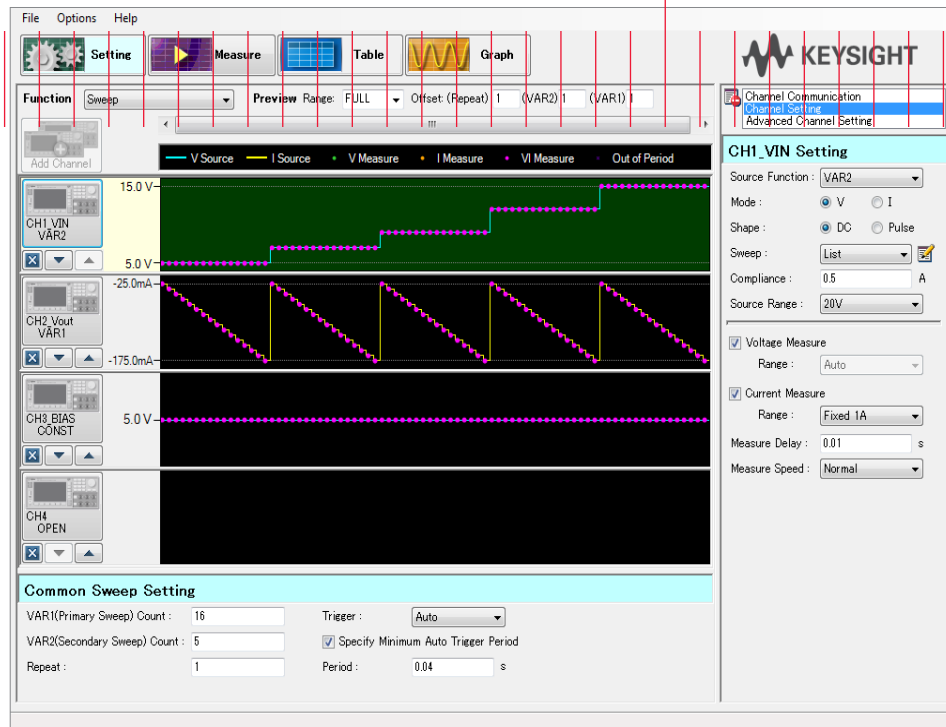# Keysight Technologies

Making Testing Easy with the Keysight B2900A Quick IV Measurement Software

Technical Overview

Keysight B2901/02/11/12A precision source/measure unit

Keysight B2961/62A 6.5 digit low noise power source

KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies, Inc. B2900A Quick IV measure-
ment software, which is included with products from the
B2900A Series of precision instruments, makes it easy to
quickly set up and perform current versus voltage (IV) and
voltage/current versus time (v–t or i–t) measurements. The
test approach using the Quick IV software can be broken
down into three steps:

1. Setup measurements using preview capability
2. View test results in table and the graphics formats
3. Transfer measurement results for post-processing on a PC

This application details the software's capabilities in each
of these areas and references actual software screens to
illustrate these features.

Benefits of using the Quick IV Software

– Ease of use

Quick IV measurement software is easy to learn and simple to use, which means you can get the data you need sooner. To obtain measurements two types of measurement functions are available: Sweep, and Source & Sampling.

– Quick and accurate test setup

To help you visualize your setup, the software provides the preview of the channel output signal in the Channel Output Graph Area of the Setting panel (shown in Figure 1). From this screen you can set the measurement by viewing the preview of the output signal and the measurement timing in the Channel Output Graph. You can quickly set up your test and get accurate results beginning with the first measurement. As illustrated in Figure 1, each channel's output timing and the measure-ment points are shown in purple dots and can be seen clearly, providing a quick validation that the test has been accurately setup.

– Easy to perform parametric test

The Quick IV software supports the secondary sweep, VAR2, making it easy for you to include parametric tests. As shown in the top preview graph of Figure 1, VAR2 increments the step value after each primary sweep, VAR1, finishes one sweep measurement. Using VAR2, you can expand the measurement range to perform parameter tests such as Id-Vd measurement (VAR1 to drain, VAR2 to gate) of field effect transistors (FETs).

