Calibration

5522A

Multi-Product Calibrator

Getting Started

PN 3795091
January 2011

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Fluke Corporation	Fluke Europe B.V.
P.O. Box 9090	P.O. Box 1186
Everett, WA 98206-9090	5602 BD Eindhoven
U.S.A.	The Netherlands

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OPERATOR SAFETY SUMMARY

WARNING

HIGH VOLTAGE

is used in the operation of this equipment

LETHAL VOLTAGE

may be present on the terminals, observe all safety precautions!

To avoid electrical shock hazard, the operator should not electrically contact the output HI or sense HI terminals or circuits connected to these terminals. During operation, lethal voltages of up to 1020 V ac or dc may be present on these terminals.

Whenever the nature of the operation permits, keep one hand away from equipment to reduce the hazard of current flowing through vital organs of the body.

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Introduction

The 5522A Multi-Product Calibrator (referred to throughout this manual as either "the Product" or "the Calibrator") is a fully programmable precision source of the following:

- DC voltage from 0 to ±1020 V.
- AC voltage from 1 mV to 1020 V, with output from 10 Hz to 500 kHz.
- AC current from 29 µA to 20.5 A, with variable frequency limits.
- DC current from 0 to ±20.5 A.
- Resistance values from 0 to 1100 MΩ.
- Capacitance values from 220 pF to 110 mF.
- Simulated output for eight types of Resistance Temperature Detectors (RTDs).
- Simulated output for eleven types of thermocouples.

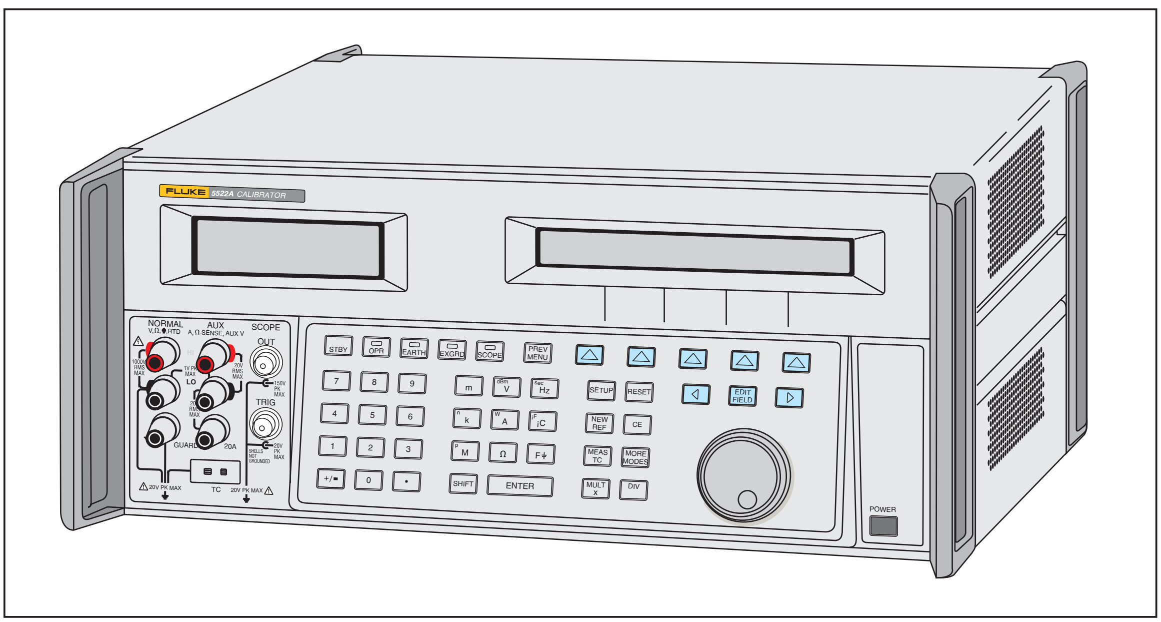

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Figure 1. 5522A Multi-Product Calibrator

Features of the Calibrator include the following:

- Automatic meter error calculation, with user selectable reference values.
- MULT X and DIV ÷ keys that change the output value to pre-determined cardinal values for various functions.

- Programmable entry limits which prevent the operator from entering values that could cause damage to the connected instrument.
- Simultaneous output of voltage and current, up to an equivalent of 20.91 kW.
- Pressure measurement when used with Fluke 700 Series pressure modules.
- 10 MHz reference input and output. Use this to input a high-accuracy 10 MHz reference to transfer the frequency accuracy to the 5522A, or to synchronize one or more additional 5522A Calibrators to a master 5522A.
- Simultaneous output of two voltages.
- Extended bandwidth mode outputs multiple waveforms down to 0.01 Hz, and sine waves to 2 MHz.
- Variable phase signal output.
- 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 printing, displaying, or transferring internally stored calibration constants, and for remote control of the 5522A.
- Pass-through RS-232 serial data interface for communicating with the Unit Under Test (UUT).

Safety Information

This Calibrator complies with:

- ANSI/ISA-61010-1 (82.02.01)
- CAN/CSA C22.2 No. 61010-1-04
- ANSI/UL 61010-1:2004
- EN 61010-1:2001

In this manual, a **Warning** identifies conditions and actions that pose hazards to the user. A **Caution** identifies conditions and actions that may damage the Calibrator or the equipment under test.

Symbols used in this manual and on the Product are explained in Table 1.

Table 1. Symbols

Symbol	Description	Symbol	Description
CAT I	IEC Measurement Category I – CAT I is for measurements not directly connected to mains. Maximum transient Overvoltage is as specified by terminal markings.	SP® C US	Conforms to relevant North American Safety Standards.
CE	Conforms to European Union directives		Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.
⚠	Risk of Danger. Important information. See manual.	⚡	Hazardous voltage
⏚	Earth ground	N10140	Conforms to relevant Australian EMC requirements

⚠⚠ Warning

To prevent personal injury:

- **Use the Product only as specified, or the protection supplied by the Product can be compromised.**

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

- **Do not use the Product if it operates incorrectly.**
- **Replace the mains power cord if the insulation is damaged or if the insulation shows signs of wear.**
- **Do not touch voltages > 30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Make sure the ground conductor in the mains power cord is connected to a protective earth ground. Disruption of the protective earth could put voltage on the chassis that could cause death.**
- **Use only the mains power cord and connector approved for the voltage and plug configuration in your country and rated for the Product.**
- **Use only cables with correct voltage ratings.**

How to Contact Fluke

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

- Technical Support USA: 1-800-99-FLUKE (1-800-993-5853)
- Calibration/Repair USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at www.fluke.com.

To register your product, visit http://register.fluke.com.

To view, print, or download the latest manual supplement, visit http://us.fluke.com/usen/support/manuals.

Overload Protection

The Calibrator supplies reverse-power protection, fast output disconnection, and/or fuse protection on the output terminals for all functions.

Reverse-power protection prevents damage to the calibrator 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 Calibrator to fail.

For volts, ohms, capacitance, and thermocouple functions, there is fast output disconnection protection. This protection senses applied voltages higher than 20 volts on the output terminals. It quickly disconnects the internal circuits from the output terminals and resets the calibrator when such overloads occur.

For current and aux voltage functions, user replaceable fuses supply protection from overloads applied to the Current/Aux Voltage output terminals. The fuses are accessed by an access door on the bottom of the calibrator. You must use replacement fuses of the same capacity and type specified in this manual, or the protection supplied by the Calibrator will be compromised.

Operation Overview

The Calibrator may be operated at the front panel in the local mode, or remotely using RS-232 or IEEE-488 ports. For remote operations, several software options are available to integrate 5522A operation into a wide variety of calibration requirements.

Local Operation

Typical local operations include front panel connections to the Unit Under Test (UUT), and then manual keystroke entries at the front panel to place the Calibrator in the desired output mode. The front panel layout facilitates hand movements from left to right, and multiply and divide keys make it easy to step up or down at the press of a single key. You can also review Calibrator specifications at the push of two buttons. The backlit liquid crystal display is easy to read from many different viewing angles and lighting conditions, and the large, easy-to-read keys are color-coded and provide tactile feedback.

Remote Operation (IEEE-488)

The Calibrator rear panel IEEE-488 port is a fully programmable parallel interface bus meeting standard IEEE-488.1 and supplemental standard IEEE-488.2. Under the remote control of an instrument controller, the Calibrator operates exclusively as a “talker/listener.” You can write your own programs using the IEEE-488 command set or run the optional Windows-based MET/CAL software. (See Chapter 6 in the Operators Manual for a discussion of the commands available for IEEE-488 operation.)

Remote Operation (RS-232)

There are two rear-panel serial data RS-232 ports: SERIAL 1 FROM HOST, and SERIAL 2 TO UUT (see Figure 2). Each port is dedicated to serial data communications for operating and controlling the 5522A during calibration procedures. For complete information on remote operations, see Chapter 5 in the Operators Manual.

The SERIAL 1 FROM HOST serial data port connects a host terminal or personal computer to the Calibrator. You have several choices for sending commands to the Calibrator: you can enter commands from a terminal (or a PC running a terminal program), you can write your own programs using BASIC, or you can run optional Windows-based software such as 5500/CAL or MET/CAL. The 5500/CAL Software includes more than 200 example procedures covering a wide range of test tools the 5522A can calibrate. (See Chapter 6 in the Operators Manual for a discussion of the RS-232 commands.)

