

# \*TB 9-6625-967-35

CHANGE 2

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

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## CALIBRATION PROCEDURE FOR DUAL-TRACE AMPLIFIER, TEKTRONIX, TYPES 3A1 AND 3A6

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Headquarters, Department of the Army, Washington, DC  
30 April 1979

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TB 9-6625-967-35, 17 September 1976, is changed as follows:

**Page 3, paragraph 4, line 4.** Change "secondard" to read "secondary."

**Line 6.** Change "4931-" to read "6695-."

**Page 6, paragraph 9a(4), line 4.** Delete ", only."

**Line 6.** Add "for Type 3A6 only" immediately following voltmeter.

**Page 8, paragraph 13a(4), line 2.** Change "300 kHz" to read "800 kHz."

**Paragraph 14b** is superseded as follows:

**b.** In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

**Page 9, paragraph 16a(2), line 2.** Change "(V5)" to read "(B5)."

**Paragraph 18a(1).** Add subparagraph "(b)" immediately following "(a)" as follows:

(b) "CHI VARIABLE - - -."

**Page 12, paragraph 26b** is superseded as follows:

**b.** In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

By Order of the Secretary of the Army:

OFFICIAL:

**BERNARD W. ROGERS**  
*General, United States Army*  
*Chief of Staff*

**J. C. PENNINGTON**  
*Major General, United States Army*  
*The Adjutant General*

Distribution:

To be distributed in accordance with DA Form 12-34A, requirements for calibration procedures publications.

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# \*TB 9-6625-967-35

CHANGE 1

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

## CALIBRATION PROCEDURE FOR DUAL-TRACE AMPLIFIER, TEKTRONIX, TYPES 3A1 AND 3A6

Headquarters, Department of the Army, Washington, DC  
16 March 1977

TB 9-6625-967-35, 17 September 1976, is changed as follows:

**Page 5, table 3, columns 1 and 2, line 3.** Change "B3 ADAPTER<sup>1</sup>" to read "B3 ADAPTER<sup>3</sup>."

**Columns 1 and 2, line 9.** Change "B9 Lead<sup>1</sup>" to read, "B9 Lead<sup>4</sup>."

**Column 4, line 3.** Under AN/TSM-55 for item B3 ADAPTER, add, "Banana jack to alligator clip, H.H. Smith, Model 301 (red)."

At end of table 3, add footnotes as follows:

<sup>3</sup>Four required.

<sup>4</sup>Three required.

**Page 6, paragraph 8.** Paragraph 8 is superseded as follows:

### 8. Output Dc Level

#### a. Performance Check

(1) Deenergize oscilloscope (A5) and short brown (lower) and blue (upper) connectors on oscilloscope crt, using two adapters and lead (B3 and B9).

(2) Connect ac/dc voltmeter (A2) between blue connector on oscilloscope crt and chassis ground, using leads supplied with ac/dc voltmeter and two adapters (B3). (For AN/GSM-256, use two adapters and two leads (B3 and B9).

(3) Energize oscilloscope. If ac/dc voltmeter does not indicate +190 V dc, perform b below.

**b. Adjustments.** Adjust OUTPUT DC LEVEL R346 (or R328) (fig. 1) until ac/dc voltmeter indicates +190 V dc.

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**Page 9, paragraph 15a(5)** is superseded as follows:

(5) Deenergize oscilloscope (A5) and short brown (lower) and blue (upper) connectors on oscilloscope crt, using two adapters and lead (B3 and B9).

**Paragraph 15a(6)** is superseded as follows:

(6) Connect multimeter (A4) between blue connector on oscilloscope crt and chassis ground, using lead (B8).

**Paragraph 15a** Add subparagraphs (7) and (8) as follows:

(7) Energize oscilloscope. If multimeter does not indicate +190 V dc, perform b below.

(8) Deenergize oscilloscope and remove short connected in (5) above, and then energize oscilloscope.

**Paragraph 15b** is superseded as follows:

**b. Adjustments** Adjust OUTPUT DC LEVEL R328 (fig. 1) until multimeter indicates +190 V dc.

By Order of the Secretary of the Army:

OFFICIAL:

**BERNARD W. ROGERS**  
*General, United States Army*  
*Chief of Staff*

**PAUL T. SMITH**  
*Major General, United States Army*  
*The Adjutant General*

Distribution:

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This document has been updated with Changes 1 and 2.

