FLUKE®
Calibration

5560A
Calibrator

Product Specifications

December 2022 Rev. 5, 11/24 (English)

Specifications

The performance specifications describe the complete instrumental uncertainty of the Product. The specifications include stability, temperature, and humidity; within specified limits, linearity, line and load regulation, and the reference standard measurement uncertainty. The product specifications are provided at a level of confidence of 99 %, k=2.58, normally distributed. In some cases, additional specifications with a level of confidence of 95 %, k=2, normally distributed are also listed. Fluke Calibration guarantees product performance to the 99 % level of confidence.

Specifications are valid after a Product warm-up period of 30 minutes, or twice the time that the Product has been turned off.

General Specifications

Mains Power	Line Voltage (automatic selection): 100 V, 120 V, 220 V, 240 V (±10 %) Line Frequency: 47 Hz to 63 Hz
Fuse ratings	T 5A 250 V (100 V to 120 V), T 2.5 A 250 V (220 V to 240 V)
Max Power Consumption	500 VA
Environment	
Temperature	
Operating	0 °C to 50 °C
Calibration (tcal)	15 °C to 35 °C
Storage	-20 °C to +70 °C
Temperature Coefficient	Temperature coefficient for temperatures outside 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 dry-out period (with power on) of at least one week may be required.
Altitude	
Operating	0 m to 3050 m (10 000 ft)
Non-operating	12 200 m (40 000 ft) maximum
Compliance	
Safety	IEC 61010-1: Overvoltage Category II, Pollution Degree 2; IEC 61010-2-030
Output Terminal Electrical Overload Protection	Provides reverse-power protection and immediate output disconnection 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

Electromagnetic Compatibility (EMC)

International ..... IEC 61326-1: Controlled Electromagnetic Environment

CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.

Korea (KCC) ..... Class A Equipment (Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC)..... 47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103.

Remote Interfaces	GPIB (IEEE-488), RS-232, USB 2.0 (TMC), Ethernet (Telnet)
Dimensions (HxWxL)	17.8 cm x 43.2 cm x 56.4 cm (7 in x 17 in x 22.2 in) Standard rack width and rack increment, plus 1.5 cm (0.6 in) for feet on bottom of Product.
Weight (without options)	22 kg (49 lb)
Range Limits	For all functions, the maximum value for each range is the range nominal. For example, the maximum output value for the 12 V dc range is 12.000 000 V.

DCV Specifications

External Sense applicable for 1.2 V, 12 V, and 120 V ranges.

DCV Specifications ±(µV/V Output + Floor)							
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
	90d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 mV	10	12	15	7.8	9.3	12	0.8 µV [1]
1.2 V	6.6	8.3	11	5.1	6.4	8.5	1 µV
12 V	6.5	8.0	10	5.0	6.2	7.8	10 µV
120 V	9.3	11	14	7.2	8.5	11	100 µV
1020 V	9.3	11	14	7.2	8.5	11	1000 µV

[1] While in DCP function, or after extended periods of operation in either DCI, ACI, or ACP the 120 mV range floor may increase up to 4 µV. This error will recover to specified performance within 10 minutes after you exit the DCP, DCI, ACI or ACP function.

DCV Operating Characteristic

Range lock available in all ranges.

Range	**Resolution**	**24 Hour Stability (±1 °C) ±(µV/V Output + Floor)**		**Linearity ±µV/V Range**	**Noise**			**Output Impedance or Max Current**
					0.1 Hz to 10 Hz ±(µV/V Output + Floor) p-p		**10 Hz to 10 kHz**	
		µV/V	**Floor**		**µV/V**	**Floor**	**RMS**	
120 mV	10 nV	3.0	0.8 µV	1	0.2	0.5 µV	6 µV	50 Ω (nom)
1.2 V	100 nV	2.0	1 µV	1	0.2	5 µV	60 µV	10 mA [1]
12 V	1 µV	2.0	5 µV	1	0.2	50 µV	600 µV	20 mA [1]
120 V	10 µV	3.0	50 µV	1	10	500 µV	20 mV	10 mA [1]
1020 V	100 µV	3.0	500 µV	1	10	5 mV	30 mV	5 mA [2]

[1] Typical output resistance is <5 mΩ, internal sense. External sense is available.
[2] Typical output resistance is <5 mΩ. External sense not available.

ACV Specifications

External Sense applicable for 1.2 V, 12 V, and 120 V ranges <100 kHz.

ACV Specifications ± (µV/V Output + Floor)								
Range	**Frequency (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
12 mV	3 to 5	2000	2500	3200	1600	1900	2500	7 µV
	5 to 10	700	875	1100	540	680	850	7 µV
	10 to 20 k	120	150	190	93	120	150	6 µV
	20 k to 50 k	300	375	475	230	290	370	6 µV
	50 k to 100 k	1200	1500	1900	930	1200	1500	15 µV
	100 k to 300 k	6400	8000	10000	5000	6200	7800	30 µV
	300 k to 500 k	6400	8000	10000	5000	6200	7800	30 µV
120 mV	3 to 5	2000	2500	3200	1600	1900	2500	7 µV
	5 to 10	700	875	1100	540	680	850	7 µV
	10 to 20 k	115	140	170	89	110	130	6 µV
	20 k to 50 k	280	350	440	220	270	340	8 µV
	50 k to 100 k	640	800	1000	500	620	780	20 µV
	100 k to 300 k	1600	2000	2500	1200	1600	1900	30 µV
	300 k to 500 k	1600	2000	2500	1200	1600	1900	30 µV
1.2 V	3 to 5	2000	2500	3200	1600	1900	2500	75 µV
	5 to 10	700	875	1100	540	680	850	70 µV
	10 to 40	115	140	170	89	110	130	60 µV
	40.01 to 20 k	115	140	170	89	110	130	8 µV
	20 k to 50 k	240	300	380	190	230	300	14 µV
	50 k to 100 k	560	700	890	430	540	690	40 µV
	100 k to 300 k	1520	1900	2400	1200	1500	1900	80 µV
	300 k to 500 k	1520	1900	2400	1200	1500	1900	80 µV
12 V	3 to 5	2000	2500	3200	1600	1900	2500	750 µV
	5 to 10	700	875	1100	540	680	850	750 µV
	10 to 40	115	140	170	89	110	130	350 µV
	40.01 to 20 k	115	140	170	89	110	130	50 µV
	20 k to 50 k	240	300	380	190	230	300	50 µV
	50 k to 100 k	560	700	890	430	540	690	125 µV
	100 k to 300 k	1600	2000	2500	1200	1600	1900	600 µV
	300 k to 500 k	1600	2000	2500	1200	1600	1900	600 µV

ACV Specifications ±(µV/V Output + Floor)								
Range	**Frequency (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 V	3 to 5	2000	2500	3200	1600	1900	2500	7.5 mV
	5 to 10	700	875	1100	540	680	850	7.5 mV
	10 to 40	115	140	170	89	110	130	3.5 mV
	40.01 to 20 k	115	140	170	89	110	130	500 µV
	20 k to 50 k	240	300	380	190	230	300	500 µV
	50 k to 100 k	560	700	890	430	540	690	1.25 mV
	100 k to 300 k [1]	1600	1700	2500	1200	1600	1900	20 mV
330 V	3 to 5	2000	2500	3200	1600	1900	2500	75 mV
	5 to 10	700	875	1100	540	680	850	75 mV
	10 to 20 k	115	140	170	89	110	130	8 mV
	20 k to 50 k	240	300	380	190	230	300	8 mV
	50 k to 100 k	1200	1500	1900	930	1200	1500	12.5 mV
1020 V	3 to 5	2000	2500	3200	1600	1900	2500	75 mV
	5 to 10	700	875	1100	540	680	850	75 mV
	10 to 10 k	115	140	170	89	110	130	80 mV
[1] 70 V max								

ACV Operating Characteristics

Range lock unavailable for ACV. Minimum output for 12 mV range is 1 mV. The maximum load capacitance is 500 pF, subject to the maximum burden current limits.

