

# B2900B / B2900BL Series Precision Source/Measure Unit



# Table of Contents

- Get Rapid and Accurate Measurement Results ..... 3
- The Best SMU Solution for a Broad Range of IV Measurements ..... 5
- Integrated Source and Measurement Capabilities Simplify Difficult IV Measurement Tasks ..... 6
- Wide Voltage and Current Coverage for Testing a Variety of Devices ..... 7
- Superior Bench-top SMU Measurement Performance ..... 8
- Fast Throughput Lowers Cost-of-test ..... 10
- Overview: Why Use an SMU? ..... 11
- Innovative GUI and 4.3" Color LCD Display Facilitate Fast Bench-top Test,  
Debug and Characterization ..... 12
- Multiple Remote Control Choices Optimize Performance for Different Applications ..... 13
- Available Accessories Facilitate Special Test Needs ..... 15
- Comparison table by model ..... 16
- Specifications ..... 17
- Furnished Accessories ..... 28
- Ordering Information ..... 29

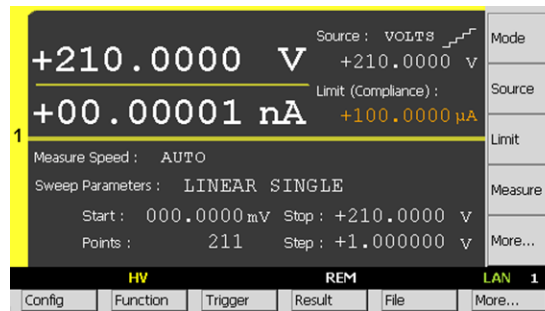
## Get Rapid and Accurate Measurement Results

The Keysight B2900B/BL Series 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 B2900B/BL Series SMU ideal for a wide variety of IV (current versus voltage) measurement tasks that require both high resolution and accuracy.

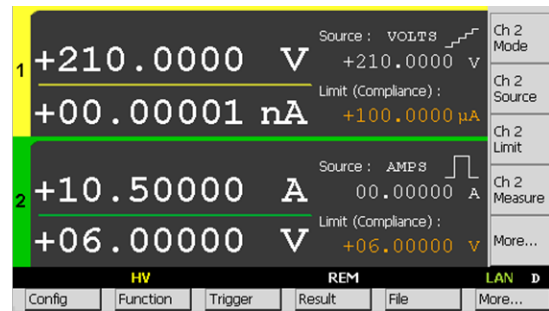
The B2900B/BL Series SMU has a voltage maximum of  $\pm 210$  V, a current maximum  $\pm 3$  A DC, and  $\pm 10.5$  A pulsed sourcing capabilities. With a precision minimum of 10 fA/100 nV sourcing and measuring resolution, a color LCD graphical user interface (GUI) and several task-based viewing modes will improve your productivity for test, debug, and characterization.

The B2900B/BL Series SMU offers superior 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.

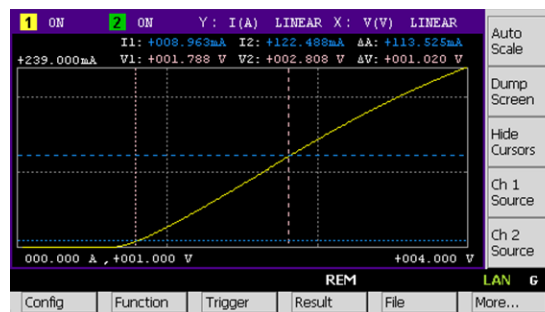
The B2900B/BL Series SMU consists of six models — the B2901BL, B2910BL, B2901B, B2902B, B2911B, and B2912B. The differentiation between the models is according to their available features: output range, number of digits displayed, measurement resolution, minimum timing interval, viewing modes, and SMU channels. These model choices make it easy for selecting the performance and price you need for your testing requirements.



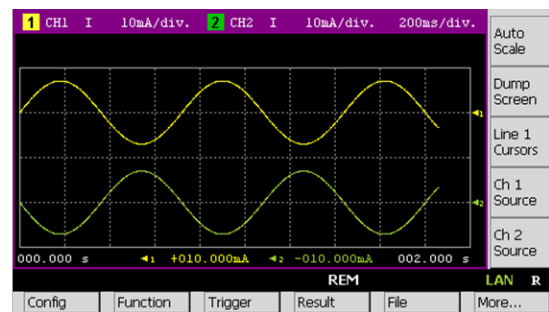
Single View



Dual View



Graph View



Roll View

| 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: $\pm 210$ V, $\pm 3$ A (DC), $\pm 10.5$ 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   |
| 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 B2900B/BL 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 B2900B/BL Series SMU provides superior performance and usability at a very reasonable price. In addition, the B2900B/BL Series SMU supports many functions to speed up production test and increase throughput. The versatile measurement capabilities of the B2900B/BL Series SMU make it 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 B2900B/BL Series SMU 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



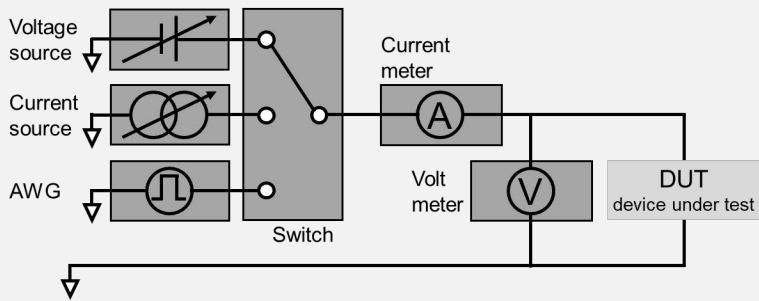
# Integrated Source and Measurement Capabilities Simplify Difficult IV Measurement Tasks

## The B2900B/BL Series SMU 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 B2900B/BL Series 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 datasheet entitled "Overview: Why use an SMU?"



Rack & stack solution:  
Multiple instruments connected 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

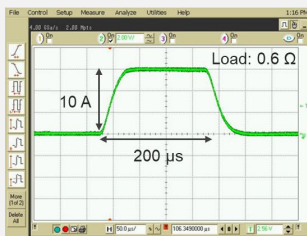
### Test up to 210 V and 3 A (DC) or 10.5 A (pulsed) with a single instrument

The B2900B SMUs can source and measure  $\pm 210$  V and currents of  $\pm 3$  A DC, or  $\pm 10.5$  A pulsed. This performance versatility enables you to standardize on a single SMU model, which minimizes support costs. These capabilities are present on both single- and dual-channel versions. Both channels in the 2-channel version operate independently.

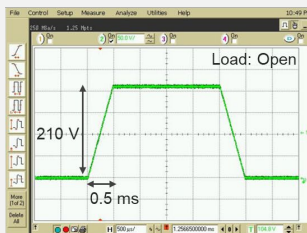
### Integrated sweep and arbitrary waveform measurement functionality

The B2900B/BL Series SMU has capabilities that allow it to perform more than just simple DC and pulsed measurements. The B2900B/BL Series SMUs have a built-in sweep capability that supports all of the standard sweep parameters such as linear and logarithmic modes, single and double sweep functions and constant and pulsed sweep operation. The B2900B/BL Series SMU's 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 B2900B/BL Series SMU under remote control using SCPI commands. This integrated sweep measurement capability improves efficiency and reduces measurement setup time.

The B2900B/BL Series SMU has arbitrary waveform generation (AWG) and list sweep capabilities. The AWG and list sweep functions enable you to create waveforms with up to 100,000 steps for maximum flexibility while the B2901BL SMU has up to 10,000 steps. You can 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 depending on the applied voltage or current. You now have the flexibility to focus on areas of interest.

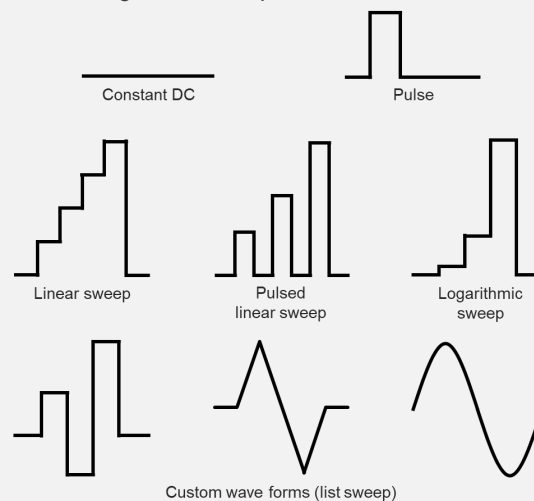


You can create current pulses of up to 10.5 amps, which helps to minimize device self-heating effects.



