

# **\*TB 9-6625-2215-24**

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**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

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**CALIBRATION PROCEDURE FOR MEASURING SYSTEM, TD-1209/U (HEWLETT-PACKARD, MODEL 5300A); 50 MHz UNIVERSAL COUNTER, TD-1211/U (HEWLETT-PACKARD, MODEL 5302A); 10 MHz COUNTER (HEWLETT-PACKARD, MODEL 5301A); 500 MHz COUNTER (HEWLETT-PACKARD, MODEL 5303A); 525 MHz COUNTER (HEWLETT-PACKARD, MODEL 5303B); TIMER/COUNTER (HEWLETT-PACKARD, MODEL 5304A) AND MULTIMETER/COUNTER (HEWLETT-PACKARD, MODEL 5306A)**

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Headquarters, Department of the Army, Washington, DC  
26 June 2009

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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](mailto: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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**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Measuring System, TD-1209/U (Hewlett-Packard, Model 5300A); 50 MHz Universal Counter, TD-1211/U (Hewlett-Packard, Model 5302A); 10 MHz Counter (Hewlett-Packard, Model 5301A); 500 MHz Counter (Hewlett-Packard, Model 5303A); 525 MHz Counter (Hewlett-Packard, Model 5303B); Timer/Counter (Hewlett-Packard, Model 5304A) and Multimeter/Counter (Hewlett-Packard, Model 5306A). The manufacturers' manuals were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

**a. Model Variations.** Variations among models are 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. 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
TD-1209/U (Hewlett-Packard, Model 5300A)	
Time base	Frequency: 10 MHz Stability: Aging rate <3 parts in 10 <sup>7</sup> /month Line stability: <± 1 part in 10 <sup>7</sup> for 10% line variation
TD-1211/U (Hewlett-Packard, Model 5302A)	
Frequency	Range: Channel A: 10 Hz to 50 MHz Channel B: 10 Hz to 10 MHz
Sensitivity	25 mV rms: 50 Hz to 1 MHz 50 mV rms: 10 Hz to 10 MHz 100 mV rms: 50 MHz
Hewlett-Packard, Model 5301A	
Frequency	Range: 10 Hz to 10 MHz
Sensitivity	25 mV rms: 50 Hz to 1 MHz 50 mV rms: 10 Hz to 10 MHz

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Hewlett-Packard, Model 5303A	
Frequency	Range: Channel A: Dc to 500 MHz Channel B: 10 Hz to 50 MHz
Sensitivity	100 mV rms: Channel A 50 mV rms: Channel B, 20 Hz to 10 MHz 100 mV rms: Channel B, 10 Hz to 50 MHz
Hewlett-Packard, Model 5303B	
Time base	Frequency: 10 MHz (nominal) exact frequency varies with instruments Stability: Aging rate: <1.2 parts in 10 <sup>6</sup> /year Line voltage: <± 5 parts in 10 <sup>8</sup> for 10% line variation
Frequency	Range: 525 MHz channel: Dc to 525 MHz 80 MHz channel: 50 Hz to 80 MHz
Sensitivity <sup>1</sup>	525 MHz channel: 100 mV rms: Dc to 500 MHz 125 mV rms: 500 to 525 MHz 80 MHz channel: 25 mV rms: 100 Hz to 50 MHz 50 mV rms: 50 to 100 Hz, and 50 to 80 MHz
Hewlett-Packard, Model 5304A	
Frequency	Range: 0 to 10 MHz (dc coupled) 100 Hz to 10 MHz (ac coupled)
Sensitivity	25 mV rms: 0 to 1 MHz 50 mV rms: 1 to 10 MHz
Hewlett-Packard, Model 5306A	
Dc voltage	Range: 0 to ±1000 V in 3 ranges Accuracy: ±10 and ±100 V ranges: ± (0.03% of reading +0.003% of range) ±1000 V range: ± (0.097% of reading +0.03% of range)
Ac voltage	Range: 0 to 1000 V in 3 ranges Accuracy: 10 V range: 40 Hz to 10 kHz ±(0.98% of reading +0.02% of range); 10 to 100 kHz ±(0.98% of reading +0.02% of range) 100 and 1000 V range: 40 to 500 Hz ±(1.5% of reading +0.05% of range)
Resistance	Range: 10 kΩ, 100 kΩ, and 10 MΩ, Accuracy: 10 and 100 kΩ, ±(0.5% of reading +0.003% of range) 10 MΩ range, ±(0.75% of reading +0.003% of range)

<sup>1</sup>Not calibrated above 500 MHz.