Range	**Resolution**	**Frequency (Hz)**	**Output Impedance or Max Current**	**Distortion and Noise 10 Hz to 2 MHz ±(% Output + Floor)**	
				%	**Floor**
12 mV	10 nV	3 to 5	50 Ω (nom)	0.20	50 µV
		5 to 10		0.20	
		10 to 20 k		0.03	
		20 k to 50 k		0.15	
		50 k to 100 k		0.25	
		100 k to 300 k		0.30	
		300 k to 500 k		0.30	

Range	Resolution	Frequency (Hz)	Output Impedance or Max Current	Distortion and Noise 10 Hz to 2 MHz ±(% Output + Floor)	
				%	Floor
120 mV	100 nV	3 to 5	50 Ω (nom)	0.15	90 µV
		5 to 10		0.15	
		10 to 20 k		0.03	
		20 k to 50 k		0.15	
		50 k to 100 k		0.25	
		100 k to 300 k		0.30	
		300 k to 500 k		0.30	
1.2 V	1 µV	3 to 5	10 mA [1]	0.15	100 µV
		5 to 10		0.15	
		10 to 20 k		0.03	
		20 k to 50 k		0.15	
		50 k to 100 k		0.20	
		100 k to 300 k		0.20	
		300 k to 500 k		0.50	
12 V	10 µV	3 to 5	20 mA [1]	0.15	200 µV
		5 to 10		0.15	
		10 to 20 k		0.03	
		20 k to 50 k		0.15	
		50 k to 100 k		0.20	
		100 k to 300 k		0.30	
		300 k to 500 k		0.50	
120 V	100 µV	3 to 5	20 mA [1]	0.15	2 mV
		5 to 10		0.15	
		10 to 20 k		0.06	
		20 k to 50 k		0.20	
		50 k to 100 k		0.50	
		100 k to 300 k		1.00	
330 V	1 mV	3 to 5	20 mA [2]	0.15	20 mV [3]
		5 to 10		0.15	
		10 to 20 k		0.07	
		20 k to 50 k		0.80	
		50 k to 100 k		1.00	
1020 V	1 mV	3 to 5	6 mA [2]	0.15	20 mV [3]
		5 to 10		0.15	
		10 to 10 k		0.07	

[1] Minimum load resistance of 50 Ω. Typical output resistance is <5 mΩ, internal sense. External sense is available.

[2] Typical output resistance is <5 mΩ, external sense not available.

[3] For outputs ≤10 kHz, noise is specified in 100 kHz bandwidth.

DCI Specifications

DCI Specifications ± (µA/A Output + Floor)							
Range	**99% confidence level**			**95% confidence level**			**Floor**
	90d	**1y**	**2y**	**90d**	**1y**	**2y**	
120 µA	100	125	160	78	97	120	6 nA
1.2 mA	80	100	130	62	78	100	15 nA
12 mA	80	100	130	62	78	100	80 nA
120 mA	80	100	130	62	78	100	800 nA
1.2 A	130	160	200	100	120	160	10 µA
3.1 A	240	300	380	190	230	300	150 µA
12 A	240	300	380	190	230	300	250 µA
30.2 A	800	1000	1300	620	780	1000	500 µA

DCI Operating Characteristics

Range lock available in all ranges. Max inductive load is 400 µH for all ranges. 8 kΩ max resistive load for specified performance.

Range	**Resolution**	**Noise**		**Max Compliance Voltage**
		0.1 Hz to 10 Hz	**10 Hz to10 kHz**	
		A p-p	**A rms**	
120 µA	100 pA	2 nA	50 nA	10 V
1.2 mA	1 nA	20 nA	200 nA	10 V
12 mA	10 nA	200 nA	2 µA	7 V
120 mA	100 nA	2000 nA	20 µA	7 V
1.2 A	1 µA	20 µA	200 µA	6 V
3.1 A	1 µA	200 µA	2 mA	6 V
12 A	10 µA	200 µA	50 mA	4 V
30.2 A	10 µA	2 mA	50 mA	4 V

ACI Specifications

ACI Specifications ±(µA/A Output + Floor)								
Range	**Frequency (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 µA	3 to 45	200	250	320	160	190	250	10 nA
	45 to 1 k	200	250	320	160	190	250	10 nA[1]
	1 k to 5 k	200	250	320	160	190	250	10 nA
	5 k to 10 k	1200	1500	1900	930	1200	1500	40 nA
	10 k to 30 k	4000	5000	6300	3100	3900	4900	1 µA

ACI Specifications ±(µA/A Output + Floor)								
Range	**Frequency (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
1.2 mA	3 to 45	200	250	320	160	190	250	100 nA
	45 to 1 k	200	250	320	160	190	250	100 nA
	1 k to 5 k	200	250	320	160	190	250	100 nA
	5 k to 10 k	1200	1500	1900	930	1200	1500	100 nA
	10 k to 30 k	4000	5000	6300	3100	3900	4900	5 µA
12 mA	3 to 45	200	250	320	160	190	250	1 µA
	45 to 1 k	200	250	320	160	190	250	1 µA
	1 k to 5 k	200	250	320	160	190	250	1 µA
	5 k to 10 k	1200	1500	1900	930	1200	1500	1 µA
	10 k to 30 k	4000	5000	6300	3100	3900	4900	10 µA
120 mA	3 to 45	200	250	320	160	190	250	10 µA
	45 to 1 k	120	150	190	93	120	150	5 µA
	1 k to 5 k	200	250	320	160	190	250	8 µA
	5 k to 10 k	1200	1500	1900	930	1200	1500	10 µA
	10 k to 30 k	4000	5000	6300	3100	3900	4900	100 µA
1.2 A	3 to 45	200	250	320	160	190	250	100 µA
	45 to 1 k	200	250	320	160	190	250	50 µA
	1 k to 5 k	200	250	320	160	190	250	80 µA
	5 k to 10 k	2000	2500	3200	1600	1900	2500	300 µA
	10 k to 30 k	4000	5000	6300	3100	3900	4900	300 µA
3.1 A	3 to 45	300	375	475	230	290	370	500 µA
	45 to 1 k	240	300	380	190	230	300	300 µA
	1 k to 5 k	300	375	475	230	290	370	300 µA
	5 k to 10 k	2000	2500	3200	1600	1900	2500	500 µA
12 A	3 to 45	300	375	475	230	290	370	1 mA [2]
	45 to 1 k	240	300	380	190	230	300	500 µA[2]
	1 k to 5 k	300	375	475	230	290	370	800 µA
	5 k to 10 k	2000	2500	3200	1600	1900	2500	1 mA
30.2 A	3 to 45	800	1000	1300	620	780	1000	10 mA
	45 to 1 k	560	700	890	430	540	690	8 mA
	1 k to 5 k	4000	5000	6300	3100	3900	4900	8 mA

[1] Floor is 100 nA when output frequency is within 2 Hz of the line frequency.
[2] Floor is 2 mA for ACP function with output voltage >120V

ACI Operational Characteristics

Max Inductive load 400 µH at frequencies < 1kHz.

Max inductive load is valid up to compliance voltage limits for each range.

$$I_{out}\sqrt{(2\pi fL)^2 + R^2} < Max\ Compliance\ Voltage$$

Range lock unavailable for ACI. Minimum output for 120 µA range is 10 µA. Accuracy specification adders apply for compliance voltages >1 V rms.

