FLUKE®

74X Series

Documenting Process Calibrator

Calibration Manual

PN 602505
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Introduction

This manual contains information necessary to perform performance verification tests and calibration adjustments on your Documenting Process Calibrator. General safety information and product specifications are also included.

Unless stated otherwise, everything in this manual applies to the Fluke 741, 741B, 743, 743B and 744 Documenting Process Calibrators, also referred to as the 74X Series in this manual.

The phone number in the USA and Canada for replacement parts is: 1-888-993-5853.

To contact Fluke, call one of the following telephone numbers:

USA and Canada: 1-888-99-FLUKE
(1-888-993-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-356-5500

Or, visit Fluke's Web site at www.fluke.com

Safety Information

This calibrator is designed and tested in accordance with IEC1010-1 and CAN/CSA C22.2 No. 1010.1-92. Use the calibrator only as specified in this manual, otherwise the protection provided by the calibrator may be impaired.

A Warning identifies conditions and actions that pose hazards to the user; a Caution identifies conditions and actions that may damage the calibrator or the equipment under test.

Symbols used on the calibrator and in this manual are explained in Table 1. To protect yourself, follow these safety guidelines:

- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the insulating cover. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Disconnect the power and discharge all high-voltage capacitors in the equipment under test before testing resistance or continuity.
- Inspect the test leads for damaged insulation or exposed metal. Check test lead continuity. Replace damaged test leads before using the calibrator.

- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Select the proper function and range for your measurement.
- Use caution when working above 30V ac rms, 42V ac pk, or 60V dc. Such voltages pose a shock hazard.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Do not operate the calibrator around explosive gas, vapor, or dust.
- When using a pressure module, make sure the process pressure line is shut off and depressurized before you connect it to or disconnect it from the pressure module.
- Disconnect test leads before changing to another measure or source function.
- When servicing the calibrator, use only specified replacement parts.

Table 1. Definition of Symbols

	AC-Alternating Current		CAUTION see explanation
	DC-Direct Current		Common (LO) Input equipotentiality
	Fuse		Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
	Pressure		Conforms to relevant European Union directives
	ON/OFF		Conforms to relevant Canadian Standards Association directives
	Recycling	CAT II	Overvoltage (Installation) Category II per IEC 1010-1 refers to the level of Impulse Withstand Voltage protection provided. Typical locations include; Mains Wall outlets, local appliances and PORTABLE EQUIPMENT

Specifications

All specifications apply from +18 °C to +28 °C unless stated otherwise.

All specifications assume a 5 minute warmup period.

Measurement specifications are valid only when damping is turned on. When damping is turned off, or when the ~ annunciator is displayed, floor specifications are multiplied by 3. Floor specifications are the second part of the specifications, usually expressed as "% of full scale." The measure pressure, temperature, and frequency functions are specified only with damping on.

The standard specification intervals for the 74X Series is 1 and 2 years. Typical 90-day source and measurement accuracy can be estimated by dividing the 1 year "% of Reading" or "% of Output" specifications by 2. Floor specifications, expressed as "% of f.s.", remain constant.

To achieve the best noise rejection, use battery power and tie all three common jacks together when performing DC and AC measurements.

DC Voltage Measurement

Range	Resolution	% of Reading +% of Full Scale	
		1 Year	2 Year
110 mV	1 µV	0.025% + 0.015%	0.05% + 0.015%
1.1V	10 µV	0.025% + 0.005%	0.05% + 0.005%
11V	100 µV	0.025% + 0.005%	0.05% + 0.005%
110V	1 mV	0.05% + 0.005%	0.1% + 0.005%
300V	10 mV	0.05% + 0.005%	0.1% + 0.005%

Temperature Coefficient: (0.001% of rdg. + 0.0015% f.s.)/ °C in the ranges -10 to 18 °C and 28 to 50 °C
Input Impedance: 5 MΩ
Common Mode Error: 0.008% f.s./(Common Mode Volt)
Maximum Input Voltage: 300V rms

AC Voltage Measurement

Frequency Range	% of Reading + Number of Counts	
	1 Year	2 Year
20 Hz to 40 Hz	2% + 10	2% + 10
40 Hz to 500 Hz	0.5% + 5	0.5% + 5
500 Hz to 1 kHz	2% + 10	2% + 10
1 kHz to 5 kHz	10% + 20	10% + 20

Ranges : 1.1000V, 11.000V, 110.00V, 300.0V rms
Resolution: 11.000 counts in all ranges except 300V; 3,000 counts on 300V range.
Input Impedance: 5 MΩ and <100 pF
Temperature Coefficient: 10% of specification/ °C in the ranges -10 to 18 °C and 28 to 50 °C
Input Coupling: ac
Maximum Input Voltage: 300 °V rms
Minimum Input Voltage: 0.5V above 1 kHz

Specifications apply for 10% to 100% of voltage range.

DC Current Measurement

Range	Resolution	% of Reading +% of Full Scale	
		1 Year	2 Year
30 mA	1 µA	0.01% + 0.015%	0.02% + 0.015%
110 mA	10 µA	0.01% + 0.015%	0.02% + 0.015%
Temperature Coefficient: (0.001% of rdg. + 0.002% f.s.)/ °C in the ranges -10 to 18 °C and 28 to 50 °C **Common Mode Error**: 0.01% f.s./(Common Mode Volt) **Maximum Input Voltage:** 30V dc			

Resistance Measurement

Range	Resolution	% of Reading + ohms	
		1 Year	2 Year
11Ω	0.001Ω	0.05% + 0.05	0.075% + 0.05
110Ω	0.01Ω	0.05% + 0.05	0.075% + 0.05
1.1 kΩ	0.1Ω	0.05% + 0.5	0.075% + 0.5
11 kΩ	1Ω	0.1% + 10	0.1% + 10
Temperature Coefficient: (0.01% f.s. + 2 mΩ) / °C in the ranges -10 to 18 °C and 28 to 50 °C **Common Mode Error**: 0.005% f.s/(Common Mode Volt) **Maximum Input Voltage:** 30V dc			

Continuity Testing

Tone	Resistance
Continuous tone	<25Ω
May or may not get tone	25 to 400Ω
No tone	>400Ω

Frequency Measurement

Ranges	Accuracy	
	1 Year	2 Year
1.00 Hz to 109.99 Hz	0.05 Hz	0.05 Hz
110.0 Hz to 1099.9 Hz	0.5 Hz	0.5 Hz
1.100 kHz to 10.999 kHz	0.005 kHz	0.005 kHz
11.00 kHz to 50.00 kHz	0.05 kHz	0.05 kHz
Minimum amplitude for frequency measurement (square wave): **<1 kHz:** 300 mV p-p **1 kHz to 30 kHz:** 1.4 V p-p **>30 kHz:** 2.8V p-p **Maximum Input:** **<1 kHz:** 300V rms **>1 kHz:** 30V rms **Input Impedance:** 5 MΩ		
For frequency measurement less than 109.99 Hz, specifications apply for signals with a slew rate greater than 5 volt/millisecond.		

DC Voltage Output

Range	Resolution	% of Output + % of Full Scale	
		1 Year	2 Year
110 mV	1 µV	0.01% + 0.005%	0.015% + 0.005%
1.1 V	10 µV	0.01% + 0.005%	0.015% + 0.005%
15 V	100 µV	0.01% + 0.005%	0.015% + 0.005%

Temperature Coefficient: (0.001% of output + 0.001% of f.s.)/ °C in the ranges -10 to 18 °C and 28 to 50 °C
Maximum Output Current: 10 mA
Loading: (0.001% f.s. + 1 µV)/ mA
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

DC Current Output

Range/Mode	Resolution	% of Output + % of Full Scale	
		1 Year	2 Year
22 mA/ Source mA	1 µA	0.01% + 0.015%	0.02% + 0.015%
22 mA/ Simulate Transmitter (Current Sink)	1 µA	0.02% + 0.03%	0.02% + 0.03%

Maximum Burden Voltage: 24V
Temperature Coefficient: (0.003% of output + 0.003% of f.s.)/ °C in the ranges -10 to 18 °C and 28 to 50 °C
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

Specification applies for currents between 2 mA and 22 mA. For current below 2 mA, typical accuracy is 0.15% of full scale.

Resistance Sourcing

Range	Resolution	% of Output + ohms	
		1 Year	2 Year
11.000Ω	1 mΩ	0.01% + 0.02	0.02% + 0.02
110.00Ω	10 mΩ	0.01% + 0.04	0.02% + 0.04
1.1000 kΩ	100 mΩ	0.02% + 0. 5	0.03% + 0.5
11.000 kΩ	1Ω	0.03% + 5	0.04% + 5

Temperature Coefficient: (0.01% of f.s.)/ °C in the ranges -10 to 18 °C and 28 to 50 °C
Maximum and Minimum Current through Source Resistance:
11Ω Range: 3 mA dc max, 0.1 mA dc min
110Ω Range: 3 mA dc max, 0.1 mA dc min
1.1 kΩ Range: 3 mA dc max, 0.01 mA dc min
11 kΩ Range: 1 mA dc max, 0.01 mA dc min
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

Frequency Sourcing

Range	Accuracy
0.00 Hz to 10.99 Hz	0.01 Hz
11.00 Hz to 109.99 Hz	0.1 Hz
110.0 Hz to 1099.9 Hz	0.1 Hz
1.100 kHz to 21.999 kHz	0.002 kHz
22.000 kHz to 50.000 kHz	0.005 kHz

Waveform Choices: Zero-symmetric sine or positive square wave, 50% duty cycle
Amplitude: 0.1 to 10V p-p
Amplitude Accuracy:

0 Hz to 1099 Hz: 3% of output + 0.5% f.s
1.1 kHz to 10.9 kHz: 10% of output + 0.5% f.s
11 kHz to 50 kHz: 30% of output + 0.5% f.s

Maximum Input Voltage: 30V dc

Temperature, Thermocouples

Temperature, TCs					
Type	**Range °C**	**Measure °C**		**Source °C**	
		1 Year	**2 Year**	**1 Year**	**2 Year**
E	-250 to -200	1.3	2.0	0.6	0.9
	-200 to -100	0.5	0.8	0.3	0.4
	-100 to -600	0.5	0.8	0.3	0.4
	600 to 1000	0.4	0.6	0.2	0.3
N	-200 to -100	1.0	1.5	0.6	0.9
	-100 to 900	0.5	0.8	0.5	0.8
	900 to 1300	0.6	0.9	0.3	0.4
J	-210 to -100	0.6	0.9	0.3	0.4
	-100 to 800	0.3	0.4	0.2	0.3
	800 to 1200	0.5	0.8	0.2	0.3
K	-200 to -100	0.7	1.0	0.4	0.6
	-100 to 400	0.3	0.4	0.3	0.4
	400 to 1200	0.5	0.8	0.3	0.4
	1200 to 1372	0.7	1.0	0.3	0.4
T	-250 to -200	1.7	2.5	0.9	1.4
	-200 to 0	0.6	0.9	0.4	0.6
	0 to 400	0.3	0.4	0.3	0.4
B	600 to 800	1.3	2.0	1.0	1.5
	800 to 1000	1.0	1.5	0.8	1.2
	1000 to 1820	0.9	1.3	0.8	1.2

Temperature, Thermocouples (cont.)

