DATA SHEET

3458A Multimeter

Reliably-Accurate Measurement Every Time

A System Multimeter with BOTH High Speed and High Accuracy

The Keysight Technologies, Inc. 3458A multimeter shatters longstanding 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 Keysight. 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.

Select a reading rate of 100,000 readings/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 Keysight multimeter language (ML) and the 3458A's simplicity of operation and you have the ideal multimeter for your most demanding applications.

KEYSIGHT TECHNOLOGIES

Access Speed and Accuracy Through a Powerful, Convenient Front Panel

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/AC 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

The 3458A Multimeter for:

High test system throughput

Faster testing

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

Greater test yield

- More accuracy for tighter test margins
- Up to 8.5 digits resolution

Longer up-time

- Two-source (10 V, 10 kΩ) calibration, including AC
- Self-adjusting, self-verifying auto-calibration for all functions and ranges

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

For high test system throughput

The Keysight 3458A system multimeter heightens test performance in three phases of your production test: faster test system startup, 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 Keysight 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 digits DC volts measurements at 100,000/second, to 8.5 digits DC volts measurements at 6/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/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/second. This is at least five times faster than other DMMs. In addition, the 3458A transfers high speed measurement data over GPIB or into and out of its 75,000 readings memory at 100,000 readings/second.

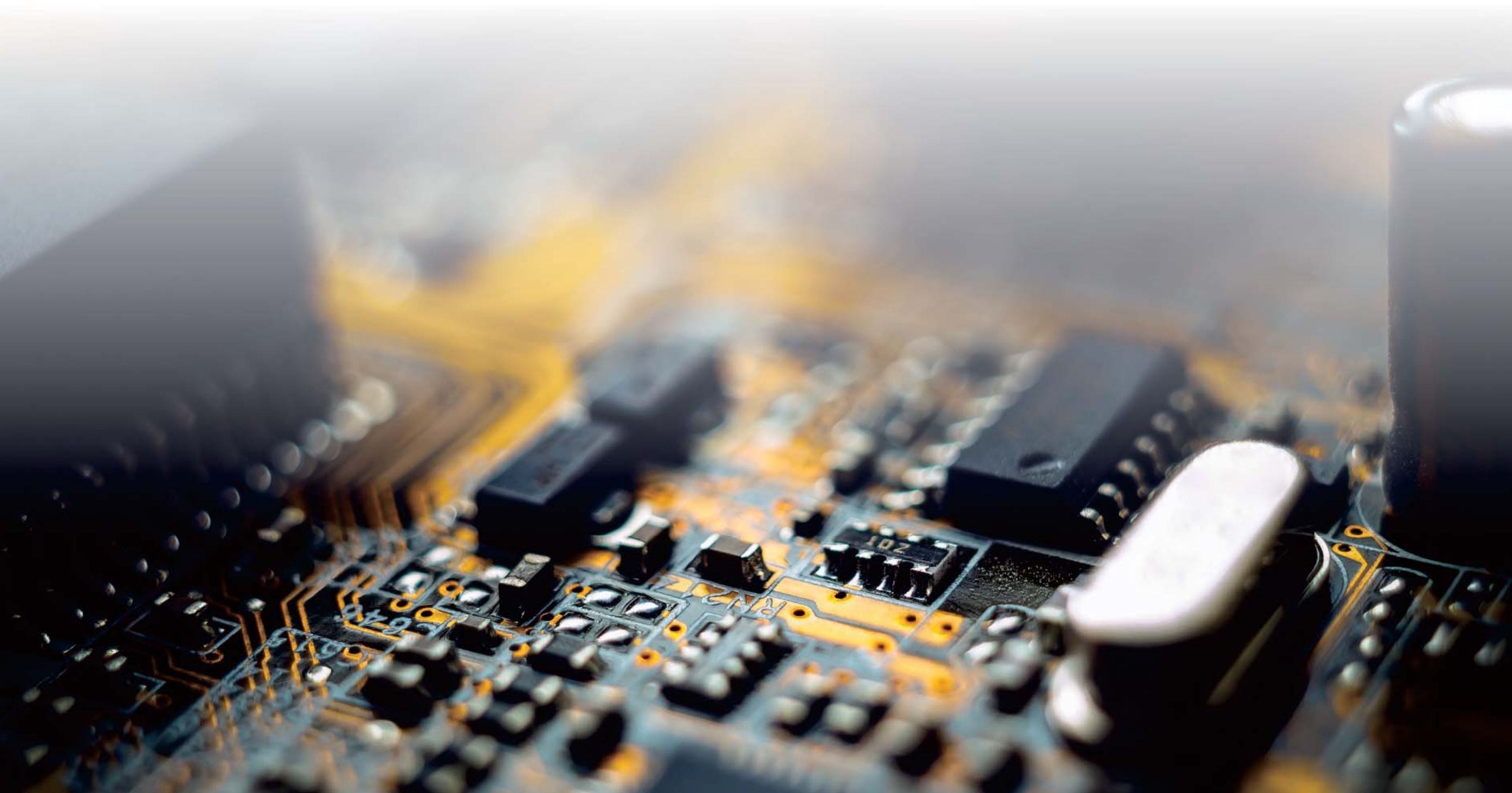
You can reduce your data transfer overhead by using the unique nonvolatile program memory of the 3458A to store complete measurement sequences. These test sequences can be programmed and initiated from the front panel for stand-alone operation without a controller.

