Agilent 34420A
NanoVolt/Micro-Ohm Meter

Data Sheet

- **7 ½ digits resolution**
- **100pV, 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 nanoVolt 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**

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.

Agilent Technologies

Specifications

Accuracy Specifications ±(% of reading + % of range) [1]

Function	Range[2]	Test Current	24 Hour 23 °C ± 1 °C	90 Day 23 °C ± 5 °C	1 Year 23 °C ± 5 °C	Temperature Coefficient 0 °C—18 °C 28 °C—55 °C	Maximum per Lead Resistance
dc Voltage	1.0000000 mV[3]		0.0025 + .0020	0.0040 + .0020	0.0050 + .0020	0.0004 + .0001	
	10.000000 mV[3]		0.0025 + .0002	0.0040 + .0002	0.0050 + .0003	0.0004 + .0001	
	100.00000 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[4]		0.0010 + .0004	0.0025 + .0005	0.0035 + .0005	0.0004 + .00005	
Resistance [5]	1.0000000 Ω	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 Ω
	10.000000 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 Ω
	100.00000 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	10 Ω
	1.0000000 KΩ	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	100 Ω
	10.000000 KΩ	100 µA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 KΩ
	100.00000 KΩ	10 µA	0.0015 + .0003	0.0040 + .0004	0.0060 + .0004	0.0005 + .00002	1 KΩ
	1.0000000 MΩ	5 µA	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004	0.0006 + .00003	1 KΩ
Low Power Resistance [5]	1.0000000 Ω	10 mA	0.0015 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 Ω
	10.000000 Ω	10 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	1 Ω
	100.00000 Ω	1 mA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	10 Ω
	1.0000000 KΩ	100 µA	0.0015 + .0002	0.0040 + .0002	0.0060 + .0002	0.0005 + .00001	100 Ω
	10.000000 KΩ	10 µA	0.0015 + .0004	0.0040 + .0004	0.0060 + .0004	0.0005 + .00001	1 KΩ
	100.00000 KΩ	5 µA	0.0015 + .0012	0.0040 + .0015	0.0060 + .0015	0.0005 + .00003	1 KΩ
	1.0000000 MΩ	5 µA	0.0020 + .0003	0.0050 + .0004	0.0070 + .0004	0.0006 + .00003	1 KΩ
Voltage Limited Resistance [5, 6]	10.000000 Ω	1 mA	0.0020 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	1 Ω
	100.00000 Ω	100 µA	0.0025 + .0002	0.0050 + .0002	0.0070 + .0002	0.0005 + .00002	5 Ω

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 [7]		SPRT Probe Accuracy + 0.003°C
RTD		RTD Probe Accuracy + 0.05°C
Thermistor		Thermistor Probe Accuracy + 0.1°C
Thermocouple [8]		Thermocouple Probe Accuracy + 0.2°C

DC Voltage Noise [9]

	Observation Period		
Range	**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 µVpp	3.7 µVpp
100 V	11 µVrms	75 µVpp	90 µVpp

DC Voltage Noise vs Source Resistance [10]

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

1 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.
2 20% overrange on all ranges except 5% on Voltage Limited Resistance.
3 After using Math Null. If Null is not used add 100 nanoVolts.
4 Channel 1 only.
5 Channel 1 only. Resistance measurements, for NPLC <1, add 160 µΩ rms noise.
6 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 Ω on the 10 Ω range and 105 Ω on the 100 Ω range.
7 For 25 Ω 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.
8 For fixed reference junction. Add 0.3ûC for external reference junction, add 2.0ûC for internal reference junction.
9 After a 2-hour warm-up, ± 1ûC, 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.
10 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

DC Voltage

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 MΩ +- 1%
1mV through 10V: > 10 GΩ, 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 $>10^{10}$ Ω

Earth Isolation:
350 V peak any input terminal to earth. Impedance from any input terminal to earth is >10 GΩ and <400 pF

Maximum Voltage:
Channel 1 LO to Channel 2 LO, 150V peak

Resistance

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 kΩ and 1 MΩ. 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

Temperature

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 kΩ

RTD: Type α =.00385 and α =.00392. R_0 from 4.9 Ω to 2.1 kΩ. ITS -90 (IEC-751) Callendar Van Dusen conversion.

Measurement Noise Rejection 60 (50) Hz[1]

dc CMRR: 140 dB
ac CMRR: 70 dB

Integration Time	Normal Mode Rejection[2]
200 plc/3.335 s (4 s)	110 dB[3]
100 plc/1.675 s (2 s)	105 dB[3]
20 plc/334 ms (400 ms)	100 dB[3]
10 plc/167 ms (200 ms)	95 dB3
2 plc/33.3 ms (40 ms)	90 dB
1 plc/16.7 ms (20 ms)	60 dB
<1 plc	0

Operating Characteristics[4]

Function	Digits	Integration Time	Readings/s [5]
dcV	7½	200 plc	.15 (.125)
Thermocouple	7½	100 plc	.3 (.25)
	6½	20 plc	1.5 (1.25)
	6½	10 plc	3 (2.5)
	5½	1 plc	25 (20.8)
	5½	0.2 plc	100 (100)
	4½	0.02 plc	250 (250)
Resistance	7½	200 plc	.075 (.062)
dcV1/DCV2	7½	100 plc	.15 (.125)
dcV 1-2	6½	20 plc	.75 (.625)
RTD	6½	10 plc	1.5 (1.25)
Thermistor	5½	1 plc	12.5 (10.4)
0.2 plc	50 (50)		
	41/2		
0.02 plc	125 (125)		

System Speeds[6]

Configuration Rates: 26/s to 50/s
Autorange 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 µs step size
External Trigger Delay: <1 ms
External Trigger Jitter: <500 µs
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.

1 For 1 kΩ unbalanced in LO lead.
2 For power line frequency ± - 0.1%, Filters OFF. For Digital Filter slow add 20 db, for medium or fast add 10 db for NPLC ³ 1.
3 For power line frequency ± - 1%, use 80 db, for ± - 3% use 60 db.
4 Speeds are for delay 0, Display OFF, Filters OFF, Offset Compensation OFF.
5 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.
6 Speeds are for NPLC 0.02, Delay 0, Display OFF, Chart Out OFF.

Chart Out (Analog Out)

Maximum output: ± 3V

Resolution: 16 bits

Accuracy: ± 0.1% of output + 1 mV

Output Resistance: 1 kΩ ± 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 manual, 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

34420A nanoVolt/micro-Ohm meter

Includes low-thermal input cable (34102A), low-thermal shorting plug (34103A), Kelvin clip set (11062A), operating manual, service manual, and quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.

Options

34420A-1CM Rack mount kit (P/N 5062-3972)
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

Accessories

34102A Low-thermal input cable (four-conductor) with copper spade lugs
34103A Low-thermal shorting plug
34104A Low-thermal input connector
34161A Accessory pouch

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