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

Built-in functions provide flexible waveform generation capabilities





## Superior Bench-top SMU Measurement Performance

### Source and measurement resolution - 10 fA and 100 nV

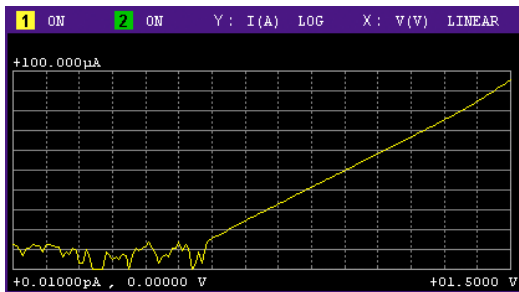
The B2900B Series SMU consists of four models — the differentiation is between the number of channels, and measurement and sourcing resolution. The B2901B (single-channel) and B2902B (dual-channel) SMUs have 100 fA and 100 nV measurement resolution, 1 pA, and 1  $\mu$ V sourcing resolution. The B2911B (single-channel) and B2912B (dual-channel) SMUs have 10 fA and 100 nV both measurement and sourcing resolution.

The B2900BL Series SMU consists of two models. The B2901BL SMU has 1 pA and 100 nV measurement resolution, 10 pA, and 1  $\mu$ V sourcing resolution. The B2910BL SMU has 10 fA and 100 nV measurement resolution, 100 fA, and 1  $\mu$ V sourcing resolution.

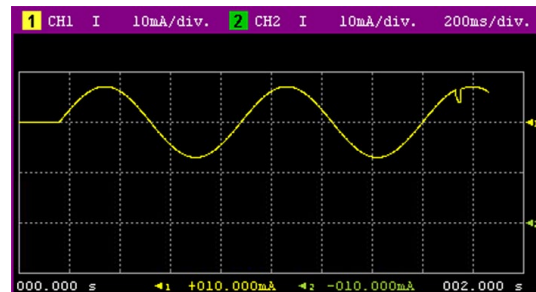
The B2900B/BL Series SMUs support popular banana jack style inputs for cost-effective and flexible connectivity. For low current measurements below 1 nA, banana jack to triaxial adapters are available.

### Capture transient phenomena effortlessly

The B2900B/BL Series SMUs support a high-speed sampling measurement function that permits the capture and display of low-frequency transient phenomena. The B2901BL and B2910BL SMUs support a 200  $\mu$ s (5,000 points/second) and 50  $\mu$ s (20,000 points/second) sampling rate. The B2901B and B2902B SMUs support a 20  $\mu$ s (50,000 points/second) sampling rate, and the B2911B and B2912B SMUs support a 10  $\mu$ s (100,000 points/second) sampling rate. The maximum achievable sampling rate depends on many factors, including signal level, ambient noise, and desired resolution.



You can make and display accurate low-current measurements directly on the B2900B/BL front panel.



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



### 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 B2900B/BL Series SMU 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 B2900B/BL Series SMU supports a high capacitance measurement mode. The high capacitance mode enables the measurement of large capacitive loads without having to worry about SMU oscillation.

## Fast Throughput Lowers Cost-of-test

### Best-in-class measurement throughput

Although an excellent R&D tool, the B2900B/BL Series SMU is also well-suited for production test. It can achieve excellent accuracy and repeatability at even short integration times. The B2900B/BL Series SMU possesses the fastest measurement speed of any SMU in its class.

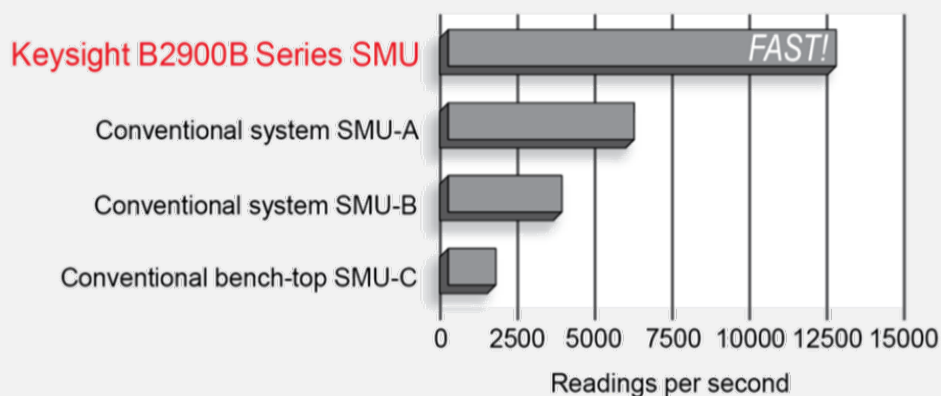
### Program memory and trace buffer features improve throughput

To reduce bus communication time, the B2900B/BL Series SMUs support a program memory feature that enables you to store long strings of SCPI commands within the instrument. You can execute these code sequences by sending a single command across the communication bus to improve throughput for frequently performed command strings. The B2900B/BL Series SMUs support a trace buffer that can store up to 100,000 data points while the B2901BL stores 10,000 data points. Downloaded results from multiple measurements are available at once to improve overall throughput while reducing the data transfer time.

### SCPI commands provide compatibility and versatility

Standard Commands for Programmable Instruments (SCPI) are a popular and easy-to-understand instrument control protocol. The B2900B/BL Series SMU 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 B2900B/BL Series SMU features and they should be used to fully utilize its performance and capabilities.

Maximum sweep operation reading rate per second  
(Source/measure to GPIB at 50 Hz)



## 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 are 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

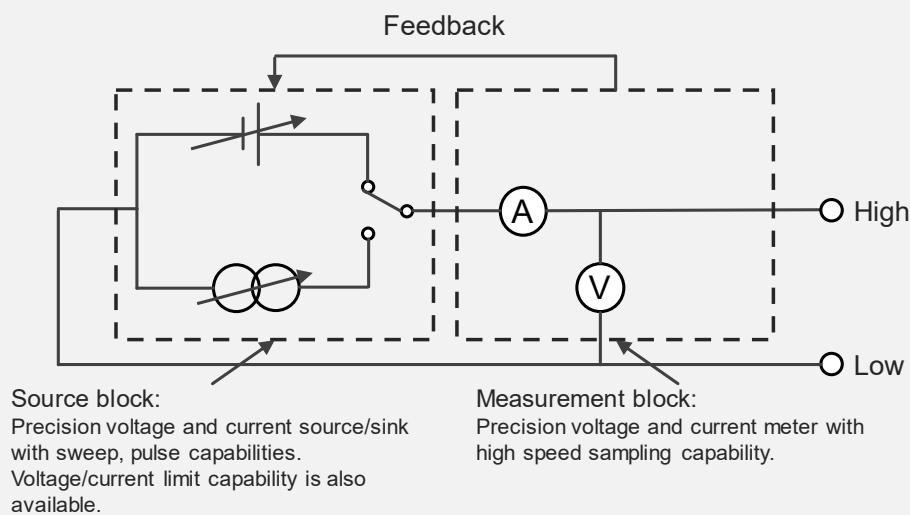
Since SMUs have the ability to very accurately measure their own current and voltage output, they have many advantages over conventional power supplies. All SMUs have internal feedback loops that provide instantaneous feedback to the sourcing circuitry, which in-turn allows the SMU output to remain accurate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

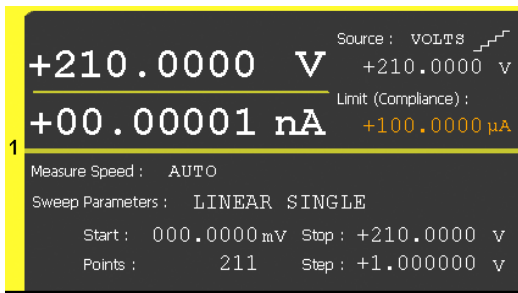
### Accurate timing control of source and measurement resources

The integration of the source and measurement resources in an SMU allows much tighter synchronization than would be possible with separate instruments. Moreover, the B2900B/BL Series SMU 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.