– Easy test automation

It is easy to automate your testing. GPIB, LAN and USB interfaces are supported, allowing you to remotely control the B2900As. Up to four channels can be used, and a channel can be added at any time, if necessary.[1]
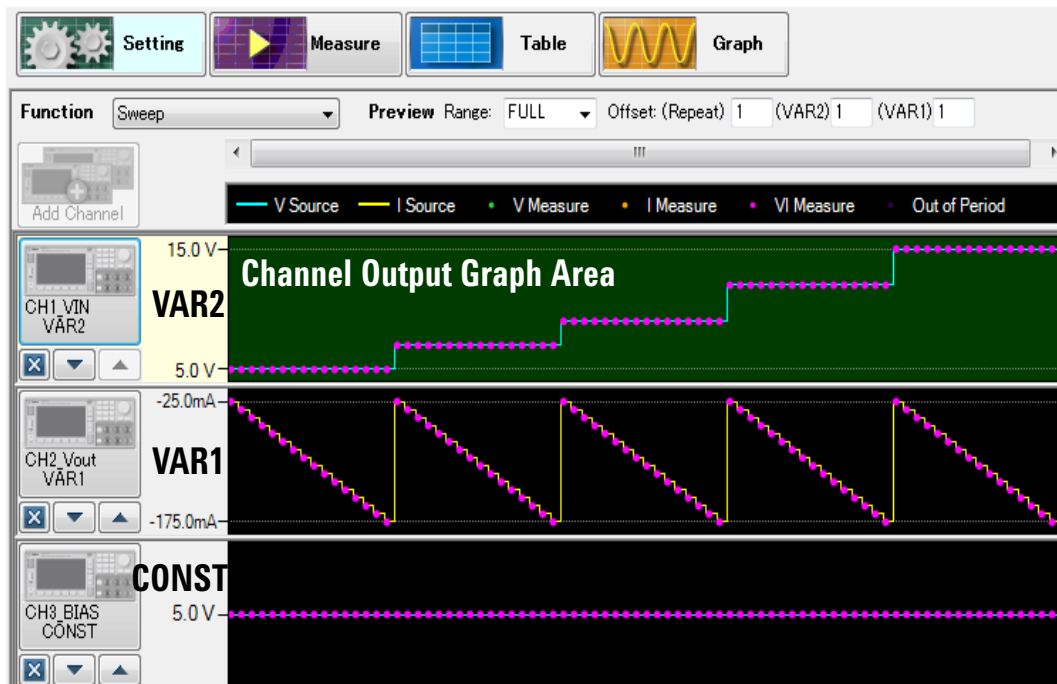

Figure 1. Preview of the channel output signal in the Channel Output Graph Area.

1. The USB interface supports only one B2900A instrument

Performing Setup and Measurements Easily

The first step is to use the software's user-friendly graphical user interface (GUI) to set up accurate measurements. The test setup used for this example is shown in Figure 2 and is for measuring switching mode DC-to-DC converter using two SMU channels: one for the input DC power supply and the other for the emulated electric load. The B2900A Series can be used with a maximum capacitance load of 50 μF, and it is suitable for characterizing a device with the capacitive components as shown in Figure 2.

The Quick IV software supports two types of measurement modes using up to four channels:

Sweep measurement
This measurement function is used to test the IV character-istics of semiconductor devices such as diodes, the resistivity of various materials, and functional ICs such as regulators, VCOs and MEMs. The parametric test can also be performed easily using the secondary source sweep function.

Source and sampling measurement
This measurement function is used to characterize transient or step response using the minimum 10 μs sampling interval of B2900A Series of precision instruments.[1] Using a Keysight B2961A/62A power source you can output an arbitrary waveform.
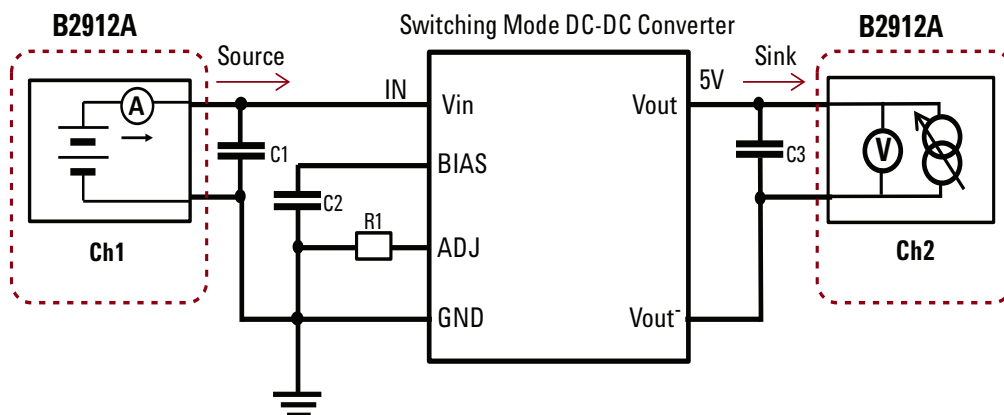

Figure 2. Typical connection block diagram for evaluating DC to DC converter.

