

NI 4071 Specifications

7½-Digit FlexDMM™ and 1.8 MS/s Isolated Digitizer



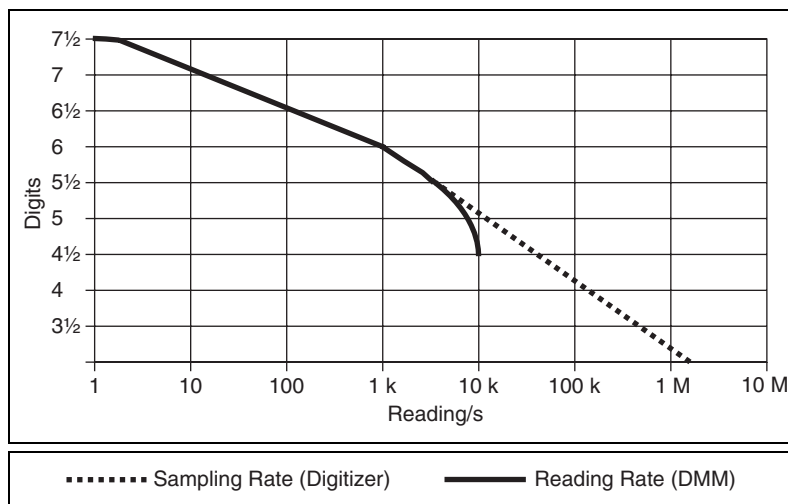
Note All specifications in this document are subject to change without notice. For the most current specifications, visit ni.com/instruments.

DC Specifications

Digits	Bits	Max Sampling Rate* (Digitizer)	Reading Rate† (DMM)
7½	26	N/A	7 S/s
6½	22	100.0 S/s	100 S/s
5½	18	5.0 kS/s	3 kS/s
4½	15	20.0 kS/s	10 kS/s
3	10	1.8 MS/s	N/A

* Maximum sampling rates refer to waveform acquisition in digitizer mode.
† Auto Zero disabled, except 7½ digits; measured on a 10 V and 10 kΩ range.

DC Voltage Maximum Reading Rate



DC System Speeds

Range or function change	100/s
Auto Range time, DC V	5 ms
Auto Range time, DC I	10 ms
Auto Range time, resistance	50 ms
Trigger latency	2 μ s
Maximum trigger rate	6 kHz

DC Accuracy Specifications



Note All DC voltage accuracy specifications apply to 7½-digit resolution, Auto Zero and ADC calibration enabled.

DC Voltage \pm (ppm* of reading + ppm of range)

Range	Resolution	Input Resistance	24 Hr [†] T _{cal} \pm 1 °C	90 Day 18 °C to 28 °C T _{cal} \pm 1 °C	2 Year 18 °C to 28 °C T _{cal} \pm 1 °C	Tempco/°C 0 °C to 55 °C		2 Year [‡] 0 °C to 55 °C T _{cal} \pm 5 °C
						Without Self-Cal	With Self-Cal	
100 mV**	10 nV	>10 G Ω , 10 M Ω	5 + 4	18 + 7	20 + 8	3 + 2	0.3 + 1	30 + 10
1 V ^{††}	100 nV	>10 G Ω , 10 M Ω	4 + 0.8	13 + 0.8	15 + 0.8	2 + 0.2	0.3 + 0.1	22 + 0.8
10 V	1 μ V	>10 G Ω , 10 M Ω	2 + 0.5	9 + 0.5	12 + 0.5	0.3 + 0.02	0.3 + 0.01	15 + 0.5
100 V	10 μ V	10 M Ω	5 + 2	18 + 2	20 + 2	4 + 0.2	0.3 + 0.1	32 + 2
1000 V ^{‡‡}	100 μ V	10 M Ω	4 + 0.5	18 + 0.5	20 + 0.5	3 + 0.02	0.3 + 0.01	32 + 0.5

* 1 ppm (part per million) = 0.0001%.

[†] Relative to external calibration source.

