

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

**CALIBRATION PROCEDURE FOR
RADIO FREQUENCY VOLTAGE STANDARD
AN/URM-93A (NSN 6625-00-679-3432)
AND
BOOTON MODELS 245-C AND 245-D**

Headquarters, Department of the Army, Washington, D.C.
22 February 1978

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This bulletin supersedes TB 9-6625-1109-50, 3 October 1969 and TB 11-6625-308-35/1, 19 September 1968.

Section I. IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Radio Frequency Voltage Standard AN/URM-93A (fig. 1) and Boonton, Models 245-C, and 245-D. The technical manual was the prime data source used in compiling these instructions. The equipment being calibrated will be referred to as the Test Instrument throughout this bulletin.

a. Model Variations. Model variations do not affect the calibration process.

b. Time and Technique. The time required for this calibration is approximately 2 hours using the dc-low

frequency technique.

2. Calibration Data Card (DA Form 2416). Forms, records, and reports required by calibration personnel at all levels are prescribed by TM 38-750. The DA Form 2416 Calibration Data Card will be annotated in accordance with TM 38-750 for each calibration performed. Reportable adjustments are followed by (R) in this procedure. Report only those adjustments made and followed by (R).

3. Calibration Description. Test Instrument parameters and performance specifications which pertain to this calibration are listed in table 1.

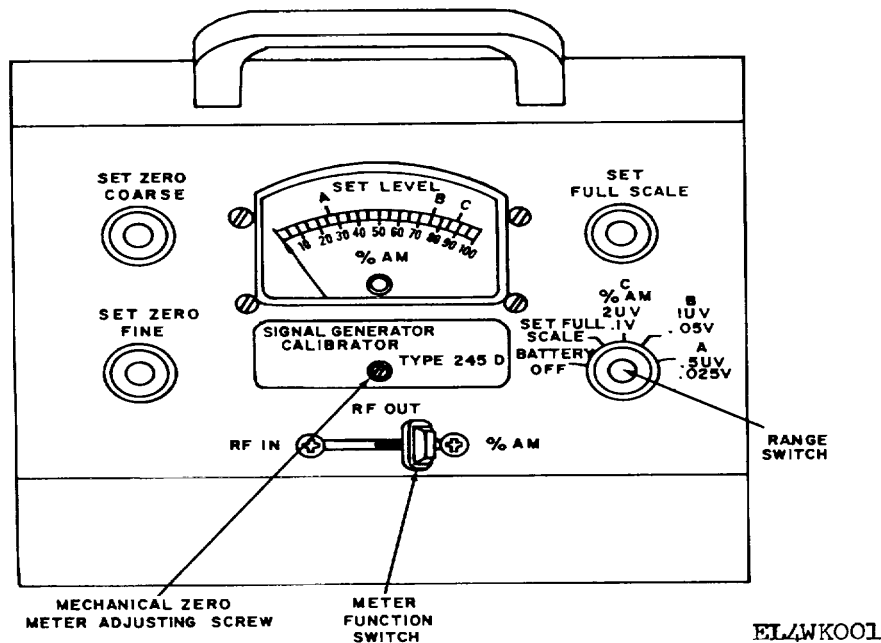


Figure 1. Radio Frequency Voltage Standard-controls and indicators.

Table 1. Calibration Description

Test Instrument parameters	Performance specifications
Power input requirements I ...	Two mercury batteries, 4.0 volts
Frequency range: Rf	500 kHz to 1 GHz
Af	20 Hz to 20 kHz
modulation frequency. Rf input voltage required: For sensitivity and calibration measurements.	0.025, 0.05, or 0.1V
For percent am measurements.	0.1V

Table 1. Calibration Description-continued

Test Instrument parameters	Performance specifications
Rf output voltages: Type 245-C	5, 10, or 20 μ V
AN/URM-93A and Type 245-D.	0.5, 1, or 2 μ V
Accuracy of rf input voltage...	Within $\pm 10\%$, 500 kHz to 500MHz. Within $\pm 15\%$, 500 MHz to 1,000 MHz.
Accuracy of rf output voltage measured at output jack with 50-ohm termination, or at	Within $\pm 10\%$, 500 kHz to 500 MHz. Within $\pm 20\%$, 500

Table 1. Calibration Description-Continued

Test Instrument parameters	Performance specifications
output connector of output cable assembly. Percent am measured Accuracy of am measurements 15 kHz.	MHz to 1,000 MHz. 10 to 100% . Within ±10%, 30 Hz to
Attenuation of rf attenuator.	Within ±15%, 20 Hz to 20 kHz. 2500:1 (Type 245-C) 25000:1 (Type 245-D and ANfURM-93A).