Range	Resolution	Frequency (Hz)	Compliance adder ±(µA/V) or Max Resistive Load for Specified Performance	Compliance Limits (V rms)	Distortion and Noise 10 Hz to 100 kHz BW ±(% Output + Floor)		Max Inductive Load > 1 kHz (µH)
					%	Floor	
120 µA	1 nA	3 to 45	2 kΩ [1]	7	0.15	200 nA	200
		45 to 1 k			0.03		
		1 k to 5 k			0.03		
		5 k to 10 k			0.5		
		10 k to 30 k			1.2		
1.2 mA	10 nA	3 to 45	1 kΩ [1]	7	0.15	400 nA	200
		45 to 1 k			0.03		
		1 k to 5 k			0.03		
		5 k to 10 k			0.5		
		10 k to 30 k			1.2		
12 mA	100 nA	3 to 45	0.05	5	0.15	3 µA	200
		45 to 1 k	0.05		0.03		
		1 k to 5 k	0.05		0.03		
		5 k to 10 k	1.5		0.5		
		10 k to 30 k	10		1.2		
120 mA	1 µA	3 to 45	0.05	5	0.15	30 µA	50
		45 to 1 k	0.05		0.03		
		1 k to 5 k	0.05		0.03		
		5 k to 10 k	1.5		0.5		
		10 k to 30 k	10		1.2		
1.2 A	10 µA	3 to 45	-	4	0.15	300 µA	50
		45 to 1 k	-		0.03		
		1 k to 5 k	100		0.1 [2]		
		5 k to 10 k	1000		0.5 [3]		
		10 k to 30 k	-		1.2		

Range	Resolution	Frequency (Hz)	Compliance adder ±(µA/V) or Max Resistive Load for Specified Performance	Compliance Limits (V rms)	Distortion and Noise 10 Hz to 100 kHz BW ±(% Output + Floor)		Max Inductive Load > 1 kHz (µH)
					%	Floor	
3.1 A	10 µA	3 to 45	-	4	0.1	3 mA	2.5
		45 to 1 k	-		0.1		
		1 k to 5 k	775		0.25 [2]		
		5 k to 10 k	5170		0.5 [3]		
12 A	100 µA	3 to 45	3600	3[6]	0.15 [4]	3 mA	2.5
		45 to 1 k	2880		0.15 [4]		
		1 k to 5 k	9000	2	0.3 [3]		
		5 k to 10 k	60000		0.5 [3]		
30.2 A	100 µA	3 to 45	24000	3[6]	0.3 [2]	5 mA	1
		45 to 1 k	16800		0.3 [2]		
		1 k to 5 k	300000	2	0.5 [5]		

[1] Max output capacitance of 50 pF must be considered at high frequencies and high load impedances.
[2] For compliance voltages >1 V, add 0.24 %/V to the distortion specification.
[3] For compliance voltages >1 V, add 0.6 %/V to the distortion specification.
[4] For compliance voltages >1 V, add 0.12 %/V to the distortion specification.
[5] For compliance voltages >1 V, add 1 %/V to the distortion specification.
[6] For inductive loads. For resistive loads max compliance voltage is 2 V.

Frequency Specifications

With REF CLK set to external, the frequency uncertainty is the uncertainty of the external 10 MHz clock. External reference must be a square or pulse signal with a positive peak voltage between 3 V and 5 V and frequency within ±20 µHz/Hz of 10 MHz.

Frequency Range	Resolution	2 Year Absolute Uncertainty	Jitter
0.01 Hz to 119.99 Hz	0.01 Hz	±2.5 µHz/Hz	100 ns p-p
120.0 Hz to 1199.9 Hz	0.1 Hz		
1.200 Hz to 11.999 kHz	1 Hz		
12.00 kHz to 119.99 kHz	10 Hz		
120.0 kHz to 1199.9 kHz	100 Hz		
1.200 MHz to 2.000 MHz	1 kHz		

Phase Specifications

Phase specifications apply to the phase difference between the Reference Clock and the OUTPUT and also apply to the phase difference between the main output and the axillary output.

See *Power and Dual Output Limit Specifications* for applicable dual outputs. For combinations of Voltage ≤120 mV and Current >3.1 A, phase specifications are double. For current between 3.101 A and 6 A, add 0.1 degrees.

Phase Specifications ±deg						
Frequency (Hz)	**99 % Confidence Level**			**95 % Confidence Level**		
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**
3 to 65	0.10	0.10	0.10	0.10	0.10	0.10
65 to 500	0.25	0.25	0.25	0.20	0.20	0.20
500 to 1 k	0.50	0.50	0.50	0.40	0.40	0.40
1 k to 5 k	2.5	2.5	2.5	1.9	1.9	1.9
5 k to 10 k	5.0	5.0	5.0	3.9	3.9	3.9
10 k to 30 k	10	10	10	7.8	7.8	7.8

Resistance Specifications

Continuously variable from 0 Ω to 1200 MΩ.

Applies for four-wire compensation only. For COMP OFF or two-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 two-wire mode, at 1 kΩ the floor specification within 24 hours of an ohms zero adjust for a measurement current of 1 mA is: 0.002 Ω + (5 µV / 1 mA) = (0.002 + 0.005) Ω = 0.007 Ω).

In RF fields between 2 V/m and 3 V/m from 80 MHz to 140 MHz, increase specifications by 150 %. For conducted RF voltages between 2 V and 3 V from 25 MHz to 50 MHz, increase specifications by 160 %.

Resistance Specifications ±(uΩ/Ω of Output + Floor)								
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**	
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	**24 h zero ±1 °C**	**14 d zero ±5 °C**
12 Ω	22	25	29	17	19	23	1 mΩ	10 mΩ
120 Ω	22	25	29	17	19	23	1 mΩ	15 mΩ
1.2 kΩ	22	25	29	17	19	23	2 mΩ	20 mΩ
12 kΩ	22	25	29	17	19	23	20 mΩ	200 mΩ
120 kΩ	22	25	29	17	19	23	200 mΩ	1 Ω
1.2 MΩ	22	25	29	17	19	23	2 Ω	10 Ω
12 MΩ	28	35	44	22	27	34	30 Ω	150 Ω
120 MΩ	380	430	500	300	330	390	2.5 kΩ	2.5 kΩ
1200 MΩ	3900	4000	4200	3000	3100	3300	100 kΩ	100 kΩ

Resistance Operating Characteristics

Max burden voltage of 13 V.

For currents lower than specified, the floor adder increases by Floor (new) = 2.5 x Floor (old) x Imin/Iactual. For example, a 50 µA stimulus measuring 100 Ω has a floor specification of: 2.5 x 0.001 Ω x 1 mA/50 µA = 0.05 Ω assuming an ohms zero adjustment within 24 hours.

For currents higher than specified (up to max current) the specification increases to Spec(new) = Specification x (Iactual / Ispecmax)$^{0.5}$ + Floor. For example, measuring 100 Ω with a 30 mA current with 1 year 99 % confidence has a specification of 0.0025 Ω x (30 mA / 13 mA)$^{0.5}$ + Floor = 0.0038 Ω + Floor.

Range	Resolution	Specified Current Range	Max Current
12 Ω	100 µΩ	4 mA to 30 mA	125 mA
120 Ω	100 µΩ	1 mA to 13 mA	70 mA
1.2 kΩ	1 mΩ	1 mA to 10 mA	13 mA
12 kΩ	10 mΩ	100 µA to 1.3 mA	1.3 mA
120 kΩ	100 mΩ	10 µA to 130 µA	130 µA
1.2 MΩ	1 Ω	1 µA to 13 µA	13 µA
12 MΩ	10 Ω	100 nA to 1.3 µA	1.3 µA
120 MΩ	100 Ω	25 nA to 1 µA	1.2 µA
1200 MΩ	1 kΩ	2.5 nA to 100 nA	120 nA

Capacitance Specifications

The output is continuously variable from 0 pF to 120 mF, specified range 200 pF to 120 mF.

Specifications apply to both dc charge/discharge capacitance meters and ac RCL meters. The maximum allowable peak voltage is10 V. The maximum allowable peak current is 130 mA, with an rms limitation of 30 mA at 1.2 µF and below and 70 mA above 1.2 µF.

The maximum lead resistance for no additional error in ZCOMP two-wire mode is 10 Ω.

Specifications apply for COMP OFF. For four-wire or two-wire COMP, add 15 pF for all ranges, plus 0.03 % of output for the 1.2 µF range, 0.05 % of output for the 120 µF range, 0.04 % of output for the 1.2 mF range, 0.07 % of output for the 12 mF range, and 0.21 % of output for the 120 mF range.