[‡] Using internal self-calibration; specifications valid over the entire operating temperature range.

** With offset nulling.

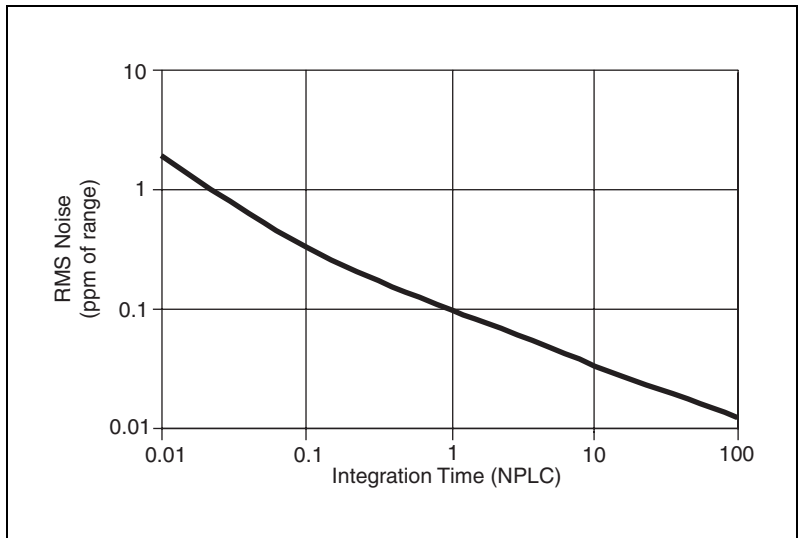
^{††} With offset nulling; add 1.3 ppm of range for no offset nulling.

^{‡‡} For inputs above 300 V, add 20 ppm \times (V_{IN}/1000 V)² to the 90 Day and 2 Year columns.

T_{cal} = temperature at which last self-calibration or external calibration was performed.

Tempco = temperature coefficient.

Additional Noise Error



RMS Noise*

Range	Multiplier
100 mV	× 15
1 V	× 2
10 V	× 1
100 V	× 6
1000 V	× 1

* Multiply the rms noise value from the graph above by the range-appropriate multiplier in this table. For the peak-to-peak noise error, multiply the rms noise by 6.



Note All DC current specifications apply to 6½-digit resolution, Auto Zero and ADC calibration enabled.

DC Current ± (ppm of reading + ppm of range)

Range	Resolution	Burden Voltage	24 Hr* T _{cal} ±1 °C	90 Day 18 °C to 28 °C T _{cal} ±1 °C	2 Year 18 °C to 28 °C T _{cal} ±1 °C	Tempco/°C 0 °C to 55 °C
1 µA	1 pA	<50 mV	25 + 20	320 + 40	350 + 40	25 + 0.7
10 µA	10 pA	<500 mV	25 + 2	320 + 15	350 + 15	25 + 0.7
100 µA	100 pA	<60 mV	10 + 20	71 + 20	100 + 20	10 + 0.5
1 mA	1 nA	<60 mV	4 + 20	80 + 20	100 + 20	4 + 0.5
10 mA	10 nA	<60 mV	12 + 20	90 + 20	110 + 20	12 + 0.5
100 mA	100 nA	<100 mV	9 + 20	140 + 20	165 + 20	15 + 0.5
1 A	1 µA	<250 mV	15 + 20	240 + 20	290 + 20	11 + 0.5
3 A [†]	1 µA	<700 mV	15 + 30	390 + 30	440 + 30	11 + 0.5

* Relative to external calibration source.
[†] Above 2 A, add 300 ppm of reading to 90-day and 2-year specifications.
 Tempco = temperature coefficient.

