

Keysight 3458A Multimeter

Shattering performance barriers of speed and accuracy

Data Sheet



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 G Ω
- Two-wire and four-wire ohms with offset compensation
- Up to 50,000 readings/sec (5.5 digits)
- Maximum sensitivity: 10 $\mu\Omega$
- 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 μ A 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

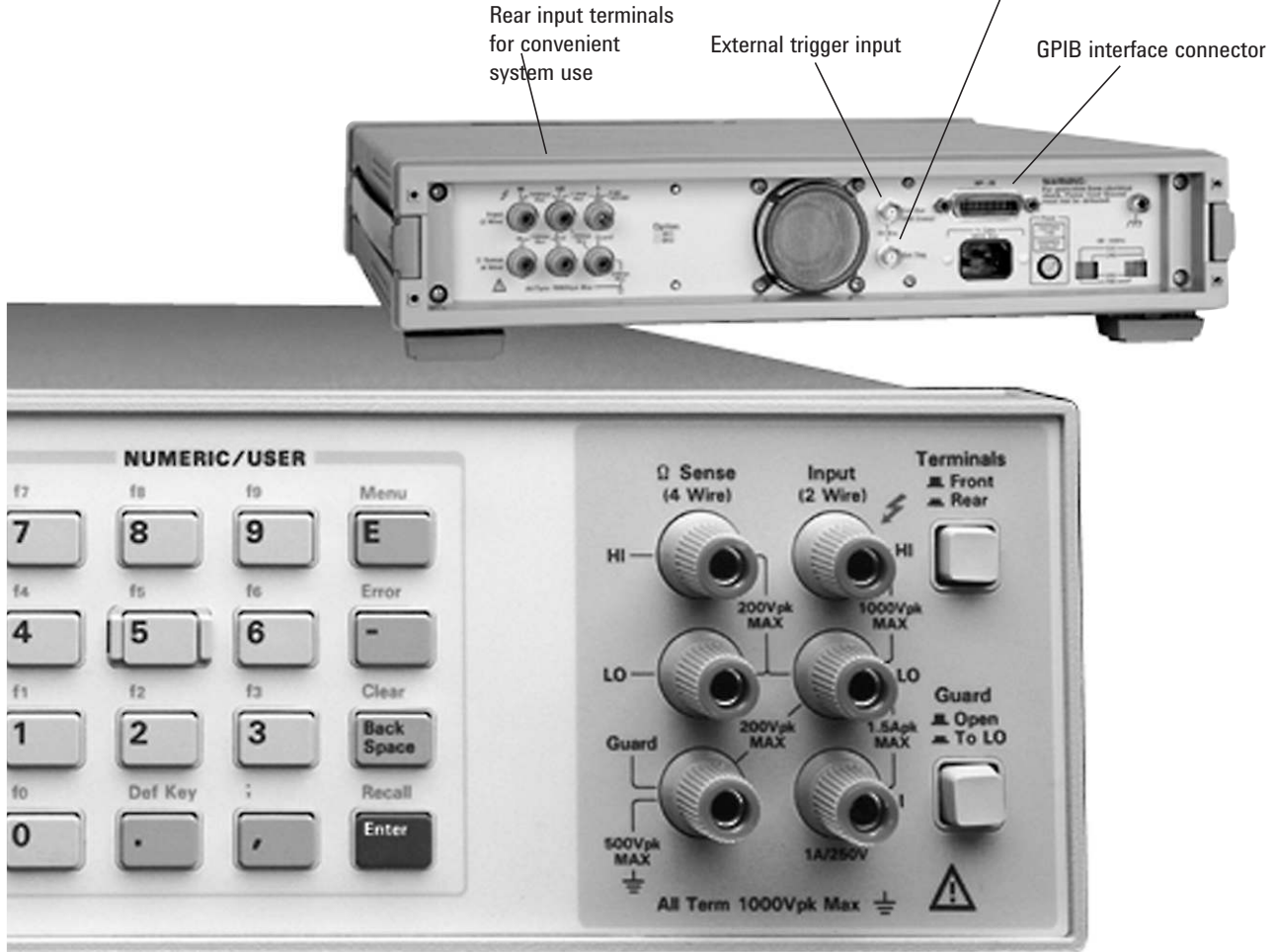
- For maximum common mode noise rejection

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



A System Multimeter with BOTH High Speed and High Accuracy

The Keysight Technologies, Inc. 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 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.

