

**CALIBRATION PROCEDURE FOR  
OSCILLOSCOPE,  
TEKTRONIX TYPE 547**

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\*This bulletin supersedes TB 9-6625-1277-50, 28 June 1968, including all changes.



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**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification**

This bulletin provides instructions for the calibration of Oscilloscope, Tektronix Type 547. The manufacturer's instruction manual was used as the prime data source in compiling these instructions. The oscilloscope will be referred to as the "TI" (test instrument) throughout this bulletin.

*a. Model Variations.* Variations among models are described in text.

*b. Time and Technique.* The time required for this calibration is approximately 12 hours, using the dc and low frequency technique.

**2. Calibration Data Card (DA Form 2416)**

Maintenance forms, records, and reports which are to be used by calibration personnel at all cali-

bration levels are listed in and prescribed by TM 38-750.

**3. Reporting of Errors**

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded direct to Commander, U.S. Army Missile Command, ATTN: AMSMI-MFPA, Redstone Arsenal, AL 35809.

**4. Calibration Description**

TI parameters and performance specifications which pertain to this calibration are listed in table 1.

*Table 1. Calibration Description*

Test Instrument Parameters	Performance Specifications
Power input requirements	115 or 230 vac ± 10%, 50 to 60 Hz
Sweep generation (A and B): Sweep rates (X1 magnification)	0.1 μsec/cm to 5 sec/cm in 24 calibrated steps. Displayed sweep-rate accuracy ± 2% for both sweeps. An uncalibrated variable sweep-rate control permits either sweep to be slowed to at least 0.4 of indicated rate.
Sweep magnification	Any sweep rate can be increased, expanding center portion of display horizontally in fixed steps of X2, X5, and X10. Sweep-rate accuracy within ± 5% in magnified positions.



Table 1. Calibration Description — Continued

Test Instrument Parameters	Performance Specifications
Trigger source selection	Internal normal, internal plug-in, external, and line
Trigger coupling selection	Da, ac, and low-frequency rejection
Trigger signal requirements: Internal (ac) Internal (dc) Internal (ac low-frequency rejection).	Minimum deflection is 2 mm, rising to 1 cm at about 50 MHz Minimum deflection is 5 mm at dc Minimum deflection is 2 mm with signals at about 2 kHz rising to 1 cm at about 50 MHz.
External	Frequency ranges are the same as internal. Minimum amplitude is 200 mv p-p (ac), 200 mv change in dc level (dc), and 200 mv p-p (ac low-frequency reject). Minimum trigger level range is greater than $\pm 2$ v with TRIGGER LEVEL control pushed in and $\pm 20$ v with control pulled out.
Sweep delay	Time base A sweep can be delayed by main time base (B) sweep. Delay is continuously variable over range of 0.1 $\mu$ sec to 50 sec with DELAY-TIME and DELAY-TIME MULTIPLIER controls. Delay time is accurate to $\pm 1\%$ of indicated delay $\pm 2$ minor divisions of DELAY-TIME MULTIPLIER at sweep rates from 50 $\mu$ sec to 50 sec.
Horizontal deflection system (EXT): Deflection factor Frequency response Input characteristics <sup>1</sup>	Continuously variable from approximately 0.1 v/cm to 10 v/cm Dc to 400 kHz (3 db down) 1 megohm paralleled by approximately 55 pf
Amplitude calibrator: Output voltages  Accuracy Frequency <sup>1</sup> Output current Accuracy	0.2 mv to 100 v p-p in 18 steps. In addition, a 100-vdc output is available. $\pm 3\%$ Approximately 1-kHz square wave 5-ma square wave available at the front panel current loop $\pm 3\%$

<sup>1</sup> This specification is for information only and is not verified in this bulletin.

## SECTION II EQUIPMENT REQUIREMENTS

### 5. Equipment Required

Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with secondary transfer calibration standards set 4931-621-7877 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-

one accuracy ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

### 6. Accessories Required

The accessories listed in table 3 are issued with secondary transfer calibration standards set 4931-621-7877 and are to be used in this calibration procedure. When necessary, these items may be substituted by equivalent items unless specifically prohibited.



Table 2. Minimum Specifications of Equipment Required

Item	Common Name	Minimum Use Specifications.	Manufacturer, Model, and Part Number.
A1	AC/DC VOLTMETER	Range: -150 to +361 vdc	Dana, Model 5703-S-2127 (7912606).
A2	AUTOTRANSFORMER	Range: 105 to 125 vac Accuracy: +0.75%	General Radio, Model W10MT3AS3 (7910809).
A3	CALIBRATION ADAPTER.	Range: 5 to 600 kHz Rise Time: 7 nsec or less	Tektronix, Type 067-0521-00 (MIS-10258).
A4	DC VOLTMETER	Range: -1794 to -1906 vdc Accuracy: +0.75%	Electrical Instrument Services, Model ESV (MIS-10276).
A5	TIME-MARK GENERATOR.	Range: 0.1 $\mu$ sec to 5 sec markers, 10 to 50 nsec sine wave. Accuracy: $\pm$ 0.1%	Tektronix, Type 184A (7912042-1).

Table 3. Accessories Required

Item	Common Name	Description and Part Number
B1	ADAPTER	BNC plug to double banana jack (7909401)
B2	ADAPTER	BNC T Type, 2 jacks, 1 plug (MS35173-274C)
B3	ADAPTER <sup>1</sup>	Single banana jack to alligator clip (red) (7907556)
B4	CABLE <sup>1</sup>	30-in., BNC plug terminations (7907467)
B5	LEAD <sup>1</sup>	24-in., No. 18 AWG; single banana plug terminations (red) (7907497).

<sup>1</sup> Two required.

### SECTION III PRELIMINARY OPERATIONS

#### 7. Preliminary Instructions

a. The instructions outlined in this section are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

#### WARNING

HIGH VOLTAGE is used during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

#### 8. Equipment Setup

- a. Remove protective covers from TI.
- b. Insert calibration adapter (A3) into TI.
- c. Connect TI to autotransformer (A2).
- d. Connect autotransformer to 115-volt ac source and adjust autotransformer for 115 volts ac.
- e. Energize equipment and allow sufficient time for equipment to warm up and stabilize.
- f. Position TI controls as listed in (1) through (16) below:

- (1) INTENSITY, FOCUS, and ASTIGMATISM controls for sharp trace.
- (2) SCALE ILLUM and TRACE SEPARATION controls as desired.
- (3) Both TRIGGERING LEVEL controls fully



counterclockwise and pushed in.

(4) Both TRIGGERING MODE switches to AUTO.

(5) Both TRIGGERING SLOPE switches to + (positive).

(6) Both TRIGGERING COUPLING switches to AC.

(7) Both TRIGGERING SOURCE switches to NORM INT.

(8) Both VARIABLE (TIME/CM) switches to CALIBRATED.

(9) Both TIME/CM controls to .5 mSEC.

(10) TIME BASE B BRIGHTNESS control fully clockwise.

(11) HORIZONTAL DISPLAY control to A.

(12) SWEEP MAGNIFIER control to X1 OFF.

(13) SINGLE SWEEP switch to NORMAL.

(14) DELAY-TIME MULTIPLIER control to 1.00.

(15) HORIZONTAL POSITION control to mid-range.

(16) AMPLITUDE CALIBRATOR control to OFF.

g. Center calibration adapter VERTICAL POSITION control.

h. Turn calibration adapter TEST FUNCTION control to LOW LOAD.

## SECTION IV CALIBRATION PROCESS

### NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met before continuing with the calibration.

### NOTE

When indications specified in paragraphs 9 through 45 are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs 9 through 45. Do not perform power supply check if all other parameters are within tolerance.

### 9. Calibrator Accuracy and Regulation

#### a. Performance Check

(1) Set TI POWER switch off (down) and remove V945 (fig. 1).

(2) Set TI POWER switch to ON.

(3) Connect ac/dc voltmeter (A1) between CAL. OUT connector and chassis ground, using adapter (B1).

(4) Turn TI AMPLITUDE CALIBRATOR switch to settings listed in table 4. If ac/dc voltmeter does not indicate within tolerance, perform b below.

Table 4. Calibrator Accuracy

Test Instrument AMPLITUDE CALIBRATOR Switch Setting.	Ac/Dc Voltmeter Indication (vdc).	
	Min	Max
100 VDC	97	103
100 VOLTS	97	103
50 VOLTS	48.5	51.5
20 VOLTS	19.4	20.6
10 VOLTS	9.7	10.3
5 VOLTS	4.85	5.15
2 VOLTS	1.94	2.06
1 VOLT	0.97	1.03
.5 VOLT	0.485	0.515
.2 VOLT	0.194	0.206
.1 VOLT	0.097	0.103
50 mVOLTS	0.0485	0.0515

(5) Turn TI AMPLITUDE CALIBRATOR switch to 100 VOLTS and vary output of autotransformer (A2) between 105 and 125 volts. Ac/dc voltmeter will remain between 97 and 103 volts dc.

(6) Set TI POWER switch off (down) and replace V945.