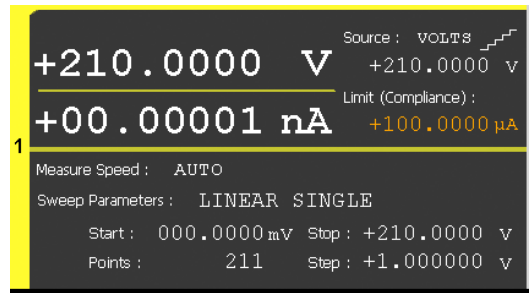
## Innovative GUI and 4.3" Color LCD Display Facilitate Fast Bench-top Test, Debug and Characterization

The B2900B /BL Series SMU'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 keypad 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.



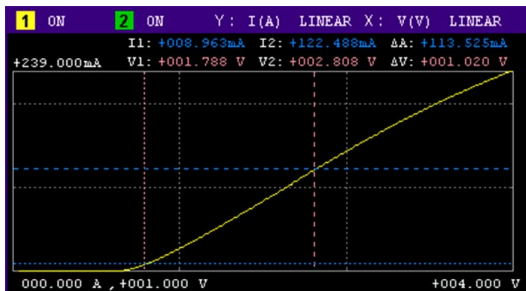
### Single view:

Single view provides basic and advanced settings and display capabilities for the selected channel from the front panel of the instrument. No additional controller or software is required.



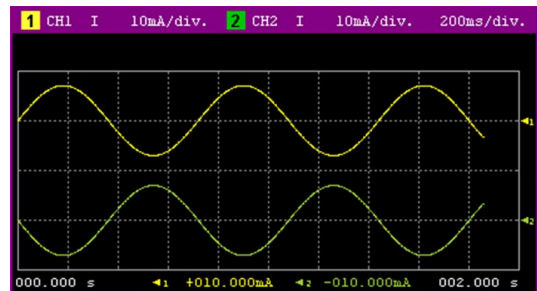
### Dual view:

Dual view provides the basic settings and display capabilities for both channels 1 and 2. Up to 6. digits can be displayed in dual view mode. This mode is available only for the B2902B / B2912B.



### 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 useful for quick evaluation of device characteristics, especially those obtained from sweep measurements.



### 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 points can be displayed and updated while the measurement is still in progress. Roll view's continuous measurement capability is especially useful for monitoring low frequency phenomena. Roll view is available only for the B2911B / B2912B.

## Multiple Remote Control Choices Optimize Performance for Different Applications

The B2900B/BL Series SMU offers multiple options for instrument remote control at little or no cost. Four solutions are available: PathWave BenchVue, B2900B/BL Graphical Web Interface, B2900 Quick IV Measurement Software, and EasyEXPERT group+. These multiple software control options allow you to choose the solution that best fits your particular application.

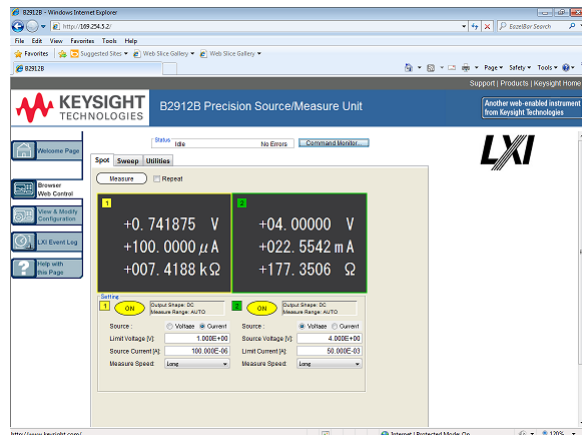
### PathWave BenchVue

PathWave BenchVue allows you to control the B2900B/BL Series SMUs as voltage/current sources from a PC without the need to do any programming. In addition, because PathWave BenchVue supports a wide variety of Keysight instruments (oscilloscopes, meters, etc.) it is a good choice when you need to integrate together many different types of instruments on a benchtop.



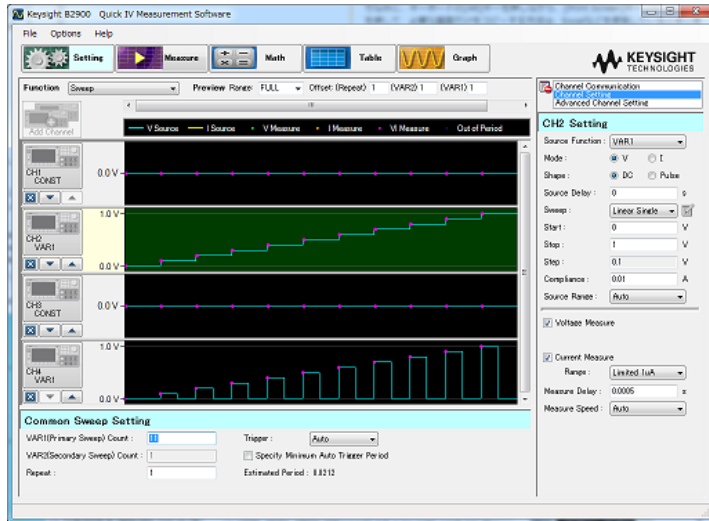
### Graphical Web Interface

The Keysight B2900B/BL Series SMU has a built-in LXI compliant web server that allows any Java enabled web browser (such as Internet Explorer) to control it over the LAN. 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.



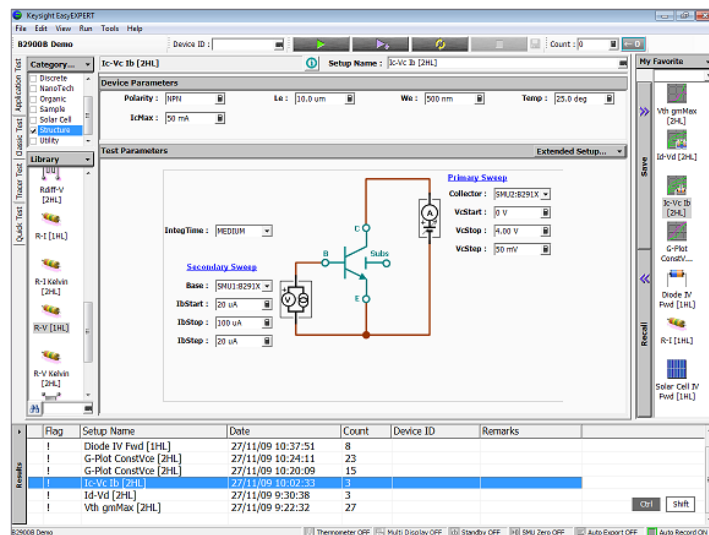
## Quick I/V Measurement Software

Keysight B2900 Quick I/V Measurement Software permits easy measurement setup and execution on a Windows-based PC. It has a user-friendly GUI that can be used with all of the B2900B/BL Series SMU's interfaces (LAN, USB and GPIB). It can control up to four SMU channels in any configuration of single and dual channel units.



## EasyEXPERTgroup+

Keysight EasyEXPERT group+ provides a powerful IV parametric characterization solution for a wide range of devices and materials. It has an intuitive mouse and keyboard driven graphical user interface that simplifies common characterization tasks such as test setup and execution, data analysis, data management/protection, etc. Moreover, since it can support up to eight SMU channels (four 2-channel SMU units) EasyEXPERT group+ makes it easy to characterize multi-terminal devices.



## Available Accessories Facilitate Special Test Needs

### Easy banana jack connectivity with various accessories

The B2900B/BL Series SMU 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 Keysight 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 Keysight 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. Keysight can supply adapters to use the 16442B interlock with the B2900B/BL Series SMU's digital output.



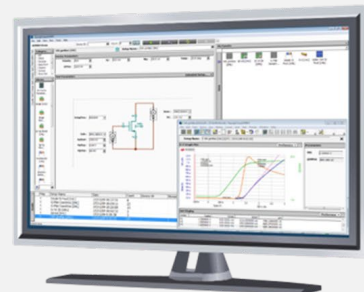
Banana jack to triaxial adapters are available in both 2-wire and 4-wire versions.



The Keysight 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.