Table 1. Calibration Description-Continued

Test Instrument parameters	Performance specifications
Rf impedances: Input Output: At output jack At output connector of output cable assembly.	50 ohms 50 ohms 50 ohms
1. May be calibrated using 4 Vdc power supply if batteries are not available.	

Section II. EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with Secondary Transfer Standards Calibration Sets (NSN 6695-00-621-7877) and electronic maintenance calibration shops and is to be used in performing this calibration. When any of the equipment listed in table 2 is not available, an equivalent calibrated item may be used. The items selected 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 the Test Instrument.

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

Table 2. Equipment Required for Calibration

Item number	Common name	Minimum use specifications	Secondary Transfer equipment	Maintenance equipment
A1	Signal Generator ¹	Range: 500 kHz to 32 MHz Accuracy: ±1%	HP 608CR (8598927-2)	AN/URM-25 or AN[USM-44
A2	Power Meter with Thermistor Mt.	Range: 0.01 to 0.25 mW	478A	HP 431C (7910462-3) HP Not required
A3	Oscilloscope with plug-ins AN/USM-281	Range: De to 10 MHz Accuracy: ±3% 3B4	(7912040-1) Tek 491 (MIS 10218)	Tek RM 561A (7910655-1) with 3A6 (7911441-1) and
A4	Spectrum Analyzer	Range: 30 MHz, 20 dB		Not required
A5	Radio Interference Measuring Set	Range: 0 to 10 uV Accuracy: ±1%		Not required AN[IJRM-85
A6	Variable Attenuator	Range: 50 to 100 dB Accuracy: ±0.5 dB	Not required	CN-796/U
A7	Voltmeter	Range: 0.01 to 0.3 vac Accuracy: ±3%	Not required	ME-301U

1 Procedure limitation: Range 10 to 480 MHz.

Table 3. Accessories Required

Item	Common name	Description
B1	Adapter Connector (two required)	BNC "I" type; 2 jacks, 1 plug, UG-274A/U (MS35173-274)
B2	Adapter	BNC jack to N plug UG-201A/U (10519457)
B3	Cable Assembly	BNC plug terminations, RG-58fU (10519140)
B4	Cable Assembly	BNC plug to BNC jack terminals
B5	Adapter Connector	BNC jack to double banana plug

Section III. PRELIMINARY OPERATIONS

6. Preliminary Instructions.

WARNING

HIGH VOLTAGE is used during the performance of this calibration.

DEATH ON CONTACT

may result it personnel fail to observe safety precautions.

The instructions in this paragraph are preparatory to performing the calibration.

a. Become familiar with the entire procedure prior to performing the calibration.

b. When an out of tolerance condition is observed, the deficiency must be corrected before continuing 3 with the procedure.

WARNING

Mercury cell batteries will explode if subjected to short circuit conditions or to fire.