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 Keysight's "10X" 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 additional years of return-to-repair.



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 multi-slope 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 ± 0.5°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 μΩ to 1 GΩ with midrange accuracy of 2.2 ppm.

Finally, the 3458A, like its DMM predecessors, offers offset-compensated ohms on the 10 Ω to 100 kΩ 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 1 Hz 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 volts 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, 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 VDC source and a precision 10 kΩ 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.

For high resolution digitizing

Easily acquire waveforms

Simple, application-oriented commands in the Keysight 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 500 ns 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, 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 µs 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

Introduction

The Keysight 3458A accuracy is specified as a part per million (ppm) of the reading plus a ppm of range for DCV, ohms, and DCI. In ACV and ACI, 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 2 ppm.

Caution: This is a sensitive measurement apparatus by design and may have some performance loss when exposed to ambient continuous electromagnetic phenomenon.

EXAMPLE 1:

Relative accuracy; 24-hour operating temperature is Tcal ± 1°C

Assume that the ambient temperature for the measurement is within ± 1°C of the temperature of calibration (Tcal). 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 x 10 V) + (0.05/1,000,000 x 10 V) = ± 5.5 µV or 0.55 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 ± 1°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

Tcal = 23°C

90-day accuracy specifications

EXAMPLE 2:

Operating temperature is 28°C; with ACAL

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

(4.1 ppm x 10 V) + (0.05 ppm x 10 V) = 42 μV

Total relative error = 42 μV

EXAMPLE 3:

Operating temperature is 38°C; without ACAL

The operating temperature of the 3458A is 38°C, 14°C beyond the range of Tcal ± 1°C. Additional measurement errors result because of the added temperature coefficient without using ACAL.

(4.1 ppm x 10 V) + (0.05 ppm x 10 V) = 42 μV

Temperature coefficient (specification is per °C):

(0.5 ppm x 10 V + 0.01 ppm x 10 V) x 14°C = 71 μV

Total error = 113 μV

EXAMPLE 4:

Operating temperature is 38°C; with ACAL

Assuming the same conditions as Example 3, using ACAL significantly reduces the error due to temperature difference from calibration temperature. Operating temperature is 10 ºC beyond the standard range of Tcal ± 5 ºC.

(4.1 ppm x 10 V) + (0.05 ppm x 10 V) = 42 μV

Temperature coefficient (specification is per ºC):

(0.15 ppm x 10 V + 0.01 ppm x 10 V) x 10°C = 16 μV

Total error = 58 μV

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 ppm x 10 V) + (0.05 ppm x 10 V) = 42 μV

Temperature coefficient (specification is per °C):

(0.15 ppm x 10 V + 0.01 ppm x 10 V) x 10 ºC = 16 μV

factory traceability error of 2 ppm:

(2 ppm x 10 V) = 20 μV

Total absolute error = 78 μV

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°C; 0.1 PLC

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

(4.1 ppm x 10 V) + (0.05 ppm x 10 V) = 42 μV

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

(2 ppm x 10 V) + (0.4 ppm x 1 x 3 x 10 V) = 32 μV

Total relative error = 74 μV

DC Voltage

DC voltage

Range	Full scale	Maximum resolution	Input impedance	Temperature coefficient (ppm of reading + ppm of range) / ºC	
				Without ACAL[1]	With ACAL[2]
100 mV	120.00000	10 nV	> 10 GΩ	1.2 + 1	0.15 + 1
1 V	1.20000000	10 nV	> 10 GΩ	1.2 + 0.1	0.15 + 0.1
10 V	12.0000000	100 nV	> 10 GΩ	0.5 + 0.01	0.15 + 0.01
100 V	120.000000	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

Accuracy[3] **[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

1. Additional error from Tcal or last ACAL ± 1ºC.
2. Additional error from Tcal ± 5 ºC.
3. Specifications are for PRESET; NPLC 100.
4. For fixed range (> 4 min.), MATH NULL and Tcal ± 1ºC
5. Specifications for 90-day, 1 year and 2 year are within 24-hours and ± 1ºC of last ACAL; Tcal ± 5^{0}C; MATH NULL and fixed range.

   ppm of reading specifications for high stability (Option 002) are in parentheses.

