

**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

**CALIBRATION PROCEDURE FOR  
FUNCTION GENERATOR SG-1133U  
(HEWLETT-PACKARD, MODEL 3312A)**

Headquarters, Department of the Army, Washington, DC  
15 May 1987

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\*This bulletin supersedes TB 9-6625-1968-35, 19 April 1978, including all changes.

## SECTION I

## IDENTIFICATION AND DESCRIPTION

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Function Generator SG-1133U (Hewlett-Packard, Model 3312A). The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

**a. Model Variations.** None.

**b. Time and Technique.** The time required for this calibration is approximately 4 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
Frequency	Range: 0.1 Hz to 13 MHz Accuracy: + 5% FS
Sine wave distortion	Accuracy: 0.5 maximum from 10 Hz to 50 kHz Modulation signal: 2% maximum, from 10 Hz to 10 kHz
Square wave output	Rise and fall time: Less than 18 ns at full rated output Aberration tolerance: Less than 10%
Output characteristics	20 V p-p into open circuit 10 V p-p into 50 $\Omega$
Attenuator accuracy	$\pm$ 5% maximum

## SECTION II

## EQUIPMENT REQUIREMENT

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

*Table 2. Minimum Specifications of Equipment Required*

Item	Common name	Minimum use specifications	Manufacturer and model (part number)
A1	AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: $\pm 1\%$	General Radio, Model W10MT3AS3 or Ridge, Model 9020F (7910809)
A2	FREQUENCY COUNTER	Range: 6060 ms to 13.65 MHz Accuracy: $\pm 1.25\%$	Hewlett-Packard, Model 5345A (MIS-28754/1 K87-59992A)
A3	DIGITAL VOLTMETER	Range: $\pm 17.442$ V ac Accuracy: $\pm 0.5\%$	Hewlett-Packard, Model 3490AOPT060 w/K25-3490A (3490AOPT060/K25-3490A)
A4	DISTORTION ANALYZER	Capability: Measure at least $<0.5\%$ distortion	Hewlett-Packard, Model C41-334A (7911957)
A5	OSCILLOSCOPE	Capability: Measure risetime of at least 18 ns	Tektronix, Type R5440 (MIS-28706/1 Type I) w/5A48 (MIS-28706/3) and 5B42 (MIS-28706/4), and 5S14 (MIS-28706-5)

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	ADAPTER	BNC jack to double banana terminations (7907592)
B2	ADAPTER	BNC T-type, 2 jacks and 1 plug (MS35173-274C)
B3	CABLE <sup>1</sup>	30-in., RG-58/U, with BNC plug terminations (7907467)
B4	TERMINATION	50Ω feed-through, BNC plug to BNC jack (11048B)
B5	TEST LEAD <sup>2</sup>	Single banana plug to test hook (SKC-4850-14 or 7913288)

<sup>1</sup>Two required.<sup>2</sup>Two required.

### 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 and item identification number as listed in tables 2 and 3. For identification of equipment referenced by item numbers prefixed with A see table 2, and for prefix B, see table 3.

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. When indications specified in paragraphs 8 through 13 are not within tolerance, perform the power supply check prior to making adjustments. After adjustments are made, repeat paragraphs 8 through 13. Do not perform power supply check if all other parameters are within tolerance.

e. 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.**

a. Connect TI to autotransformer (A1).

b. Connect autotransformer to a 115-V ac source output.

c. Set **LINE** switch to **ON** and allow 1 hour for TI to warmup and stabilize.

## 8. Frequency Accuracy

### a. Performance Check

(1) Connect SYNC output to frequency counter (A2) input, using cable and termination (B3 and B4).

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

(a) **FUNCTION** pushbutton ~ (sine wave).

(b) **AMPLITUDE** control to **1** and **VERNIER** fully cw.

(c) **OFFSET** control to **CAL.**

(d) **TRIGGER PHASE** control to **FREE RUN.**

(e) **FREQUENCY** dial to 1.

(f) **RANGE Hz** pushbutton to .1.

(g) **MODULATION** pushbutton to **OFF** (out).

(h) **RANGE Hz** control on **MODULATION** side to **0.**

(i) **TRIGGER** control (rear panel) to **INT.**

(3) If frequency counter does not indicate between 6060 and 28571 ms, perform b below.

(4) Repeat technique of (2) and (3) above, using settings and indications listed in table 4.

### b. Adjustments

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

(a) **RANGE Hz** pushbutton to **1K.**

(b) **SYM** control to **CAL.**

(c) **AMPLITUDE VERNIER** fully cw.

