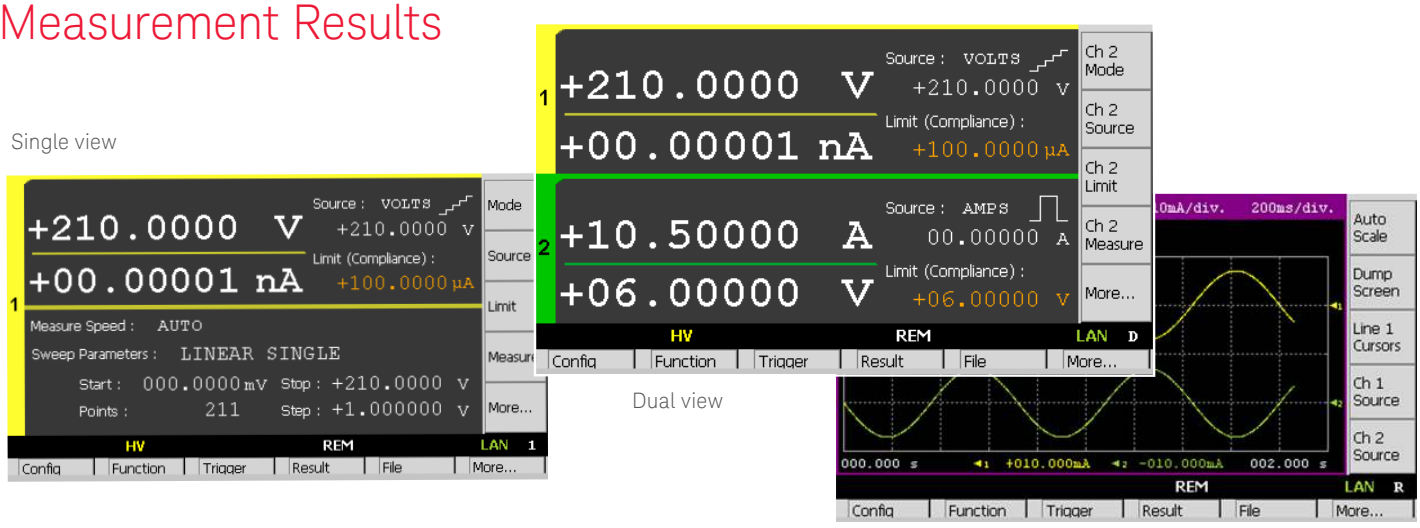
B2900A Series
Precision Source/Measure Unit
1ch/2ch
210 V, 3 A DC/10.5 A Pulse
10 fA/100 nV Resolution

Cost-effective source/measurement solutions offer superior performance and a best-in-class graphical user interface

Innovative SMU Provides Superior Performance and Rapid Measurement Results



The Technologies, Inc. B2900A Series of Precision Source/Measure Units are compact and cost-effective bench-top Source/Measure Units (SMUs) with the capability to source and measure both voltage and current. These capabilities make the B2900A Series ideal for a wide variety of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

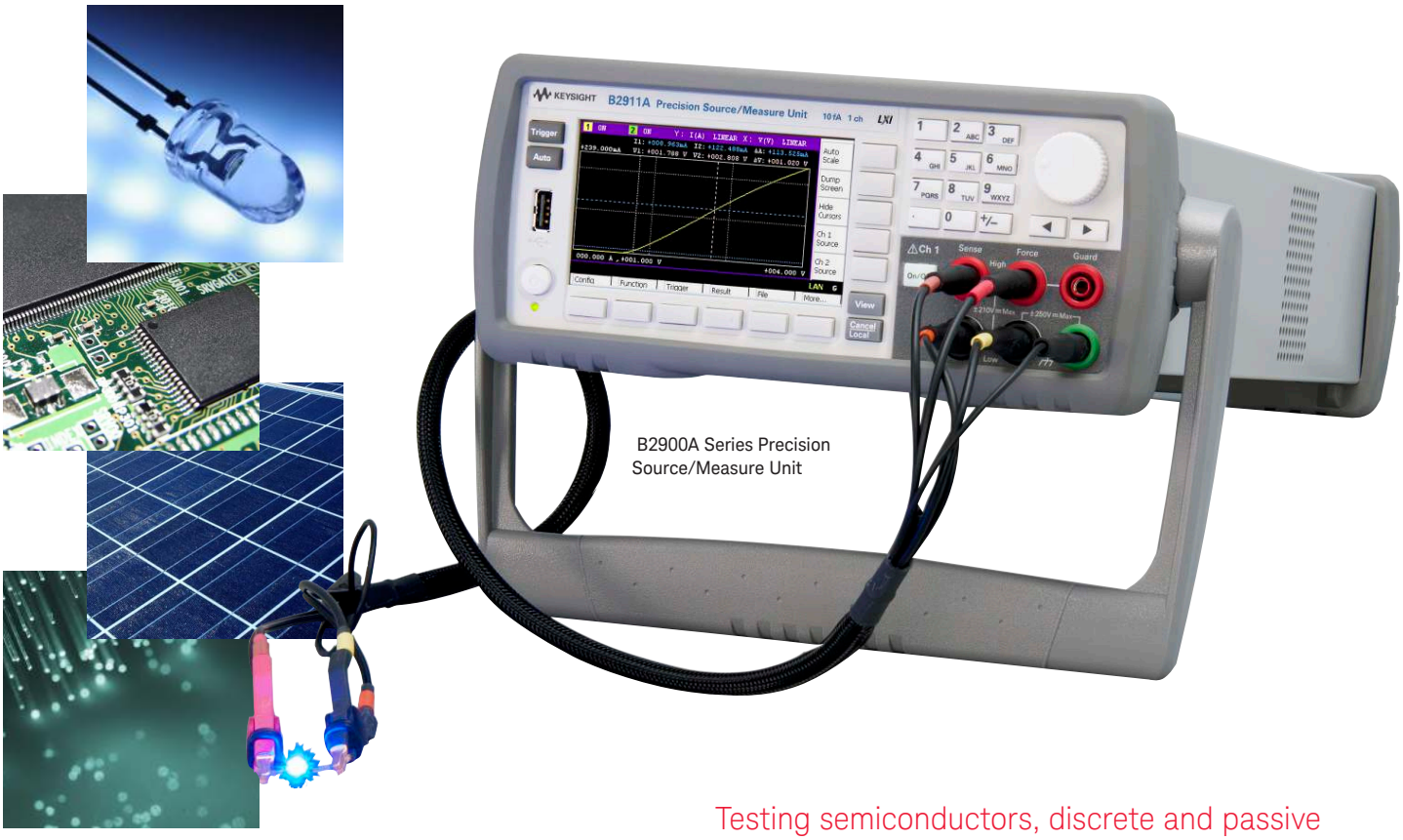
The B2900A Series of SMUs provide best-in-class performance for a modest price. They have broad voltage (±210 V) and current (± 3 A DC and ±10.5 A pulsed) sourcing capability, excellent precision (minimum 10 fA/ 100 nV sourcing and measuring resolution) and possess a superior color LCD graphical user interface (GUI). In addition, several task-based viewing modes dramatically improve productivity for test, debug and characterization.

