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CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITIZER TEKTRONIX, TYPE 7D20

Headquarters, Department of the Army, Washington, DC
8 April 2008

Distribution Statement A: Approved for public release; distribution is unlimited.

TB 9-6625-2164-24, 5 February 2008, is changed as follows:

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JOYCE E. MORROW

*Administrative Assistant to the
Secretary of the Army*

0803813

GEORGE W. CASEY, JR.
*General, United States Army
Chief of Staff*

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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, 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 send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: <https://amcom2028.redstone.army.mil>. Instructions for sending an electronic 2028 can be found at the back of this manual.

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*This bulletin supersedes TB 9-6625-2164-35, dated 22 March 2005.

**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digitizer, Tektronix, Type 7D20. 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. None.

b. Time and Technique. The time required for this calibration is approximately 5 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. 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			
Vertical gain	Range: 5 mV/division to 5 V/division in 1, 2, 5 sequence Accuracy: Within 2% with AQR GAIN adjusted at 10 mV/division			
Vertical linearity	0.12 division or less expansion or compression of a center screen 2 division signal parameters positioned anywhere within the ±4 division graticule area			
Bandwidth	Dc to 70 MHz			
Trigger sensitivity:	Triggering frequency range	Maximum vertical signal required		
		Internal	External	Ext +1 0
Ac coupled	30 Hz to 30 MHz	0.4 division	60 mV	0.6 V
	30 to 70 MHz	1.0 division	150 mV	1.5 V
Ac LF REJ	50 kHz to 30 MHz	0.4 division	60 mV	0.6 V
	30 to 70 MHz	1.0 division	150 mV	1.5 V
Ac HF REJ	30 Hz to 30 kHz	0.4 division	60 mV	0.6 V
Dc HF REJ	Dc to 30 kHz	0.4 division	60 mV	0.6 V
Dc	Dc to 30 MHz	0.4 division	60 mV	0.6 V
	30 to 70 MHz	1.0 division	150 mV	1.5 V
Max signal	---	+6 division	+1.0 V	+10 V
P-P	30 to 200 Hz	2.0 division	300 mV	3.0 V
	200 Hz to 30 MHz	0.6 division	90 mV	0.9 V
	30 to 70 MHz	1.2 division	200 mV	2.0 V
Stored timing Cursor No. 1	Range: 1 μs to 5 s/division ¹ Accuracy: ±0.1% of reading +0, -1 sample interval ±300 ps			
Resolution Vertical	Accuracy: Nominally 0.04 division			

¹Not verified at 5 s.

**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. Where the four-to-one ratio cannot be met the actual accuracy of the equipment selected is shown in parenthesis.

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. The following peculiar accessory is also required for this calibration: Tektronix, Any Type 7000 series mainframe except 7104 (supplied by user).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
FUNCTION/ARBITRARY GENERATOR	Sine Wave Frequency: Range: 10 Hz to 70 MHz Amplitude: 0 to 4 V Accuracy: ±3%	Agilent, Model 33250A (33250A)
MULTIMETER	Dc voltage: Range: -1.28 V dc to 10 mV dc Accuracy: 0.32% + 3 LSD	Fluke, Model 8840A/AF05 (AN/GSM-64D)
OSCILLOSCOPE CALIBRATOR	Volts out: Range: 20 mV to 20 V/division Accuracy: ±0.5% Time markers: Range: 1 μs to 5 s/division Accuracy: ±0.025%	Fluke, Model 5820A-5C-GHZ (5820A-5C-GHZ)

**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. 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 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

The oscilloscope mainframe should be calibrated prior to performing this procedure.

- a. Install TI into oscilloscope mainframe using Tektronix, Type 7000 series plug-in flexible extenders. Connect oscilloscope mainframe to a 115 V ac source. Set **POWER** switch to **ON** and allow at least 20 minutes for equipment warm-up.
- b. Position oscilloscope controls as listed in (1) through (3) below:
 - (1) Press **VERT MODE/LEFT** pushbutton.
 - (2) Press **TRIG SOURCE/VERT MODE** pushbutton.
 - (3) Adjust **INTENSITY**, **FOCUS**, **READOUT** and **GRAT ILLUM** control as desired.
- c. Position TI controls as listed in (1) through (3) below:
 - (1) **HORIZ POSITION** fully cw (in detent).
 - (2) **CH 1** and **CH 2 VARIABLE/CAL** controls fully cw (in detent).
 - (3) **CH 1** and **CH 2 POSITION** controls to midrange.

NOTE

All terms that pertain to display will be displayed on the oscilloscope mainframe crt part of TI.

- d. Press **MENU/TEST** pushbutton and check that pushbutton lights. If **MASTER MENU** is not displayed, press **MEMORY DISPLAY** pushbutton **6**.
- e. When **MASTER MENU** is displayed, select **DISPLAY ADJ PATTERN** by pressing **MEMORY DISPLAY** pushbutton **3**.
- f. While observing the adjustment pattern on the TI display, adjust **VERT GAIN**, **VERT CTR**, **HORIZ GAIN**, and **HORIZ CTR** adjustments to place the corner markers of the displayed pattern on the center 6 X 8 divisions of graticule, as shown in figure 1.

