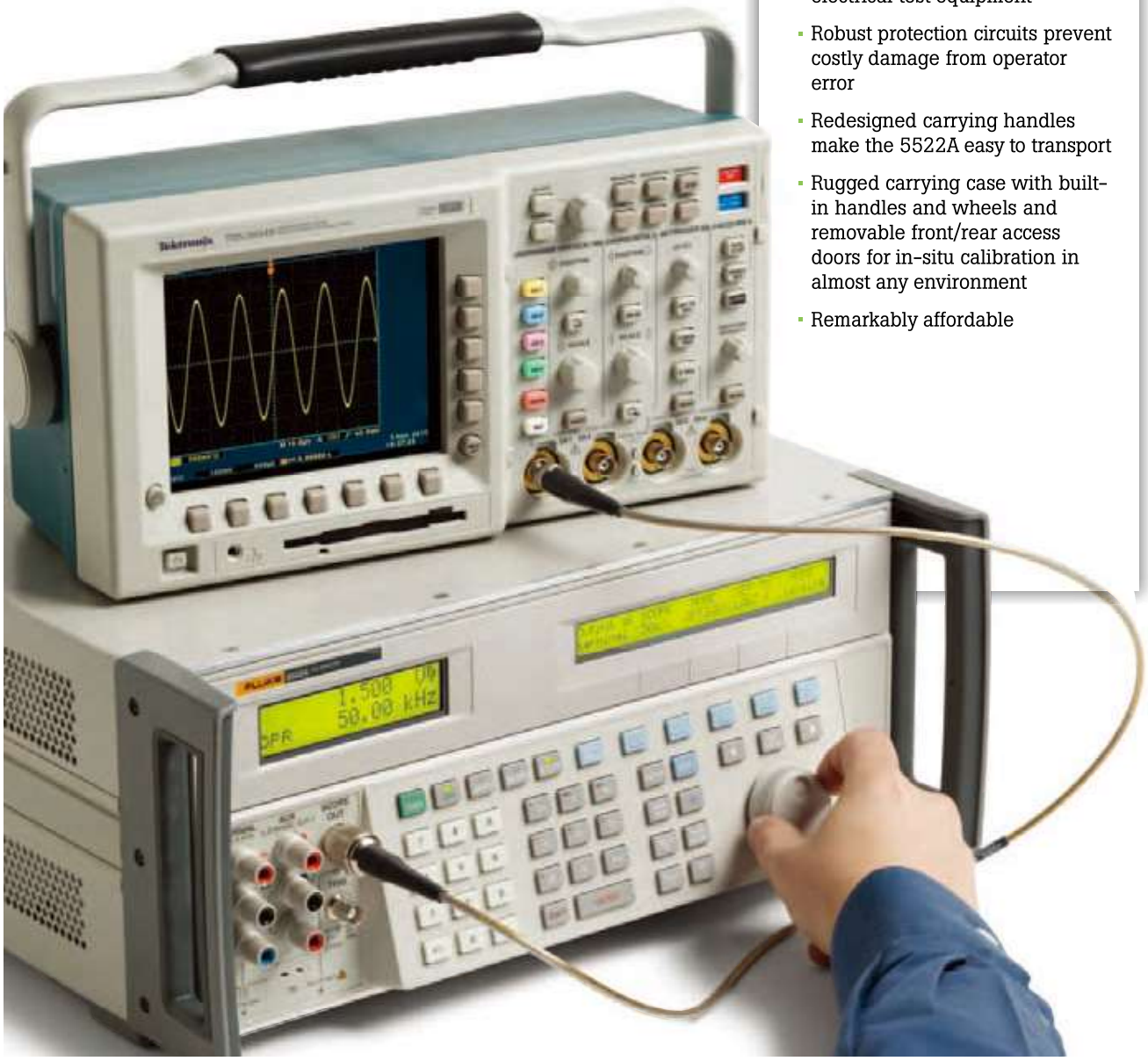
5522A Multi-Product Calibrator

5522A features at a glance

- Calibrates a wide variety of electrical test equipment
- Robust protection circuits prevent costly damage from operator error
- Redesigned carrying handles make the 5522A easy to transport
- Rugged carrying case with built-in handles and wheels and removable front/rear access doors for in-situ calibration in almost any environment
- Remarkably affordable



5522A Multi-Product Calibrator

FLUKE ®
Calibration

Multiple calibrators in one

The 5522A Multi-Product Calibrator addresses a wide calibration workload and comes with internal and external protection features that protect it against damage and make it easier to transport for on-site or mobile calibration.

