



# Agilent 34420A NanoVolt/Micro-Ohm Meter

## Data Sheet



- 7½ digits resolution
- 100 pV, 100 nΩ sensitivity
- 1.3 nVrms, 8 nVpp noise performance
- Built-in low noise 2 channel scanner
- Direct SPRT, RTD, Thermistor, and Thermocouple measurements

### Nanovolt Performance at a Microvolt Price

The Agilent Technologies 34420A nanoVolt/micro-Ohm meter is a high-sensitivity multimeter optimized for performing low-level measurements. It combines low-noise voltage measurements with resistance and temperature functions, setting a new standard in low-level flexibility and performance.

### Take the Uncertainty Out of Your Low-Level Measurements

Low-noise input amplifiers and a highly tuned input protection scheme bring reading noise down to 8 nVpp. Combine this with 7½ digits of resolution, selectable analog and digital filtering, 2 ppm basic 24-hour dcV accuracy, and a shielded, copper pin connector and you've got accurate, repeatable measurements you can count on.

### Two Input Channels

An integral two-channel programmable scanner simplifies voltage comparisons. Built-in ratio and difference functions enable automated two channel measurements without the need for an external nanoVolt scanner. Both channels share the same low noise specifications to ensure accurate comparisons.

### Built-In Resistance and Temperature

The 34420A combines its low-noise nano-Volt input circuits with a high-stability current source to provide precise low-level resistance measurements – no more hassling with the cost and complexity of an external current source. Three resistance modes are included:

- Standard
- Low-power
- Voltage-limited for dry-circuit testing

Offset compensation is also provided to minimize thermal EMFs and associated errors.

### SPRT Measurements

Built-in ITS-90 conversion routines accept the calibration coefficients from your SPRT probe for direct temperature measurement and conversion. Thermocouples, thermistors, and RTDs are also supported.

### Unequaled Versatility

The 34420A gives you the versatility to tackle your most challenging tasks, both on the benchtop and in your automated system. Standard features include RS-232 and GPIB interfaces, SCPI and Keithley 181 programming language, 1024-reading memory, scaling and statistics, and a chart recorder analog output.

### Agilent IntuiLink: Easy Data Access

The included Agilent IntuiLink software allows your captured data to be put to work easily, using PC applications such as Microsoft Excel® or Word® to analyze, interpret, display, print, and document the data you get from the 34420A. You can specify the meter setup and take a single reading or log data to the Excel spreadsheet in specified time intervals. To find out more about IntuiLink visit [www.agilent.com/find/intuilink](http://www.agilent.com/find/intuilink)

### Quality You Can Count On

The 34420A gives you the quality and reliability you expect from Agilent Technologies. From the product's proven >150,000 hour Mean Time Between Failure, to its standard 1-year warranty, Agilent stands behind you to bring a new level of confidence to your low-level measurements.

## Specifications

### Accuracy Specifications $\pm$ (% of reading + % of range) <sup>1</sup>

Function	Range <sup>2</sup>	Test Current	24 Hour 23 °C $\pm$ 1 °C	90 Day 23 °C $\pm$ 5 °C	1 Year 23 °C $\pm$ 5 °C	Temperature Coefficient 0 °C—18 °C 28 °C—55 °C	Maximum per Lead Resistance
dc Voltage	1.000000 mV <sup>3</sup>		0.0025 + .0020	0.0040 + .0020	0.0050 + .0020	0.0004 + .0001	
	10.000000 mV <sup>3</sup>		0.0025 + .0002	0.0040 + .0002	0.0050 + .0003	0.0004 + .0001	
	100.000000 mV		0.0015 + .0003	0.0030 + .0004	0.0040 + .0004	0.0004 + .00006	
	1.0000000 V		0.0010 + .0003	0.0025 + .0004	0.0035 + .0004	0.0004 + .00004	
	10.000000 V		0.0002 + .0001	0.0020 + .0004	0.0030 + .0004	0.0001 + .00002	
	100.00000 V <sup>4</sup>		0.0010 + .0004	0.0025 + .0005	0.0035 + .0005	0.0004 + .00005	
Resistance <sup>5</sup>	1.0000000 $\Omega$	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 $\Omega$
	10.000000 $\Omega$	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 $\Omega$
	100.000000 $\Omega$	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	10 $\Omega$
	1.0000000 K $\Omega$	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	100 $\Omega$
	10.000000 K $\Omega$	100 $\mu$ A	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 K $\Omega$
	100.000000 K $\Omega$	10 $\mu$ A	0.0015 + .0003	0.0040 + .0004	0.0060 + .0004	0.0005 + .00002	1 K $\Omega$
1.0000000 M $\Omega$	5 $\mu$ A	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004	0.0006 + .00003	1 K $\Omega$	
Low Power Resistance <sup>5</sup>	1.0000000 $\Omega$	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 $\Omega$
	10.000000 $\Omega$	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 $\Omega$
	100.000000 $\Omega$	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	10 $\Omega$
	1.0000000 K $\Omega$	100 $\mu$ A	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	100 $\Omega$
	10.000000 K $\Omega$	10 $\mu$ A	0.0015 + .0004	0.0040 + .0004	0.0060 + .0004	0.0005 + .00001	1 K $\Omega$
	100.000000 K $\Omega$	5 $\mu$ A	0.0015 + .0012	0.0040 + .0015	0.0060 + .0015	0.0005 + .00003	1 K $\Omega$
1.0000000 M $\Omega$	5 $\mu$ A	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004	0.0006 + .00003	1 K $\Omega$	
Voltage Limited Resistance <sup>5,6</sup>	10.000000 $\Omega$	1 mA	0.0020 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 $\Omega$
	100.000000 $\Omega$	100 $\mu$ A	0.0025 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	5 $\Omega$

