



WHITE PAPER

Multisignal Capture and Analysis with DMMs

Introduction

Keysight BenchVue software offers an easy way to control digital multimeters (DMMs) while reducing the learning curve typically associated with using DMMs and other instruments. The software application supports Keysight's 34450A, 34460A, 34461A, 34465A, and 34470A benchtop DMMs. The application will enable you to spend more time using your instrument and less time learning how to use and troubleshoot DMMs.

This white paper explores how BenchVue can help you acquire multiple signals concurrently and interpret the data you receive from them faster. You will also learn how it helps you quickly synchronize measurements, graph measurements, and export data in a variety of common formats. First, we will discuss how BenchVue makes it easy to set up communication with a DMM. Then we will look at how the application helps you better understand your data. We will conclude with an example that shows how to use two DMMs to make simultaneous voltage and current drain measurements on your device.



Modern designs demand modern DMMs

Keysight's Truevolt DMMs offer:

- Built-in graphical displays
- Smallest noise level and injected current
- Advanced triggering and digitizing capability

<http://www.keysight.com/find/truevolt>





Snapshot

An IC validation engineer needed to characterize a design for a linear regulator. His task was to measure a regulator with an output voltage range of 1 V to 3.3 V with an output current of 150 mA. His first step was to ensure the voltage would stay constant ($\pm 0.5\%$) under varying load conditions. After setting up the hardware for the test, he needed to log his V/I data. While the engineer prefers not to program, he is familiar with the Keysight DMMs on his bench. He discovered Keysight BenchVue and learned about its multiple-signal capture capability. With this utility, he was able to use one DMM to measure the output voltage and another one to monitor the load current at the same time. Without writing any code, he characterized his V/I curve and discovered the IC had a defect: every 60 seconds it deregulated for 500 ms. The engineer returned to the design team with graphical data from BenchVue and the team agreed to investigate the defect.

An Easier Way to Communicate With a DMM

When paired with Keysight I/O Libraries, identifying multiple DMMs connected to your PC is easier than ever. Keysight BenchVue automatically identifies available DMMs on RS-232, USB, GPIB, and LAN interfaces. The initial opening view below shows the DMM and the I/O address that it is connected to. The app intuitively presents the DMMs as bench tiles. Each tile's launch button will initiate control and data logging for each DMM. You can control multiple DMMs within the app.

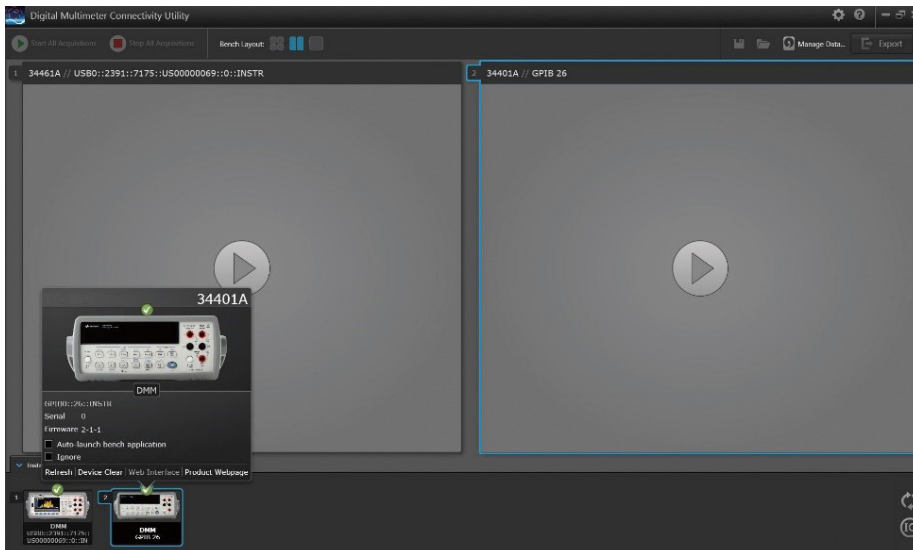


Figure 1. Connected DMMs using the BenchVue PC application

Make Measurements and Understand Data Without Learning the Entire Instrument

Engineers are often time-constrained and do not necessarily want to spend time on extraneous activities. In order to make a simple DMM measurement, ensure that the instrument is fully set up and not missing a key parameter when running a test. Measuring multiple signals is especially painful if you are not familiar with the DMM or if you have different generations of equipment. BenchVue's unified interface supports Keysight, Agilent, and HP DMMs that were released in the last 25 years. With this I/O flexibility, you can now use the same intuitive interface for all of the DMMs.

