-40 $\times \frac{5}{8}$ RHS	211-016
SCREW, 4-40 $\times \frac{1}{4}$ FHS	211-023
SCREW, 4-40 $\times \frac{3}{8}$ FHS	211-025
SCREW, 4-40 $\times 1$ FHS	211-031
SCREW, 4-40 $\times \frac{5}{16}$ PAN HS W/LOCKWASHER	211-033
SCREW, 4-40 $\times \frac{5}{16}$ FHS, PHILLIPS	211-038
SCREW, 4-40 $\times \frac{1}{4}$ BH NYLON	211-040
SCREW, 2-32 $\times \frac{5}{16}$ RHS, PHILLIPS	213-113
SCREW, 6-32 $\times \frac{3}{16}$ BHS	211-503
SCREW, 6-32 $\times \frac{1}{4}$ BHS	211-504
SCREW, 6-32 $\times \frac{5}{16}$ BHS	211-507
SCREW, 6-32 $\times \frac{3}{8}$ BHS	211-510
SCREW, 6-32 $\times \frac{1}{2}$ BHS	211-511
SCREW, 6-32 $\times \frac{1}{2}$ FHS, 100°, PHILLIPS	211-512
SCREW, 6-32 $\times \frac{7}{8}$ BHS	211-516
SCREW, 6-32 $\times 1$ BHS	211-517
SCREW, 6-32 $\times 1\frac{1}{4}$ BHS	211-529
SCREW, 6-32 $\times \frac{5}{16}$ PAN HS W/LOCKWASHER	211-534
SCREW, 6-32 $\times \frac{3}{8}$ TRUSS HS, PHILLIPS	211-537

**Mechanical Parts List (continued)**

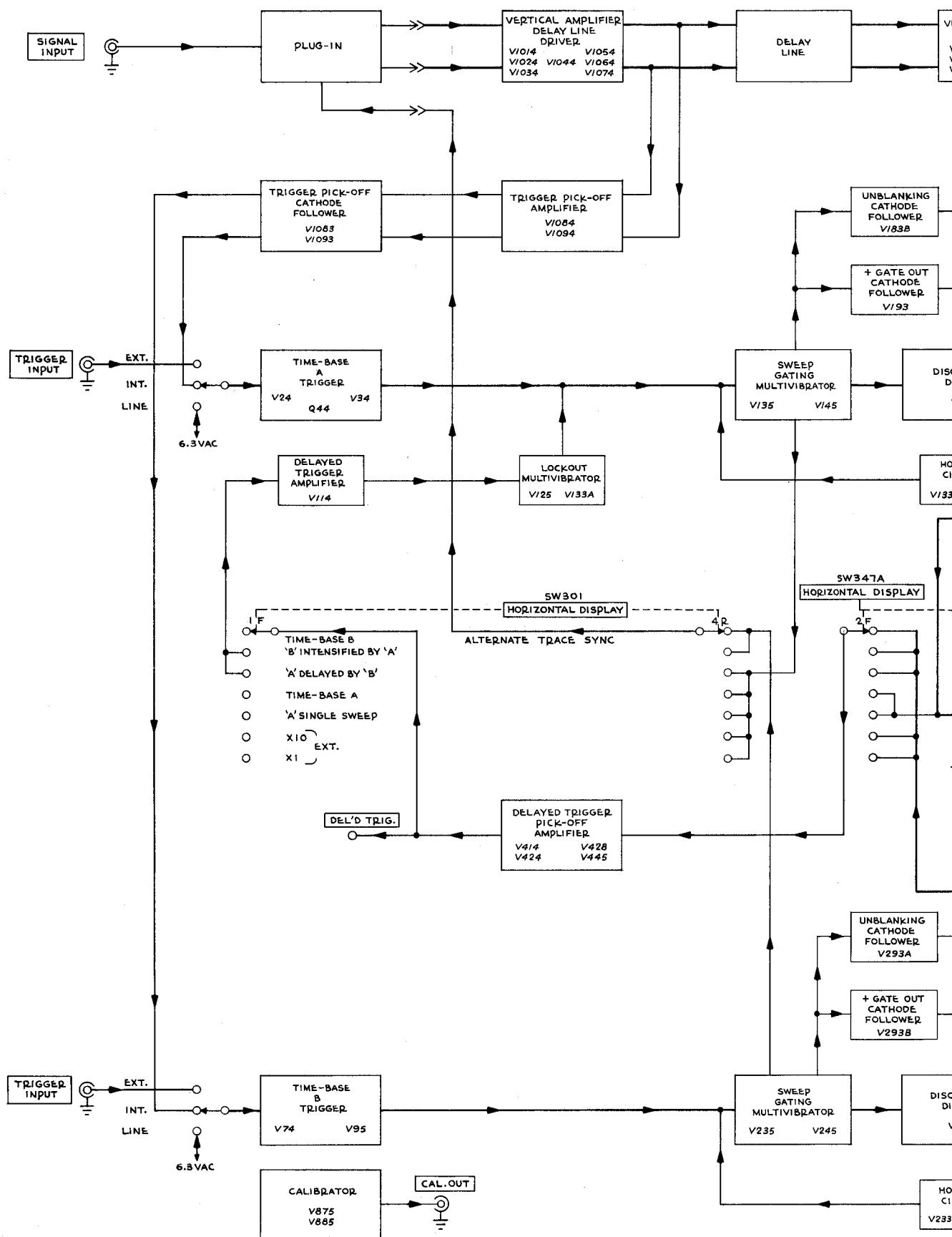
		Tektronix Part Number
SCREW, 6-32 x $\frac{5}{16}$	FHS, 100°, CSK, PHILLIPS	211-538
SCREW, 6-32 x $\frac{1}{4}$	FHS, 100°, CSK, PHILLIPS	211-541
SCREW, 6-32 x $\frac{5}{16}$	RHS	211-543
SCREW, 6-32 x $1\frac{1}{4}$	TRUSS HS, PHILLIPS	211-545
SCREW, 6-32 x $\frac{3}{8}$	FHS, 100°, CSK, PHILLIPS	211-559
SCREW, 6-32 x 1"	RHS	211-560
SCREW, 6-32 x $\frac{3}{8}$	FH CAP, HEX, SOC	211-561
SCREW, 8-32 x $\frac{5}{16}$	BHS	212-004
SCREW, 8-32 x $\frac{1}{2}$	BHS	212-008
SCREW, 8-32 x 2	RHS	212-013
SCREW, 8-32 x $\frac{3}{8}$	BHS	212-023
SCREW, 8-32 x $1\frac{3}{4}$	FIL HS	212-037
SCREW, 8-32 x $\frac{3}{8}$	TRUSS HS, PHILLIPS	212-039
SCREW, 8-32 x $\frac{3}{8}$	FHS, 100°, PHILLIPS	212-040
SCREW, 10-32 x 3	RHS	212-511
SCREW, 4-40 x $\frac{3}{8}$	FHS, THREAD CUTTING	213-012
SCREW, 4-40 x $\frac{1}{4}$	PHS, PHILLIPS, THREAD CUTTING	213-035
SCREW, 6-32 x $\frac{3}{8}$	TRUSS HS, PHILLIPS, THREAD CUTTING	213-041
SCREW, 5-32 x $\frac{3}{16}$	PAN HS, PHILLIPS, THREAD CUTTING	213-044
SCREW, 4-40 x $\frac{5}{16}$	PAN HS, PHILLIPS, SELF TAPPING	213-045
SCREW, 6-32 x $\frac{5}{16}$	FHS, 100°, PHILLIPS, THREAD CUTTING	213-068
SCREW, 4-40 x $\frac{1}{4}$	PHS, PHILLIPS, THREAD FORMING	213-088
SCREW, 6-32 x $\frac{3}{8}$	THS, PHILLIPS, THREAD FORMING	213-104
SCREW 2-56 x $\frac{5}{16}$	RHS, PHILLIPS	213-113
SHIELD, SOCKET (SMALL)		337-004
SHIELD, SOCKET, (LARGE)		337-005
SHIELD, TUBE (SHORT)		337-006
SHIELD, TUBE (MED.)		337-008
SHIELD, TUBE (LONG)		337-009
SHIELD, .040 x $5\frac{15}{16} \times 8\frac{3}{4} \times 2\frac{1}{8}$		337-066
SHIELD, .025 x $7\frac{7}{8} \times 6\frac{13}{32}$ , PLUG-IN HOUSING		337-091
SHIELD, LIGHT, 5" GRATICULE		337-187
SHIELD, .040 x $1\frac{5}{8} \times 1\frac{7}{8} \times 1\frac{1}{8}$		337-279
SHIELD, HIGH VOLTAGE		337-287
SHIELD, RECTIFIER, PLEXIGLAS		337-288
SHIELD, SWEEP AMPLIFIER, .051 x 2 x $4\frac{3}{8}$		337-289
SHIELD, UPPER CAL., .040 x $1\frac{3}{4} \times 1\frac{5}{16}$		337-290
SHIELD, LOWER CAL., $2\frac{1}{2} \times 2\frac{3}{8} \times 1\frac{1}{16}$		337-291

**Mechanical Parts List (continued)**

	Tektronix Part Number
SHIELD, CRT	337-301
SHOCKMOUNT, RUBBER, $\frac{1}{2}$ DIA. x $\frac{1}{2}$ HIGH	348-008
SOCKET, GRATICULE LAMP	136-001
SOCKET, STM7G	136-008
SOCKET, 7 PIN S/N X3170-up	136-010
SOCKET, STM8, GROUND	136-011
SOCKET, STM9G	136-015
SOCKET, PILOT LIGHT, ASS'Y	136-025
SOCKET, TIP JACK, BLACK NYLON	136-037
SOCKET, 7 PIN TUBE	136-044
SOCKET, CRT 14 PIN	136-046
SOCKET, 7 PIN UHF MINIATURE	136-071
SOCKET, 9 PIN UHF MINIATURE	136-072
SOCKET, CRT ASS'Y	136-076
SOCKET, 4 PIN TRANSISTOR	136-095
SPACER, NYLON FOR CERAMIC STRIP, $\frac{1}{16}$	361-007
SPACER, NYLON FOR CERAMIC STRIP, $\frac{3}{16}$	361-008
SPACER, NYLON FOR CERAMIC STRIP, $\frac{5}{16}$	361-009
STRAP, H. V. Transformer Mounting, W/214-009 each end .025 x $\frac{5}{16}$ x $4\frac{1}{4}$	346-001
STRIP, FELT, GREY	124-068
STRIP, CERAMIC, $\frac{3}{4} \times 2$ NOTCHES, CLIP MOUNTED	124-086
STRIP, CERAMIC, $\frac{3}{4} \times 4$ NOTCHES, CLIP MOUNTED	124-088
STRIP, CERAMIC, $\frac{3}{4} \times 7$ NOTCHES, CLIP MOUNTED	124-089
STRIP, CERAMIC, $\frac{3}{4} \times 9$ NOTCHES, CLIP MOUNTED	124-090
STRIP, CERAMIC, $\frac{3}{4} \times 11$ NOTCHES, CLIP MOUNTED	124-091
STRIP, CERAMIC, $\frac{3}{4} \times 1$ NOTCH, CLIP MOUNTED	124-100
STUD, 10-32 x $2\frac{7}{16}$ , 2" UNDER SHOULDER	355-044
STUD, CRT ROTATOR SN 600-740	355-049
TAG, VOLTAGE RATING	334-649
TAG, S/N INSERT	334-679
TUBE, SPACING, $.180 \times \frac{1}{4} \times 1\frac{23}{32}$ TAPPED 6-32	166-099
TUBE, SPACING, $.245 \times \frac{3}{8} \times 2\frac{19}{32}$	166-105
TUBE, SPACING, $.180 \times \frac{1}{4} \times \frac{7}{32}$ , 1 END CSK	166-107
TUBE, SPACING, $.065 \times \frac{3}{8} \times \frac{13}{16}$	166-143
TUBING, PLASTIC INSUL., #12 BLACK	162-531
TUBING, PLASTIC INSUL., #6 BLACK	162-532

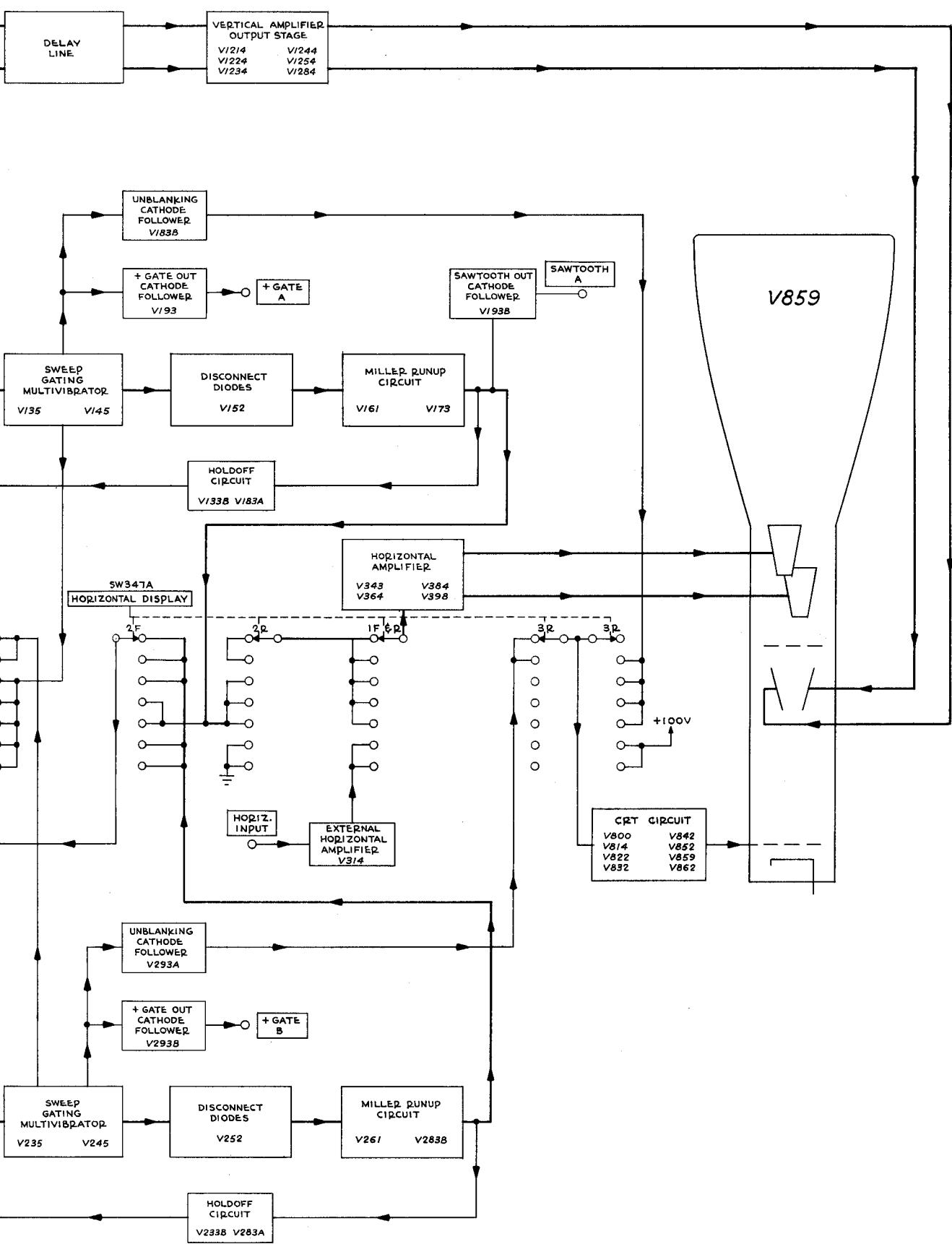
**Mechanical Parts List (continued)**Tektronix  
Part Number

WASHER, STEEL, 5S x $\frac{9}{32}$ x .025	210-801
WASHER, STEEL, 6S x $\frac{5}{16}$ x .028	210-802
WASHER, STEEL, 6L x $\frac{3}{8}$ x .032	210-803
WASHER, STEEL, 8S x $\frac{3}{8}$ x .032	210-804
WASHER, STEEL, 10S x $\frac{7}{16}$ x .036	210-805
WASHER, STEEL, 20 w RESISTOR CENTERING	210-808
WASHER, STEEL, 25 w RESISTOR CENTERING	210-809
WASHER, FIBER, #6 SHOULDERED	210-811
WASHER, FIBER, #10	210-812
WASHER, FIBER, #10 SHOULDERED	210-813
WASHER, RUBBER	210-816
WASHER, ALUM., RECTIFIER, $\frac{1}{4}$ x $\frac{1}{2}$ x .046	210-821
WASHER, FIBER, $\frac{1}{8}$ x $\frac{1}{4}$ x .035	210-823
WASHER, STEEL, .390 x $\frac{9}{16}$ x .020	210-840
WASHER, STEEL, .119 x $\frac{3}{8}$ x .025	210-851
WASHER, RUBBER, (FOR FUSE HOLDER)	210-873
WASHER, CENTERING, $\frac{3}{8}$ x $\frac{1}{8}$	210-886
WASHER, STEEL, .470 x $2\frac{1}{32}$ x .030	210-902
WASHER, PHOS. BRONZE, WAVY, CRT	210-914



