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# **\*TB 9-6625-1866-50**

**DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

## **CALIBRATION PROCEDURE FOR DIFFERENTIAL VOLTMETERS AN/USM-98, AN/USM-98A, AND AN/USM-98B (JOHN FLUKE MODELS 801, 801R, 801B, 801BR, 801B/AG)**

Headquarters, Department of the Army, Washington, DC  
19 September 1970

### **◆REPORTING OF ERRORS◆**

You can help improve this publication by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-TMD-EP, Redstone Arsenal, AL 35898-5000. FAX to DSN 788-2313 (commercial 256-842-2313). A reply will be furnished directly to you.

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\*This bulletin supersedes TB 9-6625-994-50, 28 July 1969 and TB ORD 1026/981, 12 October 1964 including all changes.

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**SECTION I  
GENERAL**

**1. Purpose and Scope.** This bulletin provides information for the periodic calibration of Differential Voltmeters AN/USM-98, AN/USM-98A, and AN/USM-98B (John Fluke Models 801, 801R, 801B, 801BR, and 801B/AG). It is to be used by personnel trained and qualified in the use of calibration equipment.

**2. Reporting of Equipment Publication Improvements.** The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to: Commander, US Army Missile Materiel Readiness Command, ATTN: DRSMI-MFPA, Redstone Arsenal, AL 35809.

**3. Descriptive Data**

**a. Identification**

Nomenclature	DIFFERENTIAL VOLTMETER
Military designation	AN/USM-98, AN/USM-98A, and AN/USM-98B
Manufacturer	John Fluke
Model number	801, 801R, 801B, 801BR, and 801B/AG
Reference	Manufacturer's instruction manual, TM 11-6625-599-12, and TM 11-6625-599-45

**b. Specifications**

AN/USM-98 (J-F 801 AND J-F 801R):  
 Input requirement<sup>1</sup> 100 to 130 vac, 60 Hz, 60 w  
 Stability of reference supply<sup>1</sup> ±0.01% for change in line voltage (105 to 130 v); 0.01% per hour after warm-up (adjustable via front panel CAL control).

As a differential voltmeter:  
 Accuracy Input voltage ranges 0 to 500 vdc in 4 ranges  
 ±0.05% from 0.1 to 500 vdc ±(0.1% of input voltage or ±0.05 mv whichever is greater below 0.1 vdc.  
 Null voltage ranges 0 to ±10, 0 to ±1, 0 to ±0.1 and 0 to ±0.01 vdc  
 Dc input resistance<sup>1</sup> Infinite at null (all ranges).

As a vacuum tube voltmeter:  
 Basic input voltage ranges 0 to 500 vdc in 4 ranges  
 Accuracy ±4% of full scale (all ranges).  
 Additional voltage ranges<sup>2</sup> 0 to 0.01, 0 to 0.1, 0 to 1, and 0 to 10 vdc.

AN/USM-98A and AN/USM-98B (J-F 801B, 801BR, and 801B/AG):  
 Power input requirements 115 or 230 vac, ±10%, 50 to 440 Hz, approx. 70w. (801B and B/AG, S/N 123 to 1632, operate only on power-line frequencies of 50 to 60 Hz).  
 Stability of meter zero<sup>1</sup> ±0.5% of full scale for ±10% line charge.

As a differential voltmeter:  
 Accuracy Input voltage ranges 0 to 500 vdc in 4 ranges  
 ±0.05% from 0.1 to 500 vdc ±(0.05% +50µv) below 0.1 vdc.  
 Null voltage ranges 0 to ±10, 0 to ±1, 0 to ±0.1 and, 0 to ±0.01 vdc.  
 Dc input resistance Infinite at null (all ranges).

As a vacuum tube voltmeter:  
 Basic input voltage ranges 0 to 500 vdc in 4 ranges.  
 Accuracy ±3% of full scale (all ranges).  
 Additional voltage ranges<sup>2</sup> 0 to 0.01, 0 to 0.1, 0 to 1, 0 to 10 vdc.

**c. Calibration**

Time required 3 hours (approx.)  
 Technique Dc and low frequency

<sup>1</sup> This specification is for information only and is not necessarily verified in this bulletin.  
<sup>2</sup> These range are obtained by setting NULL switch to desired range and readout dials to zero.

**4. General Instructions**

**a. DA Form 2416 (Calibration Data Card).** During the use of this bulletin, annotate DA Form 2416 in accordance with TM 38-750.

**b. Unit Under Test.** Differential Voltmeters AN/USM-98 (John Fluke Model 801 and 801R) will be referred to as UUT (unit under test) in section II. Differential voltmeters

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AN/USM-98A and AN/ USM-98B (John Fluke Models 801B, 801BR, and 80 1B/AG) will be referred to as UUT in section III.

**c. Equipment and Accessory Identification.** The equipment and accessories referred to throughout this bulletin are identified in tables 1, 2, 6 and 7 and section IV.

**d. Equipment Setup.** Disconnect instructions are not contained in this bulletin.

**5. Differences Among Models.** Differential Voltmeter 801R is a rack-mounted version of the 801. AN/USM-98 is the military designation for the 801. Differential Voltmeter 801B contains a standard cell; the 801B/AG contains a Zener diode. The 801BR is the rack-mounted version of the 801B. AN/USM-98A is the military designation for the 801B and 801B/AG. The AN/USM-98B is similar to the 801B. Front panel designations may vary among models.