## 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.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ±1%	Ridge, Model 9020A (9020A)
CALIBRATOR	Range: 8.9 to 914 V ac at 40 to 100 kHz Accuracy: ±0.25% Range: -9.5 to 950.77 Vdc Accuracy: ±0.008% Range: 9 kΩ to 10 MΩ Accuracy: ±0.1%	Fluke, Model 5720A (5700A/EP) (p/o MIS-35947); w/amplifier, Fluke 5725A/AR (5725A/AR)
FREQUENCY COUNTER	Range: 10 MHz Accuracy: 1 part in 10 <sup>8</sup>	Fluke, Model PM6681/656 (PM6681/656)
FREQUENCY DIFFERENCE METER	Resolution: 1 part in 10 <sup>-10</sup>	Tracor, Model 527E (527E)
FUNCTION GENERATOR	Range: 10 Hz to 80 MHz Amplitude: 0 to 100 mV	Agilent, Model 33250A (33250A)
OSCILLOSCOPE	X-Y mode capability	Agilent, OS-303/G (OS-303/G)
SIGNAL GENERATOR	Range: 80 to 500 MHz Amplitude: 0 to 100 mV	Aeroflex, Model 2023B (2023B) or (SG-1207/U)
TIME/FREQUENCY WORKSTATION	Range: 1 MHz Accuracy: ±1 part in 10 <sup>-10</sup>	Datum, Model ET6000-75 (13589305)

**SECTION III**  
**CALIBRATION PROCESS FOR MEASURING SYSTEM, TD-1209/U (HEWLETT-PACKARD, MODEL 5300A) AND 50 MHZ UNIVERSAL COUNTER, TD-1211/U (HEWLETT-PACKARD, MODEL 5302A)**

**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 tables 2.

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

Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the 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.

- a. Mount TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TD-1211/U (Hewlett-Packard, Model 5302A) 50 MHz universal counter.
- b. Connect TI measuring system to autotransformer and connect autotransformer to a 115 V ac source. Adjust autotransformer output for 115 V.
- c. Adjust TI measuring system **SAMPLE RATE** control cw to **ON** position and allow 1 hour for warm-up.

## **8. Time Base Stability**

### **a. Performance Check**

- (1) Set time/frequency workstation for 1 MHz output and connect to **REF INPUT** of frequency difference meter.
- (2) Connect **OSC** jack on rear of TI measuring system to **SIG INPUT** jack of frequency difference meter.
- (3) Adjust **OSC ADJ C7** (rear of TI measuring system) for minimum difference indication on frequency meter. Frequency difference meter will indicate less than 3 parts in  $10^{-7}$ .
- (4) While monitoring frequency difference meter indication, vary output of autotransformer from 105 to 125 V. Frequency difference meter indication will remain within  $\pm 1$  part in  $10^{-7}$ .
- (5) Adjust output of autotransformer to 115 V.

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

## **9. Sensitivity**

### **a. Performance Check**

- (1) Connect function generator **OUTPUT** to TI **A 50 MHz** jack, using termination.
- (2) Position TI 50 MHz counter controls as listed in (a) through (d) below:
  - (a) **FUNCTION** switch to **FREQ A**.

- (b) **A** waveform switch to - (sine wave).
- (c) **A SENSITIVITY** control fully cw.
- (d) **TIME BASE** switch to **10S**.

(3) Adjust function generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.

(4) Slowly increase function generator amplitude until TI measuring system indicates a stable count of the applied frequency. Function generator adjusted output will be within limit specified in first row of table 3.

(5) Repeat technique of (3) and (4) above for function generator frequencies listed in table 3. Function generator adjusted output will be within limit specified in table 3.

Table 3. Sensitivity **OUTPUT A 50 MHz**

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
10	≤ 50
50	≤ 25
100	≤ 25
1000	≤ 25
10000	≤ 25
100000	≤ 25
1000000	≤ 25
1000000 <sup>1</sup>	≤ 50
50000000	≤ 100

<sup>1</sup>Set TI **TIME BASE** switch to **AUTO**.

(6) Set function generator output to minimum and connect to TI **B 10 MHz** jack, using termination.

(7) Position TI 50 MHz counter controls as listed in (a) through (d) below:

- (a) **FUNCTION** switch to **FREQ B**.
- (b) **B SENSITIVITY** control fully cw.
- (c) **B** waveform switch to - (sine wave).
- (d) **TIME BASE** switch to **10S**.

(8) Adjust function generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.

(9) Slowly increase function generator amplitude until TI measuring system indicates a stable count of the applied frequency. Function generator adjusted output will be within limit specified in first row of table 4.