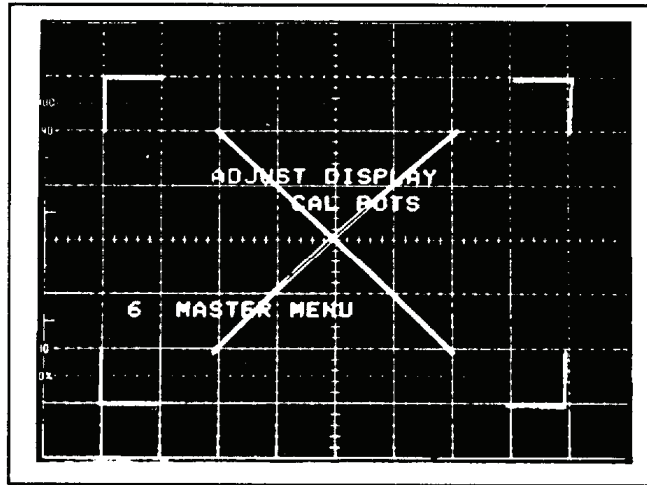


Figure 1. Display adjustment pattern.

- g. Adjust **VECT LIN** for minimum trace separation of the diagonal lines on the display pattern as shown in figure 1.
- h. Press **MEMORY DISPLAY/6** and **MENU/TEST** pushbuttons. **MASTER MENU** will clear display.
- i. Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- j. Press **TRIGGERING/MODE AUTO** pushbutton.
- k. Press **TRIGGERING/COUPLING AC** pushbutton.
- l. Press **TRIGGERING/SOURCE EXT÷** pushbutton.
- m. Connect multimeter positive lead to TP810 and negative lead to TP902 (ground) (fig. 2).
- n. Adjust **AC ZERO R241** (fig. 3) for 0 V dc ± 2 mV indication on multimeter.
- o. Press **TRIGGERING/COUPLING DC** pushbutton.
- p. Adjust **DC BALANCE R240** (fig. 3) for 0 V dc ± 2 mV indication on multimeter.
- q. Press **AQR MODE/BOTH** pushbutton and position **CH 1** and **CH 2 POSITION** controls to the center graticule line.
- r. Connect shorting cable between TP1220 and TP520 TP GND (fig. 4).
- s. Connect multimeter negative lead to TP902 (fig. 2) and positive lead to J400 (fig. 4) and adjust **CH 1 TRIGGER OFFSET R518**, (fig. 4) for 0 V ± 2 mV dc on multimeter.
- t. Remove shorting cable from TP1220 (fig. 4) and connect to TP 1230 and TP 520 TP GND (fig. 4).
- u. Connect multimeter negative lead to TP902 (fig. 2) and positive lead to J550 (fig. 4) and adjust **CH 2 TRIGGER OFFSET R445** (fig. 4) for 0 V ± 2 mV dc indication on multimeter.

- v. Remove all connections from TI.
- w. Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- x. Set **CH 1 VOLTS/DIV** switch to **100 mV**.

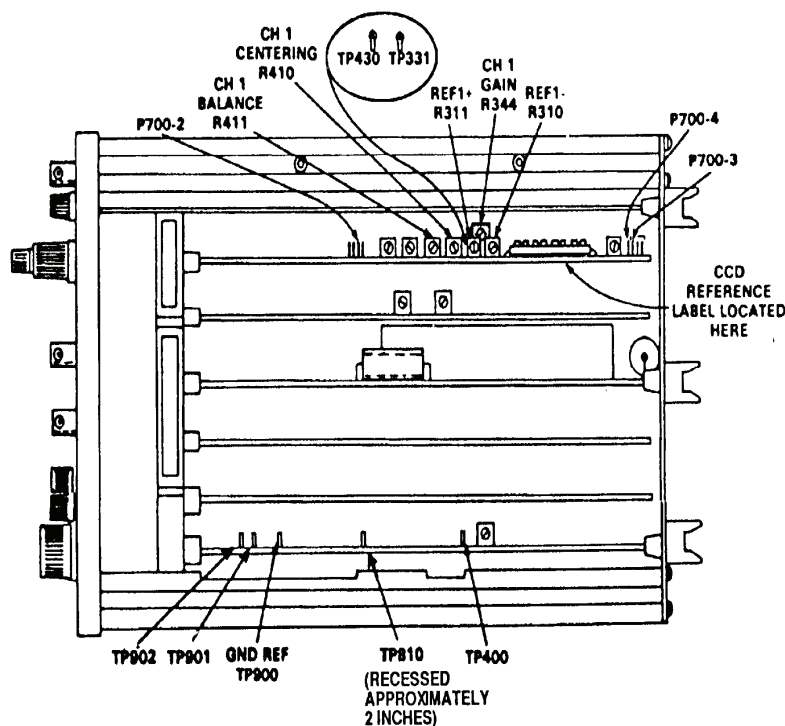


Figure 2. Tektronix, Type 7D20 top view - adjustment locations.

