

# Keysight Technologies

B2900A Series

B2961A/B2962A

6.5 Digit Low Noise Power Source

Data Sheet



A revolutionary power supply for precision low noise voltage/current sourcing featuring 6.5 digit, 100 nV/10 fA resolution, 10  $\mu$ Vrms noise, bipolar 210 V/3 A (10.5 A pulse) range, innovative sourcing functions, and GUI.

- 1 ch/2 ch
- 210 V/3 A DC/10.5 A Pulse, 31.8 W
- 100 nV/10 fA Resolution

## Impressive 6.5 digit 100 nV/10 fA resolution, 10 $\mu$ Vrms ultra low noise and innovative source functions accelerate your research and development

### Revolutionary power supply/source meets both existing and future test needs

Power supplies/sources are essential instruments for test and evaluation across the electronics industry. The on-going industry trends of reduced power consumption and faster communication data rates increasingly require power sources that can support lower levels of current and voltage. These requirements mandate that power supplies/sources meet ever higher levels of performance.

**The Keysight Technologies, Inc. B2961A/B2962A 6.5 Digit Low Noise Power Source** is a new bench-top power supply/source with revolutionary capabilities and functions not previously available. Its unique features include bipolar current sourcing and sinking, a programmable output resistance feature, and a time-domain waveform viewer supported in the graphical user interface (GUI).

You can choose between 1-channel (B2961A) and 2-channel (B2962A) models, allowing you to select the exact amount of bench-top power source performance to meet your testing needs.

- Best-in-class 6.5 digit resolution (100 nV/10 fA minimum resolutions)
- Wide bipolar (4-quadrant) voltage/current ranges (210 V/3 A DC, 10.5 A Pulse)
- Ultra low noise filter (10  $\mu$ Vrms, 1 nV/ $\sqrt{\text{Hz}}$  at 10 kHz)
- Intuitive graphical user interface with wide 4.3" color LCD
- Convenient 4.5 digit voltage/current monitor
- Time domain waveform viewer for quick check and debug
- Precision 1 MHz – 10 kHz arbitrary waveform generation capability
- Flexible programmable output resistance function.

In addition to these innovative bench-top power supply/source features, the Keysight B2961A/B2962A can be controlled remotely using Keysight free PC-based Quick IV software or through any LXI compliant web browser. These capabilities simplify the task of incorporating measurement data and graphs into reports and presentations.

The superior performance and innovative functions of the Keysight B2961A/B2962A cover a broad range of test applications.

**BEST IN CLASS RESOLUTION • ULTRA-LOW NOISE • INNOVATIVE SOURCE FUNCTIONS**



## Key features and benefits

Key Features	Benefit
<b>Best-in-class resolution and wide bipolar range</b> <ul style="list-style-type: none"> <li>– 6.5 digit (100 nV/10 fA resolution)</li> <li>– 210 V &amp; 3 A (DC)/10.5 A (pulsed) ranges</li> <li>– 4-quadrant operation</li> </ul>	Very precise test and evaluation can be performed within a wide 4-quadrant voltage and current range.
<b>External ultra low noise filter (option)</b> <ul style="list-style-type: none"> <li>– 10 <math>\mu</math>Vrms (10 Hz – 20 MHz)</li> <li>– 1 nVrms/<math>\sqrt{\text{Hz}}</math> at 10 kHz</li> </ul>	Reveal more of the true characteristics of your noise-sensitive devices and samples than ever before.
<b>Intuitive GUI implemented on 4.3" color LCD</b> <ul style="list-style-type: none"> <li>– 4.5 digit voltage/current monitor</li> <li>– Time domain waveform viewer</li> </ul>	Improved test and debug efficiency without the need for a PC.
<b>Precision 1 MHz – 10 kHz arbitrary waveform generation capability</b> <ul style="list-style-type: none"> <li>– Voltage and current waveform generation up to 210 V/3 A</li> <li>– Support for six built-in waveforms and a user-defined arbitrary waveform</li> </ul>	Goes beyond simple DC measurement and allows you to perform complex and more sophisticated testing of your devices and samples.
<b>Versatile programmable output resistance function</b> <ul style="list-style-type: none"> <li>– Constant mode</li> <li>– Voltage/current emulation mode</li> </ul>	Enables you to simulate a wide variety of devices and sample types.

## A wide variety of Keysight B2961A/B2962A applications

To reduce power consumption battery-powered devices continue to reduce their supply voltage levels, which requires ever more precise power sources to accurately characterize device behavior. Noise performance requirements also continue to become more stringent in application areas such as mobile communications due to higher data rates and faster clock frequencies. These technology trends make the testing of advanced products increasingly difficult due to their extreme sensitivity to noise and other external disturbances.