Capacitance Specifications ±(% of Output + Floor)

Range	99 % Confidence Level			95 % Confidence Level			Floor
	90 d	1 y	2 y	90 d	1 y	2 y	
1.2 nF	0.11	0.12	0.14	0.09	0.09	0.11	4 pF [1, 2]
12 nF	0.11	0.12	0.14	0.09	0.09	0.11	5 pF [2]
120 nF	0.12	0.13	0.16	0.09	0.10	0.12	30 pF
1.2 µF	0.12	0.13	0.16	0.09	0.10	0.12	300 pF
12 µF	0.12	0.13	0.16	0.09	0.10	0.12	3 nF
120 µF	0.13	0.15	0.18	0.10	0.12	0.14	25 nF [3]
1.2 mF	0.22	0.25	0.30	0.17	0.19	0.23	250 nF
12 mF	0.22	0.25	0.30	0.17	0.19	0.23	3 µF [3]
120 mF	0.45	0.50	0.60	0.35	0.39	0.47	30 µF

[1] 2 pF for relative humidity within 15 % of the humidity at adjust.
[2] After storage or operation at high relative humidity, a drying out period of at least 2 weeks can be required.
[3] After storage at temperatures outside of the operating range, a relaxation period of at least 2 weeks near the tcal temperature may be required.

Capacitance Operating Characteristics

Capacitance Operating Characteristics					
Range	**Resolution**	**Nominal Adjust Frequency (CFREQ)**	**Allowed Frequency or Charge-Discharge Rate**		
			Full Specification	**For <0.5 % Error**	**For <1 % Error**
1.2 nF	0.1 pF	1 kHz	100 Hz to 10 kHz	40 Hz to 12 kHz	20 Hz to 14 kHz
12 nF	0.1 pF	1 kHz	150 Hz [1] to 5 kHz	10 Hz to 6 kHz	10 Hz to 8 kHz
120 nF	0.1 pF	610 Hz	200 Hz [2] to 1.3 kHz	20 Hz [2] to 2700 Hz	20 Hz [2] to 3700 Hz
1.2 µF	1 pF	100 Hz	2 Hz to 310 Hz	2 Hz to 800 Hz	2 Hz to 1100 Hz
12 µF	10 pF	80 Hz	0.5 Hz to 110 Hz	0.5 Hz to 250 Hz	0.5 Hz to 350 Hz
120 µF	100 pF	20 Hz	0.5 Hz to 40 Hz	0.1 Hz to 80 Hz	0.1 Hz to 110 Hz
1.2 mF	1 nF	5 Hz	0.1 Hz to 11 Hz	0.1 Hz to 18 Hz	0.1 Hz to 25 Hz
12 mF	10 nF	2 Hz	0.03 Hz to 4 Hz	0.03 Hz to 6 Hz	0.03 Hz to 8 Hz
120 mF	100 nF	1 Hz	0.01 Hz to 1.3 Hz	0.01 Hz to 1.7 Hz	0.01 Hz to 2.5 Hz

[1] 10 Hz for >3 nF
[2] 10 Hz for >30 nF

Inductance Specifications

The output is continuously variable from 13 µH to 120 H.

The maximum allowable peak voltage is 5 V. The maximum allowable peak current is 130 mA, with an rms limitation of 30 mA and 13 mA peak on the 120 H range.

The maximum lead resistance for no additional error in two-wire COMP mode is 2 Ω. Specifications apply for four-wire COMP. For COMP Off or two-wire COMP, add 500 µH for the 12 mH range, 400 µH for the 120 mH range, 0.4 mH and 0.04 % of output for the 1.2 H range, 0.3 mH and 0.04 % of output for the 12 H range, and 0.3 mH and 0.06 % of output for the 120 H range. Four-wire COMP required for 120 µH and 1.2 mH ranges.

Inductance Specifications ±(% of Output + Floor)								
Range	**Specified Frequency**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 µH	1 kHz	0.18	0.20	0.24	0.14	0.16	0.19	200 nH
1.2 mH	1 kHz	0.11	0.12	0.14	0.09	0.09	0.11	1 µH
12 mH	110 Hz	0.11	0.12	0.14	0.09	0.09	0.11	10 µH
120 mH	100 Hz	0.11	0.12	0.14	0.09	0.09	0.11	100 µH
1.2 H	10 Hz	0.13	0.15	0.18	0.10	0.12	0.14	1 mH
12 H	3 Hz	0.18	0.20	0.24	0.14	0.16	0.19	10 mH
120 H	2 Hz	0.22	0.25	0.30	0.17	0.19	0.23	100 mH

Inductance Operating Characteristics

Frequency adder applies for frequencies other than specified frequency.

Range	Resolution	Level	Frequency Adder	
			For <0.25 % Additional Error	For <1 % Additional Error
120 µH	1 nH	13 µH to 120 µH	550 Hz to 13 kHz	490 Hz to 17 kHz
1.2 mH	10 nH	0.12001 mH to 1.2 mH	330 Hz to 1.6 kHz	260 Hz to 2.5 kHz
12 mH	100 nH	1.2001 mH to 3.3 mH	0.5 Hz to 800 Hz	0.5 Hz to 980 Hz
		3.3 mH to 12 mH	0.5 Hz to 1000 Hz	0.5 Hz to 1400 Hz
120 mH	1 µH	12.001 mH to 83 mH	0.1 Hz to 180 Hz	0.1 Hz to 230 Hz
		83 mH to 120 mH	0.1 Hz to 320 Hz	0.1 Hz to 1000 Hz
1.2 H	10 µH	0.12001 H to 0.65 H	0.05 Hz to 30 Hz	0.05 Hz to 55 Hz
		0.65 H to 1.2 H	0.05 Hz to 100 Hz	0.05 Hz to 170 Hz
12 H	100 µH	1.2001 H to 5.5 H	0.01 Hz to 8 Hz	0.01 Hz to 16 Hz
		5.5 H to 12 H	0.01 Hz to 19 Hz	0.01 Hz to 37 Hz
120 H	1 mH	12.001 H to 30 H	0.005 Hz to 4 Hz	0.002 Hz to 9 Hz
		30 H to 120 H	0.005 Hz to 7 Hz	0.002 Hz to 14 Hz

TC Specifications

Does not include thermocouple error. Sourcing currents >3 A may require a cooling off time of up to 4x the current sourcing time to a maximum of 20 minutes for <0.01 °C additional error. In RF fields between 2 V/m and 3 V/m from 150 MHz to 280 MHz, increase specifications by 70 %.

Temperature standard ITS-90 or IPTS-68 are selectable. Resolution 0.01 °C.

