Keysight Technologies

Detailed Demonstration Guide: Making Resistance Measurement Using SMU

Keysight B2901A/02A/11A/12A Precision Source/Measure Unit

Demonstration Guide

KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies, Inc. B2901A/02A/11A/12A 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 B2901A/02A/11A/12A enables you to make a wide range of current versus voltage (IV) measurements more accurately and quickly than ever before. In addition, the B2901A/02A/11A/12A 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.

This demonstration guide shows how easily basic resistance measurement can be made using the Keysight B2901A/02A/11A/12A.

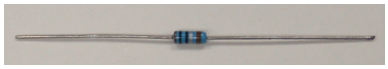
The demonstration includes not only a simple resistance measurement using 2-wire connection, but also a low resistance measurement using 4-wire connection.

Required Instrument and Accessories

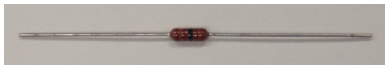
Keysight 11059A Kelvin Probe Set and Resistors are equipped as a demo kit with a demo unit of the Keysight B2900A Series of SMU.

Keysight B2901A/02A/11A/12A
Precision Source/Measure Unit

Keysight 11059A Kelvin Probe Set



1 Ω Resistor



1 kΩ Resistor

LAB 1: Make a Resistance Measurement

Objective

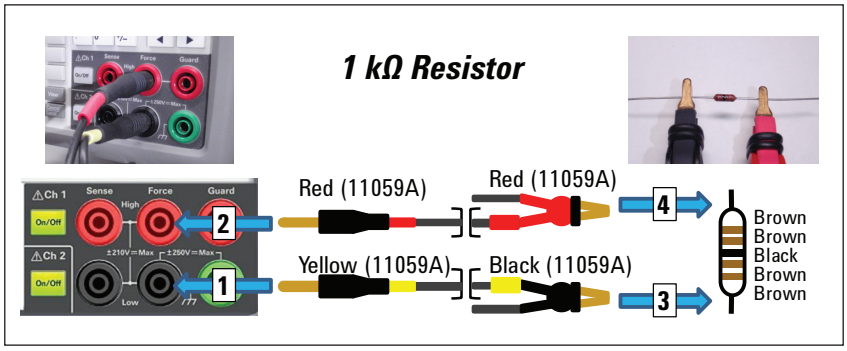
This lab shows how a single-point measurement can be done with an intuitive GUI and shallow menu tree on the B2900A Series of SMUs through the resistance measurement

Procedure overview

1. Change View mode to Single View
2. Use AUTO measurement operation
3. Turn off the channel output

Setup

1. Connect the **yellow banana plug** to **Ch 1 Low Force** terminal.
2. Connect the **red banana plug** to **Ch 1 High Force** terminal.
3. Clip the one lead of **1 kΩ Resistor** with the **black gold-plated tweezers**.
4. Clip the other lead of **1 kΩ Resistor** with the **red gold-plated tweezers**.



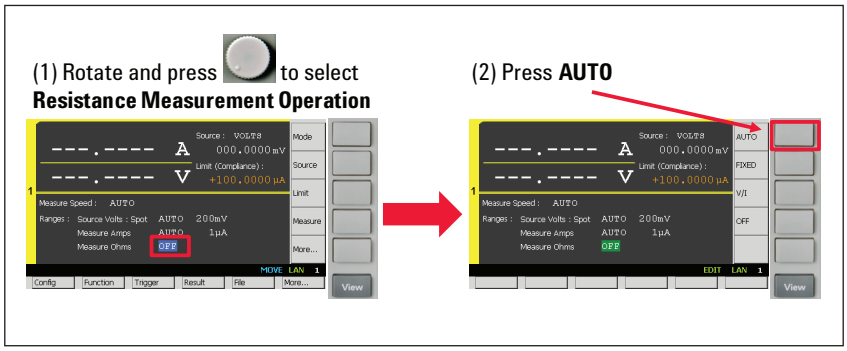
Demonstration

1. Change View mode to Single View

a. Press View repeatedly until **Single View** for Channel 1 is shown in the display.

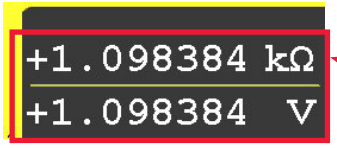
2. Use AUTO measurement operation

a. Rotate to select **Resistance measurement operation**, and then press to edit it. Then select AUTO to set **Resistance measurement operation** to **AUTO**.