The SERIAL 2 TO UUT serial data port connects a UUT to a PC or terminal via the 5522A (see Figure 2). This "pass-through" configuration eliminates the requirement for two COM ports at the PC or terminal. A set of four commands control the operation of the SERIAL 2 TO UUT serial port. See Chapter 6 in the Operators Manual for a discussion of the UUT_* commands. The SERIAL 2 TO UUT port is also used to connect to the Fluke 700 Series Pressure Modules.

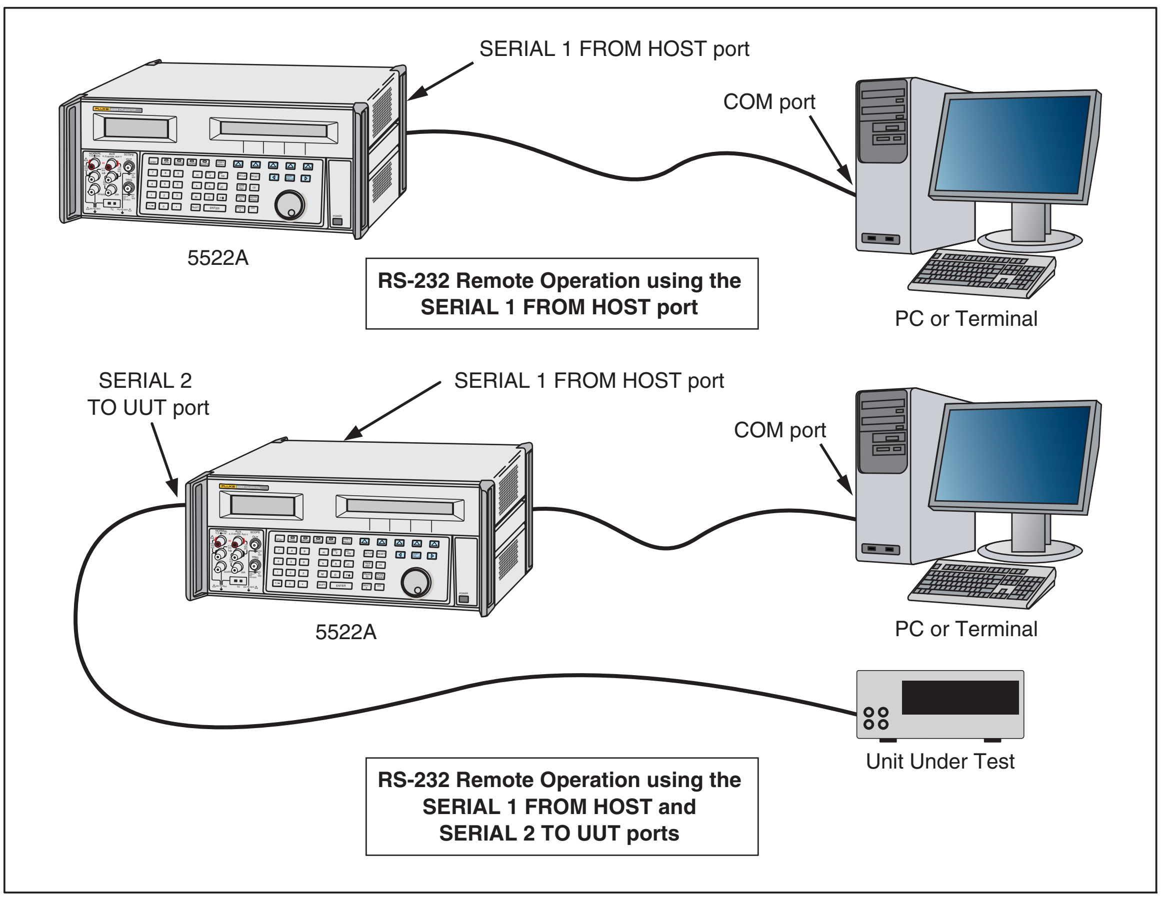

Figure 2. RS-232 Remote Connections

Unpack and Inspect

The calibrator is shipped in a container designed to prevent damage during shipping. Inspect the calibrator carefully for damage and immediately report any damage to the shipper. Instructions for inspection and claims are included in the shipping container.

When you unpack the calibrator, check for all the standard equipment listed in Table 2 and check the shipping order for any additional items ordered. Refer to Chapter 8 of the 5522A Operators Manual, "Accessories" for more information. Report any shortage to the place of purchase or to the nearest Fluke Service Center (see "How to Contact Fluke" in this manual). A performance test is provided in Chapter 7 of the 5522A Operators manual, "Maintenance."

If reshipping the calibrator, use the original container. If it is not available, you can order a new container from Fluke by indicating the Calibrator's model and serial number.

Table 2. Standard Equipment

Item	Model or Part Number
Calibrator	5522A
Line Power Cord	See Table 3 and Figure 4
5522A Getting Started Manual	3795091
5522A Operators Manual on CD-ROM	3795084

How to Replace the Mains Power Fuse

⚠ Caution

To prevent possible damage to the product, verify the correct fuse is installed for the selected line voltage setting. 100 V and 120 V, use 5.0 A/250 V time delay (slow blow); 200 V and 240 V, use 2.5 A/250 V time delay (slow blow).

The line power fuse is accessible on the rear panel. The fuse rating is 5 A/250 V slow blow fuse for the 100 V/120 V line voltage setting; 2.5 A/250 V slow blow fuse for the 220 V/240 V line voltage setting. Fuses that are not user replaceable are discussed in Chapter 7, "Maintenance."

To check or replace the fuse, refer to Figure 3 and proceed as follows:

1. **Disconnect line power**.
2. Open the fuse compartment by inserting a screwdriver blade in the tab located at the left side of the compartment and gently pry until it can be removed with the fingers.
3. Remove the fuse from the compartment for replacement or verification. Be sure the correct fuse is installed.
4. Reinstall the fuse compartment by pushing it back into place until the tab locks.

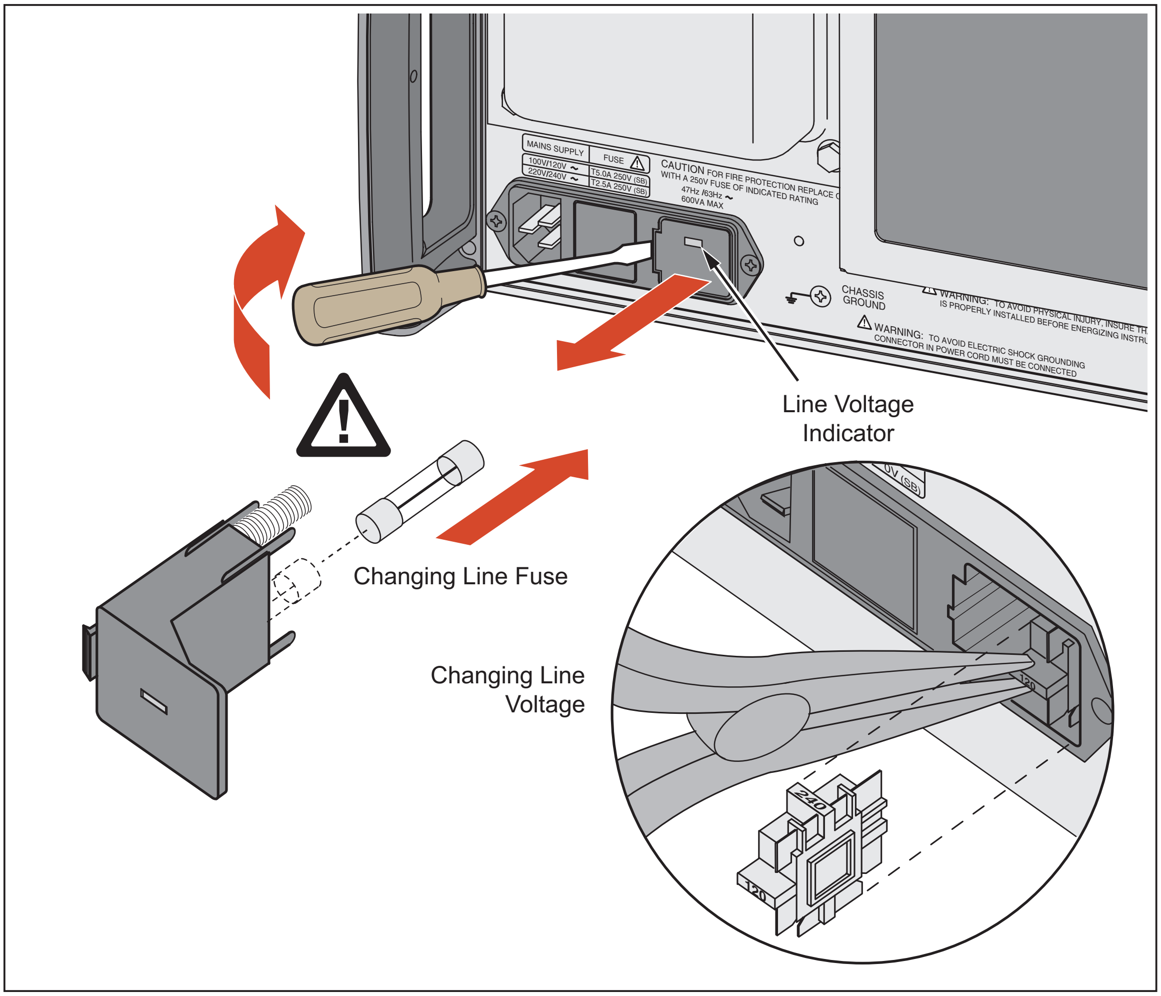

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Figure 3. How to Access the Fuse and Select Line Voltage

How to Select Line Voltage

The calibrator arrives from the factory configured for the line voltage normally appropriate for the country of purchase, or as specified at the time of your purchase order. You can operate the 5522A Calibrator from one of four line voltage settings: 100 V, 120 V, 200 V, and 240 V (47 Hz to 63 Hz). To check the line voltage setting, note the voltage setting visible through the window in the power line fuse compartment cover (Figure 3). The allowed line voltage variation is 10 % above or below the line voltage setting.

