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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR CALIBRATOR, FLUKE, MODEL 5730A

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 Calibrator, Fluke, Model 5730A. 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 8 hours, using the dc and low frequency and microwave techniques.

2. Forms, Records, and Reports. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

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

Table 1. Calibration Description.

Test instrument parameter	Performance specifications 1 year, 99% confidence, ±5°C from calibration temperature	
DC Voltage	Range	Accuracy: ± (ppm output + uV)
	220 mV	9 + 0.5
	2.2 V	6 + 0.8
	11 V	4 + 3
	22 V	4 + 5
	220 V	6 + 50
	1100 V	8 + 500
Resistance (4-wire connection)	Nominal output	Accuracy ± (ppm from displayed value)
	0.0 Ω	50 µΩ
	1.0 Ω	110
	1.9 Ω	110
	10 Ω	27
	19 Ω	27
	100 Ω	12
	190 Ω	12
	1.0 kΩ	8
	1.9 kΩ	8
	10 kΩ	8
	19 kΩ	8
	100 kΩ	10
	190 kΩ	12
	1.0 MΩ	15
	1.9 MΩ	21
	10 MΩ	46
	19 MΩ	55
	100 MΩ (2-wire only)	120
DC current	Range	Accuracy: ± (ppm output + nA)
	220 µA	50 + 7
	2.2 mA	40 + 8
	22 mA	40 + 50
	220 mA	80 + 800
	2.2 A	90 + 15,000

Table 1. Calibration Description – Continued.

Test instrument parameter	Performance specifications 1 year, 99% confidence, ±5°C from calibration temperature		
AC Voltage	Range	Hz	Accuracy: ± (ppm output + uV)
	2.2 mV	10-20	300 + 5
		20-40	115 + 5
		40-20 k	100 + 5
		20 k-50 k	250 + 5
		50 k-100 k	600 + +6
		100 k-300 k	1300 + 12
		300 k-500 k	1700 + 25
		500 k-1 M	3400 + 25
	Range	Hz	Accuracy: ±(ppm output + uV)
	22 mV	10-20	300 + 5
		20-40	115 + 5
		40-20 k	100 + 5
		20 k-50 k	250 + 5
		50 k-100 k	600 + +6
		100 k-300 k	1300 + 12
		300 k-500 k	1700 + 25
		500 k-1 M	3400 + 25
	Range	Hz	Accuracy: ±(ppm output + uV)
	220 mV	10-20	300 + 15
		20-40	115 + 8
		40-20 k	70 + 8
		20 k-50 k	150 + 12
		50 k-100 k	400 + 20
		100 k-300 k	800 + 25
		300 k-500 k	1700 + 30
		500 k-1 M	3300 + 60
	Range	Hz	Accuracy: ±(ppm output + uV)
	2.2 V	10-20	300 + 50
		20-40	110 + 20
		40-20 k	48 + 10
		20 k-50 k	80 + 12
		50 k-100 k	100 + 40
		100 k-300 k	400 + 100
		300 k-500 k	1200 + 250
		500 k-1 M	200 + 400
	Range	Hz	Accuracy: ±(ppm output + uV)
	22 V	10-20	300 + 500
		20-40	110 + 200
		40-20 k	48 + 70
		20 k-50 k	80 + 120
		50 k-100 k	100 + 250
		100 k-300 k	300+ +800
		300 k-500 k	1200 + 2500
		500 k-1 M	1800 + 4000
	Range	Hz	Accuracy: ±(ppm output + mV)
	220 V	10-20	300 + 5
		20-40	110 + 2
		40-20 k	65 + 0.7
		20 k-50 k	100 + 1.2
		50 k-100 k	180 + 3
		100 k-300 k	1100 + 20
		300 k-500 k	5400 + 50
		500 k-1 M	10,000 + 100

Table 1. Calibration Description – Continued.

Test instrument parameter	Performance specifications 1 year, 99% confidence, ±5°C from calibration temperature		
AC Voltage (continued)	Range	Hz	Accuracy: ±(ppm output + mV)
	1100 V	15-50	360 + 20
		50-1 k	85 + 4
AC Current	Range	Hz	Accuracy: ± (ppm + nA)
	220 uA	10-20	300 + 20
		20-40	200 + 12
		40-1 k	120 + 10
		1 k-5 k	350 + 15
		5 k-10 k	1300 + 80
	Range	Hz	Accuracy: ± (ppm + nA)
	2.2 mA	10-20	300 + 50
		20-40	200 + 40
		40-1 k	120 + 40
		1 k-5 k	240 + 130
		5 k-10 k	1300 + 800
	Range	Hz	Accuracy: ± (ppm + nA)
	22 mA	10-20	300 + 500
		20-40	200 + 400
		40-1 k	120 + 400
		1 k-5 k	240 + 700
		5 k-10 k	1300 + 6000
	Range	Hz	Accuracy: ± (ppm + uA)
	220 mA	10-20	300 + 5
		20-40	200 + 4
		40-1 k	120 + 3
		1 k-5 k	240 + 4
		5 k-10 k	1300 + 12
	Range	Hz	Accuracy: ± (ppm + uA)
	2.2 A	20-1 k	300 + 40
		1 k-5 k	500 + 100
		5 k-10 k	8000 + 200
Frequency (ACV and ACI)	Accuracy: ± 0.0025%		

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 Reference Calibration Standards Set, NSN 4931-00-621-7878. 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. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parentheses.

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. The following peculiar accessories are required: 2 each, Fluke high-integrity low-thermal emf 4-wire shorting PCB's and high quality low thermal leads (e.g. 8508A LEAD, 5440A-7003, 5730A-7003 or other locally available high quality substitute).

Table 2. Minimum Specifications of Equipment Required.

Common name	Minimum use specifications	Manufacturer and model (part number)
AC MEASUREMENT STANDARD	Range: 2 mV Accuracy: 10 Hz ±700 ppm (±2350 ppm) 20 Hz ±654 ppm (±1390 ppm) 40 Hz ±654 ppm (±1070 ppm) 1 kHz ±650 ppm (±1070 ppm) 20 kHz ±650 ppm (±1070 ppm) 50 kHz ±687 ppm (±1810 ppm) 100 kHz ±900 ppm (±2450 ppm) 300 kHz ±1825 ppm (±4300 ppm) 500 kHz ±3550 ppm (±6400 ppm) 1 MHz ±3975 ppm (±7500 ppm) Range: 20 mV Accuracy: 10 Hz ±137 ppm (±355 ppm) 20 Hz ±91 ppm (±255 ppm) 40 Hz ±86 ppm (±175 ppm) 1 kHz ±86 ppm (±175 ppm) 20 kHz ±86 ppm (±175 ppm) 50 kHz ±125 ppm (±175 ppm) 100 kHz ±225 ppm (±210 ppm) 300 kHz ±475 ppm (±1010 ppm) 500 kHz ±737 ppm (±1290 ppm) 1 MHz ±1162 ppm (±2100 ppm) Range: 200 mV Accuracy: 10 Hz ±94 ppm (±218 ppm) 20 Hz ±39 ppm (±93 ppm) 40 Hz ±28 ppm (±46 ppm) 1 kHz ±28 ppm (±46 ppm) 20 kHz ±28 ppm (±46 ppm) 50 kHz ±63 ppm (±79 ppm) 100 kHz ±125 ppm (±173 ppm) 300 kHz ±231 ppm (±270 ppm) 500 kHz ±463 ppm (±420 ppm) 1 MHz ±900 ppm (±1040 ppm) Range: 0.5 V Accuracy: 40 Hz ±17 ppm (±36 ppm) 1 kHz ±17 ppm (±36 ppm) 20 kHz ±17 ppm (±36 ppm) 100 kHz ±45 ppm (±84 ppm) 300 kHz ±155 ppm (±188 ppm) 1 MHz ±700 ppm (±976 ppm) Range: 1 V Accuracy: 40 Hz ±15 ppm (±24 ppm) 1 kHz ±15 ppm (±24 ppm) 20 kHz ±15 ppm (±24 ppm) 100 kHz ±35 ppm (±71 ppm) 300 kHz ±125 ppm (±160 ppm) 1 MHz ±600 ppm (±900 ppm)	Fluke, Model 5790A (13534003)

Table 2. Minimum Specifications of Equipment Required – Continued.