(10) Repeat technique of (8) and (9) above for function generator frequencies listed in table 4. Function generator adjusted output will be within limit specified in table 4.

Table 4. Sensitivity **OUTPUT B 10 MHz**

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
10	≤ 50
50	≤ 25
100	≤ 25
1000	≤ 25
10000	≤ 25
100000	≤ 25
1000000	≤ 25
10000000 <sup>1</sup>	≤ 50
50000000	≤ 100

<sup>1</sup>Set TI **TIME BASE** switch to **AUTO**.

**b. Adjustments**

**NOTE**

For serial number prefix below 1444A, no adjustments can be made. For serial number prefix 1444A and above, perform (1) through (4) below.

- (1) Remove bottom cover from TI.
- (2) Adjust function generator for 100 kHz and amplitude of 25 mV.
- (3) Adjust A1 R59 (A channel) closest to front panel or A1 R57 (B channel) near rear of TI to obtain stable indication of applied frequency.
- (4) While reducing function generator amplitude, adjust A1 R59 (A channel) or A1 R57 (B channel) to obtain maximum sensitivity.

**10. Final Procedure**

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

**SECTION IV  
CALIBRATION PROCESS FOR 10 MHZ COUNTER (HEWLETT-PACKARD,  
MODEL 5301A)**

**11. Preliminary Instructions**

- a. The instructions outlined in paragraphs **11** and **12** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.
- b. Items of equipment used in this procedure are referenced within the text by common name as listed in tables 2.



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

d. Unless otherwise specified all controls and controls settings refer to the TI.

## 12. Equipment Setup

### WARNING

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

a. Mount a calibrated TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TI.

b. Connect measuring system to autotransformer and connect autotransformer to a 115 V ac source.

c. Adjust autotransformer output for 115 V.

d. Adjust measuring system **SAMPLE RATE** control cw to **ON** position and allow 1 hour for warm-up.

## 13. Sensitivity

### a. Performance Check

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

- (a) **GATE** switch to **10S**.
- (b) **WAVEFORM** switch to - (sine wave).
- (c) **SENSITIVITY** control fully cw.

(2) Connect function generator output to **TI INPUT**, using termination.

(3) Adjust function generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.

(4) Slowly increase function generator amplitude until measuring system indicates a stable count of the applied frequency. Function generator output will be within limit specified in first row of table 5.

(5) Repeat technique of (3) and (4) above for function generator frequencies listed in table 5. Function generator adjusted output will be within limit specified in table 5.

Table 5. Sensitivity

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
10	≤ 50
50	≤ 25
100	≤ 25
1000	≤ 25
10000	≤ 25
100000 <sup>1</sup>	≤ 25
1000000 <sup>2</sup>	≤ 25
10000000 <sup>3</sup>	≤ 50

<sup>1</sup>Set TI GATE switch to **1S**.

<sup>2</sup>Set TI GATE switch to **.1S**.

<sup>3</sup>Set TI GATE switch to **AUTO**.

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

#### 14. Final Procedure

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

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

### SECTION V CALIBRATION PROCESS FOR 500 MHZ COUNTER (HEWLETT-PACKARD, MODEL 5303A)

#### 15. Preliminary Instructions

**a.** The instructions outlined in paragraphs **15** and **16** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

**b.** Items of equipment used in this procedure are referenced within the text by common name as listed in tables 2.

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

**d.** Unless otherwise specified all controls and controls settings refer to the TI.

**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.

- a. Mount a calibrated TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TI.
- b. Connect measuring system to autotransformer and connect autotransformer to a 115 V ac source.
- c. Adjust autotransformer output for 115 V.
- d. Adjust measuring system **SAMPLE RATE** control cw to **ON** position and allow 1 hour for warm-up.

**17. Sensitivity**

**a. Performance Check**

- (1) Position controls as listed in (a) through (e) below:
  - (a) **RANGE MHz** switch to **10**.
  - (b) **ATTEN** switch to **X1**.
  - (c) **SENSITIVITY** control fully cw.
  - (d) Waveform switch to - (sine wave).
  - (e) **GATE TIME SEC** switch to **10**.
- (2) Connect function generator output to TI **1 MΩ** input, using termination.
- (3) Adjust function generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.
- (4) Slowly increase function generator amplitude until measuring system indicates a stable count of the applied frequency. Function generator output will be within limits specified in first row of table 6.
- (5) Repeat technique of (3) and (4) above for function generator frequencies listed in table 6. Function generator adjusted output will be within limit specified in table 6.