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The 3458A Multimeter for:

High test system throughput

Faster testing

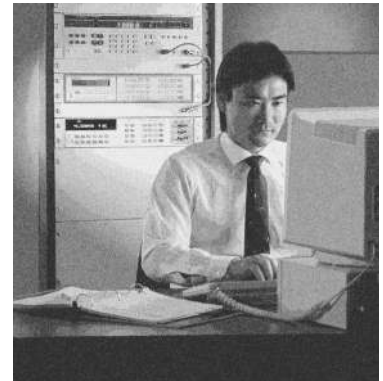
- Up to 100,000 readings/sec
- Internal test setups > 340/sec
- Programmable integration times from 500 ns to 1 sec

Greater test yield

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

Longer up-time

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



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

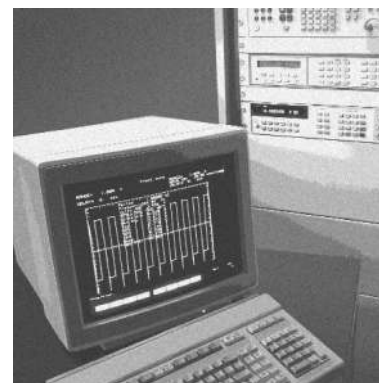
- 0.6 ppm for 24 hours in DC volts
- 2.2 ppm for 24 hours in ohms
- 100 ppm mid-band AC volts
- 8 ppm (4 ppm optional) per year voltage reference stability



High resolution digitizing

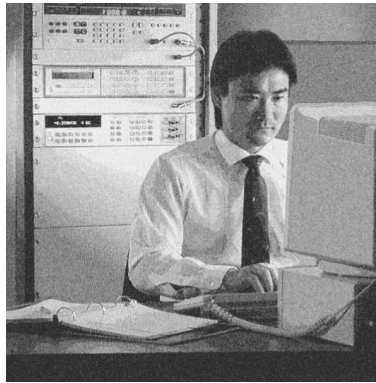
Greater waveform resolution and accuracy

- 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



For High Test System Throughput

- 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
Multimeter Language (ML) compatible



The Keysight 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 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 digit DC volts measurements at 100,000/second, to 8.5 digit 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 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/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.

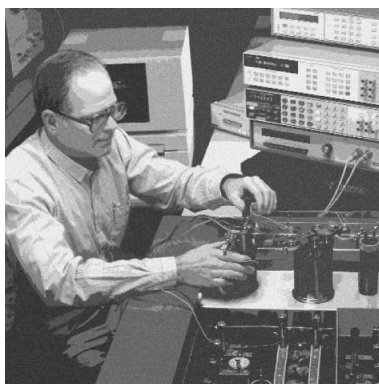
Finally, the 3458A Multimeter makes fast and accurate measurements. Consider the 3458A's 0.6 ppm 24 hour DC volts accuracy, 100 ppm AC volts accuracy and its standard functions of DCV, ACV, DCI, ACI, ohms, frequency and period. Greater measurement accuracy from your dmm means higher confidence and higher 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 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

- 8.5 digits resolution
- 0.1 ppm DCV linearity
- 100 ppm ACV absolute accuracy
- 4 ppm/year optional stability



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 Josephson 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 $\pm 0.5^\circ$ 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 G Ω with midrange accuracy of 2.2 ppm.

Finally, the 3458A, like its dmm predecessors, offers offset-compensated ohms on the 10 Ω to 100 k Ω 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 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, is an excellent choice for high throughput computer-aided testing.

