

# Agilent 34410A and 34411A Multimeters

## Setting the Standard for Next Generation Benchtop and System Testing

### Product Overview



#### Agilent 34410A 6 $\frac{1}{2}$ -Digit High-Performance DMM

- 10,000 readings/s @ 5  $\frac{1}{2}$ -digits direct to PC
- 1,000 readings/s @ 6  $\frac{1}{2}$ -digits direct to PC
- 30 PPM 1-year Basic DC accuracy
- LAN, USB & GPIB standard
- DCV, ACV, DCI, ACI, 2-wire and 4-wire Resistance, Frequency, Period, Continuity, and Diode Test
- Capacitance & Temperature measurements
- Expanded measurement ranges
- Data logger with 50 k reading non-volatile memory

#### Agilent 34411A 6 $\frac{1}{2}$ -Digit Enhanced-Performance DMM

All the features of the 34410A, plus:

- 50,000 readings/s @ 4  $\frac{1}{2}$ -digits direct to PC
- 1 million volatile reading memory
- Analog level triggering
- Programmable Pre/Post triggering

#### The Best Just Got Better

The Agilent 34410A and 34411A 6 $\frac{1}{2}$ -Digit DMMs represent the latest generation of multimeters from Agilent Technologies. Building on the phenomenal success of the industry-standard Agilent 34401A, these new meters offer improved accuracy, expanded measurement capability, dramatically improved measurement speed and throughput, and modern computer interfaces including LAN and USB. The dual display offers both dual measurement capabilities and ease of use when setting up and configuring the DMM. Improvements have been made in every facet of the 34401A to make the best even better, whether you use it on the bench or in a system.

#### Dramatic Speed Improvements

Whether it's raw reading speed or fast system throughput, the 34410A sets a new benchmark in performance. Using a new A/D technology, the 34410A achieves an impressive 10,000 readings a second at 5 $\frac{1}{2}$ -digits, and can stream readings to your computer at this same speed! Triggering is fast and precise, with both trigger latency and trigger jitter less than 1  $\mu$ s,

while bus query response is less than 500  $\mu$ s. ACV measurements are faster as well thanks to a digital measurement technique that additionally improves accuracy at high and low frequencies. For even greater reading speeds, select the 34411A, which achieves 50,000 readings a second at 4 $\frac{1}{2}$ -digits.

#### Enhanced Measurement Performance

The 34410A and 34411A offer Temperature and Capacitance capabilities, in addition to those measurements you have come to expect, such as DCV, ACV, DCI, ACI, 2-wire and 4-wire Resistance, Frequency, Period, Continuity and Diode Test. You also get Offset Compensated Ohms, allowing you to accurately measure resistance in the presence of voltages. Measurement ranges have been expanded as well; for example, DC and AC Current Ranges now go down to 100  $\mu$ A, resulting in 100 pA resolution. Real-time math and statistics are included, and a peak-detect capability allows you to capture peaks as short as 20  $\mu$ s.



**Agilent Technologies**

### Even Greater Performance with the 34411A

The 34411A has all the features of the 34410A, plus additional performance that makes it even more powerful. With the ability to make 50,000 readings per second at 4½-digits, Analog Level Triggering, programmable Pre- and Post- Trigger and 1 million readings of volatile memory in addition to 50,000 reading of non-volatile memory, you now have the ability to capture low-frequency waveforms, characterize device performance and transfer results for analysis on your computer.

### Data Logger Function

A front panel data logger function allows you to set the meter up to make unattended, paced measurements over a fixed time or number of events, then pull up the results later for review or transfer to a computer for analysis. Set the meter up to take measurements every 10 seconds for an hour, go have lunch, and check the results upon your return. The contextual front panel sequences make setup and read back a breeze.

### Improved Ease of Use

From the inclusion of a second display to configuring setups for each of the measurement functions, these new DMMs offer significant improvements in usability. Simple things are simple; more complicated setups are easier than ever. There is even a new probe set designed to more easily probe today's fine-pitch components. Finally, there is a built-in Graphical Web Interface that allows you to interactively control the DMM without the hassle of programming at all!

### Modern I/O for Improved Connectivity

When connecting to a computer, select LAN, USB or GPIB interfaces; all three are standard on the 34410A and 34411A. Concerned

about the viability of your existing software programs? These new DMMs respond to Standard Commands for Programmable Instrumentation (SCPI), and there is even a 34401A Emulation Mode to ensure the easiest upgrade possible. Agilent's I/O Library Suite ships with the 34410A and 34411A to help you quickly establish an error-free connection between your PC and instrument. It provides robust instrument control and works with the software development environment you choose.

