5502A Multi-Product Calibrator

FLUKE® Calibration

A full-functioned calibrator that covers a wide range of common workload

The 5502A Multi-Product Calibrator addresses common workload items like 3.5 and 4.5 digit digital multimeters and more. It comes with internal and external protection features that enable you to transport it easily and perform on-site or mobile calibration. The 5502A can also be fully automated with MET/CAL2® Plus Calibration Management Software. It is the ideal calibrator for metrology professionals who need a solution for calibrating low-to-medium accuracy electrical instrumentation.

The 5502A sources direct voltage and current; alternating voltage and current with multiple waveforms and harmonics; simultaneous voltage and current outputs or dual voltage outputs to simulate dc and ac power with phase control; as well as resistance, capacitance, thermocouples and RTDs. The 5502A can also measure thermocouples and thermocouple simulators. Two options add the capability to calibrate oscilloscopes to either 300 MHz or 600 MHz.

Using the Fluke Calibration 52120A Transconductance Amplifier, the 5502A's output current can be extended from 20.5 to 120 A; and with the use of 25 and 50 turn coils, it can calibrate instruments requiring up to 6000 A.

The 5502A calibrator covers many of the most common items in your workload, including:

- Handheld and bench meters (analog and digital) to 4.5 digits
- Current clamps and clamp meters
- Panel meters
- Electronic thermometers
- Chart recorders
- Oscilloscope recorders
- XY recorders
- Data loggers

	Fluke Calibrators				
	Multi-Product Calibrators			Multifunction Calibrators	
Workload	**5080A**	**5502A**	**5522A**	**5700A**	**5720A**
Analog/Panel meters					
High burden meters					
Low burden meters					
DMMs					
Basic dc V accuracy	100 ppm	50 ppm	11 ppm	6.4 ppm	3.25 ppm
3.5 digits (typ. ± 0.3 % dc V)					
4.5 digits (typ. ± 0.025 % dc V)					
5.5 digits (typ. ± 0.015 % dc V)					
6.5 digits (typ. ± 0.0024 % dc V)					
7.5 digits (typ. ± 12 ppm dc V)					
8.5 digits (typ. ± 3.9 ppm dc V)					
Temperature/Pressure					
RTD simulate					
RTD measure					
Thermocouple simulate					
Thermocouple measure					
Pressure modules			opt		
Oscilloscopes	1 channel				
200 MHz to 600 MHz	200 MHz opt	300 MHz or 600 MHz opt	600 MHz opt		
1.1 GHz			opt		
2.1 GHz					
3.2 GHz					
6 GHz					
25 ps fast edge					
Safety testers					
Hipot					
Megohm meters	opt				
Installation					
PATs					
Continuity	opt				
Power/Energy					
Wattmeters					
Harmonic analyzers					
Flicker meters PQ			opt		
Phase angle meters PQ			opt		
Power analyzers PQ			opt		
Power recorders					
Other					
Clamp meters					
LCR meters		CR only	CR only		
Process calibrators					
Data acquisition					
Non sine waveforms					
RF millivolt meters				opt	opt
# of calibrator functions	8	11	11	5	5