Easy calibration

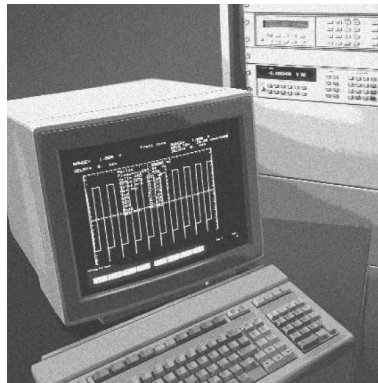
The 3458A gives you low cost of ownership with a simple, two-source electronic calibration. With its superior linearity, the 3458A is fully calibrated, including AC, from a precision 10 VDC source and a precision 10 k Ω resistor. All ranges and functions are automatically calibrated using precise internal 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

- 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



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.

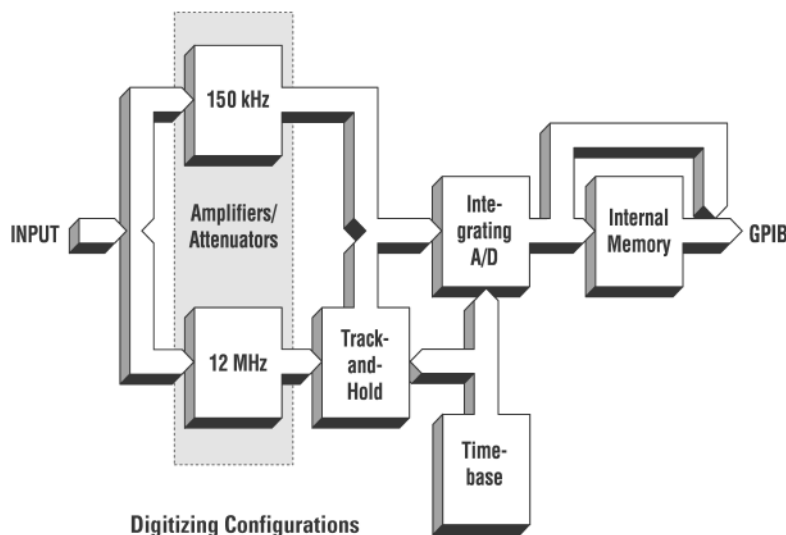
Integration or track-and-hold paths

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, 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 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.

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:

$$0.5 \text{ ppm of Reading} + 0.05 \text{ ppm of Range}$$

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

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

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:

$$\begin{aligned} &10 \text{ V DC input} \\ &10 \text{ V DC range} \\ &T_{\text{cal}} = 23 \text{ }^\circ\text{C} \\ &90 \text{ day accuracy specifications} \end{aligned}$$

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.

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

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.

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

EXAMPLE 4: Operating temperature is 38 °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 °C beyond the standard range of Tcal ±5 °C.

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

EXAMPLE 5: Absolute Accuracy; 90 Day

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

$$\begin{aligned} (4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) &= 42 \mu\text{V} \\ \text{Temperature Coefficient (specification is per } ^\circ\text{C):} \\ (0.15 \text{ ppm} \times 10 \text{ V} + 0.01 \text{ ppm} \times 10 \text{ V}) \times 10 \text{ }^\circ\text{C} &= 16 \mu\text{V} \\ \text{factory traceability error of 2 ppm:} \\ (2 \text{ ppm} \times 10 \text{ V}) &= 20 \mu\text{V} \\ \text{Total absolute error} &= 78 \mu\text{V} \end{aligned}$$

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.

$$\begin{aligned} (4.1 \text{ ppm} \times 10 \text{ V}) + (0.05 \text{ ppm} \times 10 \text{ V}) &= 42 \mu\text{V} \\ \text{Referring to the Additional Errors chart and RMS} \\ \text{Noise Multiplier table, additional error at 0.1 PLC is:} \\ (2 \text{ ppm} \times 10 \text{ V}) + (0.4 \text{ ppm} \times 1 \times 3 \times 10 \text{ V}) &= 32 \mu\text{V} \\ \text{Total relative error} &= 74 \mu\text{V} \end{aligned}$$

Section 1: DC Voltage

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 | 12.0000000 | 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 |