Channel 1 / Channel 2 (dcV Ratio) Ratio Error in % = Channel 1 accuracy in % + Channel 2 accuracy in %  
 Channel 1-Channel 2 (dcV Difference) Difference Error = Channel 1 (% of reading + % of range) + Channel 2 (% of reading + % of range)

Temperature	(resolution = 0.001 °C)	
SPRT <sup>7</sup>		SPRT Probe Accuracy + 0.003°C
RTD		RTD Probe Accuracy + 0.05°C
Thermistor		Thermistor Probe Accuracy + 0.1°C
Thermocouple <sup>8</sup>		Thermocouple Probe Accuracy + 0.2°C

### DC Voltage Noise <sup>9</sup>

Range	Observation Period		
	2-Minute RMS Noise	2-Minute Peak-Peak Noise	24-Hour Peak-Peak Noise
1 mV	1.3 nVrms	8 nVpp	12 nVpp
10 mV	1.5 nVrms	10 nVpp	14 nVpp
100 mV	10 nVrms	65 nVpp	80 nVpp
1 V	100 nVrms	650 nVpp	800 nVpp
10 V	450 nVrms	3 $\mu$ Vpp	3.7 $\mu$ Vpp
100 V	11 $\mu$ Vrms	75 $\mu$ Vpp	90 $\mu$ Vpp

### DC Voltage Noise vs Source Resistance <sup>10</sup>

Source Resistance	Noise	Analog Filter	Digital Filter
0 $\Omega$	1.3 nVrms	Off	Med
100 $\Omega$	1.7 nVrms	Off	Med
1k $\Omega$	4 nVrms	Off	Med
10k $\Omega$	13 nVrms	Off	Med
100k $\Omega$	41 nVrms	On	Med
1M $\Omega$	90 nVrms	On	Slow

- Specifications are for Channel 1 or Channel 2, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with FILTERS off. RESISTANCE specifications are for 4-wire Ohms or 2-wire ohms using Null. Without Null, add 0.2 Ohms additional error in 2-wire Ohms function. For Analog Filter ON, add 0.002% of reading.
- 20% overrange on all ranges except 5% on Voltage Limited Resistance.
- After using Math Null. If Null is not used add 100 nanoVolts.
- Channel 1 only.
- Channel 1 only. Resistance measurements, for NPLC <1, add 160  $\mu$  $\Omega$  rms noise.
- Voltage limit can be set to 20 mV (default), 100 mV, or 500 mV. Measured resistance plus Channel 1 HI and LO lead resistance is limited to 10.5  $\Omega$  on the 10  $\Omega$  range and 105  $\Omega$  on the 100  $\Omega$  range.
- For 25  $\Omega$  SPRT with triple-point of water check within the last 4 hours. Without the triple-point of water check, add 0.013°C for 24 hours, add 0.035°C for 90 day, and add 0.055°C for 1 year specifications.
- For fixed reference junction. Add 0.3 $\mu$ C for external reference junction, add 2.0 $\mu$ C for internal reference junction.
- After a 2-hour warm-up,  $\pm$  1 $\mu$ C, 6.5 digits (10 PLC) with Analog Filter Off and Digital Filter Medium (50 reading average). 2-minute rms and 24-hour noise typical. For measurements using 0.02 or 0.2 NPLC, add 800 nV rms noise.
- Typical noise behavior for Ch 1 or Ch 2, after 2 hour warm-up, 6.5 digits (10 PLC), 2 minute observation period on 1 mV range. For peak-to-peak noise, multiply rms noise by 6.

