# *TB 9-6625-2215-35

## DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

# 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

Headquarters, Department of the Army, Washington, DC
3 June 2004



**REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS**

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



*This bulletin supersedes TB 9-6625-2215-35, dated 9 September 1988, including all changes.

## 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<br>Stability: Aging rate <3 parts in $10^7$/month<br>Line stability: <± 1 part in $10^7$ for 10% line variation |
| TD-1211/U (Hewlett-Packard, Model 5302A) | |
| Frequency | Range:<br>Channel A: 10 Hz to 50 MHz<br>Channel B: 10 Hz to 10 MHz |
| Sensitivity | 25 mV rms: 50 Hz to 1 MHz<br>50 mV rms: 10 Hz to 10 MHz<br>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<br>50 mV rms: 10 Hz to 10 MHz |

Table 1. Calibration Description - Continued

| Test instrument parameters | Performance specifications |
|---|---|
| Hewlett-Packard, Model 5303A | |
| Frequency | Range:<br>Channel A: Dc to 500 MHz<br>Channel B: 10 Hz to 50 MHz |
| Sensitivity | 100 mV rms: Channel A<br>50 mV rms: Channel B, 20 Hz to 10 MHz<br>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<br>Stability: Aging rate: <1.2 parts in $10^6$/year<br>Line voltage: <± 5 parts in $10^8$ for 10% line variation |
| Frequency | Range:<br>525 MHz channel: Dc to 525 MHz<br>80 MHz channel: 50 Hz to 80 MHz |
| Sensitivity[1] | 525 MHz channel:<br>100 mV rms: Dc to 500 MHz<br>125 mV rms: 500 to 525 MHz<br>80 MHz channel:<br>25 mV rms: 100 Hz to 50 MHz<br>50 mV rms: 50 to 100 Hz, and 50 to 80 MHz |
| Hewlett-Packard, Model 5304A | |
| Frequency | Range: 0 to 10 MHz (dc coupled)<br>100 Hz to 10 MHz (ac coupled) |
| Sensitivity | 25 mV rms: 0 to 1 MHz<br>50 mV rms: 1 to 10 MHz |
| Hewlett-Packard, Model 5306A | |
| Dc voltage | Range: 0 to ±1000 V in 3 ranges<br>Accuracy: ±10 and ±100 V ranges: ± (0.03% of reading +0.003% of range)<br>±1000 V range: ± (0.097% of reading +0.03% of range) |
| Ac voltage | Range: 0 to 1000 V in 3 ranges<br>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)<br>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,<br>Accuracy: 10 and 100 kΩ, ±(0.5% of reading +0.003% of range)<br>10 MΩ range, ±(0.75% of reading +0.003% of range) |

[1]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 or AN/GSM-705. 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 ratio between the standard and TI.

**5. Accessories Required.** The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

| Common name | Minimum use specifications | Manufacturer and model (part number) |
|---|---|---|
| AUTOTRANSFORMER | Range: 105 to 125 V ac<br>Accuracy: ±1% | General Radio, Type W10MT3AS3 (7910809) or Ridge, Model 9020A (9020A), or Ridge, Model 9020F (9020F) |
| CALIBRATOR | Range: 8.9 to 914 V ac at 40 to 100 kHz<br>Accuracy: ±0.25%<br>Range: -9.5 to 950.77 Vdc<br>Accuracy: ±0.008%<br>Range: 9 kΩ to 10 MΩ<br>Accuracy: ±0.1% | Fluke, Model 5720A (5700A/EP) (p/o MIS-35947); w/power amplifier, Fluke 5725A/AR (5725A/AR) |
| FREQUENCY COUNTER | Range: 10 MHz<br>Accuracy: 1 part in $10^8$ | Fluke, Model PM6681/656 (PM6681/656) |
| FREQUENCY DIFFERENCE METER | Resolution: 1 part in $10^{10}$ | Tracor, Model 527E (MIS-10318) |
| FUNCTION/ARBITRARY GENERATOR | Range: 10 Hz to 80 MHz<br>Amplitude: 0 to 100 mV | Agilent, Model 33250A (33250A) |
| OSCILLOSCOPE | X-Y mode capability | Tektronix, Type 2465BOPT46 (2465BOPT46) |
| SIGNAL GENERATOR | Range: 80 to 500 MHz<br>Amplitude: 0 to 100 mV | (SG-1207/U) |
| TIME/FREQUENCY WORKSTATION | Range: 1 MHz<br>Accuracy: ±1 part in $10^{10}$ | 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 ± l 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/arbitrary 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/arbitrary generator for a 10 Hz sine wave frequency signal and amplitude to minimum output.