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 |

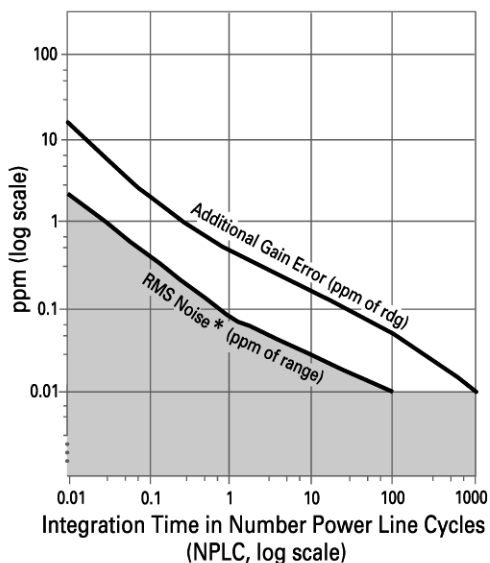
Transfer Accuracy/Linearity

| Range | 10 Min, Tref ± 0.5°C (ppm of Reading + ppm of Range) | Conditions |
|--------|--|--|
| 100 mV | 0.5 + 0.5 | <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. |
| 1 V | 0.3 + 0.1 | |
| 10 V | 0.05 + 0.05 | |
| 100 V | 0.5 + 0.1 | |
| 1000 V | 1.5 + 0.05 | |

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.

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

ppm of Reading specifications for High Stability (Option 002) are in parentheses.

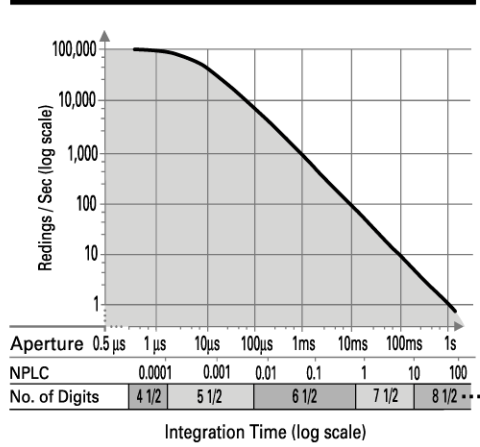
Without MATH NULL, add 0.15 ppm of Range to 10 V, 0.7 ppm of Range to 1 V, and 7 ppm of Range to 0.1V. Without math null and for fixed range less than 4 minutes, add 0.25 ppm of Range to 10 V, 1.7 ppm of Range to 1 V and 17 ppm of Range to 0.1 V.

Add 2 ppm of reading additional error for factory traceability to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration.
- Add 12 ppm X (Vin / 1000)² additional error for inputs > 100 V.

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

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 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.

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: $<20 \text{ pA}$ 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) / $^\circ\text{C}$ | |
|-----------------------------|------------|--------------------|-----------------------------|--------------|--------------|--------------------------------|----------------------------------|--|------------------------|
| | | | | | | | | Without ACAL ⁵ | With ACAL ⁶ |
| 10 Ω | 12.00000 | 10 $\mu\Omega$ | 10 mA | 0.1 V | 12 V | 20 Ω | 0.01 V | 3 + 1 | 1 + 1 |
| 100 Ω | 120.00000 | 10 $\mu\Omega$ | 1 mA | 0.1 V | 12 V | 200 Ω | 0.01 V | 3 + 1 | 1 + 1 |
| 1 k Ω | 1.2000000 | 100 $\mu\Omega$ | 1 mA | 1.0 V | 12 V | 150 Ω | 0.1 V | 3 + 0.1 | 1 + 0.1 |
| 10 k Ω | 12.0000000 | 1 m Ω | 100 μA | 1.0 V | 12 V | 1.5 k Ω | 0.1 V | 3 + 0.1 | 1 + 0.1 |
| 100 k Ω | 120.00000 | 10 m Ω | 50 μA | 5.0 V | 12 V | 1.5 k Ω | 0.5 V | 3 + 0.1 | 1 + 0.1 |
| 1 M Ω | 1.2000000 | 100 m Ω | 5 μA | 5.0 V | 12 V | 1.5 k Ω | | 3 + 1 | 1 + 1 |
| 10 M Ω | 12.0000000 | 1 Ω | 500 nA | 5.0 V | 12 V | 1.5 k Ω | | 20 + 20 | 5 + 2 |
| 100 M Ω ⁷ | 120.00000 | 10 Ω | 500 nA | 5.0 V | 5 V | 1.5 k Ω | | 100 + 20 | 25 + 2 |
| 1G Ω ⁷ | 1.2000000 | 100 Ω | 500 nA | 5.0 V | 5 V | 1.5 k Ω | | 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 M Ω in parallel with input.