- y. Press **CH 1 DC** pushbutton.
- z. Set **TIME/DIV** switch to **20 μ s**.
- aa. Press **TRIGGERING/MODE AUTO** pushbutton.
- ab. Press **TRIGGERING/COUPLING AC** and **HF REJ** pushbutton.
- ac. Connect function/arbitrary generator **Output** to **CH 1** input, using **50 Ω** termination, and set for **Sine** operation.
- ad. Set function/arbitrary generator output frequency to **30 kHz** and amplitude for **7** divisions on TI display.
- ae. Set **CH 1 VOLTS/DIV** switch to **2V**.
- af. Adjust **TRIGGERING/LEVEL** control for a stable trigger. If trigger cannot be obtained, adjust **HYSTERESIS R444** (fig. 3) so a stable trigger can be obtained.

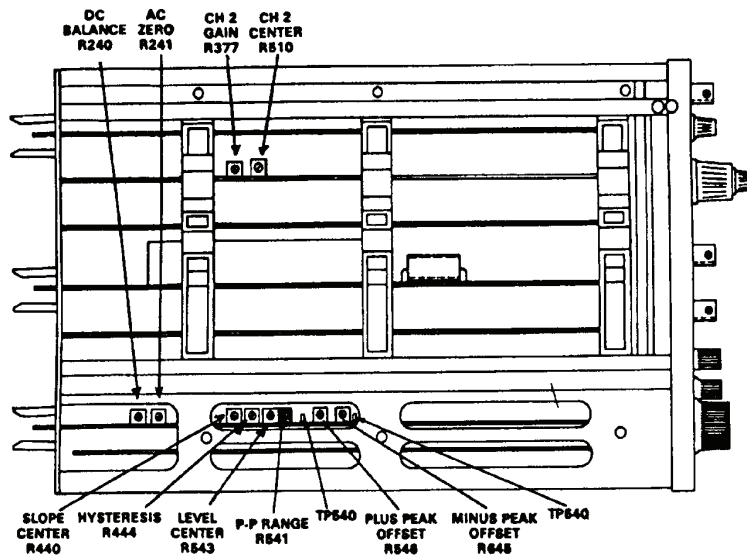


Figure 3. Tektronix, Type 7D20 bottom view - adjustment locations.

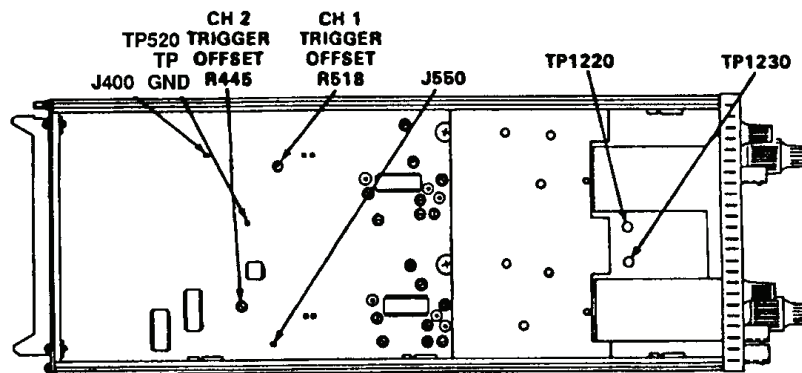


Figure 4. Tektronix, Type 7D20 left side view - adjustment locations.

ag. Set **CH 1 VOLTS/DIV** switch to **5 V**. **SIGNAL** display should not be triggered using the **TRIGGER LEVEL** control. If so, adjust **HYSTERESIS R444** (fig. 3) for a stable trigger at **CH 1, 2 V VOLTS/DIV** and no stable trigger at **CH 1, 5 V VOLTS/DIV**.

ah. Press **TRIGGERING/COUPLING AC** pushbutton.

ai. Set **CH 1 VOLTS/DIV** switch to **500 mV**.

aj. Set **TIME/DIV** switch to **1 ms**.

ak. Set function/arbitrary generator output frequency to **1 kHz** and amplitude for **6** divisions on **TI** display.

al. Adjust **TRIGGERING LEVEL** control for a stable display at **1 kHz**.

am. Observe **T=()** on display and set **CURSORS** $\leftarrow 1 \Rightarrow$ for **T=0.0S**.

an. Observe that the cursor does not move more than ± 0.04 divisions vertically while switching between the \pm **SLOPE** (- **SLOPE** is obtained when + **SLOPE** pushbutton is not lighted).

ao. If the cursor dot ± 0.04 divisions cannot be obtained in an above, adjust **SLOPE CENTER R440** (fig. 3) so that while switching between + and - **SLOPE** cursor dot does not move vertically more than ± 0.04 divisions.

ap. Press **CH 1 GND** pushbutton.

aq. Connect multimeter to TP400 (fig. 2) and GND REF TP900 (fig. 2) and adjust **TRIGGERING LEVEL** control for -1.28 V, ± 10 mV indication on multimeter .

