

Faster Data Analysis with Digital Multimeter Measurements

Data Analysis on the Instrument Display

Modern digital multimeters (DMMs) allow you to analyze your setup and data using only the front panel. The Keysight Truevolt Series of DMMs — 34460A, 34461A, 34465A, and 34470A — offers other methods for gaining insight into measurement data without having to transfer that data to a PC. Truevolt DMMs feature a large graphical display and built-in math functions that show measurement trends, statistics, and histograms in a single, compact unit. With advanced analysis and data collection methods on the 34465A and 34470A, it might be possible to run an entire analysis using only the DMM. See how the Truevolt Series DMMs can help you more quickly analyze data.



All Truevolt DMMs come with advanced triggering and digitizing capabilities that help capture fast signals that many other DMMs miss.

Learn more about Keysight's Truevolt DMMs at <http://www.keysight.com/find/Truevolt>.

Graphical Displays and Advanced Triggering

Truevolt DMMs analyze data graphically on the instrument display and offer advanced triggering. Those features help product designers quickly overcome certain technical challenges without complicated setups. Here are two typical examples:

1. You need to characterize the drift of a precision resistor in your design. Rather than setting up a program or using your PC, you decide to use your Truevolt DMM's trend chart feature to gather the data. After allowing the design to heat up for 20 minutes, you start to see nonlinear behavior in the resistor. With the pan, zoom, and cursor capability of the new 34465A/34470A DMMs, you identify the instant the measurement goes nonlinear. You then decide that the resistor is not performing to specification and that you need to evaluate other parts.
2. You are troubleshooting a switching DC power supply that appears to work well. However, some behavior drops the voltage out of tolerance. Using your Truevolt DMM, you characterize the power supply's output. By switching between trend chart and histogram mode, you identify that the power supply's noise is not Gaussian and skews toward the lower end of regulation. Your analysis takes only 10 minutes and does not require a computer.



Trend chart shows the direction

If you expect a measurement to remain constant, measure it only once. That is because, in the real world, values drift with time, track other parameters, or vary in complex ways with outside influences. You can set the trend chart display on the 34461A, 34465A, and 34470A DMMs to show the most recent data over the last minute or all data collected since the last time the readings were cleared (Figure 1).

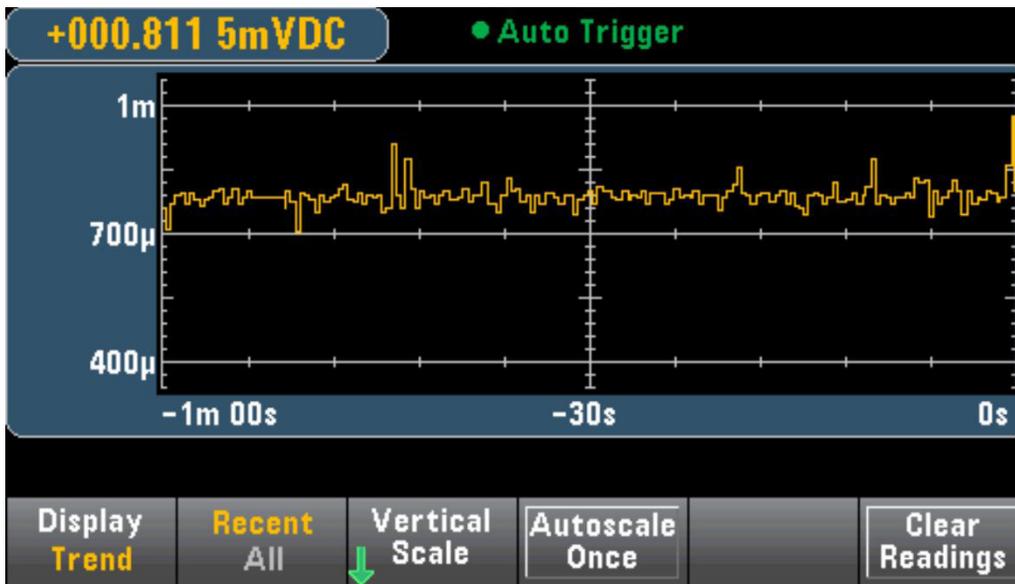


Figure 1. The trend chart display shows direction and reading anomalies

Histograms tell all about the data

When the lowest digits of a reading are changing constantly and sometimes too quickly to track visually, it is important to know the nature of that variation. The histogram provides insight by showing the distribution of the measured values (Figure 2). The average, distribution shape, and standard deviation are all critical information for understanding the variation phenomena.

