

Datos técnicos

# 5540A/5530A

## Calibrator



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## 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

|                                                       |                                                                                                                                                                                          |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mains Power</b>                                    | Line Voltage (automatic selection): 100 V, 120 V, 220 V, 240 V ( $\pm 10$ %)<br>Line Frequency: 47 Hz to 63 Hz                                                                           |
| <b>Fuse ratings</b>                                   | T 5A 250 V (100 V to 120 V), T 2.5 A 250 V (220 V to 240 V)                                                                                                                              |
| <b>Max Power Consumption</b>                          | 500 VA                                                                                                                                                                                   |
| <b>Environment</b>                                    |                                                                                                                                                                                          |
| <b>Temperature</b>                                    |                                                                                                                                                                                          |
| Operating                                             | 0 °C to 50 °C                                                                                                                                                                            |
| Calibration (tcal)                                    | 15 °C to 35 °C                                                                                                                                                                           |
| Storage                                               | -20 °C to +70 °C                                                                                                                                                                         |
| <b>Temperature Coefficient</b>                        | Temperature coefficient for temperatures outside tcal $\pm 5$ °C is 10 % of the stated specification per °C.                                                                             |
| <b>Relative Humidity</b>                              |                                                                                                                                                                                          |
| 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.                                            |
| <b>Altitude</b>                                       |                                                                                                                                                                                          |
| Operating                                             | 0 m to 3050 m (10 000 ft)                                                                                                                                                                |
| Non-operating                                         | 12 200 m (40 000 ft) maximum                                                                                                                                                             |
| <b>Compliance</b>                                     |                                                                                                                                                                                          |
| <b>Safety</b>                                         | IEC 61010-1: Overvoltage Category II, Pollution Degree 2; IEC 61010-2-030                                                                                                                |
| <b>Output Terminal Electrical Overload Protection</b> | Provides reverse-power protection and immediate output disconnection on the output terminals for all functions. This protection is for applied external voltages up to $\pm 300$ V peak. |
| <b>Analog Low Isolation</b>                           | 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.

|                                 |                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Remote Interfaces</b>        | GPIO (IEEE-488), RS-232, USB 2.0 (TMC), Ethernet (Telnet)                                                                                              |
| <b>Dimensions (HxWxL)</b>       | 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.       |
| <b>Weight (without options)</b> | 22 kg (49 lb)                                                                                                                                          |
| <b>Range Limits</b>             | 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 <sup>[1]</sup> |
| 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<br>( $\pm 1^\circ\text{C}$ )<br>$\pm(\mu\text{V/V Output} + \text{Floor})$ |                   | Linearity<br>$\pm\mu\text{V/V}$<br>Range | Noise                                                             |                   |                   | Output<br>Impedance<br>or Max<br>Current |
|-----------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------|-------------------|------------------------------------------|-------------------------------------------------------------------|-------------------|-------------------|------------------------------------------|
|                                                                                               |                   |                                                                                              |                   |                                          | 0.1 Hz to 10 Hz<br>$\pm(\mu\text{V/V Output} + \text{Floor})$ p-p |                   | 10 Hz to 10 kHz   |                                          |
|                                                                                               |                   | $\mu\text{V/V}$                                                                              | Floor             |                                          | $\mu\text{V/V}$                                                   | Floor             | RMS               |                                          |
| 120 mV                                                                                        | 10 nV             | 3.0                                                                                          | 0.8 $\mu\text{V}$ | 1                                        | 0.2                                                               | 0.5 $\mu\text{V}$ | 6 $\mu\text{V}$   | 50 $\Omega$ (nom)                        |
| 1.2 V                                                                                         | 100 nV            | 2.0                                                                                          | 1 $\mu\text{V}$   | 1                                        | 0.2                                                               | 5 $\mu\text{V}$   | 60 $\mu\text{V}$  | 10 mA <sup>[1]</sup>                     |
| 12 V                                                                                          | 1 $\mu\text{V}$   | 2.0                                                                                          | 5 $\mu\text{V}$   | 1                                        | 0.2                                                               | 50 $\mu\text{V}$  | 600 $\mu\text{V}$ | 20 mA <sup>[1]</sup>                     |
| 120 V                                                                                         | 10 $\mu\text{V}$  | 3.0                                                                                          | 50 $\mu\text{V}$  | 1                                        | 10                                                                | 500 $\mu\text{V}$ | 20 mV             | 10 mA <sup>[1]</sup>                     |
| 1020 V                                                                                        | 100 $\mu\text{V}$ | 3.0                                                                                          | 500 $\mu\text{V}$ | 1                                        | 10                                                                | 5 mV              | 30 mV             | 5 mA <sup>[2]</sup>                      |
| [1] Typical output resistance is <5 m $\Omega$ , internal sense. External sense is available. |                   |                                                                                              |                   |                                          |                                                                   |                   |                   |                                          |
| [2] Typical output resistance is <5 m $\Omega$ . External sense not available.                |                   |                                                                                              |                   |                                          |                                                                   |                   |                   |                                          |