TC Specifications Tcal ±5 °C, ±°C								
Type	**Range (°C)**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
B	600 to 800	0.35	0.44	0.56	0.27	0.34	0.43	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	800 to 1000	0.27	0.34	0.43	0.21	0.26	0.33	
	1000 to 1550	0.24	0.30	0.38	0.19	0.23	0.3	
	1550 to 1820	0.26	0.33	0.42	0.20	0.26	0.33	
C	0 to 150	0.20	0.25	0.32	0.16	0.19	0.25	W5Re/W26Re; ITS-90 per ASTM E230/E230M-17, IEC 60584-1:2013, ASTM E988-96; IPTS-68 per ASTM E988-84
	150 to 650	0.17	0.21	0.26	0.13	0.16	0.2	
	650 to 1000	0.21	0.26	0.33	0.16	0.20	0.26	
	1000 to 1800	0.36	0.45	0.57	0.28	0.35	0.44	
	1800 to 2315	0.63	0.79	1.0	0.49	0.61	0.78	
D	0 to 150	0.20	0.25	0.32	0.16	0.19	0.25	W3Re/W25Re; ITS-90 per ASTM E1751-15, ASTM E988-96
	150 to 650	0.17	0.21	0.26	0.13	0.16	0.2	
	650 to 1000	0.21	0.26	0.33	0.16	0.20	0.26	
	1000 to 1800	0.35	0.44	0.56	0.27	0.34	0.43	
	1800 to 2315	0.62	0.78	0.99	0.48	0.61	0.77	
E	-250 to -150	0.32	0.4	0.51	0.25	0.31	0.39	W/W26Re; ITS-90 per ASTM E1751-15; IPTS-68 per Hoskins Mfg. Co. (1974)
	-150 to -25	0.10	0.14	0.19	0.08	0.11	0.15	
	-25 to 350	0.09	0.11	0.14	0.07	0.09	0.11	
	350 to 650	0.13	0.16	0.20	0.10	0.12	0.16	
	650 to 1000	0.16	0.21	0.28	0.12	0.16	0.22	
G	0 to 150	0.40	0.5	0.63	0.31	0.39	0.49	W/W26Re; ITS-90 per ASTM E1751-15; IPTS-68 per Hoskins Mfg. Co. (1974)
	150 to 650	0.26	0.33	0.42	0.2	0.26	0.33	
	650 to 1000	0.21	0.26	0.33	0.16	0.20	0.26	
	1000 to 1800	0.34	0.43	0.55	0.26	0.33	0.43	
	1800 to 2315	0.62	0.77	0.97	0.48	0.60	0.75	

TC Specifications Tcal ±5 °C, ±°C								
Type	**Range (°C)**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
J	-210 to -100	0.19	0.24	0.31	0.15	0.19	0.24	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -30	0.10	0.13	0.17	0.08	0.10	0.13	
	-30 to 150	0.09	0.11	0.14	0.07	0.09	0.11	
	150 to 760	0.11	0.14	0.18	0.09	0.11	0.14	
	760 to 1200	0.16	0.20	0.25	0.12	0.16	0.19	
K	-200 to -100	0.22	0.28	0.36	0.17	0.22	0.28	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -25	0.10	0.13	0.17	0.08	0.10	0.13	
	-25 to 120	0.09	0.11	0.14	0.07	0.09	0.11	
	120 to 1000	0.17	0.21	0.26	0.13	0.16	0.20	
	1000 to 1372	0.28	0.35	0.44	0.22	0.27	0.34	
L	-200 to -100	0.25	0.31	0.39	0.19	0.24	0.30	IPTS-68: per DIN 43710-1985
	-100 to 800	0.16	0.20	0.25	0.12	0.16	0.19	
	800 to 900	0.09	0.11	0.14	0.07	0.09	0.11	
N	-200 to -100	0.26	0.33	0.42	0.20	0.26	0.33	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -25	0.12	0.15	0.19	0.09	0.12	0.15	
	-25 to 120	0.10	0.12	0.15	0.08	0.09	0.12	
	120 to 410	0.09	0.11	0.14	0.07	0.09	0.11	
	410 to 1300	0.16	0.20	0.25	0.12	0.16	0.19	
R	0 to 250	0.41	0.51	0.64	0.32	0.40	0.50	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	250 to 400	0.23	0.29	0.37	0.18	0.23	0.29	
	400 to 1000	0.22	0.27	0.34	0.17	0.21	0.26	
	1000 to 1767	0.27	0.34	0.43	0.21	0.26	0.33	
S	0 to 250	0.34	0.42	0.53	0.26	0.33	0.41	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	250 to 1000	0.25	0.31	0.39	0.19	0.24	0.30	
	1000 to 1400	0.26	0.32	0.40	0.20	0.25	0.31	
	1400 to 1767	0.33	0.41	0.52	0.26	0.32	0.40	

TC Specifications Tcal ±5 °C, ±°C								
Type	**Range (°C)**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
T	-250 to -150	0.48	0.60	0.76	0.37	0.47	0.59	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-150 to 0	0.17	0.21	0.26	0.13	0.16	0.20	
	0 to 120	0.10	0.13	0.17	0.08	0.10	0.13	
	120 to 400	0.09	0.11	0.14	0.07	0.09	0.11	
U	-200 to 0	0.32	0.40	0.51	0.25	0.31	0.40	IPTS-68: per DIN 43710-1985
	0 to 600	0.09	0.11	0.14	0.07	0.09	0.11	
BP	0 to 1000	0.32	0.40	0.51	0.25	0.31	0.40	ITS-90: per IEC 60584-1:2013, GOST R 8.585-2001
	1000 to 2000	0.48	0.60	0.76	0.37	0.47	0.59	
	2000 to 2500	0.64	0.80	1.00	0.50	0.62	0.78	
XK	-200 to 300	0.16	0.20	0.25	0.12	0.16	0.19	ITS-90: per GOST R 8.585-2001
	300 to 800	0.24	0.30	0.38	0.19	0.23	0.30	

TC Voltage Source in Linear 10 µV/°C and 1 mV/°C Modes

Resolution 0.1 µV and max burden (source) 10 Ω.

DCV Specifications ±(µV/V Output + Floor)							
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
0 mV to 120 mV	16	20	25	12	16	19	1 µV

TC Voltage Measure in Linear 10 µV/°C and 1 mV/°C Modes

Resolution 0.1 µV.

DCV Specifications ±(µV/V Input + Floor)							
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
0 mV to 120 mV	20	25	32	16	19	25	1.6 µV
120 mV to 330 mV	40	50	63	31	39	49	3 µV

RTD Specifications

Temperature standard ITS-90 or IPTS-68 is selectable. Specifications do not include sensor accuracy.
Applies within 24 hours and ±1 °C of Ω-Zero Adjustment and either COMP OFF at the Output terminals or with two-wire and four-wire compensation.

See *Resistance Operating Characteristics* for stimulus current limits for specified performance.

In RF fields between 2 and 3 V/m or 80 MHz to 140 MHz, increase the specifications by 150 %. For conducted RF voltages between 2 V and 3 V or 25 MHz to 50 MHz, increase the specifications by 160 %.

Resolution is 0.003 °C.

RTD Specifications Tcal ±5 °C, ±°C								
Type	**Range (°C)**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
Cu 10 (427)	-80 to 260	0.27	0.30	0.34	0.21	0.23	0.26	Notes [1]
Cu 50 (428)	-180 to 200	0.36	0.40	0.45	0.28	0.31	0.35	Notes [2]
Cu 100 (428)	-180 to 40	0.36	0.40	0.45	0.28	0.31	0.35	
	40 to 200	0.59	0.65	0.74	0.46	0.50	0.57	
Ni 120 (672)	-80 to 0	0.07	0.08	0.09	0.05	0.06	0.07	Notes [1]
	0 to 100	0.07	0.08	0.09	0.05	0.06	0.07	
	100 to 260	0.13	0.14	0.16	0.1	0.11	0.12	
Pt 100 (385)	-200 to -80	0.05	0.05	0.06	0.04	0.04	0.05	Notes [3]
	-80 to 0	0.05	0.05	0.06	0.04	0.04	0.05	
	0 to 100	0.06	0.07	0.08	0.05	0.05	0.06	
	100 to 300	0.08	0.09	0.10	0.06	0.07	0.08	
	300 to 400	0.09	0.10	0.11	0.07	0.08	0.09	
	400 to 630	0.11	0.12	0.14	0.09	0.09	0.11	
	630 to 800	0.19	0.23	0.24	0.15	0.18	0.19	

