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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR DIGITAL MULTIMETER, JOHN FLUKE MODELS 8010A, 8010A-01, 8010M, AND 8012A

Headquarters, Department of the Army, Washington, DC
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SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Digital Multimeter, John Fluke, Models 8010A, 8010A-01, 8010M, and 8012A. The manufacturer's manuals 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. Variations among models are described in text.

b. Time and Technique. The time required for this calibration is approximately 1 hour 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. 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 ±(% of reading + digits) (3 1/2 digit display)
Dc voltage	Range: ±200 mV, ±2V, ±20V, ±200V, ±1000V (±1200V)[1] Accuracy: (0.1 + 1)
Ac Voltage	Range: 200 mV, 2 V, 20 V Accuracy: 45 Hz to l0 kHz (0.5 + 2) 10 to 20 kHz (1.0 + 2) 20 to 50 kHz (5.0 + 3) Range: 200 V Accuracy: 45 Hz to 10 kHz (0.5 + 2) 10 to 20 kHz (1.0 + 2) 20 to 50 kHz (5 + 3)[1] Range: 750 V Accuracy: 45 Hz to 1 kHz (0.5 + 2) Range: 1200 V[1] Accuracy: 45 Hz to 10 kHz (0.5 + 2) 10 to 20 kHz (1.0 + 2)

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications ±(% of reading + digits) (3 1/2 digit display)
Dc current	Range: 200 µA, 2 mA, 20 mA, 200 mA, 2000 mA Accuracy: (0.3 +1)
High current[2]	Range: 10 A Accuracy: (0.5 + 1)
Ac current[3]	Range: 200 µA, 2 mA, 20 mA, 200 mA Accuracy: 45Hz to l0 kHz (1.0 + 2) 10 to 20 kHz (2.0 + 2) Range: 2000 mA Accuracy: 45 Hz to 2 kHz (1.0 + 2) 45 Hz to 3kHz (1.0 + 2)[1]
High current[2, 3]	Range: 10 A Accuracy: 45 Hz to 2 kHz (1.0 + 2)
Resistance	Range: 200Ω, 2 kΩ, 20 kΩ, 200 Ω Accuracy: (.2 + 1) Range: 2000 Ω and 20 MΩ Accuracy: (.5 + 1) Range: 2000 kΩ1 Accuracy: (.2 + 1)
Low resistance[4]	Range: 2Ω Accuracy: (1 + 2) Range: 20Ω Accuracy: (.5 + 2)
Conductance	Range: 2 mS and 20 µS Accuracy: (.2 + 1) Range: 200 nS Accuracy: (1 + 10)

[1]Model 8010M only.
[2]Models 8010A and 8010A-01.
[3]Ac current and high current are verified during dc current checks since same shunts are utilized for both ac and dc current functions.
[4]Model 8012A only.

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 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)
CALIBRATOR	Dc voltage: Range: -1.9 to 190 V dc Accuracy: ±0.0395% Range: 1000 V dc Accuracy: ±0.2% Ac Voltage: Range: 190 mV to 19 V ac Frequency: Accuracy: 45 Hz to 10 kHz ±0.158% 20 kHz ±0.276% 50 kHz ±1.29% Range: 190 V ac Frequency: Accuracy: 45 Hz to 10 kHz ±0.158% 20 kHz ±0.276% Range: 750 V ac Frequency: Accuracy: 50 Hz and 1 kHz ±0.2% Range: 1000 V ac Frequency: Accuracy: 50 Hz to 10 kHz ±0.175% 20 kHz ±0.3% Dc current: Range: 190 µA to 1.9 A Accuracy: ±0.092% Range: 10 A Accuracy: ±0.15% Resistance: Range: 1.9Ω Accuracy: ±0.276% Range: 19Ω Accuracy: ±0.158% Range: 100Ω to 1 MΩ Accuracy: ±0.075% Range: 10 MΩ Accuracy: ±0.15%	John Fluke, Model 5700A/CT (p/o MIS-35947), w/power amplifier, John Fluke, Model 5215A/CT (5215A/CT) w/transconductance amplifier; John Fluke, Model 5220A/CT (5220A/CT)

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
RESISTANCE STANDARD NO. 1	Range: 1000Ω and 100,000Ω Accuracy: ±0.075%	Biddle-Gray, Model 71-631 (7910328)
RESISTANCE STANDARD NO. 2	Range: 10 MΩ Accuracy: ±0.5%	Beckman, Model CR10M (8598965)

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 results 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. 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. Remove protective cover from TI as necessary to gain access to adjustments. Replace cover after completing the adjustments.

b. Connect TI to a 115 V ac source.

c. Press TI **POWER** switch to **ON** and allow at least 15 minutes for warmup and stabilization.

