

# \*TB 9-6625-2173-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

## CALIBRATION PROCEDURE FOR OSCILLOSCOPE TEKTRONIX, TYPES SC501, SC502, AND SC504

Headquarters, Department of the Army, Washington, DC

7 January 2004

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### REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, US Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is [2028@redstone.army.mil](mailto:2028@redstone.army.mil). Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use <https://amcom2028.redstone.army.mil>.

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## SECTION I

### IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Oscilloscope, Tektronix, Types SC501, SC502, and SC504. The manufacturers' manuals were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

**a. Model Variations.** Variations among models are indicated in the text.

**b. Time and Technique.** The time required for this calibration is approximately 1 hour, using the dc and low frequency technique.

#### **2. Forms, Records, and Reports**

**a.** Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. **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
Type SC501	
Vertical sensitivity	Range: 10,100 and 1000 mV/div Accuracy: ±3%
Vertical bandwidth	dc to 5 MHz
Horizontal sweep	Range: 1 μs to 100 ms in a 10 to 1 ratio Accuracy: ±5% Magnifier: X5 ±5%
Type SC502	
Vertical sensitivity	Range: 1 mV to 20 V/div; 14 steps in a 1-2-5-sequence Accuracy: 5 mV to 20 V/div: ±2% 1 and 2 mV/div: ±5%
Vertical bandwidth	dc to 15 MHz
Horizontal sweep	Range: .2 μs to .5 s/div: 20 steps in a 1-2-5 sequence Accuracy: Measured over center 8 divisions 50 ms/div to 1 ms/div: ±2% unmagnified; ±3% magnified .5 s/div to .1 s/div, and .5 μs/div to .2 μs/div: ±3% unmagnified; ±4% magnified
Calibrator voltage	Range: 0.6 V square wave Accuracy: ±1%
Type SC504	
Vertical sensitivity	Range: 5 mV to 10 V/div; 11 steps in a 1-2-5-sequence Accuracy: ±2%
Aberrations	±5%
Vertical bandwidth	dc to 80 MHz

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Type SC504 - Continued	
Horizontal sweep	Range: 50 ns to .2 s/div: 21 steps in a 1-2-5 sequence Accuracy: Measured over center 8 div, excluding first 50 ns and all after first 100 div of magnified sweep: 20 ms to .2 $\mu$ s/div: $\pm$ 2% unmagnified, $\pm$ 3% X10 magnified 0.2 s to 50 ms/div: 0.1 $\mu$ s/div and 50 ns div: $\pm$ 3% unmagnified, $\pm$ 4% X10 magnified
Calibrator	Range: 0.6 V $\pm$ 1% Frequency: Approximately 1 kHz

## SECTION II EQUIPMENT REQUIREMENTS

**4. Equipment Required.** Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286, AN/GSM-287, or AN/GSM-705. Alternate items may be used by the calibrating activity. 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 ratio between the standard and TI.

**5. Accessories Required.** The accessories required for calibration are common usage accessories, issued as indicated in paragraph 4 above and are not listed in this calibration procedure. The following peculiar accessories are also required for this calibration: Power Module Tektronix Type TM 500 Series and Standardizer 5 to 80 pF (7916146).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
DIGITAL MULTIMETER	Range: -20.6 to +20.6 V Accuracy: $\pm$ 0.3%	John Fluke, Model 8840A/AF-05/09 (AN/GSM-64D)
OSCILLOSCOPE CALIBRATOR	Volts out: Range: 5 mV to 100 V at 1 kHz Accuracy: $\pm$ 0.5% Time markers: Range: 5 ns to 0.5 s Accuracy: $\pm$ 0.5% Leveled sine wave frequency: Range: 10 Hz to 80 MHz	John Fluke, Model 5820A (5820A-5C-GHZ) (MIS 38938)

### SECTION III

## CALIBRATION PROCESS FOR TEKTRONIX, TYPE SC501

### 6. Preliminary Instructions

a. The instructions outlined in paragraphs 6 and 7 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 as listed in table 2.

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.

d. When indications specified in paragraphs 8 through 11 are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs 8 through 11. Do not perform power supply check if all other parameters are within tolerance.

e. Unless otherwise specified, all control and control settings refer to the TI.

### 7. Equipment Setup

#### WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check, where applicable.

a. Check that correct nominal line selector block has been installed on the line selector pins on the power module and that the regulating range selected includes the input line voltage.

b. Remove TI side covers and connect TI to power module, using extender cable.

c. Position controls as listed in (1) through (7) below:

- (1) Vertical and horizontal **POS** controls to midrange.
- (2) **VARIABLE** (vertical) control fully cw (**X1**).
- (3) **VARIABLE** (time base) fully cw (**X1**).
- (4) **LEVEL/SLOPE** to **AUTO** (centered and pulled out).
- (5) **TRIGGER** switch to **INT**.
- (6) **mS** pushbutton pressed to in position.
- (7) All other pushbuttons released to out position.

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- d. Connect power module to 115 V ac source and set **POWER** switch to on and allow at least 20 minutes for warm-up.
- e. Adjust **INTENSITY** and **FOCUS** controls for a sharp, well-defined display on TI.
- f. Press **AC COUPL** pushbutton in for **AC** and adjust vertical **POS** control to center trace on horizontal graticule line.
- g. Rotate vertical **VARIABLE** control from **X1** to **X10** and note position of trace on crt. Return vertical **VARIABLE** control to **X1** position. If trace shifts more than 0.5 minor division, adjust R142 (bal) (fig. 1) for less than 0.5 minor division of shift when the vertical **VARIABLE** control is adjusted from **X10** to **X1**.

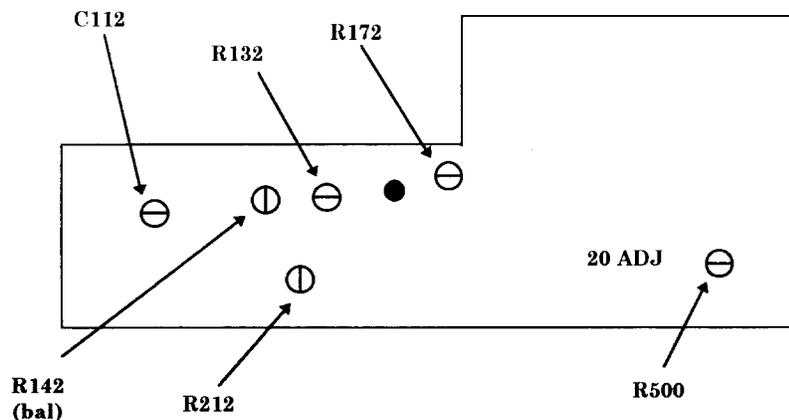


Figure 1. Oscilloscope - right side.

## 8. Input Compensation

### a. Performance Check

- (1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI VERT INPUT** using the 5-80 pF standardizer.
- (2) Set TI vertical **VARIABLE** control to **X1**.
- (3) Set oscilloscope calibrator **VOLTAGE** output for a 1 kHz, 4 division display on the TI crt.
- (4) Adjust TI **TRIGGER LEVEL** control for a triggered stable display and adjust 5-80 pF standardizer for best square wave display. If TI does not display flat top, perform **b** (1) below.
- (5) Press **100 mV** pushbutton in and rotate oscilloscope calibrator **EDIT FIELD** knob for 4 division display. If TI does not have a flat top, perform **b** (2) below.
- (6) Press **1 V** pushbutton in and rotate oscilloscope calibrator **EDIT FIELD** knob for 4 division display. If TI display does not have a flat top, perform **b** (3) below.