(7) Set TI POWER switch to ON. Ac/dc voltmeter will indicate between +45 and % 55 volts



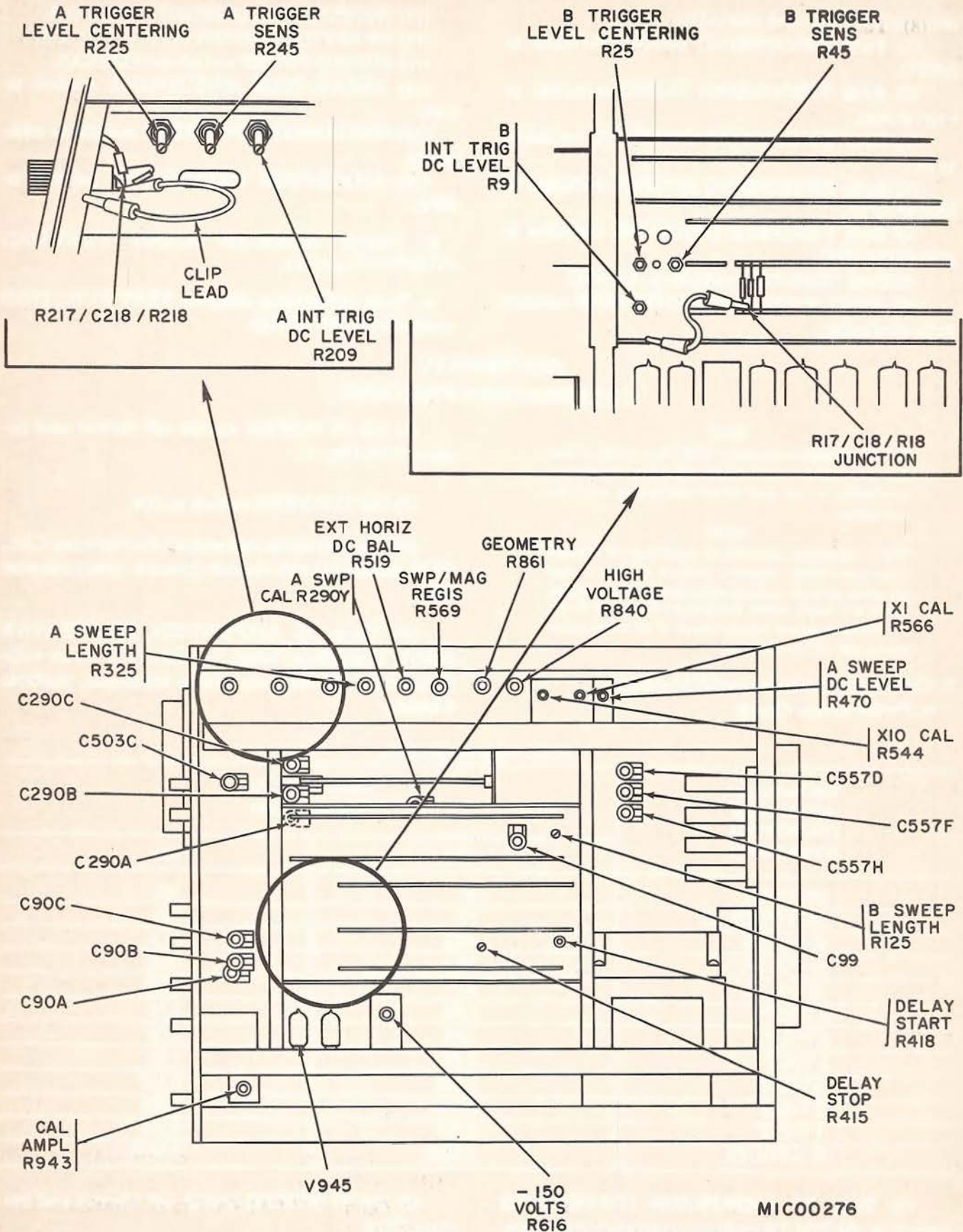


Figure 1. Oscilloscope—right-side view.



dc.

(8) Turn TI AMPLITUDE CALIBRATOR switch to OFF and disconnect ac/dc voltmeter.

*b. Adjustments*

(1) Turn TI AMPLITUDE CALIBRATOR switch to 100 VOLTS.

(2) Adjust CAL AMPL R943 (fig. 1) until ac/dc voltmeter indicates 100 volts.

### 10. Trace Rotation

*a. Performance Check*

(1) Adjust TI FOCUS and ASTIGMATISM controls for the narrowest trace.

(2) Adjust calibration adapter (A3) VERTICAL POSITION control until trace is directly behind center horizontal graticule line. If trace does not align with center graticule line over length of graticule, perform *b* below.

*b. Adjustments.* Adjust TRACE ROTATION control for indication specified in *a*(2) above.

### 11. CRT Geometry

*a. Performance Check*

(1) Connect time-mark generator (A5) to calibration adapter (A3) EXT INPUT, using cable (B4).

(2) Set time-mark generator to 50  $\mu$ SEC.

(3) Position TI controls as listed in (*a*) through (*c*) below:

(a) TIME BASE A TIME/CM switch to 50  $\mu$ SEC.

(b) INTENSITY control for visible display.

(c) TIME BASE A TRIGGERING LEVEL and calibration adapter VARIABLE controls for stable display of vertical marker lines.

(4) Adjust calibration adapter VARIABLE and VERTICAL POSITION controls so that markers overscan TI crt, and so that base line of markers is positioned below display area.

(5) Turn TI HORIZONTAL POSITION control to align markers with graticule markings. If markers are not parallel to vertical lines, at left and right edges of graticule, perform *b* below.

*b. Adjustments*

(1) Adjust GEOMETRY R861 (fig. 1) for vertical marker lines running parallel to vertical graticule lines. Note vertical curvature.

(2) Disconnect time-mark generator and adjust TI TRIGGERING LEVEL and HORIZONTAL POSITION controls and calibration adapter VERTICAL POSITION control for visible trace.

(3) Position trace to bottom graticule line, using calibration adapter VERTICAL POSITION control. Note horizontal curvature.

(4) Position trace to top graticule line and note horizontal curvature.

(5) Repeat (1) through (4) above for minimum curvature in both planes.

### 12. Vertical Dc Balance

*a. Performance Check.* Turn calibration adapter (A3) TEST FUNCTION switch to COMMON MODE. If trace is not at center graticule line, perform *b* below.

*b. Adjustments.* Adjust VERT DC BAL R1004 (fig. 2) until trace is at center graticule line.

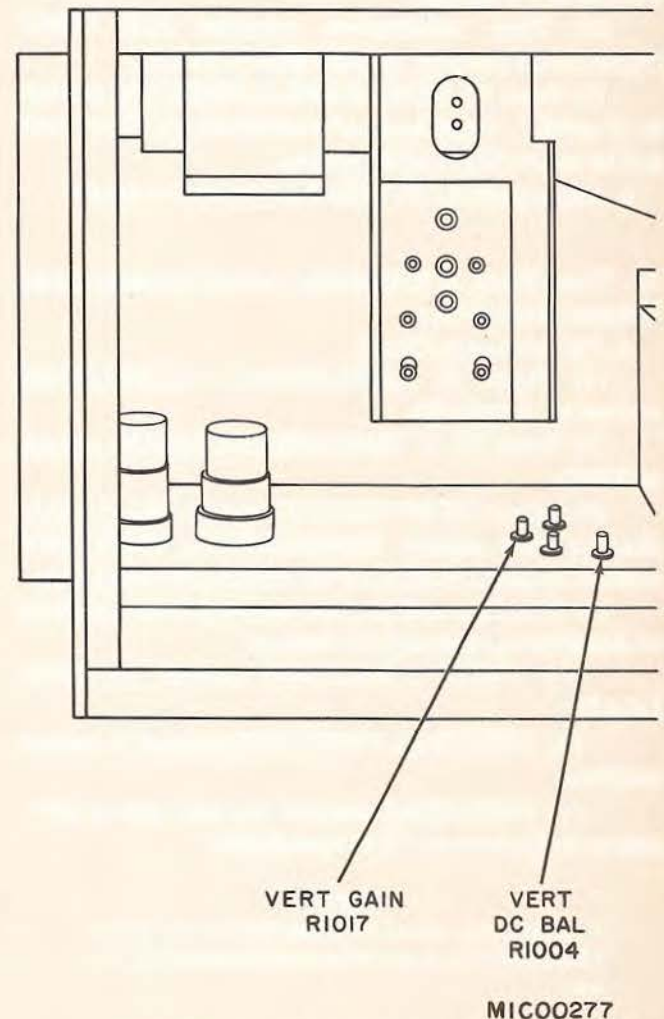


Figure 2. Oscilloscope—left view.

### 13. Vertical Gain

*a. Performance Check*

(1) Turn calibration adapter (A3) TEST FUNCTION switch to GAIN SET position.

(2) Connect TI CAL OUT to calibration adapter EXT INPUT, using cable (B4).

(3) Turn TI AMPLITUDE CALIBRATOR



switch to 100 VOLTS.

(4) Pull TI TIME BASE A TRIGGERING LEVEL out and turn fully clockwise.

(5) Adjust calibration adapter VERTICAL POSITION control as required. If amplitude of display is not between 19.4 and 20.6 minor divisions, perform *b* below.

*b. Adjustments.* Adjust VERT GAIN R1017 (fig. 2) for 4 centimeters of deflection.

#### 14. Common-Mode Rejection

##### *a. Performance Check*

(1) Turn TI AMPLITUDE CALIBRATOR switch to 1 VOLTS.

(2) Turn calibration adapter (A3) TEST FUNCTION switch to COMMON MODE.

(3) Turn TI TIME BASE A TIME/CM switch to .5 mSEC. Amplitude of waveform on TI crt will not be more than 3 millimeters.

*b. Adjustments.* No adjustments can be made.

#### 15. Time Base A Triggering Level Centering and Trigger Sensitivity

##### *a. Performance Check*

(1) Turn TI AMPLITUDE CALIBRATOR switch to .2 VOLTS.

(2) Turn TI A TRIGGERING MODE switch to TRIG.

(3) Adjust TI INTENSITY control for suitable display and adjust HORIZONTAL POSITION control to position display on center graticule line.

(4) Position calibration adapter (A3) controls as listed in (a) through (c) below:

(a) TEST FUNCTION switch to LOW LOAD.