NOTE

Do not move **TRIGGERING LEVEL** control throughout the following steps.

ar. Set **CH 1 VOLTS/DIV** switch to **1V** and press **AC** pushbutton.

as. Set function/arbitrary generator output frequency to 1 kHz and amplitude for 2 divisions on TI display.

at. Adjust **CH 1 POSITION** control to vertically center two divisions of applied signal.

au. TI display **CURSORS** dot indication will be within 0.08 division of center graticule line; if not, adjust **LEVEL CENTER R543** (fig. 3) so trigger point (**CURSOR 1** dot) is within 0.08 divisions of center graticule line.

av. Remove multimeter connections from TI.

aw. Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.

ax. Set **CH 1 VOLTS/DIV** switch to **500 MV**.

ay. Set function/arbitrary generator output frequency to 1 kHz and amplitude for 6 divisions on TI display.

az. Press **TRIGGERING/MODE P/P** pushbutton.

ba. Adjust **TRIGGERING LEVEL** control fully cw.

bb. Adjust **CURSORS** $\Leftarrow 1 \Rightarrow T=0.0S$. Triggering point (**CURSOR** dot) will indicate between 0.8 and 1.2 divisions below sine wave positive peak; if not, adjust **P-P RANGE R541** (fig. 3) for the (**CURSOR** dot) position to fall between 0.8 and 1.2 divisions below sine wave positive peak.

bc. Adjust **TRIGGERING LEVEL** control fully ccw, and press - **SLOPE** (+**SLOPE** pushbutton not lighted).

bd. Triggering point (**CURSOR** dot) will indicate between 0.8 and 1.2 divisions above sine wave negative peak; if not, adjust **P-P RANGE R541** (fig. 3) for best compromise to meet requirement of **bb** through **bd** above.

be. Press **TRIGGERING/MODE AUTO** and **TRIGGERING/+SLOPE** pushbuttons.

- bf.** Connect multimeter between TP400 and GND REF TP900 (fig. 2).
- bg.** Adjust **TRIGGERING LEVEL** control for -1.28 V, ± 10 mV indication on multimeter.
- bh.** Set **CH 1 VOLTS/DIV** switch to **1 V**, and set function/arbitrary generator output frequency to 1 kHz and amplitude for 0.4 divisions on TI display.
- bi.** The 1 kHz sine wave will remain triggered while switching between **AUTO + SLOPE** and **AUTO - SLOPE** without readjusting **TRIGGER LEVEL** control; if not, repeat steps **w** through **au** above.
- bj.** While switching between the **P-P + SLOPE** and **P-P - SLOPE**, observe that the 1 kHz remains triggered without adjusting the **TRIGGER LEVEL**.

NOTE

If the requirements of **bi** and **bj** above are met, ignore the remainder of this step (**bk** through **bs**) below.

- bk.** Press **CH 1 GND** pushbutton.
- bl.** Press **TRIGGERING MODE/AUTO, COUPLING/AC** and **+ SLOPE** pushbuttons.
- bm.** Connect multimeter between TP400 and GND REF TP900 (fig. 2).
- bn.** Adjust **TRIGGERING LEVEL** control for -1.28 V, ± 10 mV indication on multimeter .
- bo.** Move the positive lead of multimeter to TP540 and adjust **PLUS PEAK OFFSET R546** (fig. 3) for + 10.0 mV indication on multimeter.
- bp.** Move the positive lead of multimeter to TP640 and adjust **MINUS PEAK OFFSET R645** (fig. 3) for -10.0 mV indication on multimeter.
- bq.** Press **CH 1 AC** pushbutton.
- br.** Repeat **bj** above. If this requirement cannot be met, perform the following procedure. Observe the direction of trigger point movement when switching from **AUTO +SLOPE** to **P-P +SLOPE**. If triggering point moves up, subtract 10 mV from multimeter reading in **bo** above and add 10 mV to multimeter reading in **bp** above. If triggering point moves down, add 10 mV to multimeter reading in **bo** above and subtract 10 mV from multimeter reading in **bp** above.
- bs.** Repeat **aw** through **bj** above.
- bt.** Remove all connections from TI.
- bu.** Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- bv.** Press **CH 1 GND** pushbutton.
- bw.** Adjust **TRIGGERING/LEVEL** control to **0**.

NOTE

Do not disturb the settings of the **TRIGGERING LEVEL** control throughout the remainder of this step.

- bx.** Press **f** (function) and **MENU/TEST** pushbutton.
- by.** Select **CALIBRATION MENU** by pressing **MEMORY DISPLAY** pushbutton **2**. **CALIBRATION MENU** will be displayed on TI.
- bz.** Select **FAST RAMP GAIN/COUNT** by pressing **MEMORY DISPLAY** pushbutton **1**.
- ca.** The **FAST RAMP TEST/ * SERVICE ONLY *** and **GAIN COUNT** will be displayed (flashing) on TI. TI display **GAIN** will indicate between 99.7 and 100.3; if not, adjust **RAMP GAIN R320** (fig. 5) for **GAIN** indication of **100.0**.
- cb.** Press **MEMORY DISPLAY 6**, **f** (function) and **MENU/TEST** pushbuttons.
- cc.** Set **CH 1 VOLTS/DIV** switch to **50 mV** and press **AC** pushbutton.
- cd.** Set **TIME/DIV** switch to **2 μ s**.
- ce.** Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to **CH 1** input using **50 Ω** termination.

