

***TB 9-6625-2295-35**

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR OSCILLOSCOPE, OS-288/G (TEKTRONIX, TYPE 2465B) AND TEKTRONIX, TYPES 2465B OPT46 AND 2467B

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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, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028, directly to Commander, U.S. Army Aviation and Missile Command, ATTN: 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. 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, OS-288/G (Tektronix, Type 2465B), and Tektronix, Types 2465B OPT 46 and 2467B. The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. Tektronix, Type 2465B OPT46 and 2467B OPT10 are equipped with an IEEE bus.

b. Time and Technique. The time required for this calibration is approximately 6 hours, 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. 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
<u>Vertical gain CH1 and CH2</u>	Range: 2 mV/div to 5 V/div
	Accuracy: ±2% (1 MΩ input coupling)
	±3% (50Ω input coupling)
ΔV cursors	Accuracy: ±(1.25% of reading + .03 div)
CH 3 and CH 4	Range: .1 and .5 V/div
	Accuracy: ±10%

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
<u>Trigger level readout</u>	Accuracy: Within $\pm[3\%$ of setting + 3% of p-p signal + 0.2 division + 0.5 mV +(0.5 mV x probe attenuation factor)]
Sensitivity	0.35 division Dc to 50 MHz
CH 1 and CH2	1.0 division at 300 MHz
Dc coupled	1.5 division at 500 MHz
Ac coupled	0.35 division 60 Hz to 50 MHz
	1.0 division at 300 MHz
	1.5 division at 500 MHz
CH 3 or CH 4	0.5 x CH 1 or CH 2 requirement
<u>Horizontal timing</u>	
A sweep	Range: 500 ms/div to 5 ns/div extended to 0.5 ns with X10 mag Accuracy: 500 and 200 ms $\pm(1.2\%$ of time interval +0.6% of FS) 100 ms to 5 ns $\pm(0.7\%$ of time interval +0.6% of FS) X10 mag: $\pm(1.2\%$ of time interval +0.6% of FS)
B sweep	Range: 50 ms/div to 5 ns/div extended to 0.5 ns with X10 mag Accuracy: $\pm 1.0\%$ of time interval +0.6% of FS X10 mag: $\pm 1.5\%$ of time interval +0.6% of FS
Δ time with cursors	Accuracy: $\pm(0.5\%$ of time interval + 0.3% of FS) X10 mag: $\pm(1\%$ of time interval + 0.3% of FS)
Δ time with sweep delay	Accuracy: $\pm(0.3\%$ of time interval + 0.1% of FS + 200 ps) X10 mag: $\pm(0.8\%$ of time interval + 0.1% of FS + 200 ps)
Δ time with cursors on B sweep	Accuracy: $\pm(0.8\%$ of time interval + 0.3% of FS) X10 mag: $\pm(1.3\%$ of time interval + 0.3% of FS)
Delay sweep	Accuracy: $\pm(0.3\%$ of delay setting + 0.6% of FS) +0 to -25 ns
<u>Bandwidth</u>	Dc to 400 MHz at 5 mV or greater
<u>Calibrator</u>	
Output voltage	0.4V $\pm 1\%$ into 1 M Ω load
Repetition period	Two times the A SEC/DIV setting for SEC/DIV from 100 ns to 100 ms 0.1% during sweep time
<u>Parametric measurement</u>	
Period accuracy	0.9% + 0.5 ns + jitter error

**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. 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 this calibration are common usage accessories issued as indicated in paragraph 4 above and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CALIBRATOR OSCILLOSCOPE	Volts out: Range: 10 mV to 20 V Accuracy: $\pm 0.5\%$ Time markers: Range: .5 ns to .5 s Accuracy: $\pm 0.175\%$ Pulses: Risettime: ± 0.225 ns Sine wave frequency range: 0 kHz to 500 MHz	John Fluke, Model 5820A-5C-GHz (5820A-5C-GHz)
DIGITAL MULTIMETER	Range: 0 to 20 V Accuracy: $\pm 0.025\%$	John Fluke, Model 8840A/AF-05/09 (AN/GSM-64D)
OSCILLOSCOPE	Used in CAL 01 adjustment procedure	Tektronix, Type 2465BOPT46 (2465BOPT46)

**SECTION III
CALIBRATION PROCESS**

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 results 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 manufacturer's manual for this TI.

d. When indications specified in paragraphs **7** through **13** are not within tolerance, perform Section IV, Menu Calibration Process. After adjustments are made, repeat paragraphs **7** through **13**. Do not perform Section IV if all other parameters are within tolerance.

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

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of the 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 a 115 V ac source.

NOTE

When **POWER** pushbutton is pressed to **ON**, TI automatically performs a self-test sequence. Upon successful completion of self-test, TI will be in normal operating mode.

NOTE

If instrument is subjected to greater than 85 percent relative humidity, bandwidth is reduced by 50 MHz. After the instrument is subjected to greater than 85 percent relative humidity, it requires more than 50 hours of operation at less than 60 percent relative humidity before full bandwidth is restored.

b. Press **POWER** pushbutton to **ON** and allow at least 20 minutes for equipment to warm up.

NOTE

If TI displays **DIAGNOSTIC, PUSH A/B TRIG TO EXIT** at power on, one of the power-up tests has failed. If error message on bottom line of display is **TEST 04 FAIL xx**, where xx is 01, 02, 10, or 11, stored calibration data is in error. If this error message is displayed, press **A/B TRIG** pushbutton to exit diagnostic mode and perform Section IV. If any other error message occurs, the failure is probably not related to calibration. In this case, the instrument should be repaired before attempting calibration.

c. Press corresponding pushbutton for indications as listed in (1) through (9) below:

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- (1) **VERTICAL MODE CH 1** and **CH 2** on, **CH 3** and **CH 4** off.
- (2) **VERTICAL MODE ADD** and **INVERT** off.
- (3) **VERTICAL MODE CHOP/ALT** to **ALT**, and **20 MHz BW LIMIT** to off.
- (4) **CH 1** and **CH 2** input coupling to **1 MW AC**.
- (5) **TRIGGER MODE** to **AUTO LVL**, and **TRIGGER COUPLING** to **DC**.
- (6) **TRIGGER SOURCE** to **VERT CH 1** and **TRIGGER SLOPE** to + (plus).
- (7) **TRACK/INDEP** to **INDEP**.
- (8) **DV** and **Dt** to off (cursors off).
- (9) **X10 MAG** to off.

d. Position controls as listed in (1) through (9) below:

- (1) **VERTICAL POSITION** controls to midrange.
- (2) **CH 1** and **CH 2 VOLTS/DIV** switches to **100 mV** and **VAR** control cw to detent.
- (3) **A SWP SEC/DIV** switch to **2 ms** (knobs locked) and **VAR** control cw to detent.
- (4) Horizontal **POSITION** control to midrange.
- (5) **TRIGGER LEVEL** control to midrange.
- (6) **TRIGGER HOLDOFF** control fully ccw to **MIN**.
- (7) **TRACE SEP** control fully cw.
- (8) **SCALE ILLUM** control fully ccw.
- (9) **INTENSITY**, **FOCUS**, and **READOUT INTENSITY** controls for suitable viewing.

8. Vertical Gain

a. Performance Check

(1) Press and hold **CH 1** and **CH 2** input coupling pushbuttons to **PUSH BOTH BALANCE** position until display readout indicates **DC BALANCE IN PROGRESS**.

(2) When signal and readout displays automatically return to normal, connect oscilloscope calibrator output to **CH 1**.

(3) Press corresponding pushbuttons for indications as listed in (a) through (e) below:

- (a) **VERTICAL MODE CH 1** on, and **VERTICAL MODE CH 2**, **CH 3**, and **CH 4** off.
- (b) **20 MHz BW LIMIT** to on.
- (c) **CH 1** and **CH 2** input coupling to **1 MW DC**.
- (d) **TRIGGER** coupling to **DC**.
- (e) **TRIGGER SOURCE** to **VERT CH 1**.

- (4) Set **CH 1 VOLTS/DIV** switch to **2 mV** and **A SWP SEC/DIV** switch to **1 ms**.
- (5) Position oscilloscope calibrator controls for 1 kHz voltage output.
- (6) Adjust oscilloscope calibrator output settings for 4 or 5 division display as per table 3 below. If oscilloscope calibrator error readout indication is not within ± 2 percent, perform **b** below.

Table 3. Channel 1 Vertical Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
2 mV	10 mV	5
5 mV	20 mV	4
10 mV	50 mV	5
20 mV	0.1 V	5
50 mV	0.2 V	4
100 mV	0.5 V	5
200 mV	1.0 V	5
500 mV	2.0 V	4
1.0 V	5.0 V	5
2.0 V	10.0 V	5
5.0 V	20.0 V	4

- (7) Press **TRIGGER SOURCE** lower pushbutton to select **CH 2**.
- (8) Press **VERTICAL MODE** pushbuttons **CH 2** on, and **CH 1** off.
- (9) Move connection from **CH 1** to **CH 2**.
- (10) Adjust oscilloscope calibrator output settings for 4 or 5 division display as per table 4 below. If oscilloscope calibrator error readout indication is not within ± 2 percent, perform **b** below.

Table 4. Channel 2 Vertical Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
2 mV	10 mV	5
5 mV	20 mV	4
10 mV	50 mV	5
20 mV	0.1 V	5
50 mV	0.2 V	4
100 mV	0.5 V	5
200 mV	1.0 V	5
500 mV	2.0 V	4
1.0 V	5.0 V	5
2.0 V	10.0 V	5
5.0 V	20.0 V	4

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(11) Position oscilloscope calibrator controls for a 10 mV, 1 kHz output into 50Ω.

