Keysight B2961A/B2962A
6.5 Digit Low Noise Power Source
1 ch/2 ch
210 V, 3 A DC/10.5 A Pulse, 31.8W
100 nV/10 fA Resolution

Data Sheet
The general trend in electronics is for equipment and devices to become smaller, integrated and more portable. More intelligence, integration and miniaturization are demanded along with lower power consumption to maximize battery life. Researchers, designers and developers pursuing the innovations and breakthroughs needed to develop these next-generation devices typically require basic equipment such as power supplies and sources for this work. Therefore, the power supplies and sources used by these innovators also need to possess features advanced enough to meet the difficult measurement challenges they often face. The Keysight Technologies, Inc. B2900A series of precision instruments includes two next generation of power supply/source solutions that meet these needs: the B2961A 6.5 Digit Low Noise Power Source 1ch and the B2962A 6.5 Digit Low Noise Power Source 2ch. These products achieve best in class precision, support wide bipolar output ranges and have an extremely low noise floor. They also possess graphing capability and other advanced features. This makes them ideal companion products for other instruments such as oscilloscopes, network analyzers, spectrum analyzers, frequency counters, digital multi meters, nanovoltmeters, etc.

- The world’s only 6.5 digit resolution power source with a bipolar sourcing range from 100 nV to 210 V and 10 fA to 3 A (DC)/10.5 A (pulsed).
- Optional ultra-low noise filters can reveal your device’s true characteristics with low noise performance (10 μVrms from 10 Hz to 20 MHz, 1 nVrms/$\sqrt{Hz}$ @10 kHz).
- Supports both pre-defined and user-defined arbitrary waveform generation (1 mHz to 10 kHz)
- Output voltage and current can be verified quickly using the built-in 4.5 digit voltage/current monitor
- Output voltage and current can be checked graphically on the B2900A’s 4.3” LCD front panel display using the time-domain voltage/current waveform viewer.
- Programmable output resistance feature enables the emulation of a wide variety of DC voltage and current characteristics, such as driver ICs, regulators, energy generating devices, etc.
- Free application software for easy PC-based instrument control
- LXI Core conformant, USB 2.0, GPIB, LAN and digital I/O interface

**A revolutionary power supply for precision low noise voltage/current sourcing featuring 6.5 digit, 100 nV/10 fA resolution, 10 μVrms noise, bipolar 210 V/3 A (10.5 A pulse) range, innovative sourcing functions, and GUI**
The world's only 6.5 digit source with a bipolar range of 100 nV to 210 V and 10 fA to 10.5 A

The Keysight B2961A/B2962A Power Source has broad voltage (up to ±210 V) and current (up to ±3 A DC and ±10.5 A pulsed) sourcing ranges and excellent 6.5 digit resolution (minimum 100 nV/10 fA program resolution). Unlike a typical power supply/source, it supports 4-quadrant operation that gives you the freedom to accurately and precisely supply any voltage or current contained within its ranges regardless of polarity.

Noise floor of 10 μVrms (1 nVrms / √Hz @10 kHz) outperforms even linear power supplies

Low noise performance is required for the development of noise sensitive devices such as VCOs (voltage controlled oscillators), ADC/DAC, new material based components, etc. However, conventional power supplies and sources have not been able to achieve the noise level required for these applications. The Keysight B2961A/B2962A supports an optional external low noise filter that enables ultra-low noise performance down to 10 μVrms and 1 nVrms/√Hz (at 10 kHz), providing unparalleled low noise performance in a low-cost bench-top power source.

Innovative sourcing capabilities enable test and evaluation not possible with conventional power supplies and sources

The Keysight B2961A/B2962A supports a number of innovative sourcing capabilities for test and evaluation that are not available on conventional power supplies and sources. For example, the Keysight B2961A/B2962A has the ability to generate not only DC signals but also pulsed, swept and arbitrary waveforms (1 mHz to 10 kHz) in both voltage and current. Its arbitrary waveform generation capability supports common waveform types such as sine, ramp, square, etc. in addition to user-defined waveforms.

The Keysight B2961A/B2962A also supports an advanced programmable output resistance feature that allows you to specify either a particular output resistance or a specific voltage versus current source characteristic. This feature is ideal for emulating a wide variety of devices (such as batteries, photovoltaic cells, sensors, transducers, etc.) that are otherwise difficult to simulate.

Finally, the Keysight B2961A/B2962A has a 4.3 inch wide LCD display and all of its capabilities are accessible from its front-panel graphical user interface (GUI). The graphical display not only simplifies user-operation, but it also facilitates viewing measurement results. With the built-in 4.5 digit voltage and current monitoring capability, you can check the output voltage or current graphically by the time domain voltage/current waveform viewer. This permits quick checking and debugging of measurement results without the need for additional equipment.
## Key Specifications of B2900A Series