The 5522A can also be fully automated with MET/CAL® Plus Calibration Management Software.

It is the ideal calibrator for metrology professionals who need to calibrate many different types of electronic equipment and want a transportable instrument that offers them a high return on investment. The 5522A sources direct voltage and current, alternating voltage and current with multiple waveforms and harmonics, two simultaneous voltage outputs or voltage and current to simulate dc and ac power with phase control, resistance, capacitance, thermocouples and RTDs. The 5522A can also measure thermocouple temperature and pressure using one of 29 Fluke 700 Series pressure modules. Two options add the capability to calibrate oscilloscopes up to either 600 MHz or 1.1 GHz. And the 5520A-PQ Power Quality Option enables the 5522A to calibrate power quality instrumentation to the standards of the IEC and other regulatory agencies.

The 5522A calibrator covers many of the electronic test tools you use to keep your company up and running, including:

- Handheld and bench meters (analog and digital) up to 6½ digits
- Current clamps and clamp meters
- Thermocouple and RTD thermometers
- Process calibrators
- Data loggers
- Strip and chart recorders
- Watt meters
- Power harmonics analyzers
- Panel meters
- Graphical multimeters
- Power quality analyzers (with option)
- Analog or digital handheld and bench oscilloscopes to 600 MHz or 1.1 GHz (with options)
- …and more, including pressure gauges and transducers and three-phase power meters

5522A Multi-Product Calibrator

Internal circuitry offers “mistake proof” protection

The 5522A 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.

Rugged carrying case enables safe transport and efficient onsite calibration

An innovative carrying case accessory makes it easier than ever to calibrate outside of the calibration laboratory, as well as inside. The shock-mounted case features built-in handles and wheels, enabling you to move the calibrator from place to place easily and safely.

The front and rear access doors are removable, so you can calibrate with the 5522A while its top, bottom and side panels remain protected.and avoid having to completely unpack and then re-pack the calibrator.

A redesigned front panel and ergonomic carrying handles make it easy to transport the calibrator short distances within the cal lab.

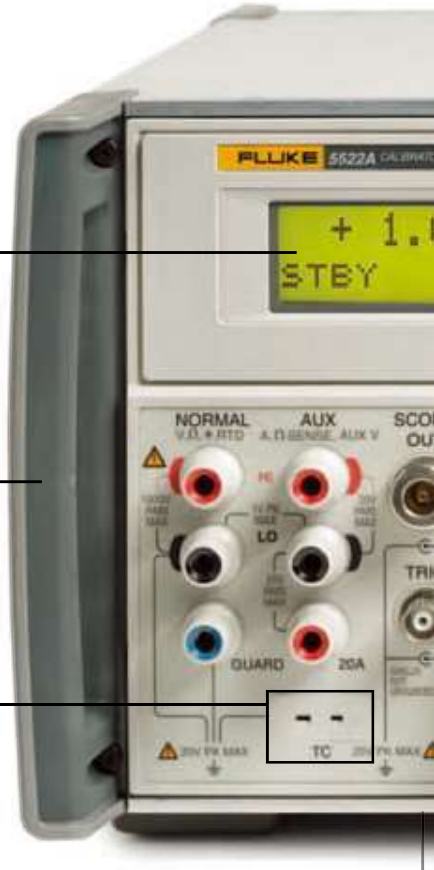
5522A Multi-Product Calibrator

FLUKE®
Calibration

5522A Multi-Product Calibrator

The Fluke 5522A Multi-Product Calibrator makes it easy to get more work done.

It's intuitive design makes learning to operate it easy even for less experienced technicians, reducing references to the manual. For most tasks, your hand moves from left to right, keeping you from having to make long, illogical or uncomfortable movements. Most functions require minimal keystrokes.



The bright, backlit LCD display is easy to read from all angles and under a variety of light conditions.

Ergonomically designed, rugged handles make the 5522A easy to transport.

