

Compatibility and Differences: 34461A and 34401A Digital Multimeters

Application Note

Introduction

The 34401A digital multimeter (DMM) is the industry standard. Its accuracy, ease of use, and flexibility have attracted users for more than two decades and its low cost of ownership and high quality have helped it to be one of the most successful products in Agilent's history. Many engineers do not even evaluate other DMMs when they want to order one; they know the 34401A will work for them. It is an essential meter for bench and automated test applications.

The 34461A DMM is the next-generation 34401A. This new DMM was designed by the same group as the 34401A, with many of the same R&D engineers participating. With this continuity of experience and expertise, Agilent has made a DMM that is a virtual drop-in replacement for the 34401A while continuing to improve usability and measurement technology.

The 34461A is a compatible 34401A replacement with few exceptions. If you are looking to migrate from the 34401A to a 34461A and want to fully understand all differences between the two models, this application note will help you. Our goal is to help you migrate from your 34401A to a 34461A effortlessly.

Compatibility

There are many factors to keep in mind when you want to replace reliable instruments such as the 34401A. Here are just some of the areas where the 34461A is equivalent to the 34401A.

- **Functions and ranges:** The 34461A is a superset of the 34401A capability. Differences are listed below.
- **Measurement accuracy and resolution:** The 34461A's specifications and typical characteristics are as accurate or better than those of the 34401A. See Table 1. All specifications are ISO17025 compliant.
- **SCPI compatibility:** We have taken extra care to ensure that the 34461A will work with SCPI programs that were written for the Agilent 34401A. Programming considerations and differences are listed below.
- **Mechanical size:** Height and width dimensions are the same.
- **Accessories:** Rack mount kits and probe accessories are compatible with both products.
- **Manufacturing:** Both DMMs are produced to the same rigorous quality standards and manufacturing process controls.
- **Service and support from Agilent:** Our international team is available to help you calibrate your DMM or answer any questions about either instrument.
- **Warranty:** Both the 34401A and 34461A offer the same outstanding 3-year standard warranty.



Table 1. Key features and model comparison

	34461A	34401A
Resolution	6½ digits	6½ digits
Input terminals	Front and rear	Front and rear
1-year DCV accuracy ± (% of reading + % of range)	0.0035 + 0.0005	0.0035 + 0.0005
Measurement speed @ 4½ digits	1000 readings/s	1000 readings/s
Measurements		
DCV, ACV, Resistance, Frequency, Period, Continuity	Same	
Diode	5 V	1 V
AC and DC current	100 µA – 10 A	10 mA – 3 A
Temperature	RTD/ PT100, thermistor	N/A
Reading memory	10,000 readings	512 readings
Display	Number, histogram, bar meter, trend chart	Number
Connectivity	USB, LAN Optional: GPIB	GPIB, RS-232

Measurement Tip

Use SCPI compatibility mode

By default, the 34461A *IDN? query returns:

*Agilent Technologies,3446xA,
<Serial Number>,ff.ff-pp.pp-mm.mm-gg.gg-bb-pp*

For compatibility purposes, use SYSTem:IDENtify HP34401A to return:

HEWLETT-PACKARD,34401A,<Serial Number>,ff.ff-pp.pp-mm.mm-gg.gg-bb-pp

You can also configure this from the front panel:

[Utility] > System Setup > User Settings > SCPI ID

Differences

The few differences between the 34461A and 34401A that might affect migration are listed below. Many of these differences improve the performance of the 34461A relative to the 34401A.

Physical differences

- The 34461A is not as long as the 34401A, and the connectors are in different positions.
- The 34461A does not support RS-232, and GPIB is optional on the 34461A.
- The 34461A does not support hardware limit test outputs.

Key measurement differences

- The 34461A and 34401A use different calibration procedures, with different default passwords.
- Some specifications vary between the 34461A and the 34401A. In general, the 34461A specifications equal or exceed those of the 34401A. One exception: the 34401A's 3-A range is slightly better than the 34401A. For best current measurement results above 1 A, use the 34461A's 10-A input terminal.
- The 34461A has additional current ranges: 100 μ A, 1 mA, and 10 A. Therefore, the MIN and MAX parameters produce different results. In addition, autorange on the 34461A may use different ranges than on the 34401A, and autoranging may take longer.
- Burden voltage is generally lower on the 34461A than the 34401A.
- 34461A uses a digital AC measurement technique. This produces better linearity and a sharper bandwidth roll off for AC measurements.