To change the line voltage setting, complete the following procedure:

1. **Disconnect line power**.
2. Open the fuse compartment by inserting a screwdriver blade in the tab located at the left side of the compartment and gently pry until it can be removed with the fingers.
3. Remove the line voltage selector assembly by gripping the line voltage indicator tab with pliers and pulling it straight out of its connector.
4. Rotate the line voltage selector assembly to the desired voltage and reinsert.
5. Verify the appropriate fuse for the selected line voltage (100 V/120 V, use 5 A/250 V slow blow; 220 V/240 V, use 2.5 A/250 V slow blow) and reinstall the fuse compartment by pushing it back into place until the tab locks.

Connecting 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 calibrator is shipped with the appropriate line power plug for the country of purchase. If you need a different type, refer to Table 3 and Figure 4 for a list and illustration of the line power plug types available from Fluke.

After you verify that the line voltage selection is set correctly and that the correct fuse for that line voltage is installed, connect the calibrator to a properly grounded three-prong outlet.

How to Select Line Frequency

The calibrator is shipped from the factory for nominal operation at 60 Hz line frequency. If you are using 50 Hz line voltage, you should re-configure the 5522A for optimal performance at 50 Hz. To do so, from the front panel, go into SETUP, INSTMT SETUP, OTHER SETUP, and then push the softkey under MAINS to change to 50 Hz. Store the change. After the instrument is properly warmed up (on for 30 minutes or longer), you must re-zero the complete instrument. For details, see the section on “Zeroing the Calibrator” in Chapter 4.

Table 3. Line Power Cord Types Available from Fluke

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

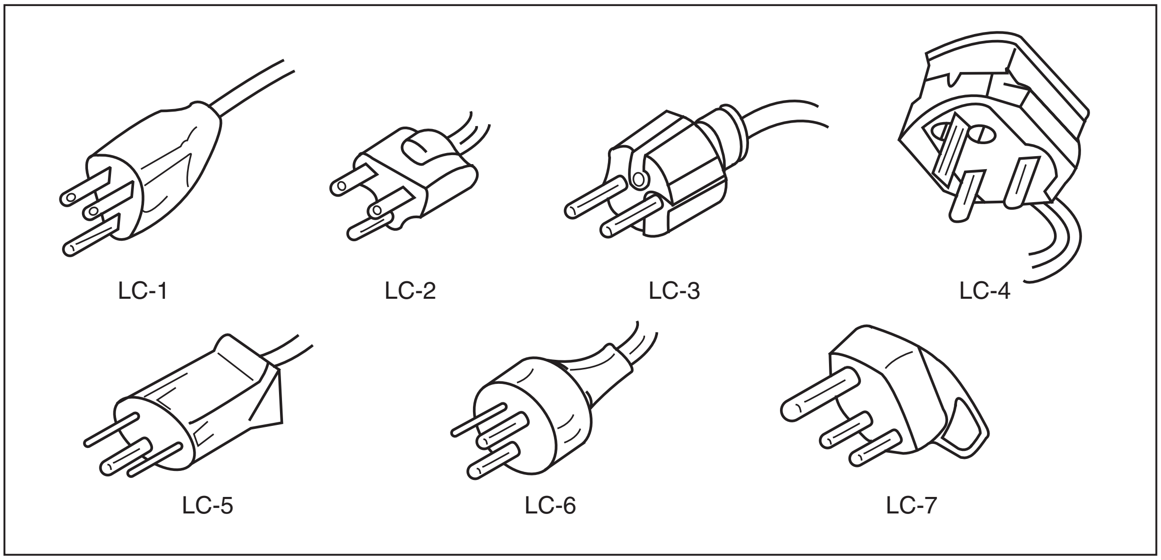

Figure 4. Line Power Cord Types Available from Fluke

Placement and Rack Mounting

⚠⚠ Warning

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

You may place the calibrator on a bench top or mount it in a standard-width, 24-inch (61-cm) deep equipment rack. For bench-top use, the calibrator is equipped with non-slipping, non-marring feet. To mount the calibrator in an equipment rack, use the 5522A Rack Mount Kit, Model Y5537. Instructions for rack mounting the calibrator are packed with the rack mount kit.

Cooling Considerations

⚠ Caution

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

Baffles direct cooling air from the fan throughout the chassis to internally dissipate heat during operation. The accuracy and dependability of all internal parts of the calibrator are enhanced by maintaining the coolest possible internal temperature. You can lengthen the life of the calibrator and enhance its performance by observing the following rules:

- The area around the air filter must be at least 3 inches from nearby walls or rack enclosures.
- The exhaust perforations on the sides of the calibrator must be clear of obstructions.
- The air entering the instrument must be at room temperature: make sure the exhaust air from another instrument is not directed into the fan inlet.
- Clean the air filter every 30 days or more frequently if the calibrator is operated in a dusty environment. (See Chapter 7, "Maintenance" for instructions on cleaning the air filter.)

Where to Go from Here

To locate specific information in the Operators Manual (provided as a pdf file on the CD-ROM) refer to the following list:

- Unpacking and setup: Chapter 2, "Prepare for Operation"
- Installation and rack mounting: Chapter 2, "Prepare for Operation," and the rack mount kit instruction sheet
- AC line power and interface cabling: Chapter 2, "Prepare for Operation"
- Controls, indicators, and displays: Chapter 3, "Features"
- Front panel operation: Chapter 4, "Front Panel Operation"
- Cabling to a UUT (Unit Under Test): Chapter 4, "Front Panel Operation"
- Remote operation (IEEE-488 or serial): Chapter 5, "Remote Operation"
- Calibrating an Oscilloscope: Chapters 9, or 10, "SC-600 Oscilloscope Calibration Option", or "SC-1100 Oscilloscope Calibration Option"
- Calibrating Power Quality Equipment: Chapter 11, "PQ Option"
- Accessories to the 5522A Calibrator: Chapter 8, "Accessories"
- Performance Specifications: Chapter 1, "Introduction and Specifications"

Instruction Manuals

The 5522A manual set provides complete information for operators. The set includes:

- *5522A Getting Started Manual* (PN 3795091)
- *5522A Operators Manual* provided on CD-ROM (PN 3795084)

5522A Getting Started Manual

This 5522A Getting Started Manual contains a brief introduction to the 5522A Manual Set, instructions on how to get your calibrator prepared for operation and a complete set of specifications.

5522A Operators Manual

The 5522A Operators Manual provides complete information for installing the 5522A Calibrator and operating it from the front panel keys and in remote configurations. This manual also provides a glossary of calibration, specifications, and error code information. The Operators Manual includes the following topics:

- Installation
- Operating controls and features, including front-panel operation.
- Remote operation (IEEE-488 bus or serial port remote control)
- Serial port operation (printing, displaying, or transferring data, and setting up for serial port remote control)
- Operator maintenance, including verification procedures and calibration approach for the 5522A.
- Oscilloscope calibration options
- Accessories

General Specifications

The following tables list the 5522A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5522A has been turned off. (For example, if the 5522A has been turned off for 5 minutes, the warm-up period is 10 minutes.)

All specifications apply for the temperature and time period indicated. For temperatures outside of tcal ±5 °C (tcal is the ambient temperature when the 5522A was calibrated), the temperature coefficient as stated in the General Specifications must be applied.

The specifications also assume the Calibrator is zeroed every seven days or whenever the ambient temperature changes more than 5 °C. The tightest ohms specifications are maintained with a zero cal every 12 hours within ±1 °C of use.

Also see additional specifications later in this chapter for information on extended specifications for ac voltage and current.

Warmup Time .... Twice the time since last warmed up, to a maximum of 30 minutes.

Settling Time .... Less than 5 seconds for all functions and ranges except as noted.

Standard Interfaces .... IEEE-488 (GPIB), RS-232

Temperature

Operating .... 0 °C to 50 °C

Calibration (tcal) .... 15 °C to 35 °C

Storage .... -20 ° to +50 °C; The DC current ranges 0 to 1.09999 A and 1.1 A to 2.99999 A are sensitive to storage temperatures above 50 °C. If the 5522A is stored above 50 °C for greater than 30 minutes, these ranges must be re-calibrated. Otherwise, the 90 day and 1 year uncertainties of these ranges double.

Temperature Coefficient .... Temperature coefficient for temperatures outside tcal +5 °C is 0.1/X/°C of the 90-day specification (or 1-year, as applicable) per °C

Relative Humidity

Operating .... <80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C

Storage .... <95 %, non-condensing. After long periods of storage at high humidity, a drying-out period (with power on) of at least one week may be required.

Altitude

Operating .... 3,050 m (10,000 ft) maximum

Non-operating .... 12,200 m (40,000 ft) maximum

Safety .... Complies with EN/IEC 61010-1:2001, CAN/CSA-C22.2 No. 61010-1-04, ANSI/UL 61010-1:2004;

Output Terminal Electrical Overload Protection Provides reverse-power protection, immediate output disconnection, and/or fuse protection on the output terminals for all functions. This protection is for applied external voltages up to ±300 V peak.