7. Equipment Setup. a. Turn range switch to BATTERY OFF.

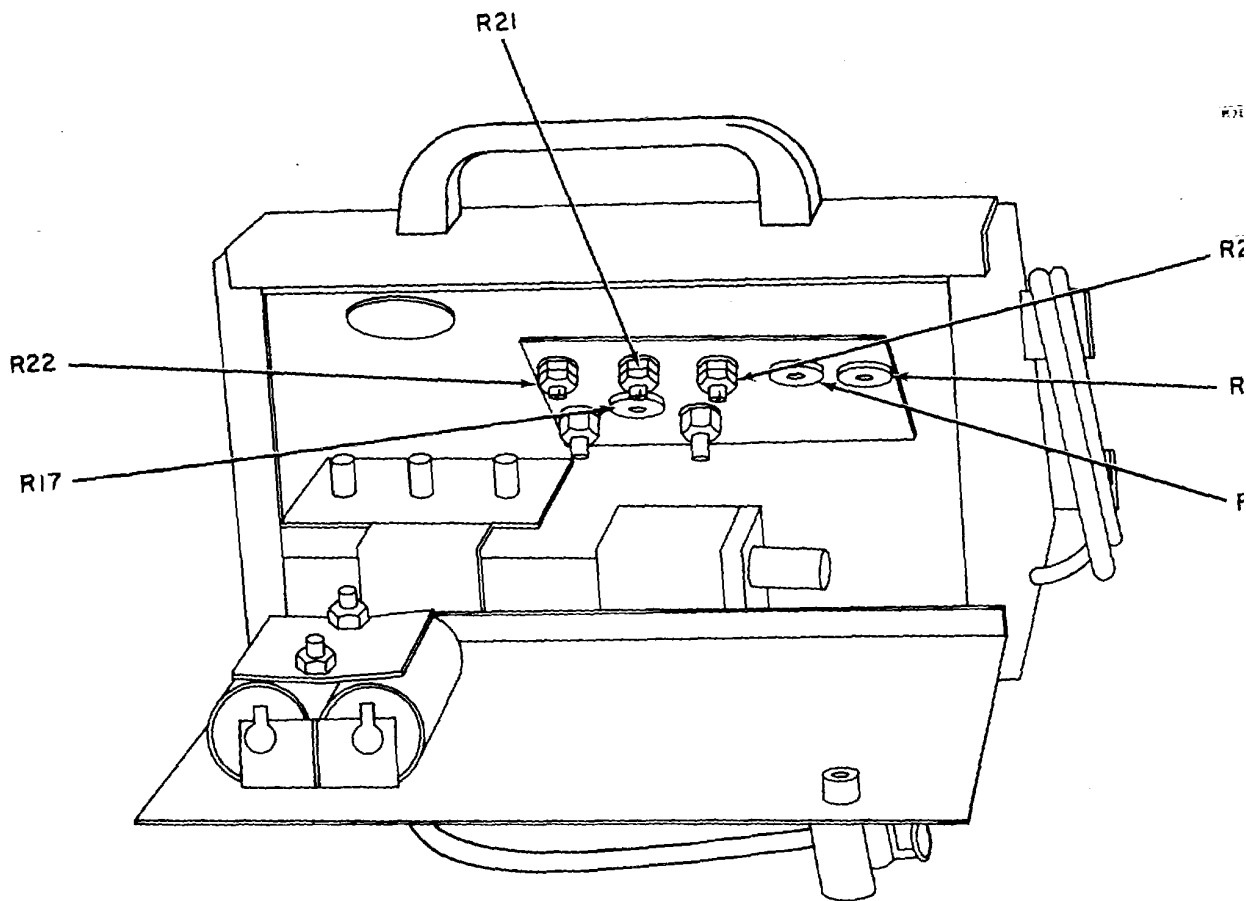
b. Readjust zero adjustment if necessary.

c. Remove Test Instrument rear cover and check to see if batteries are installed correctly. If not, correct batteries are not available, a dc power

supply may be used for this calibration.

d. Set meter function switch to RF IN and range switch to SET FULL SCALE.

e. Turn SET FULL SCALE control until Test Instrument meter indicates full scale. SET FULL SCALE control will be approximately three-quarters away from its' counterclockwise position at this point. If not, adjust R17 (fig. 2). (R)



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Figure 2. Radio frequency voltage standard-rear view.

Section IV. CALIBRATION PROCESS FOR SECONDARY TRANSFER

8. Input Level. a. Performance Check

(1) Connect signal generator (A1) rf output jack to Test Instrument input cable, using adapter (B1)

(2) Turn Test Instrument range switch to C

(3) Adjust Test Instrument SET ZERO COARSE and SET ZERO FINE controls for a 0 (zero) indication on the Test Instrument meter.