As a result, power supplies/sources with more precision, better noise performance and more versatile sourcing functions are now required. The Keysight B2961A/B2962A meet these requirements, and they can be used for a wide variety of applications that permit you to perform critical tests and evaluations that have not been previously possible.

In addition, the Keysight B2961A/B2962A's superior performance and innovative functions make these instruments ideal companion power supplies/sources for use with other instruments such as network analyzers, spectrum analyzers, digital multimeters and nano-voltmeters.

## Application examples

- A/D and D/A converters
- High precision analog IC and circuitry
- RFICs and circuitry
- Medical applications
- Cable/wire harnesses evaluation
- Voltage controlled oscillators (VCOs)
- Sensor devices and transducers
- Solar cells and the interface circuitry
- Electrochemical applications
- Research and education
- Crystal oscillators
- Current source for small voltage measurement
- Battery management
- Advanced materials evaluation

## Superior resolution and wide bipolar ranges meet your most challenging test and evaluation needs

### 6.5 digit resolution enables precise analog-to-digital converter evaluation

One area where power supply sourcing resolution is important is analog-to-digital converter (ADC) evaluation. For an 8-bit ADC, a 1 V (peak to peak) signal would have a minimum step voltage of 3.9 mV. In this case a power source with 4.5 digit resolution is sufficient to use for the DC input voltage. However, for an ADC with 14-bits or more, 4.5 digit resolution is not enough. In this case the B2961A/B2962A's best-in-class 6.5-digit sourcing resolution is required in order to properly evaluate the ADC circuit.

ADC Resolution	Steps	MinStep Voltage	Conventional power supply resolution (4.5 digit/ Min 100 $\mu$ V)	B2961A/B2962A resolution (6.5 digit/ Min 1 $\mu$ V)
8-bit	256	3.9 mV	✓	✓
10-bit	1,024	1.0 mV	✓	✓
12-bit	4,096	244 $\mu$ V	✓	✓
14-bit	16,384	61 $\mu$ V		✓
16-bit	65,536	15 $\mu$ V		✓

Figure 1. Resolution comparison: ADC with 1 Vpp (Full Scale)

### Wide bipolar range (100 nV to 210 V, 10 fA to 10.5 A) permits characterization of many types of devices and samples

The wide bipolar (four-quadrant) voltage and current ranges of the Keysight B2961A/B2962A are capable of supporting both current and future testing needs. In addition, since they support both very small and very large current and voltage signal levels the B2961A/B2962A can often replace several other bench-top instruments. As shown in Figure 2, you can program any voltage and current value within the B2961A/B2962A's wide output range without worrying about any zero-crossing glitches.

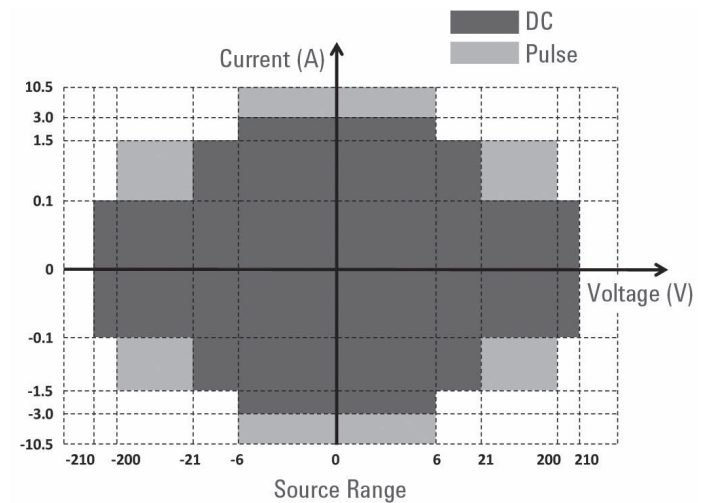


Figure 2. Wide bipolar voltage and current ranges (4-quadrant operation)

### Fast settling time increases your test efficiency

Unlike most conventional power supplies/sources, the Keysight B2961A/B2962A can quickly settle to their final value with 6.5 digit resolution throughout their entire output ranges. This reduces test times and improves measurement efficiency, especially when making multiple tests in sequence. See Figure 3.