5502A Multi-Product Calibrator

Internal circuitry protects against user error

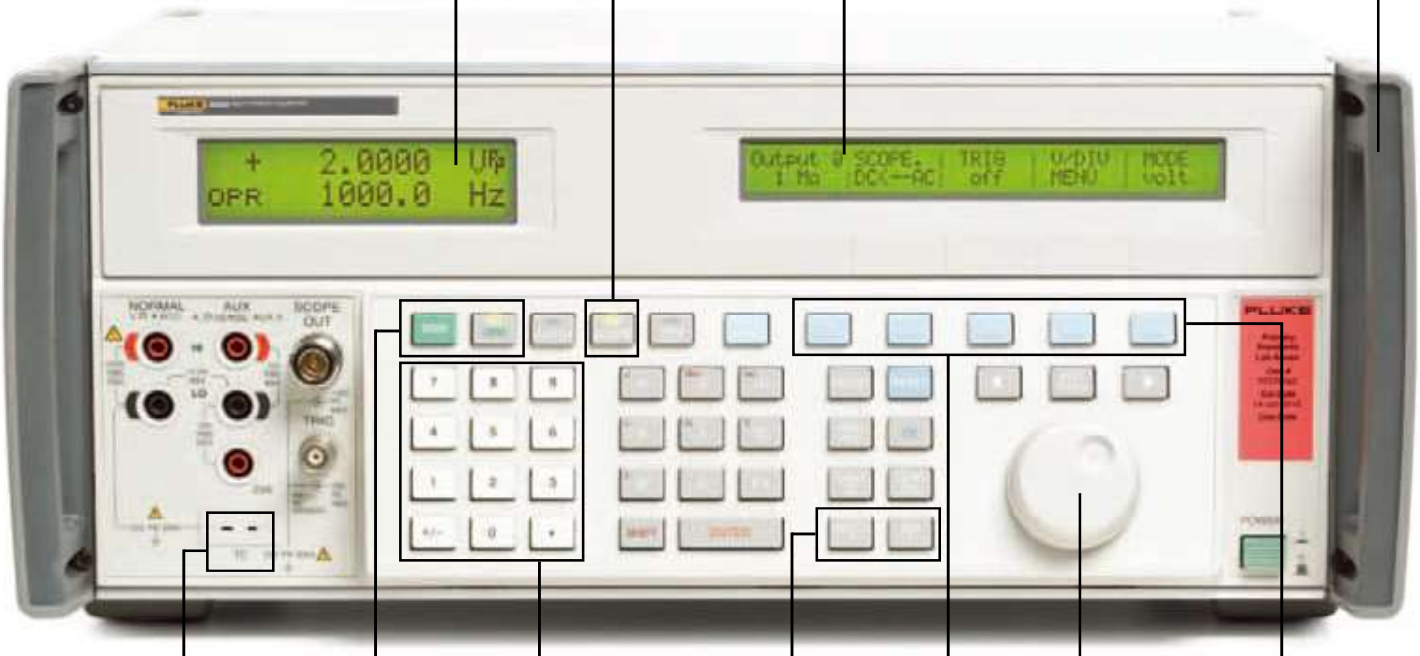
Reverse power protection, check before connect, immediate output disconnection, and fuse protection on the output terminals offers "mistake proof" protection against common user errors.
This protection is for applied external voltages up to ± 300 V peak.

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 5502A easy to transport.

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

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



Control output by pressing **STBY** and **OPR** keys.

Calculator-style **keypad** makes it easy to enter values.

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.

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

Using **soft keys** you can access a "SPEC" menu lets you view the uncertainty for the present value.

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

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.

5502A Multi-Product Calibrator

FLUKE ®
Calibration

Automate with MET/CAL® Plus software for consistent and efficient calibration

MET/CAL Plus software 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/CAL software—the industry leading software for automated calibration, and MET/TEAM™ Express—a dedicated system to manage your test and measurement assets. Or choose MET/TEAM standard edition for fully-featured enterprise calibration asset management, with optional modules for on-site calibration, commerce management, and customer web portal.

Using MET/CAL Plus Calibration Management Software can help you meet the requirements for documented processes, procedures and reports mandated by most quality standards. Automating with MET/CAL software also helps you increase throughput and streamline your calibration processes.

Priority software support helps you stay productive

MET/SUPPORTSM 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 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.

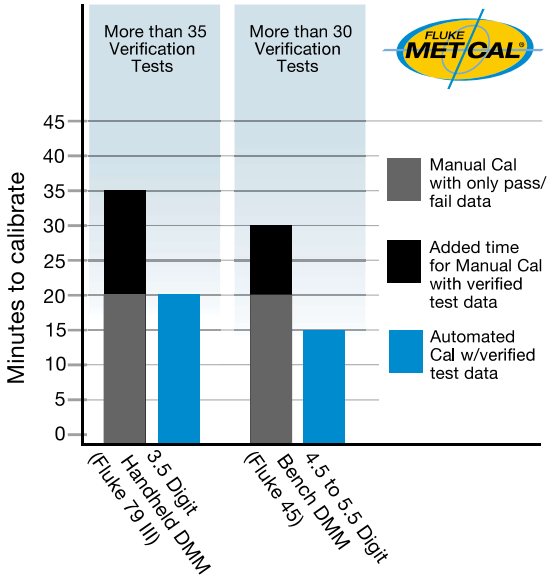
Metrology training increases skill levels

Calibration and metrology training from Fluke Calibration 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.flukecal.com.**

Time comparison for manual and automated calibration methods



5502A Multi-Product Calibrator

Summary specifications

AC Current, Triangle Wave Characteristics (typical)

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 Ω 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 and 1 mV/°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
Frequency uncertainty	< 25 ppm
Oscilloscope calibrator (options)	Levelled sine wave from 5 mV to 5.5 Vpp max, frequencies 50 kHz to 600 kHz; edge rise times of < 300 ps, multiple trigger functions, lowest dc, square wave and timing uncertainty
Amplified current (accessory amplifier)	Extend from 20.5 A to a maximum of 100 A dc and 120 A ac from 10 Hz to 10 k Hz

Calibrate almost anywhere

Rugged transit case makes on-site calibration safe, easy, convenient
An optional shock-mounted transit case featuring built-in handles and wheels gives you the option of taking the calibrator to the workload for on-site or mobile applications.

