6½-Digit FlexDMM and 1.8 MS/s Isolated Digitizer

NI 4070 FlexDMM

- Superior accuracy and measurement rates
- 12 built-in measurement functions
- 1.8 MS/s isolated waveform acquisition
- 10 to 23-bit flexible resolution
- Built-in self-calibration
- ±300 VDC/V_{rms} isolation
- 420 V_{pk} AC measurements

Models
- NI PXI-4070
- NI PCI-4070

Operating Systems
- Windows 2000/NT/XP

Recommended Software
- LabVIEW™
- LabWindows™/CVI™
- Measurement Studio
- NI Switch Executive

Other Compatible Software
- Visual Studio .NET
- C

Driver Software (included)
- NI-DMM

Calibration Certificate Included

Digits	Resolution (bits)	Max Sampling Rate[1] (DC Voltage and Current)	Reading Rate[2]
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	–

[1]Maximum sample rate refers to waveform acquisition [2]Autozero disabled, except 7 digits, measured on a 10V and 10 kΩ range

Table 1. NI 4070 Key Specifications

Overview

The National Instruments 4070 FlexDMMs are 6½-digit digital multimeters (DMMs) that achieve remarkable throughput rates while maintaining precision and stable measurement accuracy. This combination of speed and accuracy was previously available only with higher resolution DMMs costing thousands of dollars more. With National Instruments proprietary FlexDMM technology, these DMMs also provide a fully isolated, high-voltage digitizer, capable of acquiring waveforms at sampling rates up to 1.8 MS/s at all voltage and current values. Using the analysis functions in LabVIEW, you can analyze these waveforms in both the time and frequency domains. The NI 4070 FlexDMMs have superior speed, accuracy, and functionality, making them an excellent fit for use in automated tests on both the production floor and in an R&D environment.

Unmatched DC Performance

NI 4070 FlexDMMs surpass conventional 6½-digit DMM speed/performance barriers by using a modern architecture that exploits the high-speed PXI bus. At 6½-digits, the FlexDMMs achieve VDC reading rates of 100 S/s. For applications with higher throughput needs, the FlexDMMs have a maximum VDC reading rate of 10 kS/s at 4½-digits. These rates are at least three times faster than the traditional GPIB-controlled DMMs.

With NI LabVIEW and NI-DMM driver software, you can extend the resolution of the FlexDMMs to achieve 7-digit performance at 5 S/s, which is four times the resolution of a traditional 6½-digit DMM.

The superior DC performance of the NI 4070 FlexDMMs is enhanced by their noise-rejection algorithms. The algorithms range from simple power-line noise rejection to rejection of all interference above a specified frequency.

Fast, Accurate AC Measurements

With the NI 4070 FlexDMMs, slow AC measurements are a thing of the past. The FlexDMMs achieve unprecedented AC measurement speeds by solving a traditional analog problem, rms-to-DC conversion, in the digital domain. The FlexDMMs use a digital algorithm that requires only a few cycles of a waveform to compute rms values, which dramatically increases AC reading rates. The algorithm automatically rejects the DC component of the signal, making it possible to offer a DC-coupled AC voltage mode, which completely bypasses the slow-settling input coupling capacitor required with traditional methods. The digital approach to rms computation offers accuracy benefits as well. The algorithm is completely insensitive to crest factor, and can deliver exceptionally quiet and stable readings. The FlexDMMs guarantee AC accuracy down to 1% of full-scale, rather than the 10% of full-scale offered by traditional DMMs, and usable readings are obtainable even below 0.1% of full-scale.

Flexible-Resolution Isolated Digitizer

The architectural design of the NI 4070 FlexDMMs incorporates a 1.8 MS/s isolated digitizer. With the isolated digitizer mode, the FlexDMMs can acquire both AC and DC-coupled waveforms in all voltage and current modes, at a maximum sample rate of 1.8 MS/s.

