

# Keysight Technologies

## M9181A PXI Digital Multimeter

6½ Digit, Basic Features

Data Sheet



# OVERVIEW

## Product Description

The Keysight Technologies, Inc. M9181A PXI digital multimeter provides the most popular measurement functions, including DCV, ACV, DCI, ACI, 2- and 4-wire resistance at 6½ digits of resolution. The M9181A delivers trustworthy measurements at an affordable price.



## Applications

- Aerospace and defense
- Automotive electronics test
- Industrial electronics test

## Features

- 6½ digit resolution
- Up to 150 readings per second at 4½ digits
- Basic 1 year DCV accuracy of 90 ppm
- DCV, ACV, DCI, ACI, 2- and 4-wire resistance
- Floating isolation (CAT II) to 240 V (floating measurement to 240 V maximum)
- Software drivers to support most common programming environments
- PXI form factor
- Chassis connector compatibility: PXI-1 (J-1 only)

## Customer values

- The most common DMM measurements
- Measurements you can trust
- Low cost solution
- Application development in the environment of your choice reduces development time
- Customer supportable calibration procedures and calibration services available from Keysight

## PXI-DMM M918xA Feature Summary

All three products are 6½ digit PXI DMMs that take DCV, ACV, DCI, ACI, 2- and 4-wire resistance measurements.

| DMM    | Description                        | DC basic<br>1 year<br>accuracy | Maximum<br>reading rate<br>at 4½ digits | Other<br>measurements                                                                                                                       | Triggering                                            | DC source                       |
|--------|------------------------------------|--------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|---------------------------------|
| M9181A | Basic features<br>PXI DMM          | 90 ppm                         | 150 rdgs/sec                            | None                                                                                                                                        | Immediate                                             | n/a                             |
| M9182A | High<br>performance<br>PXI DMM     | 40 ppm                         | 4,500 rdgs/sec                          | Temperature,<br>capacitance,<br>frequency, period                                                                                           | Immediate,<br>analog<br>threshold, PXI<br>trigger bus | n/a                             |
| M9183A | Enhanced<br>performance<br>PXI DMM | 40 ppm                         | 15,000 rdgs/sec                         | Offset compensated<br>resistance, temperature,<br>capacitance,<br>frequency, period,<br>pulse width, duty cycle,<br>totalizer/event counter | Immediate,<br>analog<br>threshold, PXI<br>trigger bus | ± 10 V<br>±(1.2 µA to<br>12 mA) |

## EASY SETUP ... TEST ... AND MAINTENANCE

### Hardware platform

#### Compliance

The M9181A 6½ digit, DMM is PXI compliant, using either cPCI (J1) or PXI-1 (J1). The M9181A uses fast data interfaces and can be integrated with other test and automation modules in a PXI, Compact PCI, or Hybrid chassis. The PXI format offers high performance in a small, rugged package. It is ideal for many automated test systems. A wide array of complementary PXI products are currently available. Keysight products include switches, multiplexers, digitizers, waveform generators and local oscillators.

### Software platform

#### IO Libraries

Keysight IO Libraries Suite offers fast and easy instrument connections. IO Libraries Suite 16.1 adds support for PXI, helping you display all of the modules in your system and view information about installed software. In addition, IO Libraries Suite 16.1 and newer versions allow you to more easily find the right driver and start module soft front panels directly with Keysight Connection Expert.

National Instruments IO libraries are also supported and may be used along with Keysight IO libraries.

#### Drivers

Keysight's digital multimeters include software drivers for WindowsXP, Windows Vista and Windows 7. These drivers work in the most popular test and measurement development environments, including LabVIEW, Visual Studio (C, C++, C#, Visual Basic), and MATLAB.

### Easy software integration

Application code examples that demonstrate DMM setup and basic functionality are included for LabVIEW, Visual Basic and C/C++, C#, and MATLAB. These application code examples help you integrate the DMM module into your measurement system.