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>B2961A/B2962A</th>
<th>B2961A/B2962A with Ultra Low Noise Filter</th>
<th>B2961A/B2962A with Low Noise Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC or arbitrary waveform output</td>
<td>Maximum voltage</td>
<td>210 V</td>
<td>± 42 V</td>
</tr>
<tr>
<td></td>
<td>Maximum current</td>
<td>± 3.03 A</td>
<td>± 105 mA</td>
</tr>
<tr>
<td></td>
<td>Pulsed</td>
<td>Maximum voltage</td>
<td>± 200 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum current</td>
<td>± 10.5 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum Power</td>
<td>31.8 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output Polarity</td>
<td>Bipolar (4-quadrant operation)</td>
</tr>
<tr>
<td>Source Resolution</td>
<td></td>
<td>Minimum resolution</td>
<td>100 nV/10 fA</td>
</tr>
<tr>
<td>Output Capability</td>
<td></td>
<td>DC</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulsed</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweep DC/Pulse/List</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arbitrary wave form</td>
<td>Yes</td>
</tr>
<tr>
<td>Noise ¹</td>
<td>0.1 to 10 Hz</td>
<td>&lt; 5 µVpp</td>
<td>&lt; 5 µVpp</td>
</tr>
<tr>
<td></td>
<td>10 to 20 M Hz</td>
<td>3 mVrms</td>
<td>10 µVrms</td>
</tr>
<tr>
<td>Measurement Capability</td>
<td>Voltage range</td>
<td>200 mV to 200 V</td>
<td>200 mV to 200 V</td>
</tr>
<tr>
<td></td>
<td>Current range</td>
<td>10 nA to 10 A</td>
<td>10 µA to 100 mA</td>
</tr>
<tr>
<td>Programmable Output Resistance</td>
<td>Constant R</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>V/I emulation</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>View Mode</td>
<td>Single View</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Waveform Preview</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Dual View</td>
<td>Only 2ch model (B2962A)</td>
<td>Only 2ch model (B2962A)</td>
</tr>
<tr>
<td></td>
<td>Graph View</td>
<td>(time-domain voltage/current waveform viewer)</td>
<td>Yes</td>
</tr>
<tr>
<td>Max Capacitive Lead</td>
<td>0.01 µF (normal mode)</td>
<td>50 µF</td>
<td>1 mF</td>
</tr>
<tr>
<td>Interface</td>
<td>GPIB, USB 2.0, LAN and digital I/O (LXI Core Conformant)</td>
<td>GPIB, USB 2.0, LAN and digital I/O (LXI Core Conformant)</td>
<td>GPIB, USB 2.0, LAN and digital I/O (LXI Core Conformant)</td>
</tr>
</tbody>
</table>

1. Supplemental characteristics.
2. Maximum voltage output is limited to 42 V for 200 V range.
3. 10 A pulse range is not supported.
Specifications

Specification conditions
The source and measurement accuracy are specified under the conditions listed below.
1. Temperature: 23 °C ± 5 °C
2. Humidity: 30 % to 80 % RH
3. After 60 minutes warm-up
4. Ambient temperature change less than ±3 °C after self-calibration execution
5. Calibration period: 1 year
6. Measurement speed: 1 PLC (Power Line Cycle)

Maximum voltage and current

<table>
<thead>
<tr>
<th>DC, Pulsed or Arbitrary Waveform Output</th>
<th>Maximum Voltage</th>
<th>Maximum Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>210 V</td>
<td>0.105 A</td>
</tr>
<tr>
<td></td>
<td>21 V</td>
<td>1.515 A</td>
</tr>
<tr>
<td></td>
<td>6 V</td>
<td>3.03 A</td>
</tr>
<tr>
<td>Pulsed only</td>
<td>200 V</td>
<td>1.515 A</td>
</tr>
<tr>
<td></td>
<td>6 V</td>
<td>10.5 A</td>
</tr>
</tbody>
</table>

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

Maximum current limitation

<table>
<thead>
<tr>
<th>Ch1 voltage</th>
<th>Ch2 voltage</th>
<th>Max total current limitation of Ch1 and Ch2</th>
</tr>
</thead>
<tbody>
<tr>
<td>±(0 V &lt; V ≤ 6 V)</td>
<td>±(0 V &lt; V ≤ 6 V)</td>
<td>Ch1 current + Ch2 current ≤ 4 A</td>
</tr>
<tr>
<td>±(0 V &lt; V ≤ 6 V)</td>
<td>±(6 V &lt; V ≤ 21 V)</td>
<td>Ch1 current + Ch2 current x 1.6 ≤ 4 A</td>
</tr>
<tr>
<td>±(6 V &lt; V ≤ 21 V)</td>
<td>±(0 V &lt; V ≤ 6 V)</td>
<td>Ch1 current + Ch2 current x 0.625 ≤ 2.5 A</td>
</tr>
<tr>
<td>±(6 V &lt; V ≤ 21 V)</td>
<td>±(6 V &lt; V ≤ 21 V)</td>
<td>Ch1 current + Ch2 current ≤ 2.5 A</td>
</tr>
</tbody>
</table>
## Source Specifications

### DC Voltage source specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Programming Resolution</th>
<th>Accuracy (% reading + offset)</th>
<th>Noise (peak to peak) 0.1 Hz to 10 Hz</th>
<th>Maximum Voltage (over range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±200 mV</td>
<td>100 nV</td>
<td>±(0.015 % + 225 μV)</td>
<td>≤ 5 μV</td>
<td>±210 mV</td>
</tr>
<tr>
<td>±2 V</td>
<td>1 μV</td>
<td>±(0.02 % + 350 μV)</td>
<td>≤ 15 μV</td>
<td>±2.1 V</td>
</tr>
<tr>
<td>±20 V</td>
<td>10 μV</td>
<td>±(0.015 % + 5 mV)</td>
<td>≤ 150 μV</td>
<td>±21 V</td>
</tr>
<tr>
<td>±200 V</td>
<td>100 μV</td>
<td>±(0.015 % + 50 mV)</td>
<td>≤ 1.5 mV</td>
<td>±210 V</td>
</tr>
</tbody>
</table>