(2) Set **FREQUENCY** dial to **10.** Adjust A2R102 (fig. 1) for a 10.0 kHz frequency counter indication (R).

(3) Set **FREQUENCY** dial for a frequency counter indication of 1.0 kHz. If **FREQUENCY** dial is not on 1, loosen dial and adjust to 1.

(4) Set **FREQUENCY** dial to **10,** and if necessary, adjust A2R102 (fig. 1) for a frequency counter indication of 10 kHz  $\pm 30$  Hz.

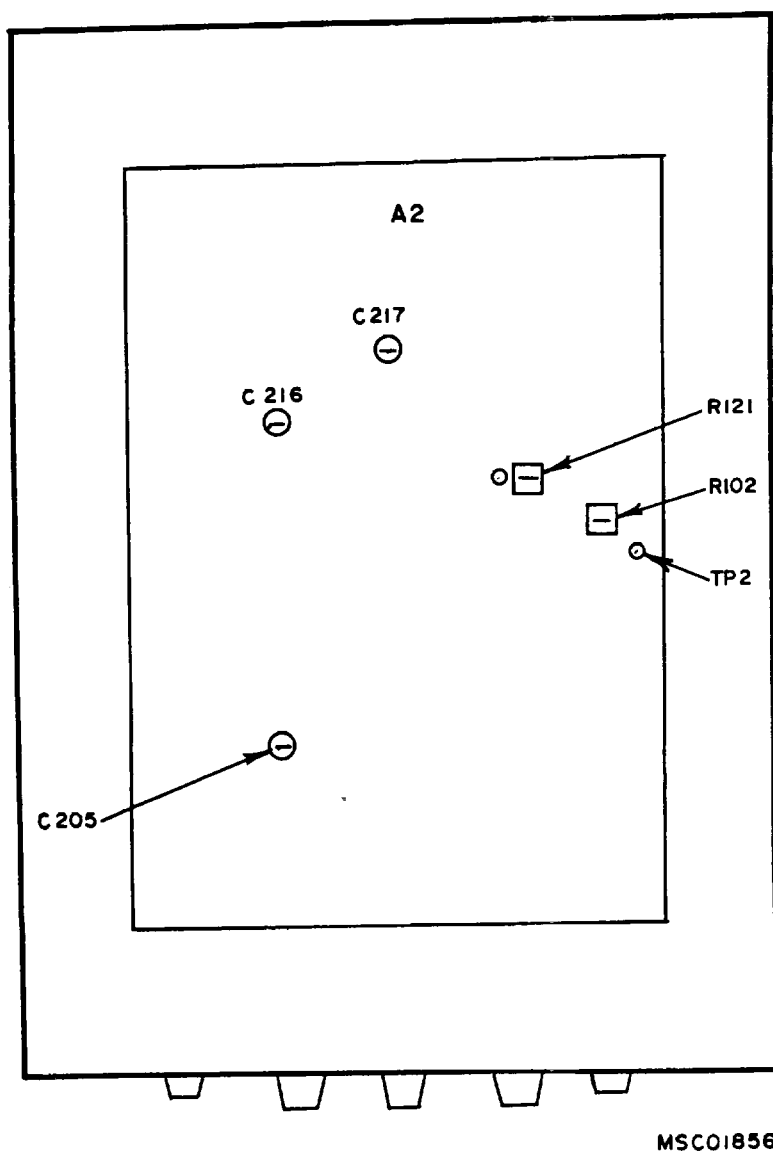
(5) Repeat (2) through (4) above until all indications remain within tolerance.

(6) Press **RANGE Hz** pushbutton to **100K** and set **FREQUENCY** dial to **10.** Adjust A2C205 (fig. 1) for a frequency counter indication of 1 MHz  $\pm 3$  kHz (R).

(7) Press **RANGE Hz** pushbutton to **1K** and set **FREQUENCY** dial to **5.** Note frequency counter indication and calculate percentage deviation from 5 kHz.

(8) Press **RANGE Hz** pushbutton to 1M. Adjust A2C217 for a frequency counter indication of 5 MHz  $\pm$  percentage of deviation recorded in (7) above (R).

(9) Set **FREQUENCY** dial to **10.** Adjust A2C216 (fig. 1) for a frequency counter indication 10.2 MHz. This allows for the frequency shift when the cover is installed. Wait 10 minutes and check frequency. If frequency counter does not indicate 10 MHz  $\pm 100$  kHz, repeat adjustment sequence (R).



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Figure 1. Test instrument - bottom view.

