

Thermistor Evaluation Using the Agilent B2900A Series

Technical Overview

B2900A Series Precision Source/Measure Unit

- B2901A Precision SMU, 1ch, 100fA resolution, 210V, 3A DC/10.5A pulse
- B2902A Precision SMU, 2ch, 100fA resolution, 210V, 3A DC/10.5A pulse
- B2911A Precision SMU, 1ch, 10fA resolution, 210V, 3A DC/10.5A pulse
- B2912A Precision SMU, 2ch, 10fA resolution, 210V, 3A DC/10.5A pulse

Introduction

The thermistor is a resistor with resistivity that varies as a function of temperature. Typical thermistor applications are thermal sensing and electric circuitry protection. However, the thermistor's sensitivity to temperature changes can work against measurement accuracy since Joule self-heating during measurement can alter device characteristics. This means that accurate thermistor characterization requires both precise low-current resistance measurement capability and pulsed bias measurement capability (to minimize temperature change during measurement).

The Agilent B2900A Series of Precision Source/Measure Units are compact and cost-effective bench-top Source/Measure Units (SMUs) with the capability to output and measure both voltage and current. The B2900A Series also supports a resistance measurement function that facilitates both low and high resistance measurements. The B2900A Series enables you to make a wide range of resistance measurements more accurately and quickly than ever before.

In addition, the B2900A Series comes with an intuitive graphical user interface (GUI) and free PC-based application software that make it easy for you to begin making productive measurements immediately.

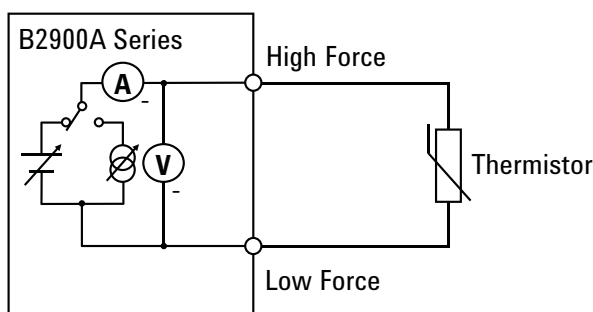


Figure 1. Using the B2900A Series to characterize a thermistor

These features make the B2900A Series the best solution for accurate characterization of thermistor and other devices.

Figure 1 illustrates the connections necessary for measuring a thermistor using a member of the B2900A Series. The B2900A Series allows you to accurately and easily measure the resistance of thermistor.



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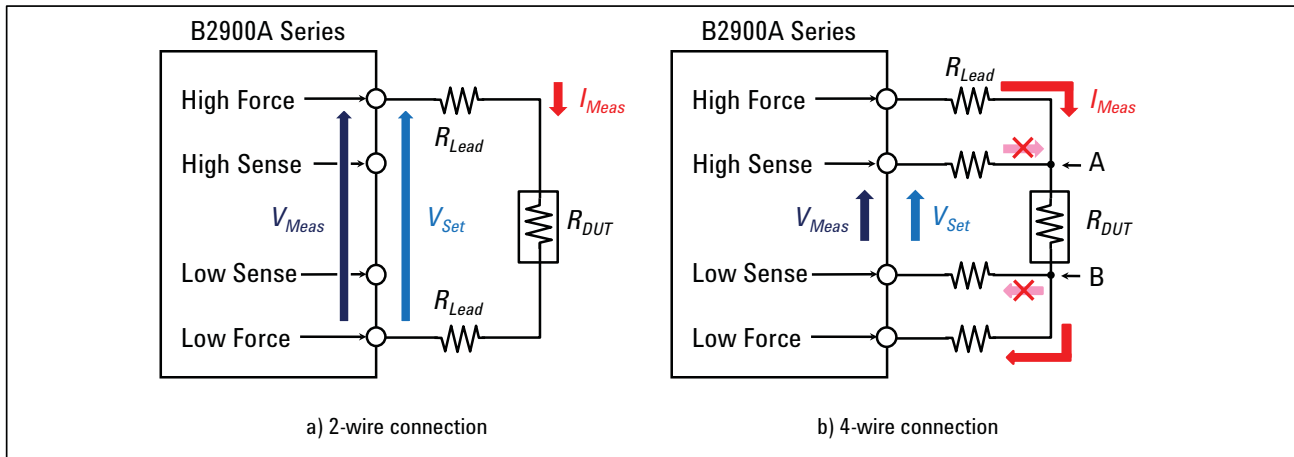


Figure 2. A 4-wire connection eliminates the measurement error caused by residual lead resistance

What is the B2900A Series SMU?