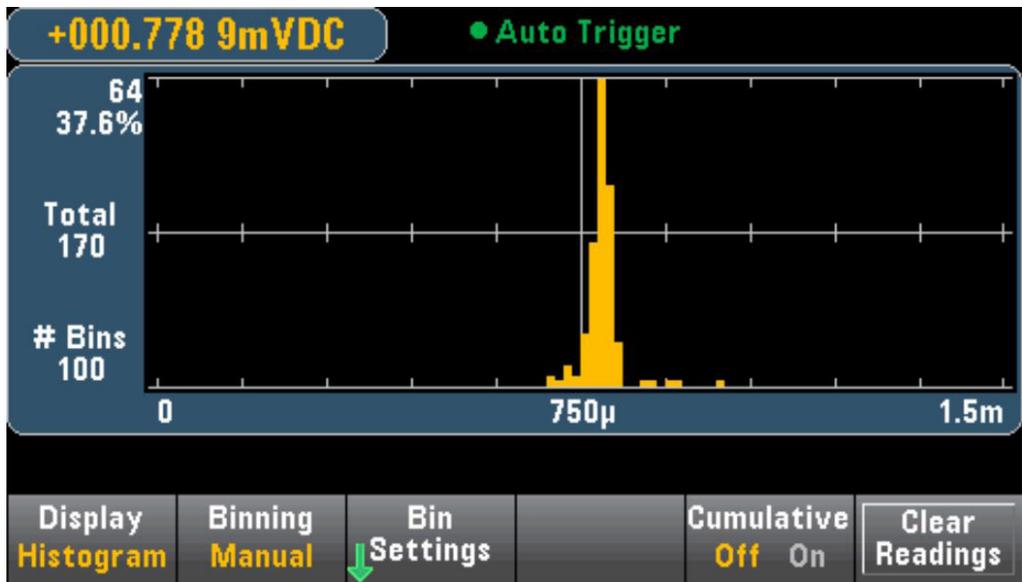


Figure 2. The histogram provides insight on variations of measured data

Secondary measurements

Truevolt DMMs let you run secondary measurements concurrently with your primary measurement. That allows you to gather two types of information — for example, a thermistor temperature measurement (primary) and the resistance measurement made on the thermistor (Figure 3) — at a glance. For further information on secondary measurements, see the Keysight Technologies application brief “*Simultaneous Measurements with a Digital Multimeter - Application Brief*,” publication number 5992-0419EN, or the *Digital Multimeters 34460A, 34461A, 34465A (6½ digit), 34470A (7½ digit) - Data Sheet*, publication number 5991-1983EN.