Table 4. Dial Accuracy

Test instrument		Frequency counter indications	
FREQUENCY dial settings	RANGE Hz pushbutton settings	Min	Max
6	.1	1504 ms	1869 ms
13	.1	733 ms	810 ms
1	1	606 ms	2857 ms
6	1	150 ms	187 ms
13	1	73 ms	81 ms
1	10	61 ms	286 ms
6	10	15 ms	18.9 ms
13	10	7.3 ms	8.1 ms
1	100	6.06 ms	28.6 ms
6	100	1.5 ms	1.89 ms
13	100	1235 Hz	1365 Hz
1	1 K	350 Hz	1650 Hz
6	1 K	5.350 kHz	6.650 kHz
13	1 K	12.350 kHz	13.650 kHz
1	10 K	3.5 kHz	16.5 kHz
6	10 K	53.5 kHz	66.5 kHz
13	10 K	123.5 kHz	136.5 kHz
1	100 K	35 kHz	165 kHz
6	100 K	535 kHz	665 kHz
13	100 K	1.235 MHz	1.365 MHz
1	1 M	350 MHz	1.65 MHz
6	1 M	5.35 MHz	6.65 MHz
13	1 M	12.35 MHz	13.65 MHz

## 9. Sine Wave Distortion

### a. Performance Check

(1) Connect equipment as shown in figure 2, connection A.

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

(a) **RANGE Hz** pushbutton to **10**.

(b) **FREQUENCY** dial to **2**.

(c) **AMPLITUDE** to **10** and **VERNIER**

centered.

(d) **SYM** control to **CAL**.

(3) Measure distortion at 20 Hz. If distortion analyzer (A4) does not indicate <0.5 percent, perform b(1) and (2) below.

(4) Repeat technique of (3) above for frequencies of 1, 10, and 50 kHz.

(5) Set MODULATION RANGE pushbutton to (sine wave) and MODULATION SYM control to CAL.

(6) Connect TI as shown in figure 2, connection B.

(7) Set MODULATION RANGE Hz switch to 100 and adjust MODULATION RANGE Hz VERNIER for a frequency counter (A2) indication of 20 Hz. If distortion analyzer does not indicate <2 percent, perform b (3) through (5) below.

(8) Repeat technique of (7) above for MODULATION RANGE Hz switch setting of 10K and MODULATION RANGE Hz VERNIER settings of 1 and 10 kHz as indicated on frequency counter.

### b. Adjustments

(1) Adjust A1R283 and A1R279 (fig. 3) for a minimum distortion of <0.5 percent (R).

(2) Perform above adjustment at frequencies of 1, 10, and 50 kHz.

(3) Adjust A1R342 and A1R348 (fig. 3) for minimum distortion <2 percent (R).

(4) Adjust A1R307 (fig. 3) for a distortion of <2 percent (R).

(5) Set MODULATION RANGE Hz switch to 10K and VERNIER fully ccw. Adjust A1R302 (fig. 3) for a minimum distortion of <2 percent (R).