# **\*TB 9-6625-967-35**

**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

## **CALIBRATION PROCEDURE FOR DUAL-TRACE AMPLIFIER, TEKTRONIX TYPES 3A1 AND 3A6**

Headquarters, Department of the Army, Washington, DC  
17 September 1976

### **REPORTING OF ERRORS**

You can help improve this publication by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-EP, Redstone Arsenal, AL 35898-5000. You may also contact this office electronically. E-mail address is tmde-ep@redstone.army.mil. FAX to DSN 788-2313 (commercial 205-842-2313). A reply will be furnished directly to you.

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\*This manual supersedes TB 9-6625-967-35, 25 March 1974, including all changes.

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**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification.** This bulletin provides instructions for the level A and level C calibration of Dual-Trace Amplifier, Tektronix Types 3A1 and 3A6. The manufacturer's instruction manuals were used as the prime data source in compiling these instructions. The dual-trace amplifier will be referred to as the "TI" (test instrument) throughout this bulletin.

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

**b. Time and Technique.** The time required for this calibration is approximately 2 hours, using the dc and low frequency technique.

**2. Calibration Data Card, DA Form 2416**

**a. Forms, records, and reports** required for calibration personnel at all levels are prescribed by TM 38-750. DA Form 2416 must be annotated in accordance with TM 38-750 for each calibration performed.

**b. Adjustments** to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) will follow the designated adjustment. Report 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
Frequency response	Dc to 10 MHz
Rise time	35 nsec or less
Deflection factors	Ten calibrated steps for each channel; .01, .02, .05, .1, .2, .5, 1, 2, 5, and 10 V/div. Continuous adjustments (uncalibrated) from 0.01 to approx. 25 V/div.
Accuracy	Within $\pm 3\%$ of indicated deflection in calibrated position.
Input impedance <sup>1</sup>	1 megohm paralleled by 47 pF
Input coupling <sup>1</sup>	Ac or dc coupling of signals may be selected for either channel. A 0.1- $\mu$ f capacitor limits low-frequency response to about 2 Hz on ac coupling.
Maximum input voltage <sup>1</sup>	600 V (dc plus peak ac) or p-p ac
Channel isolation <sup>1</sup>	50,000:1 at 100 kHz
Operating modes	Channel 1 only, channel 2 only, alternate, chopped, and added algebraically.

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

**SECTION II  
EQUIPMENT REQUIREMENT**

**4. Equipment Required.** Table 2 identifies the specific equipment used this calibration procedure. This equipment is issued with secondary transfer standards calibration set NSN 6695-00-621-7877, secondary transfer standards calibration set AN/GSM-256, NSN 6695-00-525-8175, and maintenance calibration shelter AN/TSM-55 and is to be used in performing this procedure. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one accuracy ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

**5. Accessories Required.** The accessories listed in table 3 are issued as indicated in paragraph 4 above and are to be used in this calibration procedure. When necessary, these items may be substituted by equivalent items unless specifically prohibited.

**Table 2. Minimum Specification of Equipment Required**

Item	Common Name	Minimum Use Specifications	Manufacturer, Model, and Part Number		
			Level A	AN/GSM-256	AN/TSM-55
A1	AC CALIBRATOR	Range: 17.145 mV to 18.205 V at 1 kHz. Accuracy: $\pm 0.75\%$	Hewlett-Packard, Model 745A-C90 (MIS-10342 Type 1)	Ballantine, Model 421A-S2 (6625-00-105-8198)	---
A2	AC/DC VOLTMETER	Range: -0.4 to +190 V dc Accuracy: $\pm 0.75\%$	Dana, Model 5703-S-2127 (7912606)	Hewlett-Packard, Model 3490A w/Option 060 (6625-00-557-8305)	---

See footnote at end of table.

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Table 2. Minimum Specifications of Equipment Required - Continued.

