

***TB 9-6625-2217-35**

SUPERSEDED COPY DATED 4 NOVEMBER 1996

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL ELECTRONIC COUNTER AN/USM-459A, (RACAL DANA, MODEL 1992, OPTIONS 04E AND 55)

Headquarters, Department of the Army, Washington, DC

14 November 1998

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*This bulletin supersedes TB 9-6625-2217-35, dated 4 November 1996, including all changes.

**SECTION I
IDENTIFICATION AND DESCRIPTION**

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Electronic Counter, AN/USM-459A (Racal Dana, Model 1992, Options 04E and 55). The manufacturer's manual and TM 11-6625-3232-40 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. Model 1992, option 04E, is the high stability ovened oscillator and option 55 is the GPIB interface.

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
Timebase	Frequency: 10 MHz Aging rate: $<\pm 1 \times 10^{-9}$ per day after 48 hours operation Line variation: $<\pm 5 \times 10^{-10}$ for 10% line variation
Channel A sensitivity	25 mV rms: Dc to 100 MHz (dc coupled) 10 Hz to 100 MHz (ac coupled) 50 mV rms: 100 to 160 MHz
Channel B sensitivity	25 mV rms: Dc to 100 MHz (dc coupled) 10 Hz to 100 MHz (ac coupled)
Channel C sensitivity	<15 mV rms: 40 MHz to 1 GHz <75 mV rms: 1 to 1.3 GHz
Trigger level outputs	Range: -5.1 to +5.1 V Accuracy: $\pm 1\%$ V output ± 10 mV

**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. 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 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, Type W10MT3AS3 (7910809) or Ridge, Model 9020A (9020A), or Ridge, Model 9020F (9020F)
FREQUENCY DIFFERENCE METER	Range: ± 5 parts in 10^{10}	Tracor, Model 527E (527E)
FUNCTION GENERATOR	Function: Sine wave, 50Ω Frequency: 10 Hz, 5 kHz, 100 kHz Amplitude: 1 to 71 mVp-p	(SG-1288/G)
MULTIMETER	Range: ± 5.06 V dc Accuracy: $\pm 0.3\%$	Fluke, Model 8840A/AF-05/09 (AN-GSM-64D)
SIGNAL GENERATOR	Frequency: 10 to 1300 MHz Amplitude: 1 to 75 mVrms	(SG-1207/U)
TIME/FREQUENCY WORKSTATION	Range: 10 MHz Accuracy: 1.25 parts in 10^{10}	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.

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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. Additional maintenance information is contained in the manufacturer's manual and TM 11-6625-3232-40 for this TI.

d. Unless otherwise specified, all control 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. Remove protective covers as needed to make adjustments.

b. Connect TI to autotransformer and connect autotransformer to a 115 V ac source and adjust for 115 V output.

c. Press **POWER ON OFF** pushbutton to **ON** and allow at least 72 hours for stabilization.

d. TI will assume the following states:

(1) Display **00000000**.

(2) **Hz, RESOLUTION, FREQ A, INPUT A**  and **INPUT B** 
LEDs ON.

(3) **INPUT A** and **INPUT B TRIG** LEDs may be ON or OFF.

8. Time Base Stability

a. Performance Check

(1) Connect time/frequency workstation **OUTPUT 1 MHz** to frequency difference meter **REF INPUT**.

(2) Connect TI **10MHz STD. OUTPUT** to frequency difference meter **SIG INPUT**.

(3) Adjust TI rear panel **FREQ STD ADJUST FINE** and **COARSE** for a minimum difference indication on frequency difference meter.

(4) Record frequency difference meter indication.

(5) Allow at least 24 hours for oscillator stabilization. Frequency difference meter indication will remain within 1 part in 10^9 of indication recorded in (4) above.

(6) Adjust autotransformer output to 105 V and allow 2 minutes for stabilization. Frequency difference meter will indicate a drift of less than 5 parts in 10^{10} .

(7) Adjust autotransformer output to 125 V and allow 2 minutes for stabilization. Frequency difference meter will indicate a drift of less than 5 parts in 10^{10} .