## ACV Specifications

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

| ACV Specifications $\pm (\mu\text{V/V Output} + \text{Floor})$ |                |                       |                       |                   |
|----------------------------------------------------------------|----------------|-----------------------|-----------------------|-------------------|
| Range                                                          | Frequency (Hz) | 99 % Confidence Level | 95 % Confidence Level | Floor             |
|                                                                |                | 1 y                   | 1 y                   |                   |
| 12 mV                                                          | 3 to 5         | 6000                  | 4700                  | 15 $\mu\text{V}$  |
|                                                                | 5 to 10        | 3000                  | 2300                  | 15 $\mu\text{V}$  |
|                                                                | 10 to 20 k     | 1500                  | 1200                  | 7 $\mu\text{V}$   |
|                                                                | 20 k to 50 k   | 12000                 | 9300                  | 7 $\mu\text{V}$   |
|                                                                | 50 k to 100 k  | 16000                 | 12000                 | 18 $\mu\text{V}$  |
|                                                                | 100 k to 300 k | 80000                 | 62000                 | 36 $\mu\text{V}$  |
|                                                                | 300 k to 500 k | 80000                 | 62000                 | 36 $\mu\text{V}$  |
| 120 mV                                                         | 3 to 5         | 6000                  | 4700                  | 15 $\mu\text{V}$  |
|                                                                | 5 to 10        | 3000                  | 2300                  | 15 $\mu\text{V}$  |
|                                                                | 10 to 20 k     | 1000                  | 780                   | 7 $\mu\text{V}$   |
|                                                                | 20 k to 50 k   | 2100                  | 1600                  | 20 $\mu\text{V}$  |
|                                                                | 50 k to 100 k  | 2800                  | 2200                  | 26 $\mu\text{V}$  |
|                                                                | 100 k to 300 k | 40000                 | 31000                 | 400 $\mu\text{V}$ |
|                                                                | 300 k to 500 k | 40000                 | 31000                 | 400 $\mu\text{V}$ |
| ACV Specifications $\pm (\mu\text{V/V Output} + \text{Floor})$ |                |                       |                       |                   |



| Range  | Frequency (Hz) | 99 % Confidence Level | 95 % Confidence Level | Floor       |
|--------|----------------|-----------------------|-----------------------|-------------|
|        |                | 1 y                   | 1 y                   |             |
| 1.2 V  | 3 to 5         | 6000                  | 4700                  | 150 $\mu$ V |
|        | 5 to 10        | 3000                  | 2300                  | 150 $\mu$ V |
|        | 10 to 40       | 1000                  | 780                   | 85 $\mu$ V  |
|        | 40.01 to 20 k  | 1000                  | 780                   | 40 $\mu$ V  |
|        | 20 k to 50 k   | 2100                  | 1600                  | 200 $\mu$ V |
|        | 50 k to 100 k  | 2800                  | 2200                  | 260 $\mu$ V |
|        | 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 $\mu$ V |
|        | 40.01 to 20 k  | 1000                  | 780                   | 500 $\mu$ V |
|        | 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       |
| 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<br>10 Hz to 2 MHz<br>±(% 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                                                          |        |
| 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 <sup>[1]</sup>            | 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 <sup>[1]</sup>            | 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 <sup>[1]</sup>            | 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                                                          |        |