Item	Common name	Minimum use specifications	Manufacturer, Model, and Part Number		
			Level A	AN/GSM-256	AN/GTM-55
A3	METER CALIBRATOR	Range: 0.3536 V ac to 400 Hz Accuracy: $\pm 0.5\%$	---	---	John Fluke, Model 760A (TS-2743/U)
A4	MULTIMETER	Range: 0 to 200 V dc Accuracy: $\pm 2\%$	---	---	J-Omega, Model 217A (ME-333/U)
A5	OSCILLOSCOPE <sup>1</sup>	Range: 10 cm vertical and horizontal deflection	Tektronix, Type RMS561A&B MOD171 (7910655-4)	Tektronix, Type 560 series	Tektronix, Type 560 series
A6	RATIO TRANSFORMER	Ratio of .05000 and .10000 $\pm 0.5\%$	---	---	Gertsch, Model RT-60 (TF-515/U)
A7	SQUARE-WAVE GENERATOR	Range: 100 Hz to 300 kHz Rise time: 35 nsec or less (level A), 20 nsec (C level)	Tektronix, Type 106 (MIS-10284-1)	Hewlett-Packard, Model 211B (6625-00-212-7365)	Fairchild, Model 791A (AN/USM-256)
A8	TIME BASE PLUG-IN	Range: .05 $\mu$ sec to .2 msec Accuracy: $\pm 3\%$	Tektronix, Type 3B4 (7912040-1)	Must be compatible with oscilloscope (A5)	Must be compatible with oscilloscope (A5)

<sup>1</sup>Oscilloscope should be the one normally used with TI.

Table 3. Accessories Required

Item	Common name	Description and part number	
		Level A and AN/GSM-256	AN/TSM-55
B1	ADAPTER <sup>1</sup>	BNC jack to UHF plug (10519439)	BNC jack to UHF plug; Amphenol, Model UG-273/U
B2	ADAPTER	BNC plug to UHF jack (10054847)	---
B3	ADAPTER <sup>3</sup>	Single banana jack to alligator clip (red) (7907556)	Banana jack to alligator clip, H. H. Smith, Model 301 (red)
B4	CABLE	30-in., RG-58/U; BNC plug terminations 97907467)	18-in., RG-58C/U; BNC plug terminations; Pomona, Model BNC-C-18
B5	CABLE <sup>1</sup>	36-in., RG-58/U; BNC plug to double banana plug terminations (7907471)	36-in., RG-58/U; BNC plug to black and red banana plugs; Pomona Model 2241-C-36. (CG-3572/U)
B6	STANDARDIZER <sup>2</sup>	Variable 5 to 80 pF (SKD-4850-44)	47-pF, UHF plug to UHF jack; Tektronix, Type 067-0535-00 (MS-8432/U)
B7	TERMINATION	---	50 $\Omega$ UHF plug to UHF jack; Tektronix, Type 011-0045-00 (DA-459/U)
B8	LEAD	---	36-in., double banana plug to alligator clips; Pomona, Model 2BC-A1-36
B9	LEAD <sup>4</sup>	24-in., single banana plug terminations (red) (7907497)	24-in., single banana plug to single banana plug; Pomona, Model B-24 (red)

<sup>1</sup>Two required.

<sup>2</sup>Use with (B1) and (B2).

<sup>3</sup>Four required.

<sup>4</sup>Three required.



### SECTION III PRELIMINARY OPERATIONS

#### 6. Preliminary Instructions

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

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

#### WARNING

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

#### 7. Equipment Setup

- a.** Install time base plug-in (A8) in horizontal compartment of oscilloscope (A5)
- b.** Install TI in vertical compartment of oscilloscope and remove oscilloscope top cover.
- c.** Position TI controls as listed in (1) through (7) below:
  - (1) CH1 and CH2 POSITION controls to midrange
  - (2) CH1 and CH2 VOLTS/DIV switches to .01.
  - (3) CH1 and CH2 VARIABLE VOLTS/DIV (red knob) controls to CALIB.
  - (4) CH1 and CH2 AC-DC-GND switches to GND.
  - (5) MODE switch to CH1.
  - (6) INV(CH1) NORM switch to NORM.
  - (7) TRIGGER (CH1 ONLY PULL) switch pushed in.
- d.** Energize equipment and allow at least 30 minutes for warm-up.
- e.** Turn CH1 VARIABLE VOLTS/DIV control throughout its range. If trace moves vertically, adjust CH1 DC BAL control (front panel) for no movement of trace.
- f.** Turn MODE switch to CH2 and repeat **e** above.
- g.** Turn TI MODE switch to CH1.

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- h.** Turn CH1 and CH2 VARIABLE VOLTS/DIV controls to CALIB.

**SECTION IV  
CALIBRATION PROCESS**

**NOTE**

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

**8. Output Dc Level**

**a. Performance Check**

(1) Connect ac/dc voltmeter (A2) between brown (lower) connector on oscilloscope (A5) crt and chassis ground, using leads supplied with ac/dc voltmeter and two adapters (B3) (AN/ GSM-256 use two leads and two adapters (B9 and B3) ).