### Soft front panel

The soft front panel provides easy to use instrument control. Its graphical user interface guides developers through module setup so users can quickly configure the DMM.



Figure 1. M9181A soft front panel

One notable feature of the soft front panel is the Driver Call Log, which allows the user to see the driver calls for each button pushed. The user can incorporate the driver calls into the application program – enabling fast and easy program development.

### Calibration

Each M9181A is factory calibrated and shipped with an ISO-9002, NIST-traceable calibration certificate.

Calibration is required once per year. A calibration procedure allows you to do in-rack calibration using standard calibration sources. Alternatively, Keysight and third party calibration labs offer calibration services for the M9181A DMM.

## TECHNICAL SPECIFICATIONS AND CHARACTERISTICS

| M9181A: Accuracy specifications $\pm$ (% of reading + % of range) <sup>1,2,3</sup> |                     |                                           |                            |
|------------------------------------------------------------------------------------|---------------------|-------------------------------------------|----------------------------|
| Function                                                                           | Range               | Frequency, test current or burden voltage | 1 year<br>23 °C $\pm$ 5 °C |
| DC voltage                                                                         | 200.0000 mV         |                                           | 0.0100 + 0.0018            |
|                                                                                    | 2.000000 V          |                                           | 0.0090 + 0.0005            |
|                                                                                    | 20.00000 V          |                                           | 0.0120 + 0.0015            |
|                                                                                    | 200.0000 V          |                                           | 0.0100 + 0.0005            |
| True RMS, AC voltage <sup>4,5</sup>                                                | 200.0000 mV         | 10 Hz - 20 Hz                             | 3.60 + 0.35                |
|                                                                                    |                     | 20 Hz - 47 Hz                             | 0.50 + 0.35                |
|                                                                                    |                     | 47 Hz - 10 kHz                            | 0.16 + 0.35                |
|                                                                                    |                     | 10 kHz - 50 kHz                           | 0.40 + 0.35                |
|                                                                                    |                     | 50 kHz - 100 kHz                          | 2.20 + 0.50                |
|                                                                                    | 2.000000 V          | 10 Hz - 20 Hz                             | 3.50 + 0.13                |
|                                                                                    |                     | 20 Hz - 47 Hz                             | 0.50 + 0.09                |
|                                                                                    |                     | 47 Hz - 10 kHz                            | 0.08 + 0.06                |
|                                                                                    |                     | 10 kHz - 50 kHz                           | 0.40 + 0.13                |
|                                                                                    |                     | 50 kHz - 100 kHz                          | 2.20 + 0.25                |
|                                                                                    | 20.00000 V          | 10 Hz - 20 Hz                             | 4.50 + 0.18                |
|                                                                                    |                     | 20 Hz - 47 Hz                             | 0.65 + 0.15                |
|                                                                                    |                     | 47 Hz - 10 kHz                            | 0.09 + 0.12                |
|                                                                                    |                     | 10 kHz - 50 kHz                           | 0.30 + 0.18                |
|                                                                                    |                     | 50 kHz - 100 kHz                          | 1.70 + 0.25                |
|                                                                                    | 200.0000 V          | 10 Hz - 20 Hz                             | 3.30 + 0.20                |
|                                                                                    |                     | 20 Hz - 47 Hz                             | 0.70 + 0.18                |
|                                                                                    |                     | 47 Hz - 10 kHz                            | 0.08 + 0.13                |
|                                                                                    |                     | 10 kHz - 50 kHz                           | 0.55 + 0.18                |
|                                                                                    |                     | 50 kHz - 100 kHz                          | 1.80 + 0.25                |
| Resistance <sup>6</sup>                                                            | 200.0000 $\Omega$   | 1 mA                                      | 0.013 + 0.003              |
|                                                                                    | 2.000000 k $\Omega$ | 1 mA                                      | 0.012 + 0.002              |
|                                                                                    | 20.00000 k $\Omega$ | 100 $\mu$ A                               | 0.012 + 0.002              |
|                                                                                    | 200.0000 k $\Omega$ | 10 $\mu$ A                                | 0.020 + 0.003              |
|                                                                                    | 2.000000 M $\Omega$ | 1 $\mu$ A                                 | 0.060 + 0.004              |
|                                                                                    | 20.00000 M $\Omega$ | 100 nA                                    | 0.200 + 0.003              |
| DC Current <sup>7</sup>                                                            | 2.000000 mA         | < 25 mV                                   | 0.050 + 0.050              |
|                                                                                    | 20.00000 mA         | < 250 mV                                  | 0.050 + 0.005              |
|                                                                                    | 200.0000 mA         | < 55 mV                                   | 0.050 + 0.040              |
|                                                                                    | 2.000000 A          | < 520 mV                                  | 0.200 + 0.005              |