Temperature measurement modes calibrates thermocouple simulators and can also document environmental conditions present at the time of calibration, as required by all quality standards.

Spec menu lets you view the uncertainty for the present value.

Phase lock makes it easy to simulate threephase power and enables current summing for high-current tests.

Internal circuitry plus overcurrent fuses protect against costly damage caused by electrical overloads accidently applied to the calibrator's input terminals.

A rugged carrying case makes it easy to do onsite calibration. The front and back panels remove so you can use the calibrator without unpacking it.

An interface for Fluke 700 Series Pressure Modules, which are used to make precision measurements to calibrate pressure transducers and related instrumentation. Modules span various pressure ranges, as low as 0 to 10" H20 (0 to 2.5 kPa), or as high as 0 to 10,000 psi (0 to 70,000 kPA).

5522A Multi-Product Calibrator

FLUKE ®
Calibration

Conntrol output by pre ssing STBY and OPR R keys.

Calculator-style keypad makes it easy to enter values.

Press the SCOPE key for on-demand oscilloscope calibration (optional).

The control window displays a variety of status messages, softkey menus, and status and other auxiliary information.

Edit knob allows you to vary the output. When editing, the difference between the original output and the edited output is automatically computed and displayed in the control window.

Soft keys allow access to the menus in the control windows, letting you select parameters such as offset, waveforms, phase, thermocouple or RTD type. PREV MENU lets you step backward through these menus.

MULT [X] and DIV[÷] keys simplify stepping up and down in decade multiples of any output setting, and let you step up or down to the next range in a 1–2–5 sequence for oscilloscope calibration.

5522A Multi-Product Calibrator

Automate to increase throughput and efficiency

Quality standards impose stringent requirements for documenting, reporting, and controlling calibration processes and results.

Using MET/CAL Plus Calibration Management Software can help you meet these requirements

easily while also enabling you to increase throughput and streamline your calibration processes.

MET/CAL Plus is a powerful application for creating, editing and testing calibration procedures and collecting and reporting results on a wide variety of instruments.

It includes MET/CAL2®—the industry-leading software for automated calibration and MET/TRACK2®—.a dedicated system to manage your test and measurement assets.

It is the most complete software solution available to calibration professionals.

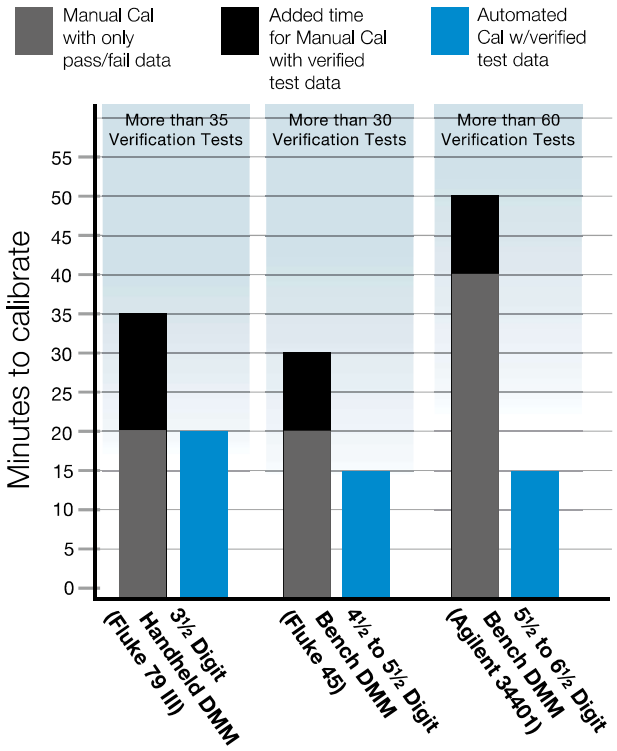
Priority software support helps you stay productive

MET/SUPPORT Gold is an annual membership program offering premium support and services to help you stay as productive as possible with MET/CAL Plus software. Services include free software updates and upgrades, free access to the Fluke MET/CAL Warranted Procedures Library, plus discounts on training and custom procedure development. Members also receive invitations to regular calibration software web seminars and user group meetings. Use only a few of the Gold services and you can easily recover more than the cost of your membership fee.