(2) Adjust TI CH1 POSITION control to align oscilloscope trace with center horizontal graticule line. Record ac/dc voltmeter indication.

(3) Connect ac/dc voltmeter between blue (upper) connector on oscilloscope crt and chassis ground. Record ac/dc voltmeter indication. If voltage recorded in (2) and (3) does not average +180 volts dc for type 3A1 and +190 volts dc for type 3A6, perform **b** below.

**b. Adjustments.** Repeat **a**(1) through (3) above and adjust OUTPUT DC LEVEL R328 (fig. 1) for +180 volts dc for type 3A1, or R346 (fig. 1) for +190 volts dc for type 3A6.

**9. Trigger Dc Level**

**a. Performance Check**

(1) Pull out TI TRIGGER (CHI ONLY PULL) switch.

(2) Connect ac/dc voltmeter (A2) between oscilloscope (A5) pin 12 of interconnecting plug (horizontal) and chassis ground, using leads supplied with ac/dc voltmeter and two adapters (B3) (AN/GSM-256 use two leads and two adapters (B9 and B3) ). If ac/dc voltmeter does not indicate between -0.4 and +0.4 volt dc, adjust CHAN 1 TRIG DC LEVEL R171 (fig. 1) to obtain required indication on ac/dc voltmeter.

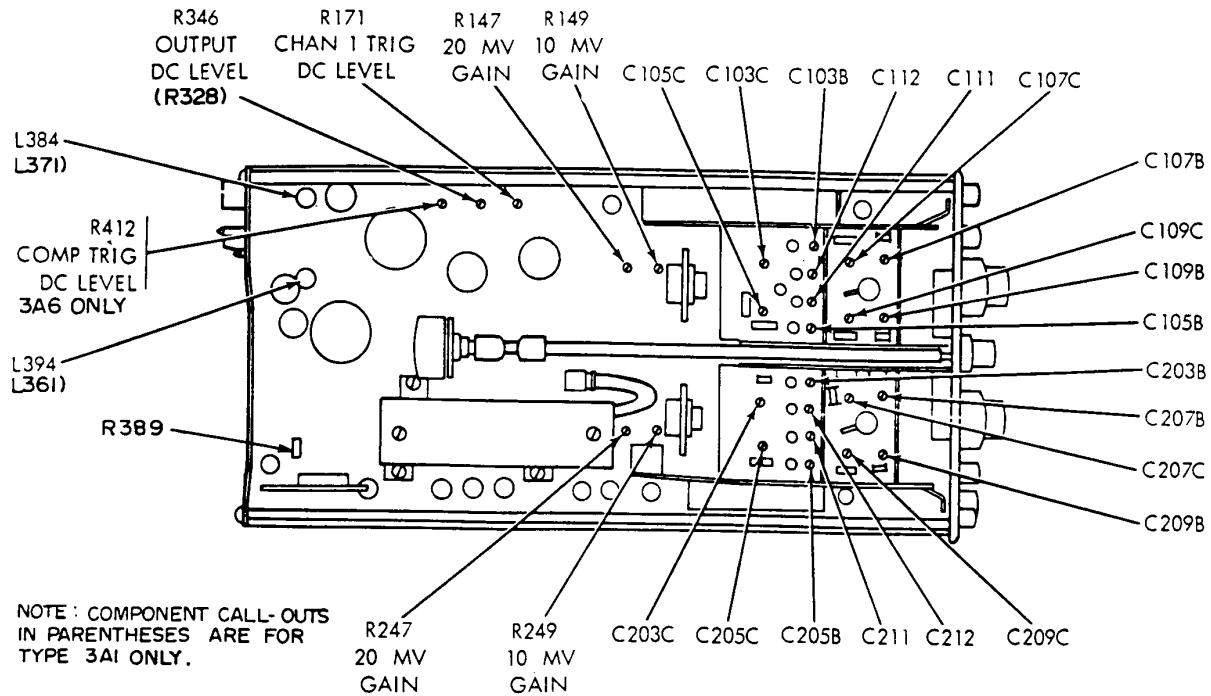


Figure 1. Dual-trace amplifier-left interior view

**NOTE**

Interaction exists between CHAN 1 TRIG DC LEVEL R171 and CH1 and DC BAL. If R171 was adjusted, repeat paragraph 7e above.

(3) Push in TI TRIGGER (CHI ONLY PULL) switch.