| Range  | Resolution | Frequency (Hz) | Output Impedance or Max Current | Distortion and Noise<br>10 Hz to 2 MHz<br>±(% Output + Floor) |                      |
|--------|------------|----------------|---------------------------------|---------------------------------------------------------------|----------------------|
|        |            |                |                                 | %                                                             | Floor                |
| 330 V  | 1 mV       | 3 to 5         | 20 mA <sup>[2]</sup>            | 0.15                                                          | 20 mV <sup>[3]</sup> |
|        |            | 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 <sup>[2]</sup>             | 0.15                                                          | 20 mV <sup>[3]</sup> |
|        |            | 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 to 10 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 <sup>[1]</sup> |
|                                                                                 | 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                 |
|                                                                                 | 1 k to 5 k     | 2100                  | 1600                  | 2 μA                 |
|                                                                                 | 5 k 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 < 1 kHz.

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

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

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

| Range  | Resolution | Frequency (Hz) | Compliance<br>adder ±(µA/<br>V) or<br>Max<br>Resistive<br>Load for<br>Specified<br>Performance | Compliance<br>Limits<br>(V rms) | Distortion and Noise<br>10 Hz to 100 kHz BW<br>±(% Output + Floor) |        | Max<br>Inductive<br>Load ><br>1 kHz (µH) |
|--------|------------|----------------|------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------------|--------|------------------------------------------|
|        |            |                |                                                                                                |                                 | %                                                                  | Floor  |                                          |
| 120 µA | 1 nA       | 3 to 45        | 2 kΩ <sup>[1]</sup>                                                                            | 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 <sup>[1]</sup>                                                                            | 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 <sup>[2]</sup>                                                 |        |                                          |
|        |            | 5 k to 10 k    | 1000                                                                                           |                                 | 0.5 <sup>[3]</sup>                                                 |        |                                          |
|        |            | 10 k to 30 k   | -                                                                                              |                                 | 1.2                                                                |        |                                          |



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

[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  $\pm 20 \mu\text{Hz}/\text{Hz}$  of 10 MHz.

| Frequency Range         | Resolution | 1-Year Absolute Uncertainty      | Jitter     |
|-------------------------|------------|----------------------------------|------------|
| 0.01 Hz to 119.99 Hz    | 0.01 Hz    | $\pm 2.5 \mu\text{Hz}/\text{Hz}$ | 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      |                                  |            |



## Phase Specifications (5530A Only)

Phase specifications apply to the phase difference between the main output and the auxiliary output in dual output AC.

See [Power and Dual Output Limit Specifications \(5530A Only\)](#) for applicable dual outputs. For combinations of Voltage  $\leq 120$  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 $\pm$ 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  |

Phase specifications for Harmonic outputs apply to the phase difference between the Fundamental and the Harmonic in terms of the degrees of the harmonic frequency. The phase specification between the Fundamental and the Harmonic is equal to the specification above, for the harmonic frequency, multiplied by a factor dependent on the harmonic number, or 2 degrees, whichever is greater.

In Harmonics mode, Phase Specification = Phase Specification from the table above  $\times (1 + N/50)$ , or 2 degrees, whichever is greater. Where N is the harmonic being sourced. See [Harmonics Dual Output Limits Specifications - AC Power \(5530A Only\)](#) or [Harmonics Dual Output Limits Specifications - ACV ACV \(5530A Only\)](#) for applicable dual harmonic outputs.

## Resistance Specifications

Continuously variable from 0  $\Omega$  to 1200 M $\Omega$ .

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  $\mu$ V divided by the stimulus current in amps). For example, in two-wire mode, at 1 k $\Omega$  the floor specification within 24 hours of an ohms zero adjust for a measurement current of 1 mA is:  $0.004 \Omega + (5 \mu\text{V} / 1 \text{ mA}) = (0.004 + 0.005) \Omega = 0.009 \Omega$ .