**SECTION II  
CALIBRATION OF DIFFERENTIAL VOLTMETERS  
AN/USM-98 (J-F 801 AND 801R)**

**6. Equipment and Accessory Required.** Table 1 lists minimum use specifications of equipment required for calibration performance checks and adjustments. Table 2 lists the required accessory. Tables 1 and 2 are provided to assist in the selection of required equipment and accessory. For specific item identification refer to section IV.

Table 1. Minimum Specifications of Equipment Required

Item Number	Common Name	Minimum Use Specifications
A1	AUTOTRANSFORMER	RANGE: 105 to 125 vac ACCURACY: ±1%
A2	DC VOLTAGE STANDARD	RANGE: 0 to 520 v ACCURACY: ±0.016%

Table 2. Accessory Required

Item Number	Common Name	Description
B1	CABLE	30-in., RG-58/U; double banana plug terminations

**7. Preliminary Procedure**

**NOTE**

Personnel should familiarize themselves with the entire bulletin prior to performing calibration.

**a.** With no power applied to UUT, mechanically zero meter, using meter mechanical zero adjustment screw.

- b.** Connect UUT to autotransformer (A1, table 1) and adjust for 115 volts ac.
- c.** Turn VOLTS RANGE, switch to 500, NULL switch to VTVM, and all 5 attenuator switches to zero.
- d.** Set UUT power switch to ON and allow approximately 15 minutes for equipment to warm up and stabilize. If UUT is Model 801B 48 hours (in upright position) may be required for stabilization of readings when UUT has been tilted more than 45°.
- e.** Set meter needle on zero with upper ZERO control.
- f.** Turn NULL switch first to 10 V and then to 1 V and check that meter needle remains on zero.
- g.** With NULL switch set to 0.1 V, adjust lower ZERO control to set meter needle on zero.
- h.** Turn NULL switch to 0.01 V and check that meter needle remains on zero.
- i.** Turn NULL switch to VTVM and VOLTS RANGE switch to .5.

**NOTE**

When the UUT is not within tolerance, perform the specified adjustment and continue the performance check. When the UUT is not within tolerance and no adjustment is specified, the deficiency must be corrected before continuing with the procedure.

**WARNING**

HIGH VOLTAGE is used during the performance of this procedure. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

**8. Dc VTVM and Null Range**

**a. Performance Check**

- (1) Connect dc voltage standard (A2, table 1) to UUT, using cable (B1, table 2).
- (2) Adjust dc voltage standard for full-scale indication (+500) on UUT meter. Dc voltage standard will indicate between 0.480 and 0.520 volts. If not, perform **b**(1) and (2) below.
- (3) Reverse polarity of UUT input and adjust dc voltage standard for full-scale (-500) indication on UUT. Dc voltage standard will indicate between 0.480 and 0.520 volt.
- (4) Reverse polarity of UUT input.

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(5) Repeat technique of (2) through (4) above for UUT switch settings and indications listed in table 3. Dc voltage standard will indicate within limits specified.

Table 3. Dc VTVM

Unit under test		Dc voltage standard indication (V dc)	
VOLTS RANGE switch	Meter indication	Min	Max
5	500	4.80	5.20
5	400	3.80	4.20
5	300	2.80	3.20
5	200	1.80	2.20
5	100	0.80	1.20
50	500	48.0	52.0
500	500	480.0	520.0

(6) Adjust dc voltage standard for 0 (zero) indication on UUT.

(7) Turn VOLTS RANGE switch to .5 and NULL, switch to .01 V.

(8) Adjust dc voltage standard for full-scale indication on UUT meter. Dc voltage standard will indicate between 9.6 and 10.4 mv. If not, perform **b**(3) and (4) below.

(9) Reverse input polarity to UUT.

(10) Adjust dc voltage standard for full-scale indication on UUT meter. Dc voltage standard will indicate between 9.6 and 10.4 mv.

(11) Reverse input polarity to UUT.

(12) Repeat technique of (7) through (11) above for UUT switch settings and indications listed in table 4.

Table 4. Null Range

Unit under test		Dc voltage standard indication	
NULL switch	Indication	Min	Max
.1	1	96 mv	104 mv
1	1	0.96 v	1.04 v
10	1	9.6 v	10.4 v

(13) Turn UUT NULL switch to VTVM.

**b. Adjustments**

(1) Adjust dc voltage standard for 0.500 volt

(2) Adjust P104 (fig. 1) until UUT indicates 500.

(3) Adjust dc voltage standard output to 10.00 mv.

(4) Adjust P103 (fig. 1) for full-scale indication on UUT.

**9. 500-Volt Range and Stability**

**a. Performance Check**

(1) Turn UUT VOLTS RANGE switch to CAL and press and hold CAL PUSH (OP CAL to CAL) switch.

(2) Adjust ADJ CAL control for 0 (zero) indication on UUT meter. Observe that ADJ CAL control is within 90 degrees of center of its rotation. If not, perform **b**(1) and (2) below.

(3) Release CAL PUSH (OP-CAL, to OP) switch and turn VOLTS RANGE switch to 500.

