# Keysight Technologies
# Digital Multimeters
## 34460A, 34461A, 34465A (6½ digit), 34470A (7½ digit)

Data Sheet


Truevolt DMMs for your next generation of insights

KEYSIGHT TECHNOLOGIES

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Keysight's NEW True*volt* Digital Multimeters (DMMs) offer a full range of measurement capabilities and price points with higher levels of accuracy, speed, and resolution.

## Get more insight quickly

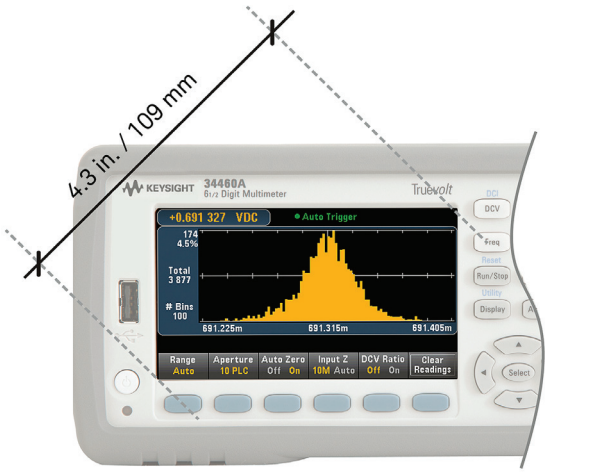
True*volt* DMM's graphical capabilities such as trend and histogram charts offer more insights quickly. Both models also provide a data logging mode for easier trend analysis and a digitizing mode for capturing transients.

## Measure low-power devices

The ability to measure very low current, 1 µA range with pA resolution, allows you to make measurements on very low power devices.

## Maintain calibrated measurements

Auto calibration allows you to compensate for temperature drift so you can maintain measurement accuracy throughout your workday.




The bright, 4.3" high-resolution monitor is a prominent feature of Keysight's True*volt* DMM family.

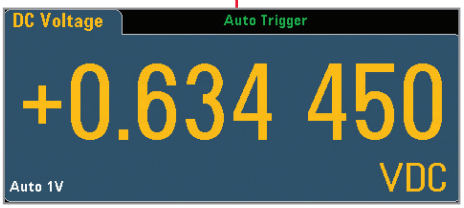
# Overview of Keysight True*volt* Digital Multimeters

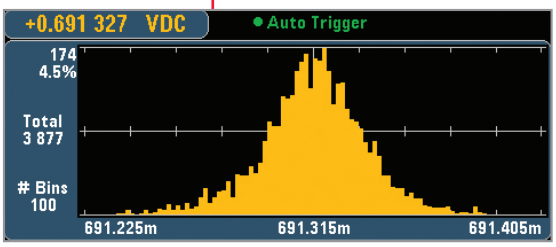
| **Key specifications** | **34460A** | **34461A** | **34465A** | **34470A** |
|---|---|---|---|---|
| Digits of resolution | 6½ | 6½ | 6½ | 7½ |
| Basic DCV accuracy | 75 ppm | 35 ppm | 30 ppm | 16 ppm |
| Max reading rate | 300 rdgs/s | 1,000 rdgs/s | 5,000 rdgs/s std<br>50,000 rdgs/s opt | 5,000 rdgs/s std<br>50,000 rdgs/s opt |
| Memory | 1,000 rdgs | 10,000 rdgs | 50,000 rdgs std<br>2 million rdgs opt | 50,000 rdgs std<br>2 million rdgs opt |
| **Measurements** | | | | |
| DCV | 100 mV to 1,000 V | 100 mV to 1,000 V | 100 mV to 1,000 V | 100 mV to 1,000 V |
| ACV (RMS) | 100 mV to 750 V | 100 mV to 750 V | 100 mV to 750 V | 100 mV to 750 V |
| DCI | 100 µA to 3 A | 100 µA to 10 A | 1 µA to 10 A | 1 µA to 10 A |
| ACI | 100 µA to 3 A | 100 µA to 10 A | 100 µA to 10 A | 100 µA to 10 A |
| 2- and 4-wire resistance | 100 Ω to 100 MΩ | 100 Ω to 100 MΩ | 100 Ω to 1,000 MΩ | 100 Ω to 1,000 MΩ |
| Continuity, diode | Y, 5 V | Y, 5 V | Y, 5 V | Y, 5 V |
| Frequency, period | 3 Hz to 300 kHz | 3 Hz to 300 kHz | 3 Hz to 300 kHz | 3 Hz to 300 kHz |
| Temperature | RTD/PT100, thermistor | RTD/PT100, thermistor | RTD/PT100, thermistor, thermocouples | RTD/PT100, thermistor, thermocouples |
| Capacitance | 1.0 nF to 100.0 µF | 1.0 nF to 100.0 µF | 1.0 nF to 100.0 µF | 1.0 nF to 100.0 µF |
| Dual line display | Yes | Yes | Yes | Yes |
| Display | Color, graphical | Color, graphical | Color, graphical | Color, graphical |
| Statistical graphics | Histogram, bar chart | Histogram, bar chart, trend chart | Histogram, bar chart, trend chart | Histogram, bar chart, trend chart |
| Rear input terminals | No | Yes | Yes | Yes |
| **IO interface** | | | | |
| USB | Yes | Yes | Yes | Yes |
| LAN/LXI Core | Optional | Yes | Yes | Yes |
| GPIB | Optional | Optional | Optional | Optional |

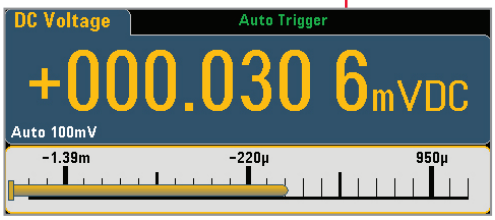
Bar meter mode provides the number display along with an analog meter to provide a visual view of your measurements.

Histogram mode gives you a statistical view of your measurements.

Number mode provides the traditional “digits” view of measurements.




# Truevolt DISPLAY

## Measure with Unquestioned Truevolt Confidence

### Worry about the quality of your design, not the quality of your measurements

In a rack or on a bench real-world signals are never flat. They have some level of AC signal riding on top from power line noise, other environmental noise, or injected current from the meter itself. How well your meter deals with these extraneous factors and eliminates them from the true measurement makes a big difference to your accuracy. Behind the scenes, Keysight’s Truevolt technology accounts for measurement errors created by these real-world factors so you can be confident in your measurements and it is only available on Keysight DMMs.

Truevolt technology starts with an analog-to-digital converter that enables a patented metrology-grade architecture. Using this architecture, Keysight delivers a good balance of measurement resolution, linearity, accuracy, and speed at a value price, all derived and guaranteed per ISO/IEC 17025 industry standards.

# BenchVue Software

## Data capture simplified. Click. Capture. Done.

BenchVue software for the PC makes it simple to connect, control, capture and view Keysight's DMMs simultaneously with other Keysight bench instruments with no additional programming.

- Visualize multiple measurements simultaneously
- Easily log data, screen shots and system state
- Rapidly prototype custom test sequences
- Recall past state of your bench to replicate results
- Export measurement data in desired format fast
- Quickly access manuals, drivers, FAQs and videos
- Monitor and control bench from mobile devices

The Digital Multimeter App within BenchVue enables control of digital multimeters to visualize measurements, perform data logging [1] and annotate captured data (included in model BV0000A). Upgrading to the Pro version (model #BV0001A) provides histograms, digitizer capability and unrestricted data logging with limit checking and alerts.


Figure 1. See your measurements across instruments in one place to quickly correlate measurement activities and obtain actionable insights.

## Benefit from a new perspective by visualizing multiple DMM's at the same time

- Display single measurements, charts, tables, or histograms from a single instrument or multiple DMMs simultaneously to correlate trends you might otherwise miss.

## Record measurements and export results in a few clicks

- Log and export data quickly to popular tools such as Microsoft Excel, Microsoft Word and MATLAB for documentation or further analysis.

## Access and control tests on your DMM remotely

- With the companion BenchVue Mobile app, monitor and respond to long-running tests from anywhere.

Download BenchVue software at no cost today
www.keysight.com/find/benchvue


Figure 2. BenchVue enables control of your DMM to data log and visualize measurements in a wide array of display options.

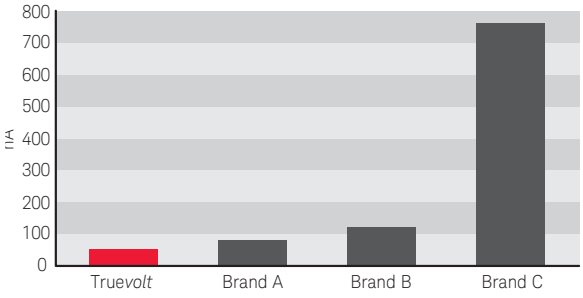
1. One hour limit in no-cost version.

# Measure with Unquestioned Truevolt Confidence

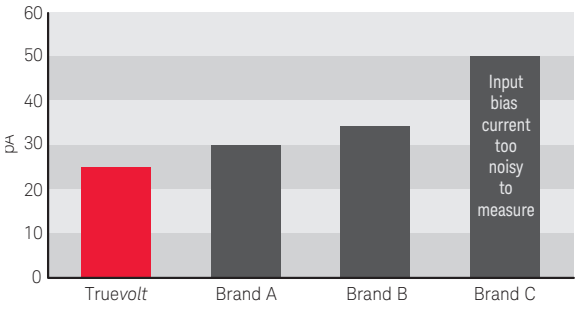
## What Truevolt technology means to you:

## You can measure your real-world signals,not instrument error

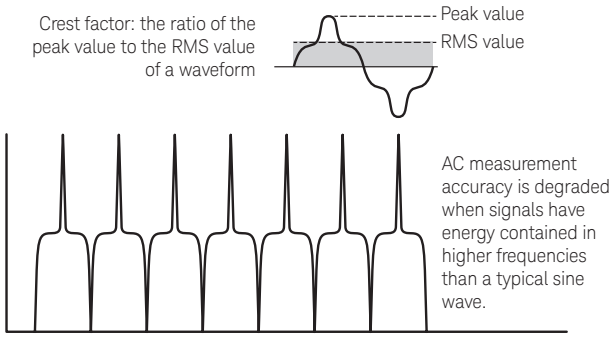
**Noise and injected current:** Keysight Truevolt DMMs contribute less than 30% of the injected current than alternatives. Compared to some lower cost alternatives, Truevolt DMMs offer almost 100% less noise.




