

Agilent 3458A Multimeter

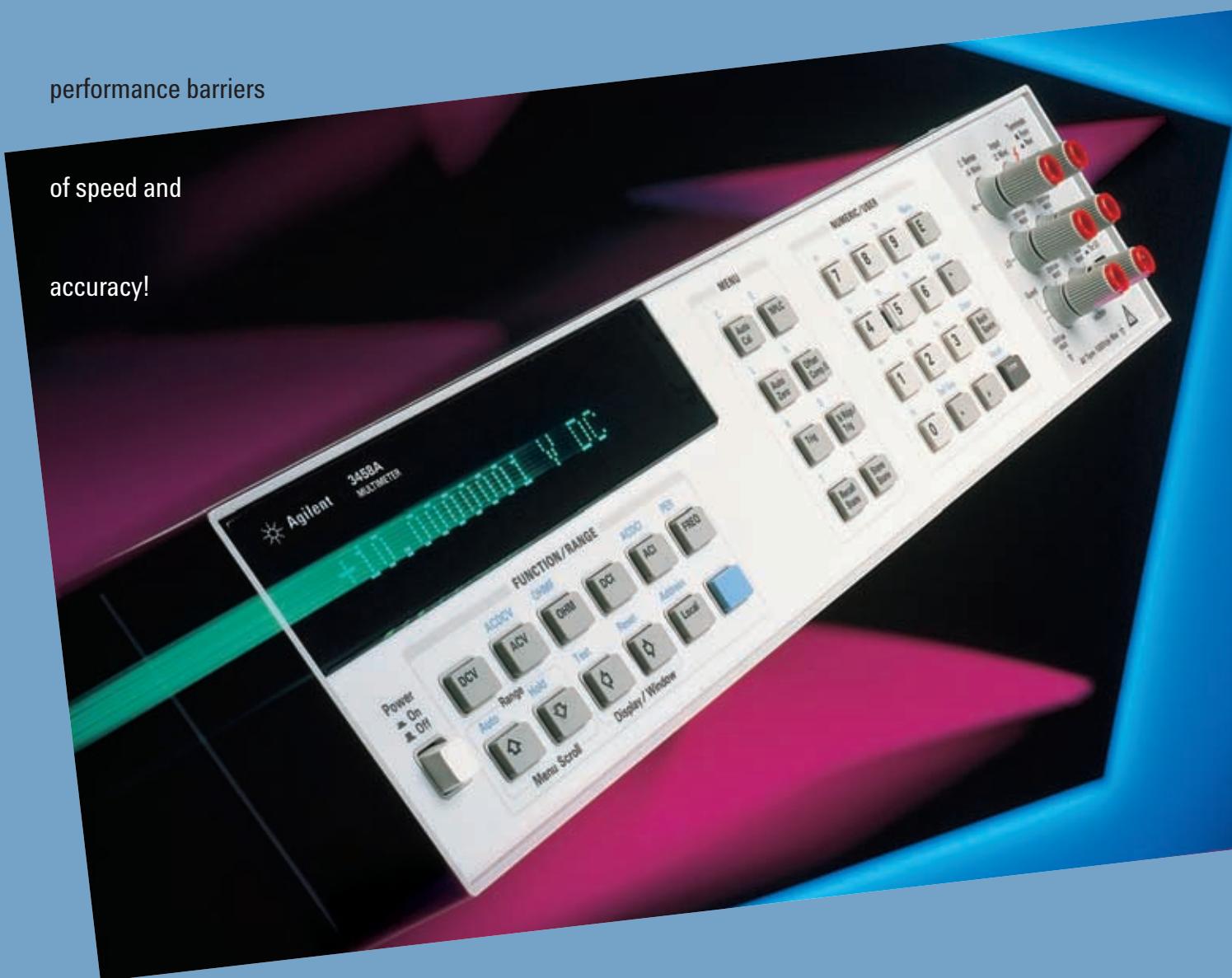
Data Sheet

Shatters

performance barriers

of speed and

accuracy!



Agilent Technologies

Innovating the HP Way

Performance Highlights

dc Volts

- 5 ranges: 0.1 V to 1000 V
- 8.5 to 4.5 digit resolution
- Up to 100,000 readings/sec (4.5 digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24 hour accuracy
- 8 ppm (4 ppm optional) / year voltage reference stability

Ohms

- 9 ranges: 10 Ω to 1 GΩ
- Two-wire and four-wire Ohms with offset compensation
- Up to 50,000 readings/sec (5.5 digits)
- Maximum Sensitivity: 10 μΩ
- 2.2 ppm 24 hour accuracy

ac Volts

- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 50 readings/sec with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

dc Current

- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/sec (5.5 digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24 hour accuracy

ac Current

- 5 ranges: 100 μA to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/sec
- 500 ppm 24 hour accuracy

Frequency and Period

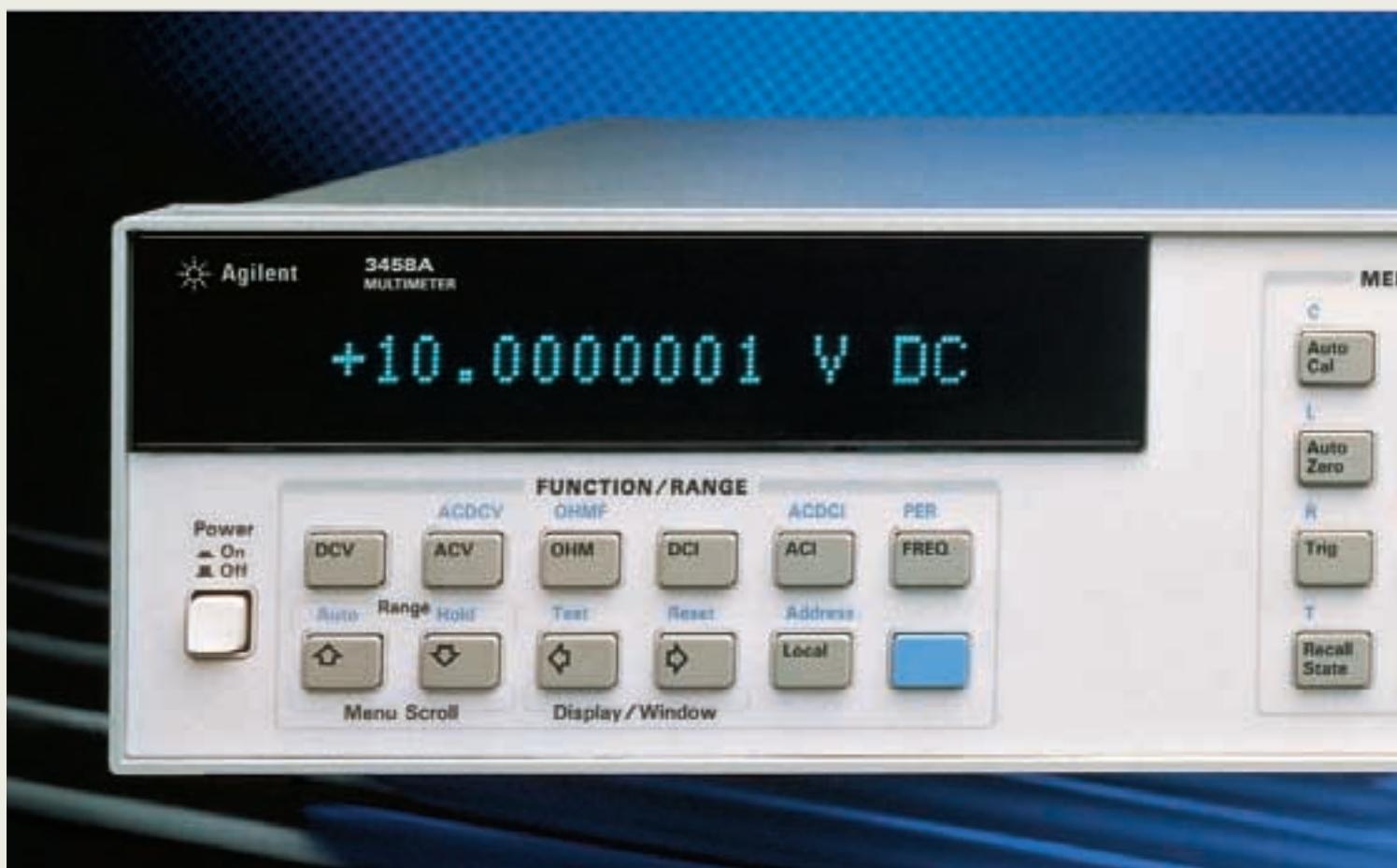
- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 sec
- 0.01% accuracy
- ac or dc coupled

Maximum Speeds

- 100,000 readings/sec at 4.5 digits (16 bits)
- 50,000 readings/sec at 5.5 digits
- 6,000 readings/sec at 6.5 digits
- 60 readings/sec at 7.5 digits
- 6 readings/sec at 8.5 digits

Measurement Set-Up Speed

- 100,000 readings/sec over GPIB* or with internal memory
- 110 autoranges/sec
- 340 function or range changes/sec
- Post-processed math from internal memory



Access speed and accuracy through a powerful, convenient front panel.

Display

- Bright, easy-to-read, vacuum fluorescent display
- 16 character alpha-numeric display to easily read data, messages, and commands

Standard Function/Range Keys

- Simple to use, for bench measurements of dcV, acV, Ohms, current, frequency and period
- Select autorange or manual ranging

Menu Command Keys

- Immediate access to eight common commands
- Shifted keys allow simple access to complete command menu

Numeric/User Keys

- Numeric entry for constants and measurement parameters
- Shifted keys (f0 through f9) access up to ten user-defined setups

Volts/Ohms/Ratio Terminals

- Gold-plated tellurium copper for minimum thermal emf
- 2-wire or 4-wire Ohms measurements
- dc/dc or ac/dc ratio inputs

Current Measurement Terminals

- Easy fuse replacement with fuse holder built into terminal

Guard Terminal and Switch

- For maximum common mode noise rejection

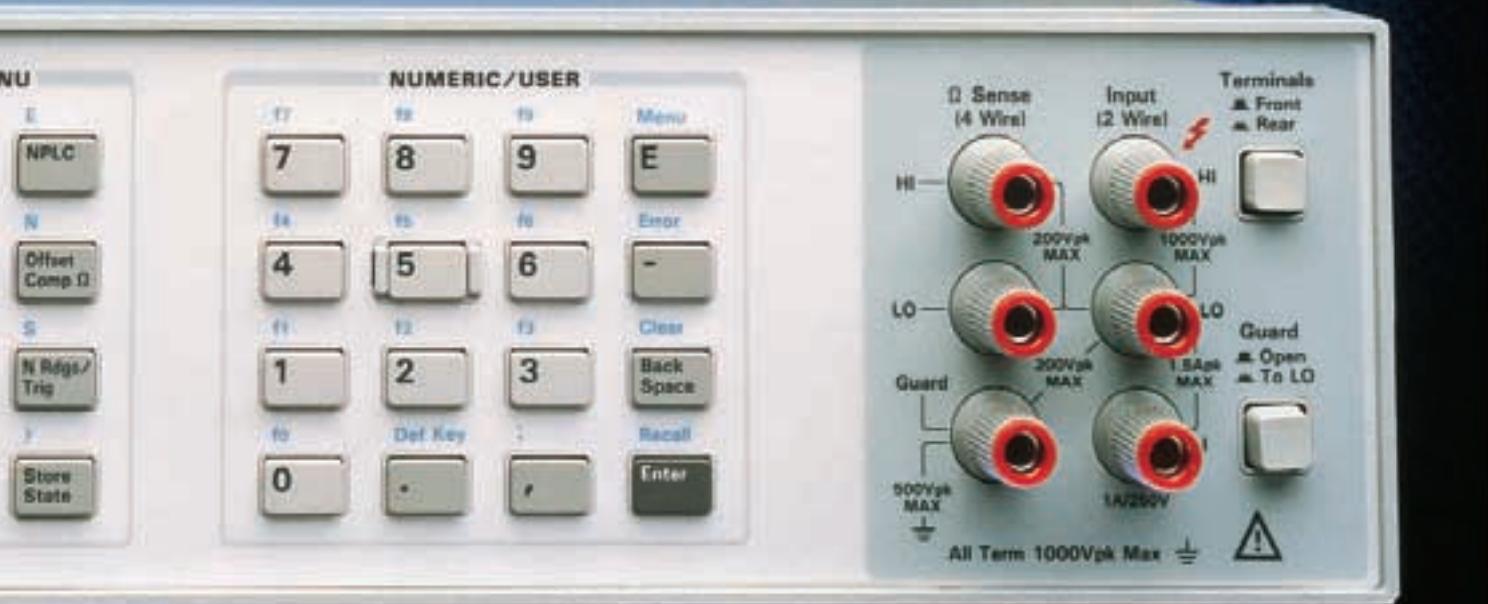
Front-Rear Terminal Switch

- Position selects front or rear measurement terminals

External Output

- Programmable TTL output pulse with 5 modes for flexible system interface
- Defaults to a voltmeter complete pulse

GPIB
Interface
Connector



Finally!

