

# NI PXI/PCI-4070 Specifications

## 6½ Digit FlexDMM™ and 1.8 MS/s Isolated Digitizer

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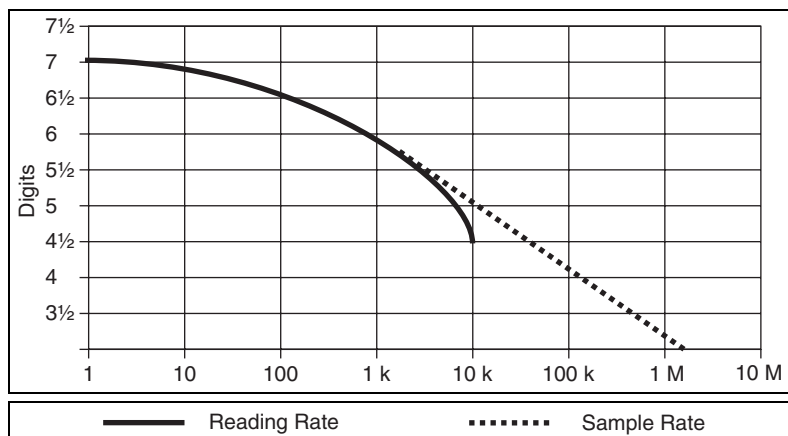
**Note** All specifications in this document are subject to change without notice.

### DC Specifications

Digits	Bits	Max Sample Rate <sup>1</sup>	Reading Rate <sup>2</sup>
7	23	5 S/s	5 S/s
6½	22	100 S/s	100 S/s
5½	18	5 kS/s	3 kS/s
4½	15	20 kS/s	10 kS/s
3	10	1.8 MS/s	N/A

<sup>1</sup> Maximum sample rates refer to waveform acquisition.  
<sup>2</sup> Autozero disabled, except 7 digits, measured on a 10 V and 10 kΩ range.

### DC Voltage Maximum Reading Rate



## DC System Speeds

Range or function change ..... 100/s

Autorange time, DC V and DC I ..... 5 ms

Autorange time, resistance ..... 50 ms

Trigger latency ..... 2  $\mu$ s

Maximum trigger rate ..... 6 kHz

## DC Accuracy Specifications



**Note** All DC accuracy specifications apply to 6½ digit resolution ( $\geq 1$  PLC), autozero and ADC calibration enabled.

### DC Voltage $\pm$ (ppm<sup>1</sup> of reading + ppm of range)

Range	Resolution	Input Resistance	24 Hr <sup>2</sup> $T_{cal} \pm 1^\circ\text{C}$	90 Day <sup>3</sup> $T_{cal} \pm 5^\circ\text{C}$	2 Year <sup>3</sup> $T_{cal} \pm 5^\circ\text{C}$	Tempco/ <sup>o</sup> C (0 °C to 50 °C)	
						Without Self-Cal	With Self-Cal
100 mV*	100 nV	>10 G $\Omega$ , 10 M $\Omega$	10 + 10	30 + 20	40 + 20	4 + 5	0.3 + 0.3
1 V	1 $\mu$ V	>10 G $\Omega$ , 10 M $\Omega$	6 + 2	20 + 6	25 + 6	2 + 1	0.3 + 0.3
10 V	10 $\mu$ V	>10 G $\Omega$ , 10 M $\Omega$	4 + 2	20 + 6	25 + 6	1 + 1	0.3 + 0.3
100 V	100 $\mu$ V	10 M $\Omega$	6 + 2 <sup>†</sup>	30 + 6	35 + 6	4 + 1	0.3 + 0.3
300 V	1 mV	10 M $\Omega$	6 + 6 <sup>‡</sup>	30 + 20	35 + 20	4 + 3	0.3 + 0.3

<sup>1</sup> 1 ppm (part per million) = 0.0001%.

<sup>2</sup> Relative to external calibration source.

<sup>3</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.

\* With offset nulling and 100 ms aperture.

<sup>†</sup> 8 + 4 on the NI PCI-4070

<sup>‡</sup> 8 + 8 on the NI PCI-4070

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

Tempco = temperature coefficient.

### DC Current<sup>1</sup> ± (ppm of reading + ppm of range)

Range	Resolution	Burden Voltage (typical)	Noise (ppm of range rms)	2 Year (0 °C to 50 °C)	Tempco/°C (0 °C to 50 °C)
20 mA	10 nA	<20 mV	20	400 + 75	8 + 1
200 mA	100 nA	<200 mV	3	400 + 20	8 + 0.2
1 A	1 µA	<800 mV	3	500 + 20	8 + 0.4

<sup>1</sup> Typical 24 hour accuracy (23 °C ± 1 °C) is ± (50 ppm of reading + 5 ppm of range).