Temperature, TCs					
Type	**Range °C**	**Measure °C**		**Source °C**	
		1 Year	**2 Year**	**1 Year**	**2 Year**
R	-20 to 0	2.3	2.8	1.2	1.8
	0 to 100	1.5	2.2	1.1	1.7
	100 to 1767	1.0	1.5	0.9	1.4
S	-20 to 0	2.3	2.8	1.2	1.8
	0 to 200	1.5	2.1	1.1	1.7
	200 to 1400	0.9	1.4	0.9	1.4
	1400 to 1767	1.1	1.7	1.0	1.5
C	0 to 800	0.6	0.9	0.6	0.9
	800 to 1200	0.8	1.2	0.7	1.0
	1200 to 1800	1.1	1.6	0.9	1.4
	1800 to 2316	2.0	3.0	1.3	2.0
L	-200 to -100	0.6	0.9	0.3	0.4
	-100 to 800	0.3	0.4	0.2	0.3
	800 to 900	0.5	0.8	0.2	0.3
U	-200 to 0	0.6	0.9	0.4	0.6
	0 to 600	0.3	0.4	0.3	0.4

Sensor inaccuracies not included.

Accuracy with external cold junction; for internal junction add 0.2 °C

Resolution: 0.1 °C

Temperature Scale: ITS-90 or IPTS-68, selectable

Compensation: ITS-90 per NIST Monograph 175 for B,R,S,E,J,K,N,T; IPTS-68 per IEC 584-1 for B,R,S,E,J,K,T; IPTS-68 per DIN 43710 for L,U.

Temperature Coefficient: 0.05 °C/ °C in the range -10 to 18 °C and 28 to 50 °C

Common Mode Error: 0.01 °C/(Common Mode Volt)

Maximum Input Voltage: 30V

Temperature, Resistance Temperature Detectors

Temperature, RTDs					
Type (α)	**Range °C**	**Measure °C**		**Source °C**	
		1 Year	**2 Year**	**1 Year**	**2 Year**
100Ω Pt(3926)	-200 to 0	0.3	0.4	0.1	0.2
	0 to 630	0.5	0.8	0.2	0.4
100Ω Pt(385)	-200 to 0	0.3	0.5	0.1	0.2
	0 to 400	0.5	0.8	0.2	0.4
	400 to 800	0.8	1.0	0.4	0.5
120Ω Ni(672)	-80 to 260	0.3	0.4	0.1	0.2
200Ω Pt(385)	-200 to 0	0.3	0.5	0.1	0.2
	0 to 400	0.5	0.8	0.2	0.4
	400 to 630	0.8	1.0	0.4	0.5
500Ω Pt(385)	-200 to 0	0.3	0.5	0.1	0.2
	0 to 400	0.5	0.8	0.2	0.4
	400 to 630	0.8	1.0	0.4	0.5
1000Ω Pt(385)	-200 to 0	0.3	0.5	0.1	0.2
	0 to 400	0.5	0.8	0.2	0.4
	400 to 630	0.8	1.0	0.4	0.5
10Ω Cu(427)	-100 to 0	2	2	1	1
	0 to 260	2	2	1	1
100Ω Pt(3916)	-200 to -190	0.3	0.4	0.3	0.4
	-190 to 0	0.3	0.4	0.1	0.2
	0 to 630	0.5	0.8	0.2	0.4

Sensor inaccuracies not included

Resolution: 0.1 °C, except 1 °C for 10Ω Cu.

Temperature Coefficient: 0.02 °C/ °C in the ranges -10 to 18 °C and 28 to 50 °C

Maximum Input Voltage: 30V

Maximum Input Current for RTD Source: 10Ω RTD: 8 mA dc
100Ω,120Ω RTDs: 3 mA dc
200Ω – 1000Ω RTDs: 1 mA dc

For two and three-wire RTD measurements, add 0.4 °C to the specifications.

Loop Power Supply

Setting	1 Year	2 Year
24 Volt	5%	5%
28 Volt	5%	5%
Short circuit protected **Maximum Current**: 22 mA **Maximum Input Voltage**: 30V dc		

Top and Bottom Limits of Ranges with Auto Range On

Range, dc V Measure	Top of Range	Bottom of Range
110 mV	±110.000 mV	0.000 mV
1.1V	±1.10000V	±0.10000V
11V	±11.0000V	±1.0000V
110V	±110.000V	±10.000V
300V	±300.00V	±100.00V
Range, dc V Source		
110 mV	+110.000 mV	-10.000 mV
1.1V	+1.10000V	+0.10000V
15V	+15.000V	+1.1000V
Range, ohms Measure and Source		
11Ω	11.000Ω	0.000Ω
110Ω	110.00Ω	10.00Ω
1.1 kΩ	1100.0Ω	100.0Ω
11 kΩ	11.000 kΩ	1.000 kΩ
Range, Current Measure		
22 mA	+22.000 mA	0.000 mA
110 mA	+110.00 mA	+30.00 mA
Range, Current Source		
22 mA	+30.000 mA	0.000 mA
Range, Frequency Measure		
100 Hz	109.99 Hz	1.00 Hz
1 kHz	1099.9 Hz	100.00 Hz
10 kHz	10.999 kHz	1.000 kHz
50 kHz	50.00 kHz	10.00 kHz

General Specifications

Display:	240 by 200 pixel graphic LCD, 70 x 58 mm.
Power:	Internal battery pack: NiCd, 7.2V, 1700 mAh.
Memory Backup:	Lithium battery, 5 years typical lifetime.
Dimensions:	130 x 236 x 61 mm (5.1 x 9.3 x 2.4 in.).
Weight:	1.4 kg (3 lb. 1 oz.).
Altitude:	Up to 2800 meters (9186 ft) above mean sea level.
Operating Temperature:	-10 to 50 °C (typically to -20 °C, except for frequency measure and ac voltage measure).
Storage Temperature:	-20 to 60 °C
Humidity:	Avoid prolonged use outside the safe operating boundaries shown in the graph on the next page.
RF Fields:	Accuracy for all functions is not specified in RF fields >3 V/m Accuracy for thermocouple measurement is not specified in RF fields >1 V/m Accuracy for ohms/RTD source is not specified in RF fields >0.5 V/m Accuracy for mADC measurement is not specified in RF fields >1.5 V/m
Safety:	Designed in accordance with CAT II 300 Volts Pollution Degree 2, IEC 1010-1, ANSI/ISA-S82, UL3111, and CSA C22.2 No. 1010.1-92. See "Safety Information" near the front of this manual.
Warranty:	See the WARRANTY, inside front cover of the Users Manual.

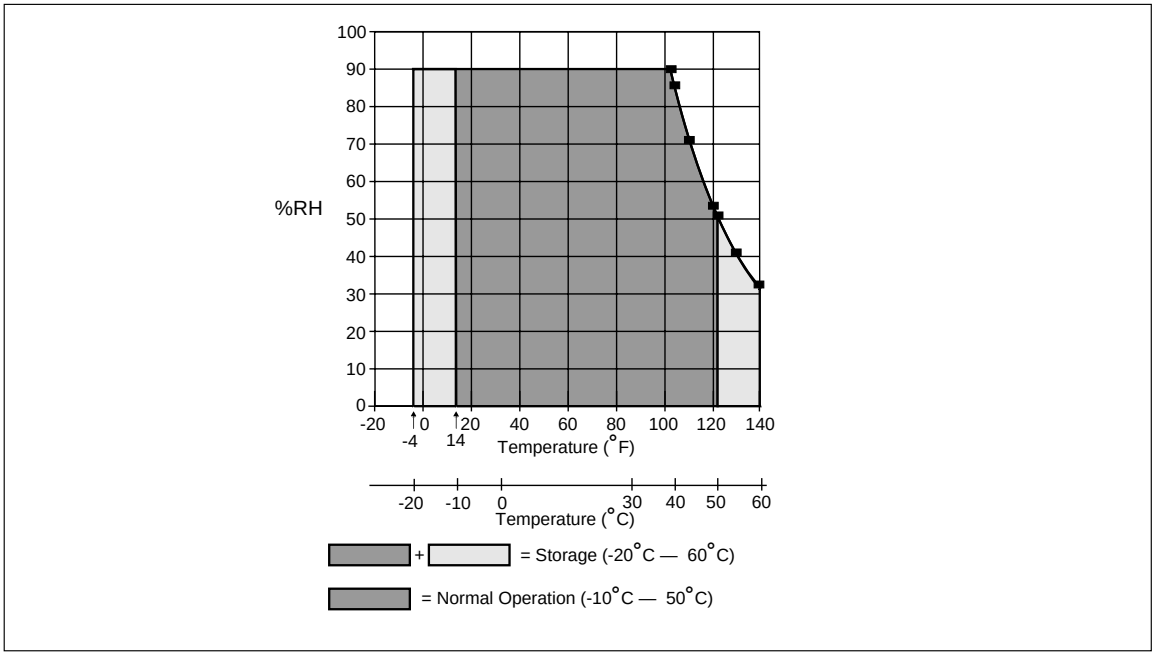

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Figure 1. LCD Operating Environment Specification

Performance Verification Tests

Fluke recommends re-certification every year. To re-certify, perform the verification procedure. If any test points are out of tolerance, you need to calibrate, then re-verify. Two-year specifications are included for those customers who do not require the highest accuracy.

The following tests verify compliance to specifications on the Documenting Process Calibrator.

Equipment Required for Verification

The equipment required for verification of the Documenting Process Calibrator is listed in the following table. If the recommended instruments are not available, you can substitute other source and measure instruments as long as they meet the minimum test requirements.

