



Via Acquanera, 29 22100 COMO
tel. 031.526.566 (r.a.) fax 031.507.984
info@calpower.it www.caltower.it

FLUKE®

Calibration

5560A/5550A/5540A

Calibrator

Operators Manual

August 2022

© 2022 Fluke Corporation. All rights reserved. Specifications are subject to change without notice.
All product names are trademarks of their respective companies.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs, and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries, or to any product which, in Fluke's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

Fluke authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke. Warranty support is available only if product is purchased through a Fluke authorized sales outlet or Buyer has paid the applicable international price. Fluke reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke's warranty obligation is limited, at Fluke's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke determines that failure was caused by neglect, misuse, contamination, alteration, accident, or abnormal condition of operation or handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Fluke will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

Fluke Corporation
P.O. Box 9090
Everett, WA 98206-9090
U.S.A.

Fluke Europe B.V.
P.O. Box 1186
5602 BD Eindhoven
The Netherlands

Table of Contents

Title	Page
Introduction	1
Contact Fluke Calibration	3
Safety Information	3
Specifications	3
Service Information	3
Operation Overview	3
Local Operation	4
Remote Operation (GPIB)	4
Remote Operation (RS-232).....	4
Remote Operation (USBTMC).....	4
Remote Operation (Ethernet)	4
Prepare the Product for Operation	4
Unpack and Inspect.....	5
Mains Voltage Selection	6
Connect to Line Power	6
Overload Protection	7
Placement and Rack Mounting.....	8
Cooling Considerations.....	8
Calibration Security Passcode	9
Features	9
Front-Panel Features.....	9
The Display.....	13
Rear-Panel Features	15
Front Panel Operation.....	17
Turn on the Calibrator.....	17
Warm up the Calibrator.....	17
Menus	17
Softkeys	17
DCV Screen.....	18
Setup Menu	18
Setup Menu > Calibration.....	18
Setup Menu > Instrument Setup	19

Setup Menu > System Settings	22
Remote Port Setup	23
Setup Menu > Self Test and Diagnostics	24
Setup Menu > Languages	25
Setup Menu > About.....	25
Function Menu	25
Function Menu > Single Output	26
Function Menu > Dual Output (Not available on 5540A)	26
Function Menu > Measure.....	26
Reset the Calibrator	27
Zero the Calibrator.....	27
Operate and Standby Modes.....	27
Connect the Calibrator to a DUT	28
Recommended Cable and Connector Types	28
55XXA/DMMCAL Cable	28
When to Use EARTH and GUARD	29
Earth	29
External Guard	29
Four-Wire versus Two-Wire Connections	30
Four-Wire Connection	30
Two-Wire Compensation	30
Compensation Off.....	30
Cable Connections.....	30
RMS Versus p-p Amplitude	35
Set an Output	36
Function Menu Common Features and Functions	38
Auto Range Versus Locked Range.....	38
Guard Softkey	38
Sense Softkey	38
Select Waveforms	39
Adjust Phase - Output to Reference	39
Adjust Phase - Aux to Output.....	40
Sync Button.....	40
Comp Softkey	40
Reference Junction	41
Lows Softkey.....	41
Thermocouple Type	42
Single Output Menu.....	42
Set DC Voltage Output	42
Set AC Voltage Output.....	43
Enter a DC Offset	43
Set a Reference.....	44
Enter a Duty Cycle.....	44
Set DC Current Output.....	44
Set AC Current Output	45
Set Resistance Output	45

Set Capacitance Output.....	45
Set Inductance Output (Not Available on 5540A).....	46
Set Temperature Simulation (RTD) Source.....	46
Set TC Source	47
Dual Output Menu (Not available on 5540A)	47
Set DC Power Output	48
Set AC Power Output	48
Measure Menu	49
Measure Thermocouple Temperatures	49
Open TC Detect Softkey	49
Waveform Types	49
Sine Wave	50
Square Wave	50
Editing and Error Output Settings	51
Output Setting.....	51
Display the DUT Error.....	52
Multiply and Divide.....	53
Set Output Limits.....	53
Set Voltage and Current Limits	53
Synchronize the Calibrator Using 10 MHz IN/OUT	53
How to Use an External 10 MHz Clock.....	54
Sample Applications.....	54
Calibrate a 77 Series IV DMM	55
55XXA/DMMCAL Cable Assembly	55
Verification Procedure	56
Adjustment	58
Adjustment Procedure.....	58
Calibrate a Fluke 51 Thermometer	60
Verification Procedure	60
Calibrate the Thermometer	61
Maintenance.....	62
Clean the Product.....	63
Replace the Mains Power Fuse.....	63
Options and Accessories	65
Rack Mount Kit	66
IEEE-488 Interface Cable	66
RS-232 Null-Modem Cables	66
55XXA-525A/LEADS	66
Error Codes.....	67

Introduction

The 5560A/5550A/5540A Calibrators (the Product or the Calibrator) addresses a wide calibration workload that includes 6.5 digit bench Digital Multimeters (DMMs), and comes with internal and external features that protect it against damage and make it easier to transport for on-site or mobile calibration. The Product, shown in Figure 1, can also be fully automated with MET/CAL[®].

The Product is a fully-programmable precision source for:

- DC voltage from 0 V to ± 1020 V
- DC current from 0 A to ± 30.2 A
- AC voltage from 1 mV to 1020 V
- AC current from 10 μ A to 30.2 A
- AC waveforms include sine wave and square wave.
- Synthesized Resistance values from a short circuit to 1200 M Ω
- Synthesized Capacitance values from 220 pF to 120 mF
- Synthesized Inductance values from 12 μ H to 120 H (Inductance not available on 5540A).
- Simulated output for 10 types of Resistance Temperature Detectors (RTDs)
- Simulated output for 17 types of thermocouples
- Simulated power output (not available on 5540A)

Note

All images shown in this manual are the 5560A unless noted otherwise.



Figure 1. 5560A Calibrator

Product features include:

- Automatic meter error calculation, with user-selectable reference values.
- **x** (Multiply) and **÷** (Divide) that change the output value by multiples of ten or to pre-determined cardinal values for various functions, including standard oscilloscope timebase and gain steps.
- Programmable entry limits that prevent the operator from entering values that exceed preset output limits.
- Simultaneous output of voltage and current, simulating power up to 30.9 kW (not available on 5540A).
- 10 MHz sync pulse reference input and output. Use this to input a high-accuracy 10 MHz reference to transfer the frequency accuracy to the Calibrator, and/or to synchronize one or more additional Calibrators to a primary 5560A/5550A/5540A.
- Simultaneous output of two voltages.
- Extended bandwidth mode outputs multiple waveforms down to 0.01 Hz, and sine waves to 2 MHz.
- Variable output between 10 MHz reference input and primary OUTPUT, and between voltage and current outputs.
- Standard IEEE-488 (GPIB) interface, complying with ANSI/IEEE Standards 488.1-1987 and 488.2-1987.
- EIA Standard RS-232 serial data interface for Calibrator remote control.
- Universal Serial Bus (USB) 2.0 high-speed interface device port for remote control of the Product using USBTMC.
- Integrated 10/100/1000BASE-T Ethernet port for network connection remote control of the Product.
- USB Host port to save calibration reports to a flash drive and to provide firmware updates.
- Visual Connection Management input terminals illuminate to help show correct cable connection configurations.
- Soft Power - automatic selection of line voltage/frequency.
- WVGA display with touch-screen and keypad control.

Contact Fluke Calibration

Fluke Corporation operates worldwide. For local contact information, go to our website:

www.flukecal.com

To register your product, view, print, or download the latest manual or manual supplement, go to our website.

Fluke Corporation
P.O. Box 9090
Everett, WA 98206-9090

+1-425-446-5500

info@flukecal.com

Safety Information

A **Warning** identifies conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

General Safety Information is located in the printed *5560A/5550A/5540A Safety Information* document that ships with the Product. It can also be found online at www.flukecal.com. More specific safety information is listed in this manual where applicable.

Specifications

Safety Specifications are located in the Safety Specifications section of the *5560A/5550A/5540A Safety Information* manual. Complete specifications are at www.flukecal.com. See the *5560A Product Specifications*, *5560A Product Specifications*, or *5540A Product Specifications*.

Service Information

Contact an authorized Fluke Calibration Service Center if the Product needs calibration or repair during the warranty period. See *Unpack and Inspect*. Please have Product information such as the purchase date and serial number ready when you schedule a repair.

Operation Overview

Operate the Product from the front panel in the local mode, or remotely with the IEEE-488, RS-232, USBTMC, or LAN ports. For remote operations, see the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com. Several software options are available to integrate product operation into a wide variety of calibration requirements.

Local Operation

Typical local operations include front-panel connections to the Device Under Test (DUT), and then manual keystroke and touch-screen entries from the front panel that place the Product in the necessary output mode.

Remote Operation (GPIB)

The Product rear-panel GPIB port is a fully-programmable parallel interface bus meeting the GPIB (IEEE-488.1) standard and supplemental IEEE-488.2 standard. Under the remote control of an instrument controller, the Product operates exclusively as a *talker/listener*. Use the IEEE-488 command set or run MET/CAL software (optional) to write your own programs. See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for a discussion of the commands available for IEEE-488 operation.

Remote Operation (RS-232)

The rear panel RS-232 port is dedicated to serial data communications to operate and control the Product during calibration procedures complying with the supplemental IEEE-488.2 standard.

The RS-232 serial data port connects a host terminal or personal computer (PC) to the Product. See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for a discussion of the RS-232 commands.

Remote Operation (USBTMC)

The Product rear-panel USB 2.0 type B port is a fully-programmable USBTMC interface that meets the USBTMC-USB488 interface standard and supplemental IEEE-488.2 standard. Use the USBTMC command set. See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for a discussion of the commands available for USBTMC operation.

Remote Operation (Ethernet)

The Product rear-panel Integrated 10/100/1000BASE-T Ethernet port is for network connection remote control of the Calibrator and complies with supplemental IEEE-488.2 standard. The Ethernet port connects a host PC to the Product. To send commands to the Product, enter commands from a telnet session running on the host computer. See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for a discussion of the Ethernet commands available for Ethernet operation.

Prepare the Product for Operation

This section provides instructions to unpack and install the Calibrator and connect to line power. Instructions for cable connections other than line power can be found here:

- DUT connections: See [Front Panel Operation](#)

For remote operation, and these topics, see the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com:

- IEEE-488 parallel interface connection
- RS-232C serial interface connection
- LAN Interface Connections
- USB 2.0 Interface Connections

Unpack and Inspect

Inspect the Product for damage and immediately report any damage to the shipper. Instructions for inspection and claims are included in the shipping container.

Check the shipping container for all the standard equipment listed in Table 1 and check the shipping order for any additional items ordered.

Table 1. Standard Equipment

Item	Model or Part Number
Calibrator	5560A/5550A/5540A
Line Power Cord	See Table 3.
Lead Set ^[1]	55XXA/LEADS SET
Transit Case	55XXA/CASE, TRANSIT CASE
<i>5560A/5550A/5540A Safety Information</i>	5037050
<i>5560A/5550A/5540A Operators Manual</i>	See the Fluke Calibration website.
<i>5560A Specifications</i>	See the Fluke Calibration website.
<i>5550A Specifications</i>	See the Fluke Calibration website.
<i>5540A Specifications</i>	See the Fluke Calibration website.
<p>[1] 55XXA/LEADS SET - Contains:</p> <p>Stackable Test Leads</p> <p>Rated Voltage: 30 V ac or 60 V dc, max non-contact use</p> <p>Rated Current: 30 A, max</p> <p>Shielded Calibration Test Leads</p> <p>Rated Voltage: 1000 V, max. For calibration use only, max transient 1500 V pk. Non-contact use</p> <p>Rated Current: 3.2 A, max</p> <p>High Current Test Leads</p> <p>Rated Voltage: 30 V ac or 60 V dc, max non-contact use</p> <p>Rated Current: 30 A, max</p> <p>Thermocouple Extension</p> <p>Thermocouple Extension, 3 ft, J (brown wire, black connectors)</p> <p>Thermocouple Extension, 3 ft, K (brown wire, yellow connectors)</p> <p>Thermocouple Extension, 3 ft, CU (white wire, white connectors)</p> <p>Thermocouple Assembly, K-Type, Beaded, Molded-Plug</p> <p>Thermocouple Set, J Assembly with extensions</p> <p>Thermocouple Short, Plug, Thermocouple, Shorted, Cu-Cu, White</p> <p>K - Type Thermocouple Adapter - Fluke</p>	

Table 2. Optional Calibration Accessories

Item	Model	Part Number
Thermocouple and test leads set	55XXA-525/ LEADS SET	5128204
1, 2, and 10-Turn Current Coil	55XXA/COIL 10	5128219
50-Turn Current Coil	55XXA/COIL 50	5128228
DMM Autocal Adapter	55XXA/ DMMCAL	5128237
Portability kit for on site calibrations	55XXA/ PORTKIT	5128243
Transit Case	55XXA/CASE, TRANSIT CASE	5128255

Mains Voltage Selection

The Calibrator automatically detects the mains line voltage when you push the soft power switch (Table 4, 20) and configures itself to work at that voltage level. Nominal mains voltages that range from 100 Vrms to 120 Vrms and from 220 Vrms to 240 Vrms ($\pm 10\%$) are acceptable, with frequencies from 47 Hz to 63 Hz.

Connect to Line Power

⚠⚠ Warning

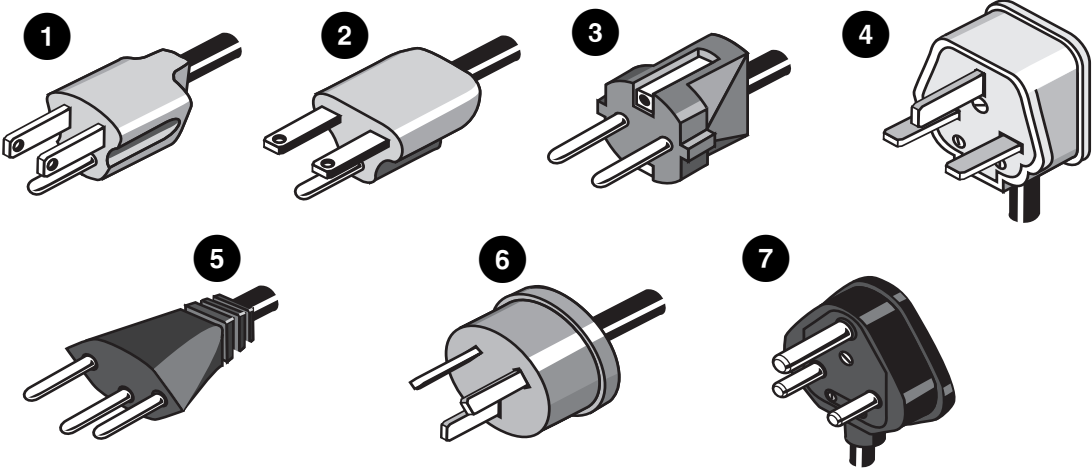
To prevent possible electrical shock, fire, or personal injury:

- **Connect an approved three-conductor mains power cord to a grounded power outlet.**
- **Make sure that the Product is grounded before use.**
- **Do not use an extension cord or adapter plug.**

The Product comes with the appropriate line power plug for the country of purchase. If you need a different type, see Table 3 For the line power plug types available from Fluke Calibration.

After you verify that the correct fuse for that line voltage is installed, connect the Product to a properly grounded three-prong outlet.

Table 3. Line Power Cord Types Available from Fluke Calibration

			
Number	Type	Voltage/Current	Fluke Option Number
1	North America	120 V/15 A	LC-1
2	North America	240 V/15 A	LC-2
3	Universal Euro	220 V/15 A	LC-3
4	United Kingdom	240 V/13 A	LC-4
5	Switzerland	220 V/10 A	LC-5
6	Australia	240 V/10 A	LC-6
7	South Africa	240 V/5 A	LC-7

Overload Protection

The Product provides reverse-power protection and fast output disconnection.

Reverse-power protection prevents damage to the Product from occasional, accidental, normal-mode and common-mode overloads to a maximum of ± 300 V peak. It is not intended as protection against frequent (systematic and repeated) abuse. Such abuse will cause the Product to fail.

For volts, ohms, capacitance, inductance, and thermocouple functions, there is fast output disconnection protection. This protection senses applied voltages >20 V on the output terminals. It quickly disconnects the internal circuits from the output terminals and places the Product into standby when such overloads occur.

Placement and Rack Mounting

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, do not restrict access to the Product mains power cord. The mains power cord is the mains disconnecting device. If access to the power cord is inhibited by rack mounting, a properly-rated accessible mains disconnect switch must be provided within reach as part of the installation.

Place the Product on a bench top or mount it in a standard-width, 24-inch (61-cm) deep equipment rack. For bench-top use, the Product is equipped with non-slipping, non-marring feet. To mount the Product in an equipment rack, use the 5560A/5550A/5540A Rack Mount Kit (Y5538). The kit includes mounting instructions and hardware.

Cooling Considerations

⚠ Caution

To prevent damage to the Product, make sure the space around the Product meets minimum requirements listed below.

The accuracy and dependability of all internal parts of the Product are enhanced by maintaining the coolest possible internal temperature. Lengthen the life of the Product and enhance its performance by observing these rules:

- Keep the vents on the Product clear of obstructions (3 inches from nearby walls or rack enclosures). The fan draws in air from the left side of the Product.
- The exhaust perforations on the right side of the Product must be clear of obstructions.
- The air that enters the Product must be at room temperature: make sure the exhaust air from another instrument is not directed into the fan inlet.

Calibration Security Passcode

The integrity of Product calibration is protected by a security passcode that must be entered before new calibration constants can be saved to non-volatile memory. This passcode replaces the hardware calibration switches found on older calibrators such as the Fluke 5522A. As with the 5522A, the passcode also protects the ability to set the date for the internal real-time clock.

If the passcode is not entered, the Product is secured. Once the passcode is entered, the Product is unsecured. The Product secures itself when it is reset or when the setup menus are closed. The Product can be unsecured at any time over the remote interface with the CAL_SECURE command and by entering the passcode.

The passcode contains 1 to 8 decimal digits. The Product ships with the passcode set to the serial number of the Product. If connected to a network, Fluke Calibration highly recommends that you change the passcode from this default. To change the passcode, select **Setup > Calibration > Change Passcode**. The Product prompts for the current passcode and then the new passcode. The passcode can also be changed over the remote interface with the CAL_PASSWD command.