A system multimeter with BOTH high speed and high accuracy.

The Agilent Technologies 3458A Multimeter shatters long-standing performance barriers of speed and accuracy on the production test floor, in R&D, and in the calibration lab. The 3458A is simply the fastest, most flexible, and most accurate multimeter ever offered by Agilent Technologies. In your system or on the bench, the 3458A saves you time and money with unprecedented test system throughput and accuracy, seven function measurement flexibility, and low cost of ownership.

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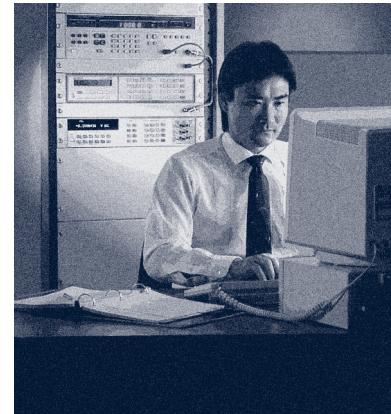
Select a reading rate of 100,000 readings per second for maximal test throughput. Or achieve highest levels of precision with up to 8.5 digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this, programming compatibility through the Agilent Multimeter Language (ML) and the 3458A's simplicity of operation and you have the ideal multimeter for your most demanding applications.

The 3458A Multimeter for:

High test system throughput

Faster testing

- Up to 100,000 readings/sec
- Internal test setups >340/sec
- Programmable integration times from 500 ns to 1 sec



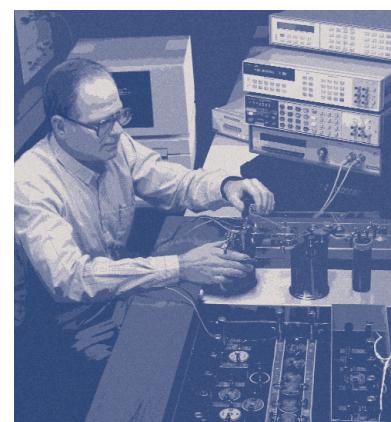
Calibration lab precision

Superb transfer measurements

- 8.5 digits resolution
- 0.1 ppm dc Volts linearity
- 0.1 ppm dc Volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary accuracy

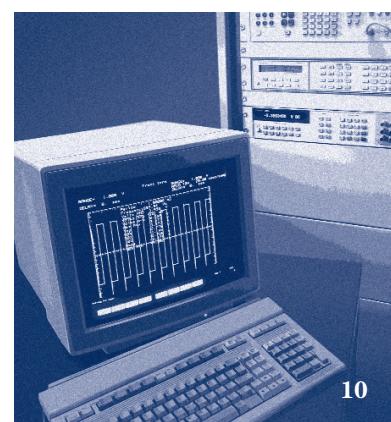
- 0.6 ppm for 24 hours in dc Volts
- 2.2 ppm for 24 hours in Ohms
- 100 ppm mid-band ac Volts
- 8 ppm (4 ppm optional) per year voltage reference stability



High resolution digitizing

Greater waveform resolution and accuracy

- 16 to 24 bits resolution
- 100,000 to 0.2 samples/sec
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory



- **Faster system start-up**

Multimeter Language (ML) compatible

- **Faster measurements and setups**

100,000 readings/sec in 4.5 digits

50,000 readings/sec in 5.5 digits

340 function or range changes/sec

- **Longer system up-time**

For High Test System Throughput

The Agilent 3458A System Multimeter heightens test performance in three phases of your production test: faster test system start-up, faster test throughput, and lower cost of ownership through longer system uptime, designed-in reliability, and fast and easy calibration.

Faster system start-up

The value of a fast system multimeter in production test is clear. But it is also important that the dmm programs easily to reduce the learning time for new system applications. The Agilent Multimeter Language (ML) offers a standard set of commands for the multimeter user that consists of easily understood, readable commands. Easier programming and clearer documentation reduce system development time.

Faster measurements and setups

Now you can have a system dmm with both fast and accurate measurements. The 3458A optimizes your measurements for the right combination of accuracy, resolution, and speed. The 3458A Multimeter fits your needs from 4.5 digit dc Volts measurements at 100,000 per second, to 8.5 digit dc Volts measurements at 6 per second, or anywhere in between in 100 ns steps.

Even the traditionally slower measurement functions, such as ac Volts, are quicker with the 3458A. For example, you can measure true rms acV at up to 50 readings per second with full accuracy for input frequencies greater than 10 kHz.

Besides high reading rates, the 3458A's design was tuned for the many function and level changes required in testing your device. The 3458A can change function and range, take a measurement, and output the result at 340 per second. This is at least 5 times faster than other dmms. In addition, the 3458A transfers high speed measurement data over GPIB or into and out of its 75,000 reading memory at 100,000 readings per second.

You can reduce your data transfer overhead by using the unique non-volatile Program Memory of the 3458A to store complete measurement sequences. These test sequences can be programmed and initiated from the front panel for stand-alone operation without a controller.

Finally, the 3458A Multimeter makes fast and accurate measurements. Consider the 3458A's 0.6 ppm 24 hour dc Volts accuracy, 100 ppm ac Volts accuracy and its standard functions of dcV, acV, dcI, acI, Ohms, frequency and period. Greater measurement accuracy from your dmm means higher confidence and higher test yields. More functions mean greater versatility and lower-cost test systems.

Longer system up-time

The 3458A Multimeter performs a complete self-calibration of all functions, including ac, using high stability internal standards. This self- or auto-calibration eliminates measurement errors due to time drift and temperature changes in your rack or on your bench for superior accuracy. When it's time for periodic calibration to external standards, simply connect a precision 10 Vdc source and a precision 10 kΩ resistor. All ranges and functions, including ac, are automatically calibrated using precision internal ratio transfer measurements relative to the external standards.

The 3458A's reliability is a product of Agilent's "10 X" program of defect reduction. Through extensive environmental, abuse, and stress testing during the design stages of product development, has reduced the number of defects and early failures in its instruments by a factor of ten over the past ten years. Our confidence in the 3458A's reliability is reflected in the low cost of the option for two additional years of return-to-repair. This option (W30), when combined with the standard one-year warranty, will give you three years of worry-free operation.





- 8.5 digits resolution
- 0.1 ppm dcV linearity
- 100 ppm acV absolute accuracy
- 4 ppm/year optional stability

For Calibration Lab Precision

In the calibration lab, you'll find the 3458A's 8.5 digits to have extraordinary linearity, low internal noise, and excellent short term stability. The linearity of the 3458A's Multislope A to D converter has been characterized with state-of-the-art precision. Using Josephsen Junction Array intrinsic standards, linearity has been measured within ± 0.05 ppm of 10 Volts. The 3458A's transfer accuracy for 10 Volts dc is 0.1 ppm over 1 hour $\pm 0.5^\circ\text{C}$. Internal noise has been reduced to less than 0.01 ppm rms yielding 8.5 digits of usable resolution. So, the right choice for your calibration standard dmm is the 3458A.

dcV stability

The long term accuracy of the 3458A is a remarkable 8 ppm per year—more accurate than many system dmms are after only a day. Option 002 gives you a higher stability voltage reference specified to 4 ppm/year for the ultimate performance.

Reduced-error resistance

The 3458A doesn't stop with accurate dcV. Similar measurement accuracy is achieved for resistance, acV, and current. You can measure resistance from $10\ \mu\Omega$ to $1\text{G}\Omega$ with midrange accuracy of 2.2 ppm.

Finally, the 3458A, like its dmm predecessors, offers offset-compensated Ohms on the $10\ \Omega$ to $100\text{k}\Omega$ ranges to eliminate the errors introduced by small

series voltage offsets. Usable for both two- and four-wire ohms, the 3458A supplies a current through the unknown resistance, measures the voltage drop, sets the current to zero, and measures the voltage drop again. The result is reduced error for resistance measurements.

Precision acV

The 3458A introduces new heights of true rms ac volts performance with a choice of traditional analog or a new sampling technique for higher accuracy. For calibration sources and periodic waveforms from 1Hz to 10 MHz, the 3458A's precision sampling technique offers extraordinary accuracy. With 100 ppm absolute accuracy for 45 Hz to 1 kHz or 170 ppm absolute accuracy to 20 kHz, the 3458A will enhance your measurement capabilities. Accuracy is maintained for up to 2 years with only a single 10 Volt dc precision standard. No ac standards are necessary. For higher speed and less accuracy, the analog true rms ac technique has a midband absolute measurement accuracy of 300 ppm using the same simple calibration procedure. With a bandwidth of 10 Hz to 2 MHz and reading rates to 50/second, the analog technique is an excellent choice for high throughput computer-aided testing.

Easy calibration

The 3458A gives you low cost of ownership with a simple, two-source electronic calibration. With its superior linearity, the 3458A is fully calibrated, including ac, from a precision 10 V dc source and a precision $10\text{k}\Omega$ resistor. All ranges and functions are automatically calibrated using precise internal ratio transfer measurements relative to these external standards. In addition, the 3458A's internal voltage standard and resistance standard are calibrated. Now you can perform a self-verifying, self- or auto-calibration relative to the 3458A's low drift internal standards at any time with the ACAL command. So, if your dmm's environment changes, auto-calibration optimizes your measurement accuracy.

Calibration security

Unlike other dmms, the 3458A goes to great lengths to assure calibration security. First, a password security code "locks" calibration values and the self-calibration function. Next, you can easily store and recall a secured message for noting items, such as calibration date and due date. Plus, the 3458A automatically increments a calibration counter each time you "unlock" the dmm—another safeguard against calibration tampering. If you have a unique situation or desire ultimate security, use the internal dmm hardwired switch to force removal of the instrument covers to perform calibration.

- 16 bits at 100,000 samples/sec
- Effective rates to 100 Msamples/sec
- Signal bandwidth of 12 MHz
- 10 ns timing with <100 ps jitter

For High Resolution Digitizing

Easily acquire waveforms

Simple, application-oriented commands in the Agilent Multimeter Language (ML) make the task of waveform digitizing as easy as measuring dcV. Simply specify the sweep rate and number of samples.