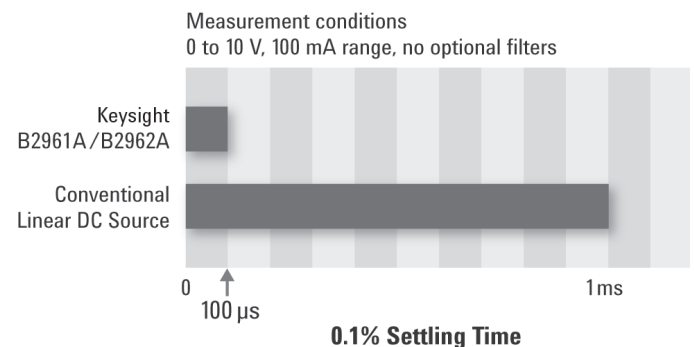


Figure 3. Fast settling time than conventional DC sources

## Best-in-class noise performance (10 $\mu\text{Vrms}$ ) unlocks the true characteristics of your devices and samples

### Two optional filters available for different test needs

For applications requiring ultra-low noise performance, the Keysight B2961A/B2962A supports two external filter options. This provides you with the flexibility to select the noise filter price/performance point that best meets your needs. The low noise filter (LNF) provides the same level of RMS noise as linear regulator-based power supplies and sources, while the ultra low noise filter (ULNF) reduces noise to an impressive 10  $\mu\text{Vrms}$ . See Figure 4.



Figure 4. Optional external noise filters can meet your most stringent noise requirements

### ULNF provides unprecedented low-noise performance (10 $\mu\text{Vrms}$ and 1 $\text{nVrms}/\sqrt{\text{Hz}}$ at 10 kHz) in a low-cost bench-top instrument

As shown in Figure 5 the ULNF reduces the voltage noise of the Keysight B2961A/B2962A to 10  $\mu\text{Vrms}$  in the frequency range of 10 Hz – 20 MHz, while still allowing it to source up to 42 V and 105 mA. This outstanding low noise performance can be used to evaluate noise-sensitive devices and circuits such as ADC/DAC as well as many other types of analog and RF ICs. In addition, the ULNF minimizes the noise density to 1  $\text{nVrms}/\sqrt{\text{Hz}}$  at 10 kHz, which is required for the phase noise evaluation of oscillator circuits such as VCOs, crystal oscillators, etc. See Figure 6. There are two user-selectable output impedance settings, 2-wire (50  $\Omega$ ) and 4-wire (low impedance close to zero), to provide optimal flexibility when characterizing your devices and samples.

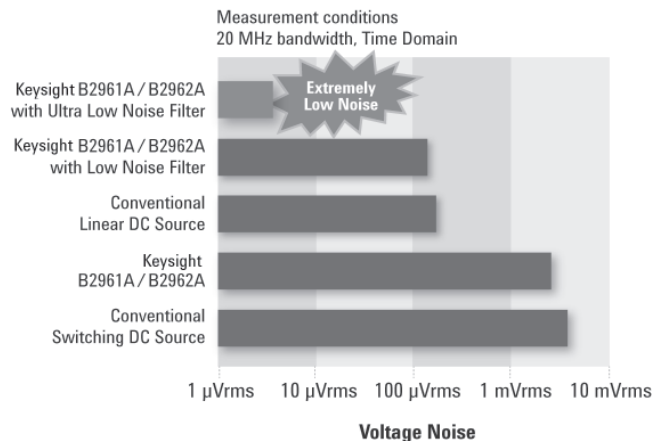


Figure 5. ULNF dramatically reduces output noise

### LNF supports full 210 V and 3 A bipolar output range

The LNF supports the B2961A/B2962A's wide bipolar voltage and current ranges (up to 210 V/3 A) while providing noise levels comparable to those of linear power supplies. In addition, when using the LNF you can still make 4-wire (Kelvin) measurements to eliminate residual cable resistance effects. For applications requiring a moderate level of low-noise performance, the LNF provides a cost-effective means to achieve low-noise sourcing capability for a modest price.

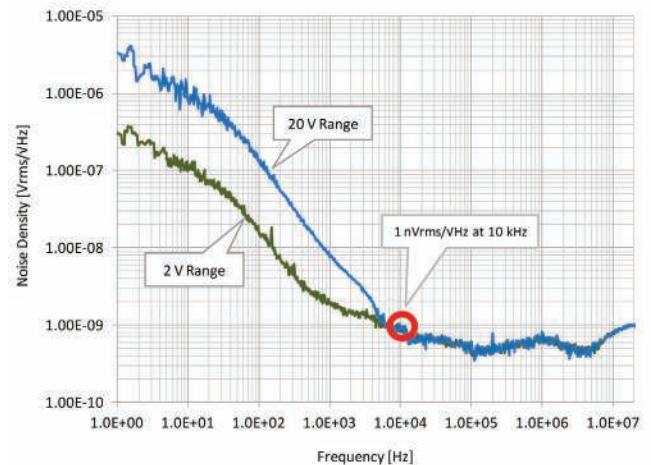


Figure 6. ULNF provides excellent noise density performance

## Intuitive front-panel GUI and wide 4.3" color LCD maximize test and debug efficiency

Many power supplies and sources only possess a numerical display or a very basic dot matrix display, which are only effective at showing DC values. In contrast, the Keysight B2961A/B2962A has an easy-to-use front panel GUI and a wide 4.3" color LCD. These make it easy to set up sourcing parameters and to display complex current and voltage waveforms. For added convenience, the Keysight B2961A/B2962A provides multiple viewing modes: single view, dual view (B2962A only) and graph view. These capabilities not only increase test and evaluation efficiency, but they also make the instrument easy to use without the need to struggle through paper manuals. See Figure 7.