(4) Slowly increase function/arbitrary generator amplitude until TI measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 50 mV.

(5) Adjust frequency of function/arbitrary generator for 50 Hz and amplitude to minimum output.

(6) Slowly increase function/arbitrary generator amplitude until TI measuring system indicates a stable count of the applicable frequency. If function/arbitrary generator output exceeds 25 mV, perform **b** below.

(7) Repeat technique of (5) and (6) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; and 1 MHz.

(8) Set **TIME BASE** switch to **AUTO** and repeat technique of (3) and (4) above at function/arbitrary generator frequency of 10 MHz.

(9) Adjust function/arbitrary generator frequency for 50 MHz and amplitude to minimum output.

(10) Slowly increase function/arbitrary generator amplitude until TI measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 100 mV.

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

(12) 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**.

(13) Repeat (3) through (8) above.

**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/arbitrary generator for 100 kHz and amplitude of 25 mV.

(3) Adjust A1R59 (A channel) closest to front panel or A1R57 (B channel) near rear of TI to obtain stable indication of applied frequency.

(4) While reducing function/arbitrary generator amplitude, adjust A1R59 (A channel) or A1R57 (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/arbitrary generator output to TI **INPUT**, using termination.

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

(4) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 50 mV.

(5) Adjust frequency of function/arbitrary generator for 50 Hz and amplitude to minimum output.

(6) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 25 mV.

(7) Repeat technique of (5) and (6) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; and 1 MHz.

**NOTE**

Set **GATE** switch to **1S** for 100 kHz check and **.1S** for 1 MHz check.

(8) Set **GATE** switch to **AUTO** and repeat technique of (3) and (4) above at function/arbitrary generator frequency of 10 MHz.

**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/arbitrary generator output to TI 1 MΩ input, using termination.

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

(4) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 100 mV.

(5) Adjust frequency of function/arbitrary generator for 50 Hz and amplitude to minimum output.

(6) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 50 mV.

(7) Repeat technique of (5) and (6) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; and 1 MHz.

**NOTE**

Set **GATE TIME SEC** switch to **1** for 100 kHz check and **.1** for 1 MHz check.

(8) Set **RANGE MHz** switch to **50** (blue).

(9) Adjust function/arbitrary generator frequency for 50 MHz and amplitude to minimum output.

(10) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. Function/arbitrary generator output will not exceed 100 mV.

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

(12) Adjust function/arbitrary generator frequency for 10 Hz and amplitude to minimum output.

(13) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. If function/arbitrary generator output exceeds 100 mV, perform **b** below.

(14) Repeat technique of (12) and (13) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; 1 and 10 MHz.

(15) Repeat (9) through (10) above. If function/arbitrary generator output exceeds 100 mV and no adjustment was performed in (13) above, perform **b** below.

(16) Set **RANGE MHz** switch to **500.**

(17) Substitute signal generator for function/arbitrary generator.

(18) Adjust signal generator for frequencies of 100, 300, and 500 MHz and at each frequency 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 100 mV and no adjustment was previously made, perform **b** below.

**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 adjustment (fig. 1) as required to obtain frequency counter indication of exact frequency stamped on TCXO case (fig. 1).

