PXIe-4190 Specifications

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LCR Specifications

LCR Specifications Conditions

The following conditions must be met when operating in LCR Mode.

- Ambient temperature[1] of 23 °C ± 5 °C
- Relative humidity between 10% and 60%, noncondensing
- Chassis with slot cooling capacity ≥58 W
- Calibration interval of 1 year
- 30 minutes warm-up time
- Self-calibration performed within the last 24 hours
- NI-DCPower 21.8 or later installed
- Automatic Level Control (ALC) is On
- LCR Measurement Time is Long unless otherwise stated
- Open and short compensation has been completed
- Connections between force and sense leads are required and must be made while the niDCPower Output Enabled or niDCPower Output Connected properties are set to FALSE[2]
- Four-terminal pair (4TP) connections to load[3]
- niDCPower Cable Length property or NIDCPOWER_ATTR_CABLE_LENGTH attribute set
- Impedance range is within 30% of DUT impedance
- Excitation voltage is set to at least 70 mV RMS
- Temperature is within ±5 °C of last self-calibration
- DC bias is off
- SHDB13W6-4BNCM-LL Cable, 1 m (NI part number 788280-01)

LCR Instrument Capabilities

Maximum AC voltage	7.07 V RMS
Maximum AC current	70.7 mA RMS
Maximum DC bias voltage range	±40 V, including peak test signal
Maximum DC bias current range	±100 mA, including peak test signal
Measurement times	
Short	1 ms
Medium	10 ms
Long	100 ms
Custom	User-defined

Note Measurement times round to the nearest positive integer number of cycles of the stimulus frequency.

LCR Measurements

- Z—Impedance
- Y—Admittance
- Ls—Inductance using series-equivalent circuit model
- Cs—Capacitance using series-equivalent circuit model
- Rs—Resistance using series-equivalent circuit model
- Lp—Inductance using parallel-equivalent circuit model
- Cp—Capacitance using parallel-equivalent circuit model

- Rp—Resistance using parallel-equivalent circuit model
- D—Dissipation factor
- Q—Quality factor
- V DC—DC voltage measurement
- I DC—DC current measurement
- AC voltage—AC voltage magnitude and phase angle
- AC current—AC current magnitude and phase angle

LCR Test Signal

Voltage stimulus	
Maximum	7.07 V RMS
Minimum	7.07 mV RMS
Resolution	<1 µV RMS
Maximum current	70.7 mA RMS

Accuracy (ALC on)	
≤10 kHz	±0.2%
10 kHz to 2 MHz	±6%

Current stimulus	
Maximum	70.7 mA RMS
Minimum	707 nA RMS
Resolution	<100 pA RMS

Maximum voltage	7.07 V RMS
Accuracy (ALC on)	
≤10 kHz	±0.2%
10 kHz to 2 MHz	±6%

LCR DC Bias

Voltage DC bias	
Maximum	±40 V, including peak AC signal
Resolution	<10 µV
Accuracy	0.02% + 5 mV

Current DC bias	
Maximum	±100 mA, including peak AC signal
Resolution	<10 nA
Accuracy	0.04% + 10 µA

LCR Frequency

Accuracy	Equal to PXIe_CLK100 accuracy, nominal

LCR Measurement Accuracy

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10kHz	10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz
100 MΩ to 1 GΩ	1.00%	1.00%	—	—	—	—	—
10 MΩ to 100 MΩ	0.15%	0.15%	0.15%	—	—	—	—
1 MΩ to 10 MΩ	0.06%	0.06%	0.15%	0.30%	—	—	—
100 kΩ to 1 MΩ	0.05%	0.05%	0.08%	0.30%	0.3%*	0.3%†	0.6%‡
10 kΩ to 100 kΩ	0.05%	0.05%	0.08%	0.30%	0.30%	0.30%	0.60%
1 kΩ to 10 kΩ	0.05%	0.05%	0.08%	0.20%	0.20%	0.20%	0.50%
300 Ω to 1 kΩ	0.08%	0.08%	0.08%	0.20%	0.20%	0.50%	1.60%
10 Ω to 300 Ω	0.80%	0.80%	0.80%	0.90%	0.90%	1.20%	2%

Note: When on boundary, use lower adjacent value.

* Up to 640 kΩ impedance range.

† Up to 255 kΩ impedance range.

‡ Up to 130 kΩ impedance range.

Table 3. Absolute Impedance Magnitude Accuracy, 708 mV RMS to 7.07 V RMS Stimulus Voltage

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10kHz	10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz
10 MΩ to 100 MΩ	0.20%	0.40%	1.10%	—	—	—	—
1 MΩ to 10 MΩ	0.06%	0.06%	0.20%	0.90%	—	—	—
100 kΩ to 1 MΩ	0.05%	0.05%	0.08%	0.90%	0.6%*	0.6%†	0.6%‡
10 kΩ to 100 kΩ	0.05%	0.05%	0.08%	0.30%	0.30%	0.30%	0.50%
1 kΩ to 10 kΩ	0.05%	0.05%	0.08%	0.20%	0.20%	0.20%	0.50%
300 Ω to 1 kΩ	0.08%	0.08%	0.08%	0.20%	0.20%	0.20%	1.60%
10 Ω to 300 Ω	0.80%	0.80%	0.80%	0.90%	0.90%	1.20%	2%

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10kHz	10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz

Note: When on boundary, use lower adjacent value.