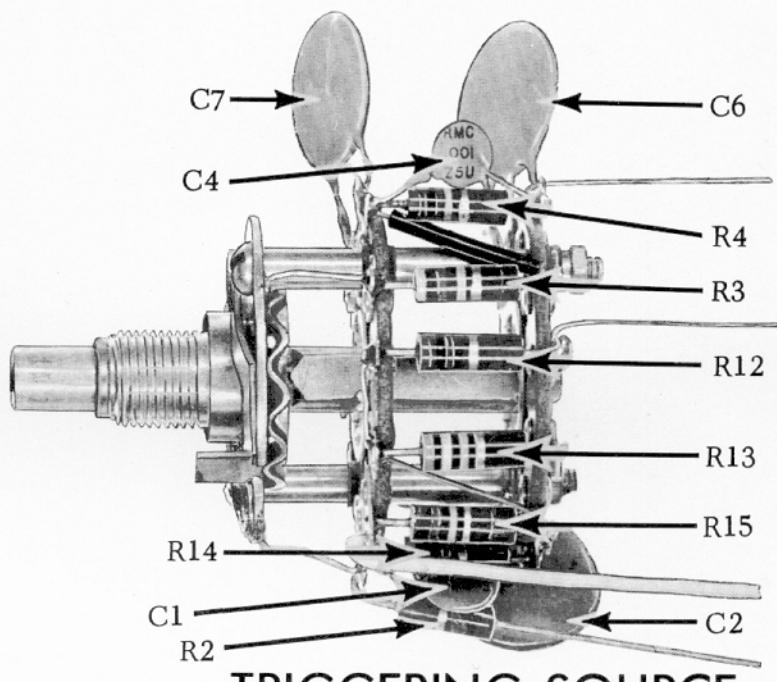
TYPE 585 OSCILLOSCOPE

AA



4-27-62  
BLOCK DIAGRAM

AA



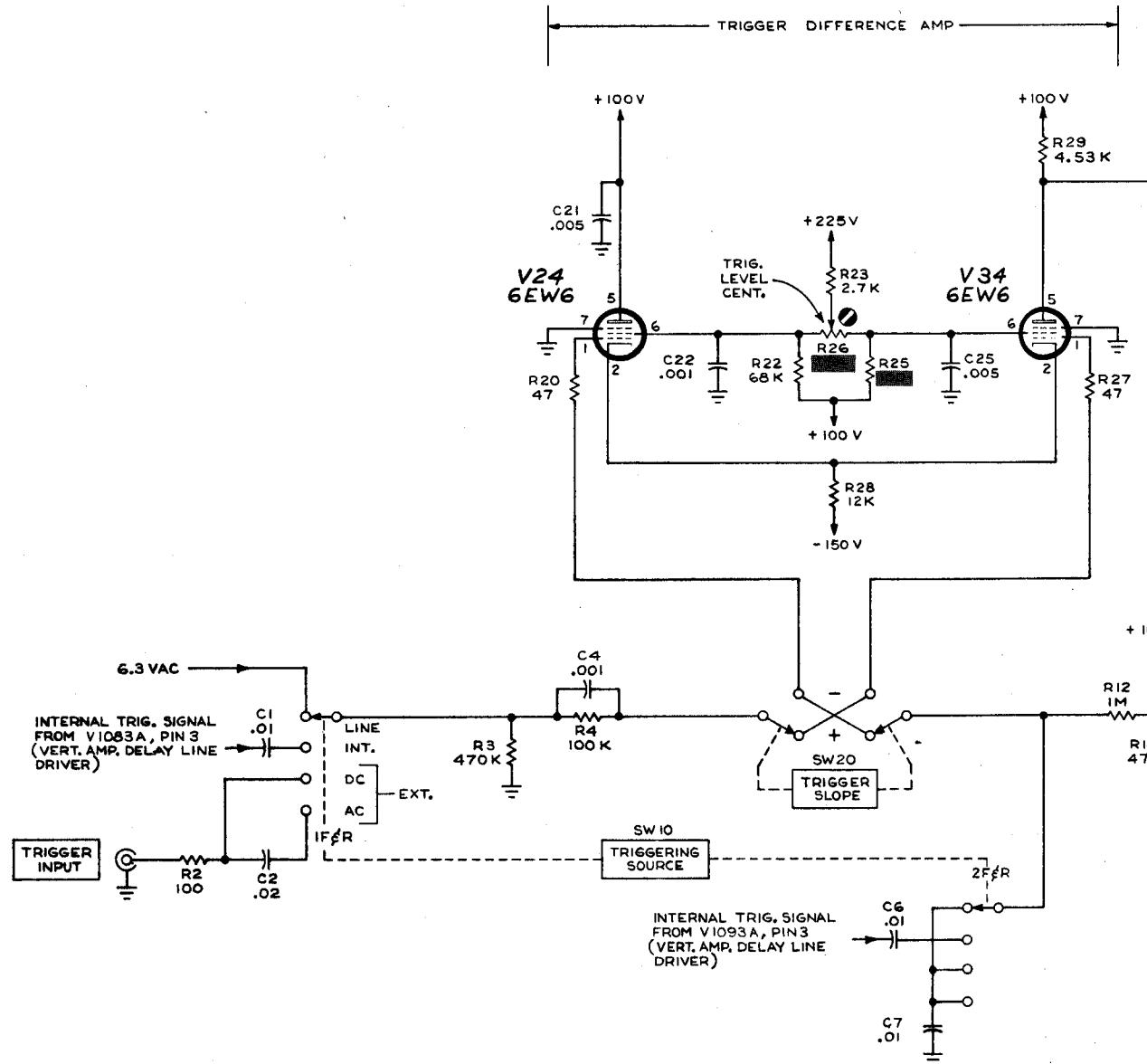
## TRIGGERING SOURCE SWITCH

581/585

Top View

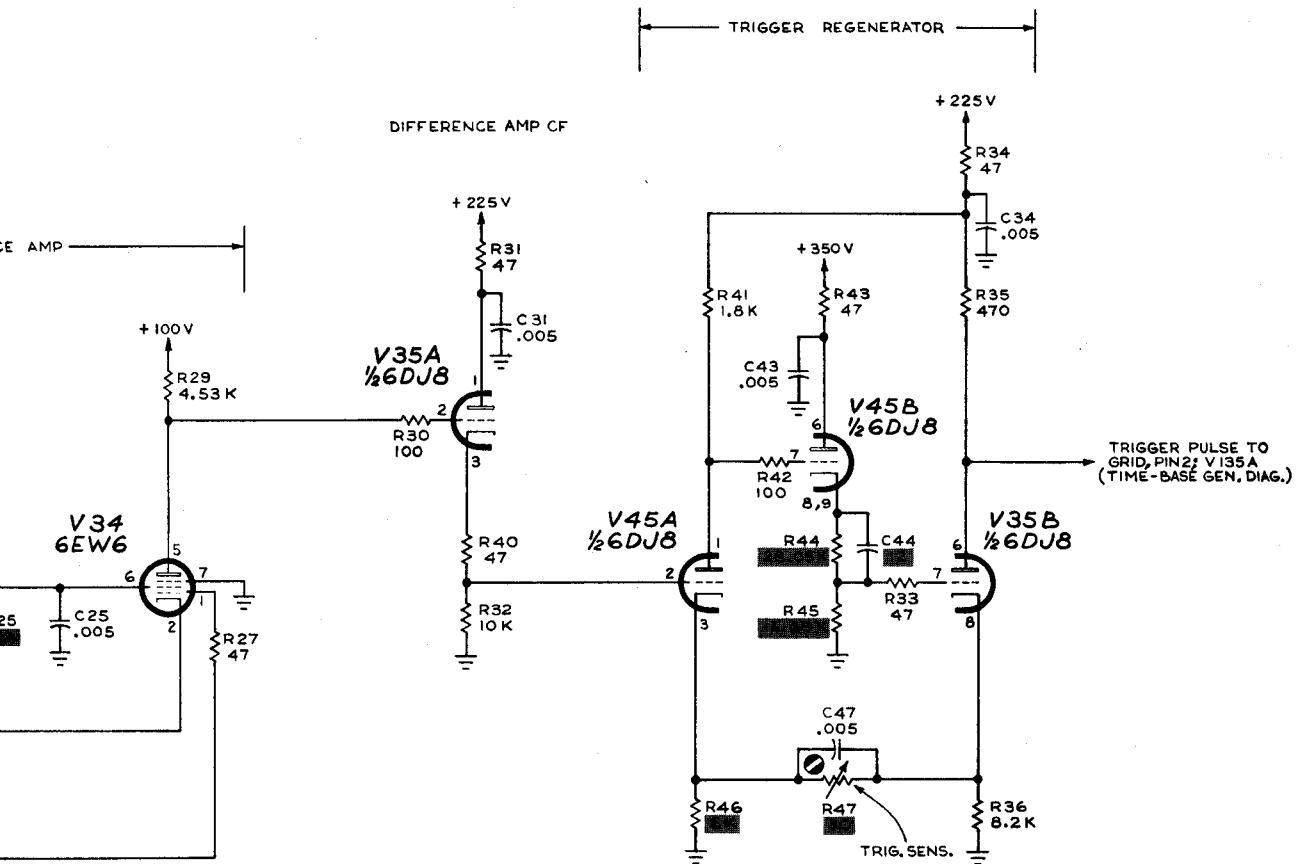
A

## SWITCH DETAIL



TYPE 585 OSCILLOSCOPE

AA



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

5 - 7 - 62

TIME-BASE A TRIGGER

EFF. S/N 101-1070

CIRCUIT NUMBERS

1 THRU 49

AA

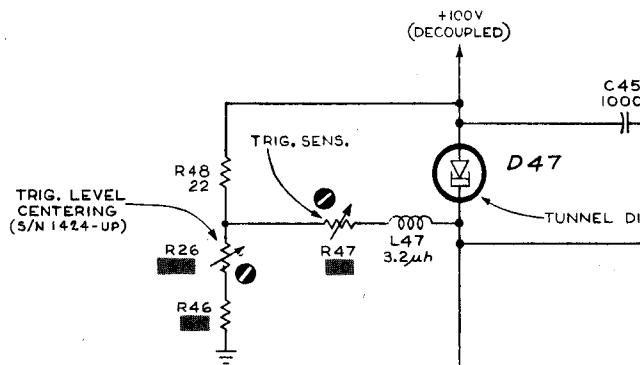
**IMPORTANT:**

ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A  
 $20,000\Omega/V$  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.

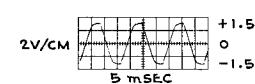
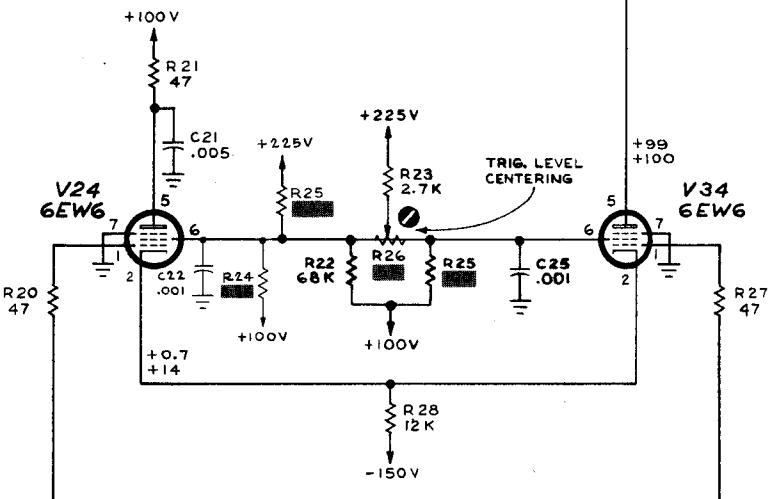
CONTROLS SET AS FOLLOWS:

AMPLITUDE CALIBRATOR..... OFF  
 HORIZONTAL DISPLAY..... TIME-BASE A  
 MAGNIFIER..... OFF  
 VARIABLE (TIME/CM)..... CALIBRATED  
 LENGTH..... CW  
 BOTH TIME-BASES:  
 TIME/CM..... 1 mSEC  
 TRIGGERING SOURCE..... LINE  
 TRIGGER SLOPE..... +  
 TRIGGERING LEVEL..... CENTERED  
 STABILITY..... PRESET



← TRIGGER DIFFERENCE AMPLIFIER →

WAVEFORMS & VOLTAGE READINGS WERE  
 OBTAINED UNDER FOLLOWING CONDITIONS:  
 TRIGGER SIGNAL:  
 WAVEFORMS..... + LINE  
 Voltages..... NONE  
 TRIGGERING LEVEL:  
 WAVEFORMS..... CENTERED  
 UPPER VOLTAGE READINGS..... CCW  
 LOWER VOLTAGE READINGS..... CW  
 ALSO SEE ABOVE NOTE....



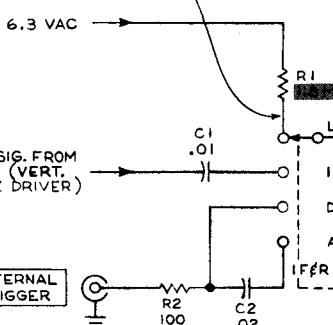
INTERNAL TRIG. SIG. FROM  
 VI083A, PIN 3 (VERT.  
 AMP. DELAY LINE DRIVER)

EXTERNAL  
 TRIGGER

TYPE 585 OSCILLOSCOPE

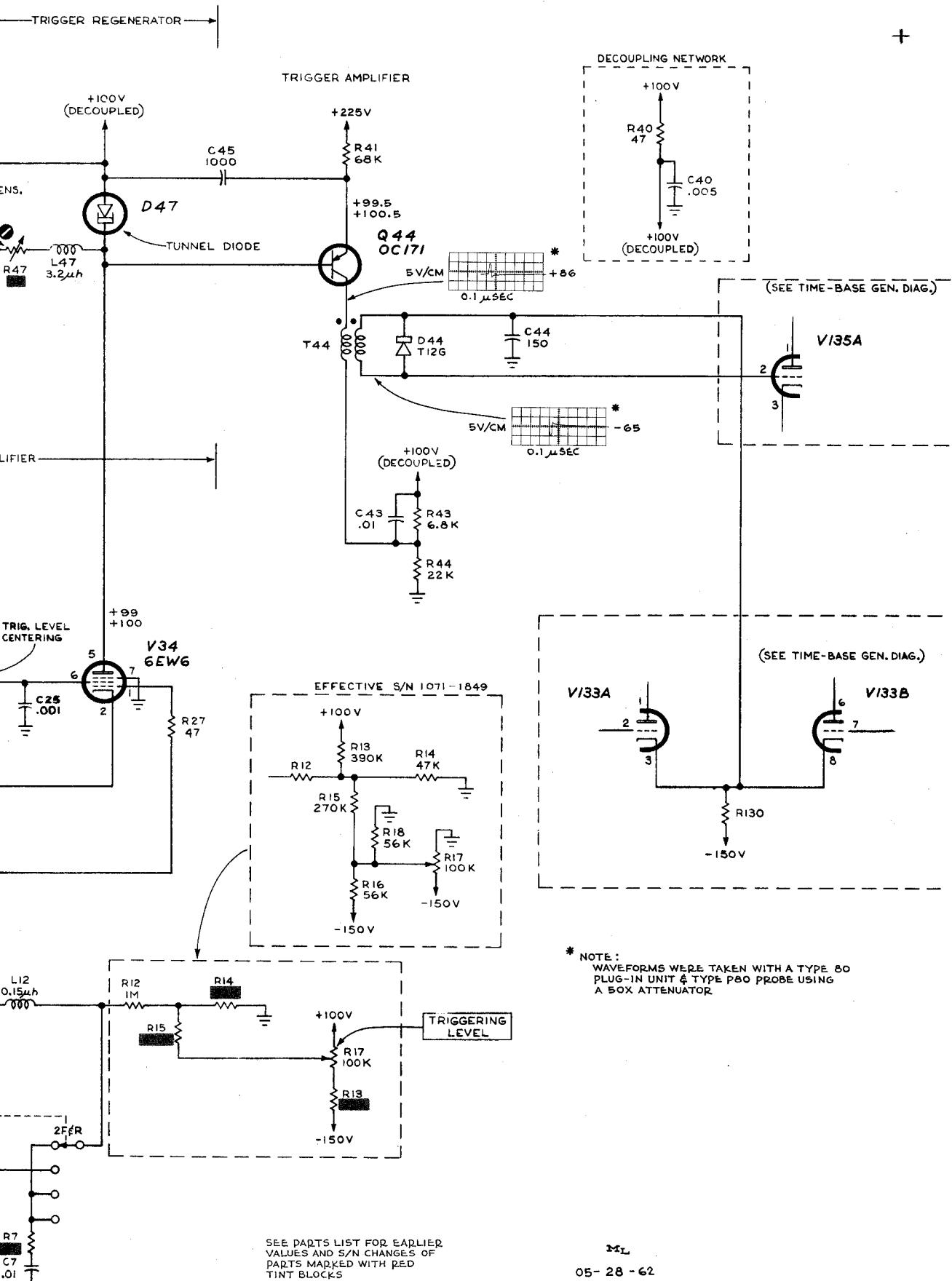
INTERNAL TRIG. SIG. FROM  
 VI093A, PIN 3 (VERT.  
 AMP. DELAY LINE DRIVER)