Additional Noise Errors for Current

Resolution	Additional Noise Error
5½ digits	10 ppm of range
5 digits	30 ppm of range
4½ digits	100 ppm of range



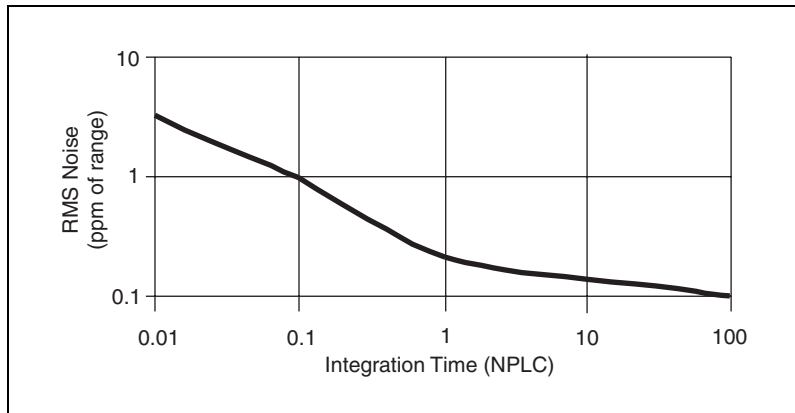
Note All resistance specifications apply to 7½-digit resolution, Auto Zero and ADC calibration enabled.

Resistance (4-Wire and 2-Wire*) ± (ppm of reading + ppm of range)

Range	Resolution	Test Current [†]	Max Test Voltage	24 Hr [‡] T _{cal} ±1 °C	90 Day 18 °C to 28 °C T _{cal} ±1 °C	2 Year 18 °C to 28 °C T _{cal} ±1 °C	Tempco/°C (0 °C to 55 °C)		2 Year** 0 °C to 55 °C T _{cal} ±5 °C
							Without Self-Cal	With Self-Cal	
100 Ω ^{††}	10 μΩ	1 mA	100 mV	8 + 2.5	31 + 4	56 + 4	6 + 0.12	0.8 + 0.12	60 + 5
1 kΩ ^{††}	100 μΩ	1 mA	1 V	5 + 0.5	26 + 0.5	48 + 0.5	5 + 0.05	0.8 + 0.05	55 + 1
10 kΩ ^{††}	1 mΩ	100 μA	1 V	5 + 0.5	26 + 0.5	48 + 0.5	5 + 0.05	0.8 + 0.05	55 + 1
100 kΩ ^{***}	10 mΩ	10 μA	1 V	5 + 0.5	28 + 0.5	50 + 0.5	5 + 0.05	0.8 + 0.05	56 + 6
1 MΩ	100 mΩ	10 μA	10 V	5 + 0.5	30 + 0.5	52 + 0.5	5 + 0.05	3 + 0.05	58 + 1
10 MΩ	1 Ω	1 μA	10 V	60 + 5	70 + 10	90 + 10	20 + 1	20 + 1	400 + 10
30 MΩ ^{‡‡}	10 Ω	1 μA 10 MΩ	10 V	180 + 20	240 + 30	360 + 60	60 + 20	60 + 20	—
100 MΩ ^{†††}	10 Ω	1 μA 10 MΩ	10 V	500 + 6	1600 + 10	2000 + 20	250 + 6	250 + 6	—
5 GΩ ^{†††}	10 Ω	1 μA 10 MΩ	10 V	1% + 0.2	5% + 0.2	5% + 0.2	2500 + 0.2	2500 + 0.2	—

* Perform offset nulling.
[†] -10% to 0% tolerance.
[‡] Relative to external calibration source.
** Using internal self-calibration; specifications valid over the entire operating temperature range.
^{††} With offset compensated ohms enabled. For ADC calibration disabled, add 4 ppm of 100 Ω range and 0.4 ppm of 1 kΩ and 10 kΩ range to the *90 Day* and *2 Year* columns.
^{‡‡} Applies to 100 MΩ range up to 30 MΩ. 2-wire resistance measurement only. Use tempco outside 18 °C to 28 °C.
^{***} Perform offset nulling *or* add 1 ppm of range to the *24 Hr* column and add 5 ppm of range to *90 Day* and *2 Year* columns.
^{†††} 2-wire resistance measurement only. Use tempco outside 18 °C to 28 °C.
For ranges ≥1 MΩ and relative humidity >80%, add 100 ppm/MΩ.
T_{cal} = temperature at which last self-calibration or external calibration was performed.
Tempco = temperature coefficient.