(12) Press **CH 2** input coupling pushbutton to select **50W DC**.

(13) Adjust oscilloscope calibrator output settings for 4 or 5 division display as per table 5 below. If oscilloscope calibrator error readout indication is not within ±3 percent, perform **b** below.

Table 5. Channel 2 50Ω Input Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
2 mV	10 mV	5
5 mV	20 mV	4
10 mV	50 mV	5
20 mV	0.1 V	5
50 mV	0.2 V	4
100 mV	0.5 V	5
200 mV	1.0 V	5
500 mV	2.0 V	4
1.0 V	5.0 V	5

(14) Press **VERTICAL MODE CH 2** pushbutton off and **CH 1** on.

(15) Press **TRIGGER SOURCE** upper pushbutton to select **CH 1**.

(16) Press **CH 1** input coupling pushbutton to select **50W DC**.

(17) Move connection from **CH 2** to **CH 1**.

(18) Adjust oscilloscope calibrator output settings for 4 or 5 division display as per table 6 below. If oscilloscope calibrator error readout indication is not within ±3 percent, perform **b** below.

Table 6. Channel 1 50Ω Input Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
2 mV	10 mV	5
5 mV	20 mV	4
10 mV	50 mV	5
20 mV	0.1 V	5
50 mV	0.2 V	4
100 mV	0.5 V	5
200 mV	1.0 V	5
500 mV	2.0 V	4
1.0 V	5.0 V	5

(19) Move connection from **CH 1** to **CH 3**.

(20) Press corresponding pushbuttons for indications as listed in (a) through (c) below:

- (a) **TRIGGER SOURCE** to select **CH 3**.
- (b) **VERTICAL MODE CH 1** off and **CH 3** on.
- (c) **CH 3 VOLTS/DIV** to display **.1 V** on **CRT**.

(21) Adjust oscilloscope calibrator Scope Z 1 MΩ and output settings for 4 or 5 division display as per table 7 below. If oscilloscope calibrator error readout indication is not within ±3 percent, perform **b** below.

Table 7. Channel 3 Input Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
0.1 V	0.5 V	5
0.5 V	2 V	4

(22) Move connection from **CH 3** to **CH 4**.

(23) Press corresponding pushbuttons for indications as listed in (a) through (c) below:

- (a) **TRIGGER SOURCE** to select **CH 4**.
- (b) **VERTICAL MODE CH 3** off and **CH 4** on.
- (c) **CH 4 VOLTS/DIV** to display **.1 V** on crt.

(24) Adjust oscilloscope calibrator output settings for 4 or 5 division display as per table 8 below. If oscilloscope calibrator error readout indication is not within ±3 percent, perform **b** below.

Table 8. Channel 4 Input Gain

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument vertical deflection in divisions
0.1 V	0.5 V	5
0.5 V	2 V	4

(25) Move connection from **CH 4** to **CH 1** and set oscilloscope calibrator for 10 mV, 1 kHz output.

(26) Press corresponding pushbuttons for indications as listed in (a) through (d) below:

- (a) **VERTICAL MODE CH 1** on and **VERTICAL MODE CH 2, CH 3, and CH 4** off.
- (b) **CH 1** input coupling to **1 MW DC**.
- (c) **TRIGGER SOURCE** to select **VERT CH 1**.
- (d) **DV** to indicate **DV** (cursors on).

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(27) Set **CH 1 VOLTS/DIV** switch to **2 mV** and adjust **CH 1 VERTICAL POSITION** control to center waveform on display.

(28) Adjust **D REF OR DLY POS** control to align reference cursor with bottom of waveform for each of the following steps.

(29) Adjust **D** control to align Δ cursor with top of waveform and verify indications are within tolerances listed in table 9 below. If **DV** readout indications are not within limits given in table 9, perform **b** below.

Table 9. ΔV with Cursors

Test instrument VOLTS/DIV switch settings	Oscilloscope calibrator output settings	Test instrument ΔV readout indications	
		Min	Max
2 mV	10 mV	9.81 mV	10.2 mV
5 mV	20 mV	19.6 mV	20.4 mV
10 mV	50 mV	49.0 mV	50.9 mV
20 mV	0.1 V	98.1 mV	102.0 mV
50 mV	0.2 V	196 mV	204 mV
100 mV	0.5 V	490 mV	509 mV
200 mV	1.0 V	.981 V	1.02 V
500 mV	2.0 V	1.96 V	2.04 V
1.0 V	5.0 V	4.90 V	5.09 V
2.0 V	10.0 V	9.81 V	10.2 V
5.0 V	20.0 V	19.6 V	20.4 V

b. Adjustments. Perform section IV below

9. Triggering

a. Performance Check

(1) Press corresponding pushbutton for indications as listed in (a) through (e) below:

(a) **VERTICAL MODE CH 1** on and **VERTICAL MODE CH 2, CH 3,** and **CH 4** off.

(b) **TRIGGER SOURCE** to **VERT CH 1.**

(c) **TRIGGER MODE** to **NORM.**

(d) **CH 1** and **CH 2** input coupling to **1 MW DC.**

(e) **DV** to off (cursors off).

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

(a) **CH 1 VOLTS/DIV** switch to **5 mV.**

(b) **CH 1** and **CH 2 VOLTS/DIV VAR** controls cw to detent.

(c) **TRIGGER LEVEL** control to midrange.

(3) Connect oscilloscope calibrator output to **CH 1.**

(4) Position oscilloscope calibrator controls for a 20 mV, 1 kHz output.

NOTE

Combine steps (5) and (6) below to avoid resetting standards.

(5) Adjust **TRIGGER LEVEL** control for most positive voltage that produces a barely triggered display when selecting + and - **SLOPE**. If **A TRIGGER LEVEL** readout indication is not within limits given in + peak column of table 10, perform **b** below.

(6) Adjust **TRIGGER LEVEL** control for most negative voltage that produces a barely triggered display when selecting + and - **SLOPE**. If **A TRIGGER LEVEL** readout indication is not within limits given in - peak column of table 10, perform **b** below.

Table 10. Trigger Level 1 MΩ Input Coupling

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument trigger level readout indications			
		+ peak		- peak	
		Min	Max	Min	Max
5 mV	20 mV	16.8 mV	23.2 mV	-2.6 mV	2.6 mV
10 mV	50 mV	44 mV	56 mV	-4.5 mV	4.5 mV
20 mV	0.1 V	89 mV	111 mV	-8.0 mV	8.0 mV
50 mV	0.2 V	178 mV	222 mV	-16 mV	16 mV
100 mV	0.5 V	450 mV	550 mV	-35 mV	35 mV
200 mV	1.0 V	0.90 V	1.10 V	-70 V	70 mV
500 mV	2.0 V	1.78 V	2.22 V	-.16 V	.16 V
1.0 V	5.0 V	4.50 V	5.50 V	-.35 V	.35 V
2.0 V	10.0 V	9.0 V	11.0 V	-0.7 V	0.7 V
5.0 V	20.0 V	17.8 V	22.2 V	-1.6 V	1.6 V

(7) Set **CH 1 VOLTS/DIV** switch to **5 mV** and position oscilloscope calibrator controls for a 20 mV, 1 kHz output.

(8) Pull **SEC/DIV** knob out and press **A/B TRIG** pushbutton for **B TRIGGER** and press **TRIGGER MODE** pushbutton for **TRIG DLY**. Adjust **TRIGGER LEVEL** for a stable display.

(9) Adjust Δ **REF** OR **DLY POS** control for a delay readout of 0.000 ms.

NOTE

Combine steps (10) and (11) below to avoid resetting standards

(10) Adjust **TRIGGER LEVEL** control (all table settings) for most positive voltage that produces an intensified point on waveform display when selecting + and - **SLOPE**. If **B TRIGGER** level readout indication is not within limits given in + peak column of table 11, perform **b** below.

(11) Adjust **TRIGGER LEVEL** control (all table settings) for most negative voltage that produces an intensified point on waveform display when selecting + and - **SLOPE**. If **B TRIGGER** level readout indication is not within limits given in -peak column of table 11, perform **b** below.

NOTE

It may be necessary to reselect **A SWP** and adjust **LEVEL** control for stable sweep before returning to check **B SWP** triggering levels in the following table.

Table 11. Trigger Level 1 MΩ Input Coupling

Test instrument VOLTS/DIV switch settings	Calibration generator output settings	Test instrument trigger level readout indications			
		+ peak		- peak	
		Min	Max	Min	Max
5 mV	20 mV	16.8 mV	23.2 mV	-2.6 mV	2.6 mV
10 mV	50 mV	44 mV	56 mV	-4.5 mV	4.5 mV
20 mV	0.1 V	89 mV	111 mV	-8.0 mV	8.0 mV
50 mV	0.2 V	178 mV	222 mV	-16 mV	16 mV
100 mV	0.5 V	450 mV	550 mV	-35 mV	35 mV
200 mV	1.0 V	0.90 V	1.10 V	-70 V	70 mV
500 mV	2.0 V	1.78 V	2.22 V	-.16 V	.16 V
1.0 V	5.0 V	4.50 V	5.50 V	-.35 V	.35 V
2.0 V	10.0 V	9.0 V	11.0 V	-0.7 V	0.7 V
5.0 V	20.0 V	17.8 V	22.2 V	-1.6 V	1.6 V

(12) Press corresponding pushbuttons for indications listed in (a) through (c) below:

- (a) **20 MHz BW LIMIT** off.
- (b) **TRIGGER SLOPE** to + (plus) and **TRIGGER COUPLING** to **AC**.
- (c) **TRIGGER MODE** to **AUTO LVL** and **TRIGGER SOURCE** to **VERT CH**

1.