(4) Position and maintain trace on horizontal graticule centerline on oscilloscope crt. If ac/dc voltmeter does not indicate between -0.4 and +0.4 volt dc, adjust COMP TRIG DC LEVEL R412 (fig. 1) to obtain required indication on ac/dc voltmeter for type 3A6 only.

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

**10. Amplifier Gain (10 mV)**

**a. Performance Check**

(1) Connect ac calibrator (A1) to TI CH1 and CH2 inputs, using two cables (B5).

(2) Turn TI CALIB (front panel screwdriver control) to midrange and set CH1 and CH2 AC-DC-GND switches to AC.

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(3) Adjust ac calibrator frequency to 1 kHz and amplitude output for 5 major divisions of deflection on oscilloscope (A5) crt. If ac calibrator does not indicate between 17.145 and 18.205 millivolts rms, perform **b** below.

(4) Turn TI MODE switch to CH2 and repeat (3) above.

**b. Adjustments**

(1) Adjust ac calibrator output for 17.675 millivolts rms.

(2) Adjust 10 MV GAIN R149 (fig. 1) for 5 major divisions of deflection for CH1, and 10 MV GAIN R249 (fig. 1) for 5 major divisions for CH2 on oscilloscope crt (R).

**11. Amplifier Gain**

**a. Performance Check**

(1) Turn TI CH1 and CH2 VOLTS/DIV switches to .02.

(2) Adjust ac calibrator output for 5 major divisions of vertical deflection on oscilloscope (A5) crt. If ac calibrator does not indicate between 34.290 and 36.411 millivolts rms, perform **b** below.

(3) Repeat technique of (1) and (2) above for TI VOLTS/DIV switch settings and indications listed in table 4. Ac calibrator will indicate within limits specified.

Table 4. Amplifier Gain (Channels 1 and 2)

Test instrument VOLTS/DIV switch position	Ac calibrator (rms)			
	Min		Max	
.05	85.724	mV	91.026	mV
.1	171.44	mV	182.05	mV
.2	342.90	mV	364.11	mV
.5	857.24	mV	910.26	mV
1	1.7144	V	1.8205	V
2	3.4290	V	3.6411	V
5	8.5724	V	9.1026	V
10	17.144	V	18.205	V

(4) Turn TI MODE switch to CH1 and repeat (2) and (3) above.

**b. Adjustments**

(1) Adjust ac calibrator output for 35.35 millivolts rms.

(2) Adjust 20 MV GAIN R147 (fig. 1) for 5 major divisions of deflection for CH1, and 20 MV GAIN R247 (fig. 1) for 5 major divisions of reflection for CH2 (R).

**12. Input Capacitance and VOLTS/DIV Switch Compensation**

**a. Performance Check**

(1) Connect square-wave generator (A7) output to TI CH1 input, using cables and termination supplied with square-wave generator, standardizer (B6) and adapters (B1 and B2) (AN/GSM-256 use cable (B4)).

(2) Adjust time base plug-in (A8) for a .2 millisecond sweep.

(3) Turn TI CH1 and CH2 VOLTS/DIV switches to .01 and set CH1 and CH2 AC-DC-GND switches to DC.

(4) Adjust square-wave generator frequency to 1 kHz and amplitude for 4 major divisions of vertical deflection on oscilloscope (A5) crt. If square-wave display does not have flat tops, adjust standardizer for optimum square wave with flat tops. If optimum square wave cannot be obtained, adjust C111 (fig. 1) to midrange and readjust standardizer. For CH2, adjust C211 (fig. 1) instead of standardizer.

(5) Repeat technique of (3) and (4) above for TI VOLTS/DIV switch settings and adjustments listed in table 5 and shown in figure 1. Adjust for optimum square-wave display on oscilloscope crt.

Table 5. VOLTS/DIV Switch Compensation

VOLTS/DIV switch setting	Test Instrument			
	Adjustments (fig. 1)			
	Channel 1 square corner	Flat top	Channel 2 Square corner	Flat top
.02	---	C112 (R)	---	C212 (R)
.05	C103C (R)	C103B (R)	C203C (R)	C203B (R)
.1	C105C (R)	C105B (R)	C205C (R)	C205B (R)
.2	C107C (R)	C107B (R)	C207C (R)	C207B (R)
2	C109C (R)	C109B (R)	C209C (R)	C209B (R)

(6) Remove square-wave generator connection from TI CH1 and connect to CH2 input.