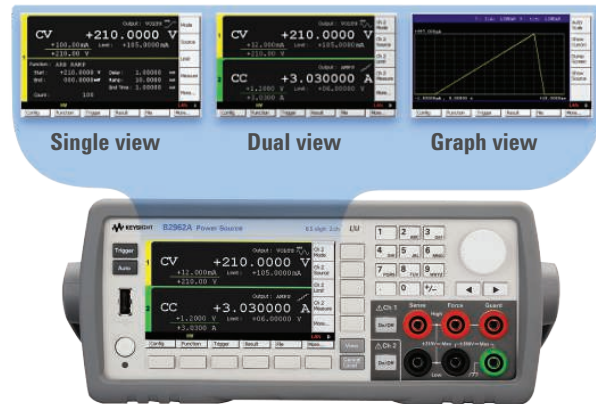


Figure 7. Three viewing modes provide you with flexible and efficient testing

## Integrated voltage and current monitoring capability verifies output with 4.5 digit resolution

The Keysight B2961A/B2962A has a built-in voltage and current monitoring feature that enables you to verify the actual voltage and current output. You can view the sourced voltage and current values with 4.5 digit numeric resolution in both single and dual viewing modes. With minimum voltage and current measurement resolution of 10  $\mu$ V and 1 pA (respectively), a digital multi-meter (DMM) is not necessary for measurement verification.

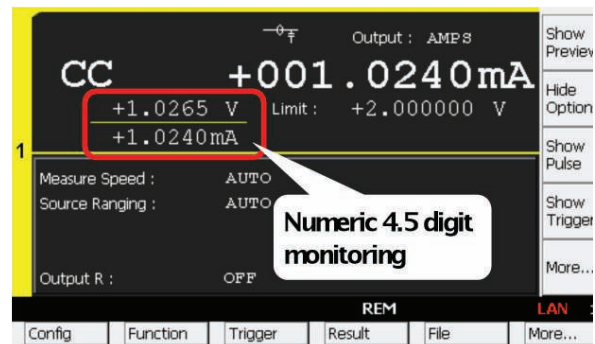


Figure 8. Perform quick status checks with 4.5 digit numeric display

## Time domain waveform viewer facilitates quick check and debug of output waveforms

In addition to the numeric monitoring, the Keysight B2961A/B2962A Power Source has a time domain waveform viewing capability (Figure 9). For most power supplies and sources, you cannot view the actual waveform you are applying to your device or sample without using some other sort of external instrument. The Keysight B2961A/B2962A's time domain monitoring capability displays applied waveforms on its LCD display (Graph View mode), enabling you to verify that you are applying the correct signal to your DUT.