RTD Specifications Tcal ±5 °C, ±°C								
Type	**Range**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
Pt 100 (3916)	-200 to -190	0.23	0.25	0.28	0.18	0.19	0.22	Notes [4]
	-190 to -80	0.04	0.04	0.05	0.03	0.03	0.04	
	-80 to 0	0.05	0.05	0.06	0.04	0.04	0.05	
	0 to 100	0.05	0.06	0.07	0.04	0.05	0.05	
	100 to 260	0.06	0.07	0.08	0.05	0.05	0.06	
	260 to 300	0.07	0.08	0.09	0.05	0.06	0.07	
	300 to 400	0.08	0.09	0.10	0.06	0.07	0.08	
	400 to 600	0.09	0.10	0.11	0.07	0.08	0.09	
	600 to 630	0.21	0.23	0.26	0.16	0.18	0.20	
Pt 100 (3926)	-200 to -80	0.05	0.05	0.06	0.04	0.04	0.05	Notes [1]
	-80 to 0	0.05	0.05	0.06	0.04	0.04	0.05	
	0 to 100	0.06	0.07	0.08	0.05	0.05	0.06	
	100 to 300	0.08	0.09	0.10	0.06	0.07	0.08	
	300 to 400	0.09	0.10	0.11	0.07	0.08	0.09	
	400 to 630	0.11	0.12	0.14	0.09	0.09	0.11	
Pt 200 (385)	-200 to -80	0.04	0.04	0.05	0.03	0.03	0.04	Notes [3]
	-80 to 0	0.04	0.04	0.05	0.03	0.03	0.04	
	0 to 100	0.04	0.04	0.05	0.03	0.03	0.04	
	100 to 260	0.05	0.05	0.06	0.04	0.04	0.05	
	260 to 300	0.11	0.12	0.14	0.09	0.09	0.11	
	300 to 400	0.12	0.13	0.15	0.09	0.10	0.12	
	400 to 600	0.13	0.14	0.16	0.10	0.11	0.12	
	600 to 630	0.14	0.16	0.18	0.11	0.12	0.14	
Pt 500 (385)	-200 to -80	0.04	0.04	0.05	0.03	0.03	0.04	
	-80 to 0	0.05	0.05	0.06	0.04	0.04	0.05	
	0 to 100	0.05	0.05	0.06	0.04	0.04	0.05	
	100 to 260	0.05	0.06	0.07	0.04	0.05	0.05	
	260 to 300	0.07	0.08	0.09	0.05	0.06	0.07	
	300 to 400	0.07	0.08	0.09	0.05	0.06	0.07	
	400 to 600	0.08	0.09	0.10	0.06	0.07	0.08	
	600 to 630	0.10	0.11	0.12	0.08	0.09	0.09	

RTD Specifications Tcal ±5 deg C, ±°C								
Type	**Range**	**99 % Confidence Level**			**95 % Confidence Level**			**Standard**
		90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
Pt 1000 (385)	-200 to -80	0.03	0.03	0.04	0.02	0.02	0.03	Notes [3]
	-80 to 0	0.03	0.03	0.04	0.02	0.02	0.03	
	0 to 100	0.04	0.04	0.05	0.03	0.03	0.04	
	100 to 260	0.05	0.05	0.06	0.04	0.04	0.05	
	260 to 300	0.05	0.06	0.07	0.04	0.05	0.05	
	300 to 400	0.06	0.07	0.08	0.05	0.05	0.06	
	400 to 600	0.06	0.07	0.08	0.05	0.05	0.06	
	600 to 630	0.21	0.23	0.26	0.16	0.18	0.20	

Notes:

[1] ITS-90 per *Resistance Thermometry* - MINCO Application Aid No. 18
[2] ITS-90: per GOST 6651-2009
[3] ITS-90: per IEC 60751:2008, ASTM E1137-08; IPTS-68: per IEC 751:1983, DIN 43760
[4] IPTS-68: per JIS C1604:1981

ACV Frequency Limits and Characteristics

Range	**Sine**				**Non Sine**	
	Normal BW		**Extended BW**		**Square**[1]	
	Min Freq (Hz)	**Max Freq (Hz)**	**Min Freq (Hz)**	**Max Freq (Hz)**	**Min Freq (Hz)**	**Max Freq (Hz)**
12 mV	3	500 k	0.01	-	0.01	100 k
120 mV	3	500 k	0.01	-	0.01	100 k
1.2 V	3	500 k	0.01	2 M	0.01	100 k
12 V	3	500 k	0.01	2 M	0.01	100 k
120 V	3	100 k	0.01	-	0.01	100 k
330 V	3	100 k	-	-	-	-
1020 V	3	10 k	-	-	-	-

[1] Square wave limited to 66 V p-p

Aux ACV Frequency Limits and Characteristics

Range	**Amplitude Resolution**	**Sine**		**Non Sine**	
		Normal BW		**Square**	
		Min Freq (Hz)	**Max Freq (Hz)**	**Min Freq (Hz)**	**Max Freq (Hz)**
120 mV	1 µV	10	30 k	10	10 k
1.2 V	10 µV	10	30 k	10	10 k
5 V	100 µV	10	30 k	10	10 k

ACI Frequency Limits and Characteristics

Range	Sine		Square	
	Min Freq (Hz)	Max Freq (Hz)	Min Freq (Hz)	Max Freq (Hz)
120 µA	3	30 k	3	10 k
1.2 mA	3	30 k	3	10 k
12 mA	3	30 k	3	10 k
120 mA	3	30 k	3	10 k
1.2 A	3	30 k	3	10 k
3.1 A	3	10 k	3	3 k
12 A	3	10 k	3	3 k
30.2 A	3	5 k	3	1 k

AC Power Frequency Limits and Characteristics

Limited by frequency of ACI or ACV whichever is lowest.

Current Range	Sine Only		
	Min Freq (Hz)	Max Freq (Hz)	
		V ≤330 V	V>330 V
120 µA	10	30 k	10 k
1.2 mA	10	30 k	10 k
12 mA	10	30 k	10 k
120 mA	10	30 k	10 k
1.2 A	10	30 k	10 k
3.1 A	10	10 k	10 k
12 A	10	10 k	10 k
30.2 A	10	5 k	5 k

Power and Dual Output Limit Specifications

Voltage, Current, and Phase specifications apply only in these ranges in Dual Output Modes.

Frequency (Hz)	NORMAL Voltage	Current	Aux Voltage
DC	0 V to ±1020 V	0 A to ±30.2 A	0 V to ±7 V
45 to 65	33 mV to 1020 V	1.2001 mA to 20.5 A	10 mV to 5 V
45 to 65	120.001 mV to 1020 V	1.2001 mA to 30.2 A	-
65 to 1 k	120.001 mV to 1020 V	12.001 mA to 3.1 A	120.01 mV to 5 V
65 to 1 k	1.20001 V to 1020 V	12.001 mA to 30.2 A	120.01 mV to 5 V
1 k to 5 k	1.20001 V to 500 V	12.001 mA to 3.1 A	120.01 mV to 5 V
5 k to 10 k	1.20001 V to 250 V	12.001 mA to 1.2 A	1.2001 V to 5 V
10 k to 30 k	1.20001 V to 250 V	12.001 mA to 1.2 A	1.2001 V to 3.3 V

DC Power Specification

Overall uncertainty in dc watts is calculated by the root sum square of the individual uncertainties of dcv and dci subject to the power and dual output limits.

$$U_{power} = \sqrt{(Uv^2 + Ui^2)}$$

AC Power Specification

Overall uncertainty in ac watts is calculated by the root sum square of the individual uncertainties of acv and aci and phase, subject to the power and dual output limits.

$$U_{power} = \sqrt{(Uv^2 + Ui^2 + U_{phase\ adder}{}^2)}$$

Where errors due to phase accuracy in % is calculated with this formula:

$$U_{phase\ adder}(\%) = 100\,(1 - \frac{Cos(\Phi + \Delta\Phi)}{Cos(\Phi)})$$

Where $\Delta\Phi$ is the phase specification.

Example: Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 (Φ =60)

Voltage Uncertainty: Uncertainty for 100 V at 400 Hz is, 140 µV/V + 0.5 mV, totaling:

100 V x 140 x 10^{-6} = 14 mV added to 0.5 mV = 14.5 mV. Expressed in percent:

14.5 mV/100 V x 100 = 0.0145 % (see *ACV Specifications*).

Current Uncertainty: Uncertainty for 1 A is 250 µA/A + 50 µA, totaling:

1 A x 250 x 10^{-6} = 250 µA added to 50 µA = 0.3 mA. Expressed in percent:

0.3 mA/1 A x 100 = 0.03 % (see *ACI Specifications*).