Key programming differences

- The 34461A does not support the older 3478A or Fluke 8840A programming languages.
- The INIT command on the 34401A is non-overlapped, except when bus triggering (*TRG) is selected. This means that CONF:VOLT:DC::INIT::CONF:CURR:DC::INIT makes two measurements. The INIT command on the 34461A is overlapped, and the above sequence generates an error message.
- By default, the 34461A *IDN? query returns:
Agilent Technologies,3446xA,<Serial Number>,ff.ff-pp.pp-mm.mm-gg.gg-bb-pp
- The 34461A parses and executes commands faster than the 34401A. The 34461A also supports overlapped command processing between INIT and measurement completion. Proper synchronization with *WAI and *OPC? minimizes the impact. Existing systems that depend (intentionally or unintentionally) on 34401A command execution speed for timing may experience subtle timing issues.
- The 34461A requires less settling time than the 34401A, yielding shorter default trigger delays. Therefore, if you use default trigger delays, these delays may start a measurement before your DUT has settled, which means that a signal that was fully settled when measured on the 34401A will still be settling on the 34461A.
- The 34461A and the 34401A may generate different error messages. This is usually not a problem, because existing programs normally do not generate SCPI errors.
- The 34461A can store up to 10,000 readings, which is more than the 512 that the 34401A allows. This is unlikely to affect existing programs.
- The 34461A defines bits in the questionable data and status byte registers that were unused by the 34401A. Programs that properly mask unused bits will minimize issues associated with querying these registers.
- Under certain conditions, the 34461A may return and display negative resistance values. For details, see **[Help] > Negative Resistance Values** from the front panel.
- The 34461A always puts readings into memory. When the READ? query finishes, a subsequent FETCh? returns those same readings. In a similar situation, the 34401A shows memory as empty. Also, if the computer is not taking readings fast enough, the 34401A slows down to avoid losing readings. The 34461A does not allow the computer to pace its reading rate.
- To support testing a wider range of diodes, the compliance voltage has been increased from 1.2 V to 5.05 V. The range for the 34461A is fixed at 10 V, as opposed to 1 V on the 34401A. The current source remains fixed at 1 mA.
- The dBm reference on the 34461A is a volatile value. It was non-volatile on the 34401A.

Conclusion

The 34461A DMM is the next-generation 34401A. When you migrate from the 33401A to the 34461A DMM, you do not need to rewrite your programs or spend hours learning a brand-new, complicated interface.

The 34461A DMM lets you:

Display DMM results in ways you never have before

Measure with unquestioned confidence

Move to the next-generation 34401A with 100% assurance

Learn more about the 34461A at www.agilent.com/find/Truevolt

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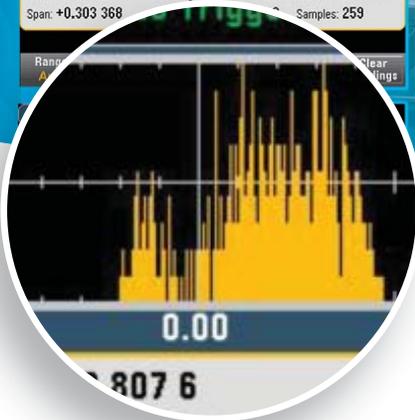
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MEASUREMENT BRIEF

Viewing Graphical Results on a DMM Display



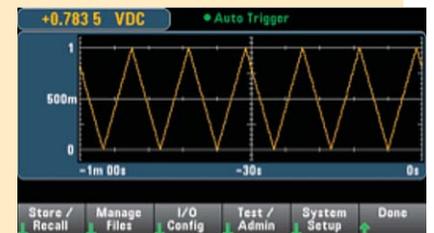
Introduction

Digital multimeters measure and display various parameters such as voltage, current, resistance, and temperature in an easy-to-read number format. However, many times you are looking for more than a single reading in the display. Often, the really meaningful information lies in the trend or statistics of a series of readings. If your DMM offers connectivity, such as LAN or USB ports, you can transfer your readings to a computer for computation and display. But transferring data to a PC may take more time than you want to spend.

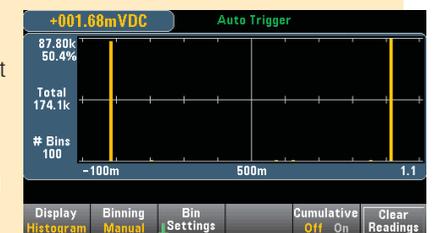
Now, a new DMM, the Agilent 34461A, offers a way to get insight into your measurement data without transferring your data to a PC. The 34461A features a large graphical display and built-in math functions that show measurement trends, statistics, and histograms all in a single, compact unit.

Snapshot

A company designing a high-power solar charger for smart phones and tablets needed to rigorously test the circuit that detected low solar-cell power for shutting down and restarting the charging circuit smoothly. This circuit was necessary because the charger had no internal battery to act as a buffer. To simulate changing solar radiation, the design team used a triangle waveform from an arb/function generator as a source.

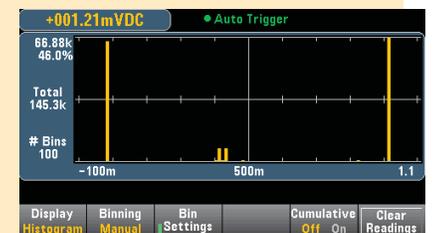


The engineers set up the Agilent 34461A to measure the on/off output voltage of the detector circuit and displayed the results using the histogram mode. At frequencies below one Hertz, the display clearly showed a binary distribution, which was the desired result.



However, they found that for higher frequencies, which occurred when they waved a hand across the solar panel, the circuit exhibited an anomaly that caused an intermediate output value. This anomaly clearly interfered with the proper output charging operation.