Once at the site, just remove the front and rear doors from the case for access to the 5502A's front and rear panels.the top, bottom and sides of the calibrator remain protected, and you don't need to fully unpack the calibrator for each use.

5502A Multi-Product Calibrator

FLUKE ®
Calibration

5522A Multi-Product Calibrator

Robust, transportable wide workload coverage

The 5522A Multi-Product Calibrator is the most accurate model in this calibrator family. It calibrates digital multimeters into the 5.5 and 6.5 digit category. The 5522A addresses the widest calibration workload with optional power quality capabilities and oscilloscope calibration for scopes with bandwidths to 1100 MHz. It comes with internal and external protection features that protect it against damage and make it easier to transport for onsite or mobile calibration.

The 5522A can 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.

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. With maximum burden up to 800 mA for ac/dc voltage, and voltage up to 50 V for ac/dc current, 5080A calibrators can drive a wide range of analog meters.

Built-in protection circuitry protects the 5080A against damaging input voltages. Versatile software applications enable you to record paperless results and more.

Options and accessories enable you to use the 5080A to calibrate an even broader workload, including clamp meters, oscilloscopes, and megohm meters.

Innovation from the leader in calibration

Fluke Calibration pioneered the multiproduct 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 calibrators to your workload and your budget.

5502A Multi-Product Calibrator

General Specifications

The following tables list the 5502A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5502A has been turned off. (For example, if the 5502A 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 5502A 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 °C 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 5502A 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 of tcal ±5 °C is 10 % of the stated specification 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 electro-static 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 line 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 5502A 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 5502A for the temperature range indicated.
Specification Confidence Level .....99 %

Detailed Specifications

DC Voltage

Range	Absolute Uncertainty, tcal ± 5 °C ±(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	0.005 + 3	0.006 + 3	5 + 1	0.1	65 Ω
0 to 3.299999 V	0.004 + 5	0.005 + 5	4 + 3	1	10 mA
0 to 32.99999 V	0.004 + 50	0.005 + 50	4 + 30	10	10 mA
30 to 329.9999 V	0.0045 + 500	0.0055 + 500	4.5 + 300	100	5 mA
100 to 1020.000 V	0.0045 + 1500	0.0055 + 1500	4.5 + 900	1000	5 mA
Auxiliary Output (dual output mode only) [2]					
0 to 329.999 mV	0.03 + 350	0.04 + 350	30 + 100	1	5 mA
0.33 to 3.29999 V	0.03 + 350	0.04 + 350	30 + 100	10	5 mA
3.3 to 7 V	0.03 + 350	0.04 + 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	0.005 + 3	0.006 + 3	5 + 1	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 of output + floor in µV)	Bandwidth 10 Hz to 10 kHz rms
0 to 329.9999 mV	0 + 1	6 µV
0 to 3.299999 V	0 + 10	60 µV
0 to 32.99999 V	0 + 100	600 µV
30 to 329.9999 V	10 + 1000	20 mV
100 to 1020.000 V	10 + 5000	20 mV
Auxiliary Output (dual output mode only) [1]		
0 to 329.999 mV	0 + 5 µV	20 µV
0.33 to 3.29999 V	0 + 20 µV	200 µV
3.3 to 7 V	0 + 100 µV	1000 µV

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

DC Current

Range	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Resolution	Max Compliance Voltage V	Max Inductive Load mH
	90 days	1 year			
0 to 329.999 .A	0.012 + 0.02	0.015 + 0.02	1 nA	10	400
0 to 3.29999 mA	0.010 + 0.05	0.013 + 0.05	0.01 µA	10	
0 to 32.9999 mA	0.008 + 0.25	0.010 + 0.25	0.1 µA	7	
0 to 329.999 mA	0.008 + 3.3	0.010 + 2.5	1 µA	7	
0 to 1.09999 A	0.023 + 44	0.038 + 44	10 µA	6	
1.1 to 2.99999 A	0.030 + 44	0.038 + 44	10 µA	6	
0 to 10.9999 A (20 A Range)	0.038 + 500	0.060 + 500	100 µA	4	
11 to 20.5 A [1]	0.080 + 750 [2]	0.10 + 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 5502A 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 5502A 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 .A	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