(8) Adjust autotransformer output to 115 V.

(9) Disconnect frequency difference meter from TI.

b. Adjustments. No further adjustments can be made.

9. Channel A Sensitivity

a. Performance Check

(1) Press TI **INPUT A 50Ω/1MΩ** key to select **50Ω** (LED ON).

(2) Connect signal generator **OUTPUT RF** to TI **INPUT A**.

(3) Set signal generator frequency to 160 MHz and amplitude to 1 mV. Slowly increase signal generator amplitude until TI displays a stable indication at approximately 160 MHz. If signal generator amplitude exceeds 50 mV, perform **b** below.

(4) Repeat technique of (3) above at 100 MHz and 10 MHz; if signal generator amplitude exceeds 25 mV, perform **b** below.

(5) Disconnect TI from signal generator.

(6) Connect TI **INPUT A** to function generator **Function Outputs Unbalanced**.

(7) Press TI **RESET/CONTINUE** key.

(8) Set function generator for a sine wave, 100 kHz, 1 mVp-p, 50Ω output. Slowly increase function generator amplitude until TI displays a stable indication at approximately 100 kHz. If function generator amplitude exceeds 71 mVp-p; perform **b** below.

(9) Repeat (8) above at 5 kHz and 10 Hz.

(10) Disconnect function generator from TI.

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b. Adjustments

(1) Disconnect signal or function generator from TI **INPUT A** and press TI **RESET/CONTINUE** key.

(2) Adjust R149 (fig. 1) fully ccw.

(3) Adjust R192 (fig. 1) to its mid-point.

(4) Press TI **RESOLUTION** ↓ key until display indicates **000**.

(5) Connect signal generator rear panel **EXT REF INPUT** to TI rear panel **10MHz STD. OUTPUT**.

(6) Connect signal generator **OUTPUT RF** to TI **INPUT A**.

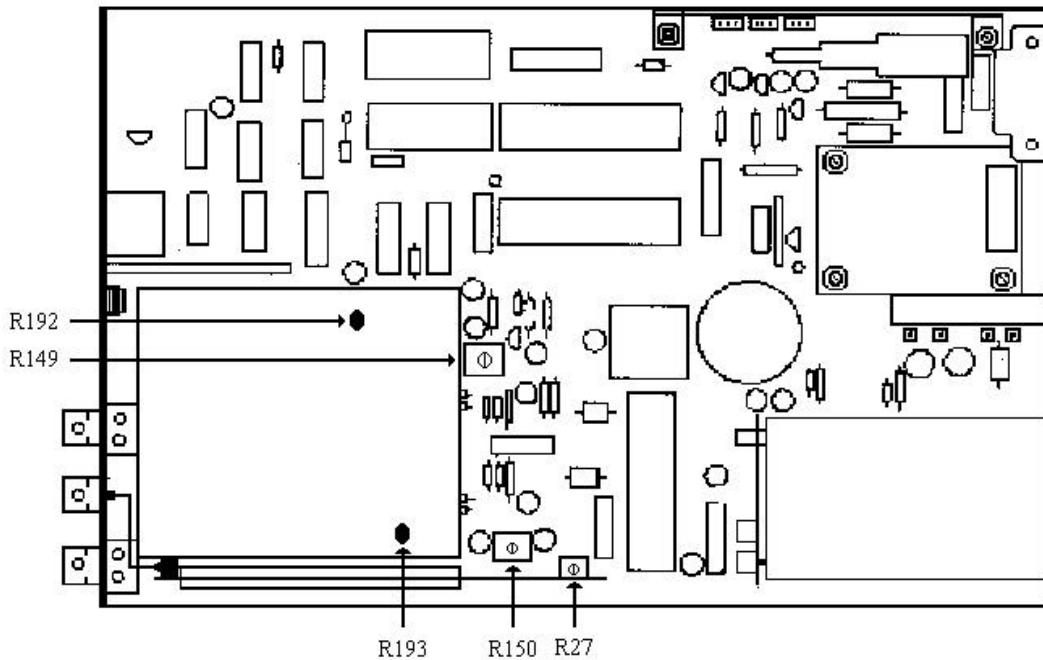


Figure 1. Adjustment locations – test instrument top view.