The B2900A Series offers unmatched measurement throughput and supports conventional SMU SCPI commands for easy test code migration. These features improve efficiency and lower the cost of ownership when integrating the SMUs into systems for production test.

The B2900A Series consists of four models, the B2901A, B2902A, B2911A and B2912A, differentiated through their available features (number of digits displayed, measurement resolution, minimum timing interval, supported viewing modes, etc.) and by the number of SMU channels (one or two) they contain. This makes it easy to select the exact price/performance point you require to meet your testing needs.

Feature	Benefit
Integrated 4-quadrant sourcing and measuring capabilities	Easily and accurately measure current and voltage using a single instrument without the need to manually change any connections
Measurement range: ±210 V, ±3 A (DC), ±10.5 A (pulsed)	A single SMU product covers both high voltage and high current measurement needs, allowing for more standardization and simplifying inventory and support concerns.
Source and measurement resolution down to 10 fA and 100 nV	Can make low-level measurements using a low-cost bench-top SMU that were previously only possible using a more expensive semiconductor device analyzer.
User-friendly front panel GUI with 4.3 inch color LCD display supports both graphical and numerical view modes	Can quickly and easily perform measurements and display data on the front panel, thereby greatly speeding up interactive test, characterization and debug operations.
10 microsecond digitizing capability	Can capture low frequency phenomena in addition to DC characteristics.
Free PC-based control software	Can make measurements remotely from a PC without the need to program.
Supports both conventional and default SCPI commands	Conventional SCPI commands provide some compatibility with older SMU code (such as Keithley 2400 series) to minimize code conversion work. Default SCPI commands support advanced B2900A Series features.
Small form factor with USB2.0, LAN, GPIB and digital I/O interfaces	Easy integration into rack and stack systems.

The Best SMU Solution for a Broad Range of IV Measurements



SMUs are popular and widespread instruments for performing IV measurements in many different fields and applications due to their integrated voltage and current sourcing and measurement capabilities. The B2900A Series provides superior performance and usability at a very reasonable price. In addition, the B2900A Series supports many functions to speed up production test and increase throughput. The versatile measurement capabilities of the B2900A Series SMUs make them an ideal choice for a variety of IV measurements such as semiconductor test, active/passive component test and general electronic device and material characterization.

The B2900A Series has a broad application range that spans uses from R&D and education to industrial development, production test and automated manufacturing. Moreover, they work equally well as either standalone or system components.

Testing semiconductors, discrete and passive components

Diodes, laser diodes, LEDs
Photodetectors, sensors
Field effect transistors (FETs), bipolar junction transistors (BJTs)
ICs (analog ICs, RFICs, MMICs, etc)
Resistor, varistor, thermistors, switches

Testing precision electronics and green energy devices

Photovoltaic cells
Power transistors, power devices
Battery
Automotive
Medical instruments
Power and DC bias source for circuit test

Research and education

New material investigations
Nano devices characterization (e.g. CNT)
Giant magnetic resistance (GMR)
Organic devices
Any precise voltage/current source and measurement

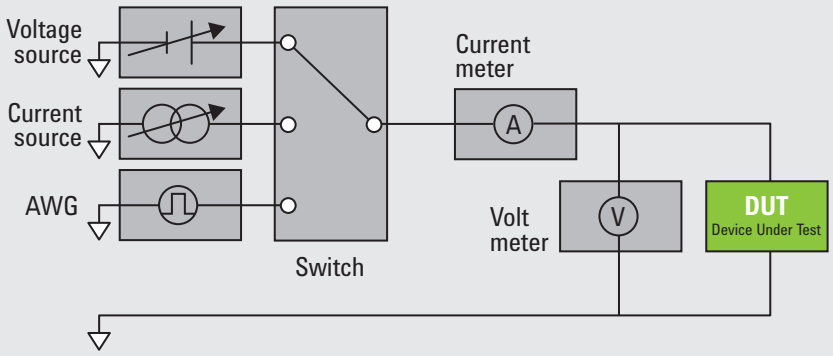
Integrated Source and Measurement Capabilities Simplify Difficult IV Measurement Tasks

The B2900A Series reduces measurement complexity

Performing IV measurements with conventional instruments such as voltage/current sources, arbitrary waveform generators (AWGs), switches, and voltage/current meters is complicated and confusing. It requires deep technical knowledge of both the measurement technique and the instrumentation to perform an accurate measurement.

The B2900A SMU integrates many different source and measurement capabilities into one compact form factor. It can operate as a seamless 4-quadrant precision voltage/current source, an electrical load, an accurate voltage/current meter, a pulse generator and an AWG. Its versatile all-in-one integrated source and measurement capabilities allow it to perform a wide variety of measurements from DC to low frequency AC without the need to change connections or use additional equipment. Moreover, the availability of 2-channel models supports the testing of devices with up to three terminals (as long as one terminal can be tied to the circuit common).

If you wish to learn more about the advantages of using SMUs to make IV measurements, then please refer to the section at the back of this brochure entitled "*Overview: Why use an SMU?*"



Rack & stack solution:
Multiple instruments connected together with no easy means to coordinate them.

Same measurement using an SMU

SMU solution:
Integrated 4-quadrant voltage and current sourcing and measurement (including AWG function).

Wide Voltage and Current Coverage for Testing a Variety of Devices

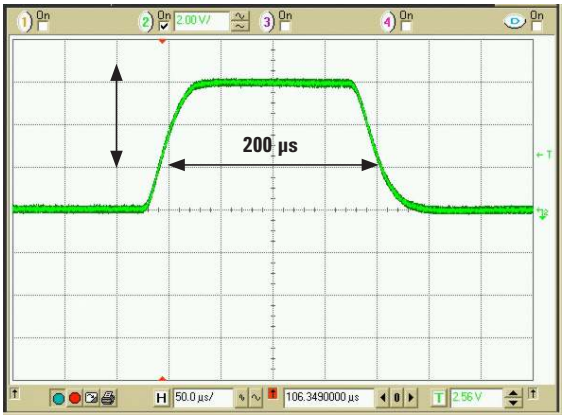
Test up to 210 V and 3 A (DC) or 10.5 A (pulsed) with a single instrument

The B2900A SMUs can source and measure voltages of ±210 V and currents of ±3 A (DC) or ±10.5 A (pulsed). This versatility allows you to standardize on a single SMU model and minimize support costs. These capabilities are present on both single and dual channel versions, since on the 2-channel versions both channels can be operated completely independently.