Analog Low Isolation .... 20 V normal operation, 400 V peak transient

EMC .... Complies with EN/IEC 61326-1:2006. If used in areas with Electromagnetic fields of 1 to 3 V/m, resistance outputs have a floor adder of 0.508 Ω. Performance not specified above 3 V/m. This instrument may be susceptible to electro-static discharge (ESD) from direct contact to the binding posts. Good static aware practices should be followed when handling this and other pieces of electronic equipment.

Line Power .... Line Voltage (selectable): 100 V, 120 V, 220 V, 240 V
Line Frequency: 47 Hz to 63 Hz
Line Voltage Variation: ±10 % about line voltage setting
For optimal performance at full dual outputs (e.g. 1000 V, 20 A) choose a ling voltage setting that is ±7.5 % from nominal.

Power Consumption .... 600 VA

Dimensions (HxWxL) .... 17.8 cm x 43.2 cm x 47.3 cm (7 in x 17 in x 18,6 in) Standard rack width and rack increment, plus 1.5 cm (0.6 in) for feet on bottom of unit.

Weight (without options) .... 22 kg (49 lb)

Absolute Uncertainty Definition .... The 5522A specifications include stability, temperature coefficient, linearity, line and load regulation, and the traceability of the external standards used for calibration. You do not need to add anything to determine the total specification of the 5522A for the temperature range indicated.

Specification Confidence Interval .... 99 %

Detailed Specifications

DC Voltage

Range	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +µV)		Stability	Resolution µV	Max Burden [1]
	90 days	1 year	24 hours, ±1 °C ±(ppm, output +µV)		
0 to 329.9999 mV	15 + 1	20 + 1	3 + 1	0.1	65 Ω
0 to 3.299999 V	9 + 2	11 + 2	2 + 1.5	1	10 mA
0 to 32.99999 V	10 + 20	12 + 20	2 + 15	10	10 mA
30 to 329.9999 V	15 + 150	18 + 150	2.5 + 100	100	5 mA
100 to 1020.000 V	15 + 1500	18 + 1500	3 + 300	1000	5 mA
Auxiliary Output (dual output mode only) [2]					
0 to 329.9999 mV	300 + 350	400 + 350	30 + 100	1	5 mA
0.33 to 3.299999 V	300 + 350	400 + 350	30 + 100	10	5 mA
3.3 to 7 V	300 + 350	400 + 350	30 + 100	100	5 mA
TC Simulate and Measure in Linear 10 µV/°C and 1 mV/°C modes [3]					
0 to 329.9999 mV	40 + 3	50 + 3	5 + 2	0.1	10 Ω

[1] Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output has an output resistance of <1 Ω. TC simulation has an output impedance of 10 Ω ±1 Ω.

[2] Two channels of dc voltage output are provided.

[3] TC simulating and measuring are not specified for operation in electromagnetic fields above 0.4 v/m.

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p ±(ppm output + floor)	Bandwidth 10 Hz to 10 kHz rms
0 to 329.9999 mV	0 + 1 µV	6 µV
0 to 3.299999 V	0 + 10 µV	60 µV
0 to 32.99999 V	0 + 100 µV	600 µV
30 to 329.9999 V	10 + 1 mV	20 mV
100 to 1020.000 V	10 + 5 mV	20 mV
Auxiliary Output (dual output mode only) [1]		
0 to 329.9999 mV	0 + 5 µV	20 µV
0.33 to 3.299999 V	0 + 20 µV	200 µV
3.3 to 7 V	0 + 100 µV	1000 µV

[1] Two channels of dc voltage output are provided.

DC Current

Range	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +µA)		Resolution	Max Compliance Voltage V	Max Inductive Load mH
	90 days	1 year			
0 to 329.999 µA	120 + 0.02	150 + 0.02	1 nA	10	400
0 to 3.29999 mA	80 + 0.05	100 + 0.05	0.01 µA	10	
0 to 32.9999 mA	80 + 0.25	100 + 0.25	0.1 µA	7	
0 to 329.999 mA	80 + 2.5	100 + 2.5	1 µA	7	
0 to 1.09999 A	160 + 40	200 + 40	10 µA	6	
1.1 to 2.99999 A	300 + 40	380 + 40	10 µA	6	
0 to 10.9999 A (20 A Range)	380 + 500	500 + 500	100 µA	4	
11 to 20.5 A [1]	800 + 750 [2]	1000 + 750 [2]	100 µA	4	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1-4. The current may be provided 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in amperes. For example, 17 A, at 23 °C could be provided for 60-17-23 = 20 minutes each hour. When the 5522A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure B is achieved only after the 5522A is outputting currents <5 A for the "off" period first.

[2] Floor specification is 1500 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 750 µA.

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p	**Bandwidth 10 Hz to 10 kHz rms**
0 to 329.999 μA	2 nA	20 nV
0 to 3.29999 mA	20 nA	200 nV
0 to 32.9999 mA	200 nA	2.0 μA
0 to 329.999 mA	2000 nA	20 μA
0 to 2.99999 A	20 μA	1 mA
0 to 20.5 A	200 μA	10 mA

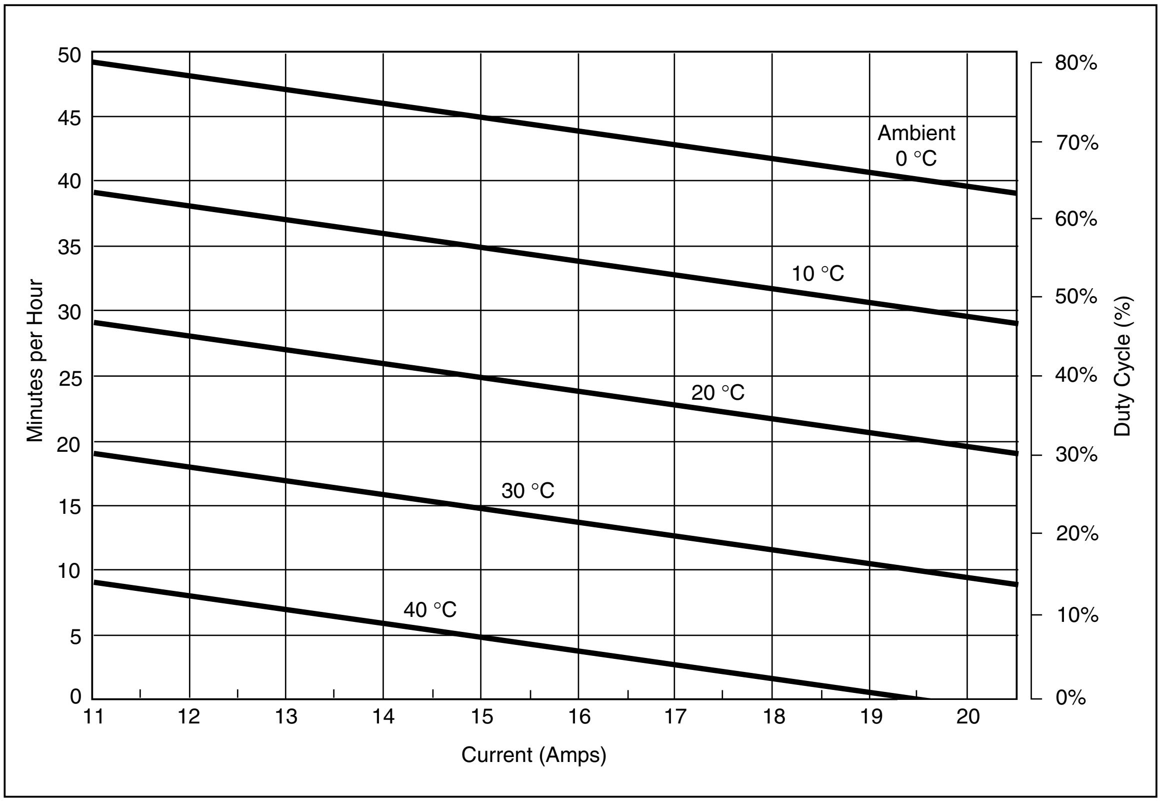

Figure 5. Allowable Duration of Current >11 A

Resistance

Range [1]	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +floor) [2]				Resolution Ω	Allowable Current [3]
	ppm of output		Floor (Ω) Temp and temp since ohms zero cal			
	90 days	1 year	12 hrs ±1 °C	7 days ±5 °C		
0 to 10.9999 Ω	35	40	0.001	0. 01	0.0001	1 mA to 125 mA
11 to 32.9999 Ω	25	30	0.0015	0.015	0.0001	1 mA to 125 mA
33 to 109.9999 Ω	22	28	0.0014	0.015	0.0001	1 mA to 70 mA
110 Ω to 329.9999 Ω	22	28	0.002	0.02	0.0001	1 mA to 40 mA
330 Ω to 1.099999 kΩ	22	28	0.002	0.02	0.001	1 mA to 18 mA
1.1 to 3.299999 kΩ	22	28	0.02	0.2	0.001	100 µA to 5 mA
3.3 to 10.99999 kΩ	22	28	0.02	0.1	0.01	100 µA to 1.8 mA
11 to 32.99999 kΩ	22	28	0.2	1	0.01	10 µA to 0.5 mA
33 to 109.9999 kΩ	22	28	0.2	1	0. 1	10 µA to 0.18 mA
110 to 329.99999 kΩ	25	32	2	10	0.1	1 µA to 0.05 mA
330 kΩ to 1.099999 MΩ	25	32	2	10	1	1 µA to 0.018 mA
1.1 to 3.299999 MΩ	40	60	30	150	1	250 nA to 5 µA
3.3 to 10.99999 MΩ	110	130	50	250	10	250 nA to 1.8 µA
11 to 32.99999 MΩ	200	250	2500	2500	10	25 nA to 500 nA
33 to 109.9999 MΩ	400	500	3000	3000	100	25 nA to 180 nA
110 to 329.9999 MΩ	2500	3000	100000	100000	1000	2.5 nA to 50 nA
330 to 1100 MΩ	12000	15000	500000	500000	10000	1 nA to 13 nA

[1] Continuously variable from 0 Ω to 1.1 GΩ.