Additional Noise Error



RMS Noise*

Range	Multiplier
100 Ω	$\times 8$
1 k Ω	$\times 1$
10 k Ω	$\times 1$
100 k Ω	$\times 2$
1 M Ω	$\times 3.5$
10 M Ω	$\times 5$
100 M Ω	$\times 55$
5 G Ω	$\times 2500$

* Multiply the rms noise value from the graph above by the range-appropriate multiplier in this table. For the peak-to-peak noise error, multiply the rms noise by 6.



Note All diode specifications apply to 6½-digit resolution, Auto Zero and ADC calibration enabled.

Diode Test*

Range	Resolution	Test Current [†]	Accuracy
10 V	10 μ V	1 μ A, 10 μ A, 100 μ A, 1 mA [‡]	Add 20 ppm of reading to 10 V DC voltage specifications.

* Can be used to test p-n junctions, LEDs, or zener diodes up to 10 V.
[†] -10% to 0% tolerance.
[‡] Up to 4.0 V measurement for 1 mA test current.

DC Functions General Specifications

Effective Common-Mode Rejection Ratio (CMRR)
 (1 k Ω resistance in LO lead) >140 dB (DC), 100 ms aperture;
 >170 dB (>46 Hz) with
 high-order DC noise rejection,
 100 ms aperture

Maximum 4-wire lead resistance Use the lesser of 10% of range
 or 1 k Ω

Overrange 105% of range except
 1000 V and 3 A range

DC voltage input bias current <30 pA at 23 °C (typical)

Normal-Mode Rejection Ratio (NMRR)

Readings/s	NMRR	Conditions
10	>100 dB*	All noise sources >46 Hz
50 (60)	>60 dB [†]	50 (60) Hz \pm 0.1%
* With high-order DC noise rejection; 100 ms aperture. † With normal DC noise rejection; 20 ms (16.67 ms) aperture.		

AC Specifications



Note All AC speed specifications apply with Auto Zero disabled.

Digits	Reading Rate	Bandwidth
6½	0.25 S/s	1 Hz to 300 kHz
6½	2.5 S/s	10 Hz to 300 kHz
6½	25 S/s	100 Hz to 300 kHz
6½	100.0 S/s	400 Hz to 300 kHz
5½	1.0 kS/s	20 kHz to 300 kHz

AC System Speeds

Range or function change 10/s

Auto Range time, AC V and AC I 250 ms

Trigger latency 2 μ s

Maximum trigger rate 1 kHz

AC Accuracy Specifications



Note All AC accuracy specifications apply to 6½-digit resolution, signal amplitudes greater than 1% of range, and Auto Zero enabled.

AC Voltage* 2 Year ± (% of reading + % of range), 18 °C to 28 °C

Range (rms)	Peak Voltage	Resolution	1 Hz to 40 Hz [†]	40 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
50 mV [‡]	±105 mV	100 nV	0.1 + 0.02	0.05 + 0.02	0.07 + 0.02	0.3 + 0.02	0.7 + 0.1
500 mV ^{**}	±1.05 V	1 μV	0.1 + 0.005	0.05 + 0.005	0.06 + 0.01	0.2 + 0.01	0.7 + 0.05
5 V ^{**}	±10.5 V	10 μV					
50 V	±105 V	100 μV	0.1 + 0.005	0.06 + 0.01	0.09 + 0.02	0.3 + 0.02	2 + 0.05
700 V	±1000 V	1 mV					

* After self-calibration. Measurement aperture greater than $4/f_L$, where f_L is the lowest frequency component of the signal being measured.
[†] Specification applies for DC coupling.
[‡] Applies to signals >1 mV_{rms}.
^{**} Add 0.1% of range to signals >200 kHz.