   Without MATH NULL, add 0.15 ppm of range to 10 V, 0.7 ppm of range to 0.1V. Without MATH NULL and for fixed range less than 4 minutes, add 0.25 ppm of range to 10 V, 1.7 ppm of range to 1 V and 17 ppm of range to 0.1 V.

   Add 2 ppm pf reading additional error for factory traceability to US NIST. Traceability error is the absolute error relative to National Standard associated with the source of last external calibration.

6. Add 12 ppm X $(Vin / 1000)^2$ additional error for inputs > 100vV.

DC Voltage Continued

Transfer accuracy/linearity

Range	10 min, Tref ± 0.5 ºC (ppm of reading + ppm of range)
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

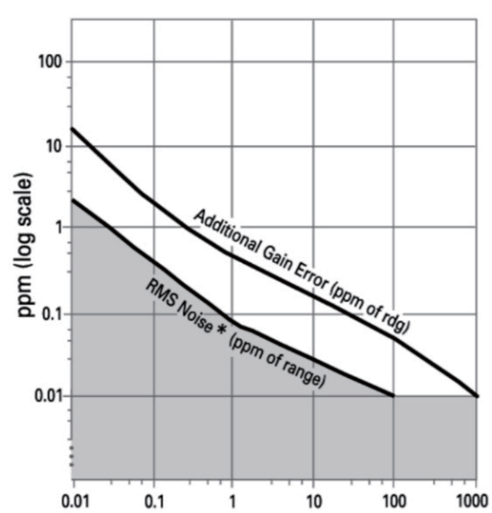
Conditions
- Following 4-hour warm-up. Full scale to 10% of full scale.
- Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling.
- Tref is the starting ambient temperature.
- Measurements are made on a fixed range (> 4 min.) using accepted metrology practices.

Settling characteristics

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

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

Additional errors



Integration time in number power line cycles (NPLC, log scale)

DC Voltage Continued

Noise rejection (dB)[1]

	AC NMR[2]	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

1. Applies for 1 kΩ unbalance in the *LO* lead and ± 0.1% of the frequency currently set for *LFREQ*.
2. 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.

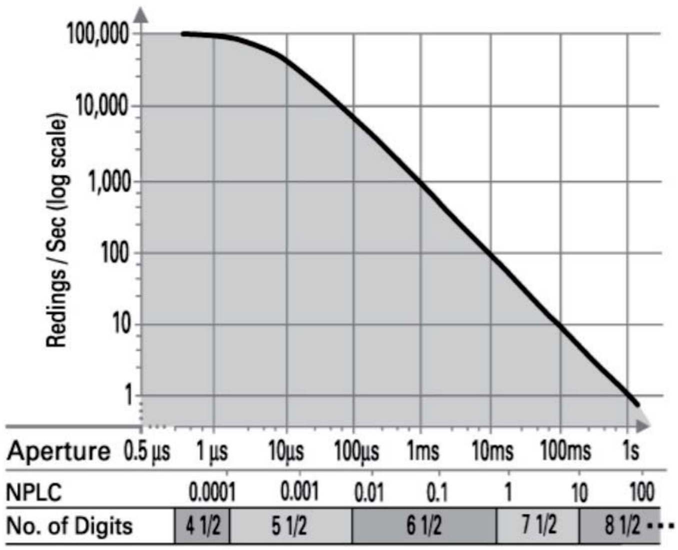
RMS noise

Range	Multiplier
0.1 V	X20
1 V	X2
10 V	X1
100 V	X2
1000 V	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.

DC Voltage Continued

Reading rate *(auto-zero off)*



Integration time (log scale)

Selected reading rates[1]

NPLC	Aperture	Digits	Bits	Readings / s	
				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 NPLC = 1 / 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.

DC Voltage Continued

Temperature coefficient (auto-zero off)

For a stable environment ± 1°C add the following additional error for AZERO OFF

Range	Error
100 mV – 10 V	5 µV/°C
100 V – 1000 V	500 µV/°C

Maximum input

	Rated input	Non-destructive
HI to LO	± 1000 V pk	± 1200 V pk
LO to Guard[1]	± 200 V pk	± 350 V pk
Guard to Earth[2]	± 500 V pk	± 1000 V pk

1. >10^{10} Ω LO to guard with guard open.
2. >10^{12} Ω guard to Earth.