(7) Turn TI MODE switch to CH2 and repeat (4) and (5) above for CH2.

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

**13. High-Frequency Compensation and Rise Time**

**a. Performance Check**

(1) Connect square-wave generator (A7) to TI CH1, using cable and termination supplied with square-wave generator (AN/GSM-256 use cable (B4)).

(2) Turn TI CH1 and CH2 VOLTS/DIV switches to .01 and MODE switch to CH1.

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(3) Adjust time base plug-in (A8) for a .5 microsecond sweep.

(4) Adjust square-wave generator frequency to 800 kHz and amplitude for 4 major divisions of vertical deflection on oscilloscope (A5) crt. If square wave does not have square corners with minimum overshoot and undershoot, perform **b** below.

(5) Adjust time base plug for a .05 microsecond sweep.

(6) Measure rise time, using standard risetime technique. Rise time will be 35 nanoseconds or less.

(7) Remove square-wave generator connection from TI CH1 and connect to CH2.

(8) Turn TI MODE switch to CH2 and repeat (6) above.

**b. Adjustments.** Adjust L361 and L371 (fig. 1) for type 3A1, or L384 and L394 (fig. 1) for type 3A6, for optimum square-wave display (R).

**14. Final Procedure**

**a.** Deenergize and disconnect all equipment and replace oscilloscope covers.

**b.** In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

**SECTION V ,  
LEVEL C CALIBRATION PROCESS FOR DUAL-TRACE AMPLIFIER)  
TEKTRONIX TYPE 3A1**

**NOTE**

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

**15. Dc Level**

**a. Performance Check**

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

(a) CH1 and CH2 VOLTS/DIV switches to .01.

(b) CH1 and CH2 POSITION controls to midrange.

- (c) CH1 and CH2 VARIABLE VOLTS/DIV controls to CALIB.
- (d) CH1 and CH2 AC-DC-GND switches to GND.
- (e) MODE switch to ALTER.
- (f) INV. (CH1) NORM switch to NORM.
- (g) TRIGGER CH1 ONLY PULL switch depressed.

(2) Place CRT CATHODE SELECTOR switch to UP position (rear panel of oscilloscope (A5)).

(3) Adjust time base plug-in (A8) controls for 1 millisecond/division and TRIGGERING controls for a free-running display on oscilloscope crt.

(4) Adjust TI POSITION controls for oscilloscope crt display with traces aligned with horizontal lines.

(5) Connect multimeter (A4) between oscilloscope CRT UPPER vertical deflection plate pin (blue wire) and ground, using lead (B8). Record multimeter indication.

(6) Connect multimeter between oscilloscope CRT LOWER vertical deflection plate pin (brown wire) and ground. Record multimeter indication. If average of multimeter indications recorded in (5) above and this step is not 180 volts dc, perform **b** below.

**b. Adjustments.** Adjust OUTPUT DC LEVEL R328 (fig. 1) for an average multimeter voltage indication of 180 volts dc.

## **16. CH1 Dc Trigger Level**

### **a. Performance Check**

(1) Set TI MODE switch to CH1 and TRIGGER CH1 ONLY PULL switch pulled out.

(2) Connect multimeter (A4) between R389 (fig. 1) and ground, using cable (B5). If multimeter does not indicate 0 volt, perform **b** below.

**b. Adjustments.** Adjust TI CHAN 1 TRIG DC LEVEL R171 (fig. 1) until multimeter indicates zero voltage.

**17. CH1 and CH2 Dc Balance**

**a. Performance Check**

(1) Turn TI CHI VARIABLE VOLTS/DIV control from CALIB to fully counterclockwise. If display on oscilloscope (A5) crt moves vertically, perform **b(1)** below.

(2) Turn TI MODE switch to CH2 and depress TRIGGER CHI ONLY PULL switch.

(3) Turn TI CH2 VARIABLE VOLTS/DIV control from CALIB to fully counterclockwise. If display on oscilloscope crt moves vertically, perform **b(2)** below.

**b. Adjustments**

(1) Adjust CH1 DC BAL (front panel screwdriver) adjustment for no vertical movement of trace when VARIABLE control is turned from CALIB to fully counterclockwise.

(2) Adjust CH2 DC BAL (front panel screwdriver) adjustment for no vertical movement of trace when VARIABLE control is turned from CALIB to fully counterclockwise.

**18. CH1 Gain**

**a. Performance Check**

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

(a) CH1 AC-DC-GND switch to DC.