An SMU 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 into a single instrument. This gives it the ability to evaluate the IV characteristics of devices across all four measurement quadrants without the need for any additional equipment. Besides being able to output and measure voltage or current very accurately, SMUs also possess a compliance feature that allows a limit to be placed on the voltage or current output to prevent device damage. The B2900A Series members are single or dual channel SMU units that offer a wide range of IV measurement capability for a variety of two-terminal and three-terminal devices. They cover currents from 10 fA to 10.5 A and voltages from 100 nV to 210 V. In addition to their DC operation mode, the B2900A Series units also have the ability to perform pulsed measurements in order to prevent device self-heating from distorting the measurement results. Finally, the B2900A Series also has a built-in resistance measurement function.

Eliminating residual resistance effects

A basic 2-wire connection is the most common scheme used for resistance measurements. In this configuration (shown in Figure 2a) the same pair of test leads is used to both force current and measure voltage. This arrangement is suitable for resistance measurements as long as the residual lead resistance is negligible compared to the resistance of the device under test (DUT).

However, for very low resistance measurements where the residual lead resistance is comparable to the DUT resistance, the 2-wire measurement will give erroneous measurement results. In this case a 4-wire

connection scheme (remote sensing) can be used to eliminate this error. A 4-wire measurement uses one pair of leads to force current and the other pair of leads to monitor voltage. This eliminates cable resistance effects so that only the voltage drop across the DUT is measured (please see Figure 2b). In addition, the B2900A Series' 4-wire measurement scheme keeps the voltage between the sense points (A and B in Figure 2b) at exactly the specified voltage V_{set} , thereby ensuring that your device is characterized exactly under the measurement conditions you specify. The B2900A Series supports both connection schemes and it is easy to switch between them.

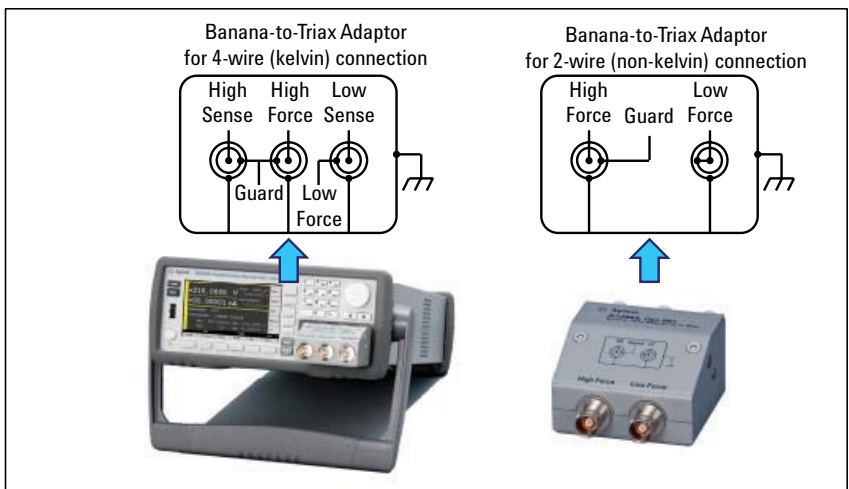


Figure 3. The B2900A Series' active guard eliminates leakage currents when used with the proper triaxial connectors and cabling

Leakage current prevention

Leakage currents in the cables and test fixturing can cause significant measurement errors, especially when measuring large resistances where the measurement current is small (less than a nanoamp). In this case, the B2900A Series' guard function can be used by employing banana-to-triaxial adaptors and triaxial cables. The SMU circuitry maintains the guard terminal at same voltage potential as the high force line, which prevents current from leaking into the cable and the surrounding measurement path (please see Figure 3).

Powerful GUI and convenient PC control options

The B2900A Series' wide QVGA LCD display supports an easy-to-use GUI that provides easy instrument control from the front panel. This makes it simple to perform both spot resistance measurements using constant voltage or current and sweep measurements to obtain an IV curve. After measurement completion you can use the front panel GUI to graphically view measurement results such as IV curves using Graph View, and display a list of the measurement data using the Measure Result dialog window (please see Figure 4).

The B2900A Series has a USB interface on the front panel so that a USB flash memory device can be used with the B2900A Series to save and load measurement setups as well as to save measurement results.