Make sure to save your passcode in a safe location. If you lose the passcode, the Product will need to be serviced at Fluke Calibration. See [Contact Fluke Calibration](#).

Features

This section is a reference for the functions and locations of the Calibrator's front and rear-panel features. Read this information before you operate the Calibrator. Front-panel operating instructions for the Calibrator are in [Front Panel Operation](#). Remote operating instructions are provided in the 5560A/5550A/5540A Remote Programmers Manual at www.flukecal.com.

The front panel features Visual Connection Management Terminals. When you push **ENTER**, after entering a value, the appropriate terminals illuminate, whether in Standby mode (Standby) or Operate mode (Operate). The terminals offer visual guidance for proper cable connections for specific functions, protect the user by indicating which terminals are active, and protect the Calibrator from damage from incorrect connections.

Front-Panel Features

Front-panel features (including all controls, the Display, indicators, and terminals) are shown and described in Table 4.

Table 4. Front-Panel Features

Number	Description
1	VI AUX (3.1 A Current OUTPUT) terminal ^[1] - This terminal is the source of current output when ≤ 3.1 A is selected.
2	OUTPUT LO terminal ^[1] ^[2]
3	Volts/Impedance (VZ) OUTPUT HI terminal ^[1] -Terminal for ac and dc voltage, resistance, capacitance and inductance sourcing, and Resistance Temperature Detector (RTD) simulation.
4	Volts/Impedance (VZ) SENSE HI terminal ^[1] - In voltage functions, or 2-wire / 4-wire compensation in impedance functions, use the Volts/Impedance (VZ) SENSE terminals to sense at the DUT. Use external sensing in the voltage functions when the DUT draws enough current to produce a significant voltage drop in the cables, and in the impedance functions when the DUT has a four-wire input. External sensing is also used for two-wire compensation in impedance functions to allow compensation to the DUT terminals.
5	SENSE LO terminal ^[1] ^[2]
6	30A terminal ^[1] - The 30 A terminal is the source of current output when the 30 A range is selected (>3.1 A to 30.2 A).

Table 4. Front-Panel Features (cont.)

Number	Description
7	OPERATE and STANDBY indicators located above the output terminals. The OPERATE indicator illuminates when the output value and function shown on the Display are active at the selected terminals. The STANDBY indicator located above the output terminals illuminates when the output value and function shown on the Display are not active at the illuminated terminals.
8	HIGH VOLTAGE indicator illuminates when there is high voltage (>30 V) present at the output terminals.
9	GUARD terminal ^[1] The GUARD terminal is always connected internally to the internal guard shield. This shield is tied to the OUTPUT LO signal ground inside the Calibrator unless External Guard is selected. See External Guard .
10	Earth Ground terminal - The EARTH terminal is always connected to the chassis ground.
11	The color touch-sensitive Display shows the output amplitude, frequency, and other active conditions and messages. The Display provides controls not available with the keys alone. The Calibrator interface is made up of multiple menus, selectable choices, and blue softkeys (at the bottom of the Display).
12	<p>Push OPERATE to place the Product in Operate. Operate is indicated by the OPERATE indicator (7) and also on the Display.</p> <p style="text-align: center;">⚠⚠ Warning</p> <p>To prevent possible electrical shock, fire, or personal injury, take care while the Product is in Operate. The terminals can have voltages present that could cause injury or death.</p>
13	Push STANDBY to place the Product in Standby. Standby is indicated by the STANDBY indicator (7) and also on the Display.
14	Use the Numeric keypad to enter the digits of the output amplitude and frequency.
15	Use a Metric Prefix key (if necessary) and an Output Units key to select the output function of the Product.
16	Push ENTER to load the output settings that were entered with the Numeric and Output Units keys. If you push ENTER without identifying the units for the entry, in Single Output functions the Product assumes the primary unit of the presently-displayed function. In Error (edit) mode, ENTER restores the output to the value of the reference.
17	Push Bksp (Back Space) to delete and re-enter a numerical entry.

Table 4. Front-Panel Features (cont.)

Number	Description
18	Push CE (Clear Entry) to delete a partially-completed keypad entry from the Display.
19	Push Reset to abort the current operating state of the Product. This returns the Product to the power-up default state.
20	Push ⏻ (lighted Soft-Power switch) to turn the Product power on and off.
21	Push x (multiplier key) to change the output to 10X the reference value (not necessarily the present output value) if the value is within performance limits. This key puts the Calibrator into Standby if the change is from ≤ 30 V to > 30 V. In some Scope functions, x changes the output to the next higher step in the sequence.
22	Push ÷ (divide key) to change the output to 1/10th reference value (not necessarily the present output value) if the value is within performance limits. In some Scope functions, ÷ changes the output to the next lower step in the sequence.
23	Push ↔ , ← , → (selection keys) to select an output signal or a specific digit. The keys allow you to adjust the magnitude of changes by moving the highlighted digit. ↔ changes the selection between the main values on the Display. In practice, for voltage and current outputs, these keys (with the Edit knob) adjust the output until the DUT reads correctly. The Display then shows the DUT deviation from the reference.
24	Turn the Edit knob clockwise to increase the output value of the active-edit digit. Turn the Edit knob counterclockwise to decrease the output value of the active-edit digit. If a digit rolls past 0 or 9, the digit to it's left or right is carried. For some values, a relative error appears on the Display that shows the difference between the original (reference) output and the new output.
25	Use the front-panel (and rear-panel) USB host ports to save Calibration report data to a flash drive or to update Product firmware.
26	SCOPE OUT (Oscilloscope) Type N connector is used for outputs during oscilloscope calibration. This is active only when an oscilloscope calibration option is installed.
27	TRIG (Scope Trigger) BNC connector is used to trigger the oscilloscope during oscilloscope calibration. This is active only when an oscilloscope option is installed.
28	TC (Thermocouple) connector is for thermocouple temperature sourcing and measurement. This connector accepts standard TC plugs, miniature TC plugs, and bare wires.
<p>[1] Visual Connection Management Terminals. The appropriate terminals light up in green or blue when you push ENTER, whether in Standby or Operate. The terminals offer visual guidance for cable connections for specific functions, protect the user by indicating which terminals are active, and help to protect the Product from damage from incorrect connections.</p> <p>[2] The low terminal for current outputs changes from out low to sense low when changing from single output to simulated power (dual output).</p>	

The Display

A sample display is shown in Table 5. Note that this is only an example for reference. The Display changes and allows access to different portions of the user interface, depending upon what function the Calibrator is in.

Note

AC Power and other dual outputs are not available on the 5540A. These items are noted throughout this manual.

Table 5. Sample Display

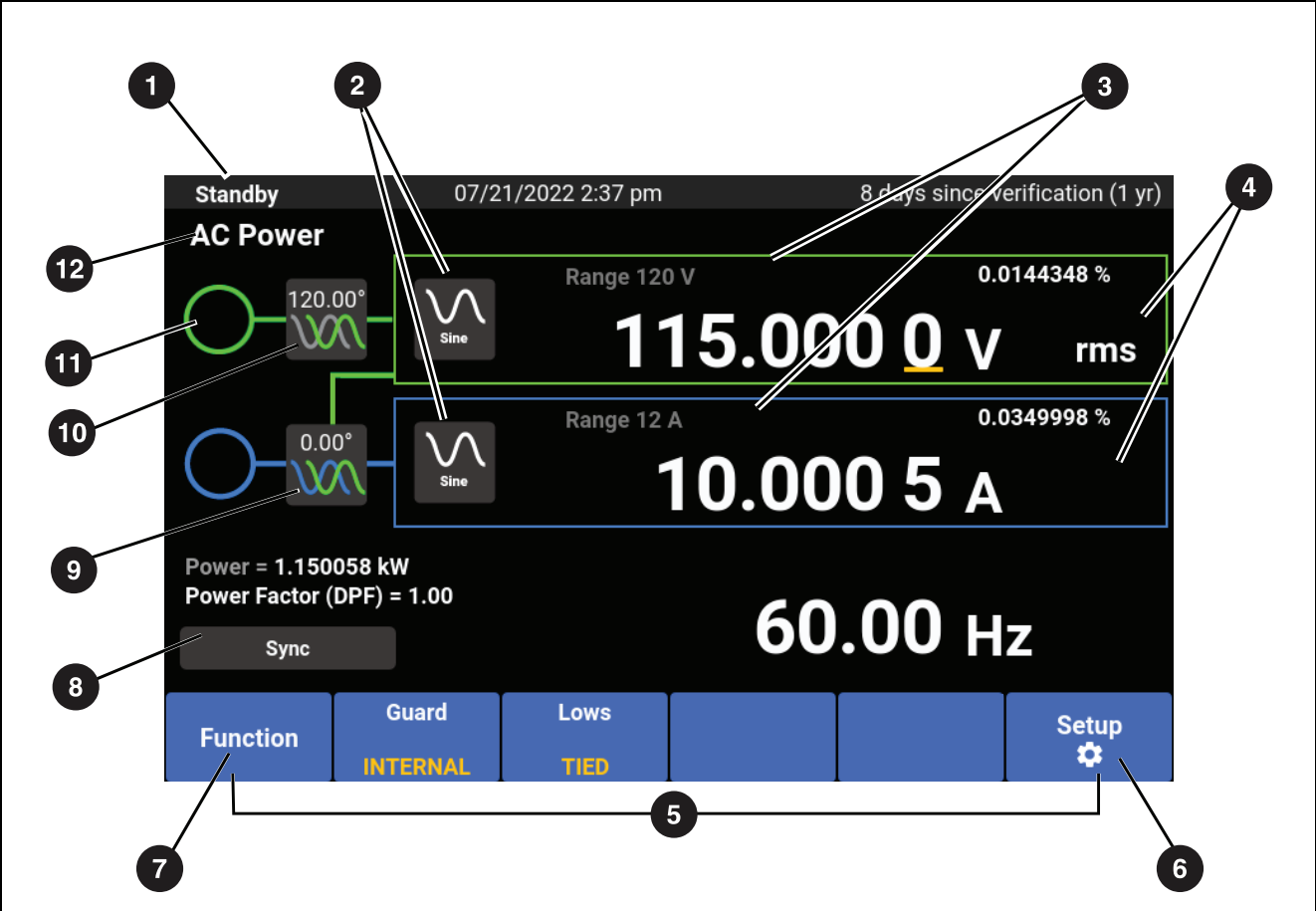
	
Number	Description
1	Operate / Standby indicator.
2	Select waveform buttons. Push to open the Select Waveform. In some functions, buttons in this location open the Select RTD or Select Thermocouple panels.

Table 5. Sample Display (cont.)

Number	Description
3	Range Lock toggle. Not available in all functions.
4	Pk-pk and rms indicator
5	See Softkeys .
6	See Setup Menu .
7	See Function Menu .
8	Multi-Unit Phase Synchronization button sends a sync pulse from the primary Calibrator in a system with 2 or more Calibrators.
9	Adjust Phase - Aux to Output button. Push to open the Adjust Phase panel and adjust the phase between Voltage and Current for AC Power functions.
10	Phase - Output to Reference button. Push to open the Adjust Phase panel and adjust the phase between the OUTPUT signal and the 10 MHz reference.
11	Hazardous voltage indicator. Illuminates when the output is programmed to a value >30 V rms.
12	Selected Function button. Push to open the Function Menu. See Function Menu .

Rear-Panel Features

Rear-panel features (including all terminals, sockets, and connectors) are shown in Table 6.

Table 6. Rear-panel Features

Number	Description
1	<p>⚠⚠ Warning</p> <p>To avoid shock hazard, connect the factory-supplied three-conductor line power cord to a properly grounded power outlet. Do not use a two-conductor adapter or extension cord; this will break the protective ground connection.</p> <p>The AC Power Input Module provides a grounded three-prong connector that accepts the line power cord, a switch mechanism to select the operating line voltage, and a mains-power fuse. See Mains Voltage Selection.</p>
2	The Rear AC Power Switch must be in the ON (I) position before the Soft-Power button on the front-panel will function.
3	Mains Power Fuse. See Replace the Mains Power Fuse for fuse rating information.
4	The CHASSIS GROUND post is internally grounded to the chassis. If the Calibrator is the ground reference point in a system, this binding post can be used to connect other instruments to earth ground. See Connect the Calibrator to a DUT for details.
5	Transformer Cover

Table 6. Rear-panel Features (cont.)

Number	Description
6	For future external amplifier control.
7	The 10 MHz OUT BNC connector passes the internal or external 10 MHz clock signal to another 5560A/5550A/5540A to synchronize one or more secondary product to a primary product.
8	The 10 MHz IN BNC connector applies an optional external clock signal to the Calibrator. This replaces the normal internal 10 MHz clock signal in the Calibrator. Frequency accuracy of the Calibrator is governed by the frequency accuracy of the clock signal internal or external. This connector is also used to connect the Calibrator as a secondary unit to another calibrator. This connection is used for multi-phase power calibration with multiple calibrators.
9	A male (DTE) RS-232 Serial Port connector for remote control of the Calibrator. See the <i>5560A/5550A/5540A Remote Programmers Manual</i> at www.flukecal.com for proper cabling, remote programming instructions, how to set up the serial interface and connect to it.
10	The IEEE-488 connector is a standard parallel interface to operate the Calibrator in remote control as a Talker/Listener on the IEEE-488 bus. See the <i>5560A/5550A/5540A Remote Programmers Manual</i> at www.flukecal.com for bus connection and remote programming instructions.
11	LAN 10/100/1000 Base/T Ethernet connector for remote control of the Calibrator. See the <i>5560A/5550A/5540A Remote Programmers Manual</i> at www.flukecal.com for proper cabling instructions and how to set up the interface, and how to transmit data from the Calibrator. The section also describes how to use the Ethernet interface for remote control.
12	USB Control Device is a Remote port for remote control of the Calibrator. See the <i>5560A/5550A/5540A Remote Programmers Manual</i> at www.flukecal.com for instructions to connect to the USBTMC interface and for remote programming instructions.
13	USB Host ports use the rear-panel (and front-panel) USB ports to save Calibration report data to a flash drive. These ports are also used to update the Product firmware.
14	Installed options list.

Front Panel Operation

Warning


The Calibrator is capable of supplying lethal voltages. To avoid shock hazard, do not make connections to the output terminals when any voltage is present. Placing the Product in Standby may not be enough to avoid shock hazard, since **OPERATE** could be pushed accidentally. Push **Reset** and verify that the Calibrator is in Standby before making connections to the output terminals.

This section explains how to operate the Calibrator from the front panel. For a description of front-panel controls, the Display, and terminals, see [Features](#).

Turn on the Calibrator

Warning

To prevent possible electrical shock, fire, or personal injury, make sure that the Product is grounded before use.

Prior to powering up the Calibrator, make sure that the rear mains power switch is in the I (ON) position and the Soft Power button is illuminated. Now push the front Soft Power button (). The Calibrator turns on.

When the Calibrator is powered on, it completes a self-test routine. If the self test fails, the Display identifies an error code. For a description of error codes, see [Maintenance](#). After the self test, the DCV function is on screen. When you push **Reset**, the Product returns to this screen.

Warm up the Calibrator

When you turn on the Calibrator, allow a warm-up period of at least 30 minutes for the internal components to stabilize. This ensures that the Calibrator meets or exceeds its specifications.

If you turn the Calibrator off after warm-up and then on again, allow a warm-up period of at least twice the length of time it was turned off (maximum of 30 minutes). For example, if the Calibrator is turned off for 10 minutes and then on again, allow a warm-up period of at least 20 minutes.

Menus

The Product user interface features keys, the knob on the right of the front panel, and the menus, buttons, and softkeys on the Display. A sample Display is briefly explained in Table 4. The Display contains the menu system where the Product settings are viewed, changed, and stored.

Softkeys

At the bottom of the screens for each function are blue softkeys. As with other Fluke Calibration products, the softkey options change depending on which function is active on the Display. The softkeys are only visible while in a function. They are not visible while in a menu.

The screens and menus are explained in the subsequent sections.

DCV Screen

The DCV (dc volts) screen is the first screen shown after the Product is powered on. This screen shows the dc voltage that is currently entered into the Product. When you first turn on the Product, the output defaults to 0 mV dc, Standby, 120 mV range. The DCV screen has these different softkeys:

- Function (see [Function Menu](#))
- Guard (see [Guard Softkey](#))
- Sense (inactive when EXTERNAL is not available) (see [Sense Softkey](#))
- Setup (see [Setup Menu](#))

Setup Menu

The initial Product setup establishes the default configuration going forward. The Setup Menu (**Setup**) is a multi-layer set of menus and screens used to set the parameters of the Product. The Setup Menu is made up of these submenus:

- Calibration
- Instrument Setup
- System Settings
- Self Test and Diagnostics
- Languages
- About

These submenus are explained in the subsequent sections.

Note

Some Setup Menu items must be manually adjusted.

To select or make changes to individual menu items:

1. Tap the menu item.
2. Select the menu choice.
3. Tap **x** under the submenu list to close the menu.

Some of the menu choices use sliders to change parameter. Touch and slide the slider to move the scroll bar to the left or right. Some of the menus use scrollbars. Touch and slide up or down to move the scrollbar.

Setup Menu > Calibration

The **Calibration** menu (**Setup Menu > Calibration**) is the first choice of the list of submenus shown on the left of the Setup Menu.

The Calibration menu includes:

- Ambient Temperature
- Ambient Humidity
- Zero Adjustment
- 5560A/5550A/5540A Adjustment
- Ω - Zero Adjustment
- Scope Adjustment (inactive when no scope option installed)
- Set Verification Date/Temp
- Change Passcode (see [Calibration Security Passcode](#))

Setup Menu > Instrument Setup

The **Instrument Setup** menu (**Setup Menu > Instrument Setup**) is the second choice of the list of submenus shown on the left of the Setup Menu. Parameters are nonvolatile and remain set after you reset the Product or when the Product power is turned on.

Note

There is a scrollbar on the right of the screen. Place your finger anywhere on the active section of the display and drag your finger to move the screen content.

The Instrument Setup menu includes:

- **Output Limits**
 - Set or view the upper and lower ac and dc voltage and terminal current limits.
 - Restore Limit Defaults
- **Defaults**
 - Set or view the Product defaults

The Product Setup Choices are in Table 7.