(13) Set **CH 1 VOLTS/DIV** switch to **100 mV** and **A SWP SEC/DIV** switch to **50 ms** (knobs locked).

(14) Set oscilloscope calibrator for leveled sine wave and connect output to **CH 1** using a 50Ω feedthrough terminator.

(15) Position oscilloscope calibrator controls for 50 kHz and an amplitude of 0.35 division of display.

(16) Adjust **TRIGGER LEVEL** control for a stable display at all settings listed in table 12. If a stable display cannot be obtained, perform **b** below.

NOTE

Set **A SWP SEC/DIV** switch and press **X10 MAG** pushbutton as necessary to obtain a well-defined display of test signal.

Table 12. Channel 1 Trigger Level Frequency Response Stability

Calibration generator frequency	Test instrument trigger coupling	Test instrument divisions of display
50 kHz	AC	.35
50 MHz	AC	.35
50 MHz	DC	.35
300 MHz	DC	1
300 MHz	AC	1
500 MHz	AC	1.5
500 MHz	DC	1.5

(17) Press corresponding pushbuttons for indications as listed in (a) through (f) below:

- (a) **VERTICAL MODE CH 1** off and **CH 2** on.
- (b) **TRIGGER SOURCE** to **CH 2**.
- (c) **TRIGGER COUPLING** to **AC**.
- (d) **CH 2** switch to **100mV**.
- (e) **X10 MAG** to off.
- (f) **SEC/DIV** switch to **50 mS**.

(18) Connect oscilloscope calibrator (with 50Ω load) to channel 2.

(19) Adjust **TRIGGER LEVEL** control for a stable display at all settings listed in table 13. If a stable display cannot be obtained, perform **b** below.

NOTE

Set **A SWP SEC/DIV** switch and press **X10 MAG** pushbutton as necessary to obtain a well-defined display of test signal.

Table 13. Channel 2 Trigger Level Frequency Response Stability

Calibration generator frequency	Test instrument Trigger coupling	Test instrument divisions of display
50 kHz	AC	.35
50 MHz	AC	.35
50 MHz	DC	.35
300 MHz	DC	1
300 MHz	AC	1
500 MHz	AC	1.5
500 MHz	DC	1.5

b. Adjustments. Perform Section IV below.

10. Timing

a. Performance Check

(1) Press corresponding pushbuttons for indications as listed in (a) through (c) below:

- (a) **VERTICAL MODE CH1** on and **CH2, CH3,** and **CH 4** off.
- (b) **TRIGGER MODE** to **AUTO LVL** and **TRIGGER SOURCE** to **VERT CH 1**.
- (c) **X10 MAG** off.

(2) Connect oscilloscope calibrator output to **CH 1** using a 50Ω feedthrough termination.

(3) Set **A SWP SEC/DIV** switch to 5 ns (knobs locked).

(4) Position oscilloscope calibrator controls for **MARKERS**, and **5 nS** output.

(5) Set **CH 1 VOLTS/DIV** switch for approximately 2 to 3 divisions of display.

(6) Adjust **TRIGGER LEVEL** control for a stable display.

(7) Adjust horizontal **POSITION** control to align 2nd time marker with 2nd vertical graticule line and oscilloscope calibrator err control to align 10th time marker with 10th vertical graticule line for all settings in table 14. If oscilloscope calibrator error readout indication is not within listed accuracies, perform **b** below.

Table 14. A SWP Timing

Test instrument A SWP SEC/DIV switch settings	Oscilloscope calibrator output settings	Accuracy (%)
5 ns	5 ns	±1.45
10 ns	10 ns	±1.45
20 ns	20 ns	±1.45
50 ns	50 ns	±1.45
100 ns	.1 μs	±1.45
200 ns	.2 μs	±1.45
500 ns	.5 μs	±1.45
1 μs	1 μs	±1.45
2 μs	2 μs	±1.45
5 μs	5 μs	±1.45
10 μs	10 μs	±1.45
20 μs	20 μs	±1.45
50 μs	50 μs	±1.45
100 μs	.1 ms	±1.45
200 μs	.2 ms	±1.45
500 μs	.5 ms	±1.45
1 ms	1 ms	±1.45
2 ms	2 ms	±1.45
5 ms	5 ms	±1.45

Table 14. A SWP Timing - Continued

Test instrument A SWP SEC/DIV switch settings	Oscilloscope calibrator output settings	Accuracy (%)
10 ms	10 ms	±1.45
20 ms	20 ms	±1.45
50 ms	50 ms	±1.45
100 ms	.1 s	±1.45
200 ms	.2 s	±1.95
500 ms	.5 s	±1.95
5 mS X10 MAG	.5 ms	±1.95

- (8) Press **X10 MAG** pushbutton to off.
- (9) Set **A SWP SEC/DIV** switch to **10 ns**, and **B SWP SEC/DIV** switch to **5 ns** (knob in) for **B SWP** only.
- (10) Position oscilloscope calibrator controls for 5 nS output.
- (11) Adjust **TRIGGER LEVEL** control for a stable display.
- (12) Adjust horizontal **POSITION** control to align 2d time marker with 2d vertical graticule line, and adjust oscilloscope calibrator controls to align 10th time marker with 10th vertical graticule line for all settings in table 15 below. If oscilloscope calibrator error readout indication is not within ±1.75 percent, perform **b** below.

Table 15. B SWP Timing

Test instrument		Calibration generator output settings
A SWP SEC/DIV switch settings	B SWP SEC/DIV switch settings	
10 nS	5 nS	5 nS
20 ns	10 ns	10 nS
50 ns	20 ns	20 nS
100 ns	50 ns	50 nS
200 ns	100 ns	.1 μS
500 ns	200 ns	.2 μS
1 μs	500 ns	.5 μS
2 μs	1 us	1 μS
5 μs	2 us	2 μS
10 μs	5 us	5 μS
20 μs	10 us	10 μS
50 μs	20 us	20 μS
100 μs	50 us	50 μS
200 μs	100 us	.1 mS
500 μs	200 us	.2 mS
1 ms	500 us	.5 mS
2 ms	1 ms	1 mS
5 ms	2 ms	2 mSD

Table 15. B SWP Timing - Continued

Test instrument		Calibration generator output settings
A SWP SEC/DIV switch settings	B SWP SEC/DIV switch settings	
10 ms	5 ms	5 ms
20 ms	10 ms	10 ms
50 ms	20 ms	20 ms
100 ms	50 ms	50 ms
5 mS X10 MAG (500 μs disp)	2 mS (200 μs disp)	200 μs

- (13) Press **X10 MAG** pushbutton off.
- (14) Press **Dt** pushbutton on (cursors on CRT).
- (15) Position oscilloscope calibrator controls for 5 nS output.
- (16) Set **A SWP SEC/DIV** switch to **5 ns** (knobs locked).
- (17) Adjust **D REF OR DLY POS** control to align one cursor with 2d time marker and **D** control to align other cursor with 10th time marker for each setting in table 16. If Δt readout indication is not within limits as listed in table 16, perform **b** below.

Table 16. A SWP Cursor Timing

Test instrument A SWP SEC/DIV switch settings	Oscilloscope calibrator output settings	Test instrument Δt readout indications	
		Min	Max
5 ns	5 ns	39.65 ns	40.35 ns
10 ns	10 ns	79.30 ns	80.70 ns
20 ns	20 ns	158.6 ns	161.4 ns
50 ns	50 ns	396.5 ns	403.5 ns
100 ns	.1 μs	793.0 ns	807.0 ns
200 ns	.2 μs	1586 ns	1614 ns
500 ns	.5 μs	3965 ns	4035 ns
1 μs	1 μs	7.93 μs	8.07 μs
2 μs	2 μs	15.86 μs	16.14 μs
5 μs	5 μs	39.65 μs	40.35 μs
10 μs	10 μs	79.30 μs	80.70 μs
20 μs	20 μs	158.60 μs	161.4 μs
50 μs	50 μs	396.5 μs	403.5 μs
100 μs	.1 ms	793.0 μs	807.0 μs
200 μs	.2 ms	1586.0 μs	1614.0 μs
500 μs	.5 ms	3965 μs	4035 μs
1 ms	1 ms	7.930 ms	8.070 ms
2 ms	2 ms	15.860 ms	16.140 ms
5 ms	5 ms	39.65 ms	40.35 ms
10 ms	10 ms	79.30 ms	80.70 ms
20 ms	20 ms	158.60 ms	161.40 ms
50 ms	50 ms	396.5 ms	403.5 ms
100 ms	.1 s	793.0 ms	807.0 ms
200 ms	.2 s	1578 ms	1622 ms
500 ms	.5 s	3945 ms	4055 ms

- (18) Set **A SWP SEC/DIV** switch to **10 ns** and **B SWP SEC/DIV** switch to **5 ns** (knob out).
- (19) Press corresponding pushbuttons for indications as listed in (a) through (d) below.
- (a) **TRIGGER SOURCE** to **VERT CH 1**.
 - (b) **Dt** to off (**DLY** readout).
 - (c) **A/B TRIG** for **B TRIGGER** and **TRIGGER MODE** to **RUN AFT DLY**.
 - (d) **X10 MAG** on.
- (20) Position oscilloscope calibrator controls for 10 nS output.
- (21) Set **VOLTS/DIV** switch as required for a display of 3 to 6 divisions and adjust **D REF OR DLY POS** control for **DLY** readout of **10.64 ns**.
- (22) Adjust **TRIGGER LEVEL** control as required for a stable display.
- (23) Adjust horizontal **POSITION** control cw until the trace stops moving, then ccw to position leading edge of the 2d time marker near graticule center.
- (24) Position oscilloscope calibrator controls for 5 nS output.
- (25) Press **Dt** pushbutton to obtain Δt display and push in **SEC/DIV** knob for **B SWP** only.
- (26) Adjust **D** control for a Δt readout indication near -10.00 ns to superimpose the two time markers. If Δt readout indication is not between -9.68 ns and -10.32 ns with the two time markers superimposed, perform **b** below.
- (27) Repeat technique of (26) above for Δt readout indications listed in table 17. If Δt readout indications are not within specified limits in table 10 with the two time markers superimposed, perform **b** below.