[2] Applies for 4-WIRE compensation only. For 2-WIRE and 2-WIRE COMP, add 5 µV per Amp of stimulus current to the floor specification. For example, in 2-WIRE mode, at 1 kΩ the floor specification within 12 hours of an ohms zero cal for a measurement current of 1 mA is:
0.002 Ω + 5 µV / 1 mA = (0.022 + 0.005) Ω = +0.007 Ω.

[3] For currents lower than shown, the floor adder increases by Floor(new) = Floor(old) x Imin/Iactual. For example, a 50 µA stimulus measuring 100 Ω has a floor specification of: 0.0014 Ω x 1 mA/50 µA = 0.028 Ω assuming an ohms zero calibration within 12 hours.

AC Voltage (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(ppm of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% output + floor)
		90 days	1 year			
Normal Output						
1.0 mV to 32.999 mV	10 Hz to 45 Hz	600 + 6	800 + 6	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	120 + 6	150 + 6			0.035 + 90 µV
	10 kHz to 20 kHz	160 + 6	200 + 6			0.06 + 90 µV
	20 kHz to 50 kHz	800 + 6	1000 + 6			0.15 + 90 µV
	50 kHz to 100 kHz	3000 + 12	3500 + 12			0.25 + 90 µV
	100 kHz to 500 kHz	6000 + 50	8000 + 50			0.3 + 90 µV [1]
33 mV to 329.999 mV	10 Hz to 45 Hz	250 + 8	300 + 8	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	140 + 8	145 + 8			0.035 + 90 µV
	10 kHz to 20 kHz	150 + 8	160 + 8			0.06 + 90 µV
	20 kHz to 50 kHz	300 + 8	350 + 8			0.15 + 90 µV
	50 kHz to 100 kHz	600 + 32	800 + 32			0.20 + 90 µV
	100 kHz to 500 kHz	1600 + 70	2000 + 70			0.20 + 90 µV [1]
0.33 V to 3.29999 V	10 Hz to 45 Hz	250 + 50	300 + 50	10 µV	10 mA	0.15 + 200 µV
	45 Hz to 10 kHz	140 + 60	150 + 60			0.035 + 200 µV
	10 kHz to 20 kHz	160 + 60	190 + 60			0.06 + 200 µV
	20 kHz to 50 kHz	250 + 50	300 + 50			0.15 + 200 µV
	50 kHz to 100 kHz	550 + 125	700 + 125			0.20 + 200 µV
	100 kHz to 500 kHz	2000 + 600	2400 + 600			0.20 + 200 µV [1]
3.3 V to 32.9999 V	10 Hz to 45 Hz	250 + 650	300 + 650	100 µV	10 mA	0.15 + 2 mV
	45 Hz to 10 kHz	125 + 600	150 + 600			0.035 + 2 mV
	10 kHz to 20 kHz	220 + 600	240 + 600			0.08 + 2 mV
	20 kHz to 50 kHz	300 + 600	350 + 600			0.2 + 2 mV
	50 kHz to 100 kHz	750 + 1600	900 + 1600			0.5 + 2 mV
33 V to 329.999 V	45 Hz to 1 kHz	150 + 2000	190 + 2000	1 mV	5 mA, except 20 mA for 45 Hz to 65 Hz	0.15 + 10 mV
	1 kHz to 10 kHz	160 + 6000	200 + 6000			0.05 +10 mV
	10 kHz to 20 kHz	220 + 6000	250 + 6000			0.6 + 10 mV
	20 kHz to 50 kHz	240 + 6000	300 + 6000			0.8 + 10 mV
	50 kHz to 100 kHz	1600 + 50000	2000 + 50000			1.0 + 10 mV
330 V to 1020 V	45 Hz to 1 kHz	250 + 10000	300 + 10000	10 mV	2 mA, except 6 mA for 45 Hz to 65 Hz	0.15 + 30 mV
	1 kHz to 5 kHz	200 + 10000	250 + 10000			0.07 + 30 mV
	5 kHz to 10 kHz	250 + 10000	300 + 10000			0.07 + 30 mV

[1] Max Distortion for 100 kHz to 200 kHz. For 200 kHz to 500 kHz, the maximum distortion is 0.9 % of output + floor as shown.

Note

Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits

AC Voltage (Sine Wave) (cont.)

Range	Frequency [1]	Absolute Uncertainty, tcal ±5 °C ±(% of output + μV) 90 days	1 year	Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% output + floor)
AUX Output						
10 mV to 329.999 mV	10 Hz to 20 Hz	0.15 + 370	0.2 + 370	1 μv	5 mA	0.2 + 200 μV
	20 Hz to 45 Hz	0.08 + 370	0.1 + 370			0.06 + 200 μV
	45 Hz to 1 kHz	0.08 + 370	0.1 + 370			0.08 + 200 μV
	1 kHz to 5 kHz	0.15 + 450	0.2 + 450			0.3 + 200 μV
	5 kHz to 10 kHz	0.3 + 450	0.4 + 450			0.6 + 200 μV
	10 kHz to 30 kHz	4.0 + 900	5.0 + 900			1 + 200 μV
0.33 V to 3.29999 V	10 Hz to 20 Hz	0.15 + 450	0.2 + 450	10 μv	5 mA	0.2 + 200 μV
	20 Hz to 45 Hz	0.08 + 450	0.1 + 450			0.06 + 200 μV
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 μV
	1 kHz to 5 kHz	0.15 + 1400	0.2 + 1400			0.3 + 200 μV
	5 kHz to 10 kHz	0.3 + 1400	0.4 + 1400			0.6 + 200 μV
	10 kHz to 30 kHz	4.0 + 2800	5.0 + 2800			1 + 200 μV
3.3 v to 5 v	10 Hz to 20 Hz	0.15 + 450	0.2 + 450	100 μv	5 mA	0.2 + 200 μV
	20 Hz to 45 Hz	0.08 + 450	0.1 + 450			0.06 + 200 μV
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 μV
	1 kHz to 5 kHz	0.15 + 1400	0.2 + 1400			0.3 + +200 μV
	5 kHz to 10 kHz	0.3 + 1400	0.4 + 1400			0.6 + 200 μV

[1] There are two channels of voltage output. The maximum frequency of the dual output is 30 kHz.

Note

Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits

AC Current (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Compliance adder ±(µA/V)	Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load µH
		90 days	1 year			
LCOMP Off						
29.00 to 329.99 µA	10 to 20 Hz	0.16 + 0.1	0.2 + 0.1	0.05	0.15 + 0.5 µA	200
	20 to 45 Hz	0.12 + 0.1	0.15 + 0.1	0.05	0.1 + 0.5 µA	
	45 Hz to 1 kHz	0.1 + 0.1	0.125 + 0.1	0.05	0.05 + 0.5 µA	
	1 to 5 kHz	0.25 + 0.15	0.3 + 0.15	1.5	0.5 + 0.5 µA	
	5 to 10 kHz	0.6 + 0.2	0.8 + 0.2	1.5	1.0 + 0.5 µA	
	10 to 30 kHz	1.2 + 0.4	1.6 + 0.4	10	1.2 + 0.5 µA	
0.33 to 3.29999 mA	10 to 20 Hz	0.16 + 0.15	0.2 + 0.15	0.05	0.15 + 1.5 µA	200
	20 to 45 Hz	0.1 + 0.15	0.125 + 0.15	0.05	0.06 + 1.5 µA	
	45 Hz to 1 kHz	0.08 + 0.15	0.1 + 0.15	0.05	0.02 + 1.5 µA	
	1 to 5 kHz	0.16 + 0.2	0.2 + 0.2	1.5	0.5 + 1.5 µA	
	5 to 10 kHz	0.4 + 0.3	0.5 + 0.3	1.5	1.0 + 1.5 µA	
	10 to 30 kHz	0.8 + 0.6	1.0 + 0.6	10	1.2 + 0.5 µA	
3.3 to 32.9999 mA	10 to 20 Hz	0.15 + 2	0.18 + 2	0.05	0.15 + 5 µA	50
	20 to 45 Hz	0.075 + 2	0.09 + 2	0.05	0.05 + 5 µA	
	45 Hz to 1 kHz	0.035 + 2	0.04 + 2	0.05	0.07 + 5 µA	
	1 to 5 kHz	0.065 + 2	0.08 + 2	1.5	0.3 + 5 µA	
	5 to 10 kHz	0.16 + 3	0.2 + 3	1.5	0.7 + 5 µA	
	10 to 30 kHz	0.32 + 4	0.4 + 4	10	1.0 + 0.5 µA	
33 to 329.999 mA	10 to 20 Hz	0.15 + 20	0.18 + 20	0.05	0.15 + 50 µA	50
	20 to 45 Hz	0.075 + 20	0.09 + 20	0.05	0.05 + 50 µA	
	45 Hz to 1 kHz	0.035 + 20	0.04 + 20	0.05	0.02 + 50 µA	
	1 to 5 kHz	0.08 + 50	0.10 + 50	1.5	0.03 + 50 µA	
	5 to 10 kHz	0.16 + 100	0.2 + 100	1.5	0.1 + 50 µA	
	10 to 30 kHz	0.32 + 200	0.4 + 200	10	0.6 + 50 µA	
0.33 to 1.09999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.2 + 500 µA	2.5
	45 Hz to 1 kHz	0.036 + 100	0.05 + 100		0.07 + 500 µA	
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2 + 500 µA	
1.1 to 2.99999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.2 + 500 µA	2.5
	45 Hz to 1 kHz	0.05 + 100	0.06 + 100		0.07 + 500 µA	
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2 + 500 µA	
3 to 10.9999 A	45 to 100 Hz	0.05 + 2000	0.06 + 2000		0.2 + 3 mA	1
	100 Hz to 1 kHz	0.08 + 2000	0.10 + 2000		0.1 + 3 mA	
	1 to 5 kHz	2.5 + 2000	3.0 + 2000		0.8 + 3 mA	
11 to 20.5 A [1]	45 to 100 Hz	0.1 + 5000	0.12 + 5000		0.2 + 3 mA	1
	100 Hz to 1 kHz	0.13 + 5000	0.15 + 5000		0.1 + 3 mA	
	1 to 5 kHz	2.5 + 5000	3.0 + 5000		0.8 + 3 mA	