Table 6. Sensitivity

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
10	≤ 100
50	≤ 50
100	≤ 25

Table 6. Sensitivity - Continued

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
1000	≤ 25
10000	≤ 25
100000 <sup>1</sup>	≤ 25
1000000 <sup>2</sup>	≤ 25
50000000 <sup>3</sup>	≤ 100

<sup>1</sup>Set TI GATE TIME SEC switch to 1.

<sup>2</sup>Set TI GATE TIME SEC switch to .1.

<sup>3</sup>Set TI RANGE MHz switch to 50 (blue).

(6) Set RANGE MHz switch to 50 (white) and GATE TIME SEC switch to 10.

(7) Adjust function generator frequency for 10 Hz and amplitude to minimum output.

(8) Slowly increase function generator amplitude until measuring system indicates a stable count of the applied frequency. If function generator output exceeds limits specified in first row of table 7, perform **b** below.

(9) Repeat technique of (7) and (8) above at function generator frequencies listed in table 7. Function generator output will not exceed limits specified in table 7.

Table 7. Sensitivity RANGE MHz 50

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
10	≤ 100
100	≤ 100
1000	≤ 100
10000	≤ 100
100000	≤ 100
1000000	≤ 100
10000000	≤ 100
50000000 <sup>1</sup>	≤ 100

<sup>1</sup>If out of tolerance and no adjustment was performed in (8) above, perform **b** below.

(10) Set RANGE MHz switch to 500.

(11) Substitute signal generator for function generator.

(12) Adjust signal generator for a frequency of 100 MHz and slowly adjust amplitude to obtain the minimum level that will produce a stable indication of applied frequency on measuring system. If signal generator amplitude exceeds limit specified in first row of table 8 and no adjustment was previously made, perform **b** below.

(13) Repeat technique of (12) above for signal generator frequencies listed in table 8. If signal generator amplitude exceeds limit specified in table 8 and no adjustment was previously made, perform **b** below.

Table 8. Sensitivity **RANGE MHz 500**

Signal generator output	
Frequency (MHz)	Amplitude limits (mV)
100	≤ 100
300	≤ 100
500	≤ 100

**b. Adjustments**

- (1) Remove bottom cover from TI.
- (2) Connect signal generator to TI 50 Ω input.
- (3) Adjust signal generator frequency for 500 MHz and amplitude to obtain 100 mV.
- (4) Set TI **GATE TIME SEC** switch to **.1** and **RANGE MHz** switch to **500**.
- (5) Adjust A1R6 (located bottom side lower center of board A1) to obtain stable indication of applied frequency on measuring system (R).
- (6) While reducing signal generator amplitude, adjust A1R6 to obtain maximum sensitivity.

**18. Final Procedure**

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

**SECTION VI**  
**CALIBRATION PROCESS FOR 525 MHZ COUNTER (HEWLETT-PACKARD,**  
**MODEL 5303B)**

**19. Preliminary Instructions**

- a. The instructions outlined in paragraphs **19** and **20** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.
- b. Items of equipment used in this procedure are referenced within the text by common name as listed in tables 2.
- c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.
- d. Unless otherwise specified all controls and controls settings refer to the TI.

## 20. Equipment Setup

### WARNING

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

- a. Remove bottom cover from TI.
- b. Mount a calibrated TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TI and orient the interconnected units upside down.
- c. Connect measuring system to autotransformer and connect autotransformer to a 115 V ac source.
- d. Adjust autotransformer output for 115 V.
- e. Adjust measuring system **SAMPLE RATE** control cw to **ON** position and allow 1 hour for warm-up.
- f. Set **INT STD-EXT STD** switch on rear panel of frequency counter to **EXT STD**.

## 21. Time Base Stability

### NOTE

Some models do not have an internal oscillator. When calibrating these models, omit this check.

- a. **Performance Check**
  - (1) Connect frequency counter **A** input to TI **OSC** jack (rear panel).
  - (2) Adjust Y1 ADJ (fig. 1) as required to obtain frequency counter indication of exact frequency stamped on TCXO CASE (fig. 1).
  - (3) Adjust autotransformer output from 105 to 125 V while monitoring frequency counter indication. Frequency will not change by more than 0.5 Hz.
  - (4) Adjust autotransformer output for 115 V.
- b. **Adjustments.** No further adjustments can be made.

## 22. Sensitivity

- a. **Performance Check**
  - (1) Press **80 MHz RANGE** and **10 Hz RESOLUTION** pushbuttons and release **CHK** pushbutton.