AA



SW10  
 TRIGGERING  
 SOURCE

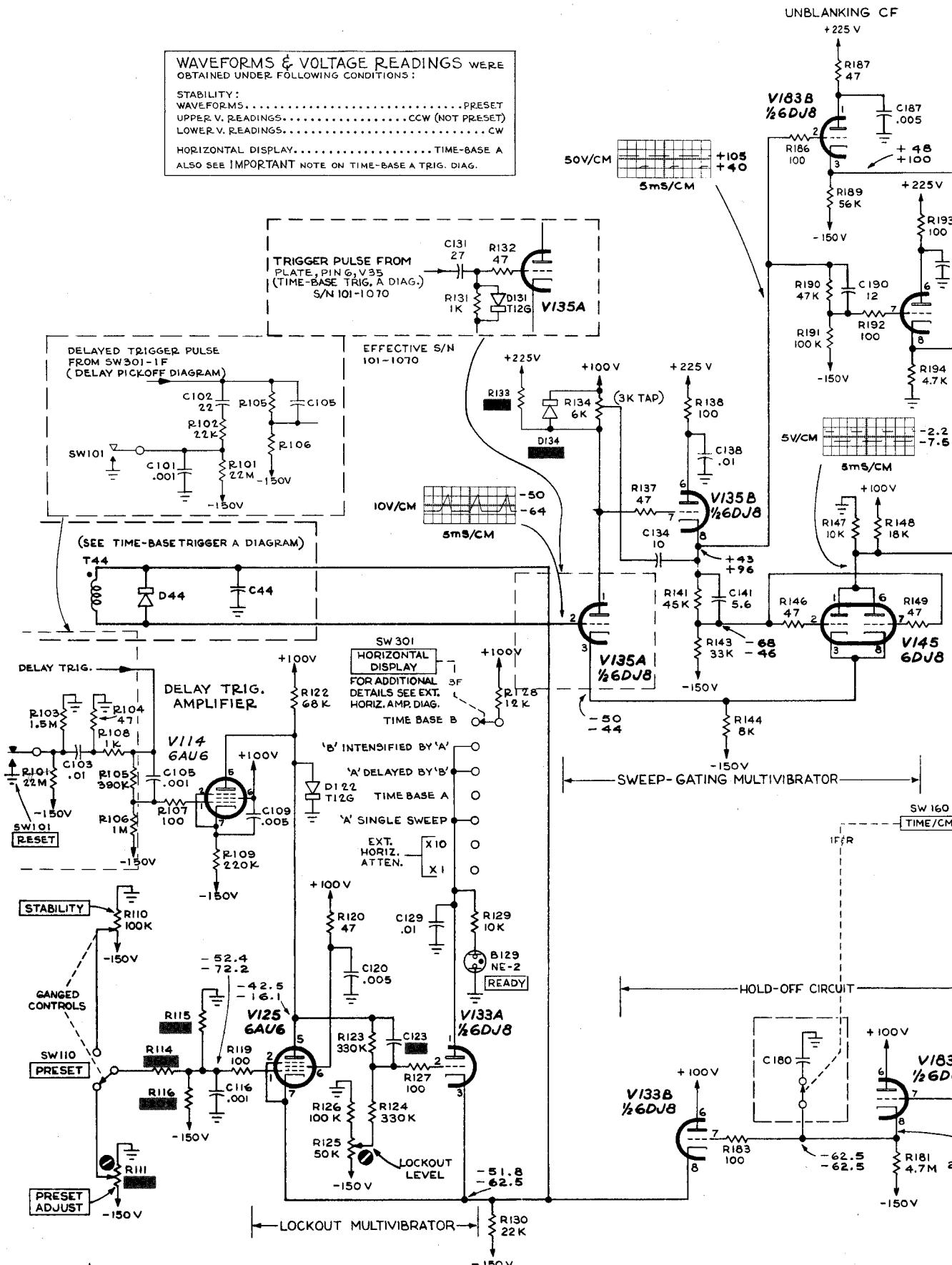


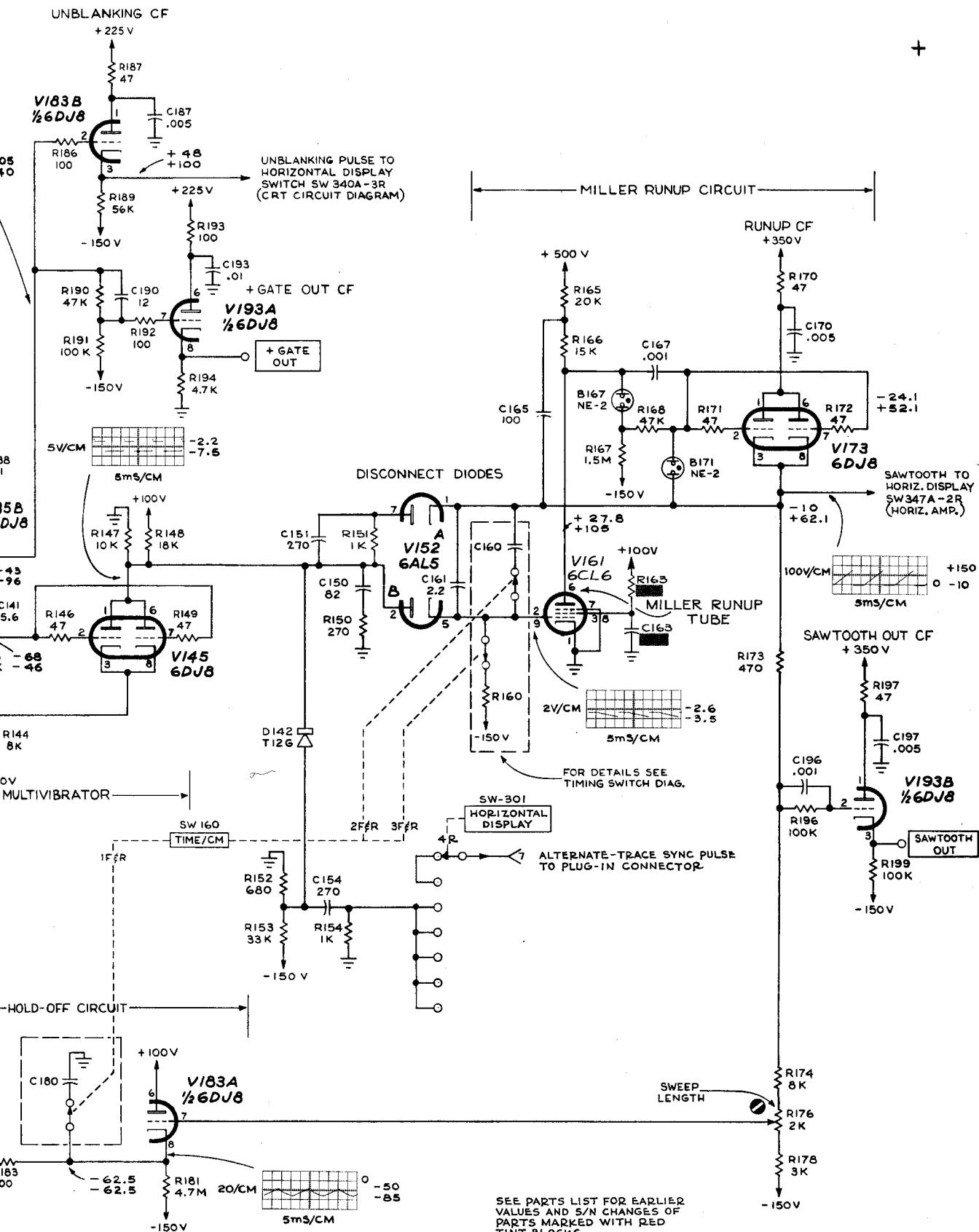


TIME-BASE A TRIGGER  
EFFECTIVE S/N 1071-UP  
CIRCUIT NUMBERS  
1 THRU 49

ML  
05-28-62

WAVEFORMS & VOLTAGE READINGS WERE  
OBTAINED UNDER FOLLOWING CONDITIONS:  
STABILITY:  
WAVEFORMS ..... PRESET  
UPPER V. READINGS ..... CCW (NOT PRESET)  
LOWER V. READINGS ..... CW  
HORIZONTAL DISPLAY ..... TIME-BASE A  
ALSO SEE IMPORTANT NOTE ON TIME-BASE A TRIG. DIAG.

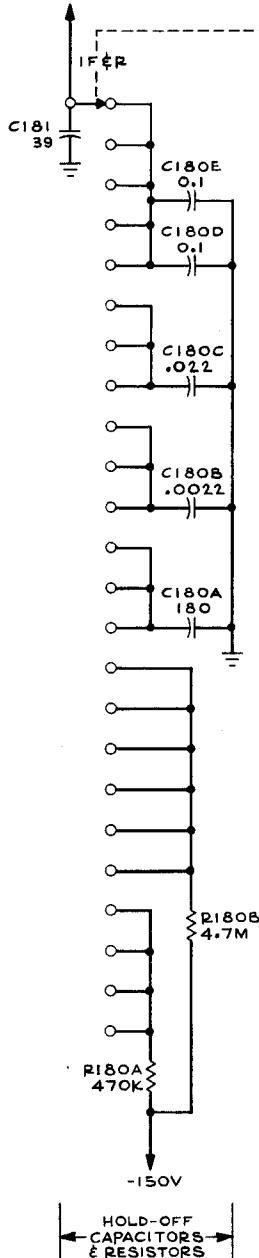




04-21-62  
TIME-BASE GENERATOR A

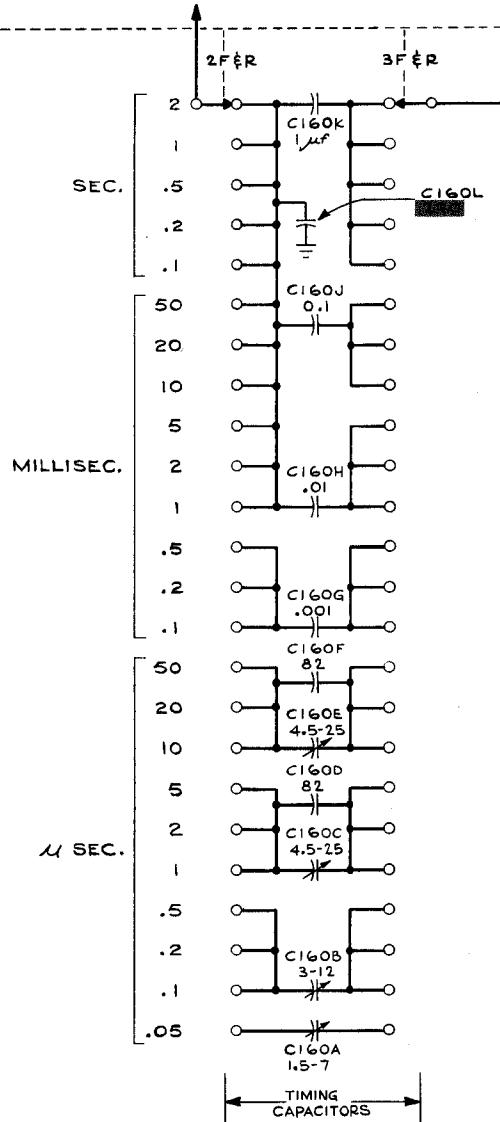
CIRCUIT NUMBERS  
100 THRU 199

TO CATH., PIN 8, VI83A  
HOLD-OFF CF  
(TIME-BASE GEN. A DIAG.)



SW160  
TIME/CM

TO CATH., PINS 3 & 8, VI73  
RUNUP CF  
(TIME-BASE GEN. DIAG.)



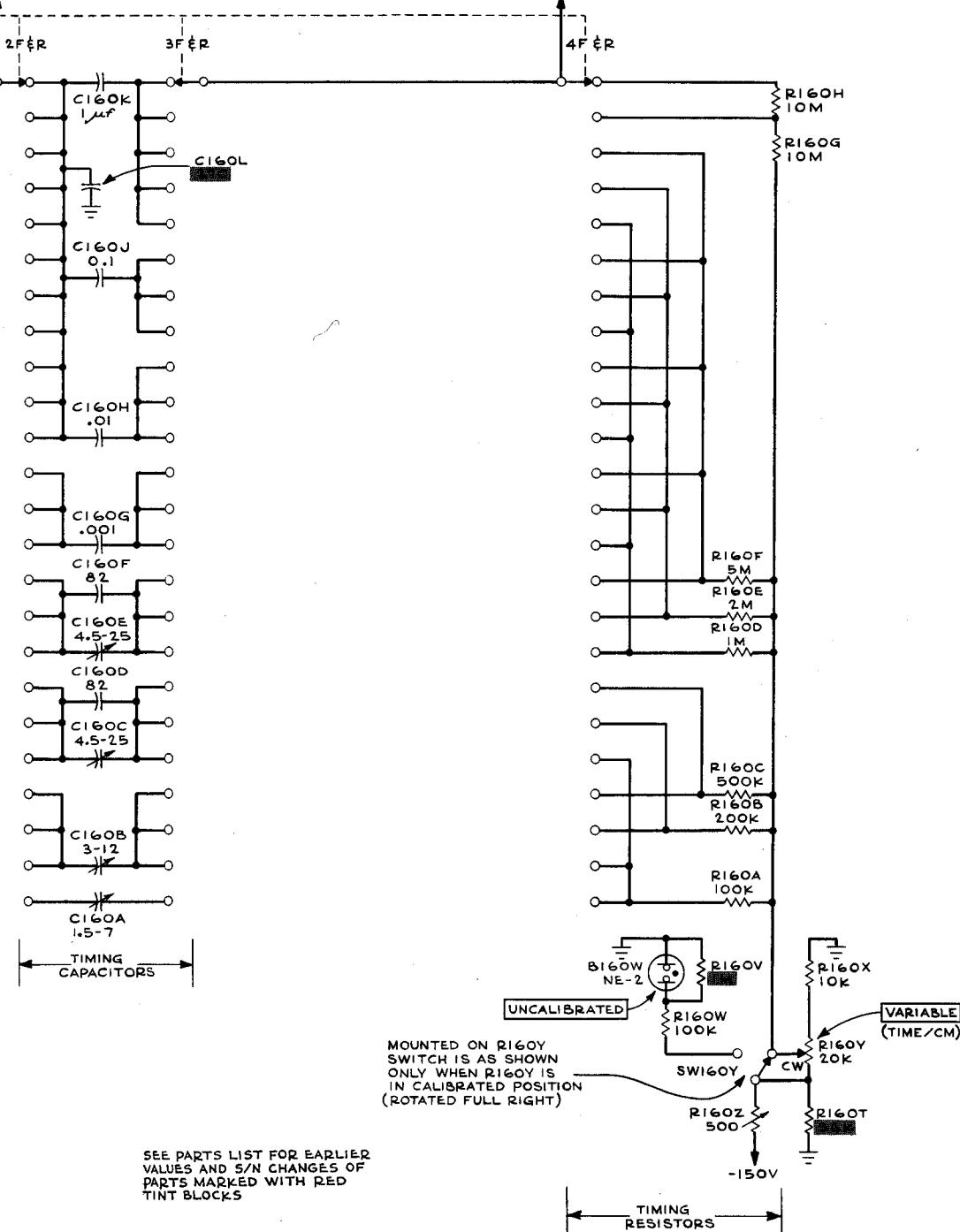
SEE PARTS LIST FOR  
VALUES AND S/N OF  
PARTS MARKED WITH  
TINT BLOCKS

TYPE 585 OSCILLOSCOPE

A A<sub>1</sub>

NS 388, VI73  
P CF  
GEN. DIAG.)

TO GRID, PIN 9, VI61  
MILLER RUNUP TUBE  
(TIME-BASE GEN. A DIAG.)