**b. Adjustments**

- (1) Adjust C117 (fig. 2) for optimum square wave (flat top and square corners).
- (2) Adjust C104 and C102 (fig. 2) for optimum flat top and square front corners.
- (3) Adjust C112 (fig. 1) and C110 (fig. 2) for optimum flat top and square corners.

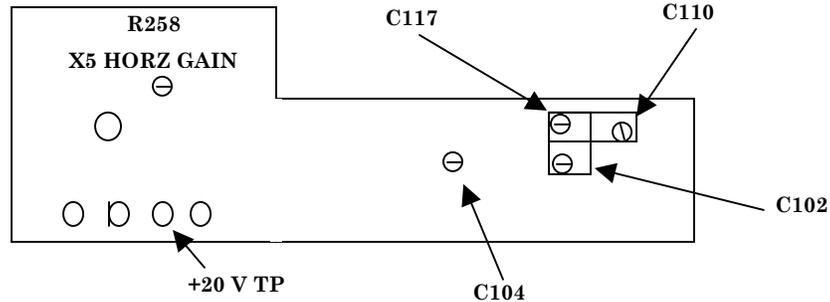


Figure 2. Oscilloscope – left side view.

**9. Vertical Gain**

**a. Performance Check**

- (1) Release both **1V** and **100 mV** pushbuttons out for **10 mV**.
- (2) Remove 5-80 pF standardizer from setup and reconnect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI VERT INPUT**.
- (3) Set oscilloscope calibrator **VOLTAGE** output to **50 mV, 1 kHz**.
- (4) Rotate oscilloscope calibrator **EDIT FIELD** knob to obtain a 5 division vertical display on TI. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 3\%$ , perform **b** (1) below.
- (5) Adjust TI vertical **VARIABLE** control fully ccw to **X10**.
- (6) Set oscilloscope calibrator output for 0.5 V and rotate **EDIT FIELD** knob for a 5 division vertical display on TI. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 3\%$ , perform **b** (2) below.
- (7) Press **100 mV** pushbutton in and adjust vertical **VARIABLE** control fully cw to **X1**. Rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical display. Oscilloscope calibrator **err** display readout will indicate within  $\pm 3\%$ .
- (8) Press **1 V** pushbutton in and set oscilloscope calibrator output for **5 V**, and rotate oscilloscope calibrator **EDIT FIELD** knob for exactly 5 divisions of vertical deflection on TI. Oscilloscope calibrator **err** display readout will be within  $\pm 3\%$ .

**b. Adjustments**

- (1) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust R172 (fig. 1) for 5 divisions of vertical deflection (R).

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(2) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust R132 (fig. 1) for 5 divisions of vertical deflection (R).

### 10. Timing

#### a. Performance Check

- (1) Set oscilloscope calibrator **MARKER** output to **1 ms**.
- (2) Set TI vertical **VARIABLE** control as needed to view 2 to 4 divisions of display.
- (3) Using horizontal **POS** control and oscilloscope calibrator **EDIT FIELD** knob, align 1 time marker per division from the second to the tenth vertical graticule line. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 5\%$ , perform **b** (1) below.
- (4) Press and release **ms** pushbutton to  **$\mu\text{s}$  /div**.
- (5) Set oscilloscope calibrator **MARKER** output to **1  $\mu\text{s}$** .
- (6) Using horizontal **POS** control and rotating oscilloscope calibrator **EDIT FIELD** knob, align 1 time marker per division from the second to the tenth vertical graticule line. Oscilloscope calibrator **err** display readout indication will be within  $\pm 5\%$ .
- (7) Pull horizontal **VARIABLE** control out to **X5** and set oscilloscope calibrator output for **0.2  $\mu\text{s}$** .
- (8) Using horizontal **POS** control and rotating oscilloscope calibrator **EDIT FIELD** knob, align 1 time marker per division from the second to the tenth vertical graticule line. If oscilloscope calibrator **err** display readout indication does not indicate within  $\pm 5\%$ , perform **b** (2) below.
- (9) Press **X10** pushbutton in and set oscilloscope calibrator **MARKER** output to **2  $\mu\text{s}$** .
- (10) Using horizontal **POS** control and rotating oscilloscope calibrator **EDIT FIELD** knob, align 1 marker per division over center 8 divisions. Oscilloscope calibrator **err** display readout indication will be within  $\pm 5\%$ .
- (11) Push horizontal **VARIABLE** control in and turn fully cw to **X1**. Press the **X100** pushbutton in.
- (12) Set oscilloscope calibrator **MARKER** output for **0.1 ms** and rotate oscilloscope calibrator **EDIT FIELD** knob for 1 time marker per division over center 8 divisions. Oscilloscope calibrator **err** display readout indication will be within  $\pm 5\%$ .
- (13) Press **ms** and **X10** pushbuttons to in.
- (14) Set oscilloscope calibrator **MARKER** output for **10 ms** and rotate oscilloscope calibrator **EDIT FIELD** knob for 1 time marker per division over center 8 divisions. Oscilloscope calibrator **err** display readout indication will be within  $\pm 5\%$ .
- (15) Press **X100** pushbutton in and set oscilloscope calibrator **MARKER** output to **0.1 s**.
- (16) Rotate oscilloscope calibrator **EDIT FIELD** knob for 1 time marker per division over center 8 divisions. Oscilloscope calibrator **err** display readout indication will be within  $\pm 5\%$ .

**b. Adjustments**

(1) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust R212 (fig. 1) until TI displays 1 time marker per division over center 8 divisions (R).

(2) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust R258 X5 **HORIZ GAIN** (fig. 2) until TI displays 1 time marker per division over center 8 divisions (R).

**11. Bandwidth****a. Performance Check**

(1) Release all pushbuttons to out position except for **ms** pushbutton.

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI VERT INPUT** using a 50  $\Omega$  feedthrough termination.

(3) Set oscilloscope calibrator **LEVEL SINE** output frequency to **50 kHz** and a reference amplitude of 6 divisions on TI crt.

(4) Change oscilloscope calibrator **LEVEL SINE** output frequency to **5 MHz**. Displayed amplitude will be 4.2 divisions or greater.

(5) Press the **100 mV** pushbutton in and repeat (3) and (4) above.

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

**12. Power Supply****NOTE**

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

**a. Performance Check.** Connect digital multimeter to +20 V TP (fig. 2) and chassis ground. If digital multimeter does not indicate between 19.9 and 20.1 V dc, perform **b** below.

**b. Adjustments.** Adjust R500 (fig. 1) until digital multimeter indicates +20 V dc (R).

**13. Final Procedure**

**a.** Deenergize and disconnect all equipment and reinstall protective covering on TI.

**b.** Annotate and affix DA label/form in accordance with TB 750-25.

## SECTION IV

### CALIBRATION PROCESS FOR TEKTRONIX, TYPE SC502

#### 14. Preliminary Instructions

a. The instruction outlined in paragraphs **14** and **15** 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 as listed in tables 2 and 3.

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.

d. When indications specified in paragraphs **16** through **22** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **16** through **22**. Do not perform power supply check if all other parameters are within tolerance.

e. Unless otherwise specified, all controls and control settings refer to the TI.