1. Supplemental characteristics

## DC Current source specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Programming Resolution</th>
<th>Accuracy (% reading + offset)</th>
<th>Noise (peak to peak) 0.1 Hz to 10 Hz</th>
<th>Maximum Current (over range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 nA</td>
<td>10 fA</td>
<td>±(0.10 % + 50 pA)</td>
<td>≤ 1 pA</td>
<td>±10.5 nA</td>
</tr>
<tr>
<td>±100 nA</td>
<td>100 fA</td>
<td>±(0.06 % + 100 pA)</td>
<td>≤ 2 pA</td>
<td>±105 nA</td>
</tr>
<tr>
<td>±1 μA</td>
<td>1 pA</td>
<td>±(0.025 % + 500 pA)</td>
<td>≤ 20 pA</td>
<td>±1.05 μA</td>
</tr>
<tr>
<td>±10 μA</td>
<td>10 pA</td>
<td>±(0.025 % + 1.5 nA)</td>
<td>≤ 60 pA</td>
<td>±10.5 μA</td>
</tr>
<tr>
<td>±100 μA</td>
<td>100 pA</td>
<td>±(0.02 % + 25 nA)</td>
<td>≤ 1 nA</td>
<td>±105 μA</td>
</tr>
<tr>
<td>±1 mA</td>
<td>1 nA</td>
<td>±(0.02 % + 200 nA)</td>
<td>≤ 6 nA</td>
<td>±1.05 mA</td>
</tr>
<tr>
<td>±10 mA</td>
<td>10 nA</td>
<td>±(0.02 % + 2.5 μA)</td>
<td>≤ 100 nA</td>
<td>±10.5 mA</td>
</tr>
<tr>
<td>±100 mA</td>
<td>100 nA</td>
<td>±(0.02 % + 20 μA)</td>
<td>≤ 600 nA</td>
<td>±105 mA</td>
</tr>
<tr>
<td>±1 A</td>
<td>1 μA</td>
<td>±(0.03 % + 1.5 mA)</td>
<td>≤ 20 μA</td>
<td>±1.05 A</td>
</tr>
<tr>
<td>±1.5 A</td>
<td>1 μA</td>
<td>±(0.05 % + 3.5 mA)</td>
<td>≤ 20 μA</td>
<td>±1.515 A</td>
</tr>
<tr>
<td>±3 A</td>
<td>10 μA</td>
<td>±(0.4 % + 7 mA)</td>
<td>≤ 60 μA</td>
<td>±3.03 A</td>
</tr>
<tr>
<td>±10 A²</td>
<td>10 μA</td>
<td>±(0.4 % + 25 mA)²</td>
<td>≤ 10 μA</td>
<td>±10.5 A</td>
</tr>
</tbody>
</table>

1. Supplemental characteristics
2. 10 A range is available only for pulse mode, not available for DC mode.
3. Measurement speed: 0.01 PLC
Source Supplemental Characteristics
Pulsing Capabilities

Minimum programmable pulse width: 50 μs
Pulse width programming resolution: 1 μs
Pulse width definition:
The time from 10 % leading to 90 % trailing edge as follows.

![Diagram illustrating pulse width and duty cycle]

Maximum pulse width and duty cycle:

<table>
<thead>
<tr>
<th>DC or pulsed</th>
<th>Pulsed</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Voltage</td>
<td>Maximum Peak Current</td>
</tr>
<tr>
<td>DC or pulsed</td>
<td>210 V</td>
<td>0.105 A</td>
</tr>
<tr>
<td></td>
<td>21 V</td>
<td>1.515 A</td>
</tr>
<tr>
<td></td>
<td>6 V</td>
<td>3.03 A</td>
</tr>
<tr>
<td>Pulsed only</td>
<td>200 V</td>
<td>1.515 A</td>
</tr>
<tr>
<td></td>
<td>180 V</td>
<td>1.05 A</td>
</tr>
<tr>
<td></td>
<td>6 V</td>
<td>0.5 A</td>
</tr>
</tbody>
</table>

1. Maximum current limitation: For 21 V/1.515 A and 6 V / 3.03 A ranges, total maximum current is limited by the table in page 3 for using 2 channels. Maximum current is not limited for using 1 channel only.

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

<table>
<thead>
<tr>
<th>Source Value</th>
<th>Limit Value</th>
<th>Load</th>
<th>Source Settling (% of range)</th>
<th>Minimum Pulse Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 V</td>
<td>1.5 A</td>
<td>200 Ω</td>
<td>0.1 %</td>
<td>1 ms</td>
</tr>
<tr>
<td>6 V</td>
<td>10.5 A</td>
<td>0.6 Ω</td>
<td>0.1 %</td>
<td>0.2 ms</td>
</tr>
<tr>
<td>1.5 A</td>
<td>200 V</td>
<td>65 Ω</td>
<td>0.1 %</td>
<td>2.5 ms</td>
</tr>
<tr>
<td>10.5 A</td>
<td>6 V</td>
<td>0.5 Ω</td>
<td>0.1 %</td>
<td>0.2 ms</td>
</tr>
</tbody>
</table>
Sweep Capabilities
Sweep mode: linear, logarithmic (log) or list
Sweep direction: single or double
Type: DC, or pulse
Number of steps: 1 to 100,000
Min programmable value to create list sweep waveform:
  Minimum 10 μs with 1 μs resolution

Arbitrary Waveform Generation Capabilities
Pre-defined waveforms and user-defined waveforms are supported.
Pre-defined waveforms:
  Supported waveforms: Sine, Square, Ramp, Triangle, Trapezoid and Exponential
  Frequency: 1 mHz to 10 kHz
  Programmable frequency/timing resolution: 1 μHz nominal (sine), 250 ns
  (waveforms other than sine)
  Frequency accuracy of time base: ±50 ppm

User-defined waveforms:
  Waveform length: 1 to 100,000 points
  Sample rate: 0.001 to 100,000 Sa/s, 250 ns resolution
  Storage: Non-volatile memory and USB memory are both available.
  Non-volatile memory can store one waveform with a length of up to 2500 points. USB memory can store waveforms of up to 100k points.
Output Characteristics

Temperature coefficient (0 °C to 18 °C and 28 °C to 50 °C):
±(0.1 x Accuracy specification) °C.