Input terminals

Terminal material: gold-plated tellurium copper
Input leakage current < 20 pA at 25 °C

Resistance

Two-wire and four-wire ohms (OHM and OHMF functions)

Range	Full scale	Maximum resolution	Current source[1]	Test voltage	Open circuit	Maximum load resistance (OHMF)	Maximum series offset (OCOMP ON)	Temperature coefficient (ppm of reading + ppm of range) / °C	
								Without ACAL[2]	With ACAL[3]
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	1.2000000	100 µΩ	1 mA	1.0 V	12 V	150 Ω	0.1 V	3 + 0.1	1 + 0.1
10 kΩ	12.000000	1 mΩ	100 µA	1.0 V	12 V	1.5 kΩ	0.1 V	3 + 0.1	1 + 0.1
100 kΩ	120.00000	10 mΩ	50 µA	5.0 V	12 V	1.5 kΩ	0.5 V	3 + 0.1	1 + 0.1
1 MΩ	1.2000000	100 mΩ	5 µA	5.0 V	12 V	1.5 kΩ		3 + 1	1 + 1
10 MΩ	12.000000	1 Ω	500 nA	5.0 V	12 V	1.5 kΩ		20 + 20	5 + 2
100 MΩ[4]	120.00000	10 Ω	500 nA	5.0 V	5 V	1.5 kΩ		100 + 20	25 + 2
1 GΩ[4]	1.2000000	100 Ω	500 nA	5.0 V	5 V	1.5 kΩ		1000 + 20	250 + 2

1. Current source is ± 3% absolute accuracy.
2. Additional error from Tcal or last ACAL ± 1 ºC
3. Additional error from Tcal ± 5 ºC.
4. Measurement is computed from 10 MΩ in parallel with input.

Accuracy[1] (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

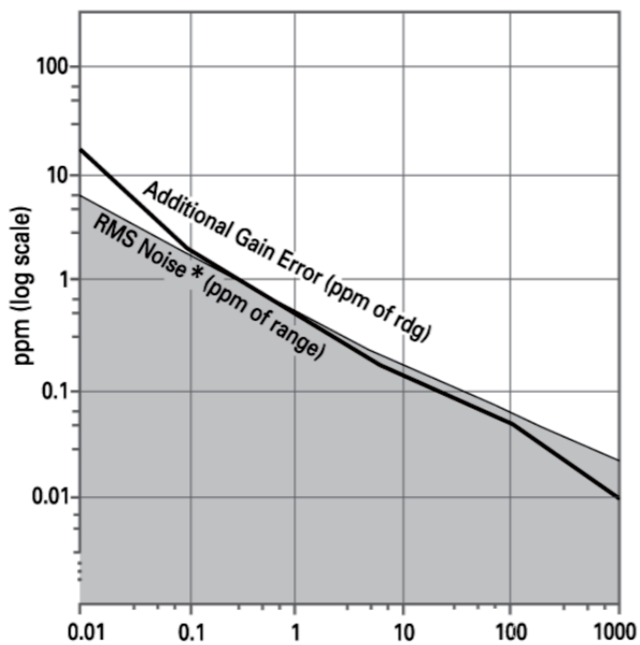
1. Specifications are for PRESET;NPLC 100; OCOMP ON; OHMF.
2. Tcal ± 1 ºC.
3. Specifications for 90-day, 1 year and 2 year are within 24-hours and ± 1ºC of last ACAL; Tcal ± 5ºC. Add 3 ppm of reading additional error for factory traceability of 10 kΩ to US NIST. Traceability is the absolute error relative to National Standards associated with the source of last external calibration.

Resistance Continued

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



Integration time in number power line cycles (NPLC, log scale)

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.

Resistance Continued

Selected reading rates[1]

NPLC[2]	Aperture	Digits	Readings / s	
			A-zero off	A-zero on
0.0001	1.4 µs	4.5	100,000[4]	4,130
0.0006	10 µs	5.5	50,000	3,150
0.01	167 µs[3]	6.5	5,300	930
0.1	1.66 ms[3]	6.5	592	245
1	16.6 ms[3]	7.5	60	29.4
10	0.166 s[3]	7.5	6	3
100		7.5	36/min	18/min

1. For PRESET;DELAY 0; DISP OFF; OFORMAT DINT; ARANGE OFF.
   For OHMF or OCOMP ON, the maximum reading rates will be slower.
2. 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.
3. 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.
4. For OFORMAT SINT.

Measurement consideration

Keysight recommends the use of PTFE (Polytetrafluoroethylene) cable or other high impedance, low dielectric absorption cable for these measurements.