(b) VERTICAL POSITION control to center position.

(c) VARIABLE control for one minor division of deflection on TI crt graticule.

##### NOTE

If (4) (c) above cannot be accomplished, turn VARIABLE control to 6 and perform adjustments in *b* below.

(5) Turn TI A TRIGGERING LEVEL control to 0 (zero).

(6) Connect a short between junction of R217, C218, and R218 (fig. 1) and ground, using lead and two adapters (B5 and B3). TI will display stable sweep starting on proper slope as indicated by TRIGGERING SLOPE switch. Set TRIGGERING SLOPE switch to -(negative) and back again to + (positive). Waveform will remain stable.

#### *b. Adjustments*

(1) Perform *a*(5) and (6) above.

(2) Turn TI A TRIGGER LEVEL CENTERING R225 and A TRIGGER SENS R245 (fig. 1) fully clockwise.

(3) Turn TI A TRIGGER LEVEL CENTERING R225 slowly counterclockwise until steady trace appears. Do not turn control any further counterclockwise than the point where steady bright trace was first observed.

##### NOTE

If a steady trace appears regardless of the setting of A TRIGGER LEVEL CENTERING R225, turn A TRIGGER SENS R245 a few degrees counterclockwise. Next, return A TRIGGER LEVEL CENTERING R225 control fully clockwise and repeat (3) above.

(4) Turn TI A TRIGGER SENS R245 counterclockwise until displayed waveform disappears. Then, turn control slightly clockwise until waveform reappears.

(5) Turn TI A TRIGGER LEVEL CENTERING R225 slowly clockwise until waveform disappears and then turn control counterclockwise until waveform reappears. Continue turning in a counterclockwise direction until waveform disappears. Note range through which A TRIGGER LEVEL CENTERING R225 was moved while obtaining a display.

(6) Turn TI A TRIGGER LEVEL CENTERING R225 in center of range noted in (5) above.

(7) Repeat (4) through (6) above to make TI A TRIGGER LEVEL CENTERING R225 adjustment range noted in (5) above as narrow as possible while keeping waveform displayed. A TRIGGER SENS R245 will be adjusted counterclockwise to a point where display just triggers at VARIABLE control setting of one minor division on TI crt graticule.

##### NOTE

These adjustments are critical.

#### 16. Time Base A Triggering Stability

##### *a. Performance Check*

(1) Turn TI AMPLITUDE CALIBRATOR switch to .5 VOLTS.

(2) Adjust calibration adapter (A3) VARIABLE control for 5 millimeters peak-to-peak waveform on TI crt and position waveform for equal amplitude above and below graticule centerline.

(3) Set TI A TRIGGERING COUPLING switch to DC.

(4) Observe TI crt and set A TRIGGERING SLOPE switch from + (positive) to -(negative)



and back to + (positive). If waveform does not remain stable in both positions, perform *b* below.

*b. Adjustments.* Adjust A INT TRIG DC LEVEL R209 (fig. 1) for indication observed in *a*(4) above.

**NOTE**

If above adjustment cannot be obtained, repeat paragraph 15*b* above.

### 17. Time Base A Triggering Level Control

#### *a. Performance Check*

(1) Set TI A TRIGGERING COUPLING switch to AC.

(2) Adjust calibration adapter (A3) VARIABLE control for 2 millimeters peak-to-peak waveform on TI crt.

(3) Disconnect short connected in paragraph 15*a*(6) above.

(4) Adjust TI A TRIGGERING LEVEL control for a stable display.

(5) Set TI A TRIGGERING SLOPE switch to -(negative) and repeat (4) above.

(6) If white dot on TI A TRIGGERING LEVEL knob is not alined with 0 (zero), perform *b* below.

#### *b. Adjustments*

(1) Loosen setscrew on TI A TRIGGERING LEVEL knob.

(2) Position white dot on knob so that it is alined with zero.

(3) Tighten setscrew.

### 18. Time Base B Triggering Level Centering and Triggering Sensitivity

#### *a. Performance Check*

(1) Turn TI B TRIGGERING MODE switch to TRIG.

(2) Turn TI AMPLITUDE CALIBRATOR switch to .2 VOLTS.

(3) Pull TI B TRIGGERING LEVEL control out and set to 0 (zero). Turn HORIZONTAL DISPLAY switch to B.

(4) Adjust TI INTENSITY control for a display and HORIZONTAL POSITION control to position display on vertical graticule centerline.

(5) Adjust calibration adapter (A3) VARIABLE control for one minor division on TI crt graticule.

**NOTE**

If (5) above cannot be accomplished, turn VARIABLE control to 6 and perform *b* below.

(6) Connect a short from junction of R17, C18, and R18 (fig. 1) and ground, using lead and two

adapters (B5 and B3).

(7) TI crt display will be stable with sweep starting on proper slope as indicated by B TRIGGERING SLOPE switch. Set B TRIGGERING SLOPE switch to -(negative) and back again to + (positive). Waveform will remain stable.

#### *b. Adjustments.*

(1) Perform *a*(5) above.

(2) Turn TI B TRIGGER LEVEL CENTERING R25 and B TRIGGER SENS R45 (fig. 1) fully clockwise.

(3) Turn TI B TRIGGER LEVEL CENTERING R25 slowly counterclockwise until a stable trace appears.

**NOTE**

If a stable trace appears regardless of setting of TI B TRIGGER LEVEL CENTERING R25, turn B TRIGGER SENS R45 a few degrees counterclockwise. Return B TRIGGER LEVEL CENTERING control fully clockwise and repeat (3) above.

(4) Turn TI B TRIGGER SENS R45 counterclockwise until displayed waveform disappears. Then, turn control slightly clockwise until waveform reappears.

(5) Turn TI B TRIGGER LEVEL CENTERING R25 slowly clockwise until waveform disappears. Then, turn control counterclockwise until waveform reappears. Continue turning control in a counterclockwise direction until waveform disappears. Note range through which B TRIGGER LEVEL CENTERING R25 was moved while obtaining a display.

(6) Turn TI B TRIGGER LEVEL CENTERING R25 in center of range, noted in (5) above, as narrow as possible while keeping the waveform displayed. B TRIGGER SENS R45 will be adjusted counterclockwise to a point where display just triggers at VARIABLE control setting of one minor division on TI crt.

(7) Repeat (4) through (6) above to make TI B TRIGGER LEVEL CENTERING R25 adjustment range noted in (5) above as narrow as possible while keeping the waveform displayed. B TRIGGER SENS R45 will be adjusted counterclockwise to a point where display just triggers at VARIABLE control setting of one minor division on TI crt.

**NOTE**

These adjustments are critical.

### 19. Time Base B Triggering Stability

#### *a. Performance Check*

(1) Turn TI AMPLITUDE CALIBRATOR switch to .5 VOLTS.

(2) Adjust calibration adapter (A3) VARIABLE



ABLE control for 5 millimeters peak-to-peak waveform on TI crt and position waveform for equal amplitude above and below graticule centerline.

(3) Set TI B TRIGGERING COUPLING switch to DC. If stable display is not observed on TI crt, perform *b* below.

(4) Set TI B TRIGGERING SLOPE switch from +(positive) to -(negative) and back to +(positive). If waveform does not remain stable in both positions, perform *b* below.

*b. Adjustments* Adjust B INT TRIG DC LEVEL R9 (fig. 1) for indication observed in *a*(4) above.

*NOTE*

If above adjustment cannot be obtained, perform paragraph 18*b* above.

## 20. Time Base B Triggering Level Control

### *a. Performance Check*

(1) Set TI B TRIGGERING COUPLING switch to AC.

(2) Adjust calibration adapter (A3) VARIABLE control for 2 millimeters peak-to-peak waveform on TI crt.

(3) Disconnect short connected in paragraph 18*a*(6) above.

(4) Adjust TI B TRIGGERING LEVEL control for a stable display.

(5) Set TI B TRIGGERING SLOPE switch to -(negative) and repeat (4) above.

(6) If white dot on TI B TRIGGERING LEVEL knob does not aline with 0 (zero), perform *b* below.

### *b. Adjustments*

(1) Loosen setscrew on TI B TRIGGERING LEVEL knob.

(2) Position white dot on knob so that it alines with zero.

(3) Tighten setscrew.

## 21. Horizontal Sweep Magnifier Registration

### *a. Performance Check*

(1) Position TI controls as listed in (a) through (d) below:

(a) AMPLITUDE CALIBRATOR to OFF.

(b) B TRIGGERING MODE switch to AUTO.

(c) B TRIGGERING SLOPE switch to +(positive).

(d) B TIME/CM control to 1 mSEC.

(2) Connect time-mark generator (A5) to calibration adapter (A3) EXT INPUT, using cable (B4).

(3) Set time-mark generator to 5 mS.

(4) Adjust TI B TRIGGERING LEVEL control for stable display.

(5) Adjust calibration adapter VARIABLE control for a 2-centimeter amplitude display on TI crt and center display vertically by using VERTICAL POSITION control.

(6) Set SWEEP MAGNIFIER switch to X10 and position middle 5-millisecond time marker to center graticule. Turn SWEEP MAGNIFIER switch to X1 OFF.

(7) If the middle 5-millisecond time marker is not alined with graticule centerline, perform *b* below.

### *b. Adjustments*

(1) Adjust SWP/MAG REGIS R569 (fig. 1) to position 5-millisecond time marker to graticule centerline.

(2) Repeat *a*(1) through (7) above, and (1) above until no movement of 5-millisecond time marker is noted when SWEEP MAGNIFIER switch is turned from X10 to X1 OFF.

## 22. X10 and X1 Magnifier

### *a. Performance Check*

(1) Turn TI SWEEP MAGNIFIER switch to X10.

(2) Set time-mark generator (A5) to .1 ms.