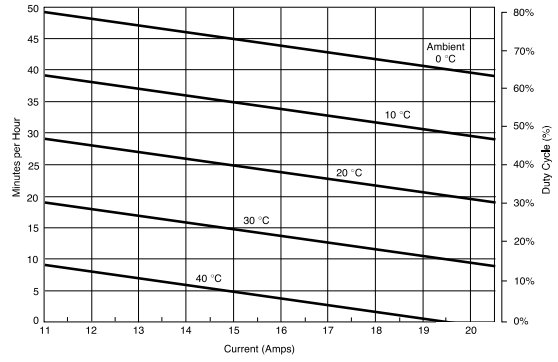


Figure 1. Allowable Duration of Current >11 A

5502A Multi-Product Calibrator

Resistance

Range [1]	Absolute Uncertainty, tcal ±5 °C ±(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 10.999 Ω	0.009	0.012	0.001	0. 01	0.001	1 mA to 125 mA
11 to 32.999 Ω	0.009	0.012	0.0015	0.015	0.001	1 mA to 125 mA
33 to 109.999 Ω	0.007	0.009	0.0014	0.015	0.001	1 mA to 70 mA
110 to 329.999 Ω	0.007	0.009	0.002	0.02	0.001	1 mA to 40 mA
330 to 1.09999 kΩ	0.007	0.009	0.002	0.02	0.01	1 mA to 18 mA
1.1 to 3.29999 kΩ	0.007	0.009	0.02	0.2	0.01	100 µA to 5 mA
3.3 to 10.9999 kΩ	0.007	0.009	0.02	0.1	0.1	100 µA to 1.8 mA
11 to 32.9999 kΩ	0.007	0.009	0.2	1	0.1	10 µA to .5 mA
33 to 109.999 kΩ	0.008	0.011	0.2	1	1	10 µA to 0.18 mA
110 to 329.999 kΩ	0.009	0.012	2	10	1	1 µA to 50 µA
330 k. to 1.09999 MΩ	0.011	0.015	2	10	10	1 µA to 18 µA
1.1 to 3.29999 MΩ	0.011	0.015	30	150	10	250 nA to 5 µA
3.3 to 10.9999 MΩ	0.045	0.06	50	250	100	250 nA to 1.8 µA
11 to 32.9999 MΩ	0.075	0.1	2500	2500	100	25 nA to 500 nA
33 to 109.999 MΩ	0.4	0.5	3000	3000	1000	25 nA to 180 nA
110 to 329.999 MΩ	0.4	0.5	100000	100000	1000	2.5 nA to 50 nA
330 to 1100.00 MΩ	1.2	1.5	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 = (0.002 + 0.005) Ω = 0.007 Ω.
[3] Do not exceed the largest current for each range. 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 ±(% of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)
		90 days	1 year			
1.0 to 32.999 mV	10 Hz to 45 Hz	0.120 + 20	0.150 + 20	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	0.080 + 20	0.100 + 20			0.035 + 90 µV
	10 kHz to 20 kHz	0.120 + 20	0.150 + 20			0.06 + 90 µV
	20 kHz to 50 kHz	0.160 + 20	0.200 + 20			0.15 + 90 µV
	50 kHz to 100 kHz	0.300 + 33	0.350 + 33			0.25 + 90 µV
	100 kHz to 500 kHz	0.750 + 60	1.000 + 60			0.3 + 90 µV [1]
33 mV to 329.999 mV	10 Hz to 45 Hz	0.042 + 20	0.050 + 20	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	0.029 + 20	0.030 + 20			0.035 + 90 µV
	10 kHz to 20 kHz	0.066 + 20	0.070 + 20			0.06 + 90 µV
	20 kHz to 50 kHz	0.086 + 40	0.100 + 40			0.15 + 90 µV
	50 kHz to 100 kHz	0.173 + 170	0.230 + 170			0.20 + 90 µV
	100 kHz to 500 kHz	0.400 + 330	0.500 + 330			0.20 + 90 µV [1]
0.33 V to 3.29999 V	10 Hz to 45 Hz	0.042 + 60	0.050 + 60	10 µV	10 mA	0.15 + 200 µV
	45 Hz to 10 kHz	0.028 + 60	0.030 + 60			0.035 + 200 µV
	10 kHz to 20 kHz	0.059 + 60	0.070 + 60			0.06 + 200 µV
	20 kHz to 50 kHz	0.083 + 60	0.100 + 60			0.15 + 200 µV
	50 kHz to 100 kHz	0.181 + 200	0.230 + 200			0.20 + 200 µV
	100 kHz to 500 kHz	0.417 + 900	0.500 + 900			0.20 + 200 µV [1]
3.3 V to 32.9999 V	10 Hz to 45 Hz	0.042 + 800	0.050 + 800	100 µV	10 mA	0.15 + 2 mV
	45 Hz to 10 kHz	0.025 + 600	0.030 + 600			0.035 + 2 mV
	10 kHz to 20 kHz	0.064 + 600	0.070 + 600			0.08 + 2 mV
	20 kHz to 50 kHz	0.086 + 600	0.100 + 600			0.2 + 2 mV
	50 kHz to 100 kHz	0.192 + 2000	0.230 + 2000			0.5 + 2 mV
33 V to 329.999 V	45 Hz to 1 kHz	0.039 + 3000	0.050 + 3000	1 mV	5 mA, except 20 mA for 45 Hz to 65 Hz	0.15 + 10 mV
	1 kHz to 10 kHz	0.064 + 9000	0.080 + 9000			0.05 +10 mV
	10 kHz to 20 kHz	0.079 + 9000	0.090 + 9000			0.6 + 10 mV
	20 kHz to 50 kHz	0.096 + 9000	0.120 + 9000			0.8 + 10 mV
	50 kHz to 100 kHz	0.192 + 80000	0.240 + 80000			1.0 + 10 mV
330 V to 1020 V	45 Hz to 1 kHz	0.042 + 20000	0.050 + 20000	10 mV	2 mA, except 6 mA for 45 Hz to 65 Hz	0.15 + 30 mV
	1 kHz to 5 kHz	0.064 + 20000	0.080 + 20000			0.07 + 30 mV
	5 kHz to 10 kHz	0.075 + 20000	0.090 + 20000			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.)