**Input bias current:** Ideally, no current flows into the measurement terminals of your DMM. In real measurement situations, there are always input currents creating additional measurement errors. Truevolt DMMs take care of input bias current. Some alternative DMMs offer 20% to infinitely poorer performance (some are too noisy to measure).




**Digital AC rms measurements:** For meters in this class, only Keysight uses digital direct sampling techniques to make AC rms measurements. This results in a true rms calculation technique that avoids the slower response of analog RMS converters used in all other vendor's 6½ digit DMMs. This allows for crest factors up to 10 without additional error terms. This is a unique, patented technique – only used by Keysight.




## You can measure your real-world signals with confidence

All Truevolt DMM specifications are tested and guaranteed for compliance with ISO/IEC 17025 standards so you can prove the effectiveness of your lab or production line's quality management system. Many lower-cost DMMs in this class do not carry a guarantee of their measurement specifications.

## You can take advantage of expanded measurement functionality

Compared to the 34401A DMM, Truevolt DMMs offer expanded current ranges from 100 µA to 10 A. We have also added a temperature measurement function (RTD/PT100, 5 kΩ thermistor). Additionally, diode measurement capability has been expanded to allow a larger full-scale voltage to be measured (5 V) to enable the measurement of more diode types such as LEDs.

# Move to The Next-Generation 34401A DMM with 100%* Assurance

## Migrate with confidence: Everything you depend on with the 34401A and more

Like most 34401A DMM owners, you rely on your DMM and you trust the answers it gives you. Now, with the Keysight True*volt* 34461A DMM, you can get all of the advantages of the 34401A and more. Now you can get faster answers and have even more confidence in your results. The best news of all? You can migrate from the 34401A to the 34461A without a hassle. No need to rewrite your software programs or spend hours learning a brand-new, complicated interface.

**Use your existing programs:** The 34461A DMM is the industry's only 100% drop-in, SCPI-compatible replacement for the 34401A DMM. Other DMMs may claim 34401A SCPI compatibility, but only a subset of SCPI commands are implemented.

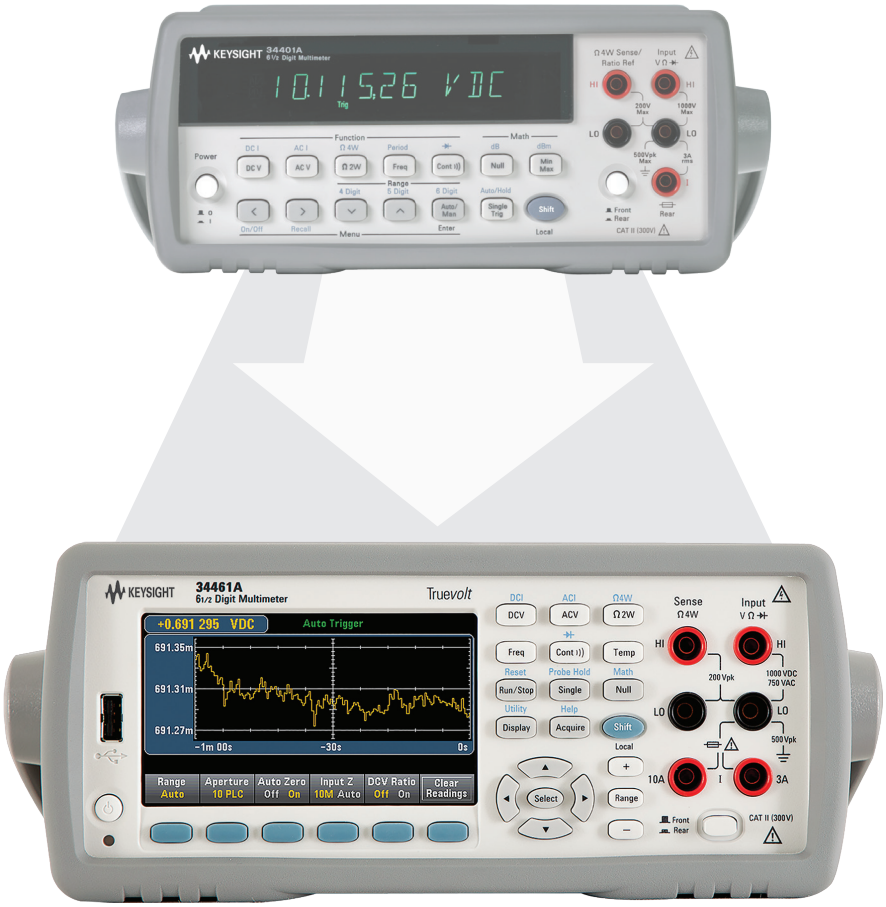
**No long learning curve:** The True*volt* DMMs were designed by the same team that created the 34401A. The team kept 34401A measurements, reliability and familiarity in mind as they created the True*volt* family of DMMs. So you can use it without spending hours learning how.

The 34461A represents everything you have known and trusted with your Keysight DMM measurements for decades – it just keeps getting stronger.

* Refer to migration guide 5991-2367EN for compatibility and key programming differences between 34461A and 34401A.

For more information visit:
www.keysight.com/find/34401Amigration

| Migration Q&A | Question | Aanswer |
|---|---|---|
| Program compatibility | Will my existing programs still work if I switch to the 34461A? | YES* |
| Measurements | Will I have the same performance so it doesn't affect the results on my line? | YES |
| Cost | Will it cost the same to buy, use, maintain, and repair? | YES |
| Reliability | My 34401A never breaks. Are the True*volt* DMMs going to be as good? | YES |
| Use | Will we be able to use it easily? Quickly? | YES |




34461A: The industry's only 100% drop-in, SCPI-compatible replacement for the 34401A DMM

# Specifications 34460A

34460A accuracy specifications: ±(% of reading + % of range) [1]
These specification are compliant to ISO/IEC 17025 for K = 2


| Range [2]/frequency | | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [4] |
|---|---|---|---|---|---|---|
| **DC voltage** | | | | | | |
| 100 mV | | 0.0040 + 0.0060 | 0.0070 + 0.0065 | 0.0090 + 0.0065 | 0.0115 + 0.0065 | 0.0005 + 0.0005 |
| 1 V | | 0.0030 + 0.0009 | 0.0060 + 0.0010 | 0.0080 + 0.0010 | 0.0105 + 0.0010 | 0.0005 + 0.0001 |
| 10 V | | 0.0025 + 0.0004 | 0.0050 + 0.0005 | 0.0075 + 0.0005 | 0.0100 + 0.0005 | 0.0005 + 0.0001 |
| 100 V | | 0.0030 + 0.0006 | 0.0065 + 0.0006 | 0.0085 + 0.0006 | 0.0110 + 0.0006 | 0.0005 + 0.0001 |
| 1000 V | | 0.0030 + 0.0006 | 0.0065 + 0.0010 | 0.0085 + 0.0010 | 0.0110 + 0.0010 | 0.0005 + 0.0001 |
| **True RMS AC voltage [2, 5, 6]** | | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges** | | | | | | |
| 3 Hz– 5 Hz | | 1.00 + 0.02 | 1.00 + 0.03 | 1.00 + 0.03 | 1.00 + 0.03 | 0.100 + 0.003 |
| 5 Hz– 10 Hz | | 0.38 + 0.02 | 0.38 + 0.03 | 0.38 + 0.03 | 0.38 + 0.03 | 0.035 + 0.003 |
| 10 Hz – 20 kHz | | 0.07 + 0.02 | 0.08 + 0.03 | 0.09 + 0.03 | 0.10 + 0.03 | 0.005 + 0.003 |
| 20 kHz – 50 kHz | | 0.13 + 0.04 | 0.14 + 0.05 | 0.15 + 0.05 | 0.16 + 0.05 | 0.011 + 0.005 |
| 50 kHz – 100 kHz | | 0.58 + 0.08 | 0.63 + 0.08 | 0.63 + 0.08 | 0.63 + 0.08 | 0.060 + 0.008 |
| 100 kHz – 300 kHz | | 4.00 + 0.50 | 4.00 + 0.50 | 4.00 + 0.50 | 4.00 + 0.50 | 0.200 + 0.020 |
| **Resistance [7]** | **Test current** | | | | | |
| 100 Ω | 1 mA | 0.0040 + 0.0060 | 0.011 + 0.007 | 0.014 + 0.007 | 0.017 + 0.007 | 0.0006 + 0.0005 |
| 1 kΩ | 1 mA | 0.0030 + 0.0008 | 0.011 + 0.001 | 0.014 + 0.001 | 0.017 + 0.001 | 0.0006 + 0.0001 |
| 10 kΩ | 100 µA | 0.0030 + 0.0005 | 0.011 + 0.001 | 0.014 + 0.001 | 0.017 + 0.001 | 0.0006 + 0.0001 |
| 100 kΩ | 10 µA | 0.0030 + 0.0005 | 0.011 + 0.001 | 0.014 + 0.001 | 0.017 + 0.001 | 0.0006 + 0.0001 |
| 1 MΩ | 5 µA | 0.0030 + 0.0010 | 0.011 + 0.001 | 0.014 + 0.001 | 0.017 + 0.001 | 0.0010 + 0.0002 |
| 10 MΩ | 500 nA | 0.015 + 0.001 | 0.020 + 0.001 | 0.040 + 0.001 | 0.060 + 0.001 | 0.0030 + 0.0004 |
| 100 MΩ | 500 nA \|\| 10 MΩ | 0.300 + 0.010 | 0.800 + 0.010 | 0.800 + 0.010 | 0.800 + 0.010 | 0.1500 + 0.0002 |
| **DC current** | **Burden voltage** | | | | | |
| 100 µA | < 0.011 V | 0.010 + 0.020 | 0.040 + 0.025 | 0.050 + 0.025 | 0.060 + 0.025 | 0.0020 + 0.0030 |
| 1 mA | < 0.11 V | 0.007 + 0.006 | 0.030 + 0.006 | 0.050 + 0.006 | 0.060 + 0.006 | 0.0020 + 0.0005 |
| 10 mA | < 0.05 V | 0.007 + 0.020 | 0.030 + 0.020 | 0.050 + 0.020 | 0.060 + 0.020 | 0.0020 + 0.0020 |
| 100 mA | < 0.5 V | 0.010 + 0.004 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0005 |
| 1 A | < 0.7 V | 0.050 + 0.006 | 0.080 + 0.010 | 0.100 + 0.010 | 0.120 + 0.010 | 0.0050 + 0.0010 |
| 3 A | < 2.0 V | 0.180 + 0.020 | 0.200 + 0.020 | 0.200 + 0.020 | 0.230 + 0.020 | 0.0050 + 0.0020 |
| **Capacitance [15]** | | | | | | |
| 1.0000 nF | | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.05 + 0.05 |
| 10.000 nF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 nF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 1.0000 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 10.000 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |

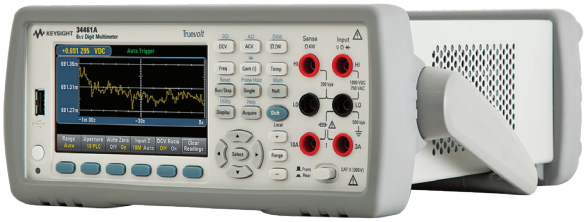
# Specifications 34460A

| Range [2]/frequency | | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [4] |
|---|---|---|---|---|---|---|
| **True RMS AC current [2, 6, 8]** | **Burden voltage** | | | | | |
| 100 µA, 1 mA, 10 mA, and 100 mA ranges | < 0.011, < 0.11, < 0.05, < 0.5 V | | | | | |
| 3 Hz – 5 kHz | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| **1 A range** | < 0.7 V | | | | | |
| 3 Hz – 5 kHz | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| **3 A range** | < 2.0 V | | | | | |
| 3 Hz – 5 kHz | | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.030 + 0.006 |
| **Continuity** | | | | | | |
| 1 kΩ | | 0.002 + 0.030 | 0.008 + 0.030 | 0.010 + 0.030 | 0.012 + 0.030 | 0.0010 + 0.0020 |
| **Diode test [9]** | | | | | | |
| 5 V | | 0.002 + 0.030 | 0.008 + 0.030 | 0.010 + 0.030 | 0.012 + 0.030 | 0.0010 + 0.0020 |
| **DC ratio (typ)** | | | | | | |
| | | (normalized input accuracy) + (normalized reference accuracy) | | | | |
| **Temperature [10]** | | | | | | |
| PT100 (DIN/ IEC 751) | | Probe accuracy + 0.05°C | | | | |
| 5 kΩ thermistor | | Probe accuracy + 0.1°C | | | | |
| **Frequency: specification ±(% of reading) [11, 12]** | | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges [13]** | | | | | | |
| 3 Hz – 10 Hz | | 0.100 | 0.100 | 0.100 | 0.100 | 0.0002 |
| 10 Hz– 100 Hz | | 0.030 | 0.030 | 0.030 | 0.035 | 0.0002 |
| 100 Hz – 1 kHz | | 0.030 | 0.010 | 0.012 | 0.017 | 0.0002 |
| 1 Hz– 300 kHz | | 0.002 | 0.008 | 0.012 | 0.017 | 0.0002 |
| Square wave [14] | | 0.001 | 0.008 | 0.012 | 0.017 | 0.0002 |
| **Additional gate time errors ±( % of reading ) [12, 10]** | | | | | | |
| **Frequency** | | **1 second** | **0.1 second** | **0.01 second** | | |
| 3 Hz– 40 Hz | | 0 | 0.200 | 0.200 | | |
| 40 Hz– 100 Hz | | 0 | 0.060 | 0.200 | | |
| 100 Hz – 1 kHz | | 0 | 0.020 | 0.200 | | |
| 1 Hz– 300 kHz | | 0 | 0.004 | 0.030 | | |
| Square wave [14] | | 0 | 0 | 0 | | |

1. For DC: Specifications are for 60-minute warm-up, aperture of 10 or 100 NPLC, and auto zero on. For AC: Specifications are for 60-minute warm-up, slow AC filter, sine wave.
2. 20% overrange on all ranges, except 1,000 V DCV, 750 ACV, 3 A AC, and diode test.
3. Relative to calibration standards.
4. Add this for each °C outside TCAL ±5°C.
5. Specifications are for sine wave input > 0.3% of range and > 1 mVrms. 750 ACV range limited to 8 x 107 Volt–Hz.
6. Low-frequency performance: three filter settings are available: 3 Hz, 20 Hz, 200 Hz. Frequencies greater than these filter settings are specified with no additional errors.
7. Specifications are for 4–wire ohms function or 2–wire ohms using math null for offset. Without math null, add 0.2 Ω additional error in 2-wire ohms function.
8. Specifications are for sinewave input > 1% of range and > 10 µA AC.
9. Specifications are for the voltage measured at the input terminals. The 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.
10. Actual measurement range and probe errors will be limited by the selected probe. Probe accuracy adder includes all measurement and ITS-90 temperature conversion errors PT100 Ro settable to 100 Ω ±5 Ω to remove the initial probe error.
11. Specifications are for 60-minute warm-up and sine wave input unless stated otherwise. Specifications are for 1-second gate time (7 digits).
12. Applies to sine and square inputs ≥ 100 mV. For 10 mV to < 100 mV inputs, multiply % of reading error x10.
13. Amplitude 10% – 120% of range and less than 750 ACV.
14. Square wave input specified for 10 – 300 kHz.
15. Specifications are for using Math Null zeroing. High dissapation factor capacitors may show different results than a single frequency measurement. Film capacitors usually have lower dissapation factors than other dielectrics.

# Specifications 34461A

34461A accuracy specifications: ±(% of reading + % of range) [1]
These specification are compliant to ISO/IEC 17025 for K = 2



| Range [2]/frequency | | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [4] |
|---|---|---|---|---|---|---|
| **DC voltage** | | | | | | |
| 100 mV | | 0.0030 + 0.0030 | 0.0040 + 0.0035 | 0.0050 + 0.0035 | 0.0065 + 0.0035 | 0.0005 + 0.0005 |
| 1 V | | 0.0020 + 0.0006 | 0.0030 + 0.0007 | 0.0040 + 0.0007 | 0.0055 + 0.0007 | 0.0005 + 0.0001 |
| 10 V | | 0.0015 + 0.0004 | 0.0020 + 0.0005 | 0.0035 + 0.0005 | 0.0050 + 0.0005 | 0.0005 + 0.0001 |
| 100 V | | 0.0020 + 0.0006 | 0.0035 + 0.0006 | 0.0045 + 0.0006 | 0.0060 + 0.0006 | 0.0005 + 0.0001 |
| 1000 V | | 0.0020 + 0.0006 | 0.0035 + 0.0010 | 0.0045 + 0.0010 | 0.0060 + 0.0010 | 0.0005 + 0.0001 |
| **True RMS AC voltage [2, 5, 6]** | | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges** | | | | | | |
| 3 Hz– 5 Hz | | 1.00 + 0.02 | 1.00 + 0.03 | 1.00 + 0.03 | 1.00 + 0.03 | 0.100 + 0.003 |
| 5 Hz– 10 Hz | | 0.35 + 0.02 | 0.35 + 0.03 | 0.35 + 0.03 | 0.35 + 0.03 | 0.035 + 0.003 |
| 10 Hz – 20 kHz | | 0.04 + 0.02 | 0.05 + 0.03 | 0.06 + 0.03 | 0.07 + 0.03 | 0.005 + 0.003 |
| 20 kHz – 50 kHz | | 0.10 + 0.04 | 0.11 + 0.05 | 0.12 + 0.05 | 0.13 + 0.05 | 0.011 + 0.005 |
| 50 kHz – 100 kHz | | 0.55 + 0.08 | 0.60 + 0.08 | 0.60 + 0.08 | 0.60 + 0.08 | 0.060 + 0.008 |
| 100 kHz– 300 kHz | | 4.00 + 0.50 | 4.00 + 0.50 | 4.00 + 0.50 | 4.00 + 0.50 | 0.200 + 0.020 |
| **Resistance [7]** | **Test current** | | | | | |
| 100 Ω | 1 mA | 0.0030 + 0.0030 | 0.008 + 0.004 | 0.010 + 0.004 | 0.012 + 0.004 | 0.0006 + 0.0005 |
| 1 kΩ | 1 mA | 0.0020 + 0.0005 | 0.008 + 0.001 | 0.010 + 0.001 | 0.012 + 0.001 | 0.0006 + 0.0001 |
| 10 kΩ | 100 µA | 0.0020 + 0.0005 | 0.008 + 0.001 | 0.010 + 0.001 | 0.012 + 0.001 | 0.0006 + 0.0001 |
| 100 kΩ | 10 µA | 0.0020 + 0.0005 | 0.008 + 0.001 | 0.010 + 0.001 | 0.012 + 0.001 | 0.0006 + 0.0001 |
| 1 MΩ | 5 µA | 0.002 + 0.001 | 0.008 + 0.001 | 0.010 + 0.001 | 0.012 + 0.001 | 0.0010 + 0.0002 |
| 10 MΩ | 500 nA | 0.015 + 0.001 | 0.020 + 0.001 | 0.040 + 0.001 | 0.060 + 0.001 | 0.0030 + 0.0004 |
| 100 MΩ | 500 nA \|\| 10 MΩ | 0.300 + 0.010 | 0.800 + 0.010 | 0.800 + 0.010 | 0.800 + 0.010 | 0.1500 + 0.0002 |
| **DC current** | **Burden voltage** | | | | | |
| 100 µA | < 0.011 V | 0.010 + 0.020 | 0.040 + 0.025 | 0.050 + 0.025 | 0.060 + 0.025 | 0.0020 + 0.0030 |
| 1 mA | < 0.11 V | 0.007 + 0.006 | 0.030 + 0.006 | 0.050 + 0.006 | 0.060 + 0.006 | 0.0020 + 0.0005 |
| 10 mA | < 0.05 V | 0.007 + 0.020 | 0.030 + 0.020 | 0.050 + 0.020 | 0.060 + 0.020 | 0.0020 + 0.0020 |
| 100 mA | < 0.5 V | 0.010 + 0.004 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0005 |
| 1 A | < 0.7 V | 0.050 + 0.006 | 0.080 + 0.010 | 0.100 + 0.010 | 0.120 + 0.010 | 0.0050 + 0.0010 |
| 3 A | < 2.0 V | 0.180 + 0.020 | 0.200 + 0.020 | 0.200 + 0.020 | 0.230 + 0.020 | 0.0050 + 0.0020 |
| 10 A [8] | < 0.5 V | 0.050 + 0.010 | 0.120 + 0.010 | 0.120 + 0.010 | 0.150 + 0.010 | 0.0050 + 0.0010 |
| **Capacitance [15]** | | | | | | |
| 1.0000 nF | | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.05 + 0.05 |
| 10.000 nF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 nF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 1.0000 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 10.000 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 µF | | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |

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| Range [2]/frequency | | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [4] |
|---|---|---|---|---|---|---|
| **True RMS AC current [2,6,9]** | **Burden voltage** | | | | | |
| 100 µA, 1 mA, 10 mA, and 100 mA ranges | < 0.011, < 0.11, < 0.05, < 0.5 V | | | | | |
| 3 Hz – 5 kHz | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| **1 A range** | **< 0.7 V** | | | | | |
| 3 Hz – 5 kHz | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| **3 A range** | **< 2.0 V** | | | | | |
| 3 Hz – 5 kHz | | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.030 + 0.006 |
| **10 A range [8]** | **< 0.5 V** | | | | | |
| 3 Hz – 5 kHz | | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.030 + 0.006 |
| **Continuity** | | | | | | |
| 1 kΩ | | 0.002 + 0.030 | 0.008 + 0.030 | 0.010 + 0.030 | 0.012 + 0.030 | 0.0010 + 0.0020 |
| **Diode test [10]** | | | | | | |
| 5 V | | 0.002 + 0.030 | 0.008 + 0.030 | 0.010 + 0.030 | 0.012 + 0.030 | 0.0010 + 0.0020 |
| **DC ratio (typ)** | | | | | | |
| | | (normalized input accuracy) + (normalized reference accuracy) | | | | |
| **Temperature [11]** | | | | | | |
| PT100 (DIN/ IEC 751) | | Probe accuracy + 0.05°C | | | | |
| 5 kΩ thermistor | | Probe accuracy + 0.1°C | | | | |
| **Frequency: specification ±(% of reading) [12, 13]** | | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges [14]** | | | | | | |
| 3 – 10 Hz | | 0.100 | 0.100 | 0.100 | 0.100 | 0.100 |
| 10 – 100 Hz | | 0.030 | 0.030 | 0.030 | 0.030 | 0.035 |
| 100 Hz – 1 kHz | | 0.003 | 0.008 | 0.010 | 0.010 | 0.015 |
| 1 – 300 kHz | | 0.002 | 0.006 | 0.010 | 0.010 | 0.015 |
| Square wave [15] | | 0.001 | 0.006 | 0.010 | 0.010 | 0.015 |
| **Additional gate time errors ±(% of reading) [13]** | | | | | | |
| **Frequency** | | **1 second** | **0.1 second** | **0.01 second** | | |
| 3 Hz – 40 Hz | | 0 | 0.200 | 0.200 | | |
| 40 Hz– 100 Hz | | 0 | 0.060 | 0.200 | | |
| 100 Hz – 1 kHz | | 0 | 0.020 | 0.200 | | |
| 1 kHz– 300 kHz | | 0 | 0.004 | 0.030 | | |
| Square wave [15] | | 0 | 0 | 0 | | |

1. For DC: Specifications are for 60-minute warm-up, aperture of 10 or 100 NPLC, and auto zero on. For AC: Specifications are for 60-minute warm-up, slow AC filter, sine wave.
2. 20% over range on all ranges, except 1,000 V DCV, 750 ACV, 10 A DC, 3 A AC, 10 A AC, and diode test.
3. Relative to calibration standards.
4. Add this for each °C outside TCAL ±5°C.
5. Specifications are for sinewave input >0.3% of range and > 1 mVrms. 750 ACV range limited to 8 x 10 7 Volt–Hz.
6. Low-frequency performance: three filter settings are available: 3 Hz, 20 Hz, 200 Hz. Frequencies greater than these filter settings are specified with no additional errors.
7. Specifications are for 4-wire ohms function or 2-wire ohms using math null for offset. Without math null, add 0.2 Ω additional error in 2-wire ohms function.
8. The 10 A range is only available on a separate front-panel connector. Add 2 mA base per amp or inputs > 5 A rms.
9. Specifications are for sinewave input > 1% of range and > 10 µA AC.
10. Specifications are for the voltage measured at the input terminals. The 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.
11. Actual measurement range and probe errors will be limited by the selected probe. Probe accuracy adder includes all measurement and ITS-90 temperature conversion errors. PT100 Ro settable to 100 Ω ±5 Ω to remove the initial probe error.
12. Specifications are for 60-minute warm-up and sine wave input unless stated otherwise. Specifications are for 1-second gate time (7-digits).
13. Applies to sine and square inputs ≥ 100 mV. For 10 mV to < 100 mV inputs, multiply % of reading error x10.
14. Amplitude 10% – 120% of range and less than 750 ACV.
15. Square wave input specified for 10 – 300 kHz.

# Specifications 34465A

34465A accuracy specifications: ±(% of reading + % of range) [1]
DC voltage and resistance. Automatic calibration (ACAL) capable.

| Range [2] | 24 hours [3] $T_{ACAL}$ ±1°C | 90 days $T_{ACAL}$ ±2°C | 1 year $T_{ACAL}$ ±2°C | 2 years $T_{ACAL}$ ±2°C | Non ACAL [6] Temperature coefficient/°C | With ACAL [7] Temperature coefficient/°C |
|---|---|---|---|---|---|---|
| **DC voltage** | | | | | | |
| 100 mV | 0.0030 + 0.0030 | 0.0040 + 0.0035 | 0.0050 + 0.0035 | 0.0065 + 0.0035 | 0.0005 + 0.0005 | 0.0002 + 0.0005 |
| 1 V | 0.0015 + 0.0004 | 0.0025 + 0.0004 | 0.0035 + 0.0004 | 0.0050 + 0.0004 | 0.0005 + 0.0001 | 0.0002 + 0.0001 |
| 10 V | 0.0010 + 0.0003 | 0.0020 + 0.0004 | 0.0030 + 0.0004 | 0.0045 + 0.0004 | 0.0005 + 0.0001 | 0.0002 + 0.0001 |
| 100 V | 0.0020 + 0.0006 | 0.0035 + 0.0006 | 0.0040 + 0.0006 | 0.0055 + 0.0006 | 0.0005 + 0.0001 | 0.0002 + 0.0001 |
| 1000 V [9] | 0.0020 + 0.0006 | 0.0035 + 0.0006 | 0.0040 + 0.0006 | 0.0055 + 0.0006 | 0.0005 + 0.0001 | 0.0002 + 0.0001 |
| **Resistance [8]** | | | | | | |
| 100 Ω | 0.0030 + 0.0030 | 0.0050 + 0.0040 | 0.0060 + 0.0040 | 0.0070 + 0.0040 | 0.0006 + 0.0005 | 0.0002 + 0.0005 |
| 1 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 10 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 100 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 1 MΩ | 0.0020 + 0.0005 | 0.0060 + 0.0005 | 0.0070 + 0.0005 | 0.0080 + 0.0005 | 0.0010 + 0.0002 | 0.0002 + 0.0002 |
| 10 MΩ | 0.010 + 0.001 | 0.020 + 0.001 | 0.025 + 0.001 | 0.030 + 0.001 | 0.0030 + 0.0004 | 0.0030 + 0.0004 |
| 100 MΩ | 0.100 + 0.001 | 0.200 + 0.001 | 0.300 + 0.001 | 0.400 + 0.001 | 0.1000 + 0.0001 | 0.0100 + 0.0001 |
| 1000 MΩ | 2.000 + 0.001 | 2.000 + 0.001 | 3.000 + 0.001 | 4.000 + 0.001 | 1.0000 + 0.0001 | 0.1000 + 0.0001 |

| Range [2] | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [5] |
|---|---|---|---|---|---|
| **DC current** | | | | | |
| 1 µA (typ) | 0.007 + 0.005 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0010 |
| 10 µA (typ) | 0.007 + 0.002 | 0.030 + 0.002 | 0.050 + 0.002 | 0.060 + 0.002 | 0.0015 + 0.0006 |
| 100 µA (typ) | 0.007 + 0.001 | 0.030 + 0.001 | 0.050 + 0.001 | 0.060 + 0.001 | 0.0015 + 0.0004 |
| 1 mA | 0.007 + 0.003 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0015 + 0.0005 |
| 10 mA | 0.007 + 0.020 | 0.030 + 0.020 | 0.050 + 0.020 | 0.060 + 0.020 | 0.0020 + 0.0020 |
| 100 mA | 0.010 + 0.004 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0005 |
| 1 A | 0.050 + 0.006 | 0.070 + 0.010 | 0.080 + 0.010 | 0.100 + 0.010 | 0.0050 + 0.0010 |
| 3 A | 0.180 + 0.020 | 0.200 + 0.020 | 0.200 + 0.020 | 0.230 + 0.020 | 0.0050 + 0.0020 |
| 10 A [4] | 0.050 + 0.010 | 0.120 + 0.010 | 0.120 + 0.010 | 0.150 + 0.010 | 0.0050 + 0.0010 |
| **Continuity** | | | | | |
| 1 KΩ | 0.002 + 0.010 | 0.008 + 0.020 | 0.010 + 0.020 | 0.012 + 0.020 | 0.0010 + 0.0020 |
| **Diode test [10]** | | | | | |
| 5 V | 0.002 + 0.010 | 0.008 + 0.010 | 0.010 + 0.010 | 0.012 + 0.020 | 0.0010 + 0.0010 |
| **DC:DC ratio (typ) [12]** | | | | | |
| | (normalized input accuracy) + (normalized reference accuracy) | | | | |

