

# TB 9-6625-2334-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

## CALIBRATION PROCEDURE FOR UNIVERSAL COUNTER, HEWLETT-PACKARD, MODEL 5328B( )

Headquarters, Department of the Army, Washington, DC

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### REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

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**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Universal Counter, Hewlett-Packard, Model 5328B( ). The manufacturer's manual was 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**

(1) Model 5328B may have the following options:

- |     |  |
|-----|--|
| 010 | High-stability time base oscillator.     |
| 021 | Digital voltmeter.                       |
| 031 | Channel C (90-1300 MHz frequency range). |

**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  |
|-------------------------------------|---|
| Time base stability (Option 010):   | Frequency: 10 MHz<br>Aging rate (after 24 hr warm-up): $<5 \times 10^{-10}$ /day<br>Line voltage stability (for 10% variation): $<5 \times 10^{-9}$   |
| Channel A and B sensitivity:        | 25 mV rms: Dc to 40 MHz (dc coupled)<br>20 Hz to 40 MHz (ac coupled)<br>50 mV rms: 40 to 100 MHz  |
| Channel C sensitivity (Option 031): | 20 mV rms: 90 to 1300 MHz   |
| Digital voltmeter (Option 021):     | Range: $\pm 10$ , $\pm 100$ , $\pm 1000$ V dc and autoranging<br>Accuracy:<br>10, 100 V ranges: $\pm 0.03\%$ of reading, $\pm 0.004\%$ of range<br>1000 V range: $\pm 0.087\%$ of reading, $\pm 0.004\%$ of range |

**SECTION II  
EQUIPMENT REQUIREMENTS**

**4. Equipment Required.** Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2.

**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  | General Radio, Model W10MT3AS3 or Ridge, Model 9020F (7910809) |
| CALIBRATOR                 | Range: -9.5 to 950 V dc<br>Accuracy: ±0.0085%                     | John Fluke, Model 5700A/CT (p/o MIS-35947)                     |
| FREQUENCY DIFFERENCE METER | Range: ±5 part in 10 <sup>10</sup>                                | Tracor, Model 527E (527E)                                      |
| FUNCTION GENERATOR         | Range: 10 Hz to 1 MHz<br>Amplitude: 1 mV to 6 V p-p               | (SG-1288/G)  |
| MULTIMETER                 | Range: 10 to 15 V dc  | John Fluke, Model 8840A/AF-05/09 (AN/GSM-64D)                  |
| SIGNAL GENERATOR           | Range: 10 to 1300 MHz<br>Amplitude: 1 to 50 mV                    | (SG-1207/U)  |
| TIME/FREQUENCY WORKSTATION | Range: 1 MHz<br>Accuracy: ±1.25 parts in 10 <sup>10</sup> per day | Autek Systems Corp., Model 620 (MIS-38946)                     |

**SECTION III  
CALIBRATION PROCESS**

**6. Preliminary Instructions**

**a.** The instructions outlined in paragraphs 6 and 7 are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

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

**c.** Unless otherwise specified, verify the 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.

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- 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. Connect TI to autotransformer.
- b. Connect autotransformer to a 115 V ac power source and adjust output to 115 V.
- c. Set power switch to **ON** and allow at least 1 hour for warmup. If TI has been disconnected from line power for more than 24 hours, allow at least 24 hours for warmup before beginning calibration.
- d. Position controls as listed in (1) through (12) below:
  - (1) **FUNCTION** switch to **FREQ A**.
  - (2) **FREQ RESOLUTION, N** switch to **1Hz**.
  - (3) **SAMPLE RATE** control fully ccw.
  - (4) **LEVEL A** and **LEVEL B** controls to **PRESET**.
  - (5) **CHANNEL A** and **B DC/AC** switches to **DC**.
  - (6) **CHANNEL A** and **B ATTEN** switches to **X1**.
  - (7) **CHANNEL A** and **B SLOPE** switches to **+**.
  - (8) **CHK/COM A/SEP** switch to **SEP**.
  - (9) **1M/50W** switch to **1M**.
  - (10) **ARM** switch (rear panel) to **OFF**.
  - (11) **STORAGE** switch (rear panel) to **OFF**.
  - (12) **OSC** switch (rear panel) to **INT**.