(3) Aline second marker with second vertical graticule line.

(4) If the 10th time marker does not coincide with 10th graticule line within  $\pm 2.5$  minor divisions, perform *b* below.

*NOTE*

MAG ON lamp will be illuminated.

(5) Turn TI SWEEP MAGNIFIER switch to X1 OFF.

(6) Set time-mark generator to 1 mS.

(7) Repeat (3) above.

(8) If 10th time marker does not coincide with 10th graticule line within  $\pm 1$  minor division, perform *b*(2) and (3) below.

(9) Turn TI SWEEP MAGNIFIER switch to X2. MAG ON lamp will be illuminated.

(10) Turn TI SWEEP MAGNIFIER switch to X5. MAG ON lamp will be illuminated.

### *b. Adjustments*

(1) Adjust X10 CAL R544 (fig. 1) to aline 10th marker with 10th graticule line.

(2) Adjust X1 CAL R566 (fig. 1) to aline 10th marker with 10th graticule line.

(3) To override interaction of adjustments, repeat *a*(1) through (8) above, and (1) and (2) above until timing is correct.



## 23. B Sweep Length

*a. Performance Check*

(1) Turn TI SWEEP MAGNIFIER switch to X1 OFF.

(2) Position display to start at left vertical graticule line.

(3) If sweep length is not 10.5 centimeters, perform *b* below.

*b. Adjustments.* Adjust B SWEEP LENGTH R125 (fig. 1) for a sweep length of 10.5 centimeters.

## 24. B Variable (Time/Cm) and Uncalibrated Neon

*a. Performance Check*

(1) Set time-mark generator (A5) to 5 mS.

(2) Adjust TI B TRIGGERING LEVEL control for stable display.

(3) Turn TI HORIZONTAL POSITION control to position start of trace to left vertical graticule line.

(4) Adjust calibration adapter (A3) VARIABLE control for markers of 2 centimeters amplitude.

(5) Turn TI B VARIABLE control fully counterclockwise.

(6) Observe that UNCALIBRATED lamp glows and that display is one marker or more per 2 centimeters.

(7) Turn TI B VARIABLE control to CALIBRATED position.

*b. Adjustments.* No adjustments can be made.

## 25. Delay Start and Delay Stop

*a. Performance Check*

(1) Set time-mark generator (A5) to 1 mS.

(2) Adjust calibration adapter (A3) VARIABLE control for a 2-centimeter display on TI crt.

(3) Position TI controls as listed in (a) through (h) below:

(a) A TRIGGERING MODE switch to AUTO.

(b) A TRIGGERING SLOPE switch to + (positive).

(c) A TIME/CM control to 10  $\mu$ SEC.

(d) HORIZONTAL DISPLAY control to B INTENS BY "A."

(e) B TRIGGERING MODE switch to TRIG.

(f) B TRIGGERING LEVEL control for stable triggering on 1-millisecond time marker.

(g) BRIGHTNESS and INTENSITY controls to make brightened portion of display clearly distinguishable.

(h) HORIZONTAL DISPLAY switch to ALT

(B INTENS BY "A"-ALT-A-DLY'D).

(4) Turn TI TRACE SEPARATION control to position trace A presentation directly above intensified trace B presentation.

(5) Turn TI DELAY-TIME MULTIPLIER control fully counterclockwise and check for dial indication of 0.10. If dial indication is not 0.10, reposition knob by loosening setscrew and turning dial to indicate 0.10.

(6) Turn TI DELAY-TIME MULTIPLIER control fully clockwise and check for dial indication of at least 10.10.

(7) Turn TI DELAY-TIME MULTIPLIER to 1.00.

(8) B trace will have second 1-millisecond time marker brightened, and A trace will start at 1.8-centimeter amplitude point of rising portion of waveform. If this display cannot be obtained, perform *b* below.

(9) Repeat (7) and (8) above for indications listed in table 5. DELAY-TIME MULTIPLIER dial indication will be within limits indicated in table 5.

Table 5. Delay Start and Delay Stop

Trace B Time Marker Brightened.	DELAY-TIME MULTIPLIER Dial Indication.	
	Min	Max
3rd	1.98	2.02
4th	2.98	3.02
5th	3.98	4.02
6th	4.98	5.02
7th	5.98	6.02
8th	6.98	7.02
9th	7.98	8.02
10th	8.98	9.02

*b. Adjustments*

(1) Repeat *a*(1) through (4) and (7) above.

(2) Adjust DELAY START R418 (fig. 1) for indication in *a*(8) above.

(3) Turn DELAY-TIME MULTIPLIER control to 9.00 and adjust DELAY STOP R415 (fig. 1) so trace A display starts at 1.8-centimeter amplitude point on rise of 1-millisecond time marker and so that trace B 10th 1-millisecond time marker is brightened.

(4) Due to interaction of adjustments, repeat (1) through (3) above until trace A starts at same point as second and 10th marker.

## 26. B Sweep Generator Unblanking Compensation

*a. Performance Check*



(1) Position calibration adapter (A3) TEST FUNCTION switch to GAIN SET.

(2) Position TI controls as listed in (a) through (i) below:

(a) A TRIGGERING LEVEL control fully clockwise.

(b) A TIME/CM switch to 50  $\mu$ SEC.

(c) HORIZONTAL DISPLAY switch to ALT (A-ALT-B).

(d) B TRIGGERING LEVEL control fully clockwise.

(e) B MODE switch to AUTO.

(f) B TIME/CM switch to 50  $\mu$ SEC.

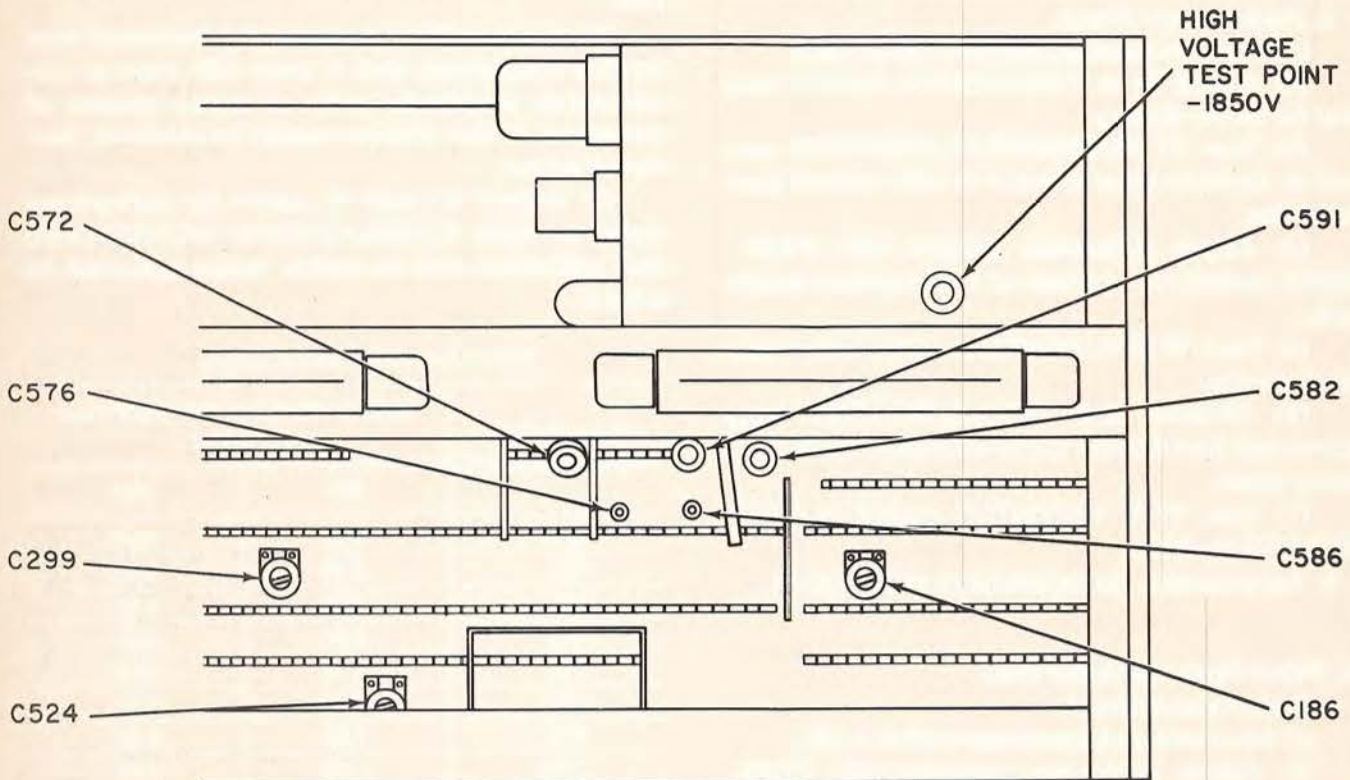
(g) BRIGHTNESS control fully clockwise.

(h) INTENSITY control slightly below normal.

(i) TRACE SEPARATION control to position two traces 2 millimeters apart.

(3) Readjust BRIGHTNESS control so that B trace is the same brightness as A trace along distance from about 2 to 10 centimeters. If starting point of trace B is not the same brightness as starting point of trace A, perform b below.

b. Adjustments. Adjust C186 (fig. 3) until starting portion of trace B is the same brightness as starting portion of trace A.



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Figure 3. Oscilloscope—top view.

### 27. 10 $\mu$ SEC B Sweep-Rate Timing

#### a. Performance Check

(1) Adjust time-mark generator (A5) to 10  $\mu$ S.

(2) Turn calibration adapter (A3) TEST FUNCTION switch to LOW LOAD.

(3) Position TI controls as listed in (a) through (i) below.