Integration or track-and-hold paths

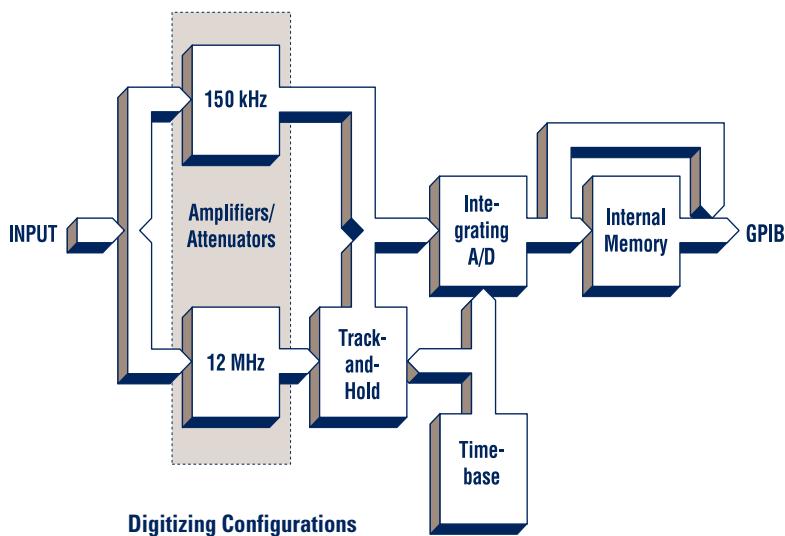
The 3458A gives you the choice of two configurations for high speed measurements: a 150 kHz bandwidth integrating path with a variable aperture from 500ns to 1 second or a 12 MHz bandwidth path with a fixed 2 ns aperture and 16-bit track-and-hold. Use the integration path for lower noise, but use the track-and-hold path to precisely capture the voltage at a single point on a waveform.

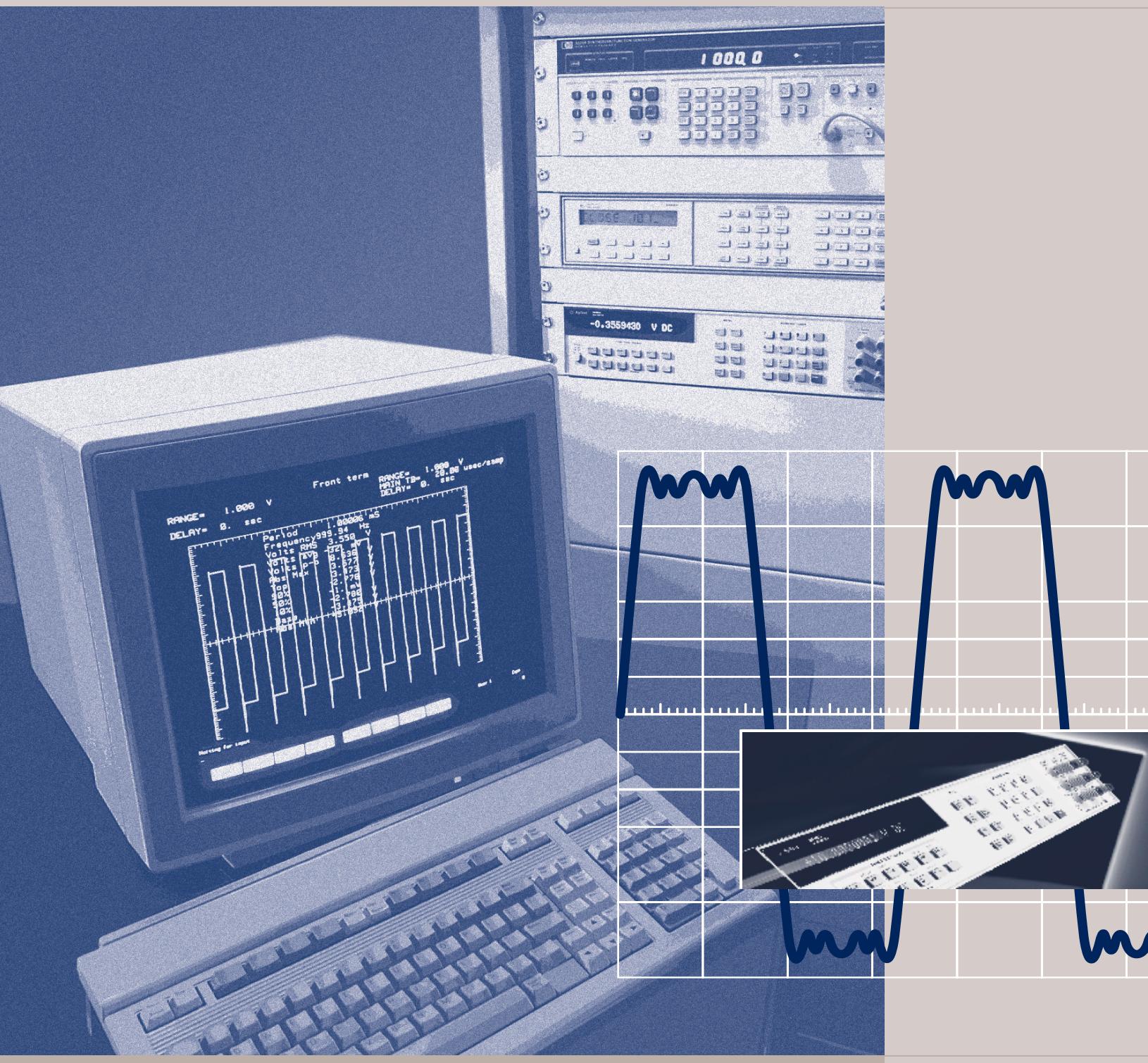
Direct sampling function

The 3458A has two sampling functions for digitizing wave-forms: direct sampling and sequential or sub-sampling. With direct sampling, the 3458A samples through the 12 MHz path followed by the 2 ns track-and-hold providing 16 bits of resolution. The maximum sample rate is 50,000 samples/second or 20 μ s between samples. Samples can be internally paced by a 0.01% accurate timebase with time increments in 100 ns steps. Data transfers directly to your computer at full speed or into the dmm's internal reading memory. Waveform reconstruction consists of simply plotting the digitized voltage readings versus the sampling interval of the timebase.

Sequential sampling function

Sequential or sub-sampling uses the same measurement path as direct sampling; however sequential sampling requires a periodic input signal. The 3458A will synchronize to a trigger point on the waveform set by a level threshold or external trigger. Once synchronized, the dmm automatically acquires the waveform through digitizing successive periods with time increment steps as small as 10 ns, effectively digitizing at rates up to 100 Msamples/second. All you specify is the effective timebase and the number of samples desired, the 3458A automatically optimizes its sampling to acquire the waveform in the least amount of time. Then, for your ease of use, the 3458A automatically re-orders the data in internal memory to reconstruct the waveform.





3458A Technical Specifications

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Introduction

The Agilent 3458A accuracy is specified as a part per million (ppm) of the reading plus a ppm of range for dcV, Ohms, and dcl. In acV and acl, the specification is percent of reading plus percent of range. Range means the name of the scale, e.g. 1 V, 10 V, etc.; range does not mean the full scale reading, e.g. 1.2 V, 12 V, etc. These accuracies are valid for a specific time from the last calibration.

Absolute versus Relative Accuracy

All 3458A accuracy specifications are relative to the calibration standards. Absolute accuracy of the 3458A is determined by adding these relative accuracies to the traceability of your calibration standard. For dcV, 2 ppm is the traceability error from the factory. That means that the absolute error relative to the U.S. National Institute of Standards and Technology (NIST) is 2 ppm in addition to the dcV accuracy specifications. When you recalibrate the 3458A, your actual traceability error will depend upon the errors from your calibration standards. These errors will likely be different from the error of 2ppm.

EXAMPLE 1: Relative Accuracy; 24 hour operating temperature is $T_{cal} \pm 1^\circ C$

Assume that the ambient temperature for the measurement is within $\pm 1^\circ C$ of the temperature of calibration (T_{cal}). The 24 hour accuracy specification for a 10 V dc measurement on the 10 V range is 0.5 ppm + 0.05 ppm. That accuracy specification means:

0.5 ppm of Reading + 0.05 ppm of Range

For relative accuracy, the error associated with the measurement is:

$$(0.5 / 1,000,000 \times 10 V) + (0.05 / 1,000,000 \times 10 V) = \pm 5.5 \mu V \text{ or } 0.55 \text{ ppm of } 10 V$$

Errors from temperature changes

The optimum technical specifications of the 3458A are based on auto-calibration (ACAL) of the instrument within the previous 24 hours and following ambient temperature changes of less than $\pm 1^\circ C$. The 3458A's ACAL capability corrects for measurement errors resulting from the drift of critical components from time and temperature.

The following examples illustrate the error correction of auto-calibration by computing the relative measurement error of the 3458A for various temperature conditions. Constant conditions for each example are:

**10 V DC input
10 V DC range
 $T_{cal} = 23^\circ C$
90 day accuracy specifications**

EXAMPLE 2: Operating temperature is $28^\circ C$; with ACAL

This example shows basic accuracy of the 3458A using auto-calibration with an operating temperature of $28^\circ C$. Results are rounded to 2 digits.

$$\begin{aligned} &(4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) = 42 \mu V \\ &\text{Total relative error} = 42 \mu V \end{aligned}$$

EXAMPLE 3: Operating temperature is $38^\circ C$; without ACAL

The operating temperature of the 3458A is $38^\circ C$, $14^\circ C$ beyond the range of $T_{cal} \pm 1^\circ C$. Additional measurement errors result because of the added temperature coefficient without using ACAL.

$$\begin{aligned} &(4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) = 42 \mu V \\ &\text{Temperature Coefficient (specification is per } ^\circ C\text{:} \\ &(0.5 \text{ ppm} \times 10 \text{ V} + 0.01 \text{ ppm} \times 10 \text{ V}) \times 14^\circ C = 71 \mu V \\ &\text{Total error} = 113 \mu V \end{aligned}$$

EXAMPLE 4: Operating temperature is $38^\circ C$; with ACAL

Assuming the same conditions as Example 3, but using ACAL significantly reduces the error due to temperature difference from calibration temperature. Operating temperature is $10^\circ C$ beyond the standard range of $T_{cal} \pm 5^\circ C$.

$$\begin{aligned} &(4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) = 42 \mu V \\ &\text{Temperature Coefficient (specification is per } ^\circ C\text{:} \\ &(0.15 \text{ ppm} \times 10 \text{ V} + 0.01 \text{ ppm} \times 10 \text{ V}) \times 10^\circ C = 16 \mu V \\ &\text{Total error} = 58 \mu V \end{aligned}$$

Example 5: Absolute Accuracy; 90 Day

Assuming the same conditions as Example 4, but now add the traceability error to establish absolute accuracy.

$$(4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) = 42 \mu V$$

Temperature Coefficient (specification is per $^\circ C$):

$$(0.15 \text{ ppm} \times 10 \text{ V} + 0.01 \text{ ppm} \times 10 \text{ V}) \times 10^\circ C = 16 \mu V$$

factory traceability error of 2 ppm:

$$(2 \text{ ppm} \times 10 \text{ V}) = 20 \mu V$$

$$\text{Total absolute error} = 78 \mu V$$

Additional errors

When the 3458A is operated at power line cycles below 100, additional errors due to noise and gain become significant. Example 6 illustrates the error correction at 0.1 PLC.