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6½-Digit FlexDMM and 1.8 MS/s Isolated Digitizer

With the the isolation feature, you can measure differential waveforms with high levels of common-mode voltage. By using LabVIEW software with the isolated digitizer capability of the NI 4070 FlexDMMs, you can analyze transients, fly-back signals, or other a periodic high-voltage AC waveforms in both the time and frequency domain. No other 6½-digit DMM has this capability. You can vary the resolution of the FlexDMMs from 10 to 23 bits by simply changing the sampling rate, as reflected in Figure 1. This unique multi-instrument functionality minimizes overall system cost by eliminating the need to purchase a separate data acquisition device, signal conditioning, fixturing, etc. The FlexDMMs are entirely software programmable and requires no external hardware intervention. Both measurements methods are available through the same input terminals.

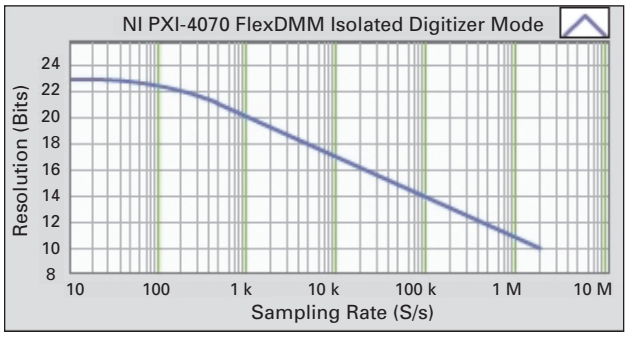

Figure 1. NI 4070 FlexDMMs Resolution Versus Sample Rate

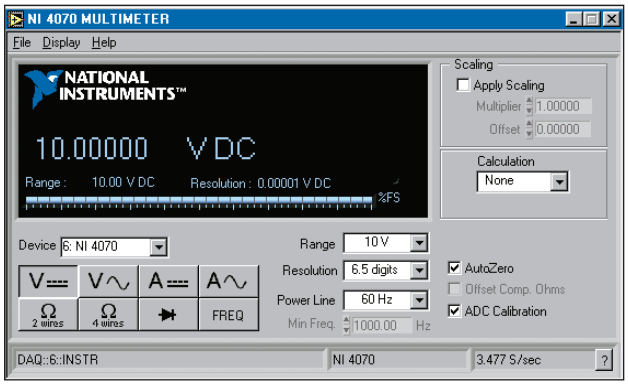

Figure 2. NI-DMM soft front panel

Guaranteed Measurement Integrity

Unlike traditional benchtop 6½-digit DMMs, the NI 4070 FlexDMMs offer self-calibration (Self-Cal), which improves long-term accuracy. Self-Cal compares measurements to onboard, high-precision NIST-traceable standards. This process removes errors due to temperature variation and long-term drift. Self-Cal takes less than a minute and requires no external calibrator. The NI 4070s have a 2-year external calibration cycle, as opposed to the traditional 1-year cycle.

The FlexDMMs provide an offset-compensated ohms (OCO) mode, which eliminates the thermal errors common in low-level resistance measurements.

Tight Switch Integration

The FlexDMMs work well with all multiplexer/matrix switch modules. In particular, the FlexDMM integrates seamlessly with National Instruments switch offerings, such as the NI PXI-2530 multiplexer and the NI SCXI-1129 high-density matrix. When you use a FlexDMM in conjunction with these NI switch modules and NI Switch Executive switch management software, you can measure thousands of channels, consisting of voltages, thermocouples, RTDs, thermistors, and keep a firm control on the cost of your system.

Calibration

Each FlexDMM is shipped with a calibration certificate stating that the instrument was calibrated to NIST-traceable standards to the levels detailed in the specifications. The FlexDMMs can be returned to National Instruments or a qualified metrology lab for calibration.