#### 15. Equipment Setup

##### WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

##### CAUTION

To prevent damage to TI because of inadequate cooling, remove TI from power module and place on extender cables to make adjustment(s) and replace TI in power module immediately after making adjustment(s).

a. Set **MODE** switch to **POWER OFF** and install TI into power module and position controls as listed in (1) through (11) below:

- (1) **CH 1** and **CH 2 POSITION** controls to midrange.
- (2) **CH 1** and **CH 2 VOLTS/DIV** switches to **10 m** and **CAL** controls fully cw.
- (3) **CH 1** and **CH 2 DC-GND-AC-** switches to **DC**.
- (4) Horizontal **POSITION** control to midrange.
- (5) **SECONDS/DIV** switch to **.2 ms**.
- (6) **CAL/PULL X10 SWP MAG** control fully cw and pushed in.

- (7) **TRIGGERING SINGL SWP/RELEASE AUTO** pushbutton to out position.
- (8) **TRIGGERING AUTO** pushbutton to in position.
- (9) **TRIGGERING COUPL, AC** and **LF REJ** pushbuttons to out position for dc.
- (10) **TRIGGERING SOURCE CH 1** pushbutton to in position.
- (11) **TRIGGERING SLOPE** switch to + (positive) and **LEVEL** control to midrange.
- b. Connect power module to 115 V ac source and **POWER** switch to on.
- c. Set **TI MODE** switch to **CH 1** and allow at least 15 minutes for warm-up.
- d. Adjust **INTENSITY** and **FOCUS** for a sharp, well defined display on TI.

## 16. Preamplifier Input Capacitance

### a. Performance Check

- (1) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI CH 1** input using a 50  $\Omega$  feedthrough termination and 5-80 pF standardizer.
- (2) Set oscilloscope calibrator **VOLTAGE** output for **50 mV, 1 kHz**, and rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on TI.
- (3) Adjust 5-80 pF standardizer for optimum square wave display. If waveform aberrations are greater than 1 minor division on front corner, perform **b (1)** below.
- (4) Set **CH 1 VOLTS/DIV** switch to **0.5**. Set oscilloscope calibrator **VOLTAGE** for **2.5 V** and rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on TI. If waveform aberrations are greater than 1 minor division on front corner, perform **b (2)** below.
- (5) Set **MODE** switch to **CH 2** and press **TRIGGERING SOURCE CH 2** pushbutton in and **CH 1** pushbutton out.
- (6) Disconnect oscilloscope calibrator from **TI CH1** and connect to **TI CH2** and repeat technique of (1) through (5) above for **CH 2**, except do not readjust standardizer.

### b. Adjustments

- (1) Adjust C105 (C205 for **CH 2**) (fig. 3) for optimum square wave on TI (R).
- (2) Adjust C115 (C215 for **CH 2**) (fig. 3) for optimum flat top and C119 (C219 for **CH 2**) (fig. 3) for square front corner (R).

## 17. Volts/Div Accuracy

### a. Performance Check

- (1) Remove the 5-80 pF standardizer from setup. Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI CH 1** input and **CHAN 2** to **TI CH 2** input.
- (2) Set **CH 1** and **CH 2 VOLTS/DIV** switches to **10m**.
- (3) Set **MODE** switch to **CH 1** and press **TRIGGERING SOURCE CH 1** pushbutton in and **CH 2** pushbutton out.
- (4) Set oscilloscope calibrator **VOLTAGE** output to **50 mV, 1 kHz**.

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(5) Rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection on TI. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b** below.

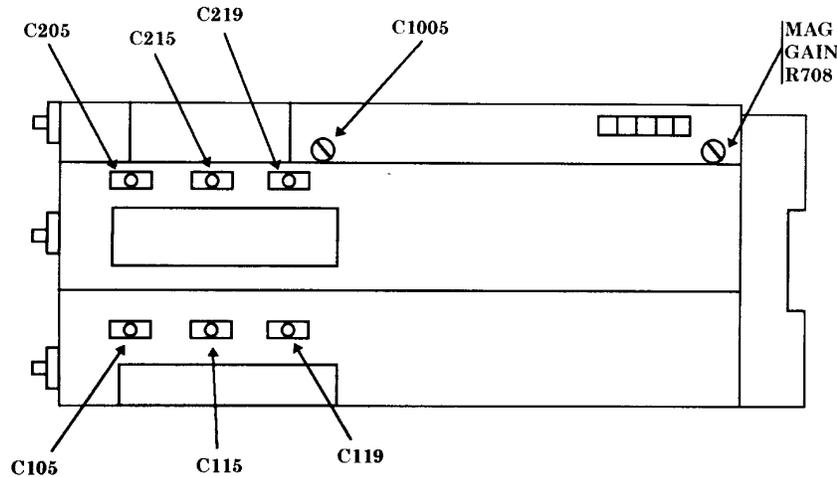


Figure 3. Test instrument - bottom view.

(6) Repeat technique of (4) and (5) above for **VOLTS/DIV** switch settings listed in table 3. Oscilloscope calibrator **err** display readout will indicate within specified percent error.

(7) Set **MODE** switch to **CH 2** and press **TRIGGERING SOURCE CH 2** pushbutton in and **CH 1** pushbutton out.

(8) Activate oscilloscope calibrator **CHAN 2** output and repeat (4) through (6) above for **CH 2**.

Table 3. Volts/Div Accuracy

Test instrument		Oscilloscope calibrator		
<b>VOLTS/DIV</b> switch settings	Divisions of vertical display	Output level		<b>err</b> ( $\pm$ )
1 mV	5	5	mV	5
2 mV	5	10	mV	5
5 mV	5	25	mV	2
20 mV	5	.1	V	2
50 mV	5	.25	V	2
.1 V	5	.5	V	2
.2 V	5	1	V	2
.5 V	5	2.5	V	2
1 V	5	5	V	2
2 V	5	10	V	2
5 V	5	25	V	2
10 V	5	50	V	2
20 V	5	100	V	2

**b. Adjustments.** Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust CH 1 GAIN R180 (CH 2 GAIN R280) (fig. 4) for 5 divisions of vertical deflection (R).

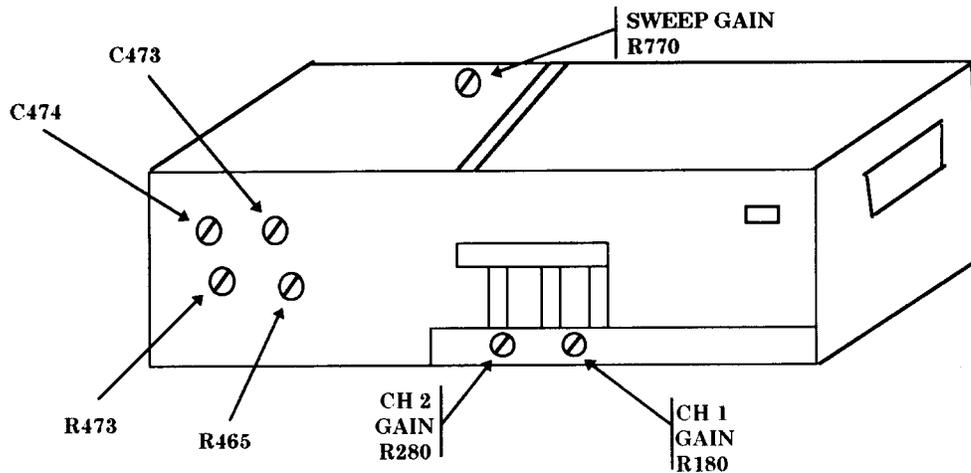


Figure 4. Test instrument – left side view.

