APPLICATION NOTE

Simultaneous Measurements with a Digital Multimeter

Overview

Traditionally, digital multimeters (DMMs) have been single-measurement instruments. However, system designers want the ability to track more than one parameter on their signal. Doing so often provides complementary data that can make measurements significantly easier to understand. With the right architecture and design, DMMs can now make secondary measurements.

Learn how the Truevolt Series DMMs help designers make secondary measurements without ever having to change the instrument's configuration. The advanced functionality on the Keysight 34460A series and Keysight 34470A series DMMs with expanded math functions mean that designers can now analyze their data faster.

Keysight's Truevolt Series DMMs

- graphical front panel display and built-in statistical tools for real-time analysis
- smallest noise level and injected current for minimum measurement intrusiveness
- advanced triggering and digitizing capability to help capture fast signals

Two Measurements on One Screen

Secondary auxiliary measurements augment information provided by a main primary measurement function. Depending on the function, you can measure complementary data that traditionally would have taken two different operations and function changes. Table 1 illustrates the secondary measurement capabilities of the Truevolt DMMs.

Primary measurement function	34460A secondary measurement function	34465A/70A secondary measurement function
DCV	ACV	ACV, peak, pre-math
ACV	Frequency	DCV, frequency, pre-math
2-wire, 4-wire resistance		Pre-math
DCI	ACI	ACI, peak, pre-math
ACI	Frequency	DCI, frequency, pre-math
Frequency	Period	Period, ACV, pre-math
Period	Frequency	Frequency, ACV, pre-math
Temperature	Sensor	Sensor, pre-math
Ratio	Input/Ref	Input/Ref, pre-math
Capacitance		Pre-math
Continuity		None
Diode		None

Table 1. Secondary measurement capabilities supported by the Truevolt DMMs

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Figure 1 is an example of a common secondary measurement with the ability to measure the frequency of an AC signal.

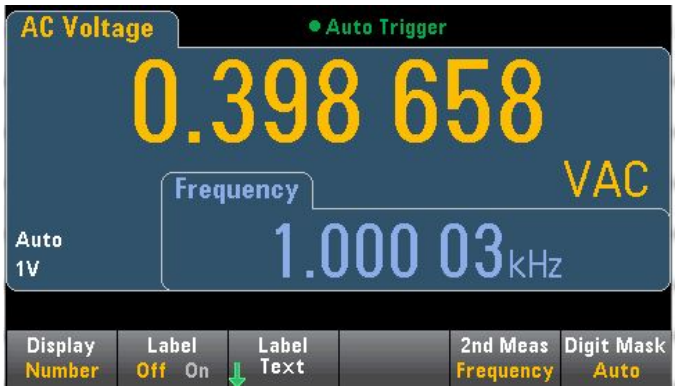

Figure 1. AC voltage with frequency

With the advanced secondary features of the 34460A and 34470A series DMMs, the secondary measurements provide more information than other DMMs. For example, Figure 2 shows the primary measurement of DC voltage (DCV) with a secondary measurement of AC voltage (ACV). This dual measurement function is an especially important measurement if your signal has both an AC and DC component.
In DCV mode, there are two additional secondary measurements available to gain insight into your signal — Peak and Pre-Math. Figure 3 shows the peak measurement tracking the minimum and maximum DCV DMM readings. This peak measurement is similar to the information that is available from the statistics display.