AC Voltage Tempco/°C (0 °C to 55 °C)

Range (rms)	1 Hz to 40 Hz	40 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
50 mV 500 mV 5 V	0.001 + 0.0002	0.001 + 0.0002	0.001 + 0.001	0.001 + 0.001	0.01 + 0.01
50 V 700 V	0.001 + 0.0002	0.003 + 0.0002	0.012 + 0.001	0.045 + 0.001	0.1 + 0.01

Tempco = temperature coefficient.

AC Voltage General Specifications

Input impedance 10 M Ω in parallel with 90 pF

Input coupling AC or DC coupling

Overrange 105% of range
except 700 V

Maximum Volt-Hertz product $>8 \times 10^7$ V-Hz

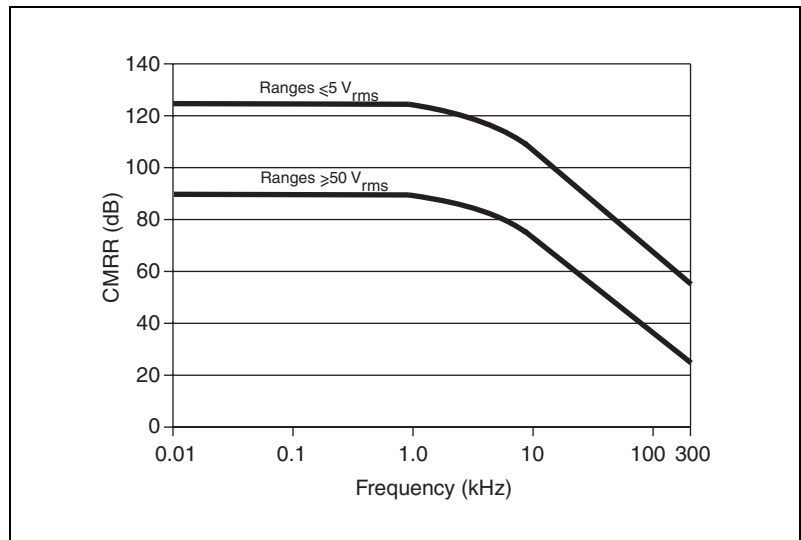
Maximum DC voltage component 400 V

CMRR

1 k Ω resistance in LO lead >70 dB (DC to 60 Hz)

Over full bandwidth (without 1 k Ω resistance
in LO lead) Refer to the following
typical graph

CMRR Over Full Bandwidth



AC Current* 2 Year ± (% of reading + % of range), 18 °C to 28 °C

Range (rms)	Peak Current	Resolution	Burden Voltage (rms at 1 kHz)	1 Hz to 20 kHz†	Tempco/°C (0 °C to 55 °C)
100 μA‡	±200 μA	100 pA	<60 mV	0.03 + 0.02	0.002 + 0.0002
1 mA	±2 mA	1 nA	<60 mV	0.01 + 0.02	0.001 + 0.0001
10 mA	±20 mA	10 nA	<60 mV	0.011 + 0.02	0.002 + 0.0002
100 mA	±200 mA	100 nA	<100 mV	0.02 + 0.02	0.001 + 0.0002
1 A	±2 A	10 μA	<250 mV	0.04 + 0.02	0.002 + 0.0002
3 A	±4.2 A**	10 μA	<700 mV	0.1 + 0.02	0.002 + 0.0001

* Measurement aperture greater than $4/f_L$, where f_L is the lowest frequency component of the signal being measured.
† Only to 5 kHz for 100 μA; specification is typical for the 5 kHz to 20 kHz frequency range.
‡ Applies to signals $>9 \mu A_{rms}$ and ≤ 1 kHz. Add 0.03% of reading from 1 kHz to 5 kHz.
** Sine wave only.
Tempco = temperature coefficient.