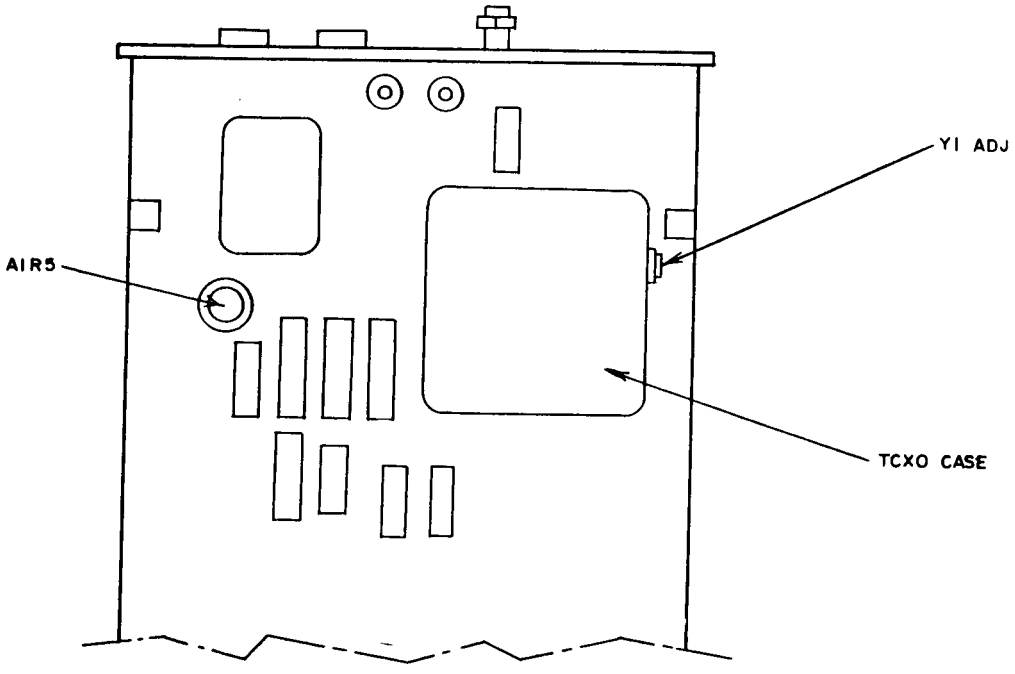



Figure 1. Test instrument - (Hewlett-Packard, Model 5303B) - bottom view.

(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.

(2) Connect function/arbitrary generator output to TI 80 MHz jack, using termination.

(3) Adjust function/arbitrary generator frequency for 50 Hz and slowly increase amplitude until measuring system indicates a stable count of applied frequency. Function/arbitrary generator output will not exceed 50 mV.

(4) Repeat technique of (3) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; and at 1 and 10 MHz. Output amplitude of function/arbitrary generator at each frequency will not exceed 25 mV.

**NOTE**

Press **100 Hz RESOLUTION** pushbutton for frequencies above 100 Hz.

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

(6) Adjust function/arbitrary generator frequency for 10 Hz and slowly increase amplitude until measuring system indicates a stable count of applied frequency. Function/arbitrary generator output will not exceed 100 mV.

(7) Repeat technique of (6) above at frequencies of 100 Hz; 1, 10, and 100 kHz; and at 1 and 10 MHz. If function/arbitrary generator output exceeds 100 mV, perform **b** below.

(8) Substitute signal generator for function/arbitrary generator.

(9) Press **1 kHz RESOLUTION** pushbutton in and repeat technique of (6) above at signal generator frequencies of 100 and 500 MHz. If signal generator output exceeds 100 mV and no adjustments were previously made, perform **b** (2) through (5) below.

(10) Remove signal input from 525 MHz jack and press **80 MHz RANGE** pushbutton.

(11) Connect function/arbitrary generator output to TI 80 MHz jack, using termination.

(12) Adjust function/arbitrary generator frequency for 25 MHz and slowly increase amplitude until measuring system indicates a stable count of applied frequency. Signal generator amplitude will not exceed 25 mV.