Table 2. Equipment Required for Verification

Equipment	Minimum Specification	Recommended Model
Calibrator	No substitute recommended	Fluke 5500A
Frequency Counter	1Hz to 50kHz, 25ppm timebase	Fluke PM6666
Oscilloscope	1Hz to 50 kHz (duty cycle accuracy 1%)	Fluke 123
DMM	No substitute recommended	Hewlett Packard 3458A
Short jumpers (2)	banana type	Fluke PN 944632
Test leads (2 sets)	banana to banana type	Fluke TL20
Thermocouple miniplug	polarize, with type-K thermocouple welded to copper wire	see Figure 11
Lag bath	characterized by a 0.1 °C standard thermometer (0.02 °C resolution) and a 1-pint thermos bottle	Princo ASTM-56C Mercury Thermometer, Dewar Flask and Cap
Smart (HART) Pressure Transmitter	HART communication protocol	Rosemount 1151 or 3051
HART Interface Cable Assembly	No substitute recommended	Fluke PN 689653

How to Verify

For each procedure there is a table of test points and acceptable readings. If the result of the test is outside the range shown, the Unit Under Test (UUT) is out of tolerance and should be re-calibrated or repaired if necessary. There are separate columns for one and two-year specifications wherever the specifications differ.

Follow these general instructions for all the tests:

- For all tests, operate the UUT on battery power. Make sure the battery is fully charged. Do not use the battery eliminator (BE9005).
- For measurement functions, press the [RANGE] button to lock the range on the range specified in the table of test points. The [RANGE] button may need to be pressed several times.

- Ranges in the specification tables include the 10% over-range capability. Range names on the 74X display do not include the 10% over-range. For example, the UUT display shows **Range 100 mV,** but the range name in the table is 110 mV.
- Allow each item of verification equipment to satisfy its specified warm-up period.
- Allow at least 5 minutes for warm up.
- For each test, make sure the verification equipment has settled and that the "unsettled" annunciator on the UUT is not displayed.

DC Volts Measurement

Proceed as follows to verify the DC Volts Measurement function:

1. Connect the UUT to the 5500A as shown in Figure 2. Connect the three lows (black input jacks) with jumpers.

Caution

Do not force a dual banana plug between any two jacks in the horizontal orientation. Doing so will damage the jacks. Use the supplied jumper wires (P/N 944632). You can use a dual banana plug in the vertical orientation.

2. Set the UUT to the DC Volts Measurement function.
3. Press [RANGE] on the UUT to lock on the 110 mV range.
4. Set the 5500A to the first test point in Table 3.
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to [STANDBY].

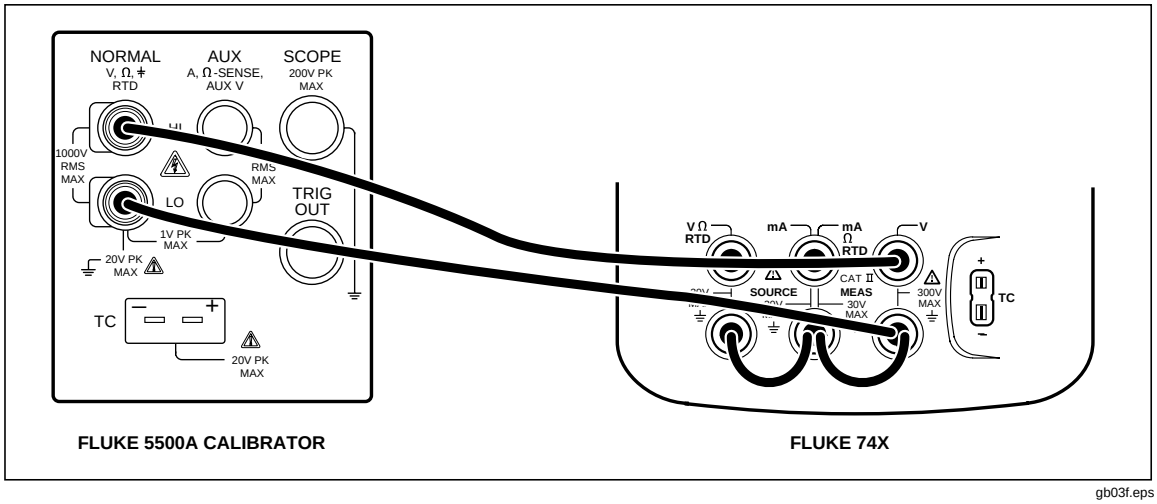

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Figure 2. DC Volts and AC Volts Measurement Connections

Table 3. DC Volts Measurement Verification Points

UUT Range	Input DCV	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
110 mV	0 mV	-0.017	0.017	-0.017	0.017
110 mV	100 mV	99.959	100.042	99.934	100.067
110 mV	-100 mV	-100.042	-99.959	-100.067	-99.934
1.1 V	0 mV	-0.00006	0.00006	-0.00006	0.00006
1.1 V	1 V	0.99970	1.00031	0.99945	1.00056
1.1 V	-1 V	-1.00031	-0.99970	-1.00056	-0.99945
11 V	0 V	-0.0006	0.0006	-0.0006	0.0006
11 V	10 V	9.9970	10.0031	9.9945	10.0056
11 V	-10 V	-10.0031	-9.9970	-10.0056	-9.9945
110 V	0 mV	-0.006	0.006	-0.006	0.006
110 V	100 V	99.945	100.056	99.895	100.106
110 V	-100 V	-100.056	-99.945	-100.106	-99.895
300 V	0 mV	-0.02	0.02	-0.02	0.02
300 V	300 V	299.84	300.17	299.69	300.32
300 V	-300 V	-300.17	-299.84	-300.32	-299.69

AC Volts Measurement

Proceed as follows to verify the AC Volts Measurement function:

1. Connect the UUT to the 5500A as shown in Figure 2. Connect the three lows (black jacks) with jumpers.
2. Set the UUT to the AC Volts Measurement function.
3. Press [RANGE] on the UUT to lock on the 1.1V range.
4. Set the 5500A to the first test point in Table 4. Wait for the output to settle.
5. Observe the reading on the UUT and check to see if it is within the range shown.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to Standby.

Table 4. AC Volts Measurement Verification Points

UUT Range	Input (RMS)	Frequency	Minimum 1 & 2 Year	Maximum 1 & 2 Year
1.1 V	0.2 V	500 Hz	0.1985	0.2015
1.1 V	1.0 V	20 Hz	0.9790	1.0210
1.1 V	1.0 V	40 Hz	0.9945	1.0055
1.1 V	1.0 V	500 Hz	0.9945	1.0055
1.1 V	1.0 V	1 kHz	0.9790	1.0210
1.1 V	1.0 V	5 kHz	0.8980	1.1020
11 V	2.0 V	500 Hz	1.985	2.015
11 V	10.0 V	500 Hz	9.945	10.055
11 V	10.0 V	5 kHz	8.980	11.020
110 V	20.0 V	500 Hz	19.85	20.15
110 V	100.0 V	500 Hz	99.45	100.55
110 V	100.0 V	5 kHz	89.80	110.20
300 V	50.0 V	500 Hz	49.3	50.8
300 V	120.0 V	60 Hz	118.9	121.1
300 V	250.0 V	500 Hz	248.3	251.8
300 V	219.0 V	5kHz	195.1	242.9

DC Current Measurement

Proceed as follows to verify the DC Current Measurement function:

1. Connect the UUT to the 5500A and the HP3458A as shown in Figure 3. Disconnect the jumpers on the three commons (lows) of the UUT if they are present.
2. Set the UUT and the HP3458A to the DC-Current Measurement function and the 5500A to Source DC-Current.
3. Press [RANGE] on the UUT to lock on the 30 mA range.
4. Set the 5500A to the first test point in Table 5, and edit its output so that the correct reading is displayed on the HP3458A.
5. Observe the reading on the UUT and check to see it is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to [STANDBY].

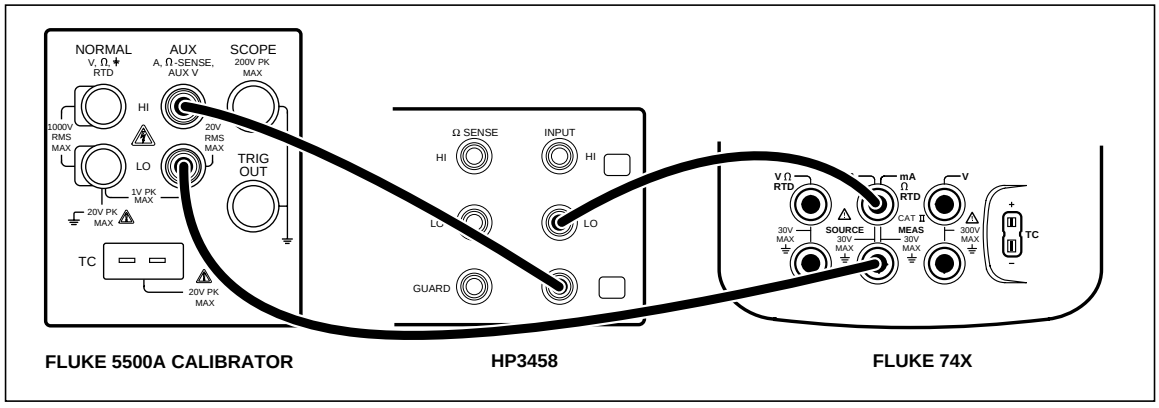

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Figure 3. DC Current Measurement Verification Connections

Table 5. DC Current Measurement Verification Points

UUT Range	Input mA	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
30 mA	4 mA	3.995	4.005	3.995	4.005
30 mA	20 mA	19.994	20.007	19.992	20.009
30 mA	30 mA	29.993	30.008	29.990	30.011
30 mA	-30 mA	-30.008	-29.993	-30.011	-29.990
110 mA	0 mA	0.02	-0.02	0.017	-0.02
110 mA	100 mA	99.97	100.03	99.96	100.04
110 mA	-100 mA	-100.03	-99.97	-100.04	-99.96

Resistance Measurement

Proceed as follows to verify the Resistance Measurement function:

1. Connect the UUT to the 5500A as shown in Figure 4. Use a four-wire connection at the 5500A, transitioning to two wires at the UUT, and turn Two-Wire Compensation on.
2. Set the UUT to the Resistance Measurement function.
3. Press [RANGE] on the UUT to lock on the 11Ω range.
4. Set the 5500A to the first test point in Table 6.
5. Observe that the reading on the UUT is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to [STANDBY].