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 $\pm(\mu\Omega/\Omega$ of Output + Floor) |                       |                       |                                 |                                 |
|---------------------------------------------------------------------|-----------------------|-----------------------|---------------------------------|---------------------------------|
| Range                                                               | 99 % Confidence Level | 95 % Confidence Level | Floor                           |                                 |
|                                                                     | 1 y                   | 1 y                   | 24 h zero $\pm 1^\circ\text{C}$ | 14 d zero $\pm 5^\circ\text{C}$ |
| 12 $\Omega$                                                         | 65                    | 50                    | 1.5 m $\Omega$                  | 10 m $\Omega$                   |
| 120 $\Omega$                                                        | 65                    | 50                    | 1.5 m $\Omega$                  | 15 m $\Omega$                   |
| 1.2 k $\Omega$                                                      | 65                    | 50                    | 4 m $\Omega$                    | 20 m $\Omega$                   |
| 12 k $\Omega$                                                       | 65                    | 50                    | 40 m $\Omega$                   | 200 m $\Omega$                  |
| 120 k $\Omega$                                                      | 65                    | 50                    | 400 m $\Omega$                  | 1 $\Omega$                      |
| 1.2 M $\Omega$                                                      | 65                    | 50                    | 4 $\Omega$                      | 10 $\Omega$                     |
| 12 M $\Omega$                                                       | 65                    | 50                    | 520 $\Omega$                    | 520 $\Omega$                    |
| 120 M $\Omega$                                                      | 500                   | 390                   | 50 k $\Omega$                   | 50 k $\Omega$                   |
| 1200 M $\Omega$                                                     | 6500                  | 5000                  | 5 M $\Omega$                    | 5 M $\Omega$                    |

## Resistance Operating Characteristics

Max burden voltage of 13 V.

For currents lower than specified, the floor adder increases by  $\text{Floor (new)} = 2.5 \times \text{Floor (old)} \times I_{\text{min}}/I_{\text{actual}}$ . For example, a 50  $\mu\text{A}$  stimulus measuring 100  $\Omega$  has a floor specification of:  $2.5 \times 0.0015 \Omega \times 1 \text{ mA}/50 \mu\text{A} = 0.075 \Omega$  assuming an ohms zero adjustment within 24 hours.

For currents higher than specified (up to max current) the specification increases to  $\text{Spec(new)} = \text{Specification} \times (I_{\text{actual}} / I_{\text{specmax}})^{0.5} + \text{Floor}$ . For example, measuring 100  $\Omega$  with a 30 mA current with 1 year 99 % confidence has a specification of  $0.0065 \Omega \times (30 \text{ mA} / 13 \text{ mA})^{0.5} + \text{Floor} = 0.0099 \Omega + \text{Floor}$ .

| Range           | Resolution      | Specified Current Range               | Max Current       |
|-----------------|-----------------|---------------------------------------|-------------------|
| 12 $\Omega$     | 100 $\mu\Omega$ | 4 mA to 30 mA                         | 125 mA            |
| 120 $\Omega$    | 100 $\mu\Omega$ | 1 mA to 13 mA                         | 70 mA             |
| 1.2 k $\Omega$  | 1 m $\Omega$    | 1 mA to 10 mA                         | 13 mA             |
| 12 k $\Omega$   | 10 m $\Omega$   | 100 $\mu\text{A}$ to 1.3 mA           | 1.3 mA            |
| 120 k $\Omega$  | 100 m $\Omega$  | 10 $\mu\text{A}$ to 130 $\mu\text{A}$ | 130 $\mu\text{A}$ |
| 1.2 M $\Omega$  | 1 $\Omega$      | 1 $\mu\text{A}$ to 13 $\mu\text{A}$   | 13 $\mu\text{A}$  |
| 12 M $\Omega$   | 10 $\Omega$     | 100 nA to 1.3 $\mu\text{A}$           | 1.3 $\mu\text{A}$ |
| 120 M $\Omega$  | 100 $\Omega$    | 25 nA to 1 $\mu\text{A}$              | 1.2 $\mu\text{A}$ |
| 1200 M $\Omega$ | 1 k $\Omega$    | 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 is 10 V. The maximum allowable peak current is 130 mA, with an rms limitation of 30 mA at 1.2  $\mu$ F and below and 70 mA above 1.2  $\mu$ F.