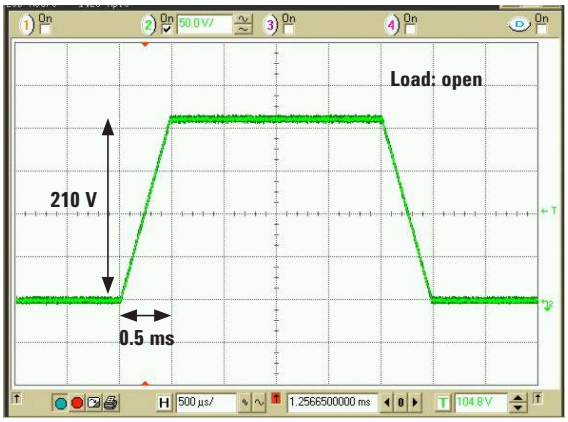
Integrated sweep and arbitrary waveform measurement functionality

The B2900A Series has capabilities that allow it to perform more than just simple DC and pulsed measurements. The B2900A SMUs have a built-in sweep capability that supports all of the standard sweep parameters such as linear and loga-rithmic modes, single and double sweep functions and constant and pulsed sweep operation. The B2900A GUI fully supports the sweep measurement function, thereby allowing sweep measurements to be made and displayed quickly from the instrument front panel. Of course, the user can also make the same sweep measurements just as efficiently on the B2900A SMUs under remote control using SCPI commands. This integrated sweep measurement capability improves efficiency and reduces measurement setup time.

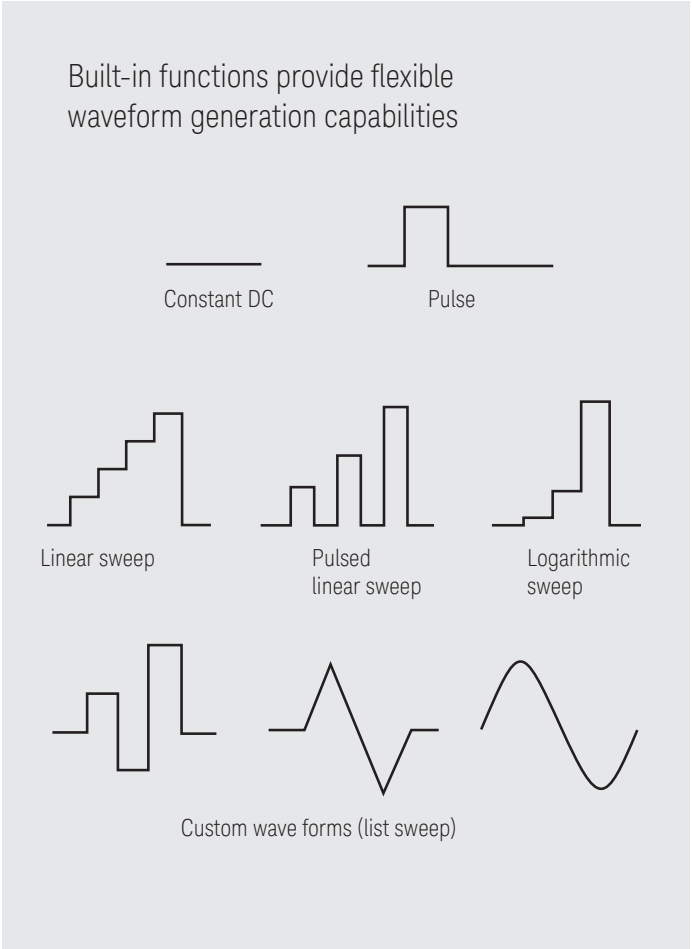
In addition to its resident sweep functionality, the B2900A Series also supports arbitrary waveform generation (AWG) and list sweep capabilities. The AWG and list sweep functions allow you to create waveforms with up to 2500 steps for maximum flexibility, and enable you to specify a waveform of arbitrary shape using familiar spreadsheet compatible data-entry formats. The AWG and list sweep features are especially useful when characterizing devices where the response varies greatly depending upon the applied voltage or current, since they give you the flexibility to “zoom in” on areas of interest.



You can create current pulses of up to 10.5 amps, which helps to minimize device self-heating effects.



You can ramp up to a voltage of 200 V in 0.5 millisecond, which is useful for evaluating high-power components.



Unmatched Bench-top SMU Measurement Performance

Source and measurement resolution down to 10 fA and 100 nV

The B2900A Series consists of four models primarily differentiated by number of channels (one or two) and measurement and sourcing resolution. The B2901A (single channel) and B2902A (dual channel) versions possess 100 fA and 100 nV measurement resolution and 1 pA and 1 µV sourcing resolution. The B2911A (single channel) and B2912A (dual channel) precision versions possess 10 fA and 100 nV of resolution for both measurement and sourcing. All members of the B2900A Series support popular banana jack style inputs for cost-effective and flexible connectivity; for low-current measurements below 1 nA, banana jack to triaxial adapters are available.

Capture transient phenomena effortlessly

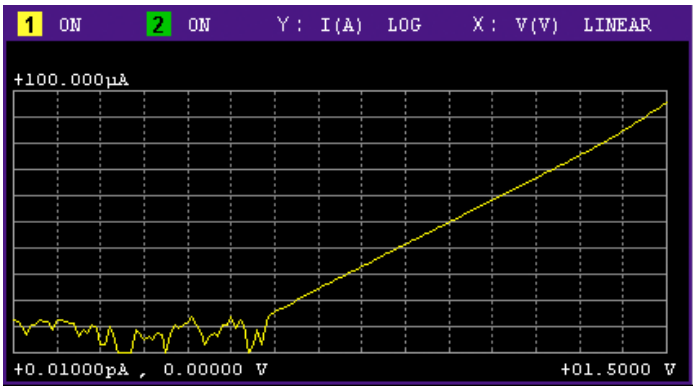
The B2900A Series supports a high speed sampling measurement function that permits the capture and display of low frequency transient phenomena. The B2901A and B2902A support a 20 µs (50,000 points/s) sampling rate and the B2911A and B2912A support a 10 µs (100,000 points/s) sampling rate. Of course, the maximum achievable sampling rate depends on many factors including signal level, ambient noise and desired resolution.

4-wire measurement capability permits accurate low resistance measurement

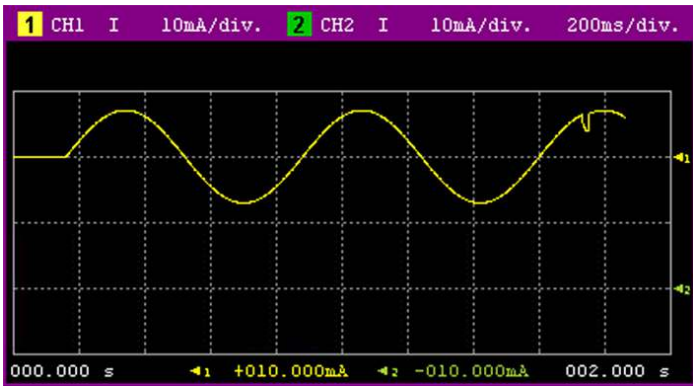
When measuring small resistances the innate cable resistance can create serious measurement error. To solve this, the B2900A Series supports a 4-wire (also known as a remote sense or Kelvin connection) measurement function. In the 4-wire scheme two of the connectors force current and the other two connectors measure voltage. Since the connectors measuring voltage do not have any current flowing through them, they can accurately sense the actual voltage at the DUT.