Common name	Minimum use specifications	Manufacturer and model (part number)
AC MEASUREMENT STANDARD (continued)	Range: 2 V Accuracy: 10 Hz ±82 ppm (±200 ppm) 20 Hz ±30 ppm (±66 ppm) 40 Hz ±13 ppm (±24 ppm) 1 kHz ±13 ppm (±24 ppm) 20 kHz ±13 ppm (±24 ppm) 50 kHz ±22 ppm (±46 ppm) 100 kHz ±30 ppm (±71 ppm) 300 kHz ±113 ppm (±160 ppm) 500 kHz ±331 ppm 1 MHz ±550 ppm (±900 ppm) Range: 20 V Accuracy: 10 Hz ±81 ppm (±200 ppm) 20 Hz ±30 ppm (±67 ppm) 40 Hz ±13 ppm (±27 ppm) 1 kHz ±13 ppm (±27 ppm) 20 kHz ±13 ppm (±27 ppm) 50 kHz ±22 ppm (±48 ppm) 100 kHz ±28 ppm (±81 ppm) 300 kHz ±85 ppm (±190 ppm) 500 kHz ±331 ppm (±400 ppm) 1 MHz ±500 ppm (±1200 ppm) Range: 22 V Accuracy: 1 MHz ±3636 ppm Range: 30 V Accuracy: 500 kHz ±1777 ppm Range: 50 V Accuracy: 300 kHz ±375 ppm Range: 200 V Accuracy: 10 Hz ±81 ppm (±200 ppm) 20 Hz ±30 ppm (±68 ppm) 40 Hz ±17 ppm (±31 ppm) 1 kHz ±17 ppm (±31 ppm) 20 kHz ±17 ppm (±31 ppm) 50 kHz ±27 ppm (±69 ppm) 100 kHz ±49 ppm (±98 ppm) Range: 250 V Accuracy: 15 Hz ±110 ppm (±200 ppm) Range: 500 V Accuracy: 50 Hz ±23 ppm (±41 ppm) 1 kHz ± 23 ppm (±41 ppm)	Fluke, Model 5790A (13534003)

Table 2. Minimum Specifications of Equipment Required – Continued.

Common name	Minimum use specifications	Manufacturer and model (part number)
AC MEASUREMENT STANDARD (continued)	Range: 1000 V Accuracy: 50 Hz ±22 ppm (±38 ppm) 1 kHz ± 22 ppm (±38 ppm)	Fluke, Model 5790A (13534003)
CURRENT SHUNT SET	Range: 1 mA to 2 A Frequency: 10 Hz to 10 kHz Accuracy: Test Report	Fluke, Model A40B-SET (A40B-SET)
DC REFERENCE STANDARD	Range:10 Vdc Accuracy: Test Report	Fluke, Model 732B (732B)
FREQUENCY COUNTER	Range:10 Hz to 1.2 MHz Accuracy: 6.25 ppm	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Function: DCV Range: 0 to ± 800 mV Accuracy: 8 ppm Range: +10 to +19 V dc & -10 to -19 V dc Linearity: 1.1 ppm Function: Resistance Range: 0 Ω Accuracy: ±12.5 μΩ Function: Resistance Ratio Range: 1 Ω to 2 Ω Accuracy: 6 ppm Range: 10 Ω to 20 Ω Accuracy: 2.2 ppm Range: 100 Ω to 200 kΩ Accuracy: 0.5 ppm Range: 1 MΩ to 2 MΩ Accuracy: 1.5 ppm Range :10 MΩ to 20 MΩ Accuracy: 7.5 ppm Range: 100 MΩ (HIVΩ) Accuracy: 3 ppm	Fluke, Model 8508A/02 (8508A/02)
REFERENCE DIVIDER	Range: ÷ 10 Accuracy: 0.2 ppm Range: ÷ 100 Accuracy: 0.5 ppm	Fluke, Model 752A (752A)
RESISTANCE STANDARD NO. 1	Range: 1 Ω Accuracy: Test Report	Measurements International Model 9331/1
RESISTANCE STANDARD NO. 2	Range: 10 Ω Accuracy: Test Report	Measurements International Model 9331/10
RESISTANCE STANDARD NO. 3	Range: 100 Ω Accuracy: Test Report	Measurements International Model 9331/100
RESISTANCE STANDARD NO. 4	Range: 1 kΩ Accuracy: Test Report	Measurements International Model 9331/1K
RESISTANCE STANDARD NO. 5	Range: 10 kΩ Accuracy: Test Report	Measurements International Model 9331/10K
RESISTANCE STANDARD NO. 6	Range: 100 kΩ Accuracy: Test Report	Measurements International Model 9331/100K
RESISTANCE STANDARD NO. 7	Range: 1 MΩ Accuracy: Test Report	Measurements International Model 9331/1M
RESISTANCE STANDARD NO. 8	Range: 10 MΩ Accuracy: Test Report	Measurements International Model 9331/10M
RESISTANCE STANDARD NO. 9	Range: 100 MΩ Accuracy: Test Report	Measurements International Model 9331G/100M

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 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 manufacturers' manuals 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. Connect TI and all powered test equipment to a common source of power (e.g. power strip). Set all power switches to on. Allow at least 30 minutes for TI to warm-up. Follow manufacturer's warm-up recommendations for other test equipment. If TI has been stored for an extended period at high temperatures and humidity, allow 4 hours for warm-up.

b. Complete TI internal self-test and diagnostics by touching screen keys as follows: [**SETUP MENU**], [**SELF TEST & DIAGNOSTICS**], [**DIAGNOSTICS-RUN TEST**]. TI must complete all tests successfully before continuing. Self-test and diagnostics take approximately 12 minutes. Touch screen keys [**CLOSE**], then [**EXIT**] when complete.

c. Perform TI **DC ZERO CALIBRATION** by touching screen keys as follows: [**SETUP MENU**], [**CALIBRATION**], [**RUN DC ZERO**]. **DC ZERO CALIBRATION** takes approximately 3 minutes. Touch screen keys [**CLOSE**], then [**EXIT**] when complete.

d. Perform DC ZERO CALIBRATION on AC measurement standard by pressing: UTIL MENUS, [CAL], [ZERO CAL].

e. Self-calibrate reference divider (appendix A).

NOTE

If "AS FOUND" data is required, complete performance checks in paragraphs **9** through **14** below before artifact calibration in paragraph **8** below. Complete performance checks in paragraphs **9** through **14** below again, after artifact calibration, to collect "AS LEFT" data as necessary.

8. Artifact Calibration

a. Alignment

(1) Press TI **RESET** button.

(2) Enter artifact calibration routine by touching keys on TI screen as follows:

(a) [**SET-UP MENU**].
(b) [**CALIBRATION**].
(c) [**TEMPERATURE**], key in ambient air temperature, press **ENTER**.
(d) [**RUN ARTIFACT CAL**].

(3) Connect artifact standards when prompted by on-screen instructions. Press [**CONTINUE**] as necessary.

NOTE

Use figure 1 or figure 2 to make connections. Enter test report values for standards as necessary.

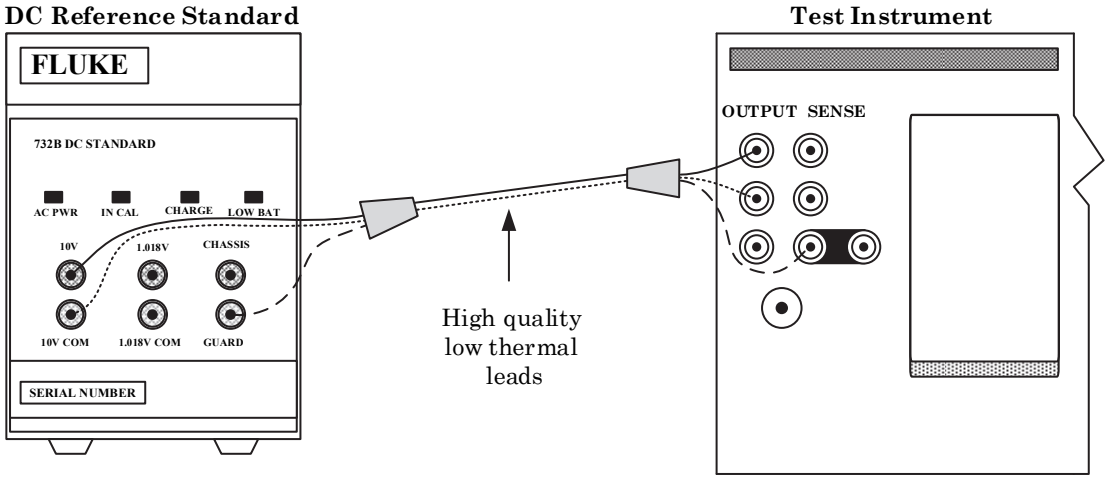


Figure 1. Artifact Calibration (+DCV).