### LXI - Class C

LAN Extensions for Instruments (LXI) provides the next generation I/O for system applications requiring the highest throughput. Transfer rates of over 250,000 readings/s are attainable ensuring even the most data intensive measurements are fast, without the overhead cost of an instrument cardcage. Both the 34410A and the 34411A are LXI - Class C compliant.

### Built To Last

Our new DMMs were designed to high standards of ruggedness and reliability. From the robust package with its shock absorbing bumpers to careful selection of components and conservative circuit design, these meters are built to last. Calculated Mean Time Between Failure (MTBF) is in excess of 100,000 hours. Backed by a 1-year warranty and a worldwide network of service centers, you can buy with confidence.

### Go to the Web

For the latest information on these or other Agilent DMMs, go to [www.agilent.com/find/dmm](http://www.agilent.com/find/dmm)

### Accessories Included:

- Test Lead Kit with probes and SMT attachments.
- Test report, power cord, and USB interface cable.

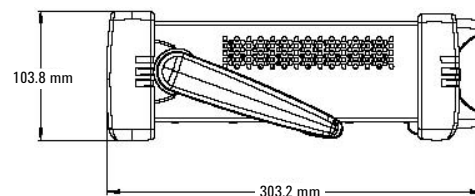
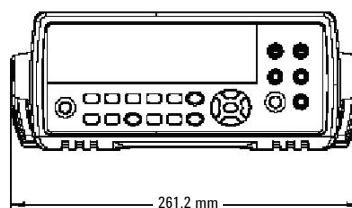
Product Reference CD-ROM with soft documentation and software:

- Programmer's Reference Help
- Quick Start Tutorial
- User's Guide
- Service Guide
- Programming Examples
- IntuiLink for Multimeters
- LabVIEW and IVI-COM drivers

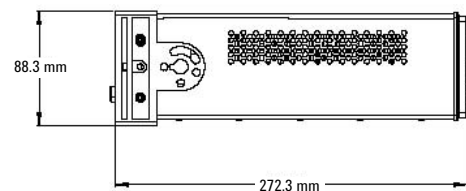
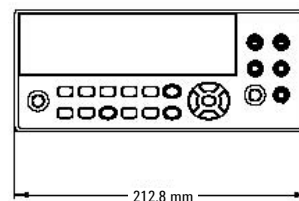
Optional Printed Documentation:

- Quick Start Tutorial
- User's Guide
- Service Guide

### Bench Dimensions:



### System Dimensions:



## Accuracy Specifications ± (% of reading + % of range)<sup>1</sup>

Function	Range <sup>3</sup>	Frequency, Test Current or Burden Voltage	24 Hour <sup>2</sup> Tcal ±1°C	90 Day Tcal ±5°C	1 Year Tcal ±5°C	Temperature Coefficient/°C 0°C to (Tcal -5°C) (Tcal +5°C) to 55°C
<b>DC Voltage</b>	100.0000 mV 1.000000 V <b>10.00000 V</b> 100.0000 V 1000.000 V <sup>4</sup>		0.0030 + 0.0030 0.0020 + 0.0006 <b>0.0015 + 0.0004</b> 0.0020 + 0.0006 0.0020 + 0.0006	0.0040 + 0.0035 0.0030 + 0.0007 <b>0.0020 + 0.0005</b> 0.0035 + 0.0006 0.0035 + 0.0006	0.0050 + 0.0035 0.0035 + 0.0007 <b>0.0030 + 0.0005</b> 0.0040 + 0.0006 0.0040 + 0.0006	0.0005 + 0.0005 0.0005 + 0.0001 <b>0.0005 + 0.0001</b> 0.0005 + 0.0001 0.0005 + 0.0001
<b>True RMS AC Voltage<sup>5</sup></b>	100.0000 mV to 750.000 V	3 Hz – 5 Hz 5 Hz – 10 Hz <b>10 Hz – 20 kHz</b> 20 kHz – 50 kHz 50 kHz – 100 kHz 100 kHz – 300 kHz	0.50 + 0.02 0.10 + 0.02 <b>0.02 + 0.02</b> 0.05 + 0.04 0.20 + 0.08 1.00 + 0.50	0.50 + 0.03 0.10 + 0.03 <b>0.05 + 0.03</b> 0.09 + 0.05 0.30 + 0.08 1.20 + 0.50	0.50 + 0.03 0.10 + 0.03 <b>0.06 + 0.03</b> 0.10 + 0.05 0.40 + 0.08 1.20 + 0.50	0.010 + 0.003 0.008 + 0.003 <b>0.005 + 0.003</b> 0.010 + 0.005 0.020 + 0.008 0.120 + 0.020
<b>Resistance<sup>6</sup></b>	100.0000 Ω 1.000000 kΩ <b>10.00000 kΩ</b> 100.0000 kΩ 1.000000 MΩ 10.00000 MΩ 100.0000 MΩ 1.000000 GΩ	1 mA 1 mA <b>100 μA</b> 10 μA 5 μA 500 nA 500 nA    10 MΩ 500 nA    10 MΩ	0.0030 + 0.0030 0.0020 + 0.0005 <b>0.0020 + 0.0005</b> 0.0020 + 0.0005 0.0020 + 0.0010 0.0100 + 0.0010 0.200 + 0.001 2.000 + 0.001	0.008 + 0.004 0.007 + 0.001 <b>0.007 + 0.001</b> 0.007 + 0.001 0.010 + 0.001 0.030 + 0.001 0.600 + 0.001 6.000 + 0.001	0.010 + 0.004 0.010 + 0.001 <b>0.010 + 0.001</b> 0.010 + 0.001 0.012 + 0.001 0.040 + 0.001 0.800 + 0.001 8.000 + 0.001	0.0006 + 0.0005 0.0006 + 0.0001 <b>0.0006 + 0.0001</b> 0.0006 + 0.0001 0.0010 + 0.0002 0.0030 + 0.0004 0.1000 + 0.0001 1.0000 + 0.0001
<b>DC Current</b>	100.0000 μA <b>1.000000 mA</b> 10.00000 mA 100.0000 mA 1.000000 A 3.000000 A	< 0.03 V <b>&lt; 0.3 V</b> < 0.03 V < 0.3 V < 0.8 V < 2.0 V	0.010 + 0.020 <b>0.007 + 0.006</b> 0.007 + 0.020 0.010 + 0.004 0.050 + 0.006 0.100 + 0.020	0.040 + 0.025 <b>0.030 + 0.006</b> 0.030 + 0.020 0.030 + 0.005 0.080 + 0.010 0.120 + 0.020	0.050 + 0.025 <b>0.050 + 0.006</b> 0.050 + 0.020 0.050 + 0.005 0.100 + 0.010 0.150 + 0.020	0.0020 + 0.0030 <b>0.0020 + 0.0005</b> 0.0020 + 0.0020 0.0020 + 0.0005 0.0050 + 0.0010 0.0050 + 0.0020
<b>True RMS AC Current<sup>7</sup></b>	100.0000 μA to 3.000000 A	<b>3 Hz – 5 kHz</b> 5 kHz – 10 kHz	<b>0.10 + 0.04</b> 0.20 + 0.04	<b>0.10 + 0.04</b> 0.20 + 0.04	<b>0.10 + 0.04</b> 0.20 + 0.04	<b>0.015 + 0.006</b> 0.030 + 0.006
<b>Frequency or Period</b>	100 mV to 750 V	3 Hz – 5 Hz 5 Hz – 10 Hz 10 Hz – 40 Hz <b>40 Hz – 300 kHz</b>	0.070 + 0.000 0.040 + 0.000 0.020 + 0.000 <b>0.005 + 0.000</b>	0.070 + 0.000 0.040 + 0.000 0.020 + 0.000 <b>0.006 + 0.000</b>	0.070 + 0.000 0.040 + 0.000 0.020 + 0.000 <b>0.007 + 0.000</b>	0.005 + 0.000 0.005 + 0.000 0.001 + 0.000 <b>0.001 + 0.000</b>
<b>Capacitance<sup>8</sup></b>	1.0000 nF 10.000 nF 100.00 nF 1.0000 μF 10.000 μF	500 nA 1 μA 10 μA 10 μA 100 μA	0.50 + 0.50 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10	0.50 + 0.50 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10	0.50 + 0.50 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10 0.40 + 0.10	0.05 + 0.05 0.05 + 0.01 0.01 + 0.01 0.01 + 0.01 0.01 + 0.01
<b>Temperature<sup>9</sup></b>						
<b>RTD</b>	-200°C to 600°C		0.06°C	0.06°C	0.06°C	0.003°C
<b>Thermistor</b>	-80°C to 150°C		0.08°C	0.08°C	0.08°C	0.002°C
<b>Continuity</b>	1000.0 Ω	1 mA	0.002 + 0.010	0.008 + 0.020	0.010 + 0.020	0.0010 + 0.0020
<b>Diode Test<sup>10</sup></b>	1.0000 V	1 mA	0.002 + 0.010	0.008 + 0.020	0.010 + 0.020	0.0010 + 0.0020

<sup>1</sup> Specifications are for 90 minute warm-up and 100 PLC..