Measure large capacitive loads without oscillation

Large capacitive loads can sometimes cause SMUs to oscillate. To mitigate this, the B2900A Series supports a high capacitance measurement mode. The high capacitance mode enables the measurement of large capacitive loads without having to worry about SMU oscillation.



You can make and display accurate low-current measurements directly on the B2900A front panel.



Roll view mode allows you to capture low-frequency transient phenomena.

Ultra Fast Throughput Lowers Cost-of-test

Best-in-class measurement throughput

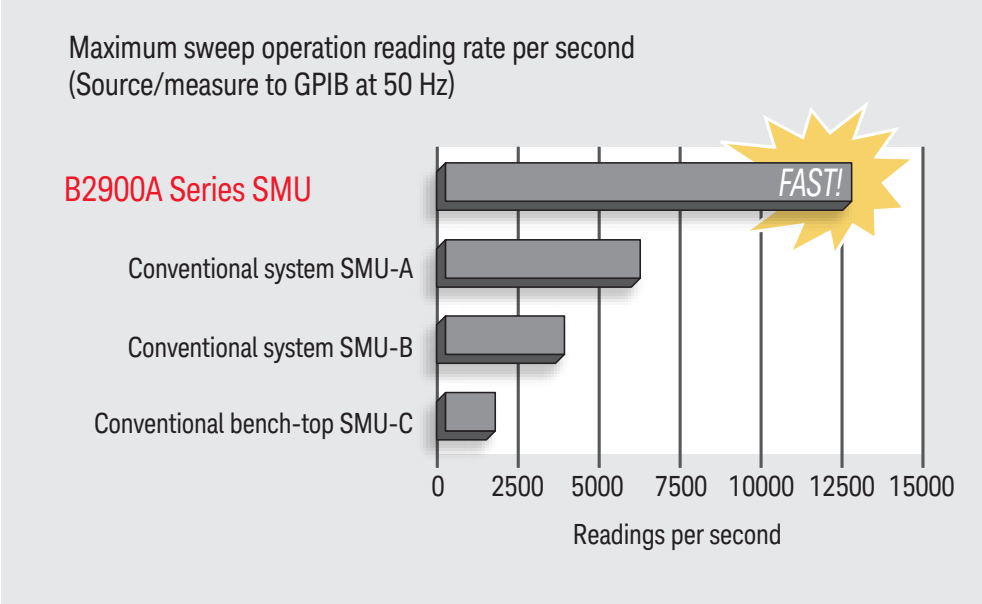
Although an excellent R&D tool, the B2900A Series is also well-suited for production test. It can achieve excellent accuracy and repeatability at even short integration times. The B2900A Series possesses the fastest measurement speed of any SMU in its class.

Program memory and trace buffer features improve throughput

To reduce bus communication time, the B2900A Series supports a program memory feature that allows long strings of SCPI commands to be stored on the instrument. These code sequences can be executed by sending a single command across the communication bus, greatly improving throughput for frequently executed command strings.In addition, the B2900A Series supports a trace buffer that can store up to 100,000 data points. This allows the results from multiple measurements to be downloaded at once, thereby reducing data transfer time and also improving overall throughput.

SCPI commands provide compatibility and versatility

Standard Commands for Programmable Instruments (SCPI) are a popular and easy-to-understand instrument control protocol. The B2900A Series supports two SCPI command sets, conventional and default, to provide both code compatibility and flexibility. The conventional command set has a large number of its commands compatible with those of older SMUs (such as the Keithley 2400) to minimize code conversion work. The default command set supports advanced B2900A Series features and they should be used to fully utilize its performance and capabilities.

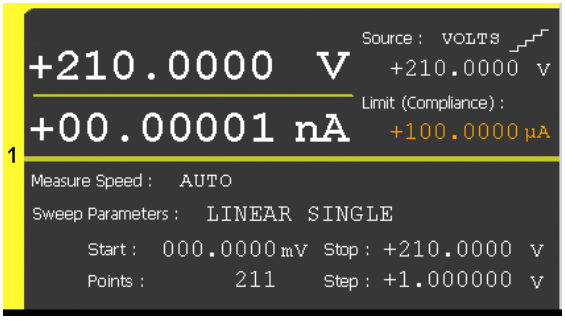


Innovative GUI and 4.3" Color LCD Display Facilitate Fast Bench-top Test, Debug and Characterization

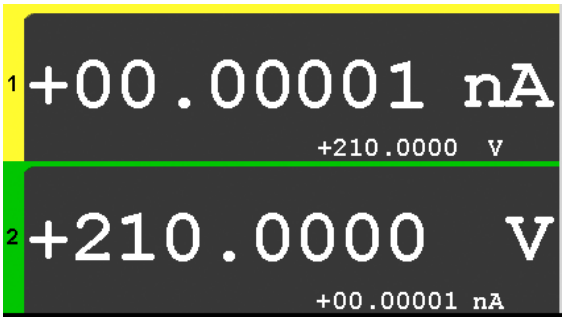
The B2900A's front panel has many features that make interactive use fast and friendly. These include a 4.3" color LCD display, a USB2.0 memory I/O port, an assist key, an alphanumeric key-pad and a rotary knob. The 4.3" color LCD display supports both graphical and numerical view modes, and enables test setup and check test results quickly. The USB2.0 memory port supports easy data storing and porting. The Innovative graphical user interfaces, such as single view, dual view, graph view, roll view and zoom, improves usability and productivity of bench-top tests, debug and characterizations dramatically.

Dual view:
On two channel units (B2902A and B2912A) dual view allows you to simultaneously display the setup and measurement results for channels 1 and 2. You can view with 6½ digits accuracy any two of the following measured quantities: voltage, current, resistance or power.