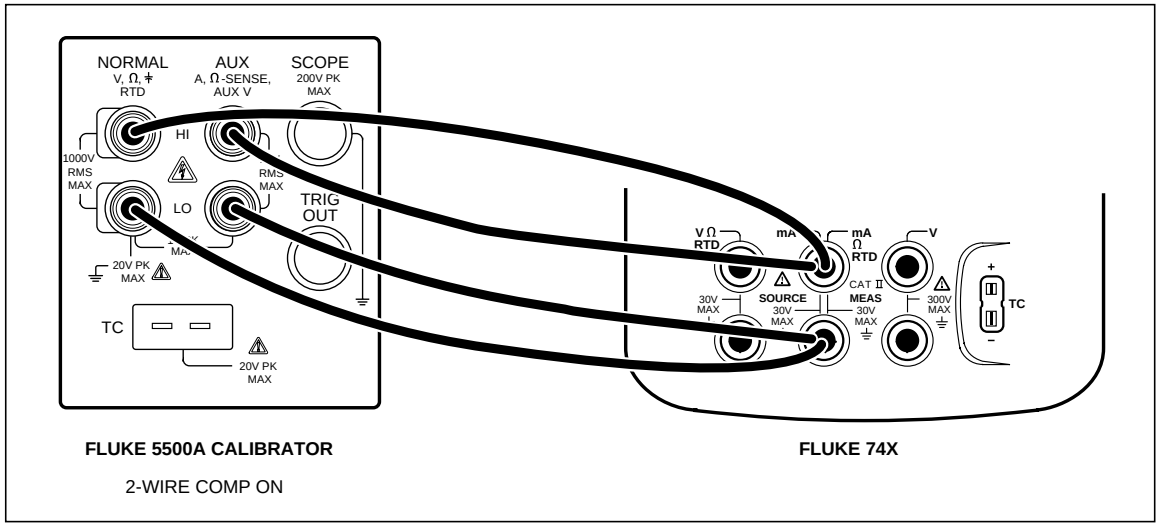

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Figure 4. Resistance Measurement Verification Connections

Table 6. Resistance Measurement Verification Points

UUT Range	Input	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
11 ohm	0.0 ohm	-0.050	0.050	-0.050	0.050
11 ohm	10 ohm	9.945	10.055	9.943	10.058
110 ohm	0.0 ohm	-0.05	0.05	-0.05	0.05
110 ohm	100 ohm	99.90	100.10	99.88	100.13
1100 ohm	0.0 ohm	-0.5	0.5	-0.5	0.5
1100 ohm	1000 ohm	999.0	1001.0	998.8	1001.3
11 kohm	0.0 ohm	-0.010	0.010	-0.010	0.010
11 kohm	10 kohm	9.980	10.020	9.980	10.020

Frequency Measurement

Proceed as follows to verify the Frequency Measurement function:

1. Connect the UUT as shown in Figure 5.
2. Set the UUT to the Frequency Measurement function.
3. Select the <20 Hz range for the first step. Use the ≥20 Hz range thereafter.
4. Set the 5500A to the first test point in Table 7.
5. Observe that the frequency reading on the UUT is within the range shown.
6. Continue through the test points, using the ≥20 Hz range of the UUT.
7. When you are finished, set the 5500A to [STANDBY].

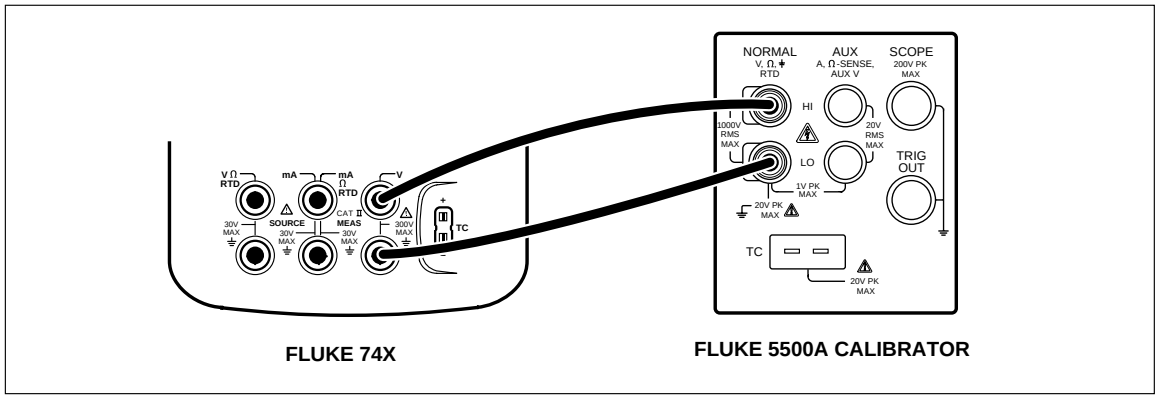

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Figure 5. Frequency Measurement Verification Connections

Table 7. Frequency Measurement Verification Points

UUT Range	Frequency Input	V RMS	Minimum 1 & 2 Year	Maximum 1 & 2 Year
<20 Hz	10 Hz	150 mV	9.95	10.05
>20 Hz	500 Hz	150 mV	499.5	500.5
>20 Hz	10 kHz	700 mV	9.995	10.005
>20 Hz	50 kHz	1.4 V	49.95	50.05

DC Volts Source

Proceed as follows to verify the DC-Volts Source function:

1. Connect the UUT to the HP3458A as shown in Figure 6.
2. Set the 3458A to measure dc-volts.
3. Set the UUT to the DC-Volts Source function at -10 mV.
4. Observe that the reading on the 3458A is within the range shown under the appropriate column in Table 8.
5. Continue through the test points, verifying compliance to specifications.
6. When you are finished, press the CLEAR (ZERO) button on the UUT twice to set the Source function to off. This saves battery life.

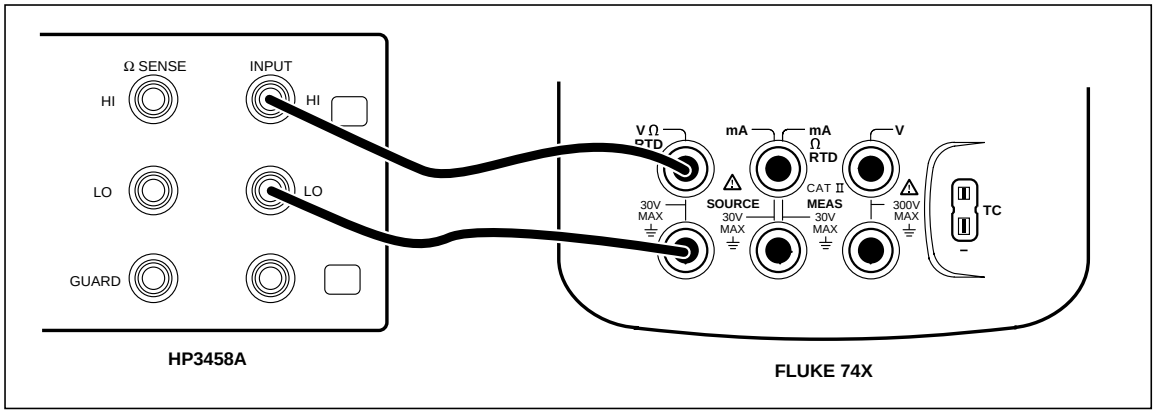

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Figure 6. DC Volts Source Verification Connections

Table 8. DC Volts Source Verification Points

UUT Range	UUT Output	Minimum 1Year	Maximum 1Year	Minimum 2Year	Maximum 2Year
110 mV	-10 mV	-10.0065	-9.9935	-10.0070	-9.9930
110 mV	100 mV	99.9845	100.0155	99.9795	100.0205
1.1 V	0.12 V	0.119933	0.120067	0.119927	0.120073
1.1 V	1 V	0.999845	1.000155	0.999795	1.000205
15 V	1.2 V	1.19913	1.20087	1.19907	1.20093
15 V	14 V	13.99785	14.00215	13.99715	14.00285

DC Current Source

Proceed as follows to verify the DC Current Source function.

1. Connect the UUT to the HP3458A as shown in Figure 7 .
2. Set the 3458A [NPLC] to 30, and the function to [DC Current].
3. Set the UUT to DC Current Source (not Simulate Transmitter) function at 2 mA.
4. Observe that the reading on the 3458A is within the range shown under the appropriate column in Table 9 .
5. Continue through the test points, verifying compliance to specifications.
6. When you are finished, press CLEAR (ZERO) twice on the UUT to set the Source function to off. This saves battery life.

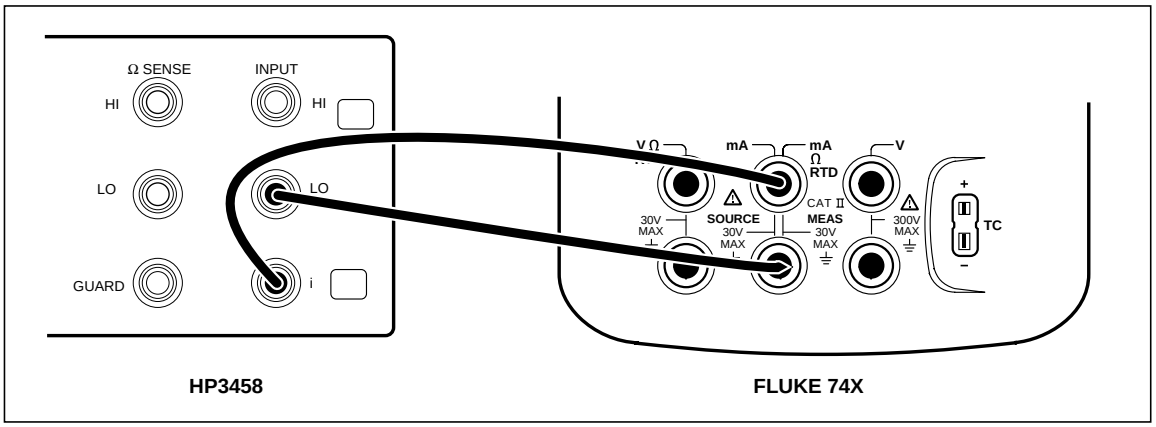

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Figure 7. DC Current Source Verification Connections

Table 9. DC Current Source Verification Points

UUT Range	UUT Output	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
22 mA	2 mA	1.9965	2.0035	1.9963	2.0037
22 mA	4 mA	3.9963	4.0037	3.9959	4.0041
22 mA	22 mA	21.9945	22.0055	21.9923	22.0077

Simulate Transmitter Function

Proceed as follows to verify the Simulate Transmitter function (accessed through DC Current Source function):

1. Connect the UUT, HP3458A, and 5500A as shown in Figure 8. The 5500A is used as a stable dc voltage source. Its value is not critical, and another dc source such as a battery can be substituted.
2. Set the 3458A [NPLC] to 30, and the function to [DC Current].
3. Set the UUT to the [mA Source] function, then select **Simulate Transmitter**.
4. Set the UUT source value to 4 mA.
5. Set the 5500A to output 4V dc.
6. Observe that the reading on the 3458A is within the range shown in Table 10.
7. Change the UUT source value to 22 mA and check the results again in Table 10.
8. Set the 5500A to [STANDBY], and press CLEAR (ZERO) twice on the UUT to turn the Source function off. This saves battery life.