Few of us can analyze a group of numbers and make quick, accurate judgments on the data set. Graphing the data is preferable, but sometimes it takes too much effort to get a robust chart that is easy to read and understand. BenchVue can help you understand your data visually and in real-time with time-stamped data. With an intuitive interface, the app also has numerical outputs for occasions when you need raw data.

BenchVue offers a full setup for given measurement functions. The app presents the DMMs as bench tiles in a single, double, or four-tiled view. You can visualize up to nine different DMMs by tiling four in the main BenchVue screen and up to five more in separate windows.

To change parameters for each DMM, press the configuration wrench in each tile. This opens the Measurement menu and the Data Logger menu in tabbed windows.

Let's review a simple example that is a common test on many benches: measuring voltage and the current drain from a device.

Making Simultaneous Voltage and Current Drain Measurements

In this example, we want to create a simple DC voltage (DCV) measurement. Use the Measurement menu to select the DCV measurement function. The context-sensitive Measurement tab now presents all the parameters you may want to use to make DCV measurements for your DMM. You can then set up your second DMM to measure DC current in the second bench tile. See Figure 2 to see DMM1 set up to measure DCV and DMM2 set up to measure DCI.

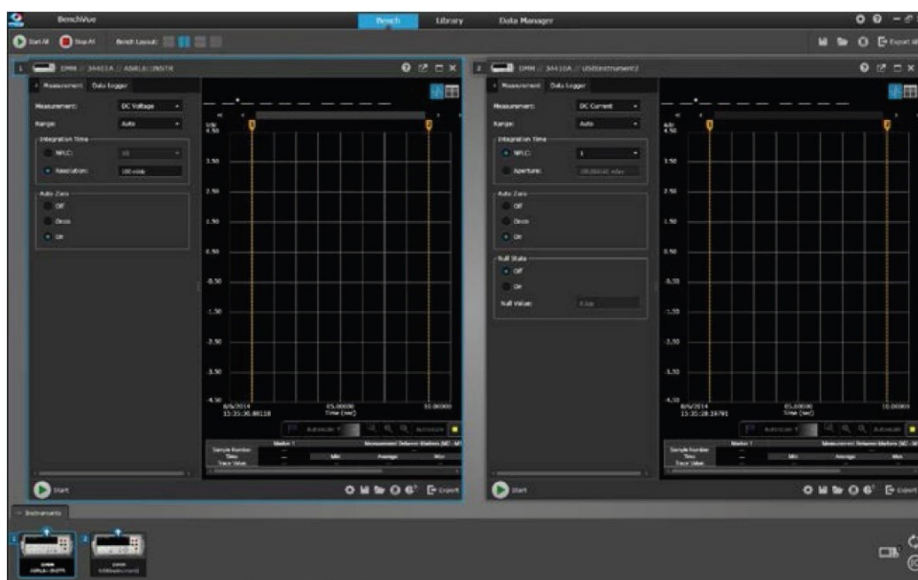


Figure 2. Side-by-side configurations of two DMMs

The Data Logger/Digitizer tab offers additional functionality including in-program limit testing, data logging, and digitizing. This context-sensitive menu is dependent on your DMM model. New functions enable you to set up the apps to e-mail you when a measurement fails a limit. Figure 3 shows that we stop after a minute of sampling, but you can also set the acquisition to sample indefinitely. Setting up synchronized sampling is easy.