Channel 1 terminal



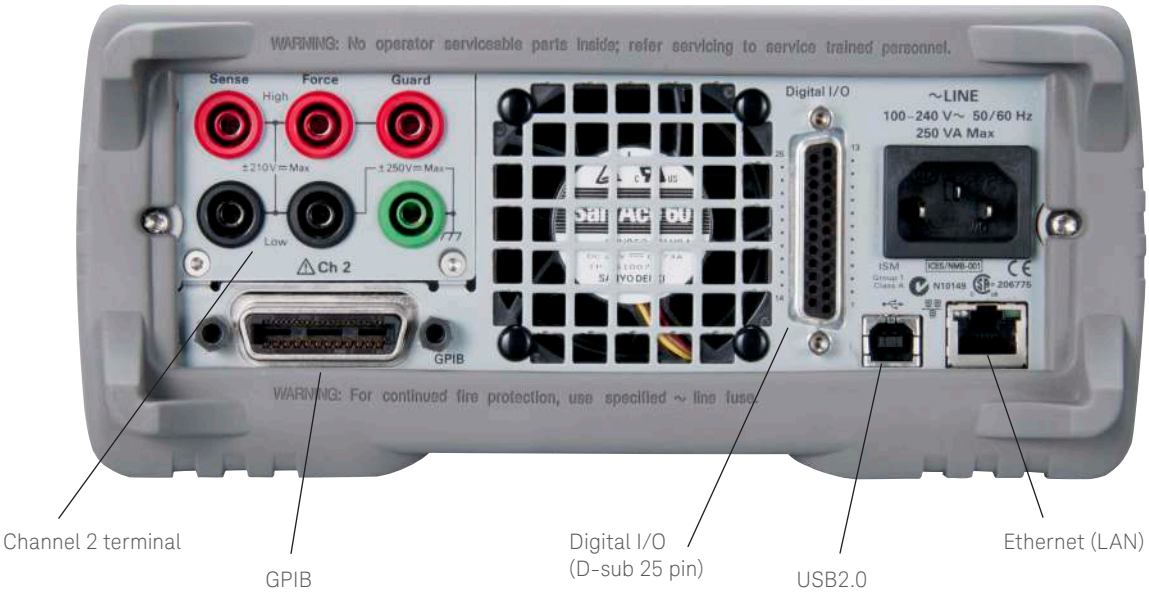
Single view:
Single view provides access to both the basic and advanced measurement and display settings for the selected channel. Just as in dual view you can view with 6½ digits accuracy any two of the following measured quantities: voltage, current, resistance or power. However, single view also allows you to set items such as integration time, pulse parameters and sweep conditions.

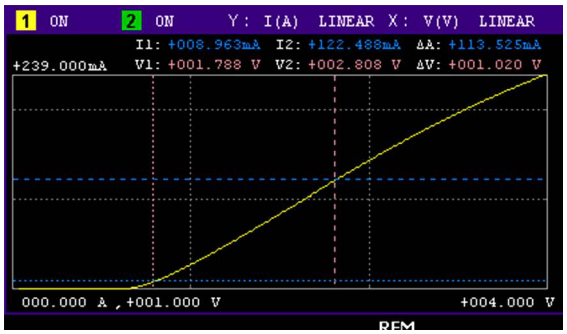


Zoom:
The zoom feature displays an enlarged version of the two parameters under measurement for easier viewing at a distance or when the instrument is rack-mounted. The zoom feature can be used in both single view and dual view modes.

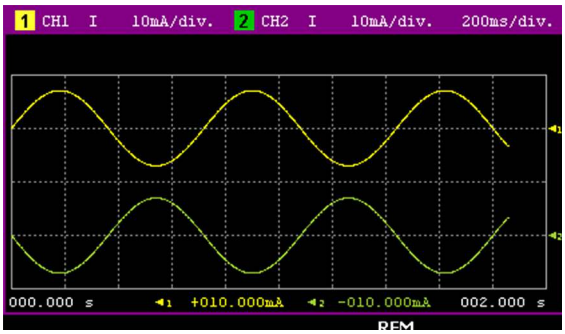
Innovative GUI and 4.3" Color LCD Display Facilitate Fast Bench-top Test, Debug and Characterization (continued)

The B2900A's rear panel provides access to its remote control interfaces (GPIB, USB2.0 and Ethernet) and to its D-sub 25 pin digital I/O port (used for internal/external trigger signals, handler control and interlock function). These interfaces make it easy to configure a system solution consisting of multiple instruments.





Graph view:
Graph View displays measurement results on XY graphs (such as I-V and I-t/V-t curves) on up to 2 channels. This is extremely useful for quick bench-top device characterization (especially when performing sweep measurements). The graphs can be saved as JPEG files onto an attached USB memory device.



Roll view:
Roll view draws I-t or V-t curves similar to the curves drawn by a strip chart recorder. Up to 1000 acquired data can be displayed and updated while the measurement is in progress. Roll view, which is available only on the B2911A and B2912A models, is especially useful for monitoring low frequency phenomena.

Flexible and Convenient Remote Use Options

Choose the method that best fits your needs

The B2900A Series offers three convenient methods to control the instrument remotely: B2900A Quick I/V Measurement Software, LXI web-browser control and ready-to-use instrument drivers.

Free PC-based software eliminates the need to program

supplies PC-based Quick I/V Measurement Software with the B2900A Series at no charge. This software makes it easy to quickly setup and perform IV measurements and to display the measurement data in tables and graphs without the need to program. Using Quick IV you can control up to four SMUs, which is ideal for bench top characterization of four-terminal devices such as MOSFETs.

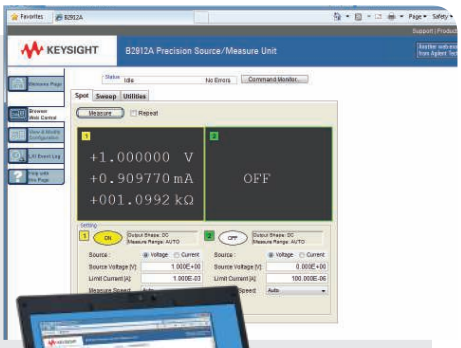
Easy web browser control

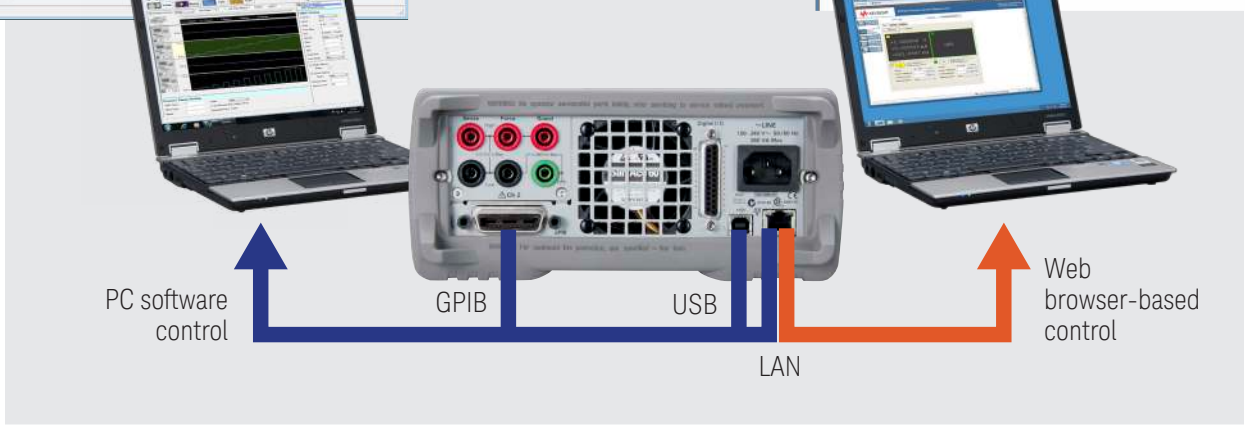
The B2900A Series has a built-in web server that allows it to be controlled using a web browser. This allows you to enjoy the convenience of external PC control without the need for any special software. Simply connect your computer to the instrument via its LAN port, type in the IP address of the B2900A unit and begin making interactive measurements.