Maximum input

	Rated input	Non-destructive
HI to LO	± 1000 V pk	± 1000 V pk
HI & LO sense to LO	± 200 V pk	± 350 V pk
LO to guard	± 200 V pk	± 350 V pk
Guard to Earth	± 500 V pk	± 1000 V pk

Resistance Continued

RMS noise

Range	Multiplier
10 Ω & 100 Ω	X10
1 kΩ 10 100 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.

Temperature coefficient (auto-zero off)

For a stable environment ± 1ºC add the following additional error for AZERO OFF. (ppm of range)/ ºC

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

DC Current

DC current (DCI function)

Range	Full scale	Maximum resolution	Shunt resistance	Burden voltage	Temperature coefficient (ppm of reading + ppm of range) / ºC	
					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	12.000000	1 nA	10 Ω	0.100 V	10 + 2	2 + 1
100 mA	120.00000	10 nA	1 Ω	0.250 V	25 + 2	2 + 1
1 A	1.0500000	100 nA	0.1 Ω	< 1.5 V	25 + 3	2+ 2

Accuracy[3] (ppm of reading + ppm of 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	10 + 40	15 + 40	20 + 40	25 + 40
10 µA	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

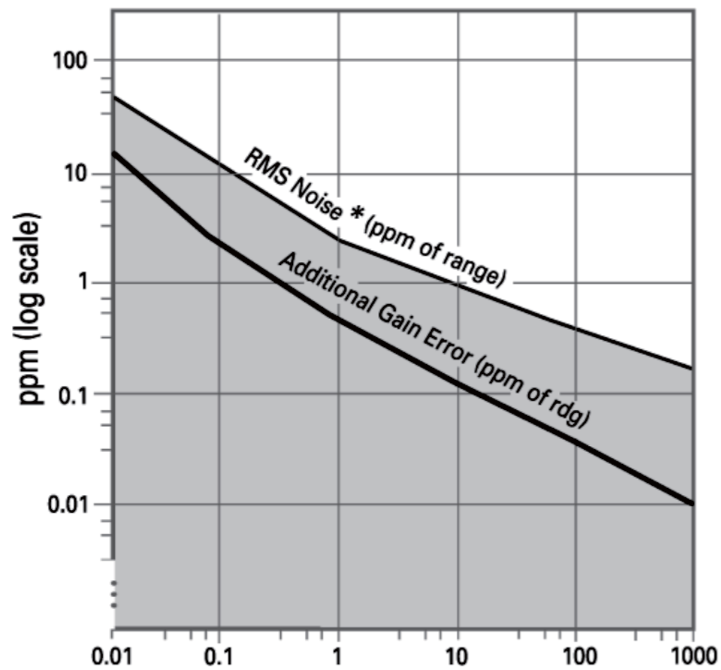
1. Additional error from Tcal or Last ACAL ± 1ºC.
2. Additional error from Tcal ± 5ºC.
3. Specifications are for PRESET;NPLC 100.
4. Tcal ± 1ºC.
5. Specifications for 90-day, 1 year, and 2 year are within 24-hours and ± 1ºC of last ACAL; Tcal ± 5ºC. Add 5 ppm of reading additional error for factory traceability to US NIST. Traceability error is the sum of the 10 V and 10 kΩ traceability values.
6. Typical accuracy.

DC Current Continued

Settling characteristics

For first reading or range change error, add 0.001% of input current step additional error. Reading settling times can be affected by source impedance and cable dielectric absorption characteristics.

Additional errors



Integration time in number power line cycles (NPLC, log scale)

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.

DC Current Continued

Selected reading rates[1]

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

Measurement considerations

Keysight recommends the use of PTFE 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.

AC Voltage

General information

The Keysight 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 / second	
				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

AC Voltage Continued

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	12.00000	10 nV	1 MΩ ± 15% with <140pF	0.002 + 0.02
100 mV	120.00000	10 nV	1 MΩ ± 15% with <140pF	0.001 + 0.0001
1 V	1.2000000	100 nV	1 MΩ ± 15% with <140pF	0.001 + 0.0001
10 V	12.000000	1 µV	1 MΩ ± 2% with <140pF	0.001 + 0.0001
100 V	120.00000	10 µV	1 MΩ ± 2% with <140pF	0.001 + 0.0001
1000 V	700.0000	100 µV	1 MΩ ± 2% with <140pF	0.001 + 0.0001

AC accuracy[2]

24-hour to 2 year (% of reading + % of range)

	ACBAND ≤ 2 MHz							
Range	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 – 10V	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			

1. Additional error beyond ± 1ºC, but within + 5ºC 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 ± 1ºC of last ACAL Lo to guard switch on. Peak (AC + DC) input limited to 5x full scale for all ranges in ACV function. Add 2ppm of reading additional error for factory traceability of 10 V DC to US NIST.
3. LFILTER ON recommended.