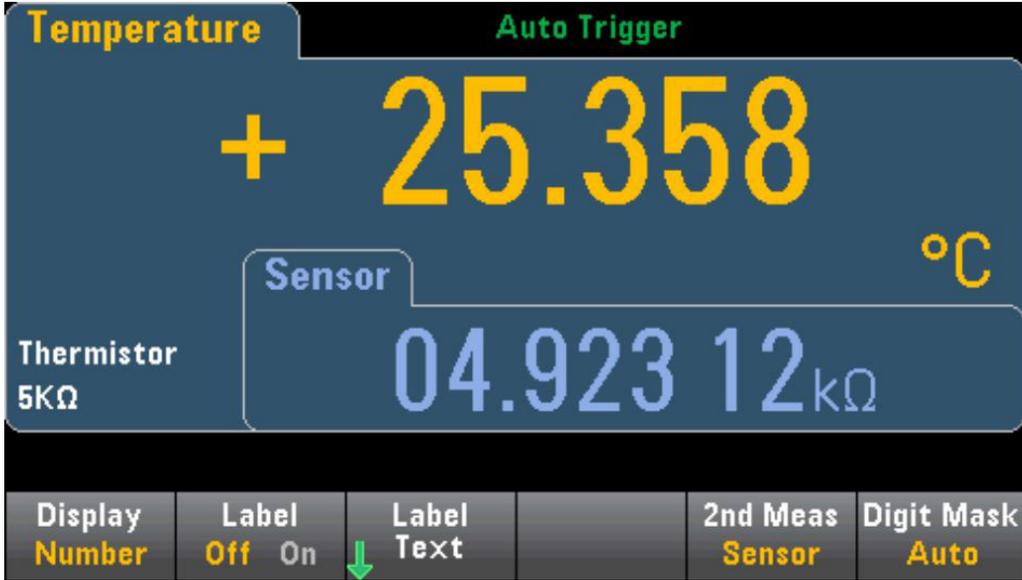


Figure 3. Truevolt DMMs allow secondary measurements to run concurrently with a primary measurement

Advanced DMM triggering

If the traditional DMM triggering model is insufficient for your testing needs, then the new Truevolt DMMs may have the solution for you. Traditional DMMs make measurements right after configuration (immediate trigger), do a single measurement, or trigger from an external source. Higher-end DMMs such as the 34465A and 34470A have additional modes wherein a combination of trigger settings, delay times, number of samples per trigger, and pre-trigger settings provide concise data (Figure 4).



Figure 4. The 34465A/34470A DMMs feature advanced trigger modes

Using the DMM's advanced trigger modes, you can set a level trigger that will start making measurements when the desired level is reached (Figure 5). You can also set a trigger delay to wait a predetermined amount of time after the trigger event. Another useful setting is the ability to define the number of samples after receiving a trigger. That helps ensure a number of continuous measurements after the trigger event, rather than just a single reading per trigger.

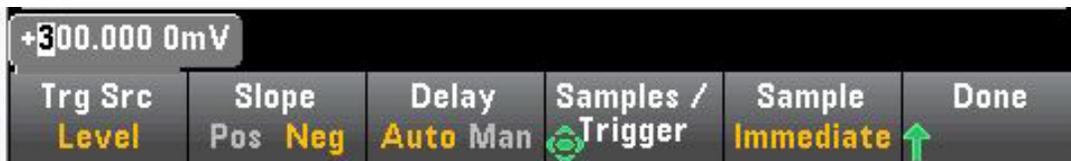


Figure 5. The Truevolt DMM's advanced trigger modes allow designers to set a level trigger



New Acquisition Modes

In addition to the traditional continuous measurement mode, the 34465A and 34470A DMMs provide data logging and digitizing modes from the front panel. These modes are accessible from the Acquire menu on the front panel. To start the acquisition, press the run/stop button.

Data logging

The 34465A and 34470A DMMs feature a new data logging mode for front-panel use. Found under the Acquire menu, the mode allows you to get readings at a constant sample interval to effectively log data over time. You can easily set a sample interval (for example, how often you want to make a measurement) and total duration (for example, how long or how many readings you want to make). You can also choose your start time by defining a delay time from when you press run or a start time in terms of hour/minute/second. Data logging lets you stream directly to a .csv file on the DMM's internal memory or a USB thumb drive connected to the front panel of the DMM. You may log up to 100 hours or 360 million readings, whichever is less (Figure 6). In data logging mode, you may sample as fast as 1,000 samples/second. Because the data logging feature is optimized for precision timing in its readings, some features, such as the level trigger and external trigger, are not available.