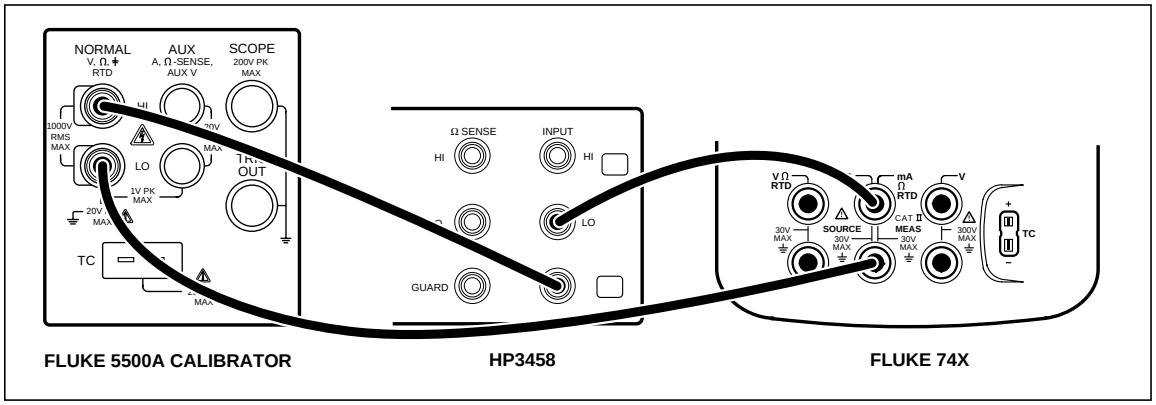

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Figure 8. Simulate Transmitter Verification Connections

Table 10. Simulate Transmitter Verification Points

Range	Output	Minimum 1 & 2 Year	Maximum 1 & 2 Year
22 mA	4 mA	3.9926	4.0074
22 mA	22 mA	21.9890	22.0110

Proceed as follows to verify the Resistance Source function.

1. Connect the UUT to the HP3458A as shown in Figure 9. Use a four-wire connection transitioning to two wires at the UUT.
2. Set the UUT to the Resistance Source function at 0.1Ω.
3. On the 3458A, select four-wire ohms measurement and up-range to the 100Ω range. Use the 100Ω range for the first three tests points, and autorange thereafter. The low range of the 3458A supplies too much current back into the UUT.
4. Observe that the reading on the 3458A is within the range shown under the appropriate column in Table 11.
5. Continue through the test points, verifying compliance to specifications.
6. When you are finished, press CLEAR (ZERO) twice on the UUT to set the Source function to off. This saves battery life.

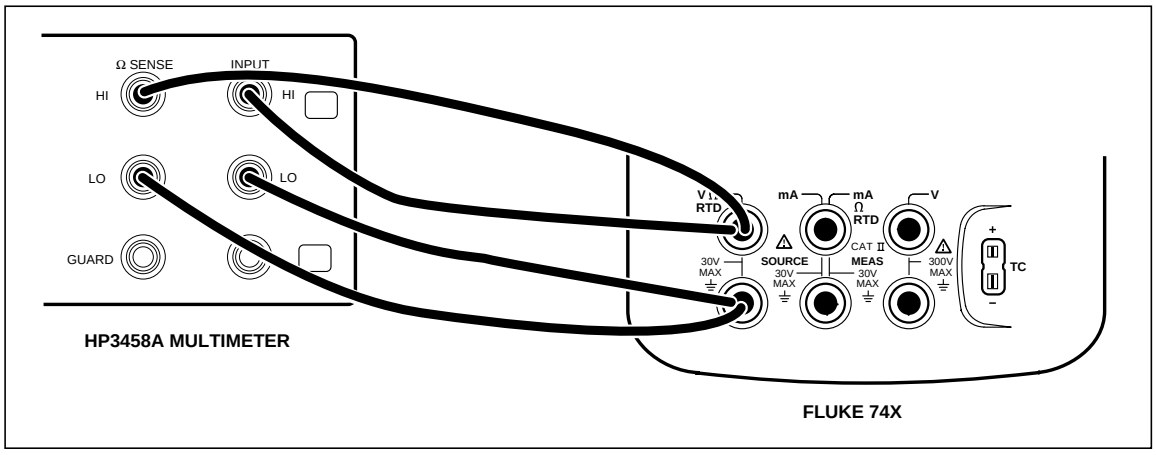

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Figure 9. Resistance Source Verification Connections

Table 11. Resistance Source Verification Points

UUT Range	UUT Output	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
11 ohm	0.1 ohm	0.0800	0.1200	0.0800	0.1200
11 ohm	1 ohm	0.9799	1.0201	0.9798	1.0202
11 ohm	10 ohm	9.9790	10.0210	9.9780	10.0220
110 ohm	20 ohm	19.958	20.042	19.956	20.044
110 ohm	100 ohm	99.950	100.050	99.940	100.060
1100 ohm	200 ohm	199.46	200.54	199.44	200.56
1100 ohm	1000 ohm	999.30	1000.70	999.20	1000.80
11 kohm	2 kohm	1.9944	2.0056	1.9942	2.0058
11 kohm	10 kohm	9.9920	10.0080	9.9910	10.0090

Frequency Source

Proceed as follows to verify the Frequency Source function:

1. Connect the UUT to the PM6666 counter as shown in Figure 10.
2. Set the UUT to Source, Frequency, 1.000 Vpp , Square Wave, at 5Hz.
3. Observe that the reading on the PM6666 is within the range shown in Table 12.
4. Use the ScopeMeter to check for a positive square wave, with a 50% duty-cycle (±5%), and 1.0V peak amplitude. Observe that the amplitude is within the range shown in Table 12. The HP3458A can also be used to check the RMS value of the signal.
5. Continue through the test points, verifying compliance to specifications.
6. At the last test point, change the UUT to source a Sine Wave. Verify the correct frequency, waveform, and amplitude.
7. When you are finished, press CLEAR (ZERO) twice on the UUT to set the Source function to off. This saves battery life.

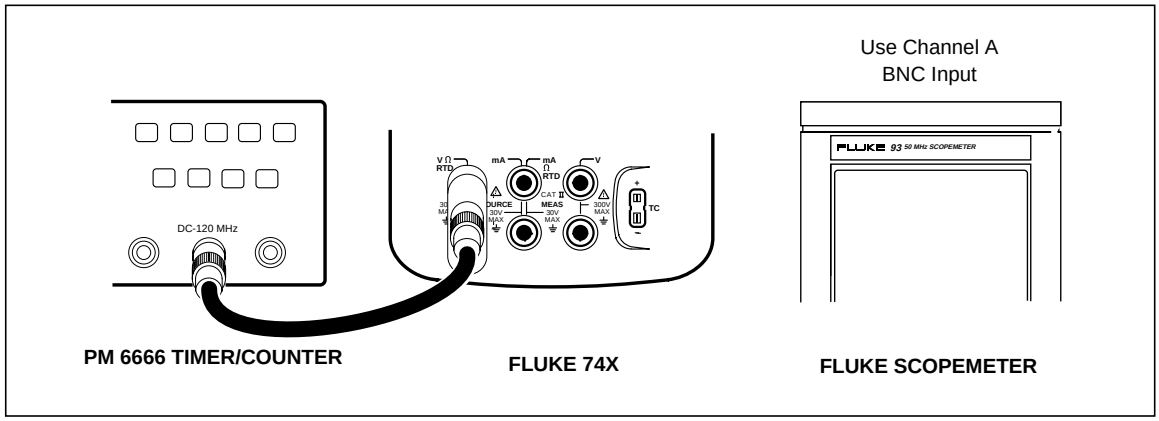

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Figure 10. Frequency Source Verification Connections

Table 12. Frequency Source Verification Points

UUT Range	Frequency @ 1 Vpp	Minimum Freq.	Maximum Freq.	Amplitude Tolerance +/- mV peak	+/- mV RMS
10.999 Hz	5 Hz	4.99	5.01	80	40
109.99 Hz	50 Hz	49.9	50.1	80	40
1099.9 Hz	500 Hz	499.9	500.1	80	40
21.999 kHz	10 kHz	9.998	10.002	150	75
50 kHz	50 kHz	49.995	50.005	350	175
1099.9 Hz	*Sine Wave* 1000 Hz	999.9	1000.1	80	28.29

Thermocouple Measure

Proceed as follows to verify the Thermocouple Measure function.

1. Use Type-K thermocouple wire and copper wire to connect the 5500A output to the UUT-TC jack as shown in Figure 11. The Type K-to-Copper junctions should be either welded or made with tight screw terminals and submersed in the lag bath (room temperature). Use the standard thermometer (0.1 °C accuracy) to measure the temperature of the lag bath.
2. Set the 5500A to source DC-millivolts and the UUT to the Thermocouple Measure function, TC Type K; ITS-90 scale, internal reference, and °C.
3. Wait at least 1 minute for thermal "emfs" (caused by insertion of the connectors) to dissipate, and allow the lag bath at least 15 minutes to stabilize.
4. Use the 5500A to source the millivolt equivalents of the temperatures in Table 13. At each point, correct the 5500A output voltage by subtracting the millivolt equivalent of the temperature at the lag bath junction (use reference chart below).
5. Observe each reading on the UUT and check to see it is within the range shown under the appropriate column in Table 13.
6. When you are finished, set the 5500A to [Standby].