<sup>2</sup> Relative to calibration standards..

<sup>3</sup> 20% overrange on all ranges, except DCV 1000 V, ACV 750 V, DCI and ACI 3 A ranges.

<sup>4</sup> For each additional volt over ± 500 V add 0.02 mV of error.

<sup>5</sup> Specifications are for sinewave input > 0.3% of range and > 1 mVrms. Add 30 uV error for frequencies below 1 kHz. 750 VAC range limited to 8 x 10<sup>7</sup> Volts-Hz. For each additional volt over 300 Vrms add 0.7 mVrms of error.

<sup>6</sup> Specifications are for 4-wire resistance measurements, or 2-wire using Math Null. Without Math Null, add 0.2 Ω additional error in 2-wire resistance measurements.

<sup>7</sup> Specifications are for sinewave input > 1% of range and > 10 μArms. Frequencies > 5 kHz are typical for 1 A and 3 A ranges.

<sup>8</sup> Specifications are for 1-hour warm-up using Math Null. Additional errors may occur for non-film capacitors.

<sup>9</sup> For total measurement accuracy, add temperature probe error.

<sup>10</sup> Accuracy specifications are for the voltage measured at the input terminals only. 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.

## A-to-D Converter Noise Performance

Integration Time (NPLC)	Resolution (ppm of range) <sup>1</sup>	Normal Mode Rejection (dB) <sup>2</sup>	Readings/Second <sup>4</sup>
0.001 <sup>5</sup>	30	0	50,000
0.002 <sup>5</sup>	15	0	25,000
0.006	6	0	10,000
0.02	3	0	3,000
0.06	1.5	0	1,000
0.2	0.7	0	300
1	0.3	55	60 (50)
2	0.2	110 <sup>3</sup>	30 (25)
10	0.1	110 <sup>3</sup>	6 (5)
100	0.03	110 <sup>3</sup>	0.6 (0.5)

<sup>1</sup> Resolution is defined as the typical DCV 10 V range RMS noise.

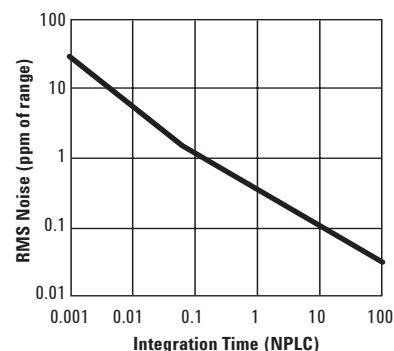
Auto-zero on for NPLC ≥ 1. See manual for additional noise characteristics.

<sup>2</sup> Normal mode rejection for power line frequency ± 0.1%.

<sup>3</sup> For power-line frequency ± 1% 75 dB and for ± 3% 55 dB.

<sup>4</sup> Maximum rate with auto-zero off for 60 Hz and (50 Hz) operation.

<sup>5</sup> Only available for the 34411A.



## System Reading and Throughput Rates

### DMM memory to PC (Maximum reading rate out of memory)<sup>1</sup>

Drawing – Path B

Reading Format	GPIO Readings/s	USB 2.0 Readings/s	LAN (VXI-11) Readings/s	LAN (Sockets) Readings/s
ASCII	4,000	8,500	7,000	8,500
32-bit Binary	89,000	265,000	110,000	270,000
64-bit Binary	47,000	154,000	60,000	160,000

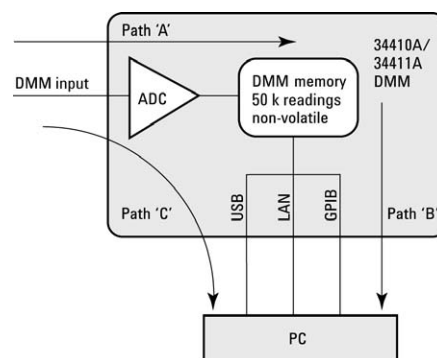
### Direct I/O Measurements (Single reading – measure and I/O time)<sup>1</sup>