## 18. Horizontal Centering and Sweep Gain

### a. Performance Check

- (1) Position controls as listed in (a) through (c) below:
  - (a) **CH 1 VOLTS/DIV** switch to **.5**.
  - (b) **MODE** switch to **CH 1**.
  - (c) **TRIGGERING SOURCE** pushbutton pressed in for **CH 1**.
- (2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI CH 1** input.
- (3) Set oscilloscope calibrator **CHAN 1 MARKER** output to **0.2 ms**.
- (4) Adjust horizontal **POSITION** control and rotate oscilloscope calibrator **EDIT FIELD** knob to align 1 time marker per division over center 8 divisions. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b** below.

**b. Adjustments.** Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust **SWEEP GAIN R770** (fig.4) until **TI** displays 1 marker per division over center 8 divisions (R).

## 19. X10 Magnifier Gain and Fast Timing

### a. Performance Check

- (1) Set oscilloscope calibrator **MARKER** output to **20  $\mu$ s**.
- (2) Pull the **SECONDS/DIV CAL** knob out for **X10 SWP MAG**.

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(3) Adjust horizontal **POSITION** control and rotate oscilloscope calibrator **EDIT FIELD** knob to align 1 time marker per division over center 8 divisions. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 3\%$ , perform **b** (1) below:

(4) Push **SECONDS/DIV CAL** control in and set **SECONDS/DIV** switch to **1  $\mu$ s**.

(5) Set oscilloscope calibrator **MARKER** output to **1  $\mu$ s**.

(6) Adjust horizontal **POSITION** control and rotate oscilloscope calibrator **EDIT FIELD** knob to align 1 time marker per division over the center 8 divisions. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b**(2) below.

(7) Set **SECONDS/DIV** switch to **.2  $\mu$ s**.

(8) Set oscilloscope calibrator **MARKER** output to **0.2  $\mu$ s**.

(9) Adjust horizontal **POSITION** control and rotate oscilloscope calibrator **EDIT FIELD** knob to align 1 time marker per division over center 8 divisions. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 3\%$ , perform **b** (2) below.

(10) Repeat technique of (7) through (9) above for oscilloscope calibrator and TI **SECONDS/DIV** switch settings and indications listed in table 4. Oscilloscope calibrator **err** display will indicate within percent of error specified.

Table 4. Fast Timing

Test instrument <b>SECONDS/DIV</b> switch settings	Oscilloscope calibrator	
	<b>MARKER</b> output	<b>err</b> ( $\pm$ )
.5 $\mu$	.5 $\mu$ s	3
2 $\mu$	2 $\mu$ s	2
5 $\mu$	5 $\mu$ s	2
10 $\mu$	10 $\mu$ s	2
20 $\mu$	20 $\mu$ s	2
50 $\mu$	50 $\mu$ s	2
.1 m	.1 ms	2
.5 m	.5 ms	2
1 m	1 ms	2
2 m	2 ms	2
5 m	5 ms	2
10 m <sup>1</sup>	10 ms	2
20 m	20 ms	2
50 m	50 ms	2
.1 s	.1 s	3
.2 s	.2 s	3
.5 s	.5 s	3

<sup>1</sup>Press and release **COUPL AUTO** pushbutton to normal.

**b. Adjustments**

**NOTE**

Interaction exists between adjustments in (1) and (2) below. Repeat as necessary for best compromise.

(1) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust **MAG GAIN R708** (fig. 3) for TI display of 1 time marker per division over center 8 divisions (R).

(2) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**. Adjust **C1005** (fig. 3) for TI display of 1 time marker per division over center 8 divisions (R).

## 20. Vertical Output Amplifier

### a. Performance Check

(1) Position **CH 1** and **CH 2 VOLTS/DIV** switches to **10 m** and **SECONDS/DIV** switch to **2  $\mu$** .

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH 1** input and **CHAN 2** to TI **CH 2** input using  $50 \Omega$  feedthrough terminations.

(3) Set oscilloscope calibrator **EDGE** output to **50 mV, 100 kHz**.

(4) Center display vertically and rotate oscilloscope calibrator **EDIT FIELD** knob for a 5 division display. If waveform roll-off or overshoot is greater than 3 percent peak-to-peak, perform **b** (1) below.

(5) Set **SECOND/DIV** switch to **0.2  $\mu$ s**. Set oscilloscope calibrator **EDGE** output to **1 MHz**, and amplitude for a 5 division display. If waveform indicates roll-off or overshoot greater than 3 percent peak-to-peak, perform **b** (2) below.

(6) Set oscilloscope calibrator output to **CHAN 2**. Set TI **MODE** and **TRIGGERING SOURCE** switches to **CH 2**.

(7) Repeat technique of (1) through (5) above for **CH 2**.

### b. Adjustments

#### NOTE

Interaction may exist between adjustments in (1) and (2) below. Repeat as necessary for best compromise.

(1) Adjust **R465** (fig. 4) for optimum square wave, without roll-off or overshoot (R).

(2) Adjust **R473, C473, and C474** (fig. 4) for optimum square front corner without roll-off or overshoot of waveform (R).

## 21. Vertical Bandwidth

### a. Performance Check

(1) Ensure oscilloscope calibrator **SOURCE/MEASURE CHAN 2** is connected to TI **CH2** using a  $50 \Omega$  termination.

(2) Set oscilloscope calibrator **CHAN 2 LEVEL SINE** output frequency to **50 kHz** and a reference amplitude of 6 divisions on TI crt.

(3) Change oscilloscope calibrator **LEVEL SINE** output frequency to **15 MHz**.

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(4) If the display amplitude is not 4.2 major divisions or greater, repeat checks and adjustments in paragraph **20** above.

(5) Set **MODE** switch to **CH 1** and set oscilloscope calibrator output to **CHAN 1**.

(6) Repeat (1) through (4) above for **CH 1**, ensuring use of 50  $\Omega$  termination.

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

## 22. Calibrator

### a. Performance Check

(1) Set TI **CH1 VOLTS/DIV** switch to **.1**.

(2) Connect TI **CALIBRATOR** (front panel) to TI **CH1**.

(3) Press **VERT MODE CH1** pushbutton (in).

(4) Adjust **TRIGGERING LEVEL**, **CH1 HORIZONTAL POSITION** and **TIME/DIV** controls for a stable, centered display.

(5) Adjust **CH1 VOLTS/DIV** and **VAR** control for 6 divisions of vertical deflection on TI.

(6) Remove connection at TI **CALIBRATOR** and connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH1** (do not change setting set in (5) above).

(7) Set oscilloscope calibrator **VOLTAGE** output to 600 mV, 1 kHz at **CHAN 1**.

(8) Rotate oscilloscope calibrator **EDIT FIELD** knob to adjust for 6 divisions of vertical deflection on TI. Oscilloscope calibrator **err** display will indicate within  $\pm 1\%$ .

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

## 23. Power Supply

### NOTE

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

### a. Performance Check

(1) Connect digital multimeter **LO** to TP942 GND and **HI** to TP940 +20 V (fig. 5). If digital multimeter does not indicate between 19.94 and 20.06 V dc, perform **b** (1) below.

(2) Move positive lead to TP941 -20 V (fig. 5). If digital voltmeter does not indicate between -19.90 and -20.10 V dc, perform **b** (2) below.

### b. Adjustments

(1) Adjust +20 V R925 (fig. 5) for digital multimeter indication of +20 V dc (R).

(2) Adjust -20 V R947 (fig. 5) for digital multimeter indication of -20.0 V dc (R).

