Keysight Technologies

Making Low Resistance Measurements using the B2961A and 34420A

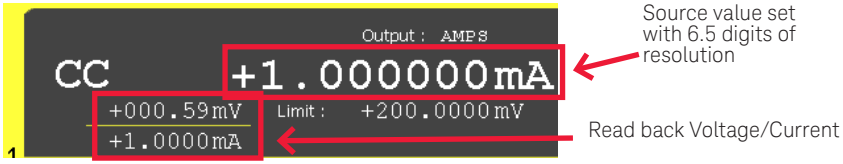
B2961A/B2962A 6.5 digit Low Noise Power Source

Using a Precision Current Source with a Nano Voltmeter

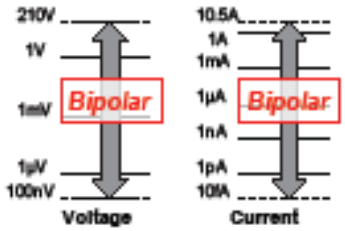
Resistance measurement is one of the most common tests performed to characterize the properties of electrical devices. However, certain types of resistance measurements require a very precise, lowlevel current source to prevent device self-heating or device damage during testing. In general, accuracy improves with the magnitude of the voltage or current being measured. Therefore, for devices with low resistance values (such as superconductors, Carbon Nano Tubes (CNTs), etc.) it is important to keep the measurement voltage as large as possible. The Keysight Technologies, Inc. B2961A 6.5 digit Low Noise Power Source satisfies these measurement requirements when used in combination with the Keysight 34420A 7 ½ Digit Nano Volt/Micro Ohm Meter.

Keysight B2961/62A Low Noise Power Source

The Agilent B2961A and B2962A are low noise power sources that can source either voltage or current while also monitoring them. They can source voltage and current with 6.5 digits of resolution, which is essential for a variety of measurement applications.

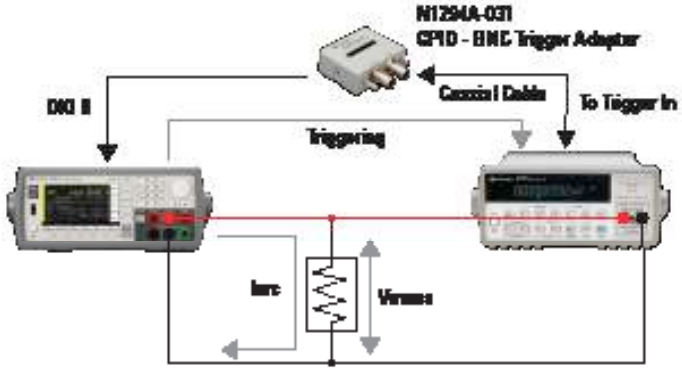


The B2961A and B2962A are bipolar sources, so the polarity for voltage and current can be either positive or negative. They can source currents from 10 fA to 3 A(DC) or 10.5 A (pulsed), and voltages from 100 nV to 210 V.



Measurement System Diagram

In this resistance measurement scheme the 34420A makes the voltage measurement while the B2961A sources a precise current. The B2961A outputs a trigger signal through the N1294A-031 GPIO – BNC Trigger Adapter to the 34420A to tell it when to make a voltage measurement.



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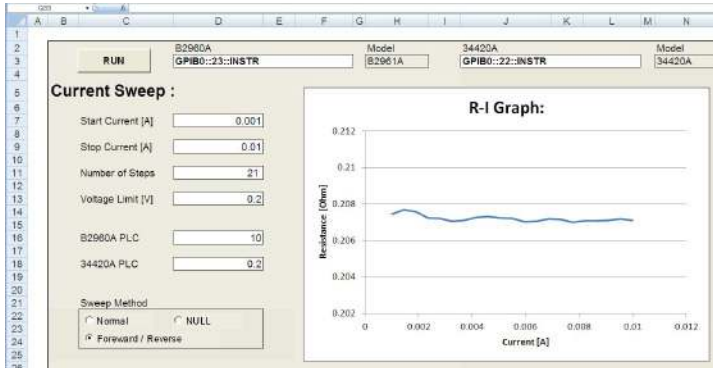
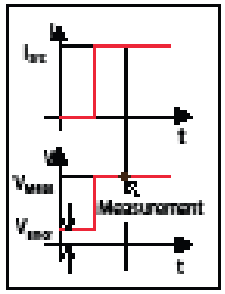
Sample Measurement Program

A sample program to make a resistance measurements with the B2961A and 34420A is included with the B2961A/B2962A. It works with C#, National Instruments LabVIEW and Microsoft Excel with VISA-COM. In addition to supporting basic resistance measurements, the program also supports the technique described to the right that eliminates measurement errors. The sample program can be also downloaded from the Keysight website.



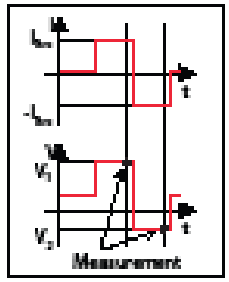
When measuring small resistances, errors due to offset voltages and thermal electromotive force (EMF) can significantly affect measurement accuracy. The following equation shows the impact of these errors on a resistance measurement made by forcing current and measuring voltage:

$$R_{Meas} = \frac{V_{Meas}}{I_{Src}} = \frac{V_{DUT}}{I_{Src}} + \frac{V_{ERROR}}{I_{Src}} = R_{DUT} + R_{ERROR}$$



This error can be eliminated by applying by both forward and reverse currents (I_{Src} and $-I_{Src}$) and averaging the two voltage measurement results. The following equation shows how to use these two measurement results to calculate the true value of the resistance:

$$R_{Meas} = \frac{V_1 - V_2}{2 \times I_{Src}} = R_{DUT}$$



As mentioned earlier, the sample program supports this measurement technique

Keysight B2961A/B2962A Low Noise Power Source Key Specifications and Characteristics

Product Number	Max output DC	Pulse	Max Power	Source Resolution Digit	Min Resolutions	Noise[1]	Measurement Resolution
B2961A	210 V	200 V	31.8 W	6 1/2	100 nV	<5 µVpp	4 1/2
B2962A	3.03 A	10.5 A	31.8 W	6 1/2	10 fA	<1 pApp	4 1/2

1. Supplemental Characteristics

B2961A/B2962A Key Features:

- 6.5 Digit High Resolution and Wide Bipolar Range
- 10 µVrms Ultra Low Noise
- Precision 10 kHz Arbitrary Waveform Generation Capability
- Programmable Output Resistance
- Time Domain Voltage/Current Waveform Viewer

The B2900A Series Precision Instruments

The B2900A series lines up products for both precision source and precision measurement.

www.keysight.com/find/b2900a

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Published in USA, August 4, 2014
5991-1421EN
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