Example 6: Operating temperature is $28^\circ C$; 0.1 PLC

Assuming the same conditions as Example 2, but now add additional error.

$$(4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) = 42 \mu V$$

Referring to the Additional Errors chart and RMS Noise Multiplier table, additional error at 0.1 PLC is:

$$\begin{aligned} &(2 \text{ ppm} \times 10 \text{ V}) + (0.4 \text{ ppm} \times 1 \times 3 \times 10 \text{ V}) = 32 \mu V \\ &\text{Total relative error} = 74 \mu V \end{aligned}$$

DC Voltage

Range	Full Scale	Maximum Resolution	Input Impedance	Temperature Coefficient (ppm of Reading + ppm of Range) / °C	
				Without ACAL ¹	With ACAL ²
100 mV	120.00000	10 nV	> 10 GΩ	1.2 + 1	0.15 + 1
1 V	1.2000000	10 nV	> 10 GΩ	1.2 + 0.1	0.15 + 0.1
10 V	12.000000	100 nV	> 10 GΩ	0.5 + 0.01	0.15 + 0.01
100 V	120.00000	1 μV	10 MΩ ± 1%	2 + 0.4	0.15 + 0.1
1000 V	1050.00000	10 μV	10 MΩ ± 1%	2 + 0.04	0.15 + 0.01

Accuracy³ [ppm of Reading (ppm of Reading for Option 002) + ppm of Range]

Range	24 Hour ⁴	90 Day ⁵	1 Year ⁵	2 Year ⁵
100 mV	2.5 + 3	5.0 (3.5) + 3	9 (5) + 3	14 (10) + 3
1 V	1.5 + 0.3	4.6 (3.1) + 0.3	8 (4) + 0.3	14 (10) + 0.3
10 V	0.5 + 0.05	4.1 (2.6) + 0.05	8 (4) + 0.05	14 (10) + 0.05
100 V	2.5 + 0.3	6.0 (4.5) + 0.3	10 (6) + 0.3	14 (10) + 0.3
1000 V ⁶	2.5 + 0.1	6.0 (4.5) + 0.1	10 (6) + 0.1	14 (10) + 0.1

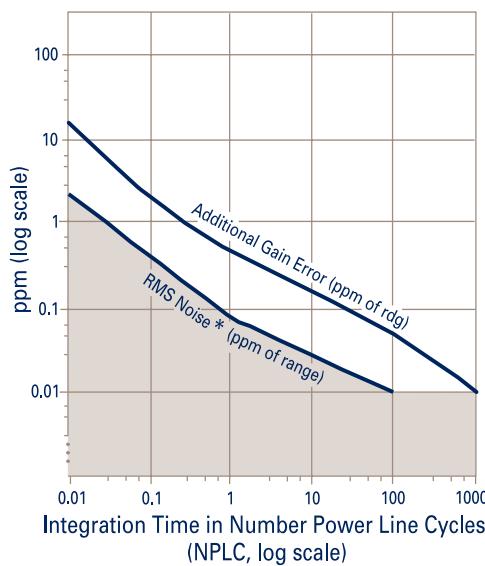
Transfer Accuracy/Linearity

Range	10 Min, Tref ± 0.5°C (ppm of Reading + ppm of Range)	Conditions
100 mV	0.5 + 0.5	
1 V	0.3 + 0.1	
10 V	0.05 + 0.05	
100 V	0.5 + 0.1	
1000 V	1.5 + 0.05	<ul style="list-style-type: none"> Following 4 hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range (> 4 min.) using accepted metrology practices.

Settling Characteristics

For first reading or range change error, add 0.0001% of input voltage step additional error.

Reading settling times are affected by source impedance and cable dielectric absorption characteristics.

Additional Errors**Noise Rejection (dB)⁷**

	AC NMR ⁸	AC ECMR	DC ECMR
NPLC < 1	0	90	140
NPLC ≥ 1	60	150	140
NPLC ≥ 10	60	150	140
NPLC ≥ 100	60	160	140
NPLC = 1000	75	170	140

***RMS Noise**

Range	Multiplier
0.1V	x20
1V	x2
10V	x1
100V	x2
1000V	x1

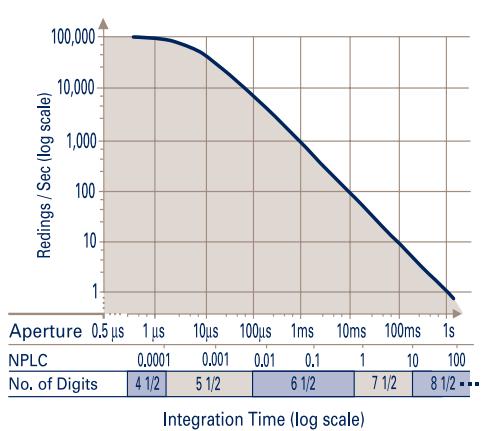
For RMS noise error, multiply RMS noise result from graph by multiplier in chart.
For peak noise error, multiply RMS noise error by 3.

⁷ Applies for 1 kΩ unbalance in the LO lead and ± 0.1% of the line frequency currently set for LFREQ.

⁸ For line frequency ± 1%, ACNMR is 40 dB for NPLC ≥ 1, or 55 dB for NPLC ≥ 100. For line frequency ± 5%, ACNMR is 30 dB for NPLC ≥ 100.

Section 1 / DC Voltage

Reading Rate (Auto-Zero Off)



Temperature Coefficient (Auto-Zero Off)

For a stable environment $\pm 1^\circ\text{C}$ add the following additional error for AZERO OFF

Range Error

100 mV - 10 V	$5 \mu\text{V}/^\circ\text{C}$
100 V - 1000 V	$500 \mu\text{V}/^\circ\text{C}$

Selected Reading Rates ¹

NPLC	Aperture	Digits	Bits	Readings / Sec	
				A-Zero Off	A-Zero On
0.0001	1.4 μs	4.5	16	100,000 ³	4,130
0.0006	10 μs	5.5	18	50,000	3,150
0.01	167 μs ²	6.5	21	5,300	930
0.1	1.67 ms ²	6.5	21	592	245
1	16.6 ms ²	7.5	25	60	29.4
10	0.166 s ²	8.5	28	6	3
100		8.5	28	36 / min	18 / min
1000		8.5	28	3.6 / min	1.8 / min

1 For PRESET;DELAY 0; DISP OFF; OFORMAT DINT; ARANGE OFF.

2 Aperture is selected independent of line frequency (LFREQ). These apertures are for 60 Hz NPLC values where $1 \text{ NPLC} = 1/\text{LFREQ}$. For 50 Hz and NPLC indicated, aperture will increase by 1.2 and reading rates will decrease by 0.833.

3 For OFORMAT SINT.

4 $>10^{10} \Omega$ LO to Guard with guard open.

5 $>10^{12} \Omega$ Guard to Earth.

Maximum Input

	Rated Input	Non-Destructive
HI to LO	$\pm 1000 \text{ V pk}$	$\pm 1200 \text{ V pk}$
LO to Guard ⁴	$\pm 200 \text{ V pk}$	$\pm 350 \text{ V pk}$
Guard to Earth ⁵	$\pm 500 \text{ V pk}$	$\pm 1000 \text{ V pk}$

Input Terminals

Terminal Material: Gold-plated Tellurium Copper
Input Leakage Current: <20 pA at 25°C

Section 2 / Resistance

Two-wire and Four-wire Ohms (OHM and OHMF Functions)

Range	Full Scale	Maximum Resolution	Current ⁴ Source	Test Voltage	Open Circuit	Maximum Lead Resistance (OHMF)	Maximum Series Offset (OCOMP ON)	Temperature Coefficient (ppm of Reading + ppm of Range) / °C	
								Without ACAL ⁵	With ACAL ⁶
10 Ω	12.00000	10 μΩ	10 mA	0.1 V	12 V	20 Ω	0.01 V	3 + 1	1 + 1
100 Ω	120.00000	10 μΩ	1 mA	0.1 V	12 V	200 Ω	0.01 V	3 + 1	1 + 1
1 kΩ	1,200,000	100 μΩ	1 mA	1.0 V	12 V	150 Ω	0.1 V	3 + 0.1	1 + 0.1
10 kΩ	12,000,000	1 mΩ	100 μA	1.0 V	12 V	1.5 kΩ	0.1 V	3 + 0.1	1 + 0.1
100 kΩ	120,000,000	10 mΩ	50 μA	5.0 V	12 V	1.5 kΩ	0.5 V	3 + 0.1	1 + 0.1
1 MΩ	1,200,000,000	100 mΩ	5 μA	5.0 V	12 V	1.5 kΩ		3 + 1	1 + 1
10 MΩ	12,000,000,000	1 Ω	500 nA	5.0 V	12 V	1.5 kΩ		20 + 20	5 + 2
100 MΩ ⁷	120,000,000,000	10 Ω	500 nA	5.0 V	5 V	1.5 kΩ		100 + 20	25 + 2
1GΩ ⁷	1,200,000,000,000	100 Ω	500 nA	5.0 V	5 V	1.5 kΩ		1000 + 20	250 + 2

4 Current source is $\pm 3\%$ absolute accuracy.

5 Additional error from Tcal or last ACAL $\pm 1^\circ\text{C}$.

6 Additional error from Tcal $\pm 5^\circ\text{C}$.

7 Measurement is computed from $10 \text{ M}\Omega$ in parallel with input.

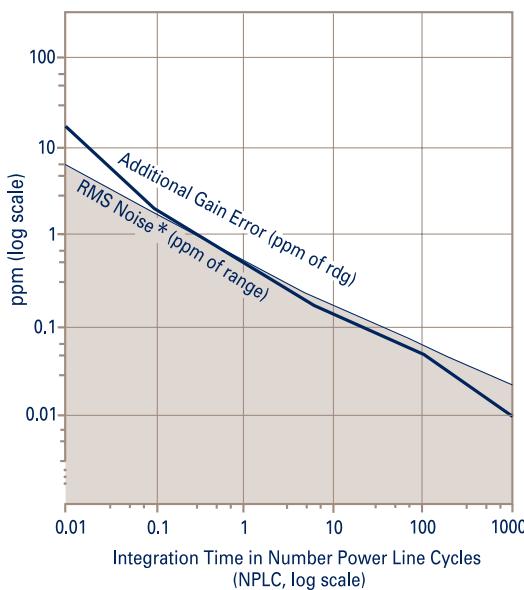
Accuracy¹ (ppm of Reading + ppm of Range)

Range	24 Hour ²	90 Day ³	1 Year ³	2 Year ³
10 Ω	5 + 3	15 + 5	15 + 5	20 + 10
100 Ω	3 + 3	10 + 5	12 + 5	20 + 10
1 kΩ	2 + 0.2	8 + 0.5	10 + 0.5	15 + 1
10 kΩ	2 + 0.2	8 + 0.5	10 + 0.5	15 + 1
100 kΩ	2 + 0.2	8 + 0.5	10 + 0.5	15 + 1
1 MΩ	10 + 1	12 + 2	15 + 2	20 + 4
10 MΩ	50 + 5	50 + 10	50 + 10	75 + 10
100 MΩ	500 + 10	500 + 10	500 + 10	0.1% + 10
1 GΩ	0.5% + 10	0.5% + 10	0.5% + 10	1% + 10

Two-Wire Ohms Accuracy

For Two-Wire Ohms (OHM) accuracy, add the following offset errors to the Four-Wire Ohms (OHMF) accuracy.
 24 Hour: 50 mΩ. 90 Day: 150 mΩ. 1 Year: 250 mΩ. 2 Year: 500 mΩ

Additional Errors



*RMS Noise

Range	Multiplier
10 Ω & 100 Ω	x10
1 kΩ to 100 kΩ	x1
1 MΩ	x1.5
10 MΩ	x2
100 MΩ	x120
1 GΩ	x1200

For RMS noise error, multiply RMS noise result from graph by multiplier in chart. For peak noise error, multiply RMS noise error by 3.

Selected Reading Rates⁴

NPLC ⁵	Aperture	Digits	Readings / Sec	
			Auto-Zero Off	Auto-Zero On
0.0001	1.4 μs	4.5	100,000 ⁷	4,130
0.0006	10 μs	5.5	50,000	3,150
0.01	167 μs ⁶	6.5	5,300	930
0.1	1.66 ms ⁶	6.5	592	245
1	16.6 ms ⁶	7.5	60	29.4
10	0.166 s ⁶	7.5	6	3
100		7.5	36 / min	18 / min

Measurement Consideration

Agilent recommends the use of Teflon* cable or other high impedance, low dielectric absorption cable for these measurements.

Maximum Input

Rated Input Non-Destructive	
Hi to LO	± 1000 V pk
Hi & LO Sense to LO	± 200 V pk
LO to Guard	± 200 V pk
Guard to Earth	± 500 V pk
	± 1000 V pk

Temperature Coefficient (Auto-Zero Off)

For a stable environment ± 1°C add the following error for AZERO OFF. (ppm of Range) / °C

Range	Error	Range	Error
10 Ω	50	1 MΩ	1
100 Ω	50	10 MΩ	1
1 kΩ	5	100 MΩ	10
10 kΩ	5	1 GΩ	100
100 kΩ	1		

Settling Characteristics

For first reading error following range change, add the total 90 day measurement error for the current range. Preprogrammed settling delay times are for <200 pF external circuit capacitance.