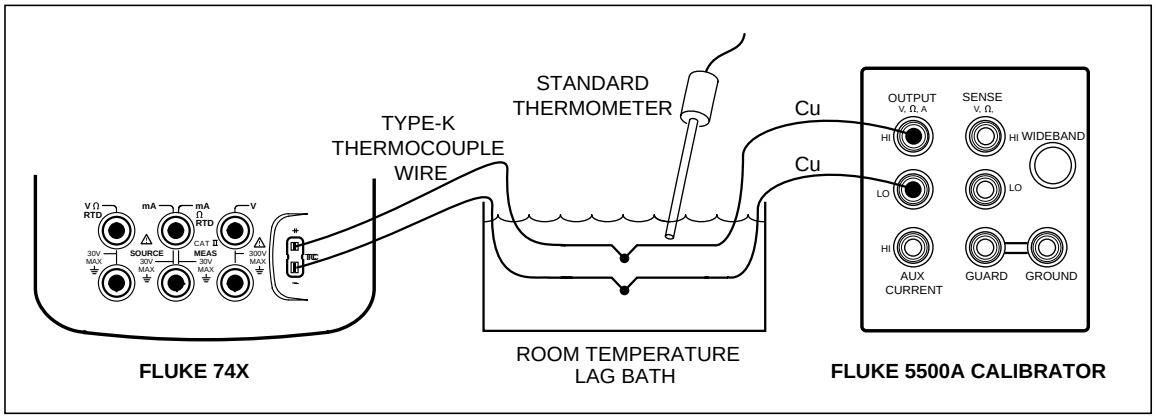


Figure 11. Temperature Measure (TC) Verification Connections

Table 13. Temperature Measure Verification

Input dcmV (referenced to 0 °C)	Minimum 1-Year °C	Maximum 1-Year °C	Minimum 2-Year °C	Maximum 2-Year °C
-5.550 mV (-180 °C)	-179.1	-180.9	-178.8	-181.2
0.000 mV (0 °C)	-0.5	0.5	-0.6	0.6
33.275 mV (800 °C)	799.3	800.7	799.0	801.0
52.410 mV (1300 °C)	1299.1	1300.9	1298.8	1301.2

Lag Bath Reference Table, Type K, ITS-90											
Temp. °C	18	19	20	21	22	23	24	25	26	27	28
mV	0.718	0.758	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122

Thermocouple Source

Proceed as follows to verify the Thermocouple Source function. This test uses a Type-K thermocouple setting on the UUT.

1. Use Type-K thermocouple wire and copper wire to connect the HP3458A to the UUT -TC jack as shown in Figure 11 (the HP3458A is used in place of the 5500A). The type K-to-copper junctions should be either welded or made with tight screw terminals and submersed in the lag bath (room temperature). Use the standard thermometer (0.1% accuracy) to measure the temperature of the lag bath.
2. Set the UUT to the thermocouple source function, linear mode, TC type K; ITS-90 scale, internal reference, and °C.
3. Set the HP3458A to measure mV-DC.
4. Wait at least 1 minute for thermal "emfs" (caused by insertion of the connectors) to dissipate, and allow the lag bath at least 15 minutes to stabilize.
5. Source each of the temperatures in Table 14 from the UUT. At each point, correct the DMM measured voltage by adding the millivolt equivalent of the Type-K junction at the lag bath temperature (use the Type-K ITS-90 chart).
6. Compare the result with the values under the appropriate column in Table 14.
7. When you are finished, press CLEAR (ZERO) twice on the UUT to set the source function to off. This saves battery life.

Table 14. Temperature Source Verification (Type-K Thermocouple, ITS-90)

UUT Output	Nominal DC mV	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
-180 °C	-5.5504	-5.5616	-5.5390	-5.5653	-5.5353
0 °C	0.0000	-0.0197	0.0197	-0.0237	0.0237
800 °C	33.2754	33.2549	33.2959	33.2508	33.2999
1300 °C	52.4103	52.3928	52.4277	52.3893	52.4312

RTD Measure, Four-Wire

Proceed as follows to verify the four-wire RTD Measure function. Three-wire RTD Measure function requires a separate verification procedure because it uses different circuits. The two-wire RTD Measure circuit is tested during the Ohms Measure procedure. If a 5500A is not available, substitute a variable resistance source such as a General Resistance RTD-100 RTD Simulator and a DMM to measure the variable resistance source for accuracy. Use the resistance equivalents shown in Table 15.

1. Connect the UUT to the 5500A as shown in Figure 12. Use a four-wire connection and 4-wire compensation.
2. Set the UUT to the RTD Measure function, Pt100 (385), ITS-90 scale, and 4-Wire termination.
3. Set the 5500A to RTD, Pt100 (385) at -180 °C, ITS-90 scale, and comp four-wire. Set the 5500A to [Operate].
4. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 15.
5. Continue through the test points.
6. When you are finished, set the 5500A to [Standby].

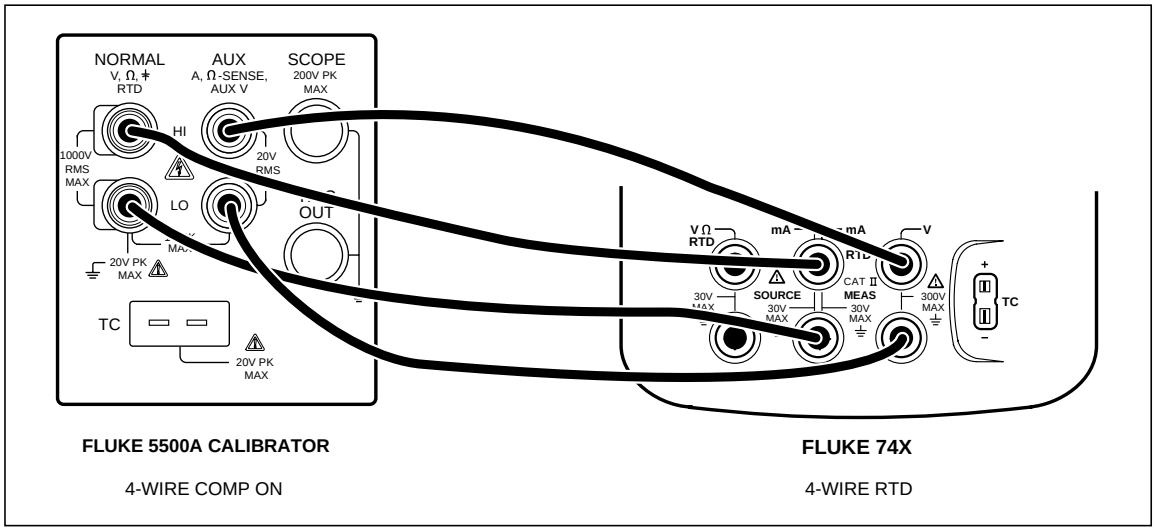


Figure 12. Four-Wire RTD Measure Verification Connections

Table 15. RTD Measure Verification (100W Pt (385), Four-Wire Connection)

Input °C (Resistance)	1-Year (°C)	2-Year (°C)
-180 ° (27.096Ω)	-179.7 to -180.3	-179.5 to -180.5
100 ° (138.505Ω)	99.5 to 100.5	99.2 to 100.8
780 ° (369.712Ω)	779.2 to 780.8	779.0 to 781.0

RTD Measure, Three-Wire

Proceed as follows to verify the three-wire RTD measure function. If a 5500A is not available, substitute a variable resistance source such as a General Resistance RTD-100 RTD Simulator and a DMM to measure the variable resistance source accurately. Use the resistance equivalents shown in Table 16.

1. Connect the UUT to the 5500A as shown in Figure 13.
2. Set the UUT to the RTD Measure function, Pt100 (385), ITS-90 scale, 3-Wire termination.
3. Set the 5500A to RTD, Pt100 (385) at -180 °C, ITS-90 scale, and comp four-wire to "OFF" position. Set the 5500A to [Operate].
4. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 16.
5. Continue through the test points.
6. When you are finished, set the 5500A to [Standby].

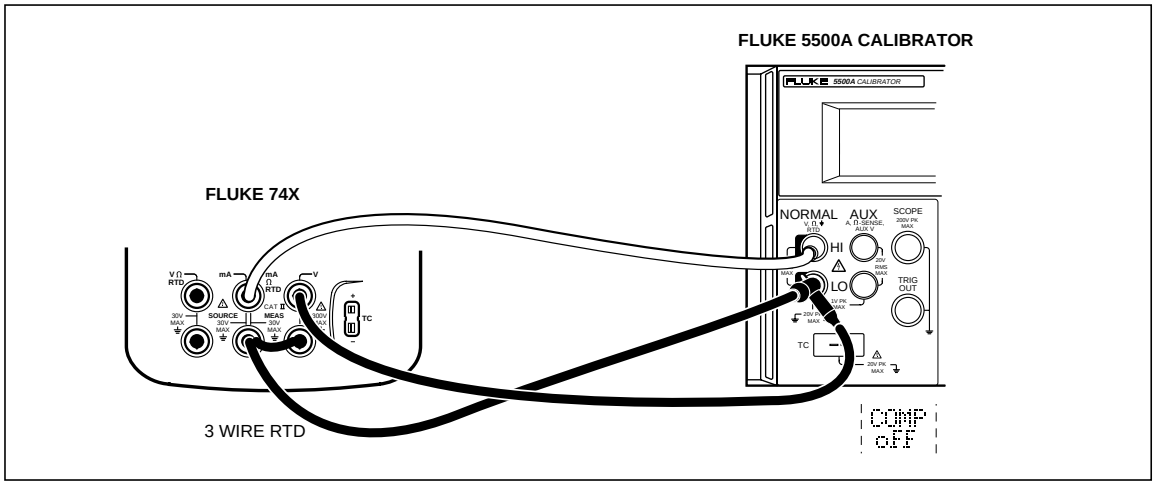


Figure 13. Three-Wire RTD Measure Verification Connections

Table 16. RTD Measure Verification (100W Pt (385), Three-Wire Connection)

Input °C (Resistance)	1-Year (°C)	2-Year (°C)
-180 ° (27.096Ω)	-179.3 to -180.7	-179.1 to -180.9
100 ° (138.505Ω)	99.1 to 100.9	98.8 to 101.2
780 ° (369.712Ω)	778.8 to 781.2	778.6 to 781.4

RTD Source

Proceed as follows to verify the RTD Source function:

1. Connect the UUT to the HP3458A DMM as shown in Figure 9. Use a 4-wire connection transitioning to 2-wires at the UUT. Set the HP3458A to 4-Wire Ohms, auto-range.
2. Set the UUT to the RTD Source function, Pt100 (385) at -180 °C, ITS-90 scale.
3. Observe the resistance reading on the DMM and check to see if it is within the range shown under the appropriate column in Table 17.
4. Continue through the test points.
5. When you are finished, press CLEAR (ZERO) twice on the UUT to set the Source function to off. This saves battery life.

Table 17. RTD Source Verification (100W Pt (385))

UUT Output	Nominal (Ohms)	Minimum 1 Year	Maximum 1 Year	Minimum 2 Year	Maximum 2 Year
-180 °C	27.096	27.053	27.139	27.011	27.181
100 °C	138.505	138.429	138.581	138.353	138.657
780 °C	369.712	369.592	369.832	369.562	369.862

Loop Power

Proceed as follows to verify the Loop Power function.