	Programming Environment
	VEE
Microsoft Visual Studio	Visual C++
	Visual C#
	Visual Basic
National Instruments	LabView
	LabWindows

B2900A Quick I/V Measurement Software

B2900A Graphical Web Interface

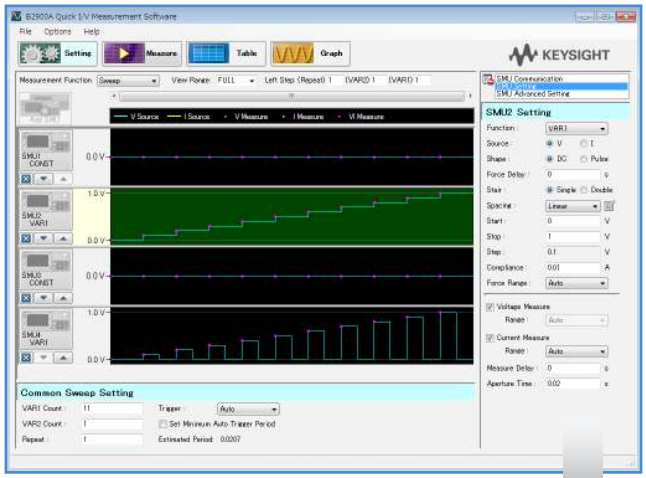




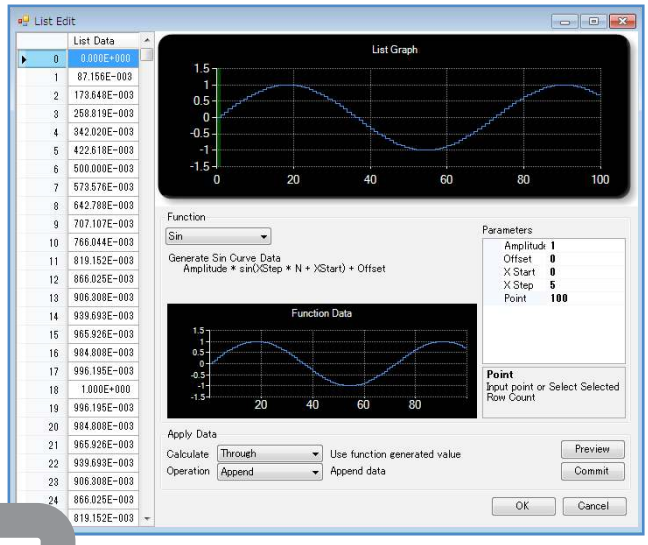
Quick I/V Measurement Software Enables Fast and Easy Measurement from a PC

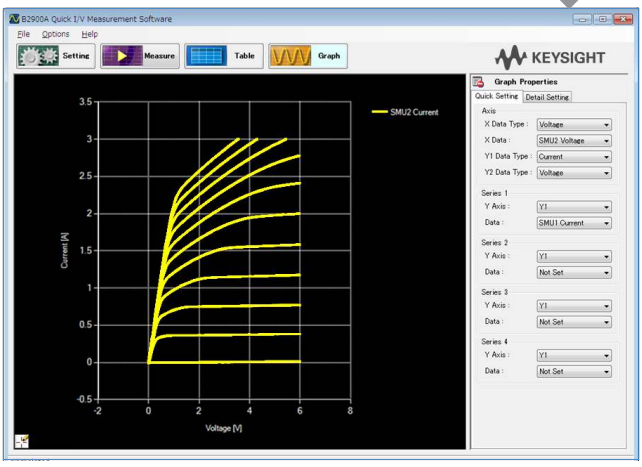
B2900A Quick I/V Measurement Software is furnished with the B2900A at no charge, and it permits easy measurement setup and execution on a Windows-based PC. The software has a user-friendly GUI, and it can be used with all of the B2900A's interfaces: LAN, USB and GPIB. The software has the ability to control up to four SMUs total in any configuration of single and dual channel units.

The setup menu allows you to specify and preview the settings on up to four SMU channels before you actually perform a measurement.

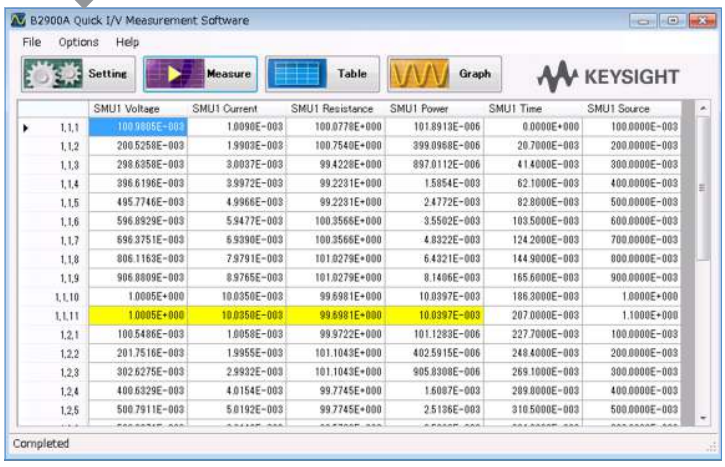


The list sweep editor allows you to create and preview voltage and current waveforms created for use with the B2900A's AWG function. Of course, the list setup data can be freely transferred back and forth from Excel.





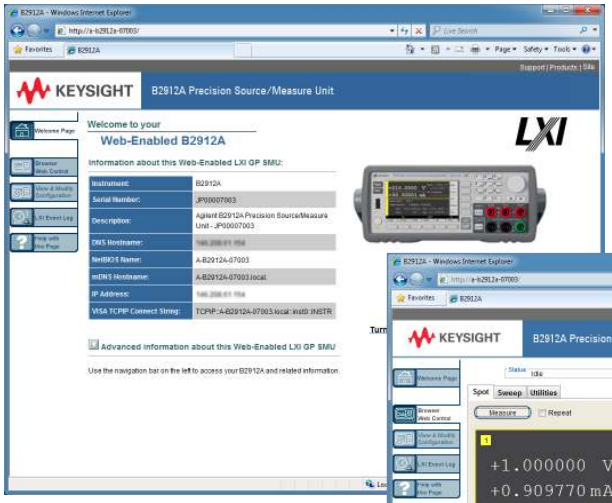
The built-in graph function supports both basic and advanced features (such as the family of curves shown here).