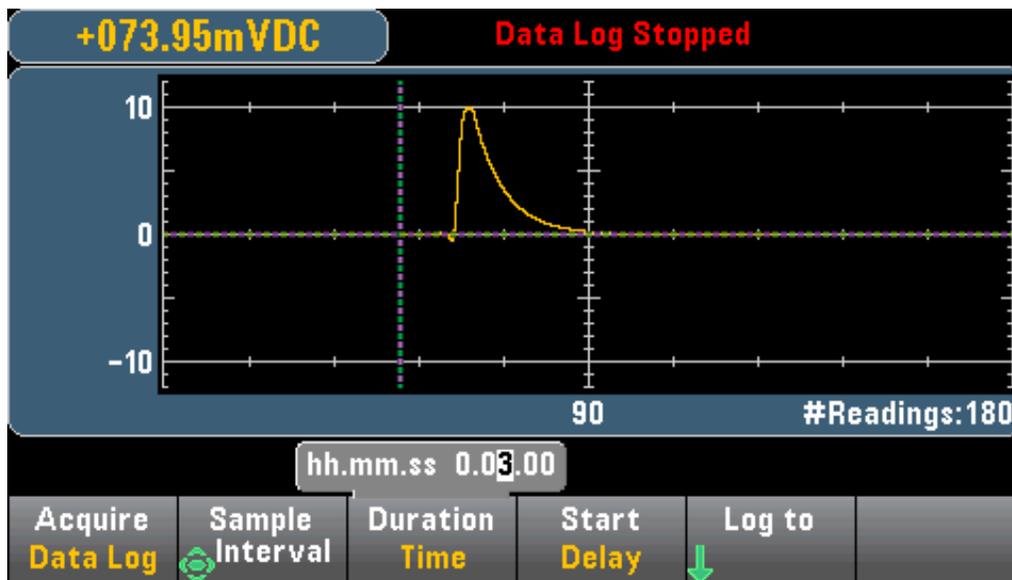


Figure 6. Data logging allows you to log up to 100 hours or 360 million readings

Exporting to a .csv file lets you analyze data on a computer (Figure 7). The .csv file includes the start time and measurement interval (in seconds), allowing you to extract the timestamp for every measurement taken.

	A	B	C	D
1	Start date	11/1/2014	Start time	18:27.3
2	Sample in	100		
3	Reading #	Reading		
4	1	8.05E-02		
5	2	7.98E-02		
6	3	7.98E-02		
7	4	7.98E-02		
8	5	7.98E-02		
9	6	7.98E-02		
10	7	7.98E-02		
11	8	7.98E-02		
12	9	7.98E-02		
13	10	7.98E-02		
14	11	7.98E-02		
15	12	7.98E-02		
16	13	7.92E-02		
17	14	9.05E-02		
18	15	8.98E-02		
19	16	8.98E-02		
20	17	8.98E-02		
21	18	8.98E-02		
22	19	8.98E-02		
23	20	8.98E-02		
24	21	8.98E-02		
25	22	8.98E-02		
26	23	8.98E-02		
27	24	8.98E-02		
28	25	8.98E-02		

Figure 7. CSV data file from Truevolt DMM

During data logging, it is important that the time stamps of your measurements are accurate. You may want to set your DMM's clock to your local time. Truevolt DMMs ship from the factory with Greenwich mean time standard. Setting the clock to your local time allows start times to be more intuitive for analysis.

With a USB connection to your PC, Truevolt DMMs show up as a drive on your PC (Figure 8). Using Easy File Access, you can drag and drop files to or from your DMM without additional software. This is an easy method to get readings from your DMM to your PC for analysis.

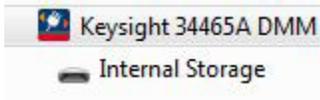


Figure 8. A Truevolt DMM shows up as a drive on your PC

Digitizing mode

Truevolt's digitizing mode allows you to sample at the maximum rate and analyze data from the front panel. With a 50 kHz sampling rate, you can take a measurement every 20 μ s (Figure 9). The slowest rate for digitizing is 100 ms. The digitizing mode sends data to the DMM's measurement memory, which can keep up to 2 million readings with the optional memory (50,000 readings standard). After the readings have completed, you can store them in a .csv file.