Table 7. Product Setup Choices

Parameter	Setting Choices
Thermocouple Type ^[1]	A1 (BP, A), B, C, D, E, G, J, K, L, N, R, S, T, U, XK, J, N, T, 10 μ V/ $^{\circ}$ C, 1mV/ $^{\circ}$ C
RTD Type ^[1]	Pt 100 (3926), Pt 100 (3916), Pt 100 (385), Pt 200 (385), Pt 500 (385), Pt 1000 (385), Ni120 (672), Cu10 (427), Cu50 (428), Cu100 (428)
Temperature Unit ^[1]	$^{\circ}$ C/ $^{\circ}$ F
Temperature Scale ^[1]	ITS-90, IPTS-68
dBm Reference ^[1]	50,100, 300,1k(dBv), 75,135, 600,1200, 90,150, 900
Verification Interval	90 Day, 1 Year, 2 Year
Confidence Level	95%, 99%
Error Reference	Nominal Value, True Value
Reference Clock	Internal, External
Multi-Unit Phase Synchronization Button	Show, Hide
Error Unit	Scientific Notation, Percent, Parts Per Million (x 10-6): when <10 PPM, <100 PPM, <1000 PPM
Reference Phase Default ^[1]	-180.0 to 180.0
Scope Overload Default	1.0 to 60.0 seconds
Show Secondary Specifications	Show or Hide
Restore Factory Defaults	-

[1] Changes to these default values does not affect the current active setting until you Reset, Power Cycle, or re-select the function through the function menu.

The Product Setup defaults are in Table 8.

Table 8. Product Default Values

Parameter	Default Value
Display Brightness	50
LED Brightness	50
Show Sync Button	true
Show Specifications	true
Time Format	HOUR12
Date Format	MDY
Passcode	5560
Report String	5560 hello world
Verification Date	1970-01-01,00:00:00
Zero Adjust Date	1970-01-01,00:00:00
Mains Adjust Date	1970-01-01,00:00:00
Scope Adjust Date	1970-01-01,00:00:00
Unsecured Date	1970-01-01,00:00:00
Serial Number	00000000
PUD String	5560A
Calibration Count	0
Calibration Interval	11Y
Confidence Level	C95
Current Max	30.2
Current Min	-30.2
dBm Reference	Z600
Degree Default	CELSIUS
Error Reference	NOMINAL
Specification Unit	PERCENT
GPIB Address	4
GPIB Enabled	true
Language	ENGLISH
RS232 Baud Rate	BX9600
RS232 Data Bits	DBIT8
RS232 Enabled	true

Table 8. Product Default Values (cont.)

Parameter	Default Value
RS232 EOL Char	CRLF
RS232 Flow Control	xon_xoff
RS232 Interface	TERM
RS232 Parity	none
RS232 Stop Bits	SBIT1
RTD Default	PT385
Tsense Type	TC
TC Default	K
Telnet Enabled	true
Telnet Port	3490
Telnet EOL Char	CRLF
Telnet Interface	TERM
Temperature Scale Default	ITS90
USBTMC Enabled	true
Voltage Max	1020.0
Voltage Min	-1020.0
Error Unit	SCI
Reference Clock Default	INT
Reference Phase Default	0.0
Scope Overload Limit Default	10.0
Overload Time Limit	10
Scope Option Type	NONE
Scope Option Detected	false
Diagnostic Fault Action	HALT
Telnet MAC Address	0.0.0.0
Telnet IP Address	0.0.0.0
Telnett Static IP	0.0.0.0

Table 8. Product Default Values (cont.)

Parameter	Default Value
Telnet Netmask	255.255.255.0
Telnet Gateway	0
Telnet Static Gateway	0.0.0.0
Telnet DHCP	true
In Remote	false
In Lockout	false
Calibrator On Time	0.0
Internal Verification Temp	0.0
User Entered Verification Temp	23.0

Setup Menu > System Settings

The **System Settings** menu (**Setup Menu > System Settings**) is the third choice of the list of submenus on the left of the Setup Menu. Some of these settings require the Product passcode. See [Calibration Security Passcode](#). The System Settings are in Table 9.

Table 9. System Settings

Parameter	Setting Choices
Date/Time	<p><i>Note</i></p> <p><i>The Product needs to be unlocked to change the date.</i></p> <p>Date Format: MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD</p> <p>Date</p> <p>Time Format: 12, 24</p> <p>Time</p> <p>Restore Date / Time Defaults</p>
Display Controls	<p>The Display Controls button accesses the slide-out menu for Screen Brightness, LED Brightness, and a Restore Display Defaults Reset button.</p> <p>Screen Brightness: 0% to 100%, LED Brightness: 0% to 100%</p>
Remote Port Setup	<p>USB, Ethernet, GPIB, RS-232 (See Remote Port Setup)</p>

Remote Port Setup

Use the **Remote Port Setup** menu (inside the System Settings menu) to enable or disable USBTMC, GPIB, Ethernet, and RS-232 ports by toggling a green/white switch. Tapping the individual port buttons provides additional options and information. See the 5560A/5550A/5540A *Remote Programmers Manual* at www.flukecal.com.

The menu is:

- **USB**

This has USBTMC information:

- USB0::0x0F7E::0x800A::[serial number]::INSTR

Where:

- 0x0F7E: The Fluke vendor ID
- 0x800A: The Product ID number
- [serial number]: The serial number of the Product (the serial number is also on the rear panel) or available using the *IDN? on one of the other remote interfaces. You can also find it with the **Setup > About** menu.
- Restore USB Defaults with the **Reset** button.

- **Ethernet**

- DHCP (On or Off)
- Static IP Settings (IP Address, Gateway, Subnet Mask)
- MAC Address
- Port
- End of Line Character (CR/LF, CR, LF)
- Remote Interface (Terminal, Computer)
- Network Security Settings (Starting Address, Ending Address)
- Restore Ethernet Defaults

- **GPIB**

- GPIB Address
- Restore GPIB Defaults

- **RS-232**

- Data Bits (8, 7)
- Stop Bits (1, 2)
- Flow Control (None, RTS/CTS, XON/XOFF)
- Parity (None, Even, Odd)
- Baud Rate (9600, 19200, 38400, 57600, 115200)
- End of Line Character (CR/LF, CR, LF)
- Remote Interface (Terminal, Computer)
- Restore RS-232 Defaults

Setup Menu > Self Test and Diagnostics

The **Self Test and Diagnostics** menu (**Setup Menu > Self Test and Diagnostics**) is the fourth choice of the list of submenus on the left of the Setup Menu. The Self Test and Diagnostics menu includes:

- **Touch Screen Test**

Test the touch interaction with the Display and visually confirm the functionality.

- **Key/Bell/Knob Tests**

- Key Test
- Knob Test
- Beeper Test

Test each of the front-panel keys, the rotary knob, and the beeper.

- **Diagnostics**

Run checks on the Calibrator functions. Follow on-screen instructions to run Diagnostics.

- **LED Test**

To run the test:

1. Tap the Run button.
2. Tap Next to visually confirm each set of LEDs on the front terminal lights up matching the on-screen representation. You may exit this test at any time.

- **Color Test**

This is an automatic test the goes through a range of colors and when finished, goes back to the main Self Test and Diagnostic screen.

- **Diagnostic Fault Action**

- Halt
- Continue
- Abort

Select the desired Product response to errors that are encountered during Diagnostics.

Once started, Diagnostics may be aborted at any time. If you select the Diagnostic Fault Action of **Halt**, a **Continue** button appears when an error is encountered. This allows Diagnostics to either be aborted or continued. If you select **Continue** as the default action, errors will not display until Diagnostics are complete. A Diagnostic Fault Action of **Abort** results in Diagnostics aborting when an error is encountered.

Setup Menu > Languages

The **Languages** menu (**Setup Menu > Languages**) is the fifth choice of the list of submenus on the left of the Setup Menu. This menu changes the Display menus and controls to different languages. A flag indicates the current language selection.

Available language selections are:

- **English**
- **Español** (Spanish)
- **Português** (Portuguese)
- **Deutsch** (German)
- **Français** (French)
- **Русский** (Russian)
- 日本語 (Japanese)
- 简体中文 (Simplified Chinese)
- 한국어 (Korean)

Setup Menu > About

The **About** menu (**Setup Menu > About**) is the sixth choice of the list of submenus on the left of the Setup Menu. This menu shows:

- Serial Number
- Build Date
- Main SW Version
- Inguard SW Version
- Kernal Build Version
- License Files (**Previous** and **Next** buttons allow you to step through the license files). Push **Exit** to return to the Setup Menu.

Function Menu

This section is a brief list of the four main Function menus. For more of an explanation of these menus and their submenus, see these sections:

- [*Single Output Menu*](#)
- [*Dual Output Menu \(Not available on 5540A\)*](#)
- [*Measure Menu*](#)
- Scope (future option)

Function Menu > Single Output

The **Single Output** menu (**Function Menu > Single Output**) offers the choices shown in Table 10. Single Output menu functions are explained in their respective sections.

Table 10. Single Output Menu Functions

Menu Item	See Section
DCV	Set DC Voltage Output
ACV	Set AC Voltage Output
DCI	Set DC Current Output
ACI	Set AC Current Output
Resistance	Set Resistance Output
Capacitance	Set Capacitance Output
Inductance	Set Inductance Output (Not Available on 5540A)
RTD Source	Set Temperature Simulation (RTD) Source
TC Source	Set TC Source

Function Menu > Dual Output (Not available on 5540A)

The **Dual Output** menu (**Function Menu > Dual Output**) offers the choices shown in Table 11. Dual Output menu functions are explained in their respective sections.

Table 11. Dual Output Menu Functions

Menu Item	See Section
DC Power	Set DC Power Output
AC Power	Set AC Power Output

Function Menu > Measure

The **Measure** menu (**Function Menu > Measure**) consists of just the TC Measure function. See [Measure Thermocouple Temperatures](#).

Reset the Calibrator

At any time during front panel operation (except during remote operation), you can push **Reset** to return the Calibrator to the power-up state: 0 mV dc, Standby, 120 mV range, all volatile values set to their most recent default values.

Zero the Calibrator

Zeroing adjusts internal circuitry, most notably dc offsets in all ranges of operation. To meet the specifications, zeroing is required every seven days, or when the Calibrator ambient temperature changes by more than 5 °C. The Display shows a message when it is time to zero the Calibrator. Zeroing is particularly important when the calibration workload has 1 mW or 1 mV resolution, and when there has been a significant temperature change in the Calibrator work environment.

To zero the Calibrator:

1. Turn on the Calibrator and allow a warm-up period of at least 30 minutes.
2. Tap the **Setup** softkey to open the Setup Menu.
3. Under **Zero Adjustment**, tap the **Run** button to open the calibration activity menu.
4. Push **Continue** as needed to step through the Zero Adjustment process. Push **Abort** to exit this function.

Operate and Standby Modes

When the **OPERATE** annunciator is lit and **Operate** shows on the Display, the output value and function shown on the Display are **active** at the selected terminals. When the **STANDBY** annunciator is lit and **Standby** is shown on the Display, the output value and function shown on the Display are **inactive** at the selected terminals. To enable Operate, push **OPERATE**. To place the Calibrator in Standby, push **STANDBY**.

If any of these events occur as the Calibrator operates, the Calibrator automatically goes into Standby:

- **Reset** is pushed.
- A voltage >30 V is selected when the previous output voltage was ≤30 V.
- The Calibrator changes functions.
- The output location for current is changed from AUX to 30 A, or vice versa.
- An overload condition is detected.
- A reverse-power condition is detected.

Connect the Calibrator to a DUT

Warning

The Calibrator is capable of supplying lethal voltages. To avoid shock hazard, do not make connections to the output terminals when any voltage is present. Placing the Product in Standby may not be enough to avoid shock hazard, since **OPERATE** could be pushed accidentally. Push **Reset** and verify that the Calibrator is in Standby before making connections to the output terminals.

The outputs labeled OUTPUT (HI and LO) source voltage, resistance, capacitance, inductance, and simulate resistance temperature detector (RTD) outputs. The LO terminal connects to the analog signal ground inside the guard shield. This signal line may or may not be tied to the guard shield, depending on the Guard setting. See [55XXA/DMMCAL Cable](#) for an explanation of this internal connection. An external connection is required to connect the signal LO to the chassis ground.

When an oscilloscope calibration option is installed, the coaxial connectors labeled SCOPE OUT and TRIG deliver signals for oscilloscope calibration.

The socket labeled TC is used to measure thermocouples and to generate simulated thermocouple outputs.

Recommended Cable and Connector Types

Warning

To prevent possible electrical shock, fire, or personal injury, do not touch exposed metal on banana plugs, they can have lethal voltages.

Cables to the Calibrator are connected to the OUTPUT and SENSE terminals. To avoid errors induced by thermal voltages (thermal emfs), use connectors and conductors made of copper or materials that generate small thermal emfs when joined to copper. Avoid using nickel-plated connectors. Optimum results can be obtained by using Fluke Model 5730A-7002 Low Thermal EMF Test Leads, which are constructed of well-insulated copper wire and tellurium copper connectors. See [Options and Accessories](#).

55XXA/DMMCAL Cable

The Fluke 55XXA/DMMCAL cable is specifically designed to connect handheld and bench DMMs to the Calibrator. The cable provides all the connections needed for most DMMs and provides the lowest thermal EMF, lowest leakage, and best ac performance possible. Additionally, the 55xxA/DMMCAL cable minimizes the number of setup changes which reduces operator intervention and increases throughput when you calibrate DMMs. The cable supports most recessed banana-style terminal DMMs. Some advanced meters may have a safety feature that if a test lead is plugged into the **mA/μA** or **A** terminal and the rotary switch is turned to a non-current function, the Meter chirps and flashes **LEAd**. In this case, remove the current leads while you test other functions.

- AC and dc voltages
- All resistances, including 2W and 4W Comp
- AC and dc currents up to 15 A

When to Use EARTH and GUARD

Figure 2 shows the internal connections made by the Guard setting.

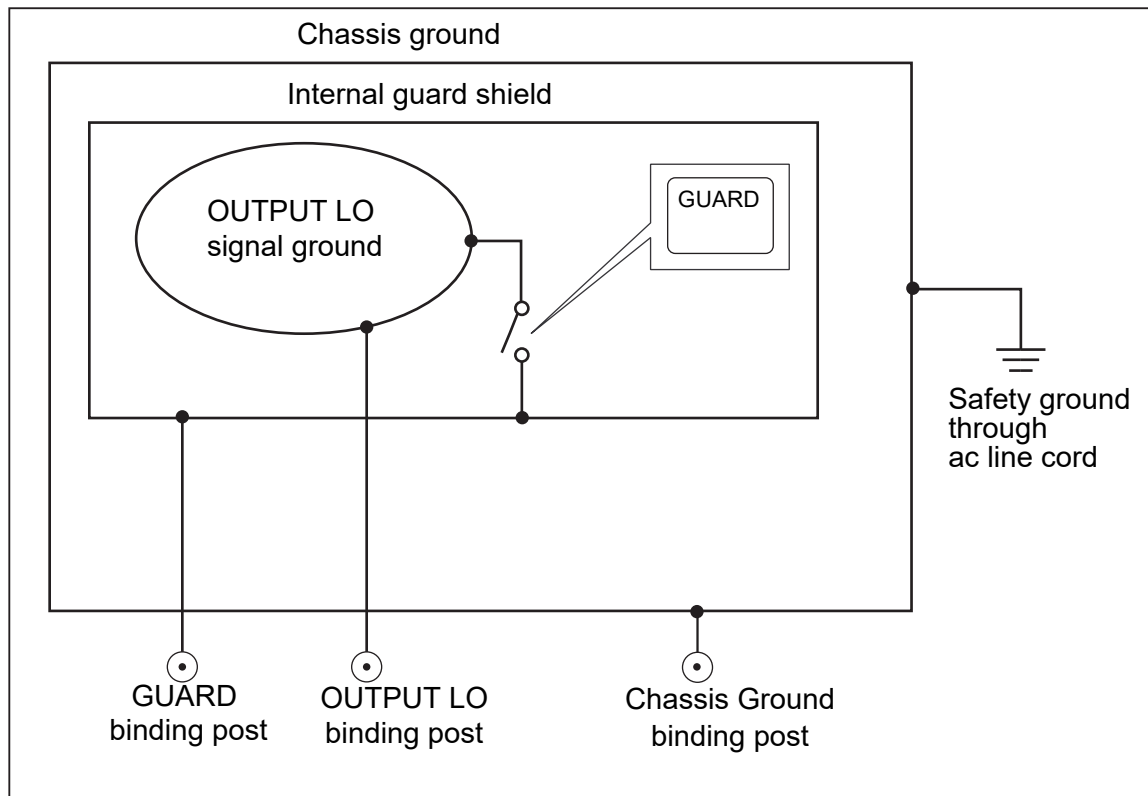


Figure 2. EARTH and GUARD Internal Connections

Earth

The Calibrator front-panel OUTPUT LO terminal is normally isolated from earth (chassis) ground. To make a connection between the OUTPUT LO terminal and earth ground, an external connection must be made to the chassis ground terminals.

To avoid ground loops and noise, you must have only one earth ground-to-LO terminal connection in the system. Usually you make all signal ground connections at the DUT. Generally, a connection to Earth ground is only used for ac and dc volts where the DUT is isolated from earth ground. There must, however, be a safety ground for the Calibrator. See [Connect to Line Power](#).

External Guard

The guard is an electrical shield, isolated from the chassis, that protects the analog circuitry. The guard provides a low-impedance path for common-mode noise and ground loop currents. The internal guard is connected to OUTPUT LO through approximately 30 Ω . There is normally an internal connection between the guard and the OUTPUT LO terminal. When you select the external guard setting, you break this internal connection, which allows you to connect a lead from the GUARD terminal to earth ground on another instrument in an interconnected system. Use this external guard connection whenever you test a DUT that has a grounded LO terminal. Remember to always maintain only one earth ground tie point in a system.

Four-Wire versus Two-Wire Connections

Four-wire and two-wire connections refer to methods used to connect the Calibrator to the DUT to cancel out test lead resistance to assure the highest precision of the calibration output. The external sensing capability of the four- and two-wire compensated connections provides increased precision for lower impedance values. Part of setting up the Calibrator output for resistance, capacitance, inductance, and RTD includes selections for four-wire compensation (**Comp 4 Wire**), two-wire compensation (**Comp 2 wire**) and two-wire no compensation (**Comp OFF**). (See [Set Resistance Output](#), [Set Capacitance Output](#), [Set Inductance Output \(Not Available on 5540A\)](#), and [Set Temperature Simulation \(RTD\) Source](#). Note that compensated connections for capacitance and inductance are to compensate for lead and internal resistances, not for lead and internal capacitances or inductances. See [Specifications](#) for impedance values where compensation is available.