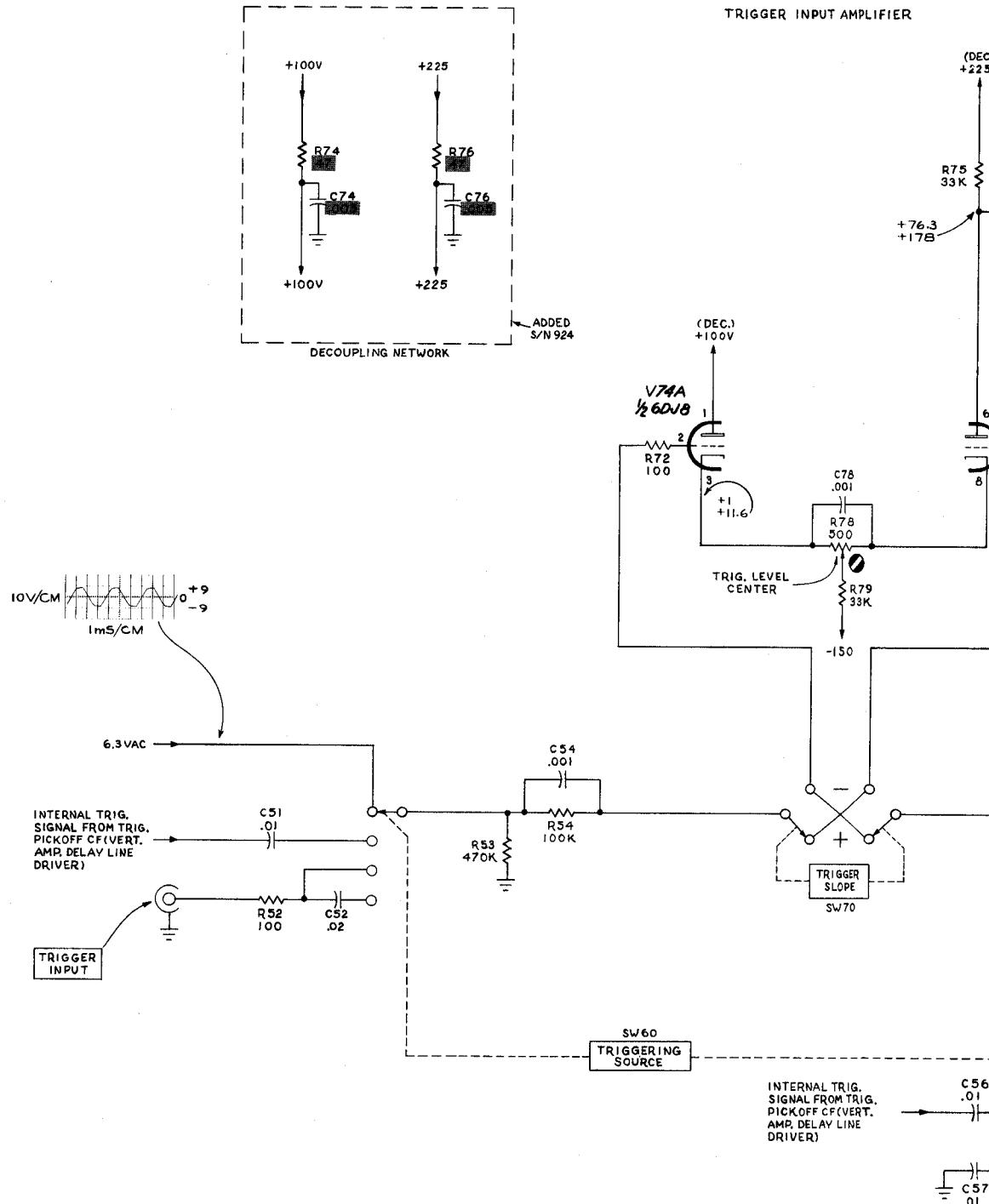


TIME-BASE A TIMING SWITCH

4-27-62  
TP

AA,

100 V/CM

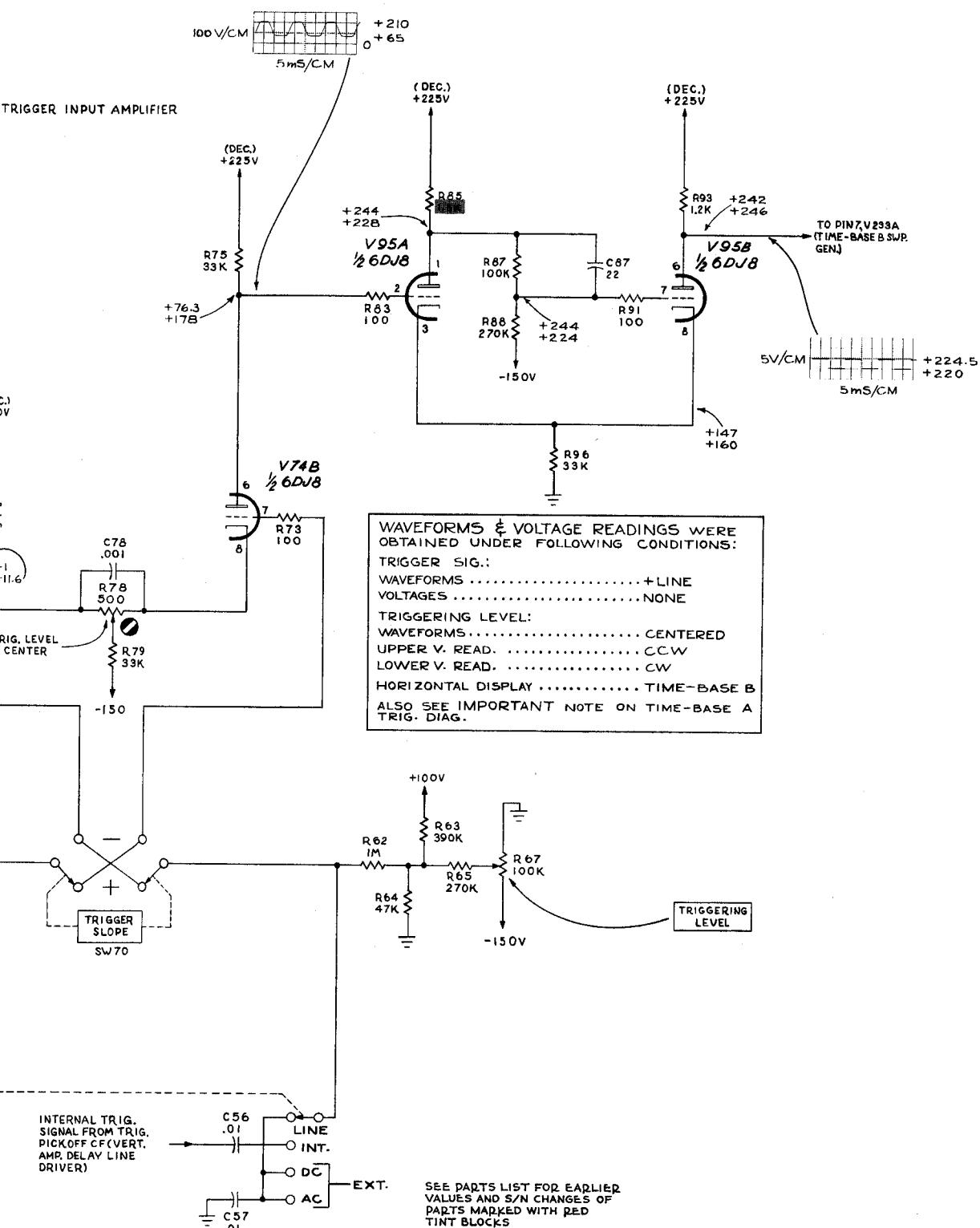


+

TYPE 585 OSCILLOSCOPE

AA

TRIGGER MULTIVIBRATOR



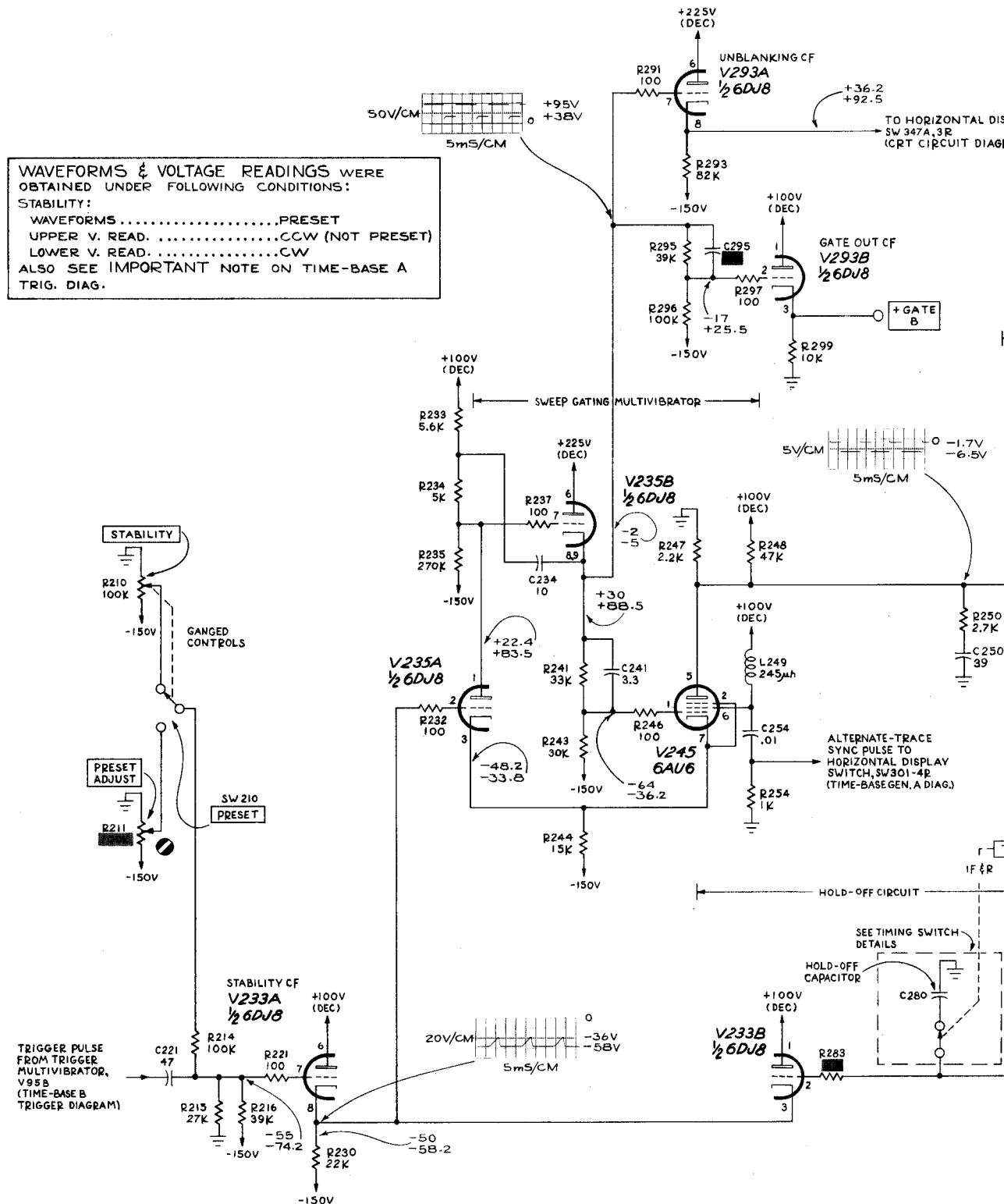
4-20-62

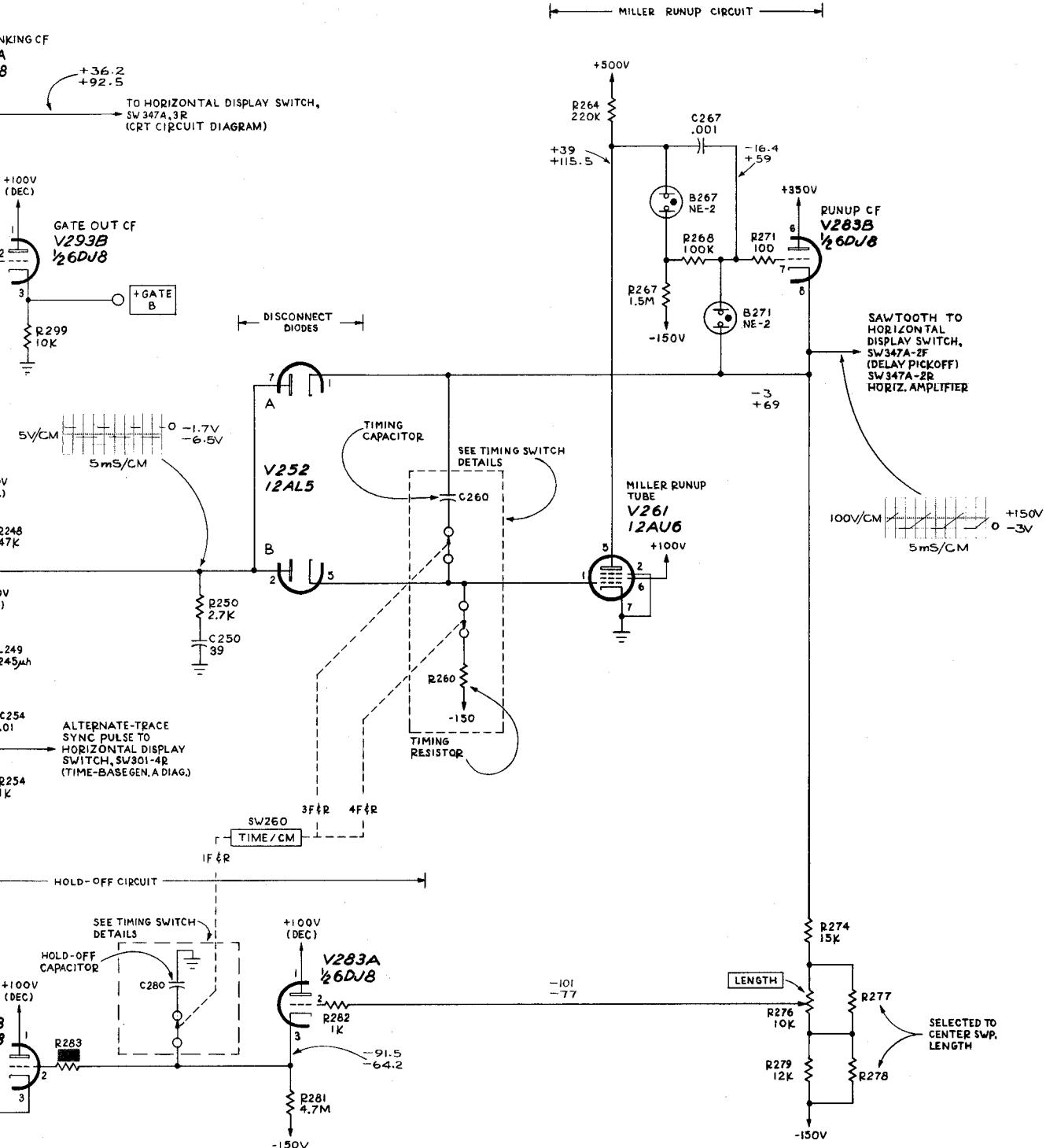
JN

TIME-BASE B TRIGGER

CIRCUIT NUMBERS  
50 THRU 99

AA



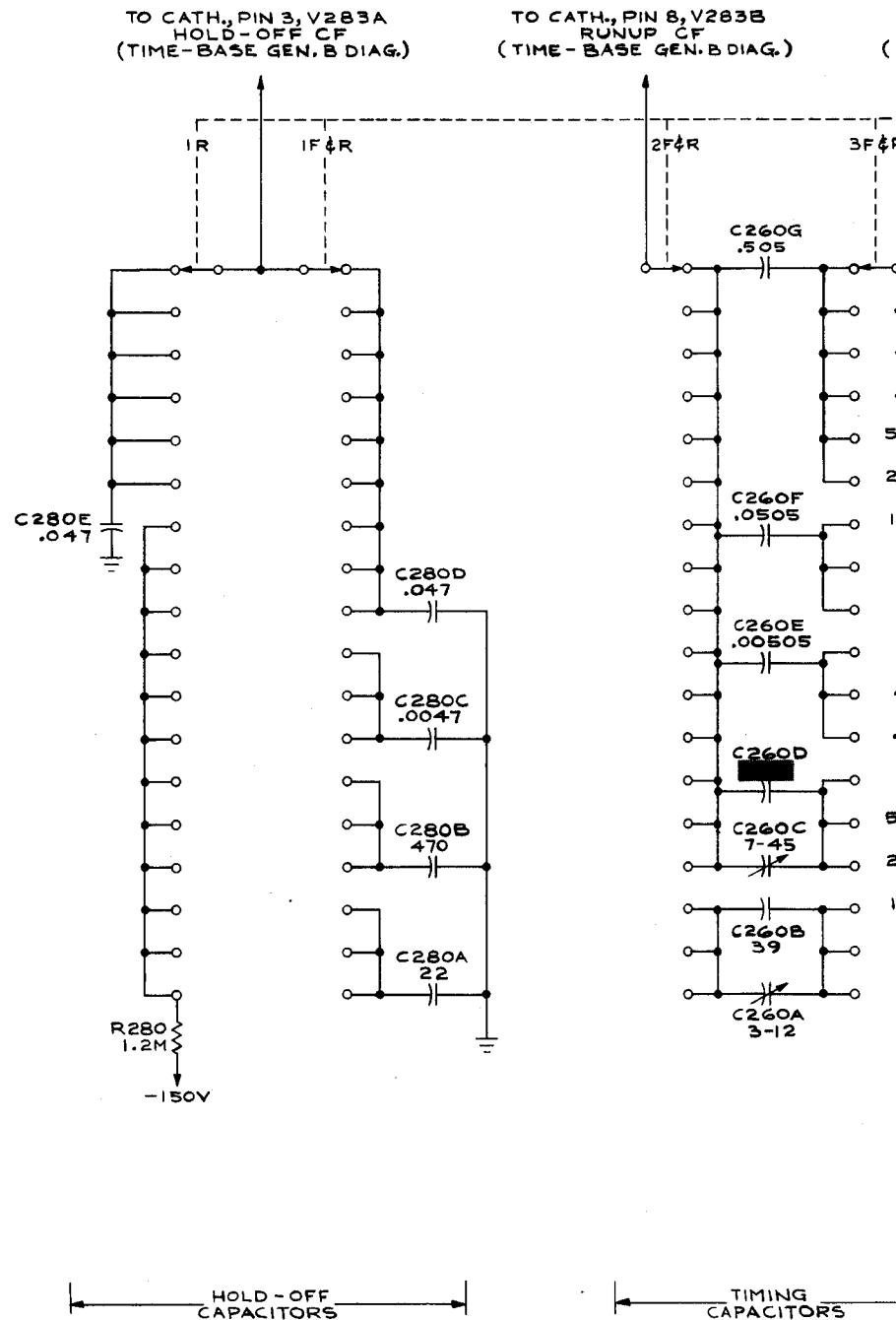


JN  
4-20-62

TIME-BASE B GENERATOR

CIRCUIT NUMBERS  
210 THRU 299

AA

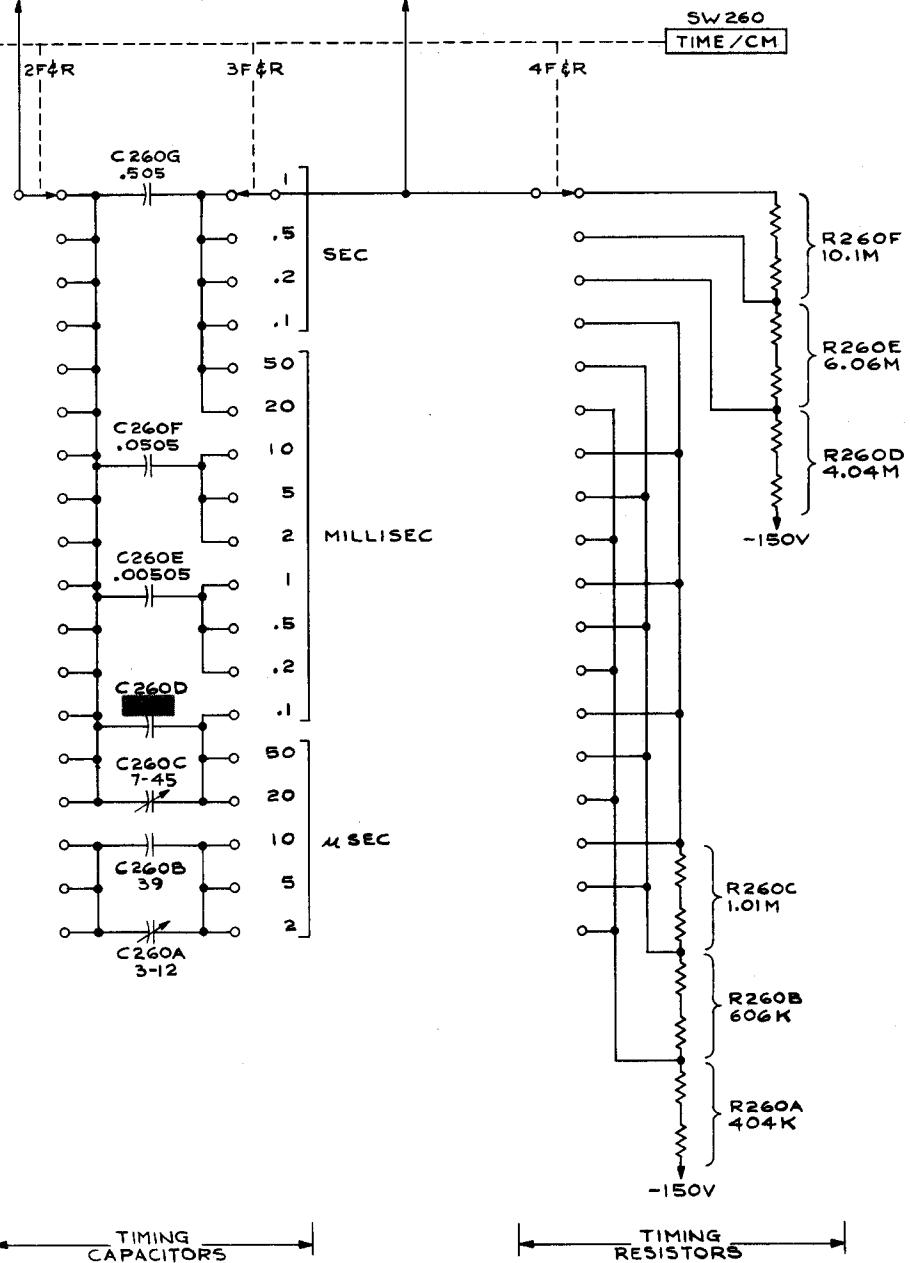


TYPE 585 OSCILLOSCOPE

AA<sub>1</sub>

4, PIN 8, V283B  
UNUP (CF  
BASE GEN. B DIAG.)

