

# NI 4071 Specifications

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



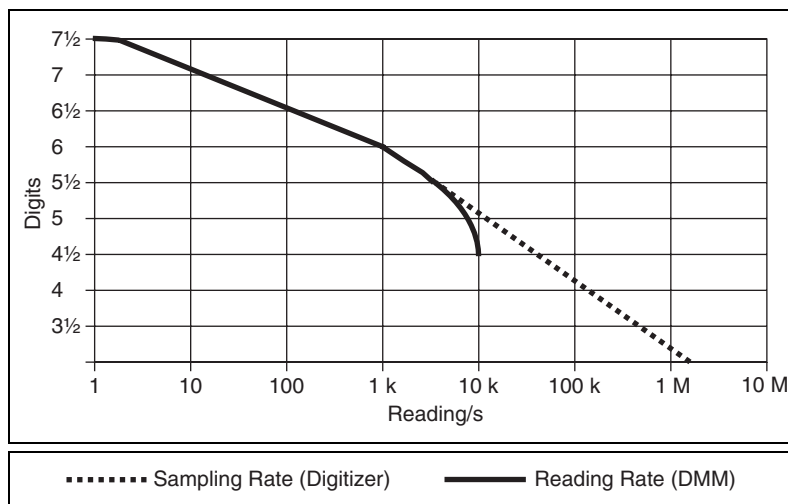
**Note** All specifications in this document are subject to change without notice. For the most current specifications, visit [ni.com/manuals](http://ni.com/manuals).

### 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 $\mu$ 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 <sup>†</sup> T <sub>cal</sub> $\pm$ 1 °C	90 Day 18 °C to 28 °C T <sub>cal</sub> $\pm$ 1 °C	2 Year 18 °C to 28 °C T <sub>cal</sub> $\pm$ 1 °C	Tempco/°C 0 °C to 55 °C		2 Year <sup>‡</sup> 0 °C to 55 °C T <sub>cal</sub> $\pm$ 5 °C
						Without Self-Cal	With Self-Cal	
100 mV**	10 nV	>10 G $\Omega$ , 10 M $\Omega$	5 + 4	18 + 7	20 + 8	3 + 2	0.3 + 1	30 + 10
1 V <sup>††</sup>	100 nV	>10 G $\Omega$ , 10 M $\Omega$	4 + 0.8	13 + 0.8	15 + 0.8	2 + 0.2	0.3 + 0.1	22 + 0.8
10 V	1 $\mu$ V	>10 G $\Omega$ , 10 M $\Omega$	2 + 0.5	9 + 0.5	12 + 0.5	0.3 + 0.02	0.3 + 0.01	15 + 0.5
100 V	10 $\mu$ V	10 M $\Omega$	5 + 2	18 + 2	20 + 2	4 + 0.2	0.3 + 0.1	32 + 2
1000 V <sup>‡‡</sup>	100 $\mu$ V	10 M $\Omega$	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%.

<sup>†</sup> Relative to external calibration source.

<sup>‡</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.

\*\* With offset nulling.

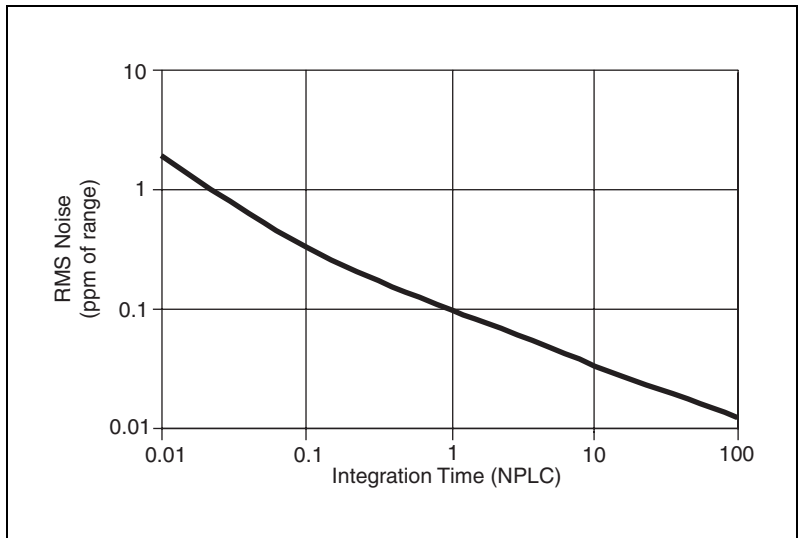
<sup>††</sup> With offset nulling; add 1.3 ppm of range for no offset nulling.

