FLUKE®
Calibration

5540A
Calibrator

Product Specifications

December 2022 Rev. 4, 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**
	1 y	**1 y**	
120 mV	47	37	1.6 µV [1]
1.2 V	31	24	2 µV
12 V	31	24	20 µV
120 V	42	33	200 µV
1020 V	42	33	2000 µV

[1] After extended periods of operation in either DCI or ACI 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 DCI or ACI 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**
		1 y	**1 y**	
12 mV	3 to 5	6000	4700	15 µV
	5 to 10	3000	2300	15 µV
	10 to 20 k	1500	1200	7 µV
	20 k to 50 k	12000	9300	7 µV
	50 k to 100 k	16000	12000	18 µV
	100 k to 300 k	80000	62000	36 µV
	300 k to 500 k	80000	62000	36 µV
120 mV	3 to 5	6000	4700	15 µV
	5 to 10	3000	2300	15 µV
	10 to 20 k	1000	780	7 µV
	20 k to 50 k	2100	1600	20 µV
	50 k to 100 k	2800	2200	26 µV
	100 k to 300 k	40000	31000	400 µV
	300 k to 500 k	40000	31000	400 µV
1.2 V	3 to 5	6000	4700	150 µV
	5 to 10	3000	2300	150 µV
	10 to 40	1000	780	85 µV
	40.01 to 20 k	1000	780	40 µV
	20 k to 50 k	2100	1600	200 µV
	50 k to 100 k	2800	2200	260 µV
	100 k to 300 k	40000	31000	4 mV
	300 k to 500 k	40000	31000	4 mV
12 V	3 to 5	6000	4700	1.5 mV
	5 to 10	3000	2300	1.5 mV
	10 to 40	1000	780	500 µV
	40.01 to 20 k	1000	780	500 µV
	20 k to 50 k	2100	1600	2 mV
	50 k to 100 k	2800	2200	2.6 mV
	100 k to 300 k	40000	31000	40 mV
	300 k to 500 k	40000	31000	40 mV

ACV Specifications ±(µV/V Output + Floor)				
Range	**Frequency (Hz)**	**99 % Confidence Level**	**95 % Confidence Level**	**Floor**
		1 y	**1 y**	
120 V	3 to 5	6000	4700	15 mV
	5 to 10	3000	2300	15 mV
	10 to 40	1000	780	4 mV
	40.01 to 20 k	1000	780	4 mV
	20 k to 50 k	2300	1800	20 mV
	50 k to 100 k	3000	2300	26 mV
330 V	3 to 5	6000	4700	150 mV
	5 to 10	3000	2300	150 mV
	10 to 20 k	1000	780	100 mV
	20 k to 50 k	2300	1800	390 mV
	50 k to 100 k	3100	2400	520 mV
1020 V	3 to 5	6000	4700	150 mV
	5 to 10	3000	2300	150 mV
	10 to 10 k	1000	780	100 mV

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	
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**
	1 y	**1 y**	
120 µA	140	110	7.2 nA
1.2 mA	110	85	18 nA
12 mA	110	85	96 nA
120 mA	130	100	4 µA
1.2 A	600	470	12 µA
3.1 A	370	290	180 µA
12 A	460	360	300 µA
30.2 A	2500	1900	600 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**
		1 y	**1 y**	
120 µA	3 to 45	2100	1600	20 nA
	45 to 1 k	2100	1600	20 nA[1]
	1 k to 5 k	2100	1600	20 nA
	5 k to 10 k	5000	3900	150 nA
	10 k to 30 k	5000	3900	1 µA
1.2 mA	3 to 45	2100	1600	200 nA
	45 to 1 k	2100	1600	200 nA
	1 k to 5 k	2100	1600	200 nA
	5 k to 10 k	4000	3100	300 nA
	10 k to 30 k	5000	3900	5 µA
12 mA	3 to 45	2100	1600	2 µA
	45 to 1 k	2100	1600	2 µA
	1k to 5 k	2100	1600	2 µA
	5k to 10 k	2000	1600	3 µA
	10 k to 30 k	5000	3900	10 µA
120 mA	3 to 45	2100	1600	20 µA
	45 to 1 k	2100	1600	20 µA
	1 k to 5 k	2100	1600	20 µA
	5 k to 10 k	2000	1600	30 µA
	10 k to 30 k	5000	3900	100 µA
1.2 A	3 to 45	2100	1600	100 µA
	45 to 1 k	2100	1600	100 µA
	1 k to 5 k	2100	1600	100 µA
	5 k to 10 k	2500	1900	300 µA
	10 k to 30 k	5000	3900	300 µA
3.1 A	3 to 45	2100	1600	1 mA
	45 to 1 k	2100	1600	1 mA
	1 k to 5 k	2100	1600	1 mA
	5 k to 10 k	10000	7800	1.5 mA
12 A	3 to 45	2100	1600	2 mA
	45 to 1 k	2100	1600	2 mA
	1 k to 5 k	2100	1600	2 mA
	5 k to 10 k	10000	7800	4 mA
30.2 A	3 to 45	5000	3900	50 mA
	45 to 1 k	5000	3900	50 mA
	1 k to 5 k	5000	3900	50 mA