TO GRID, PIN 1, V261  
MILLER RUNUP TUBE  
(TIME-BASE GEN. B DIAG.)



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

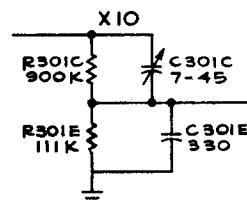
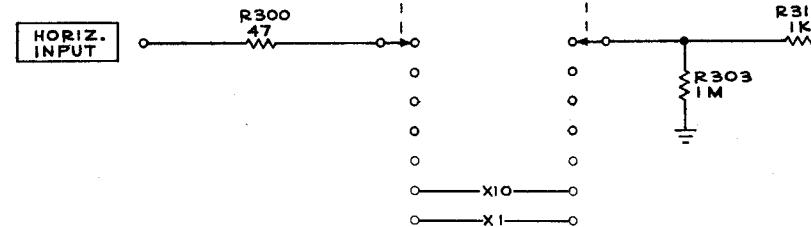
MRH

5-3-62

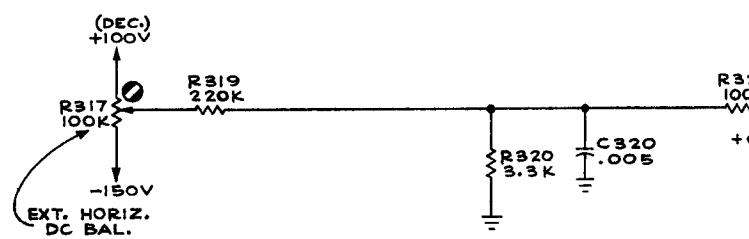
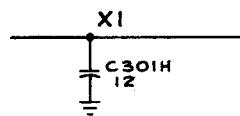
## TIME-BASE B TIMING SWITCH

AA,

SW 301  
**HORIZONTAL DISPLAY**  
FOR ADDITIONAL SWITCH DETAILS  
SEE:- TIME-BASE GEN. A DIAG.  
DELAY PICKOFF DIAG.  
BLOCK DIAG.

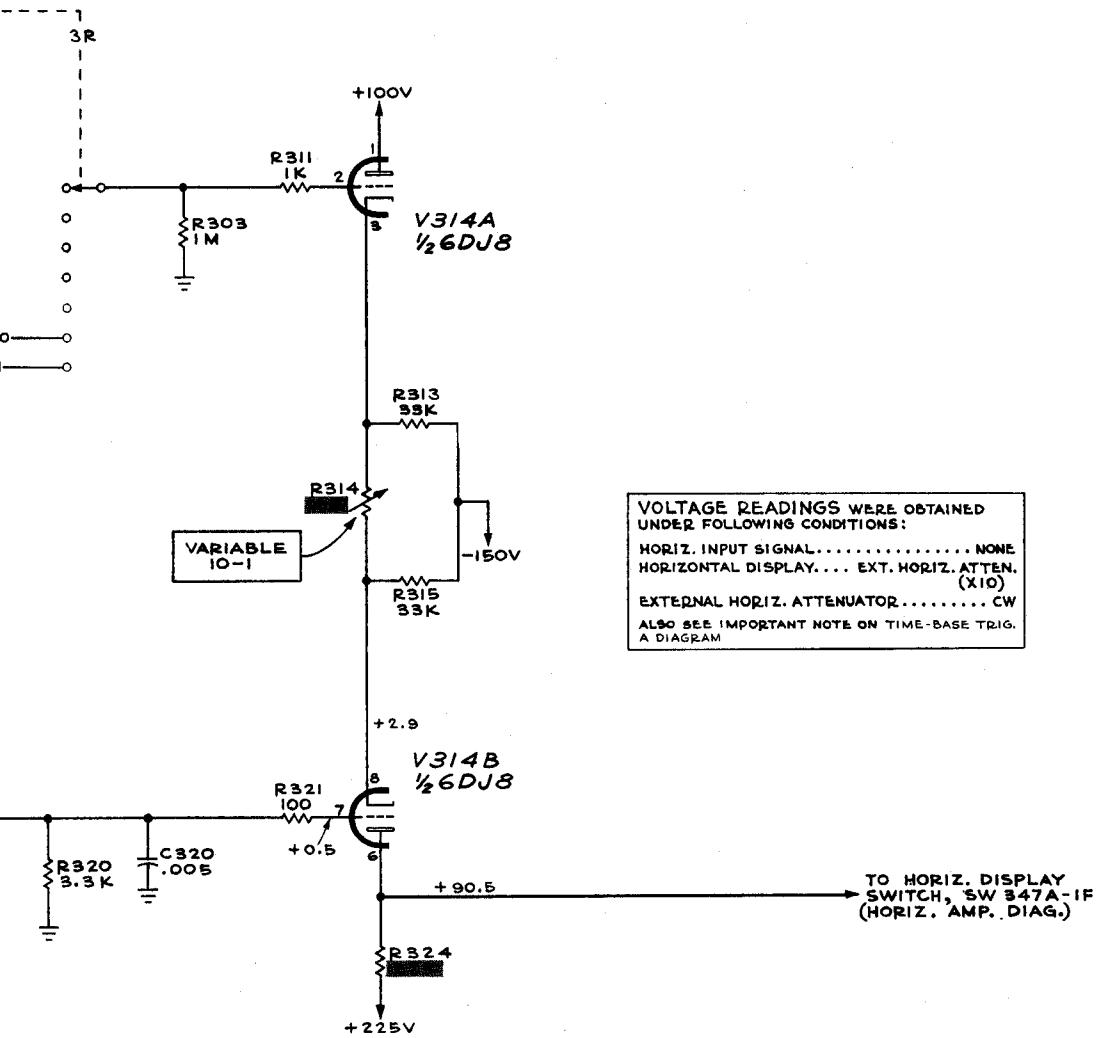


VARIABLE  
10-1



TYPE 585 OSCILLOSCOPE

AA



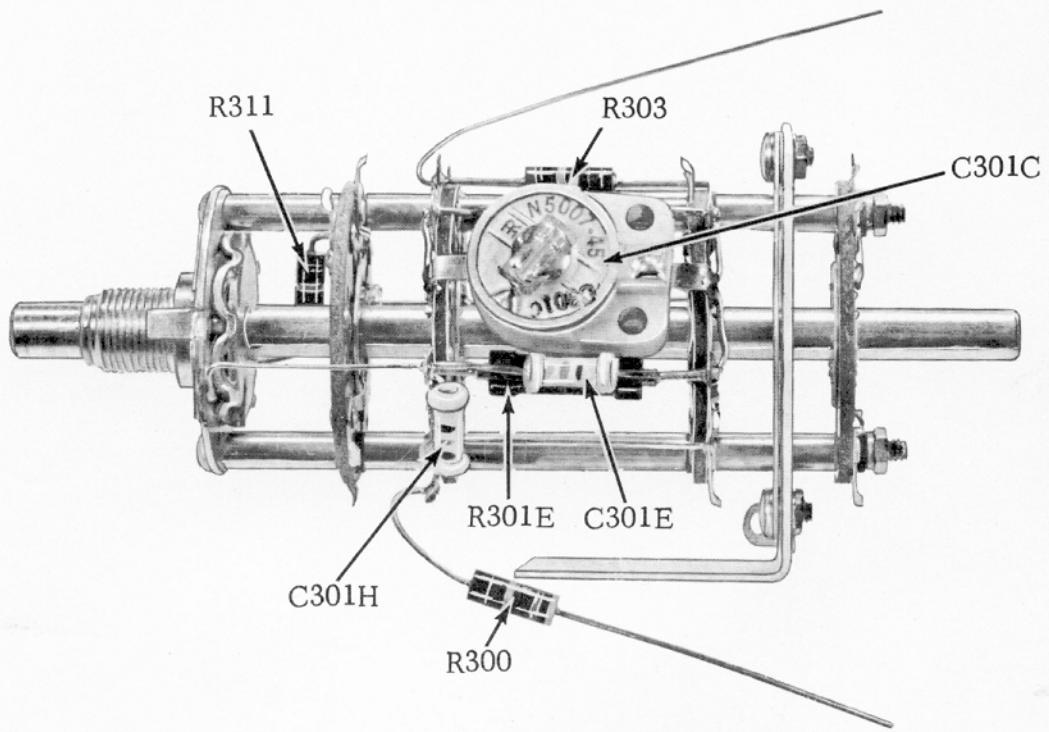
SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH RED  
TINT BLOCKS