Software

All National Instruments DMMs are shipped with NI-DMM driver software. NI-DMM is an IVI-compliant driver that provides access to the complete functionality of the DMM through an easy-to-use application programming interface. NI-DMM also includes the DMM Soft Front Panel (SFP), see Figure 2. The DMM SFP is an interactive executable that provides an easy way to test input signals or debug your system. NI-DMM is optimized for use with LabVIEW, LabWindows/CVI, Measurement Studio, and Microsoft Visual Studio .NET.

Ordering Information

NI PXI-4070 778274-01
NI PCI-4070 778275-01
Includes NI-DMM and the DMM Soft Front Panel.

BUY ONLINE!
Visit ni.com/products and enter pxi4070.

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Specifications

Specifications subject to change without notice.
For the most current specifications, visit ***ni.com/modularinstruments***.

DC Functions

Digits	Resolution (bits)	Max Sampling Rate[1] (DC Voltage and Current)	Reading Rate[2]
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	–

[1]Maximum sample rate refers to waveform acquisition [2]Autozero disabled, except 7 digits, measured on a 10V and 10 kΩ range

DC System Speeds

Range or function changes	100 changes/s
Autorange time, VDC and ADC	5 ms
Autorange time, resistance	50 ms
Trigger latency	2 µs
Maximum trigger rate	6 kHz

DC Accuracy Specifications

All DC accuracy specifications apply to 6½-digit resolution (≥1 PLC aperture), autozero and ADC calibration enabled.

DC Voltage ± (ppm[1] 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 Without Self-Cal	Tempco/°C With Self-Cal
100 mV[4]	100 nV	> 10 GΩ,10 MΩ	10 + 10	30 + 20	40 + 20	4 + 5	0.3 + 0.3
1 V	1 µV	> 10 GΩ,10 MΩ	6 + 2	20 + 6	25 + 6	2 + 1	0.3 + 0.3
10 V	10 µV	> 10 GΩ,10 MΩ	4 + 2	20 + 6	25 + 6	1 + 1	0.3 + 0.3
100 V	100 µV	10 MΩ	6 + 2	30 + 6	35 + 6	4 + 1	0.3 + 0.3
300 V	1 mV	10 MΩ	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 [4] With offset nulling and 100 ms aperture T_{cal} = temperature at which last self-calibration or external calibration was performed Tempco = temperature coefficient

DC Current[1] ± (ppm of reading + ppm of range)

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

[1]Typical 24 hour accuracy (23 °C ±1 °C) is ± (50 ppm of reading + 5 ppm of range)

Resistance (4-Wire and 2-Wire[1]) ± (ppm of reading + ppm of range)

Range[1]	Resolution	Test Current[1]	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 Without Self-Cal	Tempco/°C With Self-Cal
100 Ω[5]	100 µΩ	1 mA	100 mV	15 + 10	50 + 10	80 + 10	8 + 1	0.8 + 1
1 kΩ[5]	1 mΩ	1 mA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
10 kΩ[5]	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	12 + 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[6,7]	100 Ω	1µA‖10MΩ	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 [5]With offset compensated ohms
[6] 2-wire ohms measurement only [7] Overrange to >1 GΩ typical accuracy 5% T_{cal} = temperature at which last self-calibration or external calibration was performed

Diode Test[1]

Range	Resolution	Test Current[2]	Accuracy
10 V	10 µV	1 µA, 10 µA, 100 µA, 1 mA3	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 [3] 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	1000 ppm of range

DC Functions – General

Effective CMRR	
(1 kΩ 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 kΩ
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[1]	All noise sources >46 Hz
50 (60)	>60 dB[2]	50 (60) Hz ± 0.1 %

[1] With high-order DC noise rejection, 100 ms aperture
[2] With normal DC noise rejection; 20 ms (16.67 ms) aperture

AC Functions

All speeds are 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 changes	10 changes/s
Autorange time, VAC and AAC	250 ms
Trigger latency	2 µs
Maximum trigger rate	1 kHz

AC Accuracy Specifications

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

AC Voltage[1] 2 Year ± (% of reading + % of range), 23 ±5 °C

Range (rms)	Peak Voltage	Resolution	1 Hz[2]	40 Hz - 20 kHz	20 kHz - 50 kHz	50 kHz - 100 kHz	100 kHz - 300 kHz
50 mV[3]	±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					
5 V	±10.5 V	10 µV	0.1 + 0.01	0.05 + 0.02	0.09 + 0.02	0.5 + 0.02	3 + 0.05
50 V	±105 V	100 µV					
	300 V		±450 V	1 mV			
Tempco/°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/fL, where fL is the lowest frequency component of the signal being measured [2]Specification is typical for the 5 to 20 kHz frequency range [3]Applies to signals >200 µA.