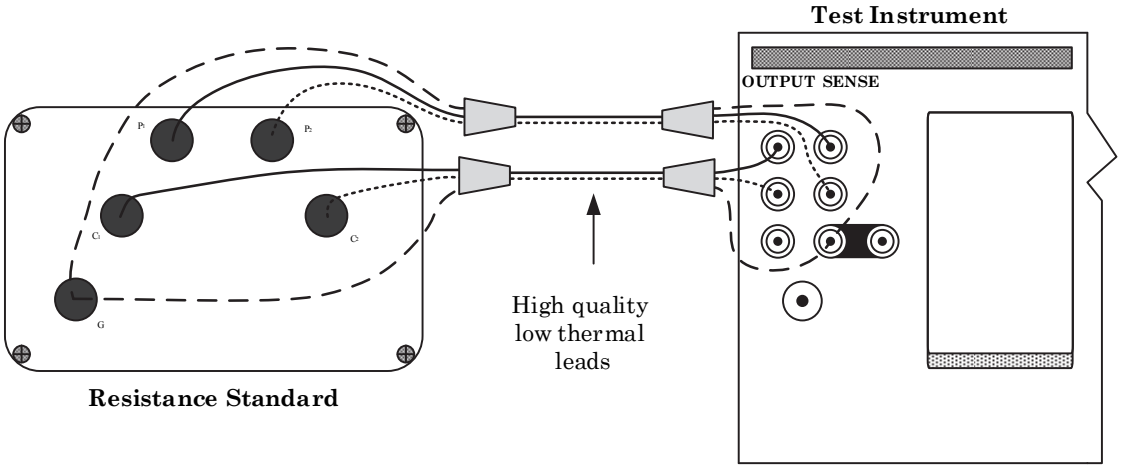


Figure 2. Artifact Calibration (Resistance 10 kΩ and 1 Ω).

(4) When TI prompts to remove 1 Ω resistance standard, an automatic internal routine will begin. Routine takes approximately 52 minutes.

(5) When TI completes automatic internal routine, touch on screen [**SAVE**] button.

(6) Enter passcode when prompted. Default passcode is 5730.

NOTE

If default passcode fails and passcode is not known, the nonvolatile (serial number dependent) passcode may be requested from the manufacturer.

NOTE

After artifact calibration is complete, individual ranges may be adjusted. This is NOT necessary to meet absolute specifications. Range adjustments are used to enhance TI performance beyond manufacturer's specifications. Range adjustments are found by selecting **SETUP MENU > CALIBRATION > RANGE ADJUSTMENT**. Then, select range to be enhanced and follow screen prompts.

(7) Press TI **RESET**.

b. Adjustments. No further adjustments can be made.

9. Dc Voltage Verification

a. Performance Check

(1) Prepare multimeter for zeroing by shorting leads on a low thermal binding post such as that shown in figure 3.

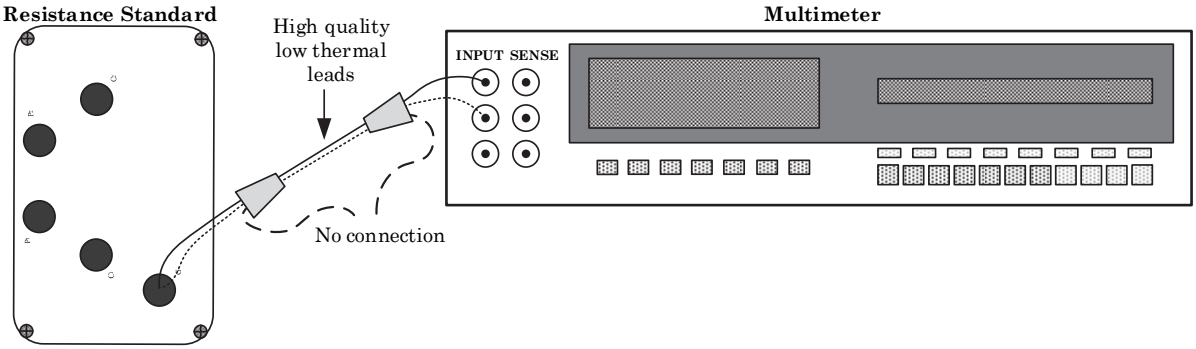


Figure 3. DCV Multimeter Zeroing Connection.

(2) Set multimeter function to DCV, Range 200 mV, RESL 7, FAST OFF, FILT ON, Internal Guard.

(3) Allow time for thermals to dissipate and multimeter reading to settle (this could take several minutes).

NOTE

When making the following nanovolt level measurements, significant errors may be introduced by offset voltages and noise. Personnel movements around measurement should be kept to a minimum. Temperature gradients caused by environmental heating and cooling systems or equipment ventilation fans near the measurement can cause error voltages and instability. High quality/low thermal leads must be used and minimal handling must be practiced to avoid offset voltages. Nickel plated banana leads must not be used for sensitive DC voltage measurements. If an out of tolerance condition is noted, check all connections, perform DC ZEROS on TI again and check/re-zero multimeter if necessary before rejecting the TI.

(4) Zero multimeter 200 mVdc and 20 Vdc ranges. Set multimeter on the 200 mV range.

(5) Disconnect leads from low thermal binding post and connect equipment as shown in figure 4.

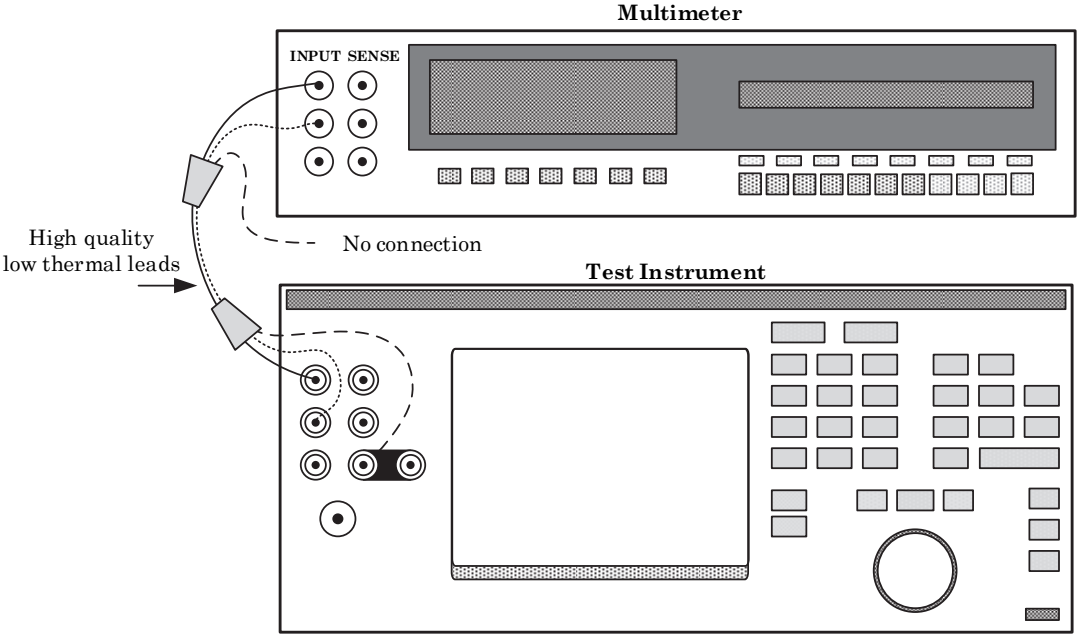


Figure 4. Zero DCV Output Connection.

(6) Set TI to first output voltage and range in table 3, output to **OPERATE**.

(7) Allow time for multimeter indication to settle (this may take several minutes).

(8) Multimeter will indicate within the limits of table 3.

Table 3. DC Zero Verification

TI		Multimeter		
Voltage	Range	Min (uV)	Measured	Max (uV)
0.00000 mV	220 mV	-0.5		0.5
-0.00001 mV	220 mV	-0.5		0.5
0.0000000 V	2.2 V	-0.8		0.8
-0.0000001 V	2.2 V	-0.8		0.8
0.000000 V	11 V	-3		3
-0.000001 V	11 V	-3		3
0.000000 V	22 V	-5		5
-0.000001 V	22 V	-5		5
0.00000 V	220 V	-50		50
-0.00001 V	220 V	-50		50

NOTE

To set output voltage to zero on ranges higher than 220 mV, set TI output to **STANDBY**, remove range lock, if set, using touch screen. Set output voltage near full scale of tested range. Lock range using touch screen and set output voltage to zero.

(9) Repeat technique of (6) through (8) for remaining rows in table 3.

(10) Press TI **RESET** and disconnect equipment set up.

(11) Record the test report value of DC reference standard as V_{ref} for use in table 4.

(12) Ensure that the reference divider has been self-calibrated (appendix A).

(13) Connect equipment as shown in figure 5.