<sup>‡‡</sup> For inputs above 300 V, add 25 ppm  $\times$  (V<sub>IN</sub>/1000 V)<sup>2</sup> to the 90 Day and 2 Year columns.

T<sub>cal</sub> = 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 <sub>cal</sub> ±1 °C	90 Day 18 °C to 28 °C T <sub>cal</sub> ±1 °C	2 Year 18 °C to 28 °C T <sub>cal</sub> ±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 <sup>†</sup>	1 µA	<700 mV	15 + 30	390 + 30	440 + 30	11 + 0.5

\* Relative to external calibration source.  
<sup>†</sup> 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



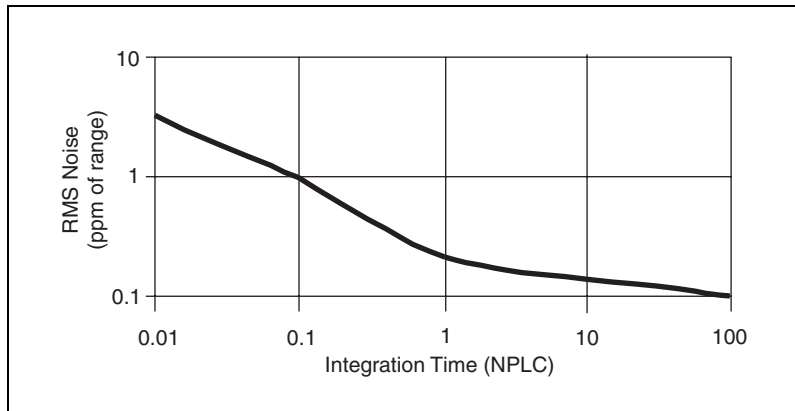
**Note** All resistance specifications apply to 7½-digit resolution, Auto Zero and ADC calibration enabled.

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

Range	Resolution	Test Current <sup>†</sup>	Max Test Voltage	24 Hr <sup>‡</sup> T <sub>cal</sub> ±1 °C	90 Day 18 °C to 28 °C T <sub>cal</sub> ±1 °C	2 Year 18 °C to 28 °C T <sub>cal</sub> ±1 °C	Tempco/°C (0 °C to 55 °C)		2 Year** 0 °C to 55 °C T <sub>cal</sub> ±5 °C
							Without Self-Cal	With Self-Cal	
100 Ω <sup>††</sup>	10 μΩ	1 mA	100 mV	8 + 2.5	31 + 4	56 + 4	6 + 0.12	0.8 + 0.12	60 + 5
1 kΩ <sup>††</sup>	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 <sup>††</sup>	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 <sup>***</sup>	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 <sup>‡‡</sup>	10 Ω	1 μA   10 MΩ	10 V	180 + 20	240 + 30	360 + 60	60 + 20	60 + 20	—
100 MΩ <sup>†††</sup>	10 Ω	1 μA   10 MΩ	10 V	500 + 6	1600 + 10	2000 + 20	250 + 6	250 + 6	—
5 GΩ <sup>†††</sup>	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.  
<sup>†</sup> -10% to 0% tolerance.  
<sup>‡</sup> Relative to external calibration source.  
<sup>\*\*</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.  
<sup>††</sup> 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.  
<sup>‡‡</sup> Applies to 100 MΩ range up to 30 MΩ. 2-wire resistance measurement only. Use tempco outside 18 °C to 28 °C.  
<sup>\*\*\*</sup> 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.  
<sup>†††</sup> 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<sub>cal</sub> = temperature at which last self-calibration or external calibration was performed.  
 Tempco = temperature coefficient.

## Additional Noise Error



## RMS Noise\*

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

\* 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 <sup>†</sup>	Accuracy
10 V	10 $\mu$ V	1 $\mu$ A, 10 $\mu$ A, 100 $\mu$ A, 1 mA <sup>‡</sup>	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.  
<sup>†</sup> -10% to 0% tolerance.  
<sup>‡</sup> Up to 4.0 V measurement for 1 mA test current.