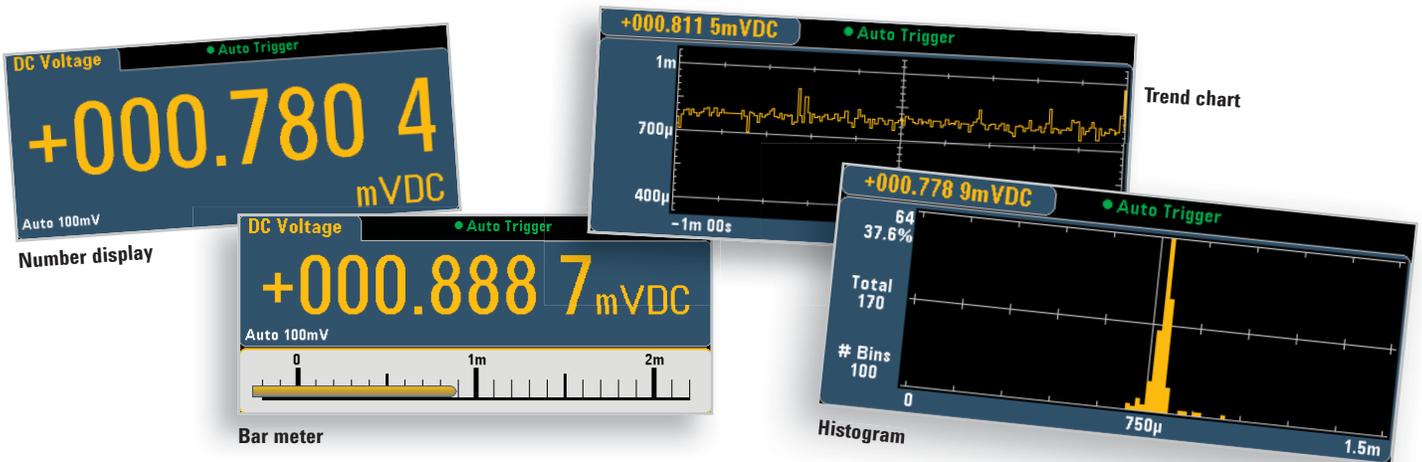
A relatively simple design change to the cutoff frequency in the detector circuit solved the problem and eliminated potential customer warranty claims.



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Display DMM results in ways you never have before

Four different display modes give you fast insight



The 34461A's simple, intuitive user interface gives you quick and intuitive access to different views of your data. You can easily access the structured display and math menus with a single key on the front panel. The menu options appear on the soft keys under the display. The six soft keys and a set of navigation buttons on the front panel eliminate the need for an external computer and software.



Figure 1. When you press the Display button, the soft keys show the choices available for the different display modes.

Info at a glance saves time

The bar meter display is ideal for showing an analog indication of the value in addition to the digital readout. Sometimes you just need a quick qualitative glance at a measurement to be assured that the test is proceeding as you planned. The bar meter also can be enhanced with the limits function in the Math menu to provide an even more informative display.

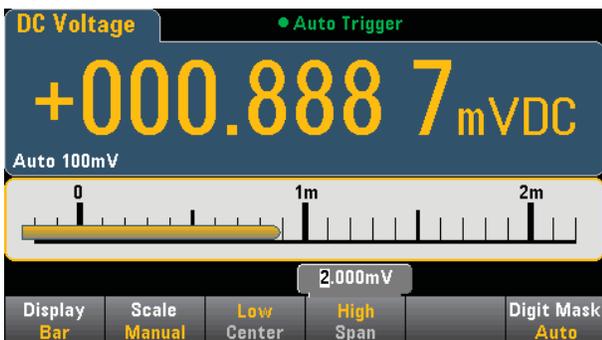


Figure 2. The bar meter display gives you a quick qualitative view of your measurement.

A trend chart shows direction

If you expect a measured parameter to remain constant, you only need to measure it once. But 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 Agilent 34461A to display the most recent data over the last minute, or all the data collected since the last time the readings were cleared. You could use this innovative capability, for example, for monitoring a power supply design under changing loads. You would set up multiple DMMs to monitor the output voltage, load current, and various temperature points inside the unit. As the load current is varied, you could see the change in voltage and temperature as a function of time.

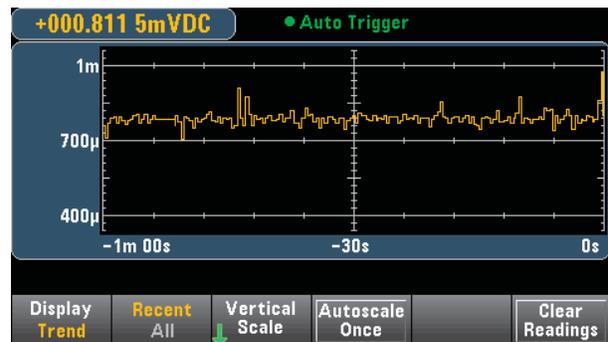


Figure 3. A trend chart shows you changes in your measurements over time.

Histograms tell all about the data

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

The histogram binning can be automatic set or you can set it to values of 10, 20, 40, 100, 200, or 400, depending on your need for resolution of the display. You can set up outer bins to catch values that occur outside the histogram range. This can give you insight into the occurrences of occasional outside influences such as power glitches or EMI from other equipment.

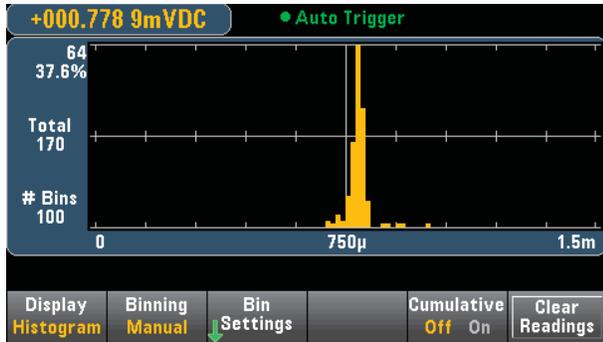


Figure 4. A histogram shows the distribution of your measured values.

Adding math to displays brings data to a new level

Null is most useful for zeroing out lead resistance when you measure small values of resistance. You can also set other measured values such as voltage or temperatures as null values simply by pressing the Null front-panel key so that deviations from the measured value can be easily observed. If you have predetermined a null value, you can enter that value using the arrow keys. There is no need to make a measurement first.