[1] Floor is 100 nA when output frequency is within 2 Hz of the line frequency.

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	1-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 kHz 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		

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: 0.004 Ω + (5 µV / 1 mA) = (0.004 + 0.005) Ω = 0.009 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**	
	1 y	**1 y**	**24 h zero ±1 °C**	**14 d zero ±5 °C**
12 Ω	65	50	1.5 mΩ	10 mΩ
120 Ω	65	50	1.5 mΩ	15 mΩ
1.2 kΩ	65	50	4 mΩ	20 mΩ
12 kΩ	65	50	40 mΩ	200 mΩ
120 kΩ	65	50	400 mΩ	1 Ω
1.2 MΩ	65	50	4 Ω	10 Ω
12 MΩ	65	50	520 Ω	520 Ω
120 MΩ	500	390	50 kΩ	50 kΩ
1200 MΩ	6500	5000	5 MΩ	5 MΩ

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 0.0015 Ω x 1 mA/50 µA = 0.075 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 0.0065 Ω x (30 mA / 13 mA)$^{0.5}$ + Floor = 0.0099 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
	1 y	1 y	
1.2 nF	0.55	0.43	5 pF [1]
12 nF	0.35	0.27	10 pF [1]
120 nF	0.25	0.19	50 pF
1.2 µF	0.25	0.19	500 pF
12 µF	0.25	0.19	5 nF
120 µF	0.35	0.27	50 nF
1.2 mF	0.45	0.35	500 nF
12 mF	0.45	0.35	5 µF [2]
120 mF	1	0.78	50 µF [2]

[1] After storage or operation at high relative humidity, a drying out period of at least 2 weeks can be required.
[2] 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

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**
		1 y	**1 y**	
B	600 to 800	0.44	0.34	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	800 to 1000	0.34	0.26	
	1000 to 1550	0.30	0.23	
	1550 to 1820	0.33	0.26	
C	0 to 150	0.25	0.19	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	0.21	0.16	
	650 to 1000	0.26	0.20	
	1000 to 1800	0.45	0.35	
	1800 to 2315	0.79	0.61	
D	0 to 150	0.25	0.19	W3Re/W25Re; ITS-90 per ASTM E1751-15, ASTM E988-96
	150 to 650	0.21	0.16	
	650 to 1000	0.26	0.20	
	1000 to 1800	0.44	0.34	
	1800 to 2315	0.78	0.61	
E	-250 to -150	0.4	0.31	W/W26Re; ITS-90 per ASTM E1751-15; IPTS-68 per Hoskins Mfg. Co. (1974)
	-150 to -25	0.14	0.11	
	-25 to 350	0.11	0.09	
	350 to 650	0.16	0.12	
	650 to 1000	0.21	0.16	
G	0 to 150	0.5	0.39	W/W26Re; ITS-90 per ASTM E1751-15; IPTS-68 per Hoskins Mfg. Co. (1974)
	150 to 650	0.33	0.26	
	650 to 1000	0.26	0.20	
	1000 to 1800	0.43	0.33	
	1800 to 2315	0.77	0.60	
J	-210 to -100	0.24	0.19	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -30	0.13	0.10	
	-30 to 150	0.11	0.09	
	150 to 760	0.14	0.11	
	760 to 1200	0.20	0.16	

