

NI 4070/4072 Specifications

6½ Digit FlexDMM™ and 1.8 MS/s Isolated Digitizer

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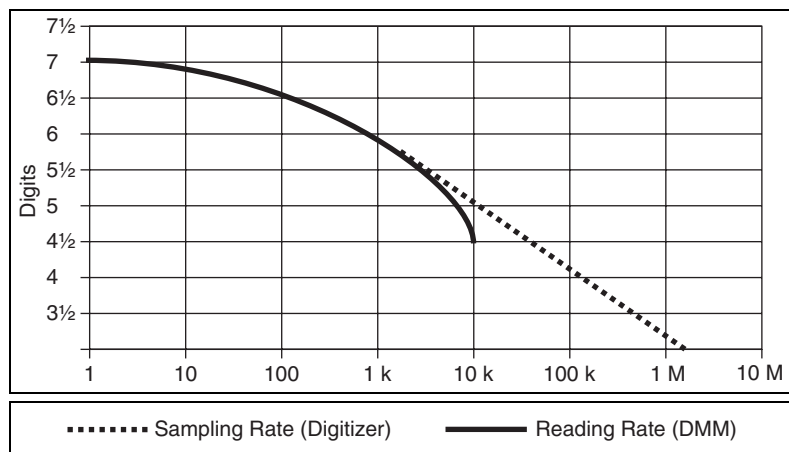
Note All specifications in this document are subject to change without notice.

DC Specifications

Digits	Bits	Max Sampling Rate ¹ (Digitizer)	Reading Rate ² (DMM)
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

¹ Maximum sampling rates refer to waveform acquisition in digitizer mode.
² Auto Zero 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 μ s

Maximum trigger rate 6 kHz

DC Accuracy Specifications



Note All DC accuracy specifications apply to 6½ digit resolution (≥ 1 PLC), Auto Zero and ADC calibration enabled.

DC Voltage \pm (ppm¹ of reading + ppm of range)

Range	Resolution	Input Resistance	24 Hr ² T _{cal} ± 1 °C	90 Day ³ T _{cal} ± 5 °C	2 Year ³ T _{cal} ± 5 °C	Tempco/°C (0 °C to 55 °C)	
						Without Self-Cal	With Self-Cal
100 mV*	100 nV	>10 G Ω , 10 M Ω	10 + 10	30 + 20	40 + 20	4 + 5	0.3 + 0.3
1 V	1 μ V	>10 G Ω , 10 M Ω	6 + 2	20 + 6	25 + 6	2 + 1	0.3 + 0.3
10 V	10 μ V	>10 G Ω , 10 M Ω	4 + 2	20 + 6	25 + 6	1 + 1	0.3 + 0.3
100 V	100 μ V	10 M Ω	6 + 2	30 + 6	35 + 6	4 + 1	0.3 + 0.3
300 V	1 mV	10 M Ω	6 + 6	30 + 20	35 + 20	4 + 3	0.3 + 0.3

¹ 1 ppm (part per million) = 0.0001%.
² Relative to external calibration source.
³ Using internal self-calibration; specifications valid over the entire operating temperature range.
 * With offset nulling and 100 ms aperture.
 T_{cal} = temperature at which last self-calibration or external calibration was performed.
 Tempco = temperature coefficient.

DC Current¹ \pm (ppm of reading + ppm of range)

Range	Resolution	Burden Voltage (typical)	Noise ²	2 Year (0 °C to 55 °C)	Tempco/°C (0 °C to 55 °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 μ A	<800 mV	3	500 + 20	8 + 0.4

¹ Typical 24 hour accuracy (23 °C \pm 1 °C) is \pm (50 ppm of reading + 5 ppm of range).
² In ppm of range rms.
 Tempco = temperature coefficient.