Figure 5. Setting null values is easy on the front-panel display.

When the range of measured values exceeds a decade or more, dB/dBm scaling provides a convenient logarithmic readout relative (dB) to a user-set reference. Or to see an absolute value (dBm) referred to 1 mW across a given resistance value, simply select a value ranging from 50 to 8000 ohms, using the front panel.



Figure 6. Automatic scaling provides a convenient logarithmic readout relative to a user-set reference.

MEASUREMENT TIP #1

Digit masking

If you are displaying noisy signals where the lowest digits constantly change, use the 34461A's digit masking feature to show just the resolution you need.



Statistical data displays are always available for the readings in memory or you can clear readings to start a new series of statistics on collected data. These statistical data are especially useful for determining the stability of a measured value and also for detecting outlying data via the min/max displays.

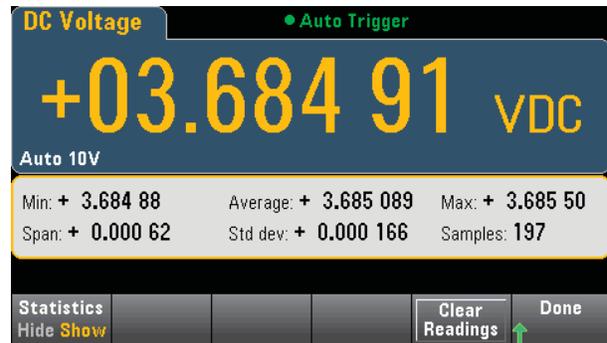


Figure 7. Use the statistical display to determine the stability of a measured value.

Limits provide both a visual indicator and an audio "beeper" tone to alert you when a preset condition has been exceeded. For example, if you are monitoring internal temperatures on prototype circuits in a heat-soak oven, it is critical to get a warning before a valuable prototype overheats and suffers damage. You can set and apply limits to all four display modes for maximum flexibility in measurement readout.

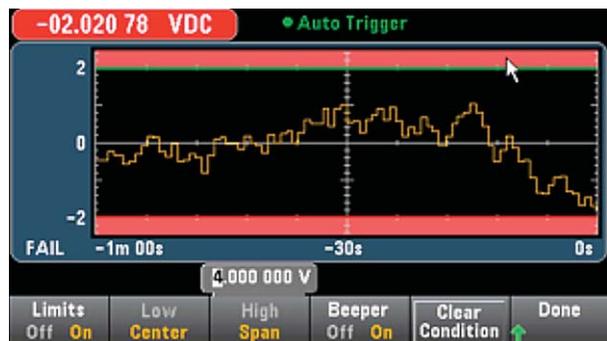


Figure 8. An example of limits with the trend chart.

Conclusion

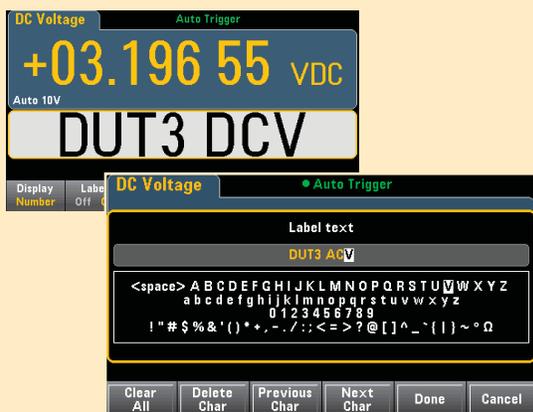
Whether you are measuring a parameter on a single point or multiple points, it is clear that a single value does not provide much insight into the performance of your DUT over time or in response to outside interference. Setting up a computer connection for data collection and analysis often takes too much time and can delay the testing schedule. Now with the new Agilent 34461A DMM's graphical display and built-in math functions, the most useful time-cumulative and data-cumulative analysis results are available at your fingertips, using simple front-panel menu entries. You can meet your testing goals faster than ever before.

See following page for additional Measurement Tips

MEASUREMENT TIP #2

Labeling your signals

When you have several DDMs on the bench or in a rack measuring a variety of points and parameters, the usual solution for identifying them is a taped-on label or adhesive-backed note. Now you can add the label to the display using the front-panel keyboard. These labels remain in memory even after a power-off situation and they never fall off the unit.

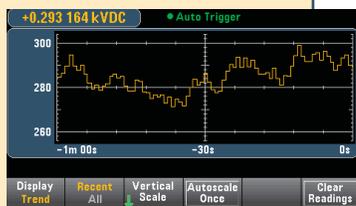


MEASUREMENT TIP #3

Alternate views of the data

It's important to know that the display view initially chosen is not the only way to look at the data in memory. You can switch back and forth between display views and math applications as required. For example, you can start with the Trend Chart, Recent display of the last minute of data, then switch to All to view all data collected, and later switch to the Histogram display of all data.

Other capabilities include the Math, Statistics function where you can also see the average and standard deviation of the histogram data.



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MEASUREMENT BRIEF

No Programming Required: Multisignal Capture and Analysis with DMMs



Introduction

New Agilent software reduces the learning curve for DMMs and provides an easy way to set up multiple Agilent DMMs to acquire your signals. In addition to making it easier to set up multiple DMMs, Agilent's new DMM Connectivity Utility supports quicker instrument setups and faster data capture and visualization and addresses many of the difficulties you face in using digital multimeters. The application supports older DMM models including the 34401A, 34405A, 34410A, and 34411A. It also supports our latest-generation 34450A, 34460A, and 34461A DMMs. With this application, you spend more time using your instrument and less time learning and troubleshooting it.