	ACBAND > 2 MHz				
Range	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 – 10V	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				

AC Voltage Continued

Transfer accuracy

Range	% of reading
100 mV - 100 V	(0.002 + resolution in %) [1]

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

   Conditions
   - Following 4-hour warm-up
   - Within 10 min and ± 0.5ºC of the reference measurement
   - 45 Hz to 20 kHz, sine wave input
   - Within ± 10% of the reference voltage and frequency

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 ≤ 2 MHz	ACBAND > 2 MHz	Temperature coefficient [2]
10 mV	0.09	0.09	0.03
100 mV – 1000V	0.008	0.09	0.0025

DC > 10% of AC voltage			
Range	ACBAND ≤ 2 MHz	ACBAND > 2 MHz	Temperature coefficient [2]
10 mV	0.7	0.7	0.18
100 mV – 1000V	0.07	0.7	0.025

2. Additional error beyond ± 1ºC, but within ± 5ºC of last ACAL (% of Range)/ºC. For ACBAND > 2 MHz, use 10 mV range temperature coefficient Lo to Guard switch on.

Additional errors

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

	Input frequency [3]			
Source	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.

AC Voltage Continued

Reading rates [1]

ACBAND low	Maximum second / 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 second / 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

1. Reading time is the sum of the second / 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; ARANGE 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 ± 5ºC add the following error. (% of reading) / ºC

	Frequency	
Range	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	± 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	$1x10^8$	

AC Voltage Continued

Analog mode (ACV function, SETACV ANA)

Range	Full scale	Maximum resolution	Input impedance	Temperature coefficient[1] (% of reading + % of range)/ °C
10 mV	12.00000	10 nV	1 MΩ ± 15% with < 140 pF	0.003 + 0.006[2]
100 mV	120.0000	100 nV	1 MΩ ± 15% with < 140 pF	0.002 + 0.0
1 V	1.200000	1 µV	1 MΩ ± 15% with < 140 pF	0.002 + 0.0
10 V	12.00000	10 µV	1 MΩ ± 2% with < 140 pF	0.002 + 0.0
100 V	120.0000	100 µV	1 MΩ ± 2% with < 140 pF	0.002 + 0.0
1000 V	700.000	1 mV	1 MΩ ± 2% with < 140 pF	0.002 + 0.0

AC accuracy[3]

24-hour to 2 year (% of reading + % of range)

	ACBAND ≤ 2 MHz									
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	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)

	DC < 10% of AC voltage		DC > 10% of AC voltage	
Range	Accuracy	Temperature coefficient [4]	Accuracy	Temperature coefficient [4]
10 mV	0.0 + 0.2	0 + 0.015	0.15 + 3	0 + 0.06
100 mV – 1000V	0.0 + 0.02	0 + 0.001	0.15 + 0.25	0 + 0.007

1. Additional error beyond ± 1°C, but within ± 5°C of last ACAL.
2. Specifications apply full scale to ¼ full scale.
3. Specifications apply full scale to 1/20 full scale, sinewave input, crest factor = 1.4, and PRESET. Within 24-hours and ± 1°C of last ACAL. Lo to guard switch on. Maximum DC is limited to 400 V in ACV functions. Add 2 ppm of reading additional error for factory traceability of 10 V DC to US NIST.
4. Additional error beyond ± 1°C, but within ± 5°C of last ACAL. (% of Reading + % of Range)/ °C

AC Voltage Continued

Additional errors

Apply the following additional errors as appropriate to your 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

Reading rates [1]

		Second / reading	
ACBAND low	NPLC	ACV	ACDC
≥ 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 / second are possible.

Common mode rejection

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

AC Voltage Continued

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	ACBAND low	DC component	Settling time
ACV	≥ 10 kHz	DC < 10% AC	0.5 sec to 0.01%
		DC > 10% AC	0.9 sec to 0.01%
ACDC	10 Hz – 1 kHz		0.5 second 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	$1x10^8$	

Random sampled mode (ACV function, SETACV RNDM)

Range	Full scale	Maximum resolution	Input impedance	Temperature coefficient [1] (% of reading + % of range)/ °C
10 mV	12.00000	1 µV	1 MΩ ± 15% with < 140 pF	0.002 + 0.02
100 mV	120.0000	10 µV	1 MΩ ± 15% with < 140 pF	0.001 + 0.00001
1 V	1.200000	100 µV	1 MΩ ± 15% with < 140 pF	0.001 + 0.00001
10 V	12.00000	1 mV	1 MΩ ± 2% with < 140 pF	0.001 + 0.00001
100 V	120.0000	10 mV	1 MΩ ± 2% with < 140 pF	0.001 + 0.00001
1000 V	700.000	100 mV	1 MΩ ± 2% with < 140 pF	0.001 + 0.00001