**8. Time Base Stability (Option 010)**

**a. Performance Check**

- (1) Connect time/frequency workstation **OUTPUT 1 MHz** to frequency difference meter **REF INPUT**.
- (2) Connect TI rear panel **10MHz OUT** to frequency difference meter **SIG INPUT**.
- (3) Adjust **FREQ ADJ** (fig. 1) for minimum difference indication on frequency difference meter. Record frequency difference meter indication.

(4) After 24 hour stabilization, frequency difference meter indication will be <5 parts in  $10^{10}$  of indication recorded in (3) above. Record frequency difference meter indication.

**NOTE**

It may be necessary to wait 5 minutes after each voltage change in (5) below for oscillator to stabilize.

(5) Adjust autotransformer from 105 to 125 V ac and verify frequency difference meter indication remains <5 parts in  $10^9$  of indication recorded in (4) above.

(6) Adjust autotransformer to 115 V ac.

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

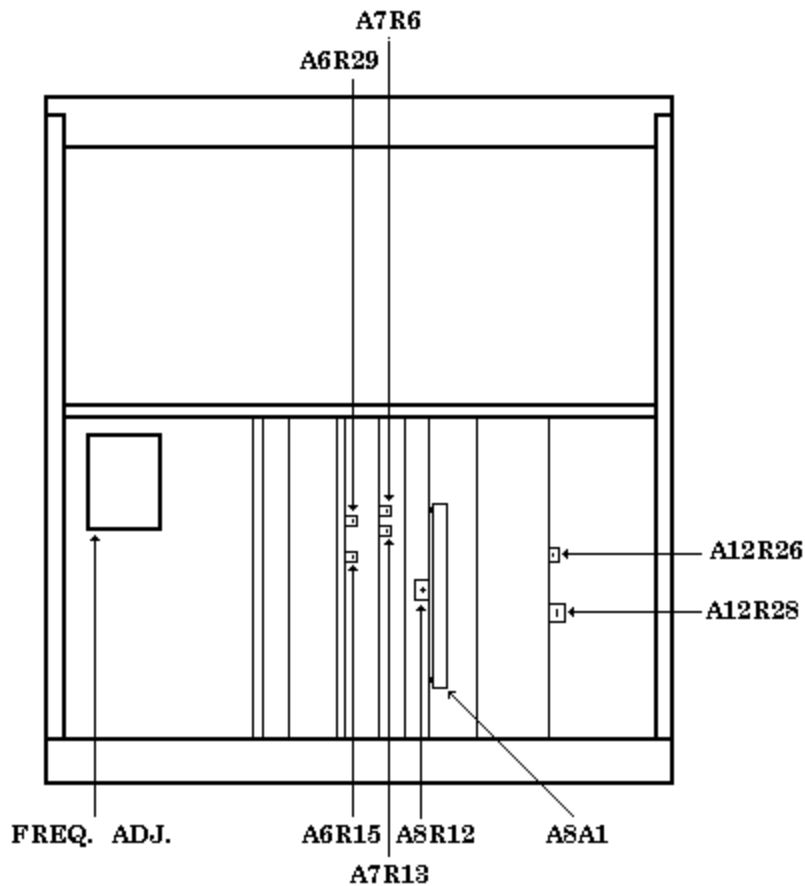


Figure 1. Test instrument - top view.

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### **9. Channel A Sensitivity**

#### **a. Performance Check**

(1) Connect function generator **Function Outputs Unbalanced** to TI **INPUT A** using 50 $\Omega$  feedthrough termination.

(2) Set function generator for a sine wave, 10 Hz, 1 mVp-p, 50 $\Omega$  output. Slowly increase function generator amplitude until TI indication is stable at applied frequency. If function generator amplitude exceeds 71 mVp-p, perform **b** below.

(3) Repeat (2) above at 1 kHz, 10 kHz, 100 kHz, and 1 MHz.

(4) Set **CHANNEL A DC/AC** switch to **AC**.

(5) Repeat (2) above at 20 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz.

(6) Set **FREQ RESOLUTION, N** switch to **10Hz**.

(7) Disconnect function generator from TI

(8) Connect signal generator **OUTPUT RF** to TI **INPUT A** using 50 $\Omega$  feedthrough termination.