This measurement brief explores how the new Agilent DMM application can help you acquire multiple signals in parallel and understand the data faster. It helps you quickly synchronize measurements, graph measurements and export data in a variety of common formats. First we'll discuss how the DMM Connectivity Utility makes setting up communication with a DMM easier, then we'll look at how the application helps you understand your data with ease. We'll conclude with an example that shows how to use two DMMs to make simultaneous voltage and current drain measurements on your device.

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 be able to log his V/I data. The engineer doesn't like to program, but he is familiar with the Agilent DMMs on his bench. He discovered the Agilent DMM Connectivity Utility and learned about its multiple-signal capture capability. With this utility, he was able to use a DMM to measure the output voltage and 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 went back to the design team with graphical data from the Agilent DMM Connectivity Utility and they agreed to investigate the defect.

Anticipate — Accelerate — Achieve



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An easier way to communicate with a DMM with I/O

Paired together with Agilent I/O Libraries, identifying DMMs connected to your PC is easier than ever. Agilent's new DMM Connectivity Utility will automatically identify connected DMMs configured on your bus. This initial opening view shows the model of 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 datalogging for each DMM. You can control multiple DMMs within the app.

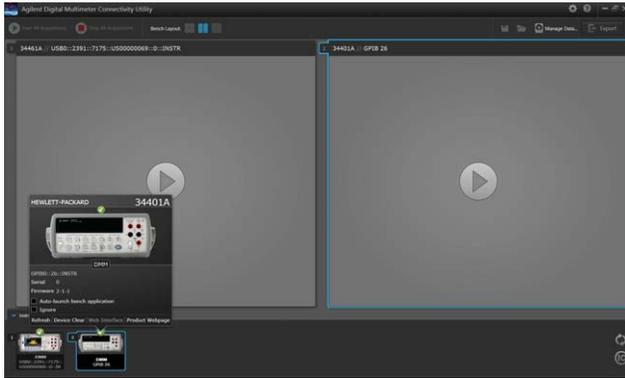


Figure 1. View of connected DMMs using PC app

Make a measurements and understand the data without learning the whole instrument

Engineers are often time constrained and don't necessarily want to spend time on extraneous activities. If you want to make a simple DMM measurement, you want to ensure that the instrument is fully set up and not missing a key parameter when running a test. Measuring multiple signals can be especially painful if you aren't familiar with the DMM or if you have differing generations of Agilent equipment. Agilent DMM Connectivity Utility's unified interface supports Agilent DMMs released in the last 25 years. The PC DMM app can communicate using RS-232, GPIB, USB, or LAN. With this I/O flexibility you can now use the same intuitive interface for all these DMMs.

Very few of us can look at a group of numbers and make quick, accurate judgments on the data set. Graphing the data is preferable, but sometimes it just takes too much effort to get a nice-looking chart that is easy to read and understand. The Agilent DMM app can help you understand your data visually, in real time, with time-stamped data. Its layout is intuitive and graphs are aesthetically pleasing. The app also has numerical outputs for those who need the raw data.

Agilent's DMM Connectivity Utility presents the full setup for given measurement functions. The app intuitively presents the DMMs as bench tiles. With this new app, you can now visualize the outputs of up to four different DMMs. The application has the ability to control and get measurements with up to 9 DMMs at a time. An intuitive bench layout allows you to see your virtual bench in a single, double, or four-tiled view.

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

Let's go through 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 do a simple DCV measurement. Use the Measurement menu to select the DC Voltage measurement function. The context-sensitive Measurement tab now presents all the parameters you would want to use for 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.

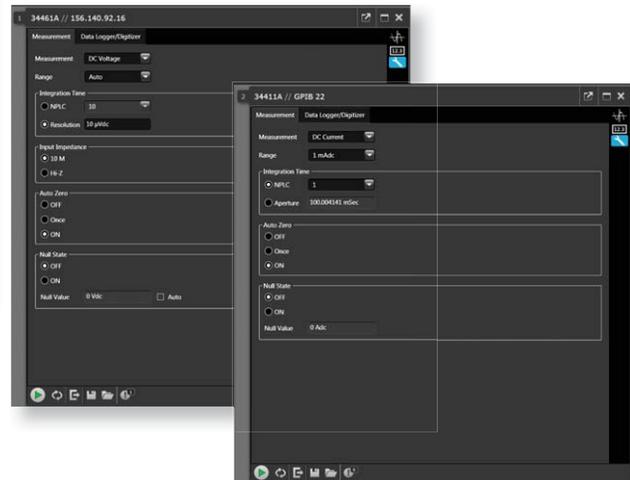


Figure 2. Configuration of two different DMMs shown side by side in the DMM Connectivity Utility

The Data Logger/Digitizer tab presents you with more advanced functionality such as trigger menus, in-program limit testing, and digitizing setups. This context-sensitive menu is dependent on your DMM model. New functionality allows you to set up the apps to email you when a measurement fails a limit. Let's set the triggering for both to be immediate triggering (you could also use an external trigger). Figure 3 also shows that we are stopping after 1 minute of sampling. You can set up the acquisition to sample indefinitely. That's all there is to setting up the synchronized sampling.