(a) A TIME/CM switch to .1  $\mu$ SEC.

(b) HORIZONTAL DISPLAY switch to ALT (B INTENS BY "A"-ALT-A-DLY'D).

(c) B TRIGGERING LEVEL control pushed in.

(d) B MODE switch to TRIG.

(e) B TIME/CM switch to 10  $\mu$ SEC.

(f) BRIGHTNESS control to midrange.

(g) INTENSITY control for visible trace.

(h) Calibration adapter VARIABLE and B TRIGGERING LEVEL controls for a 1-centimeter B display amplitude.

(i) TRACE SEPARATION control to position A trace above B.

(4) Adjust TI DELAY-TIME MULTIPLIER so the 50-percent point (1 centimeter) on rising portion of 2d 10-micorsecond marker is brightened.



Use A display to accurately determine 50-percent point (1 centimeter).

(5) Record indication on TI DELAY-TIME MULTIPLIER dial.

(6) Adjust TI DELAY-TIME MULTIPLIER dial to indicate 8.00 plus indication recorded in (5) above.

(7) If the 50-percent ( $\frac{1}{2}$  centimeter) on rising portion of 10th time marker is not at 50-percent starting point ( $\frac{1}{2}$  centimeter) on A display, perform *b* below.

*b. Adjustments*

(1) Repeat *a*(1) through (5) above.

(2) Adjust C90C (fig. 1) so that 50-percent point ( $\frac{1}{2}$  centimeter) on rising portion of 10th time marker is 50-percent starting point ( $\frac{1}{2}$  centimeter) on A display.

(3) Due to interaction of adjustments, repeat (1) and (2) above until DELAY-TIME MULTIPLIER dial indicates a difference of 8.00 between 2d and 10th time markers.

## 28. 1 $\mu$ SEC B Sweep-Rate Timing

*a. Performance Check*

(1) Set time-mark generator (A5) to 1  $\mu$ S.

(2) Turn TI B TIME/CM switch to 1  $\mu$ SEC.

(3) Adjust TI B TRIGGERING LEVEL control for stable display.

(4) Adjust calibration adapter (A3) VARIABLE control for a 2-centimeter B display.

(5) Adjust TI DELAY-TIME MULTIPLIER control so 2d time marker on B display is brightened, starting at 50-percent point ( $\frac{1}{2}$  centimeter) on rising portion of marker. Use A display to determine 50-percent point (1 centimeter) accurately.

(6) Record TI DELAY-TIME MULTIPLIER dial indication.

(7) Adjust TI DELAY-TIME MULTIPLIER control to indicate exactly 8.00, plus dial reading noted in (6) above.

(8) If the 50-percent point ( $\frac{1}{2}$  centimeter) on rising portion of 10th marker is not at 50-percent starting point ( $\frac{1}{2}$  centimeter) of A display, perform *b* below.

*b. Adjustments*

(1) Repeat *a*(1) through (7) above.

(2) Adjust C90B (fig. 1) until 50-percent point ( $\frac{1}{2}$  centimeter) on rising portion of 10th time marker is 50-percent ( $\frac{1}{2}$  centimeter) starting point of A display.

(3) Due to interaction of adjustments, repeat (1) and (2) above until DELAY-TIME MULTIPLIER dial indicates a difference of 8.00 between

2d and 10th time markers.

## 29. 0.5 $\mu$ SEC B Sweep-Rate Timing

*a. Performance Check*

(1) Set time-mark generator (A5) to .1  $\mu$ S.

(2) Turn TI B TIME/CM switch to .5  $\mu$ SEC.

(3) Adjust TI B TRIGGERING LEVEL control for stable display.

(4) Adjust calibration adapter (A3) VARIABLE control for display of 1 centimeter.

(5) If the first 2-centimeter display of starting portion of B waveform is not linear, and if 5 markers per centimeter are not displayed for remaining portion of B waveform, perform *b* below.

*b. Adjustments*

(1) Adjust C90A (fig. 1) to obtain best linearity at starting portion of display.

(2) Position TI B display with HORIZONTAL POSITION control so that tip of 12th marker aligns with 2-centimeter graticule line.

(3) Turn TI DELAY-TIME MULTIPLIER control so brightened portion of B display starts at 50-percent point on rising portion of 12th marker. Use A display to determine 50-percent point.

(4) Record TI DELAY-TIME MULTIPLIER dial indication. It will read approximately 2.00.

(5) Turn TI DELAY-TIME MULTIPLIER control to 7.00 plus indication in (4) above. Falling portion of 46th marker, starting at 50-percent point, will be brightened as observed on B display. Use A display to observe 50-percent point. If 50-percent point is not observed, adjust C90A (fig. 1) for correct point on A display while maintaining a timing of 5 centimeter/markers on B display.

(6) Repeat (2) through (5) above until DELAY-TIME MULTIPLIER dial indicates an exact difference of 7.00 between the 50-percent point of 12th marker and 50-percent point on falling portion of 46th marker. The 46th marker is the portion of B display that aligns with 9-centimeter graticule line when correct timing of 5-centimeter/marker is obtained.

## 30. B Sweep Output Compensation to Crt

*a. Performance Check*

(1) Set time-mark generator (A5) to .1  $\mu$ S.

(2) Turn TI HORIZONTAL DISPLAY switch to B and B TIME/CM switch to .1  $\mu$ SEC.

(3) Center the display vertically by using calibration adapter (A3) VERTICAL POSITION control.

(4) Adjust TI HORIZONTAL POSITION control to align tip of 2d marker with 2d vertical graticule line. If the 10th marker is not aligned with



10th vertical graticule line within  $\pm 1.6$  millimeters, perform *b* below.

*b. Adjustments*

(1) Repeat *a*(1) through (4) above.

(2) Adjust C99 (fig. 1) for a display of 1 marker per centimeter.

(3) Due to interaction between C99 and C90A, repeat paragraph 29*b*(1) through (6) above, and repeat (1) and (2) above until desired results are obtained.

31. 0.2  $\mu$ SEC/cm Sweep Rate

*a. Performance Check*

(1) Turn TI HORIZONTAL DISPLAY switch to ALT (B INTENS BY "A"-ALT-A DLY'D) position and B TIME/CM switch to .2  $\mu$ SEC.

(2) Center the display vertically. A display will be located above B display.

(3) Horizontally position display so B marker display coincides with 3*d* vertical graticule line.

(4) Adjust TI DELAY-TIME MULTIPLIER control so 50-percent point starting on rising portion of 2*d* marker is brightened on B display. Use A display to determine 50-percent point.

(5) Record TI DELAY-TIME MULTIPLIER dial indication.

(6) Turn TI DELAY-TIME MULTIPLIER control clockwise until 50-percent point starting on rising portion of marker at 10th vertical graticule line is brightened. Use A display to deter-

mine 50-percent point. Record dial indication.

(7) The difference between dial indications in (5) and (6) above will be between 6.3 and 7.7.

*b. Adjustments.* No adjustments can be made.

32. 2  $\mu$ SEC to 5 SEC/cm B Sweep Rate

*a. Performance Check*

(1) Turn TI B TIME/CM switch to 2  $\mu$ SEC and A TIME/CM switch to .5  $\mu$ SEC.

(2) Set time-mark generator (A5) to 1  $\mu$ S.

(3) Adjust calibration adapter (A3) VARIABLE control for a 1-centimeter indication on TI crt.

(4) Turn TI DELAY-TIME MULTIPLIER control to 1.00; then, fine tune marker on A sweep until alined at the 50-percent point of first vertical graticule line. Record dial indication of DELAY-TIME MULTIPLIER.

NOTE

Do not adjust B TRIGGERING LEVEL control after obtaining dial indication.

(5) Turn TI DELAY-TIME MULTIPLIER control to 9.00 and then fine tune as in (4) above. Record dial indication.

(6) The difference between (4) and (5) above will be between 7.92 and 8.08.

(7) Repeat the technique of (1) through (6) above, using settings listed in table 6. Indications will be within limits specified in table 6 and in (6) above for each sweep rate.

Table 6. B Sweep-Rate Accuracy

Time-Mark Generator Output.	Test Instrument		
	A TIME/CM Switch Setting.	B TIME/CM Switch Setting.	Marker/cm On B Display.
5 $\mu$ S	.1 $\mu$ SEC	5 $\mu$ SEC	1
10 $\mu$ S	1 $\mu$ SEC	20 $\mu$ SEC	2
50 $\mu$ S	1 $\mu$ SEC	50 $\mu$ SEC	1
.1 mS	10 $\mu$ SEC	.1 mSEC	1
.1 mS	10 $\mu$ SEC	.2 mSEC	2
.5 mS	10 $\mu$ SEC	.5 mSEC	1
1 mS	.1 mSEC	2 mSEC	2
5 mS	.1 mSEC	5 mSEC	1
10 mS	1 mSEC	10 mSEC	1
10 mS	1 mSEC	20 mSEC	2
50 mS	1 mSEC	50 mSEC	1
.1 S <sup>1</sup>	10 mSEC	.1 SEC	1
.1 S	10 mSEC	.2 SEC	2
.5 S	10 mSEC	.5 SEC	1
1 S	.1 SEC	1 SEC	1
1 S	.1 SEC	2 SEC	2
5 S	.1 SEC	5 SEC	1

<sup>1</sup>Set TI HORIZONTAL DISPLAY switch to B (B INTENS BY "A"-ALT-A-DELY'D) position for the remaining checks.



*b. Adjustments.* No adjustments can be made.

### 33. High Speed Length, Sweep, and Timing

#### *a. Performance Check*

(1) Position TI controls as listed in (a) through (c) below:

(a) HORIZONTAL DISPLAY switch to B.

(b) B TRIGGERING SOURCE switch to EXT.