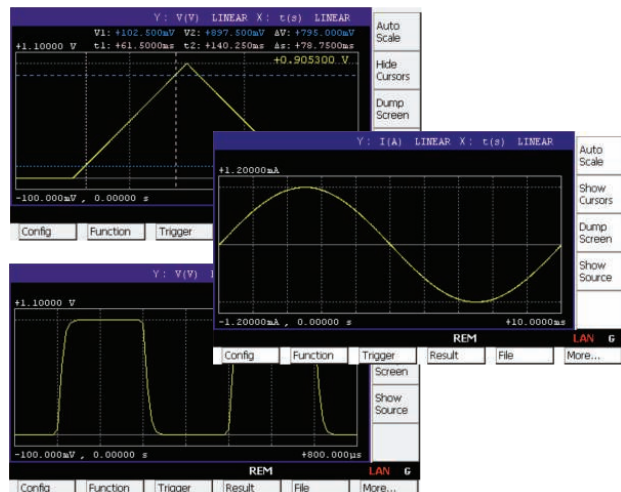
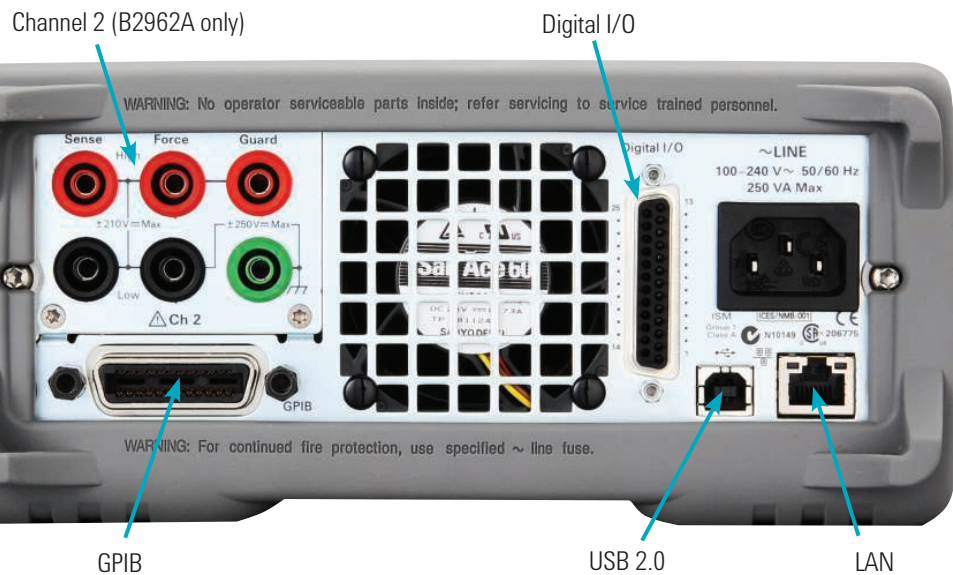
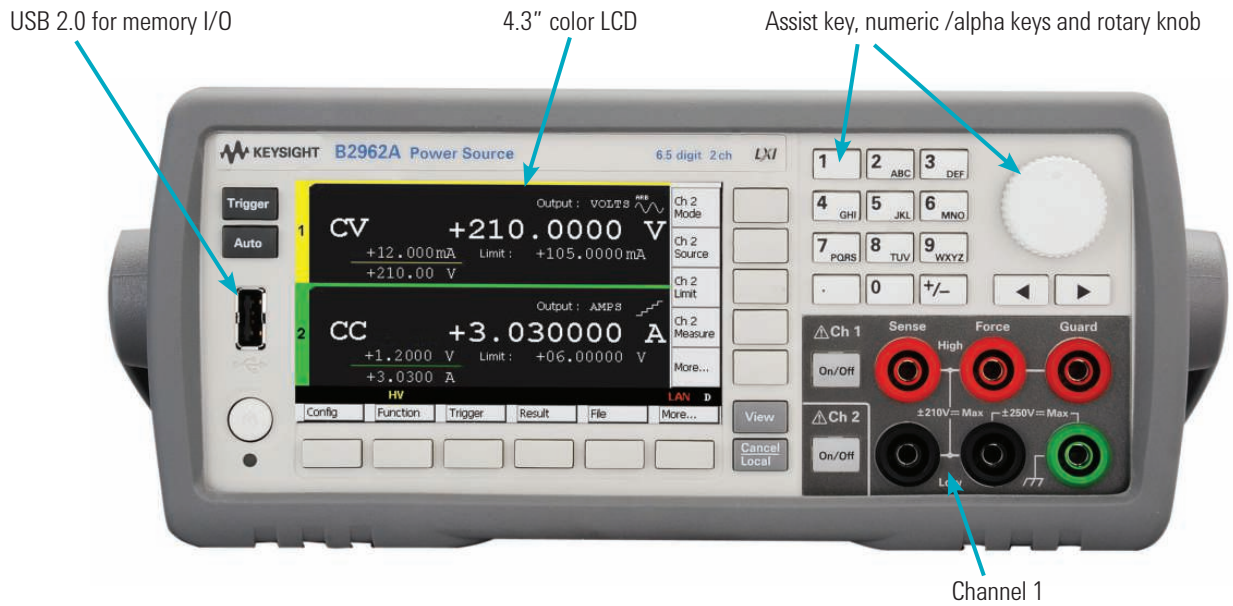


Figure 9. Graph View allows you to view output waveform in the time domain

## GUI based intuitive front panel design with rich standard interfaces for your bench-top needs



In addition to the graphical user interface and easy-to-use front panel, the Keysight B2961A/B2962A integrates standard interfaces such as USB 2.0, LAN (LXI class C compliant), digital I/O and GPIB in a bench-top instrument form. The optional filters are well designed for the B2961A/B2962A and easy to attach and detach to/from front channels.



## Flexible source functions beyond a DC instrument remove your test restrictions

### Pre-defined and arbitrary waveforms increase your test and evaluation flexibility

The Keysight B2961A/B2962A features full-fledged test and evaluation beyond conventional static DC testing. The pre-defined waveform generation capability provides six waveforms: sinusoidal, exponential, ramp, triangle, square and trapezoidal. In addition to these commonly used waveforms, you can set user-defined arbitrary waveforms with up to 100,000 points of setting. These flexible output capabilities should help you make deeper evaluation of your devices/samples that you've tested with other instruments than power supplies and sources.