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  $\mu$ F range, 0.05 % of output for the 120  $\mu$ F 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.

The maximum lead resistance for specified performance in ZCOMP two-wire mode is 10  $\Omega$ .

| Capacitance Specifications $\pm$ (% of Output + Floor)                                                                                                                                                                                                                     |                       |                       |                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|---------------------------|
| Range                                                                                                                                                                                                                                                                      | 99 % Confidence Level | 95 % Confidence Level | Floor                     |
|                                                                                                                                                                                                                                                                            | 1 y                   | 1 y                   |                           |
| 1.2 nF                                                                                                                                                                                                                                                                     | 0.55                  | 0.43                  | 5 pF <sup>[1]</sup>       |
| 12 nF                                                                                                                                                                                                                                                                      | 0.35                  | 0.27                  | 10 pF <sup>[1]</sup>      |
| 120 nF                                                                                                                                                                                                                                                                     | 0.25                  | 0.19                  | 50 pF                     |
| 1.2 $\mu$ F                                                                                                                                                                                                                                                                | 0.25                  | 0.19                  | 500 pF                    |
| 12 $\mu$ F                                                                                                                                                                                                                                                                 | 0.25                  | 0.19                  | 5 nF                      |
| 120 $\mu$ F                                                                                                                                                                                                                                                                | 0.35                  | 0.27                  | 50 nF                     |
| 1.2 mF                                                                                                                                                                                                                                                                     | 0.45                  | 0.35                  | 500 nF                    |
| 12 mF                                                                                                                                                                                                                                                                      | 0.45                  | 0.35                  | 5 $\mu$ F <sup>[2]</sup>  |
| 120 mF                                                                                                                                                                                                                                                                     | 1                     | 0.78                  | 50 $\mu$ F <sup>[2]</sup> |
| [1] After storage or operation at high relative humidity, a drying out period of at least 2 weeks can be required.<br>[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 <sup>[1]</sup> to 5 kHz             | 10 Hz to 6 kHz                  | 10 Hz to 8 kHz                  |
| 120 nF                                      | 0.1 pF     | 610 Hz                           | 200 Hz <sup>[2]</sup> to 1.3 kHz           | 20 Hz <sup>[2]</sup> to 2700 Hz | 20 Hz <sup>[2]</sup> to 3700 Hz |
| 1.2 $\mu$ F                                 | 1 pF       | 100 Hz                           | 2 Hz to 310 Hz                             | 2 Hz to 800 Hz                  | 2 Hz to 1100 Hz                 |
| 12 $\mu$ F                                  | 10 pF      | 80 Hz                            | 0.5 Hz to 110 Hz                           | 0.5 Hz to 250 Hz                | 0.5 Hz to 350 Hz                |
| 120 $\mu$ F                                 | 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<br>[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<br>(°C) | 99 %<br>Confidence<br>Level | 95 %<br>Confidence<br>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<br>(°C) | 99 %<br>Confidence<br>Level | 95 %<br>Confidence<br>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 $\mu\text{V}/^\circ\text{C}$ and 1 $\text{mV}/^\circ\text{C}$ Modes

Resolution 0.1  $\mu\text{V}$  and max burden (source) 10  $\Omega$ .

| DCV Specifications $\pm(\mu\text{V}/\text{V Output} + \text{Floor})$ |                       |                       |                 |
|----------------------------------------------------------------------|-----------------------|-----------------------|-----------------|
| Range                                                                | 99 % Confidence Level | 95 % Confidence Level | Floor           |
|                                                                      | 1 y                   | 1 y                   |                 |
| 0 mV to 120 mV                                                       | 20                    | 16                    | 1 $\mu\text{V}$ |