(4) Energize single generator and adjust for 10 MHz cw output.

(5) Adjust single generator output until Test Instrument meter pointer is aligned with the C calibration mark on SET LEVEL scale.

(6) Signal generator output will be between 0.162 and 0.222 mW. If not, perform b(1) below.

NOTE

Use power meter (A2) to monitor output of single generator throughout this procedure.

(7) Adjust signal generator for zero output.

(8) Turn range switch to SET FULL SCALE and adjust SET FULL SCALE control for full-scale indication.

(9) Turn Test Instrument range switch to B and adjust SET ZERO COARSE and FINE controls for zero indication on Test Instrument meter.

(10) Adjust signal generator output until Test Instrument meter pointer is aligned with B calibration mark on SET LEVEL SCALE.

(11) Signal generator output will be between 0.040 and 0.060 mW. If not, perform b(2) below.

(12) Adjust signal generator for zero output.

(13) Repeat step (8) above.

(14) Turn Test Instrument range switch to **A** and adjust SET ZERO COARSE and FINE controls for

ZERO indication on Test Instrument meter.

(15) Adjust signal generator output until Test Instrument meter pointer is aligned with A calibration mark on SET LEVEL SCALE.

(16) Signal generator output will be between 0.010 and 0.015 mW. If not, perform b(3) below.

b. Adjustments.

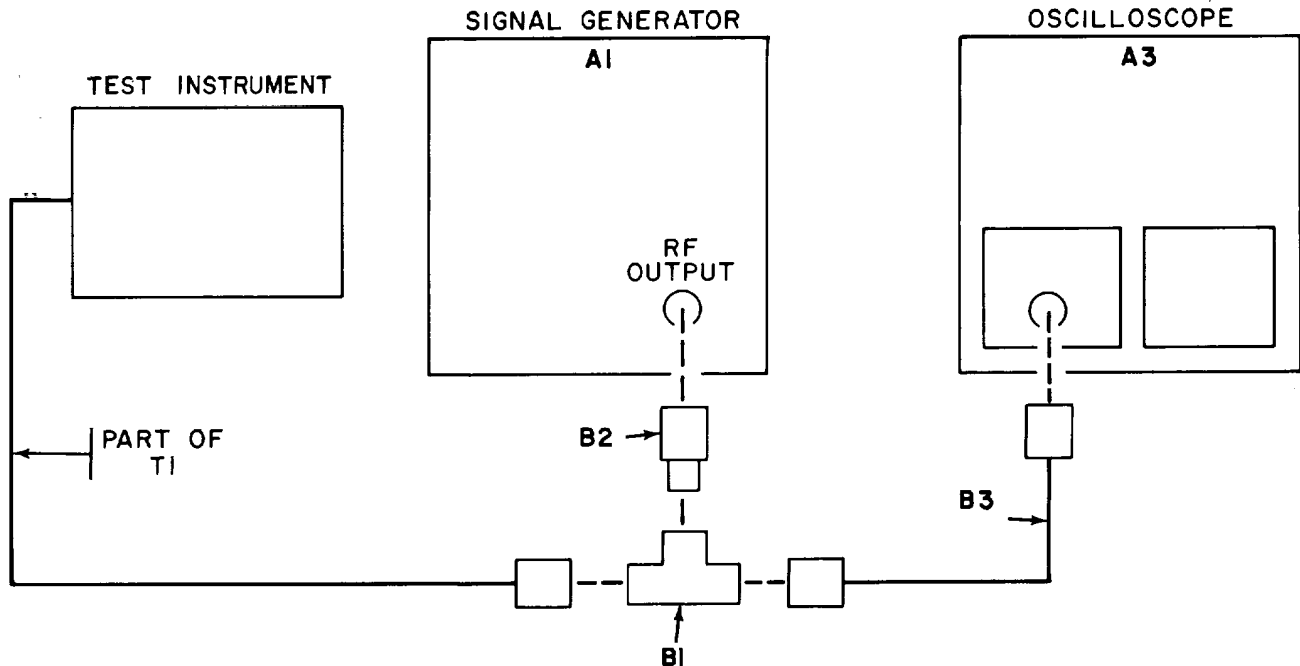
(1) Adjust signal generator output to 0.2 mW and adjust R21 (fig. 2) until meter pointer is aligned with C calibration mark.