Max output power and source/sink limits:
31.8 W
±6 V @ ±3.03 A, ±21 V @ ±1.515 A, ±210 V @ ±105 mA, four quadrant source or sink operation.

Output location: Channel 1 at front, and channel 2 at rear.

Output connectors:
Banana jack. Triaxial connections are recommended for sourcing less than 1 nA. A banana jack to triaxial adapter is available for low current source.

Low terminal connection: Chassis grounded or floating

Sensing Modes: 2-wire or 4-wire (Remote-sensing) connections

Maximum load:
Normal mode: 0.01 μF
High Capacitance mode: 50 μF

DC floating voltage: Maximum ±250 V DC between low force and chassis ground.

Guard offset voltage (V source): <4 mV

Remote sense operation range:
Maximum voltage between High Force and High Sense = 3 V
Maximum voltage between Low Force and Low Sense = 3 V

Common mode isolation: >1 GΩ, <4500 pF

Maximum sense lead resistance: 1kΩ for rated accuracy

Sense input impedance: >10 GΩ

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.

Over temperature protection:
Output turns off then resets at over temperature sensed internally.

Voltage Source:

Settling time:
Time required to reach 0.1 % of final value at open load condition.
Step is 10 % to 90 % range.

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Settling Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>&lt; 50 μs</td>
</tr>
<tr>
<td>2 V</td>
<td>&lt; 50 μs</td>
</tr>
<tr>
<td>20 V</td>
<td>&lt; 110 μs</td>
</tr>
<tr>
<td>200 V</td>
<td>&lt; 700 μs</td>
</tr>
</tbody>
</table>
Slew rate/small signal bandwidth

<table>
<thead>
<tr>
<th>Current range</th>
<th>200 mV</th>
<th>2 V</th>
<th>20 V</th>
<th>200 V</th>
<th>Load Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mA</td>
<td>44 mV/µs, 28 kHz</td>
<td>57 mV/µs, 18 kHz</td>
<td>57 mV/µs, 28 kHz</td>
<td>57 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
</tr>
<tr>
<td>10 mA</td>
<td>44 mV/µs, 28 kHz</td>
<td>360 mV/µs, 20 kHz</td>
<td>360 mV/µs, 17 kHz</td>
<td>360 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
</tr>
<tr>
<td>100 mA</td>
<td>28 mV/µs, 28 kHz</td>
<td>28 mV/µs, 20 kHz</td>
<td>28 mV/µs, 28 kHz</td>
<td>57 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
</tr>
<tr>
<td>1 A</td>
<td>25 mV/µs, 28 kHz</td>
<td>25 mV/µs, 28 kHz</td>
<td>25 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
<td></td>
</tr>
<tr>
<td>1.5 A</td>
<td>36 mV/µs, 28 kHz</td>
<td>36 mV/µs, 18 kHz</td>
<td>36 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
<td></td>
</tr>
<tr>
<td>3 A</td>
<td>27 mV/µs, 28 kHz</td>
<td>27 mV/µs, 28 kHz</td>
<td>27 mV/µs, 28 kHz</td>
<td>10 MΩ</td>
<td></td>
</tr>
</tbody>
</table>

Note: Slew rate and small signal bandwidth can be down to -20% in maximum.

Noise 10 Hz to 20 MHz : < 3 mVrms, 20 V range, without external filter
V source overshoot:
< ±0.1 % +10 mV). Step is 10 % to 90 % range, resistive load.
Voltage source range change overshoot:
< 250 mV. 100 kΩ load, 20 MHz bandwidth
Line regulation/load regulation: Included in voltage source specifications.
Load transient recovery time
Time to recover to within the settling band following a load change.

<table>
<thead>
<tr>
<th>Settling band</th>
<th>100 mA current change</th>
<th>800 mA current change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>10 µs</td>
<td>30 µs</td>
</tr>
</tbody>
</table>

1. At a load change to change the flowing current from +50 mA to +150 mA, 10 V voltage force, 20 V range, 1 A limit.
2. At a load change to change the flowing current from +100 mA to +900 mA, 10 V voltage force, 20 V range, 1.5 A limit.

Current Source:
Setting 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.