(7) Set signal generator frequency to 100 MHz and amplitude to 3 mV.

NOTE

Adjustment of R192 in (8) below will cause random displays to occur on both sides of the correct setting.

(8) Adjust R192 (fig. 1) to obtain a stable 100.0 ± 0.1 E6 TI indication with **GATE** and **INPUT A TRIG** LEDs flashing.

(9) Disconnect signal generator from TI **INPUT A**.

(10) If TI does not indicate 100.0 ± 0.1 E6 without **GATE** LED flashing; repeat (6) above through (10).

(11) Press TI **RESET/CONTINUE** key.

(12) Press TI **RESOLUTION** \uparrow key until display indicates **00000000**.

(13) Reconnect signal generator **OUTPUT RF** to TI **INPUT A**.

(14) Set signal generator amplitude to 13 mV.

(15) Slowly adjust R149 (fig. 1) cw until TI display just becomes unstable.

(16) Slowly adjust R149 (fig. 1) ccw until TI display stabilizes and indicates $100.000000 \pm .000001$ E6.

(17) Set signal generator amplitude to 7 mV.

(18) If TI **GATE** LED is flashing; repeat (14) above through (18).

10. Channel B Sensitivity

a. Performance Check

(1) Press TI **INPUT B 50 Ω /1M Ω** key to select **50 Ω** (LED ON).

(2) Press TI keys **2, 1, SHIFT, STORE, SF, SHIFT, SF**.

(3) Connect signal generator **OUTPUT RF** to TI **INPUT B**.

(4) Set signal generator frequency to 100 MHz and amplitude to 1 mV. Slowly increase signal generator amplitude until TI displays a stable indication at approximately 100 MHz. If signal generator amplitude exceeds 25 mV, perform **b** below.

(5) Repeat (4) above at 10 MHz .

(6) Disconnect TI from signal generator.

(7) Connect TI **INPUT B** to function generator **Function Outputs Unbalanced**.

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(8) Press TI **RESET/CONTINUE** key.

(9) Set function generator for a sine wave, 100 kHz, 1 mVp-p, 50 Ω output. Slowly increase function generator amplitude until TI displays a stable indication at approximately 100 kHz. If function generator amplitude exceeds 71 mVp-p; perform **b** below.

(10) Repeat (9) above at 5 kHz and 10 Hz.

(11) Press TI keys **2, 0, SHIFT, STORE, SF, SHIFT, SF**.

(12) Disconnect function generator from TI.

b. Adjustments

(1) Disconnect signal or function generator from TI **INPUT B** and press TI **RESET/CONTINUE** key.

(2) Adjust R150 (fig. 1) fully ccw.

(3) Adjust R193 (fig. 1) to its mid-point.

(4) Press TI **RESOLUTION** \downarrow key until TI displays **000**.

(5) Connect signal generator rear panel **EXT REF INPUT** to TI rear panel **10MHz STD. OUTPUT**.

(6) Connect signal generator **OUTPUT RF** to TI **INPUT B**.

(7) Set signal generator output to 100 MHz and output level to 3 mV rms.

NOTE

Adjustment of R193 in (8) below will cause random displays to occur on both sides of the correct setting.

(8) Adjust R193 (fig. 1) to obtain a stable 100.0 ± 0.1 E6 TI indication with **GATE** and **INPUT B TRIG** LEDs flashing.

(9) Disconnect signal generator from TI **INPUT B**.

(10) If TI does not indicate 100.0 ± 0.1 E6 without **GATE** LED flashing, repeat (6) above through (10).

(11) Press TI **RESET/CONTINUE** key.