Resistance (4-Wire and 2-Wire¹) ± (ppm of reading + ppm of range)

Range	Resolution	Test Current ²	Max Test Voltage	24 Hr ³ T _{cal} ±1 °C	90 Day ⁴ T _{cal} ±5 °C	2 Year ⁴ T _{cal} ±5 °C	Tempco/°C (0 °C to 55 °C)	
							Without Self-Cal	With Self-Cal
100 Ω [†]	100 μΩ	1 mA	100 mV	15 + 10	50 + 10	80 + 10	8 + 1	0.8 + 1
1 kΩ [†]	1 mΩ	1 mA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
10 kΩ [†]	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 [‡]	100 Ω	1 μA 10 MΩ	10 V	900 + 20	1,800 + 40	2,000 + 40	200 + 10	200 + 10

¹ Perform offset nulling or add 200 mΩ to reading.
² –10% to 0% tolerance.
³ Relative to external calibration source.
⁴ Using internal self-calibration; specifications valid over the entire operating temperature range.
[†] With offset compensated ohms enabled.
[‡] 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_{cal} = temperature at which last self-calibration or external calibration was performed.
Tempco = temperature coefficient.

Diode Test¹

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

¹ Can be used to test p-n junctions, LEDs, or zener diodes up to 10 V.
² –10% to 0% tolerance.
[†] 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
5 digits	30 ppm of range
4½ digits	100 ppm of range

DC Functions General Specifications

Effective Common-Mode Rejection Ratio (CMRR)
 (1 k Ω 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 Ω

Overrange105% 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 [†]	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 S/s	400 Hz to 300 kHz
5½	1 kS/s	20 kHz to 300 kHz

AC System Speeds

Range or function change10/s

Autorange time, AC V and AC I250 ms

Trigger latency2 μ s

Maximum trigger rate1 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 Voltage¹ 2 Year ± (% of reading + % of range), 23 °C ± 10 °C

Range (rms)	Peak Voltage	Resolution	1 Hz to 40 Hz ²	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 + 0.04	0.05 + 0.04	0.09 + 0.04	0.5 + 0.08	3 + 0.1
500 mV	±1.05 V	1 µV	0.1 + 0.01	0.05 + 0.02	0.09 + 0.02	0.5 + 0.02	3 + 0.05
5 V	±10.5 V	10 µV					
50 V	±105 V	100 µV					
300 V	±450 V	1 mV					
Tempco/°C (0 °C to 55 °C)			0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.01 + 0.01

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

AC Current¹ 2 Year ± (% of reading + % of range), 0 °C to 55 °C

Range (rms)	Peak Current	Resolution	Burden Voltage (rms)	1 Hz to 20 kHz ²	Tempco/°C (0 °C to 55 °C)
10 mA [†]	±20 mA	10 nA	<10 mV	0.04 + 0.02	0.001 + 0.0001
100 mA	±200 mA	100 nA	<100 mV	0.04 + 0.02	0.001 + 0.0001
1 A	±2 A	1 µA	<800 mV	0.1 + 0.02	0.001 + 0.0001

¹ Measurement aperture greater than $4/f_L$, where f_L is the lowest frequency component of the signal being measured.
² Specification is typical for the 5 kHz to 20 kHz frequency range.
[†] Applies to signals >200 µA.
 Tempco = temperature coefficient.



Note No degradation in accuracy due to crest factor for signals up to the rated peak voltage/current or bandwidth occurs. For high crest factor signals, increase range. For example, for a 500 mV_{rms} 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 $>8 \times 10^7$ 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
300 V, 1 A range

Frequency and Period¹

Input Range	Frequency Range	Period Range	Resolution	2 Year Accuracy ² 0 °C to 55 °C ±% of reading
50 mV to 300 V	1 Hz to 500 kHz	1 s to 2 μs	6½ digits	0.01
¹ 2 second gate time; input signal must be >10% of AC voltage input range. ² 0.0025% of reading typical.				