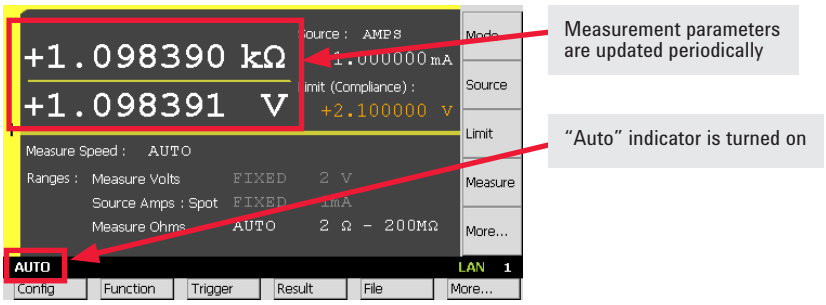
b. Press Ch1 On/Off to turn on Channel 1 Output relay.

c. Press Trigger to perform a single point measurement.



Measurement parameters are updated whenever Trigger Button is pressed

d. Press Auto to repeat single point measurements periodically.



e. Press Auto to stop making measurements periodically.

3. Turn off the channel output

a. Press Ch1 On/Off to turn off Channel 1 Output relay.

LAB 2: Make an Accurate Low Resistance Measurement

Objective

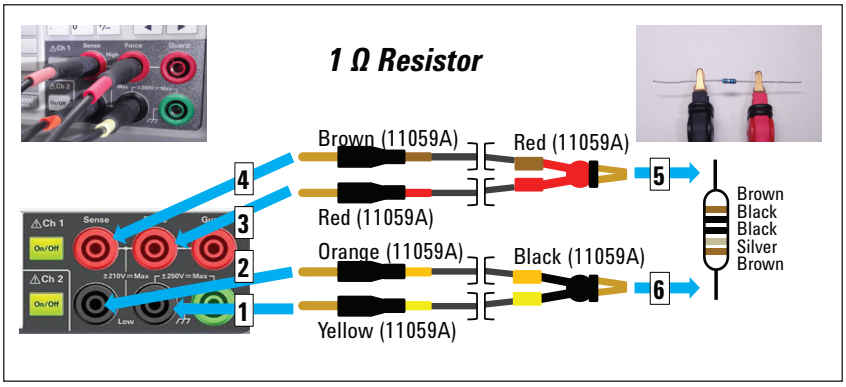
This demonstration shows how accurately a low resistance measurement can be done with 4-wire connection by comparing the result with 4-wire connection to the one with 2-wire connection.

Procedure overview

1. Reset the instrument
2. Perform the measurement via 4-wire connection
3. Perform the measurement via 2-wire connection
4. Compare two results

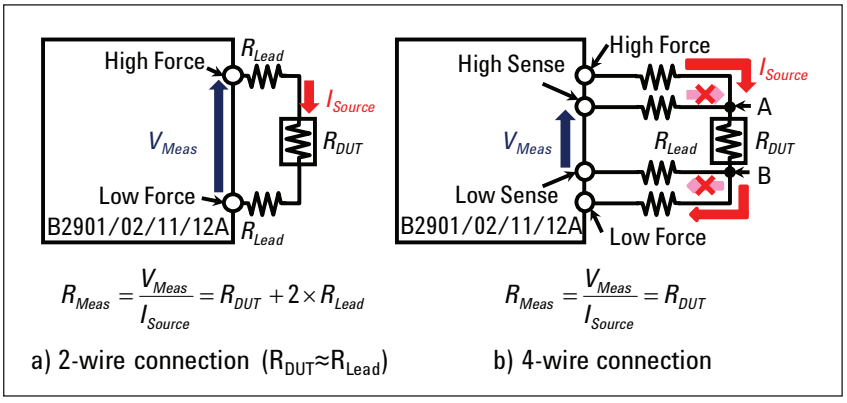
Setup

1. Connect the **yellow banana plug** to **Ch 1 Low Force** terminal.
2. Connect the **orange banana plug** to **Ch 1 Low Sense** terminal.
3. Connect the **red banana plug** to **Ch 1 High Force** terminal.
4. Connect the **brown banana plug** to **Ch 1 High Sense** terminal.
5. Clip the one lead of **1 Ω Resistor** with **red gold-plated flat tweezers**.
6. Clip the other lead of **1 Ω Resistor** with **black gold-plated tweezers**.



Why is 4-wire connection required?