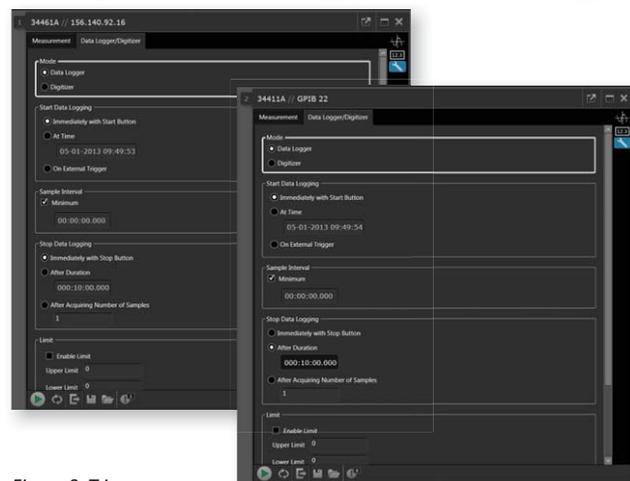


Figure 3. Trigger menus

To start gathering data, press the Start All Acquisitions key. This will automatically trigger all instruments you have set up. It also synchronizes measurements whether you are in single-tiled or multi-tiled bench mode. The data log chart is updated in real time, and you can see that the data points line up. The time stamp feature shows the time when the sample was taken. This allows for a quick understanding of measurement peaks, noise, or drift. Figure 4 shows the chart view of DMM1 (DCV) and DMM2 (DCI). This visualization allows us to understand the relationship between the two measurements graphically. You can control your DMMs and visualize the synchronous measurements in one program.

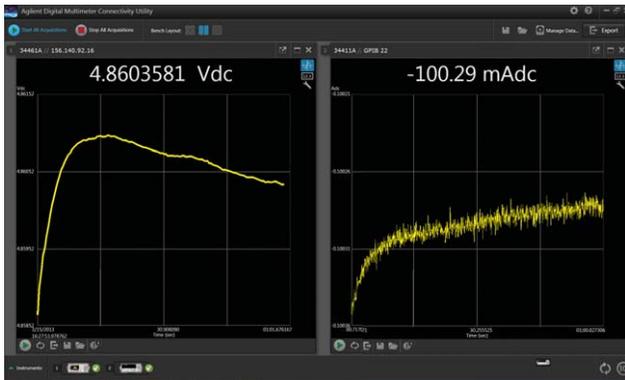


Figure 4. V and I curves with respect to time

In Multi-tiled view, the trend chart is the only graphing view available. You can set your bench layout to a single-tiled view and see the DMM's data as a histogram or table. You can toggle between multi-tiled view and single-tiled view modes without needing to re-acquire your data. You can do further analysis in single-tiled mode on the trend chart. Included in this mode are 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 allow you to modify your view of the data. You can annotate measurement events with in-program notes too.

You can also 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.

What if you want to use your own program to look at the data? Once the measurements are finished, users 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 taken, as shown in Figure 6.

The example we are using had 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.

Time	Elapsed Time	34411A // GPIB 22 [Adc]	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	-0.100356533
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
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
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

Figure 7. Raw data in Excel

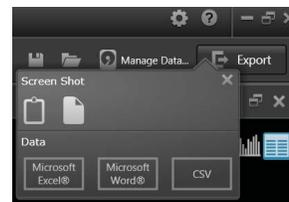


Figure 5. Export menu

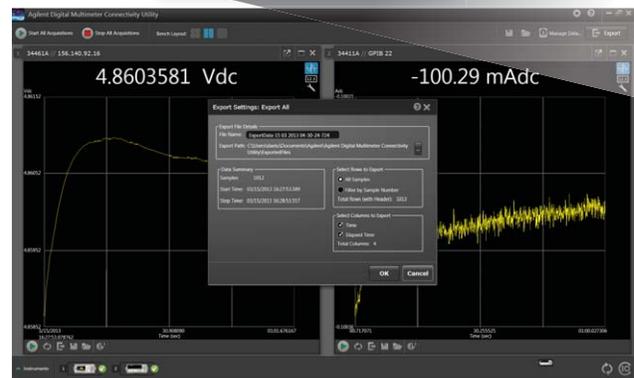


Figure 6. Exporting the data into a file

If you forget to save your data, Agilent's DMM application can help. The Data Manager (shown in Figure 8), accessed through the Manage Data button, keeps track of data from past sessions. This data is stored in a file on the PC and can be deleted or copied like other PC files. You can open past data sessions and use the same DMM tools to analyze your data just like if you had just acquired it. With this feature, you can go back 20 years and look at the measurements you made when you first started using a DMM. A more practical use case would be to transfer groups of measurements to another PC, then view the data in the familiar Agilent DMM application.

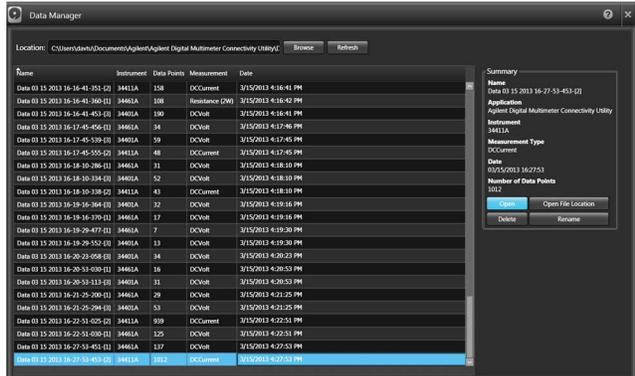


Figure 8. Data Manager

Summary

With the Agilent Digital Multimeter Connectivity Utility, you can save time and effort. Benefits include:

- Measuring multiple signals synchronously is simpler than ever.
- Synchronize your measurements in minutes.
- Set up your DMM and gather data in less time than you would spend for wiring up your measurement.
- Understanding your data just got easier; visualize it immediately or export it to popular tools such as Excel or Word.
- Understanding your sampling is simpler when you can see if the DMM's are measuring at different intervals.
- Go deeper into your data by looking at each instrument's measurements graphically or numerically without having to take the data all over again.