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1. Some models start from 20 μs. Refere to the datasheet for details

Load regulation test using sweep function

Switching mode DC-to-DC converter converts the input DC voltage to a stable DC output voltage and keeps the output stable. The load regulation test measures the output voltage variation when the output current load is varying. The following procedures show how to set up the load regulation test. Each step corresponds to each number shown in Figure 3.

1. Select the "Setting" panel

2. Sweep function is used for load regulation test. In the example, Ch1 is set to constant 12 V as the input voltage source, Vin.

3. The status of Ch2 is active and is set as the current load of the regulator. The background color in the output signal graph turns to green, indicating that the channel is active and that the test parameters can be set.

4. Ch2 is set as VAR1 primary sweep function to emulate the sweeping electric load from 25 mA to 175 mA by 10 mA step.

5. The measurement parameters for Ch2 are set as a current source (the negative sign indicates that the Ch2 sinks the current for the Ch2 operation). The calculated sweep waveform and the measurement points are shown as a preview in the output signal graph.

6. The Measurement Delay is set at 0.01 seconds, which is the amount of time delay that will occur before starting the measurement after the VAR1 step is made. The Measurement Speed parameter is set to Normal, which is one power line cycle period.

7. Change the Preview Range from VAR1 to STEP for the output signal graph setting.

8. Once set to STEP, the graph expands for one step of the VAR1 period in the horizontal axis, as shown in the enlarged preview graph in Figure 3. In this image you can see that the measurement starts at a point 10 ms (0.01 sec) after the VAR1 is set. The measurement is made for one power line cycle period after this point, which is 20 ms for the 50 Hz line frequency and 16.6 ms for 60 Hz. Then VAR1 is stepped to the next value.

In this way, you can set the measurement quickly and accurately by reviewing the preview in the output signal graph. You can monitor any of the points by sliding the Time Bar, which is located at the top of the output signal graph.
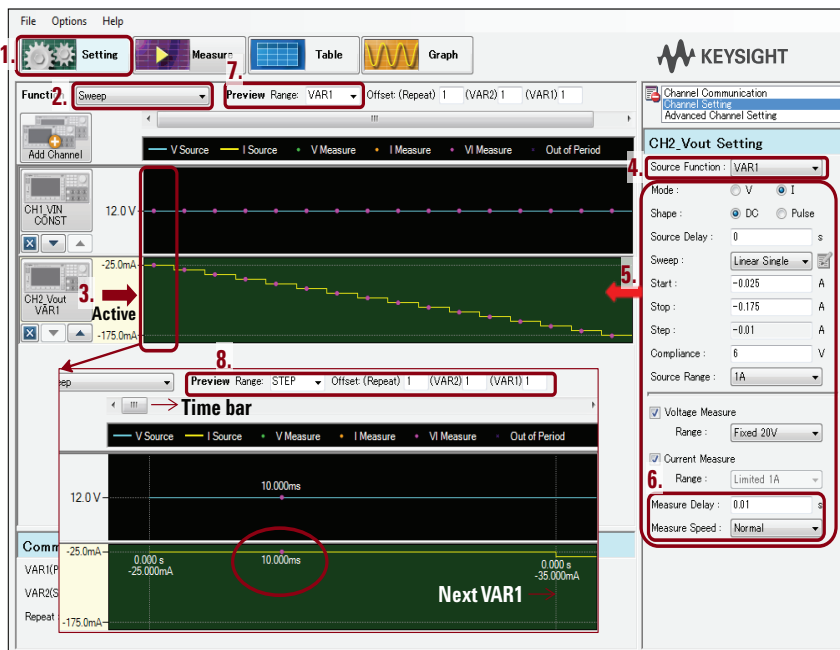

Figure 3. Load regulation test setup.

Load transient response test using source and sampling function

Load transient response is an important characteristic of switching mode DC-to-DC converter. When the output load shows sudden changes, a glitch appears in the output. The load transient test is typically made by applying a short current pulse load to the output and measuring the output voltage transient with an oscilloscope. The same measurement can be made simply by using the v-t sampling capability of the Quick IV software and the B2900A Series of precision instruments.