Calibration and repair service

Fluke Calibration offers extensive calibration support and service to ensure your long-term satisfaction and return on investment in calibration equipment. Our worldwide network of calibration centers offers accredited calibrations traceable to national standards. We also offer fast, quality repair and calibration services including a module exchange program and full support in setting up your lab.

Time comparison for manual and automated calibration methods



5522A Multi-Product Calibrator

FLUKE® Calibration

Summary specifications

Function and range

Direct volts	0 to ± 1020 V
Direct current	0 to ± 20.5 A
Alternating volts	1 mV to 1020 V 10 Hz to 500 kHz
Volt/hertz	1000 V@10 kHz/330 V@100 kHz
Alternating current	29 µA to 20.5 A 10 Hz to 30 kHz
Waveforms	Sine, square, triangle, truncated sine
Resistance	0 MΩ to 1100 MΩ
Capacitance	220 pF to 110 mF
Power (phantom loads)	20.9 kW
Phase control	0.01°
Thermocouple (source and measure temperature)	B, C, E, J, K L N R, S, T, U 10 µV/°C
RTD (source temperature)	Pt 385-100 Ω, Pt 3926-100 Ω Pt 3916-100 Ω, Pt 385-200 Ω, Pt 385-500 Ω, Pt 385 1000 Ω, PtNi 385-120 Ω (Ni120), Cu 427 10 Ω
Interfaces	RS-232, IEEE 488
Phase lock	Yes
Frequency uncertainty	< 2.5 ppm
External frequency reference (10 MHz)	Yes
Oscilloscope calibrator (options)	Levelled sine wave from 5 mV to 5.5 Vpp max, frequencies 50 kHz to 600 kHz and 3.5 Vpp max to 1100 MHz; edge rise times of < 300ps, multiple trigger functions, lowest dc, square wave and timing uncertainty
Power Calibrator (options)	Composite harmonic, flicker simulation, sags and swells simulation modes and swells simulation modes

Metrology training increases skill levels
Calibration and metrology training from Fluke can help you and your staff become more knowledgeable in a wide variety of disciplines. Instructor-led classroom training is available for general topics in metrology, as well as for calibration software. On-site training can also be scheduled if you have a number of people in your organization who would benefit.

Fluke Calibration also offers other educational events such as web seminars and road shows on a wide variety of topics. The best way to stay informed about these events is to register to receive email and direct mail from Fluke Calibration. You can register online at **www.fluke.com**.

5522A Multi-Product Calibrator

Innovation from the leader in calibration

Fluke Calibration pioneered the multi-product calibrator concept, creating a family of instruments that allow you to calibrate the widest range of today's electronic test tools with a single instrument. These calibrators offer simple, portable, cost-effective solutions that allow you to match your calibrator to your workload and your budget.

Fluke is also recognized for its offerings in temperature, pressure, power, process, and rf calibration. Fluke provides the calibrators, standards, software, service, support and training you need for a complete solution in your cal lab.

5500A Multi-Product Calibrator

Calibration solutions that match your workload and budget

The 5500A is a versatile product that addresses a wide cross-section of your electrical calibration work load. It sources direct voltage and current, alternating voltage and current with multiple waveforms and harmonics, two simultaneous voltage outputs or voltage and current, and simulates power with phase control, resistance, capacitance, thermocouples and RTDs. The 5500A's Oscilloscope Calibration options provide level sine wave, fast edge, time mark and amplitude signals for calibration of oscilloscopes up to 600 MHz.

The 5500A was designed to cover a very wide range of medium accuracy electrical measurement devices including:

- Handheld and bench multimeters
- Oscilloscopes and ScopeMeter2® Test Tools
- Wattmeters
- Analog volt/ohm/amp/watt instruments
- Electronic thermometers
- Data loggers
- Strip chart recorders
- XY Recorders
- Power harmonics analyzers
- Process calibrators
- Current clamps
- And related instruments

5522A Multi-Product Calibrator

FLUKE ®
Calibration

9100A Universal Calibration System

The world's best value multi-product calibrator

The 9100 is a multifunction calibrator with a wide breadth and depth of outputs. In addition to dc and ac voltage to 1050 V, variable resistance to 400 MΩ and dc and ac current to 20 A (1000 A via the optional current coils), the 9100 delivers continuously variable capacitance values to 40 mF and conductance values to 2.5 milliSiemens. It also generates digitally synthesized and phase-locked sine, square, triangle, impulse and trapezoidal waveforms, variable amplitude pulses to 10 MHz, pulse widths to 2 seconds, and duty cycles between 0.05 % and 99.95 %.