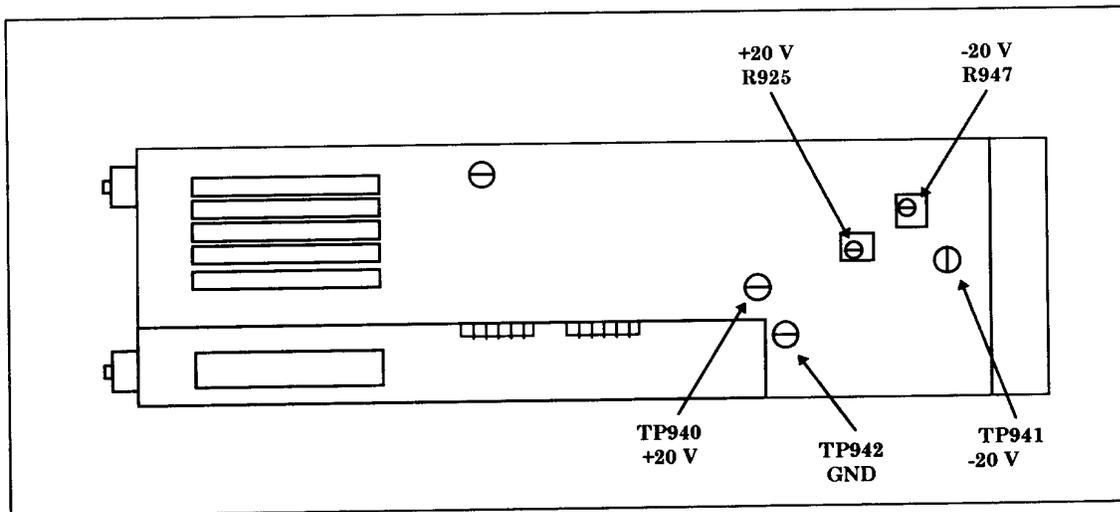


Figure 5. Test instrument – right side view.

## 24. Final Procedure

- a. Deenergize and disconnect all equipment.
- b. Annotate and affix DA label/form in accordance with TB 750-25.

## SECTION V

### CALIBRATION PROCESS FOR TEKTRONIX, TYPE SC504

## 25. Preliminary Instructions

- a. The instructions outlined in paragraphs **25** and **26** 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 as listed in tables 2 and 3.
- c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturers' manuals for this TI.
- d. When indications specified in paragraphs **28** through **33** are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs **26** through **33**. Do not perform power supply check if all other parameters are within tolerance.
- e. Unless otherwise specified, all controls and control settings refer to the TI.

## 26. Equipment Setup

### WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Connect TI to power module using two Tektronix, Type 067-0645-02 extender cables. Remove protective cover from TI only when necessary to make adjustments. Replace cover after completing the adjustments.

### CAUTION

Verify that extenders are not twisted and are aligned properly to both TI and power module connectors.

b. Position controls as listed in (1) through (13) below:

- (1) Display switch to **CH 1**.
- (2) **CH 1** and **CH 2 POSITION** controls to midrange.
- (3) **CH 1** and **CH 2 VOLTS/DIV** switches to **.1** and **CAL** controls fully cw detent.
- (4) **CH 1** and **CH 2 DC-GND-AC-INT DC** switches to **DC**.
- (5) Horizontal **POSITION** control to midrange.
- (6) **SECONDS/DIV** switch to **.2m**.
- (7) **PULL X10 HORIZ MAG/CAL** control pushed in and fully cw to detent.
- (8) **TRIGGERING MODE AUTO** pushbutton pressed to in position.
- (9) **TRIGGERING SLOPE** switch to **+** (positive).
- (10) **TRIGGERING LEVEL** control to midrange.
- (11) **CPLG AC** pushbutton to out position.
- (12) **CPLG AC-LF-REJ** and **HF REJ** pushbuttons to out position.
- (13) **SOURCE** switch to **CH 1**.

c. Connect power module to 115 V ac and set power module **POWER** switch to on and allow a 15 minute warm-up period.

d. Adjust **INTEN** and **FOCUS** controls for a suitable viewing.

## 27. Calibrator

a. Performance Check

- (1) Set TI **CH1 VOLTS/DIV** switch to **0.1**.
- (2) Connect TI **CAL 0.6 V** (front panel) to TI **CH1**.

(3) Adjust **TRIGGERING LEVEL**, **CH1 HORIZONTAL POSITION** and **TIME/DIV** controls for a stable, centered display.

(4) Adjust **CH1 VOLTS/DIV** and **VAR** control for 6 divisions of vertical deflection on TI.

(5) Remove connection at **TI CALIBRATOR** and connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI CH1** (do not change setting set in (4) above).

(6) Set oscilloscope calibrator **VOLTAGE** output to **600 mV, 1 kHz**.

(7) Rotate oscilloscope calibrator **EDIT FIELD** knob to adjust for 6 divisions of vertical deflection on TI. Oscilloscope calibrator **err** display will indicate within  $\pm 1\%$ , if not, perform **b** below.

**b. Adjustments**

(1) Connect digital multimeter **HI** to **TI CAL 0.6V** and **LO** to chassis ground.

(2) Short TP1110 and TP1112 (fig. 6).

(3) Adjust R3466 (fig. 7) for a 0.6000 V dc indication on digital multimeter. (R).

(4) Disconnect short from between TP1110 and TP1112 (fig. 6).

(5) Disconnect digital multimeter from TI.

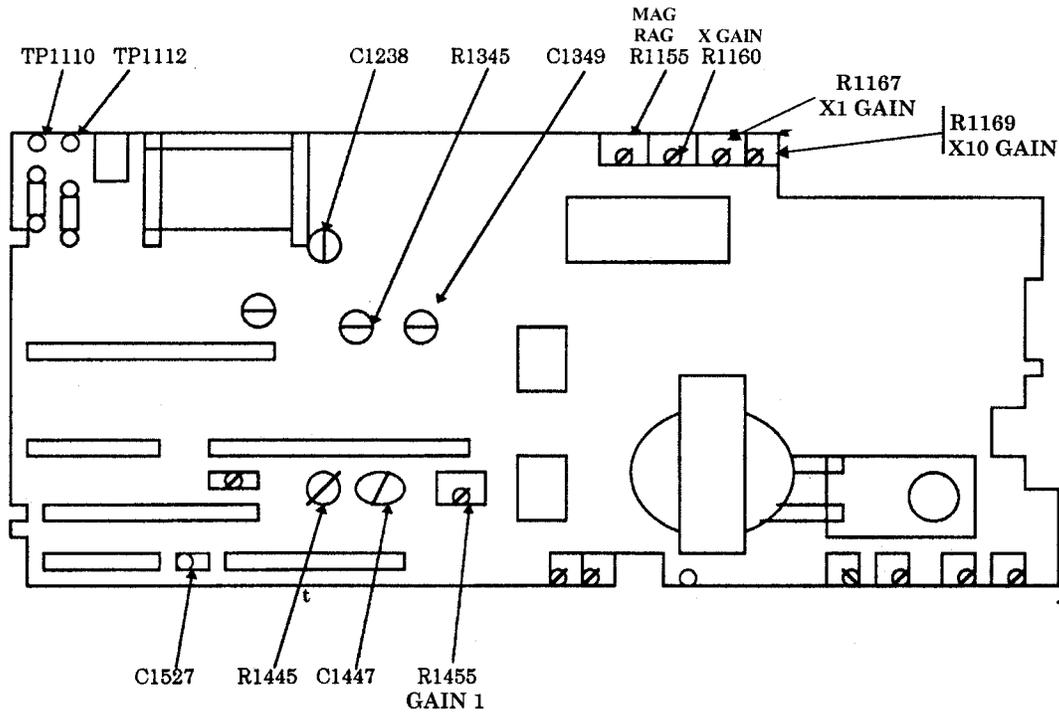


Figure 6. Main board.