Figure 4 shows the preview of the output signal graph of Quick IV Software sample setup for the load transient response test. A 5 ms current pulse is applied at Channel 2, and the current and the voltage of both channels are measured with a 10 µs sampling interval. The sampling points are indicated in purple color/dots which show i-t sampling points.
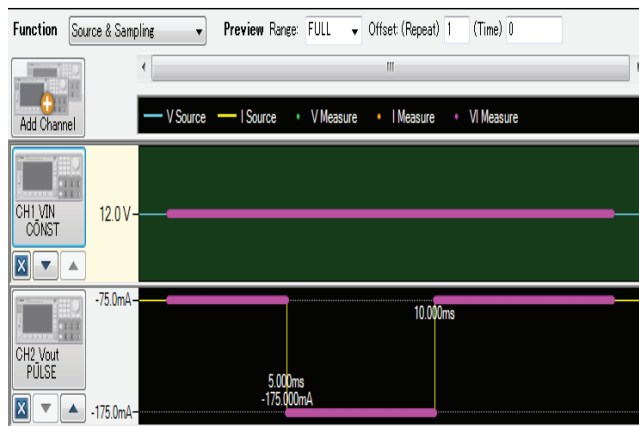
Arbitrary waveforms for emulating the real operation

Using a B2961A/62A power source you can use arbitrary waveforms or select from the pre-defined waveforms to emulate real operations. Figure 5 shows an example where the Trapezoid waveform is used as a load transient source. Arbitrary waveforms can also be used for emulating the power-on transient response of the ICs. As shown in examples depicted in Figures 4 and 5, you can set up a variety of tests very easily by using the B2900A Quick IV software.
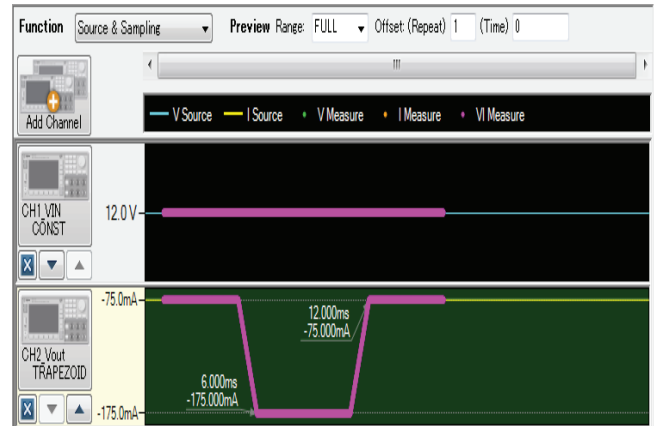

Figure 4. Load transient response test setup.

Figure 5. Trapezoid waveform setup example as the load current source using a B2961A/62A power source.

Viewing Results Quickly and Graphically

After measurements are completed, the test results can be viewed quickly since results are displayed in both table and graph formats.

Table view

Figure 6 shows an example of the Table view in the default setup condition. The measured voltage and current, which are specified in the measurement setup, along with the timestamp data are shown in the table format.

– Adding table parameters
You can add power, measurement state, and source value to the Table view by selecting in the optional Select Column window. Resistance can be added if conditions are met.

– Checking measurement status
You can check the measurement status, which is shown in a different color. For example, the yellow column in the lower left of Figure 6 shows that the measurement status is not normal. This can occur, for example, when a measurement result hits a limit value, in other words, a compliance value. In this way, you can check the data in the numeric form and the measurement status by using the Table view.
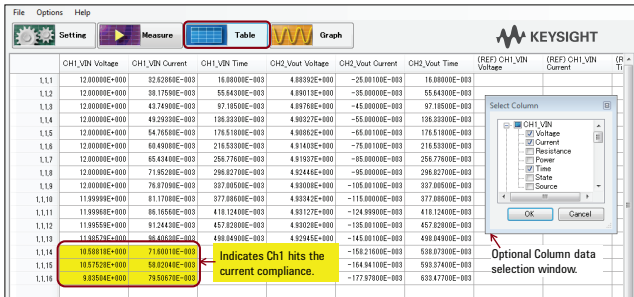

Figure 6. Table view example.

Graph view

The Graph view is useful for quickly checking the measurement results at a glance, or using it in a report showing the overall view of the test results. The following section describes a few useful capabilities of the Graph view of the Quick IV software.

Figure 7 shows a Graph view example of load regulation of switching mode DC-to-DC converter. You can use three axes (X, Y1, and Y2) to display your data and assign any of the parameters to these three axes. You can check a maximum of four parameters in the Y-axes at the same time, because you can assign multiple parameters to the same Y-axis.