AUX (Auxiliary Output) [dual output mode only]						
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			
10 to 329.999 mV	10 Hz to 20 Hz	0.15 + 370	0.20 + 370	1 µV	5 mA	0.20 + 200 µV
	20 Hz to 45 Hz	0.08 + 370	0.10 + 370			0.06 + 200 µV
	45 Hz to 1 kHz	0.08 + 370	0.10 + 370			0.08 + 200 µV
	1 kHz to 5 kHz	0.15 + 450	0.20 + 450			0.30 + 200 µV
	5 kHz to 10 kHz	0.30 + 450	0.40 + 450			0.60 + 200 µV
	10 kHz to 30 kHz	4.00 + 900	5.00 + 900			1.00 + 200 µV
0.33 to 3.29999 V	10 Hz to 20 Hz	0.15 + 450	0.20 + 450	10 µV	5 mA	0.20 + 200 µV
	20 Hz to 45 Hz	0.08 + 450	0.10 + 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	0.20 + 1400			0.30 + 200 µV
	5 kHz to 10 kHz	0.30 + 1400	0.40 + 1400			0.60 + 200 µV
	10 kHz to 30 kHz	4.00 + 2800	5.00 + 2800			1.00 + 200 µV
3.3 to 5 V	10 Hz to 20 Hz	0.15 + 450	0.20 + 450	100 µV	5 mA	0.20 + 200 µV
	20 Hz to 45 Hz	0.08 + 450	0.10 + 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	0.20 + 1400			0.30 + 200 µV
	5 kHz to 10 kHz	0.30 + 1400	0.40 + 1400			0.60 + 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 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	0.10 + 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	0.50 + 0.5 µA	
	5 to 10 kHz	0.6 + 0.2	0.8 + 0.2	1.5	1.00 + 0.5 µA	
	10 to 30 kHz	1.2 + 0.4	1.6 + 0.4	10	1.20 + 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	0.50 + 1.5 µA	
	5 to 10 kHz	0.4 + 0.3	0.5 + 0.3	1.5	1.00 + 1.5 µA	
	10 to 30 kHz	0.8 + 0.6	1.0 + 0.6	10	1.20 + 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	0.30 + 5 µA	
	5 to 10 kHz	0.16 + 3	0.2 + 3	1.5	0.70 + 5 µA	
	10 to 30 kHz	0.32 + 4	0.4 + 4	10	1.00 + 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	0.10 + 50 µA	
	10 to 30 kHz	0.32 + 200	0.4 + 200	10	0.60 + 50 µA	
0.33 to 1.09999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.20 + 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]	1.00 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2.00 + 500 µA	
1.1 to 2.99999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.20 + 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]	1.00 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2.00 + 500 µA	
3 to 10.9999 A	45 to 100 Hz	0.05 + 2000	0.06 + 2000		0.2 + 3 mA	1
	1100 Hz to 1 kHz	0.08 + 2000	0.10 + 2000		0.1 + 3 mA	
	1 kHz 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
	1100 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 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 5502A 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 5502A 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.