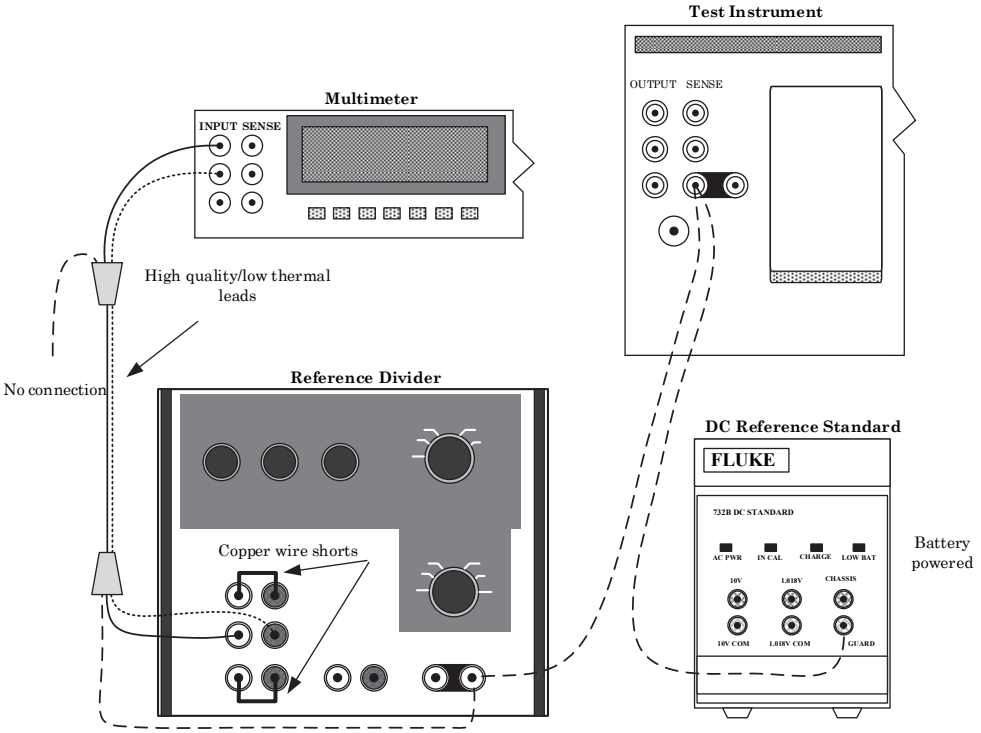


Figure 5. DCV System Zero Connection.

(14) Set reference divider to OPERATE and mode switch to 0.1 V.

(15) Set multimeter function to DCV, Range 200 mV, RESL 7, FAST OFF, FILT ON, Internal Guard.

(16) Allow time for thermals to dissipate and multimeter reading to settle (this could take several minutes).

(17) Zero multimeter 200 mV range, then set range to AUTO.

(18) Remove copper shorts from reference divider.

(19) Connect equipment as shown in figure 6.

NOTE

To prevent errors caused by voltage drop across connecting leads, very low resistive leads must be used to connect TI and DC reference standard.

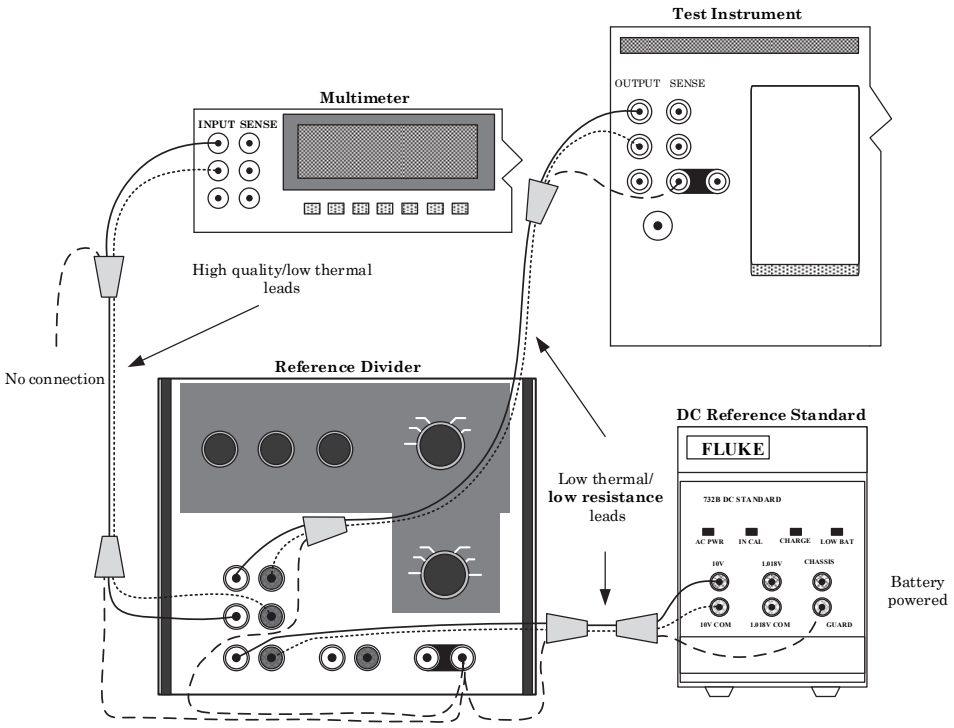


Figure 6. DCV Verification Connection.

(20) Set TI voltage/range and reference divider to the first values in table 4. Set TI output to **OPERATE**.

(21) Allow time for multimeter reading to settle (this could take several minutes). Record multimeter indication as V_{dmm}.

(22) Calculate TI output using the first equation in table 4.

(23) TI output will indicate within the limits of table 4.

(24) Repeat technique of (20) through (23) for remaining rows in table 4 (except do not do the last two rows). To change the polarity of the DC reference standard, reverse the leads at the output.

NOTE

Multimeter averaging may be used for better stability. Multimeter FAST ON may be used when TI output is greater than 100 mV.

Table 4. DC Voltage Verification.

TI		DC Ref Std	Ref divider	Multimeter Indication	Equation	Limits		
Volts	Range	+/-	Range	V_{dmm}		Min (V)	Calculated	Max (V)
0.1	220 m	+	0.1		$\frac{V_{ref}}{100} - V_{dmm}$	0.09999860		0.10000140
-0.1	220 m	-	0.1		$\frac{-V_{ref}}{100} - V_{dmm}$	-0.10000140		-0.09999860
-1	2.2	-	1		$\frac{-V_{ref}}{10} - V_{dmm}$	-1.0000068		-0.9999932
1	2.2	+	1		$\frac{V_{ref}}{10} - V_{dmm}$	0.9999932		1.0000068
10	11	+	10		$V_{ref} + V_{dmm}$	9.999957		10.000043
10	22	+	10		$V_{ref} + V_{dmm}$	9.999955		10.000045
-10	11	-	10		$-V_{ref} + V_{dmm}$	-10.000043		-9.999957
-10	22	-	10		$-V_{ref} + V_{dmm}$	-10.000045		-9.999955
-100	220	-	100		$\frac{-V_{ref} + V_{dmm}}{0.1}$	-100.00065		-99.99935
-100	1100	-	100		$\frac{-V_{ref} + V_{dmm}}{0.1}$	-100.0011		-99.9989
100	220	+	100		$\frac{V_{ref} + V_{dmm}}{0.1}$	99.99935		100.00065
100	1100	+	100		$\frac{V_{ref} + V_{dmm}}{0.1}$	99.9989		1000.0011
1000	1100	+	1000		$\frac{V_{ref} + V_{dmm}}{0.01}$	999.9915		1000.0085
-1000	1100	-	1000		$\frac{-V_{ref} + V_{dmm}}{0.01}$	-1000.0085		-999.9915
19	22	+	-----	-----	$V_{ref} * \frac{V_{dmm19+}}{V_{dmm10+}}$	18.999919		19.000081
-19	22	-	-----	-----	$-V_{ref} * \frac{V_{dmm19-}}{V_{dmm10-}}$	-19.000081		-18.999919

(25) Press TI **RESET** and disconnect equipment set up.

NOTE

Steps (26) through (37) below complete the last two rows of table 4.

(26) Ensure that multimeter has been zeroed on the 20 V dc Range as described in step (1) through (4) above).

(27) Set multimeter function to DCV, Range 20 V, RESL 7, FAST OFF, FILT ON, Internal Guard.

(28) Connect DC reference standard directly to multimeter input (positive polarity).

(29) Allow time for multimeter reading to settle. Record indication as V_{dmm10+}.

(30) Reverse DC reference standard polarity to multimeter input (negative polarity).

(31) Allow time for multimeter reading to settle. Record indication as V_{dmm10-}.

(32) Move connection from DC reference standard output to TI output.

(33) Set TI output to +19 Vdc, output to **OPERATE**.

(34) Allow time for multimeter reading to settle. Record indication as V_{dmm19+}.

(35) Calculate TI +19 Vdc output using equation in table 4.

(36) TI output will indicate within the limits of table 4.

(37) Repeat technique of (33) through (36) for -19 Vdc output.

(38) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

10. Resistance Verification

a. Performance Check

(1) Ensure that table 6 is populated with the test report values of the resistance standards.

(2) Attach Fluke high-integrity low-thermal emf 4-wire shorting PCB's to front and rear terminals of multimeter.

NOTE

Use only Fluke high-integrity low-thermal emf 4-wire shorting PCB's from 8508A LEAD kit supplied with multimeter. Other shorting methods may cause erroneous readings.

(3) Set multimeter to configuration #1 in table 5.

(4) Select front terminals

(5) Set multimeter to RESL 7, FAST OFF, normal current (not LoI) and Internal Guard for all resistance modes.