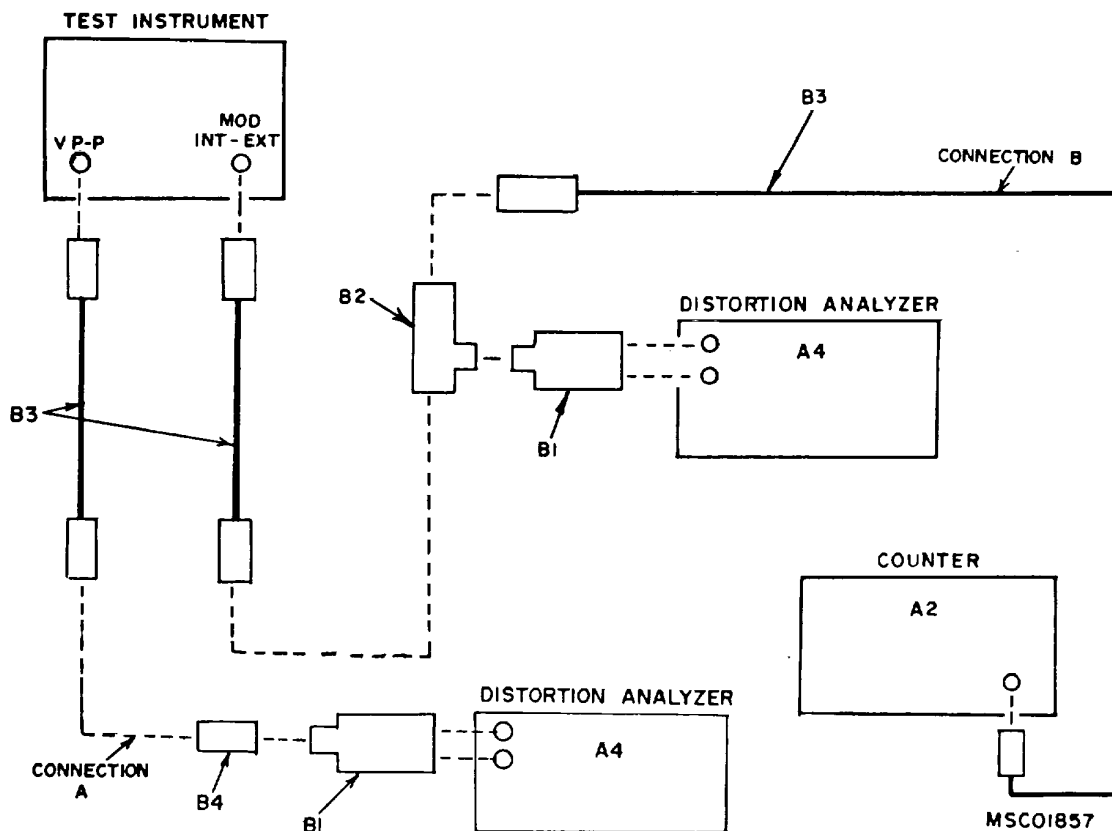


Figure 2. Distortion equipment setup.



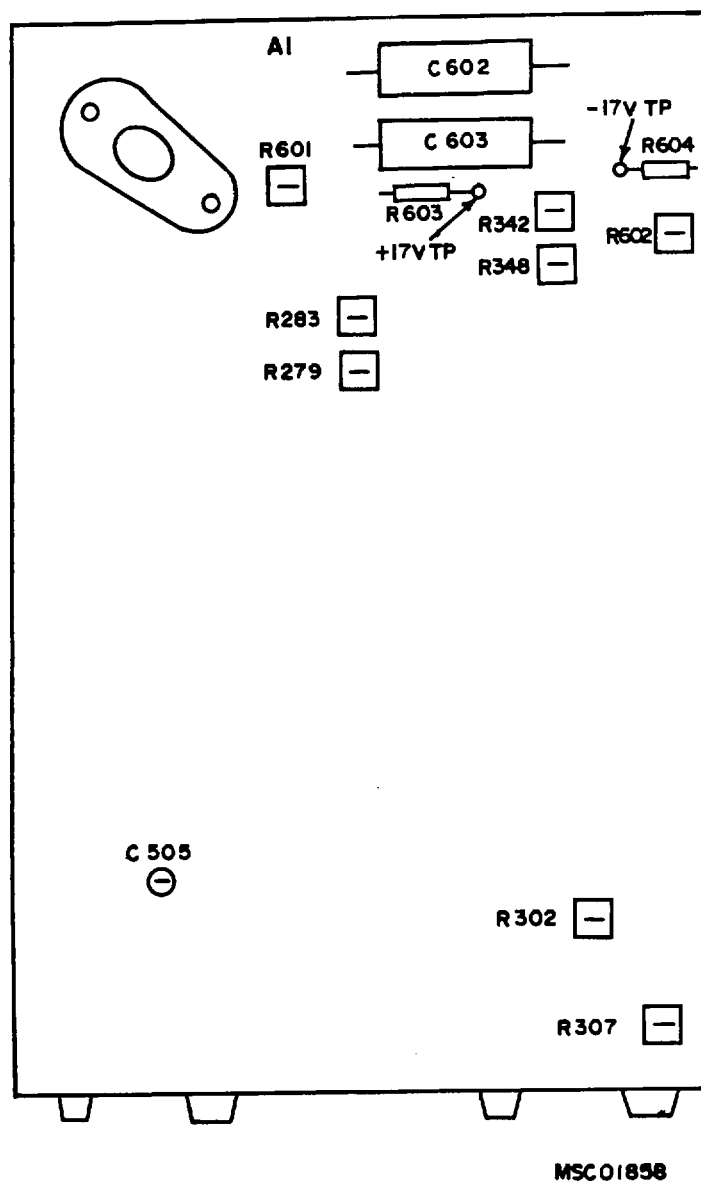


Figure 3. Test equipment - top view.

## 10. Square Wave Rise and Faltime

### a. Performance Check

(1) Install plug-ins 5A48 and 5B42 into oscilloscope (A5).

(2) Connect V p-p output to oscilloscope (A5) CH 1 input, using cable and termination (B3 and B4).