### EXTERNAL HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS  
300 THRU 325

GAB  
4 - 28 - 62

AA

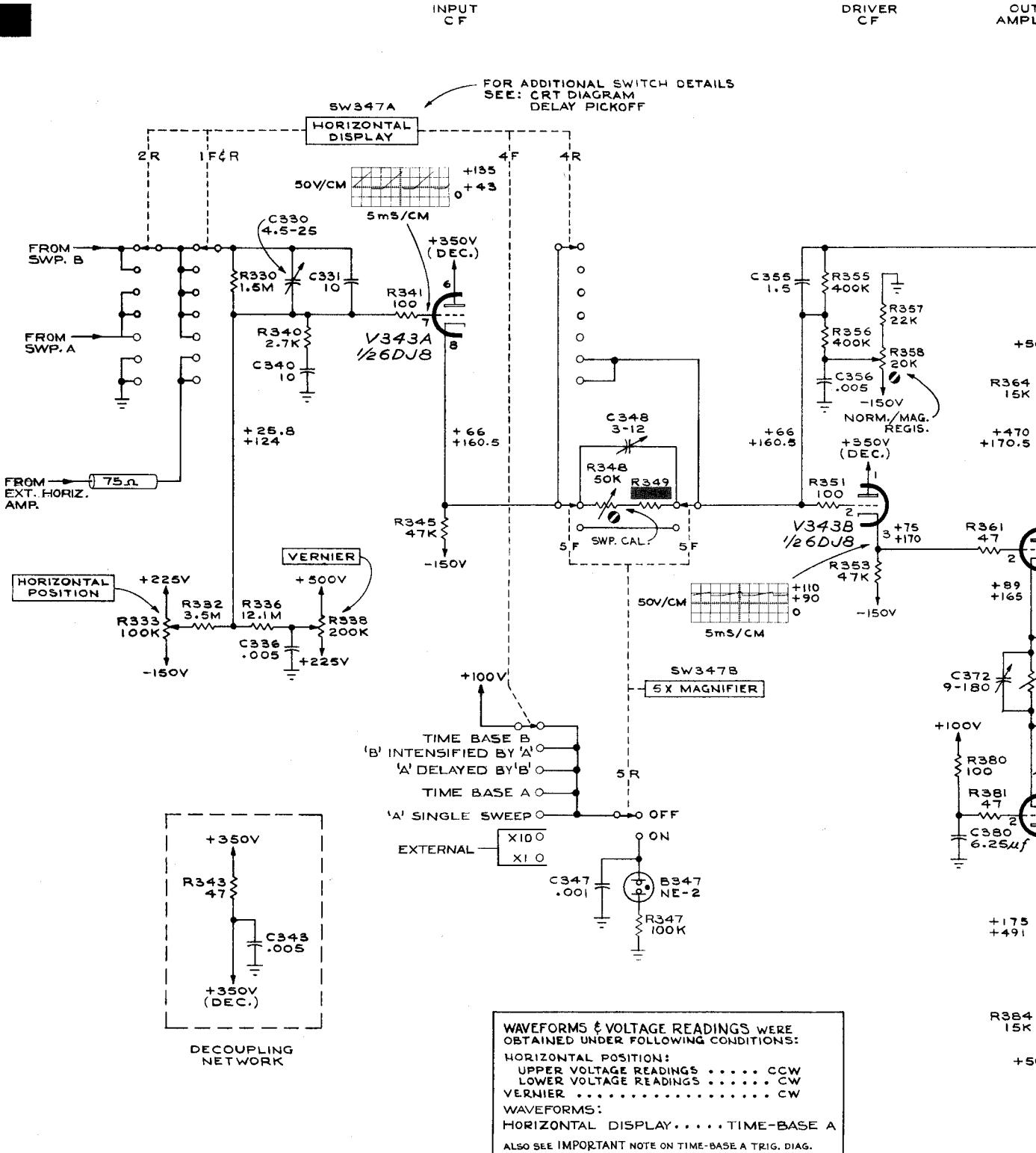


## HORIZONTAL DISPLAY SWITCH

Right Side View

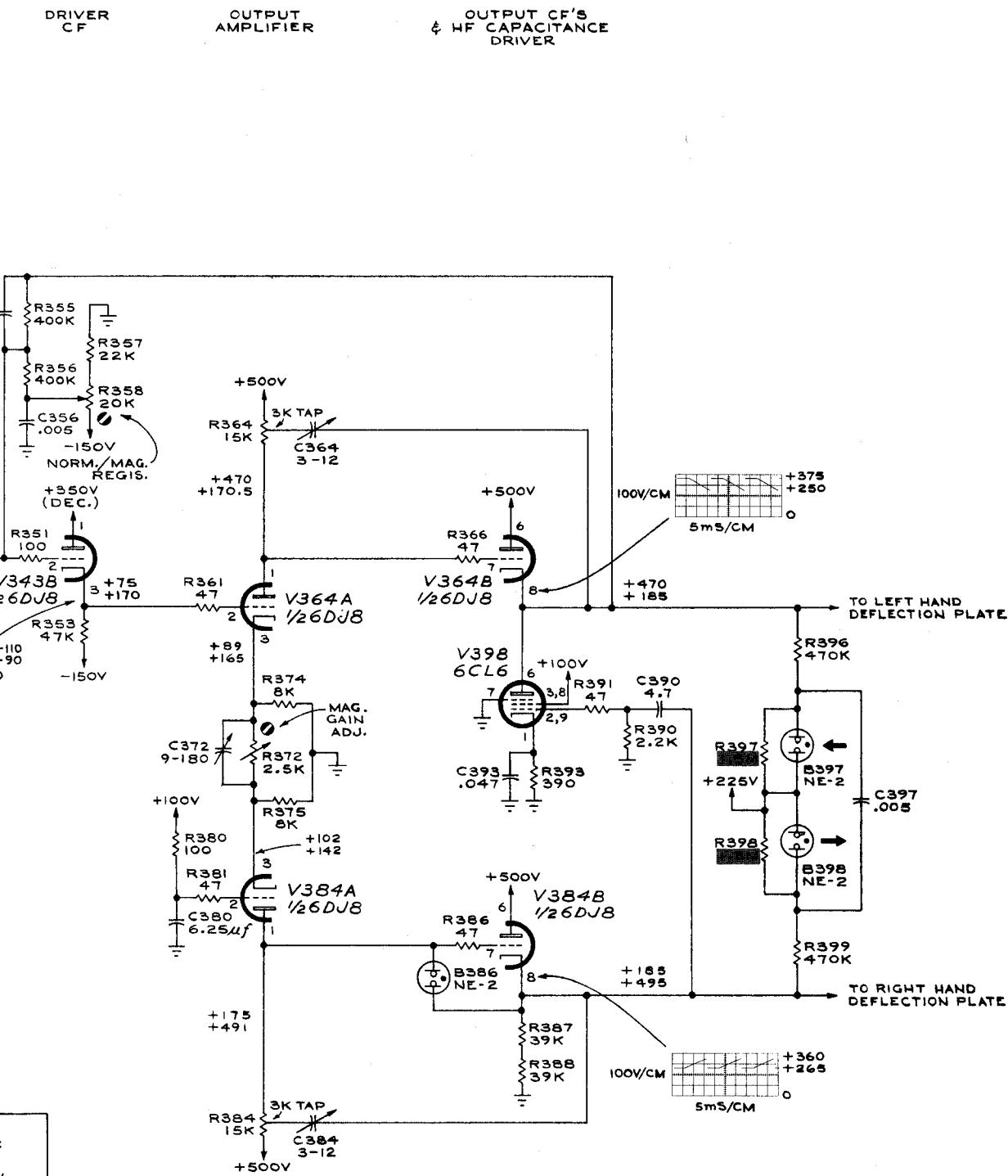
A

## SWITCH DETAIL



TYPE 585 OSCILLOSCOPE

AA

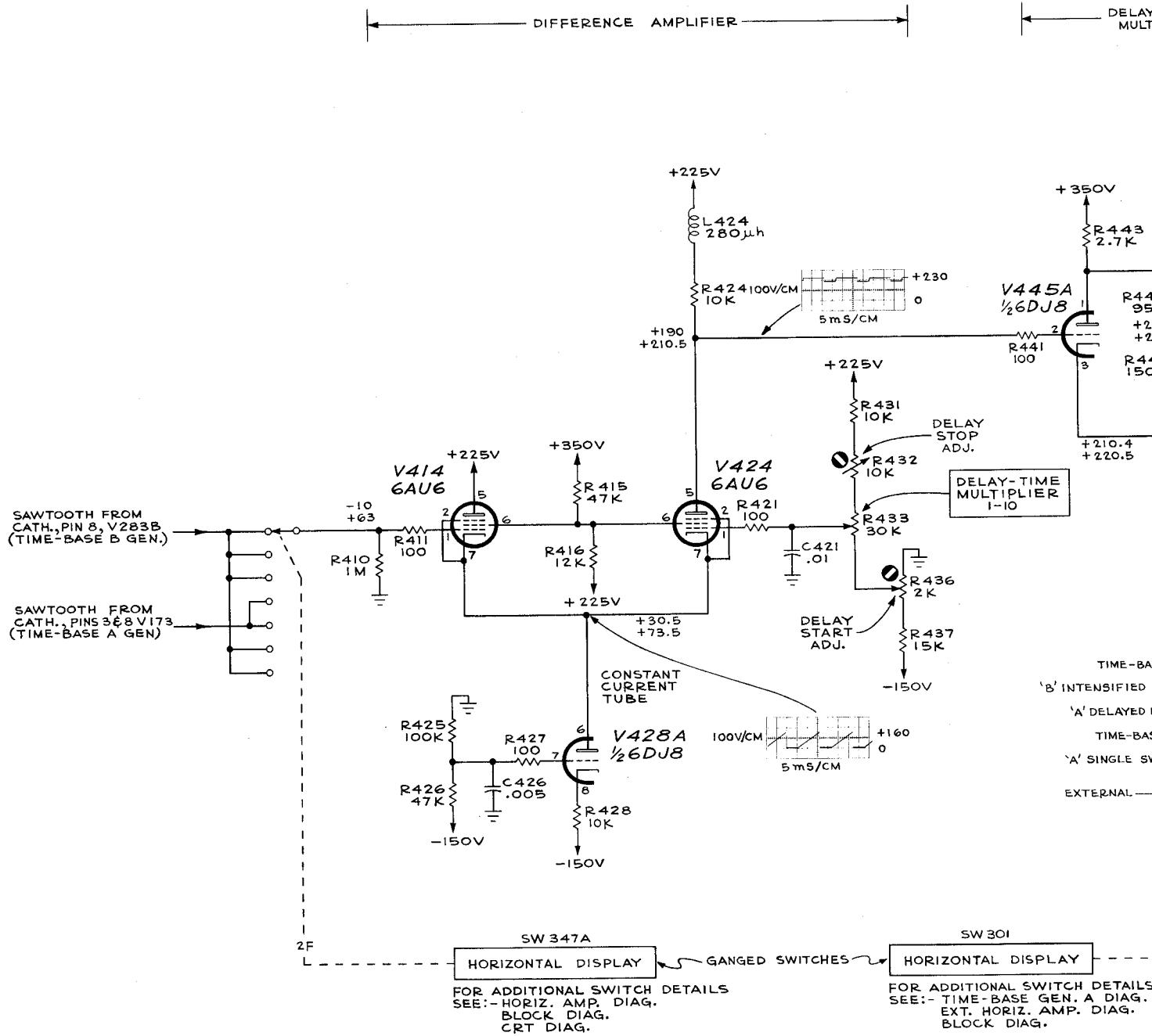


SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH RED  
TINT BLOCKS

MRH  
4-20-62

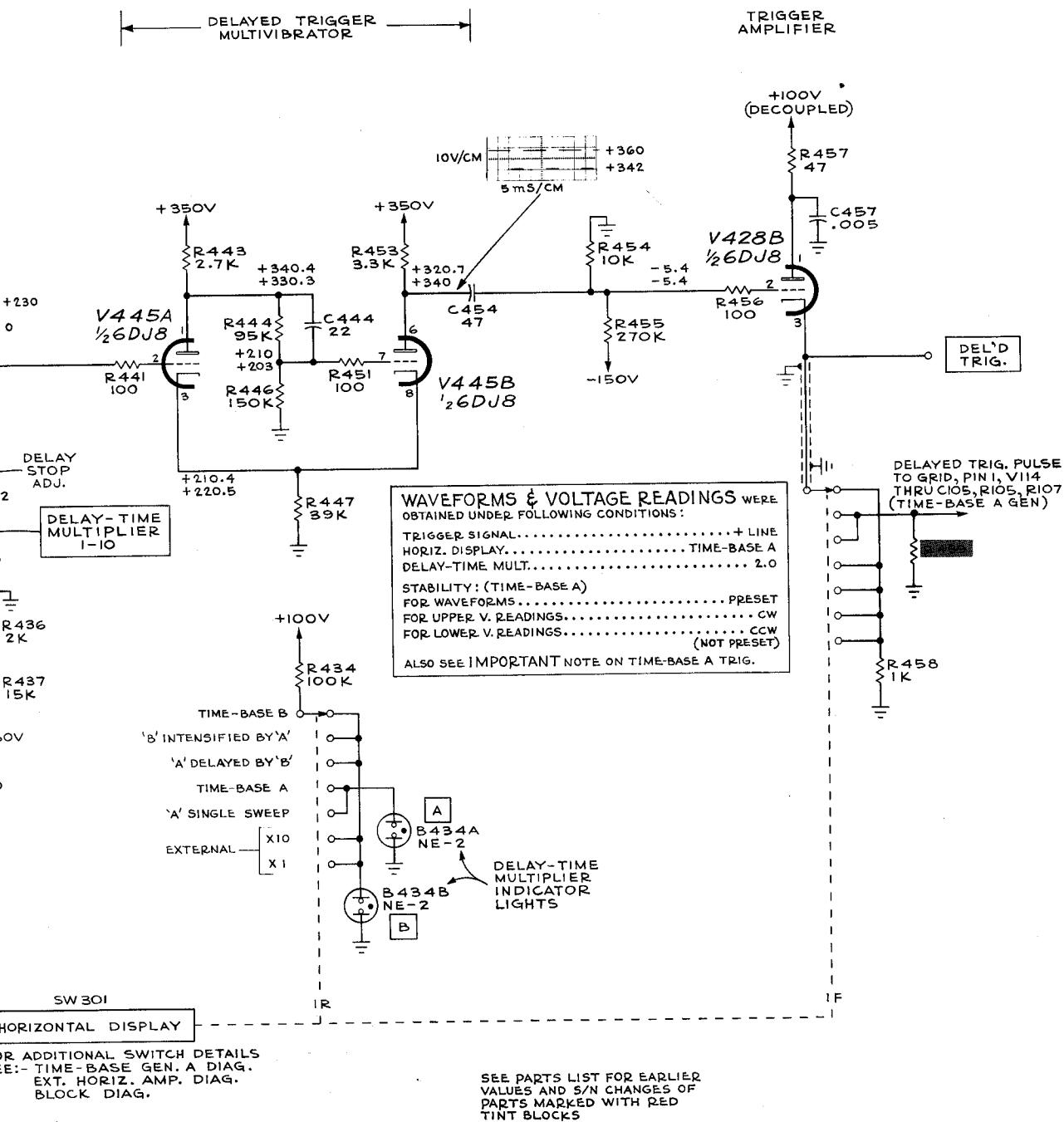
### HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS  
330 THRU 399



TYPE 585 OSCILLOSCOPE

AA<sub>1</sub>

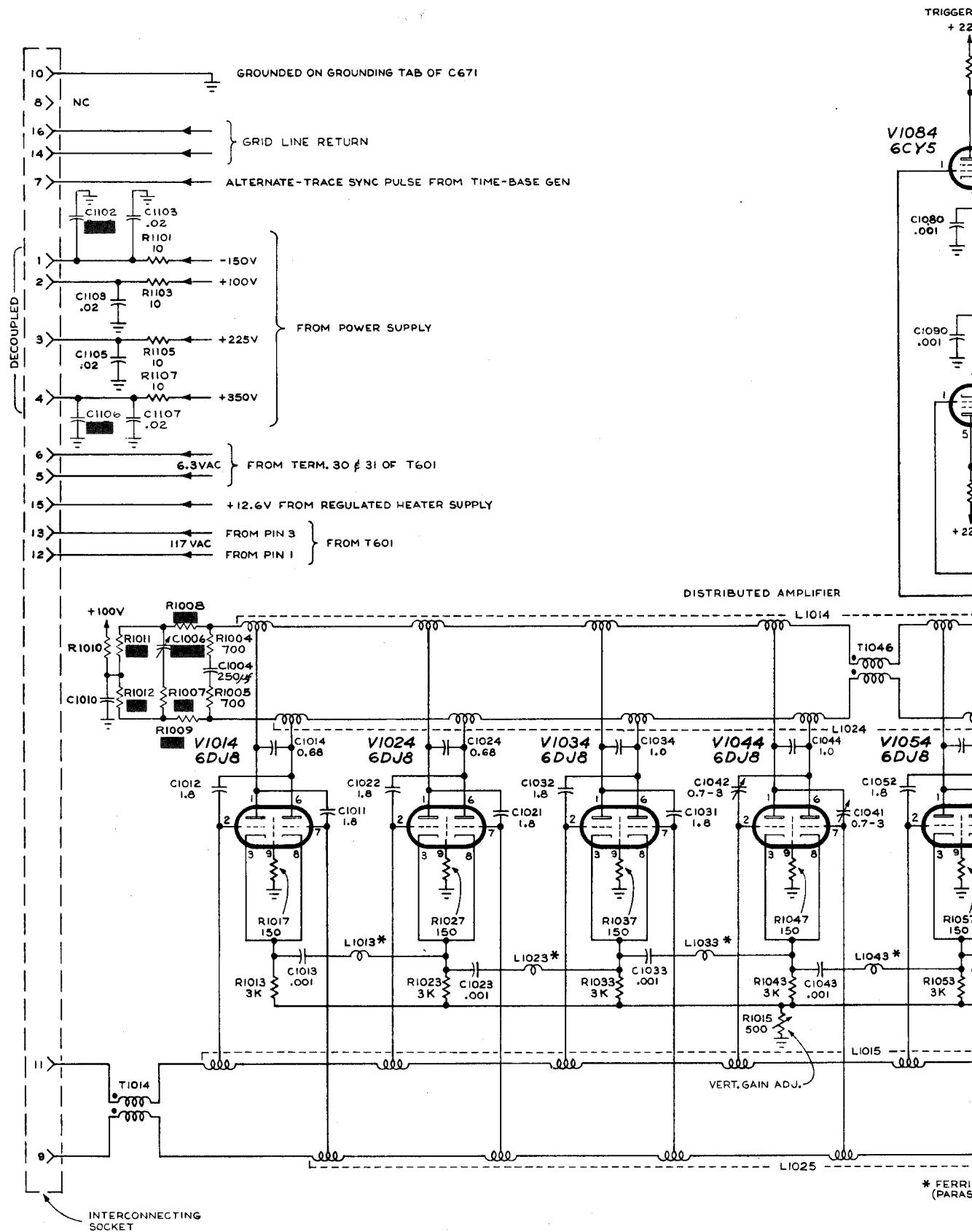


GAB  
4-23-62

DELAY PICKOFF

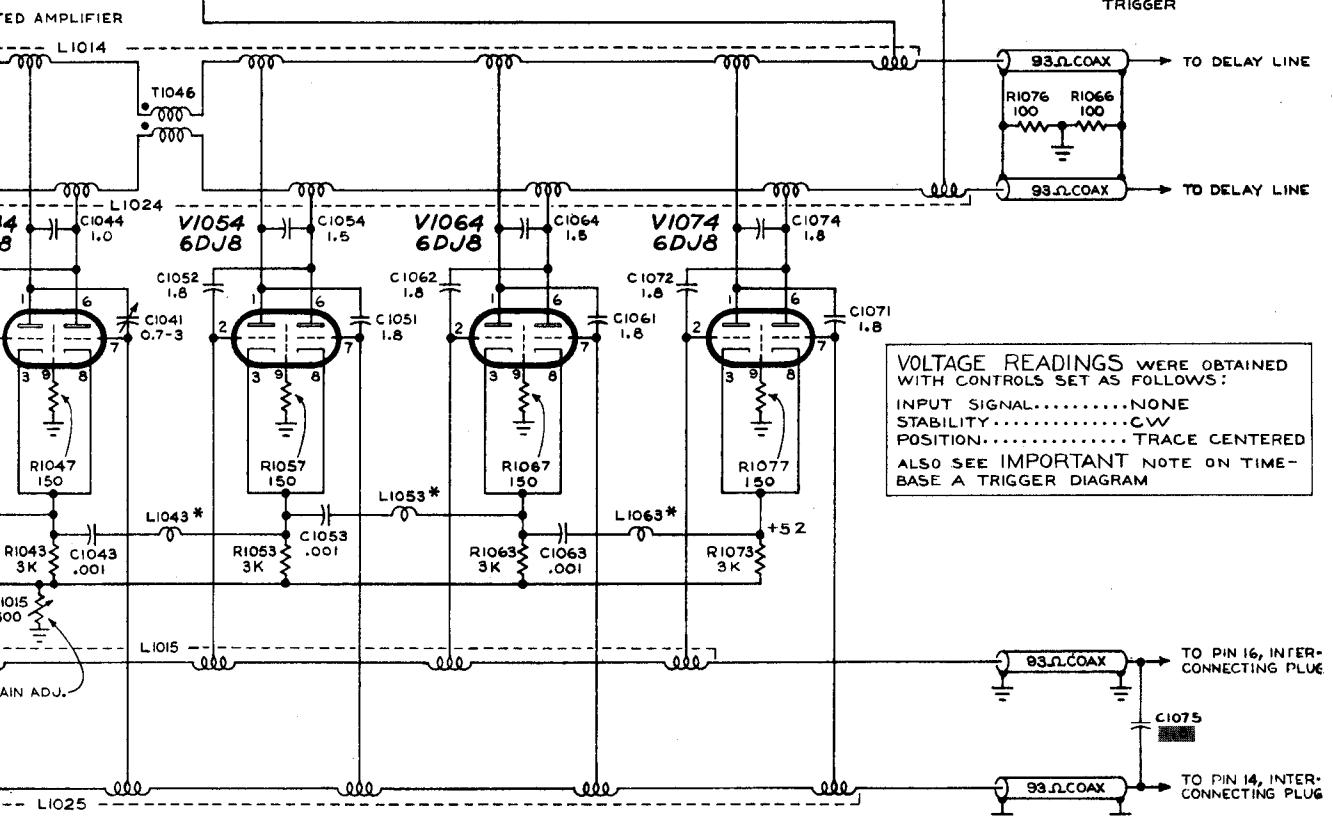
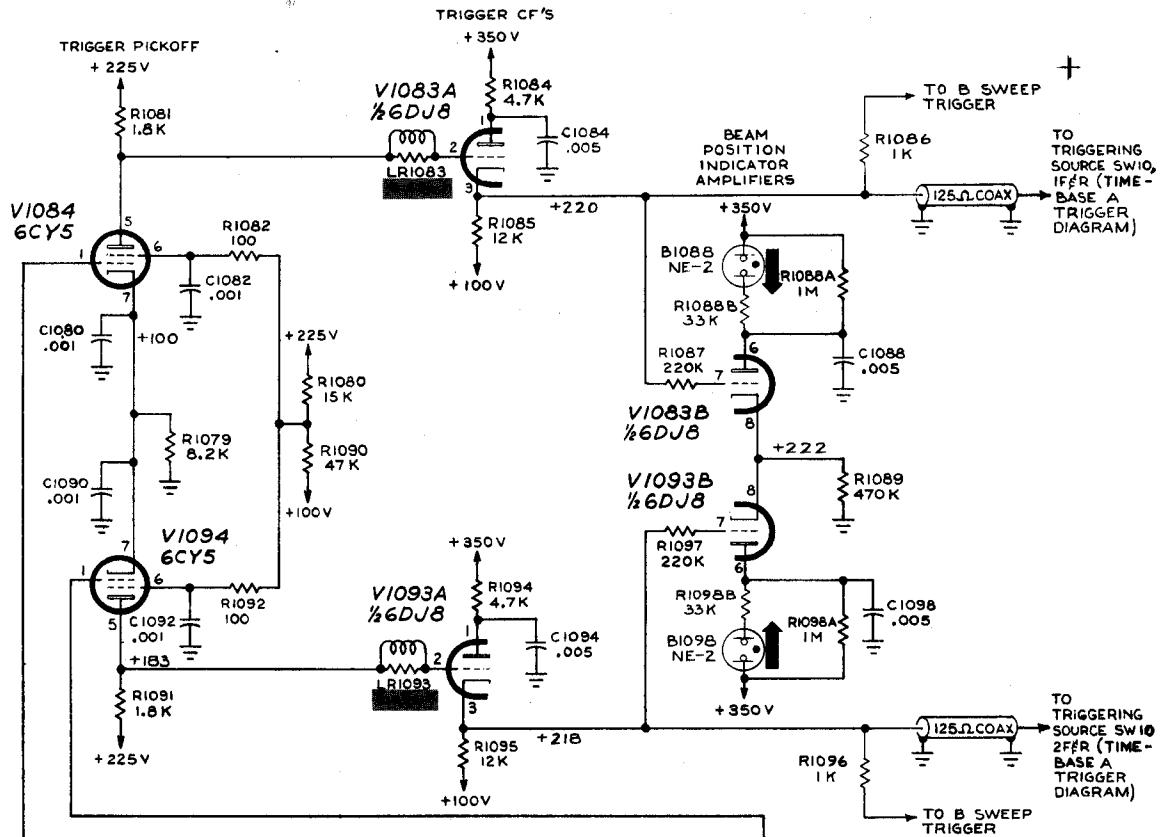
CIRCUIT NUMBERS  
410 THRU 459