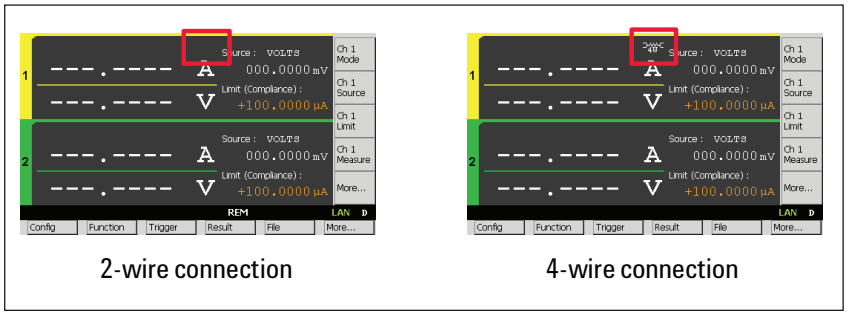
For very low resistance measurements where the residual lead resistance is comparable to the DUT resistance, the 2-wire measurement will give erroneous measurement results. In this case a 4-wire connection scheme (remote sensing) can be used to eliminate this error. A 4-wire measurement uses one pair 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.



LAB 2: Make an Accurate Low Resistance Measurement (continued)

Status indicator to show 4-wire configuration

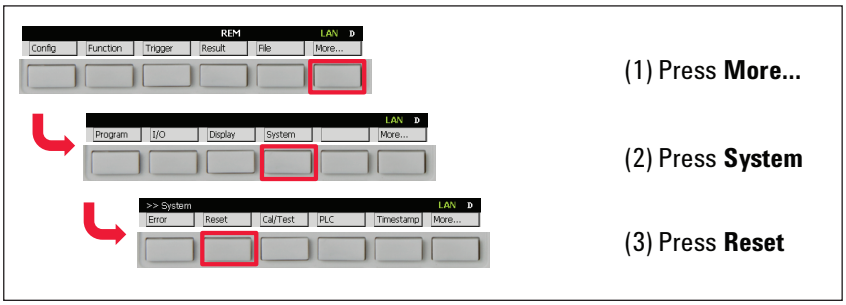
If the channel is configured to use 4-wire connection, you can see the status indicator on GUI as below, although no indicator can be seen on being configured to use 2-wire connection.



Demonstration

1. Reset the instrument

a. Press [More...] , [System] , and then press [Reset] to display **Confirmation dialogue**.

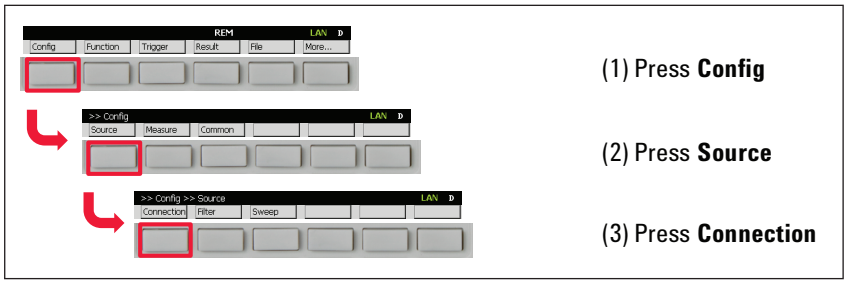


b. Press [OK] to reset the instrument.

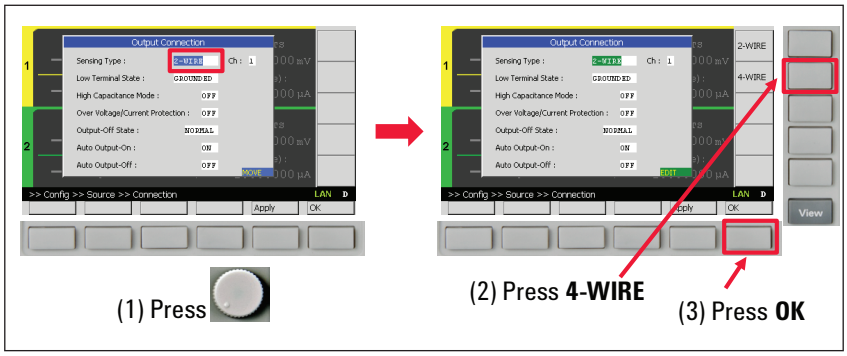
LAB 2: Make an Accurate Low Resistance Measurement (continued)

2. Perform the measurement via 4-wire connection

a. Press Config, Source, and then press Connection to display **Output Connection dialogue**.