(6) Zero multimeter front terminals.

(7) Select multimeter rear terminals.

(8) Zero multimeter rear terminals.

(9) Repeat technique of (3) through (8) to zero all configurations in table 5.

WARNING

HI voltage is present at multimeter terminals when using configuration #9 (HIVΩ). To avoid personal injury, deselect HIVΩ when making connections/disconnections to multimeter.

Table 5. Multimeter Resistance Zeroing.

Configuration #	Mode	Range	2w/4w
1	Ω PLUS TruΩ	2 Ω	-----
2	Ω PLUS TruΩ	20 Ω	-----
3	Ω PLUS TruΩ	200 Ω	-----
4	Ω PLUS TruΩ	2 kΩ	-----
5	Ω PLUS TruΩ	20 kΩ	-----
6	Ω	200 kΩ	4 wΩ
7	Ω	2 MΩ	4 wΩ
8	Ω	20 MΩ	4 wΩ
9	Ω PLUS HIVΩ	200 MΩ	2 wΩ

(10) Remove Fluke high-integrity low-thermal emf 4-wire shorting PCB's.

(11) Connect TI **OUTPUT HI/LO** and **SENSE HI/LO** to multimeter front INPUT HI/LO and SENSE HI/LO (4-wire resistance measurement). Connect shield to TI GUARD terminal. Do not connect shield at multimeter.

(12) Set multimeter to configuration #1, front terminals (see table 5).

(13) Set TI output to first value in table 6, **4-WIRE SENSE ON** (touch screen), output to **OPERATE**.

Table 6. Resistance Verification.

TI	Multimeter	Resistance Standard			Limits		
Nominal Resistance (Ω)	Configuration #	No.	Nominal (Ω)	Test Report (Ω)	Min (ppm)[1]	Measured	Max (ppm)[1]
0	1	----			0		50 uΩ
1	1	1	1		-110		110
1.9	1	1	1		-110		110
10	2	2	10		-27		27
19	2	2	10		-27		27
100	3	3	100		-12		12
190	3	3	100		-12		12
1 k	4	4	1 k		-8		8
1.9 k	4	4	1 k		-8		8
10 k	5	5	10 k		-8		8
19 k	5	5	10 k		-8		8
100 k	6	6	100 k		-10		10
190 k	6	6	100 k		-12		12
1 M	7	7	1 M		-15		15
1.9 M	7	7	1 M		-21		21
10 M	8	8	10 M		-46		46
19 M	8	8	10 M		-55		55
100 M[2]	9	9	100 M		-120		120

[1]All limits in ppm except for 0 Ω which is given in uΩ

[2]TI 4-WIRE SENSE OFF, RESL 8, SLOW on multimeter, Hi voltage present at multimeter terminals

(14) Allow time for multimeter indication to settle.

(15) Multimeter will indicate within the limits of the first row in table 6.

NOTE

Multimeter will be used in resistance ratio mode to complete remaining rows in table 6.

(16) Connect first resistance standard (2^d row table 6) to multimeter rear INPUT HI/LO and SENSE HI/LO (4-wire resistance measurement). Connect shield to resistance standard G terminal. Do not connect shield at multimeter. TI must remain connected to multimeter front terminals.

(17) Set multimeter to make a front-to-rear ratio measurement by pressing INPUT, SCAN, FRONT ÷ REAR.

(18) Set TI output resistance to next value in table 6, **4-WIRE SENSE ON** (touch screen), output to **OPERATE.**

(19) Allow time for multimeter indication to settle.

(20) Calculate TI output resistance using formula below.

$$R_x = R_s \times \text{Ratio}$$

Where:
R_x = Measured resistance at TI output terminals
R_s = Resistance standard test report value
Ratio = Multimeter indication

(21) Calculate TI displayed vs measured error using the formula below.

$$Error_{ppm} = \left(\frac{R_x - R_d}{R_d}\right) 1{,}000{,}000$$

Where:
R_x = Resistance calculated in (19) above
R_d = Resistance value displayed on TI

(22) Verify that TI error is within the limits of table 6.

(23) Repeat technique of (16) through (22) for remaining rows in table 6.

(24) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

11. DC Current Verification

a. Performance Check

(1) Ensure that table 7 is populated with the test report values of the resistance standards/shunt.

(2) Prepare multimeter for zeroing by shorting leads on a low thermal binding post such as that shown in figure 7.

NOTE

Do not short leads on the binding post of a powered instrument. Erroneous zero may result.

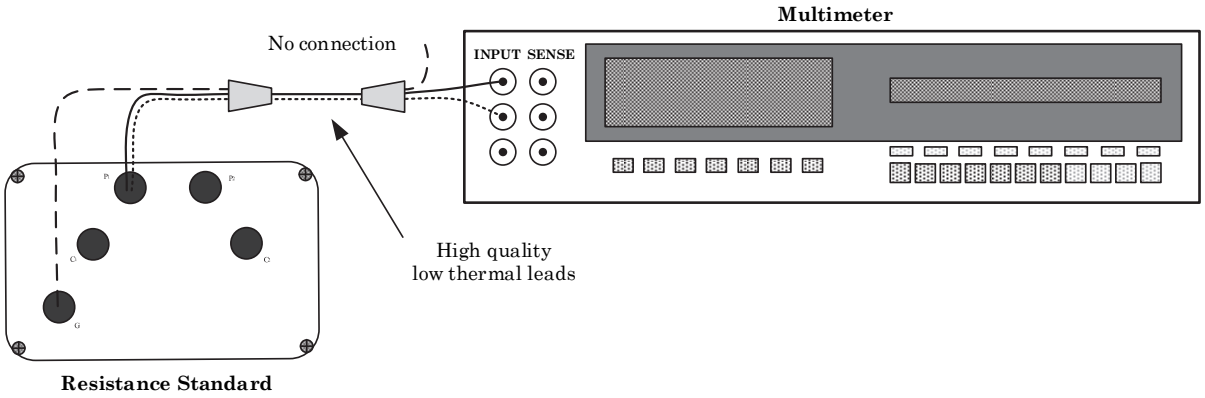


Figure 7. DCV Zeroing Connection.

(3) Set multimeter to DCV, RESL 7, FAST OFF, FILT ON, Internal Guard.

(4) Zero multimeter on the 20 V dc, 2 V dc and 200 mV dc ranges.

(5) Set multimeter range to AUTO.

(6) Connect equipment as shown in figure 8 using the first resistance standard in table 7.

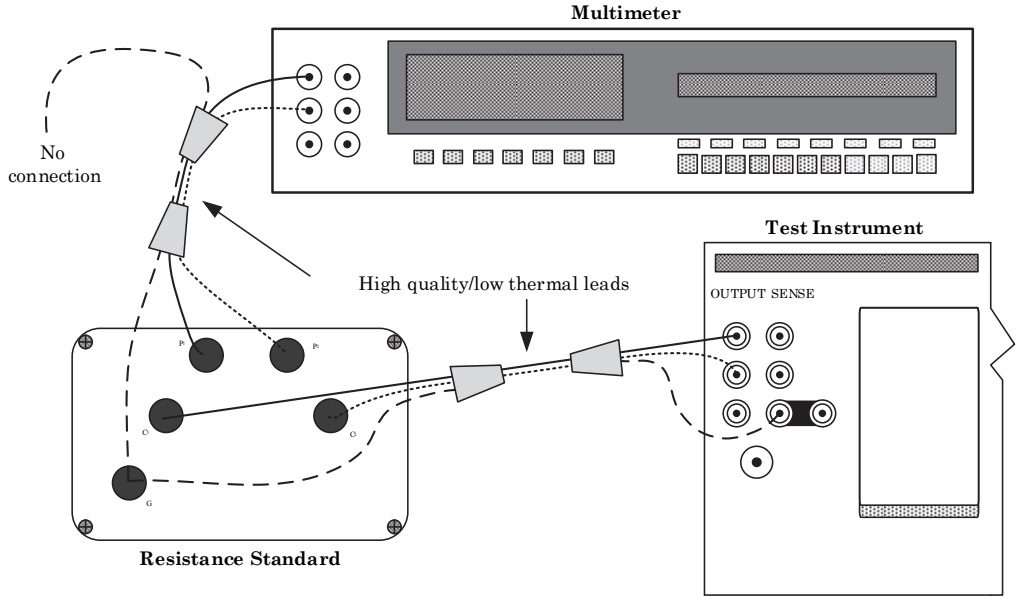


Figure 8. DCI Verification Connection.

(7) Set TI output and range to first values in table 7, output to **OPERATE.**

NOTE

If the current in table 7 is zero, first ensure that TI is set to STBY, then, set the TI to a current near full scale on the range tested. Using touch screen, lock that range before setting the TI to zero current.

(8) Allow multimeter indication to settle. Record multimeter indication in table 7.

(9) Calculate TI output current using formula below.

$$\text{Output Current (A)} = \frac{V}{R}$$

Where:
V = Multimeter indication (volts)
R = Test report value of resistance standard or shunt (ohms)

(10) Calculated (measured) current must not exceed the limits in table 7.