AC Current (Sine Wave) (cont.)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + μA) 90 days	Absolute Uncertainty, tcal ±5 °C ±(% of output + μA) 1 year	Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load μH
LCOMP On					
29.00 to 329.99 μA	10 to 100 Hz	0.2 + 0.2	0.25 + 0.2	0.1 + 1.0 μA	400
	100 Hz to 1 kHz	0.5 + 0.5	0.6 + 0.5	0.05 + 1.0 μA	
0.33 to 3.29999 mA	10 to 100 Hz	0.2 + 0.3	0.25 + 0.3	0.15 + 1.5 μA	
	100 Hz to 1 kHz	0.5 + 0.8	0.6 + 0.8	0.06 + 1.5 μA	
3.3 to 32.9999 mA	10 to 100 Hz	0.07 + 4	0.08 + 4	0.15 + 5 μA	
	100 Hz to 1 kHz	0.18 + 10	0.2 + 10	0.05 + 5 μA	
33 to 329.999 mA	10 to 100 Hz	0.07 + 40	0.08 + 40	0.15 + 50 μA	
	100 Hz to 1 kHz	0.18 + 100	0.2 + 100	0.05 + 50 μA	
0.33 to 2.99999 A	10 to 100 Hz	0.1 + 200	0.12 + 200	0.2 + 500 μA	
	100 to 440 Hz	0.25 + 1000	0.3 + 1000	0.25 + 500 μA	
3 to 20.5 A [1]	10 to 100 Hz	0.1 + 2000 [2]	0.12 + 2000 [2]	0.1 + 0 μA	400 [4]
	100 Hz to 1 kHz	0.8 + 5000 [3]	1.0 + 5000 [3]	0.5 + 0 μA	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure B. The current may be provided 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in Amps. For example, 17 A, at 23 °C could be provided for 60-17-23 = 20 minutes each hour. When the 5522A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure B is achieved only after the 5522A is outputting currents <5 A for the "off" period first.

[2] For currents >11 A, Floor specification is 4000 μA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 2000 μA.

[3] For currents >11 A, Floor specification is 1000 μA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 5000 μA.

[4] Subject to compliance voltages limits.

Range	Resolution μA	Max Compliance Voltage V rms [1]
0.029 to 0.32999 mA	0.01	7
0.33 to 3.29999 mA	0.01	7
3.3 to 32.9999 mA	0.1	5
33 to 329.999 mA	1	5
0.33 to 2.99999 A	10	4
3 to 20.5 A	100	3

[1] Subject to specification adder for compliance voltages greater than 1 V rms.

Capacitance

Range	Absolute Uncertainty, tcal ±5 °C ±(% of output + floor) [1] [2] [3]		Resolution	Allowed Frequency or Charge-Discharge Rate		
	90 days	1 year		Min and Max to Meet Specification	Typical Max for <0.5 % Error	Typical Max for <1 % Error
220 to 399.9 pF	0.38 + 10 pF	0.5 + 10 pF	0.1 pF	10 Hz to 10 kHz	20 kHz	40 kHz
0.4 to 1.0999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 10 kHz	30 kHz	50 kHz
1.1 to 3.2999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 3 kHz	30 kHz	50 kHz
3.3 to 10.9999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	0.1 pF	10 Hz to 1 kHz	20 kHz	25 kHz
11 to 32.9999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	0.1 pF	10 Hz to 1 kHz	8 kHz	10 kHz
33 to 109.999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	1 pF	10 Hz to 1 kHz	4 kHz	6 kHz
110 to 329.999 nF	0.19 + 0.3 nF	0.25 + 0.03 nF	1 pF	10 Hz to 1 kHz	2.5 kHz	3.5 kHz
0.33 to 1.09999 µF	0.19 + 1 nF	0.25 + 1 nF	10 pF	10 to 600 Hz	1.5 kHz	2 kHz
1.1 to 3.29999 µF	0.19 + 3 nF	0.25 + 3 nF	10 pF	10 to 300 Hz	800 Hz	1 kHz
3.3 to 10.9999 µF	0.19 + 10 nF	0.25 + 10 nF	100 pF	10 to 150 Hz	450 Hz	650 Hz
11 to 32.9999 µF	0.30 + 30 nF	0.40 + 30 nF	100 pF	10 to 120 Hz	250 Hz	350 Hz
33 to 109.999 µF	0.34 + 100 nF	0.45 + 100 nF	1 nF	10 to 80 Hz	150 Hz	200 Hz
110 to 329.999 µF	0.34 + 300 nF	0.45 + 300 nF	1 nF	0 to 50 Hz	80 Hz	120 Hz
0.33 to 1.09999 mF	0.34 + 1 µF	0.45 + 1 µF	10 nF	0 to 20 Hz	45 Hz	65 Hz
1.1 to 3.29999 mF	0.34 + 3 µF	0.45 + 3 µF	10 nF	0 to 6 Hz	30 Hz	40 Hz
3.3 to 10.9999 mF	0.34 + 10 µF	0.45 + 10 µF	100 nF	0 to 2 Hz	15 Hz	20 Hz
11 to 32.9999 mF	0.7 + 30 µF	0.75 + 30 µF	100 nF	0 to 0.6 Hz	7.5 Hz	10 Hz
33 to 110 mF	1.0 + 100 µF	1.1 + 100 µF	10 µF	0 to 0.2 Hz	3 Hz	5 Hz

[1] The output is continuously variable from 220 pF to 110 mF.

[2] Specifications apply to both dc charge/discharge capacitance meters and ac RCL meters. The maximum allowable peak voltage is 3 V. The maximum allowable peak current is 150 mA, with an rms limitation of 30 mA below 1.1 µF and 100 mA for 1.1 µF and above.

[3] The maximum lead resistance for no additional error in 2-wire COMP mode is 10 Ω.

Temperature Calibration (Thermocouple)

TC Type [1]	Range °C [2]	Absolute Uncertainty Source/Measure tcal ±5 °C ± °C [3]		TC Type [1]	Range °C [2]	Absolute Uncertainty Source/Measure tcal ±5 °C ± °C [3]	
		90 days	**1 year**			**90 days**	**1 year**
B	600 to 800	0.42	0.44	L	-200 to -100	0.37	0.37
	800 to 1000	0.34	0.34		-100 to 800	0.26	0.26
	1000 to 1550	0.30	0.30		800 to 900	0.17	0.17
	1550 to 1820	0.26	0.33	N	-200 to -100	0.30	0.40
C	0 to 150	0.23	0.30		-100 to -25	0.17	0.22
	150 to 650	0.19	0.26		-25 to 120	0.15	0.19
	650 to 1000	0.23	0.31		120 to 410	0.14	0.18
	1000 to 1800	0.38	0.50		410 to 1300	0.21	0.27
	1800 to 2316	0.63	0.84	R	0 to 250	0.48	0.57
E	-250 to -100	0.38	0.50		250 to 400	0.28	0.35
	-100 to -25	0.12	0.16		400 to 1000	0.26	0.33
	-25 to 350	0.10	0.14		1000 to 1767	0.30	0.40
	350 to 650	0.12	0.16	S	0 to 250	0.47	0.47
	650 to 1000	0.16	0.21		250 to 1000	0.30	0.36
J	-210 to -100	0.20	0.27		1000 to 1400	0.28	0.37
	-100 to -30	0.12	0.16		1400 to 1767	0.34	0.46
	-30 to 150	0.10	0.14	T	-250 to -150	0.48	0.63
	150 to 760	0.13	0.17		-150 to 0	0.18	0.24
	760 to 1200	0.18	0.23		0 to 120	0.12	0.16
K	-200 to -100	0.25	0.33		120 to 400	0.10	0.14
	-100 to -25	0.14	0.18	U	-200 to 0	0.56	0.56
	-25 to 120	0.12	0.16		0 to 600	0.27	0.27
	120 to 1000	0.19	0.26				
	1000 to 1372	0.30	0.40				

[1] Temperature standard ITS-90 or IPTS-68 is selectable.
TC simulating and measuring are not specified for operation in electromagnetic fields above 0.4 V/m.