## TC Voltage Measure in Linear 10 $\mu\text{V}/^\circ\text{C}$ and 1 $\text{mV}/^\circ\text{C}$ Modes

Resolution 0.1  $\mu\text{V}$ .

| DCV Specifications $\pm(\mu\text{V}/\text{V Input} + \text{Floor})$ |                       |                       |                   |
|---------------------------------------------------------------------|-----------------------|-----------------------|-------------------|
| Range                                                               | 99 % Confidence Level | 95 % Confidence Level | Floor             |
|                                                                     | 1 y                   | 1 y                   |                   |
| 0 mV to 120 mV                                                      | 25                    | 19                    | 1.6 $\mu\text{V}$ |
| 120 mV to 330 mV                                                    | 50                    | 39                    | 3 $\mu\text{V}$   |

## RTD Specifications

Temperature standard ITS-90 or IPTS-68 is selectable. Specifications do not include sensor accuracy.

Applies within 24 hours and  $\pm 1^\circ\text{C}$  of  $\Omega$ -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 0.001  $^\circ\text{C}$ .

| 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 <sup>[1]</sup> |
| Cu 50 (428)                        | -180 to 200 | 0.40                  | 0.31                  | Notes <sup>[2]</sup> |
| 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<br>(°C) | 99 %<br>Confidence<br>Level | 95 %<br>Confidence<br>Level | Standard             |
|---------------|---------------|-----------------------------|-----------------------------|----------------------|
|               |               | 1 y                         | 1 y                         |                      |
| Ni 120 (672)  | -80 to 0      | 0.08                        | 0.06                        | Notes <sup>[1]</sup> |
|               | 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 <sup>[3]</sup> |
|               | -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 <sup>[4]</sup> |
|               | -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 <sup>[1]</sup> |
|               | -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                        |                      |
| Pt 200 (385)  | -200 to -80   | 0.04                        | 0.03                        | Notes <sup>[3]</sup> |
|               | -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                        | Notes <sup>[3]</sup> |
|               | -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                        |                      |



| RTD Specifications Tcal ±5 °C, ±°C                                                  |             |                       |                       |                      |
|-------------------------------------------------------------------------------------|-------------|-----------------------|-----------------------|----------------------|
| Type                                                                                | Range (°C)  | 99 % Confidence Level | 95 % Confidence Level | Standard             |
|                                                                                     |             | 1 y                   | 1 y                   |                      |
| Pt 1000 (385)                                                                       | -200 to -80 | 0.03                  | 0.02                  | Notes <sup>[3]</sup> |
|                                                                                     | -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 <i>Resistance Thermometry</i> - 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 <sup>[1]</sup> |               |
|                                     | 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 $\mu\text{A}$ | 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 (5530A Only)

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 (5530A Only)

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 (5530A Only)

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.

$$U_{power} = \sqrt{(U_v^2 + U_i^2)}$$

## AC Power Specification (5530A Only)

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.

$$U_{power} = \sqrt{(U_v^2 + U_i^2 + U_{phase\ adder}^2)}$$



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

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

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

**Example:** Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 ( $\Phi = 60^\circ$ )

**Voltage Uncertainty:** Uncertainty for 100 V at 400 Hz is, 1000  $\mu\text{V/V}$  + 4 mV, totaling:

100 V x 1000 x  $10^{-6}$  = 100 mV added to 4 mV = 104 mV. Expressed in percent:

104 mV/100 V x 100 = 0.104 % (see [ACV Specifications](#)).

**Current Uncertainty:** Uncertainty for 1 A is 2100  $\mu\text{A/A}$  + 100  $\mu\text{A}$ , totaling:

1 A x 2100 x  $10^{-6}$  = 2.1 mA added to 100  $\mu\text{A}$  = 2.2 mA. Expressed in percent:

2.2 mA/1 A x 100 = 0.22 % (see [ACI Specifications](#)).