1. Specifications are for 1 hour warm up, within 1 hour self-cal, aperture  $\geq$  0.5 sec; null measurement for DCV,  $\Omega$ , DCI.

2. For temperatures outside the range of 23 °C  $\pm$  5 °C, but within 0 to 50 °C, add 0.1  $\times$  accuracy specification per °C.

3. 20% overrange on all ranges.

4. Minimum input specified: 20 mV or 5% of range, whichever is larger.

5. Signal is limited to  $8 \times 10^6$  volt Hz product. For example, at 100 kHz, the highest input is 80 V.

6. Specifications are for 4-wire resistance measurements, for 2-wire, add 1 m $\Omega$ .

7. For 2 mA and 200 mA DCI ranges, resolution is limited to 5½ digits.

### Definitions for specifications

**Specification (spec):** Represents warranted performance of a calibrated instrument that has been stored for a minimum of two hours within the operating temperature range of 0 to 50 °C, unless otherwise stated and after a one hour warm-up period. The specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

**Typical (typ):** Represents characteristic performance, which 80% of the instruments manufactured will meet. This data is not warranted, does not include measurement uncertainty and is valid only at room temperature (approximately 25 °C).

**Nominal (nom):** The expected mean or average performance, or an attribute whose performance is by design, such as the 50  $\Omega$  connector. This data is not warranted and is measured at room temperature (approximately 25 °C).

**Measured (meas):** An attribute measured during the design phase for purposes of communicating expected performance, such as amplitude drift vs. time. This data is not warranted and is measured at room temperature (approximately 25 °C).

## TECHNICAL SPECIFICATIONS AND CHARACTERISTICS continued

| M9181A: Accuracy specifications $\pm$ (% of reading + % of range) <sup>1,2,3</sup> |             |                                           |                            |
|------------------------------------------------------------------------------------|-------------|-------------------------------------------|----------------------------|
| Function                                                                           | Range       | Frequency, test current or burden voltage | 1 year<br>23 °C $\pm$ 5 °C |
| True RMS, AC current <sup>4</sup>                                                  | 2.000000 mA | 10 Hz - 20 Hz                             | 2.90 + 0.20                |
|                                                                                    |             | 20 Hz - 47 Hz                             | 1.00 + 0.20                |
|                                                                                    |             | 47 Hz - 1 kHz                             | 0.12 + 0.20                |
|                                                                                    |             | 1 kHz - 10 kHz                            | 0.22 + 0.20                |
|                                                                                    | 20.00000 mA | 10 Hz - 20 Hz                             | 2.80 + 0.15                |
|                                                                                    |             | 20 Hz - 47 Hz                             | 1.00 + 0.15                |
|                                                                                    |             | 47 Hz - 1 kHz                             | 0.16 + 0.15                |
|                                                                                    |             | 1 kHz - 10 kHz                            | 0.40 + 0.20                |
|                                                                                    | 200.0000 mA | 10 Hz - 20 Hz                             | 2.80 + 0.20                |
|                                                                                    |             | 20 Hz - 47 Hz                             | 1.00 + 0.20                |
|                                                                                    |             | 47 Hz - 1 kHz                             | 0.20 + 0.11                |
|                                                                                    |             | 1 kHz - 10 kHz                            | 0.40 + 0.20                |
|                                                                                    | 2.000000 A  | 10 Hz - 20 Hz                             | 2.70 + 0.25                |
|                                                                                    |             | 20 Hz - 47 Hz                             | 0.90 + 0.30                |
|                                                                                    |             | 47 Hz - 1 kHz                             | 0.35 + 0.20                |
|                                                                                    |             | 1 kHz - 10 kHz                            | 0.50 + 0.25                |