(9) Set signal generator for a 10 MHz, 1 mV output. Slowly increase signal generator amplitude until TI indication is stable at applied frequency. If signal generator amplitude exceeds 25 mV, perform **b** below.

(10) Repeat (9) above at 40 MHz.

(11) Repeat technique of (9) above at 70 and 100 MHz. If signal generator amplitude exceeds 50 mV, perform **b** below.

(12) Set **CHANNEL A DC/AC** switch to **DC** and repeat (9) through (11) above.

#### **b. Adjustments**

(1) Connect signal generator **OUTPUT RF** to TI **INPUT A** using 50 $\Omega$  feedthrough termination.

(2) Set signal generator for a 100 MHz, 50 mV output.

(3) Slowly decrease signal generator amplitude to 25 mV while adjusting A12R28 (fig. 1) to obtain a stable indication of applied frequency (R). Continue decreasing signal generator amplitude while adjusting A12R28 (fig. 1) until maximum sensitivity is achieved.

### **10. Channel B Sensitivity**

#### **a. Performance Check**

(1) Set TI switches as listed in (a) through (d) below:

(a) **FUNCTION** to **RATIO B/A**.

(b) **FREQ RESOLUTION, N** to **1Hz**.

(c) **CHANNEL A DC/AC** to **AC**.

(d) **CHANNEL A ATTEN** to **X10**.

(2) Connect TI rear panel internal 10 MHz oscillator output (**10MHz OUT** for option 010) to TI **INPUT A**.

(3) Connect function generator **Function Outputs Unbalanced** to TI **INPUT B** using 50Ω feedthrough termination.

**NOTE**

In (4) through (10) below the TI indications are not critical but should be stable. Only the channel B input sensitivity is being checked.

(4) Set function generator for a sine wave, 10 kHz, 1 mVp-p, 50Ω output. Slowly increase function generator amplitude until TI indicates 0.001000. If function generator amplitude exceeds 71 mVp-p, perform **b** below.

(5) Repeat (4) above using frequencies and indications listed in table 4.

Table 4. Channel B Sensitivity

| Function generator frequencies | Test instrument indications |
|--------------------------------|-----------------------------|
| 10 Hz                          | 0.000001                    |
| 100 Hz                         | 0.000010                    |
| 1 kHz                          | 0.000100                    |
| 100 kHz                        | 0.010000                    |
| 1 MHz                          | 0.100000                    |

(6) Disconnect function generator from TI.

(7) Connect signal generator **OUTPUT RF** to TI **INPUT B** using 50Ω feedthrough termination.

(8) Set TI **FREQ RESOLUTION, N** switch to **10Hz**.

(9) Set signal generator for a 10 MHz, 1 mV output. Slowly increase signal generator amplitude until TI indicates 1.00000. If signal generator amplitude exceeds 25 mV, perform **b** below.

(10) Repeat technique of (9) above using frequencies and indications listed in table 5. If signal generator amplitude exceeds values listed in table 5, perform **b** below.

Table 5. Channel B Sensitivity

| Signal generator |               | Test instrument indications |
|------------------|---------------|-----------------------------|
| Frequencies      | Amplitude (≤) |                             |
| 40 MHz           | 25 mV         | 4.00000                     |
| 70 MHz           | 50 mV         | 7.00000                     |
| 100 MHz          | 50 mV         | 10.00000                    |

(11) Disconnect signal generator from TI.

(12) Set TI **FREQ RESOLUTION, N** switch to **1Hz** and **CHANNEL B DC/AC** switch to **AC**.

(13) Repeat (3) through (11) above substituting 20 Hz for 10 Hz and 0.000002 for 0.000001 in table 4.

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### **b. Adjustments**

(1) Connect signal generator **OUTPUT RF** to TI **INPUT B** using 50 $\Omega$  feedthrough termination.

(2) Set signal generator for a 40 MHz, 50 mV output.

(3) Slowly decrease signal generator amplitude while adjusting A12R26 (fig. 1) for a stable TI 4.00000 indication. Continue decreasing signal generator amplitude while adjusting A12R26 (fig. 1) until maximum sensitivity is obtained (R).

## **11. Channel C Sensitivity (Option 031)**

### **a. Performance Check**

(1) Connect signal generator **OUTPUT RF** to TI **CHANNEL C** input.