## Comparison table by model

| Model number           |                      | B2901BL     | B2910BL    | B2901B/<br>B2902B | B2911B/<br>B2912B |
|------------------------|----------------------|-------------|------------|-------------------|-------------------|
| Number of channels     |                      | 1           | 1          | 1 or 2            | 1 or 2            |
| Output range           | Max. voltage         | 21 V        | 210 V      | 210 V             | 210 V             |
|                        | Max. current (DC)    | 1.5 A       | 1.5 A      | 3.03 A            | 3.03 A            |
|                        | Max. current (Pulse) | No          | No         | 10.5 A            | 10.5 A            |
| Source resolution      | Digit                | 5.5 digit   | 5.5 digit  | 5.5 digit         | 6.5 digit         |
|                        | Min. voltage         | 1 $\mu$ V   | 1 $\mu$ V  | 1 $\mu$ V         | 100 nV            |
|                        | Min. current         | 10 pA       | 100 fA     | 1 pA              | 10 fA             |
| Lowest current range   |                      | 1 $\mu$ A   | 10 nA      | 100 nA            | 10 nA             |
| Measurement resolution | Digit                | 6.5 digit   | 6.5 digit  | 6.5 digit         | 6.5 digit         |
|                        | Min. voltage         | 100 nV      | 100 nV     | 100 nV            | 100 nV            |
|                        | Min. current         | 1 pA        | 10 fA      | 100 fA            | 10 fA             |
| Min. trigger interval  |                      | 200 $\mu$ s | 50 $\mu$ s | 20 $\mu$ s        | 10 $\mu$ s        |
| Max. trigger count     |                      | 10,000      | 100,000    | Infinite          | Infinite          |
| Max. data buffer size  |                      | 10,000      | 100,000    | 100,000           | 100,000           |
| Limit test             |                      | No          | Yes        | Yes               | Yes               |
| Fast transient mode    |                      | No          | No         | Yes               | Yes               |
| Easy file access       |                      | No          | No         | Yes               | Yes               |
| View mode              | Single view          | Yes         | Yes        | Yes               | Yes               |
|                        | Dual view            | No          | No         | Yes (B2902B)      | Yes (B2912B)      |
|                        | Graph view           | Yes         | Yes        | Yes               | Yes               |
|                        | Roll view            | No          | No         | No                | Yes               |

# Specifications

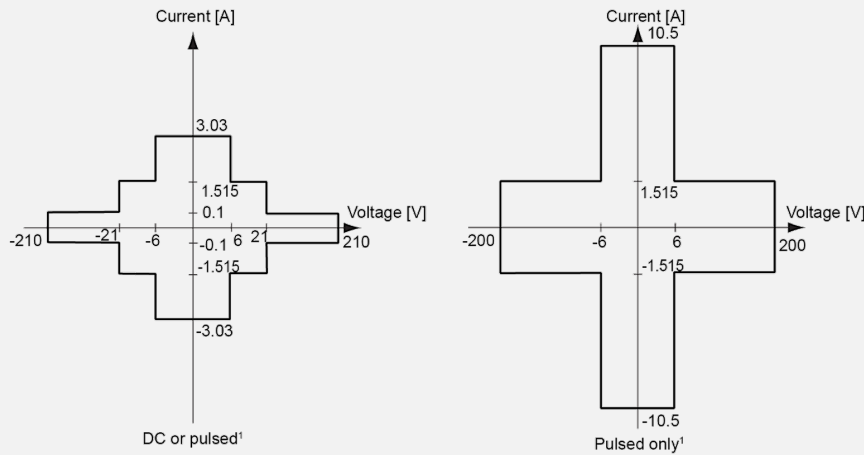
## Specification conditions

|                          |   |
|--------------------------|---|
| Temperature              | 23 °C ±5 °C   |
| Humidity                 | 30% to 80% RH   |
| After 60 minutes warm-up | Ambient temperature change less than ±3 °C after self-calibration execution |
| Calibration period       | 1 year  |
| Measurement speed        | 1 PLC (power line cycle)  |

## Maximum voltage and current

|                           | Max voltage | Max current          |
|---------------------------|-------------|----------------------|
| DC or pulsed <sup>1</sup> | 210 V       | 0.105 A              |
|                           | 21 V        | 1.515 A <sup>2</sup> |
|                           | 6 V         | 3.03 A <sup>2</sup>  |
| Pulsed only <sup>1</sup>  | 200 V       | 1.515 A              |
|                           | 6 V         | 10.5 A               |

- See "Maximum pulse width and duty cycle" in Pulse Source Supplemental Characteristics for applicable maximum voltage and current. Pulse mode is not available for B2901BL/B2910BL SMUs.
- Max current limitation: For 21 V/1.515 A and 6 V/3.03 A ranges, total max current is limited by the table below for using 2 channels. Max current is not limited for using 1 channel only.



## Maximum current limitation

| Ch 1 voltage       | Ch 2 voltage       | Max total current limitation of Ch 1 and Ch 2 |
|--------------------|--------------------|---|
| ± (0 V < V ≤ 6 V)  | ± (0 V < V ≤ 6 V)  | Ch 1 current + Ch 2 current ≤ 4 A             |
| ± (0 V < V ≤ 6 V)  | ± (6 V < V ≤ 21 V) | Ch 1 current + Ch 2 current x 1.6 ≤ 4 A       |
| ± (6 V < V ≤ 21 V) | ± (0 V < V ≤ 6 V)  | Ch 1 current + Ch 2 current x 0.625 ≤ 2.5 A   |
| ± (6 V < V ≤ 21 V) | ± (6 V < V ≤ 21 V) | Ch 1 current + Ch 2 current ≤ 2.5 A           |

## Voltage source specifications

| Range               | Programming resolution |         |                   |                   | Accuracy<br>(% reading + offset) | Noise (peak to peak)<br>0.1 Hz to 10 Hz <sup>1</sup> | Max voltage<br>(over range) |
|---------------------|------------------------|---------|-------------------|-------------------|----------------------------------|--|-----------------------------|
|                     | B2901BL                | B2910BL | B2901B/<br>B2902B | B2911B/<br>B2912B |                                  |  |                             |
| ±200 mV             | 1 µV                   | 1 µV    | 1 µV              | 100 nV            | ± (0.015 % + 225 µV)             | ≤ 10 µV  | ± 210 mV                    |
| ±2 V                | 10 µV                  | 10 µV   | 10 µV             | 1 µV              | ± (0.02 % + 350 µV)              | ≤ 20 µV  | ± 2.1 V                     |
| ±20 V               | 100 µV                 | 100 µV  | 100 µV            | 10 µV             | ± (0.015 % + 5 mV)               | ≤ 200 µV   | ±21 V                       |
| ±200 V <sup>2</sup> | —                      | 1 mV    | 1 mV              | 100 µV            | ± (0.015 % + 50 mV)              | ≤ 2 mV   | ±210 V                      |

1. Supplemental characteristics.
2. 200 V range is not available for B2901BL.

## Current source specifications

| Range                | Programming resolution |         |                   |                   | Accuracy<br>(% reading + offset) | Noise (peak to peak)<br>0.1 Hz to 10 Hz <sup>1</sup> | Max voltage<br>(over range) |
|----------------------|------------------------|---------|-------------------|-------------------|----------------------------------|--|-----------------------------|
|                      | B2901BL                | B2910BL | B2901B/<br>B2902B | B2911B/<br>B2912B |                                  |  |                             |
| ±10 nA <sup>2</sup>  | —                      | 100 fA  | —                 | 10 fA             | ± (0.10 % + 50 pA)               | ≤ 1 pA   | ±10.5 nA                    |
| ±100 nA <sup>3</sup> | —                      | 1 pA    | 1 pA              | 100 fA            | ± (0.06 % + 100 pA)              | ≤ 2 pA   | ±105 nA                     |
| ±1 µA                | 10 pA                  | 10 pA   | 10 pA             | 1 pA              | ± (0.025 % + 500 pA)             | ≤ 25 pA  | ±1.05 µA                    |
| ±10 µA               | 100 pA                 | 100 pA  | 100 pA            | 10 pA             | ± (0.025 % + 1.5 nA)             | ≤ 60 pA  | ±10.5 µA                    |
| ±100 µA              | 1 nA                   | 1 nA    | 1 nA              | 100 pA            | ± (0.02 % + 25 nA)               | ≤ 2 nA   | ±105 µA                     |
| ±1 mA                | 10 nA                  | 10 nA   | 10 nA             | 1 nA              | ± (0.02 % + 200 nA)              | ≤ 6 nA   | ±1.05 mA                    |
| ±10 mA               | 100 nA                 | 100 nA  | 100 nA            | 10 nA             | ± (0.02 % + 2.5 µA)              | ≤ 200 nA   | ±10.5 mA                    |
| ±100 mA              | 1 µA                   | 1 µA    | 1 µA              | 100 nA            | ± (0.02 % + 20 µA)               | ≤ 600 nA   | ±105 mA                     |
| ±1 A                 | 10 µA                  | 10 µA   | 10 µA             | 1 µA              | ± (0.03 % + 1.5 mA)              | ≤ 70 µA  | ±1.05 A                     |
| ±1.5 A               | 10 µA                  | 10 µA   | 10 µA             | 1 µA              | ± (0.05 % + 3.5 mA)              | ≤ 100 µA   | ±1.515 A                    |
| ±3 A <sup>4</sup>    | —                      | —       | 100 µA            | 10 µA             | ± (0.4 % + 7 mA)                 | ≤ 120 µA   | ±3.03 A                     |
| ±10 A <sup>4,5</sup> | —                      | —       | 100 µA            | 10 µA             | ± (0.4 % + 25 mA) <sup>6</sup>   |  | ±10.5 A                     |