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
		90 days	1 year		
LCOMP On					
29 to 329.99 µA	10 to 100 Hz	0.20 + 0.2	0.25 + 0.2	0.1 + 1.0 µA	400 µH
	100 Hz to 1 kHz	0.50 + 0.5	0.60 + 0.5	0.05 + 1.0 µA	
330 µA to 3.29999 mA	10 to 100 Hz	0.20 + 0.3	0.25 + 0.3	0.15 + 1.5 µA	
	100 Hz to 1 kHz	0.50 + 0.8	0.60 + 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	0.20 + 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	0.20 + 100	0.05 + 50 µA	
330 mA to 2.99999 A	10 to 100 Hz	0.10 + 200	0.12 + 200	0.2 + 500 µA	
	100 to 440 Hz	0.25 + 1000	0.30 + 1000	0.25 + 500 µA	
3.3 A to 20.5 A [1]	45 to 100 Hz	0.10 + 2000 [2]	0.12 + 2000 [2]	0.1 + 0 µA	400 µH [4]
	100 to 440 Hz	0.80 + 5000 [3]	1.00 + 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 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 5502A 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 5502A 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]
29 to 329.99 µA	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 + 0.01 nF	0.5 + 0.01 nF	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 10.999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	1 pF	10 Hz to 1 kHz	20 kHz	25 kHz
11 to 32.999 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	1 pF	10 Hz to 1 kHz	8 kHz	10 kHz
33 to 109.99 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	10 pF	10 Hz to 1 kHz	4 kHz	6 kHz
110 to 329.99 nF	0.19 + 0.3 nF	0.25 + 0.3 nF	10 pF	10 Hz to 1 kHz	2.5 kHz	3.5 kHz
0.33 to 1.0999 µF	0.19 + 1 nF	0.25 + 1 nF	100 pF	10 to 600 Hz	1.5 kHz	2 kHz
1.1 to 3.2999 µF	0.19 + 3 nF	0.25 + 3 nF	100 pF	10 to 300 Hz	800 Hz	1 kHz
3.3 to 10.999 µF	0.19 + 10 nF	0.25 + 10 nF	1 nF	10 to 150 Hz	450 Hz	650 Hz
11 to 32.999 µF	0.30 + 30 nF	0.40 + 30 nF	1 nF	10 to 120 Hz	250 Hz	350 Hz
33 to 109.99 µF	0.34 + 100 nF	0.45 + 100 nF	10 nF	10 to 80 Hz	150 Hz	200 Hz
110 to 329.99 µF	0.34 + 300 nF	0.45 + 300 nF	10 nF	0 to 50 Hz	80 Hz	120 Hz
0.33 to 1.0999 mF	0.34 + 1 µF	0.45 + 1 µF	100 nF	0 to 20 Hz	45 Hz	65 Hz
1.1 to 3.2999 mF	0.34 + 3 µF	0.45 + 3 µF	100 nF	0 to 6 Hz	30 Hz	40 Hz
3.3 to 10.999 mF	0.34 + 10 µF	0.45 + 10 µF	1 µF	0 to 2 Hz	15 Hz	20 Hz
11 to 32.999 mF	0.7 + 30 µF	0.75 + 30 µF	1 µF	0 to 0.6 Hz	7.5 Hz	10 Hz
33 to 110.00 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.

5502A Multi-Product Calibrator

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	U -200 to 0	0.56	0.56
	0 to 600	0.27	0.27

[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 5502A Calibrator front panel NORMAL terminals) and 2-wire and 4-wire compensation.
[3] Based on MINCO Application Aid No. 18

Phase

1-Year Absolute Uncertainty, tcal ±5 °C, (ΔΦ°)						Note
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	See Power and Dual Output Limit Specifications for applicable outputs.
0.15 °	0.9 °	2 °	6 °	10 °	15 °	