### Resistance (4-Wire and 2-Wire<sup>1</sup>) ± (ppm of reading + ppm of range)

Range	Resolution	Test Current <sup>2</sup>	Max Test Voltage	24 Hr <sup>3</sup> T <sub>cal</sub> ± 1 °C	90 Day <sup>4</sup> T <sub>cal</sub> ± 5 °C	2 Year <sup>4</sup> T <sub>cal</sub> ± 5 °C	Tempco/°C (0 °C to 50 °C)	
							Without Self-Cal	With Self-Cal
100 Ω <sup>†</sup>	100 µΩ	1 mA	100 mV	15 + 10	50 + 10	80 + 10	8 + 1	0.8 + 1
1 kΩ <sup>†</sup>	1 mΩ	1 mA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
10 kΩ <sup>†</sup>	10 mΩ	100 µA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
100 kΩ	100 mΩ	10 µA	1 V	15 + 2	50 + 6	80 + 6	8 + 0.5	0.8 + 0.5
1 MΩ	1 Ω	10 µA	10 V	20 + 2	60 + 10	90 + 10	8 + 1	0.8 + 1
10 MΩ	10 Ω	1 µA	10 V	100 + 2	200 + 10	400 + 10	30 + 3	30 + 3
100 MΩ <sup>‡</sup>	100 Ω	1 µA  10 MΩ	10 V	900 + 20	1,800 + 40	2,000 + 40	200 + 10	200 + 10

<sup>1</sup> Perform offset nulling or add 200 mΩ to reading.  
<sup>2</sup> –10% to 0% tolerance.  
<sup>3</sup> Relative to external calibration source.  
<sup>4</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.  
<sup>†</sup> With offset compensated ohms enabled.  
<sup>‡</sup> 2-wire resistance measurement only. Typical accuracy is 5% between 105 MΩ and 1.05 GΩ. Use tempco outside 18 °C to 28 °C.  
T<sub>cal</sub> = temperature at which last self-calibration or external calibration was performed.

### Diode Test<sup>1</sup>

Range	Resolution	Test Current <sup>2</sup>	Accuracy
10 V	10 µV	1 µA, 10 µA, 100 µA, 1 mA <sup>†</sup>	Add 20 ppm of reading to 10 V DC voltage specifications.

<sup>1</sup> Can be used to test p-n junctions, LEDs, or zener diodes up to 10 V.  
<sup>2</sup> –10% to 0% tolerance.  
<sup>†</sup> Up to 4.5 V measurement for 1 mA test current.

### Additional Noise Errors for DC Voltage, Current, Resistance

Resolution	Additional Noise Error
5½ digits	10 ppm of range
4½ digits	100 ppm of range
3½ digits	1,000 ppm of range

## DC Functions General Specifications

Effective Common-Mode Rejection Ratio (CMRR)

(1 k $\Omega$  resistance in LO lead).....>170 dB (DC, >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 300 V and 1 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 <sup>†</sup>	All noise sources >46 Hz
50 (60)	>60 dB <sup>‡</sup>	50 (60) Hz $\pm$ 0.1%

<sup>†</sup> With high-order DC noise rejection; 100 ms aperture.  
<sup>‡</sup> With normal DC noise rejection; 20 ms (16.67 ms) aperture.

## AC Specifications



**Note** All AC speed specifications apply with autozero 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 S/s	400 Hz to 300 kHz
5½	1 kS/s	20 kHz to 300 kHz

## AC System Speeds

Range or function change ..... 10/s

Autorange 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 autozero enabled.

### AC Voltage<sup>1</sup> 2 Year $\pm$ (% of reading + % of range), 23 °C $\pm$ 5 °C

Range (rms)	Peak Voltage	Resolution	1 Hz to 40 Hz <sup>2</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>	$\pm$ 105 mV	100 nV	0.1 + 0.04	0.05 + 0.04	0.09 + 0.04	0.5 + 0.08	3 + 0.1
500 mV	$\pm$ 1.05 V	1 $\mu$ V	0.1 + 0.01	0.05 + 0.02	0.09 + 0.02	0.5 + 0.02	3 + 0.05
5 V	$\pm$ 10.5 V	10 $\mu$ V					
50 V	$\pm$ 105 V	100 $\mu$ V					
300 V	$\pm$ 450 V	1 mV					
Tempco/°C (0 °C to 50 °C)			0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.01 + 0.01

<sup>1</sup> After self-calibration. Measurement aperture greater than  $4/f_L$ , where  $f_L$  is the lowest frequency component of the signal being measured.  
<sup>2</sup> Specification applies for DC coupling.  
<sup>†</sup> Applies to signals >2 mV.