This application helps you use your equipment right away, without the learning curve. Agilent's DMM application is available for free download from Agilent.com.



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MEASUREMENT BRIEF

No Programming Required: Digitizing Signals and Analyzing Data with a DMM



Introduction

Agilent digital multimeters are ubiquitous on work benches and in automated test systems. You have most likely used one at some point in time. They measure basic electrical properties and give you a clear reading. More sophisticated DMMs have higher precision, data logging capability, and higher measurement speeds. If your DMM has these capabilities, you can use it to digitize your signals. Digitizing is useful to understand your signal better, and you can plot the data for a visual representation of your signal. Digitizing with your DMM has been simplified with the Agilent DMM Connectivity Utility.

This measurement brief explains how the new Agilent DMM app can help you digitize your signals and understand your data faster. In a couple of clicks, it can graph your measurements. The app also synchronizes multiple DMMs and allows you to put together a multichannel DMM system.

Snapshot

A mechanical engineering student was designing an airplane wing for his fluid dynamics class. In order to evaluate the flex of the wing under different conditions, he needed to be able to measure forces on the wing in at least four different locations. He had some force transducers that change resistance depending on strain, these sensors were as old as he is. Since he is an undergrad, he did not have access to the really expensive equipment that the Graduate students use. He realized that he had access to the electronics' lab equipment to borrow a few DMMs. The student downloaded the Agilent DMM Connectivity Utility and used the app to setup his measurement. He was going to take lot of discrete data points then put the data together in Excel later. But he found out that he can use this app to digitize all four points and graph the data right away. In an afternoon, he's able to digitize the transducer outputs in parallel and sweep through all of the test conditions. He then spent the rest of the weekend "studying".



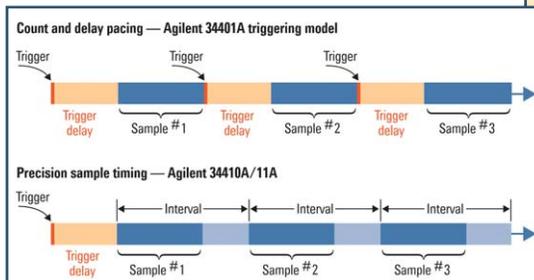
Simplified Digitizing

If you digitize your signals, you can analyze transients, non-repetitive signals, and other AC waveforms in the time and frequency domains. You use fast sampling techniques to understand your signals better. Focused off-the-shelf solutions, such as a digitizer or high-precision scope, often cost more than \$10K and they may not offer the resolution you need for your measurement.

A general-purpose DMM can digitize signals, but it is not the first instrument that comes to mind when you think of digitizing. Historically, DMMs were set up to make discrete measurements with varying sample intervals. Newer DMMs have deterministic sample intervals and sampling models that allow for digitizing your signal. DMMs are flexible, have up to 22 bits of resolution, and are relatively inexpensive. The DMM has the added advantage of being able to digitize resistance, current, and temperature straight out of the box. A new Agilent DMM software app makes it easier to set up your test, gather your digitized data, and visualize it in the time domain.

The app supports DMMs with digitizing capabilities which include the 34410A, 34411A, 34460A, and 34461A. The PC DMM app can communicate to these DMMs over GPIB, USB, or LAN. With this app you can now use the same intuitive interface to set up digitizing for those DMMs.

Agilent's DMM app will help you set up for your measurement functions. The app presents the DMMs as bench tiles on your computer screen. With this new app, you can now visualize signals on up to four different DMMs at the same time. Using the application, you can control and make measurements with up to nine DMMs.



Setup for Digitizing Measurements

To change parameters for each DMM, press the configuration wrench in each tile. This brings up a Measurement menu and a Data logger/Digitizer menu in tabbed windows. Let's go through a simple example: digitizing a simple waveform. The waveform we want to capture is a model of a cardiac pulse.

In this example, we want to make DCV measurements. Use the Measurement menu to select DC Voltage as the measurement function. The context-sensitive Measurement tab now presents you with all the parameters you would want to use for DCV measurements for your DMM. Figure 2 illustrates a typical setup for DCV measurements.

MEASUREMENT TIP #1

Sample Intervals

When you use a DMM for data logging or digitizing, you will want to minimize the variation in the timing between samples. Eliminating the sources of additional delays can improve the consistency between readings. The time required for autoranging, range changes, auto zero, performing math functions and updating the display can add to the variability between measurements. See measurement tip "Improving Digital Multimeter Throughput", 5990-3218EN

Rather than insert a trigger delay between one sample and the next, use a sample interval. A sample interval specifies the time to wait after a trigger event has occurred before making the next measurement. Using a DMM that allows you to specify a sample interval instead of a trigger delay allows precise sampling times, even when you are using features such as autoranging and auto zero. For more information, see "Data Logging and Digitizing Using a Digital Multimeter", 5990-3220EN

Figure 1. Setting the sample interval specifies the timing of the measurements rather than the delay between samples.



Figure 2. DCV setup

MEASUREMENT TIP #2

Easier Connections

Use Agilent IO Libraries Suite to make identifying DMMs connected to your PC easier. Instruments with direct connections like USB and GPIB will auto-identify and be recognized upon boot-up of the program. DMMs connected via LAN and RS-232 require a configuration step in Agilent Connection Expert, which you can access through the DMM utility.