PF Adder: Watts Adder for PF = 0.5 (Φ =60) at 400 Hz is 0.76 % (see *Phase Specifications*).

Total Watts Output Uncertainty =

$$Total\ Watts\ Output\ Uncertainty = \sqrt{0.0145^2 + 0.03^2 + 0.76^2} = 0.76\%$$

ACV Extended Bandwidth (Sine) Specifications

External Sense applicable for 1.2 V, 12 V, 120 V, 330 V, and 1000 V ranges; <100 kHz.

ACV Extended Frequency Characteristics ±(% Output + Floor)			
Range	**Frequency (Hz)**	**1 Yr, ±5 deg Tcal**	**Floor**
12 mV	0.01 Hz to 3 Hz	5.0	60 µV
120 mV	0.01 Hz to 3 Hz	5.0	600 µV
1.2 V	0.01 Hz to 3 Hz	5.0	6 mV
	500 kHz to 1 MHz	-30 [1]	-
	1 MHz to 2 MHz	-90 [2]	-
12 V	0.01 Hz to 3 Hz	5.0	60 mV
	500 kHz to 1MHz	-30 [1]	-
	1 MHz to 2 MHz	-90 [2]	-
120 V	0.01 Hz to 3 Hz	5.0	600 mV

[1] Level rolls off with frequency above 500 KHz. Output could be as low as 30 % of programmed value at 1 MHz.
[2] Output could be as low as 90 % of programmed value at 2 MHz.

ACV Square Wave Specification

Amplitude verified with an RMS -responding DMM. Minimum output for 120 µA range is 2 mV p-p.

ACV Square Wave Specifications ±(% Output + Floor)									
Range	**Max Vpp**	**Freq. (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor p-p**
			90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
12 mV	22 mV	0.01 to 10	5.0	5.0	5.0	3.9	3.9	3.9	110 µV
		10 to 45	0.25	0.25	0.25	0.20	0.20	0.20	110 µV
		45 to 1 k	0.25	0.25	0.25	0.20	0.20	0.20	55 µV
		1 k to 20 k	0.50	0.50	0.50	0.40	0.40	0.40	55 µV
		20 k to 100 k	5.0	5.0	5.0	3.9	3.9	3.9	110 µV
120 mV	220 mV	0.01 to 10	5.0	5.0	5.0	3.9	3.9	3.9	1.1 mV
		10 to 45	0.25	0.25	0.25	0.20	0.20	0.20	1.1 mV
		45 to 1 k	0.25	0.25	0.25	0.20	0.20	0.20	0.55 mV
		1 k to 20 k	0.50	0.50	0.50	0.40	0.40	0.40	0.55 mV
		20 k to 100 k	5.0	5.0	5.0	3.9	3.9	3.9	1.1 mV

ACV Square Wave Specifications ±(% Output + Floor)									
Range	**Max Vpp**	**Freq. (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor p-p**
			90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
1.2 V	2.2 V	0.01 to 10	5.0	5.0	5.0	3.9	3.9	3.9	11 mV
		10 to 45	0.25	0.25	0.25	0.20	0.20	0.20	11 mV
		45 to 1 k	0.25	0.25	0.25	0.20	0.20	0.20	5.5 mV
		1 k to 20 k	0.50	0.50	0.50	0.40	0.40	0.40	5.5 mV
		20 k to 100 k	5.0	5.0	5.0	3.9	3.9	3.9	11 mV
12 V	22 V	0.01 to 10	5.0	5.0	5.0	3.9	3.9	3.9	110 mV
		10 to 45	0.25	0.25	0.25	0.20	0.20	0.20	110 mV
		45 to 1 k	0.25	0.25	0.25	0.20	0.20	0.20	55 mV
		1 k to 20 k	0.50	0.50	0.50	0.40	0.40	0.40	55 mV
		20 k to 100 k	5.0	5.0	5.0	3.9	3.9	3.9	110 mV
120 V	66 V	0.01 to 10	5.0	5.0	5.0	3.9	3.9	3.9	1.1 V
		10 to 45	0.25	0.25	0.25	0.20	0.20	0.20	1.1 V
		45 to 1 k	0.25	0.25	0.25	0.20	0.20	0.20	0.55 V
		1 k to 20 k	0.50	0.50	0.50	0.40	0.40	0.40	0.55 V
		20 k to 100 k	5.0	5.0	5.0	3.9	3.9	3.9	1.1 V

ACV Square Wave Characteristics

Risetime, Settling Time and Overshoot are @ 1kHz

Frequency (Hz)	**Risetime**	**Settling Time (to 1 % of final value)**	**Overshoot**	**Duty Cycle Range**	**Duty Cycle Uncertainty**
0.01 to 100 k	<1 µs	<10 µs	<2 %	1 % to 99 %	±(0.02 % of period + 100 ns) @ 50 % duty cycle ±(0.05 % of period +100 ns) duty cycles from 10 % to 90 %

ACI Square Wave Specifications

Amplitude verified with an RMS-responding DMM. Minimum output for 120 µA range is 20 µA p-p.

ACI Square Wave Specifications ±(% Output + Floor)									
Range	**Max App**	**Freq. (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor p-p**
			90d	**1y**	**2y**	**90d**	**1y**	**2y**	
120 µA	220 µA	3 to 45	0.25	0.25	0.25	0.20	0.20	0.20	1.1 µA
		45 to 1k	0.25	0.25	0.25	0.20	0.20	0.20	0.55 µA
		1k to 10k	10	10	10	7.8	7.8	7.8	4.4 µA
1.2 mA	2.2 mA	3 to 45	0.25	0.25	0.25	0.20	0.20	0.20	11 µA
		45 to 1k	0.25	0.25	0.25	0.20	0.20	0.20	5.5 µA
		1k to 10k	10	10	10	7.8	7.8	7.8	44 µA
12 mA	22 mA	3 to 45	0.25	0.25	0.25	0.20	0.20	0.20	110 µA
		45 to 1k	0.25	0.25	0.25	0.20	0.20	0.20	55 µA
		1k to 10k	10	10	10	7.8	7.8	7.8	440 µA
120 mA	220 mA	3 to 45	0.25	0.25	0.25	0.20	0.20	0.20	1.1 mA
		45 to 1k	0.25	0.25	0.25	0.20	0.20	0.20	1.1 mA
		1k to 10k	10	10	10	7.8	7.8	7.8	4.4 mA
1.2 A	2.2 A	3 to 45	0.25	0.25	0.25	0.20	0.20	0.20	11 mA
		45 to 1k	0.25	0.25	0.25	0.20	0.20	0.20	11 mA
		1k to 10k	10	10	10	7.8	7.8	7.8	44 mA
3.1 A	5.6 A	3 to 45	0.5	0.5	0.5	0.40	0.40	0.40	56 mA
		45 to 1k	0.5	0.5	0.5	0.40	0.40	0.40	28 mA
		1k to 3k	10	10	10	7.8	7.8	7.8	110 mA
12 A	22 A	3 to 45	0.5	0.5	0.5	0.4	0.4	0.4	220 mA
		45 to 1k	1.0	1.0	1.0	0.80	0.80	0.80	110 mA
		1k to 3k	10	10	10	7.8	7.8	7.8	440 mA
30.2 A	55.4 A	3 to 500	0.50	0.50	0.50	0.40	0.40	0.40	550 mA
		500 to 1k	1.0	1.0	1.0	0.80	0.80	0.80	550 mA

ACI Square Wave Characteristics

Risetime, Settling Time, and Overshoot are @ 400 Hz.

Frequency (Hz)	**Risetime**	**Settling Time (to 1% of Final Value)**	**Overshoot**
3 to 10 k	<25 µs	<40 µs	<10 % for <1 V compliance

ACV DC Offset Specifications

For frequencies 500 kHz to 2 MHz, the offset uncertainty is 5 % of output, ±1 % of the range.