(11) Repeat technique of (6) through (10) for remaining rows in table 7.

Table 7. DC Current Verification.

TI		Resistance Standard			Multimeter	Limits		
Output (A)	Range (A)	No.	Nominal (Ω)	Test Report (Ω)	Indication (V)	Min (A)	Measured (A)	Max (A)
0 µ	220 u	5	10 k			-0.00700 u		0.00700 u
10 µ	220 u	5	10 k			9.99250 u		10.00750 u
-10 µ	220 u	5	10 k			-10.00750 u		-9.99250 u
200 µ	220 u	4	1 k			199.98300 u		200.01700 u
-200 µ	220 u	4	1 k			-200.01700 u		-199.98300 u
0 m	2.2 m	4	1 k			-0.00800 u		0.00800 u
2 m	2.2 m	3	100			1.9999120 m		2.0000880 m
-2 m	2.2 m	3	100			-2.0000880 m		-1.9999120 m
0 m	22 m	3	100			-0.05000 u		0.05000 u
20 m	22 m	2	10			19.999150 m		20.000850 m
-20 m	22 m	2	10			-20.000850 m		-19.999150 m
0 m	220 m	2	10			-0.80000 u		0.80000 u
100 m	220 m	1	1			99.99420 m		100.00580 m
200 m	220 m	1	1			199.98760 m		200.01240 m
-200 m	220 m	1	1			-200.01240 m		-199.98760 m
0	2.2 A	1	1			-15.000 u		15.000 u
1	2.2 A	----[1]	0.4			0.9998950		1.0001050
2	2.2 A	----[1]	0.4			1.9997250		2.0002750
-2	2.2 A	----[1]	0.4			-2.0002750		-1.9997250

[1] use A40B 2 A shunt, adapt as necessary

(12) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

12. AC Voltage Verification

a. Performance Check

(1) Connect equipment as shown in figure 9.

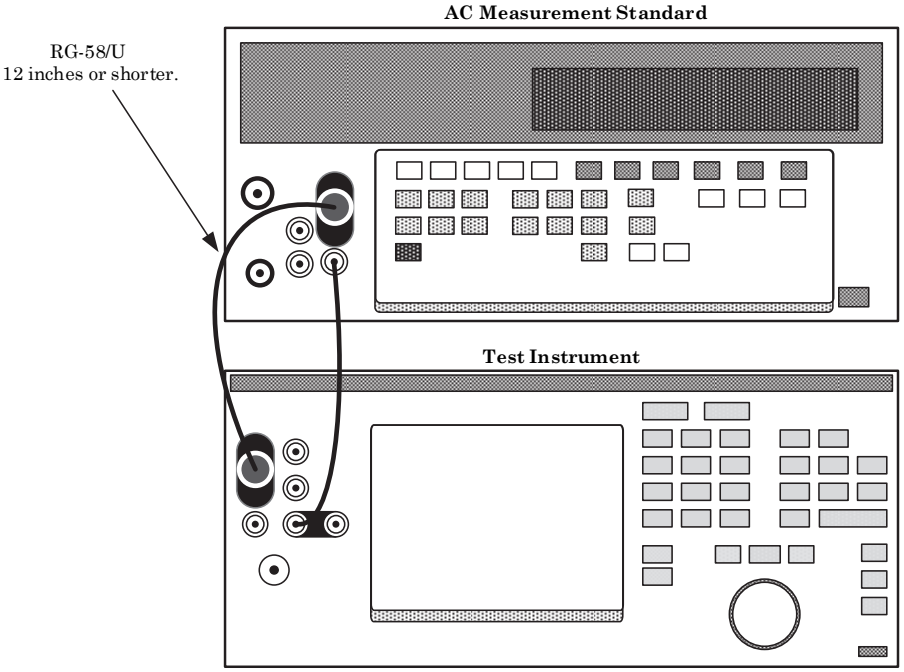


Figure 9. AC Voltage Connection.

(2) Set AC measurement standard to INPUT 2, RANGE AUTO, EX GRD ON, digital filter MODE to MEDIUM, RESTART to MEDIUM.

NOTE

Refresh the EX GRD on the AC measurement standard by pressing it off and on 3 times and leaving it on after the third time.

(3) Set TI voltage and frequency to the first values in table 8, output to **OPERATE**.

(4) Allow AC measurement standard indication time to settle.

(5) AC measurement standard will indicate within the limits of table 8.

(6) Repeat technique of (3) through (5) for remaining rows in table 8.

Table 8. AC Voltage Verification.

TI		AC Measurement Standard		
Voltage	Frequency	Min	Measured	Max
2 m	10 Hz	1.9944 m		2.0056 m
2 m	20 Hz	1.9948 m		2.0052 m
2 m	40 Hz	1.9948 m		2.0052 m
2 m	1 kHz	1.9948 m		2.0052 m
2 m	20 kHz	1.9948 m		2.0052 m
2 m	50 kHz	1.9945 m		2.0055 m
2 m	100 kHz	1.9928 m		2.0072 m
2 m	300 kHz	1.9854 m		2.0146 m
2 m	500 kHz	1.9716 m		2.0284 m
2 m	1 MHz	1.9682 m		2.0318 m
20 m	10 Hz	19.9890 m		20.0110 m
20 m	20 Hz	19.9927 m		20.0073 m
20 m	40 Hz	19.9931 m		20.0069 m

Table 8. AC Voltage Verification – Continued.

TI		AC Measurement Standard		
Voltage	Frequency	Min	Measured	Max
20 m	1 kHz	19.9931 m		20.0069 m
20 m	20 kHz	19.9931 m		20.0069 m
20 m	50 kHz	19.9900 m		20.0100 m
20 m	100 kHz	19.9820 m		20.0180 m
20 m	300 kHz	19.9620 m		20.0380 m
20 m	500 kHz	19.9410 m		20.0590 m
20 m	1 MHz	19.9070 m		20.0930 m
200 m	10 Hz	199.9250 m		200.0750 m
200 m	20 Hz	199.9690 m		200.0310 m
200 m	40 Hz	199.9780 m		200.0220 m
200 m	1 kHz	199.9780 m		200.0220 m
200 m	20 kHz	199.9780 m		200.0220 m
200 m	50 kHz	199.9500 m		200.0500 m
200 m	100 kHz	199.9000 m		200.1000 m
200 m	300 kHz	199.8150 m		200.1850 m
200 m	500 kHz	199.6300 m		200.3700 m
200 m	1 MHz	199.2800 m		200.7200 m
500 m	40 Hz	499.9660 m		500.0340 m
500 m	1 kHz	499.9660 m		500.0340 m
500 m	20 kHz	499.9660 m		500.0340 m
500 m	100 kHz	499.9100 m		500.0900 m
500 m	300 kHz	499.7000 m		500.3000 m
500 m	1 MHz	498.6000 m		501.4000 m
1	40 Hz	0.9999420		1.0000580
1	1 kHz	0.9999420		1.0000580
1	20 kHz	0.9999420		1.0000580
1	100 kHz	0.9998600		1.0001400
1	300 kHz	0.9995000		1.0005000
1	1 MHz	0.9976000		1.0024000
2	10 Hz	1.9993500		2.0006500
2	20 Hz	1.9997600		2.0002400
2	40 Hz	1.9998940		2.0001060
2	1 kHz	1.9998940		2.0001060
2	20 kHz	1.9998940		2.0001060
2	50 kHz	1.9998280		2.0001720
2	100 kHz	1.9997600		2.0002400
2	300 kHz	1.9991000		2.0009000
2	500 kHz	1.9973500		2.0026500
2	1 MHz	1.9956000		2.0044000
20	10 Hz	19.993500		20.006500
20	20 Hz	19.997600		20.002400
20	40 Hz	19.998970		20.001030
20	1 kHz	19.998970		20.001030
20	20 kHz	19.998970		20.001030
20	50 kHz	19.998280		20.001720
20	100 kHz	19.997750		20.002250
20	300 kHz	19.993200		20.006800
20	500 kHz	19.973500		20.026500
20	1 MHz	19.960000		20.040000
200	10 Hz	199.93500		200.06500
200	20 Hz	199.97600		200.02400
200	40 Hz	199.98630		200.01370
200	1 kHz	199.98630		200.01370
200	20 kHz	199.98630		200.01370

Table 8. AC Voltage Verification – Continued.

TI		AC Measurement Standard		
Voltage	Frequency	Min	Measured	Max
200	50 kHz	199.97880		200.02120
200	100 kHz	199.96100		200.03900
50	300 kHz	49.92500		50.07500
30	500 kHz	29.78800		30.21200
22	1 MHz	21.68000		22.32000
250	15 Hz	249.8900		250.1100
500	50 Hz	499.9535		500.0465
500	1 kHz	499.9535		500.0465
1000	50 Hz	999.9110		1000.0890
1000	1 kHz	999.9110		1000.0890

(7) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

13. Frequency Verification

a. Performance Check

(1) Connect TI **OUTPUT HI/LO** to frequency counter channel A input.