Four-Wire Connection

The four-wire connection is typical for calibrating laboratory measurement equipment. Increased precision is provided by four-wire connections. See [Specifications](#) for impedance values where compensation is available.

Two-Wire Compensation

The two-wire connection is typical for calibrating precision handheld Digital Multimeters (DMMs) with a two-wire input. Increased precision is provided for lower impedance values. For higher values, the Calibrator changes the compensation to off (**Comp OFF**). See [Specifications](#) for impedance values where compensation is available.

Compensation Off

Compensation off is a typical connection used to calibrate handheld analog meters or DMMs with a two-wire input. This connection is available for most values of resistance, capacitance, and inductance and is usually selected when the analog meter or DMM level of accuracy does not require the additional precision. This is the default condition whenever an impedance output is made, following an output that was not impedance.

Cable Connections

Table 12 indicates a figure reference for each type of connection between a DUT and the Calibrator, referencing Figures 3 through 10.

When calibrating Resistance Temperature Detector (RTD) meters with the three-terminal connection shown in Figure 9, be sure the test leads have identical resistances to cancel any errors due to lead resistance. This can be accomplished, for example, by using three identical test lead lengths and sizes and identical connector styles.

When you calibrate a thermocouple meter, it is important to use the correct hookup wire and a connector between the Calibrator front-panel TC terminal and the DUT. You must use thermocouple wire and connectors that match the type of thermocouple. For example, if you simulate a temperature output for a type K thermocouple, use type K-thermocouple wire and type-K plugs for the hookup.

To connect the Calibrator to a DUT:

1. If the Calibrator is turned on, push **Reset** to remove the output from the Calibrator terminals.
2. Make the connections to the DUT by selecting the appropriate figure from Table 12. For capacitance outputs, null out stray capacitance by connecting the test leads to the DUT, routing them (but not connecting) to the Calibrator on a non-conductive surface. Null out the reading on the DUT using **rel**, **offset**, or **null**, whichever method applies, and then connect the test leads to the Calibrator.

Table 12. DUT Connections

Calibrator Output	Figure Reference
Resistance	3 Impedance - four-wire compensated
Capacitance	4 Impedance - two-wire compensated
Inductance (not available on 5540A)	5 Impedance - compensation off
DC or AC Voltage	6 DC Voltage/AC Voltage
DC or AC Current <3 A	7 DC Current/AC Current <3 A
DC or AC Current ≤ 3 A	8 DC Current/AC Current ≥ 3 A
RTD Simulation	9 Temperature (RTD) - three-terminal connection
Thermocouple Simulation	10 Temperature (Thermocouple)

See the discussion in [Four-Wire versus Two-Wire Connections](#).

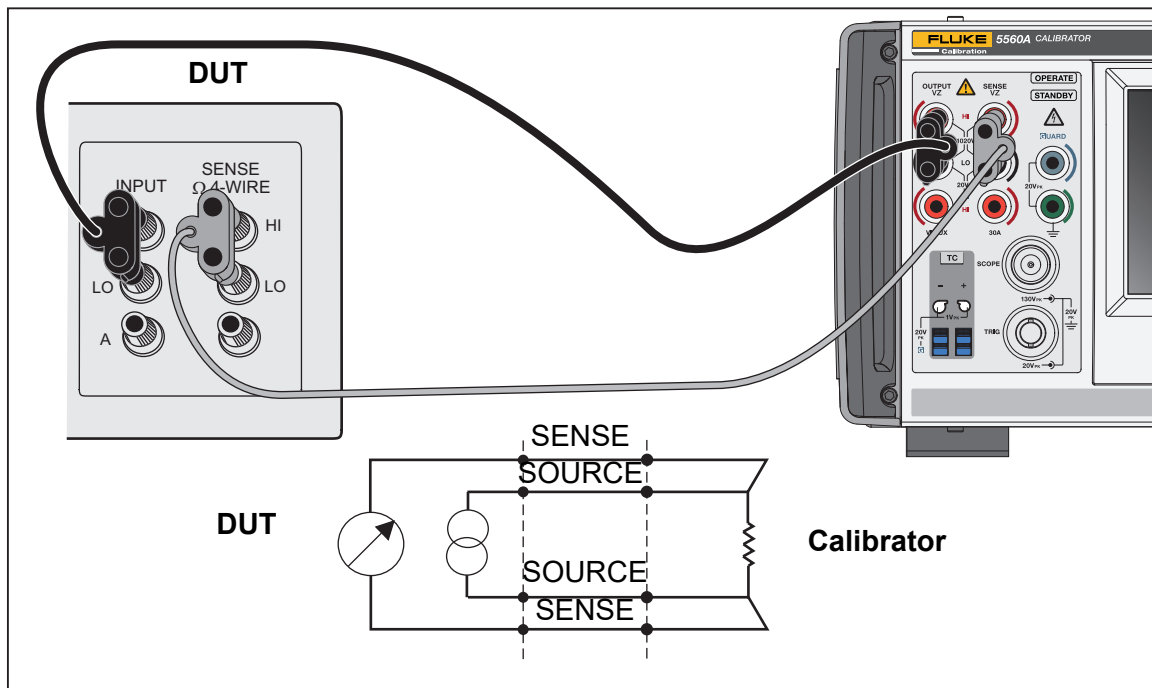


Figure 3. DUT Connection: Impedance (Four-Wire Compensation)

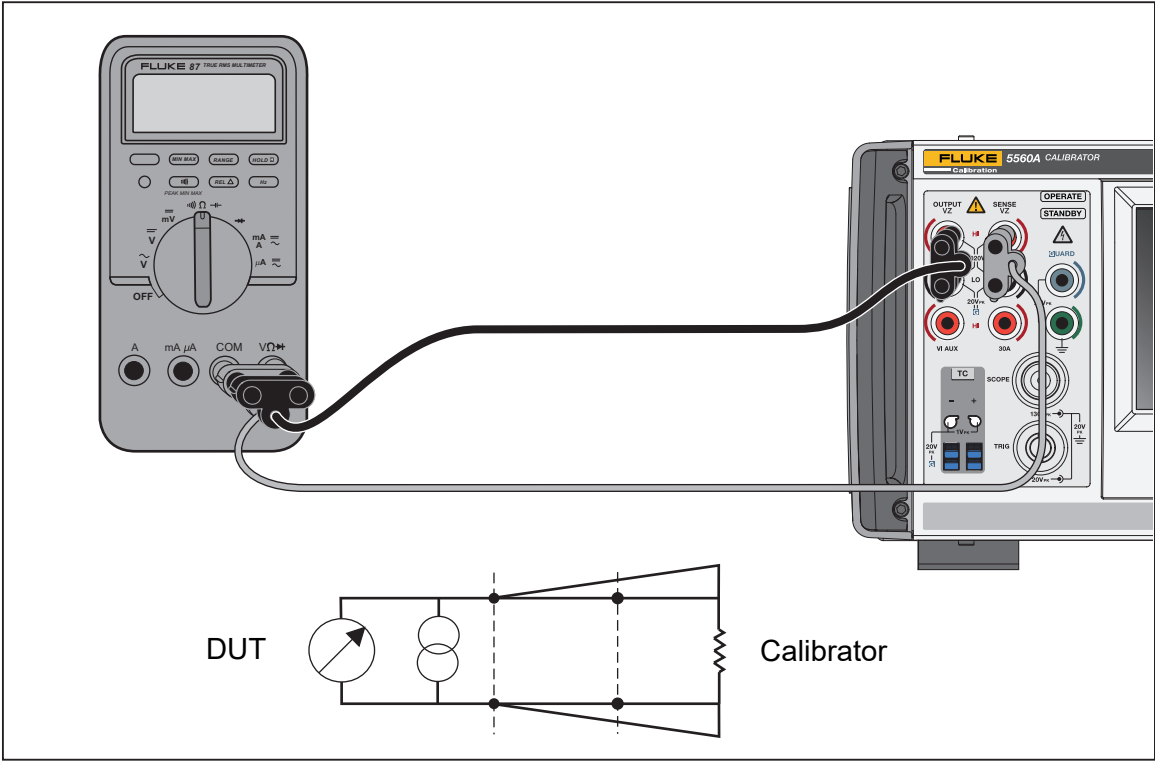


Figure 4. DUT Connection: Impedance (Two-Wire Compensation)

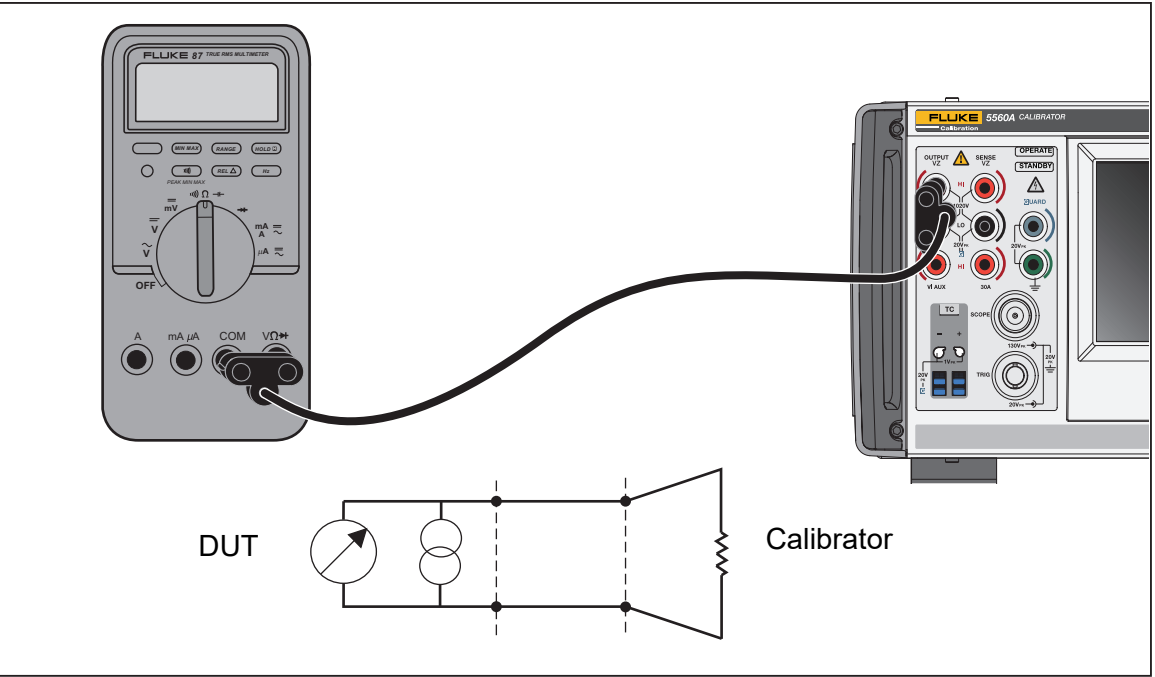


Figure 5. DUT Connection: Impedance (Compensation Off)

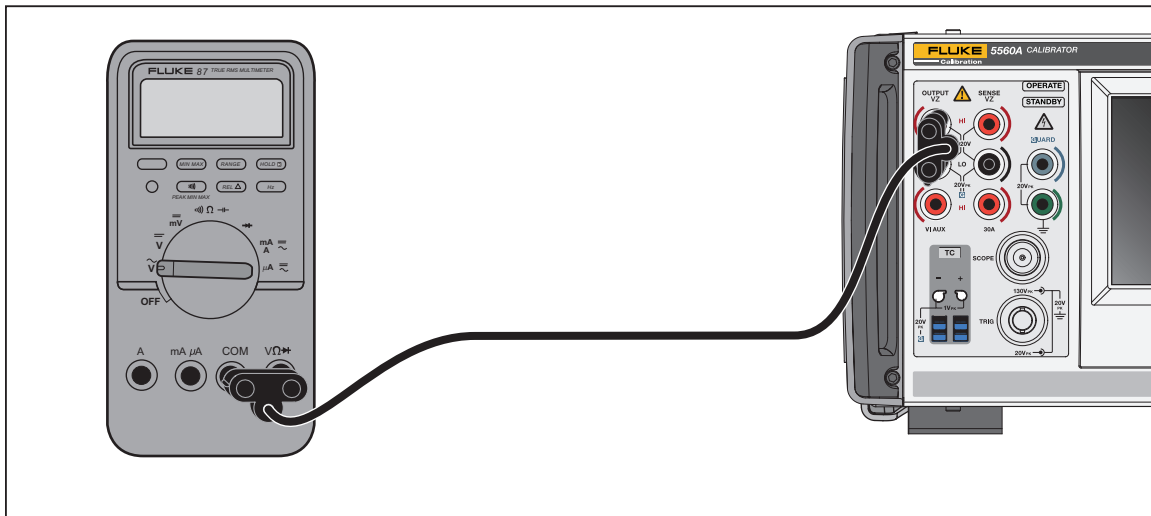


Figure 6. DUT Connection: DC Voltage/AC Voltage

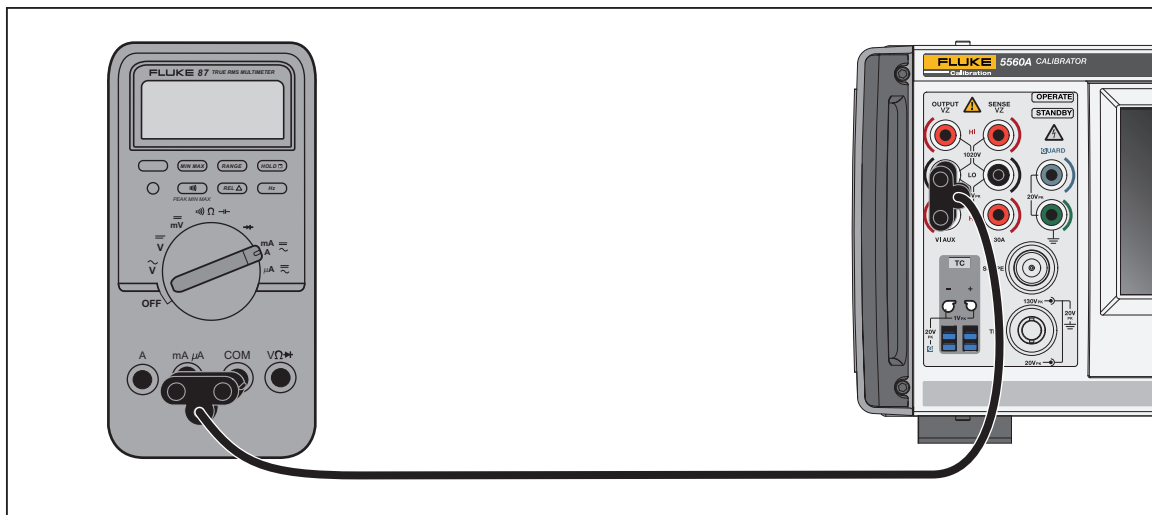


Figure 7. DUT Connection: DC Current/AC Current <3.1 A

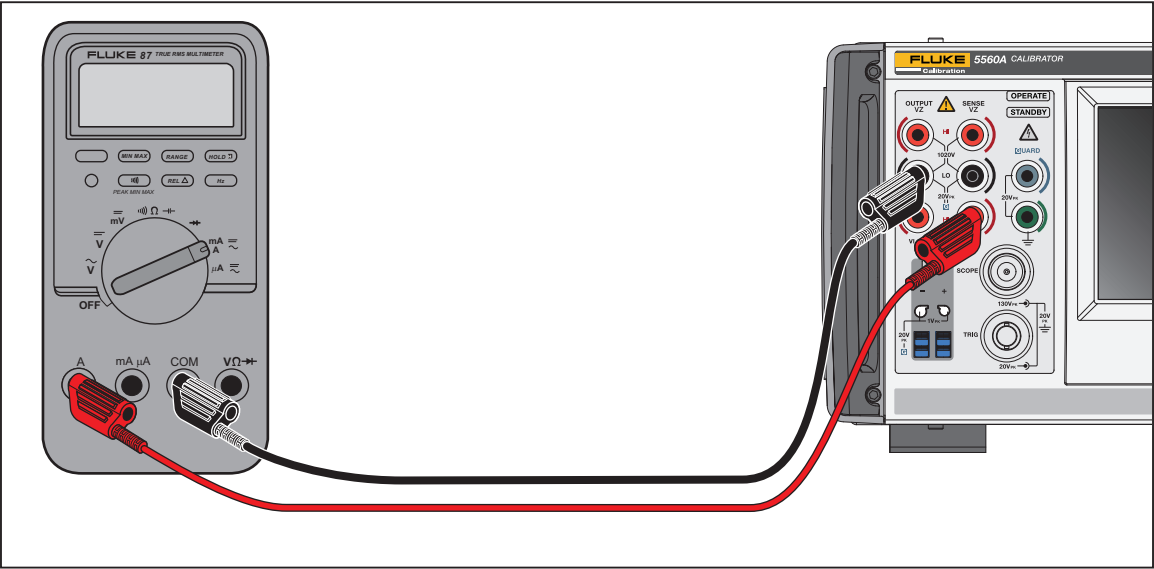


Figure 8. DUT Connection: DC Current /AC Current ≥ 3.1 A

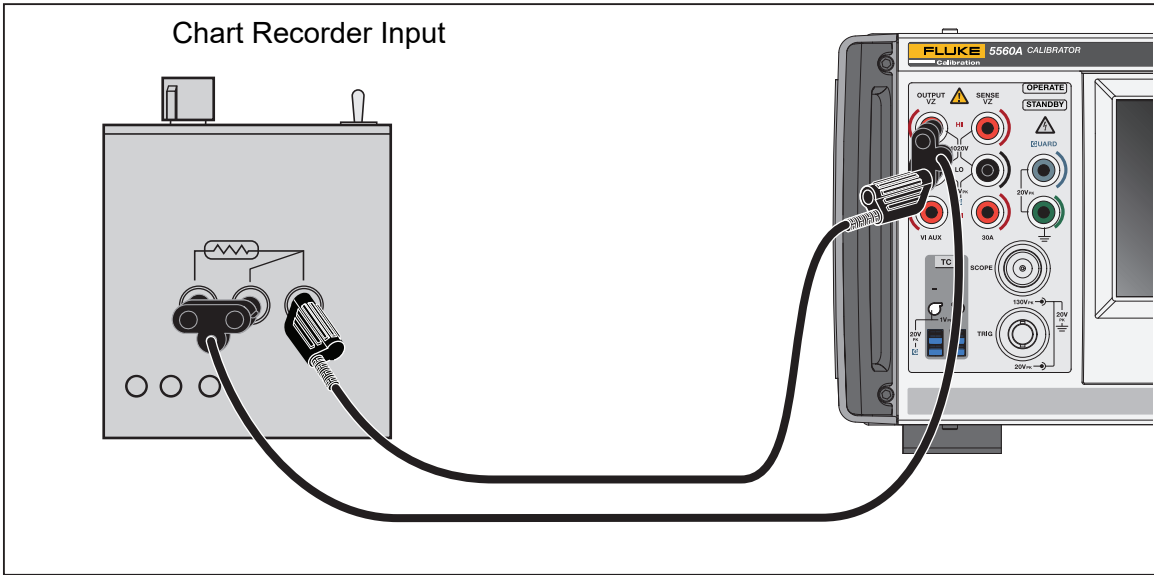


Figure 9. DUT Connection: Temperature (RTD) (Three-Terminal Connection)