### AC Current<sup>1</sup> 2 Year $\pm$ (% of reading + % of range), 0 °C to 50 °C

Range (rms)	Peak Current	Resolution	Burden Voltage (rms)	1 Hz to 20 kHz <sup>2</sup>	Tempco/°C (0 °C to 50 °C)
10 mA <sup>†</sup>	$\pm$ 20 mA	10 nA	<10 mV	0.04 + 0.02	0.001 + 0.0001
100 mA	$\pm$ 200 mA	100 nA	<100 mV	0.04 + 0.02	0.001 + 0.0001
1 A	$\pm$ 2 A	1 $\mu$ A	<800 mV	0.1 + 0.02	0.001 + 0.0001

<sup>1</sup> Measurement aperture greater than  $4/f_L$ , where  $f_L$  is the lowest frequency component of the signal being measured.  
<sup>2</sup> Specification is typical for the 5 kHz to 20 kHz frequency range.  
<sup>†</sup> Applies to signals >200  $\mu$ A.



**Note** There is no degradation in accuracy due to crest factor 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 and 10, use the 5 V range.

# AC Functions General Specifications

Input impedance ..... 1 MΩ in parallel with 150 pF

Input coupling ..... AC or DC coupling

Maximum Volt-Hertz product ..... >8 × 10<sup>7</sup> V-Hz

Maximum DC voltage component ..... 250 V

CMRR  
(1 kΩ resistance in LO lead) ..... >70 dB (DC to 60 Hz)

Overrange ..... 105% of range except on 300 V and 1 A ranges

## Frequency and Period<sup>1</sup>

Input Range	Frequency Range	Period Range	Resolution	2 Year Accuracy <sup>2</sup> 0 °C to 50 °C ±% of reading
50 mV to 300 V	1 Hz to 500 kHz	1 s to 2 μs	6½ digits	0.01

<sup>1</sup> 2 second gate time; input signal must be >10% of AC voltage input range.  
<sup>2</sup> 0.0025% of reading typical.

## Isolated Digitizer Specifications

### Acquisition System

Available sample rates .....  $\frac{1.8 \text{ MS/s}}{n}$ ,  
 where  $n = 1, 2, 3, \dots 1.8 \times 10^5$

Variable resolution ..... 10 bits to 23 bits; refer to the *Digitizer Maximum Sampling Rate* graph

Available functions ..... Voltage and current

Voltage ranges ..... ±100 mV to ±300 V  
(DC or AC coupled)

Current ranges ..... 20 mA to 1 A

Maximum record duration ..... 140 s

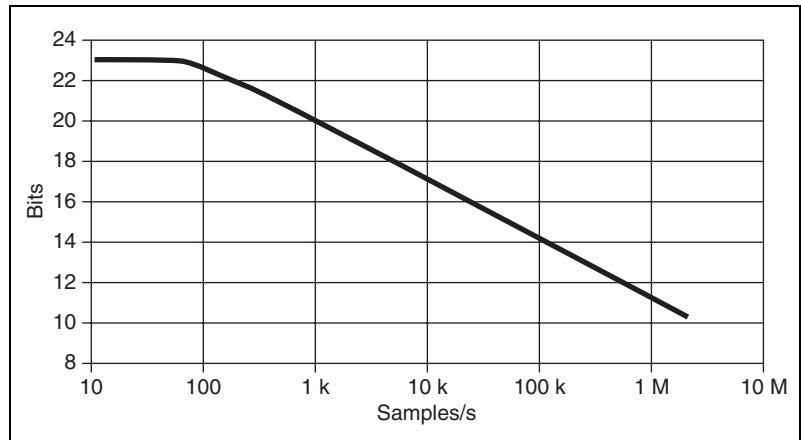
Timebase accuracy ..... 25 ppm

## Trigger

Latency..... 1.8  $\mu$ s

Jitter ..... <600 ns

## Digitizer Maximum Sampling Rate



## Isolated Digitizer Accuracy Specifications



**Note** All digitizer accuracy specifications apply to autozero enabled, DC coupling, after self-calibration, and 1.8 MS/s sampling rate.