**PF Adder:** Watts Adder for PF = 0.5 ( $\Phi = 60^\circ$ ) at 400 Hz is 0.76 % (see [Phase Specifications \(5530A Only\)](#)).

Total Watts Output Uncertainty =

$$\text{Total Watts Output Uncertainty} = \sqrt{0.104^2 + 0.22^2 + 0.76^2} = 0.80 \%$$

## Harmonics Dual Output Limits Specifications - AC Power (5530A Only)

Within these limits, the specified voltage and current performance is the same as for the equivalent level and frequency in the ACV and ACI specification tables but with twice the floor adder.

The maximum frequency of the harmonic output is 30 kHz.

| Harmonic Frequency (Hz) | NORMAL Voltage       | Current             |
|-------------------------|----------------------|---------------------|
| 90 to 1 k               | 120.001 mV to 1020 V | 12.001 mA to 3.1 A  |
| 90 to 1 k               | 1.20001 V to 1020 V  | 3.1 A to 12 A       |
| 1 k to 5 k              | 1.20001 V to 500 V   | 12.001 mA to 1.2 A  |
| 5 k to 10 k             | 1.20001 V to 250 V   | 12.001 mA to 1.2 A  |
| 10 k to 30 k            | 1.20001 V to 120 V   | 12.001 mA to 330 mA |



## Harmonics Dual Output Limits Specifications - ACV ACV (5530A Only)

Within these limits, the specified Primary and Aux voltage performance is the same as for the equivalent level and frequency in the ACV and Aux Voltage specification tables but with twice the floor adder.

The maximum frequency of the harmonic output is 30 kHz.

| Harmonic Frequency (Hz) | NORMAL Voltage       | Aux Voltage      |
|-------------------------|----------------------|------------------|
| 90 to 500               | 120.001 mV to 1020 V | 120.01 mV to 5 V |
| 500 to 1 k              | 120.001 mV to 500 V  | 120.01 mV to 5 V |
| 1 k to 10 k             | 1.20001 V to 250 V   | 1.2001 V to 5 V  |
| 10 k to 30 k            | 1.20001 V to 120 V   | 1.2001V to 3.3 V |

## ACV Extended Bandwidth (Sine) Specifications

| 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 <sup>[1]</sup> | -      |
|                                                                                                                | 1 MHz to 2 MHz   | -90 <sup>[2]</sup> | -      |
| 12 V                                                                                                           | 0.01 Hz to 3 Hz  | 5.0                | 60 mV  |
|                                                                                                                | 500 kHz to 1 MHz | -30 <sup>[1]</sup> | -      |
|                                                                                                                | 1 MHz to 2 MHz   | -90 <sup>[2]</sup> | -      |
| 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 12 mV 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    |
| ACV Square Wave Specifications ±(% Output + Floor) |         |               |                       |                       |           |



| Range  | Max Vpp | Freq. (Hz)    | 99 % Confidence Level | 95 % Confidence Level | Floor p-p |
|--------|---------|---------------|-----------------------|-----------------------|-----------|
|        |         |               | 1 y                   | 1 y                   |           |
| 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 $\mu$ s | <10 $\mu$ s                           | <2 %      | 1 % to 99 %      | $\pm(0.02$ % of period + 100 ns) @ 50 % duty cycle<br>$\pm(0.05$ % 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  $\mu$ A range is 20  $\mu$ A p-p.