[2] Resolution is 0.01 °C

[3] Does not include thermocouple error

Temperature Calibration (RTD)

RTD Type	Range °C [1]	Absolute Uncertainty tcal ±5 °C ± °C [2]	
		90 days	1 year
Pt 385, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
	630 to 800	0.21	0.23
Pt 3926, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
Pt 3916, 100 Ω	-200 to -190	0.25	0.25
	-190 to -80	0.04	0.04
	-80 to 0	0.05	0.05
	0 to 100	0.06	0.06
	100 to 260	0.06	0.07
	260 to 300	0.07	0.08
	300 to 400	0.08	0.09
	400 to 600	0.08	0.10
	600 to 630	0.21	0.23
Pt 385, 200 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.03	0.04
	0 to 100	0.04	0.04
	100 to 260	0.04	0.05
	260 to 300	0.11	0.12
	300 to 400	0.12	0.13
	400 to 600	0.12	0.14
	600 to 630	0.14	0.16
Pt 385, 500 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.04	0.05
	0 to 100	0.05	0.05
	100 to 260	0.06	0.06
	260 to 300	0.07	0.08
	300 to 400	0.07	0.08
	400 to 600	0.08	0.09
	600 to 630	0.09	0.11
Pt 385, 1000 Ω	-200 to -80	0.03	0.03
	-80 to 0	0.03	0.03
	0 to 100	0.03	0.04
	100 to 260	0.04	0.05
	260 to 300	0.05	0.06
	300 to 400	0.05	0.07
	400 to 600	0.06	0.07
	600 to 630	0.22	0.23
PtNi 385, 120 Ω (Ni120)	-80 to 0	0.06	0.08
	0 to 100	0.07	0.08
	100 to 260	0.13	0.14
Cu 427, 10 Ω [3]	-100 to 260	0.3	0.3

[1] Resolution is 0.003 °C
[2] Applies for COMP OFF (to the 5522A Calibrator front panel NORMAL terminals) and 2-wire and 4-wire compensation.
[3] Based on MINCO Application Aid No. 18

DC Power Specification Summary

	Voltage Range	Current Range		
		0.33 to 329.99 mA	0.33 to 2.9999 A	3 to 20.5 A
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]		
90 days	33 mV to 1020 V	0.021	0.019 [2]	0.06 [2]
1 year	33 mV to 1020 V	0.023	0.022 [2]	0.07 [2]

[1] To determine dc power uncertainty with more precision, see the individual "AC Voltage Specifications," "AC Current Specifications," and "Calculating Power Uncertainty."
[2] Add 0.02 % unless a settling time of 30 seconds is allowed for output currents >10 A or for currents on the highest two current ranges within 30 seconds of an output current >10 A.

AC Power (45 Hz to 65 Hz) Specification Summary, PF=1

	Voltage Range	Current Range			
		3.3 to 8.999 mA	9 to 32.999 mA	33 to 89.99 mA	90 to 329.99 mA
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]			
90 days	33 to 329.999 mV	0.13	0.09	0.13	0.09
	330 mV to 1020 V	0.11	0.07	0.11	0.07
1 year	33 to 329.999 mV	0.14	0.10	0.14	0.10
	330 mV to 1020 V	0.12	0.08	0.12	0.08
	Voltage Range	Current Range [2]			
		0.33 to 0.8999 A	0.9 to 2.1999 A	2.2 to 4.4999 A	4.5 to 20.5 A
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]			
90 days	33 to 329.999 mV	0.12	0.10	0.12	0.10
	330 mV to 1020 V	0.10	0.08	0.11	0.09
1 year	33 to 329.999 mV	0.13	0.11	0.13	0.11
	330 mV to 1020 V	0.11	0.09	0.12	0.10

[1] To determine ac power uncertainty with more precision, see the individual “DC Voltage Specifications” and “DC Current Specifications” and “Calculating Power Uncertainty.”

[2] Add 0.02 % unless a settling time of 30 seconds is allowed for output currents >10 A or for currents on the highest two current ranges within 30 seconds of an output current >10 A.

Power and Dual Output Limit Specifications

Frequency	Voltages (NORMAL)	Currents	Voltages (AUX)	Power Factor (PF)
dc	0 to ±1020 V	0 to ±20.5 A	0 to ±7 V	—
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	0 to 1
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	0 to 1
65 to 500 Hz	330 mV to 1020 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
65 to 500 Hz	3.3 to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
500 Hz to 1 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
1 to 5 kHz	3.3 to 500 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
5 to 10 kHz	3.3 to 250 V	33 to 329.99 mA	1 to 5 V	0 to 1
10 to 30 kHz	3.3 V to 250 V	33 mA to 329.99 mA	1 V to 3.29999 V	0 to 1

Notes

The range of voltages and currents shown in “DC Voltage Specifications,” “DC Current Specifications,” “AC Voltage (Sine Wave) Specifications,” and “AC Current (Sine Wave) Specifications” are available in the power and dual output modes (except minimum current for ac power is 0.33 mA). However, only those limits shown in this table are specified. See “Calculating Power Uncertainty” to determine the uncertainty at these points.

The phase adjustment range for dual ac outputs is 0 ° to ±179.99 °. The phase resolution for dual ac outputs is 0.01 degree.

Phase

1-Year Absolute Uncertainty, tcal ±5 °C, (Δ Φ °)					
10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz
0.10 °	0.25 °	0.5 °	2.5 °	5 °	10 °
Note See Power and Dual Output Limit Specifications for applicable outputs.					

Phase (Φ) Watts	Phase (Φ) VARs	PF	Power Uncertainty Adder due to Phase Error					
			10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz
0 °	90 °	1.000	0.00 %	0.00 %	0.00 %	0.10 %	0.38 %	1.52 %
10 °	80 °	0.985	0.03 %	0.08 %	0.16 %	0.86 %	1.92 %	4.58 %
20 °	70 °	0.940	0.06 %	0.16 %	0.32 %	1.68 %	3.55 %	7.84 %
30 °	60 °	0.866	0.10 %	0.25 %	0.51 %	2.61 %	5.41 %	11.54 %
40 °	50 °	0.766	0.15 %	0.37 %	0.74 %	3.76 %	7.69 %	16.09 %
50 °	40 °	0.643	0.21 %	0.52 %	1.04 %	5.29 %	10.77 %	22.21 %
60 °	30 °	0.500	0.30 %	0.76 %	1.52 %	7.65 %	15.48 %	31.60 %
70 °	20 °	0.342	0.48 %	1.20 %	2.40 %	12.08 %	24.33 %	49.23 %
80 °	10 °	0.174	0.99 %	2.48 %	4.95 %	24.83 %	49.81 %	100.00 %
90 °	0 °	0.000	—	—	—	—	—	—

To calculate exact ac Watts power adders due to phase uncertainty for values not shown, use the following formula:

$$Adder(\%) = 100(1 - \frac{Cos(\Phi + \Delta\Phi)}{Cos(\Phi)})$$

For example: for a PF of .9205 (Φ = 23) and a phase uncertainty of ΔΦ = 0.15, the ac Watts power adder is:

$$Adder(\%) = 100(1 - \frac{Cos(23{+}.15)}{Cos(23)}) = 0.11\%$$

Calculating Power Uncertainty

Overall uncertainty for power output in Watts (or VARs) is based on the root sum square (rss) of the individual uncertainties in percent for the selected voltage, current, and power factor parameters:

Watts uncertainty $U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{PFadder}}$

VARs uncertainty $U_{VARs} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{VARsadder}}$

Because there are an infinite number of combinations, you should calculate the actual ac power uncertainty for your selected parameters. The method of calculation is best shown in the following examples (using 1 year specifications):

<u>**Example 1**</u> Output: 100 V, 1 A, 60 Hz, Power Factor = 1.0 (Φ=0).

Voltage Uncertainty Uncertainty for 100 V at 60 Hz is 150 ppm + 2 mV, totaling:
100 V x 190 x 10^{-6} = 15 mV added to 2 mV = 17 mV. Expressed in percent:
17 mV/100 V x 100 = <u>0.017 %</u> (see “AC Voltage (Sine Wave) Specifications”).

Current Uncertainty Uncertainty for 1 A is 0.05 % 100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA. Expressed in percent:
0. 6 mA/1 A x 100 = <u>0.06 %</u> (see “AC Current (Sine Waves) Specifications”).

PF Adder Watts Adder for PF = 1 (Φ=0) at 60 Hz is <u>0 %</u> (see “Phase Specifications”).

Total Watts Output Uncertainty = $U_{power} = \sqrt{0.017^2 + 0.06^2 + 0^2} = 0.062\%$

<u>**Example 2**</u> Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 (Φ=60)

Voltage Uncertainty Uncertainty for 100 V at 400 Hz is, 150 ppm + 2 mV, totaling:
100 V x 190 x 10^{-6} = 15 mV added to 2 mV = 17 mV. Expressed in percent:
17 mV/100 V x 100 = <u>0.017 %</u> (see “AC Voltage (Sine Wave) Specifications”).

Current Uncertainty Uncertainty for 1 A is 0.05 % 100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA. Expressed in percent:
0.6 mA/1 A x 100 = <u>0.06 %</u> (see “AC Current (Sine Waves) Specifications”).

PF Adder Watts Adder for PF = 0.5 (Φ=60) at 400 Hz is <u>0.76 %</u> (see “Phase Specifications”).

Total Watts Output Uncertainty = $U_{power} = \sqrt{0.017^2 + 0.06^2 + 0.76^2} = 0.76\%$

VARs When the Power Factor approaches 0.0, the Watts output uncertainty becomes unrealistic because the dominant characteristic is the VARs (volts-amps-reactive) output. In these cases, calculate the Total VARs Output Uncertainty, as shown in example 3:

Example 3 Output: 100 V, 1 A, 60 Hz, Power Factor = 0.174 (Φ=80)

Voltage Uncertainty Uncertainty for 100 V at 400 Hz is, 150 ppm + 2 mV, totaling:
100 V x 190 x 10^{-6} = 15 mV added to 2 mV = 17 mV. Expressed in percent:
17 mV/100 V x 100 = 0.017 % (see “AC Voltage (Sine Wave) Specifications”).