Table 17. Delta Time Display

Δt readout indications (ns)	Test instrument	
	Δt readout indications limits	
	Min (ns)	Max (ns)
0.0	-0.30	0.30
10	9.68	10.32
20	19.64	20.36
30	29.62	30.38
40	39.58	40.42
50	49.56	50.44
60	59.52	60.48
70	69.50	70.50
80	79.46	80.54

- (28) Set **A SWP SEC/DIV** switch to **20 ns** and **B SWP SEC/DIV** switch to **5 ns** (knob out).
- (29) Press **X10 MAG** pushbutton on and **Dt** pushbutton off for **DLY** readout.

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- (30) Position oscilloscope calibrator controls for 20 nS output.
- (31) Adjust **DREF OR DLY POS** control for **DLY** readout of **21.25 ns** and horizontal **POSITION** control to position leading edge of 2d time marker near graticule center.
- (32) Position oscilloscope calibrator controls for 5 nS output.
- (33) Press **Dt** pushbutton to obtain a Δt display and push in **SEC/DIV** knob for **B SWP** only.
- (34) Adjust **D** control for a Δt readout indication near -20.00 ns to superimpose the two time markers. If Δt readout indication is not between -19.55 ns and -20.45 ns with the two time markers superimposed, perform **b** below.
- (35) Adjust **D** control for a Δt readout indication near 20.00 ns to superimpose the two time markers. If Δt readout indication is not between 19.55 ns and 20.45 ns with the two time markers superimposed, perform **b** below.
- (36) Adjust **D** control for a Δt readout indication near 160.00 ns to superimpose the two time markers. If Δt readout indication is not between 159.15 ns and 160.85 ns with the two time markers superimposed, perform **b** below.
- (37) Set **A SWP SEC/DIV** switch to **50 ns** and **B SWP SEC/DIV** switch to **5 ns** (knob out).
- (38) Press **X10 MAG** pushbutton on and **Dt** pushbutton off for **DLY** readout.
- (39) Position oscilloscope calibrator controls for 50 ns output.
- (40) Adjust **D REF OR DLY POS** control for **DLY 53.2 ns** and horizontal **POSITION** control to position leading edge of 2d time marker near graticule center.
- (41) Position oscilloscope calibrator controls for 5 ns output.
- (42) Press **Dt** pushbutton to obtain a Δt display and push in **SEC/DIV** knob for **B SWP** only.
- (43) Adjust **D** control for a Δt readout indication near -50.0 ns to superimpose the two time markers. If Δt readout indication is not between -49.20 ns and -50.80 ns with the two time markers superimposed, perform **b** below.
- (44) Adjust **D** control for a Δt readout indication near 50.00 ns to superimpose the two time markers. If Δt readout indication is not between 49.20 ns and 50.80 ns with the two time markers superimposed, perform **b** below.
- (45) Adjust **D** control for a Δt readout indication near 400.00 ns to superimpose the two time markers. If Δt readout indication is not between 398.10 ns and 401.90 ns with the two time markers superimposed, perform **b** below.
- (46) Press **TRACK/INDEP** pushbutton for **TRACK**.
- (47) Set **A SWP SEC/DIV** switch to **100 ns** and set **B SWP SEC/DIV** switch to **10 ns** (knob out).
- (48) Press **X10 MAG** pushbutton on.

- (49) Position oscilloscope calibrator controls for .1 μ s output.
- (50) Press **Dt** pushbutton for **DLY** and adjust **D REF OR DLY POS** controls for a Δt readout of **800.0 ns** (8 times **A SWP SEC/DIV** setting).
- (51) Adjust horizontal **POSITION** control to align leading edge of 2d time marker on A sweep with center vertical graticule line.
- (52) Adjust **TRACE SEP** control ccw to separate traces.
- (53) If B sweep time marker is not 3.4 divisions or less from center graticule line, perform **b** below.
- (54) Set **A SWP SEC/DIV** switch to **200 ns** and set **B SWP SEC/DIV** switch to **20 ns** (knob out).
- (55) Press **X10 MAG** pushbutton on.
- (56) Position oscilloscope calibrator controls for .2 μ S output.
- (57) Repeat technique of (50) through (54) above.
- (58) Press **TRACK/INDEP** pushbutton for **INDEP** (out).
- (59) Set **A SWP SEC/DIV** switch to **500 ns** and set **B SWP SEC/DIV** switch to **5 ns** (knob out).
- (60) Position oscilloscope calibrator controls for .5 μ s output.

NOTE

Performing (62) below will lock A and B sweep together at difference established in (60) above. Rotating the **SEC/DIV** knob will set both A sweep and B sweep while maintaining the established difference.

- (61) Press and hold **TRACK/INDEP** separate traces pushbutton then push in **SEC/DIV** knob.
- (62) Pull **SEC/DIV** knob out.
- (63) Adjust A and **A REF OR DLY POS** controls for a Δt readout of 8 times **A SWP SEC/DIV** setting.
- (64) Adjust horizontal **POSITION** control to align leading edge of 2d time markers on A sweep with 2d vertical graticule line.
- (65) Adjust **TRACE SEP** control ccw to separate traces.
- (66) If B sweep time marker is not 3.4 divisions or less from center graticule line, perform **b** below.
- (67) Repeat technique of (63) through (66) above for settings listed in table 18. If B sweep time marker is not 3.4 divisions from center graticule line, (except where noted), perform **b** below.

Table 18. Delayed Sweep Delta Time

Oscilloscope calibrator output settings	Test instrument	
	A SWP SEC/DIV switch settings	B SWP SEC/DIV switch settings
1 μ S	1 ms	10 ns
2 μ S	2 ms	20 ns
5 μ S	5 ms	50 ns
10 μ S	10 ms	100 ns
20 μ S	20 ms	200 ns
50 μ S	50 ms	500 ns
.1 mS	100 ms	1 ms
.2 mS	200 ms	2 ms
.5 mS	500 ms	5 ms
1 mS	1 ms	10 ms
2 mS	2 ms	20 ms
5 mS	5 mS	50 ms
10 mS	10 ms	100 ms
20 mS	20 ms	200 ms
50 mS	50 ms	500 ms
.1 S	100 ms	1 ms
.2 S	200 ms	2 ms ¹
.5 S	500 ms	5 ms ¹

¹7.4 divisions or less.

b. Adjustments. Refer to Section IV below.

11. Bandwidth

a. Performance Check

- (1) Set **A SWP SEC/DIV** switch to **50 ms** (knobs locked).
- (2) Set **CH 1 VOLTS/DIV** switch to **20 mV**.
- (3) Press corresponding pushbuttons for indications as listed in (a) through (e) below:
 - (a) **VERTICAL MODE CH1** on and **VERTICAL MODE CH2, CH3,** and **CH4** off.
 - (b) **CH1** and **CH2** input coupling for **1 MWDC**.
 - (c) **TRIGGER SOURCE** for **VERT CH1**.
 - (d) **Dt** off.
 - (e) **TRACK/INDEP** for **INDEP**.
- (4) Connect oscilloscope calibrator level sine to **CH1** using a 50 Ω feedthrough termination.
- (5) Position oscilloscope calibrator controls for a 6 division display at 50 kHz.

NOTE

Adjust **SEC/DIV**, **X10 MAG**, and triggering **LEVEL** as needed in the following checks.

(6) Increase oscilloscope calibrator frequency until display is 3.5 divisions for channels and levels as listed in table 19 below. If oscilloscope calibrator frequency is not 400 MHz or greater, perform **b** below.

Table 19. Bandwidth

Test instrument CHANNEL	VOLTS/DIVISION	Calibrator output
1	20 mV	6 Div @ 50 kHz (ref)
2	20 mV	6 Div @ 50 kHz (ref)
3	.1 V	6 Div @ 50 kHz (ref)
4	.1 V	6 Div @ 50 kHz (ref)

b. Adjustments. Perform section IV below.

12. Calibrator

a. Performance Check

(1) Press corresponding pushbuttons for indications as listed in (a) through (c) below:

(a) **VERTICAL MODE CH 1** on, and **VERTICAL MODE CH 2, CH 3** and **CH 4** off.

(b) **CH 1** input coupling to **1 MW**.

(2) Set **CH 1** and **CH 2 VOLTS/DIV** switches to **50 mV**, and **VAR** control fully cw to detent.

(3) Set **A SWP** and **B SWP SEC/DIV** switch to **50 ms** (knobs locked) and adjust **SEC/DIV VAR** control fully cw to detent.

(4) Connect **CH 1** to TI **CALIBRATOR** output terminal.

(5) Set **CH1 VAR** control for a full-scale (8 division) vertical display.

NOTE

If **VAR** control will not display full scale, set **VOLTS/DIV** switch for **20 mV**.

(6) Disconnect TI calibrator from **CH 1**.

(7) Connect oscilloscope calibrator output to **CH 1**.

(8) Set oscilloscope calibrator controls for 400 mV voltage out at 10 kHz. Adjust oscilloscope calibrator full vertical scale display. If oscilloscope calibrator error is not less than 1% perform **b** below.

b. Adjustments. Refer to Section IV below.