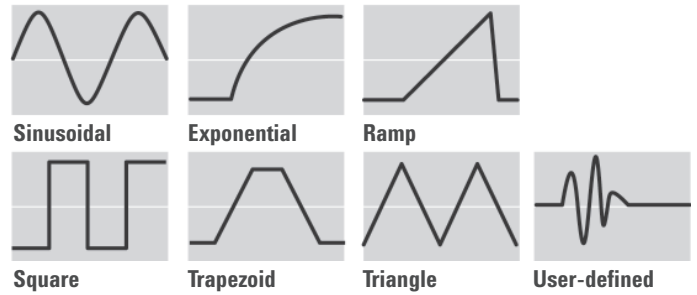


Figure 10. Convenient built-in waveform generation capabilities

### Precision and wide voltage/current waveform generation

The arbitrary waveform generation capability of Keysight B2961A/B2962A can generate both precision voltage and current waveforms in 1 mHz–10 kHz frequency range. Although some of conventional voltage/current source instruments feature a waveform generation capability, the output waveforms do not have enough accuracy as shown in Figure 11A. In contrast, as shown in Figure 11B, the Keysight B2961A/B2962A can generate cleaner and more precision waveforms for more sensitive device/sample testing. You can also make use of the same output voltage/current ranges (210 V/3 A) and the same resolutions (100 nV/10 fA) as those of original DC voltage/current specifications. This outstanding capability helps you make precision test and evaluation even in time domain.

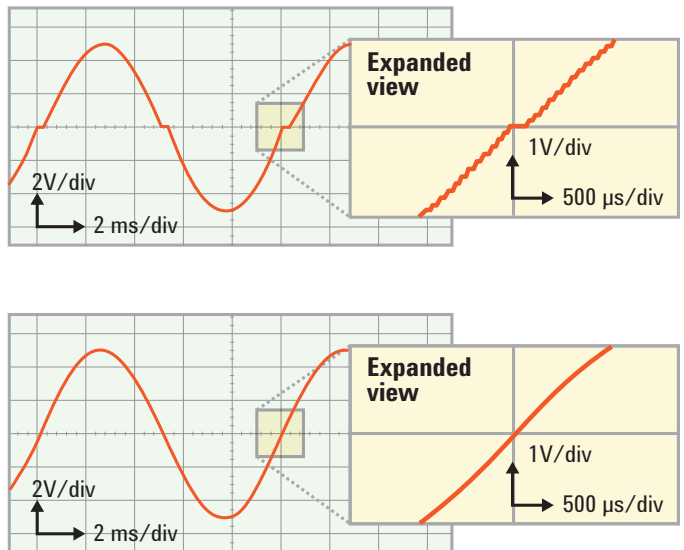


Figure 11B. Sinusoid waveform comparison at 100 Hz

### Preview of output waveform and simple user interface helps quick and reliable test

The Keysight B2961A/B2962A provides convenient and user-friendly interface for this arbitrary waveform generation capabilities. The preview mode shows the waveform shape on the same display that you set the waveform parameters, and enables you to check the forcing waveform shape in advance. This well-considered user interface provides you with an intuitive test environment, and improves your test and evaluation efficiency.



Figure 12. The preview of waveform you have just set



## Programmable output resistance and DC voltage/current output emulation capabilities solve real-world measurement challenges

### The B2961A/B2962A's programmable output resistance function provides flexible measurement capabilities

The Keysight B2961A/B2962A has a programmable output resistance feature that allows you to control the output behavior of the power source. It supports two test modes, constant and V/I emulation, to provide maximum flexibility and versatility. Constant mode allows you to specify an output resistance value (either positive or negative) such that the output will respond exactly as if the specified resistance value were in series (voltage source mode) or in parallel (current source mode) with the source output. The constant mode can emulate resistance values over a wide range, and the negative resistance capability is particularly useful for cancelling out unwanted external resistances. For example, you can use the negative resistance feature to eliminate the resistance of long connection wires without the need to use a 4-wire (Kelvin) connection scheme. This is especially useful in situations where a 4-wire measurement is not possible due to packaged device limitations or to the absence of sense pads for probing.