Current Uncertainty Uncertainty for 1 A is 0.05 % + 100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA. Expressed in percent:
0.6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).

VARs Adder VARs Adder for Φ=80 at 60 Hz is 0.03 % (see “Phase Specifications”).

Total VARS Output Uncertainty = $U_{VARs} = \sqrt{0.017^2 + 0.06^2 + 0.03^2} = 0.069\%$

Additional Specifications

The following paragraphs provide additional specifications for the 5522A Calibrator ac voltage and ac current functions. These specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5522A has been turned off. All extended range specifications are based on performing the internal zero-cal function at weekly intervals, or when the ambient temperature changes by more than 5 °C.

Frequency

Frequency Range	Resolution	1-Year Absolute Uncertainty, tcal ±5 °C	Jitter
0.01 to 119.99 Hz	0.01 Hz	2.5 ppm +5 µHz [1]	100 nS
120.0 to 1199.9 Hz	0.1 Hz		
1.200 to 11.999 kHz	1.0 Hz		
12.00 to 119.99 kHz	10 Hz		
120.0 to 1199.9 kHz	100 Hz		
1.200 to 2.000 MHz	1 kHz		

[1] With REF CLK set to ext, the frequency uncertainty of the 5522A is the uncertainty of the external 10 MHz clock ±5 µHz. The amplitude of the 10 MHz external reference clock signal should be between 1 V and 5 V p-p.

Harmonics (2^{nd} to 50^{th})

Fundamental Frequency [1]	Voltages NORMAL Terminals	Currents	Voltages AUX Terminals	Amplitude Uncertainty
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	Same % of output as the equivalent single output, but twice the floor adder.
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	
65 to 500 Hz	33 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
500 Hz to 5 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
5 to 10 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 5 V	
10 to 30 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 3.29999 V	

[1] The maximum frequency of the harmonic output is 30 kHz (10 kHz for 3 to 5 V on the Aux terminals). For example, if the fundamental output is 5 kHz, the maximum selection is the 6th harmonic (30 kHz). All harmonic frequencies (2nd to 50th) are available for fundamental outputs between 10 Hz and 600 Hz (200 Hz for 3 to 5 V on the Aux terminals).

Phase Uncertainty.. Phase uncertainty for harmonic outputs is 1 degree or the phase uncertainty shown in “Phase Specifications” for the particular output, whichever is greater. For example, the phase uncertainty of a 400 Hz fundamental output and 10 kHz harmonic output is 10 ° (from “Phase Specifications”). Another example, the phase uncertainty of a 60 Hz fundamental output and a 400 Hz harmonic output is 1 degree.

Example of determining Amplitude Uncertainty in a Dual Output Harmonic Mode

What are the amplitude uncertainties for the following dual outputs?

NORMAL (Fundamental) Output:

100 V, 100 Hz .... From “AC Voltage (Sine Wave) Specifications” the single output specification for 100 V, 100 Hz, is 0.015 % + 2 mV. For the dual output

in this example, the specification is 0.015 % +4 mV as the 0.015 % is the same, and the floor is twice the value (2 x 2 mV).

AUX (50th Harmonic) Output:

100 mV, 5 kHz .... From “AC Voltage (Sine Wave) Specifications” the auxiliary output specification for 100 mV, 5 kHz, is 0.15 % + 450 mV. For the dual output in this example, the specification is 0.15 % 900 mV as the 0.15 % is the same, and the floor is twice the value (2 x 450 mV).

AC Voltage (Sine Wave) Extended Bandwidth

Range	Frequency	1-Year Absolute Uncertainty tcal ±5 °C	Max Voltage Resolution
Normal Channel (Single Output Mode)			
1.0 to 33 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Two digits, e.g., 25 mV
34 to 330 mV			Three digits
0.4 to 33 V			Two digits
0.3 to 3.3 V	500.1 kHz to 1 MHz	-10 dB at 1 MHz, typical	Two digits
	1.001 to 2 MHz	-31 dB at 2 MHz, typical	
Auxiliary Output (Dual Output Mode)			
10 to 330 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Three digits
0.4 to 5 V			Two digits

AC Voltage (Non-Sine Wave)

Triangle Wave & Truncated Sine Range, p-p [1]	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 92.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
93 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
9.3 to 93 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
9.3 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	

[1] To convert p-p to rms for triangle wave, multiply the p-p value by 0.2886751. To convert p-p to rms for truncated sine wave, multiply the p-p value by 0.2165063.

[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.

[3] Uncertainty for Truncated Sine outputs is typical over this frequency band.

AC Voltage (Non-Sine Wave) (cont.)

Square Wave Range [1] (p-p)	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 65.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
66 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
6.6 to 66.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
6.6 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	

[1] To convert p-p to rms for square wave, multiply the p-p value by 0.5.
[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.
[3] Limited to 1 kHz for Auxiliary outputs ≥6.6 V p-p.

AC Voltage, DC Offset

Range [1] (Normal Channel)	Offset Range [2]	Max Peak Signal	1-Year Absolute Uncertainty, tcal ±5 °C [3] ±(% dc output + floor)
Sine Waves (rms)			
3.3 to 32.999 mV	0 to 50 mV	80 mV	0.1 + 33 µV
33 to 329.999 mV	0 to 500 mV	800 mV	0.1 + 330 µV
0.33 to 3.29999 V	0 to 5 V	8 V	0.1 + 3300 µV
3.3 to 32.9999 V	0 to 50 V	55 V	0.1 + 33 mV
Triangle Waves and Truncated Sine Waves (p-p)			
9.3 to 92.999 mV	0 to 50 mV	80 mV	0.1 + 93 µV
93 to 929.999 mV	0 to 500 mV	800 mV	0.1 + 930 µV
0.93 to 9.29999 V	0 to 5 V	8 V	0.1 + 9300 µV
9.3 to 93.0000 V	0 to 50 V	55 V	0.1 + 93 mV
Square Waves (p-p)			
6.6 to 65.999 mV	0 to 50 mV	80 mV	0.1 + 66 µV
66 to 659.999 mV	0 to 500 mV	800 mV	0.1 + 660 µV
0.66 to 6.59999 V	0 to 5 V	8 V	0.1 + 6600 µV
6.6 to 66.0000 V	0 to 50 V	55 V	0.1 + 66 mV

[1] Offsets are not allowed on ranges above the highest range shown above.
[2] The maximum offset value is determined by the difference between the peak value of the selected voltage output and the allowable maximum peak signal. For example, a 10 V p-p square wave output has a peak value of 5 V, allowing a maximum offset up to ± 50 V to not exceed the 55 V maximum peak signal. The maximum offset values shown above are for the minimum outputs in each range.
[3] For frequencies 0.01 to 10 Hz, and 500 kHz to 2 MHz, the offset uncertainty is 5 % of output, ±1 % of the offset range.

AC Voltage, Square Wave Characteristics

Risetime @ 1 kHz Typical	Settling Time @ 1 kHz Typical	Overshoot @ 1 kHz Typical	Duty Cycle Range	Duty Cycle Uncertainty
<1 µs	<10 µS to 1 % of final value	<2 %	1 % to 99 % <3.3 V p-p. 0,01 Hz to 100 kHz	±(0.02 % of period + 100 ns), 50 % duty cycle ±(0.05 % of period + 100 ns), other duty cycles from 10 % to 90 % ±(0.8 % of period +100 ns)

AC Voltage, Triangle Wave Characteristics (typical)

Linearity to 1 kHz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range

AC Current (Non-Sine Wave)

Triangle Wave & Truncated Sine Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution
0.047 to 0.92999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
0.93 to 9.29999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
9.3 to 92.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
93 to 929.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.5	
	1 to 10 kHz	10 + 2	
0.93 to 8.49999 A	10 to 45 Hz	0.5 + 1.0	Six digits
	45 Hz to 1 kHz	0.5 + 0.5	
	1 to 10 kHz	10 + 2	
8.5 to 57 A [2]	45 to 500 Hz	0.5 + 0.5	
	500 Hz to 1 kHz	1.0 + 1.0	

[1] Frequency limited to 1 kHz with LCOMP on.
[2] Frequency limited to 440 Hz with LCOMP on.

Square Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution
0.047 to 0.65999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
0.66 to 6.59999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
6.6 to 65.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
66 to 659.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.5	
	1 to 10 kHz	10 + 2	
0.66 to 5.99999 A [2]	10 to 45 Hz	0.5 + 1.0	
	45 Hz to 1 kHz	0.5 + 0.5	
	1 to 10 kHz	10 + 2	
6 to 41 A [2]	45 to 500 Hz	0.5 + 0.5	
	500 Hz to 1 kHz	1.0 + 1.0	

[1] Frequency limited to 1 kHz with LCOMP on.
[2] Frequency limited to 440 Hz with LCOMP on.

AC Current, Square Wave Characteristics (typical)

Range	LCOMP	Risetime	Settling Time	Overshoot
I <6 A @ 400 Hz	off	25 μs	40 μs to 1 % of final value	<10 % for <1 V Compliance
3 A & 20 A Ranges	on	100 μs	200 μs to 1 % of final value	<10 % for <1 V Compliance

AC Current, Triangle Wave Characteristics (typical)

Linearity to 400 Hz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range