AA,



TYPE 585 OSCILLOSCOPE

AB



\* FERRITE BEAD  
(PARASITIC SUPPRESSOR)

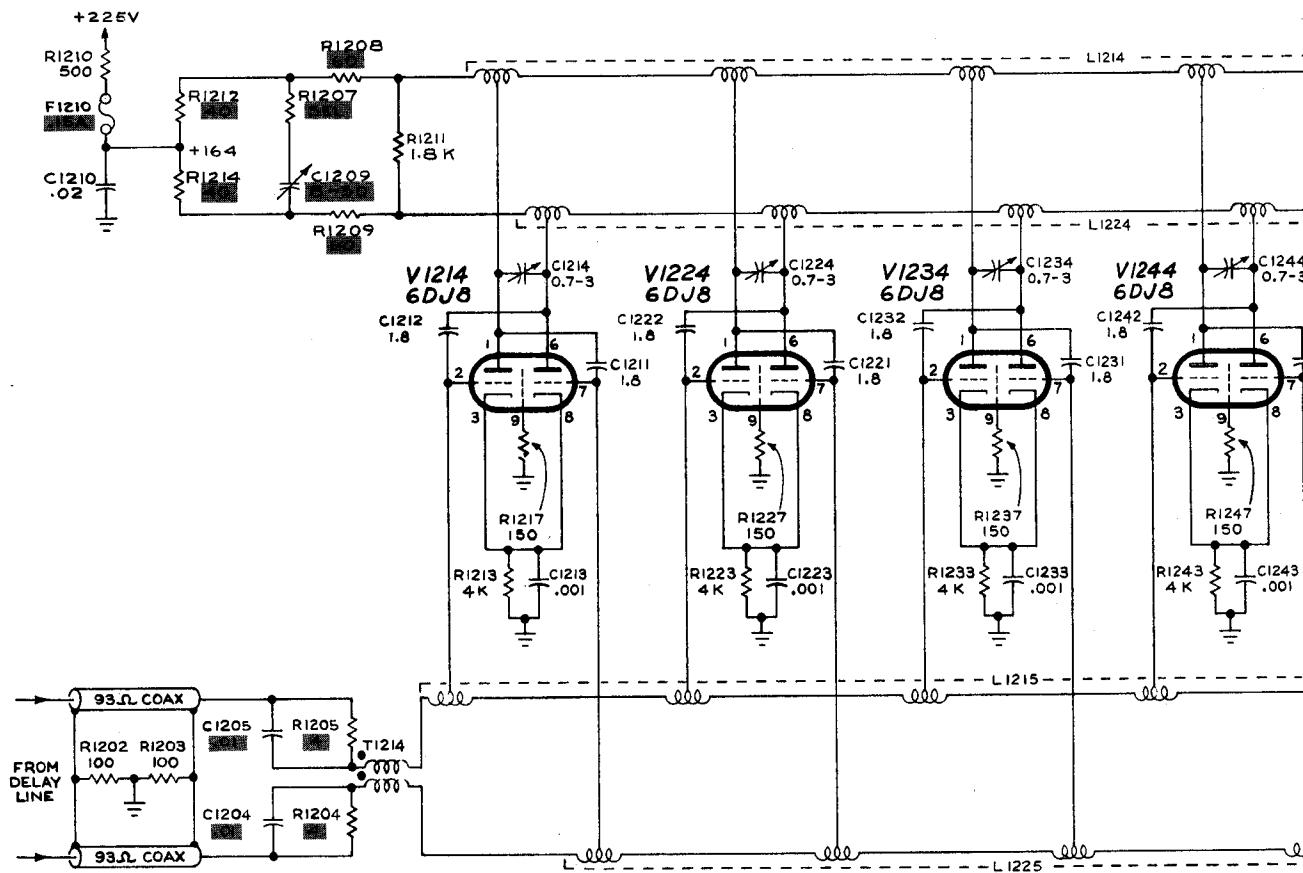
SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH RED  
TINT BLOCKS