# Specifications 34465A

| **Temperature** | | | | | |
|---|---|---|---|---|---|
| PT100 (DIN/ IEC 751) [13] | Probe accuracy + 0.05°C | | | | |
| 5 kΩ thermistor | Probe accuracy + 0.1°C | | | | |
| K,J,T,E,N thermocouples [14] | Probe accuracy + reference junction accuracy + 0.3°C | | | | |
| R thermocouples [14] (250 - 1760°C) | Probe accuracy + reference junction accuracy + 0.5°C | | | | |
| **True RMS AC voltage [15, 16]** | **24 hours [3] $T_{CAL}$ ±1°C** | **90 days $T_{CAL}$ ±5°C** | **1 year $T_{CAL}$ ±5°C** | **2 years $T_{CAL}$ ±5°C** | **Temperature coefficient/°C [5]** |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges** | | | | | |
| 3 Hz – 5 Hz | 0.50 + 0.02 | 0.50 + 0.02 | 0.50 + 0.02 | 0.50 + 0.02 | 0.010 + 0.003 |
| 5 Hz– 10 Hz | 0.10 + 0.02 | 0.10 + 0.02 | 0.10 + 0.02 | 0.11 + 0.02 | 0.008 + 0.003 |
| 10 Hz – 20 kHz | 0.02 + 0.02 | 0.04 + 0.02 | 0.05 + 0.02 | 0.06 + 0.02 | 0.007 + 0.003 |
| 20 kHz – 50 kHz | 0.05 + 0.03 | 0.06 + 0.03 | 0.07 + 0.03 | 0.08+ 0.03 | 0.010 + 0.005 |
| 50 kHz – 100 kHz | 0.15 + 0.05 | 0.15 + 0.05 | 0.15 + 0.05 | 0.15 + 0.05 | 0.060 + 0.008 |
| 100 kHz – 300 kHz | 1.00 + 0.1 | 1.00 + 0.1 | 1.00 + 0.1 | 1.00 + 0.1 | 0.200 + 0.020 |
| **True RMS AC current [16, 17]** | | | | | |
| **100 µA, 1 mA, 10 mA, 100 mA, 1 A ranges** | | | | | |
| 3 Hz – 5 kHz | 0.07 + 0.04 | 0.09 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 kHz – 10 kHz (typ) | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| 3 A range | | | | | |
| 3 Hz – 5 kHz | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.015 + 0.006 |
| 5 kHz – 10 kHz (typ) | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.030 + 0.006 |
| 10 A range [4] | | | | | |
| 3 Hz – 5 kHz | 0.10 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.015 + 0.006 |
| 5 kHz – 10 kHz (typ) | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.030 + 0.006 |
| **Capacitance [21]** | | | | | |
| 1.0000 nF | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.05 + 0.05 |
| 10.000 nF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 nF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 1.0000 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 10.000 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| **Frequency [18, 20]** | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges [20]** | | | | | |
| 3 Hz – 10 Hz | 0.070 | 0.070 | 0.070 | 0.070 | 0.0002 |
| 10 Hz – 100 Hz | 0.030 | 0.030 | 0.030 | 0.030 | 0.0002 |
| 100 Hz – 1 kHz | 0.003 | 0.006 | 0.007 | 0.010 | 0.0002 |
| 1 kHz – 300 kHz | 0.002 | 0.005 | 0.007 | 0.009 | 0.0002 |
| Square wave [18] | 0.001 | 0.004 | 0.006 | 0.008 | 0.0002 |
| **Additional frequency errors ±( % of reading ) [18]** | | | | | |
| **Aperture (resolution/range)** | **1 second (0.1 ppm)** | **0.1 second (1 ppm)** | **0.01 second (10 ppm)** | **0.001 second (100 ppm)** | |
| 3 Hz – 40 Hz | 0 | 0.100 | 0.160 | 0.160 | |
| 40 Hz – 100 Hz | 0 | 0.030 | 0.160 | 0.160 | |
| 100 Hz – 1 kHz | 0 | 0.020 | 0.200 | 0.200 | |
| 1 kHz – 300 kHz | 0 | 0.004 | 0.030 | 0.240 | |
| Square wave [18] | 0 | 0.000 | 0.000 | 0.003 | |

# Specifications 34465A

| DC and AC current burden voltage at full scale | |
|---|---|
| **DC current range** | **Burden voltage** |
| 1 µA | < 0.0011 V |
| 10 µA | < 0.011 V |
| 100 µA | < 0.11 V |
| 1 mA | < 0.11 V |
| 10 mA | < 0.027 V |
| 100 mA | < 0.27 V |
| 1 A | < 0.7 V/0.05 V [21] |
| 3 A | < 2.0 V/0.15 V [21] |
| 10 A | < 0.5 V |

**Digitizing[22]**

Typical performance for these conditions: Sample rate: 50 kHz (Aperture = 20 µS); Sine wave input: Vpeak = Full scale of range; Input frequency: 1 kHz/10 kHz

| Function: range | Spur-free range SFDR | THD + noise SNDR | BW (-3 db) |
|---|---|---|---|
| DCV: 0.1, 1 V | 79/60 | 75/57 | 15 kHz |
| DCV: 10 V | 86/59 | 82/58 | 15 kHz |
| DCV: 100, 1000 V | 64/42 | 60/42 | 15 kHz |
| DCI: 0.1, 1 mA | 78/62 | 75/60 | 10 kHz |
| DCI: 10, 100 mA | 78/62 | 67/60 | 10 kHz |
| DCI: 1-10 A | 65/49 | 63/48 | 10 kHz |

1. Specifications are for 60-minute warm-up, integration setting of 10 or 100 NPLC, auto-zero on, AC slow filter. ACAL run within the last 2 days.
2. 20% over range on all ranges, except 1000 DCV, 750 ACV, 10 DCA, 3 DCA, 10 ACA, 3 ACA, and diode test have 0%.
3. Relative to calibration standards.
4. The 10 A range is only available on a separate front panel connector. Add 2 mA per amp for inputs greater than 5 Arms.
5. Add this for each °C outside TCAL ±5°C.
6. Add this for each °C outside the last ACAL ±2°C.
7. Add this for each °C outside ACAL ±2°C.
8. Specifications are for 4-wire ohms function or 2-wire ohms using math null for offset. Without math null, add 0.2 Ω additional error in 2-wire ohms function.The 100 M and 1 G ohm ranges are 2-wire only. See the manual for low power ohms specification and measurement currents
9. For each additional volt over ±500 V add 0.02 mV of error.
10. Specifications are for the voltage measured at the input terminals. The 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.
11. See user manual for details.
12. Actual measurement range and probe errors will be limited by the selected probe. Probe accuracy adder includes all measurement and ITS-90 temperature conversion errors. PT100 Ro settable to 100 Ω ±5 Ω to remove the initial probe error.
13. The internal reference junction uses the U1180A or equivalent adapter. This has a typical performance of ±1.0°C. This internal reference junction can be adjusted for better accuracy. An external reference junction can also be used.
14. Specifications are for sinewave input > 0.3% of range and > 1 mVrms. 750 ACV range limited to 8 x 107 Volt–Hz.For each additional volt over 300 Vrms add 1 mVrms of error.
15. Low-frequency performance: three filter settings are available: 3 Hz, 20 Hz, 200 Hz. Frequencies greater than these filter settings are specified with no additional errors.
16. Specifications are for sinewave input > 1% of range and > 10 µArms.
17. Specifications are for sine wave input unless stated otherwise.
18. Square wave input specified for 10 Hz– 300 kHz for 1 second aperature. For shorter aperatures the minimun frequency requires > 2 cycles.
19. Input > 100 mV. For 10 mV to 100 mV inputs, multiply % of reading error x10. Amplitude 10 – 120% of range except 14 – 100% for the 750 ACV range. Specifications are for 1-second gate time (7-digits).
20. Specifications are for using Math Null zeroing. High dissapation factor capacitors may show different results than a single frequency measurement. Film capacitors usually have lower dissapation factors than other dielectrics.
21. The second burden voltage can be obtained by using the 10 A input range.
22. Sample rate (actual): 50.118 kHz (Aperture = 19.953 µs).

# Specifications 34470A

34470A accuracy specifications: ±(% of reading + % of range) [1]
DC voltage and resistance. Automatic calibration (ACAL) capable.


| Range [2] | 24 hours [3] $T_{ACAL}$ ±1°C | 90 days $T_{ACAL}$ ±5°C | 1 year $T_{ACAL}$ ±5°C | 2 years $T_{ACAL}$ ±5°C | Non ACAL [6] Temperature coefficient/°C | With ACAL [7] Temperature coefficient/°C |
|---|---|---|---|---|---|---|
| **DC voltage** | | | | | | |
| 100 mV | 0.0030 + 0.0030 | 0.0040 + 0.0035 | 0.0040 + 0.0035 | 0.0045 + 0.0035 | 0.0005 + 0.0005 | 0.0001 + 0.0005 |
| 1 V | 0.0010 + 0.0004 | 0.0015 + 0.0004 | 0.0020 + 0.0004 | 0.0025 + 0.0004 | 0.0005 + 0.0001 | 0.0001 + 0.0001 |
| 10 V | 0.0008 + 0.0002 | 0.0013 + 0.0002 | 0.0016 + 0.0002 | 0.0020 + 0.0002 | 0.0005 + 0.0001 | 0.0001 + 0.0001 |
| 100 V | 0.0020 + 0.0006 | 0.0032 + 0.0006 | 0.0038 + 0.0006 | 0.0040 + 0.0006 | 0.0005 + 0.0001 | 0.0001 + 0.0001 |
| 1000 V [9] | 0.0020 + 0.0006 | 0.0032 + 0.0006 | 0.0038 + 0.0006 | 0.0040 + 0.0006 | 0.0005 + 0.0001 | 0.0001 + 0.0001 |
| **Resistance [8]** | | | | | | |
| 100 Ω | 0.0030 + 0.0030 | 0.0050 + 0.0040 | 0.0060 + 0.0040 | 0.0070 + 0.0040 | 0.0006 + 0.0005 | 0.0002 + 0.0005 |
| 1 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 10 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 100 KΩ | 0.0020 + 0.0005 | 0.0030 + 0.0005 | 0.0040 + 0.0005 | 0.0050 + 0.0005 | 0.0006 + 0.0001 | 0.0002 + 0.0001 |
| 1 MΩ | 0.0020 + 0.0005 | 0.0060 + 0.0005 | 0.0070 + 0.0005 | 0.0080 + 0.0005 | 0.0010 + 0.0002 | 0.0002 + 0.0002 |
| 10 MΩ | 0.010 + 0.001 | 0.020 + 0.001 | 0.025 + 0.001 | 0.030 + 0.001 | 0.0030 + 0.0004 | 0.0030 + 0.0004 |
| 100 MΩ | 0.100 + 0.001 | 0.200 + 0.001 | 0.300 + 0.001 | 0.400 + 0.001 | 0.1000 + 0.0001 | 0.0100 + 0.0001 |
| 1000 MΩ | 2.000 + 0.001 | 2.000 + 0.001 | 3.000 + 0.001 | 4.000 + 0.001 | 1.0000 + 0.0001 | 0.1000 + 0.0001 |