(c) B TIME/CM switch to .1  $\mu$ SEC.

(2) Set time-mark generator (A5) to 20 nS.

(3) Connect cable (B4) between trigger output of time-mark generator and TI B TRIGGER INPUT.

(4) Set trigger rate of time-mark generator to 10  $\mu$ S.

(5) Adjust TI B TRIGGERING LEVEL control to obtain stable display.

(6) Adjust TI HORIZONTAL POSITION control to position display to start at left graticule line.

(7) Turn TI SWEEP MAGNIFIER switch to X10.

(8) If timing accuracy between 3d vertical graticule line and 9th vertical graticule line is not 3 cycles  $\pm$  2.5 minor divisions and does not have a center-sweep linearity of 1 cycle per 2 centimeters, perform *b* below.

#### *b. Adjustments*

(1) Adjust C572 and C582 (fig. 3) for maximum center-sweep expansion. (Use a low-capacitance alignment tool when making adjustments.) These two capacitors will be adjusted to nearly the same physical setting.

(2) Adjust C591 (fig. 3) for best center-sweep linearity of 1 cycle per 2 centimeters.

(3) Adjust C576 and C586 (fig. 3) in equal increments for timing of 1 cycle per 2 centimeters from 3d vertical graticule line to 9th vertical graticule line.

### 34. X10, X5, and X2 Sweep Magnifier Compensation

#### *a. Performance Check*

(1) Turn TI SWEEP MAGNIFIER switch to X1 OFF.

(2) Using TI HORIZONTAL POSITION control, adjust crt trace so that beginning of sweep coincides with first graticule line; then, position the 10 centimeter portion of sweep to coincide with the 8th vertical graticule line.

(3) Turn TI SWEEP MAGNIFIER switch to X10.

(4) If timing error of display is not within two

minor divisions of 2d to 10th vertical graticule lines, perform *b*(1) through (3) below.

(5) Turn TI SWEEP MAGNIFIER switch to X5.

(6) If 1 cycle per centimeter is not observed after first 2 centimeters from start of sweep, perform *b*(4) below.

(7) Turn TI SWEEP MAGNIFIER switch to X2.

(8) If 2½ cycles per centimeter are not observed after the 1st centimeter from start of sweep, perform *b*(5) below.

#### *b. Adjustments*

(1) Turn TI HORIZONTAL POSITION control clockwise so start of sweep (or display) can be seen. Then, position tip of 4th cycle from start of sweep to coincide with 5th vertical graticule line.

(2) Adjust C557H (fig. 1) for best timing of 1 cycle per 2 centimeters from 5th to 11th vertical graticule lines.

(3) Repeat *a*(1) and (2) above.

(4) Adjust C557F (fig. 1) for 1 cycle per centimeter after first 2 centimeters from start of sweep.

(5) Adjust C557D (fig. 1) for 2½ cycles per centimeter after 1st centimeter from start of sweep.

### 35. A Sweep Dc Level

#### *a. Performance Check*

(1) Set time-mark generator (A5) to .5 mS.

(2) Position TI controls as listed in (a) through (f) below:

(a) B TRIGGERING LEVEL control switch pulled out.

(b) B TRIGGERING MODE switch to AUTO.

(c) B TRIGGERING SOURCE switch to NORM INT.

(d) A and B TIME/CM switches to 1 mSEC.

(e) HORIZONTAL DISPLAY switch to ALT (A-ALT-B).

(f) SWEEP MAGNIFIER switch to X1 OFF.

(3) Adjust TI A and B TRIGGERING LEVEL controls for stable display.

(4) Turn calibration adapter (A3) VARIABLE control so markers are 2 centimeters in amplitude.

(5) Adjust TI HORIZONTAL POSITION control so both sweeps start at or near center of TI crt.

(6) Turn TI SWEEP MAGNIFIER switch to X10.

(7) Adjust TI TRACE SEPARATION control so that two displays are superimposed.

(8) If start of A sweep does not coincide with start of B sweep, perform *b*(1) below.

(9) Turn TI SWEEP MAGNIFIER switch to



**X1 OFF.**

(10) Adjust TI HORIZONTAL POSITION and VERNIER controls so both sweeps start at left vertical graticule line.

(11) If A and B sweep lengths are not equal, perform *b*(2) below.

(12) If time mark on A sweep display does not coincide with corresponding time mark on B sweep, perform *b*(3) below.

**b. Adjustments**

(1) Adjust A SWEEP DC LEVEL R470 (fig. 1) until start of A sweep coincides with start of B sweep.

(2) Adjust A SWEEP LENGTH R325 (fig. 1) until A sweep length equals B sweep length.

(3) Adjust A SWP CAL R290Y (fig. 1) until each time marker on A sweep display coincides with corresponding time marker on B sweep.

**36. A Variable (Time/Cm) and Uncalibrated Neon****a. Performance Check**

(1) Set time-mark generator (A5) to 5 mS.

(2) Turn TI HORIZONTAL DISPLAY switch to A.

(3) Turn TI HORIZONTAL POSITION control to position start of display to left vertical graticule line.

(4) Adjust TI A TRIGGERING LEVEL control for stable display.

(5) Adjust calibration adapter (A3) VARIABLE control for a 2-centimeter amplitude display.

(6) Turn TI A VARIABLE control fully counterclockwise.

(7) Observe that UNCALIBRATED lamp glows and display is one marker or more per 2 centimeters.

(8) Turn A VARIABLE control fully clockwise.

**b. Adjustments.** No adjustments can be made.

**37. 10  $\mu$ SEC A Sweep-Rate Timing****a. Performance Check**

(1) Set time-mark generator (A5) to 10  $\mu$ S.

(2) Turn TI A and B TIME/CM switches to 10  $\mu$ SEC and HORIZONTAL DISPLAY switch to ALT (A-ALT-B).

(3) Adjust TI TRACE SEPARATION control for separate waveform.

(4) Adjust TI A and B TRIGGERING LEVEL controls for stable display.

(5) Turn calibration adapter (A3) VARIABLE control for markers 1 centimeter in amplitude.

(6) Adjust TRACE SEPARATION to super-

impose waveforms.

(7) If each time marker displayed by A sweep does not coincide with corresponding time marker on B sweep, perform *b* below.

**b. Adjustments.** Adjust C290C (fig. 1) so that each time marker displayed by A sweep coincides with corresponding time marker on B sweep.

**38. 1  $\mu$ SEC A Sweep-Rate Timing****a. Performance Check**

(1) Set time-mark generator (A5) to 1  $\mu$ S.

(2) Turn TI A and B TIME/CM switches to 1  $\mu$ SEC.

(3) Adjust calibration adapter (A3) VARIABLE control for markers 1 centimeter in amplitude.

(4) If each time marker displayed by A sweep does not coincide with corresponding time marker on B sweep, perform *b* below.

**b. Adjustments**

(1) Adjust C290B (fig. 1) for correct matching of markers at end of A sweep and adjust C299 (fig. 3) for best linearity for first half of sweep.

(2) Adjust C290B and C299 for best matching of A display to B display.

**39. 0.5  $\mu$ SEC A Sweep-Rate Timing****a. Performance Check**

(1) Set time-mark generator (A5) to .5  $\mu$ S.

(2) Turn TI A and B TIME/CM switches to .5  $\mu$ SEC.

(3) Adjust calibration adapter (A3) VARIABLE control for display of 2 centimeters in amplitude.

(4) Adjust TI A and B TRIGGERING LEVEL controls for stable crt display so that markers coincide.

(5) If each marker of A display does not coincide with corresponding markers of B display, perform *b* below.

**b. Adjustments.** Adjust C290A (fig. 1) so that each marker of A display coincides exactly with corresponding marker of B display.

**40. 0.1  $\mu$ SEC A Sweep-Rate Timing****a. Performance Check**

(1) Set time-mark generator (A5) to .1  $\mu$ S.

(2) Turn TI A and B TIME/CM switches to .1  $\mu$ SEC.

(3) Adjust TI A and B TRIGGERING LEVEL controls for stable display.

(4) If each marker of A display does not coincide with corresponding marker of B display, perform *b* below.



**b. Adjustments**

(1) Adjust C299 (fig. 3) until A display matches B display.

(2) Repeat paragraphs 39 and 40 above for optimum matching of A to B sweep.

**41. 0.1  $\mu$ SEC/Cm to 5 Sec/Cm A Sweep Rate****a. Performance Check**

(1) Turn TI A TIME/CM switch to .1  $\mu$ SEC

and HORIZONTAL DISPLAY switch to A.

(2) Set time-mark generator (A5) to .1  $\mu$ S.

(3) Aline 1st marker with 1st vertical graticule line.

(4) The 9th marker will be within  $\pm 1$  minor division of 10th vertical graticule line.

(5) Repeat (1) through (4) above for TI and time-mark generator settings listed in table 7. TI display will be as specified in table.

Table 7. A Sweep-Rate Accuracy

Time-Mark Generator Output.	Test Instrument	
	A TIME/CM Switch Settings.	Crt Display.
1 $\mu$ S	2 $\mu$ SEC	2 markers/cm
5 $\mu$ S	5 $\mu$ SEC	1 marker/cm
10 $\mu$ S	20 $\mu$ SEC	2 markers/cm
50 $\mu$ S	50 $\mu$ SEC	1 marker/cm
.1 mS	.1 mSEC	1 marker/cm
.1 mS	.2 mSEC	2 markers/cm
.5 mS	.5 mSEC	1 marker/cm
1 mS	1 mSEC	1 marker/cm
1 mS	2 mSEC	2 markers/cm
5 mS	5 mSEC	1 marker/cm
10 mS	10 mSEC	1 marker/cm
10 mS	20 mSEC	2 markers/cm
50 ms	50 mSEC	1 marker/cm
.1 S	.1 SEC	1 marker/cm
.1 S	.2 SEC	2 markers/cm
.5 S	.5 SEC	1 marker/cm
1 S	1 SEC	1 marker/cm
1 S	2 SEC	2 markers/cm
5 S	5 SEC	1 marker/cm

**b. Adjustments.** No adjustments can be made.

**42. External Horizontal Dc Balance****a. Performance Check**

(1) Position TI controls as listed in (a) through (f) below:

(a) A TRIGGERING LEVEL control pushed in.