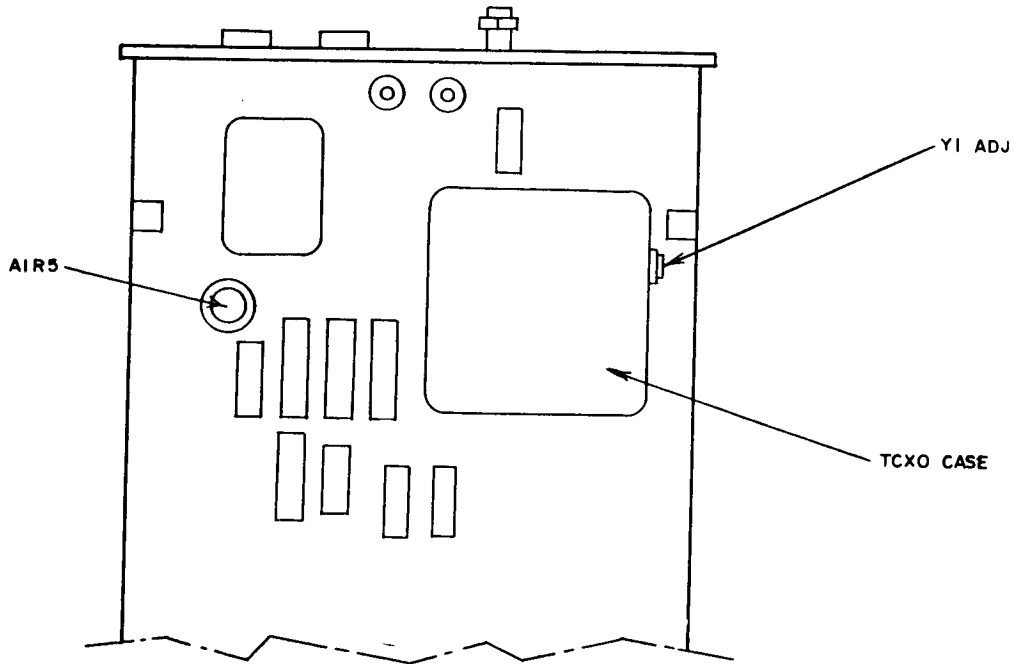


Figure 1. Test instrument - (Hewlett-Packard, Model 5303B) - bottom view.

- (2) Connect function generator output to TI 80 MHz jack, using termination.
- (3) Adjust function generator frequency for 50 Hz and slowly increase amplitude until measuring system indicates a stable count of applied frequency. Function generator output will not exceed limit specified in first row of table 9.
- (4) Repeat technique of (3) above at function generator frequencies listed in table 9. Output amplitude of function generator at each frequency will not exceed limit specified in table 9.

Table 9. Sensitivity **80 MHz RANGE**

Function generator output	
Frequency (Hz)	Amplitude limits (mV)
50	≤ 50
100	≤ 25
1000 <sup>1</sup>	≤ 25
10000	≤ 25
100000	≤ 25
1000000	≤ 25
10000000	≤ 25
25000000	≤ 25
50000000	≤ 25
80000000	≤ 50

<sup>1</sup>Press TI 100 Hz RESOLUTION button.

(5) Remove signal input from 80 MHz jack and connect to 525 MHz jack without termination; press **525 MHz RANGE** pushbutton.

(6) Adjust function generator frequency for 10 Hz and slowly increase amplitude until measuring system indicates a stable count of applied frequency. Function generator output will not exceed limit specified in first row of table 10.

(7) Repeat technique of (6) above at frequencies listed in table 10. If function generator output exceeds limits specified in table 10, perform **b** below.

Table 10. Sensitivity **525 MHz RANGE**

Function generator output	
Frequency (Hz)	Amplitude limit (mV)
10	≤ 100
100	≤ 100
1000	≤ 100
10000	≤ 100
100000	≤ 100
1000000	≤ 100
10000000	≤ 100

(8) Substitute signal generator for function generator.

(9) Press **1 kHz RESOLUTION** pushbutton in and repeat technique of (6) above at signal generator frequencies listed in table 11. If signal generator output exceeds limits listed in table 11 and no adjustments were previously made, perform **b** (2) through (5) below.

Table 11. Sensitivity **525 MHz RANGE**

Signal generator output	
Frequency (MHz)	Amplitude limits (mV)
100	≤ 100
500	≤ 100

**b. Adjustments**

(1) Connect signal generator to 525 MHz jack, using adapter and cable.

(2) Press **1 kHz RESOLUTION** pushbutton.

(3) Adjust signal generator frequency for 500 MHz and amplitude to obtain 100 mV.