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Settling Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 nA</td>
<td>&lt;10 ms</td>
</tr>
<tr>
<td>100 nA</td>
<td>&lt;10 ms</td>
</tr>
<tr>
<td>1 µA</td>
<td>&lt;500 µs</td>
</tr>
<tr>
<td>10 µA</td>
<td>&lt;250 µs</td>
</tr>
<tr>
<td>100 µA</td>
<td>&lt;250 µs</td>
</tr>
<tr>
<td>1 mA</td>
<td>&lt;80 µs</td>
</tr>
<tr>
<td>10 mA</td>
<td>&lt;80 µs</td>
</tr>
<tr>
<td>100 mA</td>
<td>&lt;80 µs</td>
</tr>
<tr>
<td>1 A</td>
<td>&lt;80 µs</td>
</tr>
<tr>
<td>1.5 A</td>
<td>&lt;80 µs</td>
</tr>
<tr>
<td>3 A</td>
<td>&lt;80 µs</td>
</tr>
</tbody>
</table>
**Slew rate/small signal bandwidth**

<table>
<thead>
<tr>
<th>Current range</th>
<th>Voltage Range</th>
<th>Load Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200 mV</td>
<td>2 V</td>
</tr>
<tr>
<td>1 mA</td>
<td>94 µA/µs, 21 kHz</td>
<td>160 µA/µs, 21 kHz</td>
</tr>
<tr>
<td>10 mA</td>
<td>94 µA/µs, 21 kHz</td>
<td>670 µA/µs, 21 kHz</td>
</tr>
<tr>
<td>100 mA</td>
<td>8 mA/µs, 10 kHz</td>
<td>8 mA/µs, 10 kHz</td>
</tr>
<tr>
<td>1 A</td>
<td>78 mA/µs, 12 kHz</td>
<td>94 mA/µs, 12 kHz</td>
</tr>
<tr>
<td>1.5 A</td>
<td>125 mA/µs, 12 kHz</td>
<td>135 mA/µs, 12 kHz</td>
</tr>
<tr>
<td>3 A</td>
<td>250 mA/µs, 13 kHz</td>
<td>270 mA/µs, 13 kHz</td>
</tr>
</tbody>
</table>

Note: Slew rate and small signal bandwidth can be down to -20% in maximum.

**I source overshoot:**

<±0.1% (<±0.3% for 3 A range). Step is 10% to 90% range, resistive load.

**Current source range change overshoot:**

≤ 250 mV/R load, 20 MHz bandwidth

**Line regulation/load regulation:** Included in current source specifications.

### High Capacitance Mode

The high capacitance mode supports sources and measurements when the load capacitance is greater than 0.01 µF. In high capacitance mode the maximum allowed load capacitance value is 50 µF.

**Voltage output settling time:**

Time required to reach within 0.1% of final value with 4.7 µF capacitive load on a fixed range at specified current range and limit value.

- 200 mV, 2 V Ranges: 600 µs, 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 0.1% of the final value after the voltage source stabilizes in a fixed range. Vout is 5 V unless noted.

- 1 µA Range: 230 ms
- 10 µA, 100 µA Ranges: 23 ms
- 1 mA, 10 mA Ranges: 0.23 ms
- 100 mA to 3 A Ranges: 100 µs

**Mode change delay:**

Delay into High Cap mode:

- 1 µA Range: 230 ms
- 10 µA, 100 µA 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.
- Current limit: ± 1 µA
Programmable Output Resistance

In its default state the Keysight B2961A/B2962A behaves like either an ideal voltage source with a negligibly small source resistance or an ideal current source with a huge source resistance. The programmable output resistance feature allows you to specify either a particular output resistance or a specific voltage versus current source characteristic. This feature is ideal for emulating a wide variety of devices (such as batteries, photovoltaic cells, sensors, transducers, etc.) that are otherwise difficult to simulate.

Mode: Constant or V/I Emulation

Programmable resistance range:

Series resistance (Rs) at voltage source:
- \((\text{Load Resistance}/2) \leq \text{Rs} \leq \text{Load Resistance}\), for resistive load
- \(\text{Rs} \leq 25 \, \Omega\) at 3 A range, \(\leq 100 \, \Omega\) at 1 A and 1.5 A ranges, \(\leq 1 \, \kappa\Omega\) at 100 mA range, or \(\leq 10 \, \kappa\Omega\) at other ranges,
- \(\text{Rs}\) can be limited by capacitive load.

Shunt resistance (Rsh) at current source:
- \(\text{Load Resistance} \leq \text{Rsh} \leq 2 \, \Omega\), for resistive load
- \(\text{Rsh} \geq 10 \, \text{M}\Omega\) at 10 nA and 100 nA ranges, \(\geq 1 \, \text{M}\Omega\) at other ranges
- \(\text{Rsh}\) can be limited by capacitive load.

Emulation mode:

Emulation mode allows you to program a non-linear resistance. You specify the desired voltage/current characteristic using a tabular format.

Maximum number of points: 16 (piecewise linear interpolation between points)

* Programmable Output Resistance is only available for DC output.

External Low Noise Filter Supplemental Characteristics

The Keysight B2961A/B2962A supports dedicated external low-noise filters; they are available as an option or as an accessory. They connect to the banana jack outputs of each Keysight B2961A/B2962A channel.

Ultra Low Noise Filter (N1294A-021)
- Maximum output range: 42 V / 105 mA (DC)
- Output connector: BNC
- Output / residual resistance: 50 Ω nominal (2-wire), 0.3 Ω nominal (4-wire, 4-wire connected inside of filter)
- Small signal bandwidth: 23 Hz nominal (2-wire), 8 Hz nominal (4-wire)

Noise

Voltage source
- 0.1 to 10 Hz: Same as voltage specification
- 10 to 20 MHz: \(10 \, \mu\text{Vrms}, 1\,\text{Vrms}/\sqrt{\text{Hz}}\) at 10 kHz (20 V / 100 mA range, 50 Ω load)

Current source
- 0.1 to 10 Hz: Same as current specification
- 10 to 1 MHz: \(300 \, \text{nArms}\) (20 V / 100 mA range, 10 Ω load)
Settling time
Voltage source 1: 80 ms (2-wire), 140 ms (4-wire)
Current source 2: 11 ms (2-wire), 150 ms (4-wire)
1. Time required to reach within 0.1% of final value at open load condition. Step is 10% to 90% range. At 20 V range, 100 mA limit/100 mA range
2. Time required to reach within 0.1% of final value at short condition. Step is 10% to 90% range. At 100 mA range, 20 V limit / 20V range

Load transient recovery time
Time to recover to within the settling band following a load change.