Add one of the two oscilloscope calibration options and it generates all the waveforms required to calibrate oscilloscopes up to 250 MHz or 600 MHz.

Fit the insulation/continuity tester option and it synthesizes resistance values as high as 2 GΩ at test voltages up to 1000 V. Fit the power meter option and it simultaneously generates variable phase angle voltages and currents that allow you to calibrate power meters up to 1 MW or 1 MVAR.

9100 features:

- Calibrates over 15 different categories of general-purpose test equipment
- Options for power meter, insulation/continuity tester and oscilloscope calibration – internally installed and retrofittable
- Semi-automated and fully automated procedure modes for maximum calibration throughput
- Fully supported by MET/CAL Plus software and procedure libraries
- Rapid return on investment
- Intuitive front panel operation for ease of use

5080A High Compliance Multi-Product Calibrator

Calibration solutions for your analog and digital workload

The 5080A Multi-Product Calibrator calibrates your analog and digital workload accurately and economically. Its high voltage and current compliance makes analog workload calibration easy and precise. Built-in protection circuitry protects it against damaging input voltages.

This easy-to-use instrument calibrates a wide workload that includes:

- Analog meters
- Panel meters
- Digital multimeters
- Watt meters
- Clamp meters (with coil accessory)
- Megohm meters (optional)
- Oscilloscopes to 200 MHz (optional)
- …and more

Versatile software applications enable you to record paperless results, and more.

Options and accessories expand workload coverage

Options and accessories enable you to use the 5080A to calibrate an even broader workload, including:

- Clamp meters. The 9100-200 10/50 turn coil and 5500A/COIL 50-turn current coil enables the 5080A to calibrate most popular clamp meters at currents up to 1000 A rms amps.
- Oscilloscopes. Calibrate oscilloscopes to 200 MHz quickly, easily, and cost effectively.
- Megohm meters. This option sources high ohms, high voltage resistors up to 18 G ohms. It also measures high voltage outputs.

5522A Multi-Product Calibrator Extended specifications

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 +70 °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, EN/IEC 61326-2-1:2006 for controlled EM environments under the following conditions. If used in areas with Electromagnetic fields of 1 to 3 V/m from 0.08-1GHz, resistance outputs have a floor adder of 0.508 Ω Performance not specified above 3 V/m. This instrument may be susceptible to electrostatic discharge (ESD) to the binding posts. Good static awareness practices should be followed when handling this and other pieces of electronic equipment. Additionally this instrument may be susceptible to electrical fast transients on the mains terminals. If any disturbances in operation are observed, it is recommended that the rear panel chassis ground terminal be connected to a known good earth ground with a low inductance ground strap. Note that a mains power outlet while providing a suitable ground for protection against electric shock hazard may not provide an adequate ground to properly drain away conducted rf disturbances and may in fact be the source of the disturbance. This instrument was certified for EMC performance with data I/O cables not in excess of 3m.
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 Level ..... 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 of 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.

5522A Multi-Product Calibrator Extended specifications

FLUKE® Calibration

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p ±(ppm of 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. The current may be provided Formula 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 60-23-17 = 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 1 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 nA
0 to 3.29999 mA	20 nA	200 nA
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