(2) Set frequency counter to measure frequency on A channel, 1 MΩ input impedance, AC coupled.

(3) Set TI voltage and frequency to first values in table 9, output to **OPERATE**.

NOTE

Frequency counter indication may be unstable at low frequencies (particularly 10 Hz). For better stability it may be necessary to increase gate time to 1 second or greater and activate internal 100 kHz low pass filter. Ensure that 100 kHz low pass filter is deactivated at frequencies above 100 kHz.

(4) TI will indicate within the limits of table 9.

(5) Repeat technique of (3) and (4) for remaining rows in table 9.

Table 9. Frequency Verification.

TI			Frequency Counter		
Voltage	Frequency		Min	Measured	Max
2 V	10	Hz	9.999750		10.000250
2 V	119.9	Hz	119.89700		119.90300
2 V	120	Hz	119.99700		120.00300
2 V	400	Hz	399.99000		400.01000
2 V	1.199	kHz	1.1989700		1.1990300
2 V	1.2	kHz	1.1999700		1.2000300
2 V	11.99	kHz	11.989700		11.990300
2 V	12	kHz	11.999700		12.000300
2 V	119.9	kHz	119.89700		119.90300
2 V	120	kHz	119.99700		120.00300
2 V	1	MHz	0.9999750		1.0000250
2 V	1.1999	MHz	1.1998700		1.1999300

(6) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

14. AC Current Verification

a. Performance Check

(1) Ensure that table 10 is populated with the test report values of the current shunts.

(2) Connect equipment as shown in figure 10 using the first current shunt in table 10.

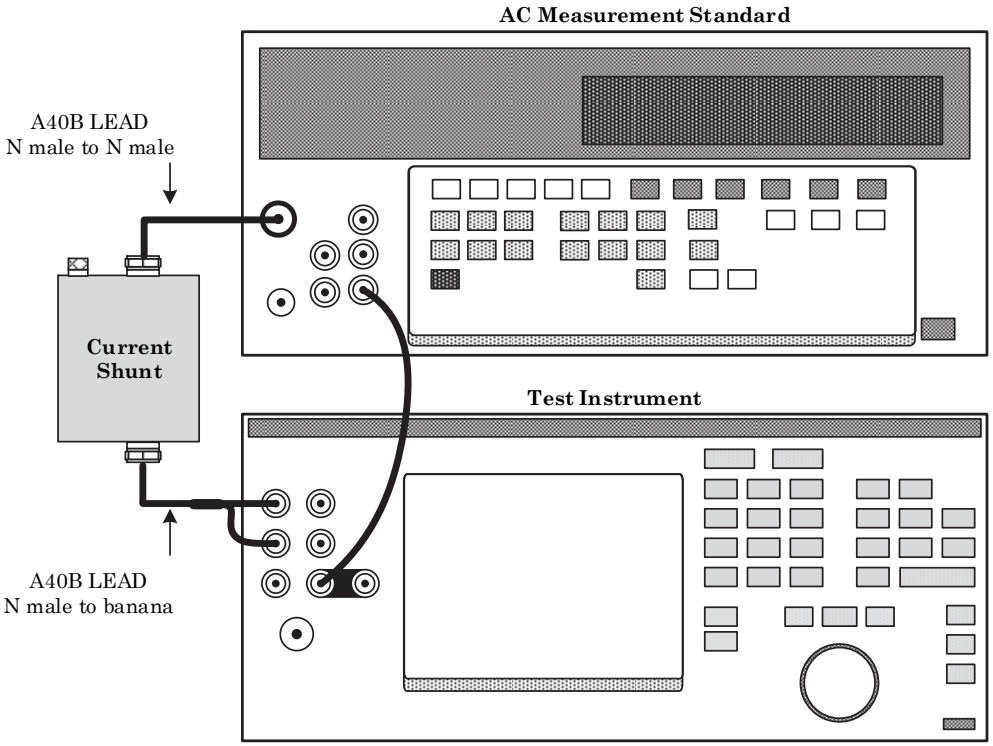


Figure 10. AC Current Connection.

(3) Set AC measurement standard to INPUT 1, RANGE AUTO, EX GRD ON, digital filter MODE to MEDIUM, RESTART to MEDIUM.

NOTE

Refresh the EX GRD on the AC measurement standard by pressing it off and on 3 times and leaving it on after the 3rd time.

(4) Set TI current output/frequency to the first values in table 10, output to **OPERATE**.

(5) Allow time for AC measurement standard indication time to settle. Record AC measurement standard indication in table 10.

(6) Calculate TI output current using the formula below.

$$\text{Output Current (A)} = \left(\frac{V}{R}\right) * \left[1 + \left(\frac{\text{ACDCdif}}{1{,}000{,}000}\right)\right]$$

Where:
V = AC measurement standard indication (volts)
R = Test reported DC resistance value of current shunt (ohms)
ACDCdif = Test reported AC/DC difference value of the current shunt (ppm)

(7) Calculated (measured) current must not exceed the limits in table 10.

(8) Repeat technique of (2) and (4) through (7) for remaining rows in table 10.

Table 10. AC Current Verification.

Calibrator		Current Shunt			AC Measurement Standard	Limits		
Output (A)	Freq (Hz)	(A)	Test report DC (Ω)	Test report AC/DC dif (ppm)	Indication (V)	Min (A)	Measured (A)	Max (A)
20 u	1 k	1 m				19.9876 u		20.0124 u
20 u	10 k	1 m				19.8940 u		20.1060 u
200 u	10	1 m				199.9200 u		200.0800 u
200 u	20	1 m				199.9480 u		200.0520 u
200 u	40	1 m				199.9660 u		200.0340 u
200 u	1 k	1 m				199.9660 u		200.0340 u
200 u	5 k	1 m				199.9150 u		200.0850 u
200 u	10 k	1 m				199.6600 u		200.3400 u
20 u[1]	1 k	1 m				19.9876 u		20.0124 u
200 u[1]	5 k	1 m				199.9150 u		200.0850 u
200 u[1]	10 k	1 m				199.6600 u		200.3400 u
2 m	10	10 m				1.999350 m		2.000650 m
2 m	20	10 m				1.999560 m		2.000440 m
2 m	40	10 m				1.999720 m		2.000280 m
2 m	1 k	10 m				1.999720 m		2.000280 m
2 m	5 k	10 m				1.999390 m		2.000610 m
2 m	10 k	10 m				1.996600 m		2.003400 m
20 m	10	20 m				19.99350 m		20.00650 m
20 m	20	20 m				19.99560 m		20.00440 m
20 m	40	20 m				19.99720 m		20.00280 m
20 m	1 k	20 m				19.99720 m		20.00280 m
20 m	5 k	20 m				19.99450 m		20.00550 m
20 m	10 k	20 m				19.96800 m		20.03200 m
200 m	10	200 m				199.9350 m		200.0650 m
200 m	20	200 m				199.9560 m		200.0440 m
200 m	40	200 m				199.9730 m		200.0270 m
200 m	1 k	200 m				199.9730 m		200.0270 m
200 m	5 k	200 m				199.9480 m		200.0520 m
200 m	10 k	200 m				199.7280 m		200.2720 m
2	20	2				1.999360		2.000640
2	1 k	2				1.999360		2.000640
2	5 k	2				1.998900		2.001100
2	10 k	2				1.983800		2.016200

[1] Measured at AUX terminals.

(9) Press TI **RESET** and disconnect equipment set up.

b. Adjustments. No adjustments can be made.

15. Final Procedure

a. Deenergize and disconnect all equipment.

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

APPENDIX A
REFERENCE DIVIDER SELF CALIBRATION

NOTE

The Fluke 8508A/02 is used as the null detector in self-calibration procedure below. Other methods using a traditional null detector may also be used.

NOTE

TI or any 57XX calibrator may be used to perform the steps below.

(1) Ensure that the reference divider has been in a thermally stable environment for at least 4 hours.