<table>
<thead>
<tr>
<th>50 mA current change 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting band</td>
</tr>
<tr>
<td>Time</td>
</tr>
</tbody>
</table>

1. At a load change to change the flowing current from +10 mA to +60 mA, 10 V voltage force, 20 V range, 100 mA limit.

Supported ranges:
Voltage: 200 mV to 200 V ranges (42 V maximum)
Current: 10 µA to 100 mA ranges (105 mA maximum)
Maximum capacitive load: 50 µF (for 4-wire)
Dimensions: 41 mm H x 58.2 mm W x 141.5 mm D (When the filter is inserted to the output connector of B2961A/B2962A, the depth is 126.5 mm.)
Weight: 0.3 kg

Note:
- The 10 A pulse range and programmable output resistance capability are not supported by external filters.
- For the current output, only DC is supported when using with external filters.
- The current measurement data monitored by the built-in voltage/current monitor can be influenced by the charge and discharge current of the capacitance inside of the filters.
Low Noise Filter (N1294A-022)

Maximum output range: 210 V / 3 A (DC)
Output connector/connection: Banana, 2-wire/4-wire
Output / residual resistance: 0.3 Ω nominal (2-wire)
Small signal bandwidth: 2 kHz nominal (1 A and 3 A ranges), 800 Hz nominal (100 mA range)

Noise

Voltage source
- 0.1 to 10 Hz: Same as voltage specification
- 10 to 20 MHz : 350 µVrms (20 V / 1.5 A range, 50 Ω load)

Current source
- 0.1 to 10 Hz: Same as current specification
- 10 to 1 MHz : 450 µArms (20 V / 1.5 A range, 0.67 Ω load)

Settling time

Voltage source : 640 µs (2-wire/4-wire)
Current source : 1.2 ms (2-wire/4-wire)

1. Time required to reach within 0.1 % of final value at open load condition. Step is 10 % to 90 % range. At 20 V range, 1.5 A limit / 1.5 A range
2. Time required to reach within 0.1 % of final value at short condition. Step is 10 % to 90 % range. At 1.5 A range, 20 V limit / 20V range

Load transient recovery time

Time to recover to within the settling band following a load change.

<table>
<thead>
<tr>
<th>Settling band</th>
<th>± 20 mV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>450 µs (2-wire), 650 µs (4-wire)</td>
</tr>
</tbody>
</table>

1. At a load change to change the flowing current from +100 mA to +900 mA, 10 V voltage force, 20 V range, 1.5 A limit.

Supported ranges:

- Voltage: 200 mV to 200 V ranges (210 V maximum)
- Current: 10 µA to 3 A ranges (3 A maximum)

Maximum capacitive load: 1 mF

Dimensions: 41.5 mm H x 58.2 mm W x 127.5 mm D (When the filter is inserted to the output connector of B2961A/B2962A, the depth is 112.5 mm.)

Weight: 0.25 kg

Note:
- The 10 A pulse range and programmable output resistance capability are not supported by external filters.
- For the current output, only DC is supported when using with external filters.
- The current measurement data monitored by the built-in voltage/current monitor can be influenced by the charge and discharge current of the capacitance inside of the filters.
Built-in Voltage/Current Monitor Specifications

### Voltage Measurement Specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Measurement Resolution</th>
<th>Accuracy (% reading + offset)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±200 mV</td>
<td>10 µV</td>
<td>±(0.015 % + 225 µV)</td>
</tr>
<tr>
<td>±2 V</td>
<td>100 µV</td>
<td>±(0.02 % + 350 µV)</td>
</tr>
<tr>
<td>±20 V</td>
<td>1 mV</td>
<td>±(0.015 % + 5 mV)</td>
</tr>
<tr>
<td>±200 V</td>
<td>10 mV</td>
<td>±(0.015 % + 50 mV)</td>
</tr>
</tbody>
</table>

### Current Measurement Specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Measurement Resolution</th>
<th>Accuracy (% reading + offset)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10 nA</td>
<td>1 pA</td>
<td>±(0.10 % + 50 pA)</td>
</tr>
<tr>
<td>±100 nA</td>
<td>10 pA</td>
<td>±(0.06 % + 100 pA)</td>
</tr>
<tr>
<td>±1 µA</td>
<td>100 pA</td>
<td>±(0.025 % + 500 pA)</td>
</tr>
<tr>
<td>±10 µA</td>
<td>1 nA</td>
<td>±(0.025 % + 1.5 nA)</td>
</tr>
<tr>
<td>±100 µA</td>
<td>10 nA</td>
<td>±(0.02 % + 25 nA)</td>
</tr>
<tr>
<td>±1 mA</td>
<td>100 nA</td>
<td>±(0.02 % + 200 nA)</td>
</tr>
<tr>
<td>±10 mA</td>
<td>1 µA</td>
<td>±(0.02 % + 2.5 µA)</td>
</tr>
<tr>
<td>±100 mA</td>
<td>10 µA</td>
<td>±(0.02 % + 20 µA)</td>
</tr>
<tr>
<td>±1 A</td>
<td>100 µA</td>
<td>±(0.03 % + 1.5 mA)</td>
</tr>
<tr>
<td>±1.5 A</td>
<td>100 µA</td>
<td>±(0.05 % + 3.5 mA)</td>
</tr>
<tr>
<td>±3 A</td>
<td>1 mA</td>
<td>±(0.4 % + 7 mA)</td>
</tr>
<tr>
<td>±10 A ¹</td>
<td>1 mA</td>
<td>±(0.4 % + 25 mA) ²</td>
</tr>
</tbody>
</table>