Note No degradation in accuracy due to crest factor occurs for signals up to the rated peak voltage/current or bandwidth. For high crest factor signals, increase range. For example, for a 500 mV_{rms} signal with a crest factor between 2–20, use the 5 V range.

AC Current General Specification

Overrange105% of range
except 3 A range

Frequency and Period*

Input Range	Frequency Range	Period Range	Resolution	2-Year Accuracy† 0 °C to 55 °C ±% of reading
50 mV to 700 V	1 Hz to 500 kHz	1 s to 2 μs	6½ digits	0.01

* 2 second gate time; input signal must be >10% of AC voltage input range.
† 0.0025% of reading typical.

Isolated Digitizer Specifications

Acquisition System

Sampling rate and record duration

$$\text{Available sampling rates } r = \frac{1.8 \text{ MS/s}}{y},$$

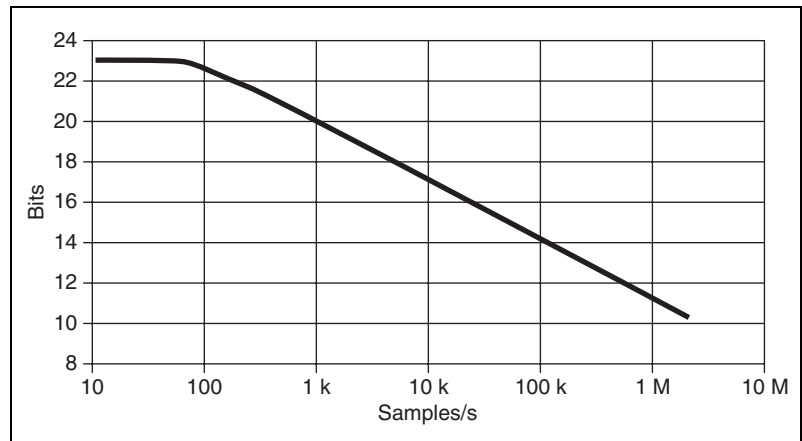
where $y = 1, 2, 3, \dots, 1.8 \times 10^5$

Minimum record duration	8.89 μ s
Maximum record duration	149 s
Record duration.....	n/r , where n = number of samples, r = sampling rate
Variable resolution	10–23 bits; refer to the <i>Digitizer Maximum Sampling Rate</i> graph
Available functions	Voltage and current
Voltage ranges.....	± 100 mV to ± 1000 V (DC or AC coupled)
Current ranges	100 μ A to 3 A
Timebase accuracy	25 ppm
Input trigger	
Latency ¹	3.6 μ s
Jitter	<600 ns



Note Refer to *Triggers* under *General Specifications* for additional input trigger specifications.

Digitizer Maximum Sampling Rate



¹ Is actually negative latency. Can be reduced to near zero (within the jitter specification) or made positive in software.

Voltage

Range	Input Impedance*	Flatness Error [†] 20 kHz	Bandwidth ^{†, ‡} (-3 dB)	THD [†] 1 kHz signal, -1 dBfs	THD [†] 20 kHz signal, -1 dBfs
100 mV	>10 GΩ 10 MΩ	-0.014 dB	340 kHz	-108 dB	-90 dB
1 V	>10 GΩ 10 MΩ	-0.014 dB	335 kHz	-110 dB	-86 dB
10 V	>10 GΩ 10 MΩ	-0.014 dB	325 kHz	-90 dB	-64 dB
100 V	10 MΩ	-0.050 dB	280 kHz	-110 dB	-92 dB
1000 V	10 MΩ	-0.050 dB	245 kHz	-89 dB	-70 dB

* In parallel with 90 pF.
[†] Typical specification.
[‡] The AC coupling low frequency (-3 dB) point is 0.7 Hz.



Note For basic DC accuracy, refer to the DC voltage specifications in the [DC Specifications](#) section.