Section 2: Resistance continued

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 |

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.

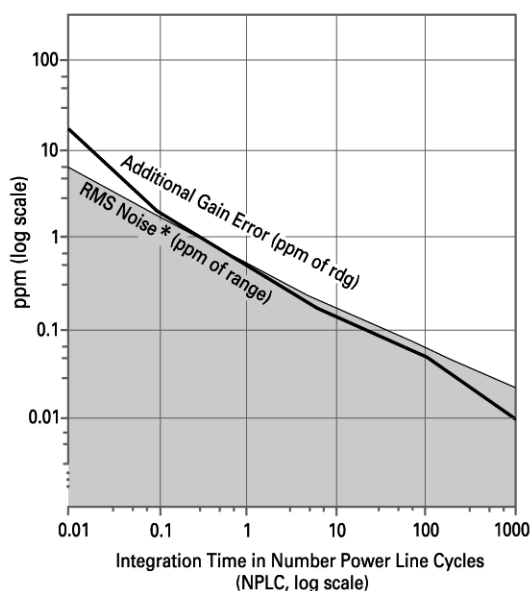
Add 3 ppm of reading additional error for factory traceability of 10 kΩ to US NIST. Traceability is the absolute error relative to National Standards associated with the source of last external calibration.

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 |
| 1k Ω 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.

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.

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 |

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

Measurement Consideration

Keysight recommends the use of PTFE* 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 |

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 | | |

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 | 12.000000 | 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 |

¹ Additional error from Tcal or last ACAL ± 1° C.

² Additional error from Tcal ± 5° C.

³ Specifications are for PRESET; NPLC 100.

⁴ Tcal ± 1° C.

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

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.

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 |

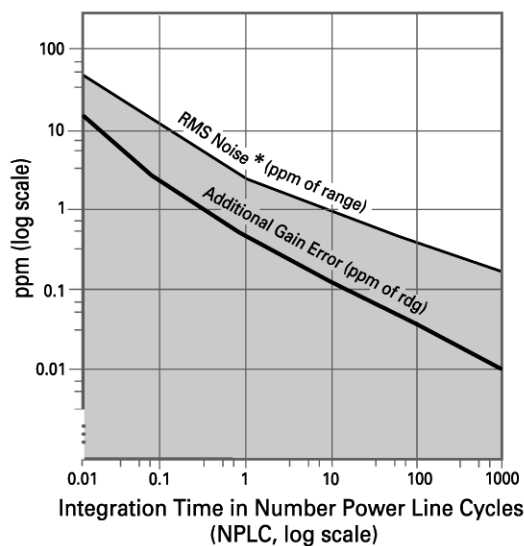
Settling Characteristics

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.

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.

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.

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; ARRANGE 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 |

Section 4: 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 / 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 | 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 | 12.0000000 | 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 |

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 to 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 continued

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 |
|----------------|--|
| 100 mV - 100 V | (0.002 + Resolution in %) ¹ |

Conditions

- 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 to 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 | | | | Crest Factor | Resolution Multiplier ¹ |
|------------------------|------------------------------|-----------|-----------|------------|--------------|------------------------------------|
| | 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 2 |
| 75 Ω Terminated | 0.004 | 2 | 5 | 5 | 3 - 4 | (Resolution in %) x 3 |
| 50 Ω | 0.005 | 3 | 7 | 10 | 4 - 5 | (Resolution in %) x 5 |

³ Flatness error including instrument loading.

Reading Rates ⁴

| 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; ARANGE OFF.