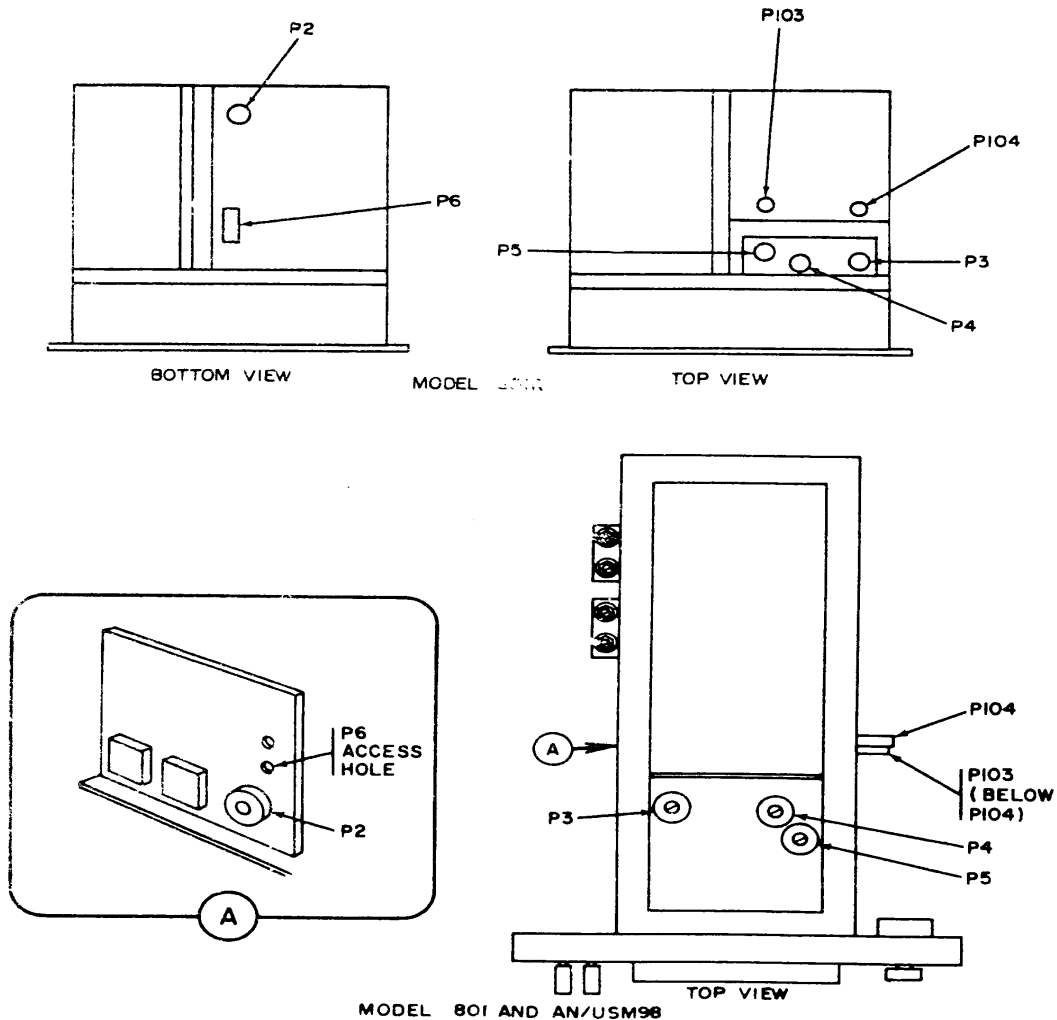


Figure 1. Differential voltmeter.

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(4) Repeat paragraph **7e** through **i**. Connect dc voltage standard (A2, table 1) to UUT, using cable (B1, table 2).

(5) Turn UUT A, B, C, D, and E switches to 4, 9, 9, 9, and 10. Adjust dc voltage standard for full-scale indication on UUT.

(6) Turn NULL switch to 10, 1, and .1 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 499.750 and 500.250 volts. If not, perform **b(3)** through (9) below.

(7) While maintaining null on UUT with dc voltage standard, vary autotransformer (A1, table 1) from 105 to 125 Volts. Dc voltage standard output will remain between 499.750 and 500.250 volts. If not, and no adjustment was performed in (6) above, perform **b(3)** through (9) below.

(8) Adjust autotransformer output to 115 volts.

(9) Turn UUT NULL switch to VTVM.

(10) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

**b. Adjustments**

(1) Center ADJ CAL knob.

(2) Press CAL PUSH switch while adjusting P6 (fig. 1) for zero indication on UUT meter.

**NOTE**

Some models do not have CAL adjustment P6.

(3) Turn NULL switch to VTVM, and adjust dc voltage standard output to 500.000 volts.

(4) Adjust ADJ CAL for null (0) indication on UUT NULL switch in 10, 1, .1 and .01 V position.

(5) Turn NULL switch to VTVM.

(6) Adjust dc voltage standard for 0 (zero) volt.

(7) Turn VOLTS RANGE switch to CAL.

(8) Press and hold CAL PUSH (OP-CAL, to CAL) switch and adjust P2 (fig. 1) for null on UUT.



- (9) Turn VOLTS RANGE switch to 500 and repeat **a**(5) and (6) above.