(3) Position controls as listed in (a) through (e) below:

(a) **AMPLITUDE** control to **10**.

(b) **FUNCTION** pushbutton to W (square wave).

(c) **OFFSET** control to **CAL**.

(d) **FREQUENCY** dial to **3**.

(e) **RANGE Hz** pushbutton to **1M**.

(4) Measure rise and fall times. If displayed pulse is not less than 18 ns, perform b below:

(5) Adjust oscilloscope for 2 cycles display and measure pulse aberrations. Pulse aberrations will not exceed 10 percent of pulse amplitude.

**b. Adjustments.** Adjust AIC505 (fig. 3) for best overall rise and faltime and pulse aberration (R).

## 11. Modulation Symmetry

### a. Performance Check

(1) Connect **MOD INT/EXT** output to frequency counter (A2), using cable (B3).

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

(a) **FREQUENCY** dial fully **cw**.

(b) **RANGE Hz** pushbutton to **1K**.

(c) **AM, FM, SWP** switches to **off** (out).

(d) **MODULATION RANGE Hz** control to **100** and **VERNIER** fully **cw**.

(e) **MODULATION** function to 

(square wave).

(3) Using the time interval function of frequency counter, measure width of both positive and negative half-cycles of output square wave. If difference between two intervals is not less than 10  $\mu$ s, perform b(l) below.

(4) Set **MODULATION RANGE Hz** switch to 10K and **VERNIER** fully ccw. Repeat technique of (3) above. If difference between intervals is not less than 10  $\mu$ s, perform b(2) below.

### b. Adjustments

(1) Adjust A1R307 (fig. 3) for an indication of less than 10  $\mu$ s (R).

(2) Adjust A1R302 (fig. 3) for an indication of less than 10  $\mu$ s (R).

(3) If above adjustments are performed, repeat paragraph 9a(5) through (8) above. The adjustments affect both checks.

## 12. Output Waveform

### a. Performance Check

(1) Connect V p-p output to oscilloscope (A5), using cable and termination (B3 and B4).

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

(a) **FUNCTION** pushbutton to  $\sim$  (sine wave).

(b) **FREQUENCY** dial to **1**.

(c) **TRIGGER PHASE** control to **FREE**

**RUN**.

(d) **MODULATION** pushbutton to off (out).

(e) **AMPLITUDE** control to 10 and **VERNIER** fully **cw**.

(3) Oscilloscope will indicate at least 10 V p-p.

(4) Press **FUNCTION** pushbutton to (square □ wave). Oscilloscope will indicate at least 10 V p-p.

(5) Press **FUNCTION** pushbutton to ∨ (triangle). Oscilloscope will indicate at least 10 V p-p.

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

### 13. Attenuator Accuracy

#### a. Performance Check

(1) Connect V p-p output to digital voltmeter (A3), using termination, cable, and adapter (B4, B2, and B1).

(2) Set **AMPLITUDE** switch to **10** and press **FUNCTION** pushbutton to (sine wave).

(3) Using **AMPLITUDE VERNIER** control, adjust output for 3.000-V output, as indicated on digital voltmeter.

(4) Position controls as listed in table 5. Digital voltmeter indications will be as specified.

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

Table 5. Attenuator Accuracy

Test instrument			Digital voltmeter indications
FREQUENCY dial settings	RANGE Hz pushbuttons settings (K)	AMPLITUDE switch settings (V)	
1	1	1	.285 to .315 V
1	1	.1	28.5 to 31.5 mV
1	1	.01	2.85 to 3.15 mV
1	100	10	3.0 <sup>1</sup> V
1	100	1	.285 to .315 V
1	100	.1	28.5 to 31.5 mV
1	100	.01	2.85 to 3.15 mV

<sup>1</sup>Establish a new reference.

## **14. Power Supply**

### **NOTE**

**Do not perform power supply check if all other parameters are within tolerance.**

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

(1) Connect digital voltmeter (A3) to TI +17 V TP (fig. 3) and ground, using two test leads (BS).

(2) If digital voltmeter does not indicate between 16.758 and 17.442 V de, perform b(l) below.

(3) Move test lead from +17 V TP to -17 V TP (fig. 3).

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(4) If digital voltmeter does not indicate between -16.758 and -17.442 V de, perform b(2) below.

#### **b. Adjustments**

(1) Adjust AIR601 (fig. 3) for a digital voltmeter indication of 17.10 V (R).

(2) Adjust A1R602 (fig. 3) for a digital voltmeter indication of -17.10 V (R).

## **15. 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.

**JOHN A. WICKHAM, JR.**  
General, United States Army  
Chief of Staff

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