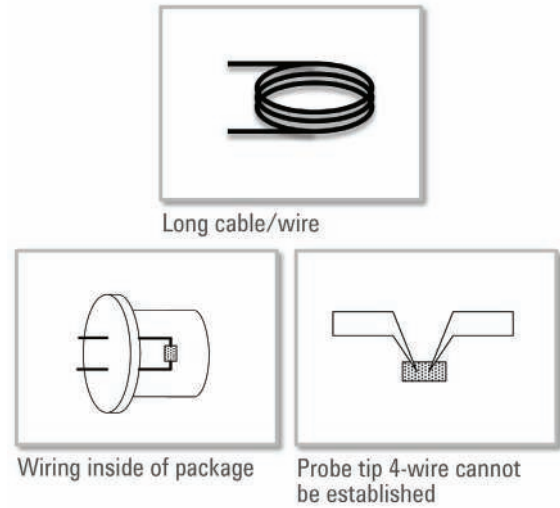


Figure 13. Measurement situations that benefit from Programmable Output Resistance's Constant mode feature

### DC voltage/current characteristic emulation feature provides powerful bench-top analysis capabilities

The programmable output resistance's V/I emulation mode function allows you to simulate any DC voltage/current output characteristic. You can specify up to 16 voltage and current points to create the desired DC electrical characteristic. Since in this mode the Keysight B2961A/B2962A responds exactly like the equivalent device or sample, it is useful for simulating electrical behavior when an actual component is not available as well as for testing corner cases. In the example shown in Figure 14, the output of an active device (solar cell) is simulated using the V/I emulation mode function. This ability to simulate both active and passive devices provides unprecedented power and flexibility in a compact bench-top form factor. (Figure 15).

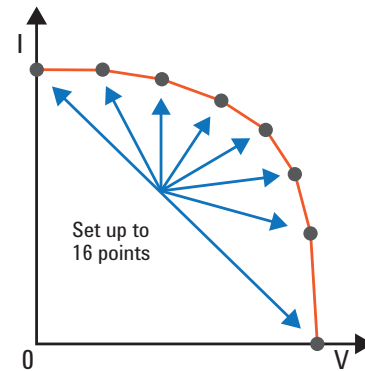


Figure 14. In V/I emulation mode you can specify up to 16 voltage/current points to synthesize a desired electrical characteristic

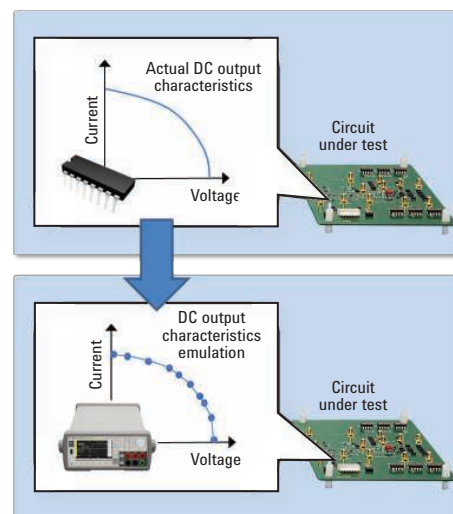
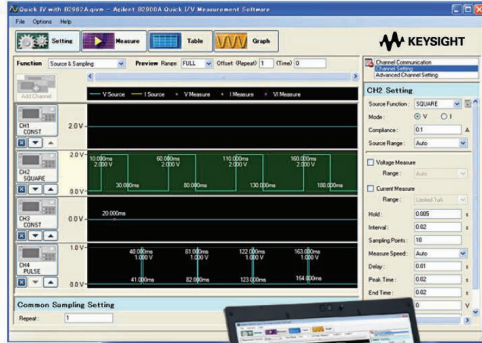


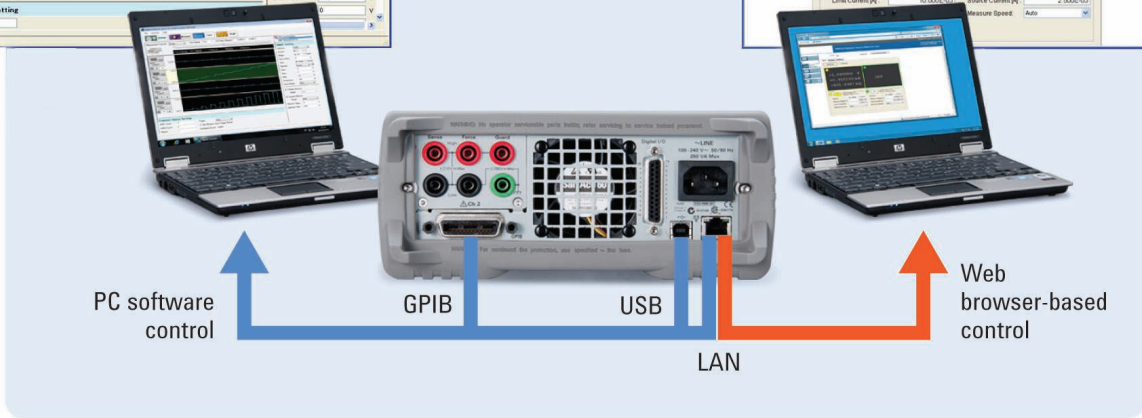
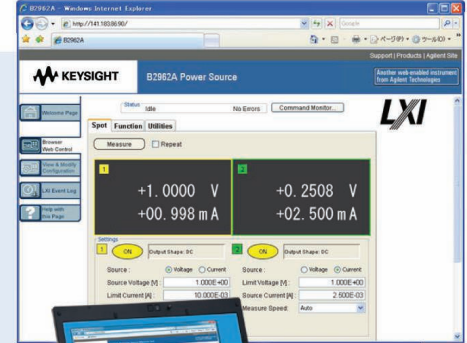
Figure 15. The B2961A/B2962A can emulate the DC voltage/current output characteristics of many devices and samples