(2) Adjust signal generator output to 0.05 mW and adjust R18 (fig. 2) until meter pointer is aligned with B calibration mark.

(3) Adjust signal generator output to 0.01 mW and adjust R19 (fig. 2) until meter pointer is aligned with A calibration mark.

9. Modulation. a. Performance Check.

(1) Connect equipment as shown in figure 3.



EL4WK003

Figure 3. Modulation accuracy-equipment setup.

(2) Turn range switch to SET FULL SCALE and adjust SET FULL SCALE control for full-scale indication on Test Instrument meter.

(3) Repeat the procedure in paragraph 8, steps (2) through (5).

(4) Adjust signal generator for 1000 Hz am modulation at 10 MHz output signal.

(5) Adjust signal generator modulation until Test Instrument meter indicates 50 percent modulation.

(6) Set Test Instrument function switch to % AM.

(7) Oscilloscope (A3) will indicate between 40 and 60 percent am modulation. If not, perform b(1) and (2) below.

(8) Repeat (5) and (5) above at Test Instrument

meter indications listed in table 4. Oscilloscope will indicate within limits specified. If not, perform b(3) below.

NOTE

Use oscilloscope to determine modulation per cent of signal generator.

Table 4. Modulation Accuracy.

Test Instrument modulation percent	Oscilloscope indication (% modulation)	
	Minimum	Maximum
25	15	35
75	65	85
90	80	100

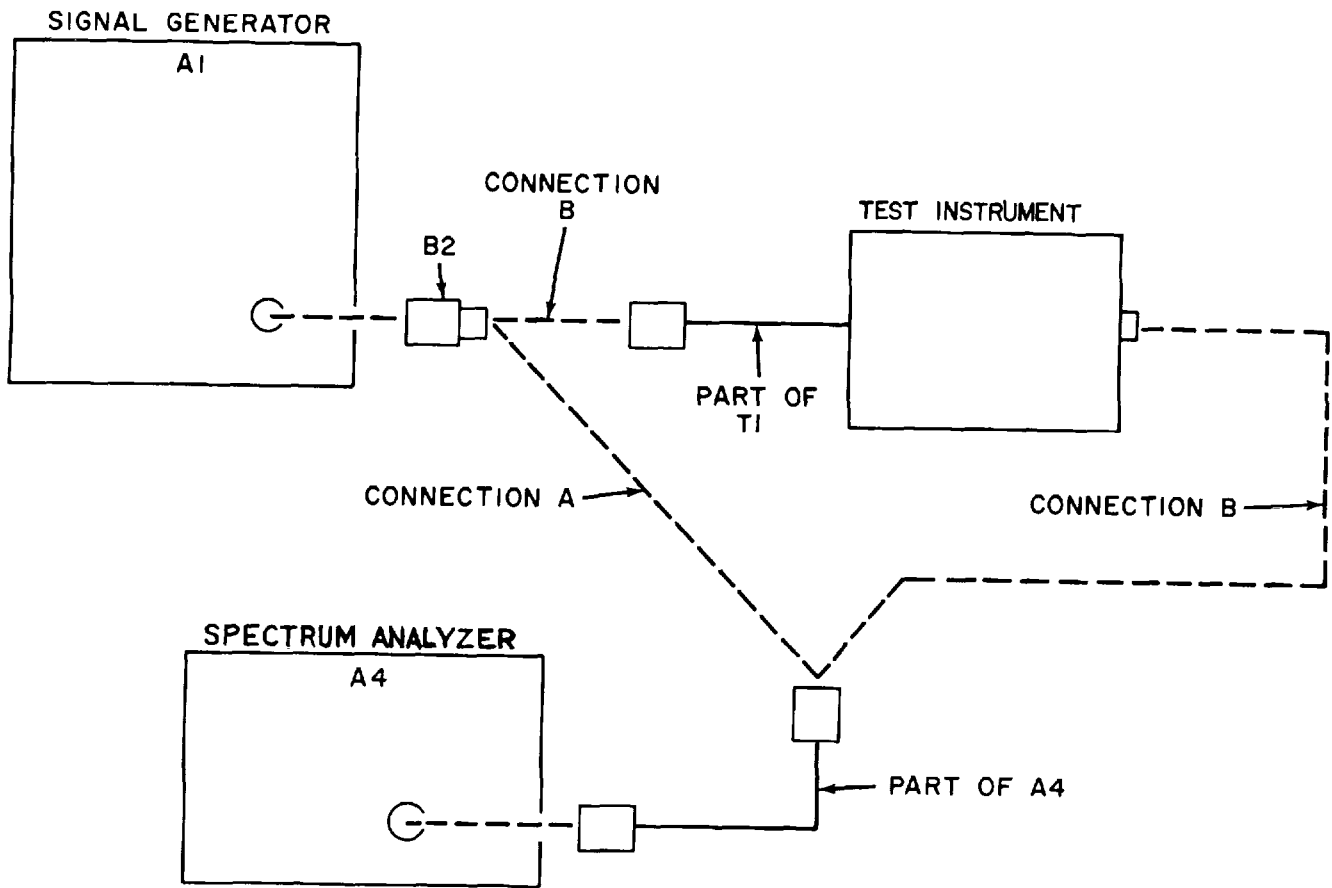
b. Adjustments.