Current

Range	Burden Voltage (typical)	Flatness Error* 20 kHz	Bandwidth* (-3 dB)
100 μA	<60 mV	±0.42 dB	42 kHz
1 mA	<60 mV	±0.01 dB	450 kHz
10 mA	<60 mV	±0.01 dB	450 kHz
100 mA	<100 mV	±0.01 dB	450 kHz
1 A	<250 mV	±0.01 dB	450 kHz
3 A	<700 mV	±0.01 dB	450 kHz

* Typical specification.



Note For basic DC accuracy, refer to the DC current specifications in the [DC Specifications](#) section.

General Specifications

Self-calibration Calibrates the FlexDMM relative to high-precision internal voltage and resistance standards. Requires no external calibration equipment.

External calibration interval..... 2 year recommended

Input protection

Resistance

2-wire Up to 1000 V DC

4-wire Up to 500 V DC

Diode Up to 1000 V DC

DC V, AC V Up to 1000 V DC, 700 V AC_{rms}, 1000 V AC peak

DC I and AC I 3 A, 250 V fast-acting user-replaceable fuse

Maximum common-mode voltage 500 V DC or AC_{rms}

Maximum voltage to earth ground

HI 1000 V DC or peak AC

LO 500 V DC or peak AC

HI SENSE 500 V DC or peak AC

LO SENSE 500 V DC or peak AC

Input terminals Gold-plated low-thermal EMF solid copper

Triggers

Measurement complete trigger

pulse width 3 μ s

Input trigger pulse width 1 μ s, with <2 m cable

Maximum voltage to earth ground

at AUX I/O connector 5.5 V DC

Trigger Voltage Levels

Trigger Voltage	High	Low
V _{in}	2.4 V min	0.4 V max
V _{out}	2.0 V min	0.8 V max

Trigger Voltage Level Absolute Maximums

Trigger Voltage	High	Low
V_{in}	5.5 V	-0.5 V



Note Triggers are LVTTTL/TTL compatible.



Caution The AUX I/O connector is *not* isolated. This connector is not referenced to the measurement circuit but is referenced to the ground of the PXI chassis. Do *not* operate the digital signals on this connector beyond -0.5 V to 5.5 V of the PXI chassis ground.

Power consumption<8 W from PXI backplane

Rail Voltage	Current Consumption	Power Consumption
12 V	500 mA	6.00 W
5.0 V	30 mA	0.15 W
3.3 V	230 mA	0.76 W
-12 V	0 mA	0.00 W

Warm-up1 hour to rated accuracy

Dimensions3U, one slot, PXI/cPCI module;
2.0 cm × 13.0 cm × 21.6 cm
(0.8 in. × 5.1 in. × 8.5 in.)

Weight314 g (11 oz)

Measurement CategoryI (up to 1000 V DC or AC_{rms}),
II (up to 500 V DC or AC_{rms})



Caution Do *not* use the NI 4071 to connect to signals above 500 V Category II. Do *not* use the NI 4071 in Category III or IV applications. Do *not* connect to MAINS supply circuits above 500 VAC.



Note Refer to the *Read Me First: Safety and Radio-Frequency Interference* document for definitions of Categories and other safety information.

Impulse overvoltage4000 V

Environment

Maximum altitude 2000 m (at 25 °C ambient temperature)

Pollution Degree 2

Indoor use only

Operating Environment

Ambient temperature range 0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range Up to 95% at 40 °C

Storage Environment

Ambient temperature range –40 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range 5% to 95% noncondensing (Tested in accordance with IEC-60068-2-56.)

Shock and Vibration

Operational Shock 30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

Random Vibration

Operating 5 Hz to 500 Hz, 0.3 g_{rms}

Nonoperating 5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

The NI 4071 meets the requirements of the following standards of safety and electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1
- CAN/CSA-C22.2 No. 61010-1



Note For UL and other safety certifications, refer to the product label, or visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

EmissionsEN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

ImmunityEN 61326:1997 + A2:2001,
Table 1

EMC/EMICE, C-Tick, and FCC Part 15
(Class A) Compliant



Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility
Directive (EMC).....89/336/EEC



Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

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