Power and Dual Output Limit Specifications

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 °C	90 °C	1.0	0.00 %	0.01 %	0.06 %	0.55 %	1.52 %	3.41 %
5 °C	85 °C	0.996	0.02 %	0.15 %	0.37 %	1.46 %	3.04 %	5.67 %
10 °C	80 °C	0.985	0.05 %	0.29 %	0.68 %	2.39 %	4.58 %	7.97 %
15 °C	75 °C	0.966	0.07 %	0.43 %	1.00 %	3.35 %	6.17 %	10.34 %
20 °C	70 °C	0.940	0.10 %	0.58 %	1.33 %	4.35 %	7.84 %	12.83 %
25 °C	65 °C	0.906	0.12 %	0.74 %	1.69 %	5.42 %	9.62 %	15.48 %
30 °C	60 °C	0.866	0.15 %	0.92 %	2.08 %	6.58 %	11.54 %	18.35 %
35 °C	55 °C	0.819	0.18 %	1.11 %	2.50 %	7.87 %	13.68 %	21.53 %
40 °C	50 °C	0.766	0.22 %	1.33 %	2.99 %	9.32 %	16.09 %	25.12 %
45 °C	45 °C	0.707	0.26 %	1.58 %	3.55 %	11.00 %	18.88 %	29.29 %
50 °C	40 °C	0.643	0.31 %	1.88 %	4.22 %	13.01 %	22.21 %	34.25 %
55 °C	35 °C	0.574	0.37 %	2.26 %	5.05 %	15.48 %	26.32 %	40.37 %
60 °C	30 °C	0.500	0.45 %	2.73 %	6.11 %	18.65 %	31.60 %	48.24 %
65 °C	25 °C	0.423	0.56 %	3.38 %	7.55 %	22.96 %	38.76 %	58.91 %
70 °C	20 °C	0.342	0.72 %	4.33 %	9.65 %	29.27 %	49.23 %	74.52 %
75 °C	15 °C	0.259	0.98 %	5.87 %	13.09 %	39.56 %	66.33 %	100.00 %
80 °C	10 °C	0.174	1.49 %	8.92 %	19.85 %	59.83 %	100.00 %	-
85 °C	5 °C	0.087	2.99 %	17.97 %	39.95 %	-	-	-
90 °C	0 °C	0.000	-	-	-	-	-	-

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

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

For example: For a PF of .9205 (Φ = 23) and a phase uncertainty of $\Delta\Phi$= 0.15, the ac watts power adder is:

$$\text{Adder}(\%)=100\left(1-\frac{\cos(23+.15)}{\cos(23)}\right)=0.11\%$$

AC and DC Power Specifications

Power is simulated through the controlled simultaneous outputs of voltage and current from the Calibrator. While the amplitude and frequency ranges of the outputs are broad, there are certain combinations of voltage and current where the specifications are valid. In general these are for all dc voltages and currents, and AC voltages of 30 mV to 1020 V, ac currents from 33 mA to 20.5 A, for frequencies from 10 Hz to 30 kHz. Operation outside of these areas, within the overall calibrator capabilities, is possible, but it is not specified. The table and figure below illustrate the specified areas where power and dual output are possible.

Specification Limits for Power and Dual Output Operation

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). Only those limits shown in this table and illustrated in the following figure are specified.
See "Calculate 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°.

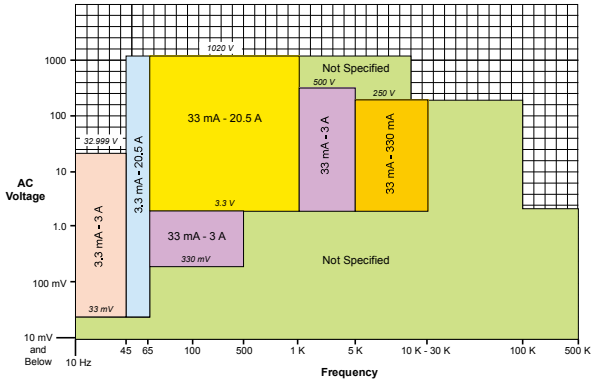


Figure 2. Permissible Combinations of AC Voltage and AC Current for Power and Dual Output

5502A Multi-Product Calibrator

FLUKE ® Calibration

Calculate the Uncertainty Specifications of Power and Dual Output Settings alculate the Uncertainty Specifications of Power and Dual Output Settings

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, if AC power, the phase parameters:

Watts uncertainty

$$U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

VARs uncertainty

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

Dual Output uncertainty

$$U_{Dual} = \sqrt{U^2_{voltage} + U^2_{AuxVoltage} + U^2_{VARsadder}}$$

Because there are an infinite number of combinations, you must calculate the actual ac power uncertainty for your selected parameters. The results of this method of calculation are shown in the subsequent example. These examples are at various selected calibrator settings (with 1-year specifications):

Calculate 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 phase parameters:

Watts uncertainty

$$U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

VARs uncertainty

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

Because there are an infinite number of combinations, you must calculate the actual ac power uncertainty for your selected parameters. The method of calculation is best shown in the subsequent examples (with 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 0.050 % + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 60 Hz is 0.05 % +100 .A, totaling: 1 A x 0.0005 = 500 .A added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (Watts) Adder for PF = 1 (Φ=0) at 60 Hz is 0 % (see “Phase Specifications”).