| Range [2] | 24 hours [3] $T_{CAL}$ ±1°C | 90 days $T_{CAL}$ ±5°C | 1 year $T_{CAL}$ ±5°C | 2 years $T_{CAL}$ ±5°C | Temperature coefficient/°C [5] |
|---|---|---|---|---|---|
| **DC current** | | | | | |
| 1 µA (typ) | 0.007 + 0.005 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0010 |
| 10 µA (typ) | 0.007 + 0.002 | 0.030 + 0.002 | 0.050 + 0.002 | 0.060 + 0.002 | 0.0015 + 0.0006 |
| 100 µA (typ) | 0.007 + 0.001 | 0.030 + 0.001 | 0.050 + 0.001 | 0.060 + 0.001 | 0.0015 + 0.0004 |
| 1 mA | 0.007 + 0.003 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0015 + 0.0005 |
| 10 mA | 0.007 + 0.020 | 0.030 + 0.020 | 0.050 + 0.020 | 0.060 + 0.020 | 0.0020 + 0.0020 |
| 100 mA | 0.010 + 0.004 | 0.030 + 0.005 | 0.050 + 0.005 | 0.060 + 0.005 | 0.0020 + 0.0005 |
| 1 A | 0.050 + 0.006 | 0.070 + 0.010 | 0.080 + 0.010 | 0.100 + 0.010 | 0.0050 + 0.0010 |
| 3 A | 0.180 + 0.020 | 0.200 + 0.020 | 0.200 + 0.020 | 0.230 + 0.020 | 0.0050 + 0.0020 |
| 10 A [4] | 0.050 + 0.010 | 0.120 + 0.010 | 0.120 + 0.010 | 0.150 + 0.010 | 0.0050 + 0.0010 |
| **Continuity** | | | | | |
| 1 KΩ | 0.002 + 0.010 | 0.008 + 0.020 | 0.010 + 0.020 | 0.012 + 0.020 | 0.0010 + 0.0020 |
| **Diode test [10]** | | | | | |
| 5 V | 0.002 + 0.010 | 0.008 + 0.010 | 0.010 + 0.010 | 0.012 + 0.020 | 0.0010 + 0.0010 |
| **DC:DC ratio (typ) [12]** | | | | | |
| | (normalized input accuracy) + (normalized reference accuracy) | | | | |

# Specifications 34470A

| **Temperature** | | | | | |
|---|---|---|---|---|---|
| PT100 (DIN/ IEC 751) [13] | Probe accuracy + 0.05°C | | | | |
| 5 kΩ thermistor | Probe accuracy + 0.1°C | | | | |
| K,J,T,E,N thermocouples [14] | Probe accuracy + reference junction accuracy + 0.3°C | | | | |
| R thermocouples [14] (250 - 1760°C) | Probe accuracy + reference junction accuracy + 0.5°C | | | | |
| **True RMS AC voltage [15, 16]** | **24 hours 3 $T_{CAL}$ ±1°C** | **90 days $T_{CAL}$ ±5°C** | **1 year $T_{CAL}$ ±5°C** | **2 years $T_{CAL}$ ±5°C** | **Temperature coefficient/°C [5]** |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges** | | | | | |
| 3 Hz – 5 Hz | 0.50 + 0.02 | 0.50 + 0.02 | 0.50 + 0.02 | 0.50 + 0.02 | 0.010 + 0.003 |
| 5 Hz– 10 Hz | 0.10 + 0.02 | 0.10 + 0.02 | 0.10 + 0.02 | 0.11 + 0.02 | 0.008 + 0.003 |
| 10 Hz – 20 kHz | 0.02 + 0.02 | 0.04 + 0.02 | 0.05 + 0.02 | 0.06 + 0.02 | 0.007 + 0.003 |
| 20 kHz – 50 kHz | 0.05 + 0.03 | 0.06 + 0.03 | 0.07 + 0.03 | 0.08+ 0.03 | 0.010 + 0.005 |
| 50 kHz – 100 kHz | 0.15 + 0.05 | 0.15 + 0.05 | 0.15 + 0.05 | 0.15 + 0.05 | 0.060 + 0.008 |
| 100 kHz – 300 kHz | 1.00 + 0.1 | 1.00 + 0.1 | 1.00 + 0.1 | 1.00 + 0.1 | 0.200 + 0.020 |
| **True RMS AC current [16, 17]** | | | | | |
| **100 µA, 1 mA, 10 mA, 100 mA, 1 A ranges** | | | | | |
| 3 Hz – 5 kHz | 0.07 + 0.04 | 0.09 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.10 + 0.04 | 0.030 + 0.006 |
| 3 A range | | | | | |
| 3 Hz – 5 kHz | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.23 + 0.04 | 0.030 + 0.006 |
| 10 A range [5] | | | | | |
| 3 Hz – 5 kHz | 0.10 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.015 + 0.006 |
| 5 – 10 kHz (typ) | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.15 + 0.04 | 0.030 + 0.006 |
| **Capacitance [21]** | | | | | |
| 1.0000 nF | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.50 + 0.50 | 0.05 + 0.05 |
| 10.000 nF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 nF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 1.0000 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 10.000 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| 100.00 µF | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.40 + 0.10 | 0.05 + 0.01 |
| **Frequency [18, 20]** | | | | | |
| **100 mV, 1 V, 10 V, 100 V, and 750 V ranges [20]** | | | | | |
| 3 Hz– 40 Hz | 0.070 | 0.070 | 0.070 | 0.070 | 0.0002 |
| 40 Hz– 100 Hz | 0.030 | 0.030 | 0.030 | 0.030 | 0.0002 |
| 100 Hz – 1 kHz | 0.003 | 0.006 | 0.007 | 0.010 | 0.0002 |
| 1 kHz – 300 kHz | 0.002 | 0.005 | 0.007 | 0.009 | 0.0002 |
| Square wave [18] | 0.001 | 0.004 | 0.006 | 0.008 | 0.0002 |
| **Additional frequency errors ±(% of reading) [18]** | | | | | |
| **Aperture (resolution/range)** | **1 second (0.1 ppm)** | **0.1 second (1 ppm)** | **0.01 second (10 ppm)** | **0.001 second (100 ppm)** | |
| 3 Hz – 10 Hz | 0 | 0.100 | 0.160 | 0.160 | |
| 10 Hz – 100 Hz | 0 | 0.030 | 0.160 | 0.160 | |
| 100 Hz – 1 kHz | 0 | 0.020 | 0.200 | 0.200 | |
| 1 kHz– 300 kHz | 0 | 0.004 | 0.030 | 0.240 | |
| Square wave [18] | 0 | 0.000 | 0.000 | 0.003 | |

# Specifications 34470A

| DC and AC current burden voltage at full scale | |
|---|---|
| **DC current range** | **Burden voltage** |
| 1 µA | < 0.0011 V |
| 10 µA | < 0.011 V |
| 100 µA | < 0.11 V |
| 1 mA | < 0.11 V |
| 10 mA | < 0.027 V |
| 100 mA | < 0.27 V |
| 1 A | < 0.7 V/0.05 V [21] |
| 3A | < 2.0 V/0.15 V [21] |
| 10 A | < 0.5 V |

**Digitizing[22]**

Typical performance for these conditions: Sample rate: 50 kHz (Aperture = 20 µS);
Sine wave input: Vpeak = Full scale of range; Input frequency: 1 kHz/10 kHz

| Function: range | Spur-free range SFDR | THD + noise SNDR | BW (-3 db) |
|---|---|---|---|
| DCV: 0.1, 1 V | 79/60 | 75/57 | 15 kHz |
| DCV: 10 V | 86/59 | 82/58 | 15 kHz |
| DCV: 100, 1000 V | 64/42 | 60/42 | 15 kHz |
| DCI: 0.1, 1 mA | 78/62 | 75/60 | 10 kHz |
| DCI: 10, 100 mA | 78/62 | 67/60 | 10 kHz |
| DCI: 1-10 A | 65/49 | 63/48 | 10 kHz |

1. Specifications are for 60-minute warm-up, integration setting of 10 or 100 NPLC, auto-zero on, AC slow filter. ACAL run within the last 2 days.
2. 20% over range on all ranges, except 1000 DCV, 750 ACV, 10 DCA, 3 DCA, 10 ACA, 3 ACA, and diode test have 0%.
3. Relative to calibration standards.
4. The 10 A range is only available on a separate front panel connector. Add 2 mA per amp for inputs greater than 5 Arms.
5. Add this for each °C outside TCAL ±5°C.
6. Add this for each °C outside the last ACAL ±2°C.
7. Add this for each °C outside ACAL ±2°C.
8. Specifications are for 4-wire ohms function or 2-wire ohms using math null for offset. Without math null, add 0.2 Ω additional error in 2-wire ohms function. The 100 M and 1 G ohm ranges are 2-wire only. See the manual for low power ohms specification and measurement currents
9. For each additional volt over ±500 V add 0.02 mV of error.
10. Specifications are for the voltage measured at the input terminals. The 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.
11. See user manual for details.
12. Actual measurement range and probe errors will be limited by the selected probe. Probe accuracy adder includes all measurement and ITS-90 temperature conversion errors. PT100 Ro settable to 100 Ω ±5 Ω to remove the initial probe error.
13. The internal reference junction uses the U1180A or equivalent adapter. This has a typical performance of ±1.0°C. This internal reference junction can be adjusted for better accuracy. An external reference junction can also be used.
14. Specifications are for sinewave input > 0.3% of range and > 1 mVrms. 750 ACV range limited to 8 x 107 Volt–Hz. For each additional volt over 300 Vrms add 1 mVrms of error.
15. Low-frequency performance: three filter settings are available: 3 Hz, 20 Hz, 200 Hz. Frequencies greater than these filter settings are specified with no additional errors.
16. Specifications are for sinewave input > 1% of range and > 10 µArms.
17. Specifications are for sine wave input unless stated otherwise.
18. Square wave input specified for 10 Hz– 300 kHz for 1 second aperature. For shorter aperatures the minimun frequency requires > 2 cycles.
19. Input > 100 mV. For 10 mV to 100 mV inputs, multiply % of reading error x10. Amplitude 10 – 120% of range except 14 – 100% for the 750 ACV range. Specifications are for 1-second gate time (7-digits).
20. Specifications are for using Math Null zeroing. High dissapation factor capacitors may show different results than a single frequency measurement. Film capacitors usually have lower dissapation factors than other dielectrics.
21. The second burden voltage can be obtained by using the 10 A input range.
22. Sample rate (actual): 50.118 kHz (Aperture = 19.953 µs).