In Figure 7, Ch2 load current is shown on the X-axis, Ch2 output voltage on the Y1-axis, and Ch1 input current on the Y2-axis. Two markers are shown on Ch2 output voltage: one at the highest voltage and the other at the lowest voltage. The marker function shows each X and Y value and the data index. The differences for each two values are shown in the Delta field.

In the case of the load regulation test, the maximum variation in the output voltage, when the load current is swept, accounts for the load regulation performance. In the example, you can read the maximum load regulation as 50 mV.
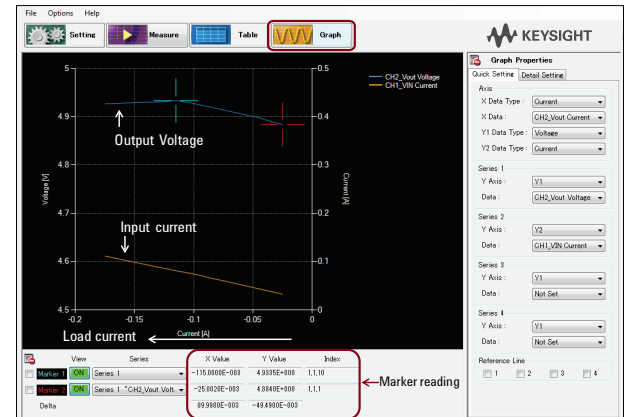

Figure 7. Graph view example of load regulation of Switching mode DC to DC converter.

Useful functions in Graph view

The Graph view has the following useful functions and capabilities.

– Two markers on any data points.

– Axis inversion capability.

– Reference Lines to compare the data on the graph.

– Detail setting for all the color setting, graph and axis title, and line type can be made.

The graph shown in Figure 7 is plotted using the default graph property. The load current shown on the X-axis is negative and the plot is made from the maximum to the minimum direction in absolute scale. The negative sign comes from the fact that the instrument actually sinks the current from the regulator output as an electric load, which is equivalent to the regulator's source current (in opposite direction).

In addition to correcting the X-scale direction, let's consider that you want to paste the graph into your report, and the black background color is not suitable. Figure 8 shows
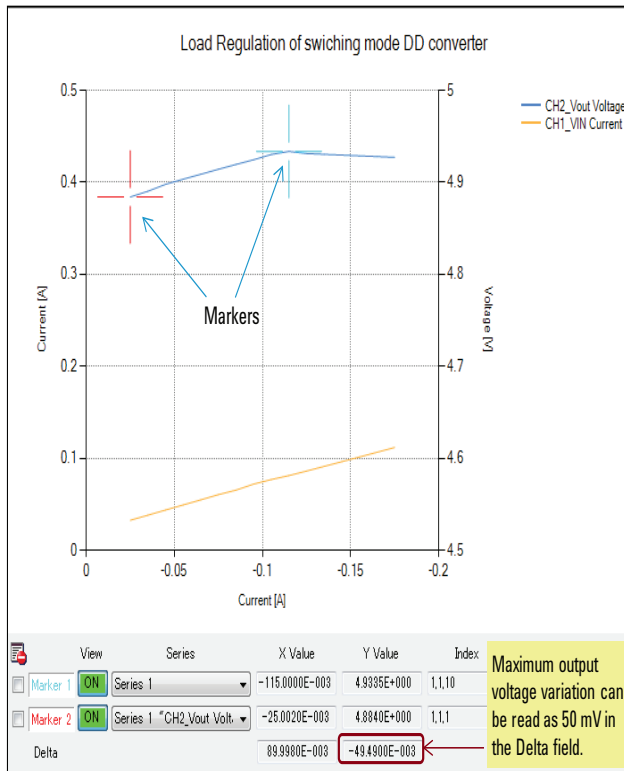
an example of the change in the graphic's appearance, in which the background color is switched to white, the X-axis is inverted for showing the typical expression of regulation, and the title of the graph is added for reporting purpose.

Figure 9 shows the load transient response examples, which are the results of the setups shown in Figure 4 and Figure 5. It can be seen that the peak of the transient response becomes lower as shown in Figure 9(b), which compares the response from the two transition edges, one is 1 ms and the other is 2 ms, using the Reference Trace function.