1. 10 A range is available only for pulse mode, not available for DC mode.
2. Measurement speed: 0.01 PLC
Built-in Voltage/Current Monitor Supplemental Characteristics

Temperature coefficient (0 °C to 18 °C and 28 °C to 50 °C):
±(0.1 x Accuracy specification) /°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.

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Current Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2 V</td>
<td>2 V to 200 V</td>
</tr>
<tr>
<td>10 nA</td>
<td>100 nA</td>
</tr>
<tr>
<td>1 A to 3 A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Derating accuracy with PLC setting&lt; 1 PLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Range</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>0.1 PLC</td>
</tr>
<tr>
<td>0.01 PLC</td>
</tr>
<tr>
<td>0.001 PLC</td>
</tr>
</tbody>
</table>

Data Buffer
A data buffer is an array of measurement elements. Each element holds the following values.
- Source setting
- Time stamp
- Measurement value
- Status

Maximum buffer size: 100,000 points / channel

Triggering and Timing Specifications

Triggering
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
LAN[0-7] Event Receiving Latency: Unknown
LAN[0-7] Event Sending Latency: Unknown
Minimum trigger interval: 10 μs

Timer
Trigger timing resolution: 1 μs to 100 ms
Timer accuracy: ±50 ppm
Arm/trigger delay: 0 to 100,000 s
Arm/trigger interval: 10 μs to 100,000 s
Arm/trigger event: 1 to 100,000
Time stamp: TIMER value automatically saved when each measurement is triggered.

Supplemental Characteristics

Timer
Trigger timing resolution: 1 μs to 100 ms
Timer accuracy: ±50 ppm
Arm/trigger delay: 0 to 100,000 s
Arm/trigger interval: 10 μs to 100,000 s
Arm/trigger event: 1 to 100,000
Time stamp: TIMER value automatically saved when each measurement is triggered.
General Specifications

Environment
For use in indoor facilities

Temperature Range
- Operating: 0 °C to +55 °C
- Storage: -30 °C to +70 °C

Humidity Range
- Operating: 30 % to 80 % RH, non-condensing
- Storage: 10 % to 90 % RH, non-condensing

Altitude
- Operating: 0 m to 2000 m
- Storage: 0 m to 4600 m

Power Supply
- AC voltage: 90 V to 264 V
- Line frequency: 47 Hz to 63 Hz
- Maximum volt-amps: 250 VA

Cooling
- Forced air. Side intake and rear exhaust.

EMC
- IEC61326-1/EN61326-1
- AS/NZS CISPR 11

Safety
- IEC61010-1/EN61010-1
- CAN/CSA-C22.2 No. 61010-1-04, C/US

Certifications
- CE, cCSAus, C-Tick, KC

Dimensions
- Without handle & feet: 88 mm H x 213 mm W x 450 mm D
- Bench Configuration (with handle & feet): 180 mm H x 260 mm W x 480 mm D

Weight
- B2961A: 5.0 kg
- B2962A: 6.4 kg

Operation and Functions

Front Panel Interface
4.3” Color TFT WQVGA (480x272, with LED backlight) provides a graphical user interface (GUI) with the following features.
- Single, Dual View and time domain view (voltage vs. time or current vs. time) on Graph view
- Preview of output waveform
- Easy-to-use key operations
- Easy access to basic and advanced source/measurement capabilities
Single view

Single view provides basic and advanced settings and display capabilities for a selected channel from the front panel of the instrument. The DC, pulse and integrated arbitrary waveform generation capabilities do not require any additional controller or software. The GUI has a feature that allows you to preview an arbitrary waveform before application. It also displays the measured voltage and current for the selected channel with 4.5 digits of resolution.

Dual view

Dual view allows you to view both channels simultaneously and provides basic setting and display capabilities. It also displays the measured voltage and current for both channels 1 and 2 with 4.5 digits of resolution. This mode is available only for the B2962A.

Graph view

Graph View displays measurement results in the time-domain (V-t or I-t curves) for up to 2 channels. This is useful for quick checking and debug of the output waveform(s).

Easy-to-use Key Operations

- Numeric/alpha keys, assist key and rotary knob for easy operation.
- Numeric/alpha keys enable direct input of alphanumeric values.
- Assist key guides operation on the front panel.

Easy Access to Source/Measurement Capabilities

Settings:
- V/I source mode
- Source value
- Limit (compliance) value
- Sweep parameters
- Pulse parameters
- Parameters for built-in waveform
- Measure speed
- Range setting
- Trigger setting

Displays:
- Numeric display in 6.5 digits for sourcing
- Numeric display in 4.5 digits for monitoring
- V-t/I-t curve in Graph View

Advanced Capabilities:
- Trace memory for accumulating measurement (or math) result and collecting their statistics

File Operations (USB memory):
- Save
- System Configuration
- Measurement/Math result
- Trace data
- Graph screen dump
- Load
- System configuration
- List sweep data / User-defined arbitrary waveform data
Program and Interface Capabilities

Programming Language
The Keysight B2961A/B2962A supports SCPI (Standard Commands for Programmable Instruments).