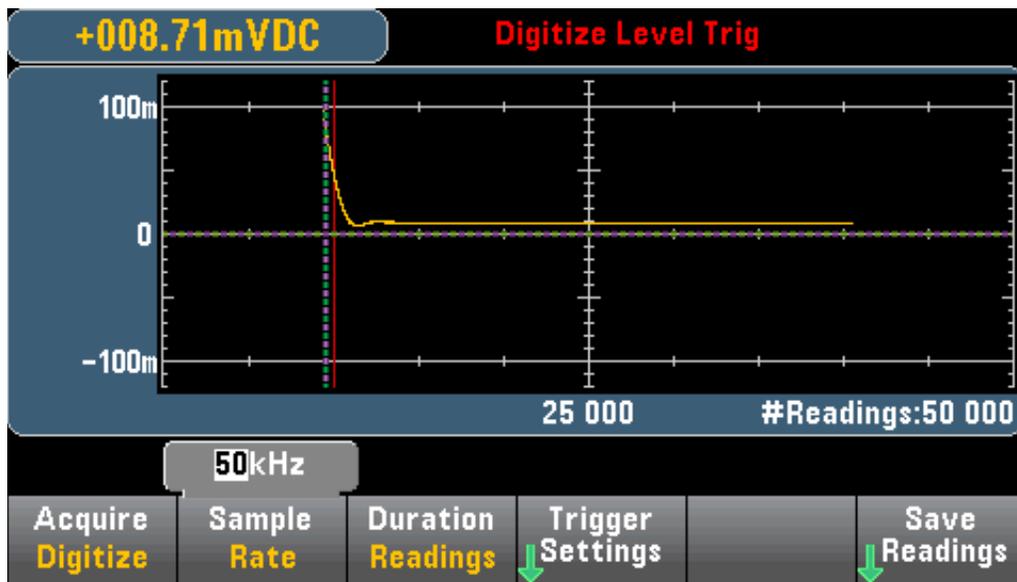


Figure 9. A 50 kHz sampling rate allows you to capture fast changes in your signal

In addition to fast sampling, digitizing mode lets you set up a level trigger to start your readings. You can set the level and polarity at which you want to trigger the measurement. You can also select the number of pre-trigger readings to digitize. This allows you to keep measurements that happen before your trigger level has been reached.

Pan, zoom, and cursors

If you are using the histogram or trend chart display modes, you have additional features for analysis. For readings in measurement memory, you can pan or zoom in to your data. With zooming, you can enlarge portions of your data for viewing. Panning lets you move the display screen to the measurement sample number that you want to view. Figure 10 shows a digitized reading that looks similar to the Keysight logo. In Figure 11, the DMM has zoomed in on a number of readings to show how individual sine waves actually make up the total logo.