(b) CH1 VARIABLE VOLTS/DIV control to CALIB.

(c) MODE switch to CH1.

(2) Connect equipment to TI CH1 input as shown in figure 2.

(3) Adjust time base plug-in (A8) TRIGGERING LEVEL control for automatic triggering.

(4) Adjust meter calibrator (A3) frequency to 400 Hz and amplitude output for 000.3536 volt ac.

(5) Adjust ratio transformer (A6) until 5 divisions of deflection are displayed on oscilloscope (A5) crt. Ratio transformer will indicate between .04850 and .05150.

(6) Set TI CH1 VOLTS/DIV switch to .02.



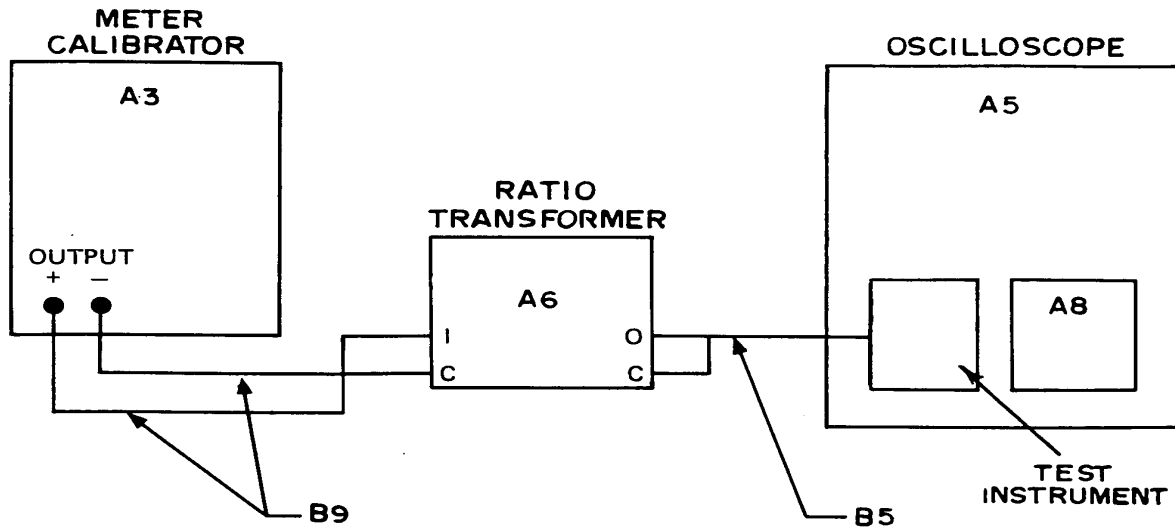


Figure 2. CH1 and CH2 gain - equipment setup.

(7) Adjust ratio transformer switches until 5 divisions of deflection are displayed on oscilloscope crt. If ratio transformer does not indicate between .09700 and .10300, perform **b** below.

**b. Adjustments.** Set ratio transformer switches to 10000 and adjust 20 MV GAIN R147 (fig. 1) until oscilloscope displays 5 divisions of deflection (R).

## 19. CH2 Gain

### a. Performance Check

(1) Connect ratio transformer (A6) to TI CH1 and CH2 inputs, using two cables (B5).

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

- (a) CH1 and CH2 VOLTS/DIV switches to .01.
- (b) MODE switch to ADDED.
- (c) CH2 AC-CD-GND switch to DC.
- (d) INV (CH1) NORM switch to INV.

(3) Set ratio transformer switches to 05000. If oscilloscope (A5) crt does not display a straight line, perform **b**(1) below.

(4) Set TI CH1 and CH2 VOLTS/DIV switches to .02.

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(5) Set ratio transformer switches to 10000. If oscilloscope crt does not display a straight line, perform **b(2)** below.

### **b. Adjustments**

(1) Adjust 10 MV GAIN R249 (fig. 1) until oscilloscope displays a straight line.

(2) Adjust 20 MV GAIN R247 (fig. 1) until oscilloscope displays a straight line (R).

## **20. VARIABLE VOLTS/DIV Control**

### **a. Performance Check**

(1) Set TI CH1 and CH2 VOLTS/DIV switches to .01 and MODE switch to CH1.

(2) Turn TI INV (CH1) NORM switch to NORM.

(3) Set ratio transformer (A6) switches to .05000.