ML  
1 - 5 - 63

### VERTICAL AMPLIFIER DELAY LINE DRIVER

CIRCUIT NUMBERS  
1000 THRU 1109

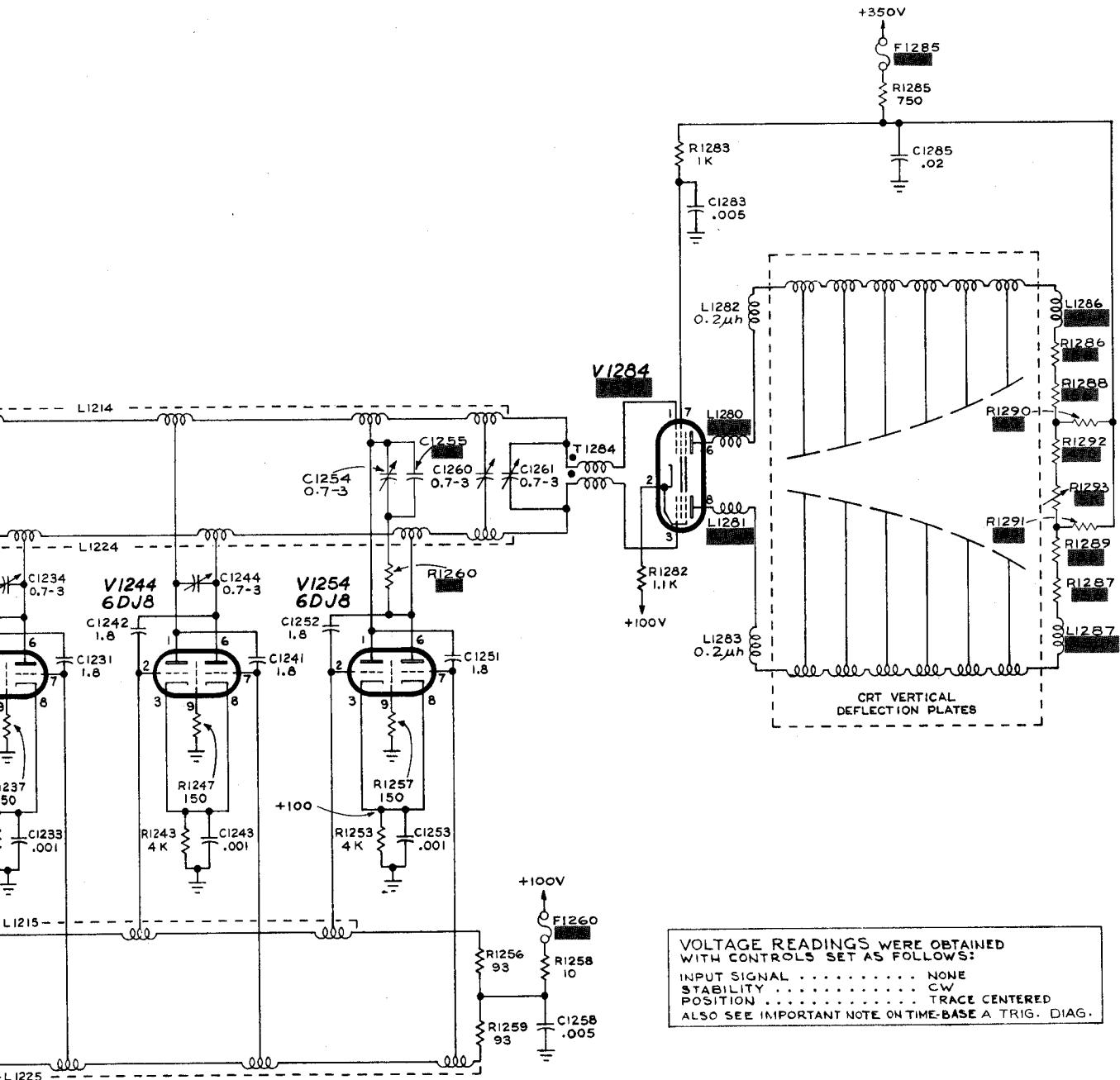
AB



+

TYPE 585 OSCILLOSCOPE

AB



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

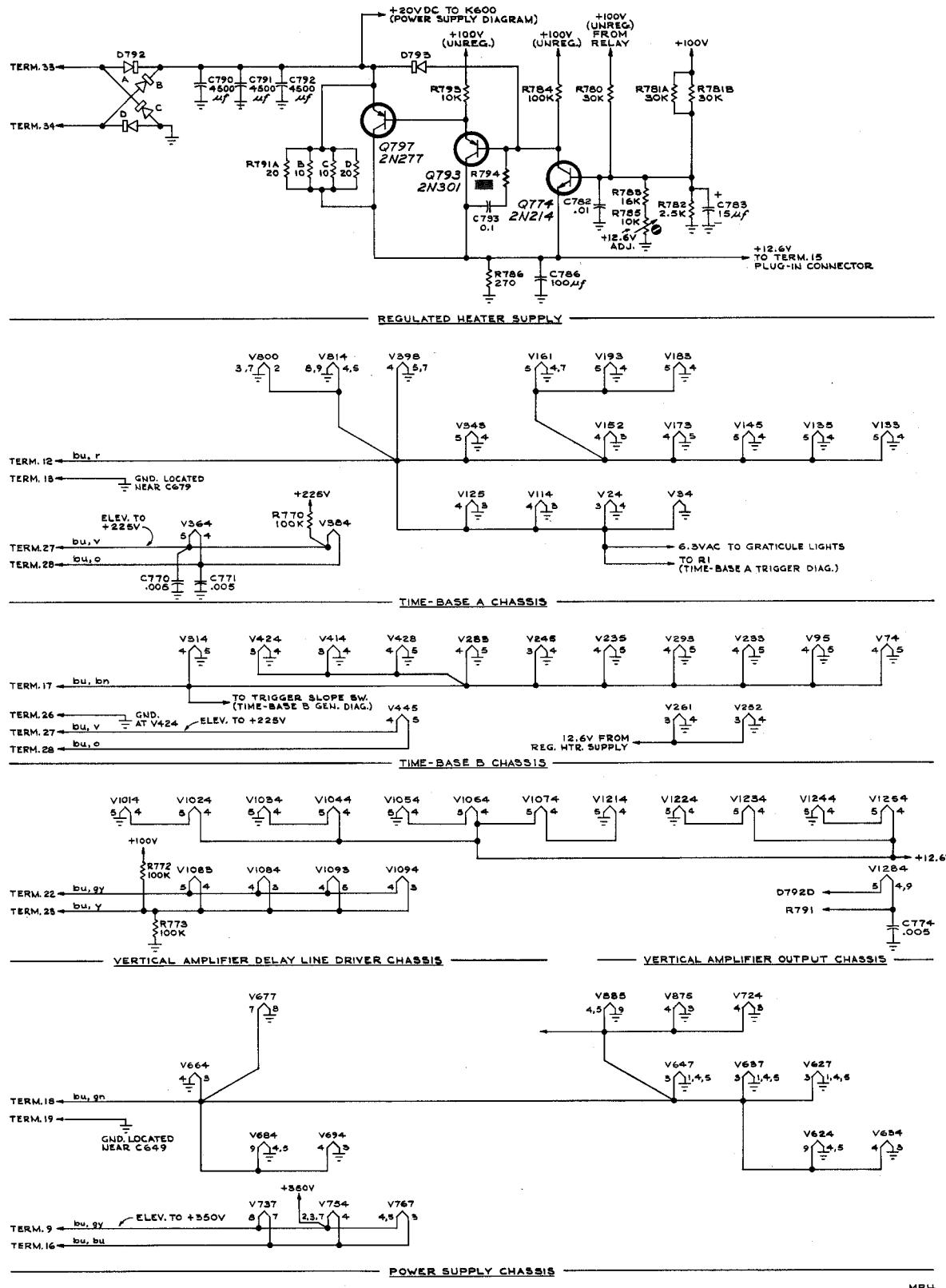
I - 5 - 63

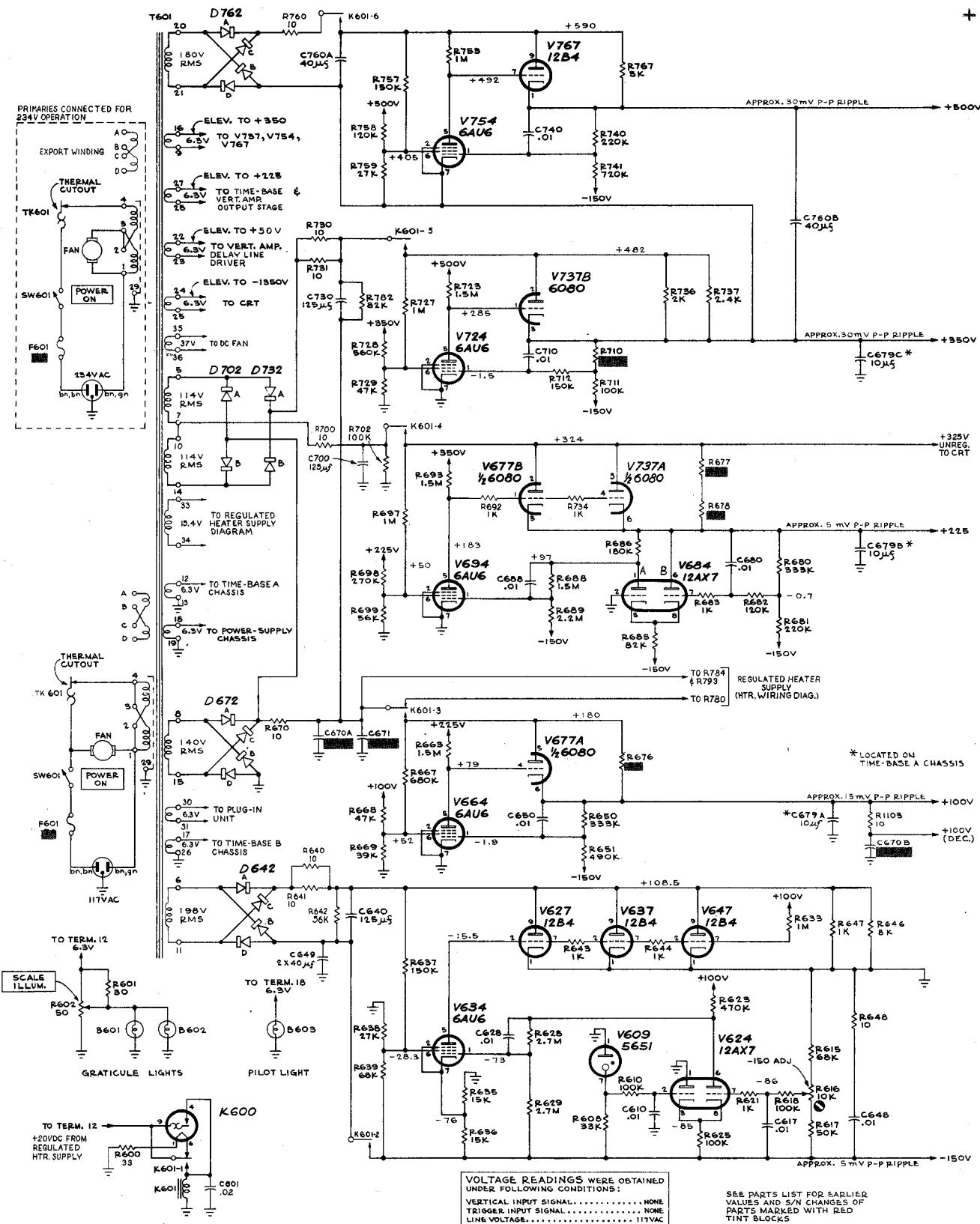
ML

### VERTICAL AMPLIFIER OUTPUT STAGE

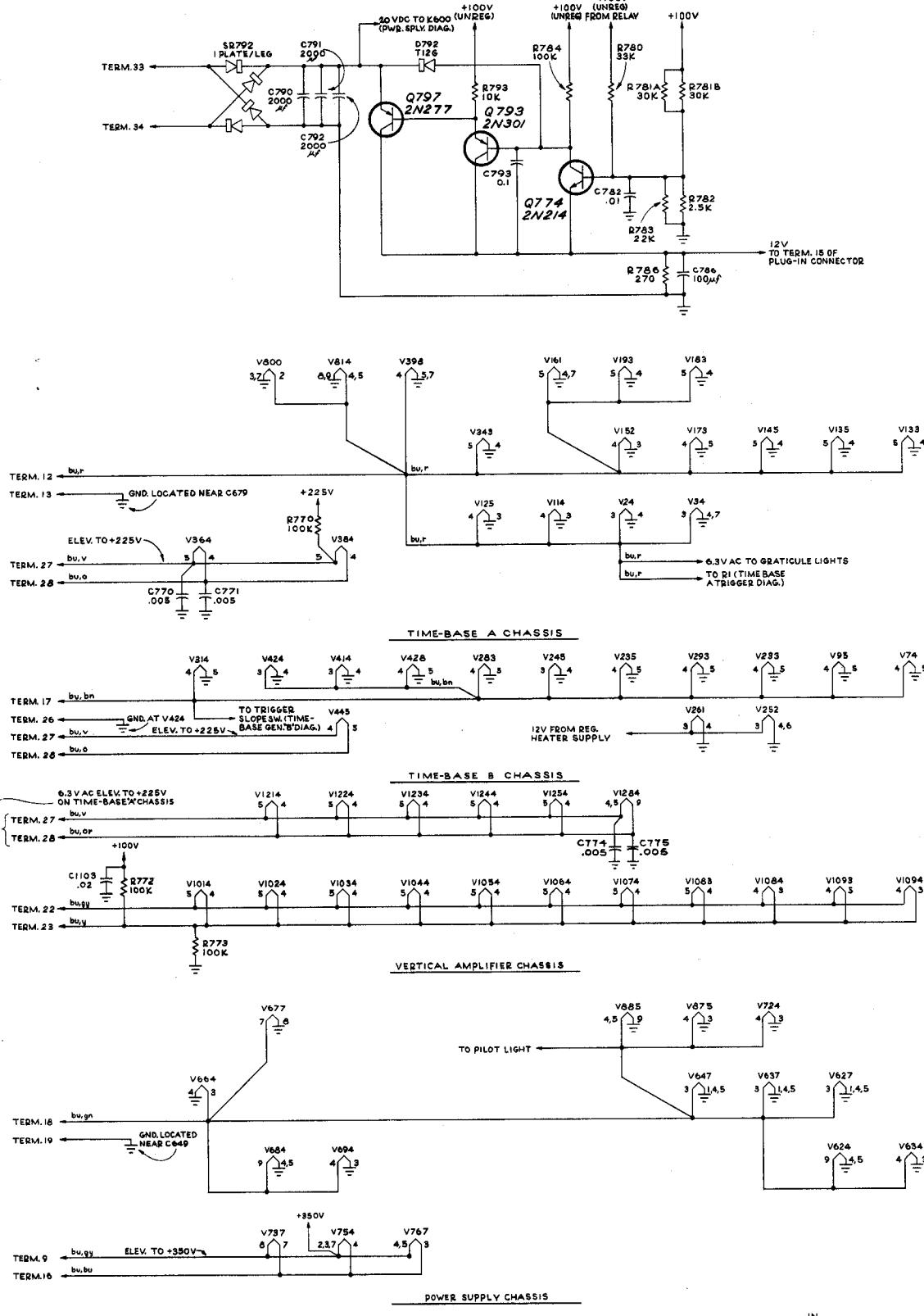
CIRCUIT NUMBERS  
 1200 THRU 1299

AB





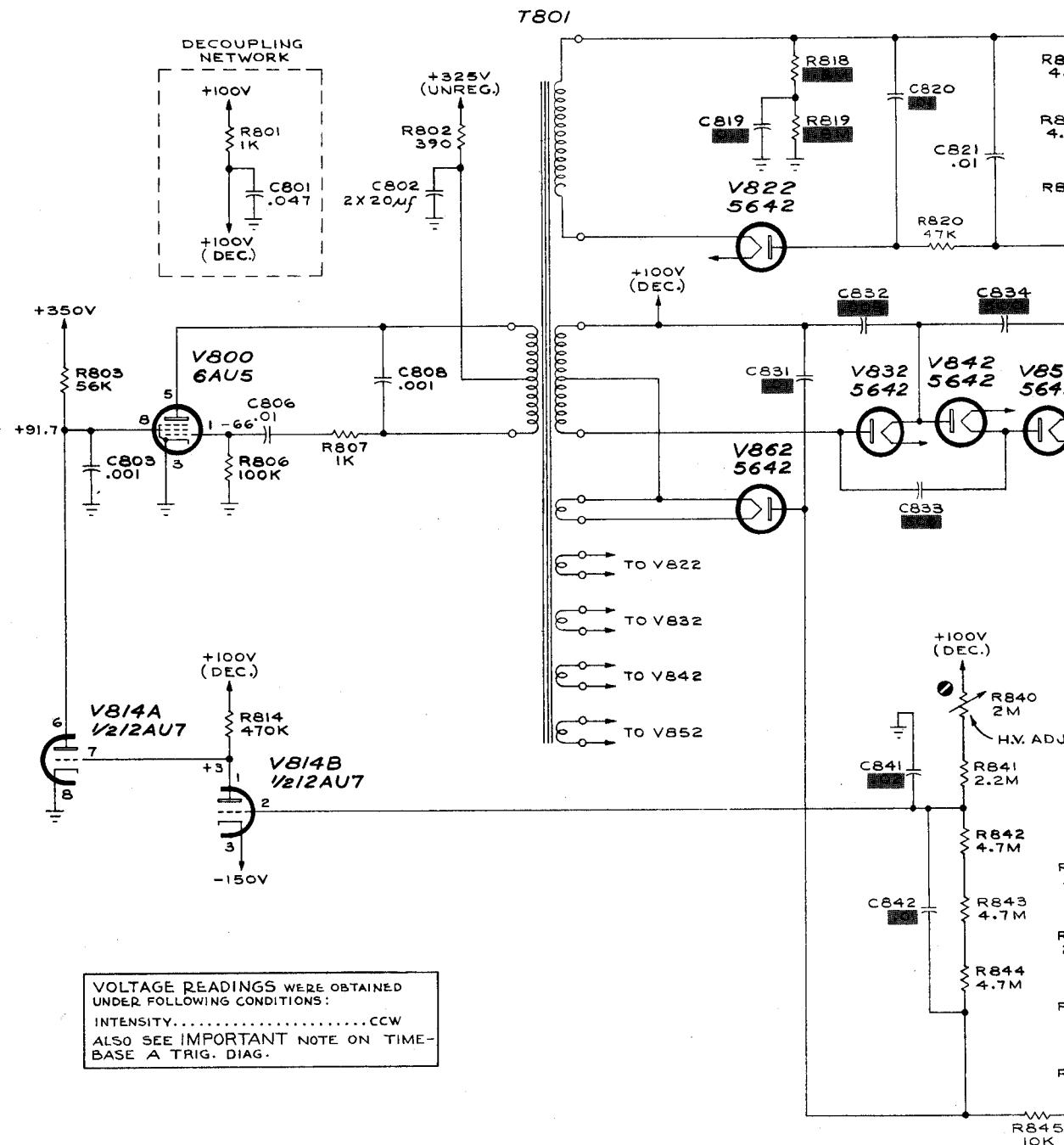
TYPE 585 OSCILLOSCOPE



TYPE 585 OSCILLOSCOPE

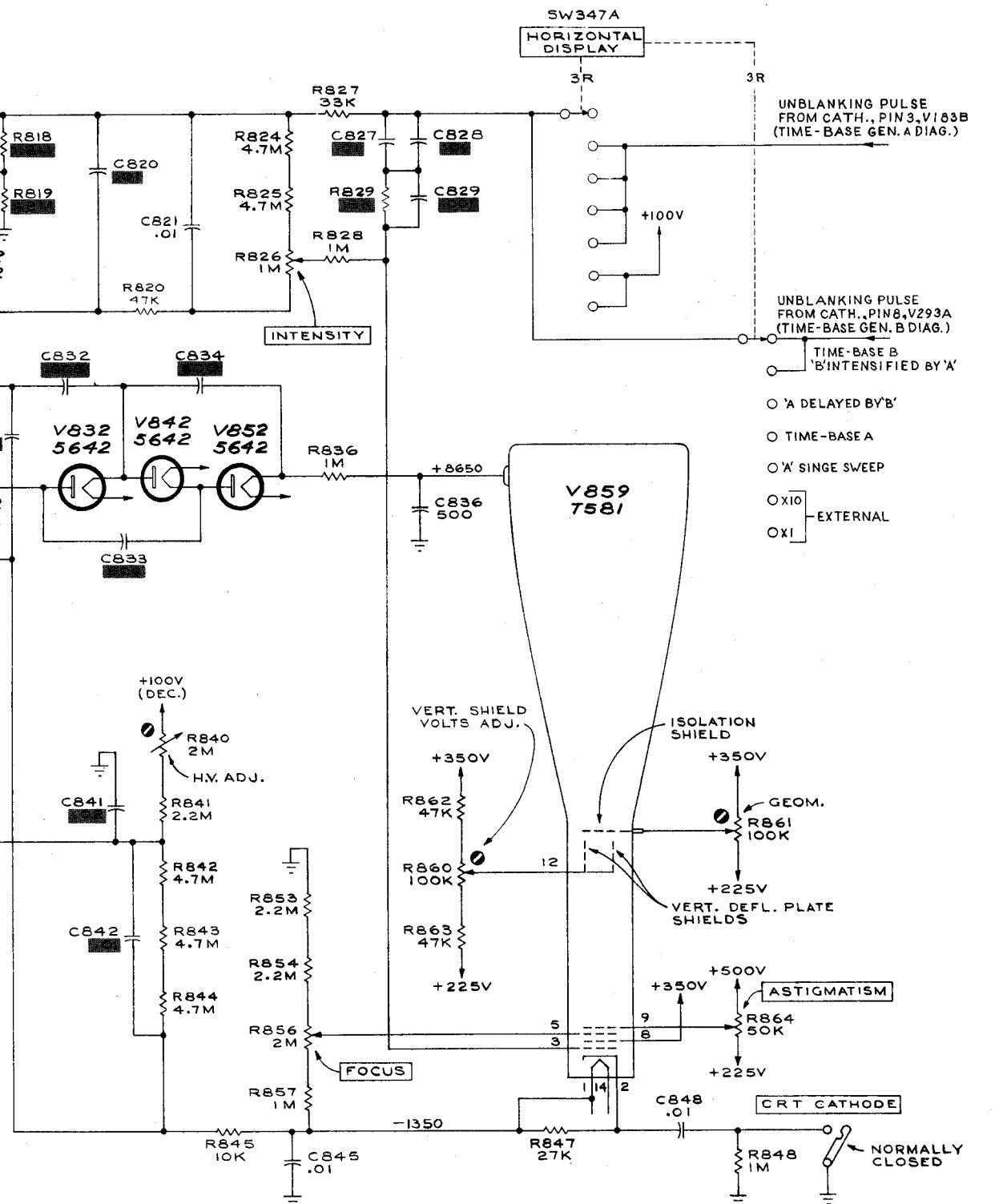
JN  
4-20-62  
HEATER WIRING DIAGRAM  
S/N 101-5762

AA



TYPE 585 OSCILLOSCOPE

AA,



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

MRH

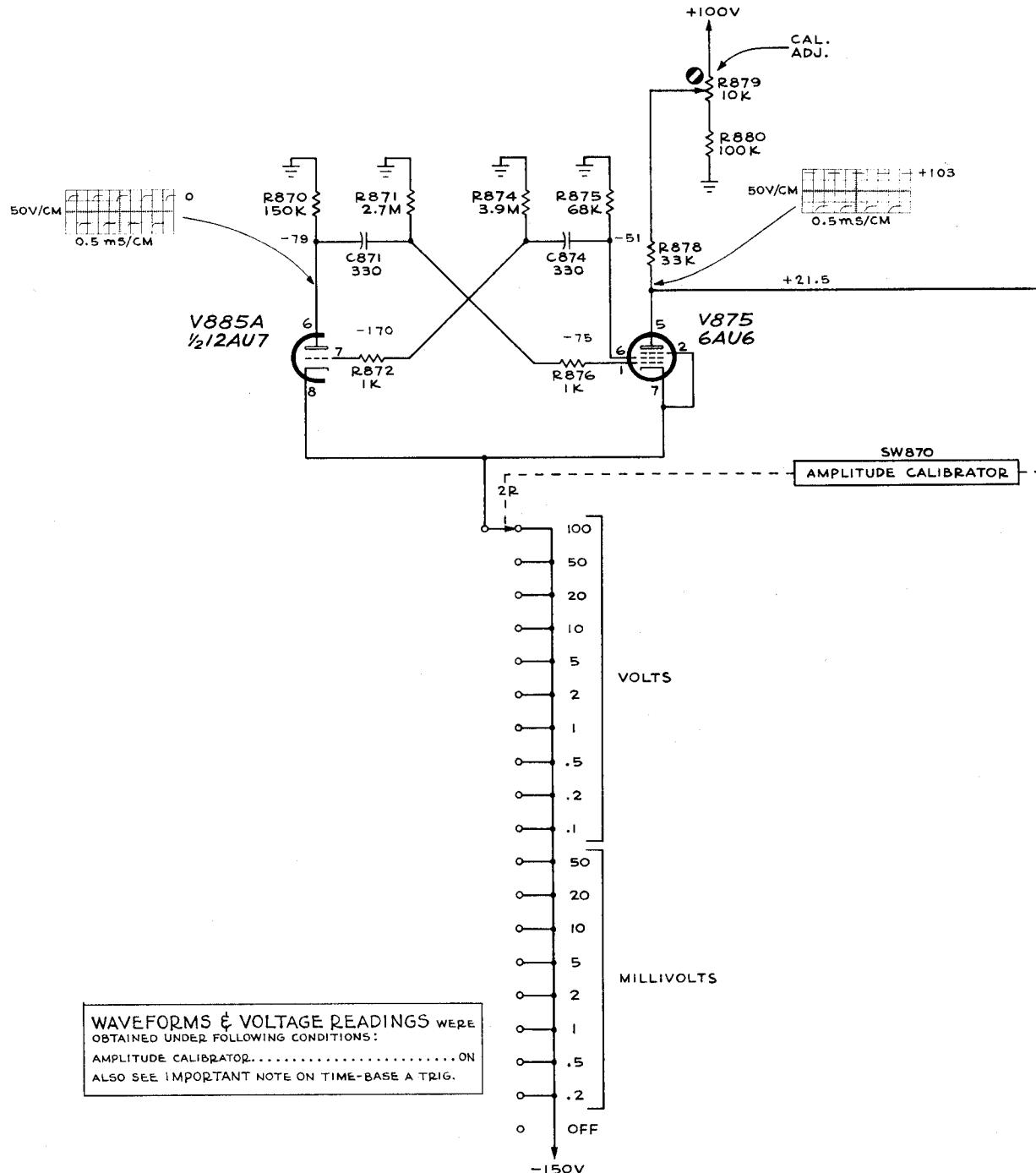
4-20-62

CRT CIRCUIT

CIRCUIT NUMBERS  
800 THRU 869  
ALSO SW340A

AA,

CALIBRATOR  
MULTIVIBRATOR



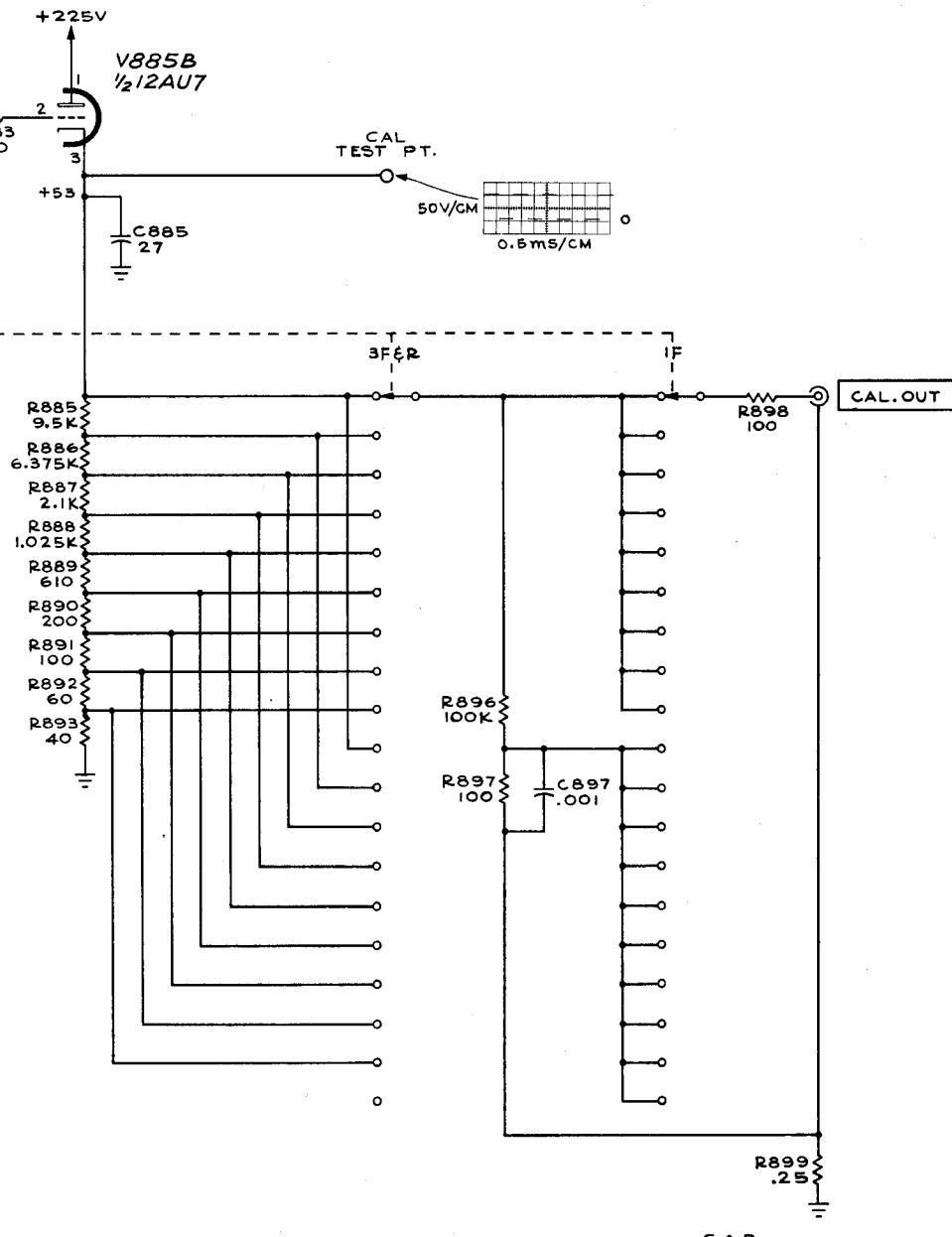
TYPE 585 OSCILLOSCOPE

AA

+

CAL. OUT  
CF

+103



CALIBRATOR

4-20-62

CIRCUIT NUMBERS  
870 THRU 899

AA

## **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.

# K4XL's BAMA

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