8. Dc Voltage

a. Performance Check

(1) Connect calibrator output to TI **V/kΩ/S (V/kΩ** on model 8010M) and **COMMON.**

(2) Press **AC/DC** pushbutton to **DC.**

(3) Press **V** function and **2** range pushbuttons.

(4) Set calibrator output to 1.9 V dc. If TI does not indicate between 1.897 and 1.903, perform **b** below.

(5) Set calibrator output to -1.9 V dc. If TI does not indicate between -1.897 and -1.903, perform **b** below.

(6) Press TI range pushbutton and set calibrator output for settings listed in table 3. TI will indicate within limits specified in table 3.

b. Adjustments

(1) Set calibrator output to 1.9 V dc. Adjust R4 (DC CAL) for a TI indication between 1.899 and 1.901 (R).

(2) Set calibrator output to -1.9 V dc. If TI does not indicate between -1.899 and -1.901, adjust R4 (DC CAL) (R).

(3) Repeat (1) and (2) above until both indications are within limits specified.

Table 3. Dc Voltage

Test instrument range pushbuttons	Calibrator settings	Test instrument indications	
		Min	Max
200 mV	190 mv	189.7	190.3
20	19 V	18.97	19.03
200	190 V	189.7	190.3
1000 V DC (1200V DC) [1]	1000 V	998	1002

[1]Model 8010M.

9. Ac Voltage

a. Performance Check

(1) Connect calibrator output to TI **V/kΩS** (**V/kΩ** on model 8010M) and **COMMON**.

(2) Press **V** function pushbutton and **AC/DC** pushbutton to **AC**.

(3) Press TI range pushbutton and set calibrator output for settings listed in table 4. If TI does not indicate within limits specified in table 4, perform **b** below.

b. Adjustments

(1) Set calibrator output to standby and press T1 **2** range pushbutton.

(2) Adjust R21 to center of range.

(3) Set calibrator output to 1.9 V and 100Hz. Adjust Rl9 (AC HI) for a TI indication between 1.899 and 1.901 (R).

(4) Set calibrator output to l90 mV and 100 Hz. Adjust R21 (AC LO) for a TI indication between .189 and .191 (R).

(5) Set calibrator output to 1.9 V and 100 Hz. If TI does not indicate between 1.899 and 1.901, repeat (2) through (4) above.

(6) Press TI **20** pushbutton and set calibrator output to 19 V and 10 kHz. Adjust C1 for a TI indication of exactly 19.00 (R).

Table 4. Ac Voltage

Test instrument range pushbuttons	Calibrator settings		Test instrument indications	
	Voltage	Frequency	Min	Max
200mV	190 mV	45 Hz	188.8	191.2
200 mV	190 mV	1 kHz	188.8	191.2
200 mV	190 mV	10 kHz	188.8	191.2
200 mV	190 mV	20 kHz	187.9	192.1
200 mV	190 mV	50 kHz	180.2	199.8
2	1.9 V	50 kHz	1.802	1.998
2	1.9 V	20 kHz	1.879	1.921
2	1.9 V	10 kHz	1.888	1.912
2	1.9 V	1 kHz	1.888	1.912
2	1.9 V	45 Hz	1.888	1.912
20	19 V	45 Hz	18.88	19.12
20	19 V	1 kHz	18.88	19.12
20	19 V	10 kHz	18.88	19.12
20	19 V	20 kHz	18.79	19.21
20	19 V	50 kHz	18.02	19.98
200[1]	190 V	50 kHz	180.2	199.8
200	190 V	20 kHz	187.9	192.1
200	190 V	10 kHz	188.8	191.2
200	190 V	1 kHz	188.8	191.2
200	190 V	45 Hz	188.8	191.2
750 V AC (1200 V AC)[1]	750 V (1000 V)	50 Hz	744 (993)	756 (1007)
750 V AC (1200 V AC)[1]	750 V (1000 V)	1 kHz	744 (993)	756 (1007)
1200 V AC[1]	1000 V	20 kHz	988	1012

[1]Model 8010M.

(7) Press TI **200** pushbutton and set calibrator.output to 110 V and 10 kHz. Adjust C4 for a TI indication of exactly 110.0 (R).

(8) Repeat (1) and (3) through (7) above until no further adjustments are required.

NOTE

Perform (9) and (10) below for model 8010M only.

(9) Press TI **1200V AC** pushbutton and set calibrator output to 1000 V and 10 kHz. Adjust C25 for a TI indication of exactly 1000 (R).

(10) Repeat (1) and (3) through (9) above until no further adjustments are required.

10. DC Current

a. Performance Check

(1) Connect calibrator output to TI **mA** and **COMMON.**

(2) Press **mA/A (mA** on models 8012A and 8010M) function and **AC/DC** pushbutton to **DC.**

(3) Press TI range pushbutton and set calibrator output for settings listed in table 5. TI will indicate within limits specified in table 5.

b. Adjustments. No adjustments can be made.