6½-Digit FlexDMM and 1.8 MS/s Isolated Digitizer

Specifications

AC Current[1] 2 Year ± (% of reading + % of range)

Range (rms)	Peak Current	Resolution	Burden Voltage (rms)	1 Hz–20 kHz[2]	Tempco/°C
10 mA[3]	±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/fL, where fL is the lowest frequency component of the signal being measured.
[2]Specification is typical for the 5 kHz–20 kHz frequency range. [3]Applies to signals > 200 µA

Accuracy degradation due to crest factor for signals up to the rated peak voltage/current or bandwidth does not occur. For high crest factor signals, increase range.

Example: For a 500 mV_{rms} signal with a crest factor between 2 and 10, use the 5 V range.

AC Functions – General

Input impedance ..... 1 MΩ in parallel with 120 pF
Input coupling ..... AC or DC coupling
Maximum volt-hertz product ..... >8 x 10^7
Maximum DC voltage component ..... 250 VDC

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[1]

Input Range	Frequency Range	Period Range	Resolution	2 Year Accuracy[1] % 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

Isolated Digitizer Mode

Acquisition System

Available sample rates ..... $\frac{1.8\ MS/s}{n}$,

where n = 1, 2, 3,…1.8 x 10^5
Variable resolution ..... 10 to 23 bits
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 µs
  Jitter ..... <600 ns

Accuracy Specifications

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

DC Voltage ± (ppm[1] 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] 1 kHz Signal, -1 dBfs	Tempco/°C
100 mV[1]	>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 120 pF [2] Typical specification [3] The AC coupling low frequency (-3 dB) point is 0.8 Hz [1] With offset nulling
T_{cal} = temperature at which last self-calibration or external calibration was performed

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

Range	Resolution	Burden Voltage (Typical)	2 Year	Flatness Error[1] 20 kHz	Bandwidth[1] (-3 dB)	Tempco/°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

General

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 VDC
  DC V, ACV ..... Up to 300 VDC, 300 VAC_{rms}, 450 VAC peak
  DC I, 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 cycle ..... 2 year recommended

Power Requirements

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

Physical

Warm-up ..... 1 hour to rated accuracy
Dimensions, weight
  PXI-4070 ..... 10 by 16 cm (3.9 by 6.33 in.)
  PCI-4070 ..... 12.6 by 35.2 cm (4.95 by 13.86 in.)

Environment

Operating temperature
  PXI-4070 ..... 0 to 55 °C
  PCI-4070 ..... 0 to 40 °C
Storage temperature ..... -40 to 70 °C
Relative humidity ..... 0 to 80% noncondensing

Safety

The NI PXI-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 61010-1
  CAN/CSA C22.2 No. 1010.1
Installation Category II
Pollution Degree 2
Electromagnetic Compatibility
Emissions ..... EN 55011 Class A at 10 m
  FCC Part 15A above 1 GHz
Immunity ..... Evaluated to EN 61326:1997 + A2: 2001, Table 1
EMC/EMI ..... CE, C-Tick and FCC Part 15 (Class A) Compliant

Global Services and Support

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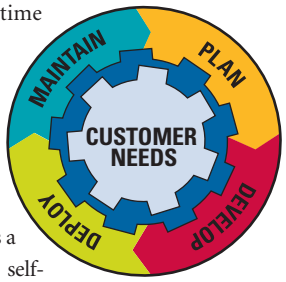

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