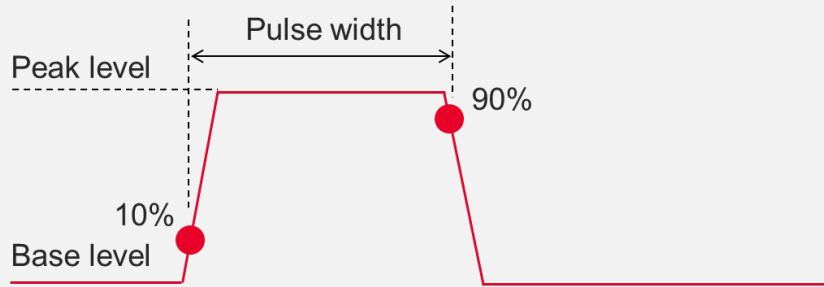
1. Supplemental characteristics.
2. 10 nA range is not available for B2901BL/B2901B/B2902B.
3. 100 nA range is not available for B2901BL.
4. 3A, 10 A ranges are not available for B2901BL/B2910BL.
5. 10 A range is available only for pulse mode, not available for DC mode.
6. Measurement speed: 0.01 PLC.

## Source supplemental characteristics

|   |  |   |
|---|--|---|
| Temperature coefficient<br>(0 to 18°C and 28 to 50°C) | $\pm (0.1 \times \text{accuracy})/^{\circ}\text{C}$  |   |
| Max output power and<br>source/sink limits            | B2901BL  | 31.8 W  |
|   |  | $\pm 6 \text{ V @ } \pm 1.515 \text{ A}, \pm 21 \text{ V @ } \pm 1.515 \text{ A}$ , four quadrant source or sink operation  |
|   | B2910BL  | 31.8 W  |
|   |  | $\pm 6 \text{ V @ } \pm 1.515 \text{ A}, \pm 21 \text{ V @ } \pm 1.515 \text{ A}, \pm 210 \text{ V @ } \pm 105 \text{ mA}$ , four quadrant source or sink operation |
|   | Other models   | 31.8 W  |
|   |  | $\pm 6 \text{ V @ } \pm 3.03 \text{ A}, \pm 21 \text{ V @ } \pm 1.515 \text{ A}, \pm 210 \text{ V @ } \pm 105 \text{ mA}$ , four quadrant source or sink operation  |
| Current limit/compliance                              | Accuracy is same as current source. Minimum value is 1 % of range, or 1 nA in 10 nA range.   |   |
| Voltage limit/compliance                              | Accuracy is same as voltage source. Minimum value is 1 % of range, or 20 mV in 200 mV range  |   |
| Over range  | 101 % of source range for 1.5 A and 3 A ranges. 105 % of source range other than 1.5 A and 3 A ranges. No over range for 200 V range with current exceeding 105 mA pulse only condition. |   |
| Voltage output settling time                          | Time required to reach within 0.1 % of final value at open load condition. Step is 10 % to 90 % range  |   |
|   | 200 mV, 2 V ranges   | < 50 $\mu\text{s}$  |
|   | 20 V range   | < 110 $\mu\text{s}$   |
|   | 200 V range  | < 700 $\mu\text{s}$   |
| Slew rate   | $\leq 0.36 \text{ V}/\mu\text{s}$ , 20 V and 10 mA ranges, 10 M $\Omega$ load resistance   |   |
| Over temperature protection                           | Output turns off then resets at over temperature sensed internally   |   |
| Current output settling time                          | Time required to reach within 0.1 % (0.3 % for 3 A range) of final value at short condition. Step is 10 % to 90 % range  |   |
|   | 10 nA, 100 nA ranges   | < 10 ms   |
|   | 1 $\mu\text{A}$ range  | < 500 $\mu\text{s}$   |
|   | 10 $\mu\text{A}$ , 100 $\mu\text{A}$ ranges  | < 250 $\mu\text{s}$   |
|   | 1 mA to 3 A ranges   | < 80 $\mu\text{s}$  |
| Noise 10 Hz to 20 MHz (V source)                      | 3 mVrms, 20 V range  |   |
| V source overshoot                                    | < $\pm (0.1 \% + 10 \text{ mV})$ . Step is 10 % to 90 % range, resistive load  |   |
| I source overshoot                                    | < $\pm 0.1 \% (< \pm 0.3 \% \text{ for } 3 \text{ A range})$ . Step is 10 % to 90 % range, resistive load  |   |
| Voltage source range change overshoot                 | $\leq 250 \text{ mV}$ . 100 k $\Omega$ load, 20 MHz bandwidth  |   |
| Current source range change overshoot                 | $\leq 250 \text{ mV}/R$ load, 20 MHz bandwidth   |   |

## Pulse source supplemental characteristics

|                                    |   |
|------------------------------------|---|
| Minimum programmable pulse width   | 50 $\mu$ s  |
| Pulse width programming resolution | 1 $\mu$ s   |
| Pulse width definition             | The time from 10 % leading to 90 % trailing edge as follows |



|              | Pulsed      |                      |                      |                         |                | DC          |                      |
|--------------|-------------|----------------------|----------------------|-------------------------|----------------|-------------|----------------------|
|              | Max voltage | Max peak current     | Max base current     | Pulse width             | Max duty cycle | Max voltage | Max current          |
| DC or pulsed | 210 V       | 0.105 A              | 0.105 A              | 50 $\mu$ s to 99999.9 s | 99.9999 %      | 210 V       | 0.105 A              |
|              | 21 V        | 1.515 A <sup>1</sup> | 1.515 A <sup>1</sup> | 50 $\mu$ s to 99999.9 s | 99.9999 %      | 21 V        | 1.515 A <sup>1</sup> |
|              | 6 V         | 3.03A <sup>1</sup>   | 3.03 A <sup>1</sup>  | 50 $\mu$ s to 99999.9 s | 99.9999 %      | 6 V         | 3.03 A <sup>1</sup>  |
| Pulsed only  | 200 V       | 1.515A               | 50 mA                | 50 $\mu$ s to 2.5 ms    | 2.5 %          |             |                      |
|              | 180 V       | 1.05 A               | 50 mA                | 50 $\mu$ s to 10 ms     | 2.5 %          |             |                      |
|              | 6 V         | 5.25 A               | 0.1 A                | 50 $\mu$ s to 3 ms      | 3.0 %          |             |                      |
|              | 6 V         | 10.5 A               | 0.5 A                | 50 $\mu$ s to 1 ms      | 2.5 %          |             |                      |

1. Max current limitation: For 21 V/1.515 A and 6 V/3.03 A ranges, total max current is limited by the table in page 13 for using 2 channels. Max current is not limited for using 1 channel only.

## Minimum pulse width at the given voltage, current and settling conditions

| Source value        | Limit value      | Load                      | Source settling (% of range) | Min pulse width     |
|---------------------|------------------|---------------------------|------------------------------|---------------------|
| 200 V               | 1.5 A            | 200 $\Omega$              | 0.1%                         | 1 ms                |
| 6 V                 | 10.5 A           | 0.6 $\Omega$              | 0.1%                         | 0.2 ms              |
| 1.5 A               | 200 V            | 65 $\Omega$               | 0.1%                         | 2.5 ms              |
| 10.5 A              | 6 V              | 0.5 $\Omega$              | 0.1%                         | 0.2 ms              |
| 10.5 A <sup>1</sup> | 6 V <sup>1</sup> | 0.1 $\Omega$ <sup>1</sup> | 0.1 % <sup>1</sup>           | 0.1 ms <sup>1</sup> |

1. Transient speed mode is set to FAST.

## Voltage measurement specifications

| Range               | Measurement resolution |         |                   |                   | Accuracy<br>(% reading + offset) |
|---------------------|------------------------|---------|-------------------|-------------------|----------------------------------|
|                     | B2901BL                | B2910BL | B2901B/<br>B2902B | B2911B/<br>B2912B |                                  |
| ±200 mV             | 100 nV                 | 100 nV  | 100 nV            | 100 nV            | ± (0.015 % + 225 µV)             |
| ±2 V                | 1 µV                   | 1 µV    | 1 µV              | 1 µV              | ± (0.02 % + 350 µV)              |
| ±20 V               | 10 µV                  | 10 µV   | 10 µV             | 10 µV             | ± (0.015 % + 5 mV)               |
| ±200 V <sup>1</sup> | —                      | 100 µV  | 100 µV            | 100 µV            | ± (0.015 % + 50 mV)              |

1. 200 V range is not available for B2901BL.