### Voltage $\pm$ (ppm of reading + ppm of range)

Range	Input Impedance <sup>1</sup>	2 Year $T_{cal} \pm 5^\circ\text{C}$	Flatness Error <sup>2</sup> 20 kHz	Bandwidth <sup>2,3</sup> (-3 dB)	THD <sup>2</sup> 1 kHz signal, -1 dBfs	THD <sup>2</sup> 20 kHz signal, -1 dBfs	Tempco/ $^\circ\text{C}$ (0 $^\circ\text{C}$ to 50 $^\circ\text{C}$ )
100 mV <sup>†</sup>	>10 G $\Omega$ 1 M $\Omega$	45 + 30	-0.03 dB	300 kHz	-104 dB	-78 dB	4 + 6
1 V	>10 G $\Omega$ 1 M $\Omega$	35 + 6	-0.03 dB	300 kHz	-109 dB	-83 dB	3 + 1
10 V	>10 G $\Omega$ 1 M $\Omega$	30 + 6	-0.03 dB	300 kHz	-96 dB	-70 dB	3 + 1
100 V	1 M $\Omega$	45 + 6	-0.03 dB	300 kHz	-96 dB	-70 dB	7 + 1
300 V	1 M $\Omega$	45 + 30	-0.03 dB	300 kHz	-98 dB	-72 dB	7 + 3

<sup>1</sup> In parallel with 120 pF.

<sup>2</sup> Typical specification.

<sup>3</sup> The AC coupling low frequency (-3 dB) point is 0.8 Hz.

<sup>†</sup> With offset nulling.

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

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

Range	Resolution	Burden Voltage (typical)	2 Year (0 °C to 50 °C)	Flatness Error <sup>1</sup> 20 kHz	Bandwidth <sup>1</sup> (-3 dB)	Tempco/°C (0 °C to 50 °C)
20 mA	10 nA	<20 mV	400 + 75	±0.01 dB	430 kHz	8 + 1
200 mA	100 nA	<200 mV	400 + 20	±0.01 dB	430 kHz	8 + 0.2
1 A	1 µA	<800 mV	500 + 20	±0.01 dB	400 kHz	8 + 0.4

<sup>1</sup> Typical specification.

## General Specifications

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

### Input protection

Resistance, diode .....Up to 300 V DC  
 DC V, AC V .....Up to 300 V DC, 300 V AC<sub>rms</sub>, 450 V AC peak  
 DC I and AC I.....1.25 A, 250 V fast-acting user replaceable fuse

Maximum common-mode voltage.....300 V

Input terminals .....Gold-plated low-thermal EMF solid copper

Measurement complete trigger pulse width.....3 µs

Input trigger pulse width.....1 µs, with <2 m cable

External calibration interval .....2 year recommended

### Power consumption

NI PXI-4070 .....<12 W from PXI backplane  
 NI PCI-4070 .....<12 W from PCI slot



### Operating environment

NI PXI-4070 .....	0 °C to 55 °C, up to 80% RH at 35 °C
NI PCI-4070.....	0 °C to 40 °C, up to 80% RH at 35 °C

Storage environment ..... –40 °C to 70 °C

Warm-up ..... 1 hour to rated accuracy

### Dimensions, weight

NI PXI-4070 .....	10 cm × 16 cm (3.9 in. × 6.33 in.), 340 g (12 oz)
NI PCI-4070.....	12.6 cm × 35.2 cm (4.95 in. × 13.86 in.), 570 g (20 oz)

Installation Category ..... II

Pollution Degree ..... 2



**Caution** The AUX I/O connector and the interdevice connector on the NI PCI-4070 are *not* isolated. These connectors are not referenced to your measurement circuit, but they are referenced to the ground of your computer. The digital signals on these connectors should *not* operate beyond –0.5 to 5.5 V of your computer ground. The trigger signals are TTL-compatible.

## Safety

The NI PXI/PCI-4070 meets the requirements of the following standards for safety and electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 3111-1, UL 61010B-1
- CAN/CSA C22.2 No. 1010.1



**Note** For UL and other safety certifications, refer to the product label, or visit [ni.com/hardref.nsf](http://ni.com/hardref.nsf), 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, you *must* 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/hardref.nsf](http://ni.com/hardref.nsf), search by model number or product line, and click the appropriate link in the Certification column.

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