## **10. 50-Volt Range**

### **a. Performance Check**

(1) Turn, VOLTS RANGE switch to 50 and adjust dc voltage standard (A2, table 1) for full-scale indication on UUT meter.

(2) Turn NULL switch to 10, 1, and .1 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 49.975 and 50.025 volts. If not, perform **b** below.

(3) Turn NULL switch to VTVM.

(4) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

### **b. Adjustments**

(1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 50.000 volts.

(3) Turn NULL switch to 10, 1, and .1 while adjusting P3 (fig. 1) for 0 (zero) indication on UUT meter.

## **11. 5-Volt Range**

### **a. Performance Check**

(1) Turn UUT VOLTS RANGE switch to 5.

(2) Adjust dc voltage standard (A2, table 1) for full-scale indication on UUT meter.

(3) Turn NULL switch to 10, 1, .1 and .01 while adjusting dc voltage standard for 0 indication on UUT meter. Dc voltage standard will indicate between 4.9975 and 5.0025 volts. If not, perform **b** below.

(4) Turn NULL switch to VTVM.

(5) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

### **b. Adjustments**

(1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 5.00000 volts.

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(3) Turn NULL switch to 10, 1, .1, and .01 while adjusting P4 (fig. 1) for 0 (zero) indication on UUT meter.

### **12. 0.5-Volt Range**

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

(1) Turn VOLTS RANGE switch to .5.

(2) Adjust dc voltage standard (A2, table 1) for full-scale indication on UUT meter.

(3) Turn NULL switch to 10, 1, .1, and .01 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 0.49975 and 0.50025 volt. If not, perform **b** below.

(4) Turn NULL switch to VTVM.

(5) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

#### **b. Adjustments**

(1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 0.500000 volt.

(3) Turn NULL switch to 10, 1, .1 and .01 while adjusting P5 (fig. 1) for 0 (zero) indication on UUT meter.

### **13. Voltage Dividers**

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

(1) Turn VOLTS RANGE switch to CAL and press and hold CAL PUSH (OP-CAL, to CAL) switch.

(2) Adjust CAL ADJ control for 0 (zero) indication on UUT meter.

(3) Release CAL PUSH (OP-CAL, to OP) switch.

(4) Turn VOLTS RANGE switch to 500 and A, B, C, D and E switches to 3, 9, 9, 9 and 10.

(5) Adjust dc voltage standard (A2, table 1) to 400 volts.

(6) Turn NULL switch to 10, 1, .1, and .01 while adjusting dc voltage standard for 0 (zero) indication on UUT meter for each NULL switch position. Dc voltage standard will indicate between 399.800 and 400.200 volts.

(7) Turn NULL switch to VTVM.

(8) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

(9) Repeat technique of (5) through (8) above for A, B, C, D, and E switch settings and corresponding initial dc voltage standard settings listed in table 5. Dc voltage standard will indicate within limits specified for each setting of A, B, C, and D, and E switch.

Table 5. Voltage Divider

Unit under test switch settings					Dc voltage standard initial setting	Dc voltage standard indication (V)	
A	B	C	D	E		Min	Max
2	9	9	9	10	300.00	299.850	300.150
1	9	9	9	10	200.00	199.900	200.100
0	9	9	9	10	100.00	99.950	100.050
0	8	9	9	10	90.00	89.9550	90.0450
0	7	9	9	10	80.00	79.9600	80.0400
0	6	9	9	10	70.00	69.9650	70.0350
0	5	9	9	10	60.00	59.9700	60.0300
0	4	9	9	10	50.00	49.9750	50.0250
0	3	9	9	10	40.00	39.9800	40.0200
0	2	9	9	10	30.00	29.9850	30.0150
0	1	9	9	10	20.00	19.9900	20.0100
0	0	9	9	10	10.00	9.9950	10.0050
0	0	8	9	10	9.00	8.99550	9.00450
0	0	7	9	10	8.00	7.99600	8.00400
0	0	6	9	10	7.00	6.99650	7.00350
0	0	5	9	10	6.00	5.99700	6.00300
0	0	4	9	10	5.00	4.99750	5.00250
0	0	3	9	10	4.00	3.99800	4.00200
0	0	2	9	10	3.00	2.99850	3.00150
0	0	1	9	10	2.00	1.99900	2.00100
0	0	0	9	10	1.00	0.99950	1.00050
0	0	0	8	10	0.900	0.899550	0.900450
0	0	0	7	10	0.800	0.799600	0.800400
0	0	0	6	10	0.700	0.699650	0.700350
0	0	0	5	10	0.600	0.599700	0.600300
0	0	0	4	10	0.500	0.499750	0.500250
0	0	0	3	10	0.400	0.399800	0.400200
0	0	0	2	10	0.300	0.299850	0.300150
0	0	0	1	10 <sup>1</sup>	0.200	0.199900	0.200100
0	0	0	1	0 <sup>2</sup>	0.100	0.099950	0.100050

<sup>1</sup>Note Recalibrate UUT as necessary throughout this check, using the ADJ. CAL. Control in conjunction with VOLTS RANGE and CAL PUSH (OP-CAL) switches. Recalibration is necessary if a beyond-specified-tolerance indication is obtained; recheck any erroneous indications after recalibration. Recalibration procedure is given in paragraph 12a(1) through (3).