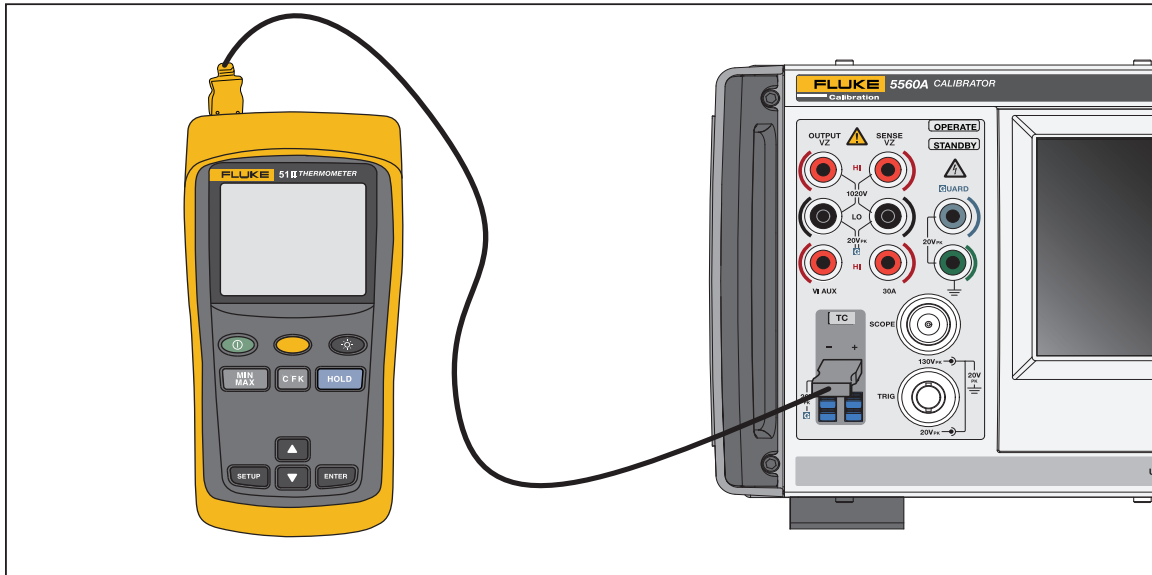


Figure 10. DUT Connection: Temperature (Thermocouple)

For Figure 10, connection wiring must match the thermocouple type (for example, K, J).

RMS Versus p-p Amplitude

The Calibrator ranges for sinusoidal ac functions are specified in rms (root-mean-square; the effective value of the waveform). For example, 12 mV, 120 mV, 1.2 V, and so forth. The relationship between p-p and rms for square wave is $p-p \times 0.5 = rms$.

Set an Output

To set an output on the Calibrator, the basic steps are:

1. Use the numeric keypad to enter the value.
2. Select a multiplier if necessary (for example, **M**, **k**, or **μ**).
3. Push an output units key to identify the unit to represent. The white entry box indicates the value and units as you type them into the Calibrator.
4. Repeat steps 1 through 3 for the next set of values, multiplier, and units until all desired parameters are entered (for example, voltage, current, and frequency).
5. Once you enter the values, push **ENTER**. If the display indicates **Standby**, push **OPERATE** to output the selection.

Note

*The display of a small empty green box (or a circle in some functions) next to **OPERATE** in the upper left of the Display indicates the Calibrator is allowing its internal circuitry to settle. Once settled, the empty green box becomes solid green.*

Note

*A useful feature of the user interface is that the Product can change from any single or dual output function to any other single or dual output function with the steps in this section. The exception to this are the temperature functions (TC Source, RTD Source, TC Measure). Follow the steps in this section and use a degree unit to take you to the last active temperature source function selected through the Function menu or through remote. TC Measure must be selected through the Function menu or remote command. When you push **ENTER** the selected unit(s) automatically configure the product to the new function.*

See Table 13 for an example that uses the ACV screen. This same basic process is used for all functions except temperature functions as noted above. Note that ACV also has other adjustable parameters. See [Set AC Voltage Output](#).

Table 13. Enter an Output Example (ACV)

<p>If you make an entry error on any step, push CE to clear the display or Bksp to remove the last item entered, and then reenter the value.</p> <p style="text-align: center;">⚠ Caution</p> <p>To prevent damage to the DUT, make sure that the applied voltage to the DUT does not exceed the rating of the DUT insulation and the interconnecting wiring.</p>	
1.	Push Reset to place the Calibrator into its power up default state (0 mV DC). Note that the OUTPUT HI and OUTPUT LO terminals illuminate in green and also note that the STANDBY indicator illuminates.
2.	Connect the DUT as described in Connect the Calibrator to a DUT .
3.	Set the DUT to measure the correct function (in this example, ac voltage) in the correct range.
4.	Push the numbers on the numeric keypad (for example 100) to enter the voltage output.
5.	Push a prefix key if necessary (for example m).
6.	Push the units key (in this example v). In other examples, use the appropriate keys). The white entry box now shows the amplitude of your entry (in this example 100 mV).
7.	Use the numeric keypad and prefix keys to enter the frequency (in this example, 60 Hz).
8.	Push ENTER . The values are added to the Display but the entered voltage (100 mV @ 60 Hz because you are on the ACV screen) is not yet active at the terminals.
9.	(Optional) When necessary, push +/- to select the polarity of the current (default is +).
10.	To activate the terminals, push OPERATE . The voltage is now present at the active terminal. Note that the STANDBY indicator turns off and the OPERATE indicator illuminates.
<p style="text-align: center;">Note</p> <p><i>At voltage outputs of ≥ 120 V, you may notice a slight high-pitched sound. This is normal.</i></p>	

For all functions, except current, the terminals illuminate in green. For current functions, the terminals illuminate in blue.

The sequence to enter an output is relatively the same for each function as in the previous example. In the sections below, the manual will not restate these entry steps but will detail where there are deviations from this procedure.

Also see these sections:

- [Function Menu > Single Output](#)
- [Function Menu > Dual Output \(Not available on 5540A\)](#)
- [Function Menu > Measure](#)

Function Menu Common Features and Functions

The Product Function menus share several common features and functions. Use this section of the manual as a reference for these items. Sections that explain the menus will refer back to this section where necessary.

Auto Range Versus Locked Range

The option to toggle between locking and unlocking the range is available only for Single Output menu DCV and DCI functions. The range locking and unlocking is located above and left of the output value on the main function screen. If the range can be locked/unlocked, it is in white. If the range cannot be locked, the range is greyed out and does not respond.

When you select **Auto Range** (the default setting), the Calibrator automatically selects the range that provides the best output resolution. When you select **Locked**, the Calibrator locks the selected range and will not change ranges when you edit the output, or enter new outputs. Values higher than the locked range are not allowed. The locked selection is usually made when you do not want range changes that may cause a small deviation in the output, for example, when checking the linearity of a given multimeter range.

Guard Softkey

The **Guard** softkey is available for all function menus under the Single Output menu, Dual Output menu, and Measure menu functions. This softkey can be toggled between **INTERNAL** and **EXTERNAL**. For more information about guarding, see [When to Use EARTH and GUARD](#).

Sense Softkey

The **Sense** softkey is available for Single Output menu DCV and ACV functions. This softkey can be toggled between **INTERNAL** and **EXTERNAL**. In DCV and ACV, **EXTERNAL** is only available for voltages >120 mV.

Select Waveforms

Note


The units change from RMS for sine wave to pk-pk for square wave.

Note

In the Scope Menu Marker Function, this feature is more complex.

The Select Waveform slide-out menu is available for all Single Output menu ac, Dual Output menu ac, Scope Marker, and Scope Waveform Generator functions. This menu lets you select different waveforms. See [Waveform Types](#).



To select a waveform:

1. Tap the select waveform button (). The Select Waveform slide-out menu opens.
2. Choose the waveform type (not all waveforms listed are available in all Select Waveform menus):
 - Sine
 - Square
 - %Duty (Scope Only)
 - Spike (Scope Only)
3. Tap the **Apply** button or push **ENTER**. The Select Waveform menu closes and the entry is copied to the waveform button on the screen. Tapping **x** instead of **Apply** closes the menu without saving changes.

Adjust Phase - Output to Reference

This slide-out menu is available for all ac functions and adjusts the phase between the primary Output and the 10 MHz reference.

To adjust the phase:

1. Tap the Adjust Phase Output to Reference button ( for ACV,  for ACI). A menu opens and shows the current degrees.
2. Touch the deg white box and use the number pad to enter a value.
3. Tap the **Apply** button or push **ENTER**. This closes the menu. The entry is copied to the correct output on the screen. Tapping **x** instead of **Apply** closes the menu without saving changes.


When you use the knob to adjust phase, changes are applied immediately and the **Apply** button disappears. Push **ENTER** or tap **x** to exit the slide-out. Tapping **x** does not revert changes.

Adjust Phase - Aux to Output

This slide-out menu is available for all Dual Output ac functions and adjusts the phase difference between the Aux Output and the primary Output.

For Sine-Sine AC Power, the phase shift adjustments may be entered as a displacement power factor (DPF) as well as in degrees. When you enter a power factor, this activates the Lead/Lag toggle. A leading or positive phase shift causes the AUX waveform to lead the OUTPUT waveform; a lagging or negative phase shift causes the AUX waveform to lag the OUTPUT waveform.

To adjust the phase:

1. Tap the Adjust Phase Aux to Output button (). A menu opens and shows the current degree, or degree and power factor for Sine-Sine ACP.
2. Touch the deg or DPF white box and use the number pad to enter a value. If a DPF is entered, then select Lead or Lag using the toggle.
3. Tap the **Apply** button or push **ENTER**. This closes the menu. The entry is copied to the correct output on the screen. Tapping **x** instead of **Apply** closes the menu without saving changes.

When you use the knob to adjust phase, changes are applied immediately and the **Apply** button disappears. Push **ENTER** or tap **x** to exit the slide-out. Tapping **x** does not revert changes.

Sync Button

The **Sync** button is available for Single Output and Dual Output ac functions. Because the button requires a longer explanation, see [Synchronize the Calibrator Using 10 MHz IN/OUT](#).

Comp Softkey

The **Comp** softkey is available in Single Output menu Resistance, Capacitance, and Inductance functions. Compensation (Comp) Applies 4-wire compensation, 2-wire compensation or turns compensation off. Compensation refers to methods of connecting the Calibrator to the DUT to cancel out test lead resistance. See [Four-Wire versus Two-Wire Connections](#) for more information. For the 3-lead connection (Figure 9) select Comp **OFF**.

Reference Junction

Note

The Reference Junction softkey and slide-out menu are not available for TC Types X or Z ($10\ \mu\text{V}/^\circ\text{C}$ or $1\ \text{mV}/^\circ\text{C}$).

The Reference Junction slide-out menu is available in the Single Output menu TC Source, and Measure menu TC Measure functions.

The Reference Junction softkey selects the internal or external temperature reference source. The reference source indicates the ambient temperature contribution to the thermocouple output, which is taken into account when simulating an accurate temperature output. Select **Internal** when the selected thermocouple has alloy wires and the isothermal block internal to the Calibrator. Select **External** when you use an external isothermal block, and when the selected thermocouple has copper wires.

To edit the reference junction:

1. Tap the **Reference Junction** softkey to toggle from **INTERNAL** to **EXTERNAL**. When you select **EXTERNAL**, the **Reference Junction** button appears on the lower left of the Display.
2. Tap the **Reference Junction** button to open the Reference Junction slide-out menu.
3. Use the numeric keypad to enter the external reference junction temperature.
4. Tap the **Apply** button or push **ENTER**. This closes the menu. The Calibrator copies the entry to the Reference Junction area of the screen. Tapping **x** instead of **Apply** closes the menu without saving changes.

Note

The unsettled indicator (open yellow square) that occasionally appears in the upper left of the Display indicates an internal adjustment to the measured isothermal block temperature and is normal. If it appears for more than 10 seconds (nominal), or if it appears to flash continuously, check to see that you are not externally heating the thermocouple connector or wires, or that more time is needed for thermocouple path temperatures to come to equilibrium.



Lows Softkey

The **Lows** (Low Potential Output Terminals) softkey is available in all Dual Output menu functions. The **Lows** of both channels must be tied together at a single point. This can be done internally, with the Lows TIED/OPEN toggle set to **TIED** (default), or externally at the DUT with the toggle set to **OPEN**.

Thermocouple Type

The Thermocouple Type slide-out menu is available in Single Output menu TC Source and Measure menu TC Measure functions.

To select a thermocouple:

1. Tap the Thermocouple Type button (). The Thermocouple Type slide-out menu opens.
2. Select the thermocouple type to simulate (listed in order horizontally):
 - A1 (BP, A)
 - B
 - C
 - D
 - E
 - G
 - J
 - K
 - L
 - N
 - R
 - S
 - T
 - U
 - XK
 - 10 μ V/ $^{\circ}$ C
 - 1mV/ $^{\circ}$ C
3. Tap the **Apply** button or push  . This closes the menu. The entry is copied to the thermocouple button. Tapping **x** instead of **Apply** closes the menu without saving changes.

Note

The unsettled indicator (open yellow square) that occasionally appears in the upper left of the Display indicates an internal adjustment to the measured isothermal block temperature and is normal. If it appears for more than 10 seconds (nominal), or if it appears to flash continuously, check to see that you are not externally heating the thermocouple connector or wires, or that more time is needed for thermocouple path temperatures to come to equilibrium.

Single Output Menu

Set DC Voltage Output

To set the dc voltage output (**Function > Single Output > DCV**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

Also see these sections:

- [Auto Range Versus Locked Range](#)
- [Guard Softkey](#)
- [Sense Softkey](#)

Set AC Voltage Output

To set the ac voltage output (**Function > Single Output > ACV**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics. The output range is 1 mV to 1020 V.

Also see these sections:

- [Guard Softkey](#)
- [Sense Softkey](#)
- [Select Waveforms](#)
- [Adjust Phase - Output to Reference](#)
- [Enter a DC Offset](#)
- [Set a Reference](#)
- [Enter a Duty Cycle](#)
- [Sync Button](#)

Below are explanations of three other functions used with the Single Output ACV function.

Enter a DC Offset

The dc offset (**Offset** on the lower section of the ACV screen) is for ranges ≤ 120 V, and for frequencies between 45 Hz and 100 kHz. Selecting a non-zero offset changes the range limits, based on the selected waveform. The offset mode range limits are always lower than the limits for non-offset mode.

See the specifications for details on these range limits and accuracy specifications in offset mode. If you use an offset voltage and you cause the output to move into a range where offset is not allowed, the Calibrator goes into Standby mode and the offset function is disabled.

To enter a dc voltage offset:

1. Tap a digit in the Offset field.
2. Enter the offset with the numeric keypad and decimal point key or rotate the knob to slew to the desired offset. For example, 0.123 V.
3. Push the **ENTER** key to enter the offset. The screen shows the offset.

Set a Reference

The **Ref** button is on lower left of the ACV screen, opens a slide-out menu where you can set a new reference for accuracy of a new standard.

1. Tap the **Ref** button to open the Select Z_0 slide-out menu.
2. Choose from these values (listed in order horizontally) :
 - 50 Ω
 - 75 Ω
 - 90 Ω
 - 100 Ω
 - 135 Ω
 - 150 Ω
 - 300 Ω
 - 600 Ω
 - 900 Ω
 - 1000 Ω
 - 1200 Ω
3. Tap the **Apply** button or push **ENTER**. This closes the menu. The entry shows on the screen. Tapping **x** instead of **Apply** closes the menu without saving changes.

Enter a Duty Cycle

Duty cycle adjustment is available for ACV when you select a square wave. After you select a square wave with the Waveform Selection procedure outlined in [Waveform Types](#), a **Mode** softkey appears. This toggles between **OFFSET** mode and **DUTY CYCLE** mode. The duty cycle value is adjusted in the same manner as offset. If the mode is changed from offset to duty cycle, the offset is automatically set to zero. If the mode is changed from duty cycle to offset, the duty cycle is set to 50 %.

To change the duty cycle of a square wave output:

1. Set the Product to output a 2 V p-p square wave at 1 kHz.
2. Tap the **Mode** softkey to show **DUTY CYCLE**.
3. Tap the duty cycle value.
4. Enter a new duty cycle between 1 and 99, or rotate the knob to slew to the desired duty cycle.
5. Push the **ENTER**.

Set DC Current Output

To set the dc current output (**Function > Single Output > DCI**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics. Complete the procedure with the necessary output between VI AUX and OUTPUT LO or 30A and OUTPUT LO, depending on the current level selected. Current >3.1 A is sourced between the 30A and OUTPUT LO terminals.

Also see these sections:

- [Auto Range Versus Locked Range](#)
- [Guard Softkey](#)

Set AC Current Output

To set the ac current output (**Function > Single Output > ACI**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics. The ac current output is at the VI AUX or 30A terminal to OUTPUT LO.

Also see these sections:

- [Guard Softkey](#)
- [Sync Button](#)
- [Waveform Types](#)
- [Adjust Phase - Output to Reference](#)

Set Resistance Output

Note

Since this is a synthesized output, make sure the terminal connections from the Calibrator to the DUT are LO to LO and HI to HI.

To set a synthesized resistance output at the front-panel OUTPUT terminals (**Function > Single Output > Resistance**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

Also see these sections:

- [Guard Softkey](#)
- [Comp Softkey](#)

Set Capacitance Output

Note

Since this is a synthesized output, make sure the terminal connections from the Calibrator to the DUT are LO to LO and HI to HI.