(13) Repeat technique of (12) above at function/arbitrary generator frequencies of 50 and 80 MHz. Function/arbitrary generator amplitude will not exceed 25 mV at 50 MHz, or 50 mV at 80 MHz.

**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/arbitrary generator output to TI **A INPUT**, using termination.

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

(4) Slowly increase function/arbitrary generator amplitude until measuring system indicates a stable count of the applied frequency. If function/arbitrary generator output exceeds 25 mV, perform **b** (1) through (3) below.

(5) Repeat technique of (3) and (4) above at function/arbitrary generator frequencies of 100 Hz; 1, 10, and 100 kHz; and 1 MHz.

**NOTE**

Set function switch to **1S** for 100 kHz check and **.1S** for 1 MHz check.

(6) Set TI function switch to **AUTO** and repeat technique of (3) and (4) above at function/arbitrary generator frequency of 10 MHz. If function/arbitrary generator output exceeds 50 mV and no adjustment was previously made, perform **b** (1) through (3) below.

(7) Adjust function/arbitrary generator for 10 kHz and minimum output.

(8) Connect function/arbitrary 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/arbitrary generator amplitude until TI indicates a stable count. If function/arbitrary generator exceeds 25 mV, perform **b** (4) and (5) below.

**b. Adjustments**

(1) Connect oscilloscope CH 1 input to U18 pin 6 (fig. 2).

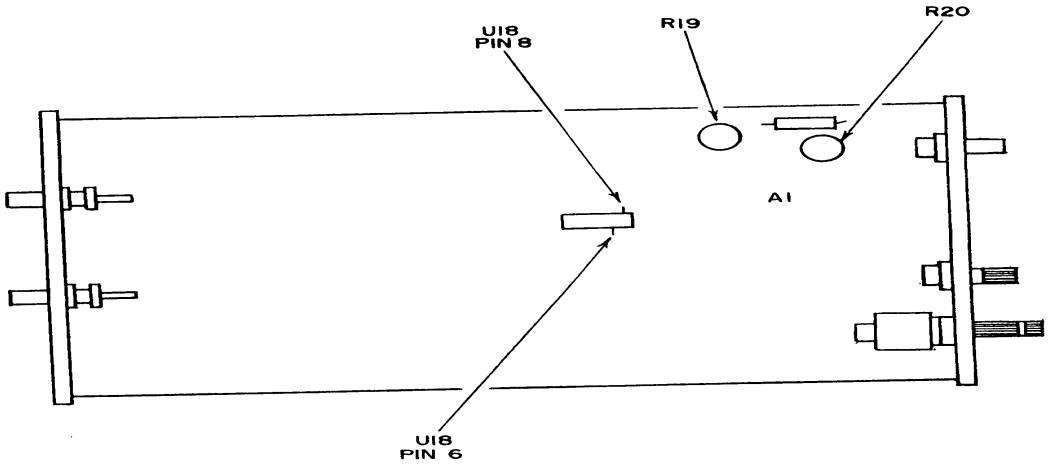



Figure 2. Test instrument - (Hewlett-Packard, Model 5304B) - bottom view.

(2) Adjust function/arbitrary generator frequency to 10 MHz and amplitude to 50 mV.

(3) Adjust AlR20 (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 A1R19 (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 (±0.0003).

(3) Press **RANGE 100 V** pushbutton. Measuring system will indicate 00.000 (±00.003).

(4) Press **RANGE 1000 V** pushbutton. Measuring system will indicate 000.00 (±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 between 8.9970 and 9.0030, perform **b** (1) below.

(8) Set calibrator output to -9.0000 V dc. If TI does not indicate between -8.9970 and –9.0030 V dc, perform **b** (2) below.

(9) Press **RANGE 100V** pushbutton.

(10) Set calibrator output to +90.000 V dc. If TI does not indicate between +89.970 and +90.030 V dc, perform **b** (3) below.