## Current measurement specifications

| Range                | Measurement resolution |         |                   |                   | Accuracy<br>(% reading + offset) |
|----------------------|------------------------|---------|-------------------|-------------------|----------------------------------|
|                      | B2901BL                | B2910BL | B2901B/<br>B2902B | B2911B/<br>B2912B |                                  |
| ±10 nA <sup>1</sup>  | —                      | 10 fA   | —                 | 10 fA             | ± (0.10 % + 50 pA)               |
| ±100 nA <sup>2</sup> | —                      | 100 fA  | 100 fA            | 100 fA            | ± (0.06 % + 100 pA)              |
| ±1 µA                | 1 pA                   | 1 pA    | 1 pA              | 1 pA              | ± (0.025 % + 500 pA)             |
| ±10 µA               | 10 pA                  | 10 pA   | 10 pA             | 10 pA             | ± (0.025 % + 1.5 nA)             |
| ±100 µA              | 100 pA                 | 100 pA  | 100 pA            | 100 pA            | ± (0.02 % + 25 nA)               |
| ±1 mA                | 1 nA                   | 1 nA    | 1 nA              | 1 nA              | ± (0.02 % + 200 nA)              |
| ±10 mA               | 10 nA                  | 10 nA   | 10 nA             | 10 nA             | ± (0.02 % + 2.5 µA)              |
| ±100 mA              | 100 nA                 | 100 nA  | 100 nA            | 100 nA            | ± (0.02 % + 20 µA)               |
| ±1 A                 | 1 µA                   | 1 µA    | 1 µA              | 1 µA              | ± (0.03 % + 1.5 mA)              |
| ±1.5 A               | 1 µA                   | 1 µA    | 1 µA              | 1 µA              | ± (0.05 % + 3.5 mA)              |
| ±3 A <sup>3</sup>    | —                      | —       | 10 µA             | 10 µA             | ± (0.4 % + 7 mA)                 |
| ±10 A <sup>3,4</sup> | —                      | —       | 10 µA             | 10 µA             | ± (0.4 % + 25 mA) <sup>5</sup>   |

1. 10 nA range is not available for B2901BL/B2901B/B2902B.
2. 100 nA range is not available for B2901BL.
3. 3 A, 10 A ranges are not available for B2901BL/B2910BL.
4. 10 A range is available only for pulse mode, not available for DC mode.
5. Measurement speed: 0.01 PLC.

## Measurement supplemental characteristics

|   |   |
|---|---|
| Temperature coefficient (0 to 18 °C and 28 to 50 °C)    | ± (0.1 x accuracy)/°C   |
| Over range  | 102 % of measurement range for 1.5 A and 3 A ranges                   |
|   | 106 % of measurement range other than 1.5 A and 3 A ranges            |
| Voltage measurement range change overshoot              | < 250 mV. 100 kΩ load, 20 MHz bandwidth                               |
| Current measurement range change overshoot              | < 250 mV/R load, 20 MHz bandwidth                                     |
| Derating accuracy for measurement speed less than 1 PLC | Add % of range using the following table for measurement with PLC < 1 |

## Derating accuracy with PLC setting < 1 PLC

|           | Voltage range |              |       | Current range |                |            |
|-----------|---------------|--------------|-------|---------------|----------------|------------|
|           | 0.2 V         | 2 V to 200 V | 10 nA | 100 nA        | 1 μA to 100 mA | 1 A to 3 A |
| 0.1 PLC   | 0.01%         | 0.01%        | 0.1%  | 0.01%         | 0.01%          | 0.01%      |
| 0.01 PLC  | 0.05%         | 0.02%        | 1%    | 0.1%          | 0.05%          | 0.02%      |
| 0.001 PLC | 0.5%          | 0.2%         | 5%    | 1%            | 0.5%           | 0.2%       |

## Timer and triggering specification

|                                   |   |  |
|-----------------------------------|---|--|
| Timer                             | Time stamp                                    | TIMER value automatically saved when each measurement is triggered |
|                                   | Trigger timing resolution                     | 1 μs to 100 ms   |
|                                   | Accuracy                                      | ±50 ppm  |
|                                   | Arm/trigger delay                             | 0 μs to 100,000 s  |
|                                   | Arm/trigger interval                          | B2901BL: 200 μs to 100,000 s                                       |
|                                   |   | B2910BL: 50 μs to 100,000 s  |
|                                   |   | B2901B/B2902B: 20 μs to 100,000 s                                  |
| B2911B/B2912B: 10 μs to 100,000 s |   |  |
| Arm/trigger event                 | B2901BL: 1 to 10,000                          |  |
|                                   | Other models: 1 to 100,000                    |  |
| Triggering <sup>1</sup>           | Digital I/O Trigger in to trigger out         | ≤ 5 μs   |
|                                   | Digital I/O Trigger in to source change       | ≤ 5 μs   |
|                                   | LXI Trigger in to source change               | Minimum 100 μs, Typical 200 μs, Maximum Unknown                    |
|                                   | LXI Trigger in to measurement                 | Minimum 100 μs, Typical 200 μs, Maximum Unknown                    |
|                                   | Internal event to external LXI trigger output | Minimum 100 μs, Typical 200 μs, Maximum Unknown                    |
|                                   | LXI event send/receive latency                | Unknown  |
|                                   | Minimum trigger interval                      | 10 μs  |

1. Supplemental characteristics.



## Other supplemental characteristics

| Output characteristics          |  |
|---------------------------------|--|
| Sensing Modes                   | 2-wire or 4-wire (Remote-sensing) connections  |
| Low terminal connection         | Chassis grounded or floating   |
| Output connectors               | Banana jack. Triaxial connections are recommended for sourcing and measuring less than 1 nA. A banana jack to triaxial adapter is available for low current measurement. |
| Output location                 | Channel 1 at front, and channel 2 at rear  |
| Maximum load                    | Normal mode: 0.01 $\mu\text{F}$  |
|                                 | High Capacitance mode: 50 $\mu\text{F}$  |
| DC floating voltage             | Max $\pm 250$ V DC between low force and chassis ground  |
| Guard offset voltage (V source) | < 4 mV   |
| Remote sense operation range    | Max voltage between High Force and High Sense = 3 V  |
|                                 | Max voltage between Low Force and Low Sense = 3 V  |
| Common mode isolation           | > 1 G $\Omega$ , < 4500 pF   |
| Maximum sense lead resistance   | 1 k $\Omega$ for rated accuracy  |
| Sense input impedance           | > 10 G $\Omega$  |

| High capacitance mode  |   |  |        |
|--|---|--|--------|
| <p>The high capacitance mode permits the measurement of devices with capacitances greater than the normal mode maximum load value of 0.01 <math>\mu\text{F}</math>. In high capacitance mode the maximum allowed value of the load capacitance is 50 <math>\mu\text{F}</math>.</p> |   |  |        |
| Voltage output settling time   | Time required to reach within 0.1 % of final value with 4.7 $\mu\text{F}$ capacitive load on a fixed range at specified current range and limit value |  |        |
|  | 200 mV, 2 V ranges  | 600 $\mu\text{s}$ , at 1 A limit   |        |
|  | 20 V range  | 1.5 ms, at 1 A limit   |        |
|  | 200 V range   | 20 ms, at 100 mA limit   |        |
| Current measurement settling time  | Time required to reach within 0.1 % of final value after voltage source is stabilized on fixed range. Vout is 5 V unless noted.                       |  |        |
|  | 1 $\mu\text{A}$ range   | 230 ms   |        |
|  | 10 $\mu\text{A}$ , 100 $\mu\text{A}$ ranges   | 23 ms  |        |
|  | 1 mA, 10 mA ranges  | 0.23 ms  |        |
|  | 100 mA to 3 A ranges  | 100 $\mu\text{s}$  |        |
| Mode change delay  | Delay into high cap mode  | 1 $\mu\text{A}$ range  | 230 ms |
|  |   | 10 $\mu\text{A}$ , 100 $\mu\text{A}$ ranges  | 23 ms  |
|  |   | 1 mA to 3 A ranges   | 1 ms   |
|  | Delay out of high cap mode  | All ranges   | 10 ms  |
| Noise 10 Hz to 20 MHz (20 V range)   |   | 4.5 mVrms  |        |
| Voltage source range change overshoot (20 V range or below)  |   | < 250 mV, 20 MHz bandwidth   |        |
| High Capacitance mode working conditions   | V/I mode  | Voltage source mode only   |        |
|  | Range   | Current measurement range is limited to fixed range only. 10 nA and 100 nA ranges are not available. |        |