(4) Adjust A1R5 (fig. 1) for stable indication of applied frequency on measuring system (R).

(5) While reducing signal generator amplitude, continue adjusting A1R5 until maximum sensitivity is obtained.

**23. Final Procedure**

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

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



**SECTION VII  
CALIBRATION PROCESS FOR TIMER/COUNTER (HEWLETT-PACKARD,  
MODEL 5304A)**

**24. Preliminary Instructions**

**a.** The instructions outlined in paragraphs **24** and **25** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

**b.** Items of equipment used in this procedure are referenced within the text by common name as listed in tables 2.

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

**25. Equipment Setup**

**WARNING**

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

- a.** Remove bottom cover from TI.

**NOTE**

Do not handle yellow printed circuit board except at extreme edges. Fingerprints on this board may degrade instrument performance.

**b.** Mount a calibrated TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TI and orient the interconnected units upside down.

**c.** Connect measuring system to autotransformer and connect autotransformer to a 115 V ac source.

**d.** Adjust autotransformer output for 115 V.

**e.** Adjust measuring system **SAMPLE RATE** control cw to on position and allow 1 hour for warm-up.

**26. Sensitivity**

- a.** Performance Check

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

- (a) **COM-SEP-CHK** switch to **SEP**.  
(b) **A** and **B ATTEN** switches to **X1**.

- (c) **A** and **B AC/DC** switches to **DC**.
  - (d) **A** and **B SLOPE** switches to **+**.
  - (e) **A** and **B LEVEL** controls ccw to **PSET**.
  - (f) Function switch to **10S**.
  - (g) **DELAY** switch ccw to **OFF**.
- (2) Connect function generator output to **TI A INPUT**, using termination.
- (3) Adjust function generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.
- (4) Slowly increase function generator amplitude until measuring system indicates a stable count of the applied frequency. If function generator output exceeds limit specified in first row of table 12, perform **b** (1) through (3) below.
- (5) Repeat technique of (3) and (4) above at remaining function generator frequencies listed in table 12. If function generator output exceeds limit specified in table 12, perform **b** (1) through (3) below.

Table 12. Sensitivity

Function generator output	
Frequency (Hz)	Amplitude limit (mV)
10	≤ 25
100	≤ 25
1000	≤ 25
10000	≤ 25
100000 <sup>1</sup>	≤ 25
1000000 <sup>2</sup>	≤ 25

<sup>1</sup>Set TI function switch to **1S**.

<sup>2</sup>Set TI function switch to **.1S**.

- (6) Set TI function switch to **AUTO** and repeat technique of (3) and (4) above at function generator frequency of 10 MHz. If function generator output exceeds 50 mV and no adjustment was previously made, perform **b** (1) through (3) below.
- (7) Adjust function generator for 10 kHz and minimum output.
- (8) Connect function generator output to **TI A** and **B INPUT** using termination and tee connector.
- (9) Set TI function switch to **.1 μs**.
- (10) Slowly increase function generator amplitude until TI indicates a stable count. If function generator exceeds 25 mV, perform **b** (4) and (5) below.

**b. Adjustments**

- (1) Connect oscilloscope **VERTICAL 1** input to U18 PIN 6 (fig. 2).

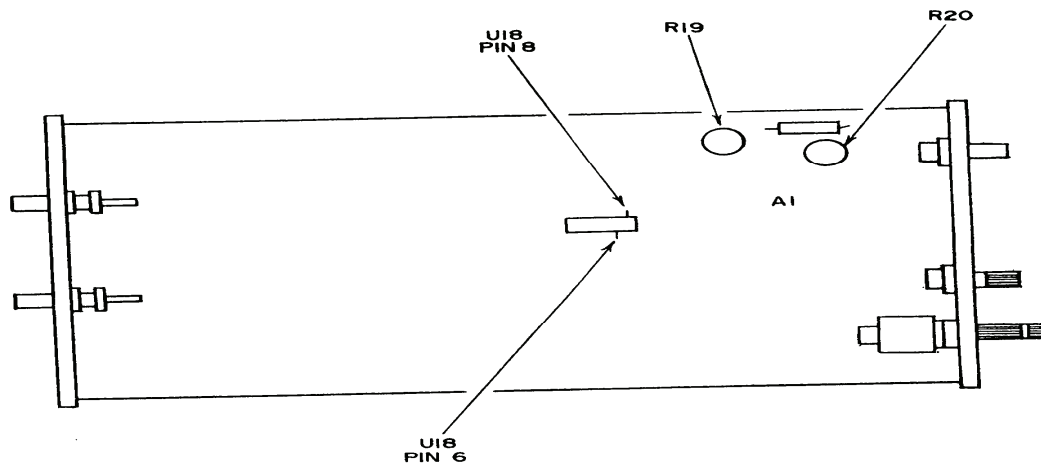


Figure 2. Test instrument - (Hewlett-Packard, Model 5304B) - bottom view.