Drawing – Path C

Function	Resolution (NPLC)	GPIO ms	USB 2.0 ms	LAN (VXI-11) ms	LAN (Sockets) ms	Maximum Reading Rate into Memory or to Direct I/O (Readings/s) Drawing – Path A or C
DCV/2-wire Resistance	0.006 (0.001)	2.6	2.9	4.6	3.2	10,000 (50,000)
ACV/Frequency	Fast Filter 1 ms Gate	10.0	10.0	10.0	10.0	500

<sup>1</sup> 1/2 scale input signal, immediate trigger, trigger delay 0, auto-zero off, auto-range off, no math, null off, 60 Hz line frequency. Specifications are for 34410A or (34411A). See manual for performance on other functions.

### System Reading Architecture



## System Performance

Function	Function Change (ms) <sup>1</sup>	Range Change (ms) <sup>2</sup> LAN/GPIB	Auto-range (ms) <sup>3</sup>	Maximum External Trigger Rate	Maximum Internal Trigger Rate <sup>4</sup>
DCV/2-wire Resistance	22	3.9/2.6	7.5	5,000/s	10,000/s (50,000/s)
ACV/Frequency	37	6.5/6.4	19	500/s	500/s

<sup>1</sup> Time to change from 2-wire Resistance to this specified function, or DCV to 2-wire Resistance using the SCPI "FUNC" command.

<sup>2</sup> Time to change from one range to the next higher range, ≤ 10 V, ≤ 10 MΩ.

<sup>3</sup> Time to automatically change one range and be ready for the new measurement, ≤ 10 V, ≤ 10 MΩ.

<sup>4</sup> Specifications are for 34410A or (34411A).

# Measurement Characteristics

## DC Voltage

**Measurement Method:**

Continuously integrating multi-slope IV A/D converter

**Linearity:** 0.0002% of reading  
(10 V range) + 0.0001% of range

**Input Resistance:**

0.1 V, 1 V, 10 V 10 M $\Omega$  or > 10 G $\Omega$   
Ranges (Selectable)  
100 V, 1000 V 10 M $\Omega$   $\pm$ 1%  
Ranges (Fixed)

**Input Bias Current:** < 50 pA at 25°C

**Input Protection:** 1000 V

**DC CMRR:** 140 dB<sup>1</sup>

## True RMS AC Voltage

**Measurement Method:**

AC-coupled True RMS measurement. Digital sampling with anti-alias filter.

**Crest Factor:**

No additional error for crest factors < 10. Limited by peak input and 300 kHz bandwidth.

**Peak Input:**

300% of range or 1100 V

**Overload Ranging:**

Will select higher range if peak input overload is detected during auto range. Overload is reported in manual ranging.

**AC CMR:** 70 dB<sup>2</sup>

**Maximum Input:** 400 Vdc, 1100 Vpk

**Input Impedance:**

1 M $\Omega$   $\pm$  2% in parallel with < 150 pF

**Input Protection:** 750 Vrms all ranges

## Resistance

**Measurement Method:**

Selectable 2-wire or 4-wire. Current source referenced to LO input.

**Offset Compensation:**

Selectable on the 100  $\Omega$ , 1 k $\Omega$ , and 10 k $\Omega$  ranges

**Max. Lead Resistance (4-wire):**

10% of range per lead for 100  $\Omega$ , 1 k $\Omega$ . 1 k $\Omega$  per lead on all other ranges

**Input Protection:**

1000 V on all ranges

## DC Current

**Current Shunt:**

200  $\Omega$  for 100  $\mu$ A, 1 mA  
2  $\Omega$  for 10 mA, 100 mA  
0.1  $\Omega$  for 1 A, 3 A

**Input Protection:** 3 A, 250 V fuse

## True RMS AC Current

**Measurement Method:**

AC-coupled True RMS measurement. Directly coupled to the fuse and shunt. Digital sampling with anti-alias filter.

**Current Shunt:**

200  $\Omega$  for 100  $\mu$ A, 1 mA  
2  $\Omega$  for 10 mA, 100 mA  
0.1  $\Omega$  for 1 A, 3 A

**Maximum Input:**

The peak value of the DC + AC current must be <300% of range. The RMS current must be <3 A including the DC current content.

**Input Protection:** 3 A, 250 V fuse

## Frequency and Period

**Measurement Method:**

Reciprocal-counting technique. AC-coupled input using the AC voltage measurement function.