1. Specifications are for 1 hour warm up, within 1 hour self-cal, aperture  $\geq$  0.5 sec; null measurement for DCV,  $\Omega$ , DCI.

2. For temperatures outside the range of 23 °C  $\pm$  5 °C, but within 0 to 50 °C, add 0.1  $\times$  accuracy specification per °C.

3. 20% overrange on all ranges.

4. Minimum input specified: 0.2 mA or 5% of range, whichever is greater.

## MEASUREMENT CHARACTERISTICS

| Environmental and physical characteristics |                                                                                  |                                                                                              |
|--------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Temperature range                          | Operating -10° to 55 °C<br>Non-operating -40 ° to +85 °C                         |                                                                                              |
| Relative humidity                          | Operating to 80% at 40 °C<br>Storage to 95% at 40 °C                             |                                                                                              |
| Connectors                                 | V HI, 2-wire Ω IN<br>V LO, 2-wire Ω IN<br>I HI, 4-wire Ω IN<br>I LO, 4-wire Ω IN | Sheathed banana jack<br>Sheathed banana jack<br>Sheathed banana jack<br>Sheathed banana jack |
| Safety                                     | Complies with IEC 61010-1, CAT II 240 V, Pollution degree 2                      |                                                                                              |
| EMC                                        | Complies with EN61326-1 Industrial Environment                                   |                                                                                              |
| Warm-up time                               | 1 hour                                                                           |                                                                                              |
|                                            |                                                                                  |                                                                                              |
| Physical characteristics                   |                                                                                  |                                                                                              |
| Dimensions                                 | 3U/1-slot PXI/CompactPCI standard                                                |                                                                                              |
| Weight                                     | 0.5 kg (1 lb.)                                                                   |                                                                                              |
|                                            |                                                                                  |                                                                                              |
| Power dissipation                          |                                                                                  |                                                                                              |
| +5 V                                       | Total power                                                                      |                                                                                              |
| 300 mA                                     | 1.5 W max                                                                        |                                                                                              |

## MEASUREMENT CHARACTERISTICS continued

| DC voltage                   |                                                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement method           | Delta-Sigma A/D conversion                                                                                                                     |
| Input resistance             | 200 mV, 2.0 V ranges: >10 G $\Omega$ with typical leakage of < 50 pA;<br>20 V, 200 V ranges: 10.0 M $\Omega$                                   |
| Input isolation              | 240 V from earth ground                                                                                                                        |
| Input overvoltage protection | 300 VDC on voltage inputs                                                                                                                      |
| DCV noise rejection          | Normal mode rejection at 50, 60, or 400 Hz $\pm$ 0.5%; > 90 dB (apertures $\geq$ 0.160 s);<br>CMRR (1 k $\Omega$ lead imbalance) $\geq$ 100 dB |

| True RMS AC voltage          |                                                                                                    |
|------------------------------|----------------------------------------------------------------------------------------------------|
| Measurement method           | AC coupled (10 Hz to 100 kHz) true RMS — measures the AC component only<br>Analog RMS DC converter |
| Crest factor                 | Maximum crest factor of 4 at full scale, 7 at 10% of range                                         |
| Input impedance              | 1 M $\Omega$ , in parallel with capacitance of less than 300 pF                                    |
| Settling time                | < 0.5 sec to within 0.1% of final value                                                            |
| Peak input                   | 8 x 10 <sup>6</sup> volt Hz product (example: 80 V @ 100 kHz)                                      |
| Input overvoltage protection | 250 VAC on voltage inputs                                                                          |
| ACV noise rejection          | Common mode rejection at 50 Hz or 60 Hz; 1 k $\Omega$ imbalance in either lead > 60 dB             |