Capacitance and Inductance Specifications (NI 4072 only)

Capacitance Accuracy Specifications

Capacitance \pm (% of reading + % of range), 23 °C \pm 10 °C

Range	Resolution	2 Year ¹	Tempco/°C (0 °C to 55 °C)	Effective Test Current ²	Effective Frequency ²	Default Model
300 pF	0.05 pF	0.15 + 0.5	0.01 + 0.025	160 nA	3 kHz	Parallel
1 nF	0.1 pF	0.15 + 0.1	0.01 + 0.003	330 nA	3 kHz	Parallel
10 nF	1 pF	0.15 + 0.1	0.01 + 0.001	330 nA	3 kHz	Parallel
100 nF	10 pF	0.15 + 0.1	0.01 + 0.001	3.3 μ A	3 kHz	Parallel
1 μ F	100 pF	0.18 + 0.1	0.01 + 0.001	100 μ A	1 kHz	Series
10 μ F	1 nF	0.18 + 0.1	0.01 + 0.001	1 mA	1 kHz	Series
100 μ F	10 nF	0.18 + 0.1	0.01 + 0.001	1 mA	91 Hz	Series
1,000 μ F	100 nF	0.18 + 0.1	0.01 + 0.001	1 mA	91 Hz	Series
10,000 μ F	1 μ F	0.18 + 0.1	0.01 + 0.001	1 mA	91 Hz	Series

¹ Relative to external calibration source. After lead compensation with <3 meters of coaxial or shielded twisted-pair cabling. Number of averages = 20. Specifications apply to >5% of range and <110% of range, except the 300 pF range which measures down to 0.05 pF.

² Correlated to single-tone test method.

Inductance Accuracy Specifications

Inductance \pm (% of reading + % of range), 23 °C \pm 10 °C

Range	Resolution	2 Year ¹	Tempco/°C (0 °C to 55 °C)	Effective Test Current ²	Effective Frequency ²	Default Model
10 μ H	1 nH	0.5 + 1	0.01 + 0.01	330 μ A	30 kHz	Series
100 μ H	10 nH	0.2 + 0.1	0.01 + 0.01	330 μ A	30 kHz	Series
1 mH	100 nH	0.2 + 0.1	0.01 + 0.001	330 μ A	3 kHz	Series
10 mH [†]	1 μ H	0.15 + 0.1	0.005 + 0.001	3.3 μ A	3 kHz	Series
100 mH [†]	10 μ H	0.15 + 0.1	0.005 + 0.001	33 μ A	273 Hz	Series
1 H [†]	100 μ H	0.18 + 0.1	0.007 + 0.001	3.3 μ A	273 Hz	Series
5 H [†]	1 mH	0.18 + 0.1	0.007 + 0.001	330 nA	273 Hz	Series

¹ Relative to external calibration source. After lead compensation with <3 meters of coaxial or shielded twisted-pair cabling. Number of averages = 20. Specifications apply to <110% of range.

² Correlated to single-tone test method.

[†] Specifications apply to >1% of range.

Capacitance and Inductance General Specifications

Range or function change 10/s

Mode	Ranges	Reading Rate
Capacitance	300 pF, 1 nF, 10 nF, 100 nF, 1 μF, 10 μF	20 S/s
	100 μF, 1000 μF, 10,000 μF	3 S/s
Inductance	10 μH, 100 μH	40 S/s
	1 mH, 10 mH	20 S/s
	100 mH, 1 H, 5 H	3 S/s

Capacitance underrange 5% of range

Inductance overrange 110% of range

Excitation technique¹ Multi-tone, constant current

Measurement technique¹ Measures fundamental and third harmonic of voltage waveform, and calculates inductance or capacitance using FFT peak analysis

Lead compensation OPEN/SHORT

Measurement configuration 2-wire with lead compensation

DC bias (capacitance only) 0.46 V from HI to LO, user selectable (off by default)