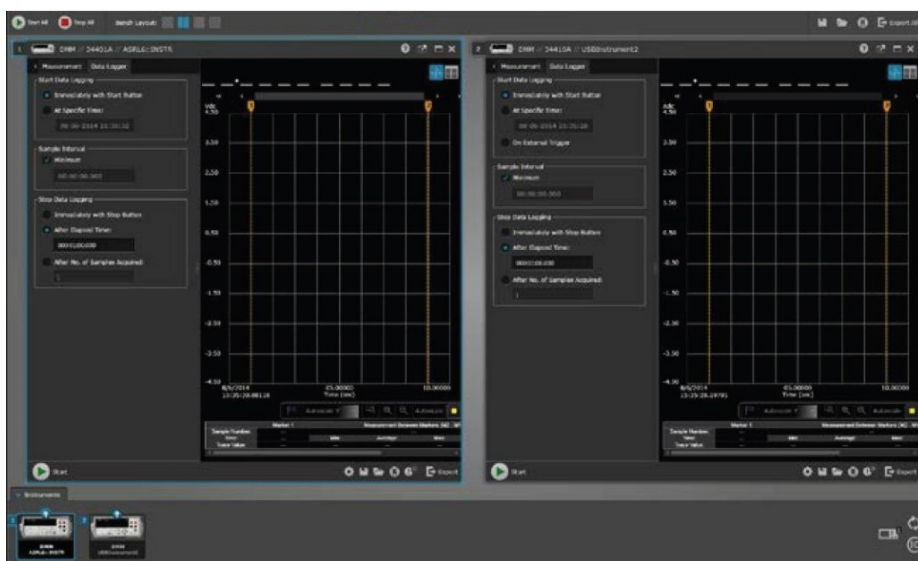


Figure 3. Data logging menus to set the sampling interval and data logging period

To begin measurement and gathering data, press the Start All key which automatically triggers all the instruments you set up. It also synchronizes measurements whether you are in single-tiled or multi-tiled bench mode. The data log chart offers updates in real time, and all the data points align. The time stamp feature shows the time when the sample was taken which enables a quick understanding of measurement peaks, noise, or drift. Figure 4 shows the chart view of DMM1 (DCV) and DMM2 (DCI) and the relationship between the two measurements. You can control your DMMs and visualize the synchronous measurements all on the same computer screen.

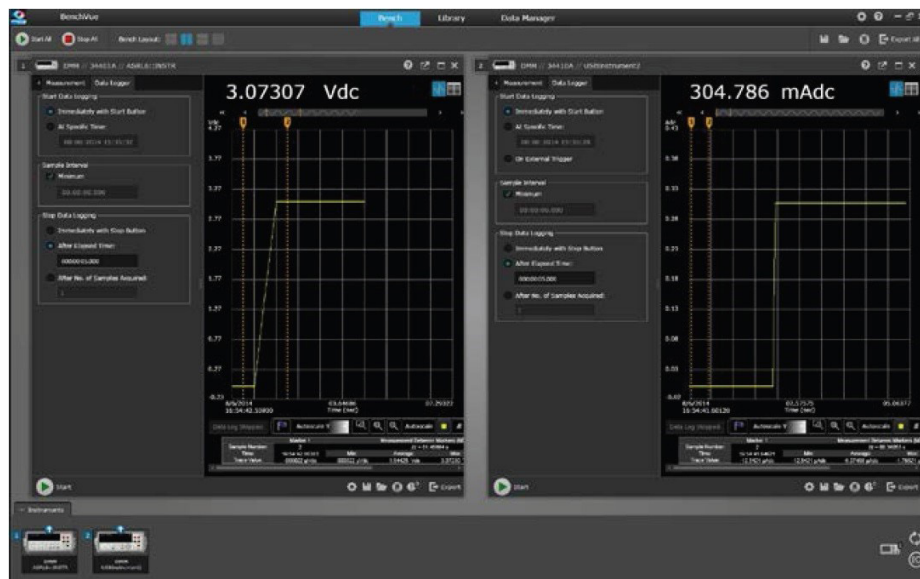


Figure 4. V and I curve with respect to time

In a multi-tiled view, the trend chart is the only graphing view available. You can set your bench layout to a single-tiled view and view the DMM's data as a histogram or table. You can also toggle between multi-tiled view and single-tiled view modes without re-acquiring your data and conduct additional analysis in single-tiled mode on the trend chart. This mode also includes measurement markers that allow you to analyze the measurement between the markers, similar to an oscilloscope. Customizable features such as auto scale, zoom, and trace color enable you to modify your view of the data. And, you can annotate measurement events with in-program notes as well.