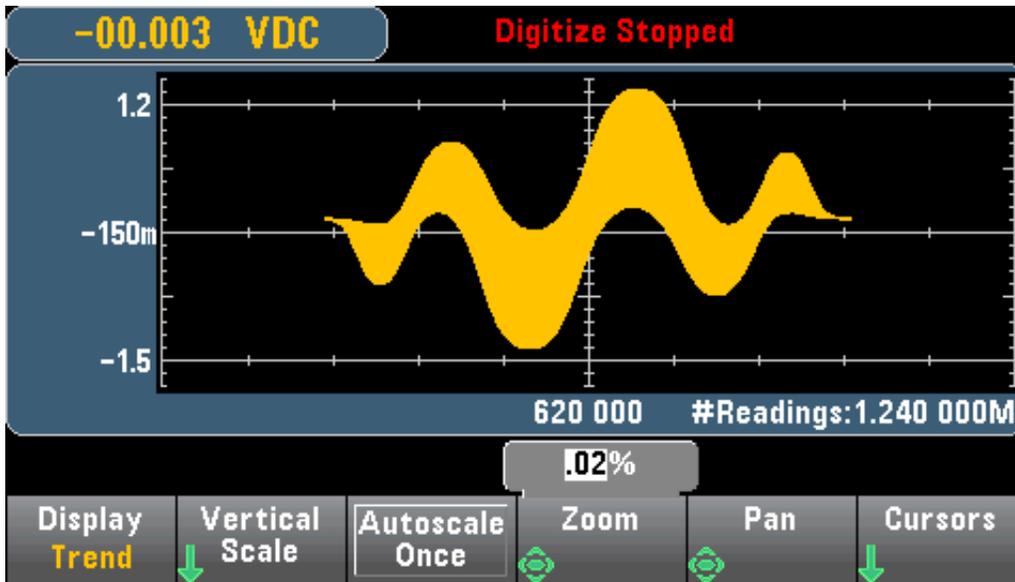


Figure 10. Digitized data of 1.2 million readings

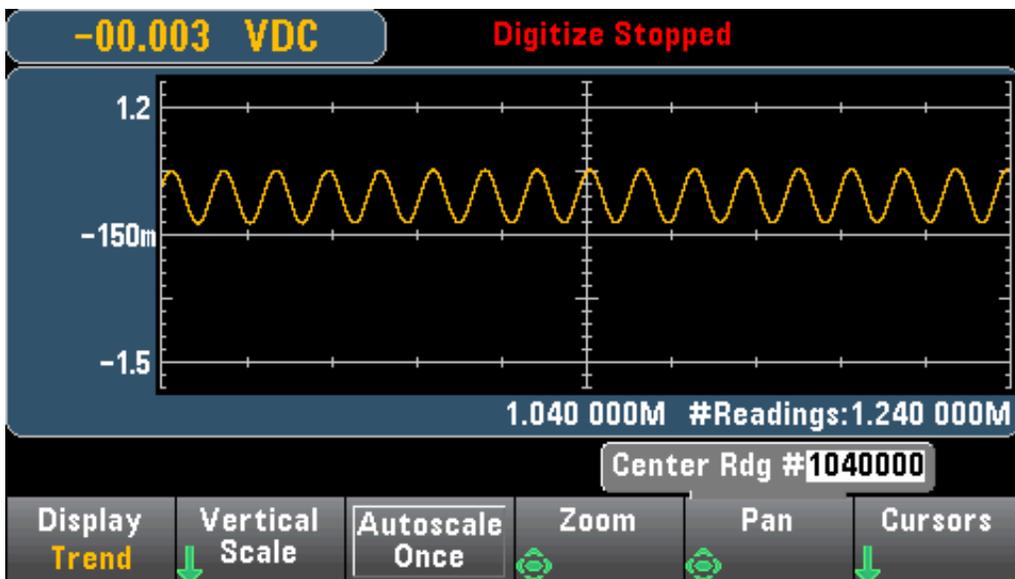


Figure 11. Zoomed/panned-in data showing individual sine waves

The new cursor functionality in the trend chart allows you to place two X and Y cursors on your data (Figure 12). Each cursor shows the time (from a start time of 0 seconds) and measurement value for the location of the cursor. While oscilloscopes have used this feature for years, it is new to DMMs and available only on Truevolt DMMs.