¹ Specifications are for PRESET; NPLC 100; OCOMP ON; OHMF.

² Tcal ± 1°C.

³ Specifications for 90 day, 1 year, and 2 year are within 24 hours and ± 1°C of last ACAL; Tcal ± 5°C.

Add 3 ppm of reading additional error for factory traceability of 10 kΩ to US NIST. Traceability is the absolute error relative to National Standards associated with the source of last external calibration.

⁴ For PRESET; DELAY 0; DISP OFF; OFORMAT DINT; ORANGE OFF.

For OHMF or OCOMP ON, the maximum reading rates will be slower.

⁵ Ohms measurements at rates < NPLC 1 are subject to potential noise pickup. Care must be taken to provide adequate shielding and guarding to maintain measurement accuracies.

⁶ Aperture is selected independent of line frequency (LFREQ). These apertures are for 60 Hz NPLC values where 1 NPLC = 1 / LFREQ. For 50 Hz and NPLC indicated, aperture will increase by 1.2 and reading rates will decrease by 0.833.

⁷ For OFORMAT SINT.

* Teflon is a registered trademark of E.I. duPont deNemours and Co.

Section 3 / DC Current

DC Current (DCI Function)

Range	Full Scale	Maximum Resolution	Shunt Resistance	Burden Voltage	Temperature Coefficient (ppm of Reading + ppm of Range) / °C	
					Without ACAL ¹	With ACAL ²
100 nA	120.000	1 pA	545.2 kΩ	0.055 V	10 + 200	2 + 50
1 µA	1.200000	1 pA	45.2 kΩ	0.045 V	2 + 20	2 + 5
10 µA	12.000000	1 pA	5.2 kΩ	0.055 V	10 + 4	2 + 1
100 µA	120.00000	10 pA	730 Ω	0.075 V	10 + 3	2 + 1
1 mA	1.2000000	100 pA	100 Ω	0.100 V	10 + 2	2 + 1
10 mA	12.0000000	1 nA	10 Ω	0.100 V	10 + 2	2 + 1
100 mA	120.000000	10 nA	1 Ω	0.250 V	25 + 2	2 + 1
1 A	1.05000000	100 nA	0.1 Ω	<1.5 V	25 + 3	2 + 2

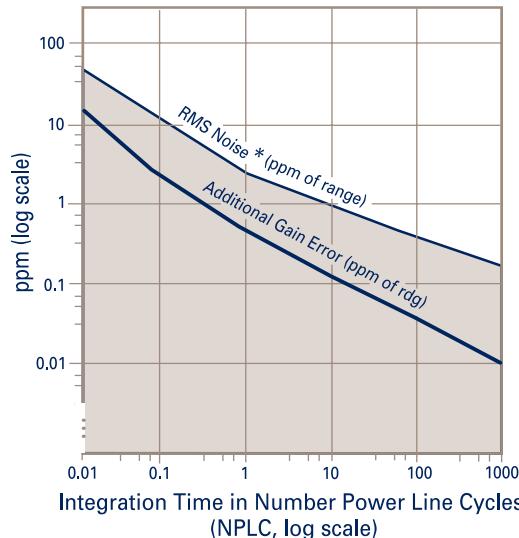
Accuracy³ (ppm Reading + ppm Range)

Range	24 Hour ⁴	90 Day ⁵	1 Year ⁵	2 Year ⁵
100 nA ⁶	10 + 400	30 + 400	30 + 400	35 + 400
1 µA ⁶	10 + 40	15 + 40	20 + 40	25 + 40
10 µA ⁶	10 + 7	15 + 10	20 + 10	25 + 10
100 µA	10 + 6	15 + 8	20 + 8	25 + 8
1 mA	10 + 4	15 + 5	20 + 5	25 + 5
10 mA	10 + 4	15 + 5	20 + 5	25 + 5
100 mA	25 + 4	30 + 5	35 + 5	40 + 5
1 A	100 + 10	100 + 10	110 + 10	115 + 10

Settling Characteristics

For first reading or range change error, add .001% of input current step additional error. Reading settling times can be affected by source impedance and cable dielectric absorption characteristics.

Additional Errors



*RMS Noise

Range	Multiplier
100 nA	x100
1 µA	x10
10 µA to 1 A	x1

For RMS noise error, multiply RMS noise result from graph by multiplier in chart. For peak noise error, multiply RMS noise error by 3.

Measurement Considerations

Agilent recommends the use of Teflon cable or other high impedance, low dielectric absorption cable for low current measurements. Current measurements at rates < NPLC 1 are subject to potential noise pickup. Care must be taken to provide adequate shielding and guarding to maintain measurement accuracies.

Selected Reading Rates⁷

NPLC	Aperture	Digits	Readings / Sec
0.0001	1.4 µs	4.5	2,300
0.0006	10 µs	5.5	1,350
0.01	167 µs ⁸	6.5	157
0.1	1.67 ms ⁸	6.5	108
1	16.6 ms ⁸	7.5	26
10	0.166 s ⁸	7.5	3
100		7.5	18 / min

⁷ For PRESET; DELAY 0; DISP OFF; OFORMAT DINT; ARANGE OFF.

⁸ Aperture is selected independent of line frequency (LFREQ). These apertures are for 60 Hz NPLC values where 1 NPLC = 1/LFREQ. For 50 Hz and NPLC indicated, aperture will increase by 1.2 and reading rates will decrease by 0.833.

Maximum Input

	Rated Input	Non-Destructive
I to LO	± 1.5 A pk	< 1.25 A rms
LO to Guard	± 200 V pk	± 350 V pk
Guard to Earth	± 500 V pk	± 1000 V pk

General Information

The Agilent 3458A supports three techniques for measuring true rms AC voltage, each offering unique capabilities. The desired measurement technique is selected through the SETACV command. The ACV functions will then apply the chosen method for subsequent measurements.

The following section provides a brief description of the three operation modes along with a summary table helpful in choosing the technique best suited to your specific measurement need.

SETACV SYNC Synchronously Sub-sampled Computed true rms technique.

This technique provides excellent linearity and the most accurate measurement results. It does require that the input signal be repetitive (not random noise for example). The bandwidth in this mode is from 1 Hz to 10 MHz.

SETACV ANA Analog Computing true rms conversion technique.

This is the measurement technique at power-up or following an instrument reset. This mode works well with any signal within its 10 Hz to 2 MHz bandwidth and provides the fastest measurement speeds.

SETACV RNDM Random Sampled Computed true rms technique.

This technique again provides excellent linearity, however the overall accuracy is the lowest of the three modes. It does not require a repetitive input signal and is therefore well suited to wideband noise measurements. The bandwidth in this mode is from 20 Hz to 10 MHz.

Selection Table

Technique	Frequency Range	Best Accuracy	Repetitive Signal Required	Readings / Sec	
				Minimum	Maximum
Synchronous Sub-sampled	1 Hz - 10 MHz	0.010%	Yes	0.025	10
Analog	10 Hz - 2 MHz	0.03%	No	0.8	50
Random Sampled	20 Hz - 10 MHz	0.1%	No	0.025	45

Synchronous Sub-sampled Mode (ACV Function, SETACV SYNC)

Range	Full Scale	Maximum Resolution	Input Impedance	Temperature Coefficient ¹ (% of Reading + % of Range) / °C	
				10 mV	100 mV
10 mV	12.00000	10 nV	1 MΩ ± 15% with <140 pF	0.002 + 0.02	
100 mV	120.00000	10 nV	1 MΩ ± 15% with <140 pF	0.001 + 0.0001	
1 V	1.200000	100 nV	1 MΩ ± 15% with <140 pF	0.001 + 0.0001	
10 V	12.00000	1 µV	1 MΩ ± 2% with <140 pF	0.001 + 0.0001	
100 V	120.00000	10 µV	1 MΩ ± 2% with <140 pF	0.001 + 0.0001	
1000 V	700.0000	100 µV	1 MΩ ± 2% with <140 pF	0.001 + 0.0001	

1 Additional error beyond ± 1°C, but within + 5°C of last ACAL.

For ACBAND > 2MHz, use 10 mV range temperature coefficient for all ranges.

2 Specifications apply full scale to 10% of full scale, DC < 10% of AC, sine wave input, crest factor = 1.4, and PRESET. Within 24 hours and ± 1° C of last ACAL. Lo Guard Switch on.

Peak (AC + DC) input limited to 5 x full scale for all ranges in ACV function.

Add 2 ppm of reading additional error for factory traceability of 10 V DC to US NIST.

3 LFILTER ON recommended.

AC Accuracy²

24 Hour to 2 Year (% of Reading + % of Range)

Range	ACBAND ≤ 2MHz							
	1 Hz to ³ 40 Hz	40 Hz to ³ 1 kHz	1 kHz to ³ 20 kHz	20 kHz to ³ 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz	300 kHz to 1 MHz	1 MHz to 2 MHz
10 mV	0.03 + 0.03	0.02 + 0.011	0.03 + 0.011	0.1 + 0.011	0.5 + 0.011	4.0 + 0.02		
100 mV - 10 V	0.007 + 0.004	0.007 + 0.002	0.014 + 0.002	0.03 + 0.002	0.08 + 0.002	0.3 + 0.01	1 + 0.01	1.5 + 0.01
100 V	0.02 + 0.004	0.02 + 0.002	0.02 + 0.002	0.035 + 0.002	0.12 + 0.002	0.4 + 0.01	1.5 + 0.01	
1000 V	0.04 + 0.004	0.04 + 0.002	0.06 + 0.002	0.12 + 0.002	0.3 + 0.002			

AC Accuracy continued on following page.

Section 4 / AC Voltage

AC Accuracy continued: 24 Hour to 2 Year (% of Reading + % of Range)

Range	ACBAND >2 MHz				
	45 Hz to 100 kHz	100 kHz to 1 MHz	1 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
10 mV	0.09 + 0.06	1.2 + 0.05	7 + 0.07	20 + 0.08	
100 mV - 10 V	0.09 + 0.06	2.0 + 0.05	4 + 0.07	4 + 0.08	15 + 0.1
100 V	0.12 + 0.002				
1000 V	0.3 + 0.01				

Transfer Accuracy

Range	% of Reading	Conditions
100 mV - 100 V	(0.002 + Resolution in %) ¹	<ul style="list-style-type: none"> Following 4 Hour warm-up Within 10 min and $\pm 0.5^{\circ}\text{C}$ of the reference measurement 45 Hz to 20 kHz, sine wave input Within $\pm 10\%$ of the reference voltage and frequency

¹ Resolution in % is the value of RES command or parameter (reading resolution as percentage of measurement range).

² Additional error beyond $\pm 1^{\circ}\text{C}$, but within $\pm 5^{\circ}\text{C}$ of last ACAL. (% of Range) / $^{\circ}\text{C}$. For ACBAND >2MHz, use 10mV range temperature coefficient. Lo Guard switch on.

AC + DC Accuracy (ACDCV Function)

For ACDCV Accuracy apply the following additional error to the ACV accuracy. (% of Range)

DC <10% of AC Voltage			
Range	ACBAND \leq 2MHz	ACBAND > 2MHz	Temperature Coefficient ²
10 mV	0.09	0.09	0.03
100 mV - 1000 V	0.008	0.09	0.0025

DC >10% of AC Voltage			
Range	ACBAND \leq 2MHz	ACBAND > 2MHz	Temperature Coefficient ²
10 mV	0.7	0.7	0.18
100 mV - 1000 V	0.07	0.7	0.025

Additional Errors

Apply the following additional errors as appropriate to your particular measurement setup. (% of Reading)

Source R	Input Frequency ³			
	0 - 1 MHz	1 - 4 MHz	4 - 8 MHz	8 - 10 MHz
0 Ω	0	2	5	5
50 Ω Terminated	0.003	0	0	0
75 Ω Terminated	0.004	2	5	5
50 Ω	0.005	3	7	10

Crest Factor	Resolution Multiplier ¹
1 - 2	(Resolution in %) x 1
2 - 3	(Resolution in %) x 2
3 - 4	(Resolution in %) x 3
4 - 5	(Resolution in %) x 5

³ Flatness error including instrument loading.