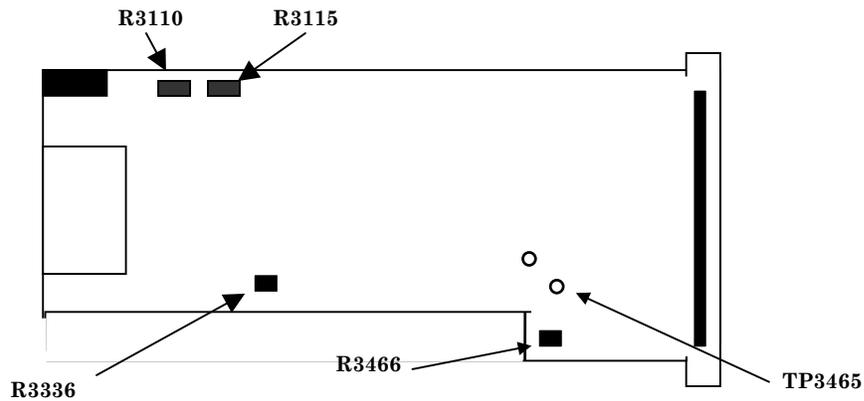


Figure 7. Trigger board.

## 28. Vertical Gain

### a. Performance Check

- (1) Set TI **SECONDS/DIV** switch to **.5 ms**.
- (2) Set TI **CH 1** and **CH2 VOLTS/DIV** switches to **10m**.
- (3) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH 1** and **CHAN 2** to TI **CH 2**.
- (4) Set oscilloscope calibrator **VOLTAGE** output to **50 mV, 1 kHz**.
- (5) Adjust **TRIGGERING LEVEL** and **POSITION** controls, as necessary, to view waveform.
- (6) Adjust **INTEN** and **FOCUS** controls for suitable viewing.
- (7) Rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of vertical deflection. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b** (1).
- (8) Repeat technique of (1) through (7) above for settings listed in table 5. Oscilloscope calibrator **err** display readout will indicate within  $\pm 2\%$ .
- (9) Set TI **DISPLAY** and **SOURCE** switches to **CH 2**.
- (10) Activate oscilloscope calibrator **CHAN 2** output and repeat technique of (1) through (7) above for **CH 2**. If oscilloscope calibrator **err** display readout does not indicate within limits specified, perform **b** (2).

Table 5. Vertical Deflection

Test instrument VOLTS/DIV switch settings	Oscilloscope calibrator output settings	Test instrument divisions of vertical deflection
5 mV	5 mV	5
20 mV	.1 V	5
50 mV	.25 V	5
.1 V	.5 V	5
.2 V	1 V	5
.5 V	2.5 V	5
1 V	5 V	5
2 V	10 V	5
5 V	25 V	5
10 V	50 V	5

**b. Adjustments**

(1) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**.  
Adjust R1455 GAIN 1 (fig. 6) for 5 divisions of display (R).

(2) Rotate oscilloscope calibrator **EDIT FIELD** knob for an **err** display of **0.0%**.  
Adjust GAIN 2 R2336 (fig. 8) for 5 divisions of display (R).

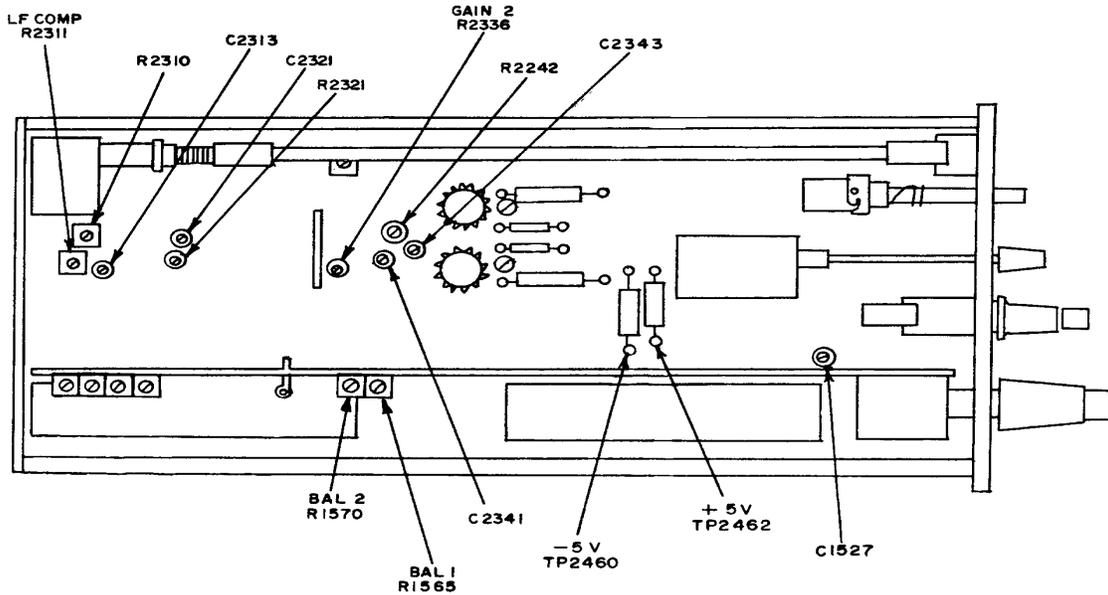


Figure 8. Oscilloscope – left side view

**29. Horizontal X Gain**

**a. Performance Check**

- (1) Set TI **DISPLAY** switch to **XY** position.
- (2) Set **CH 2 VOLTS/DIV** switch to **10m**.

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(3) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 2** to **TI CH 2** and activate **CHAN 2** on oscilloscope calibrator.

(4) Set oscilloscope calibrator **VOLTAGE** output to **50 mV, 1 kHz**.

(5) Adjust **FOCUS, INTEN, CH 1,** and **CH 2 POSITION** controls as necessary to view the two dots.

(6) Using the position controls place the first dot on the second vertical graticule and center horizontal graticule lines.

(7) If the two displayed dots are not located 5 divisions apart  $\pm 1.25$  minor divisions, perform **b** below.

**b. Adjustments.** Adjust X GAIN R1160, (fig. 6) for 5 major divisions of horizontal deflection between the two displayed dots. (R)

### 30. Vertical Amplifier Transient Response

#### a. Performance Check

(1) Position TI controls as listed below.

(a) Set **CH 1** and **CH 2 VOLTS/DIV** switches to **10m**.

(b) Set **SECONDS/DIV** switch to **0.1 $\mu$** .

(2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 2** to **TI CH 2** input, using a 50  $\Omega$  terminator.

(3) Set **TI TRIGGERING SOURCE** and **DISPLAY** switches to **CH 2**.

(4) Set oscilloscope calibrator **EDGE** output to **50 mV, 1 MHz** on **CHAN 2**.

(5) Adjust **INTEN, FOCUS, TRIGGERING LEVEL,** and **CH 2** and horizontal **POSITION** controls as necessary for a stable, centered display.

(6) Rotate oscilloscope calibrator **EDIT FIELD** knob for 5 divisions of display.

(7) Pull **PULL X10 HORIZ MAG** switch to out position.

(8) Adjust **INTEN** and **FOCUS** controls for suitable viewing.

(9) Adjust horizontal **POSITION** control to position leading edge of waveform to the 1st (extreme left) vertical graticule line.