## DC Functions General Specifications

Effective Common-Mode Rejection Ratio (CMRR)  
 (1 k $\Omega$  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 $\Omega$

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 <sup>†</sup>	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  $\mu$ 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 <sup>†</sup>	40 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
50 mV <sup>‡</sup>	±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 <sup>**</sup>	±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 <sup>**</sup>	±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.  
<sup>†</sup> Specification applies for DC coupling.  
<sup>‡</sup> Applies to signals >1 mV<sub>rms</sub>.  
<sup>\*\*</sup> 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 $\Omega$  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

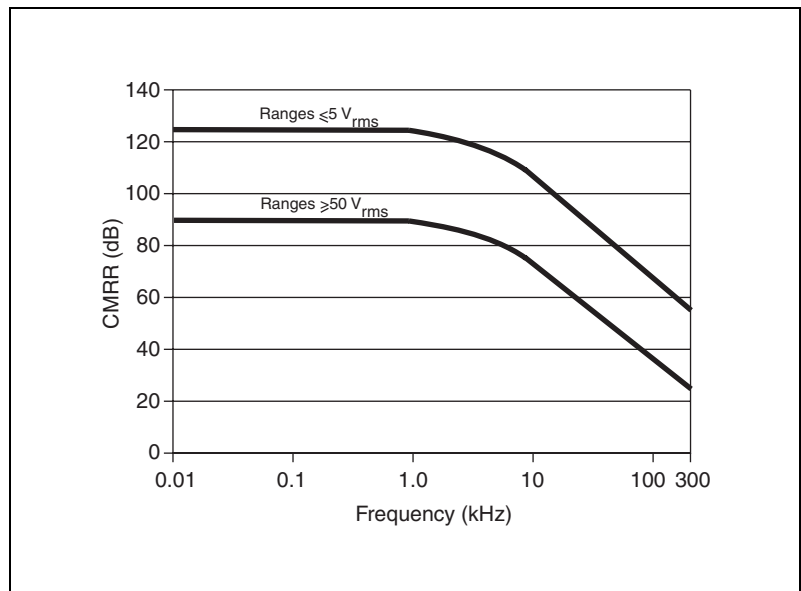
## CMRR

1 k $\Omega$  resistance in LO lead .....  $>70$  dB (DC to 60 Hz)

Over full bandwidth (without

1 k $\Omega$  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  $\leq 1$  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<sub>rms</sub> signal with a crest factor between 2–20, use the 5 V range.

## AC Current General Specification

Overrange .....105% 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

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

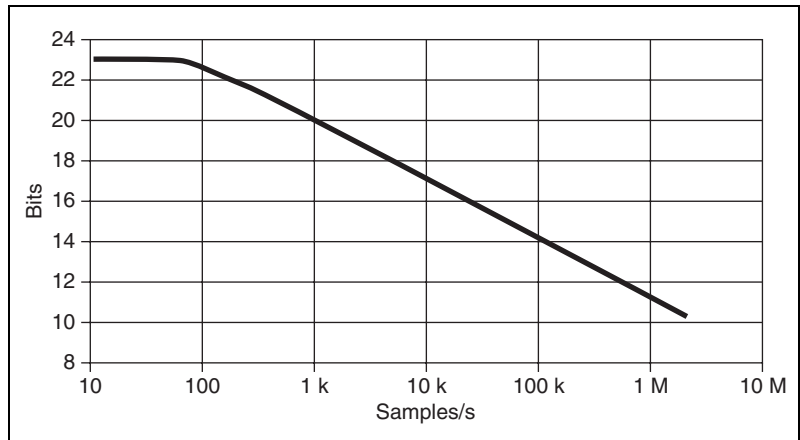
where  $y = 1, 2, 3, \dots, 1.8 \times 10^5$

Minimum record duration .....	8.89 $\mu$ 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.....	$\pm 100$ mV to $\pm 1000$ V (DC or AC coupled)
Current ranges .....	100 $\mu$ A to 3 A
Timebase accuracy .....	25 ppm
Input trigger	
Latency <sup>1</sup> .....	3.6 $\mu$ s
Jitter .....	<600 ns



**Note** Refer to *Triggers* in the *General Specifications* section for additional input trigger specifications.

### Digitizer Maximum Sampling Rate



<sup>1</sup> 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<sub>rms</sub>, 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<sub>rms</sub>

## 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  $\mu$ s

Input trigger pulse width ..... 1  $\mu$ 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 <sub>in</sub>	2.4 V min	0.4 V max
V <sub>out</sub>	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-up .....1 hour to rated accuracy

Dimensions .....3U, one slot, PXI/cPCI module;  
2.0 cm × 13.0 cm × 21.6 cm  
(0.8 in. × 5.1 in. × 8.5 in.)

Weight .....314 g (11 oz)

Measurement Category .....I (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 overvoltage .....4000 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<sub>rms</sub>

Nonoperating ..... 5 Hz to 500 Hz, 2.4 g<sub>rms</sub>

(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 for 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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

# Electromagnetic Compatibility

Emissions .....EN 55011 Class A at 10 m  
FCC Part 15A above 1 GHz

Immunity .....EN 61326:1997 + A2:2001,  
Table 1

EMC/EMI .....CE, 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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

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