| ACI Square Wave Specifications $\pm$ (% Output + Floor) |             |            |                      |                      |              |
|---------------------------------------------------------|-------------|------------|----------------------|----------------------|--------------|
| Range                                                   | Max App     | Freq. (Hz) | 99% Confidence Level | 95% Confidence Level | Floor p-p    |
|                                                         |             |            | 1y                   | 1y                   |              |
| 120 $\mu$ A                                             | 220 $\mu$ A | 3 to 45    | 0.25                 | 0.20                 | 1.1 $\mu$ A  |
|                                                         |             | 45 to 1k   | 0.25                 | 0.20                 | 0.55 $\mu$ A |
|                                                         |             | 1k to 10k  | 10                   | 7.8                  | 4.4 $\mu$ A  |
| 1.2 mA                                                  | 2.2 mA      | 3 to 45    | 0.25                 | 0.20                 | 11 $\mu$ A   |
|                                                         |             | 45 to 1k   | 0.25                 | 0.20                 | 5.5 $\mu$ A  |
|                                                         |             | 1k to 10k  | 10                   | 7.8                  | 44 $\mu$ A   |
| 12 mA                                                   | 22 mA       | 3 to 45    | 0.25                 | 0.20                 | 110 $\mu$ A  |
|                                                         |             | 45 to 1k   | 0.25                 | 0.20                 | 55 $\mu$ A   |
|                                                         |             | 1k to 10k  | 10                   | 7.8                  | 440 $\mu$ A  |
| 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 $\mu$ s | <40 $\mu$ s                          | <10 % for <1 V compliance |



## ACV DC Offset Specifications

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

| ACV DC Offset Specifications $\pm$ (% of dc Output + Floor) |                       |                       |             |
|-------------------------------------------------------------|-----------------------|-----------------------|-------------|
| Range                                                       | 99 % Confidence Level | 95 % Confidence Level | Floor       |
|                                                             | 1 y                   | 1 y                   |             |
| 12 mV                                                       | 0.10                  | 0.10                  | 12 $\mu$ V  |
| 120 mV                                                      | 0.10                  | 0.10                  | 120 $\mu$ V |
| 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 <sup>[1]</sup> | 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/5530A with 52120A Current Specifications

Current specification of a single 52120A, when controlled by a 5540A or 5530A. For specifications for multiple 52120As in parallel (up to three), RSS the specification for each 52120A.

| DCI / ACI Specifications $\pm$ ( $\mu$ A/A Output + Floor) |                |                       |                       |             |
|------------------------------------------------------------|----------------|-----------------------|-----------------------|-------------|
| Range                                                      | Frequency (Hz) | 99 % Confidence Level | 95 % Confidence Level | Floor       |
|                                                            |                | 1yr                   | 1yr                   |             |
| 2 A                                                        | DC             | 150                   | 120                   | 200 $\mu$ A |
|                                                            | 16 to 40       | 2000                  | 1600                  | 300 $\mu$ A |
|                                                            | 40.01 to 850   | 2000                  | 1600                  | 200 $\mu$ A |
|                                                            | 850 to 6 k     | 2400                  | 1900                  | 200 $\mu$ A |
| 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/5530A with 52120A Operating Characteristics

Range lock unavailable for ACI.

Minimum ACI output for 2 A range is 0.2 A.

| Frequency<br>(Hz) | Resolution | Distortion |             |          |             | Noise<br>(16 Hz -<br>10 MHz,<br>relative<br>to range) | Max Inductive Load<br>( $\mu$ H) |             |
|-------------------|------------|------------|-------------|----------|-------------|-------------------------------------------------------|----------------------------------|-------------|
|                   |            | LCOMP OFF  |             | LCOMP ON |             |                                                       | LCOMP<br>OFF                     | LCOMP<br>ON |
|                   |            | % Output   | Floor       | % Output | Floor       | % Output                                              |                                  |             |
| 2 A Range         |            |            |             |          |             |                                                       |                                  |             |
| 16 to 300         | 1 $\mu$ A  | 0.1        | 200 $\mu$ A | 0.1      | 200 $\mu$ A | 0.1                                                   | 100                              | 400         |
| 300 to 1 k        |            | 0.2        | 200 $\mu$ A | 0.3      | 200 $\mu$ A | 0.1                                                   | -                                | -           |
| 1 kHz to 6 k      |            | 0.5        | 662 $\mu$ A | -        | -           | 0.1                                                   | -                                | -           |
| 20 A Range        |            |            |             |          |             |                                                       |                                  |             |
| 16 to 300         | 10 $\mu$ A | 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 $\mu$ A | 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:

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

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.



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