Agilent DMM Connectivity Utility's unified interface supports Agilent DMMs released in the last 25 years. It supports older models, including 34401A, 34405A, 34410A, and 34411A as well as our latest-generation 34450A, 34460A, and 34461A DMMs.

The Data Logger/Digitizer tab presents you with more advanced functionality such as data logging and digitizing setups. The content of this context-sensitive menu is dependent on your DMM model. Under the data logging menu you can find trigger menus, in-program limit testing options and sample interval settings. New functionality allows you to set up the apps to email you when a measurement exceeds a limit. Using this mode, you can visualize live data as the measurements are taken.

Under the Digitizing menu, you'll find the settings for the most common digitizing configuration using a single trigger to sample multiple readings (see Figure 3). By using this menu, your sample interval is set to the minimum value. In this mode, the samples are taken and stored inside the DMM. After the data has been acquired, it is transferred to the app. This minimizes any sample timing error due to data transfer rates.

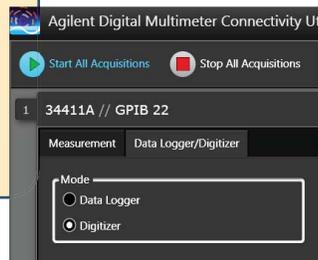


Figure 3. Digitizer Configuration menu

As we mentioned earlier, you can set up your bench to digitize multiple signals using this app. For more information see "No Programming Required: Multisignal Capture and Analysis with DMMs", 5991-2283. After setting up your digitizing configuration, pressing Start All Acquisitions will start the measurements for all DMMs you have on your bench. Once you have the data, you can visualize it using the app's graph mode, as shown in Figure 4.

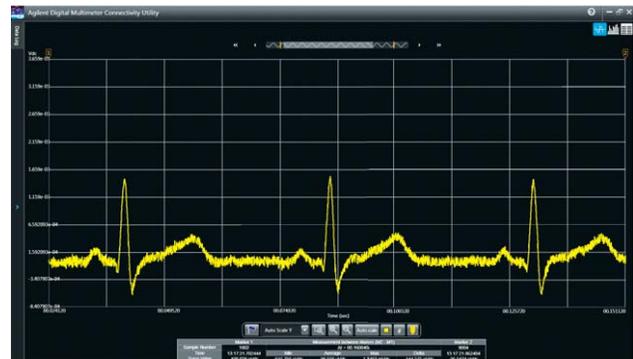


Figure 4. Digitized data

Analyzing Digitized Data

The Agilent DMM apps can help you understand your data visually in real time. The application has a trend chart mode that displays your data across time. This capability allows for a quick understanding of measurement peaks, noise, or drift. Similar to an oscilloscope, this mode features measurement markers that allow you to analyze the measurement between the markers. Customizable features such as autoscale, zoom, and trace color allow you to modify your view of the data. You can annotate measurement events with in-program notes too.

What if you want to use your own program to analyze data? Once the measurements are finished, you can export the data into a variety of formats (see 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 of when measurements were taken.

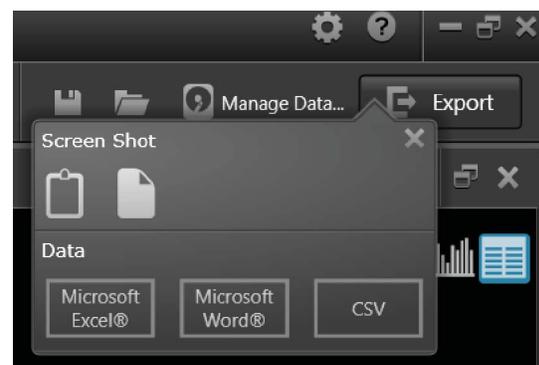


Figure 5. Export menu

If you forget to save your data, Agilent's DMM application can help. The Data Manager (shown in Figure 6), accessed through the Manage Data button, keeps track of data from past sessions. The data is stored in a file on the PC and can be managed like other PC files. You can open past data sessions and use the same DMM tools to analyze your data as if you had just acquired it. With this feature, you can go back 20 years and look at the measurements you made when you first started. You also can use this capability to transfer groups of measurements to another PC, and then view the data in the familiar Agilent DMM application.

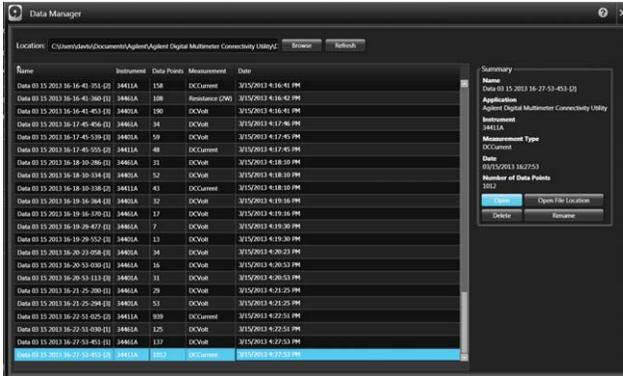


Figure 6. Data Manager

Summary

Simple digitizing can be done using a DMM. The Agilent Digital Multimeter Connectivity Utility enables you to save time and effort. You can digitize multiple channels in parallel with synchronized measurements and set up your DMM and gather data in less time than you would spend wiring up your measurement. Understanding your data just got easier; you can visualize it immediately or export it to popular tools such as Excel or Word. This application enables you to use your equipment right away, without a long learning curve. Agilent's DMM application is available for free download from Agilent.com.



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