To set a synthesized capacitance output at the front-panel OUTPUT terminals (**Function > Single Output > Capacitance**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

Also see these sections:

- [Guard Softkey](#)
- [Comp Softkey](#)

Set Inductance Output (Not Available on 5540A)

Note

Since this is a synthesized output, be sure the terminal connections from the Calibrator to the DUT are LO to LO and HI to HI.

To set a synthesized inductance output at the front-panel OUTPUT terminals (**Function > Single Output > Inductance**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

Also see these sections:


- [Guard Softkey](#)
- [Comp Softkey](#)

Set Temperature Simulation (RTD) Source


To set the RTD output (**Function > Single Output > RTD Source**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

Note

When you calibrate Resistance Temperature Detectors (RTDs) with the three-terminal connection shown in Figure 9, make sure that the test leads have identical resistances to cancel any errors due to lead resistance. This can be accomplished, for example, by using three identical test lead lengths and identical connector styles.

RTDs have a characteristic resistance at specific temperatures. The simulated output, then, is a resistance value based on the selected temperature and type of RTD being simulated. Where necessary, use  to set °F or °C. To toggle the degree reference between the 1968 International Provisional Temperature Standard (IPTS-68) and the 1990 International Temperature Standard (IPTS-90), toggle the **Temperature Scale** softkey.

To select an RTD type:

1. Tap the RTD Type button (). The RTD Type slide-out menu opens.
2. Select the RTD type:
 - Cu 10 (427)
 - Cu 50 (428)
 - Cu100 (428)
 - Ni 120 (672)
 - Pt 100 (385)
 - Pt 100 (3916)
 - Pt 100 (3926)
 - Pt 200 (385)
 - Pt 500 (385)
 - Pt 1000 (385)

3. Tap the **Apply** button or push **ENTER**. This closes the menu. The entry is copied to the RTD Type button. Tapping **x** instead of **Apply** closes the menu without saving changes.

Also see these sections:

- [Comp Softkey](#)
- [Guard Softkey](#)

Set TC Source

Note

Thermocouples often have no electrical isolation. Make sure the thermocouple wire and plug are not affected by extraneous temperature sources. For example, do not place fingers on the thermocouple plug or wire when simulating a temperature.

You must use thermocouple wire and connectors that match the type of thermocouple. For example, if simulating a temperature output for a type K thermocouple, use type K thermocouple wire and type K connectors.

To set a simulated Thermocouple output (**Function > Single Output > TC Source**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics. The simulated thermocouple temperature output (a small dc voltage based on the selected temperature and type of thermocouple) is at the Calibrator front-panel TC connector. Where necessary, use **degree** to set °F or °C. To toggle the degree reference between the 1968 International Provisional Temperature Standard (IPTS-68) and the 1990 International Temperature Standard (ITS-90), toggle the **Temperature Scale** softkey.

Also see these sections:

- [Guard Softkey](#)
- [Reference Junction](#)
- [Thermocouple Type](#)

Dual Output Menu (Not available on 5540A)

Dual output functions facilitate calibration of power analyzers and meters for single-phase instruments. Multiple Calibrators can be configured together in a system for multiphase-power analyzers and meters.

For all dual output functions, two simultaneous outputs are generated and use four output terminals. The primary output is always voltage and uses the Output VZ and LO terminals, while currents ≤ 3.1 A use the VI AUX and Sense LO terminals. For dual outputs where the current is > 3.1 A, use the 30A and Sense LO terminals.

When you enter only a current value, the Calibrator changes to SINGLE output current. When you enter only a voltage value, the Calibrator changes to SINGLE output voltage. When in dual output, always enter BOTH voltage and current, even if you want to change only one entry.

When you enter the inputs:

- You can tap a value and use the Edit knob for the values.
- Enter voltage or current and then a watts entry with **W** to open the DC Power function or to edit the AC Power function if an AC function is the active function. The remaining volts or current value is calculated and displayed.

Set DC Power Output

To set the dc power output (**Function > Dual Output > DC Power**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

The Calibrator produces a dc power output by sourcing a dc voltage on the OUTPUT HI and OUTPUT LO terminals and an ac current on the VI AUX or 30A and SENSE LO terminal outputs.

Also see these sections:

- [Guard Softkey](#)
- [Lows Softkey](#)

Set AC Power Output

To set the ac power output (**Function > Dual Output > AC Power**), refer to [Set an Output](#) and the example shown in Table 13 for output entry basics.

The Calibrator simulates an ac power output by sourcing an ac voltage on the OUTPUT HI and OUTPUT LO terminals and an ac current on the VI AUX and SENSE LO terminals, or the 30A and SENSE LO terminals, depending on amperage.

For Sine-Sine ACP, the Display also shows the real power output for sine waves. Power out is computed as $\text{Power} = \text{Cosine } \Phi (\text{Volts} \times \text{Current})$ where Φ is the phase difference between the volts and current waveforms. Cosine Φ is also known as the Power Factor (DPF).

Adjust Phase- Aux to Output - selects the phase difference between the VI AUX and OUTPUT outputs.

Adjust Phase - Output to Reference - sets the phase difference between the OUTPUT and the 10 MHz reference or between the OUTPUT and an external primary Calibrator (using 10 MHz (IN/OUT) and the OUTPUT output. See [Synchronize the Calibrator Using 10 MHz IN/OUT](#).

Also see these sections:

- [Guard Softkey](#)
- [Lows Softkey](#)
- [Sync Button](#)
- [Select Waveforms](#)
- [Adjust Phase - Aux to Output](#)
- [Adjust Phase - Output to Reference](#)

Measure Menu

Measure Thermocouple Temperatures

Note

Use thermocouple wire and connectors that match the type of thermocouple. For example, type K wire and type K connectors.

To select the TC Measure function (**Function > Measure > TC Measure**), refer to [Function Menu](#). Where necessary, use **degree** to set °F or °C. To toggle the temperature scale between the 1968 International Provisional Temperature Standard (IPTS-68) and the 1990 International Temperature Standard (IPTS-90), toggle the **Temperature Scale** softkey.

Equivalent, on the lower left of the screen, is the actual dc voltage at the front-panel TC terminals. This is a displayed reading only.

Also see these sections:

- [Guard Softkey](#)
- [Reference Junction](#)
- [Enter a DC Offset](#)
- [Thermocouple Type](#)

Open TC Detect Softkey

The **Open TC Detect** softkey turns the Open TC Detect feature **ON** or **OFF**. When Open TC Detect is ON, a small electrical pulse checks for thermocouple continuity that, in most cases, has no effect on the measurement. If you measure the thermocouple with the Calibrator in parallel with another temperature-measuring device, select **OFF** for Open TC Detect. When an open thermocouple is detected, **Open TC** is displayed in the TC menu, providing positive identification of the fault.

Waveform Types

AC voltage, ac current and ac power functions provide a waveform button to select between sine wave (sine) and square wave (square).

Note


Dual output is not available on 5540A.

Waveforms are expressed as RMS for Sine and Peak to Peak (p-p) for Square.

Also see these sections:

- [Select Waveforms](#)
- [Adjust Phase - Aux to Output](#)
- [Adjust Phase - Output to Reference](#)

Sine Wave

When the wave selection is sine (), a sine wave current or voltage signal is present on the Calibrator outputs (Figure 11). The variables for the sine wave are amplitude, frequency, and dc offset voltage. When you select a sine wave, the Display indicates amplitude in rms units.

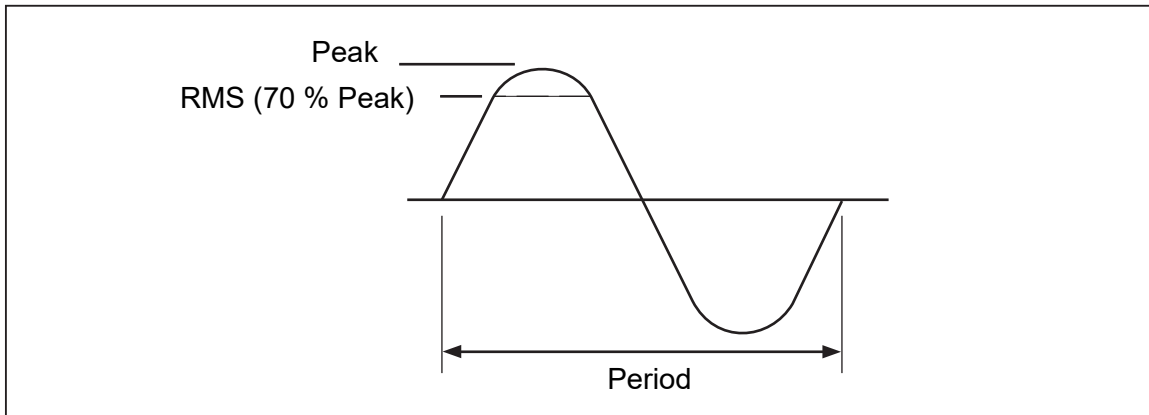



Figure 11. Sine Wave

Square Wave

When the wave selection is square (), a square wave current or voltage signal is present on the Calibrator outputs (Figure 12). The variables for the square wave are duty cycle, amplitude, frequency, and dc offset voltage. Whenever a square wave is selected, the Display indicates amplitude in p-p units. If the Calibrator is set for a single voltage output, the duty cycle of the signal can be set through the numeric keypad. To enter a new duty cycle, tap the **Mode** softkey and toggle the setting to **DUTY CYCLE** tap the duty cycle value on screen to select it, then use the numeric keypad to enter the new duty cycle followed by **ENTER**. The negative-going edge of the square wave will move based on the duty cycle setting.

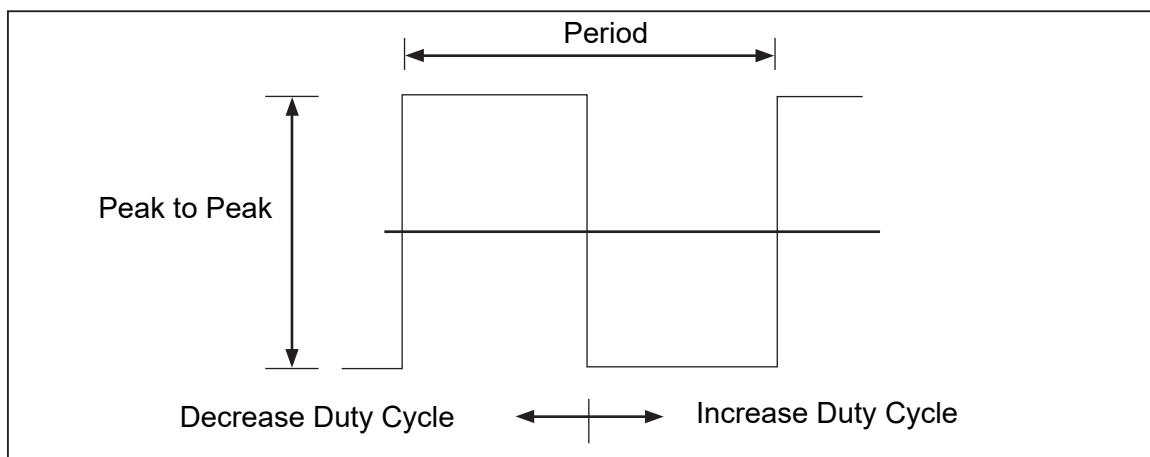







Figure 12. Square Wave and Duty Cycle

Editing and Error Output Settings

All Calibrator outputs can be edited using the Edit knob and associated Selection keys. Using the knob in many cases opens an Error Mode slide out where the Error, Reference and Type (Error Reference, either Nominal Value or True Value), and sometimes Power is displayed. While *slewing* (turning) the knob, the error continues to update. Tap the **New Reference** button to save the new value to reference and clear the error value. Change the Error Reference Type in the Setup Menu if necessary. See [Display the DUT Error](#).

Table 14 shows the actions that cause the Calibrator to exit the error mode and return to the original reference output, or to output a new reference, as selected.

Table 14. Keys That Exit Error Mode Or Output a New Reference

Keys	Action
X or 	Returns to the previous reference value and exits the Error Mode.
New Reference	Establishes a new reference exits the Error Mode.
A new numeric keypad entry + 	Establishes a new reference.
	Sets the Calibrator to ten times the reference value and establishes a new reference.
	Sets the Calibrator to one-tenth the reference value and establishes a new reference.
	Returns to the power-up state.

Output Setting

When you initially source an output from the Calibrator, you enter a specific value. For example, 10.00000 V dc. To edit the output value to suit the application:

1. Tap the desired output on the screen to select it.
2. Turn the Edit Field knob clockwise to increase the value or counter-clockwise to decrease the value. Many pop-ups, slide-outs, and menu screens block the editing of function output fields and should be closed first.

To select a digit, use an Edit Field cursor key  or . The output digit in edit will be underlined.

The momentary display of the open yellow box or open green circle in the upper left of the display when editing during OPERATE indicates **unsettled**. That is, the Calibrator output is settling with a new value when the open green square or circle goes solid.

Display the DUT Error

When you edit the output value using the knob, the Error Mode slide out shows the difference between the reference value (the value that you originally entered) and the edit value (the value shown in the Display), displaying the error difference in scientific notation, parts per million (ppm), or percent (%). For example, if Error Units (found in the **Setup > Instrument Setup > Defaults** menu) is set to <100 ppm, the error shows in ppm up to 99 and then the error changes to 0.0100 % at 100 ppm. This allows you to edit the output such that the DUT displays the expected value and thus give an indication of the DUT accuracy. Note that if you enter digits from the front-panel keys, the Error Mode slide out is not shown.

For example, an edited difference of .00030 V for an output of 10.00000 V represents $0.00030 / 10.00000 = 0.000030$, or 30 parts per million. The sign is negative (-30.0 ppm) because the output necessary to display 10.00000 at the DUT shows the DUT is reading below the output value. When the reference is negative, the error sign is relative to the magnitude. For example, if the reference is -10.00000 V and the Display is -10.00030, the error is -30 ppm.

The Calibrator has two methods of displaying the DUT error. The first method, called the *nominal* method is used in the Fluke 57XXA and 55XXA Calibrators. The second method is called *true value*. Both methods are used in this Calibrator.

The nominal method of error calculation uses the formula:

$$\frac{\text{reference value} - \text{edit value}}{\text{reference value}}$$

The nominal method is useful for checking the error of the Calibrator itself, when you are verifying its performance against a more accurate measuring device.

The true value method of error calculation uses the formula:

$$\frac{\text{reference value} - \text{edit value}}{\text{edit value}}$$

With either the nominal or true value method, small changes in output value result in a calculated error that is the same. In the example above, the Display will show the error as -30.0 ppm ($\times 10^{-6}$).

The true value method is useful for large changes in output value. For example, if you apply 10.0000 V to an analog meter, and then adjust the Calibrator output to 11.0000 V such that the analog meter now reads exactly 10 V, the true value method will display

$$\text{reference} = +10.0000 \text{ V}$$

$$\text{rel err} = -9.0909 \%$$

The -9.0909 % represents the relative error of the analog meter when compared to the true value (11.00000 V in this case).

To select the DUT error calculation method:

1. Tap the **Setup** softkey.
2. Select **Instrument Setup** from the Setup Menu.
3. Under **Defaults**, tap **Set** to open the defaults setup submenus.
4. Flick the screen up to get to the **Error Reference** options.
5. Tap the radio button for either Nominal Value or True Value.

Multiply and Divide

The Calibrator output value (or reference value if you have edited the output with the knob) can be multiplied by a factor of 10 by pushing **x**. Similarly, the output value (or reference value if you have edited the output with the knob) can be divided a factor of 10 by pushing **÷**. The output will be placed in Standby if the multiplied value exceeds 30 V. Push **OPERATE** to continue. This feature is useful for DUTs with ranges organized in decades.

Set Output Limits

The output limit feature helps prevent accidental damage to a DUT from overcurrent or overvoltage conditions. Use the feature to preset the maximum positive and negative allowable voltage or current output. These set entry limits prevent any output greater than the limit from being activated by entry through the front-panel keys or the output adjustment controls. Positive limits for voltage and current set the limits for ac voltage and current. Limit selections are saved in nonvolatile memory. Voltage limits are expressed as rms values, and any voltage offsets are ignored.

Set Voltage and Current Limits

To set voltage and current entry limits:

1. Tap the **Setup** softkey.
2. Select **Instrument Setup** from the Setup Menu.
3. Under **Output Limits**, tap **Set** to open the output setup submenus.
4. Select the box for what you wish to limit, such as the box under **Voltage (V RMS), Upper Limit**.
5. Use the numeric keypad to enter the value.
6. Push the **ENTER**.
7. Select **Back** to go to the prior Setup Menu screen or **Exit** to close the Setup Menu.

Synchronize the Calibrator Using 10 MHz IN/OUT

You can synchronize one or more Calibrators using the 10 MHz IN and OUT input/output on the rear panel. Example applications of this capability are connecting two or more calibrators in parallel in the current output function to sum their outputs, or using three calibrators to calibrate a three-phase power meter.

The multiphase system can be configured in different ways. In some cases, a **Sync** button will be necessary.

To show the Sync button:

1. Go to **Setup > Instrument Setup**.
2. Tap the **Set** button under **Defaults**.
3. Scroll down to Multi-Unit Phase Synchronization Button and select **Show**.

Set up your multiphase system as in one of these configurations:

- Complete standalone system, where the primary unit is set to internal clock and all secondary units are set to external clock. The clocks are all daisy chained in a ring. This system does not need a **Sync** button.
- Same as above, but without a ring configuration. In this case the primary unit needs the **Sync** button displayed.
- The entire system will be locked to a house 10 MHz standard. In this case all units have to be set to external clock and the **Sync** button needs to be displayed on the primary unit.

Another use for the 10 MHz IN reference input is to improve the frequency performance of the Calibrator by injecting a reference 10 MHz clock signal.

How to Use an External 10 MHz Clock

The Calibrator uses an internal 10 MHz clock signal as a reference for all ac functions. Although this internal clock is very accurate and stable, you may have a lab standard that you want to govern the frequency performance of the Calibrator. To apply an external clock to the Calibrator, you can make external reference the power-up and reset default condition.

To make external reference the power-up and reset default setting:

1. Tap the **Setup** softkey.
2. Select **Instrument Setup** from the Setup Menu.
3. Under **Defaults**, tap **Set**.
4. Scroll the screen up to reach the **Reference Clock** options.
5. Tap the radio button for **Internal** or **External**.
6. Tap **Back** to go to the prior Setup Menu screen or **Exit** to close the Setup Menu.

Sample Applications

See the subsequent sections for sample calibration examples for these models.