- (2) Adjust function generator frequency to 10 MHz and amplitude to 50 mV.
- (3) Adjust A1 R20 (fig. 2) for a symmetrical waveform with minimum or no change in duty cycle when **SLOPE** switch is changed from + to - and minimum or no change when **AC/DC** switch is set to **AC** or **DC** (R).
- (4) Connect oscilloscope input to U18 PIN 8 (fig. 2).
- (5) Repeat (2) above and adjust A1 R19 (fig. 2) for a symmetrical waveform with minimum or no change in duty cycle when **SLOPE** switch is changed from + to - and minimum or no change when **AC/DC** switch is set to **AC** or **DC** (R).

## 27. Final Procedure

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

## SECTION VIII CALIBRATION PROCESS FOR MULTIMETER/COUNTER (HEWLETT-PACKARD, MODEL 5306A)

### 28. Preliminary Instructions

- a. The instructions outlined in paragraphs **28** and **29** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.
- b. Items of equipment used in this procedure are referenced within the text by common name as listed in tables 2.
- c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

- d. Unless otherwise specified all controls and controls settings refer to the TI.

## **29. Equipment Setup**

### **WARNING**

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

- a. Remove bottom cover from TI.

### **NOTE**

Do not handle yellow printed circuit board except at extreme edges. Fingerprints on this board may degrade instrument performance.

- b. Mount a calibrated TD-1209/U (Hewlett-Packard, Model 5300A) measuring system on TI and orient the interconnected units upside down.

- c. Connect measuring system to autotransformer and connect autotransformer to a 115 V ac source.

- d. Adjust autotransformer output for 115 V.

- e. Adjust measuring system **SAMPLE RATE** control cw to on position and allow 1 hour for warm-up.

## **30. Dc Voltage**

### **a. Performance Check**

- (1) Connect leads between TI **GUARD** and **LO** terminals and between **LO** and **HI** terminals.

- (2) Press **FUNCTION DCV** and **RANGE 10 V** pushbuttons and release **FAST** pushbutton. Measuring system will indicate 0.0000 ( $\pm 0.0003$ ).

- (3) Press **RANGE 100 V** pushbutton. Measuring system will indicate 00.000 ( $\pm 00.003$ ).

- (4) Press **RANGE 1000 V** pushbutton. Measuring system will indicate 000.00 ( $\pm 000.30$ ).

- (5) Press **RANGE 10 V** pushbutton and remove jumper from **HI** and **LO** terminals.

### **CAUTION**

Do not exceed maximum voltages indicated on front panel of TI.

- (6) Connect calibrator to TI **HI** and **LO** terminals.

- (7) Set calibrator output to +9.0000 V dc. If TI does not indicate within limits specified in first row of table 13, perform corresponding adjustment listed in table 13.

Table 13. DC Voltage

Calibrator Output (Vdc)	Test instrument			
	RANGE	Limits		Adjustment
		Min	Max	
9.0000	<b>10 V</b>	8.9970	9.0030	<b>b (1)</b>
-9.0000	<b>10 V</b>	-9.0030	-8.9970	<b>b (2)</b>
90.000	<b>100 V</b>	89.970	90.030	<b>b (3)</b>
900.00	<b>1000 V</b>	898.83	901.17	<b>b (4)</b>

(8) Repeat technique of (7) above using calibrator outputs and setting TI to range settings listed in table 13. If TI does not indicate within limits specified in table 13, perform corresponding adjustment listed in table.

**b. Adjustments**

(1) Adjust +V ADJ R24 (rear panel) to obtain +9.0000 V dc indication on measuring system (R).

(2) Adjust -V ADJ R1 (rear panel) to obtain -9.0000 V dc indication on measuring system (R).

(3) Adjust A2 R18 (fig. 3) to obtain indication of +90.000 V dc on measuring system (R).

(4) Adjust A2 R24 (fig. 3) to obtain indication of +900.000 V dc on measuring system (R).