(10) If aberrations within the first 100 ns of the displayed waveform are not 2.5 minor divisions or less perform **b** (1) through (3) below.

(10) Insert 50  $\Omega$  terminator into cable connection at **TI CH 1**.

(12) Select oscilloscope calibrator **CHAN 1** output.

(13) Press **PULL X10 HORIZ MAG** switch to in position and set display switch to **CH 1**.

(14) Set **TRIGGERING SOURCE** and **DISPLAY** switches to **CH 1**, and repeat (5) through (10).

(15) If aberrations within the first 100 ns of the displayed waveform are not 2.5 minor divisions or less, perform **b** (4) below.

**b. Adjustments**

- (1) Adjust R2242, R2310, C2313, C2341 (fig. 8), C1349, and R1345, (fig. 6) for the fastest flat top waveform in the first 100 ns.
- (2) Adjust R2321, C2321, and C2343 (fig. 8) for the fastest flat top waveform in the first 30 ns.
- (3) Repeat adjustments above as necessary.
- (4) Adjust C1447, R1455 GAIN 1, and C1527 (fig. 6) for the fastest flat top waveform in the first 100 ns.

**31. Vertical Bandwidth****a. Performance Check**

- (1) Set **TRIGGER SOURCE** to **LINE**.
- (2) Press **PULL X10 HORIZ MAG** switch to in position than set **SECONDS/DIV** switch to **1m**, and horizontal **POSITION** control to midrange.
- (3) Ensure oscilloscope calibrator **SOURCE/MEASURE CHAN 1** is connected to **TI CH1** using a 50  $\Omega$  termination.
- (4) Set oscilloscope calibrator **LEVEL SINE** output frequency to **50 kHz** and a reference amplitude of 6 divisions on **TI crt**.
- (5) Change oscilloscope calibrator **LEVEL SINE** frequency to **80 MHz**.
- (6) If the display amplitude is not 4.2 major divisions or greater, repeat checks and adjustments in paragraph **30** above.
- (7) Set **DISPLAY** switch to **CH 2** and set oscilloscope calibrator output to **CHAN 2**.
- (8) Repeat (4) through (6) above for **CH 2**, ensuring use of 50  $\Omega$  termination.

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

**32. External Trigger Sensitivity****a. Performance Check**

- (1) Set **CH 1** and **CH 2 VOLTS/DIV** switch to **1**.
- (2) Set **SECONDS/DIV** switch to **50n** and **TRIGGERING SOURCE** to **EXT**.
- (3) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to **TI EXT TRIG** input using a 50  $\Omega$  termination.
- (4) Set oscilloscope calibrator **LEVEL SINE** output for 0.060 V, 30 MHz on **CHAN 1**.
- (5) Press in and hold **DISPLAY TRIG VIEW** pushbutton and adjust **INTEN** and **FOCUS** controls for suitable viewing.
- (6) While holding **DISPLAY TRIG VIEW** pushbutton in, verify a stable display can be obtained by adjusting the **TRIGGERING LEVEL** control.
- (7) Set oscilloscope calibrator **LEVEL SINE** output for **0.150 V, 80 MHz**.

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(8) Press in and hold **DISPLAY TRIG VIEW** pushbutton and adjust **INTEN** and **FOCUS** controls for suitable viewing.

(9) While holding **DISPLAY TRIG VIEW** pushbutton in, verify a stable display can be obtained by adjusting the **TRIGGERING LEVEL** control.

**b. Adjustments**

(1) Set digital multimeter to measure 2 V dc fullscale and connect **HI** input to TP3520 and **LO** input to TP3521 (fig. 9).

(2) Press the **CPLG AC** pushbutton in and set the **TRIGGERING SOURCE** switch to **INT**.

(3) Adjust R3527 EXT BAL (fig. 9) for 0 V  $\pm$ 10 mV. Disconnect the digital multimeter (R).

(4) Set the **SECONDS/DIV** switch to **2 m** and **TRIGGERING SOURCE** switch to **LINE**.

(5) Press the **TRIGGERING MODE AUTO** pushbutton in.

(6) Press and hold **DISPLAY TRIG VIEW** pushbutton and adjust R3336 (fig. 7) so the start of waveform trace is at horizontal graticule center line (R).

(7) Set **TRIGGERING SLOPE** switch to **-** and compromise final adjustment of R3336 (fig. 7) between display starts of both **+** and **- SLOPE** switch settings while pressing the **TRIG VIEW** pushbutton in.

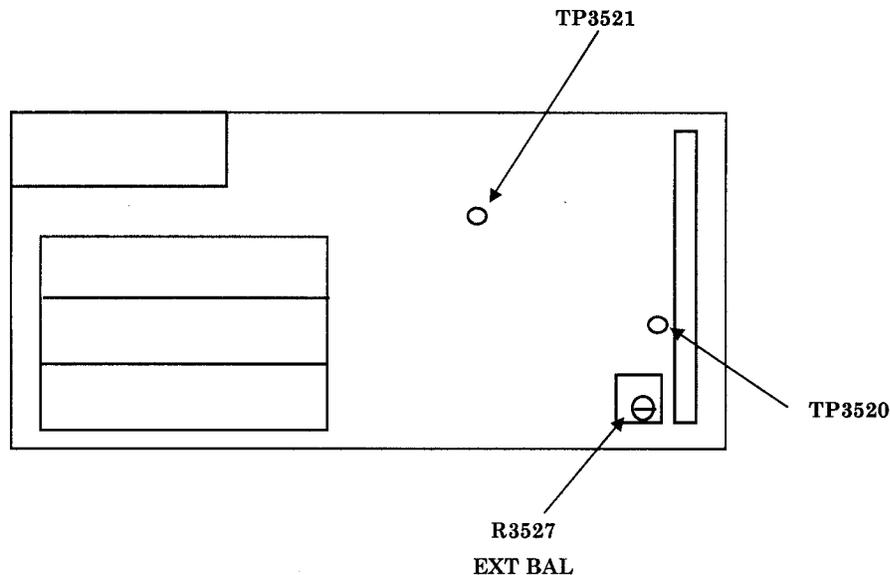


Figure 9. Trigger switch board.

(8) Set **TRIGGERING LEVEL** control fully ccw.

(9) Press and hold **TRIG VIEW** pushbutton in and adjust R3110 (fig. 7) to position bottom of displayed waveform to one half major graticule division above point where waveform just loses triggering (R).

(10) Position **TRIGGERING LEVEL** control fully cw.

(11) Press and hold **TRIG VIEW** pushbutton in and adjust R3115 (fig. 7) to position bottom of displayed waveform one half major graticule division below point where waveform just loses triggering (R).