| High capacitance mode  |  |
|--|--|
| Current limit  | $\geq 1 \mu\text{A}$   |
| Resistance measurement   |  |
| Resistance measurement can be performed under either auto or manual test conditions. Auto resistance measurement is performed in current source and voltage measurement mode. The total auto resistance measurement error is shown in the table below. The total error of a manual resistance measurement can be calculated using the voltage and current accuracy information as shown below. |  |
| Source I mode, manual ohm measurement (4-wire)   | Total error = $V_{\text{meas}}/I_{\text{src}} = R \text{ reading} \times (\text{gain error \% of V range} + \text{gain error \% of I range} + \text{offset error of I range}/I_{\text{src}} \text{ value \%}) + (\text{offset error of V range}/I_{\text{src}} \text{ value})$       |
| Source V mode, manual ohm measurement (4-wire)   | Total error = $V_{\text{src}}/I_{\text{meas}} = 1/[1/R \text{ reading} \times (\text{gain error \% of I range} + \text{gain error \% of V range} + \text{offset error of V range}/V_{\text{src}} \text{ value \%}) + (\text{offset error of I range}/V_{\text{src}} \text{ value})]$ |
| Measurement speed  | 1 PLC  |
| Applicable for temperature   | $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$   |
| Example of total error calculation   | I source value = 1 mA at 1 mA range  |
|  | V measure range = 2 V range  |
|  | Total error (% reading + offset) = $(0.02 \% + 0.02 \% + 200 \text{ nA}/1 \text{ mA}) + (350 \mu\text{V}/1 \text{ mA}) = 0.06 \% + 0.35 \Omega$  |

### Typical performance of auto resistance measurement (4-wire), 2 V range

| Range                       | Resolution      | Test current      | Current range     | Total error (% reading + offset) |
|-----------------------------|-----------------|-------------------|-------------------|----------------------------------|
| 2 $\Omega$                  | 1 $\mu\Omega$   | 1 A               | 1 A               | 0.2 % + 0.00035 $\Omega$         |
| 20 $\Omega$                 | 10 $\mu\Omega$  | 100 mA            | 100 mA            | 0.06 % + 0.0035 $\Omega$         |
| 200 $\Omega$                | 100 $\mu\Omega$ | 10 mA             | 10 mA             | 0.065 % + 0.035 $\Omega$         |
| 2 k $\Omega$                | 1 m $\Omega$    | 1 mA              | 1 mA              | 0.06 % + 0.35 $\Omega$           |
| 20 k $\Omega$               | 10 m $\Omega$   | 100 $\mu\text{A}$ | 100 $\mu\text{A}$ | 0.065 % + 3.5 $\Omega$           |
| 200 k $\Omega$              | 100 m $\Omega$  | 10 $\mu\text{A}$  | 10 $\mu\text{A}$  | 0.06 % + 35 $\Omega$             |
| 2 M $\Omega$                | 1 $\Omega$      | 1 $\mu\text{A}$   | 1 $\mu\text{A}$   | 0.095 % + 350 $\Omega$           |
| 20 M $\Omega$ <sup>1</sup>  | 10 $\Omega$     | 100 nA            | 100 nA            | 0.18 % + 3.5 k $\Omega$          |
| 200 M $\Omega$ <sup>1</sup> | 100 $\Omega$    | 10 nA             | 100 nA            | 1.08 % + 35 k $\Omega$           |

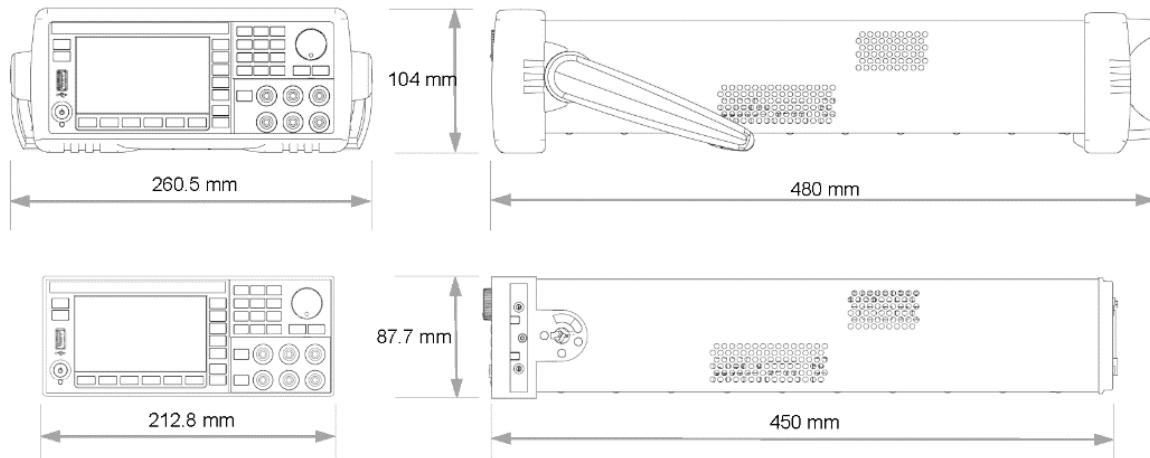
1. 20 M $\Omega$ , 200 M $\Omega$  ranges are not available for B2901BL.

| System speeds: Maximum sweep operation reading rates (reading/second) for 50 Hz |                   |                 |                          |                        |
|---|-------------------|-----------------|--------------------------|------------------------|
| Measure speed   | Measure to memory | Measure to GPIB | Source measure to memory | Source measure to GPIB |
| < 0.001 PLC   | 20000             | 12500           | 19500                    | 12500                  |
| 0.01 PLC  | 4500              | 3950            | 4500                     | 3950                   |
| 0.1 PLC   | 500               | 490             | 500                      | 490                    |
| 1 PLC   | 49                | 49              | 49                       | 49                     |

Operation reading rate varies by number of sweep steps. Number of sweep steps is specified.

## Environmental specifications

| Environment          |          | For use in indoor facilities  |
|----------------------|----------|---|
| Operating            |          | 0 °C to +55 °C, 30 % to 80 % non-condensing   |
| Storage              |          | -30 °C to 70 °C, 10 % to 90 % non-condensing  |
| Altitude             |          | Operating: 0 m to 2000 m, Storage: 0 m to 4600 m  |
| Power supply         |          | 90 V to 264 V, 47 Hz to 63 Hz, 250 VA maximum   |
| Overvoltage category |          | II  |
| Pollution degree     |          | 2   |
| EMC                  |          | IEC61326-1/EN61326-1, AS/NZS CISPR 11, KC: RRA Notification amending Radio Waves Act Article 58-2 |
| Safety               |          | IEC61010-1/EN61010-1, CAN/CSA-C22.2 No. 61010-1, C/US   |
| Certifications       |          | CE, cCSAus, RCM, KC   |
| Warm-up              |          | 1 hour  |
| Dimensions           | Case     | 88 mm (2U) x 213 mm (half width) x 450 mm   |
|                      | Working  | 180 mm x 260 mm x 480 mm (with handle and feet)   |
| Weight               | Net      | 6.0 kg (B2901BL, B2910BL, B2901B, B2911B), 7.4 kg (B2902B, B2912B)                                |
|                      | Shipping | 9.5 kg (B2901BL, B2910BL, B2901B, B2911B), 11.0 kg (B2902B, B2912B)                               |



| Front panel operation |  |
|-----------------------|--|
| Front panel interface | 4.3" TFT color display (480 x 272, with LED backlight) with keypads and rotary knob                          |
| View mode             | Single view, Dual view, Graph view and Roll view   |
| Hard keys             | Single Trigger and Auto Trigger control, 10-key, Rotary Knob and Cursors, Channel on/off, View, Cancel/Local |
| Softkeys              | Function, System and Input Assist Keys   |
| Indicators            | Channel (measurement) status, System status  |