13. Parametric Measurements

a. Performance Check

- (1) Press **VERTICAL MODE CH1** pushbutton to on.
- (2) Press **VERTICAL MODE CH 2, 3, and 4** pushbuttons to off.
- (3) Press **CH1** input coupling pushbutton to **50WDC**.
- (4) Control settings not listed do not affect the procedure.
- (5) Connect oscilloscope calibrator output to **CH1**.
- (6) Position oscilloscope calibrator controls for **MARKERS**, and a 2 nS output.
- (7) Press **SETUP MEASURE** pushbutton.
- (8) Press **1** pushbutton to select **FREQ** measurement.
- (9) If TI **PERIOD** readout indication is not between 1.49 ns and 2.51 ns, perform

b below.

(10) Repeat technique of (6) through (9) above for each oscilloscope calibrator output setting listed in table 20.

Table 20. Period

Calibration generator output settings	Test instrument period indications	
	Min	Max
5 nS	4.48 ns	5.52 ns
10 nS	9.54 ns	10.55 ns
20 nS	19.40 ns	20.40 ns
50 nS	49.25 ns	50.75 ns
.1 uS	99.0 ns	101.0 ns
.2 uS	198.5 ns	201.5 ns
.5 uS	497.0 ns	503.0 ns
1 uS	994.5 ns	1.005 us
2 uS	1.989 us	2.011 us
5 uS	4.975 us	5.025 us
10 uS	9.950 us	10.05 us
20 uS	19.90 us	20.10 us
50 uS	49.75 us	50.25 us
.1 mS	99.50 us	100.5 us
.2 mS	199.0 us	201.0 us
.5 mS	497.5 us	502.5 us
1 mS	995.0 us	1.005 ms
2 mS	1.990 ms	2.010 ms
5 mS	4.975 ms	5.025 ms
10 mS	9.950 ms	10.05 ms
20 mS	19.90 ms	20.10 ms
50 mS1	49.75 ms	50.25 ms
.1 S1	99.50 ms	100.5 ms

¹To perform the 50 and 100 ms measurements, the **MINFREQ** must be set to **10 Hz**.

NOTE

To set the **MINFREQ** to **10 Hz** program the TI as follows:

- Press **SETUP MEASURE** pushbutton.
- Select **CONFIGURE (4)** pushbutton) and press.
- Select **MINFREQ (3)** pushbutton) and press.
- Select **10 Hz (2)** pushbutton) and press.

NOTE

After the 50 ms and 100 ms checks are made, return **MINFREQ** to **50 Hz**.

b. Adjustments

(1) Press **POWER** pushbutton to **OFF**, remove protective cover, and move **CAL NO/CAL** jumper to the **CAL** position.

(2) Press **POWER** pushbutton to **ON** and allow 20 minutes warm-up.

(3) Simultaneously press and hold **Dt** and **DV** pushbuttons; then press and hold **TRIGGER SLOPE** pushbutton. Hold in all three pushbuttons for approximately 1 second and then release. Top of display will indicate: **DIAGNSTIC.PUSH A/B TRIG TO EXIT**.

(4) Proceed to Section IV, paragraph **24**, below.

14. Final Procedure

a. Deenergize and disconnect all equipment.

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

SECTION IV MENU CALIBRATION PROCESS

15. Preliminary Instructions

a. The procedures in paragraph **17** through **24** should be performed only if an out-of-tolerance condition exists in paragraphs **8** through **14** or if an error message on the bottom line of the crt display is:

TEST 04 XX

where XX is 01, 02, 10, or 11 when **POWER** pushbutton is pressed to **ON**.

b. When performing paragraphs **19** through **24**, touch only the specific control or controls called out in the procedure. Movement of any other control may cause erroneous calibration results.

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c. Within the automatic calibration procedure, the calibration constants for timing, vertical gain, and trigger level are generated by the system microprocessor and stored in nonvolatile memory. The adjustments in **CAL 01, 02, 03** should be done in numerical sequence.

d. When performing automatic **CAL** steps, initial setting of front-panel controls is not required.

16. 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.

NOTE

When performing any of the automatic calibration routines the **CAL/NO CAL** jumper P501 must be moved to its **CAL** position (between pins 1 and 2) before turning the power on. When the desired calibration has been performed, return the jumper to its **NO CAL** position.

a. Press TI **POWER** pushbutton to off and disconnect TI from the 115 V ac source. Remove protective cover and move **CAL NO/CAL** jumper (P501) on A5 control board (right side of TI) to **CAL** position.

b. Connect TI to a 115 V ac source and press **POWER** pushbutton to **ON** and allow at least 20 minutes for equipment warm-up.

NOTE

When **POWER** pushbutton is pressed to **ON**, TI automatically performs a self-test sequence. Upon successful completion of self-test, TI will be in normal operating mode.

NOTE

Throughout this procedure, readout and control messages are displayed along the top and bottom of display (crt).

c. Press corresponding pushbuttons for indications as listed in (1) through (10) below:

- (1) **VERTICAL MODE CH 1** and **CH 2** on.
- (2) **VERTICAL MODE CH 3** and **CH 4** off.
- (3) **CH 1** and **CH 2** input coupling to **1 MWDC**.

- (4) **VERTICAL MODE ADD, INVERT**, and **BW LIMIT** off.
- (5) **VERTICAL MODE CHOP/ALT** to **ALT**.
- (6) **TRIGGER MODE** to **AUTO LVL**.
- (7) **TRIGGER SOURCE** to **VERT, CH 1**.
- (8) **TRIGGER COUPLING** to **DC**.
- (9) **TRIGGER SLOPE** to + (plus).
- (10) **TRACK/INDEP** to **INDEP**.

d. Position controls as listed in (1) through (9) below:

- (1) **VERTICAL POSITION** to midrange.
- (2) **CH 1** and **CH 2 VOLTS/DIV** switch to **100 mV** and **VAR** controls to fully cw detent.
- (3) **A SEC/DIV** switch to **100 ms**.
- (4) **SEC/DIV VAR** control fully cw detent.
- (5) Horizontal **POSITION** control to midrange.
- (6) **TRIGGER LEVEL** to midrange.
- (7) **TRIGGER HOLDOFF** fully cw to detent.
- (8) **SCALE ILLUM** fully ccw.
- (9) **INTENSITY, FOCUS**, and **READOUT INTENSITY** controls for suitable viewing.

e. Allow at least 20 minutes for equipment warm-up.

17. Power Supply

a. Performance Check

- (1) Press **VERTICAL MODE** pushbuttons **CH 2, CH 3**, and **CH 4** to off.
- (2) Connect digital multimeter **HI** to TI J119 (fig. 1) pin 4 and **LO** to chassis ground. If digital voltmeter does not indicate between +9.99 and +10.01 V DC, perform **b** below.

b. Adjustments. Adjust VOLT REF ADJ R1292 (fig. 2) until digital multimeter indicates 10.00 V DC (R).

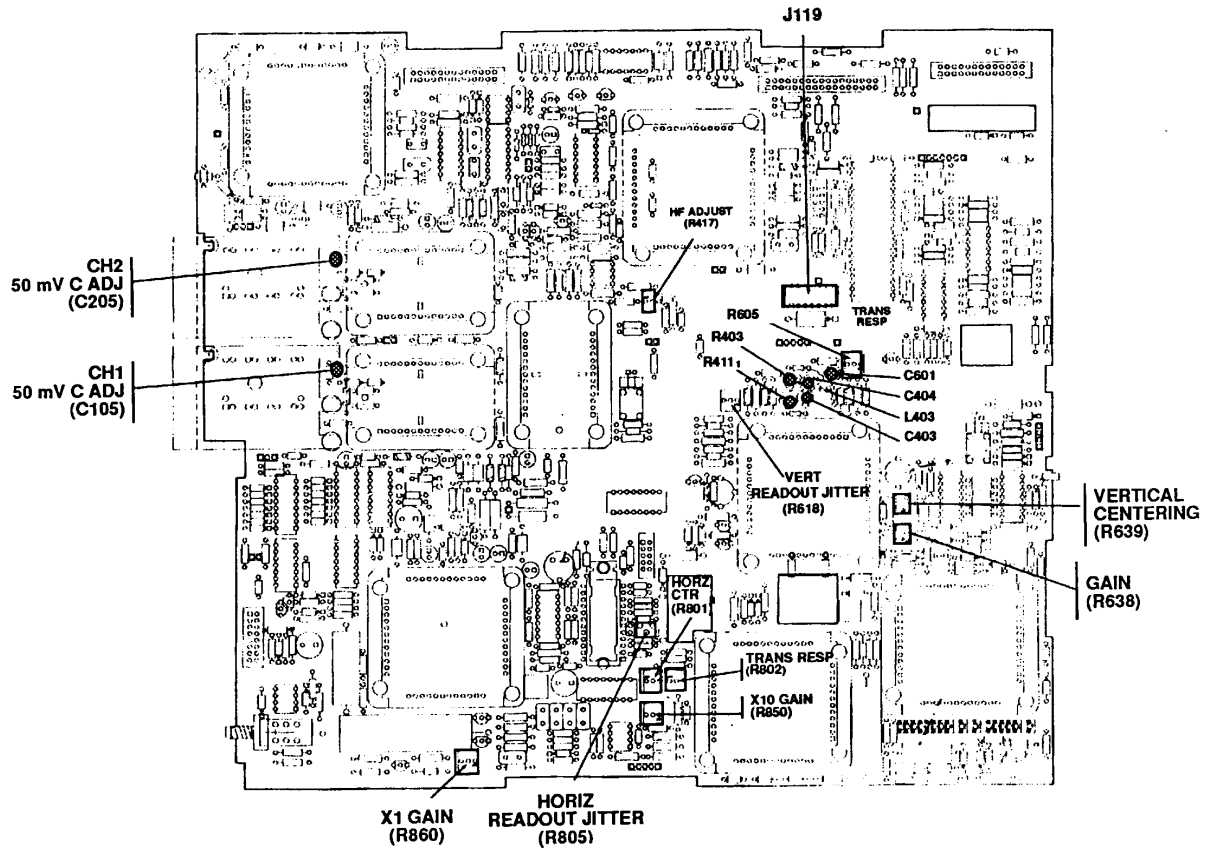


Figure 1. A1 main board - adjustment locations.