Total Power Uncertainty =

$$U_{power} = \sqrt{0.053^2 + 0.06^2 + 0^2} = 0.080\%$$

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 0.050% + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 400 Hz is 0.05 % +100 .A, totaling: 1 A x 0.0005 = 500 .A added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (Watts) Adder for PF = 0.5 (Φ=60) at 400 Hz is 2.73 % (see “Phase Specifications”).

Total Power Uncertainty =

$$U_{power} = \sqrt{0.053^2 + 0.06^2 + 2.73^2} = 2.73\%$$

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 0.050% + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 60 Hz is 0.05 % +100 µA, totaling: 1 A x 0.0005 = 500 µA added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (VARs) Adder for Φ=80 at 60 Hz is 0.05 % (see “Phase Specifications”).

Total VARS Uncertainty =

$$U_{UVARs} = \sqrt{0.053^2 + 0.06^2 + 0.05^2} = 0.094\%$$

Examples of Specified Power Uncertainties at Various Output Settings:

Selected Output Settings						Absolute Uncertainty as specified for tcal ±5 °C, ±(% of output setting)			Power Absolute Uncerainty ±(% of Watts)[1]
Voltage Setting (Volts)	Current Setting (Amps)	Frequency Hz	Phase Setting(units of PF)	Phase Setting (Degrees)	Selected Power (Watts)	$U_{Voltage}$	$U_{Current}$	U_{Phase}	U_{Power}
+10.000	+0.500.000	DC			5	0.00550 %	0.04680 %		0.047 %
15.000	+2.0000	DC			30	0.00533 %	0.03220 %		0.033 %
100.000	+20.000	DC			2000	0.00600 %	0.10375 %		0.104 %
1000.00	20.000	DC			20000	0.00565 %	0.10375 %		0.104 %
120.000	1.00000	60	1	0.0	120	0.05250 %	0.06000 %	0.000 %	0.080 %
120.000	1.00000	60	0.766	40.0	91.92	0.05250 %	0.06000 %	0.220 %	0.234 %
240.000	1.00000	50	1	0.0	240	0.05125 %	0.06000 %	0.000 %	0.079 %
240.000	1.00000	50	0.766	40.0	183.84	0.05125 %	0.06000 %	0.220 %	0.234 %
1000.00	20	55	1	0.0	20000	0.05200 %	0.14500 %	0.000 %	0.154 %
1000.00	20	55	0.766	40.0	15320	0.05200 %	0.14500 %	0.220 %	0.269 %
1000.00	20	55	-0.906	-25.0	18120	0.05200 %	0.14500 %	0.122 %	0.196 %
100	0.30	30000	1	0.0	30.0	0.12900 %	0.4667 %	3.407 %	3.442 %
100	0.30	30000	0.766	40.0	22.98	0.12900 %	0.4667 %	25.128 %	25.133 %

[1] 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.

Additional Specifications

The subsequent paragraphs provide additional specifications for the 5502A 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 5502A 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 ±(ppm + mHz)	Jitter
0.01 to 119.99 Hz	0.01 Hz	25 + 1	2 µs
120.0 to 1199.9 Hz	0.1 Hz	25 + 1	2 µs
1.2 to 11.999 kHz	1 Hz	25 + 1	2 µs
12 to 119.99 kHz	10 Hz	25 + 15	140 ns
120.0 to 1199.9 kHz	100 Hz	25 + 15	140 ns
1.2 to 2.000 MHz	1 kHz	25 + 15	140 ns

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 10 ° (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 0.039 % + 3 mV. For the dual output in this example, the specification is 0.039 % + 6 mV as the 0.039 % is the same, and the floor is twice the value (2 x 3 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 .V. For the dual output in this example, the specification is 0.15 % + 900 .V as the 0.15 % is the same, and the floor is twice the value (2 x 450 µV).

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

5502A Multi-Product Calibrator

FLUKE ® Calibration

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.)

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 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.

5502A Multi-Product Calibrator

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	8V	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	8V	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	8V	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 %

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 [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	

[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	[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		
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