**Input Impedance:**

1 M $\Omega$   $\pm$  2% in parallel with < 150 pF

**Input Protection:** 750 Vrms all ranges

## Capacitance

**Measurement Method:**

Current input with measurement of resulting ramp.

**Connection Type:** 2-wire

## Temperature

**Thermistor:**

2.2 k $\Omega$ , 5 k $\Omega$ , and 10 k $\Omega$

**RTD:**  $\alpha$  = 0.00385

R<sub>0</sub> from 49  $\Omega$  to 2.1 k $\Omega$

## Continuity/Diode Test

**Response Time:**

300 samples/sec with audible tone

**Continuity Threshold:** Fixed at 10  $\Omega$

## Operating Characteristics

**Maximum readings/second**

	Digits		
Function <sup>3</sup>	4.5	5.5	6.5
DCV	50 k <sup>4</sup>	10 k	1 k
2-wire $\Omega$	50 k <sup>4</sup>	10 k	1 k
DCI	50 k <sup>4</sup>	10 k	1 k
Frequency	500	90	10
Period	500	90	10
Filter setting	fast	med	slow
ACV	500	150	50
ACI	500	150	50

## Additional 34411A Specifications

**Resolution:** See table on page 4

**Overall Bandwidth, DCV & DCI:**

15 kHz typical @ 20  $\mu$ s aperture (-3 dB)

**Triggering:** Pre/Post, Int/Ext, Pos/Neg

**Timebase Resolution:** 19.9524  $\mu$ s 0.01% accuracy

**Trigger Jitter:**

2  $\mu$ s (p-p), 20  $\mu$ s (p-p) when pre-triggered

**Spurious-Free Dynamic Range & Signal to Noise Distortion Ratio**

Function DCV	Range	Spur-Free	SNDR
	1 V	-75 dB	60 dB
	10 V <sup>1</sup>	-70 dB	60 dB
	100 V	-75 dB	60 dB

<sup>1</sup>10 V range: 2 V (p-p) <signal < 16 V (p-p)

## Triggering and Memory

**Reading Hold Sensitivity:** 1% of reading

**Samples per Trigger:**

1 to 50,000 (34410A)

1 to 1,000,000 (34411A)

**Trigger Delay:** 0 to 3600 s (20  $\mu$ s step size)

**External Trigger:**

Programmable edge, Low-power TTL compatible

**Delay:** < 1  $\mu$ s **Max rate:** 5,000/s

**Jitter:** < 1  $\mu$ s **Min Pulswidth:** 1  $\mu$ s

**Voltmeter Complete:** 3 V Logic output, 2  $\mu$ s pulse with programmable edge

**Nonvolatile Memory:** 50,000 readings

**Volatile Memory:**

50,000 readings (34410A)

1,000,000 readings (34411A)

**Sample Timer:**

**Range:** 0 to 3600 s (20  $\mu$ s step sizes)

**Jitter:** < 100 ns

## General Specifications

**Power Supply:**

100 V/120 V/220 V/240 V  $\pm$ 10%

**Power Line Frequency:**

45 Hz to 66 Hz and 360 Hz to 440 Hz, Automatically sensed at power-on

**Power Consumption:** 25 VA peak (16 W average)

**Operating Environment:** Full accuracy for 0°C to 55°C, 80% R.H. at 40°C non-condensing

**Storage Temperature:** -40°C to 70°C

**Weight:** 3.72 kg (8.2 lbs)

**Safety:** IEC 61010-1, EN 61010-1, UL 61010-1, CAN/CSA-C22.2 No. 61010-1, Refer to Declarations of Conformity for current revisions. Measurement CAT II 300 V, CAT I 1000 V. Pollution Degree 2

**EMC:** IEC 61326, EN 61326, CISPR 11, ICES-001, AS/NZS 2064.1, Refer to Declaration of Conformity for current revisions.

**Vibration & Shock:** MIL-T-28800E, Type III, Class 5 (Sine Only)

**LXI Compliance:** LXI Class C, ver. 1.0

**Warranty:** 1 year

<sup>1</sup> For 1 k $\Omega$  unbalanced in LO lead,  $\pm$  500 V peak maximum

<sup>2</sup> For 1 k $\Omega$  unbalanced in LO lead and <60 Hz,  $\pm$  500 V peak maximum

<sup>3</sup> Maximum rate for DCV, DCI, and resistance functions (using zero settling delay, autozero off, manual range)

<sup>4</sup> 34411A only