TC Specifications Tcal ±5 °C, ±°C				
Type	**Range (°C)**	**99 % Confidence Level**	**95 % Confidence Level**	**Standard**
		1 y	**1 y**	
K	-200 to -100	0.28	0.22	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -25	0.13	0.10	
	-25 to 120	0.11	0.09	
	120 to 1000	0.21	0.16	
	1000 to 1372	0.35	0.27	
L	-200 to -100	0.31	0.24	IPTS-68: per DIN 43710-1985
	-100 to 800	0.20	0.16	
	800 to 900	0.11	0.09	
N	-200 to -100	0.33	0.26	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-100 to -25	0.15	0.12	
	-25 to 120	0.12	0.09	
	120 to 410	0.11	0.09	
	410 to 1300	0.20	0.16	
R	0 to 250	0.51	0.40	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	250 to 400	0.29	0.23	
	400 to 1000	0.27	0.21	
	1000 to 1767	0.34	0.26	
S	0 to 250	0.42	0.33	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	250 to 1000	0.31	0.24	
	1000 to 1400	0.32	0.25	
	1400 to 1767	0.41	0.32	
T	-250 to -150	0.60	0.47	ITS-90: per NIST M.175, IEC 60584-1:2013; IPTS-68: per IEC 584-1(1977)
	-150 to 0	0.21	0.16	
	0 to 120	0.13	0.10	
	120 to 400	0.11	0.09	
U	-200 to 0	0.40	0.31	IPTS-68: per DIN 43710-1985
	0 to 600	0.11	0.09	
BP	0 to 1000	0.40	0.31	ITS-90: per IEC 60584-1:2013, GOST R 8.585-2001
	1000 to 2000	0.60	0.47	
	2000 to 2500	0.80	0.62	
XK	-200 to 300	0.20	0.16	ITS-90: per GOST R 8.585-2001
	300 to 800	0.30	0.23	

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**
	1 y	**1 y**	
0 mV to 120 mV	20	16	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**
	1 y	**1 y**	
0 mV to 120 mV	25	19	1.6 µV
120 mV to 330 mV	50	39	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**
		1 y	**1 y**	
Cu 10 (427)	-80 to 260	0.30	0.23	Notes [1]
Cu 50 (428)	-180 to 200	0.40	0.31	Notes [2]
Cu 100 (428)	-180 to 40	0.40	0.31	
	40 to 200	0.65	0.50	

RTD Specifications Tcal ±5 °C, ±°C				
Type	**Range (°C)**	**99 % Confidence Level**	**95 % Confidence Level**	**Standard**
		1 y	**1 y**	
Ni 120 (672)	-80 to 0	0.08	0.06	Notes [1]
	0 to 100	0.08	0.06	
	100 to 260	0.14	0.11	
Pt 100 (385)	-200 to -80	0.05	0.04	Notes [3]
	-80 to 0	0.05	0.04	
	0 to 100	0.07	0.05	
	100 to 300	0.09	0.07	
	300 to 400	0.10	0.08	
	400 to 630	0.12	0.09	
	630 to 800	0.23	0.18	
Pt 100 (3916)	-200 to -190	0.25	0.19	Notes [4]
	-190 to -80	0.04	0.03	
	-80 to 0	0.05	0.04	
	0 to 100	0.06	0.05	
	100 to 260	0.07	0.05	
	260 to 300	0.08	0.06	
	300 to 400	0.09	0.07	
	400 to 600	0.10	0.08	
	600 to 630	0.23	0.18	
Pt 100 (3926)	-200 to -80	0.05	0.04	Notes [1]
	-80 to 0	0.05	0.04	
	0 to 100	0.07	0.05	
	100 to 300	0.09	0.07	
	300 to 400	0.10	0.08	
	400 to 630	0.12	0.09	

RTD Specifications Tcal ±5 °C, ±°C				
Type	**Range (°C)**	**99 % Confidence Level**	**95 % Confidence Level**	**Standard**
		1 y	**1 y**	
Pt 200 (385)	-200 to -80	0.04	0.03	Notes [3]
	-80 to 0	0.04	0.03	
	0 to 100	0.04	0.03	
	100 to 260	0.05	0.04	
	260 to 300	0.12	0.09	
	300 to 400	0.13	0.10	
	400 to 600	0.14	0.11	
	600 to 630	0.16	0.12	
Pt 500 (385)	-200 to -80	0.04	0.03	
	-80 to 0	0.05	0.04	
	0 to 100	0.05	0.04	
	100 to 260	0.06	0.05	
	260 to 300	0.08	0.06	
	300 to 400	0.08	0.06	
	400 to 600	0.09	0.07	
	600 to 630	0.11	0.09	
Pt 1000 (385)	-200 to -80	0.03	0.02	Notes [3]
	-80 to 0	0.03	0.02	
	0 to 100	0.04	0.03	
	100 to 260	0.05	0.04	
	260 to 300	0.06	0.05	
	300 to 400	0.07	0.05	
	400 to 600	0.07	0.05	
	600 to 630	0.23	0.18	