(b) A TRIGGERING SOURCE switch to EXT.

(c) A TIME/CM switch to 1 mSEC.

(d) HORIZONTAL DISPLAY switch to EXT X1.

(e) VAR 10-1 control fully clockwise.

(f) B TRIGGERING LEVEL control fully counterclockwise.

(2) Turn calibration adapter (A3) VERTICAL POSITION control to center range and VARIABLE control to 2.5.

(3) Connect TI SWEEP A to calibration adapter EXT INPUT, using lead and adapter (B5 and B1). Ground the HORIZ INPUT, using lead (B5).

(4) Adjust TI HORIZONTAL POSITION and INTENSITY control for display at center vertical graticule line.

(5) Observe TI crt. If horizontal shift of display occurs as VAR 10-1 control is rotated from fully clockwise to fully counterclockwise, perform b below.

(6) Disconnect lead from HORIZ INPUT to ground.

**b. Adjustments**

(1) Adjust EXT HORIZ DC BAL R519 (fig. 1) so that no horizontal shift occurs as VAR 10-1 control is rotated.

(2) Repeat a(1) through (6) above.



### 43. Output X1 and X10 Compensation

#### a. Performance Check

(1) Connect TI CAL OUT to A TRIGGER INPUT and HORIZ INPUT, using cable and adapters (B4, B2, and B1).

(2) Position TI controls as listed in (a) through (d) below:

(a) AMPLITUDE CALIBRATOR switch to .5 VOLTS.

(b) A TRIGGERING LEVEL control for stable display.

(c) VAR 10-1 control fully clockwise.

(d) HORIZONTAL POSITION control to center the display.

(3) Adjust calibration adapter (A3) VARIABLE control so that several cycles of waveform are displayed on crt.

(4) If waveform on TI crt does not have the appearance as shown in figure 4 (A), perform b(1) and (2) below. Record horizontal amplitude.

(5) Turn HORIZONTAL DISPLAY switch to EXT X10 and AMPLITUDE CALIBRATOR switch to 5 VOLTS.

(6) If waveform on TI crt does not have the appearance as shown in figure 4(A), perform b(3) below.

#### b. Adjustments

(1) Turn HORIZONTAL DISPLAY switch to EXT X1.

(2) Adjust C524 (fig. 3) for indication described in a(4) above.

(3) Adjust C503C (fig. 1) for optimum square-wave response.

### 44. Horizontal Gain, VAR 10-1 Control, and X10 Attenuation

#### a. Performance Check

(1) Turn TI AMPLITUDE CALIBRATOR switch to .1 VOLTS and HORIZONTAL DISPLAY switch to EXT X1.

(2) Adjust TI A TRIGGERING LEVEL control for stable display.

(3) Horizontal amplitude of waveform displayed on TI crt will be greater than 1 centimeter.

(4) Turn TI AMPLITUDE CALIBRATOR switch to .5 VOLTS.

(5) Record horizontal amplitude of waveform in centimeters.

(6) Turn TI VAR 10-1 control fully counter-clockwise.

(7) Amplitude of waveform will be 1/10 or less than that recorded in (5) above.

(8) Turn TI VAR 10-1 control for a 5-centimeter display on crt.

(9) Turn TI HORIZONTAL DISPLAY switch to EXT X10.

(10) Turn TI AMPLITUDE CALIBRATOR switch to 5 VOLTS and record amplitude of display.

(11) Amplitude will be within  $\pm 3$  percent of waveform described in (8) above.

b. Adjustments. No adjustments can be made.

### 45. Rise Time

#### a. Performance Check

(1) Position TI controls as listed in (a) through (f) below:

(a) B TRIGGERING LEVEL control near 0 (zero).

(b) HORIZONTAL DISPLAY switch to B (A-ALT-B).

(c) B TIME/CM switch to .1  $\mu$ SEC.

(d) SWEEP MAGNIFIER switch to X1.

(e) INTENSITY control for display.

(f) AMPLITUDE CALIBRATOR switch to OFF.

(2) Turn calibration adapter (A3) VERTICAL POSITION control to center position and TEST FUNCTION switch to + PULSE.

(3) Adjust HORIZONTAL POSITION and TRIGGERING LEVEL controls of TI and AMPLITUDE and VERTICAL position controls of calibration adapter for display as shown in figure 4 (E).

(4) Adjust TI INTENSITY, FOCUS, and ASTIGMATISM controls to produce a bright, well-defined leading top corner on step waveform. Waveform will appear as shown in figure 4(D). If not, perform b below.

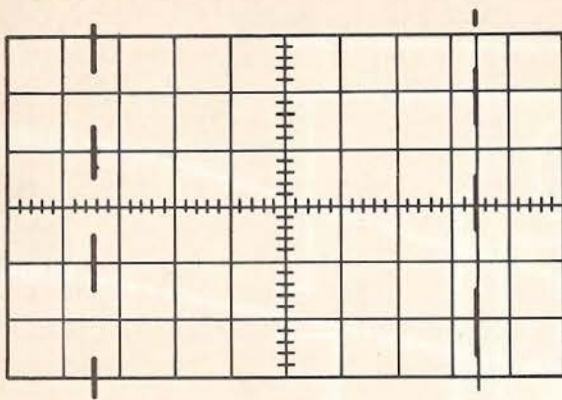
(5) Set SWEEP MAGNIFIER switch to X10.

(6) Measure rise time, using points shown in figure 4(E). Rise time will be 7 nanoseconds or less.

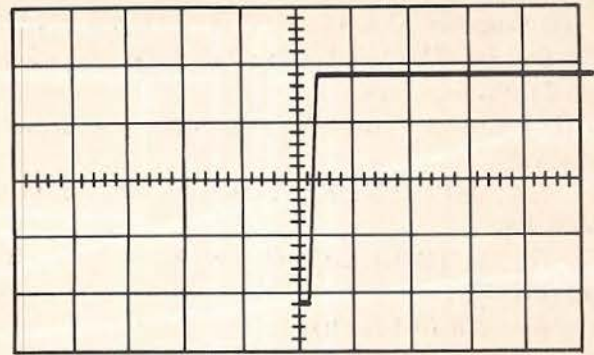
(7) Depress transient response compensation switch SW1000 (fig. 5). Rise time will be 10 nanoseconds or less.

b. Adjustments. Perform adjustments according to table 8. Due to interaction of adjustments, it may be necessary to repeat adjustment procedure several times.

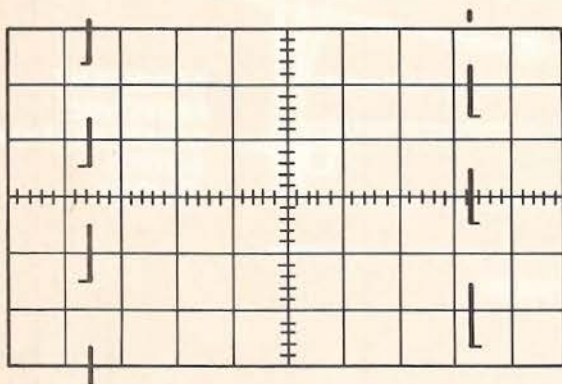




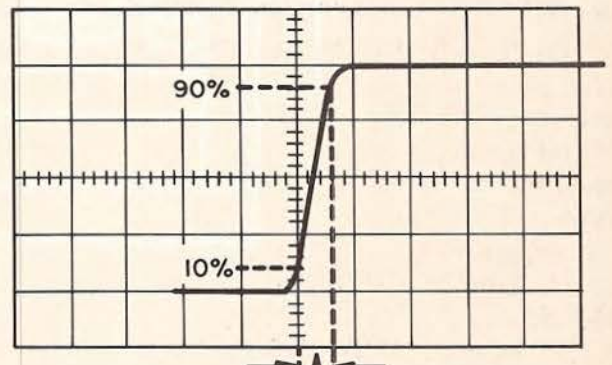
(A) TYPICAL DISPLAY WITH C524 PROPERLY ADJUSTED



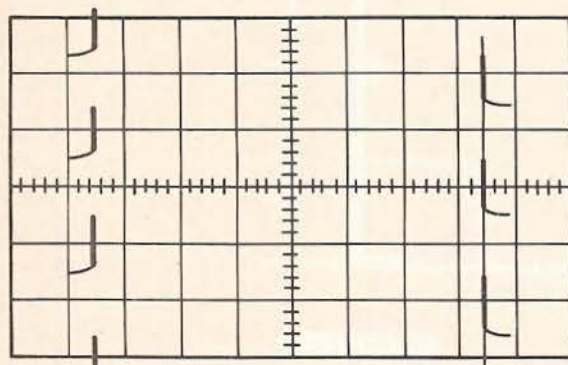
(D) NORMAL WAVEFORM; SWEEP RATE IS 0.1 μSEC/CM