<sup>2</sup>Record dc voltage standard indication.

<sup>3</sup>Difference between the dc voltage standard indication recorded above and this indication will be between 0.09995 and 0.10005 volt.

**b. Adjustments.** No adjustments can be made to voltage divider. Recalibration may correct an out-of-tolerance condition. (See note below table 5.)

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**14. Final Procedure**

a. Deenergize and disconnect all equipment.

b. In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

**SECTION III**

**CALIBRATION OF DIFFERENTIAL VOLTMETERS AN/USM-98A AND AN/USM-98B (J-F 801 B, J-F 801BR, AND J-F 801B/AG)**

**15. Equipment and Accessories Required.** Table 6 lists minimum use specifications of equipment required for calibration performance checks and adjustments. Table 7 lists required accessories. Tables 6 and 7 are provided to assist in the selection of required equipment and accessories. For specific item identification, refer to section IV.

Table 6. Minimum Specifications of Equipment Required

Item number	Common name	Minimum use specifications
A1	AUTOTRANSFORMER	RANGE: 105 to 125 vac ACCURACY: $\pm 1\%$
A2	DC VOLTAGE STANDARD	RANGE: 0 to 515 v ACCURACY: $\pm 0.016\%$

Table 7. Accessories Required

Item number	Common name	Description
B1	CABLE	30-in., RG-58/U; double banana plug terminations
B2	LEAD	12-in., No. 18; single banana plug terminations (black)

**16. Preliminary Procedure**

**NOTE**

Personnel should familiarize themselves with the entire bulletin prior to performing calibration.

a. Remove protective cover from UUT as necessary to perform adjustments and replace protective cover to check parameter.

b. Connect UUT to autotransformer (A1, table 6).

c. Connect autotransformer to 115-volt ac source and adjust for 115 volts ac.

d. Mechanically zero UUT meter.

**c.** Position UUT controls as listed in (1) through (4) below:

- (1) RANGE switch to 5.
- (2) NULL switch to .01.
- (3) Polarity switch to + (positive).
- (4) Voltage readout dials (A through E) to zero.

**f.** Set UUT power switch to on and allow at least 20 minutes for equipment to warm-up and stabilize.

**g.** Connect lead (B2, table 7) between UUT input terminals.

**h.** UUT meter will indicate zero. If not, adjust R227 (fig. 2) (rear of AN/USM-98B) until UUT meter indicates zero.

**NOTE**

When the UUT is not within tolerance, perform the specified adjustment and continue the performance check. When the UUT is not within tolerance and no adjustment is specified, the deficiency must be corrected before continuing with the procedure.

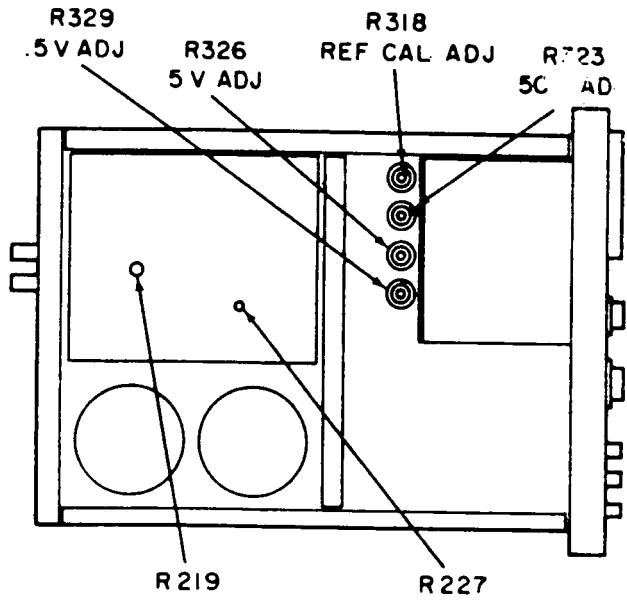
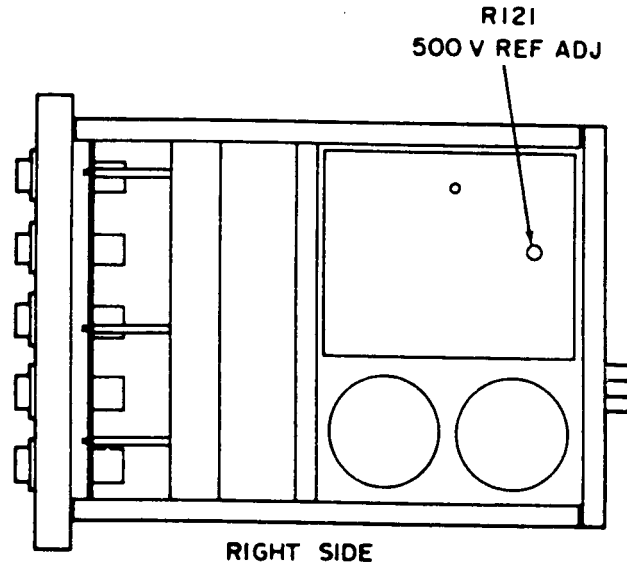
**WARNING**

HIGH VOLTAGE is used during the performance of this procedure. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

**17. Dc VTVM and Null Range**

**a. Performance Check**

- (1) Turn UUT NULL switch to VTVM and RANGE switch to .5.
- (2) Connect dc voltage standard (A2, table 6) output to UUT input terminal, using cable (B1, table 7).
- (3) Adjust dc voltage standard output until UUT meter indicates 500. Dc voltage standard will indicate between 0.485 and 0.515 volt. If not, perform **b** below.
- (4) Turn UUT RANGE switch to settings listed in table 8 and repeat technique of (3) above. Voltage standard will indicate within limits specified.