ACV DC Offset Specifications ±(% of dc Output + Floor)							
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
12 mV	0.10	0.10	0.10	0.10	0.10	0.10	12 µV
120 mV	0.10	0.10	0.10	0.10	0.10	0.10	120 µV
1.2 V	0.10	0.10	0.10	0.10	0.10	0.10	1.2 mV
12 V	0.10	0.10	0.10	0.10	0.10	0.10	120 mV
120 V	0.10	0.10	0.10	0.10	0.10	0.10	1.2 V

DC Offset Operation Characteristics

DC Offset available for Frequency >40 Hz.

Range [1]	**AC and DC Levels Available with DC Offset**			
	Sine		**Square**	
	AC Max (rms)	**DC Max**	**AC Max p-p**	**DC Max**
12 mV	6 mV	8.48528 mV	17 mV	8.5 mV
120 mV	60 mV	84.8528 mV	170 mV	85 mV
1.2 V	0.6 V	0.848528 V	1.7 V	0.85 V
12 V	6 V	8.48528 V	17 V	8.5 V
120 V	60 V	84.8528 V	66 V	85 V

[1] For ac accuracies, use corresponding *ACV Specifications* for each range and waveform type. Minimum settable values are max/10 + 1 count resolution for the corresponding voltage range.

Aux Voltage

Aux DCV Specifications

Range lock unavailable for Aux DCV. Two channels of dc voltage output are provided.

Aux DCV Specifications ±(µV/V Output + Floor)							
Range	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
	90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 mV	240	300	380	190	230	300	300 µV
1.2 V	240	300	380	190	230	300	300 µV
7 V	240	300	380	190	230	300	300 µV

Aux DCV Operating Characteristics

The AUXV output has an output resistance of <1 Ω. Max output current is 5 mA.

Range	Resolution	Noise	
		0.1 Hz to 10 Hz	10 Hz to 10 kHz
		Floor p-p	RMS
120 mV	100 nV	2 µV	20 µV
1.2 V	1 µV	20 µV	200 µV
7 V	10 µV	200 µV	2 mV

Aux ACV-Sine Specifications

Minimum output 10 mV. See *Power and Dual Output Limit Specifications* for applicable dual outputs.

Aux ACV - Sine Specifications ±(µV/V Output + Floor)								
Range	Frequency (Hz)	99% Confidence Level			95% Confidence Level			Floor
		90 d	1 y	2 y	90 d	1 y	2 y	
120 mV	45 to 65	600	750	970	470	580	750	300 µV
1.2 V	45 to 1 k	600	750	970	470	580	750	300 µV
	1 k to 5 k	1200	1500	1900	930	1200	1500	350 µV
5 V	45 to 1 k	600	750	970	470	580	750	300 µV
	1 k to 5 k	1200	1500	1900	930	1200	1500	350 µV
	5 k to 10 k	2400	3000	3900	1900	2300	3000	350 µV
	10 k to 30 k	30000	38000	49000	23000	30000	38000	750 µV

Aux ACV-Sine Operating Characteristics

Range lock unavailable for Aux ACV. The AUX V output has an output resistance of <1 Ω. Max output current is 5 mA.

Range	Resolution	Frequency (Hz)	Distortion and Noise 10 Hz to 100 kHz ±(% Output + Floor)	
			%	Floor
120 mV	1 µV	45 to 65	0.03	200 µV
1.2 V	10 µV	45 to 1 k	0.03	400 µV
		1 k to 5 k	0.03	
5 V	100 µV	45 to 1 k	0.03	3 mV
		1 k to 5 k	0.03	
		5 k to 10 k	0.5	
		10 k to 30 k	1.2	

Aux ACV-Square Specifications

Minimum output 20 mVpp. See *Power and Dual Output Limit Specifications* for applicable dual outputs.

Aux ACV-Square Specifications ± (% Output + Floor)									
Range	**Max Vpp**	**Frequency (Hz)**	**99 % Confidence Level**			**95 % Confidence Level**			**Floor**
			90 d	**1 y**	**2 y**	**90 d**	**1 y**	**2 y**	
120 mV	220 mV	45 to 65	0.20	0.25	0.32	0.16	0.19	0.25	0.55 mV
1.2 V	2.2 V	45 to 1 k	0.20	0.25	0.32	0.16	0.19	0.25	5.5 mV
		1 k to 5 k	8.0	10	13	6.2	7.8	10	
5 V	14 V	45 to 1 k	0.20	0.25	0.32	0.16	0.19	0.25	110 mV
		1 k to 10 k	8.0	10	13	6.2	7.8	10	500 mV

Aux ACV Square Wave Characteristics

Frequency (Hz)	**Risetime**	**Settling Time (to 1% of final value)**	**Overshoot**
10 to 10 k	<25 µs	<40 µs	<10 %

Risetime, Settling Time and Overshoot are @ 400 Hz.

5560A with 52120A Current Specifications

Current specification of a single 52120A, when controlled by a 5560A. For specifications with multiple 52120As in parallel (up to three), RSS the specification for each 52120A.

DCI / ACI Specifications ± (µA/A Output + Floor)				
Range	**Frequency (Hz)**	**99 % Confidence Level**	**95 % Confidence Level**	**Floor**
		1yr	**1yr**	
2 A	DC	150	120	200 µA
	16 to 40	400	310	200 µA
	40.01 to 850	330 [1]	260 [2]	60 µA
	850 to 6k	1700	1300	100 µA
20 A	DC	150	120	2 mA
	16 to 40	400	310	2 mA
	40.01 to 850	330 [1]	260 [2]	600 µA
	850 to 6k	1700	1300	1 mA
100 A/120 A	DC	150	120	20 mA
	16 to 40	400	310	20 mA
	40.01 to 850	330 [1]	260 [2]	6 mA
	850 to 6k	1700	1300	10 mA

[1] 1000 with LCOMP ON and frequency above 300 Hz.
[2] 780 with LCOMP ON and frequency above 300 Hz.

5560A with 52120A Operating Characteristics

Range lock unavailable for ACI.

Minimum ACI output for 2 A range is 0.2 A.

Frequency (Hz)	Resolution	Distortion				Noise (16 Hz - 10 MHz, relative to range)	Max Inductive Load (uH)	
		LCOMP OFF		LCOMP ON			LCOMP OFF	LCOMP ON
		% Output	Floor	% Output	Floor	% Output		
2 A Range								
16 to 300	1 µA	0.1	200 µA	0.1	200 µA	0.1	100	400
300 to 1 k		0.2	200 µA	0.3	200 µA	0.1	-	-
1 kHz to 6 k		0.5	662 µA	-	-	0.1	-	-
20 A Range								
16 to 300	10 µA	0.1	2 mA	0.1	2.6 mA	0.03	100	400
300 to 1 k		0.2	2 mA	0.3	2.6 mA	0.03	-	-
1 k to 6 k		0.5	6.6 mA	-	-	0.03	-	-
100 A/120 A Range								
16 to 300	10 µA	0.1	12 mA	0.1	12 mA	0.03	100	100
300 to 1 k		0.2	12 mA	0.3	12 mA	0.03	-	-
1 k to 6k		0.5	40 mA	-	-	0.03	-	-

Maximum Output Compliance Voltage: 4.5 V rms (6.4 V pk), 6.4 V dc. 120 A range maximum compliance voltage decreases from 4.5 V at 1 kHz to about 3 V at 10 kHz.

Voltage compliance developed across inductive loads may prevent range maximum current output being achieved at higher frequencies. The appropriate maximum frequency (F_{max}) for a given load inductance and current is given by:

$$Fmax = \frac{4.5}{2 \cdot \pi \cdot I \cdot L}$$

I = Current
L = Total inductance

The maximum frequency calculated with this equation is approximate. Series resistance and parallel capacitance also affect the maximum achievable frequency.

DC Offset: Magnetic remanence that follows abrupt changes in output current level may cause small changes to the dc current offset. For best results, correct for offsets in dc measurements and techniques such as dc reversal measurement results in best accuracy.