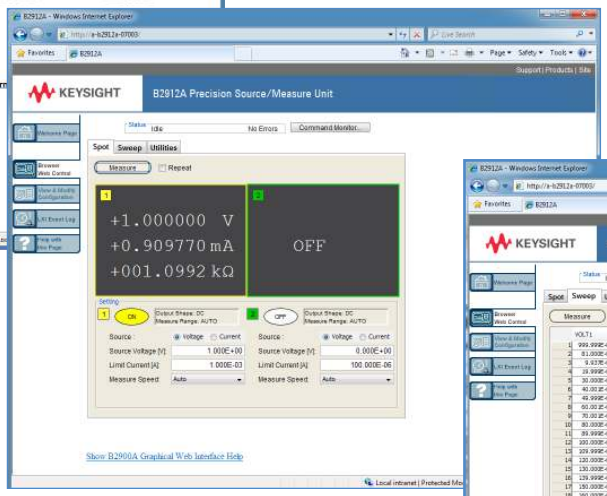
Numerical measurement results can be viewed in a table format, and this data can easily be copied into Excel for further analysis.

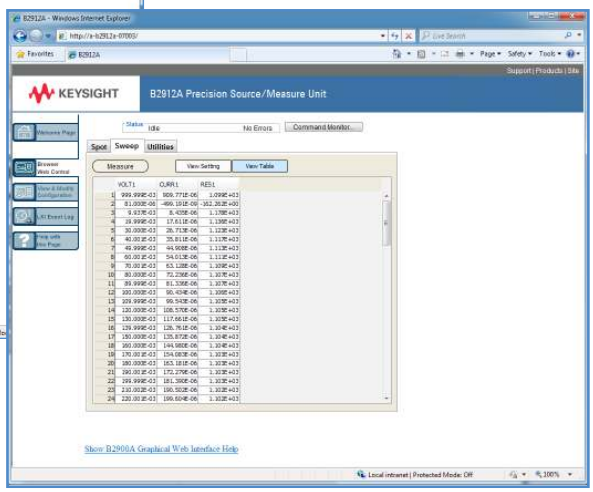
Graphical Web Interface Provides Convenient Web Browser-based Instrument Control

The B2900A has a built-in LXI compliant web server that allows it to be controlled over the LAN using any Java- enabled web browser (such as Internet Explorer). The graphical web interface supports all of the basic measurement functions such as spot measurements, sweep measurements and pulsed source measurements. Since no special software is required this feature is convenient for making quick measurements on the fly.



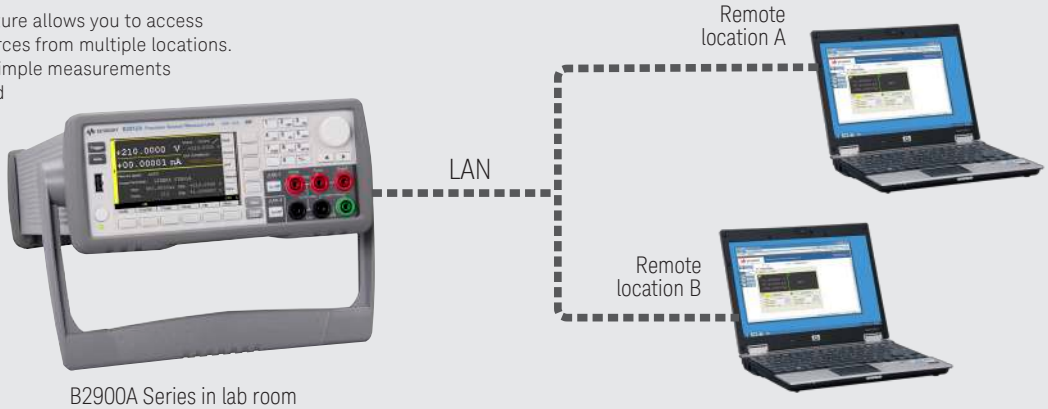
B2900A is accessed easily by IP address.





The web browser interface supports the B2900A's basic measurement capabilities (such as spot, sweep and pulsed measurement). Measurement results are displayed in a tabular format that can easily be copied into Excel for graphing and reporting.

The web browser control feature allows you to access B2900A measurement resources from multiple locations. For example, you can make simple measurements at your desk without the need to actually go into your lab.



B2900A Series in lab room

Available Accessories Facilitate Special Test Needs

Easy banana jack connectivity with various accessories

The B2900A uses convenient and low-cost banana jack terminals, which support a variety of cables, adaptors and accessories.

Banana to triaxial adaptor for low current measurement

Since banana jacks cannot support low current measurement (i.e. measurements of 1 nA and below), a banana jack to triaxial adapter is available to permit the use of high-performance triaxial cables. This makes it easy to connect to both triaxial-based test fixtures and wafer probers. Of course, both 2-wire and 4-wire triaxial adapters are available.

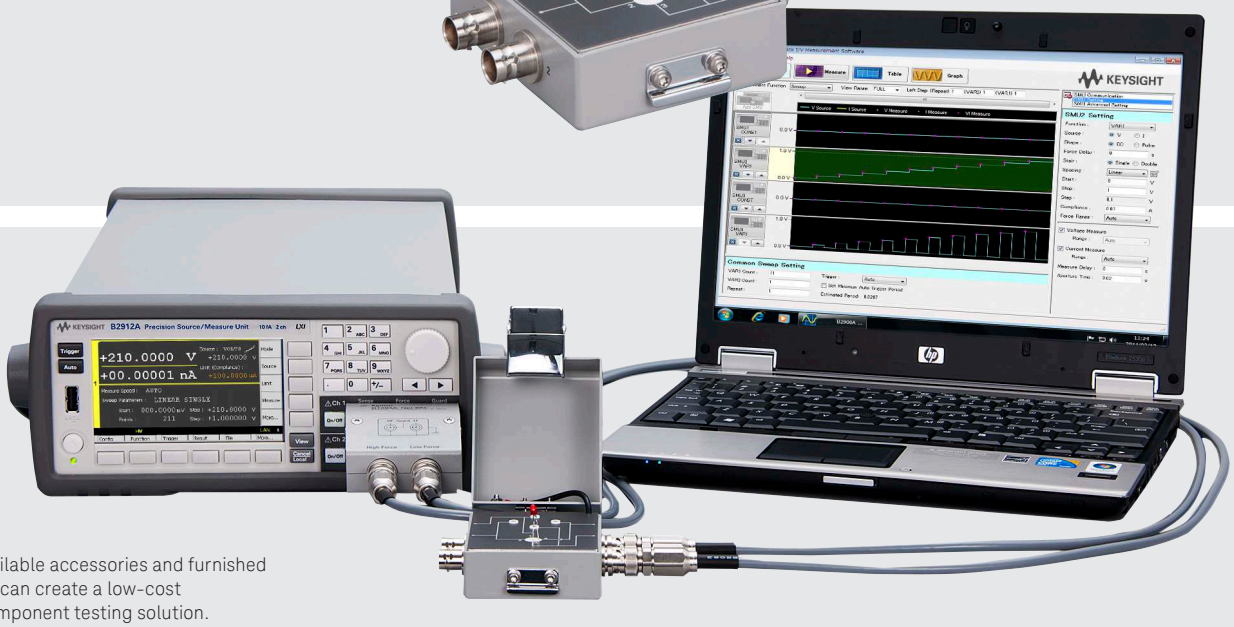
Test fixtures for testing packaged devices

The N1295A Device/Component Test Fixture provides a low-cost solution to quickly and easily test packaged devices and components. It has four triaxial inputs and supports voltage and current measurements of up to 42 V and 1 A.