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Figure 2. Differential voltmeter.

- (5) Turn UUT polarity switch to - (negative).
- (6) Repeat (1) through (3) above for negative indications on UUT meter.
- (7) Adjust dc voltage standard for 0 (zero) indication on UUT meter and turn UUT NULL switch to .01.

Table 8. Dc VTVM

Unit under test		Dc voltage standard indication (V)	
Range switch position	Meter indication	Min	Max
5	100	0.85	1.15
5	200	1.85	2.15
5	300	2.85	3.15
5	400	3.85	4.15
5	500	4.85	5.15
50	500	48.5	51.5
500	500	485	515

- (8) Adjust dc voltage standard output until UUT meter indicates a negative 10 mV (100 on lower scale). Dc voltage standard will indicate between 9.7 and 10.3 mV.
- (9) Repeat technique of (7) and (8) above for settings and indications listed in table 9. Dc voltage standard indications will be within limits specified.

Table 9. Null Range

Unit Under Test		Dc voltage standard indication	
NULL switch position	Meter indication (lower scale)	Min	Max
.1	100	97 mV	103 mV
1	100	0.97 V	1.03 V
10	100	9.7 V	10.3 V

- (10) Turn UUT polarity switch to + (positive).
- (11) Repeat technique of (7) through (9) above for positive indications on UUT meter.
- (12) Turn UUT NULL switch to VTVM.

**b. Adjustments**

- (1) Adjust dc voltage standard output to .500 volt.
- (2) Adjust R219 (fig. 2) (rear of AN/USM -98B) until UUT meter indicates 500.

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### **18. 500-Volt Range and Stability**

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

(1) Position UUT A, B, C, D, and E dials to 4.9, 9, 9 and 10 and RANGE switch to 500.

(2) Turn OPERATE-CALIBRATE switch to CALIBRATE and hold. Adjust CALIBRATE control for null on meter. Release OPERATE-CALIBRATE switch. The CALIBRATE control will be within 90 degrees of midrange. If not, perform **b** below.

(3) Adjust dc voltage standard (A2, table 6) to 500 volts.

(4) Turn NULL switch to 10, 1, and .1 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 499.75 and 500.25 volts. If not, and no adjustment was made in (2) above, perform **b** below.

(5) While maintaining null on UUT with dc voltage standard, vary autotransformer (A1, table 6) from 105 to 125 volts (wait 1 minute at 105 and 125 volts). Dc voltage standard output will remain between 499.75 and 500.25 volts. If not, and no adjustment was performed in (2) or (4) above, perform **b** below.

(6) Adjust autotransformer output to 115 volts.

(7) Turn UUT NULL switch to VTVM.

(8) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

#### **b. Adjustments**

(1) Turn NULL switch to VTVM and CALIBRATE control to midrange. Adjust dc voltage standard for 500.000 volts.

(2) Turn NULL switch to 10, 1, and .1 while adjusting R121 (fig. 2) (rear of AN/USM-98B). Continue adjustment until NULL is obtained in .1 NULL switch position.

(3) Turn OPERATE-CALIBRATE switch to CALIBRATE and hold. Adjust R318 (fig. 2 or 3) for NULL on UUT meter.

(4) Release OPERATE-CALIBRATE switch.

### **19. 50-Volt Range**

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

(1) Turn VOLTS RANGE switch to 50.



(2) Adjust dc voltage standard (A2, table 6) for full-scale indication on UUT meter.

(3) Turn NULL switch to 10, 1, .1, and .01 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 49.975 and 50.025 volts. If not, perform **b** below.

(4) Turn NULL switch to VTVM.

(5) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

**b. Adjustments**

(1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 50.000 volts.

(3) Turn NULL switch to 10, 1, .1 and .01 while adjusting R323 (fig. 2 or 3) for 0 (zero) indication on UUT meter.

**20. 5-Volt Range**

**a. Performance Check**

(1) Turn UUT VOLTS RANGE switch to 5.

(2) Adjust dc voltage standard (A2, table 6) for full-scale indication on UUT meter

(3) Turn NULL switch to 10, 1, .1 and .01 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 4.9975 and 5.0025 volts. If not, perform **b** below.

(2) Turn NULL switch to VTVM.