Table 5. Dc Current

Test instrument range pushbuttons	Calibrator settings	Test instrument indications	
		Min	Max
200 µA	190 µA	189.3	190.7
2	1.9 mA	1.893	1.907
20	19 mA	18.93	19.07
200	190 mA	189.3	190.7
2000	1.9 A	1893	1907
10 A[1]	10 A	9.94	10.06

[1]For models 8010A and 8010a-01 only, connect transconductance amplifier output to TI **10A** and **COMMON**.

11. Resistance

a. Performance Check

(1) Connect calibrator output to TI **V/kΩ/S** (**V/kΩ** on model 8010M) and **COMMON.**

(2) Press **kΩ/S** function pushbutton.

(3) Press TI range pushbutton and set calibrator to the nominal resistance outputs as listed in table 6. At each resistance output, adjust calibrator adjustment control for a calibrator control display indication equal to TI indication. The calibrator control **Error** display indication will be within limits specified in table 6.

NOTE

Perform (4) through (10) below for models 8010A and 8010A-01.

(4) Disconnect calibrator and connect resistance standard No. 1 to TI **V/kΩ/S** and **COMMON.**

(5) Simultaneously press **200Ω** and **2** range pushbuttons to select **2 mS** range.

(6) Set resistance standard No. 1 for 1000 ohms. TI will indicate between .997 and 1.003.

(7) Simultaneously press **20** and **200** range pushbuttons to select **20 µS** range.

(8) Set resistance standard No. 1 for 100000 ohms. TI will indicate between 9.97 and 10.03.

(9) Simultaneously press **2000** and **20MΩ** range pushbuttons to select **200 nS** range.

(10) Substitute resistance standard No. 2 (10 MΩ) for resistance standard No. 1. TI will indicate between 98.0 and 102.0.

b. Adjustments. No adjustments can be made.

Table 6. Resistance

Test instrument range pushbuttons	Calibrator output nominal value	Calibrator **Error** display indications ±(%)
200 Ω	100 Ω	.3
2	1 kΩ	.3
20	10 kΩ	.3
200	100 kΩ	.3
2000	1 MΩ	.6 (.3)[1]
20 MΩ	10 MΩ	.6

[1]Model **8010M**.

12. Resistance (Model 8012A only)

a. Performance Check

(1) Connect calibrator output to TI **LO RANGE Ω** and **COMMON.**

(2) Simultaneously press **V** and **mA** function pushbuttons to select **LO RANGE Ω** function and press **2** range pushbutton.

NOTE

Calibrator **2 wire Comp** must be set to **ON** in (3) through (5) below.

(3) Set calibrator output for 0 ohm. Adjust TI **ZERO** control for a .000 to .001 TI indication.

(4) Set calibrator for a nominal 1.9 ohm output. Adjust calibrator adjustment control for a calibrator control display indication equal to TI indication. If calibrator control **Error** display indication is not within ±1.105 %, perform **b** below.

(5) Press **20** range pushbutton.

(6) Set calibrator for a nominal 19Ω output. Adjust calibrator adjustment control for a calibrator control display indication equal to TI indication. If calibrator control **Error** display indication is not within ±.632%, perform **b** below.

(7) Connect calibrator output to TI **V/kΩ/S** and **COMMON.** Press **kΩ/S** function pushbutton.

(8) Press TI range pushbutton and set calibrator to the nominal resistance outputs as listed in table 7. At each resistance output, adjust calibrator adjustment control for a calibrator control display indication equal to TI indication. Calibrator control **Error** display indication will be within limits specified in table 7.

(9) Disconnect calibrator and connect resistance standard No. 1 to TI **V/kΩ/S** and **COMMON.**

(10) Simultaneously press **200Ω** and **2** range pushbuttons to select **2 mS** range.

(11) Set resistance standard No. 1 for 1000 ohms. TI will indicate between .997 and 1.003.

(12) Simultaneously press **20** and **200** range pushbuttons to select **20 μS** range.

(13) Set resistance standard No. 1 for 100000 ohms. TI will indicate between 9.97 and 10.03.

(14) Simultaneously press **2000** and **20MΩ** range pushbuttons to select **200 nS** range.

Table 7. Resistance

Test instrument range pushbuttons	Calibrator output nominal value	Calibrator **Error** display indications ±(%)
200 Ω	100 Ω	.3
2	1 kΩ	.3
20	10 kΩ	.3
200	100 kΩ	.3
2000	1 MΩ	.6
20 MΩ	10 MΩ	.6

(15) Substitute resistance standard No. 2 (10 MΩ) for resistance standard No. 1. TI will indicate between 98.0 and 102.0.

b. Adjustments. Press **20** range pushbutton and set calibrator for a nominal 19 ohm output and adjust R57 for a TI indication equal to value displayed on calibrator to two decimal places (R).

13. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

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