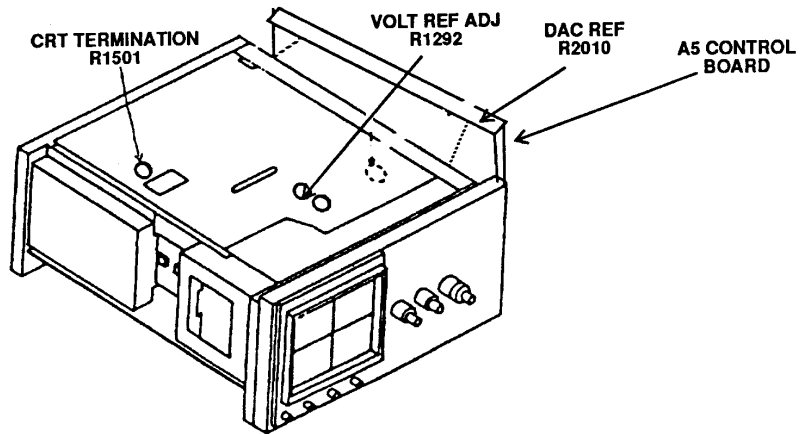


Figure 2. Adjustment locations.

18. DAC REF and Input Capacitance

a. Performance Check

- (1) Connect digital multimeter **HI** to J119 (fig. 1) pin 13 and **LO** to chassis ground.
- (2) Press **Dt** pushbutton for a Δt display on crt.
- (3) Adjust D control ccw until digital multimeter indication remains at a constant value (approximately -1.25 V dc). Record indication.
- (4) Adjust D control cw until digital multimeter indication remains at a constant value (approximately 1.25 V dc). Record indication.
- (5) Add the absolute values of indications recorded in (3) and (4) above. If sum of indications does not equal 2.500 V dc, adjust DAC RF R2010 (fig. 2) for 1.250 V dc or best compromise on digital multimeter while repeating (3) and (4) above.
- (6) Disconnect digital multimeter.
- (7) Press **Dt** pushbuttons to off (no cursors on display).
- (8) Connect oscilloscope calibrator output to **CH 1** using a 5-80 pF standardizer.
- (9) Position oscilloscope calibrator controls for **AMPL MODE EDGE, VARIABLE ON**, and a 600 mV, 1 kHz output.
- (10) Adjust oscilloscope calibrator **VAR** control for a 6 division display.
- (11) Adjust 5-80 pF standardizer for a square front corner over the first 40 μ s (0.4 division) of the positive portion of waveform. Note waveform front corner for use in (14) below.
- (12) Position oscilloscope calibrator controls for a 300 mV, 1 kHz output.
- (13) Set **VOLTS/DIV** switch to 50 mV and repeat (10) above.
- (14) Adjust 50 mV C ADJ C105 (C205 for CH 2) (fig. 1) for same waveform front corner as noted in (11) above.
- (15) Set **VOLTS/DIV** switch to **100 mV**.
- (16) Repeat (9) through (15) above until no change is observed in the waveform front corner.
- (17) Press **VERTICAL MODE CH 1** to off and **CH 2** to on.
- (18) Press **TRIGGER SOURCE** pushbutton to **CH 2**.
- (19) Repeat technique of (8) through (16) above for **CH 2**.

19. CAL 01 Horizontal

a. Performance Check

- (1) Simultaneously press and hold **Dt** and **DV** pushbuttons; then press and hold **TRIGGER SLOPE** pushbutton. Hold in all three pushbuttons for approximately 1 second and then release. Top of display will indicate: **DIAGNSTIC.PUSH A/B TRIG TO EXIT**.

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- (2) Press upper **TRIGGER MODE** pushbutton to **CAL 01** (bottom left of display).

CAUTION

Upon entering **CAL 01**, the input coupling is automatically set to **50W DC** and 50Ω overload protection is disabled. Before starting procedure, make sure any 50Ω overload condition has been cleared.

NOTE

In this procedure, pressing up and releasing **TRIGGER COUPLING** pushbutton stores current calibration parameter being set and increments routine to next step (except where otherwise noted).

NOTE

Throughout this paragraph the **INTENSITY** and **POSITION** controls may be adjusted as necessary for proper viewing of displayed signal.

- (3) Connect digital multimeter **HI** to TI **CALIBRATOR** output (front panel) and **LO** to chassis ground.
- (4) Set digital multimeter to measure dc volts.
- (5) Press and release upper **TRIGGER COUPLING** pushbutton. The display readout will indicate **ADJ D**, (step) **0**, **CH 1 PROBE TO FRONT SIDE OF R489**.
- (6) Connect X10 probe from **CH 1** to front side of R489 (TP800) (located at rear of A1 main board near readout connector).
- (7) Adjust D **REF OR DLY POS** control to center signal on displayed cursor, and adjust D control to join traces.
- (8) Press and release upper **TRIGGER COUPLING** pushbutton. Check display readout indicates **ADJ D** (step) **1**, **100 ms** (for A sweep), **1 ms** (for B sweep), and digital multimeter indicates 0 ±1 mV dc.
- (9) Disconnect X10 probe and connect oscilloscope calibrator output to **CH 1**.
- (10) Position oscilloscope calibrator controls for **MARKERS** and .1 mS output.
- (11) Set **CH 1 VOLTS/DIV** switch and adjust **TRACE SEP** and **CH 1** vertical **POSITION** controls to view main sweep, with time markers on top half of crt and delayed B sweep on bottom half of crt.
- (12) Adjust horizontal **POSITION** control to start main sweep at left vertical graticule line and adjust D **REF OR DLY POS** and D controls to align both intensified dots on 6th time marker on main sweep and superimpose delayed B sweep time markers.

(13) Press and release upper **TRIGGER COUPLING** pushbutton. Digital multimeter will indicate between 398 and 402 mV dc, and display readout will indicate **ADJ D (step) 2, 100 ms, 1 ms.**

(14) Disconnect digital multimeter from TI and adjust **D REF OR DLY POS** control to intensify 2d time marker.

(15) Adjust **D** control to intensify 10th time marker and superimpose delayed B sweep time markers within .2 division.

(16) Press and release upper **TRIGGER COUPLING** pushbutton.

(17) Display readout will indicate **ADJ D, (step) 3, 300 ms, 1 ms.**

(18) Adjust **D REF OR DLY POS** control to intensify 4th time marker and **D** control to intensify 28th time marker and superimpose delayed B sweep markers within 1 division.

(19) Press and release upper **TRIGGER COUPLING** pushbutton.

NOTE

If adjustments are made in (18) above, display readout will indicate **ADJ D (step) 2, 200 ms, 1 ms.** Repeat (14) through (19) above until no adjustments are made in (18) above.

(20) If no adjustments were made in (18) above, display readout will indicate **ADJ D, (step) 4, 100 ms, 1 ms.**

(21) Position oscilloscope calibrator controls for 5 μ S output.

(22) Adjust **D** control ccw until no further movement of B sweep display occurs. Note position of first time marker of B sweep.

(23) Adjust **D** control cw until 2d time marker of B sweep moves left and aligns with position noted in (22) above.

NOTE

Movement of **D REF OR DLY POS** control at this point will adversely affect calibration.

(24) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **XI, X10, HRZ CTR, (step) 5, 10 ms** and two vertical cursors appear on the display.

(25) Position oscilloscope calibrator controls for 10 μ S output.

(26) If cursors are not aligned with 2d and 10th vertical graticule lines, adjust **X1 GAIN R860** (fig. 1), and **HRZ CTR R801** (fig. 1) to align the two cursors with 2d and 10th vertical graticule line (R).

(27) If TI does not display 1 time marker per division \pm 1 minor division, adjust **X10 GAIN R850** (fig. 1) for 1 marker per division (R).

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(28) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D**, (step) **6, 10 ms, 100 ms**.

(29) Position oscilloscope calibrator controls for 10 mS output and adjust D **REF OR DLY POS** control to intensify 2d time marker and D control to intensify 10th time marker, and superimpose delayed sweep time markers within .2 division.

(30) Press and release upper **TRIGGER COUPLING** pushbutton, and position oscilloscope calibrator controls for 1 μS output.

(31) For each step in table 21 do the following:

(a) Adjust D **REF OR DLY POS** and D controls as necessary, to intensify indicated time markers on the A sweep and superimpose displayed B sweep time markers within listed limits.

(b) Press and release upper **TRIGGER COUPLING** pushbutton.

Table 21. Timing (CAL 01, steps 7 through 15)

Test instrument			Calibration generator output settings	Test instrument superimposed displayed B sweep ±division
CAL 01 displayed step number	DREF time marker	D time marker		
7	2	10	1 μS	0.2
8	2	10	2 μS	0.2
9 ¹	4	28	2 μS	1.2
10	2	10	10 μS	0.2
11	2	10	50 μS	0.2
12 ¹	4	28	50 μS	1.2
13	2	10	.5 μS	0.2
14 ¹	4	28	.5 μS	1.2
15	3	19	50 nS	0.2

¹If D control is adjusted, the previous step will be repeated.