(1) Adjust R22 (fig. 2) for a 50 percent modulation indication on Test Instrument meter. (R)

(2) Adjust R22 for best compromise if error exists.

10. Output Level. a. Performance Check.

(1) Connect equipment as shown in figure 4, connection A.



EL4WK004

Figure 4. Output level accuracy-equipment setup.

(2) Adjust signal generator frequency to 30 MHz and OUTPUT ATTENUATOR to 2 μ V.

(3) Adjust spectrum analyzer (A4) ATTENUATOR and other controls for NULL and record this value.

(4) Connect equipment as shown in figure 4, connection B.

(5) Set Test Instrument meter function switch to RF OUT and range switch to SET FULL SCALE.

(6) Adjust Test Instrument SET FULL SCALE control until Test Instrument meter pointer is aligned with full scale calibration mark.

(7) Set Test Instrument range switch to **C**.

(8) Adjust Test Instrument SET ZERO COARSE and SET ZERO FINE controls until Test Instrument meter indicates 0 (zero).

(9) Adjust signal generator output attenuator for **C** reference indication on Test Instrument meter.

(10) Readjust spectrum analyzer attenuator until NULL is obtained on spectrum analyzer. Attenuator indication will be within ± 1 dB of that recorded in (3) above. If not, perform b below.

b. Adjustments.

(1) Adjust spectrum analyzer attenuator for indication recorded in a(3) above.

(2) Adjust signal generator attenuator for NULL on spectrum analyzer.

(3) Adjust R20 (fig. 2) until Test Instrument indicates at "C" reference point. (R)

NOTE

For final procedure see paragraph 14.