(11) Press **RANGE 1000V** pushbutton.

(12) Set calibrator output to +900.000 V dc. If TI does not indicate between +898.83 and +901.17 V dc, perform **b** (4) below.

**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 A2R18 (fig. 3) to obtain indication of +90.000 V dc on measuring system (R).

(4) Adjust A2R24 (fig. 3) to obtain indication of +900.000 V dc on measuring system (R).

**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 3. If measuring system indications are not as specified in table, perform **b** (1) below.

(3) Remove lead from **HI** and **LO** terminals.

Table 3. 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) |

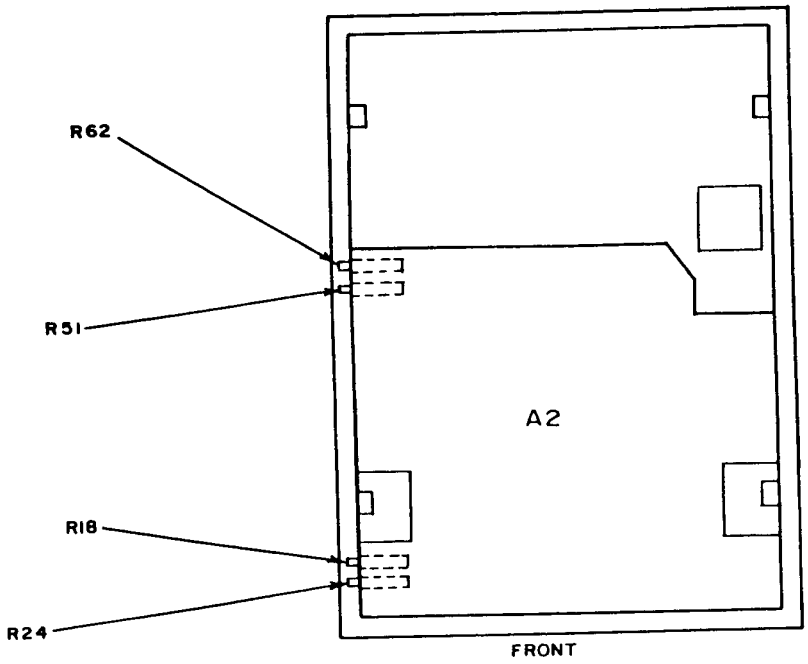



Figure 3. Test instrument - (Hewlett-Packard, Model 5306A) - bottom view.

(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 between 8.9098 and 9.0902 V ac, perform **b** (2) below.

(7) Repeat technique of (5) and (6) above, using values listed in table 4.

Table 4. Ac Voltage

| Test instrument **RANGE** pushbuttons | Calibrator output | | Test instrument indications (Vac) | |
|---|---|---|---|---|
| | Voltage | Frequency (Hz) | Min | Max |
| 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 A2R62 (fig. 3) to obtain best in tolerance compromise of error on each range (R).

(2) Adjust A2R51 (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 between 9.8502 and 9.9498 kΩ**.**

(4) Press **RANGE 100 kΩ** pushbutton.

(5) Set calibrator output to 99.000 kΩ. TI will indicate between 98.502 and 99.498 kΩ.

(6) Press **RANGE 10 MΩ** pushbutton.

(7) Set calibrator output to 9.9000 MΩ. TI will indicate between 9.8258 and 9.9742 MΩ**.**

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

**33. Final Procedure**

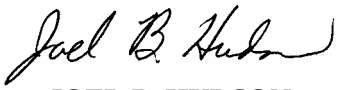
**a.** Deenergize and disconnect all equipment and reinstall protective cover on TI.

**b.** Annotate and affix DA Label/Form in accordance with TB 750-25.

By Order of the Secretary of the Army:

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

OFFICIAL:



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

0409601

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 342292, requirements for calibration procedure TB 9-6625-2215-35.

## Instructions for Submitting an Electronic 2028

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

From: "Whomever" whomever@redstone.army.mil
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.