Reading Rates⁴

ACBAND Low	Maximum Sec / Reading
1 - 5 Hz	6.5
5 - 20 Hz	2.0
20 - 100 Hz	1.2
100 - 500 Hz	0.32
>500 Hz	0.02

% Resolution	Maximum Sec / Reading
0.001 - 0.005	32
0.005 - 0.01	6.5
0.01 - 0.05	3.2
0.05 - 0.1	0.64
0.1 - 1	0.32
>1	0.1

⁴ Reading time is the sum of the Sec / Reading shown for your configuration. The tables will yield the slowest reading rate for your configuration. Actual reading rates may be faster. For DELAY-1; RANGE OFF

Settling Characteristics

There is no instrument settling required.

Common Mode Rejection

For 1 kΩ imbalance in LO lead, > 90 dB, DC to 60 Hz.

High Frequency Temperature Coefficient

For outside Tcal $\pm 5^\circ\text{C}$ add the following error.
(% of Reading) / $^\circ\text{C}$

Range	Frequency	
	2 - 4 MHz	4 - 10 MHz
10 mV - 1 V	0.02	0.08
10 V - 1000 V	0.08	0.08

Maximum Input

	Rated Input	Non-Destructive
Hi to LO	$\pm 1000 \text{ V pk}$	$\pm 1200 \text{ V pk}$
LO to Guard	$\pm 200 \text{ V pk}$	$\pm 350 \text{ V pk}$
Guard to Earth	$\pm 500 \text{ V pk}$	$\pm 1000 \text{ V pk}$
Volt - Hz Product	1×10^8	

Analog Mode (ACV Function, SETACV ANA)

Range	Full Scale	Maximum Resolution	Input Impedance	Temperature Coefficient ¹ (% of Reading + % of Range) / $^\circ\text{C}$	
				10 mV	100 mV
10 mV	12.00000	10 nV	$1 \text{ M}\Omega \pm 15\%$ with $< 140 \text{ pF}$	0.003 + 0.006	
100 mV	120.0000	100 nV	$1 \text{ M}\Omega \pm 15\%$ with $< 140 \text{ pF}$	0.002 + 0.0	
1 V	1.200000	1 μV	$1 \text{ M}\Omega \pm 15\%$ with $< 140 \text{ pF}$	0.002 + 0.0	
10 V	12.00000	10 μV	$1 \text{ M}\Omega \pm 2\%$ with $< 140 \text{ pF}$	0.002 + 0.0	
100 V	120.0000	100 μV	$1 \text{ M}\Omega \pm 2\%$ with $< 140 \text{ pF}$	0.002 + 0.0	
1000 V	700.0000	1 mV	$1 \text{ M}\Omega \pm 2\%$ with $< 140 \text{ pF}$	0.002 + 0.0	

AC Accuracy²

24 Hour to 2 Year (% Reading + % Range)

Range	10 Hz to 20 Hz	20 Hz to 40 Hz	40 Hz to 100 Hz	100 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 250 kHz	250 kHz to 500 kHz	500 kHz to 1 MHz	1 MHz to 2 MHz
	10 mV	100 mV - 10 V	100 V	1000 V						
10 mV	0.4 + 0.32	0.15 + 0.25	0.06 + 0.25	0.02 + 0.25	0.15 + 0.25	0.7 + 0.35	4 + 0.7			
100 mV - 10 V	0.4 + 0.02	0.15 + 0.02	0.06 + 0.01	0.02 + 0.01	0.15 + 0.04	0.6 + 0.08	2 + 0.5	3 + 0.6	5 + 2	10 + 5
100 V	0.4 + 0.02	0.15 + 0.02	0.06 + 0.01	0.03 + 0.01	0.15 + 0.04	0.6 + 0.08	2 + 0.5	3 + 0.6	5 + 2	
1000 V	0.42 + 0.03	0.17 + 0.03	0.08 + 0.02	0.06 + 0.02	0.15 + 0.04	0.6 + 0.2				

AC + DC Accuracy (ACDCV Function)

For ACDCV Accuracy apply the following additional error to the ACV accuracy. (% of Reading + % of Range)

Range	DC < 10% of AC Voltage		DC > 10% of AC Voltage	
	Accuracy	Temperature Coefficient ³	Accuracy	Temperature Coefficient ³
10 mV	0.0 + 0.2	0 + 0.015	0.15 + 3	0 + 0.06
100 mV-1000 V	0.0 + 0.02	0 + 0.001	0.15 + 0.25	0 + 0.007

¹ Additional error beyond $\pm 1^\circ\text{C}$, but within $\pm 5^\circ\text{C}$ of last ACAL.

² Specifications apply full scale to 1/20 full scale, sinewave input, crest factor = 1.4, and PRESET. Within 24 hours and $\pm 1^\circ\text{C}$ of last ACAL. Lo to Guard switch on.

Maximum DC is limited to 400V in ACV function.

Add 2 ppm of reading additional error for factory traceability of 10V DC to US NIST.

Additional Errors

Apply the following additional errors as appropriate to your particular measurement setup.

Low Frequency Error (% of Reading)

ACBAND Low			
Signal Frequency	10 Hz - 1 kHz NPLC > 10	1 - 10 kHz NPLC > 1	> 10 kHz NPLC > 0.1
10 - 200 Hz	0		
200 - 500 Hz	0	0.15	
500 - 1 kHz	0	0.015	0.9
1 - 2 kHz	0	0	0.2
2 - 5 kHz	0	0	0.05
5 - 10 kHz	0	0	0.01

Crest Factor Error (% of Reading)

Crest Factor	Additional Error
1 - 2	0
2 - 3	0.15
3 - 4	0.25
4 - 5	0.40

³ Additional error beyond $\pm 1^\circ\text{C}$, but within $\pm 5^\circ\text{C}$ of last ACAL.
(% of Reading + % of Range) / $^\circ\text{C}$.

Section 4 / AC Voltage

Reading Rates¹

ACBAND Low	NPLC	Sec / Reading	
		ACV	ACDCV
≥ 10 Hz	10	1.2	1
≥ 1 kHz	1	1	0.1
≥ 10 kHz	0.1	1	0.02

¹ For DELAY-1; ARANGE OFF.

For DELAY 0; NPLC 1, unspecified reading rates of greater than 500 / Sec are possible.

Settling Characteristics

For first reading or range change error using default delays, add .01% of input step additional error.
The following data applies for DELAY 0.

Function	ACBAND Low	DC Component	Settling Time
ACV	≥ 10Hz	DC < 10% AC	0.5 sec to 0.01%
		DC > 10% AC	0.9 sec to 0.01%
ACDCV	10 Hz-1 kHz		0.5 sec to 0.01%
	1 kHz - 10 kHz		0.08 sec to 0.01%
	≥ 10 kHz		0.015 sec to 0.01%

Maximum Input

	Rated Input	Non-Destructive
HI to LO	± 1000 V pk	± 1200 V pk
LO to Guard	± 200 V pk	± 350 V pk
Guard to Earth	± 500 V pk	± 1000 V pk
Volt - Hz Product	1 x10 ⁸	

Common Mode Rejection

For 1 kΩ imbalance in LO lead, > 90 dB, DC - 60 Hz.

Random Sampled Mode (ACV Function, SETACV RNDM)

Range	Full Scale	Maximum Resolution	Input Impedance	Temperature Coefficient ²
				(% of Reading + % of Range) / °C
10 mV	12.000	1 µV	1 MΩ ± 15% with < 140pF	0.002 + 0.02
100 mV	120.00	10 µV	1 MΩ ± 15% with < 140pF	0.001+ 0.0001
1 V	1.2000	100 µV	1 MΩ ± 15% with < 140pF	0.001+ 0.0001
10 V	12.000	1 mV	1 MΩ ± 2% with < 140pF	0.001+ 0.0001
100 V	120.00	10 mV	1 MΩ ± 2% with < 140pF	0.001+ 0.0001
1000 V	700.0	100 mV	1 MΩ ± 2% with < 140pF	0.001+ 0.0001

² Additional error beyond ± 1 °C, but within ± 5 °C of last ACAL.

For ACBAND > 2 MHz, use 10 mV range temperature coefficient for all ranges.

AC Accuracy³

24 Hour to 2 Year (% of Reading + % of Range)

Range	ACBAND ≤ 2 MHz				ACBAND > 2 MHz				
	20 Hz to 100 kHz	100 kHz to 300 kHz	300 kHz to 1 MHz	1 MHz to 2 MHz	20 Hz to 100 kHz	100 kHz to 1 MHz	1 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
10 mV	0.5+0.02	4+0.02			0.1+0.05	1.2+0.05	7+0.07	20+0.08	
100 mV-10 V	0.08+0.002	0.3+0.01	1+0.01	1.5+0.01	0.1+0.05	2+0.05	4+0.07	4+0.08	15+0.1
100 V	0.12+0.002	0.4+0.01	1.5+0.01		0.12+0.002				
1000 V	0.3+0.01				0.3+0.01				

³ Specifications apply from full scale to 5% of full scale, DC < 10% of AC, sine wave input, crest factor = 1.4, and PRESET. Within 24 hours and ± 1°C of last ACAL. LO to Guard switch on.

Add 2 ppm of reading additional error for factory traceability of 10V DC to US NIST.

Maximum DC is limited to 400V in ACV function.

AC + DCV Accuracy (ACDCV Function)

For ACDCV Accuracy apply the following additional error to the ACV accuracy. (% of Range).

Range	DC ≤ 10% of AC Voltage			DC > 10% of AC Voltage		
	ACBAND ≤ 2 MHz	ACBAND > 2 MHz	Temperature Coefficient ¹	ACBAND ≤ 2 MHz	ACBAND > 2 MHz	Temperature Coefficient ¹
10 mV	0.09	0.09	0.03	0.7	0.7	0.18
100 mV - 1 kV	0.008	0.09	0.0025	0.07	0.7	0.025

Additional Errors

Apply the following additional errors as appropriate to your particular measurement setup. (% of Reading)

Source R	Input Frequency ²				Crest Factor	Resolution Multiplier
	0 - 1 MHz	1 - 4 MHz	4 - 8 MHz	8 - 10 MHz		
0 Ω	0	2	5	5	1 - 2	(Resolution in %) x 1
50 Ω Terminated	0.003	0	0	0	2 - 3	(Resolution in %) x 3
75 Ω Terminated	0.004	2	5	5	3 - 4	(Resolution in %) x 5
50 Ω	0.005	3	7	10	4 - 5	(Resolution in %) x 8

Reading Rates³

% Resolution	Sec / Reading	
	ACV	ACDCV
0.1 - 0.2	40	39
0.2 - 0.4	11	9.6
0.4 - 0.6	2.7	2.4
0.6 - 1	1.4	1.1
1 - 2	0.8	0.5
2 - 5	0.4	0.1
>5	0.32	0.022

High Frequency Temperature Coefficient

For outside Tcal ± 5°C add the following error. (% of Reading) / °C

Range	2 - 4 MHz	4 - 10 MHz
10 mV - 1 V	0.02	0.08
10 V - 1000 V	0.08	0.08

Settling Characteristics

For first reading or range change error using default delays, add 0.01% of input step additional error.

The following data applies for DELAY 0.

Function	DC Component	Settling Time
ACV	DC < 10% of AC	0.5 sec to 0.01%
	DC > 10% of AC	0.9 sec to 0.01%
ACDCV	No instrument settling required.	

Common Mode Rejection

For 1 kΩ imbalance in LO lead, > 90 dB, DC to 60 Hz.

Maximum Input

	Rated Input	Non-Destructive
HI to LO	± 1000 V pk	± 1200 V pk
LO to Guard	± 200 V pk	± 350 V pk
Guard to Earth	± 500 V pk	± 1000 V pk
Volt - Hz Product		1 x 10 ⁸

¹ Additional error beyond ± 1°C, but within ± 5°C of last ACAL. (% of Reading) / °C.