- Fluke 77 Series IV Digital Multimeter (DMM)
- Fluke 51 Digital Thermometer

The Calibration process is made up of two procedures:

- Verification of the Device Under Test (DUT) that tests each function and range for compliance to specifications.
- Adjustment of the DUT so that it meets the performance test ranges.

Calibrate a 77 Series IV DMM

Note

This is an example procedure. The 77 Series IV Calibration Information Manual contains the authoritative verification and adjustment procedures for that product.

This example uses the Fluke 55XXA/DMMCAL cable assembly and the Product to verify a Fluke 77 Series IV DMM.

55XXA/DMMCAL Cable Assembly

⚠⚠ Warning

To prevent electric shock, fire, or personal injury, make sure the product is in Standby before making any connection between the product and tester.

Use the 55XXA/DMMCAL cable assembly to connect the DUT to the Calibrator. See Figure 13.

1. Connect the stackable double banana plug labeled DMM SENSE to the DUT inputs: **VΩ** and **COM**.
2. Stack the double banana plug labeled DMM INPUT into the DMM SENSE plug from step 1.
3. Connect the single banana plug labeled LO I INPUT to the DUT **400mA** input.
4. Connect the single banana plug labeled HI I INPUT to the DUT **10A** input.

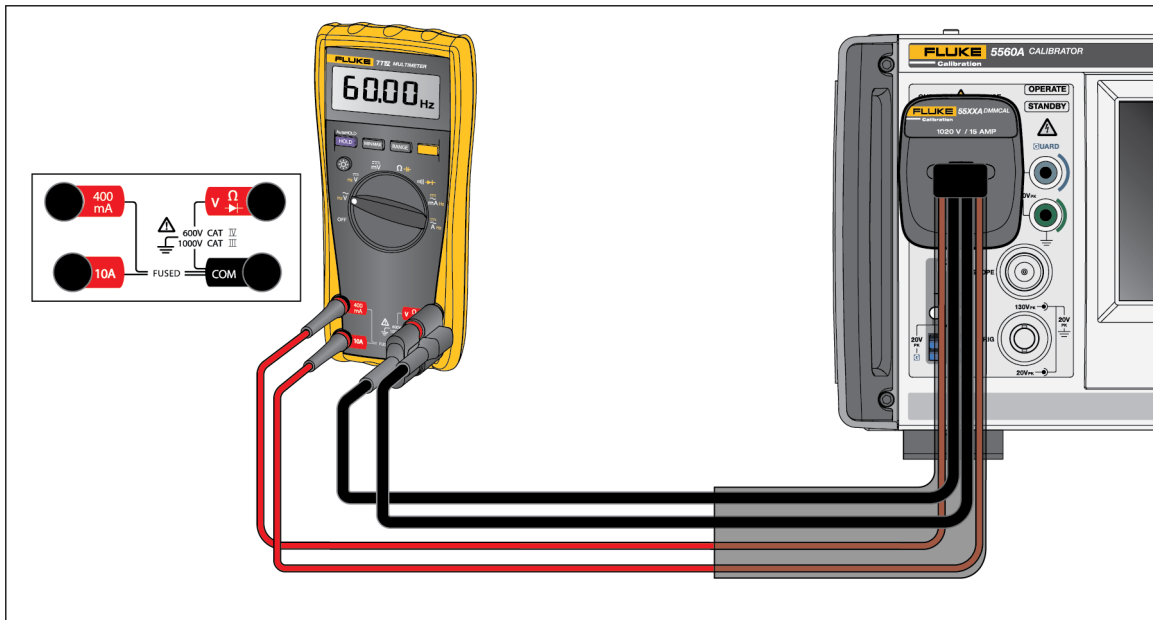


Figure 13. 55XXA/DMMCAL Cable Connection to a 77 IV Series DMM









Verification Procedure

1. Set the DUT function to the position called for in Table 15.
2. Apply the indicated Calibrator output to the DUT for each test.
3. To verify the performance of the DUT, make sure that the DUT reads within the limits shown in the Meter Response column.

Table 15. Performance Test - 77 Series IV DMM

Steps	Test (Switch Position)	Calibrator Output	Meter Response	
			Lower Limit	Upper Limit
1	Ω Ohms ^[2]	500 Ω	497.3 Ω	502.7 Ω
2		5 k Ω	4.974 k Ω	5.026 k Ω
3		50 k Ω	49.74 k Ω	50.26 k Ω
4		5 M Ω	4.974 M Ω	5.026 M Ω
5		10 M Ω	9.79 M Ω	10.21 M Ω
6		40 M Ω	39.19 M Ω	40.81 M Ω
7))) Continuity	25 Ω	Beeper On	
8		250 Ω	Beeper Off	
9	\tilde{V} AC Volts	50 mV 45 Hz	0.047 V ac	0.053 V ac
10		5 V 45 Hz	4.898 V ac	5.102 V ac
11		5 V 1 kHz	4.898 V ac	5.102 V ac
12		50 V 45 Hz	48.98 V ac	51.02 V ac
13		50 V 1 kHz	48.98 V ac	51.02 V ac
14		500 V 45 Hz	489.8 V ac	510.2 V ac
15		500 V 1 kHz	489.8 V ac	510.2 V ac
16		1000 V 45 Hz	978 V ac	1022 V ac
17		1000 V 1 kHz	978 V ac	1022 V ac
18	\tilde{V} Hz AC Volts Frequency ^[1]	5 V 99 Hz	98.89 Hz	99.11 Hz
19		5 V 900 Hz	899 Hz	901 Hz
21		5 V 50 kHz	49.94 kHz	50.06 Hz
22	\bar{V} DC Volts	5 V	4.984 V dc	5.016 V dc
23		50 V	49.84 V dc	50.16 V dc
24		300 V	299.0 V dc	301.0 V dc
25		1000 V	996 V dc	1004 V dc
26		-1000 V	-1004 V dc	-996 V dc




Table 15. Performance Test - 77 Series IV DMM (cont.)

Steps	Test (Switch Position)	Calibrator Output	Meter Response	
			Lower Limit	Upper Limit
27	 DC Millivolts	30 mV dc	29.8 mV dc	30.2 mV dc
28		-300 mV dc	-301.0 mV dc	-299.0 mV dc
29		600 mV dc	598.1 mV dc	601.9 mV dc
30	 Capacitance ^[1]	900 nF	887 nF	913 nF
31		9 μF	8.87 μF	9.13 μF
32		90 μF	88.7 μF	91.3 μF
33	 Diode Test ^[1]	2.0 V	1.978 V dc	2.022 V dc
34	 Diode Test ^[1]  AC Milliamps	0.5 mA 45 Hz	0.47 mA ac	0.53 mA ac
35		50 mA 1 kHz	48.73 mA ac	51.27 mA ac
36		400 mA 1 kHz	389.8 mA ac	410.2 mA ac
37	 AC Amps	4.0 A 45 Hz	3.898 A ac	4.102 A ac
38		9.0 A 1 kHz	8.75 A ac	9.25 A ac
39	 DC Milliamps ^[1]	3 mA, 0 Hz	2.93 mA dc	3.07 mA dc
40		50 mA	49.23 mA dc	50.77 mA dc
41		-400 mA	-406.2 mA dc	-393.8 mA dc
42	 DC Amps ^[1]	4.0 A	3.938 A dc	4.062 A dc
43		-9.0 A	-9.16 A dc	-8.84 A dc
<div>[1] Push the YELLOW button to access this function.</div> <div>[2] Does not include test lead resistance.</div>				

Adjustment


Adjust the DUT if it fails the verification tests.

The DMM buttons behave as follows when the calibration mode is enabled:

-  Push and hold this button to test the present function. This measurement is uncalibrated and may be inaccurate. This is normal.
-  Push and hold this button to display the required input.
-  Push this YELLOW button to store the calibration value and advance to the next step. This button is also used to exit calibration mode after the calibration adjustment sequence is complete.

Adjustment Procedure

To adjust the DMM:

1. Turn the Rotary Function Knob of the DMM to $\overline{m}V$ (dc).
2. Turn the DMM over and find the Calibration Seal located near the top.
3. With a small probe, break the Calibration Seal and push the Calibration Button for 1 second. The DMM beeps and changes to the calibration mode. The display reads [-0], designating the first adjustment step. The DMM remains in calibration mode until the Rotary Function Knob is turned off.
4. Enter the input value listed in Table 16 for each step.
5. After each input value is applied, push  to accept the value and proceed to the next step.
6. When the last step in a function is reached, turn the Rotary Function Knob to the next required function. The DMM does not allow a step to be completed if the Rotary Function Knob is turned to the wrong function.

Note

If the adjustment procedure is not completed correctly, the DMM will not operate correctly. When adjustment is not performed correctly, the DMM displays the messages \overline{RL} and \overline{Err} and you must adjust the DMM again.

The DMM is damaged and requires service if:

- \overline{RL} and \overline{Err} messages continue to appear after a proper adjustment.
- \overline{EEPr} and \overline{Err} messages are alternating on the display.
- \overline{EEPr} message appears on the display.

Table 16. Adjustment- 77 Series IV DMM

Function (Switch Position)	Adjustment Step ^[1]	Input Value
$\overline{\text{mV}}$ (DC Millivolts)	[- 01	600.0 mV dc
	[- 02	120.0 mV dc
$\overline{\text{V}}$ (DC Volts)	[- 03	6.000 V dc
	[- 04	60.00 V dc
	[- 05	600.0 V dc
$\sim \text{V}$ (AC Volts)	[- 06	600.0 mV, 60 Hz
	[- 07	600.0 V, 60 Hz
Ω (Ohms)	[- 08	600.0 Ω
	[- 09	6.000 k Ω
	[- 10	60.00 k Ω
	[- 11	600.0 k Ω
	[- 12	6.000 M Ω
$\rightarrow +$ (Diode Test)	[- 13	5.000 V dc
mA (Milliamps)	[- 14	400.0 mA dc
	[- 15	400.0 mA ac, 60 Hz
A (Amps)	[- 16	6.000 A dc
	[- 17	6.000 A ac, 60 Hz
[1] If the DMM is not connected correctly, or if the rotary switch is in the wrong position, the DMM beeps 2 times to alert the user.		

Calibrate a Fluke 51 Thermometer

The Fluke 51 Thermometer measures temperature using a type J or K thermocouple. The Calibrator simulates both thermocouples, simplifying testing and calibration. This section demonstrates how the Calibrator is used to calibrate this thermometer.

Note

These procedures are included here as an example. The Model 51 Service Manual contains the authoritative testing and calibration procedures.

Verification Procedure

Conduct this test only after the thermometer has had time to stabilize to an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ ($73\text{ }^{\circ}\text{F} \pm 9\text{ }^{\circ}\text{F}$).

1. Connect the Fluke 51 Thermometer to the Calibrator using the appropriate connection cable (Figure 14). The connection cable and miniconnector material must match the thermocouple type. For example, if testing a K thermocouple, the cable and miniconnector are for a type K thermocouple.

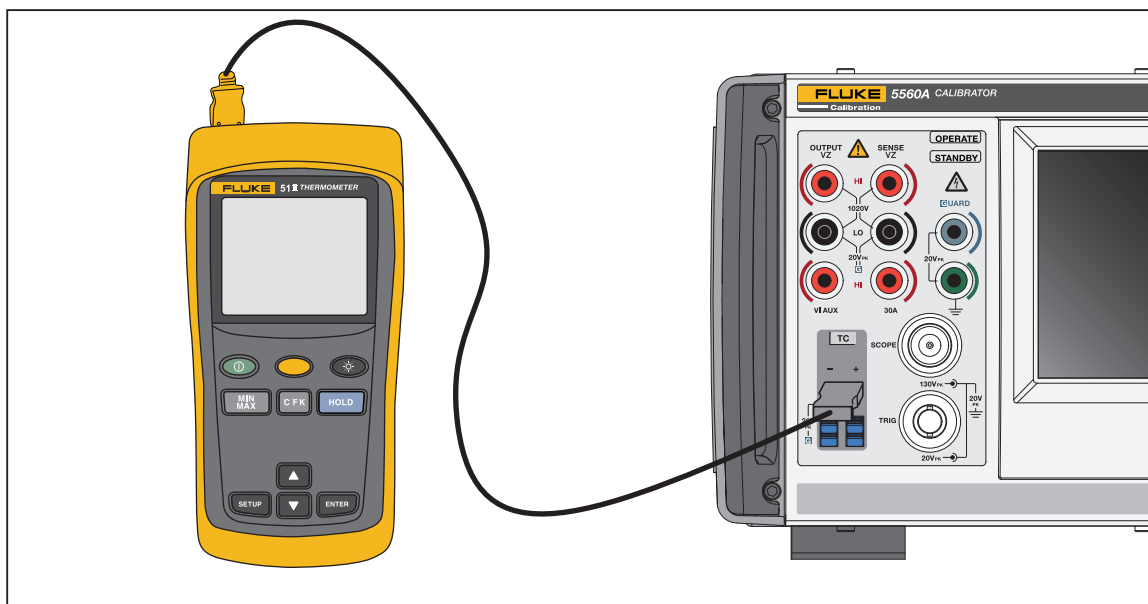


Figure 14. Cable Connections for Testing a 50 Series Thermometer

For Figure 14, connection wiring must match the thermocouple type (for example, K, J).

2. Go to the TC Source function and push **0**, **degree**, and **ENTER**.
3. Tap the Thermocouple Type button to select the thermocouple type. Ensure that the **Reference Junction** softkey selection indicates **Internal**. If not, tap the **Reference Junction** softkey.
4. Enter the Calibrator settings listed in Table 17 and verify that performance is within specification.

Table 17. Thermocouple Performance

Thermocouple Type [1]	Calibrator Output	Display Readings	
		Degrees C	Degrees F
K	-182.0 °C	-182.0 ±(0.9)	-295.6 ±(1.6)
K	-80.0 °C	-80.0 ±(0.8)	-112.0 ±(1.4)
K	530.0 °C	530.0 ±(1.2)	986.0 ±(2.3)
K	1355.0 °C	1355.0 ±(2.1)	2471.0 ±(3.8)
J	-197.0 °C	-197.0 ±(1.0)	-322.6 ±(1.7)
J	258.0 °C	258.0 ±(1.1)	496.4 ±(1.9)
J	705.0 °C	705.0 ±(1.5)	1301.0 ±(2.7)

[1] When changing thermocouple types, make sure to change the corresponding hookup wire. For example, K-type thermocouple wire changes to J-type thermocouple wire.

Calibrate the Thermometer

The procedure below refers to the Fluke 51 as the Device Under Test (DUT). Use copper hookup wire for all connections, except for steps 17 to 20.

Caution

To prevent damage to the Fluke 51 Thermometer, use only the elastomeric switch pad supplied when directed to short the switch grid on the circuit board.

1. Turn the DUT off and remove the top case, leaving the pca in the bottom case.
2. Ensure the Calibrator is in standby and connect the DUT to the Calibrator as shown in Figure 14. When making this connection with the DUT case top removed, make sure that the wide blade of the thermocouple is oriented the same as the case top would normally allow.
3. Simultaneously short the TP1 grid and turn on the DUT by shorting the ON/OFF switch grid. Hold the elastomeric switch pad on TP1 for at least 3 seconds after turn on. This puts the DUT into the Thermocouple Calibration mode.
4. Select °C mode and T1 on the DUT.

Note

The next few steps require specific voltages to be present on the inputs of the Thermometer. By using the 10 µV/°C type thermocouple selection of the Calibrator, you can specify the output voltage on the TC terminals.

5. Push **0**, **degree**, and **ENTER**.
6. Tap the Thermocouple Type button and select 10 µV/°C from the slide out so that 10 µV/°C is displayed.
7. Push **OPERATE**.
8. Allow the DUT reading to settle and then adjust the T1 offset adjustment (R7) for a display reading of 25.2 °C ±0.1 °C.
9. Change the Calibrator output to 5380.7 °C. This places 53.807 mV on the tc terminals.

10. Allow the DUT reading to settle and adjust R21 for a display reading of $+1370.0\text{ }^{\circ}\text{C} \pm 0.4\text{ }^{\circ}\text{C}$.
11. Push **Reset** on the Calibrator to remove voltage from the DUT. Disconnect the DUT from the Calibrator. Power down the DUT by shorting the ON/OFF switch grid.
12. With an elastomeric switch pad in both hands, use the left one to short out the TP2 grid, and use the right one to first turn on the instrument and then quickly short out the VIEW switch grid. Hold this position until the display is held in self-test. This puts the DUT into the Reference Junction Sensor calibration mode, and the VIEW maneuver turns off a filter so that the reading settled immediately.
13. Using a type K thermocouple bead included with the Calibrator lead kit and the Calibrator TC Measure mode (**Function > Measure > TC Measure**) measure the reference junction transistor temperature by placing the K-bead into the middle hole of the isothermal block. The bead tip should be placed into the well, against the body of Q1. Hint: Covering the well and positioning the bead with a piece of tissue may help the bead stay in place. Do not hold the bead in place with your hands as this may introduce a measurement error. Wait for the temperature reading to stabilize.
14. Adjust R16 for a temperature reading on the DUT that is the same as displayed on the Calibrator.
15. Power down the DUT and reassemble.

Maintenance

This section explains how to perform the routine maintenance and calibration task required to keep a normally-operating Calibrator in service.

Refer to the Service manual found on the Fluke Calibration website for intensive maintenance tasks such as troubleshooting, calibration or repair, and all procedures that require opening the cover of the instrument. The Service Manual also contains complete, detailed verification and calibration procedures.

Warning

To prevent possible electrical shock, fire, or personal injury:

- **Disconnect the mains power cord before you remove the Product covers.**
- **Remove the input signals before you clean the Product.**
- **Use only specified replacement parts.**
- **Use only specified replacement fuses.**
- **Have an approved technician repair the Product.**
- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**

Clean the Product

Clean the case, front-panel keys, and Display with a soft cloth slightly dampened with a mild detergent solution that is not harmful to plastics.

⚠ Caution

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the Product.

Replace the Mains Power Fuse

Access the fuses from the rear panel. The correct fuse rating for each operating voltage is shown on the label to the right of the fuse compartment.

⚠⚠ Warning

To prevent possible electric shock, fire, or personal injury:

- **Turn the Product off and remove the mains power cord. Stop for two minutes to let the power assemblies discharge before you open the fuse door.**
- **Use only specified replacement fuses, see the back of the Product for the correct replacement fuse.**

To check or replace the fuse, refer to Table 18 and Figure 15 and proceed as follows:

1. **Disconnect line power.**
2. Open the fuse compartment by inserting a flat screwdriver blade into the tab located at the top of the compartment door and gently pry until it can be removed with the fingers.
3. Remove the fuse from the compartment for replacement or verification.
4. Install the fuse. Make sure the correct fuse is installed.
5. Push the fuse compartment door back into place until the tab locks.