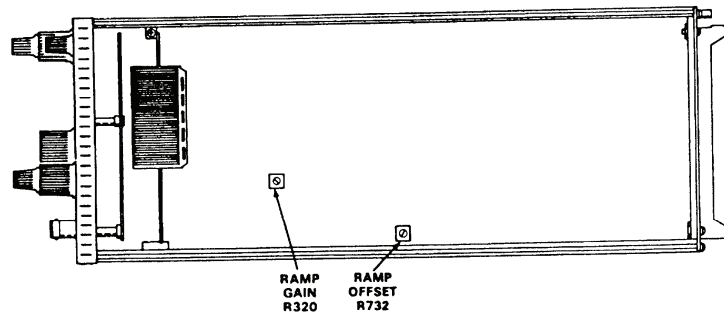


Figure 5. Tektronix, Type 7D20 right side view - adjustment locations.

- cf.** Press oscilloscope calibrator **EDGE** key and then press **FAST EDGE** soft-key for a **FAST EDGE** output and set for **250 kHz** frequency.
- cg.** Adjust TI controls for a display of **5 divisions** centered vertically.
- ch.** Set **TIME/DIV** switch to **50 ns**.
- ci.** Press pushbuttons **TRIG POS** to read **TPOS 1** on TI display (+ **SLOPE** if signal is not positive).
- cj.** Press **CURSOR \leftarrow 1 \Rightarrow** pushbutton to read **T=0.0S** on TI display.
- ck.** Press **TRIGGERING/MODE AUTO**, **TRIGGERING/COUPLING DC** pushbuttons. TI display **CURSOR** dot indication will be within **2 vertical divisions** of center graticule line; if not, adjust **RAMP OFFSET R732** (fig. 5) so **CURSOR** dot is within **1 vertical division** of center graticule line.

NOTE

Adjustment of **RAMP OFFSET R732** affects the adjustment setting of **RAMP GAIN R320** (fig. 5). Repeat **bu** through **ca** above.

cl. Remove all connections from TI.

8. Vertical Gain

a. Performance Check

- (1) Press **MENU/TEST**, **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- (2) Press **TRIGGERING/COUPLING HF REJ** pushbutton.
- (3) Set **VOLTS/DIV** switch to **10 mV** and **TIME/DIV** to **200 μ s**.
- (4) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to **CH 1**.
- (5) Press oscilloscope calibrator **VOLTAGE** key and set for a frequency of 1 kHz and amplitude for 50 mV.
- (6) Press **f** (function) and **CURSORS Δ ON** pushbutton and position **CURSORS 1** and **2** as shown in figure 6.
- (7) Adjust **CH 1 AQR GAIN** for **CURSOR** readout of $\Delta V=50$ mV.
- (8) Adjust oscilloscope calibrator knob located below the **EDIT FIELD** key for 5 divisions displayed on TI crt. Displayed **err** on oscilloscope calibrator will indicate ± 2 percent and TI ΔV readout will indicate between 49.0 and 51.0 mV.
- (9) Adjust TI settings and oscilloscope calibrator **VOLTAGE** output settings as listed in table 3. At each setting, verify TI ΔV readout is within limits specified and vertical deflection is as specified ± 2 percent.

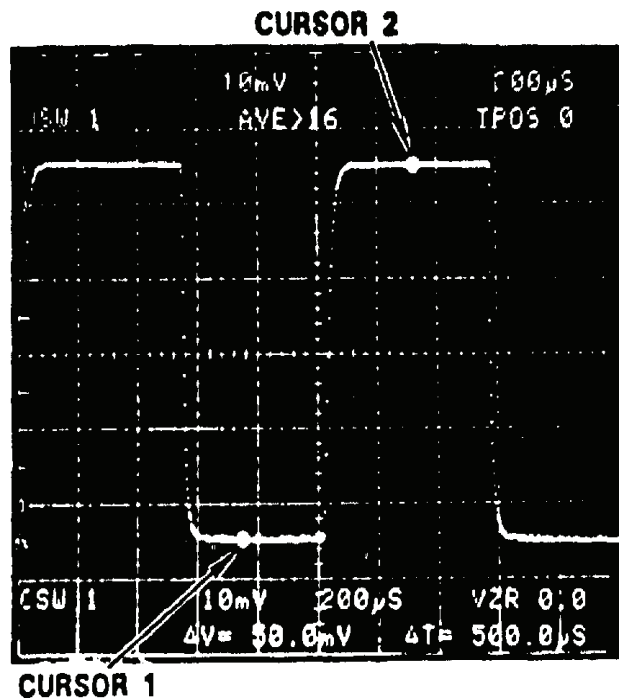


Figure 6. CURSORS 1 and 2 used to measure p-p voltage.