(2) Set **FUNCTION** switch to **FREQ C** and **FREQ RESOLUTION, N** switch to **1 kHz**.

(3) Set signal generator for a 90 MHz, 1 mV output. Slowly increase signal generator amplitude until TI indication is stable at applied frequency. If signal generator amplitude exceeds 20 mV, perform **b** below.

(4) Repeat (3) above at 300, 600, 900, and 1300 MHz.

### **b. Adjustments**

(1) Set TI **RESOLUTION, N** switch to **.1kHz**.

(2) Adjust A8R12 (fig. 1) fully ccw.

(3) Set signal generator for a 1299 MHz, 100 mV output. Slowly decrease signal generator amplitude while adjusting A8A1 (fig. 1) R22 for maximum sensitivity (at least 20 mV) and a stable indication at approximately 1299 MHz (R).

(4) Set signal generator for a 90 MHz, 100 mV output. Slowly decrease signal generator amplitude until TI displays erroneous indications above 100 MHz (Example: 101.nnnnn).

(5) Adjust A8R12 (fig. 1) until TI stops gating (R).

(6) Set signal generator for a 90 MHz, 125 mV output.

(7) Connect multimeter **INPUT HI** to A8A1 (fig. 1) pin 1 and **LO** to ground.

(8) Adjust A8A1 (fig. 1) R13 until multimeter indication switches from approximately 12 to 15 V dc to 10 V dc (R).



**12. Digital Voltmeter (Option 021)**

**a. Performance Check**

- (1) Position controls as listed in (a) through (e) below:
  - (a) **FUNCTION** switch to **DVM**.
  - (b) **FREQ RESOLUTION, N** switch to **1Hz**.
  - (c) **DCV RANGE** switch to **AUTO**.
  - (d) **FILTER** switch to **OFF**.
  - (e) **READ A** and **READ B** pushbuttons out.
- (2) Short TI **HI** and **LO**. If TI display does not indicate between -0.0004 V and +0.0004 V, perform **b(1)** below.
- (3) Disconnect short from TI **HI** and **LO**.
- (4) Connect calibrator **OUTPUT HI** and **LO** to TI **HI** and **LO**.
- (5) Set calibrator output for settings listed in table 6. If TI does not indicate within limits specified, perform corresponding adjustments.

Table 6. Digital Voltmeter Check

| Calibrator output settings (V dc) | Test instrument indications (V) |         | Adjustments |
|-----------------------------------|---------------------------------|---------|-------------|
|                                   | Min                             | Max     |             |
| +9.5                              | +9.5033                         | +9.4967 | <b>b(2)</b> |
| -9.5                              | -9.5033                         | -9.4967 | <b>b(3)</b> |
| +95                               | +94.967                         | +95.033 | <b>b(4)</b> |
| +950                              | +949.13                         | +950.87 | <b>b(5)</b> |

**b. Adjustments**

- (1) Adjust DVM zero A6R28 (accessible through a hole in TI front panel) for a TI indication between -0.0001 and +0.0001 (R).
- (2) Adjust A7R13 (fig. 1) for a TI indication between +9.4999 and +9.5001 (R).
- (3) Adjust A7R6 (fig. 1) for a TI indication between -9.4999 and -9.5001 (R).
- (4) Adjust A6R29 (fig. 1) for a TI indication between +94.999 and +95.001 (R).
- (5) Adjust A6R15 (fig. 1) for a TI indication between +949.99 and +950.01 (R).

**13. Final Procedure**

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

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To: [2028@redstone.army.mil](mailto:2028@redstone.army.mil)

Subject: DA Form 2028

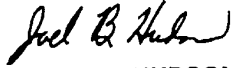
1. **From:** Joe Smith
2. **Unit:** Home
3. **Address:** 4300 Park
4. **City:** Hometown
5. **St:** MO
6. **Zip:** 77777
7. **Date Sent:** 19-Oct-93
8. **Pub No:** TB 9-6625-xxxx-35
9. **Pub Title:** Calibration Procedure for ...
10. **Publication Date:**
11. **Change Number:**
12. **Submitted Rank:** MSG
13. **Submitter Fname:** Joe
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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:**

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*Chief of Staff*

**OFFICIAL:**



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