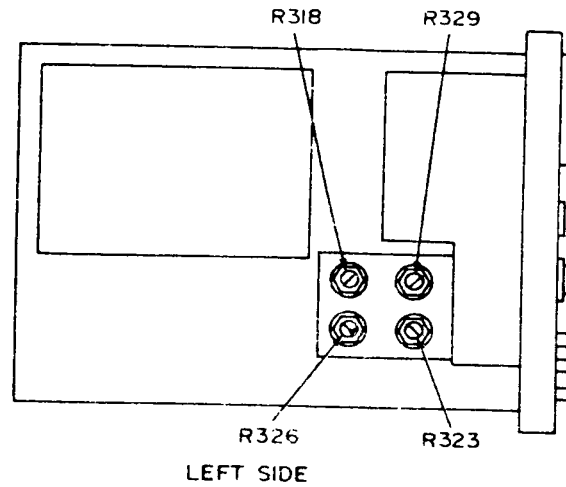
(5) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

**b. Adjustments**

(1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 5.00000 Volts.

(3) Turn NULL switch to 10, 1, .1, and .01 while adjusting R326 (fig. 2 or 3) for 0 (zero) indication on UUT meter.



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Figure 3. Differential voltmeter (AN/USM-98B).

## **21. 0.5-Volt Range**

### **a. Performance Check**

- (1) Turn NULL switch to VTVM and polarity switch to + (positive).
- (2) Turn UUT A, B, C, D, and E dials to 4, 9, 9, 9, and 10.
- (3) Connect dc voltage standard (A2, table 6) output to UUT input terminals, using cable (B1, table 7).
- (4) Turn VOLTS RANGE switch to .5.
- (5) Adjust dc voltage standard for full-scale indication on UUT meter.
- (6) Turn NULL switch to 10, 1, .1, and .01 while adjusting dc voltage standard for 0 (zero) indication on UUT meter. Dc voltage standard will indicate between 0.49975 and 0.50025 volt. If not, perform **b** below.
- (7) Turn NULL switch to VTVM.
- (8) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

### **b. Adjustments**

- (1) Turn NULL switch to VTVM.

(2) Adjust dc voltage standard for 0.500000 volt.

(3) Turn NULL switch to 10, 1, .1, and .01 while adjusting R329 (fig. 2 or 3) for 0 (zero) indication on UUT meter.

**22. Voltage Dividers**

**a. Performance Check**

(1) Turn UUT RANGE selector switch to 500 and A, B, C, D, and E dials to 3, 9, 9, 9 and 10.

(2) Adjust dc voltage standard (A2, table 1) to 400 volts.

(3) Turn NULL switch to 10, 1, and .1 positions and at each position adjust dc voltage standard for null indication on UUT meter. Dc voltage standard will indicate between 399.80 and 400.20 volts.

(4) Turn NULL switch to VTVM.

(5) Adjust dc voltage standard for 0 (zero) indication on UUT meter.

(6) Repeat technique of (2) through (5) above for A, B, C, D, and E switch settings listed in table 10. Dc voltage standard indication will be within specific limits for each set of A, B, C, D, and E switch settings.

Table 10. Voltage Divider

Unit under test switch settings					Dc voltage standard initial setting	Dc voltage standard indication (V)	
A	B	C	D	E		Min	Max
2	9	9	9	10	300.00	299.850	300.150
1	9	9	9	10	200.00	199.900	200.100
0	9	9	9	10 <sup>1</sup>	100.00	99.950	100.050
0	8	9	9	10	90.00	89.9550	90.0450
0	7	9	9	10	80.00	79.9600	80.0400
0	6	9	9	10	70.00	69.9650	70.0350
0	5	9	9	10	60.00	59.9700	60.0300
0	4	9	9	10	50.00	49.9750	50.0250
0	3	9	9	10	40.00	39.9800	40.0200
0	2	9	9	10	30.00	29.9850	30.0150
0	1	9	9	10	20.00	19.9900	20.0100
0	0	9	9	10	10.00	9.9950	10.0050
0	0	8	9	10	9.00	8.99550	9.00450
0	0	7	9	10	8.00	7.99600	8.00400
0	0	6	9	10	7.00	6.99650	7.00350
0	0	5	9	10	6.00	5.99700	6.00300
0	0	4	9	10	5.00	4.99750	5.00250
0	0	3	9	10	4.00	3.99800	4.00200
0	0	2	9	10	3.00	2.99850	3.00150

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Table 10. Voltage Divider

Unit under test switch settings					Dc voltage standard initial setting	Dc voltage standard indication (V)	
A	B	C	D	E		Min	Max
0	0	1	9	10	2.00	1.99900	2.00100
0	0	0	9	10	1.00	0.99950	1.00050
0	0	0	8	10	0.900	0.899550	0.900450
0	0	0	7	10	0.800	0.799600	0.800400
0	0	0	6	10	0.700	0.699650	0.700350
0	0	0	5	10	0.600	0.599700	0.600300
0	0	0	4	10	0.500	0.499750	0.500250
0	0	0	3	10	0.400	0.399800	0.400200
0	0	0	2	10	0.300	0.299850	0.300150
0	0	0	1	10 <sup>2</sup>	0.200	0.199900	0.200100
0	0	0	1	0 <sup>3</sup>	0.100	0.099950	0.100050

Note. Recalibrate UUT as necessary throughout this check, using the ADJ. CAL control in conjunction with VOLTS RANGE (or OPERATE) and CAL switches. Recalibration is necessary if a beyond specified tolerance indication is obtained; Recheck any erroneous indications after recalibration. Recalibration procedure is given in paragraph 18a (2).

<sup>1</sup>Begin using .01 NULL switch position.