* Up to 640 kΩ impedance range.

† Up to 255 kΩ impedance range.

‡ Up to 130 kΩ impedance range.

Table 4. Absolute Impedance Magnitude Accuracy, 150 mV RMS to 707 mV RMS Stimulus Voltage

	10 Ω to 300 Ω	300 Ω to 10 MΩ	10 MΩ to 100 MΩ
50 mV RMS to 150 mV RMS	1	2	3
7.08 mV RMS to 50 mV RMS, typical	2	11	—

Note: Absolute accuracy is the **Absolute Impedance Magnitude Accuracy, 150 mV RMS to 707 mV RMS Stimulus Voltage** table value times the respective multiplier.

Table 5. Absolute Impedance Magnitude Accuracy Multiplier for Stimuli Below 150 mV RMS

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10 kHz	>10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz
100 MΩ to 1 GΩ	0.55 °	0.55 °	—	—	—	—	—
10 MΩ to 100 MΩ	0.19 °	0.08 °	0.25 °	—	—	—	—
1 MΩ to 10 MΩ	0.02 °	0.03 °	0.21 °	0.19 °	—	—	—
100 kΩ to 1 MΩ	0.01 °	0.02 °	0.19 °	0.19 °	0.14 °*	0.16 °†	0.26 °‡
10 kΩ to 100 kΩ	0.01 °	0.02 °	0.10 °	0.11 °	0.12 °	0.13 °	0.26 °
1 kΩ to 10 kΩ	0.01 °	0.02 °	0.09 °	0.10 °	0.10 °	0.12 °	0.31 °
300 Ω to 1 kΩ	0.01 °	0.03 °	0.12 °	0.08 °	0.13 °	0.21 °	0.34 °
10 Ω to 300 Ω	0.01 °	0.03 °	0.13 °	0.08 °	0.09 °	0.11 °	0.15 °

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10 kHz	>10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz

Note: When on boundary, use lower adjacent value.

* Up to 640 kΩ impedance range.

† Up to 255 kΩ impedance range.

‡ Up to 130 kΩ impedance range.

Table 6. Absolute Impedance Phase Accuracy, 708 mV RMS to 7.07 V RMS Stimulus Voltage

Impedance Range	Frequency						
	40 Hz to 100 Hz	100 Hz to 1 kHz	1 kHz to 10kHz	>10 kHz to 200 kHz	200 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz
10 MΩ to 100 MΩ	0.14 °	0.30 °	0.50 °	—	—	—	—
1 MΩ to 10 MΩ	0.03 °	0.03 °	0.14 °	0.45 °	—	—	—
100 kΩ to 1 MΩ	0.02 °	0.03 °	0.14 °	0.45 °	0.22 °*	0.22 °†	0.34 °‡
10 kΩ to 100 kΩ	0.01 °	0.02 °	0.07 °	0.15 °	0.14 °	0.14 °	0.34 °
1 kΩ to 10 kΩ	0.01 °	0.02 °	0.07 °	0.15 °	0.09 °	0.11 °	0.20 °
300 Ω to 1 kΩ	0.01 °	0.02 °	0.07 °	0.08 °	0.09 °	0.12 °	0.34 °
10 Ω to 300 Ω	0.01 °	0.04 °	0.22 °	0.08 °	0.10 °	0.13 °	0.18 °

Note: When on boundary, use lower adjacent value.

* Up to 640 kΩ impedance range.

† Up to 255 kΩ impedance range.

‡ Up to 130 kΩ impedance range.

Table 7. Absolute Impedance Phase Accuracy, 150 mV RMS to 707 mV RMS Stimulus Voltage

	10 Ω to 300 Ω	300 Ω to 1 kΩ	1 kΩ to 10 kΩ	>10 kΩ to 100 kΩ	100 kΩ to 1 MΩ	1 MΩ to 10 MΩ	10 MΩ to 100 MΩ
50 mV RMS to 150 mV RMS	2	2	2	2	2	2	3
7.08 mV RMS to 50 mV RMS, typical	20	70	25	25	10	8	8
Note: Absolute accuracy is the **Absolute Impedance Phase Accuracy, 150 mV RMS to 707 mV RMS Stimulus Voltage** table value times the respective multiplier.							

Table 8. Absolute Impedance Phase Accuracy Multiplier for Stimuli Below 150 mV RMS

[1] The ambient temperature of a PXI system is defined as the temperature at the chassis fan inlet (air intake).

[2] Disconnecting the sense leads while both these properties are set to TRUE may result in output protection errors or long settling tails due to the feedback path for the control loop being open. If the PXIe-4190 is run open loop due to accidental sense lead disconnection, allow a minimum of 1 minute after establishing proper lead connections before making measurements.

[3] Refer to the **PXIe-4190 Getting Started** for more information on 4TP connections.