## Measurement Characteristics

<b>DC Voltage</b>	
Measurement Method: Continuously integrating multi-slope III A-D Converter	
A-D Linearity: 0.00008% of reading + 0.00005% of range	
Input Resistance: 100V (Ch1 only): 10 M $\Omega$ +/- 1% 1mV through 10V: > 10 G $\Omega$ , in parallel with < 3.6 nF	
Input Bias Current: <50 pA at 25 °C	
Injected Current: <50 nA pp at 50 or 60 Hz	
Input Protection: 150 V peak any input terminal to Channel 1 LO, continuous	
Channel-to-channel switching error (typical): 3 nV	
Channel Isolation: Isolation between input channels >10 <sup>10</sup> $\Omega$	
Earth Isolation: 350 V peak any input terminal to earth. Impedance from any input terminal to earth is >10 G $\Omega$ and <400 pF	
Maximum Voltage: Channel 1 LO to Channel 2 LO, 150V peak	
<b>Resistance</b>	
Measurement Method: Selectable 4-wire or 2-wire ohms. Current Source referenced to Channel 1 LO input	
Offset Compensation: Used on all ranges except 100 k $\Omega$ and 1 M $\Omega$ . Can be turned off if desired	
Protection: 150 V peak	
Open Circuit Voltage: For Resistance and Low Power Resistance <14 V, 20 mV, 100 mV, 500 mV selectable clamp	
<b>Temperature</b>	
SPRT: ITS-90 calibrated temperature with the range of -190°C to +660°C	
Thermocouple: ITS-90 conversions of Type B, E, J, K, N, R, S, T	
Thermistor: 5 k $\Omega$	
RTD: Type $\alpha = .00385$ and $\alpha = .00392$ . $R_0$ from 4.9 $\Omega$ to 2.1 k $\Omega$ . ITS -90 (IEC-751) Callendar Van Dusen conversion.	
<b>Measurement Noise Rejection 60 (50) Hz<sup>1</sup></b>	
dc CMRR: 140 dB ac CMRR: 70 dB	
<b>Integration Time</b>	<b>Normal Mode Rejection<sup>2</sup></b>
200 plc/3.335 s (4 s)	110 dB <sup>3</sup>
100 plc/1.675 s (2 s)	105 dB <sup>3</sup>
20 plc/334 ms (400 ms)	100 dB <sup>3</sup>
10 plc/167 ms (200 ms)	95 dB <sup>3</sup>
2 plc/33.3 ms (40 ms)	90 dB
1 plc/16.7 ms (20 ms)	60 dB
<1 plc	0

## Operating Characteristics<sup>4</sup>

Function	Digits	Integration Time	Readings/s <sup>5</sup>
dcV Thermocouple	7 $\frac{1}{2}$	200 plc	.15 (.125)
	7 $\frac{1}{2}$	100 plc	.3 (.25)
	6 $\frac{1}{2}$	20 plc	1.5 (1.25)
	6 $\frac{1}{2}$	10 plc	3 (2.5)
	5 $\frac{1}{2}$	1 plc	25 (20.8)
	5 $\frac{1}{2}$	0.2 plc	100 (100)
Resistance dcV1/DCV2 dcV 1-2 RTD Thermistor 0.2 plc	7 $\frac{1}{2}$	200 plc	.075 (.062)
	7 $\frac{1}{2}$	100 plc	.15 (.125)
	6 $\frac{1}{2}$	20 plc	.75 (.625)
	6 $\frac{1}{2}$	10 plc	1.5 (1.25)
	5 $\frac{1}{2}$	1 plc	12.5 (10.4)
	50 (50) 41/2		
0.02 plc	125 (125)		

### System Speeds<sup>5</sup>

Configuration Rates: 26/s to 50/s  
Aurorance Rate (Volts): >30/s  
ASCII reading to RS-232: 55/s  
ASCII reading to GPIB: 250/s  
Max. Internal Trigger Rate: 250/s  
Max. Ext. Trig. Rate to Memory: 250/s