| Resistance                       |                                                                                                                                                                                                              |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement method               | Selectable 2-wire or 4-wire. Current source referenced to LO output                                                                                                                                          |
| Maximum test voltage             | 240 mV for 200 $\Omega$ ranges; 2.4 V for 20 k $\Omega$ to 20 M $\Omega$ ranges                                                                                                                              |
| Maximum lead resistance (4-wire) | 50 k $\Omega$ for 200 k $\Omega$ , 2.0 M $\Omega$ and 20 M $\Omega$ ranges; 5 k $\Omega$ for 20 k $\Omega$ range<br>500 $\Omega$ for 200 $\Omega$ and 2 k $\Omega$ ranges; 50 $\Omega$ for 20 $\Omega$ range |
| Input protection                 | 300 V on all ranges                                                                                                                                                                                          |

| DC current       |                                                                 |
|------------------|-----------------------------------------------------------------|
| Shunt resistance | 10 $\Omega$ for 2 mA and 20 mA, 0.1 $\Omega$ for 200 mA and 2 A |
| Input protection | Protected with 2.5 A, 250 V fast blow fuse                      |

| True RMS AC current |                                                                                              |
|---------------------|----------------------------------------------------------------------------------------------|
| Measurement method  | AC coupled true RMS measurement (measures the AC component only). Analog<br>RMS DC converter |
| Shunt resistance    | 10 $\Omega$ for 2 mA and 20 mA, 0.1 $\Omega$ for 200 mA and 2 A                              |
| Input protection    | Protected with 2.5 A, 250 V fast blow fuse                                                   |

| Sensitivity (typ) |                  |                 |
|-------------------|------------------|-----------------|
| Function          | Lowest range     | Sensitivity     |
| DCV               | 200.0000 mV      | 100 nV          |
| ACV               | 200.0000 mV      | 100 nV          |
| Resistance        | 20.0000 $\Omega$ | 100 $\mu\Omega$ |
| DCI               | 2.000000 mA      | 10 nA           |
| ACI               | 2.000000 mA      | 1 nA            |

| Resolution vs. aperture and reading rate for DCV, DCI, $\Omega$ |                             |                     |
|-----------------------------------------------------------------|-----------------------------|---------------------|
| Measurement aperture                                            | Maximum readings per second | Resolution          |
| 1.28 s                                                          | 0.8                         | 6½ digits (21 bits) |
| 160 ms                                                          | 6                           | 6 digits (20 bits)  |
| 20 ms                                                           | 45                          | 5½ digits (18 bits) |
| 10 ms                                                           | 85                          | 5 digits (17 bits)  |
| 5 ms                                                            | 150                         | 4½ digits (16 bits) |

## CONFIGURATION AND ORDERING INFORMATION

### Hardware<sup>1</sup>

| Model              | Description                                                                                                 |
|--------------------|-------------------------------------------------------------------------------------------------------------|
| M9181A             | PXI 6½ digit multimeter, basic features                                                                     |
| DMM units include: | Getting started guide, software drivers, user and service documentation (on CD ROM), Keysight I/O libraries |

1. The M9181A is intended for use in a PXI chassis.

### Software

| Model                              | Description                                                                                         |
|------------------------------------|-----------------------------------------------------------------------------------------------------|
| Supported operating systems        | Microsoft Windows XP (32-bit), Microsoft Windows Vista (32/64-bit), Microsoft Windows 7 (32/64-bit) |
| Standard compliant drivers         | IVI-C, IVI-COM, LabVIEW                                                                             |
| Supported application environments | Visual Studio (VB.NET, C#, C/C++), LabVIEW, MATLAB                                                  |
| Keysight IO Libraries              | Includes: VISA Libraries, Keysight Connection Expert, IO Monitor                                    |