Table 3. Vertical Gain

VOLTS/DIV switch settings	Oscilloscope calibrator output	TI display readout ΔV		TI vertical deflection	Oscilloscope calibrator err display
		Min	Max		
5 mV	20 mV	19.6 mV	20.4 mV	4	$\pm 2\%$
20 mV	0.1 V	98.0 mV	102.0 mV	5	$\pm 2\%$
50 mV	0.2 V	196 mV	204 mV	4	$\pm 2\%$
100 mV	0.5 V	490 mv	510 mV	5	$\pm 2\%$
200 mV	1.0 V	0.98 V	1.02 V	5	$\pm 2\%$
500 mV	2.0 V	1.96 V	2.04 V	4	$\pm 2\%$
1 V	5.0 V	4.90 V	5.10 V	5	$\pm 2\%$
2 V	10 V	9.80 V	10.20 V	5	$\pm 2/o$
5 V ¹	20 V	19.60 V	20.40 V	4	$\pm 2\%$

¹Do not change settings after this step.

(10) Adjust **CH 1 VARIABLE VOLTS/ DIV** control fully ccw. TI display waveform will not exceed 1.6 divisions in amplitude. TI display ΔV readout will be less than 8.0 V and > sign will appear on TI display.

(11) Adjust **CH 1 VARIABLE VOLTS DIV** control fully cw.

(12) Press **AQR MODE CH 2→2** pushbutton and repeat (3) through (10) above for **CH 2**.

(13) Remove all connections from TI.

b. Adjustments. No adjustments can be made.

9. Vertical Linearity

a. Performance Check

- (1) Press **MENU/TEST**, **MEMOR DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- (2) Press **f** (function) and **CURSOR Δ ON** pushbuttons.
- (3) Set **CH 1 VOLTS/DIV** switch to **20 mV**.
- (4) Set **TIME/DIV** switch to **200 μ s**.
- (5) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output TI **CH 1** input and set oscilloscope calibrator frequency for 1 kHz and output amplitude to 50 mV.
- (6) Adjust **CURSORS 1** and **2** as shown in figure 7.
- (7) Press **AVE N** pushbutton.
- (8) Adjust **CH 1 POSITION** control to move 2 division display over the entire graticule area. The **CURSOR** readout display should not vary more than 2.4 mV.
- (9) Press **AQR MODE CH 2→2** pushbutton.
- (10) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to TI **CH 2** input and set **CH 2 VOLTS/DIV** to **20 mV**.
- (11) Adjust **CH 2 POSITION** control to move 2 division display over the entire graticule area. The **CURSOR** readout display indication should not vary more than 2.4 mV.

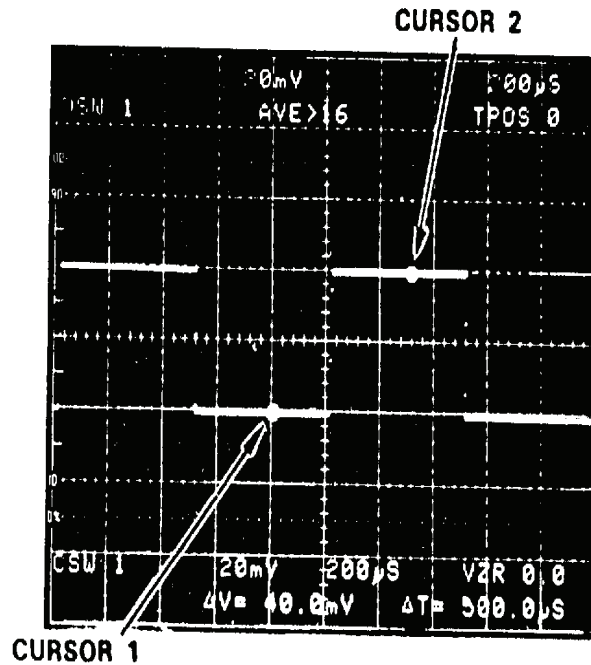


Figure 7. Check vertical linearity.

- (12) Press **CH 1** and **CH 2 GND** pushbuttons.
- (13) Adjust **CH 2 POSITION** control fully cw and then fully ccw. TI **VZR** display indication will be at least 5.0 (cw) and -5.0 (ccw); if not, perform **b** (11) through (20) below.
- (14) Press **AQR MODE CH 1→1** pushbutton.
- (15) Adjust **CH 1 POSITION** control fully cw then fully ccw. TI **VZR** display indication will be at least 5.0 (cw) and -5.0 (ccw); if not, perform **b** (1) through (10) below.

b. Adjustments

- (1) Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- (2) Position controls as listed in (a) through (d) below:
 - (a) Set **CH 1 VOLTS/DIV** switch to **10 mV**.
 - (b) Press **CH 1 GND** pushbutton.
 - (c) Set **TIME/DIV** switch to **500 µs**.
 - (d) Adjust **CH 1 POSITION** control to align trace with the center graticule line.
- (3) Connect a shorting cable between TP1220 and TP520 TP GND (fig. 4). TI **VZR** display readout will indicate between -0.2 and +0.2; if not, adjust CH 1 CENTERING R410 (fig. 2) to align trace with center graticule line (R).
- (4) Remove shorting cable from TP1220 and TP520 TP GND (fig. 4).
- (5) Press **CH 1 AC** pushbutton and set **VOLTS/DIV** to **20 mV**.
- (6) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to **CH 1** input and adjust oscilloscope calibrator frequency for 1 kHz and amplitude for 50 mV.