# Measurement Characteristics
## (for all models except where noted)

| | |
|---|---|
| **DC voltage** | |
| Measurement method: | Keysight patented continuously integrating multi-slope IV A/D converter |
| A/D Linearity<br>34460/61A<br>34465A<br>34470A | <br>0.0002% of reading + 0.0001% of range<br>0.0001% of reading + 0.0001% of range<br>0.00005% of reading + 0.0001% of range |
| Input resistance<br>0.1 V, 1 V, 10 V range<br>100 V, 1,000 V range | <br>Selectable 10 MΩ or >10 GΩ<br>10 MΩ ±1% |
| Input bias current | < 30 pA at 25°C |
| Input terminals | Copper alloy |
| Input protection | 1,000 V on all ranges |
| **True RMS AC voltage** | |
| Measurement type | AC–coupled True RMS.<br>Measures the AC component of the input. |
| Measurement method | Digital sampling with anti-alias filter |
| Maximum input | 400 DCV, 1,100 Vpeak |
| Input impedance | 1 MΩ ±1%, in parallel with < 100 pF |
| Input protection | 750 Vrms all ranges |
| **DC and True RMS AC current** | |
| AC measurement type | Directly coupled to the fuse and shunt.<br>AC True RMS measurement (measures the AC component only). |
| AC measurement method | Digital sampling with anti-alias filter |
| Input protection 3 A | Externally accessible 3.15 A, 500 V fuse (Replacement part number 2110-1547 3.15 A external fuse)<br>Internal 11 A, 1,000 V fuse (Replacement part number 2110-1402 11 A external fuse) |
| Input protection 10 A (34461/65/70A only) | Internal 11 A, 1000 V fuse (Replacement part number 2110-1402 11 A external fuse) |
| **AC crest factor and peak input** | |
| Crest factor | 10:1 maximum crest factor, (3:1 at full-scale). Measurement bandwidth limited to 300 kHz for signal plus harmonics. |
| Peak input | 300% of range or maximum input |
| Overload ranging | Will select higher range if peak input overload is detected during auto range. Overload is reported in manual ranging. |
| **Resistance** | |
| Measurement method | Selectable 4-wire or 2-wire ohms.<br>Current source referenced to LO input. |
| Maximum lead resistance (4-wire ohms) | 10% of range per lead for 100 Ω, 1 kΩ ranges.<br>1 kΩ per lead on all other ranges. |
| Input protection | 1,000 V on all ranges |
| **Continuity/diode test** | |
| Response time | 300 samples/s with audible tone |
| Continuity threshold | Fixed at 10 Ω |

| | |
|---|---|
| **DC ratio** | |
| Measurement method | Input HI-LO/reference (sense) HI-LO |
| Input HI-LO | 100 mV to 1000 V ranges |
| Reference (sense) | HI-Input LO: 100 mV to 10 V ranges (autoranged) |
| Input to reference (sense) | HI and LO reference (sense) terminals reference to LO input < 12 V |
| **Temperature** | |
| PT100 platinum RTD sensor, α = 0.00385Ω/Ω/°C; DIN/IEC 751.<br>Measurement conversions limited to –200 to 600°C. | |
| 5 kΩ thermistor β = 3891; YSI 44007 or equivalent.<br>Measurement conversions limited to –80 to 150°C. | |
| **Measurement noise rejection** | |
| 60 Hz (50 Hz ) for 1 kΩ LO lead unbalance ( ±500 V peak maximum)<br>DCV CMRR: 140 dB<br>ACV CMRR: 70 dB | |
| Integration time | Normal mode rejection [1] |
| ≥ to 1 PLC | 60 dB [2] |
| < 1 PLC | 0 db |
| **Frequency and period** | |
| Measurement method: | Reciprocal-counting technique. Measurement is AC-coupled using AC measurement functions. |
| Voltage ranges: | 100 mVrms full scale to 750 Vrms. Auto or manual ranging. |
| Gate time: | 1 ms (34465/70A), 10 ms, 100 ms, or 1 s |
| Measurement considerations | All frequency counters are susceptible to error when measuring low-voltage, low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors. |
| **Autozero OFF operation** | |
| Following instrument warm–up at a stable ambient temperature ±1°C and < 10 minutes. | |
| Add 0.0002% of range + 5 µV for DCV or + 5 mΩ for resistance. | |
| **Measurement settling considerations** | |
| High-power settling | |
| Applying high-power signals (more than 300 Vrms, 500 VDC, 1 A DC or 1 Arms) can cause self-heating in the signal-conditioning components. These errors are included in the instrument specifications. Internal temperature changes due to self-heating may cause additional error on other functions or ranges. The additional error will generally dissipate within a few minutes. | |
| DC blocking capacitor | |
| Errors will occur in ACV and Frequency functions when attempting to measure an input following a DC offset voltage change. The input blocking RC time constant must be allowed to fully settle (up to 1 second) before the most accurate measurements are possible. | |
| External connections | |
| Reading settling times are affected by source impedance, cable dielectric characteristics, and thermal EMF of connections. Keysight recommends the use of PTFE or other high-impedance, low-dielectric absorption wire insulation for these measurements. To maintain low thermal EMF, connectors and wires made of copper are recommended. | |

1. For power-line frequency ±0.1%
2. For power-line frequency ±1%, the NMR is 40 dB
   For ±3%, use 30 dB

# Operating Characteristics
(for all models except where noted)

## Performance versus measurement speed

### For DC voltage, DC current, and resistance [1] (34460A & 34461A)

| | 34460A | | 34461A | | |
|---|---|---|---|---|---|
| **Integration time** | **Digits** | **Readings/s** | **Digits** | **Readings/s** | **Additional noise error** |
| 100 PLC/1.67 s (2 s) | 6½ | 0.6 (0.5) | 6½ | 0.6 (0.5) | 0% of range |
| 10 PLC/167 ms (200 ms) | 6½ | 6 (5) | 6½ | 6 (5) | 0% of range |
| 1 PLC/16.7 ms (20 ms) | 5½ | 60 (50) | 5½ | 60 (50) | 0.001% of range [2] |
| 0.2 PLC/3 ms (3 ms) | 5½ | 100 | 5½ | 300 | 0.001% of range [3] |
| 0.02 PLC/300 µs (300 µs) | 3½ | 300 | 4½ | 1000 | 0.01% of range [3] |
| **AC voltage, AC current [4, 5]** | **Digits** | **ACV** | **ACI** | **AC filter** | |
| 34460A, 34461A, 34465A, 34470A | 6½ | 0.4/s | 0.6/s | Slow | |
| | 6½ | 1.6/s | 4/s | Medium | |
| | 6½ | 40/s | 40/s | Fast | |
| | 6½ | 50/s [6] | 50/s [6] | Fast | |
| **Frequency, period** | **Aperture** | **Digits** | **Readings** | | |
| 34460A, 34461A, 34465A, 34470A | 1 second | 7 | 1 | | |
| | 0.1 second | 6 | 10 | | |
| | 0.01 second | 5 | 80 | | |
| **Frequency, period** | **Aperture** | **Digits** | **Readings** | | |
| 34465A, 34470A | 1 second | 8 | 1 | | |
| | 0.1 second | 7 | 10 | | |
| | 0.01 second | 6 | 100 | | |
| | 0.001 second | 5 | 1000 | | |

1. Reading speeds for 60 Hz (and 50 Hz) operation, autozero off, fixed range.
2. Add 5 nA for the 100 µA range, add 0.2 µA for the 10 mA range.
3. Add 20 µV for DCV and 20 mΩ for resistance. Add 0.2 µA for DC current + 10x the above range error for the 10 mA range. For 0.2 PLC multiply the above range error by 5x on the 1 A and 10 A ranges, and by 10x for the 10 mA range.
4. Maximum reading rates for 0.01% of AC step additional error. Additional settling delay required when input DC level varies.
5. For external trigger or remote operation using default settling delay (Delay Auto).
6. Maximum useful limit with default settling delays defeated.

## Noise performance for DC voltage, DC current, and resistance (34465A & 34470A)

| Integration time | Digits [1] | Readings/s | RMS noise adder (% of range + fixed base) [2] | | |
|---|---|---|---|---|---|
| | 34465/34470 | | DC volts | Ohms | DC current [3] |
| 100 PLC/1.67 s (2 s) | 6½ / 7½ | 0.06 (0.5) | 0 | 0 | 0 |
| 10 PLC/167 ms (200 ms) | 6½ / 7½ | 6 (5) | 0 | 0 | 0 |
| 1 PLC/16.7 ms (20 ms) | 6½ / 7 | 60/50 | 0.0001 + 0.5 µV | 0.0001 + 0.5 mΩ | 0.0006 + 0 .01 nA |
| 0.2 PLC/3 ms (3 ms) | 6½ / 6½ | 333 | 0.0005 + 3 µV | 0.0010 +10 mΩ | 0.0050 + 5 nA |
| 0.06 PLC/1 ms (1 ms) | 6/6 | 1,000 | 0.0020 + 3 µV | 0.0020 + 10 mΩ | 0.0070 + 10 nA |
| 0.02 PLC/300 µs (300 µs) | 6/6 | 3,333 | 0.0020 + 3 µV | 0.0020 + 10 mΩ | 0.0070 + 10 nA |
| 0.006 PLC/100 µs (100 µs) [4] | 5/5 | 10,000 | 0.0050 + 4 µV | 0.0050 + 10 mΩ | 0.0100 +15 nA |
| 0.002 PLC/40 µs (40 µs) [4] | 5/5 | 25,000 | 0.0050 + 4 µV | 0.0050 + 10 mΩ | 0.0100 +15 nA |
| 0.0.001 PLC/20 us (20 µs) [4,5] | 4½ / 4½ | 50,000 | 0.0100 + 4 µV | 0.0150 + 10 mΩ | 0.0150 + 30 nA |

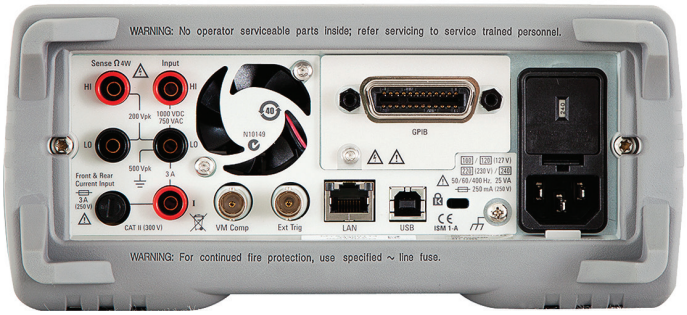
1. For DCV on the 10 V range with zero volts input and auto zero on.
2. RMS noise adder for both the 34465 and the 34470. Measured with zero volts input and auto zero on.
3. The following DCI ranges have these additional multipliers: The 10 mA by 5x, the 100 mA by 2x, and the 10 A by 1.6x.
4. Requires the digitizing option (Option DIG).
5. Actual integration time is 19.953 µs.