- (12) Press TI **RESOLUTION** ↑ key until display indicates **00000000**.
- (13) Reconnect signal generator **OUTPUT RF** to TI **INPUT B**.
- (14) Set signal generator amplitude to 13 mV.
- (15) Slowly adjust R150 (fig. 1) cw until TI display just becomes unstable.
- (16) Slowly adjust R150 (fig. 1) ccw until TI display stabilizes and indicates 100.000000 ±.000001 E6.
- (17) Set signal generator amplitude to 7 mV.
- (18) If TI **GATE** LED is flashing; repeat (14) above through (18).

11. Channel C Sensitivity

a. Performance Check

- (1) Press TI **RESET/CONTINUE** key.
- (2) Connect signal generator **OUTPUT RF** to TI **INPUT C 50Ω**.
- (3) Press **FUNCTION** ↑ or ↓ key to select **INPUT C**.
- (4) Set signal generator frequency to 1300 MHz and amplitude to 1 mV. Slowly increase signal generator amplitude until TI displays a stable indication at approximately 1300 MHz. If signal generator amplitude is not less than 75 mV; perform **b** below.
- (5) Repeat technique of (4) above at 1000 MHz, 500 MHz, 100 MHz and 40 MHz. If signal generator amplitude is not less than 15 mV; perform **b** below.
- (6) Disconnect signal generator from TI.

b. Adjustments

- (1) Connect signal generator rear panel **EXT REF INPUT** to TI rear panel **10MHz STD. OUTPUT**.
- (2) Adjust R27 (fig. 1) fully cw.
- (3) Set signal generator frequency to 1000 MHz and amplitude to 8 mV.
- (4) Slowly adjust R27 (fig. 1) ccw to obtain a stable TI indication of 1000.00000 ±.00001 E6 with **GATE** LED flashing.

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- (5) Set signal generator amplitude to 7 mV.
- (6) If TI **GATE** LED is flashing; repeat (3) above through (6).

12. Trigger Levels

a. Performance Check

- (1) Cycle **POWER ON/OFF** pushbutton from **OFF** to **ON**.
- (2) Connect multimeter **INPUT HI** to TI rear panel **A TRIGGER LEVEL OUTPUTS** and **INPUT LO** to TI chassis ground.
- (3) Press TI keys **INPUT A TRIG LEVEL, 5, INPUT A TRIG LEVEL**.
- (4) Multimeter will indicate between +4.94 and +5.06 V dc.
- (5) Press TI keys **INPUT A TRIG LEVEL, 5, SHIFT, +/-, INPUT A TRIG LEVEL**.
- (6) Multimeter will indicate between -5.06 and -4.94 V dc.
- (7) Press TI keys **INPUT A TRIG LEVEL, 0, INPUT A TRIG LEVEL**.
- (8) Multimeter will indicate between -0.010 and +0.010 V dc.
- (9) Connect multimeter **INPUT HI** to TI rear panel **B TRIGGER LEVEL OUTPUTS**.
- (10) Press TI keys **INPUT B TRIG LEVEL, 5, INPUT B TRIG LEVEL**.
- (11) Multimeter will indicate between +4.94 and +5.06 V dc.
- (12) Press TI keys **INPUT B TRIG LEVEL, 5, SHIFT, +/-, INPUT B TRIG LEVEL**.
- (13) Multimeter will indicate between -5.06 and -4.94 V dc.
- (14) Press TI keys **INPUT B TRIG LEVEL, 0, INPUT B TRIG LEVEL**.
- (15) Multimeter will indicate between -0.010 and +0.010 V dc.
- (16) Disconnect multimeter from TI.

b. Adjustments. No adjustments can be made.

13. Final Procedure

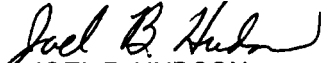
- a.** Deenergize and disconnect all equipment and reinstall protective covers on TI.
- b.** Annotate and affix DA label/form in accordance with TB 750-25.

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By Order of the Secretary of the Army:

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To be distributed in accordance with initial distribution number (IDN) 343075 requirements for calibration procedure TB 9-6625-2217-35

US GOVERNMENT PRINTING OFFICE: 1998-633-283/80139

PIN NO: 064989-000