Table 18. Replacement Fuses

Line Voltage Range	Fuse Description	Fluke Part Number
100 V - 120 V	T5.0 A 250 V	109215
220 - 240 V	T 2.5 A 250 V	851931

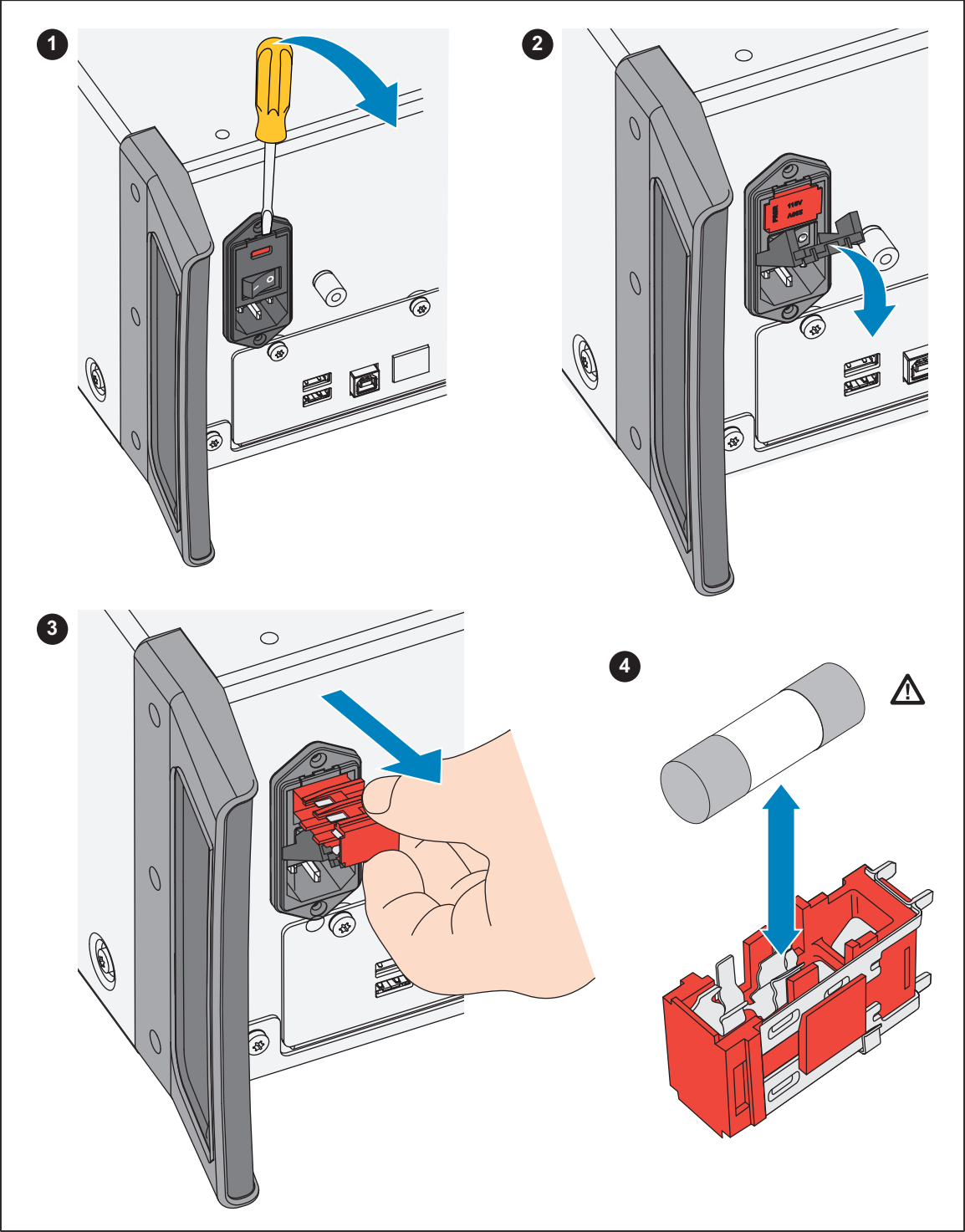


Figure 15. Access the Fuse

Options and Accessories

Options and accessories for the Product are listed in this section. To order, note the Model Number and Description and [Contact Fluke Calibration](#), see Table 19.

Table 19. Options and Accessories

Model	Description
5560A/600M	600 MHz Oscilloscope Calibration Option
5560A/1G	1.1 GHz Oscilloscope Calibration Option
5560A/2G	2.2 GHz Oscilloscope Calibration Option
55XXA/ CARRYCASE	Carry Case with removable front/back panels
55XXA/PORTKIT	Installable option with rugged handles, side handle, cross bar, and front pouch
55XXA/LEAD SET	Thermocouple and Test Leads Set
664828	MET/CAL-IEEE NT, Option, IEEE Interface
666339	MET/CAL-IEEE PCI, Option, IEEE Interface (PCI)
943738	RS-232 Modem Cable, 2.44 m (8 ft) (SERIAL 2 TO DUT) to DUT (DB-9)
MET/CAL-L	Automated Calibration Software.
MET/TEAM-L	T&M Asset management Software.
MET/TEAM	Fluke Metrology Software.
MET/CAL-IEEE NT	IEEE Interface Option.
MET/CAL-IEEE PCI	IEEE Interface Option.
MET/CAL-IEEE PCMA	IEEE Interface Option.
MET/CAL-IEEE USB	IEEE Interface Option.
PM8914/001	RS-232 Null Modem Cable, 1.5 m (5 ft) (SERIAL 1 FROM HOST) to PC COM (DB-9)
RS40	RS-232 Null Modem Cable, 1.83 m (6 ft) (SERIAL 1 FROM HOST) to PC COM (DB-25)
5346298	5560A-2502, EAR, RACK, 7 in.
Y5538	Rack Mount Kit for 5560A, 5550A, and 5540A
55XXA/DMMCAL	Cable (See Earth)
Y8021	Shielded IEEE-488 Cable 0.5 m (1.64 ft)
Y8022	Shielded IEEE-488 Cable 2 m (6.56 ft)
Y8023	Shielded IEEE-488 Cable 4 m (13 ft)
4376007	5730A-7002, TEST LEAD SET, LOW THERMAL BANANA

Rack Mount Kit

The Y5538 rack mount kit provides all the hardware necessary to mount the Calibrator in a 24-inch (61 cm) equipment rack. Instructions are provided in the kit.

IEEE-488 Interface Cable

Shielded IEEE-488 cables are available in three lengths (See Table 19). The cables attach to the Calibrator to any other IEEE-488 device. Each cable has double 24-pin connectors at both ends to allow stacking. Metric threaded mounting screws are provided with each connector. See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for the pinout information for the IEEE-488 connector.

RS-232 Null-Modem Cables

The PM8914/001 and RS40 null modem cables connect the Calibrator RS-232 Serial Port to a video display terminal, computer, or other serial device configured as DTE (Data Terminal Equipment). See the *5560A/5550A/5540A Remote Programmers Manual* at www.flukecal.com for the pinouts for the serial connectors.

55XXA-525A/LEADS

The optional test lead kit, 55XXA-525A/LEADS, is a kit of test leads for voltage and current, thermocouple extension wires, thermocouple miniconnectors, and thermocouple measuring *beads*.

Error Codes

The subsequent is a list of the Calibrator error messages.

Error 0 result No error
Error -440 result 488.2 query after indefinite response
Error -430 result 488.2 I/O deadlock
Error -420 result 488.2 unterminated command
Error -410 result 488.2 interrupted query
Error -376 result Command only allowed on synchronous (for example, gpib/usb-tmc) interface type
Error -375 result Command only allowed on asynchronous (for example, serial/telnet) interface type
Error -374 result GPIB/488.1 unspecified error
Error -373 result GPIB/488.1 write operation timeout
Error -372 result GPIB/488.1 read/write operation aborted
Error -371 result GPIB/488.1 board address error
Error -370 result GPIB/488.1 system call has failed
Error -369 result LAN port encountered error while reading data
Error -368 result Fatal error occurred while accessing the LAN port
Error -367 result USB-TMC encountered error while reading data
Error -366 result GPIB/488.1 encountered error while reading data
Error -365 result Fatal error occurred while accessing the serial port
Error -363 result Input Buffer Overrun
Error -361 result RS-232 framing/parity/overrun error detected
Error -350 result Too many errors
Error -302 result Command execution locked out
Error -301 result Restricted Command
Error -224 result Characters must be A-Z, 0-9, - or _
Error -223 result Character string was more than limit
Error -222 result Illegal data value was entered
Error -193 result No entry in list to retrieve
Error -192 result Too many dimensions to be returned
Error -191 result Parameter type detection error
Error -190 result Parameter is not a boolean type
Error -157 result Unmatched bracket
Error -154 result String size is beyond limit
Error -153 result Parameter is not an unquoted string type
Error -152 result Parameter is not an quoted string type
Error -150 result Invalid string data
Error -140 result Parameter is not a character type
Error -138 result Too many suffixes in command header
Error -137 result Invalid suffix in command header
Error -130 result Suffix Error. Wrong units for parameter
Error -127 result Invalid dimensions in a channel list

Error -126 result Numeric value is real
Error -125 result Numeric value is negative
Error -124 result Numeric value overflowed its storage
Error -122 result Parameter is not a numeric type
Error -120 result Numeric value is invalid
Error -117 result Wrong type of parameter(s)
Error -115 result Missing or wrong number of parameters
Error -102 result Syntax error
Error 1000 result Illegal Parameter
Error 1001 result Failed to save data to non-volatile storage
Error 1002 result Failed to read data from non-volatile storage
Error 1003 result Remote Port Configuration Invalid
Error 1004 result Units Must Be The Same
Error 1005 result Limit Too Small or Large
Error 1006 result Cannot Get Range Data
Error 1007 result Cannot Find Range
Error 1008 result Cannot Send Sync Pulse
Error 1009 result The passcode must be 1 to 8 digits in length
Error 1201 result Feature not available
Error 1202 result Failed self-test [VALUE]
Error 1300 result Cannot change the LAN settings now
Error 1500 result Failed to set DAC to desired value
Error 1501 result Cannot change the monitor now
Error 1502 result Cannot find that cal constant
Error 1503 result Cannot save cal constant
Error 1504 result Cannot Store, Cal is Secured
Error 1506 result Cannot Change the Date While Instrument is Secured
Error 1507 result Continue command ignored
Error 1508 result Backup command ignored
Error 1509 result Cannot execute procedure backup request now
Error 1510 result Cannot execute procedure abort request now
Error 1511 result Cannot execute procedure start request now
Error 1512 result Cannot execute procedure step skip request now
Error 1513 result Cannot execute procedure section jump request now
Error 1514 result Cannot start diagnostics now
Error 1515 result Cannot Change the Temperature While Instrument is Secured
Error 1516 result Cannot Change the Report String While Instrument is Secured
Error 1600 result Invalid Time or Time Setting
Error 1601 result Invalid Date or Date Setting
Error 1700 result Cannot communicate with 52120
Error 4001 result Overvoltage on the 12V amplifier
Error 4002 result Overvoltage on the millivolt output

Error 4003 result Power up, line power fault
Error 4004 result External clock failure
Error 4005 result Overcurrent on the 12V amplifier
Error 4006 result PLL unlocked, missing 10 MHz reference
Error 4007 result Excess output current or common mode voltage on the guard terminal
Error 4008 result Overvoltage or overcurrent condition
Error 4100 result Compliance voltage exceeded
Error 4101 result Specification exceeded
Error 4102 result Compliance current limit exceeded
Error 4103 result Output settling timed out
Error 4200 result Temperature monitoring has failed
Error 4201 result Compliance voltage monitoring has failed
Error 4202 result Compliance voltage above threshold
Error 4300 result Zero Cal nulling operation exceeded maximum attempts to converge
Error 4301 result Zero Cal convergence write failed
Error 4302 result Zero Cal failed to take measurement
Error 4303 result Zero Cal no starting value provided
Error 4304 result Zero Cal pre-checkpoint sequence failed
Error 4305 result Zero Cal failed to take checkpoint measurement
Error 4404 result Unknown hardware fault
Error 4500 result Cannot open 52120 control port
Error 4501 result DAC counts out of range
Error 4502 result Out current limit has been exceeded
Error 4503 result External voltage detected on Output post
Error 4504 result External voltage detected on VI AUX post
Error 4505 result Thermocouple output voltage exceeds hardware limits
Error 4506 result Could not start LED test
Error 5000 result Error while reading 52120A cal store
Error 5001 result Expected a 52120A but it was gone
Error 5002 result 52120A cal store corrupted
Error 5003 result Value out of range of 52120A
Error 5004 result Unknown error reported by 52120A
Error 5005 result 52120A added or removed
Error 5006 result 52120A forcibly turned off
Error 5007 result 52120A detected over compliance
Error 5008 result 52120A detected over range
Error 5009 result 52120A detected over temperature
Error 6001 result Cal constant does not exist
Error 6002 result Cal correction is missing an input value
Error 6003 result Attempted to divide by zero
Error 6004 result Attempted to reverse an irreversible calculation
Error 6005 result Cal parameter does not exist
Error 6006 result Cal correction is value only

Error 6007 result Calculated corrector out of tolerance
Error 7001 result Frequency must be > 0.0 Hz
Error 7002 result Function does not permit a frequency below [VALUE]
Error 7003 result Cannot specify more than one frequency
Error 7004 result Cannot specify more than two magnitudes
Error 7005 result Units are required for dual output mode
Error 7006 result Not applicable
Error 7007 result Cannot set Duty Cycle in this configuration
Error 7008 result Cannot set Offset in this configuration
Error 7009 result Range Lock disabled in this configuration
Error 7010 result Compensation not available for this function
Error 7011 result Cannot enable compensation in this configuration
Error 7012 result Harmonic not available for this function
Error 7013 result Fundamental not available for this function
Error 7014 result Setting Range not available for this function
Error 7015 result Cannot change polarity for this function
Error 7016 result This value cannot be slewed
Error 7017 result Cannot change Phase for this function
Error 7018 result Validation of requested attributes failed
Error 7019 result Offset range not found
Error 7020 result Read only mode for calibration control
Error 7021 result Must be in read only mode to execute this command
Error 7022 result Cannot enter watts by itself
Error 7023 result Value not available
Error 7024 result Harmonic not available for non-sine waveforms
Error 7025 result TC offset can only be set while in TC Measurement function
Error 7026 result Temperature Scale can only be set while sourcing or measuring temperature
Error 7027 result RTD type can only be set while in RTD Source function
Error 7028 result TC type can only be set while in TC Source/Measure function
Error 7029 result Coupled command queue limit exceeded
Error 7500 result Cannot have magnitude above [VALUE] in function [FUNCTION]
Error 7501 result Cannot have magnitude below [VALUE] in function [FUNCTION]
Error 7502 result No appropriate range found in function
Error 7503 result Magnitude exceeds boundaries of selected range
Error 7504 result Incorrect units for selected function [FUNCTION]
Error 7505 result Invalid second range selected for function [FUNCTION]
Error 7506 result Current post/range mismatch for function [FUNCTION]
Error 7507 result Cannot have frequency above [VALUE]
Error 7508 result Cannot combine greater than [VALUE] with frequency above [VALUE]
Error 7509 result Cannot have both Duty Cycle and DC Offset
Error 7510 result Duty Cycle must be between 1 and 99
Error 7511 result Duty Cycle is only available with Square Wave

Error 7512 result Requested offset exceeds the maximum allowed for this output range and waveform

Error 7513 result Cannot accept non-coupled command while coupled-commands are queued

Error 7515 result Harmonic must be greater than zero

Error 7516 result Cannot enable 2 wire compensation below [VALUE] in function [FUNCTION]

Error 7517 result Thermocouple reference must be specified as a temperature

Error 7518 result Thermocouple offset must be specified as a temperature

Error 7519 result Cannot have reference below [VALUE] in function [FUNCTION]

Error 7520 result Cannot have reference above [VALUE] in function [FUNCTION]

Error 7521 result Thermocouple offset is limited to +/- [VALUE]

Error 7522 result Cannot use external sense on selected range

Error 7523 result Function not available

Error 7524 result Cannot have line marker above [VALUE] with the selected frame format in function [FUNCTION]

Error 7525 result Cannot enable external reference in this function

Error 7526 result Trigger Option not available with given primary magnitude

Error 7527 result Cannot change Power Factor for this function

Error 7528 result Cannot change Phase Angle Sign for this function

Error 7530 result The magnitude representation cannot be changed in this function

Error 7531 result Cannot set wave now

Error 7532 result Cannot enable 2 wire compensation above [VALUE] in function [FUNCTION]

Error 7533 result Cannot enter watts with non-sine waveform

Error 7600 result Cannot use boost amplifier now

Error 7601 result Cannot select boost amplifier post now

Error 7602 result Can only output that current on the HIGH post

Error 7603 result Valid Pulse amplitudes are 2.5V, 1V, 250mV, 100mV, 25mV, 10mV

Error 8001 result Power up was less than 30 minutes ago

Error 8002 result Zero adjustment is required every [VALUE] days

Error 8003 result Ohms zero adjustment is required every [VALUE] hours

Error 8012 result Zero adjustment is required every [VALUE] days

Error 8013 result Ohms zero adjustment is required every [VALUE] hours

Error 8101 result Size of X and Y should be the same for Polyfit

Error 8102 result Failed matrix reduction using Gauss-Jordan elimination

Error 8103 result Cannot read coefficients from the matrix

Error 8104 result Missing required input for calculation

Error 8106 result Failed to read matrix coefficients

Error 8107 result TC Measurement is invalid

Error 8108 result Lag bath input needs to be between -10 °C and 70 °C

Error 8109 result Entered value out of bounds

Error 8110 result Wrong unit for reference

Error 10001 result Exception happened during json serialization:

Error 10002 result Exception happened during RPC communication

Error 10003 result Unhandled exception:

Error 10101 result Memory allocation error:
Error 10201 result Unknown command:
Error 10301 result Unknown string Id:
Error 11001 result Duplicate Setting
Error 11002 result Setting not found
Error 11003 result Unable to read clock
Error 11004 result Unable to set clock
Error 11005 result Entered value is outside allowable limits
Error 11006 result Invalid password
Error 65535 result Unknown Error
Error 65536 result Default Error