1. Connect the UUT to the HP3458A DMM as shown in Figure 14.
2. On the UUT press [SETUP], [ENTER], select **Loop Power 24V**, and press [ENTER] again.
3. Observe the no-load voltage reading on the DMM and verify that it is within the range shown in Table 18.
4. Set the Loop Power voltage to the 28V setting and repeat step 3.
5. When complete, disable Loop Power through the [SETUP] menu or by turning the UUT off. This saves battery life.

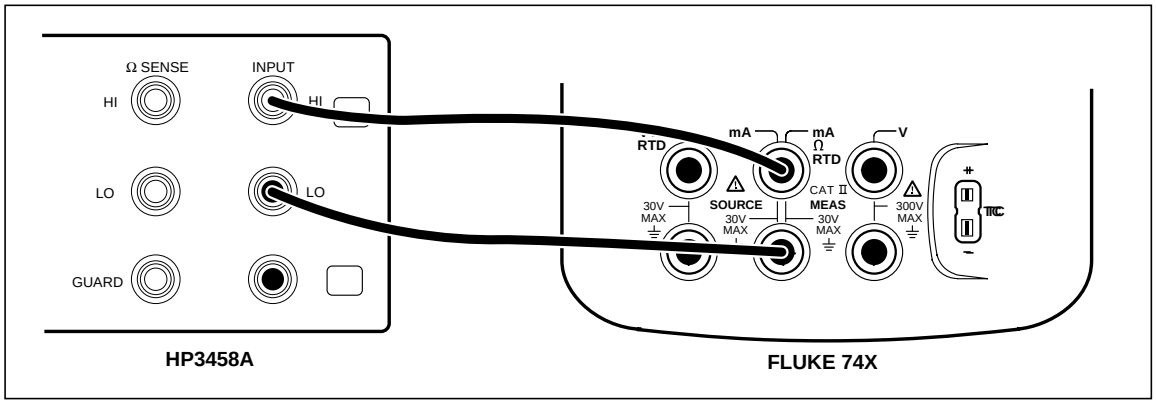


Figure 14. Loop Power Verification Connections

Table 18. Loop Power Verification

UUT SETTING	Output Accuracy 1 and 2Year
24 Volt	22.8 to 25.2
28 Volt	26.6 to 29.4

HART Mode Verification

The following test verifies the ability of the Fluke 744 to communicate over a serial HART® (Highway Addressable Remote Transducer) interface to a HART transmitter. The calibrator communicates with virtually all HART transmitters and related software versions. These are “supported transmitters”. All other transmitters are “generic”. This procedure requires a Smart (HART) Pressure Transmitter. The Rosemount Models 1151 or 3051 are recommended (may be substituted with any HART communicator protocol device).

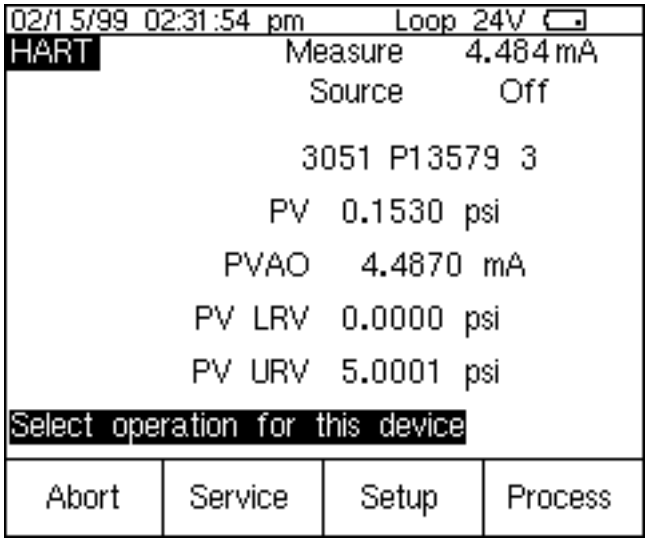
This verification test is a pass or fail test. The HART mode requires no calibration. If the calibrator fails this test repair is required. Refer to the 744 HART Mode Users Guide for additional information on the HART feature.

It is not necessary to open the case or adjust the calibrator to perform this test. Simply make the required connections and determine if the calibrator responds properly.

1. Connect the 744 to the HART transmitter as shown in Figure 15.

2. Press HART to activate HART mode. If required, press the appropriate blue soft key to enable Loop Power.

3. The calibrator will recognize and identify the HART transmitter. When used with a Model 3051, the display will appear as follows:



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The Active Device screen provides the following information for all HART transmitters, supported or generic:

- Poll address (if not 0)
- Model number and Tag ID
- PV (Primary Variable)
- PVAO (digital representation of the Analog Output)
- PV LRV (PV Lower Range Value)
- PV URV (PV Upper Range Value)
- Softkeys for accessing HART operation menus

4. Communication to the HART transmitter has been established if step two has been observed. The calibrator has passed the HART mode verification test.
5. If the calibrator does not recognize the transmitter, the test has failed and the calibrator requires repair. Contact your nearest authorized Fluke Service Center for additional service.
6. Disconnect and secure all test equipment.

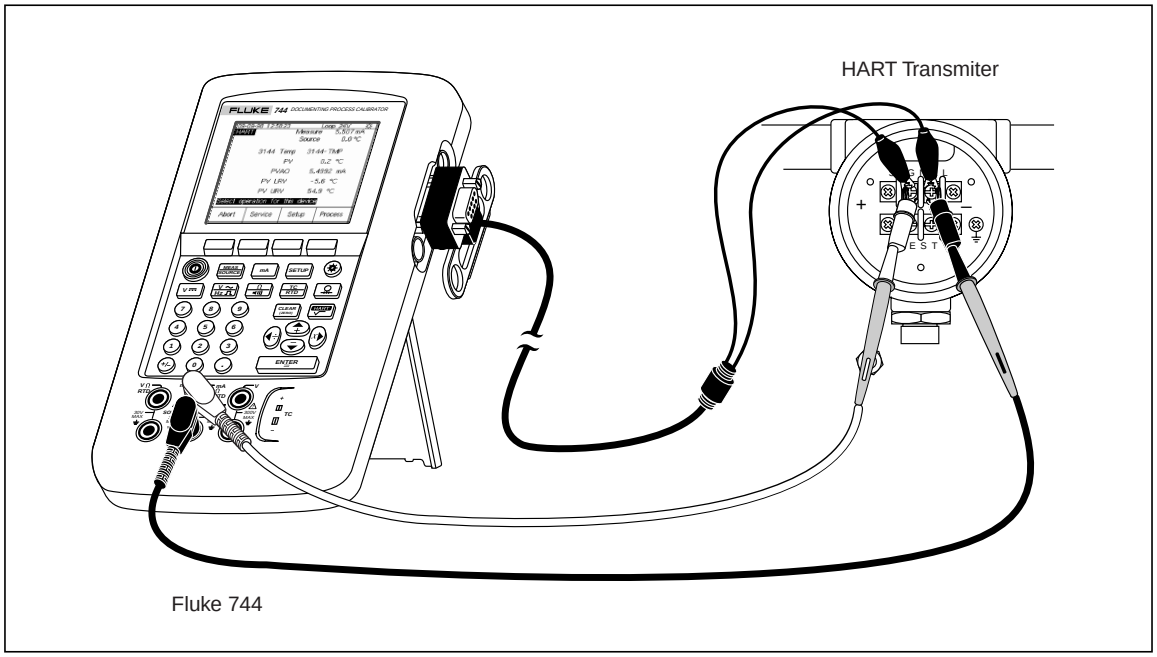


Figure 15. HART Mode Verification Connections

Calibration

Calibration is required only if the unit-under-test (UUT) fails verification. Always re-verify after calibration.

All Documenting Process Calibrators referenced in this manual use the same calibration procedure. Calibration is done using internal software. There are no physical adjustments (except for three potentiometers used for common-mode error; explained later in this chapter). The following instructions for calibration are minimal because of the built-in guided procedures. The internal software routines produce displays that give step-by-step prompts for the correct stimulus or measurement. The guided procedures also illustrate which terminals (jacks) to use when applying a stimulus, taking a measurement, or which terminals need to be shorted with jumpers. Follow the instructions exactly to complete each calibration routine successfully.

Equipment Required for Calibration

The required accuracy of the source or measurement does not necessarily correspond to the number of decimal places indicated on the UUT's display. For example, in calibrating **Frequency Measure**, when the display requests a source value of 5.00000V at 1.00000 kHz, the required accuracies are not of that magnitude. Use the measurement and source equipment suggested at the beginning of the Performance Verification Test.

Calibration Status Indicator

The calibration display is accessed by pressing [**SETUP**], and then the **Next Page** softkey three times. At the top of the display is the **Calibration Status** followed by a number. This number is incremented after each subroutine is finished and the new constants are saved. Doing a complete calibration increments the **Calibration Status** by 10. Because the Calibration Status number is changed only by a re-calibration, it can be used to confirm that previous cal constants have not been changed.

Calibration Constant Out of Bounds

If one or more of the calibration stimuli (or measurements) were out of range during a calibration routine, or the cabling arrangement was incorrect, the message [**Error - Calibration Constant Out of Bounds**] will appear at the end of the routine. A general fault with the UUT can also be indicated by this error. The fault will first have to be rectified before repeating the entire sub-routine.

Order of Calibration

There are ten (10) sub-routines in the Calibration menu display. The sub-routines are as follows:

- Volts DC Measure
- Volts AC Measure
- Frequency Measure
- mA Measure
- Volts DC Source
- Frequency Source
- Ohms Source
- mA Source
- Ohms Measure
- TC Measure

To completely re-calibrate these Process Calibrators, do each of the 10 sub-routines. At the end of each sub-routines you are prompted to either save the new constants, or abandon them and start over.