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

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

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 1 MHz	-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**
			1 y	**1 y**	
12 mV	22 mV	0.01 to 10	5.0	3.9	110 µV
		10 to 45	0.25	0.20	110 µV
		45 to 1 k	0.25	0.20	55 µV
		1 k to 20 k	0.50	0.40	55 µV
		20 k to 100 k	5.0	3.9	110 µV
120 mV	220 mV	0.01 to 10	5.0	3.9	1.1 mV
		10 to 45	0.25	0.20	1.1 mV
		45 to 1 k	0.25	0.20	0.55 mV
		1 k to 20 k	0.50	0.40	0.55 mV
		20 k to 100 k	5.0	3.9	1.1 mV
1.2 V	2.2 V	0.01 to 10	5.0	3.9	11 mV
		10 to 45	0.25	0.20	11 mV
		45 to 1 k	0.25	0.20	5.5 mV
		1 k to 20 k	0.50	0.40	5.5 mV
		20 k to 100 k	5.0	3.9	11 mV
12 V	22 V	0.01 to 10	5.0	3.9	110 mV
		10 to 45	0.25	0.20	110 mV
		45 to 1 k	0.25	0.20	55 mV
		1 k to 20 k	0.50	0.40	55 mV
		20 k to 100 k	5.0	3.9	110 mV
120 V	66 V	0.01 to 10	5.0	3.9	1.1 V
		10 to 45	0.25	0.20	1.1 V
		45 to 1 k	0.25	0.20	0.55 V
		1 k to 20 k	0.50	0.40	0.55 V
		20 k to 100 k	5.0	3.9	1.1 V

ACV Square Wave Characteristics

Risetime, Settling Time and Overshoot are @ 1 kHz

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**
			1y	**1y**	
120 µA	220 µA	3 to 45	0.25	0.20	1.1 µA
		45 to 1k	0.25	0.20	0.55 µA
		1k to 10k	10	7.8	4.4 µA
1.2 mA	2.2 mA	3 to 45	0.25	0.20	11 µA
		45 to 1k	0.25	0.20	5.5 µA
		1k to 10k	10	7.8	44 µA
12 mA	22 mA	3 to 45	0.25	0.20	110 µA
		45 to 1k	0.25	0.20	55 µA
		1k to 10k	10	7.8	440 µA
120 mA	220 mA	3 to 45	0.25	0.20	1.1 mA
		45 to 1k	0.25	0.20	1.1 mA
		1k to 10k	10	7.8	4.4 mA
1.2 A	2.2 A	3 to 45	0.25	0.20	11 mA
		45 to 1k	0.25	0.20	11 mA
		1k to 10k	10	7.8	44 mA
3.1 A	5.6 A	3 to 45	0.5	0.40	56 mA
		45 to 1k	0.5	0.40	28 mA
		1k to 3k	10	7.8	110 mA
12 A	22 A	3 to 45	0.5	0.4	220 mA
		45 to 1k	1.0	0.80	110 mA
		1k to 3k	10	7.8	440 mA
30.2 A	55.4 A	3 to 500	0.50	0.40	550 mA
		500 to 1k	1.0	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**
	1 y	**1 y**	
12 mV	0.10	0.10	12 µV
120 mV	0.10	0.10	120 µV
1.2 V	0.10	0.10	1.2 mV
12 V	0.10	0.10	120 mV
120 V	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.

5540A with 52120A Current Specifications

Current specification of a single 52120A, when controlled by a 5540A. For specifications for 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	2000	1600	300 µA
	40.01 to 850	2000	1600	200 µA
	850 to 6 k	2400	1900	200 µA
20 A	DC	150	120	2 mA
	16 to 40	2000	1600	3 mA
	40.01 to 850	2000	1600	2 mA
	850 to 6 k	2400	1900	2 mA
100A / 120 A	DC	150	120	20 mA
	16 to 40	2000	1600	30 mA
	40.01 to 850	2000	1600	20 mA
	850 to 6 k	2400	1900	20 mA

5540A 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.