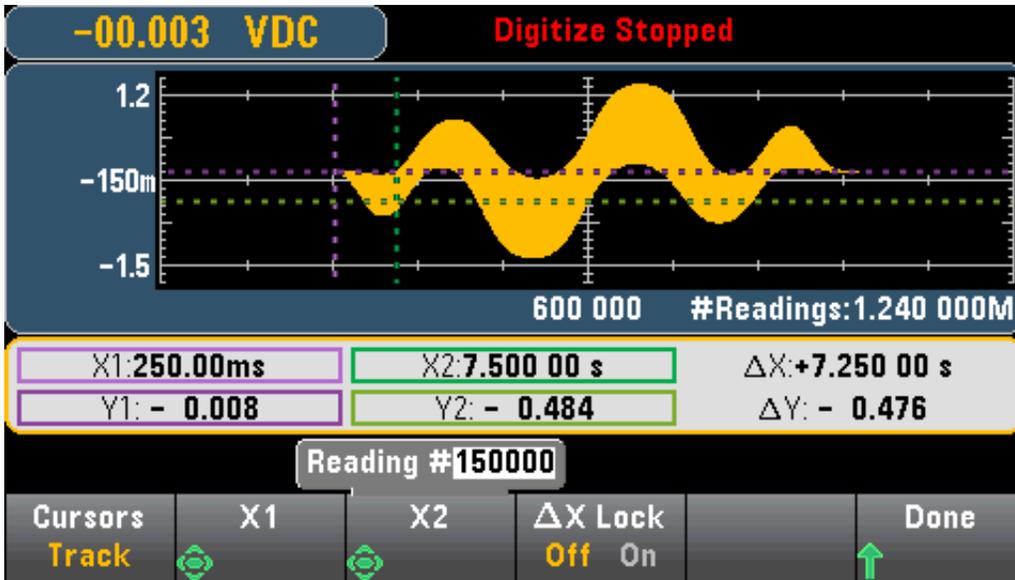


Figure 12. Truevolt DMMs allow you to place X and Y cursors on your data

Histograms include cursor functionality as well (Figure 13). Histogram cursors let you select which bin to view and show the number of occurrences and percentage of total readings the bin has accumulated. The span feature includes information about the range of the readings, the number of readings, and the percentage of readings between the cursors compared to the total readings.

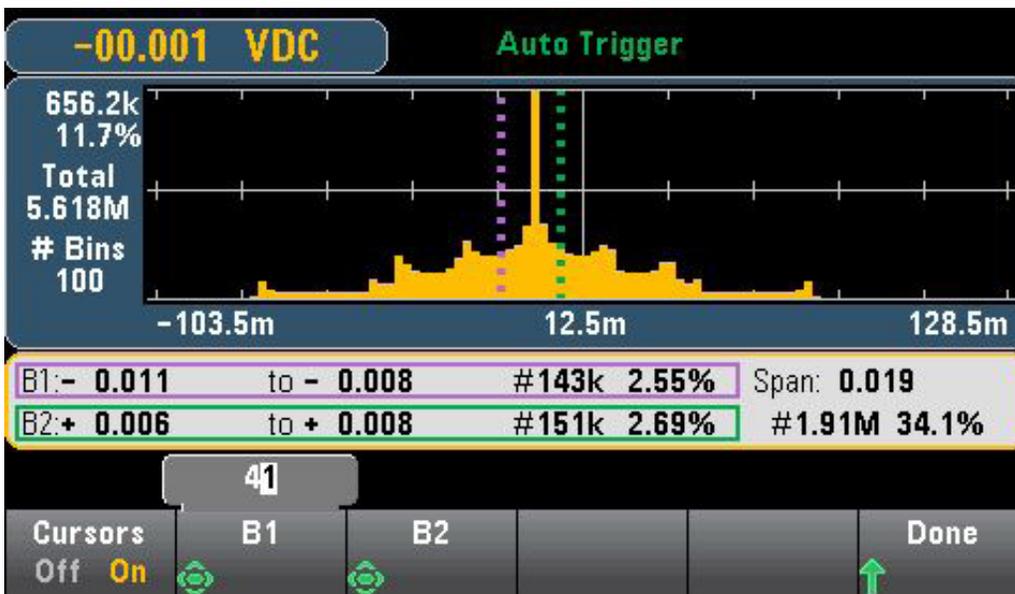


Figure 13. Histogram with cursors

Conclusion

Setting up a computer connection for data collection and analysis can take too much time, especially if you measure a single parameter. It is clear that a single value does not provide much insight into the performance of your device under test over time or in response to outside interference. A picture, on the other hand, offers much richer insight with a single glance. Now, with the Truevolt Series DMMs' new graphical display, advanced analysis modes, and built-in math functions, the ability to turn lots of data into results that can be analyzed quickly is at your fingertips — all with simple front-panel menu entries. Using Truevolt DMMs, you can meet your testing goals faster than ever before.

Learn more about Keysight's Truevolt DMMs at <http://www.keysight.com/find/Truevolt>.

If you wish to perform data analysis on your PC, a BenchVue software license (BV0001B) comes with your instrument. BenchVue makes it simple to connect, control instruments, and automate test sequences. Learn more about BenchVue at <http://www.keysight.com/find/BenchVue>.

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