### Triggering and Memory

Reading HOLD Sensitivity:  
10%, 1%, 0.1%, or 0.01% of range  
Samples/Trigger: 1 to 50,000  
Trigger Delay: 0 to 3600 s; 10  $\mu$ s step size  
External Trigger Delay: <1 ms  
External Trigger Jitter: <500  $\mu$ s  
Memory: 1024 readings

### Math Functions

NULL (Channel 1 dcV, Channel 2 dcV,  
Difference, Resistance, Temperature)

STATS (Min, Max, Average, Peak-Peak,  
Standard Deviation, Number of readings)

SCALE (Allows linear scaling as  $y = mx+b$ )

CHART NULL (Establishes zero for rear panel  
output)

### Filter (Analog or Digital or Both)

Analog:  
Low pass 2 pole @ 13Hz, available for dcV  
on

1 mV, 10 mV, 100 mV range

Digital:  
Moving average filter, 10 (fast), 50 (medium),  
or 100 (slow) reading averages.

- For 1 k $\Omega$  unbalanced in LO lead.
- For power line frequency  $\pm$  - 0.1%, Filters OFF. For Digital Filter slow add 20 db, for medium or fast add 10 db for NPLC<sup>3</sup> 1.
- For power line frequency  $\pm$  - 1%, use 80 db, for  $\pm$  - 3% use 60 db.
- Speeds are for delay 0, Display OFF, Filters OFF, Offset Compensation OFF.
- Reading speeds for 60 Hz or (50 Hz), 100 mV through 100 V ranges. 1 mV range 30/s MAX, 10 mV range 170/s MAX, thermocouple 120/s MAX.
- Speeds are for NPLC 0.02, Delay 0, Display OFF, Chart Out OFF.

### Chart Out (Analog Out)

Maximum output:  $\pm$  3V

Resolution: 16 bits

Accuracy:  $\pm$  0.1% of output + 1 mV

Output Resistance: 1 k $\Omega$   $\pm$  5%

Update rate: once per reading

Span and Offset: Adjustable

### Standard Programming Languages

SCPI (IEEE 488.2), Keithley 181

### Accessories Included

4 ft low thermal cable with copper spade lugs,  
Kelvin clip set, 4-wire shorting plug, user's man-  
ual, service manual, test report, contact cleaner,  
and power cord.

### General Specifications

Front Panel Connection:  
Shielded, low thermal, 99% copper contacts.

Power Supply:  
100V/120V/220V(230V)/240V +/- 10%.

Power Line Frequency:  
45 Hz to 66 Hz and 360 Hz to 440 Hz.  
Automatically sensed at power-on.

Power Consumption:  
25VA peak (10W average).

Operating Environment:  
Full accuracy for 0 °C to 55 °C. Full accuracy  
to 80% R.H. up to 30 °C.

Storage Environment:  
-40 °C to 75 °C.

Size: 254.4 mm W x 374.0 mm L x 103.6 mm H  
(10.02" W x 14.72" L x 4.08" H)

Weight: 3 kg (6.5 lbs).

Safety:  
Designed to CSA, UL-1244, IEC-1010.  
RFI and ESD: CISPR 11.

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**Ordering Information**

Includes low thermal input cable (34102A), low thermal shorting plug (34103A), Kelvin clip set (11062A), calibration certificate, power cord. Also includes CD with: IntuiLink software, IVI and VXI PnP drivers, user's guide, service guide, and data sheet.

Options

- 34420A-ABA** English localization
- 34420A-ABD** German localization: translated operating manual
- 34420A-ABF** French localization: translated operating manual
- 34420A-ABJ** Japanese localization: translated operating manual
- 34420A-A6J** ANSI Z540 compliant calibration



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**Accessories**

- 34102A** Low-thermal input cable (four-conductor) with copper spade lugs
- 34103A** Low-thermal shorting plug
- 34104A** Low-thermal input connector
- 34131A** Transit Case
- 34161A** Accessory pouch
- 34190A** Rackmount Kit: designed for use with only one instrument, mounted on either the left or the right side of the rack.
- 34191A** 2U Dual Flange Kit: secures the instrument to the front of the rack. This kit can be used with the 34194A Dual Lock Link Kit to mount two half-width, 2U height instruments side-by-side.
- 34194A** Dual Lock Link Kit: recommended for side-by-side combinations and includes links for instruments of different depths. This kit can be used with the 34191A 2U Dual Flange Kit to mount two half-width, 2U height instruments side-by-side.

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