## System speeds (nom)

| DC voltage, DC current, resistance [1, 2] | 34460A | 34461A | 34465A/34470A |
|---|---|---|---|
| Autorange time [3] | < 30 ms | < 30 ms | < 5 ms |
| Maximum internal trigger rate | 300/s | 1000/s | 5,000/s |
| Maximum external trigger rate | 300/s | 1000/s | 5,000/s |
| ASCII readings to bus | 300/s | 1000/s | 40,000/s (GPIB 8,000/s) |
| Single reading transaction rate [4] | 50/s | 150/s | 250/s |
| **AC voltage, AC current [5]** | | | |
| Autorange time [3] | 10/s | 10/s | < 5 ms |
| Maximum internal trigger rate | 50/s | 50/s | 250/s |
| Maximum external trigger rate | 50/s | 50/s | 250/s |
| ASCII readings to bus | 50/s | 50/s | 250/s |
| Single reading transaction rate [4] | 50/s | 50/s 5 | 200/s |
| **Frequency, period [6]** | | | |
| Autorange time [3] | 10/s | 10/s | < 5 ms |
| Maximum internal trigger rate | 80/s | 80/s | 800/s |
| Maximum external trigger rate | 80/s | 80/s | 800/s |
| ASCII readings to bus | 80/s | 80/s | 900/s |
| Single reading transaction rate [4] | 50/s | 50/s | 200/s |

1. 0.02 NPLC, delay 0, autozero off, math off, and display off.
2. These rates apply to all I/O interfaces.
3. Time to automatically change one range and be ready for new measurement, ≤ 10 V, ≤ 10 MΩ.
4. Includes measurement and IO time (assumes connection via SOCKETS. VXI-11 connections may be slower).
5. Fast AC filter, delay 0, math off, and display off.
6. 10 ms aperture, fast AC filter, delay 0, math off, and display off.


34460A DMM rear panel with GPIB option installed.




34461/65/70A DMM rear panel with GPIB option installed.

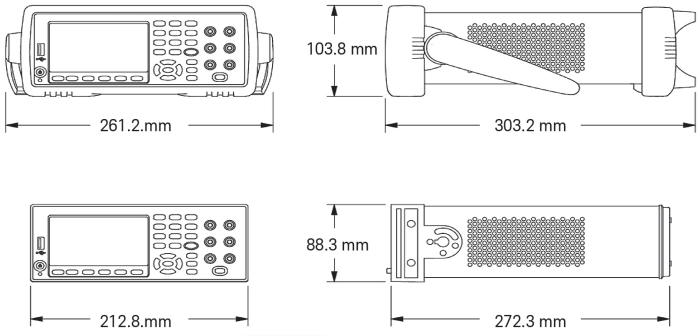
# General Characteristics
## (for all models except where noted)

| | |
|---|---|
| **Line power** | |
| Power supply | 100/120 (127)/ 220 (230)/240 ACV ±10%, CAT II |
| Power line frequency | 50/60/400 Hz ±10% |
| Power consumption | 25 VA |
| **Environment** | |
| Operating environment | Full accuracy for 0 to 55°C<br>Full accuracy to 80% R.H. at 40°C non–condensing |
| Operating altitude | Up to 3,000 m |
| Storage temperature | –40 to 70°C |
| **Mechanical** | |
| Rack dimensions | (W x H x D): 212.8 mm x 88.3 mm x 272.3 mm |
| Bench dimensions | (W x H x D): 261.2 mm x 103.8 mm x 303.2 mm |
| Weight | 34460A: 3.68 kg (8.1 lb)<br>34461/65/70A: 3.76 kg (8.3 lb) |
| **Regulatory** | |
| Safety | EN 61010-1:2010 (3rd Edition) |
| | ANSI/ISA-61010-1 (82.02.01) Third Edition |
| | ANSI/UL 61010-1 Third Edition |
| | CAN/CSA-C22.2 No. 61010-1 Third Edition |
| | EN 61010-2-030:2010 (1st Edition) |
| | ANSI/ISA-61010-2-030 (82.02.03) First Edition |
| | ANSI/UL 61010-2-030 First Edition |
| | CAN/CSA-C22.2 No. 61010-2-030 First Edition |
| | Refer to Declaration of Conformity for current revisions |
| | Measurement Category II to 300 V |
| | Other non MAINS circuits to 1,000 Vpk |
| | Pollution Degree 2 |
| EMC | IEC 61326 |
| | EN 61326 |
| | CISPR |
| | ICES-001 |
| | AS/NZS 2064.1 |
| | Refer to Declaration of Conformity for current revisions |
| Acoustic noise (nominal) | 35 dBA |
| **Triggering conditions** | |
| External input | Low–power TTL compatible input programmable edge triggered |
| Delay | < 1 µs |
| Jitter | < 1 µs |
| Minimum pulse width | 1 µs |
| Maximum rate | Up to 1 kHz (34461A), up to 300 Hz (34460A) |
| Voltmeter complete output | 3.3 V logic output |
| Polarity | Programmable edge pulse |
| Pulse width | Approximately 2 µs |
| **Computer interfaces** | |
| LXI (rev 1.4) | 10/100Base-T Ethernet (Sockets, VXI-11 protocol, Web user interface) (Optional on 34460A) |
| USB | USB 2.0 (USB-TMC488 & MTP protocol) |
| GPIB | Optional GPIB IEEE-488 |
| Language | SCPI-1999, IEEE-488.2, 34401A compatible |

**Front-panel USB host port**

Supports USB 2.0 high-speed mass storage (MSC) class devices

Capability: Import/export instrument configuration files, save volatile readings and screen captures




**System speeds (nom)**

| Benchmark | GPIB | USB 2.0 | VXI-11 | Sockets |
|---|---|---|---|---|
| Function change 1 | 50/s | 50/s | 50/s | 50/s |
| Range change 2 | 100/s | 100/s | 100/s | 100/s |

1. Rate to change from 2-wire resistance to any other function
2. Rate to change from one range to the next higher range, ≤ 10 V, ≤ 10 MΩ

| **Triggering and memory** | |
|---|---|
| Samples per trigger | 1 to 1,000,000 |
| Trigger delay | 0 to 3600 sec (~1 µs step size) |
| External trigger delay | < 10 µs |
| External trigger jitter | < 1 µs (DC fixed range) |
| Volatile reading memory | 10,000 (34461A), 1,000 (34460A) |

**Probe hold**

Capture and navigate stable list of readings

**Internal flash file system**

80 MB total capacity
Save reading memory to non-volatile memory in CSV format
Store and recall user-defined states, power-off state,1 and preference files
Save screen captures in BMP or PNG formats

1. Power-off state only when power-down is initiated via front-panel power switch.

**Math functions**

Per function null, min/max/avg/Sdev, dB, dBm, span, count, limit test, histogram

**Display**

4.3" color TFT WQVGA (480x272) with LED backlight
Supports: basic number, bar meter, trend chart (34461A only), histogram views. User-defined power-on message, display label, and selectable screen colors Integrated, context-sensitive system help through press-and-hold buttons

**Real-time clock/calendar**

Set and read, year, month, day, hour, minute, seconds (Note: seconds not settable). Battery CR-2032 coin-type, replaceable, > 10-year life (typ)

**Software available**

IO Libraries: www.keysight.com/find/IOLibraries
BenchVue: www.keysight.com/find/benchvue

# Options, Upgrades & Accessories

## Options & upgrades

| Option (at purchase) | Upgrades (post purchase) | Applicable models | Description | Upgrade process |
|---|---|---|---|---|
| GPB | 3446GPBU | All | Add GPIB interface, user-installable | Customer installable hardware |
| SEC | 3446SECU | All | Enable NISPOM and file security | Software license |
| LAN | 3446LANU | 34460A | Enable LAN interface and external triggering | Software license |
| ACC | 3446ACCU | 34460A | Add 34138A accessory kit, includes test leads, USB cable | Accessory kit |
| DIG | 3446DIGU | 34465/70A | Enable high-speed digitizing and advanced triggering | Software license |
| MEM | 3446MEMU | 34465/70A | Enable 2 million readings memory | Software license |
| Z54 | N/A | All | Certificate of calibration: ANSI/NCSL Z540.3-2006 | Calibration certificate |

## Accessories

| Accessories included | |
|---|---|
| 34460A: | Power cord<br>Calibration certificate |
| 34461A,<br>34465A,<br>34470A: | 34138A test lead set with probes, fine tip probes,<br>SMT grabbers and mini grabber attachments<br>Power cord<br>IO Libraries CD<br>USB cable<br>Calibration certificate |

| Accessories available | |
|---|---|
| 11059A | Kelvin probe set |
| 11060A | Surface-mount device probe |
| 11062A | Kelvin clip set |
| 34131A | Transit case |
| 34133A | Precision electronic test leads |
| 34134A | DC-coupled current probe |
| 34136A | High-voltage probe |
| 34138A | Test lead set |
| 34151A | Three signal wedge probe kit |
| 34152A | PT100/RTD 4-wire class A sensor kit |
| 34153A | PT100/RTD 4-wire class sensor elements |
| 34162A | Accessory pouch |
| 34171B | Input terminal block |
| 34172B | Calibration short |
| 34330A | 30-A current shunt |
| E2308A | Thermistor temperature probe |
| Y1133A | Low-thermal external digital multimeter scanning kit |

## Definitions

### Specification (spec)

The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 – 55°C and after a 60-minute warm up period. All specifications include measurement uncertainty and were created in compliance with ISO-17025 methods. Data published in this document are specifications (spec) only where specifically indicated.

### Typical (typ)

The characteristic performance, which 80% or more of manufactured instruments will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23°C).

### Nominal (nom)

The mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed. This data is not warranted and is measured at room temperature (approximately 23°C).

### Measured (meas)

An attribute measured during development for purposes of communicating the expected performance. This data is not warranted and is measured at room temperature (approximately 23°C).

### $T_{CAL}$

The temperature at which the instrument was calibrated.

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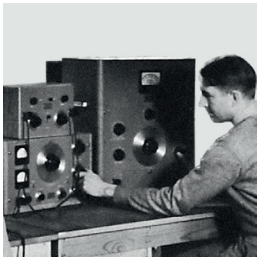

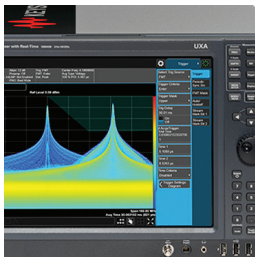

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