### Warranty and Calibration

| Advantage Services: Calibration and Warranty                                                   |                                                        |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Keysight Advantage Services is committed to your success throughout your equipment's lifetime. |                                                        |
| Calibration                                                                                    |                                                        |
| R-50C-011-3                                                                                    | Yearly calibration, for 3 years                        |
| R-50C-011-5                                                                                    | Yearly calibration, for 5 years                        |
| Warranty                                                                                       |                                                        |
|                                                                                                | Standard warranty is 3 year                            |
| R-51B-001-3C                                                                                   | 1 year return-to-Keysight warranty extended to 3 years |
| R-51B-001-5C                                                                                   | 1 year return-to-Keysight warranty extended to 5 years |

### Accessories

| Model  | Description   |
|--------|---------------|
| 34138A | Test lead set |

### Related products

| Model  | Description                                                |
|--------|------------------------------------------------------------|
| M9018A | 18-slot PXIe chassis                                       |
| M9021A | PXIe system interface                                      |
| M9101A | PXI high-density multiplexer, 64 channels, reed relays     |
| M9103A | PXI high-density multiplexer, 99 channels, armature relays |
| M9120A | PXI high-density matrix switch, 4x32, armature relays      |
| M9121A | PXI high-density matrix switch, 4x64, reed relays          |
| M9182A | PXI multimeter, 6 ½ digit, high performance                |
| M9183A | PXI multimeter, 6 ½ digit, enhanced performance            |

**myKeysight****myKeysight****[www.keysight.com/find/mykeysight](http://www.keysight.com/find/mykeysight)**

A personalized view into the information most relevant to you.

**[www.pxisa.org](http://www.pxisa.org)****PXI**

PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

**Three-Year Warranty****[www.keysight.com/find/ThreeYearWarranty](http://www.keysight.com/find/ThreeYearWarranty)**

Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

**Keysight Assurance Plans****[www.keysight.com/find/AssurancePlans](http://www.keysight.com/find/AssurancePlans)**

Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

**Keysight Channel Partners****[www.keysight.com/find/channelpartners](http://www.keysight.com/find/channelpartners)**

Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

**[www.keysight.com/find/modular](http://www.keysight.com/find/modular)****[www.keysight.com/find/m9181a](http://www.keysight.com/find/m9181a)****[www.keysight.com/find/pxi-dmm](http://www.keysight.com/find/pxi-dmm)**

For more information on Keysight

Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:

[www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)**Americas**

|               |                  |
|---------------|------------------|
| Canada        | (877) 894 4414   |
| Brazil        | 55 11 3351 7010  |
| Mexico        | 001 800 254 2440 |
| United States | (800) 829 4444   |

**Asia Pacific**

|                    |                |
|--------------------|----------------|
| Australia          | 1 800 629 485  |
| China              | 800 810 0189   |
| Hong Kong          | 800 938 693    |
| India              | 1 800 112 929  |
| Japan              | 0120 (421) 345 |
| Korea              | 080 769 0800   |
| Malaysia           | 1 800 888 848  |
| Singapore          | 1 800 375 8100 |
| Taiwan             | 0800 047 866   |
| Other AP Countries | (65) 6375 8100 |

**Europe & Middle East**

|                |               |
|----------------|---------------|
| Austria        | 0800 001122   |
| Belgium        | 0800 58580    |
| Finland        | 0800 523252   |
| France         | 0805 980333   |
| Germany        | 0800 6270999  |
| Ireland        | 1800 832700   |
| Israel         | 1 809 343051  |
| Italy          | 800 599100    |
| Luxembourg     | +32 800 58580 |
| Netherlands    | 0800 0233200  |
| Russia         | 8800 5009286  |
| Spain          | 0800 000154   |
| Sweden         | 0200 882255   |
| Switzerland    | 0800 805353   |
|                | Opt. 1 (DE)   |
|                | Opt. 2 (FR)   |
|                | Opt. 3 (IT)   |
| United Kingdom | 0800 0260637  |

For other unlisted countries:

[www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

(BP-06-16-14)