The best course is to do them in order from top to bottom. However, the first seven are independent and can be done in any order. The last three subroutines (**mA Source, Ohms Measure,** and **TC Measure**) are dependent on previous calibration constants, and must be done in a specific order, as follows:

1. If **mA Source** is to be calibrated, **mA Measure** should be calibrated first. In other words, re-calibrating **mA Measure** could affect **mA Source**.
2. If **Ohms Measure** is to be calibrated, the following sub-routines should be done first in the order shown: **Volts DC Measure**, **mA Measure**, **mA Source**, and **Ohms Measure**. This means that re-calibrating **Volts DC Measure** or **mA Measure** can have an impact on **Ohms Measure**.
3. If **TC Measure** is to be calibrated, **Volts DC Source** must be calibrated first. Calibrating **Volts DC Source** could affect **TC Measure.**

Note

TC Measure *also characterizes component RT2, which could affect the* ***TC Source*** *function (of which there is no calibration sub-routine), and affects the contrast of the display LCD.*

How to Calibrate

Follow these general instructions for all calibrations:

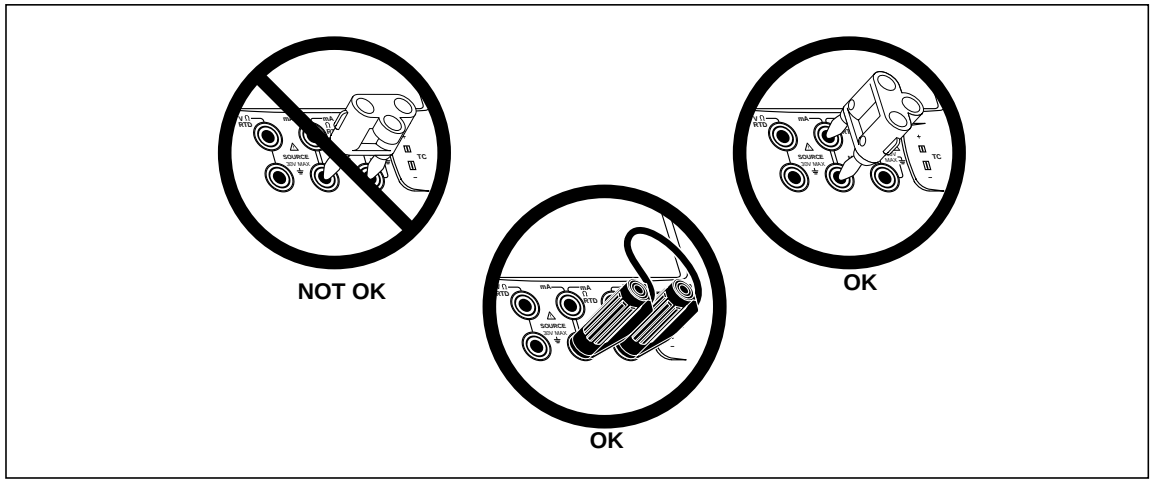
- Operate the UUT on battery power. Make sure the battery is fully charged. Do not use the battery eliminator (BE9005).
- Allow each item of calibration equipment to satisfy its specified warm-up period.
- Allow the UUT a minimum of 5 minutes to warm up.
- For each calibration, make sure the calibration equipment has settled and that the "unsettled" annunciator on the UUT is not displayed.

Proceed as follows:

1. Turn on the UUT , press [SETUP] , and then the **Next Page** softkey three times.
2. The cursor bar should be at the **Volts DC Measure** subroutine. If you want to start with another subroutine, use the ⇧ (up) and ⇩ (down) keys to move the cursor to the desired subroutine. To start, press the **Calibrate** softkey.
3. For **Volts DC Measure**, do as the display illustrates: connect a shorting bar across the right side high and low jacks (not the TC connector), then connect all three lows (commons) together with two jumpers. Press the **Continue** softkey.

Caution

Do not force a dual banana plug between any two jacks in the horizontal orientation (see Figure 16). Doing so will damage the jacks. Use the supplied jumper wires. You can use a dual banana plug in the vertical orientation.



gb16f.eps

Figure 16. Proper and Improper Jumper Use

4. Again, do as the display illustrates: remove the shorting bar, connect the test leads from the right side jacks to the output of the dc source.
5. The display requests an input of **100.000 mV** dc but shows an allowed range of **90.0** ≤ **100.000 mV** ≤ **110.0**. Apply the requested input, or apply an input in the allowed range, and use the numeric keys to enter the value into the UUT, followed by [ENTER]. Press the **Continue** softkey.
6. Apply the next requested value as in step 5. Press the **Continue** softkey.

⚠ Warning

Some of the voltages required for calibration are dangerous. To avoid injury or death from electric shock, do not touch live conductors during high voltage calibration. Put the source device into Standby after each calibration step.

7. Continue applying voltages as requested. Make sure you follow the hookup instructions each time because the input jack configuration changes.
8. When you complete the last point in the subroutine, the display asks you if you want to save the new constants. If you save the new constants, the calibration takes effect and the **Calibration Status** counter is incremented and the date is updated. If you discard the constants at this point, the calibration has no effect, the **Calibration Status** counter is not incremented, and the date does not change.

The other functions are also calibrated by following the step-by-step instructions on the display.

Frequency Source: When you calibrate the [Frequency Source] function, it requests that you measure the frequency and voltage output. This signal is an approximate 50% duty cycle, positive square wave, and the amplitude needs to be measured in pk volts, so multiply the DMM reading by 2. The DMM must be a true-RMS type.

mA Measure: When you calibrate the [mA Measure] function, the display requests 0.0 mA input. This does not equate to a *short* between mA high and low. Instead, set the source device to source 0.0 mA, which is in effect the same as an *open* circuit.

TC Measure: For [TC Measure] calibration, refer to the Thermocouple Measure part of the Verification Procedure for the correct techniques. [TC Measure] should be calibrated using ITS-90 standards.

Ohms Source: Always configure the DMM in a 4-wire configuration.

Adjustment of Potentiometers

There are three potentiometers on the Main PCA: R61, R77, and R82. These are factory adjusted to tune out common mode error. Normally these should never need re-adjustment. If after a repair you need to repeat this adjustment, proceed as follows.

1. Carefully gain access to the Main PCA, and carefully power on the UUT.
2. Set the calibrator to the [**DC Voltage Measure**] function.
3. Short the front panel **V MEAS** high and low jacks together.
4. Apply 10V at 60 Hz between the **V MEAS** high jack and TP12 on the Main PCB.
5. Adjust R82 for a minimum output measured between TP24 and TP12. This value must be less than 3 mV rms.
6. Remove the jumper, then set the UUT to the [**DC Current Measure**] function.
7. Apply 10V at 60 Hz between **mA/Ω/RTD MEAS** low jack (common) and TP12.
8. Adjust R61 for a minimum output measured between TP17 and TP12. This value must be less than 12 mV rms.
9. Set the UUT to the [**TC Measure**] function, any type.
10. Short the TC jack "+" and "-" terminals.
11. Apply 10V at 60 Hz between the TC jacks and TP12.
12. Adjust R77 for a minimum output measured between TP40 and TP12. This value must be less than 3 mV rms.
13. Remove the jumper.

Replaceable Parts

Table 19 lists the customer replaceable parts. Replacement parts can be ordered from the Fluke Corporation and its authorized representatives by using the part number under the heading Part Number column. In the U.S., order directly from the Fluke Parts Dept. by calling 1-888-993-5853. Parts price information is available from the Fluke Corporation or its representatives. Prices are also available in a Fluke Replacement Parts Catalog which is available on request.

In the event that the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

Table 19. Replacement Parts

Designator	Description	Part Number	Notes
A20	PCA. KEYBOARD	202389	1.2.3.4
A31	PCA, POWER SUPPLY	606738	1,2,3,4
A31	PCA, POWER SUPPLY	662798	5
A32	PCA, MAIN	606886	1,2
A32	PCA, MAIN	202496	3,4
A32	PCA, MAIN	202371	5
A33	PCA, I/O, CONNECTOR	662806	5
A34	PCA, I/O	606753	1,2
A34	PCA, I/O	202520	3,4
A34, J4	CABLE ASSY, PCB INTERFACE	662855	5
A35	PCA, THERMAL	606761	1,2,3,4
A35	PCA, THERMAL	662814	5
B1	BATTERY, LITHIUM, 3.0V, 0.18AH	929369	
J7	JACK, BAT.ELIM., 2.54 MM, PIN	942730	5
J4	CABLE ASSY,FLAT,20COND,2ROW	107463	
MP3	TOP CASE, YELLOW/GREY	202421	
MP4	BOTTOM CASE, YELLOW/GREY	202439	
MP6	LENS /DECAL	606894	1
MP5	LENS /DECAL	606902	3
MP7	LCD MODULE, 240X200,TRNSF	944967	1,3
MP7	LCD MODULE, 240X200 GRAPH TRANSMISSIVE	602430	2,4,5
MP8	BATTERY DOOR	938357	
MP10	SIDE PLUG (MOLDED RUBBER)	938274	
MP11	KEYPAD (MOLDED RUBBER)	606910	1,2,3,4

1. Used on 741 only
2. Used on 741B only
3. Used on 743 only
4. Used on 743B only
5. Used on 744 only

Table 19. Replacement Parts (cont)

Designator	Description	Part Number	Notes
MP14	BATTERY PACK ASSY	938170	1.2.3.4
MP14	BATTERY PACK, NIMH	665083	5
MP19	BATTERY PAD	949441	
MP33	DECAL FOR TOP CASE	202413	
MP77	DISPLAY BRACKET	946681	
MP109	CABLE ASSY, 2 COND, 9P/9S D-SUB, 2 CLIPS	689653	5
MP111	GUIDE SET, ENG/FR/SP USER	689646	5
MP203	HANDLE STRAP	946769	
MP210	CORD,LINE, EURO, 2.5M, 10A	769422	
MP211	BATTERY CHARGER DECAL	949453	1,2,3,4
MP404	BAT CHRGR STAND	943746	1,2,3,4
MP405	PWR SUP, 30W, 15VDC @ 2A, INTL	690552	5
MP405	PWR SUP, BAT CHRGR, INTL, 15W, 15V@1A	944223	1,2,3,4
MP406	PWR SUP, BAT CHRGR, USA, 15W, 15V@1A	106200	1,2,3,4
MP406	PWR SUP 23W 15V @ 1.5A CHRGR/CNV USA	690344	5
MP821	MAIN SHIELD	606787	
MP840	MANUAL SET, ENG/FR/SP, USER	688846	5
MP843	LENS DECAL	662871	5
MP843	LENS DECAL	949487	2
MP843	LENS DECAL	949490	4
MP94	KEYPAD	662863	5
P3	CONN., CIRCLULAR, 5 SOCKET	942714	
P4	702 SERIAL CONN, D-SUB, 9 SCKT	942727	
TM1	MANUAL, USER, ENG	601689	1,3
TM1	MANUAL, PERF BIND, USER, ENGLISH	644788	2,4
TM4	BC7210 INSTRUCTION SHEET,INTL	944020	

1. Used on 741 only
2. Used on 741B only
3. Used on 743 only
4. Used on 743B only
5. Used on 744 only

Service Centers

To locate an authorized service center, call Fluke using any of the phone numbers listed below, or visit us on the World Wide Web: www.fluke.com

USA and Canada: 1-888-99-FLUKE (1-888-993-5853)
Europe: +31-402-678-200
Japan: +81-3-3434-0181
Singapore: +65-738-5655
Anywhere in the world: +1-425-356-5500