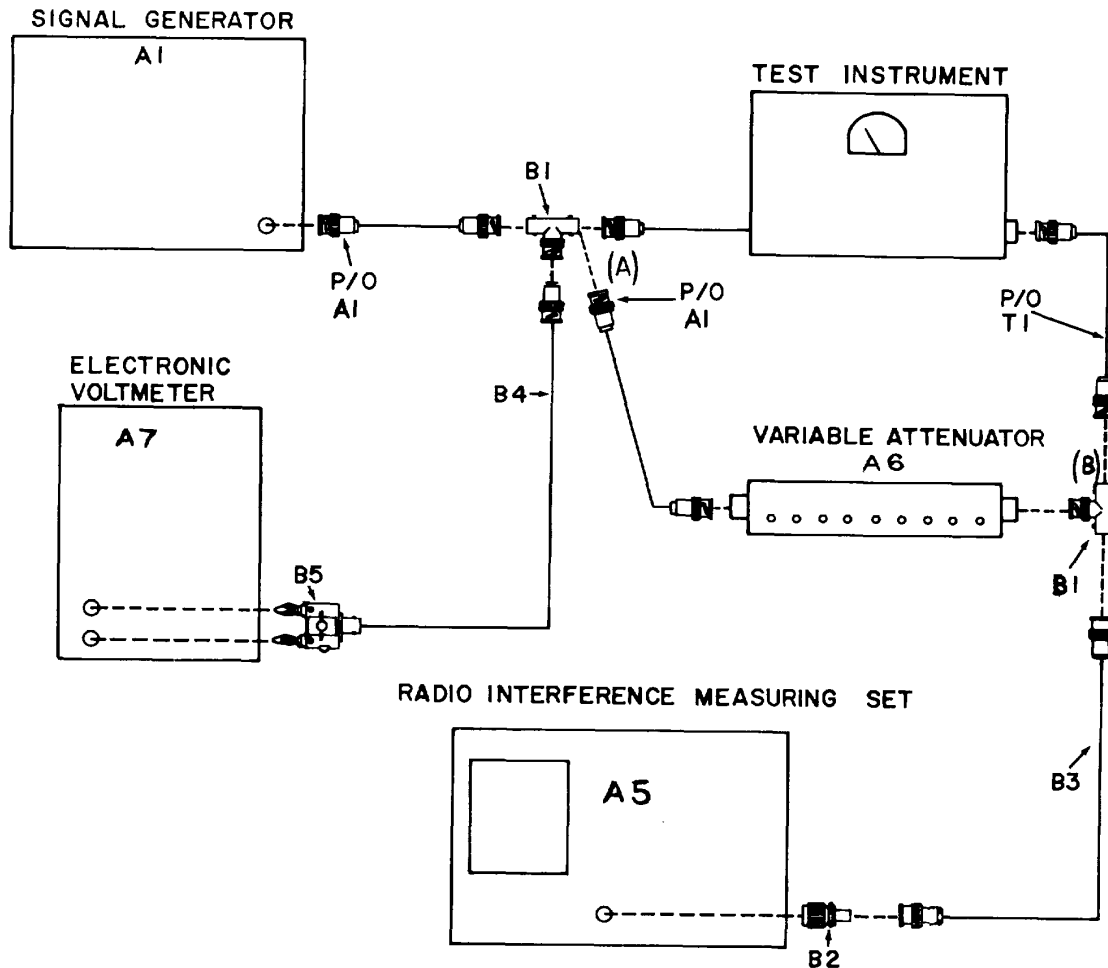
Section V. CALIBRATION PROCESS FOR MAINTENANCE ORGANIZATIONS

NOTE

Become familiar with the entire procedure prior to performing calibration. For preliminary instructions refer to paragraph 6.

11. Input Level. a. Performance Check.

(1) Connect the equipment as shown in figure 5, but do not connect the attenuator and the radio interference measuring set at this time.



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Figure 5. Input level - equipment setup for maintenance organizations.

(2) Position Test Instrument controls as follows:

- (a) Range switch to C.
- (b) RF IN-RF OUT-% AM to RF IN.

(c) Set ZERO COARSE and SET ZERO FINE as required to maintain zero indication of the SET LEVEL meter without input.

(3) Adjust signal generator (A1) frequency to 500 kHz and output to produce an indication at C on the

Test Instrument SET LEVEL meter.

(4) Indication of voltmeter (A5) should be between 0.09 and 0.11 volts ac. Set Test Instrument RF IN-RF OUT-% MOD switch to RF out. SET LEVEL meter should indicate at C calibration mark. Reset RF IN-RF OUT-% MOD switch to RF IN.

(5) Position Test Instrument range switch to B. Adjust the signal generator output to produce an in

dication at B on the Test Instrument SET LEVEL meter.

(6) Electronic voltmeter indication should be between 0.045 and 0.055 volts ac.

(7) Position Test Instrument range switch to A..

Adjust the signal generator output to produce an indication at A on the Test Instrument SET LEVEL meter.