(7) Press **f** (function) and **CURSORS Δ ON** pushbutton and adjust **CURSORS** as shown in figure 8.

(8) Press **AVE N** pushbutton. **CURSORS** readout will indicate between 49.6 and 50.4 mW; if not, adjust CH 1 GAIN R344 (fig. 2) for $\Delta V=50.0$ mV (R).

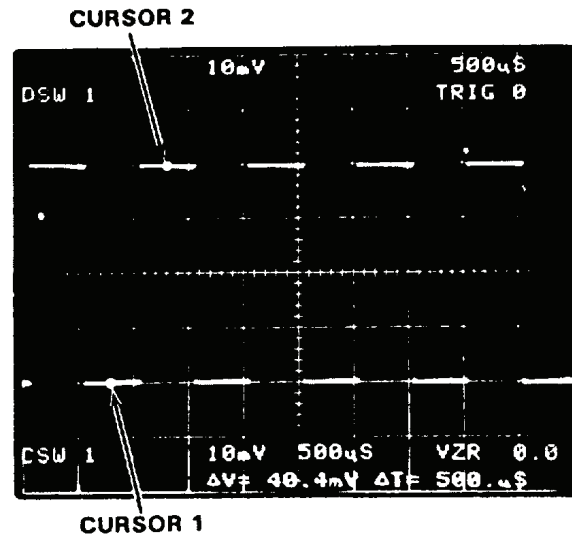


Figure 8. Typical CURSORS Δ display.

(9) Set **CH 1 VOLTS/DIV** switch to **20 mV**, press **AVE N**, and adjust **CH 1 POSITION** to align trace with center graticule lines.

(10) Adjust **CH 1 POSITION** control to move the two division display over the entire graticule area. The **CURSORS** readout will not vary more than 2.4 mV.

(11) Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.

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

- (a) Press **AQR MODE CH 2→2** pushbutton.
- (b) Set **CH 2 VOLTS/DIV** switch to **10 mV**.
- (c) Press **CH 2 GND** pushbutton.
- (d) Set **TIME/DIV** switch to **500 μs**.

(13) Adjust **CH 2 POSITION** control to align trace with the center graticule line.

(14) Connect a shorting cable between TP1230 and TP520 TP GND (fig. 4). **TI VZR** display will indicate between -0.2 and +0.2; if not, adjust CH 2 CENTER R510 (fig. 3) to align trace with center graticule line (R).

(15) Remove shorting cable from TP1230 and TP520 TP GND (fig. 4).

(16) Press **CH 2 AC** pushbutton and set **VOLTS/DIV** to **20 mV**.

(17) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to **CH 2** input and adjust oscilloscope calibrator frequency for 1 kHz and amplitude for 50 mV.

(18) Press **AVE N** pushbutton. **CURSORS** readout will indicate between 49.6 and 50.4 mW; if not, adjust CH 2 GAIN R377 (fig. 3) for $\Delta V=50.0$ mV (R).

(19) Set **CH 2 VOLTS/DIV** switch to **20 mV**, press **AVE N**, and adjust **CH 2 POSITION** to move display to center of screen.

(20) Adjust **CH 2 POSITION** control to move the two division display over the entire graticule area. The **CURSORS** readout will not vary more than 2.4 mV.

(21) Remove all connections from TI.

10. Bandwidth

a. Performance Check

(1) Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.

(2) Set **CH 1 VOLTS/DIV** switch to **100 mV**.

(3) Set **TIME/DIV** switch to **10 μ s**.

(4) Connect function/arbitrary generator **Output** to **CH 1** input, using 50 Ω termination, and press function/arbitrary generator **Sine** key.

(5) Set function/arbitrary generator frequency for 50 kHz and amplitude for 8 divisions on TI display.

(6) Set leveled sine frequency to 70 MHz.

(7) Set **TIME/DIV** to **50 ns**. TI display will indicate at least 5.7 divisions.

(8) Move connection from TI **CH 1** input to **CH 2** input.

(9) Press **AQR MODE CH 2→2** pushbutton and repeat (2) through (7) above for CH 2.

(10) Set **TIME/DIV** switch to **500 μ s**.

(11) Set function/arbitrary generator frequency for 1 kHz and amplitude for 8 divisions centered on TI display.

(12) Set **TIME/DIV** switch to **50 ms**.

(13) Set function/arbitrary generator frequency to 10 Hz. TI will indicate at least 5.7 divisions.

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

(15) Press **AQR MODE CH 1→1** pushbutton and repeat (10) through (13) above.

(16) Remove all connections from TI.

b. Adjustments. No adjustments can be made.

11. Triggering

a. Performance Check

(1) Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.

(2) Connect function/arbitrary generator **Output** to **CH 1** and **EXT TRIG** inputs, using BNC T and two 50 Ω terminations.

(3) Set function/arbitrary generator frequency for 30 Hz and amplitude for 60 mV.

(4) Press **TRIGGERING/MODE AUTO** pushbutton.