For ACBAND > 2MHz, use 10mV range temperature coefficient for all ranges.

² Flatness error including instrument loading.

³ For DELAY -1; RANGE OFF. For DELAY 0 in ACV, the reading rates are identical to ACDCV.

Section 5 / AC Current

AC Current (ACI and ACDCI Functions)

Range	Full Scale	Maximum Resolution	Shunt Resistance	Burden Voltage	Temperature Coefficient ¹ (% of Reading + % of Range) / °C
100 µA	120.0000	100 pA	730 Ω	0.1 V	0.002 + 0
1 mA	1.200000	1 nA	100 Ω	0.1 V	0.002 + 0
10 mA	12.00000	10 nA	10 Ω	0.1 V	0.002 + 0
100 mA	120.0000	100 nA	1 Ω	0.25 V	0.002 + 0
1 A	1.050000	1 µA	0.1 Ω	< 1.5 V	0.002 + 0

AC Accuracy²

24 Hour to 2 Year (% Reading + % Range)

Range	10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 5kHz	5 kHz to 20 kHz ³	20 kHz to 50 kHz ³	50 kHz to 100 kHz ³
100 µA ⁴	0.4+0.03	0.15+0.03	0.06+0.03	0.06 +0.03			
1 mA - 100 mA	0.4+0.02	0.15+0.02	0.06+0.02	0.03+0.02	0.06+0.02	0.4 +0.04	0.55+0.15
1 A	0.4+0.02	0.16+0.02	0.08+0.02	0.1+0.02	0.3 +0.02	1 + 0.04	

AC + DC Accuracy (ACDCI Function)

For ACDCI Accuracy apply the following additional error to the ACI accuracy.
(% of Reading + % of Range).

DC≤10% of AC Accuracy	Temperature Coefficient ⁵	DC > 10% of AC Accuracy	Temperature Coefficient ⁵
0.005 + 0.02	0.0 + .001	0.15 + 0.25	0.0 + 0.007

¹ Additional error beyond ± 1°C, but within ± 5°C of last ACAL.

² Specifications apply full scale to 1/20 full scale, for sine wave inputs, crest factor = 1.4, and following PRESET within 24 hours and ± 1°C of last ACAL.

Add 5 ppm of reading additional error for factory traceability to US NIST. Traceability is the sum of the 10 V and 10 kΩ traceability values.

³ Typical performance.

⁴ 1 kHz maximum on the 100 µA range.

Additional Errors

Apply the following additional errors as appropriate to your particular measurement setup.

Low Frequency Error (% of Reading)

ACBAND Low			
Signal Frequency	10 Hz - 1 kHz NPLC >10	1 - 10 kHz NPLC >1	> 10 kHz NPLC >0.1
10 - 200Hz	0		
200 - 500 Hz	0	0.15	
500 - 1 kHz	0	0.015	0.9
1 - 2 kHz	0	0	0.2
2 - 5 kHz	0	0	0.05
5 - 10 kHz	0	0	0.01

Crest Factor Error (% of Reading)

Crest Factor	Additional Error
1 - 2	0
2 - 3	0.15
3 - 4	0.25
4 - 5	0.40

Reading Rates⁶

ACBAND Low	NPLC	Maximum Sec / Reading	
		ACI	ACDCI
≥ 10 Hz	10	1.2	1
≥ 1 kHz	1	1	0.1
≥ 10 kHz	0.1	1	0.02

⁶ For DELAY-1; RANGE OFF. For DELAY 0; NPLC 1, unspecified reading rates of greater than 500/sec are possible.

Settling Characteristics

For first reading or range change error using default delays, add .01% of input step additional error for the 100 µA to 100 mA ranges. For the 1 A range add .05% of input step additional error.

The following data applies for DELAY 0.

Function	ACBAND Low	DC Component	Settling Time
ACI	≥10 Hz	DC < 10% AC	0.5 sec to 0.01%
		DC > 10% AC	0.9 sec to 0.01%
ACDCI	10 Hz-1 kHz		0.5 sec to 0.01%
	1 kHz - 10 kHz		0.08 sec to 0.01%
	≥ 10 kHz		0.015 sec to 0.01%

Maximum Input

	Rated Input	Non-Destructive
I to LO	± 1.5 A pk	< 1.25 A rms
LO to Guard	± 200 V pk	± 350 V pk
Guard to Earth	± 500 V pk	± 1000 V pk

Section 6 / Frequency/Period

Frequency / Period Characteristics

	Voltage (AC or DC Coupled) ACV or ACDCV Functions ¹	Current (AC or DC Coupled) ACI or ACDCI Functions ¹
Frequency Range	1 Hz – 10 MHz	1 Hz – 100 kHz
Period Range	1 sec – 100 ns	1 sec – 10 µs
Input Signal Range	700 V rms – 1 mV rms	1 A rms – 10 µA rms
Input Impedance	1 MΩ ± 15% with < 140 pF	0.1 – 730 Ω ²

Accuracy

Range	24 Hour – 2 Year 0°C – 55°C
1 Hz – 40 Hz 1 s – 25 ms	0.05 % of Reading
40 Hz – 10 MHz 25 ms – 100 ns	0.01 % of Reading

Reading Rates

Resolution	Gate Time ³	Readings/Sec ⁴
0.00001%	1 s	0.95
> 0.0001%	100 ms	9.6
> 0.001%	10 ms	73
> 0.01%	1 ms	215
> 0.1%	100 µs	270

Measurement Technique:

Reciprocal Counting

Time Base:

10 MHz ± 0.01%, 0°C to 55°C

Level Trigger:

± 500% of Range in 5% steps

Trigger Filter:

Selectable 75 kHz Low Pass Trigger Filter

Slope Trigger:

Positive or Negative

¹ The source of frequency measurements and the measurement input coupling are determined by the FSOURCE command.

² Range dependent, see ACI for specific range impedance values.

³ Gate Time is determined by the specified measurement resolution.

⁴ For Maximum Input specified to fixed range operation. For auto range, the maximum speed is 30 readings/sec for ACBAND ≥ 1 kHz.

Actual Reading Speed is the longer of 1 period of the input, the chosen gate time, or the default reading time-out of 1.2 sec.

Section 7 / Digitizing

General Information

The Agilent 3458A supports three independent methods for signal digitizing. Each method is discussed below to aid in selecting the appropriate setup best suited to your specific application.

DCV

Standard DCV function.

This mode of digitizing allows signal acquisition at rates from 0.2 readings/sec at 28 bits resolution to 100 k readings/sec at 16 bits. Arbitrary sample apertures from 500 ns to 1 sec are selectable with 100 ns resolution. Input voltage ranges cover 100 mV to 1000 V full scale. Input bandwidth varies from 30 kHz to 150 kHz depending on the measurement range.

DSDC

Direct Sampling DC Coupled measurement technique.

DSAC

Direct Sampling AC Coupled measurement technique.

In these modes the input is sampled through a track / hold with a fixed 2 ns aperture which yields a 16 bit resolution result. The sample rate is selectable from 6000 sec / sample to 20 µs / sample with 100 ns resolution. Input voltage ranges cover 10 mV peak to 1000 V peak full scale. The input bandwidth is limited to 12 MHz.

SSDC

Sub-Sampling (Effective time sampling) DC Coupled.

SSAC

Sub-Sampling (Effective time sampling) AC Coupled.

These techniques implement synchronous sub-sampling of a repetitive input signal through a track / hold with a 2 ns sample aperture which yields a 16 bit resolution result. The effective sample rate is settable from 6000 sec / sample to 10 ns / sample with 10 ns resolution. Sampled data can be time ordered by the instrument and output to the GPIB. Input voltage ranges cover 10 mV peak to 1000 V peak full scale. The input bandwidth is limited to 12 MHz.

Summary of Digitizing Capabilities

Technique	Function	Input Bandwidth	Best Accuracy	Sample Rate
Standard	DCV	DC - 150 kHz	0.00005 - 0.01%	100 k / sec
Direct-sampled	DSDC / DSAC	DC - 12 MHz	0.02%	50 k / sec
Sub-sampled	SSDC / SSAC	DC - 12 MHz	0.02%	100 M / sec (effective)

Standard DC Volts Digitizing (DCV Function)

Range	Input Impedance	Offset Voltage ¹	Typical Bandwidth	Settling Time to 0.01% of Step
100 mV	>10 ¹⁰ Ω	< 5 µV	80 kHz	50 µs
1 V	>10 ¹⁰ Ω	< 5 µV	150 kHz	20 µs
10 V	>10 ¹⁰ Ω	< 5 µV	150 kHz	20 µs
100 V	10 MΩ	< 500 µV	30 kHz	200 µs
1000 V	10 MΩ	< 500 µV	30 kHz	200 µs

¹ ±1°C of an AZERO or within 24 hours and ± 1°C of last ACAL.

DC Performance

0.005 % of Reading + Offset¹

Maximum Sample Rate (See DCV for more data.)

Readings / sec	Resolution	Aperture
100 k	15 bits	0.8 µs
100 k	16 bits	1.4 µs
50 k	18 bits	6.0 µs

Sample Timebase

Accuracy: 0.01 %

Jitter: < 100 ps rms

² < 125 ns variability between multiple 3458As.

External Trigger

Latency: < 175 ns²

Jitter: < 50 ns rms

Level Trigger

Latency: < 700 ns

Jitter: < 50 ns rms

Dynamic Performance100 mV, 1 V, 10 V Ranges; Aperture = 6 μ s

Test	Input (2 x full scale pk-pk)	Result
DFT-harmonics	1 kHz	< -96 dB
DFT-spurious	1 kHz	< -100 dB
Differential non-linearity	dc	< 0.003% of Range
Signal to Noise Ratio	1 kHz	> 96 dB

Direct and Sub-sampled Digitizing (DSDC, DSAC, SSDC and SSAC Functions)

Range ¹	Input Impedance	Offset Voltage ²	Typical Bandwidth
10 mV	1 M Ω with 140 pF	< 50 μ V	2 MHz
100 mV	1 M Ω with 140 pF	< 90 μ V	12 MHz
1 V	1 M Ω with 140 pF	< 800 μ V	12 MHz
10 V	1 M Ω with 140 pF	< 8 mV	12 MHz
100 V	1 M Ω with 140 pF	< 80 mV	12 MHz ³
1000 V	1 M Ω with 140 pF	< 800 mV	2 MHz ³

DC to 20 kHz Performance0.02 % of Reading + Offset ²**Maximum Sample Rate**

Function	Readings / sec	Resolution
SSDC, SSAC	100 M (effective) ⁴	16 bits
DSDC, DSAC	50 k	16 bits

Dynamic Performance

100 mV, 1 V, 10 V Ranges; 50,000 Samples/sec

Test	Input (2 x full scale pk-pk)	Result
DFT-harmonics	20 kHz	< - 90 dB
DFT-harmonics	1.005 MHz	< - 60 dB
DFT-spurious	20 kHz	< - 90 dB
Differential non-linearity	20 kHz	< 0.005 % of Range
Signal to Noise Ratio	20 kHz	> 66 dB

¹ Maximum DC voltage limited to 400 V DC in DSAC or SSAC functions.² $\pm 1^\circ\text{C}$ and within 24 hours of last ACAL ACV.³ Limited to 1×10^8 V-Hz product.**Sample Timebase**

Accuracy: 0.01 %

Jitter: < 100 ps rms

External TriggerLatency: < 125 ns ⁵

Jitter: < 2 ns rms

Level Trigger

Latency: < 700 ns

Jitter: < 100 ps, for 1 MHz full scale input

⁴ Effective sample rate is determined by the smallest time increment used during synchronous sub-sampling of the repetitive input signal, which is 10 ns.⁵ < 25 ns variability between multiple 3458As.

Section 8 / System Specifications

Function-Range-Measurement

The time required to program via GPIB a new measurement configuration, trigger a reading, and return the result to a controller with the following instrument setup: PRESET FAST; DELAY 0; AZERO ON; OFORMAT SINT; INBUF ON; NPLC 0.