(8) Electronic voltmeter indication should be between 0.0225 and 0.0275 volts ac.

b. Adjustments.

(1) Readjust signal generator output to produce an indication of 0.1, 0.05, or 0.025 volts ac as required.

(2) Adjust R21, R18, or R19 (fig. 2) for indication at C, B, or A, respectively, on the Test Instrument SET LEVEL meter, as required. (R) (3) Adjust the signal generator output for an indication at C on the SET LEVEL meter.

(4) Set RF IN-RF OUT-% AM switch to RF OUT.

Adjust R20 (fig. 2) for an indication at C on SET LEVEL meter. (R)

12. Output Level. a. Performance Check.

(1) Disconnect input cable of the Test Instrument at A (fig. 5) and output cable at B (fig. 5). Connect variable attenuator (A6) and radio interference measuring set (A5) using connection points A and B.

(2) Set the attenuator switches for 100 dB attenuation.

(3) Adjust the signal generator output for an indication of 0.1 volt on the electronic voltmeter. SET LEVEL meter will indicate at C (RF IN or RF OUT).

(4) Adjust radio interference measuring set TUNING, GAIN, and SIGNAL ATTENUATOR controls to show an indication of 5 microvolts on the interference measuring set panel meter.

(5) Disconnect the variable attenuator at A and at B (fig. 5). Connect input and output cables of the Test Instrument to corresponding points A and B. Recheck indication of electronic voltmeter for 0.1 volt. Do not disturb controls of interference measuring set.

(6) Indication of radio interference measuring set shall be between 4.5 and 5.5 microvolts.

(7) Disconnect input and output cables of the Test Instrument and repeat the procedures in a(1) through (6) above, using frequencies of 5 MHz and 50 MHz (Substitute Voltmeter AN/URM-145 for ME-30/U for the higher frequencies).

NOTE

Check the input voltage accuracy only by reference to the signal generator output meter and step attenuator setting for 5 and 50 MHz tests. Remove electronic voltmeter if required.

b. Adjustments. No adjustments can be made.

13. Amplitude-Modulation. a. Performance Check.

(1) Connect the equipment as shown in figure 3.

(2) Set the Test Instrument function switch to RF IN, and the range switch to SET FULL SCALE.

(3) Adjust the SET FULL SCALE control for an indication of full scale on the Test Instrument meter.

(4) Set the range switch to C.

(5) Adjust the SET ZERO COARSE and SET ZERO FINE controls for zero indication of the SET LEVEL meter.

(6) Turn the signal generator on and adjust to 1 MHz frequency and 0.1 volt output indication (SET LEVEL meter indicates C) on the Test Instrument SET LEVEL meter.

(7) Set the Test Instrument function switch to % AM, adjust the signal generator modulation at 1,000 Hz to indicate 50 on the Test Instrument SET LEVEL meter.

(8) Adjust oscilloscope (A3) vertical SENSITIVITY controls for a maximum display height of 6 cm.

(9) Minimum display height shall be between 1.8 and 2.2 cm.

(10) Adjust the signal generator modulation at 1,000 Hz to indicate 30 on the Test Instrument SET LEVEL meter.

(11) Adjust the oscilloscope vertical SENSITIVITY controls for a maximum display height of 6 cm.

(12) Minimum display height shall be between 2.9 and 3.5 cm.

b. Adjustments.

(1) Adjust the signal generator modulation at 1,000 Hz and oscilloscope SENSITIVITY controls to indicate a maximum height of 6 cm and a minimum height of 2 cm simultaneously.

(2) Adjust R22 (fig. 2) for an indication of 50 on the Test Instrument SET LEVEL meter. (R)

(3) Repeat a(10), (11), and (12) above and readjust R22 if necessary.

14. Final Procedure. a. Deenergize and disconnect all test equipment, and install Test Instrument rear cover.

b. In accordance with TM 38-750, annotate and affix calibration DA Label 80 (US Army Calibration System). When the Test Instrument cannot be adjusted to within tolerance, annotate and affix red tag, DA Form 2417 (Unserviceable, or Limited Use) (red tag).

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