Program Memory
Program memory allows you to store long strings of SCPI command lines once into the B2961A/B2962A's volatile memory and then recall those strings multiple times while the program is executing using a single SCPI command. By storing the command strings in memory, the time that would have been spent sending those same commands over a communication bus is eliminated. For tests that utilize lots of repeated code (such as subroutines), program memory can dramatically reduce test times.

Maximum number of characters in program name:
32, consisting of alphabetic characters, numbers, hyphens and underscores.
Maximum memory size: 100 KB (2500 lines typical)

LXI
LXI Core Conformant. The Keysight B2961A/B2962A follows specified LAN protocols and adheres to LXI requirements such as a built-in Web control server and IVI-COM driver.

Ethernet: 10/100Base-T
USB2.0: USB-TMC488 protocol (Rear x 1)
GPIB: IEEE-488.2 compliant
USB file system
USB 2.0 high-speed mass storage (MSC) class device (Front x 1)

Digital I/O interface
Connector: 25-pin female D.
Input/output pins: 14 open drain I/O bits
Absolute maximum input voltage: 5.25 V
Absolute minimum input voltage: -0.25 V
Logic low maximum input voltage: 0.8 V
Logic high minimum input voltage: 2.0 V
Maximum source current: 1 mA, Vout = 0 V
Maximum sink current: 50 mA, Vout = 5 V
5 V power supply pin:
Limited to 600 mA, solid state fuse protected.
Safety interlock pin:
One active high pin and one active low pin. Activation of both pin enables output voltage > 42 V.
Maximum Number of Simultaneously Triggered Units (using Digital I/O) 1: 8

Furnished accessories
Power cable
USB cable
Quick Reference (English)
Product Reference CD-ROM (including PDF manuals, Keysight B2900A Quick I/V Measurement Software and drivers)
Keysight I/O Library Suite
Software and drivers

Keysight B2900A Quick I/V Measurement Software
The Keysight B2961A/B2962A includes PC-based Keysight B2900A Quick I/V Measurement Software. This powerful software makes it easy to quickly setup and perform I/V measurements and to display the measurement data in a table or graph without the need to perform any programming. The software allows you

1. Supplemental Characteristic
to control up to four channels over a GPIB or LAN connection, or one B2900A series unit via a USB connection.

Operating environment:
Operating System: Windows 7 (64bit/32bit), XP SP3 (32-bit).
Other requirements: Microsoft .NET framework 4.0 or greater, and IO Libraries 16.0 or greater.

**Keysight B2900A Graphical Web Interface**
The Keysight B2900A Graphical Web Interface is a web browser based instrument control panel. It enables you to set up and perform a measurement easily and quickly from a web browser using the Keysight B2961A/B2962A's built-in web server. This allows you to control one Keysight B2900A series unit over a LAN connection.

**IVI-C or IVI-COM drivers**
Compatible with Windows 7 (64bit/32bit), XP SP3 (32-bit) IO Libraries 16.0 or greater. Supports Keysight VEE, Microsoft Visual Studio (Visual Basic, Visual C++, Visual C#), National Instruments LabWindows and LabVIEW.

**LabVIEW driver (VI)**
National Instruments LabVIEW 7.0 or greater. LabView drivers are available at NI.COM.

### Ordering Information

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2961A</td>
<td>6.5 Digit Low Noise Power Source, 32W, 210V, 3A, 1ch</td>
</tr>
<tr>
<td>B2962A</td>
<td>6.5 Digit Low Noise Power Source, 32W, 210V, 3A, 2ch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Low Noise Filter</td>
<td>Ultra Low Noise Filter, 42V/105mA, 50 Ω (N1294A-021)</td>
</tr>
<tr>
<td>LN1</td>
<td>Low Noise Filter, 210V/3A (N1294A-022)</td>
</tr>
<tr>
<td>LN2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>ABA</td>
<td>English</td>
</tr>
<tr>
<td>ABJ</td>
<td>Japanese</td>
</tr>
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<table>
<thead>
<tr>
<th>Calibration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6J</td>
<td>ANSI Z540 compliant calibration</td>
</tr>
<tr>
<td>UK6</td>
<td>Commercial calibration certificate with test data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rack Mount Kit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1CM</td>
<td>Rack mount kit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana to Triaxial Adapter</td>
<td></td>
</tr>
<tr>
<td>N1294A-001</td>
<td>Banana - Triax Adapter for 2-wire (non Kelvin) connection</td>
</tr>
<tr>
<td>N1294A-002</td>
<td>Banana - Triax Adapter for 4-wire (Kelvin) connection</td>
</tr>
<tr>
<td>External Low Noise Figure</td>
<td></td>
</tr>
<tr>
<td>N1294A-021</td>
<td>Ultra Low Noise Filter, 42V/105mA, 50 Ω</td>
</tr>
<tr>
<td>N1294A-022</td>
<td>Low Noise Filter, 210V/3A</td>
</tr>
<tr>
<td>BNC Trigger Adapter</td>
<td></td>
</tr>
<tr>
<td>N1294A-031</td>
<td>GPIO-BNC Trigger Adapter</td>
</tr>
</tbody>
</table>
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