<sup>2</sup>Record dc voltage standard indication.

<sup>3</sup>Difference between the voltage standard indication recorded above and this indication will be between 0.09995 and 0.10005 volt.

**b. Adjustments.** No adjustments can be made to voltage divider. Recalibration may correct an out-of-tolerance condition. (See **NOTE** below table 10.)

**23. Final Procedure**

**a.** Deenergize and disconnect all equipment.

**b.** In accordance with TM 38-750, annotate and affix DA Label 80 (US Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (US Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, annotate and affix DA Form 2417 (US Army Calibration System Rejected Instrument).

**SECTION IV  
SPECIFIC ITEM IDENTIFICATION**

**24. Identification.** This section identifies specific equipment and accessories as issued with specific calibration standards sets or specific maintenance equipment groups.

**25. Secondary Transfer Calibration Standards Set**

**a. Equipment Identification.** The equipment listed in table 11 is issued with secondary transfer calibration standards set 6695-00-621-7877 and is to be used in performing this procedure. When any equipment listed in table 11 is not available, equivalent items may be substituted provided that they meet the minimum use specifications listed in table 1 or 6.

Table 11. Equipment Identification

Item number	Nomenclature	Identifying number	Manufacturer and model number
A1	TRANSFORMER, VARIABLE POWER	7910809	General Radio, Model W10MT3AS3
A2	VOLTAGE STANDARD, DC	7911393	Cohu, Model 351 or John Fluke, Model 332A

**b. Accessory Identification.** The accessories listed in table 12 are issued with secondary transfer calibration standards set 6695-00-621-7877 and are to be used in performing this procedure. These accessories may be substituted unless specifically prohibited.

Table 12. Accessory Identification

Item Number	Nomenclature	Identifying number	Description
B1	CABLE ASSEMBLY, RADIO FREQUENCY	7907470	30-in., RF-58/U; double banana plug terminations
B2	LEAD, ELECTRICAL	7907496	12-in., No. 18; single banana plug terminations (black)

By Order of the Secretary of the Army:

**W. C. WESTMORELAND**  
*General, United States Army*  
*Chief Of Staff*

Official:

**KENNETH G. WICKHAM**  
*Major General, United States Army*  
*The Adjutant General*

**Distribution:**

Active Army:

TAG (1)	USAERDAA (22)	Cornhusker Army Ammo Plant (1)
TIG (2)	USAARMC (11)	Lake City Army Ammo Plant (1)
ARADCOM (2)	USAGETA (2)	Sunflower Army Ammo Plant (2)
ARADCOM Rgn (2)	USA Mat & Mech Rsch Cen (2)	Longhorn Army Ammo Plant (1)
USARHAW (4)	USAMCI&SA (3)	Milan Army Ammo Plant (1)
USARPAC (2)	USANDL (2)	Newport Army Ammo Plant (1)
2d LOGCOMD (40)	NLABS (2)	Radford Army Ammo Plant (1)
USATECOM (1)	USARSO (4)	Louisiana Army Ammo Plant (1)
USAMC - Europe (2)	USARADBD (2)	Rocky Mountain Arsenal (2)
USA Arberdeen R&D Cen (4)	USAVLABS (2)	Picatinny Arsenal (5)
USAMUCOM (2)	USACRREL (2)	Edgewood Arsenal (4)
USAECOM (10)	Harry Diamond Lab (2)	Frankford Arsenal (5)
USACDCEC (10)	APG (2)	Pine Bluff Arsenal (2)
USA SAFSCOM (3)	DTC (2)	Rock Island Arsenal (2)
USAAPSA (4)	USAEPG (3)	Albrook AFB (3)
USAMICOM (59)	JPG (2)	WSMR (6)
USAWECOM (34)	YPG (2)	USATTC (2)
USAMECOM (2)	ANAD (20)	Elmendorf AFB (3)
USAAVSCOM (19)	USARJ (7)	Flat-Top Fld Ofc (3)
USATACOM (2)	USA Camp Carrol Dep (14)	Davis-Monthan AFB (5)
USASA Mat Spt Comd (2)	LEAD (37)	USAMC Taiwan Mat Agcy (1)
USAMC (2)	UMAD (2)	AMC Nuc Actv Fld Ofc (3)
USATOPOCOM (2)	SHAD (4)	SAMSO (SMSDI) (6)
Armies (3) except Eighth	SIAD (2)	Newark AF Sta (1)
US Army (1)	LBAD (20)	Norfolk Naval Air Sta (1)
138th Ord Co (2)	PUAD (20)	Naval Air Tech Svc Fac (1)
Ft Detrick (2)	SEAD (2)	Pirmasens Army Dep (75)
Ft Hood (5)	SAAD (18)	USN Air Dev Cen (2)
Korea Spt Cmd (1)	SVAD (6)	Comdt of Marine Corps (8)
USAOC&S (21)	RRAD (4)	NYU (2)
USAMMCS (1)	TOAD (19)	NAVPRO MEC Lib (2)
USAATC (2)	TEAD (42)	USARAL (2)
ARADMAC (4)	Iowa Army Ammo Plant (1)	
USAMERDC (2)	Indiana Army Ammo Plant (6)	
NG: None		
USAR: None		

For explanation of abbreviations used, see AR 310-50

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