If you have specialized programming needs then both Standard Commands for Programmable Instruments (SCPI) and IVI-COM drivers are available for the B2900A Series. SCPI is an industry-standard command set for basic instruments, and it has a uniform structure that supports a com-

mon set of commands. The B2900A Series' SCPI command set not only supports its advanced features but also general-purpose SMU commands (such as those used by the Keithley 2400) to simplify test program migration. In addition to SCPI, the B2900A Series IVI-COM drivers work in a variety of programming environments and languages so that you can develop programs without having to use low-level commands. The Agilent B2900A Quick I/V

Measurement Software is available for download from the Agilent Web site for free (Please see Figure 5). The Agilent B2900A Graphical Web Interface is also available, and it provides functionality to allow access to the B2900A Series over a LAN connection. The B2900A Series is fully compliant with the LXI class C specification, making it easy to take measurements using a standard web browser by just connecting the B2900A Series to a PC using a LAN cable.

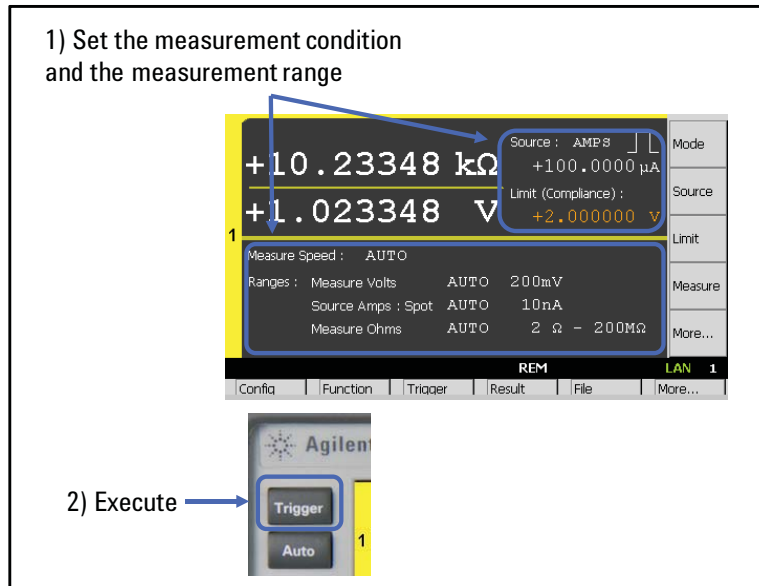


Figure 4. B2900A Series' GUI makes it easy to take a quick measurement

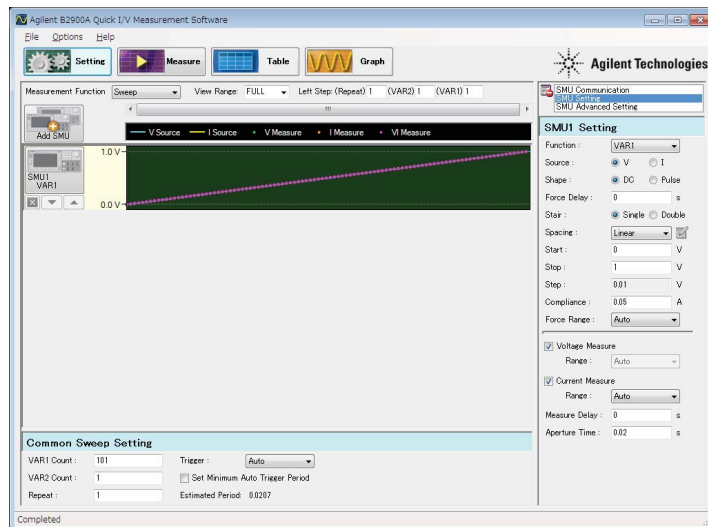


Figure 5. It is easy to make a quick measurement on a PC using the Agilent B2900A Quick I/V Measurement Software

Summary

The Agilent B2900A Series of Precision Source/Measure Units is the best solution for IV characterization of thermistor and a variety of other devices. Its wide current and voltage measurement ranges (from 10 fA/100 nV to 10.5 A/210 V) provide superior measurement performance and allow you to characterize devices more accurately and easily than ever before.

The B2900A Series' easy-to-use GUI has a variety of capabilities and features that make it easy to take measurements quickly and to save both the measurement setup conditions and data to USB-based flash memory devices.

In addition to being able to control the B2900A Series remotely over GPIB, USB and LAN interfaces, Agilent supplies PC-based Agilent B2900A Graphical Web Interface and Agilent B2900A Quick I/V Measurement Software for free to simplify controlling the B2900A Series from your PC.

For more detailed information on the various B2900A Series models, please refer to the B2900A Series data sheet (5990-7009EN).

The B2900A Series enables you to quickly debug and accurately characterize a wide variety of devices using only a single bench-top SMU.



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