It is also possible to set up asynchronous measurements. To enable this mode, start with the single-tiled view. In the upper left-hand corner of the tile, you will see an icon that allows you to open the bench tile in a new window. This allows you to start the acquisition of this individual DMM separately from the rest of your bench.

But what if you want to use your own program to analyze the data? Once you complete the measurements, you can export the data into a variety of formats as shown in Figure 5. Formats include Microsoft Excel, Microsoft Word, MATLAB, and .csv. The export menu also enables a quick screen capture. Exported data includes time stamps that indicate when measurements were made as shown in Figure 6.

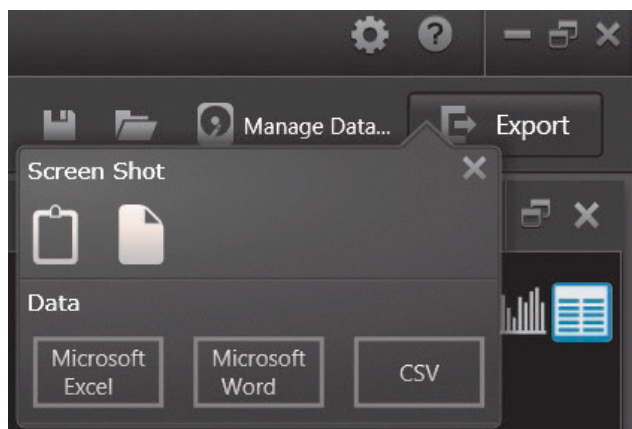


Figure 5. The export menu allows you to export your data in Microsoft Excel or Microsoft Word directly or into a comma-separated values (.CSV) file format



Figure 6. A dialog box on settings for exporting the data into a file

The example we used in Figure 6, has different integration cycles for the two measurements, but how does this affect the data? Exported data as shown in Excel in Figure 7 shows that the samples were taken at different intervals, with spaces in between samples. This makes it easier to understand that DMM1 is sampling faster than DMM2.

	A	B	C	D
1	Time	Elapsed Tr [2]	34411A // GPIB 22 (Adc)	[1] 34461A // 156.140.92.16 (Vdc)
2	3/15/2013 16:27:53.589	0	-0.100363354	
3	3/15/2013 16:27:53.647	0.058006	-0.10035633	
4	3/15/2013 16:27:53.707	0.118012	-0.100356764	
5	3/15/2013 16:27:53.766	0.177018	-0.100357721	
6	3/15/2013 16:27:53.824	0.235024	-0.10036162	
7	3/15/2013 16:27:53.881	0.292529	-0.100360224	
8	3/15/2013 16:27:53.940	0.351535	-0.100360405	
9	3/15/2013 16:27:53.997	0.408541	-0.100361915	4.85867152
10	3/15/2013 16:27:54.059	0.470547	-0.100356306	
11	3/15/2013 16:27:54.122	0.533053	-0.100352622	
12	3/15/2013 16:27:54.182	0.593559	-0.100349105	
13	3/15/2013 16:27:54.241	0.652565	-0.100351679	
14	3/15/2013 16:27:54.306	0.717072	-0.100357106	
15	3/15/2013 16:27:54.363	0.774577	-0.10035131	
16	3/15/2013 16:27:54.424	0.835084	-0.100350051	4.85903563
17	3/15/2013 16:27:54.484	0.89559	-0.100349439	
18	3/15/2013 16:27:54.541	0.952095	-0.100352013	
19	3/15/2013 16:27:54.602	1.013101	-0.100349256	
20	3/15/2013 16:27:54.666	1.077108	-0.100354935	
21	3/15/2013 16:27:54.728	1.139114	-0.100351043	
22	3/15/2013 16:27:54.784	1.19562	-0.100348784	
23	3/15/2013 16:27:54.841	1.252125	-0.100347318	4.85923269

Figure 7. Raw data exported from BenchVue into Excel

Keysight BenchVue is also helpful in the unfortunate event that you forget to save your data. The Data Manager (shown in Figure 8), accessed through the Manage Data button, keeps track of data from previous sessions. This data is stored in a file on the PC – you can delete or copy it just like other PC files, open previous data sessions, and use the same DMM tools to analyze your data the same way as if you had just acquired it. This feature enables you to rewind back in time and look at the measurements you made when you first started using a DMM. A more practical use case is to transfer groups of measurements to another PC, then view the data in BenchVue.