Figure 8. X axis inverted and background is changed to white with an addition of the graph title.
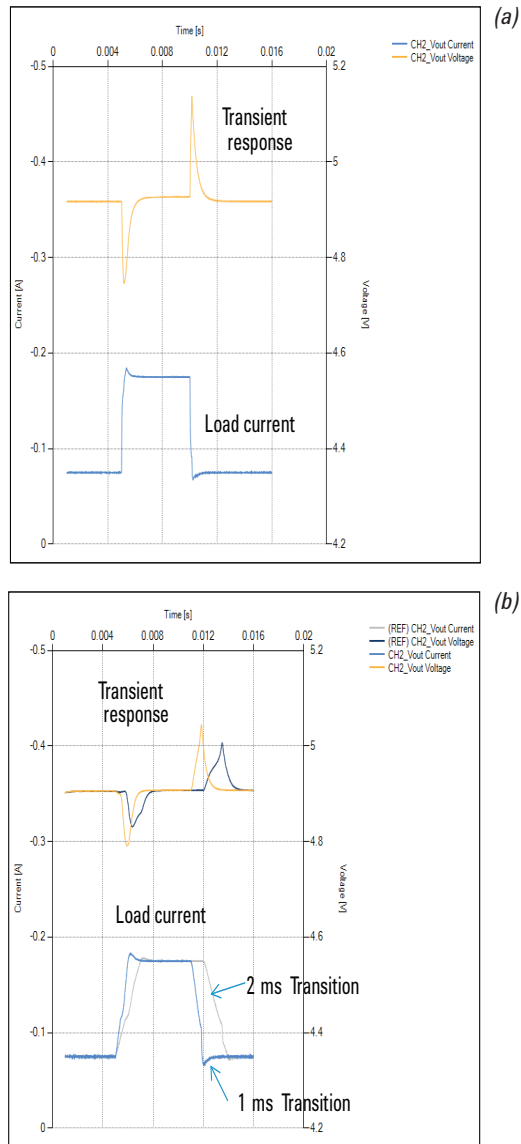

Figure 9. Load transient response example
(a) Load transient by pulse wave
(b) Two load transient responses of trapezoid wave are shown by using the Reference Trace function.

Exporting Data to Microsoft Excel Easily

The final step is to port table data. The Quick IV software is designed to accommodate further data analysis on a PC and provides the following three ways to pass the data to a PC spreadsheet application:

– Export as CSV file

– Export to Excel worksheet (manually)

– Export to Excel worksheet (automatically)

By saving data in the CSV format, you can manipulate the data in a variety of applications. Exporting to Excel opens a new Excel worksheet automatically, and all the table data of the Quick IV software is transferred to the worksheet. As shown in Figure 10, checking Automatic Export automatically transfers all the measurement data to a new Excel worksheet once the measurement is completed. That worksheet is in the same Excel file and is given a unique name by date-time format, eliminating the need to manually perform repetitive postings. The date-time format assures that existing data is not overwritten and secures all of your measurement data.
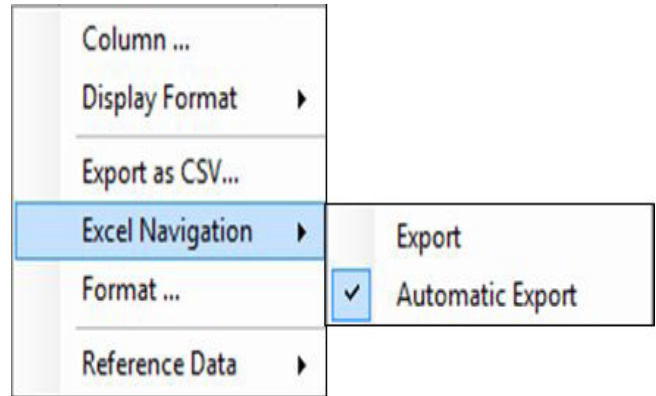

Figure 10. Automatic Export to Excel setup example.

Conclusion

The Keysight B2900A Quick IV measurement software is free and has powerful measurement capabilities to control the Keysight B2900A Series of precision instruments over GPIB, USB or LAN connections. You can quickly and easily use the powerful B2900A Series capabilities without programming or setting multiple items on the B2900A Series' front panel. The easy-to-use software is suitable for a wide variety of applications that require IV, v-t, and i-t measurements. The graphic views have powerful capabilities that provide the ability to change parameters on X, Y1 and Y2 axes, use two markers, compare data using reference traces, and customize the output for reporting use. In addition, you can easily and efficiently export the test data from the Table view panel to your PC for further analysis.

The B2900A Quick IV measurement software is simple software designed for faster start-up and ease-of-use. At the same time, it has powerful measurement capabilities and is suitable for quickly viewing or checking of your data.

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