## Source/measurement capabilities

| Sweep measurement                                    |   |
|--|---|
| Number of steps                                      | B2901BL: 1 to 10,000                                    |
|  | Other models: 1 to 100,000                              |
| Sweep mode   | Linear, logarithmic (log) or list                       |
| Sweep direction                                      | Single or double  |
| Type   | DC, or pulse  |
| Min programmable value to create list sweep waveform | B2901BL: Min 200 $\mu$ s with 1 $\mu$ s resolution      |
|  | B2910BL: Min 50 $\mu$ s with 1 $\mu$ s resolution       |
|  | B2901B/B2902B: Min 20 $\mu$ s with 1 $\mu$ s resolution |
|  | B2911B/B2912B: Min 10 $\mu$ s with 1 $\mu$ s resolution |

| Digitizing/sampling measurement                 |  |
|---|--|
| Min trigger interval (Max speed of measurement) | B2901BL: 200 $\mu$ s (5,000 points/s)        |
|   | B2910BL: 50 $\mu$ s (20,000 points/s)        |
|   | B2901B/B2902B: 20 $\mu$ s (50,000 points/s)  |
|   | B2911B/B2912B: 10 $\mu$ s (100,000 points/s) |

| Data buffers    |                                      |
|-----------------|--------------------------------------|
| Max buffer size | B2901BL: 10,000 points/channel       |
|                 | Other models: 100,000 points/channel |

| Input/output connectivity   |                            |   |
|---|----------------------------|---|
| GP-IB   |                            | IEEE-488.2  |
| Ethernet  |                            | 100BASE-T/10BASE-T  |
| USB   |                            | USB 2.0 host controller (front)<br>USB 2.0 device interface (rear)                                |
| Digital I/O   | Connector type             | 25-pin female D   |
|   | Input/output pins          | 14 open drain I/O bits  |
|   | Absolute max input voltage | 5.25 V  |
|   | Absolute min input voltage | -0.25 V   |
|   | Max logic L input voltage  | 0.8 V   |
|   | Min logic H input voltage  | 2.0 V   |
|   | Max source current         | 1 mA @ Vout = 0 V   |
|   | Max sink current           | 50 mA @ Vout = 5 V  |
|   | 5 V power supply pin       | Limited to 500 mA, solid state fuse protected   |
|   | Safety interlock pin       | One active high pin and one active low pin. Activation of both pins enables output voltage > 42 V |
| Maximum number of simultaneously triggered units (using Digital I/O) <sup>1</sup> |                            | 8   |

1. Supplemental characteristics.



| Program, software and drivers |   |
|-------------------------------|---|
| Programming                   | SCPI  |
| Program memory                | 100 kB (2500 lines typical)   |
| LXI compliance                | LXI Core 2011   |
| Software available            | EasyEXPERT group+, Quick I/V Measurement Software, Graphical Web Interface, PathWave BenchVue |
| Drivers available             | IVI-C, IVI-COM drivers, LabVIEW drivers   |

| Software prerequisites |                      |  |
|------------------------|----------------------|--|
| EasyEXPERTgroup+       | Operating system     | Microsoft Windows 8.1 Professional or later (32bit/64bit), Microsoft Windows 10 Pro or later (32bit/64bit)   |
|                        | Supporting language  | English (US)   |
|                        | .NET Framework       | Microsoft .NET, Framework 3.5 SP1  |
|                        | IO Libraries         | Keysight IO Libraries Suite 17.1 update 1 or later (for the Online execution mode)   |
|                        | Memory               | 2 GB memory  |
|                        | Display              | XGA 1024 x 768 (SXGA 1280 x 1024 recommended)  |
|                        | HDD                  | Installation: 1GB free disk space on the C drive, Test setup/result data storage: Free disk space more than 30GB is recommended  |
|                        | Recommended GPIB I/F | Keysight 82350B/C (PCI) <sup>1</sup> , 82351B(PCIe) <sup>1</sup><br>82357A (USB) <sup>2,3</sup> , 82357B (USB) <sup>2,3</sup><br>National Instrument: GPIB-USB-HS (USB) <sup>1,2</sup> |
| Quick IV               | Operating system     | Windows 8 (32 bit/64 bit), Windows 8.1 (32 bit/64 bit), Windows 10 (32 bit/64 bit),  |
|                        | Supporting language  | English (US)   |
|                        | .NET Framework       | Microsoft .NET, Framework 4.5.2  |
|                        | IO Libraries         | 17.0 or later  |
|                        | Interfaces           | USB, GP-IB, LAN  |
| PathWave BenchVue      | Operating system     | Windows 10 32-bit and 64-bit (Professional, Enterprise, Education, Home versions)  |
|                        |                      | Windows 8 32-bit and 64-bit (Professional, Enterprise, Core)   |
|                        | CPU                  | 1 GHz or faster (2 GHz or greater recommended)   |
|                        | RAM                  | 1 GB (32-bit) or 2 GB (64-bit) (3 GB or greater recommended)   |
|                        | Display resolution   | 1024 x 768 minimum for single instrument view (higher resolutions are recommended for multiple instrument view)  |
|                        | Interfaces           | USB, GPIB, LAN, RS-232   |

1. A PCI or PCIe card is highly recommended because of stability and speed.
2. USB GPIB interfaces might cause serial poll error intermittently due to the intrinsic communication scheme differences. It is reported that using an even GPIB address sometimes significantly decreases the chance of the error. The NI GPIB-USB-HS is recommended for stability, and the Keysight 82357x is recommended for speed.
3. EasyEXPERT software prohibits to set the odd GPIB address to prevent the issue above.

## Furnished Accessories

|   |
|---|
| Power cable, USB cable, Quick Reference (English) |
|---|

## Ordering Information

| Model number |   |
|--------------|---|
| B2901BL      | Precision Source/Measure Unit, 1 ch, 1 pA resolution, 21 V, 1.5 A       |
| B2910BL      | Precision Source/Measure Unit, 1 ch, 10 fA resolution, 210 V, 1.5 A     |
| B2901B       | Precision Source/Measure Unit, 1 ch, 100 fA, 210 V, 3 A DC/10.5 A pulse |
| B2902B       | Precision Source/Measure Unit, 2 ch, 100 fA, 210 V, 3 A DC/10.5 A pulse |
| B2911B       | Precision Source/Measure Unit, 1 ch, 10 fA, 210 V, 3 A DC/10.5 A pulse  |
| B2912B       | Precision Source/Measure Unit, 2 ch, 10 fA, 210 V, 3 A DC/10.5 A pulse  |

| Options |   |
|---------|---|
| 1A7     | Calibration + Uncertainties + Guardbanding (Not Accredited) |
| A6J     | ANSI Z540-1-1994 Calibration                                |
| UK6     | Commercial Calibration Certificate with Test Data           |

| Accessories |   |
|-------------|---|
| N1297A      | Banana - Triax adapter for 2-wire (non-Kelvin) connection |
| N1297B      | Banana - Triax adapter for 4-wire (Kelvin) connection     |
| N1294A-011  | Interlock cable for 16442B (1.5 m)                        |
| N1294A-012  | Interlock cable for 16442B (3.0 m)                        |
| N1294A-031  | GPIO-BNC trigger adapter                                  |
| N1294A-032  | Digital I/O trigger cable for multiple unit control       |
| 16494A-001  | Low leakage triax cable (1.5 m)                           |
| 16494A-002  | Low leakage triax cable (3.0 m)                           |
| 16494A-005  | Low leakage triax cable (4.0 m)                           |
| 1CM124A     | Rack mount flange kit                                     |

| Upgrade kit |  |
|-------------|--|
| B2901BLU    | B2901BL Software Upgrade Package, Extension Support and Subscription |
| B2910BLU    | B2910BL Software Upgrade Package, Extension Support and Subscription |
| B2901BU     | B2901B Software Upgrade Package, Extension Support and Subscription  |
| B2902BU     | B2902B Software Upgrade Package, Extension Support and Subscription  |
| B2911BU     | B2911B Software Upgrade Package, Extension Support and Subscription  |
| B2912BU     | B2912B Software Upgrade Package, Extension Support and Subscription  |