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

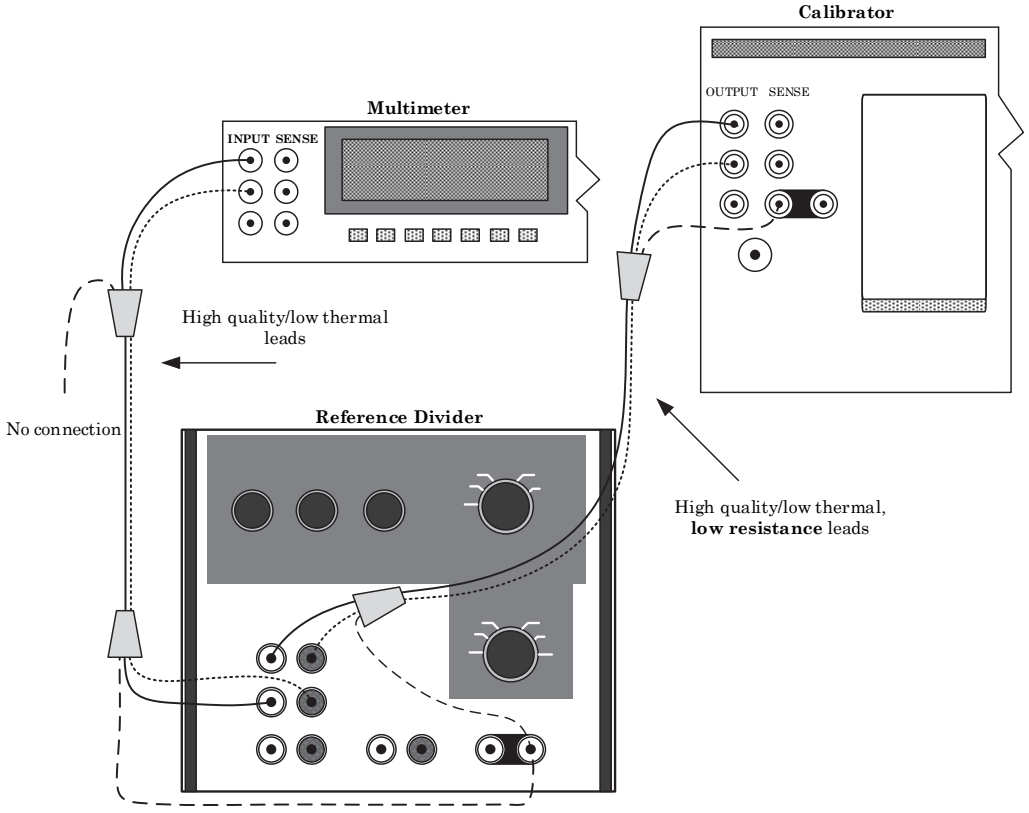


Figure A-1. Reference Divider Self-Calibration.

(3) Set multimeter function to DCV, Range 200 mV, RESL 7, FAST OFF, FILT ON, Internal Guard.

(4) Set DC reference divider MODE switch to 752 CAL and CALIBRATE switch to 10:1+.

(5) Set calibrator output to 0.0 mV, output to OPERATE.

(6) Allow time multimeter reading to settle (this could take several minutes).

NOTE

Keep disturbances near the measurement to an absolute minimum. Personnel movements, drafts, opening and closing of doors, etc. will all contribute significantly to instability.

(7) Zero multimeter 200 mV dc range.

(8) Set calibrator output to 20.0 V, output to OPERATE.

(9) Allow time for multimeter reading to settle (this could take several minutes).

(10) Record multimeter indication.

(11) Set DC reference divider CALIBRATE switch to 10:1-.

(12) Allow time for multimeter reading to settle (this could take several minutes).

(13) Record multimeter indication.

(14) Calculate the average of the values recorded in step (10) and (13).

$$\textit{Example}: \ \frac{[0.00120\ \text{mV}+(-0.00190\ \text{mV})]}{2} = -0.00035\ \text{mV}$$

NOTE

Multimeter FAST mode may be selected during adjustment of reference divider for better tracking of the adjustment. However, this may cause the measurement to be somewhat noisy. Filter may be used as necessary for stability. Some settings (FILT, FAST, RESL 7 or 8) will work better while making adjustments while others work best for the final measurement. Select configuration as necessary.

NOTE

When the reference divider CALIBRATE switch is set to 10:1-, rotating the BALANCE control CW results in a more positive multimeter indication.

(15) Adjust the reference divider BALANCE control as close as possible to the value calculated in (14).

NOTE

When the reference divider CALIBRATE switch is set to either 10:1+ or -10:1-, rotating the CALIBRATE 10:1 control CW results in a more positive multimeter indication.

(16) Adjust the reference divider 10:1 control to 0 (±0.5 uV).

(17) Set the CALIBRATE switch back to 10:1+. Ensure that multimeter does not exceed ±0.5 uV. Repeat adjustments if necessary.

NOTE

All 10:1 adjustments must be completed before proceeding with the 100:1 adjustment.

(18) Set DC reference divider CALIBRATE switch to 100:1+.

(19) Set calibrator output to 0.0 mV, output to OPERATE.

(20) Allow time multimeter reading to settle (this could take several minutes).

(21) Zero multimeter 200 mV dc range.

(22) Set calibrator output to 20.0 V, output to OPERATE.

(23) Allow time for multimeter reading to settle (this could take several minutes).

(24) Adjust the reference divider 100:1 control to 0 (±1 uV).

(25) Set DC reference divider CALIBRATE switch to 100:1-.

(26) Check multimeter indication for 0 (±1 uV).

(27) Set the CALIBRATE switch back to 100:1+. Ensure that multimeter does not exceed ±1.0 uV. Repeat adjustment if necessary.

NOTE

If reference divider does not meet 0 ±1 uV limit when switched between 100:1+ or -100:1-, repeat the 10:1+ and 10:1- calibration. Do NOT adjust BALANCE control in the 100:1+ or 100:1- positions. Slight compromise using 100:1 control may be necessary.

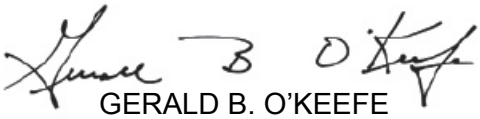
(28) Set calibrator output to minimum and disconnect equipment set-up.

(29) Set the reference divider CALIBRATE switch to OPERATE.

By Order of the Secretary of the Army:

MARK A. MILLEY
General, United States Army
Chief of Staff

Official:



GERALD B. O'KEEFE
Administrative Assistant to the
Secretary of the Army

1618105

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These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: “Whomever” whomever@wherever.army.mil
To: 2028@redstone.army.mil

Subject: DA Form 2028

1 ***From: Joe Smith***
2 *Unit: home*
3 ***Address: 4300 Park***
4 ***City***: Hometown
5 ***St: MO***
6 ***Zip: 77777***
7 ***Date Sent***: 19-OCT-93
8 ***Pub no***: 55-2840-229-23
9 ***Pub Title: TM***
10 ***Publication Date***: 04-JUL-85
11 *Change Number*: 7
12 *Submitter Rank*: MSG
13 ***Submitter FName***: Joe
14 *Submitter MName*: T
15 ***Submitter LName***: Smith
16 ***Submitter Phone***: 123-123-1234
17 ***Problem: 1***
18 *Page: 2*
19 *Paragraph: 3*
20 *Line: 4*
21 *NSN: 5*
22 *Reference: 6*
23 *Figure: 7*
24 *Table: 8*
25 *Item: 9*
26 *Total: 123*

27 ***Text***:
This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

For use of this form, see AR 25-30; the proponent agency is OAASA.

DATE: 20160610

INSTRUCTIONS FOR SUBMITTING THE DA FORM 2028

After completing the DA Form 2028 (Recommended Changes to Publications and Blank Forms), you may send it via Mail, Email, or Web. Preferred methods of submission are Web and Email. A reply will be furnished directly to you. To submit via the World Wide Web use https://amcom2028.redstone.army.mil. E-mail directly to 2028@redstone.army.mil or by fax (256) 842-6546 or DSN 788-6546. Mail directly to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MSS-LP, Redstone Arsenal, AL, 35898-5230. **Part II** *(page 2)* is for changes to Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

DETERMINING AND SELECTING THE PROPER PROPONENT

You can identify the proper proponent for any publication or form by searching for the its title using DA Pam 25-30, which can be accessed at: http://www.apd.army.mil/pamdocs/APD_Search.asp

TO: *(Forward to proponent of publication or form) (Include ZIP Code)*	**FROM:** *(Activity and location) (Include ZIP Code)*
COMMANDER U.S. ARMY AVIATION AND MISSILE COMMAND ATTN: AMSAM-MSS-LP REDSTONE ARSENAL, AL 35898	MSG, JANE Q. DOE 1234 ANY STREET NOWHERE TOWN, AL 34567

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9-1005-433-24	20020916	Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used on Avenger Air Defense

ITEM	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).
1	WP 0005-3		2			Test or Corrective Action column should identify a different WP number.

EXAMPLE

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, JANE Q. DOE	788-1234	

TO: *(Forward direct to addressee listed in publication)*	**FROM:** *Activity and location) (Include ZIP Code)*	**DATE**
COMMANDER U.S. ARMY AVIATION AND MISSILE COMMAND ATTN: AMSAM-MSS-LP	MSG, JANE Q. DOE 1234 ANY STREET NOWHERE TOWN, AL 34567	20160610

PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 9-1005-433-24	20020916	Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used on Avenger Air Defe

PAGE NO.	COL. NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

EXAMPLE

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, JANE Q. DOE	788-1234	

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

For use of this form, see AR 25-30; the proponent agency is OAASA.

DATE

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TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. Ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. Inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. Inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temparature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius °C temperature