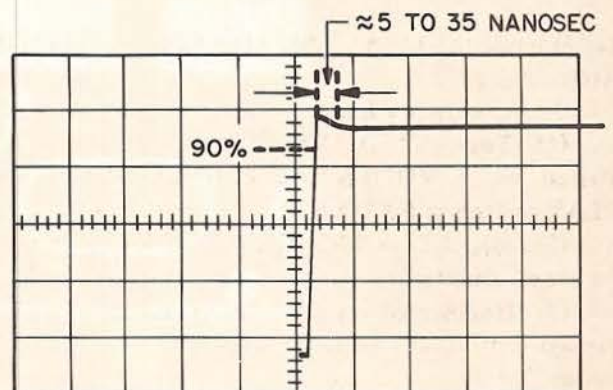
(B) C524 MISADJUSTED



(E) MEASURING THE RISE TIME OF A NORMAL WAVEFORM; SWEEP RATE IS 10 NANOCSEC



(C) DISTORTION OBTAINED WHEN C503C IS MISADJUSTED

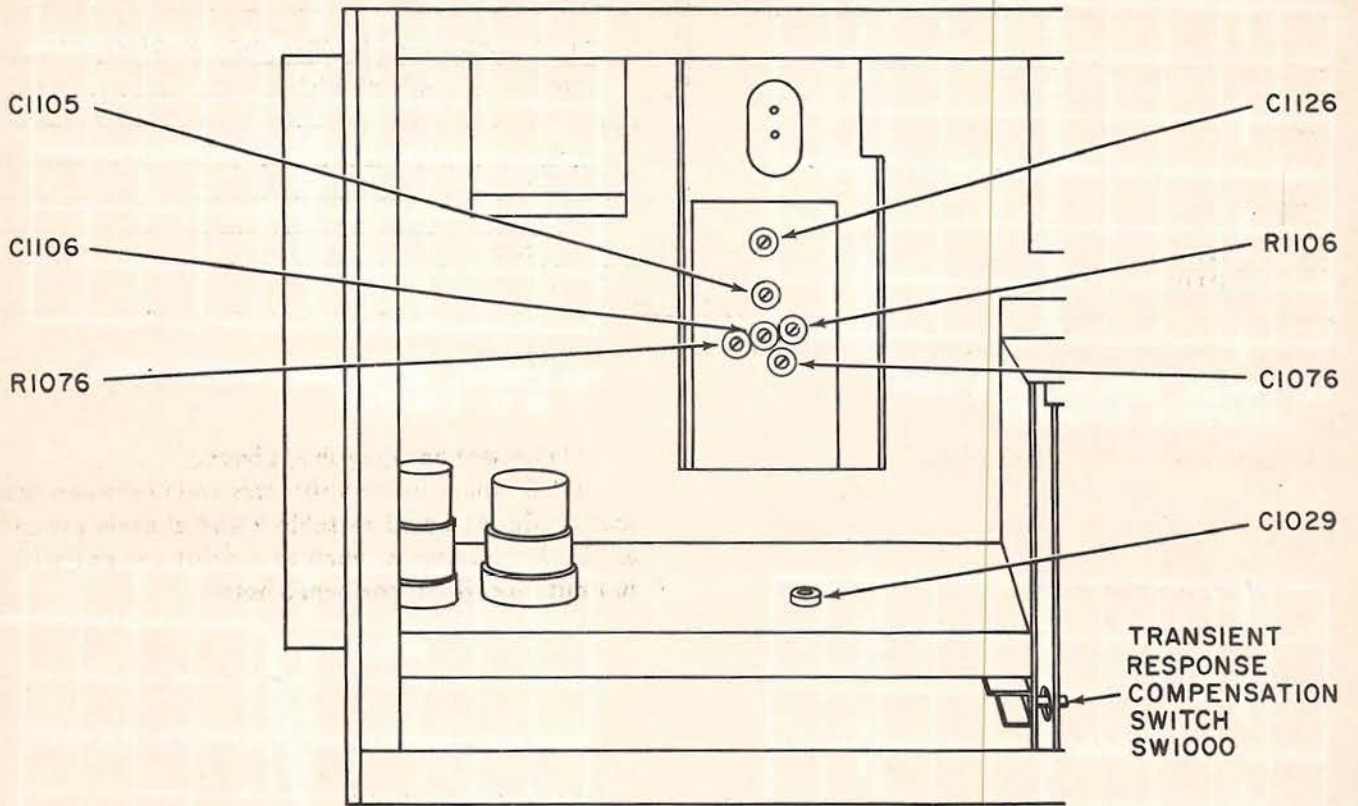


(F) EFFECT ON WAVEFORM WHEN C1106 IS MISADJUSTED; SWEEP RATE IS 0.1 μSEC/CM

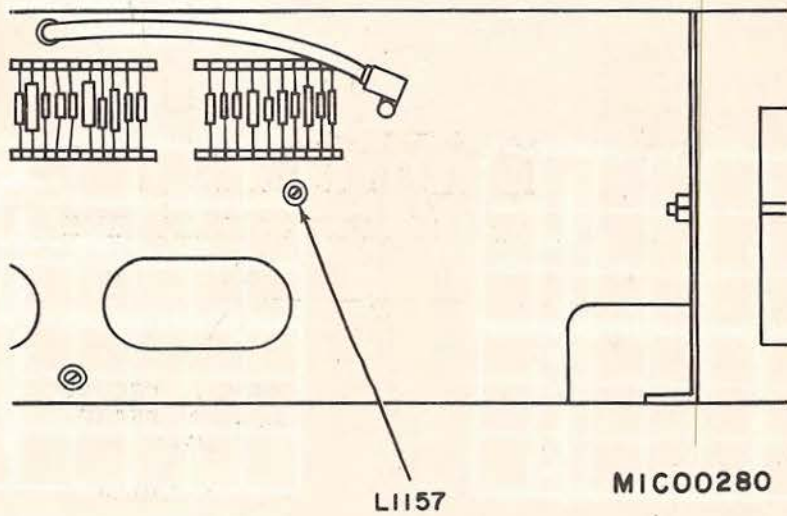
MIC00279

Figure 4. Output compensation waveforms.





LEFT SIDE VIEW



BOTTOM VIEW

Figure 5. Test instrument—rise-time adjustment location.



Adjustment (fig. 5).	Approximate Area Affected: <sup>1</sup>
L1157	0 to 100 nsec, adjust for minimum wrinkles
C1029 <sup>2</sup>	Termination bump at 340 nsec
C1076 <sup>3</sup>	0 to 15 nsec
C1105	1 to 4 nsec
C1106	5 to 35 nsec
C1126	20 to 80 nsec
R1076	0 to 10 nsec
R1106	2 to 20 nsec

<sup>1</sup>Distance measured to right starting from 90-percent point on rising portion of waveform. For example, see figure 4 (F).

<sup>2</sup>Adjust for low value of C, if possible, for best rise time.

<sup>3</sup>For remaining adjustments, set SWEEP MAGNIFIER switch to X10.

#### 46. Low Voltage Power Supply

##### NOTE

Do not perform power supply check if all other parameters are within tolerance.

##### a. Performance Check

(1) Repeat paragraph 8f above.

(2) Connect ac/dc voltmeter (A1) between test points (fig. 6) listed in table 9 and chassis ground on TI. If voltages at each test point are not within limits specified, perform b below.

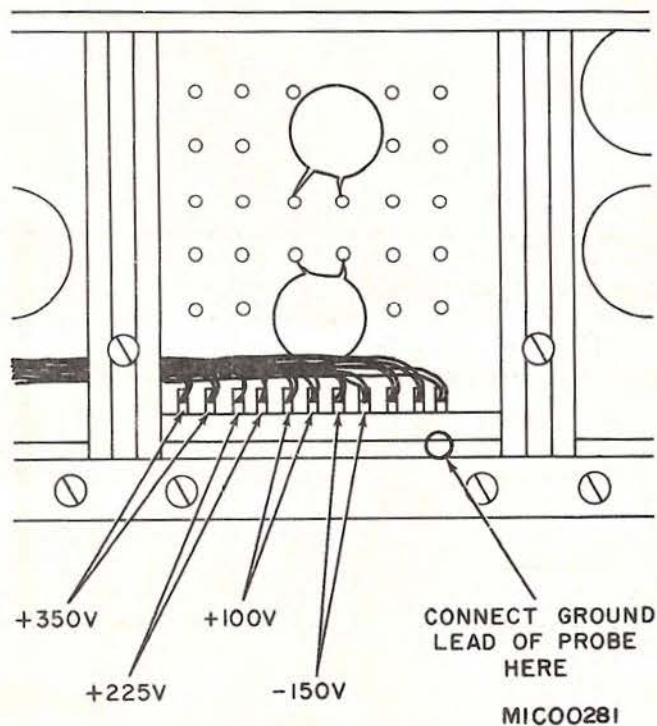


Figure 6. Test instrument—low voltage power supply test points.



Table 9. Low Voltage Power Supply

Test Instrument Test Point.	Ac/Dc Voltmeter Indication (vdc).	
	Min	Max
-150 V	-148.5	-151.5
+100 V	+97	+103
+225 V	+218	+232
+350 V	+339	+361

**b. Adjustments**

(1) Connect ac/dc voltmeter to -150 V test point (fig. 6) and chassis ground.

(2) Adjust -150 VOLTS R616 (fig. 1) until all power supply voltages are within tolerance, as specified in table 9.

**47. High Voltage Power Supply****a. Performance Check**

(1) Connect dc voltmeter (A4) to high voltage test point -1850V (fig. 3).

(2) Dc voltmeter will indicate between -1794 and -1906 volts dc.

**b. Adjustments.** Adjust HIGH VOLTAGE R840 (fig. 1) for dc voltmeter indication of -1850 volts dc.

**48. Final Procedure**

**a. Deenergize and disconnect all equipment and replace TI within protective cover.**

**b. In accordance with TM 38-750, annotate and affix DA Label 80 (U.S. Army Calibration System). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (Unserviceable or Limited Use tag).**

By Order of the Secretary of the Army:

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Major General, United States Army

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