(32) After completion of step 15 of table 21, TI display will indicate **ADJ D**, (step) **16, 20 ns, 500 ps**.

(33) Position oscilloscope calibrator controls for 20 nS output.

(34) Adjust D control for approximately 1 time marker per division. Position oscilloscope calibrator controls for 2 nS output.

(35) Set **VOLTS/DIV** switch for a display amplitude of >3 division. Adjust D control to superimpose displayed B sweep time markers.

(36) Press and release upper **TRIGGER COUPLING** pushbutton and display readout will indicate **ADJ D**, (step) **17, 1 ms**.

(37) Return **VOLTS/DIV** switch to original setting.

(38) Adjust **TRACE SEP** control fully cw.

(39) Connect oscilloscope calibrator output to TI **CH 1** and oscilloscope **CH 1**.

(40) Connect TI **B GATE OUT** to oscilloscope **CH 2**.

(41) Set oscilloscope controls as listed in (a) through (c) below.

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- (a) **CH 1** and **CH 2** input coupling to **50W DC** and **CH 1** on.
- (b) **TRIGGER SOURCE** to **CH 2** and **TRIGGER SLOPE** to + (plus).
- (c) **A SWP SEC/DIV** switch to **20 ns**.

(42) Position oscilloscope calibrator controls for 1 μ S output.

(43) Adjust TI D control for 8 time markers over center 8 major divisions of TI display. Adjust TI Δ **REF OR DLY POS** control to bring time markers onto oscilloscope display.

NOTE

It may be necessary to adjust oscilloscope **HOLDOFF** control to view both time markers.

(44) Adjust TI D control to superimpose time markers on oscilloscope within 0.2 division.

(45) Press and release upper **TRIGGER COUPLING** pushbutton and display readout will indicate **ADJ D**, (step) **18, 3 ms**.

(46) Repeat technique of (42) through (45) for setting listed in table 22. Each time upper **TRIGGER COUPLING** pushbutton is pressed in (45) above the TI display will indicate next step listed in table 22 unless noted.

Table 22. Timing (CAL 01, Steps 18 Through 27)

Test instrument		Calibration generator output settings (μ S)	Oscilloscope	
CAL 01 displayed step number	Time markers over 8 divisions		SEC/DIV settings	Superposition tolerance in divisions
18 ¹	24	1	20 ns	1.2
19	8	2	50 ns	0.2
20 ¹	24	2	50 ns	1.2
21	8	10	200 ns	0.1
22	8	0	1 μ s	0.2
23 ¹	24	50	1 μ s	1.2
24	8	.5	10 ns	0.2
25 ¹	24	.5	10 ns	1.2
26	8	.1	2 ns	0.2

¹If adjustments are made, TI will indicate previous step.

(47) After step 26 has been completed TI display will indicate **ADJ D** (step) **27, 20 ns**.

(48) Adjust D control for approximately 1 time marker per division.

(49) Position oscilloscope calibrator controls for 5 nS output.

(50) Adjust D **REF or DLY POS** control to bring time markers on to oscilloscope display.

(51) Adjust D control to superimpose displayed time markers on oscilloscope to within .2 division.

(52) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 28, 500 ps.**

(53) Disconnect oscilloscope calibrator from oscilloscope **CH 1** and connect to **CH 2** of TI.

(54) Position oscilloscope calibrator controls for 2 nS output.

(55) Adjust TRANS RESP (R802) for 2 cycles between 2d and 10th graticule lines at intersections of the two waveforms (R).

(56) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 29, 1 ms.**

(57) Move connection from TI **CH 2** to oscilloscope **CH 1** and set oscilloscope **SEC/DIV** switch to **20 ms.**

(58) Position oscilloscope calibrator controls for 1 mS output and adjust D control for 8 time markers over the center 8 divisions of display.

(59) Adjust D **REF OR DLY POS** control as necessary to bring time markers on to oscilloscope display and D control to superimpose time markers to within .2 division.

(60) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 30, 5 ns.**

(61) Remove connection from oscilloscope **CH 1.**

(62) Position oscilloscope calibrator controls for 5 nS output.

(63) Set **VOLTS/DIV** switch for >3 divisions of amplitude.

(64) Adjust D control for 1 time marker per division over center 8 divisions.

(65) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 31, 10 ns.**

(66) Position oscilloscope calibrator controls for 10 nS output.

(67) Set **VOLTS/DIV** switch for >3 divisions of amplitude.

(68) Adjust D control for 1 time marker per division over center 8 divisions.

(69) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 32, 10 ns.**

NOTE

CAL 01 steps **32, 33,** and **34** are for instruments with serial numbers B012946 and above.

(70) Position oscilloscope calibrator controls for 10 nS output.

(71) Set **VOLTS/DIV** switch for >3 divisions of amplitude.

(72) Adjust D control for 1 time marker per division over center 8 divisions.

(73) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 33, 1 ns.**

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- (74) Position oscilloscope calibrator controls for 2 nS output.
- (75) Set **VOLTS/DIV** switch for 1 to 4 divisions of amplitude.
- (76) Adjust D control for 1 time marker per 2 divisions over center 8 divisions.
- (77) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **ADJ D (step) 34, 1 ns**.
- (78) Position oscilloscope calibrator controls for 2 nS output.
- (79) Set **VOLTS/DIV** switch for 1 to 4 divisions of amplitude.
- (80) Adjust D control for 1 time marker per 2 divisions over center 8 divisions.
- (81) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **DIAGNOSTIC PUSH A/B TRIG TO EXIT**.

20. CAL 02 -Vertical

a. Performance Check

- (1) Press upper **TRIGGER MODE** pushbutton to **CAL 02** (bottom left of display).
- (2) Press and release upper **TRIGGER COUPLING** pushbutton. TI will step from 100 to 111 and display will indicate **DC BALANCE IN PROGRESS**.
- (3) Display readout will indicate **CH 1 VAR, CH 2 POS, (step) 111, 500 mV**.
- (4) Connect oscilloscope calibrator output to **CH 1** and position controls for **AMPL MODE VOLT** and a .5 V, 1 kHz output.
- (5) Adjust **CH 2 POSITION** control to position sweep within 1 division of center horizontal graticule line.
- (6) Adjust **CH 1 POSITION** and **VOLTS/DIV VAR** controls for 10 divisions of horizontal deflection.

NOTE

When step 111 is performed, step 112 is also automatically performed. No indication of step 112 will be shown unless a **LIMIT** error is encountered.

- (7) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate (step) **113, 500 mV, BWL**.

NOTE

In the following steps, if the **LIMIT** message appears, it probably indicates that the upper **TRIGGER COUPLING** pushbutton was pressed before the required signal was applied. Press and release the lower **TRIGGER COUPLING** pushbutton, verify that the correct signal is applied, and then press and release the upper **TRIGGER COUPLING** pushbutton.

(8) Press and release upper **TRIGGER COUPLING** pushbutton for TI step numbers and oscilloscope calibrator output settings as listed in table 23.

Table 23. Vertical Attenuator Check

Test instrument CAL 02 step numbers	Oscilloscope calibrator output settings
113, 114 ¹	.5 V
115	.2 V
116	.1 V
117	50 mV
118	20 mV
119	1 V
120	10 V

¹When step 113 is performed, step 114 is also automatically done. No indication of step 114 will be shown unless a **LIMIT** error is encountered.

(9) Move connection from **CH 1** to **CH 2**. Display readout indicates **CONNECT SIGNAL TO CH 2**, (step) **121, 500 mV, 500 mV** and **BWL**.

NOTE

When (step) 121 is performed, (step) 122 is also automatically performed. No indication of (step) 122 will be shown unless a **LIMIT** error is encountered.

(10) Position oscilloscope calibrator controls for a .5 V 1 kHz output.

(11) Press and release upper **TRIGGER COUPLING** switch. Display readout will indicate (step) **123, 500 mV, 500 mV**, and **BWL**.

(12) Press and release upper **TRIGGER COUPLING** pushbutton for TI step numbers and oscilloscope calibrator output settings listed in table 24.

Table 24. Vertical Attenuator

Test instrument CAL 02 step numbers	Oscilloscope calibrator output settings
1123, 124 ¹	.5 V
125	.2 V
126	.1 V
127	50 mV
128	20 mV
129	1 V
130 ²	10 V

¹When (step) 123 is performed, (step) 124 is also automatically done. No indication of step 124 will be shown unless a **LIMIT** error is encountered.

²When (step) 130 is performed, (step) 131 is automatically done. No indication of (step) 131 will be shown unless a **LIMIT** error is encountered.

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(13) Press and release upper **TRIGGER COUPLING** pushbutton. TI will automatically step from 130 to 142. Display readout will indicate **CONNECT SIGNAL TO CH 1**, (step) **142, 50 mV**, and **BWL**.

(14) Move connection from **CH 2** to **CH 1**.

(15) Position oscilloscope calibrator controls for a 50 mV output.

(16) Press and release upper **TRIGGER COUPLING** pushbutton. Wait approximately 10 seconds for automatic calibration of ΔV cursors. Display readout will indicate **VERT CENTER GAIN**. Adjust GAIN R638 (fig. 1) for 5 divisions between horizontal cursors (R).

(17) Adjust VERTICAL CENTERING R639 (fig. 1) to align cursors with 0 percent and 100 percent graticule lines (R).

(18) Press and release upper **TRIGGER COUPLING** pushbutton. Self calibration will continue **15** to **45** seconds. Display will indicate **DIAGNSTIC.PUSH A/B TRIG TO EXIT**.

21. CAL 03 - Triggering

a. Performance Check

(1) Press upper **TRIGGER MODE** pushbutton to **CAL 03** (bottom left of display).