(4) Turn TI CH1 VARIABLE VOLTS/DIV control fully counterclockwise. Vertical display on oscilloscope (A5) crt will be less than 2 major divisions, and CH1 UNCAL indicator will glow.

(5) Turn TI MODE switch to CH2 and repeat technique of (4) above.

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

## **21. Alternate Mode**

### **a. Performance Check**

(1) Turn TI CH1 and CH2 variable VOLTS/DIV controls to CALIB.

(2) Turn TI MODE switch to ALTER.

(3) Adjust TI CH1 and CH2 POSITION controls for two sweeps, two divisions apart.

(4) Adjust time base plug-in (A8) controls for 0.1 second/division sweep rate on oscilloscope (A5) crt. Horizontal display will alternate between CH1 and CH2 traces.

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

## **22. Chopped Mode**

### **a. Performance Check**

(1) Turn TI MODE switch to CHOP and oscilloscope (A5) CRT CATHODE SELECTOR switch (rear panel) to CHOPPED BLANKING.

(2) Adjust time base plug-in (A8) control for a 5-microsecond/division sweep rate on oscilloscope. Crt will display between 4 and 10 cycles of square wave with vertical portions of waveform dimmed

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

## **23. Gassy Input Amplifier**

### **a. Performance Check**

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

(a) CH1 and CH2 VOLTS/DIV switches to .02.

(b) CH1 and CH2 AC-DC-GND switches to GND.

(c) MODE switch to ALTER.

(2) Adjust time base plug-in (A8) controls for 1-millisecond/division horizontal display on oscilloscope (A5) crt.

(3) Set CH1 AC-DC-GND switch to AC. Oscilloscope display will not shift by more than  $\pm 1$  minor vertical division.

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

## **24. Waveform**

### **a. Performance Check**

(1) Turn CH1 and CH2 VOLTS/DIV switches to .01 and AC-DC-GND switches to AC.

(2) Connect square-wave generator (A7) to TI CH1 input, using cable (B5), adapters (B1 and B2), termination (B7), and standardizer (B6).

(3) Adjust time base plug-in (A8) for a .2 millisecond/division horizontal display on oscilloscope (A5) crt.

(4) Adjust square-wave generator frequency for 1 kHz and amplitude for 4 divisions of deflection on oscilloscope crt.

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(5) Repeat technique of (4) above for TI switch settings and adjustments listed in table 6. At each setting, adjust for optimum square-wave display on oscilloscope crt.

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

Table 6. Waveform Adjustments

Test instrument			
MODE SWITCH setting	VOLTS/DIV switch setting	Adjustments (fig. 1)	
		Flat top	Square corner
CH1	.01	C111 (R)	NONE
CH1	.02	C112 (R)	NONE
CH1	.05	C103B (R)	C103C (R)
CH1	.1	C105B (R)	C105C (R)
CH1	.2	C107B (R)	C107C (R)
CH1 <sup>1</sup>	2	C109B (R)	C109C (R)
CH2	.01	C211 (R)	NONE
CH2	.02	C212 (R)	NONE
CH2	.05	C203B (R)	C203C (R)
CH2	.1	C205B (R)	C205C (R)
CH2	.2	C207B (R)	C207C (R)
CH2 <sup>1</sup>	2	C209B (R)	C209C (R)

<sup>1</sup>Remove termination (B7) between adapter (B1) and standardizer (B6).

**25. High Frequency Compensation and Rise Time**

**a. Performance Check**

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

- (a) MODE switch to CH1.
- (b) CH1 and CH2 AC-DC-GND switches to DC.
- (c) CH1 and CH2 VOLTS/DIV switches to 1.

(2) Adjust square-wave generator (A7) frequency to 250 kHz and amplitude for a 3-division vertical display on oscilloscope (A5) crt.

(3) Adjust time base plug-in (A8) control for two cycles of square-wave display on oscilloscope crt. If optimum square wave is not displayed, perform **b** below.

(4) Measure rise time, using standard rise time technique. Rise time will be 35 nanoseconds or less.

(5) Set TI MODE switch to CH2 and repeat technique of (2) through (4) above for channel 2.

**b. Adjustments.** Adjust (L361) and (L371) (fig. 1) for square-wave display with no overshoot (R).

**26. Final Procedure**

**a.** Deenergize and disconnect all equipment.

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

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By Order of the Secretary of the Army:

**FRED C. WEYAND**  
*General, United States Army*  
*Chief Of Staff*

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**PAUL T. SMITH**  
*Major General, United States Army*  
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