Name	Instrument	Data Points	Measurement	Date
Data 03 15 2013 16-16-41-351-[2]	34411A	158	DCCurrent	3/15/2013 4:16:41 PM
Data 03 15 2013 16-16-41-360-[1]	34461A	108	Resistance (2W)	3/15/2013 4:16:42 PM
Data 03 15 2013 16-16-41-453-[3]	34401A	190	DCVolt	3/15/2013 4:16:41 PM
Data 03 15 2013 16-17-45-456-[1]	34461A	34	DCVolt	3/15/2013 4:17:46 PM
Data 03 15 2013 16-17-45-539-[3]	34401A	59	DCVolt	3/15/2013 4:17:45 PM
Data 03 15 2013 16-17-45-555-[2]	34411A	48	DCCurrent	3/15/2013 4:17:45 PM
Data 03 15 2013 16-18-10-286-[1]	34461A	31	DCVolt	3/15/2013 4:18:10 PM
Data 03 15 2013 16-18-10-334-[3]	34401A	52	DCVolt	3/15/2013 4:18:10 PM
Data 03 15 2013 16-18-10-338-[2]	34411A	43	DCCurrent	3/15/2013 4:18:10 PM
Data 03 15 2013 16-19-16-364-[3]	34401A	32	DCVolt	3/15/2013 4:19:16 PM
Data 03 15 2013 16-19-16-370-[1]	34461A	17	DCVolt	3/15/2013 4:19:16 PM
Data 03 15 2013 16-19-29-477-[1]	34461A	7	DCVolt	3/15/2013 4:19:30 PM
Data 03 15 2013 16-19-29-552-[3]	34401A	13	DCVolt	3/15/2013 4:19:30 PM
Data 03 15 2013 16-20-23-058-[3]	34401A	34	DCVolt	3/15/2013 4:20:23 PM
Data 03 15 2013 16-20-53-030-[1]	34461A	16	DCVolt	3/15/2013 4:20:53 PM
Data 03 15 2013 16-20-53-113-[3]	34401A	31	DCVolt	3/15/2013 4:20:53 PM
Data 03 15 2013 16-21-25-200-[1]	34461A	29	DCVolt	3/15/2013 4:21:25 PM
Data 03 15 2013 16-21-25-294-[3]	34401A	53	DCVolt	3/15/2013 4:21:25 PM
Data 03 15 2013 16-22-51-025-[2]	34411A	939	DCCurrent	3/15/2013 4:22:51 PM
Data 03 15 2013 16-22-51-030-[1]	34461A	125	DCVolt	3/15/2013 4:22:51 PM
Data 03 15 2013 16-27-53-451-[1]	34461A	137	DCVolt	3/15/2013 4:27:53 PM
Data 03 15 2013 16-27-53-453-[2]	34411A	1012	DCCurrent	3/15/2013 4:27:53 PM

Figure 8. Data manager with a list of data files saved over time

Summary

Using Keysight BenchVue will allow you to save time and effort in making measurements. With BenchVue, you can:

- Measure multiple signals synchronously more simply than ever.
- Synchronize measurements in minutes.
- Set up the DMM and gather data in less time than you would spend manually setting up your measurement.
- Easily understand data, visualize it immediately, or export it to popular tools such as Excel or Word.
- Gain a better understanding of your sampling by monitoring whether the DMMs measure at different intervals.
- Dive deeper into your data by analyzing each instrument's measurements graphically or numerically.

Benchvue allows you to skip the learning curve and use your equipment right away. The Keysight BenchVue application comes bundled together when you purchase your Truevolt DMM. BenchVue makes it simple to connect, control instruments, and automate test sequences.



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