(5) Position **TIME/DIV**, **TRIGGERING/COUPLING/SOURCE** switches, and function/arbitrary generator frequency and amplitude controls for indications listed in table 4. Trigger indication will be stable and TRIG'D lamp will light at each position.

(6) Remove all connections from TI.

Table 4. Triggering Checks

Test instrument			Displayed signal/ external amplitude	Function/arbitrary generator
TRIGGERING pushbutton settings		TIME/DIV switch settings		
COUPLING	SOURCE		CRT display	
AC	CH 1	10 ms	0.4 DIV	30 Hz
AC HF REJ	CH 1	10 ms	0.4 DIV	30 Hz
DC	CH 1	10 ms	0.4 DIV	30 Hz
DC HF REJ	CH 1	10 ms	0.4 DIV	30 Hz
AC HF REJ	CH 1	20 μs	0.4 DIV	30 kHz
DC HF REJ	CH 1	20 μs	0.4 DIV	30 kHz
AC HF REJ	CH 1	20 μs	0.4 DIV	50 kHz
AC	EXT	10 ms	60 mv	30 Hz
AC HF REJ	EXT	10 ms	60 mv	30 Hz
DC	EXT	10 ms	60 mv	30 Hz
AC HF REJ	EXT	20 μs	60 mv	30 kHz
AC LF REJ	EXT	20 μs	60 mV	50 kHz
DC	EXT	50 ns	60 mV	30 MHz
AC	EXT	50 ns	60 mV	30 MHz
AC LF REJ	EXT	50 ns	60 mV	30 MHz
DC	CH 1	50 ns	0.4 DIV	30 MHz
AC	CH 1	50 ns	0.4 DIV	30 MHz
AC LF REJ	CH 1	50 ns	0.4 DIV	30 MHz
AC LF REJ	CH 1	50 ns HMAG	1.0 DIV	70 MHz
DC	CH 1	50 ns HMAG	1.0 DIV	70 MHz
AC	CH 1	10 ns HMAG	1.0 DIV	70 MHz
AC	EXT	50 ns HMAG	150 mV	70 MHz
DC	EXT	50 ns HMAG	150 mV	70 MHz
AC LF REJ	EXT	50 ns HMAG	150 mV	70 MHz

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

12. Timing

a. Performance Check

- (1) Press **MENU/TEST** and **MEMORY DISPLAY 4, 5, 6** and **MENU/TEST** pushbuttons.
- (2) Position controls as listed in (a) through (e) below:
 - (a) Press **TRIGGERING/MODE NORM** pushbutton.

- (b) Press **TRIGGERING/COUPUNG DC** pushbutton.
 - (c) Set **VOLTS/DIV** switch to **200 mV**.
 - (d) Set **TIME/DIV** switch to **1 μs**.
 - (e) Press **← TRIG POS ⇒** pushbutton for TI display indication of **TPOS -95**.
- (3) Connect oscilloscope calibrator **SOURCE/MEASURE CHAN 1** output to **CH 1** input through 50 Ω termination.
- (4) Press oscilloscope calibrator **MARKER** key and set for 0.1 ms markers output.
 - (5) Position **CH 1 VOLTS/DIV** and **VARIABLE** control for 4 divisions on TI display.
 - (6) Press **f** (function) and **CURSORS Δ ON** pushbuttons.
 - (7) Press **CURSORS ←1⇒** control until cursor falls on the rising edge of time mark as close to the 50% point as possible.
 - (8) Press **f** (function) and **CURSORS Δ OFF** pushbutton.
 - (9) Display **CURSOR** readout T= indication will be between 99.9 and 100.1 μs.
 - (10) Set oscilloscope calibrator and TI for settings listed in table 5. TI will be within specified limits.

Table 5. Timing Accuracy

TIME/DIV switch settings	TRIG POS pushbutton indications	Oscilloscope calibrator marker output	CURSORS readout	
			Min	Max
2 μs	-95	0.2 ms	199.8 μs	200.2 μs
5 μs	-95	0.5 ms	499.5 μs	500.5 μs
10 μs	-95	1 ms	999 μs	1.001 ms
20 μs	-95	2 ms	1.998 ms	2.002 ms
50 μs	-95	5 ms	4.995 ms	5.005 ms
100 μs	-95	10 ms	9.99 ms	10.01 ms
200 μs	-95	20 ms	19.98 ms	20.02 ms
500 μs	-95	50 ms	49.95 ms	50.05 ms
1 ms	-95	0.1 s	99.9 ms	100.1 ms
2 ms	-95	0.2 s	199.8 ms	200.2 ms
20 ms ¹	-95	2 s	1.998 s	2.002 s
500 ms ¹	-35	2 s	19.98 s	20.02 s

¹Press **TRIGGERING/MODE HOLD NEXT** pushbutton and wait for display to stop rolling before making cursor measurement.

b. Adjustments. No adjustments can be made.

13. 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:



JOYCE E. MORROW
*Administrative Assistant to the
Secretary of the Army*

0734604

GEORGE W. CASEY, JR.
*General, United States Army
Chief of Staff*

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 341127, requirements for calibration procedure TB 9-6625-2164-24.

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
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.