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 μs

Maximum record duration 149 s

Record duration n/r , where n = number of samples, r = sampling rate

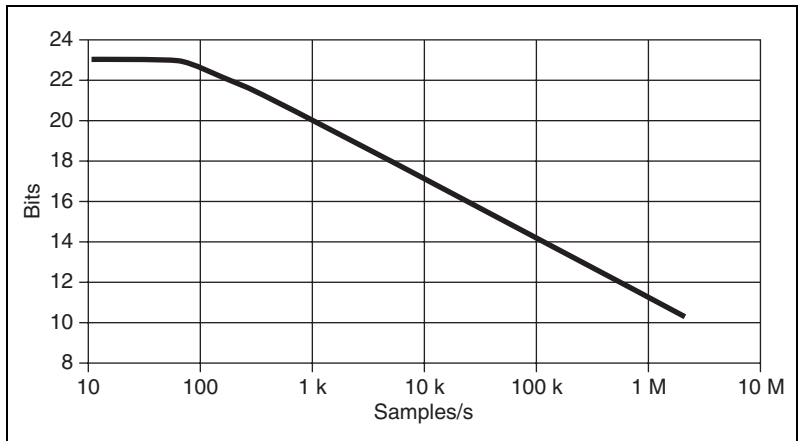
¹ Patents pending.

Variable resolution	10 bits to 23 bits; refer to the <i>Digitizer Maximum Sampling Rate</i> graph
Available functions	Voltage and current
Voltage ranges.....	± 100 mV to ± 300 V (DC or AC coupled)
Current ranges.....	20 mA to 1 A
Timebase accuracy	25 ppm
Input trigger	
Latency.....	1.8 μ s
Jitter	<600 ns



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

Digitizer Maximum Sampling Rate



Isolated Digitizer Accuracy Specifications



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

Voltage ± (ppm of reading + ppm of range)

Range	Input Impedance ¹	2 Year T _{cal} ±5 °C	Flatness Error ² 20 kHz	Bandwidth ^{2,3} (-3 dB)	THD ² 1 kHz signal, -1 dBfs	THD ² 20 kHz signal, -1 dBfs	Tempco/°C (0 °C to 55 °C)
100 mV [†]	>10 GΩ 1 MΩ	45 + 30	-0.03 dB	300 kHz	-104 dB	-78 dB	4 + 6
1 V	>10 GΩ 1 MΩ	35 + 6	-0.03 dB	300 kHz	-109 dB	-83 dB	3 + 1
10 V	>10 GΩ 1 MΩ	30 + 6	-0.03 dB	300 kHz	-96 dB	-70 dB	3 + 1
100 V	1 MΩ	45 + 6	-0.03 dB	300 kHz	-96 dB	-70 dB	7 + 1
300 V	1 MΩ	45 + 30	-0.03 dB	300 kHz	-98 dB	-72 dB	7 + 3

¹ In parallel with 150 pF.
² Typical specification.
³ The AC coupling low frequency (-3 dB) point is 0.8 Hz.
[†] With offset nulling.
T_{cal} = temperature at which last self-calibration or external calibration was performed.
Tempco = temperature coefficient.

Current ± (ppm of reading + ppm of range)

Range	Resolution	Burden Voltage (typical)	2 Year (0 °C to 55 °C)	Flatness Error ¹ 20 kHz	Bandwidth ¹ (-3 dB)	Tempco/°C (0 °C to 55 °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

¹ Typical specification.
Tempco = temperature coefficient.

General Specifications

Self-calibration	Calibrates the FlexDMM relative to high-precision internal voltage and resistance standards. No external calibration equipment required.
External calibration interval	2 year recommended
Input protection	
Resistance, diode	Up to 300 V DC
DC V, AC V	Up to 300 V DC, 300 V AC _{rms} , 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
Triggers	
Measurement complete trigger pulse width	3 μ s
Input trigger pulse width	1 μ s, with <2 m cable



Note Refer to the [Isolated Digitizer Specifications](#) section for additional digitizer specifications.

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.

Power consumption

PXI devices.....<12 W from PXI backplane

PCI devices.....<12 W from PCI slot

Operating environment

PXI devices.....0 °C to 55 °C,
up to 80% relative humidity
at 35 °C

PCI devices.....0 °C to 40 °C,
up to 80% relative humidity
at 35 °C

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

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

Dimensions

PXI devices.....10 cm × 16 cm
(3.9 in. × 6.33 in.)

PCI devices.....12.6 cm × 35.2 cm
(4.95 in. × 13.86 in.)

Weight

PXI devices.....340 g (12 oz)

PCI devices.....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 4070/4072 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 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

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/certification, search by model number or product line, and click the appropriate link in the Certification column.

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