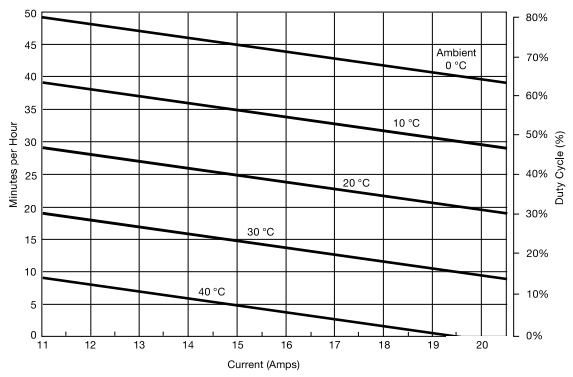


Figure 1. Allowable Duration of Current >11 A

5522A Multi-Product Calibrator Extended specifications

Resistance

Range [1]	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +floor) [2]				Resolution Ω	Allowable Current [3]
	ppm of output		Floor (Ω) Time 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 an additional amount to the floor specification as calculated by: (5 µV divided by the stimulus current in amps). 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) = (0.002 + 0.005) Ω = 0.007 Ω.
[3] For currents lower than shown, the floor adder increases by $Floor_{(new)} = Floor_{(old)} \times I_{min}/I_{actual}$. 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 ±(% of 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

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FLUKE ® Calibration

AC Voltage (Sine Wave) (cont.)

Range	Frequency [1]	Absolute Uncertainty, tcal ±5 °C ±(% of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)
		90 days	1 year			
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	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided 60T- 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 60-23-17 = 20 minutes each hour. When the 5520A 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 1 is achieved only after the 5520A is outputting currents <5 A for the "off" period first.
[2] For compliance voltages greater than 1 V, add 1 mA/V to the floor specification from 1 to 5 kHz.
[3] For compliance voltages greater than 1 V, add 5 mA/V to the floor specification from 5 to 10 kHz.

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AC Current (Sine Wave) (cont.)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load µH
		90 days	1 year		
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]	45 to 100 Hz	0.1 + 2000 [2]	0.12 + 2000 [2]	0.1 + 0 µA	400 [4]
	100 to 440 Hz	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 1. The current may be provided Formula 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 60-23-17 = 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 1 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 10000 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
220.0 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 + 0.1 nF	0.25 + 0.1 nF	0.1 pF	10 Hz to 1 kHz	8 kHz	10 kHz
33 to 109.999 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	1 pF	10 Hz to 1 kHz	4 kHz	6 kHz
110 to 329.999 nF	0.19 + 0.3 nF	0.25 + 0.3 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.

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FLUKE® Calibration

Temperature Calibration (Thermocouple)

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

[1] Temperature standard ITS-68 is selectable. TC simulating and measuring are not specified 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	0.1	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

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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 "DC Voltage Specifications," "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.

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	0.1	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 "AC Voltage Specifications" and "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 s 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, (ΔΦ°)					
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:

$$\text{Adder}(\%) = 100\left(1 - \frac{\cos(\Phi + \Delta\Phi)}{\cos(\Phi)}\right)$$

For example: At 60 Hz, for a PF of .9205 (Φ = 23) and a phase uncertainty of $\Delta\Phi$ = 0.10, the ac Watts power adder is:

$$\text{Adder}(\%) = 100\left(1 - \frac{\cos(23+.10)}{\cos(23)}\right) = 0.074\%$$

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FLUKE ®
Calibration

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):

Example 1

Output: 100 V, 1 A, 60 Hz, Power Factor = 1.0 (Φ=0).
Voltage Uncertainty Uncertainty for 100 V at 60 Hz is 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (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").
PF Adder Watts Adder for PF = 1 (Φ=0) at 60 Hz is 0 % (see "Phase Specifications").
Total Watts Output Uncertainty =

$$U_{power} = \sqrt{0.021^2 + 0.06^2 + 0^2} = 0.064\%$$

Example 2

Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 (Φ=60)
Voltage Uncertainty Uncertainty for 100 V at 400 Hz is, 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (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").
PF Adder Watts Adder for PF = 0.5 (Φ=60) at 400 Hz is 0.76 % (see "Phase Specifications").
Total Watts Output Uncertainty =

$$U_{power} = \sqrt{0.021^2 + 0.06^2 + 0.76^2} = 0.76\%$$

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 60 Hz is, 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (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 =

$$U_{VARS} = \sqrt{0.021^2 + 0.06^2 + 0.03^2} = 0.070\%$$

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 (2nd to 50th)

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 3.3 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 3.3 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 5 ° (from "Phase Specifications"). Another example, the phase uncertainty of a 50 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) 90 Day 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) 90 Day 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).

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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.

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

Square Wave 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 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] ±(% of 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.

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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 %

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

AC Current (Non-Sine Wave)

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

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