TO - FROM Configuration Description	GPIB Rate ¹	Subprogram Rate
DCV \leq 10 V to DCV \leq 10 V	180 / sec	340 / sec
any DCV / OHMS to any DCV / OHMS	85 / sec	110 / sec
any DCV / OHMS to any DCV / OHMS with DEFEAT ON	150 / sec	270 / sec
TO or FROM any DCI	70 / sec	90 / sec
TO or FROM any ACV or ACI	75 / sec	90 / sec

¹ Using HP 9000 Series 350.

² SINT data is valid for APER \leq 10.8 μ s.

Selected Operating Rates²

	Rate
DCV Autorange Rate (100 mV to 10 V)	110 / sec
Execute simple command changes (CALL, OCOMP, etc.)	330 / sec
Readings to GPIB, ASCII	630 / sec
Readings to GPIB, DREAL	1000 / sec
Readings to GPIB, DINT	50,000 / sec
Readings to internal memory, DINT	50,000 / sec
Readings from internal memory to GPIB, DINT	50,000 / sec
Readings to GPIB, SINT	100,000 / sec
Readings to internal memory, SINT	100,000 / sec
Readings from internal memory to GPIB, SINT	100,000 / sec
Maximum internal trigger reading rate	100,000 / sec
Maximum external trigger reading rate	100,000 / sec

Memory

	Standard		Option 001	
	Readings	Bytes	Readings	Bytes
Reading Storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for subprograms and / or state storage		14 k		

Delay Time

Accuracy	$\pm 0.01\% \pm 5$ ns
Maximum	6000 s
Resolution	10 ns
Jitter	50 ns pk-pk

Timer

Accuracy	$\pm 0.01\% \pm 5$ ns
Maximum	6000 s
Resolution	100 ns
Jitter	<100 ps rms

Type of Ratio¹

DCV / DCV	Ratio = (Input) / (Reference)
ACV / DCV	Reference: (HI Sense to LO) - (LO Sense to LO)
ACDCV / DCV	Reference Signal Range: ± 12 V DC (autorange only)

¹ All SETACV measurement types are selectable.

LO Sense to LO limited to
 ± 0.25 V.

Accuracy

\pm (Input error + Reference Error)
 Input error = 1 x Total Error for input signal measurement function (DCV, ACV, ACDCV)
 Reference error = 1.5 x Total error for the range of the reference DC input

Section 10 / Math Functions

General Math Function Specifications

Math is executable as either a real-time or post processed operation.

Math function specifications do not include the error in X (the instrument reading) or errors in user entered values. The range of values input or output is $+1.0 \times 10^{-37}$ to $+1.0 \times 10^{37}$. Out of range values indicate OVLD in the display and 1×10^{38} to GPIB. The minimum execution time is the time required to complete one math operation after each reading has completed.

NULL:

X-OFFSET
 Minimum Execution Time = 180 μ s

SCALE:

(X-OFFSET) / SCALE
 Minimum Execution Time = 500 μ s

PERC:

100 x (X-PERC) / PERC
 Minimum Execution Time = 600 μ s

PFAIL:

Based on MIN, MAX registers
 Minimum Execution Time = 160 μ s

dB:

20 x Log (X/REF)
 Minimum Execution Time = 3.9 ms

dBm:

10 x Log [(X² / RES) / 1mW]
 Minimum Execution Time = 3.9 ms

RMS:

1-pole digital filter
 Computed rms of inputs.
 Minimum Execution Time = 2.7 ms

FILTER:

1-pole digital filter
 Weighted Average of inputs
 Minimum Execution Time= 750 μ s

STAT:

MEAN, SDEV computed for sample population (N-1).
 NSAMP, UPPER, LOWER accumulated.
 Minimum Execution Time = 900 μ s

CTHRM (FTHRM):

$^{\circ}$ C ($^{\circ}$ F) temperature conversion for 5 k Ω thermistor (40653B).
 Minimum Execution Time = 160 μ s

CTHRM2K (FTHRM2K):

$^{\circ}$ C ($^{\circ}$ F) temperature conversion for 2.2 k Ω thermistor (40653A).
 Minimum Execution Time = 160 μ s

CTHRM10K (FTHRM10K):

$^{\circ}$ C ($^{\circ}$ F) temperature conversion for 10 k Ω thermistor (40653C).
 Minimum Execution Time = 160 μ s

CRTD85 (FRTD85):

$^{\circ}$ C ($^{\circ}$ F) temperature conversion for RTD of 100 Ω , Alpha = 0.00385 (40654A or 40654B).
 Minimum Execution Time = 160 μ s

CRTD92 (FRTD92):

$^{\circ}$ C ($^{\circ}$ F) temperature conversion for RTD of 100 Ω , Alpha = 0.003916
 Minimum Execution Time = 160 μ s

Section 11 / General Specifications

Operating Environment

0°C to 55°C

Operating Humidity Range

up to 95% RH at 40°C

Physical Characteristics

88.9 mm H x 425.5 mm W x 502.9 mm D

Net Weight: 12 kg (26.5 lbs)

Shipping Weight 14.8 kg (32.5 lbs)

IEEE-488 Interface

Complies with the following:

IEEE-488.1 Interface Standard

IEEE-728 Codes/Formats Standard

HPML (Multimeter Language)

Storage Temperature

-40°C to + 75°C

Warm-Up Time

4 Hours to published specifications

Power Requirements

100/120 V, 220/240 V ±10%

48-66 Hz, 360-420 Hz automatically sensed

< 30 W, < 80 VA (peak)

Fused: 1.5 @ 115 V or 0.5 A @230 V

Designed in Accordance with

Safety: IEC 348, UL1244, CSA

EMI:FTZ 1046, FCC part 15-J

Classification: Classified
under MIL-T-2880D as Type III,
Class 5, Style E, and Color R.

Warranty Period

One year

Input Terminals

Gold-plated Tellurium Copper

Included with 3458A

Test Lead Set (34118B)

Power Cord

Operating Manual (P/N 03458-90004)

Calibration Manual (P/N 03458-90016)

Assembly Level Repair Manual (P/N 03458-90010)

Quick Reference Guide (P/N 03458-90005)

Field Installation Kits

Option 001 Extended Reading Memory

Part Number

03458-87901

Option 002 High Stability Reference

03458-80002

Extra Keyboard Overlays (5 each)

03458-84303

Available Documentation

Product Note 3458A-1: Optimizing Throughput and Reading Rate

Part Number

5953-7058

Product Note 3458A-2: High Resolution Digitizing with the 3458A

5953-7059

Product Note 3458A-3: Electronic Calibration of the 3458A

5953-7060

Extra Manual Set

03458-90100

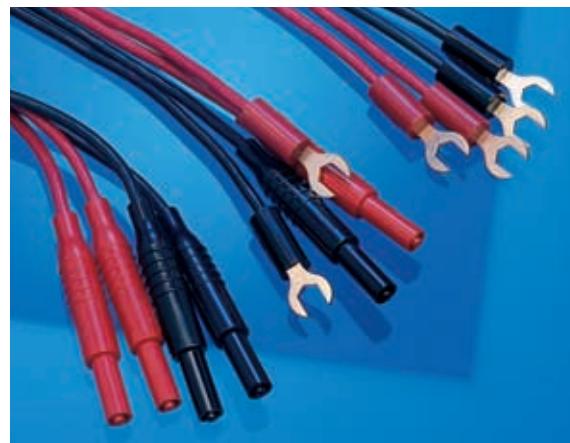
Agilent 3458A Multimeter

(with GPIB, 20k bytes reading memory, and 8 ppm stability)

Option 001	Extended Reading Memory (Expands total to 148 k bytes)
Option 002	High Stability (4 ppm/year) Reference
Option 1BP	MIL-STD-45662A Certificate of Calibration - with data
Option W30	Three year customer return repair coverage
Option W32	Three year customer return calibration coverage
Option 907	Front Handles Kit (P/N 5062-3988)
Option 908	Rack Mount Kit (P/N 5062-3974)
Option 909	Rack Mount Kit with handles (P/N 5062-3975)

Accessories

10833A	GPIB Cable (1m)
10833B	GPIB Cable (2m)
10833C	GPIB Cable (4m)
10833D	GPIB Cable (0.5m)
34118B	Test Lead Set
11053A	Low thermal test lead pair, spade lug to spade lug, 0.9 m
11174A	Low thermal test lead pair, spade lug to banana, 0.9 m
11058A	Low thermal test lead pair, banana to banana, 0.9 m
34301A	700 MHz Rf Probe
34300A	40 kV ac/dc High Voltage Probe
34119A	5 kV dc/ac 1 MHz High Voltage Probe
34302A	Clamp-on ac/dc Current Probe (100A)
11059A	Kelvin Probe Set (4-wires, 1 m)
11062A	Kelvin Clip Set (2 each)

Top: Low thermal test leads**Bottom:** Kelvin probe and clip set

34401A Multimeter

- 6.5 digits of resolution
- 15 ppm basic 24-hr accuracy
- 11 measurement functions
- 1,000 readings per second
- GPIB and RS-232 standard

*Agilent offers a full line
of affordable, high
performance DMMs
from 3.5 digit Handhelds
to the 8.5 digit 3458A. Please
consult your T&M catalog
or contact the nearest
Agilent Technologies sales
office for more information.*

The new standard in price/performance

If you are looking for an affordable, high performance DMM, look no further. The 34401A brings you all the performance you expect from Agilent Technologies, but at a price that will surprise you.

Uncompromised performance

The 34401A combines a powerful measurement engine with an advanced feature set. The results are impressive: 6.5 digits of resolution, 1,000 readings per second, 11 measurement functions, standard GPIB and RS-232, built-in limit test, and room for 512 readings in volatile memory. The 34401A is at home either on your bench or in your test system.

Affordable workhorse

By leveraging 3458A measurement technology, replacing piles of discrete chips with custom ICs, and by designing for manufacturability, we have eliminated costs without sacrificing reliability. The 34401A has a proven track record, with tens of thousands of units in the field today and an actual MTBF of over 150,000 hours. With numbers like that, chances are you'll retire before it does.

**6.5 digit accuracy
at a 5.5 digit price...
the 34401A
Multimeter**



34420A **Nanovolt/Micro-ohm meter**

- 7.5 digits of resolution
- 100 pV/100 nΩ of sensitivity
- 8 nVpp noise
- Built-in two channel dcV scanner
- ITS-90 temperature, including SPRTs

Take the uncertainty out of your low-level measurements

When every nanovolt counts, look to the 34420A for its low-noise, accuracy, and reliability. Low-noise input amplifiers and a highly tuned input protection scheme bring reading noise down to 8 nVpp—half that of other nanovolt meters in its class. Now add 100 pV/100 nΩ of sensitivity, 2 ppm basic 24-hr dcV accuracy, and 7.5 digits of resolution, and you've got accurate, repeatable measurements you can rely on month after month.

More measurements for your money

Most existing nanovoltmeters measure only nanovolts. However, the 34420A provides a more complete solution for meeting your low-level needs. We've added a high precision current source to enable resistance measurements from 100 nΩ to 1 MΩ, all without the hassle and expense of an external supply. We've also included ITS-90 conversion routines so you can read thermocouples, thermistors, and RTDs—even SPRTs—directly in degrees. And if that isn't enough, a built-in two channel scanner allows automated dcV ratio and difference measurements. Better still, the 34420A offers all this functionality for less than what you are used to paying for nanovolt-only products.



**Nanovolt performance
at a Microvolt price...
the 34420A**
Nanovolt/Micro-Ohm Meter

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you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage

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(tel) (305) 269 7500

(fax) (305) 269 7599

Australia:

(tel) 1 800 629 485

(fax) (61 3) 9272 0749

New Zealand:

(tel) 0 800 738 378

(fax) (64 4) 495 8950

Asia Pacific:

(tel) (852) 3197 7777

(fax) (852) 2506 9284

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