1. 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 Voltage Continued

AC accuracy [1]

24-hour to 2 year (% of reading + % of range)

	ACBAND ≤ 2 MHz				ACBAND > 2 MHz				
Range	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				

AC + DCV accuracy (ACDCV function)

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

	DC ≤ 10% of AC voltage			DC > 10% of AC voltage		
Range	ACBAND ≤ 2 MHz	ACBAND > 2 MHz	Temperature coefficient	ACBAND ≤ 2 MHz	ACBAND > 2 MHz	Temperature coefficient [2]
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 measurement setup (% of reading)

	Input frequency [3]			
Source R	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 – 2	(Resolution in %) x 1
2 – 3	(Resolution in %) x 3
3 – 4	(Resolution in %) x 5
4 – 5	(Resolution in %) x 8

1. 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 ± 1ºC 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.
2. Additional error beyond ± 1ºC, but within ± 5ºC of last ACAL. (% of reading) / ºC. For ACBAND > 2 MHz, use 10 mV range temperature coefficient for all ranges.
3. Flatness error including instrument loading.

Common mode rejection

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

AC Voltage Continued

Reading rate [1]

	Second / reading	
% resolution	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	0.22

1. For DELAY -1; ARANGE OFF. For DELAY 0 in ACV, the reading rated are identical to ACDCV.

High frequency temperature coefficient

For outside Tcal ± 5 ºC add the following error (% of reading)/ ºC

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% AC	0.5 sec to 0.01%
	DC > 10% AC	0.9 sec to 0.01%
ACDC	No instrument settling required	

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	1×10^8	

AC Current

AC current (ACI and ACDCI functions)

Range	Full scale	Maximum resolution	Shunt resistance	Burden voltage	Temperature coefficient [1] (% of reading + % of range)/ ºC
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 accuracy [2]

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 5 kHz	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 + 0.001	0.15 + 0.25	0.0 + 0.007

1. Additional error beyond ± 1ºC, but within ± 5ºC 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 ± 1ºC 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.
5. Additional error beyond ± 5ºC of last ACAL (% of reading + % of range)/ºC.

AC Current Continued

Additional errors

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

Low frequency errors

	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

Reading rates [1]

		Maximum second /reading	
ACBAND low	NPLC	ACI	ACDCI
≥ 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/second are possible.

AC Current Continued

Settling characteristics

For first reading or range change error using default delays, add 0.01% of input step additional error for the 100 µA to 100 mA ranges. For the 1 A range, add 0.05% 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

Frequency/Period

Frequency / period characteristics

	Voltage (AC or DC coupled) ACV or ACDCV function [1]	Current (AC or DC coupled) ACI or ACDCI function [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]

1. The source of frequency measurements and the measurement input coupling are determined by FSOURCE command.
2. Gate dependent, see ACI for specific range impedance values.

Accuracy

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

Frequency/Period Continued

Reading rates

Resolution	Gate time [1]	Readings/second [2]
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

1. Gate time is determined by the specific measurement resolution.
2. The maximum input specified to fixed range operation. For auto range, the maximum speed is 30 readings/second 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 second.

Measurement technique:

Reciprocal counting

Time base:

10 MHz ± 0.01%, 0 ºC to 55 ºC

Level trigger

± 500% of range in 5% steps

Trigger filter:

Selectable 75 kHz low pass trigger filter

Slope trigger:

Positive or negative

Digitizing

General information

The Keysight 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 second 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)

Digitizing Continued

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

DC performance

0.005 % of reading + offset [1]

Maximum sample rate (see DCV for more data)

Readings / second	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

External trigger

Latency: < 175 ns [2] Jitter: < 50 ns rms

Level trigger

Latency: < 700 ns Jitter: < 50 ns rms

1. ± 1ºC of an AZERO or within 24-hours and ± 1ºC of last ACAL.
2. < 125 ns variability between multiple 3458As.