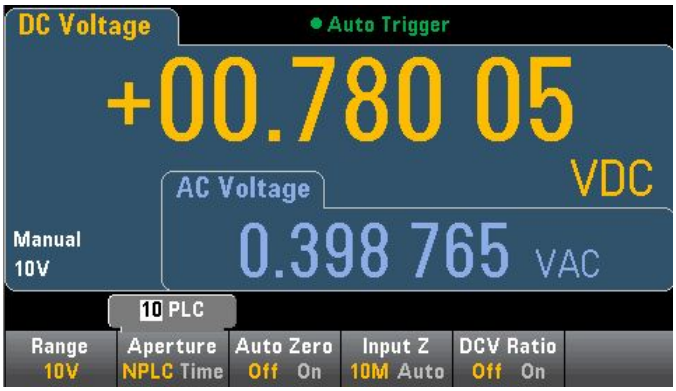

Figure 2. DC voltage (primary) and AC voltage (secondary) measurements

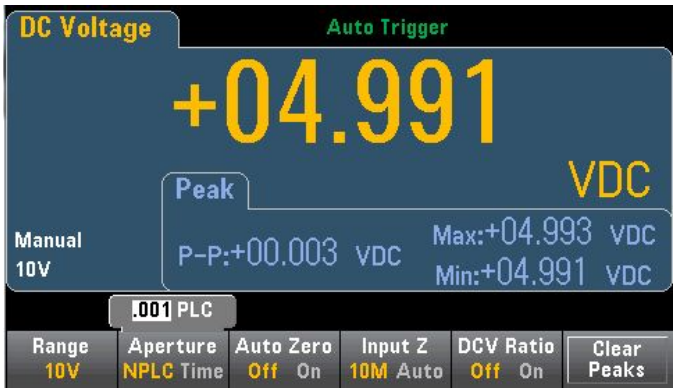

Figure 3. Peak measurement of DCV

Pre-Math is also a helpful measurement because it allows you to view modified readings and raw readings in one screen (Figure 4). You can even modify your primary display by applying useful math functions to your data (a null value or scaling) or filtering your data (Figure 5).

Once you have applied the desired math function, the secondary display will display the raw reading without the math. This raw data display is useful for determining if the applied math is correct and if the readings are within the expected range.

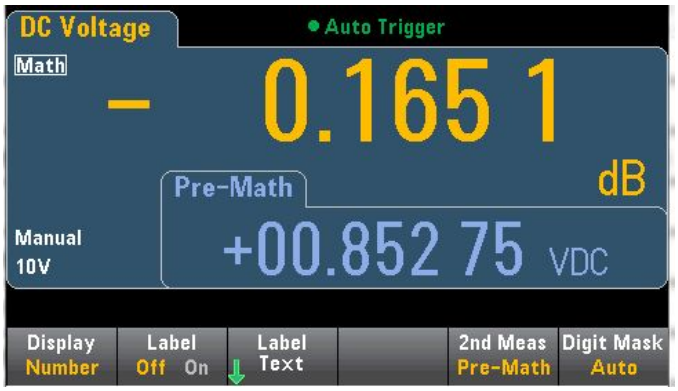

Figure 4. A DCV signal with dB scaling with the Pre-Math measurement

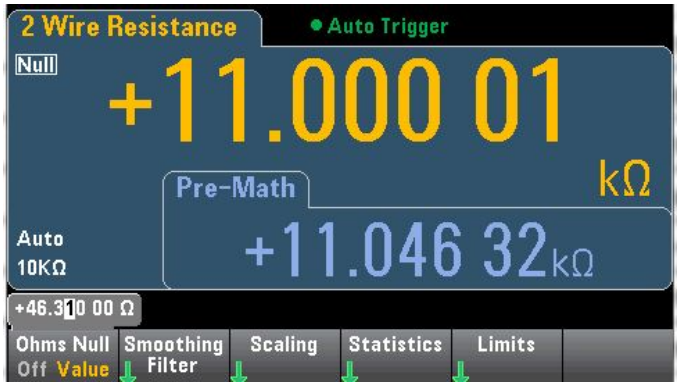

Figure 5. The null value applied with the raw measurement on the secondary display

With the temperature measurement capabilities included in Truevolt DMMs, you might also want to view what the sensor readings are in volts or ohms, depending on your sensor (Figure 6). All four Truevolt DMM models provide this capability on the secondary display.