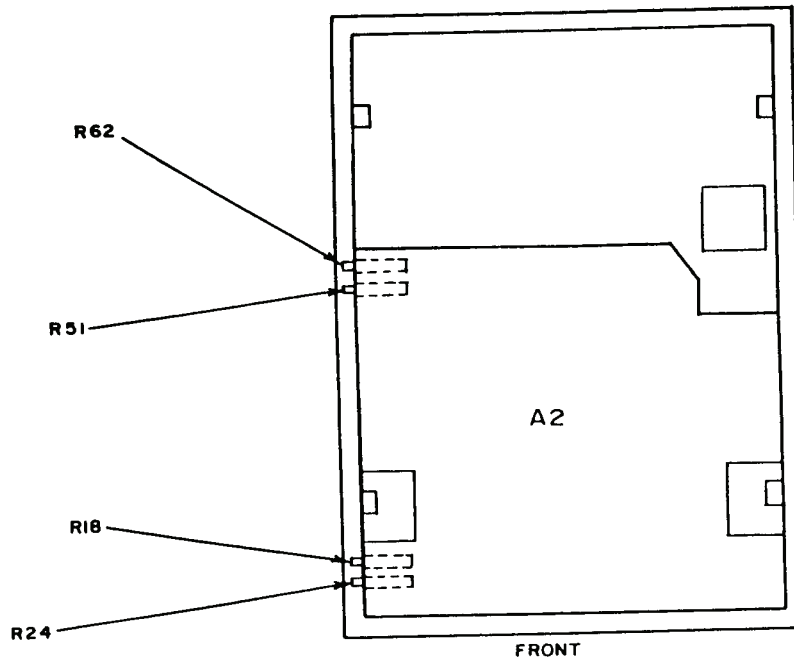


Figure 3. Test instrument - (Hewlett-Packard, Model 5306A) - bottom view.

### 31. Ac Voltage

#### a. Performance Check

- (1) Connect lead between TI **HI** and **LO** terminals.
- (2) Press **FUNCTION ACV** pushbutton and **RANGE** pushbuttons as listed in table 14. If measuring system indications are not as specified in table, perform **b** (1) below.
- (3) Remove lead from **HI** and **LO** terminals.

Table 14. ACV Zero

Test instrument RANGE pushbutton settings (V)	Measuring system indications
10	0.0000 (±0.0020)
100	00.000 (±00.050)
1000	000.00 (±000.50)

- (4) Connect calibrator to TI **HI** and **LO** terminals.
- (5) Press **RANGE 10 V** pushbutton.
- (6) Set calibrator output to 9.000 V at 40 Hz. If TI does not indicate within limits specified in first row of table 15, perform **b** (2) below.
- (7) Repeat technique of (5) and (6) above, using values listed in table 15. If TI does not indicate within limits specified in table 15, perform **b** (2) below.

Table 15. Ac Voltage

Test instrument RANGE pushbuttons	Calibrator output		Test instrument indications (Vac)	
	Voltage	Frequency (Hz)	Min	Max
10	9.000	40	8.9098	9.0902
10	9.000	1000	8.9098	9.0902
10	9.000	100000	8.9018	9.0982
100	90.000	40	88.600	91.400
100	90.000	100	88.600	91.400
100	90.000	500	88.600	91.400
1000	900.00	500	886.00	914.00
1000	900.00	100	886.00	914.00
1000	900.00	40	886.00	914.00

#### b. Adjustments

- (1) Adjust A2 R62 (fig. 3) to obtain best in tolerance compromise of error on each range (R).
- (2) Adjust A2 R51 (fig. 3) to obtain best in tolerance compromise of error on each range (R).

**32. Resistance**

**a. Performance Check**

- (1) Press **FUNCTION OHM** and **RANGE 10 kΩ** pushbuttons.
- (2) Connect calibrator to TI **HI** and **LO** terminals.
- (3) Set calibrator output to 9.9000 kΩ. TI will indicate within limits specified in first row of table 16.
- (4) Repeat technique of (1) and (3) above using TI range settings and calibrator outputs listed in table 16. TI will indicate within limits specified in table 16.

Table 16. Resistance

Calibrator Output (Ω)	Test instrument		
	RANGE	Limits	
		Min	Max
9.9000 k	<b>10 kΩ</b>	9.8502 kΩ	9.9498 kΩ
99.000 k	<b>100 kΩ</b>	98.502 kΩ	99.498 kΩ
9.9000 M	<b>10 MΩ</b>	9.8258 MΩ	9.9742 MΩ

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

**33. Final Procedure**


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

0911807

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

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342292, requirements for calibration procedure TB 9-6625-2215-24.



### 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](mailto:whomever@redstone.army.mil)  
To: <2028@redstone.army.mil

Subject: DA Form 2028

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

This is the text for the problem below line 27.