## Multiple communication methods and free software provide flexible and convenient remote control options

### Keysight B2900A Quick I/V Measurement Software



### Keysight B2900A Graphical Web Interface



### Free PC-based software eliminates the need to program

Keysight supplies PC-based Quick I/V Measurement Software with the Keysight B2961A/B2962A at no charge. This software makes it easy to quickly setup and perform voltage or current sourcing and to display measurement data in tables and graphs without the need to program. Using Keysight Quick IV software you can control up to four instrument channels.

### Easy web browser control

The Keysight B2961A/B2962A 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 Keysight B2961A/B2962A unit and begin making interactive tests

### Ready-to-use instrument drivers simplify programming

For users that want to create their own customized software, IVI-C and IVI-COM drivers for the Keysight B2961A/B2962A are available. In addition, National Instruments LabView drivers are available at NI.COM.

## Selection Guide and Ordering Information

Key Specifications		B2961A	B2962A	B2961A or B2962A with Ultra-low Noise Filter	B2961A or B2962A with Low Noise Filter	
<b>No. of channels</b>		1	2	1 or 2	1 or 2	
<b>Max output</b>	Voltage	±210 V	±210 V	±42 V	±210 V	
	Current	DC	±3.03 A	±3.03 A	±105 A	±3.03 A
		Pulsed	±10.5 A	±10.5 A	±105 A	±10.5 A
Power		31.8 W	31.8 W	4.4 W	31.8 W	
<b>Source</b>	Max digits	6.5	6.5	6.5	6.5	
	Min resolution	Voltage	100 nV	100 nV	100 nV	100 nV
		Current	10 fA	10 fA	10 pA	10 pA
<b>Measurement</b>	Max Digits	4.5	4.5	4.5	4.5	
<b>Noise<sup>1</sup></b>	0.1 Hz to 10 Hz	< 5 $\mu$ Vpp	< 5 $\mu$ Vpp	< 5 $\mu$ Vpp	< 5 $\mu$ Vpp	
		< 1 pApp	< 1 pApp	< 1 pApp	< 1 pApp	
	10 Hz to 20 MHz	3 mVrms	3 mVrms	10 $\mu$ Vrms 1 nVrms / $\sqrt{\text{Hz}}$ @ 10 kHz	350 $\mu$ Vrms	
<b>View modes</b>	Single view	YES	YES	YES	YES	
	Dual view	NO	YES	NO (B2961A) or YES (B2962A)	NO (B2961A) or YES (B2962A)	
	Graph view	YES	YES	YES	YES	

1. Supplemental characteristics

### Ordering Information

Model number	Description
<b>B2961A</b>	6.5 digit low noise power source: 32 W, 210 V, 3 A, 1 channel
<b>B2962A</b>	6.5 digit low noise power source: 32 W, 210 V, 3 A, 2 channel

### Options

#### User's Guide (printed manual)

ABA	English
ABJ	Japanese

#### Calibration

A6J	ANZI Z540 compliant calibration
UK5	Commercial calibration certified with test data

#### External Low Noise Filter

LN1	Ultr-low Noise Filter (42 V / 105 mA) for B2961A/62A
LN2	Low Noise Filter (210 V / 3 A) for B2961A/62A

#### Rack Mount Kit

1CM	Rack mount kit
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### Accessories

#### External Low Noise Filter

N1294A-021	Ultra-low noise filter (42 V / 105 mA) for B2961A/62A
N1294A-022	Low noise filter (210 V / 3 A) for B2961A/62A

#### Trigger Adapter

N1294A-031	GPIO – BNC trigger adapter
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## B2901A/B2902A/B2911A/B2912A Precision Source/Measure Unit



If you need more measurement resolutions and capabilities, please check SMU (Source/Measure Unit) products. Keysight provides cost-effective SMU products with superior performance and a best-in-class graphical user interface.

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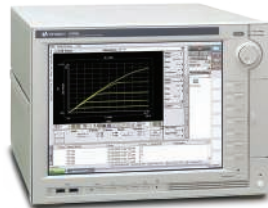
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