(2) Press and release upper **TRIGGER COUPLING** pushbutton.

(3) TI will automatically step from 200 to 214 and stop at 215. Display indicates **CH 1, 500 mV, (step) 215**.

(4) Connect oscilloscope calibrator output to **CH 1**.

(5) Position oscilloscope calibrator controls for **AMPL MODE VOLT** and a .5 V, 1 kHz output.

(6) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **CH 1, 500 mV, (step) 216**.

(7) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **CH 2, 500 mV, (step) 217**.

(8) Move connection from **CH 1** to **CH 2** and repeat (5) above.

(9) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **CH 3, 500 mV, (step) 218**.

(10) Move connection from **CH 2** to **CH 3** and repeat (5) above.

(11) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **CH 3, 2V, (step) 219**.

(12) Position oscilloscope calibrator controls for a 2 V output.

(13) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **CH 4, 500 mV, (step) 220**.

- (14) Move connection from **CH 3** to **CH 4**.
- (15) Position oscilloscope calibrator controls for a .5 V output.
- (16) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **CH 4, 2 V**, (step) **221**.
- (17) Position oscilloscope calibrator controls for a 2 V output.
- (18) Press and release upper **TRIGGER COUPLING** pushbutton. Display will indicate **DIAGNOSTIC. PUSH A/B TRIG TO EXIT**.

22. CAL 06 - Vertical Transient Response

a. Performance Check

- (1) Press upper **TRIGGER MODE** pushbutton to **CAL 06** (bottom left of display).
- (2) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D** (step) **1, 10 mV, 100 ns**.
- (3) Connect oscilloscope calibrator output to **CH 1** using pulse head and 10X and 2X attenuator.
- (4) Position oscilloscope calibrator controls for **AMPL MODE FAST EDGE, FREQ 100 kHz, VARIABLE ON**.

NOTE

INTENSITY and **POSITION** controls may be adjusted as necessary to view waveform in the following steps.

- (5) Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (6) Press and release upper **TRIGGER COUPLING** pushbutton twice.
- (7) Display readout will indicate **ADJD** (step) **3, 10 mV, 10 ns**.
- (8) Adjust C403, R411, HF ADJUST (R417), L403, (fig. 1) and D control for flattest corner over first 5 ns (R).
- (9) Adjust **SEC/DIV VAR** control fully ccw and adjust CRT TERMINATION R1501 (fig. 2) for flattest waveform over first 0.2 division (R). Return **SEC/DIV VAR** control fully cw to detent. Total system will tune up best if indicator cursor is in the 7th or 8th divisions.
- (10) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D** (step) **4, 10 mV, 100 ns**.

NOTE

Pressing the lower **TRIGGER COUPLING** pushbutton at any step of **CAL 06** will return to step 1, then pressing the upper **TRIGGER COUPLING** pushbutton repeatedly, the routine can be advanced to the desired step. This is useful for **CAL** steps **1, 2, 3**, and **4** where some compromise of adjustments may be necessary.

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- (11) Move connection from **CH 1** to **CH 2**.
- (12) Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (13) Adjust **D** control for flattest waveform.
- (14) Press and release lower **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 1, 10 mV, 100 ns**.
- (15) Move connection from **CH 2** to **CH 1**. Position oscilloscope calibrator controls for a 5 division display.
- (16) Adjust R605, R403, C404, C601 (fig. 1) and CRT TERMINATION R1501 (fig. 2) for flattest response in first 100 ns (R).
- (17) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 2, 10 mV, 100 ns**.
- (18) Move connection from **CH 1** to **CH 2**. Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (19) Check for necessary compromise of adjustments made in 16 above.
- (20) Press and release lower **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 1, 10 mV, 100 ns**.
- (21) Remove connection from **CH 2** and connect leveled sine wave generator leveling head to **CH I** using a 50 Ω feedthrough terminator.
- (22) Position leveled sine wave generator controls for 2 MHz, and a 6 division display.
- (23) Adjust leveled sine wave generator frequency controls for 250 MHz.
- (24) Increase leveled sine wave generator frequency from 250 MHz to 420 MHz. Displayed amplitude will be between 4.4 and 6 divisions.
- (25) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 2, 10 mV, 100 ns**.
- (26) Move connection from **CH 1** to **CH 2**.
- (27) Repeat (22) through (24) above for **CH 2**.
- (28) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 3, 10 mV, 10 ns**.
- (29) Connect oscilloscope calibrator output to **CH 1** using pulse head and 10X and 2X attenuators.
- (30) Position oscilloscope calibrator controls for **AMPL MODE FAST EDGE, FREQ 100 kHz, VARIABLE ON**. Adjust **VAR** control for a 5 division display.
- (31) Adjust R411, C403, L403 (fig 1) and **D** control for best response. Note waveform for use in (35) below (R).
- (32) Press and release upper **TRIGGER COUPLING** pushbutton. The crt readout will indicate **ADJ D (step) 4, 10 mV, 100 ns**.

- (33) Move connection from **CH 1** to **CH 2**.
- (34) Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (35) Adjust D control until **CH 2** waveform matches that noted in (31) above.
- (36) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 5, 2 mV, 10 ns**.
- (37) Remove connection from **CH 2** and connect pulse head to **CH 1** using 10X, 5X, and 2X attenuators. Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (38) Adjust D control for a spike on front corner of 4 to 5 percent.
- (39) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 6, 10 mV, 10 ns**.
- (40) Remove 2X attenuator from setup and adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (41) Adjust D control for best front corner.
- (42) Press and release the upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 7, 20 mV, 10 ns**.
- (43) Remove 5X attenuator from setup and adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (44) Adjust D control for best front corner.
- (45) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 8, 50 mV and 10 ns**.
- (46) Replace 10X attenuator in setup with a 5X attenuator and adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (47) Adjust Δ control for a spike on front corner of 4 to 5 percent.
- (48) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 9, 100 mV, 10 ns**.
- (49) Replace 5X attenuator in setup with 2X attenuator and adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (50) Adjust D control for a front corner overshoot of 6 to 7 percent. This is necessary so 10X bandwidth (0.1 to 0.5 V) will be similar to the 10 mV bandwidth.
- (51) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 10, 200 mV, 10 ns**.
- (52) Remove 2X attenuator from setup and adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (53) Adjust D control for best corner.
- (54) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 11, 500 mV, 10 ns**.

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- (55) Adjust oscilloscope calibrator **VAR** control for a 2 division display.
- (56) Adjust D control for best corner.
- (57) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **ADJ D (step) 12, 1 V, 10 ns**.
- (58) Adjust oscilloscope calibrator **VAR** control for a 1 division display.
- (59) Adjust D control for best corner.
- (60) Press and release upper **TRIGGER COUPLING** pushbutton.
- (61) Steps 13 and 14 are automatically calibrated and display readout will indicate **ADJ D (step) 15, 2 mV, 10 ns**.
- (62) Connect oscilloscope calibrator output to **CH 2** using pulse head and X10, X5, and X2 attenuators.
- (63) Adjust oscilloscope calibrator **VAR** control for a 5 division display.
- (64) Repeat (38) through (59) above for **CH 2** (steps 14-21).
- (65) Steps 22 and 23 are automatically calibrated after step 21, and display readout will indicate **VERT CENTER GAIN**.
- (66) Adjust GAIN R638 (fig. 1) and VERTICAL CENTERING (R639) (fig. 1) to align cursors with the dotted 0 percent and 100 percent graticule markings.
- (67) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate **DIAGNOSTIC. PUSH A/B TRIG TO EXIT**.
- (68) Proceed to paragraph **24a(l)**.

23. CAL 09 Parametric Measurements

a. Performance Check

- (1) Press **TRIGGER MODE** pushbutton up to **CAL 09** (bottom left of display).
- (2) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate (step) **1, CAL 09, 100 NS**.
- (3) Connect oscilloscope calibrator output to **CH 1** input through a 50 Ω termination.
- (4) Adjust oscilloscope calibrator controls for **TIMING MODE, MARKERS** and .1 μ S output.
- (5) Press and release upper **TRIGGER COUPLING** pushbutton. Display readout will indicate (step) **2, CAL 09, 100 NS**.
- (6) Repeat the technique of (4) and (5) above for each step listed in table 25, setting oscilloscope calibrator for corresponding outputs.

Table 25. CAL 09 Period

Test instrument CAL 09 step numbers	Oscilloscope calibrator output settings
2	.1 μ S
3	.2 μ S
4	.5 μ S
5	1 μ S
6	2 μ S
7	5 μ S
8	10 μ S
9	20 μ S
10	50 μ S
11	.1 mS
12	.2 mS
13	.5 mS
14	1 mS
15	2 mS
16	5 mS
17	.2 mS

(7) TI will automatically step from step 18 through 28, and display readout will indicate **DIAGNSTIC.PUSH A/B TRIG TO EXIT.**

24. Final Procedure

- a.** Press **A/B TRIG** pushbutton to exit, press **POWER** pushbutton to **OFF**, and move **CAL NO/CAL** jumper to **NO CAL** position and replace protective cover.
- b.** Repeat paragraphs **7** through **14**.

THESE ARE THE INSTRUCTIONS FOR SENDING 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: "Whoever" whomever@avma27.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:** TB 9-6625-xxxx-35
9. **Pub Title:** Calibration Procedure for ...
10. **Publication Date:**
11. **Change Number:**
12. **Submitted 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:**

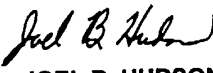
This is the text for the problem below line 27.

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By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

OFFICIAL:


JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
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To be distributed in accordance with IDN 344490, requirements for calibration procedure TB 9-6625-2295-35.

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