Settling Characteristics

There is no instrument settling required.

Common Mode Rejection

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

Section 4: AC Voltage continued

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 | 12.00000 | 10 nV | 1 M Ω \pm 15% with < 140pF | 0.003 + 0.006 |
| 100 mV | 120.0000 | 100 nV | 1 M Ω \pm 15% with < 140pF | 0.002 + 0.0 |
| 1 V | 1.200000 | 1 μV | 1 M Ω \pm 15% with < 140pF | 0.002 + 0.0 |
| 10 V | 12.00000 | 10 μV | 1 M Ω \pm 2% with < 140pF | 0.002 + 0.0 |
| 100 V | 120.0000 | 100 μV | 1 M Ω \pm 2% with < 140pF | 0.002 + 0.0 |
| 1000 V | 700.000 | 1 mV | 1 M Ω \pm 2% with < 140pF | 0.002 + 0.0 |

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.

AC Accuracy ²

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 | 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 |

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

Additional Errors

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

Low Frequency Error (% of Reading)

| Signal Frequency | ACBAND Low | | |
|------------------|----------------------------|------------------------|------------------------|
| | 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 |

Section 4: AC Voltage continued

Reading Rates ¹

| 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; ARRANGE 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 x 10 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 Accuracy ³

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.

Section 4: AC Voltage continued

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 |

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.

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 |

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

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 | |

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 | 12.000000 | 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 |

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.

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 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 + .001 | 0.15 + 0.25 | 0.0 + 0.007 |

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

Additional Errors

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

Low Frequency Error (% of Reading)

| Signal Frequency | ACBAND Low | | |
|------------------|----------------------------|------------------------|------------------------|
| | 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 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; ARANGE OFF. For DELAY 0; NPLC .1, unspecified reading rates of greater than 500/sec are possible.

Section 5: AC Current continued

Settling Characteristics

For first reading or range change error using default delays, add .01% of input step additional error for the 100 μ A 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 μ s |
| Input Signal Range | 700 V rms – 1 mV rms | 1 A rms – 10 μ A rms |
| Input Impedance | 1 M Ω \pm 15% with < 140 pF | 0.1 – 730 Ω ² |

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.

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 μ s | 270 |

Measurement Technique:

Reciprocal Counting

Time Base:

10 MHz \pm 0.01%, 0°C to 55°C

Level Trigger:

\pm 500% of Range in 5% steps

Trigger Filter:

Selectable 75 kHz Low Pass Trigger Filter

Slope Trigger:

Positive or Negative

Section 7: 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 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 μ s/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. |
| SDDC | 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 | SDDC / 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 μ V | 80 kHz | 50 μ s |
| 1 V | >10 ¹⁰ Ω | < 5 μ V | 150 kHz | 20 μ s |
| 10 V | >10 ¹⁰ Ω | < 5 μ V | 150 kHz | 20 μ s |
| 100 V | 10 M Ω | < 500 μ V | 30 kHz | 200 μ s |
| 1000 V | 10 M Ω | < 500 μ V | 30 kHz | 200 μ s |

¹ $\pm 1^\circ\text{C}$ of an AZERO or within 24 hours and $\pm 1^\circ\text{C}$ 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 μ s |
| 100 k | 16 bits | 1.4 μ s |
| 50 k | 18 bits | 6.0 μ s |

Sample Timebase

Accuracy: 0.01 %
Jitter: < 100 ps rms

External Trigger

Latency: < 175 ns²
Jitter: < 50 ns rms

Level Trigger

Latency: < 700 ns
Jitter: < 50 ns rms

² < 125 ns variability between multiple 3458As.

Section 7: Digitizing continued

Dynamic Performance

100 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 |

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 x 10⁸ V-Hz product.

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 |

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: < 125 ns⁵

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 ≤ 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 |

¹ Using HP 9000 Series 350.

² SINT data is valid for APER ≤ 10.8 μs.