For more advanced packaged testing needs, the 16442B test fixture provides more capabilities. It offers support for higher pin count devices, more flexible connectivity and an interlock feature for safely applying voltages greater than 42 V. can supply adapters to use the 16442B interlock with the B2900A's digital output.

Banana jack to triaxial adapters are available in both 2-wire and 4-wire versions.

The N1295A Device/Component Test Fixture provides a low-cost solution to quickly and easily test packaged devices and components.



Using the available accessories and furnished software you can create a low-cost PC-based component testing solution.

Overview: Why Use an SMU?

Resource integration reduces measurement error

An SMU is an instrument that combines the capabilities of a current source, a voltage source, a current meter and a voltage meter (along with the capability to switch easily between these various functions). Because the source and measurement circuitry is closely integrated, the user can achieve far better measurement performance with less measurement error than would be possible by using various independent instruments to make the same measurement.

Feedback mechanism stabilizes voltage and current sourcing

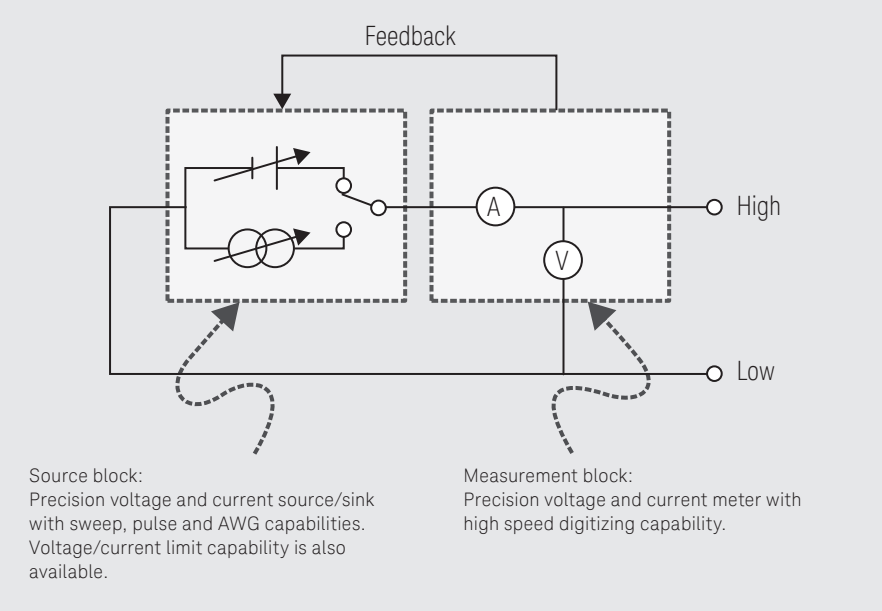
Since SMUs have the ability to very accurately measure their own current and voltage output, they have many advantages over conventional power supplies. All SMUs have internal feedback loops that provide instantaneous feedback to the sourcing circuitry, which in-turn allows the SMU output to remain accurate and stable even if the load conditions change unexpectedly.

Limit (compliance) feature prevents device damage

SMUs also possess a voltage and current limit (compliance) feature that allows the user to set limits and to protect devices from damage caused by excessive voltage or current. Although the SMU normally continues to function when it reaches the user-specified limit value, it can also be set to shutdown just like the over current protection (OCP) and over voltage protection (OVP) functions do on a power supply.

Accurate timing control of source and measurement resources

The integration of the source and measurement resources in an SMU allows much tighter synchronization than would be possible with separate instruments. Moreover, the B2900A Series provides very flexible triggering options that allow the measurements points to be defined independently from the sourced current or voltage waveform. On two channel units you can operate both channels in synchronization or independently, and under remote control you can trigger multiple units in unison using a group trigger signal.



Simplified block diagram of the B2900A Series

Selection Guide and Ordering Information

Key specifications			B2901A	B2902A	B2911A	B2912A
Number of channels			1	2	1	2
Max output	Voltage		210 V	210 V	210 V	210 V
	Current	DC	3.03 A	3.03 A	3.03 A	3.03 A
		Pulsed	10.5 A	10.5 A	10.5 A	10.5 A
	Power		31.8 W	31.8 W	31.8 W	31.8 W
Source	Max digits		5½	5½	6½	6½
	Min resolution	Voltage	1 µV	1 µV	100 nV	100 nV
		Current	1 pA	1 pA	10 fA	10 fA
Measurement	Max digits		6½	6½	6½	6½
	Min resolution	Voltage	100 nV	100 nV	100 nV	100 nV
		Current	100 fA	100 fA	10 fA	10 fA
Min programmable interval for List sweep/AWG waveform			20 µs	20 µs	10 µs	10 µs
Min trigger interval for digitizing (max sample rate)			20 µs (50,000 pts/s)	20 µs (50,000 pts/s)	10 µs (100,000 pts/s)	10 µs (100,000 pts/s)
View modes	Single view		YES	YES	YES	YES
	Dual view		NO	YES	NO	YES
	Graph view		YES	YES	YES	YES
	Roll view		NO	NO	YES	YES

Ordering information	
Model number	Description
B2901A	Precision Source/Measure Unit, 1ch, 100 fA, 210 V, 3 A DC/10.5 A pulse
B2902A	Precision Source/Measure Unit, 2ch, 100 fA, 210 V, 3 A DC/10.5 A pulse
B2911A	Precision Source/Measure Unit, 1ch, 10 fA, 210 V, 3 A DC/10.5 A pulse
B2912A	Precision Source/Measure Unit, 2ch, 10 fA, 210 V, 3 A DC/10.5 A pulse

Options	
Printed manual (User's Guide)	
ABA	English
ABJ	Japanese
AB0	Traditional Chinese
AB2	Simplified Chinese
Calibration	
A6J	ANSI Z540 compliant calibration
UK6	Commercial calibration certificate with test data
Rack mount kit	
1CM	Rack mount kit

Accessories	
Banana to triaxial adapter	
N1294A-001	2-wire (non-Kelvin) connection
N1294A-002	4-wire (Kelvin) connection
Interlock cable for 16442B	
N1294A-011	1.5 m
N1294A-012	3.0 m
Trigger Adapter	
N1294A-031	GPIO – BNC trigger adapter
Test fixture	
N1295A	Device/component test fixture

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