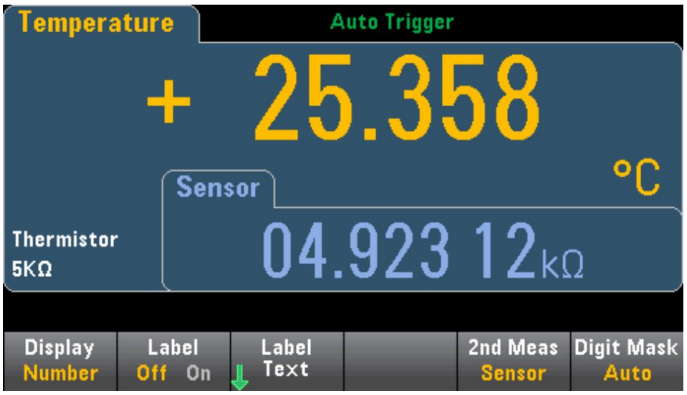

Figure 6. Sensor readings displayed on the secondary display for a given temperature measurement

Another useful feature of the dual display is the ability to provide raw measurements when you are using the DCV ratio function. With the addition of the second display, you can read the ratio, the input voltage, and the reference voltage in one glance (Figure 7). The DCV ratio is a function measured by comparing the voltage on the Input terminals divided by the reference voltage. The reference voltage is the difference of two separate measurements. These measurements are the DC voltages from the HI sense terminal to the LO input terminal and from the LO sense terminal to the LO input terminal. Figure 8 shows a simple DCV ratio diagram.

Figure 7. With the Truevolt DMM dual display, you can view two voltage measurements when using the DCV ratio function

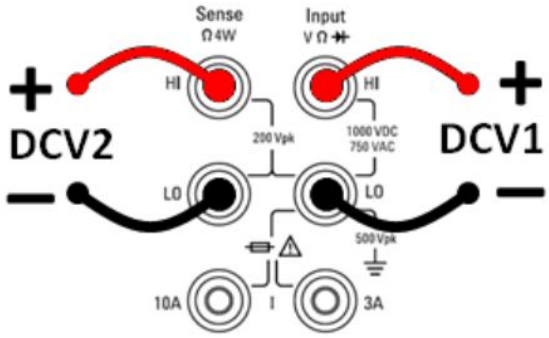

Figure 8. Basic DCV ratio diagram

Adding math enables faster analysis

A key advantage of the 34465A/34470A Truevolt Series DMMs is the feature of additional math functions as compared to their predecessors — the Keysight 34460A and Keysight 34461A. These earlier Truevolt DMMs allow you to null readings to zero out your measurement offsets, set limits for your readings, and display statistics. The 34465A/34470A DMMs have the same capabilities, including a smoothing filter and scaling (Figure 9).

The smoothing filter is useful if you want to average out statistical outliers. Applying the smoothing filter means the DMM uses a moving average (boxcar) filter to reduce random noise. You may change the filter response by choosing Fast/Medium/Slow (Figure 10). The slower the filter, the more readings are available in the filter.

Additional scaling features are available on the 34465A/34470A DMMs. You can now change the readings on your front panel by scaling the readings with either a dB, dBm, %, or Mx-B scaling (Figure 11). For dB scaling, the result is the difference between the input signal and the stored dB-relative value reference. The dBm scaling is a result based on the calculation of power delivered to a reference resistance (Ref R), relative to 1 milliwatt. The % scaling shows a percent change from a reference value, while the Mx-B allows for linear scaling with an offset operation.

Figure 9. Math functions available in the 34465A/34470A DMMs

Figure 10. Smoothing filter options

Figure 11. Options for scaling

Conclusion

Advanced dual-screen measurements allow you to get more information concurrently. They also let you check your raw data compared to your adjusted measurements. You will save time and gain more information than is possible with other similar instruments by using the Truevolt Series DMMs to make dual measurements

For more information about Keysight's Truevolt Series DMMs, please go to www.keysight.com/find/Truevolt.

Figure 12. Keysight's 34465A Truevolt DMM displaying dual-screen measurements

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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