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 | ±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 | 100 ns |
| Jitter | <100 ps rms |

Section 9: Ratio

Type 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) |

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: | SCALE: |
| X-OFFSET Minimum Execution Time = 180 μ s | (X-OFFSET) / SCALE Minimum Execution Time = 500 μ s |
| PERC: | PFAIL: |
| 100 x (X-PERC) / PERC Minimum Execution Time = 600 μ s | Based on MIN, MAX registers Minimum Execution Time = 160 μ s |
| dB: | dBm: |
| 20 x Log (X/REF) Minimum Execution Time = 3.9 ms | 10 x Log [(X ² / RES) / 1mW] Minimum Execution Time = 3.9 ms |
| RMS: | FILTER: |
| 1-pole digital filter Computed rms of inputs. Minimum Execution Time = 2.7 ms | 1-pole digital filter Weighted Average of inputs Minimum Execution Time = 750 μ s |
| STAT: | CTHRM (FTHRM): |
| MEAN, SDEV computed for sample population (N-1). NSAMP, UPPER, LOWER accumulated. Minimum Execution Time = 900 μ s | $^{\circ}$ C ($^{\circ}$ F) temperature conversion for 5 k Ω thermistor (40653B). Minimum Execution Time = 160 μ s |
| CTHRM2K (FTHRM2K): | CTHRM10K (FTHRM10K): |
| $^{\circ}$ C ($^{\circ}$ F) temperature conversion for 2.2 k Ω thermistor (40653A). Minimum Execution Time = 160 μ s | $^{\circ}$ C ($^{\circ}$ F) temperature conversion for 10 k Ω thermistor (40653C). Minimum Execution Time = 160 μ s |
| CRTD85 (FRTD85): | CRTD92 (FRTD92): |
| $^{\circ}$ C ($^{\circ}$ F) temperature conversion for RTD of 100 Ω , Alpha = 0.00385 (40654A or 40654B). Minimum Execution Time = 160 μ s | $^{\circ}$ 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 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-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 \pm 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, UL 1244, CSA

7n: Classified under

MIL-T-28800D as Type III,

Class 5, Style E, and Color R.

Warranty period

One year

Input terminals

Gold-plated tellurium copper

Included with 3458A

34137A Test lead set for 3458A

calibration certificate

Section 12: Ordering Information

Keysight 3458A multimeter

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

| | |
|-----------|---|
| 3458A-001 | Extended reading memory (Expands total to 148 k bytes) |
| 3458A-002 | High stability (4 ppm/year) reference |
| 3458A-A6J | ANSI Z540 compliant calibration |
| 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) |
| 3458A-ABD | German manual |
| 3458A-ABF | French manual |
| 3458A-ABJ | Japanese manual |
| 3458A-ABZ | Italian manual |

Kelvin probe and clip set



Accessories

| | |
|--------|--|
| 10833A | GPIB cable (1 m) |
| 10833B | GPIB cable (2 m) |
| 10833C | GPIB cable (4 m) |
| 10833D | GPIB cable (0.5 m) |
| 11059A | Kelvin probe set (4-wires, 1 m) |
| 11060A | Surface mount device (SMD) test probes |
| 11062A | Kelvin clip set (2 each) |
| 34137A | Deluxe test lead set for the 3458A |
| 34308A | Thermistor kit |
| 34330A | 30 A current shunt |
| E2308A | Thermistor temperature probe |

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| | |
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| Brazil | 55 11 3351 7010 |
| Mexico | 001 800 254 2440 |
| United States | (800) 829 4444 |

Asia Pacific

| | |
|--------------------|----------------|
| Australia | 1 800 629 485 |
| China | 800 810 0189 |
| Hong Kong | 800 938 693 |
| India | 1 800 112 929 |
| Japan | 0120 (421) 345 |
| Korea | 080 769 0800 |
| Malaysia | 1 800 888 848 |
| Singapore | 1 800 375 8100 |
| Taiwan | 0800 047 866 |
| Other AP Countries | (65) 6375 8100 |

Europe & Middle East

| | |
|----------------|---------------|
| Austria | 0800 001122 |
| Belgium | 0800 58580 |
| Finland | 0800 523252 |
| France | 0805 980333 |
| Germany | 0800 6270999 |
| Ireland | 1800 832700 |
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