Digitizing Continued

Dynamic performance

100 mV, 1 V, 10 V ranges aperture = 6 µs

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 MΩ with 140 pF	< 50 µV	2 MHz
100 mV	1 MΩ with 140 pF	< 90 µV	12 MHz
1 V	1 MΩ with 140 pF	< 800 µV	12 MHz
10 V	1 MΩ with 140 pF	< 8 mV	12 MHz
100 V	1 MΩ with 140 pF	< 80 mV	12 MHz [3]
1000 V	1 MΩ with 140 pF	< 800 mV	2 MHz [3]

DC to 20 kHz performance

0.02% 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

1. Maximum DC voltage limited to 400 V DC in DSAC or SSAC functions.
2. ± 1ºC and within 24-hours of last ACAL ACV.
3. Limited to 1 x 10 8 V-Hz product.
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.

Digitizing Continued

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

Sample timebase

Accuracy: 0.01%

Jitter: < 100 ps rms

External trigger

Latency: < 1275 ns [1]

Jitter: < 2 ns rms

Level trigger

Latency: < 700 ns

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

1. < 25 ns variability between multiple 3458As.

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 ≤ 10 V to DCV ≤ 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

Selected operating rates [2]

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

Memory

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

1. Using HP 9000 Series350
2. SINT data is valid for APER ≤ 10.8 µs.

System Specifications Continued

Delay time

Accuracy	± 0.01% ± 5 ns
Maximum	6000 s
Resolution	10 ns
Jitter	50 ns pk-pk

Timer

Accuracy	± 0.01% ± 5 ns
Maximum	6000 s
Resolution	10 ns
Jitter	< 100 ps rms

Ratio

Types of ratio [1]

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)

Accuracy

± (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

1. All SETACV measurement types are selectable. LO sense to LO limited to ± 0.25 V.

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 x 10^{-37} + 1.0 X 10^{37}. Out of range values indicate OVLD in the display and 1 x 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 µs

SCALE:

(X-OFFSET)/SCALE

Minimum execution time = 500 µs

PERC:

100 x (X-PERC) / PERC

Minimum execution time = 600 µs

PFAIL:

Based on MIN, MAX registers

Minimum execution time = 160 µs

dB:

20 x Log (X/REF)

Minimum execution time = 3.9 ms

dBm:

10 x Log [(X^2 / 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 µs

STAT:

MEAN, SDEV computed for sample

Population (N-1).

NSAMP, UPPER, LOWER accumulated.

Minimum execution time = 160 µs

CTHRM (FTHRM):

ºC (ºF) temperature conversion for

5 kΩ thermistor (40653B)

Minimum execution time = 160 µs

Math Functions Continued

CTHRM2K (FTHRM2K):

ºC (ºF) temperature conversion for

2.2 kΩ thermistor (40653A).

Minimum execution time = 160 µs

CTHRM10K (FTHRM10K):

ºC (ºF) temperature conversion for

10 kΩ thermistor (40653C).

Minimum execution time = 160 µs

CRTD85 (FRTD85):

ºC (ºF) temperature conversion for

RTD of 100 Ω, Alpha = 0.00385

(40654 or 40654B).

Minimum execution time = 160 µs

CRTD92 (FRTD92):

ºC (ºF) temperature conversion for

RTD of 100 Ω, alpha = 003916

Minimum execution time = 160 µs

General Specifications

Operating environment	Full accuracy at 0 to 55 °C
Operating humidity range	Full accuracy to 95% RH at 40 °C (non-condensing) Full accuracy to 40% RH for 41 °C to 55 °C (non-condensing)
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-4888 interface	Complies with the following: IEEE-488.1 Interface Standard IEEE-728 Codes/Formats Standard HPML (multimeter language)
Storage temperature	- 40 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 61010-1:2010/EN 61010-1:2010; IEC 61010-2-030:2010/EN61010-2-030:2010 Canada: CAN/CSA-C22.2 No.61010-1-12; CAN/CSA-C22.2 No. 61010-2-030-12 USA: ANSI/UL Std. No. 61010-1:2012; ANSI/UL Std No.61010-2-030:2012 7n: Classified under MIL-T-28800D as Type III, Class 5, Style E, and Color R
Input terminal	Gold-plated tellurium copper
Included with 3458A	34137A test lead set for 3458A Certificate of calibration

Ordering Information

Keysight 3458A multimeter

(with GPIB, 148 k bytes reading memory, and 8 ppm stability)

3458A-002	**High stability (4 ppm/year) reference**
3458A-H01	**Special 1000 vrms ac maximum input voltage**
3458A-A6J	**ANSI Z540 compliant calibration**
3458A-OGC	**Precision calibration, intended for metrology use only**
3458A-907	**Front handles kit (P/N 5063-9226)**
3458A-908	**Rack mount kit (P/N 5063-9212)**
3458A-909	**Rack mount kit with handles (P/N 5063-9219)**

Note: The 148 k bytes reading memory (option 001) is now standard with the new 3458A.

Learn more at: www.keysight.com

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