### 33. Sweep Timing

#### a. Performance Check

- (1) Position TI controls as listed in (a) through (f) below:
  - (a) **SECOND/DIV** switch to **.2 ms**.
  - (b) **DISPLAY** switch to **CH 1**.
  - (c) **CH 1 VOLTS/DIV** switch as needed.
  - (d) **TRIGGERING SOURCE** switch to **CH1**.
  - (e) **TRIGGERING MODE** to **AUTO**.
  - (f) **PULL X10 HORIZ MAG** switch to in position.
- (2) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** to TI **CH 1** using 50  $\Omega$  feedthrough termination.
- (3) Set oscilloscope calibrator **MARKER** output to **0.2 ms**.
- (4) Adjust **TRIGGERING LEVEL** and horizontal **POSITION** controls to align 2d time marker with 2d vertical graticule line.
- (5) Rotate oscilloscope calibrator **EDIT FIELD** knob to align one time marker per division between 2d and 10th vertical graticule lines. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b** (1) through (2) below.
- (6) Set TI **SECOND/DIV** switch to **1  $\mu$ s**.
- (7) Set oscilloscope calibrator **MARKER** output for **1  $\mu$ s**.
- (8) Adjust **TRIGGERING LEVEL** and horizontal **POSITION** controls to align 2d time marker with 2d vertical graticule line.
- (9) Rotate oscilloscope calibrator **EDIT FIELD** knob to align one time marker per division between 2d and 10th vertical graticule lines. If oscilloscope calibrator **err** display readout does not indicate within  $\pm 2\%$ , perform **b** (3) through (4) below.
- (10) Repeat technique of (6) through (9) above for oscilloscope calibrator **MARKER** outputs and **SECONDS/DIV** switch settings listed in table 7. Oscilloscope calibrator **err** display readout will be within limits as listed in table (7).

Table 7. Sweep Timing

Test instrument <b>SECONDS/DIV</b> switch settings	Oscilloscope calibrator	
	Marker	err ±
50 ns	50 ns	3
.1 μs	.1 μs	3
.2 μs	.2 μs	2
.5 μs	.5 μs	2
2 μs	2 μs	2
5 μs	5 μs	2
10 μs	10 μs	2
20 μs	20 μs	2
50 μs	50 μs	2
.1 ms	.1 ms	2
.5 ms	.5 ms	2
1 ms	1 ms	2
2 ms	2 ms	2
5 ms	5 ms	2
10 ms	10 ms	2
20 ms	20 ms	2
50 ms	50 ms	3
.1 s	.1 s	3
.2 s	.2 s	3

(11) Connect oscilloscope calibrator **EXT TRIG/CHAN 5** to TI **EXT TRIG** input using 50 Ω feedthrough termination.

(12) Set **PULL X10 HORIZ MAG** switch to out position.

(13) Set TI **TRIGGERING SOURCE** switch to **EXT**.

(14) Activate oscilloscope calibrator **CHAN 5** for External Trigger operation at this time.

(15) Press TI **TRIGGERING MODE** pushbutton to **NORM**.

(16) Set TI **SECOND/DIV** switch to **.2 ms** and oscilloscope calibrator **MARKER** output for **20 μs**.

(17) Excluding the first 50 ns and all after the first 100 divisions of magnified sweep, adjust **TRIGGERING LEVEL** and horizontal **POSITION** controls to align 2d time marker with 2d vertical graticule line.

(18) Rotate oscilloscope calibrator **EDIT FIELD** knob to align one time marker per division between 2d and 10th vertical graticule lines. If oscilloscope calibrator **err** display readout does not indicate within ±3%, perform **b** (5) through (15) below.

(19) Repeat technique of (11) through (18) above for oscilloscope calibrator **MARKER** outputs and **SECONDS/DIV** switch settings listed in table 8. Oscilloscope calibrator **err** display readout will be within limits as listed in table (8).

Table 8. Mag Sweep Timing

Test instrument <b>SECONDS/DIV</b> switch settings	Oscilloscope Calibrator	
	Marker	err ±
50 ns	5 ns	4
.1 μs	10 ns	4
.2 μs	20 ns	3
.5 μs	50 ns	3
1 ms	.1 ms	3
2 μs	.2 ms	3
5 μs	.5 μs	3
10 μs	1 μs	3
20 ms	2 μs	3
50 μs	5 μs	3
.1 ms	10 μs	3
.5 ms	50 μs	3
1 ms	.1 ms	3
2 ms	.2 ms	3
5 ms	.5 ms	3
10 ms	1 ms	3
20 ms	2 ms	3
50 ms	5 ms	4
.1 s	10 ms	4
.2 s	20 ms	4

**b. Adjustments**

- (1) Rotate oscilloscope calibrator **EDIT FIELD** for an **err** display of **0.0%**. Adjust horizontal **POSITION** control to align 2d time marker with 2d vertical graticule line.
- (2) Adjust R1167 X1 GAIN (fig. 6) for 1 marker per division. The 2d and 10th markers must align with the 2d and 10th vertical graticule lines (R).
- (3) Rotate oscilloscope calibrator **EDIT FIELD** for an **err** display of **0.0%**. Adjust horizontal **POSITION** control to align 2d marker with 2d vertical graticule line.
- (4) Adjust C1238 (fig. 6) for 1 marker per division. The 2d and 10th markers must align with the 2d and 10th vertical graticule lines (R).

**NOTE**

Steps **b** (5) through (9) below are prerequisite steps that need to be performed at this time in addition to the requirements within steps **b** (10) through (15).

- (5) Set **PULL X10 HORIZ MAG** switch to in position.
- (6) Set **SECONDS/DIV** switch to **.1 m** and oscilloscope calibrator **MARKER** output to **0.5ms**.
- (7) Adjust **INTEN**, **FOCUS**, **TRIGGERING LEVEL**, and **CH 1 POSITION** controls as necessary for a stable, centered display.

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- (8) Set **PULL X10 HORIZ MAG** switch to out position.
- (9) Adjust horizontal **POSITION** control to align leading edge of any one time marker to center vertical graticule line.
- (10) Press **PULL X10 HORIZ MAG** switch to in position and adjust **MAG RAG R1155** (fig. 6) to align leading edge of marker to center vertical graticule line.
- (11) Repeat (6) through (9) above for no shift.
- (12) Set **PULL X10 HORIZ MAG** switch to out position.
- (13) Set **TI SECONDS/DIV** switch to **.2 ms** and oscilloscope calibrator **MARKER** output to **20 μs**.
- (14) Adjust **TRIGGERING LEVEL** and horizontal **POSITION** control to align 2d marker with 2d vertical graticule line.
- (15) Adjust **R1169 X10 GAIN** (fig. 6) for 1 marker per division. The 2d and 10th markers must align with the 2d and 10th vertical graticule lines (R).

**34. Power Supply.** Connect digital multimeter LO to chassis ground and HI to TP3465 (fig. 7). If digital multimeter does not indicate between 19.6 and 20.4 V dc, adjust R3466 (fig 7) for 20.0 V (R).

### **NOTE**

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

## **35. Final Procedure**

- a. Deenergize and disconnect all equipment.
- b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

Official:

**PETER J. SCHOOMAKER**  
*General, United States Army*  
*Chief of Staff*



**JOEL B. HUDSON**  
*Administrative Assistant to the*  
*Secretary of the Army*

0331604

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342263, requirements TB 9-6625-2173-35.



## Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" [whomever@redstone.army.mil](mailto:whomever@redstone.army.mil)

To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From:** Joe Smith
2. **Unit:** home
3. **Address:** 4300 Park
4. **City:** Hometown
5. **St:** MO
6. **Zip:** 77777
7. **Date Sent:** 19-OCT-93
8. **Pub no:** 55-2840-229-23
9. **Pub Title:** TM
10. **Publication Date:** 04-JUL-85
11. **Change Number:** 7
12. **Submitter Rank:** MSG
13. **Submitter FName:** Joe
14. **Submitter MName:** T
15. **Submitter LName:** Smith
16. **Submitter Phone:** 123-123-1234
17. **Problem:** 1
18. **Page:** 2
19. **Paragraph:** 3
20. **Line:** 4
21. **NSN:** 5
22. **Reference:** 6
23. **Figure:** 7
24. **Table:** 8
25. **Item:** 9
26. **Total:** 123
27. **Text**

This is the text for the problem below line 27.