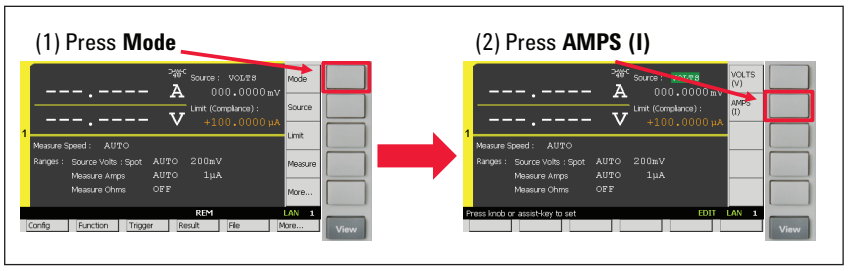


b. Press  and select 4-WIRE, and then press OK to configure to use 4-wire connection.

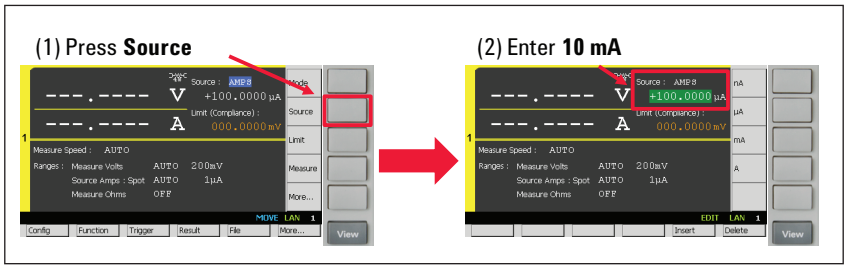


c. Press Mode, then press AMPS (I) to set **Channel 1 V/I Source Function** to **I Source**.

(If Mode can't be found on the Assist keys, press More... to change the keys.)



d. Press Source and set **Channel 1 Source Value** to **10 mA**.

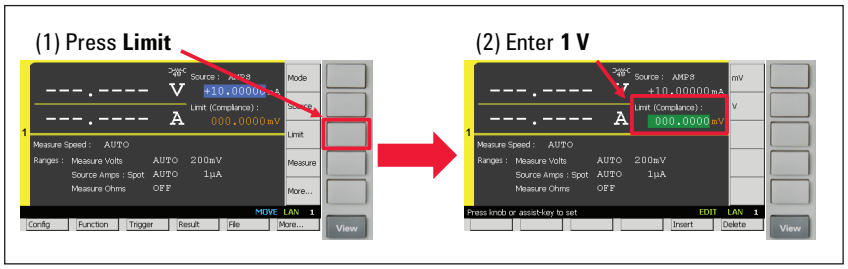


LAB 2: Make an Accurate Low Resistance Measurement (continued)

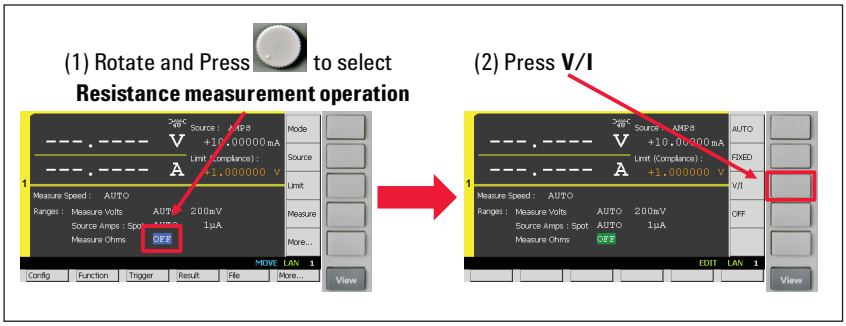
Resistance measurement operation

The resistance measurement operation is set to OFF in the default setting. To perform resistance measurement, you need to select the operation among AUTO, FIXED and V/I. For AUTO and FIXED, the B2900A Series of SMUs performs resistance measurement by using the current source and voltage measure condition automatically set by the resistance measurement range setting. For V/I, the B2900A Series of SMUs performs measurement by using the present source/measure condition and calculates the resistance value.

e. Press Limit and set **Channel 1 Limit value** to **1 V**.

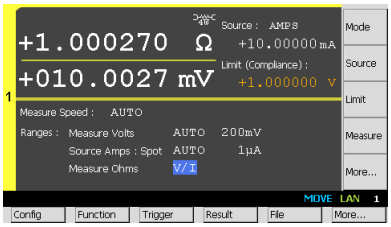


f. Rotate to select **Resistance measurement operation** and press to edit it. Then press V/I to set **Resistance measurement operation** to **V/I**.



g. Press Ch1 On/Off to turn on Channel 1 Output relay.

h. Press Trigger to perform a single point measurement.



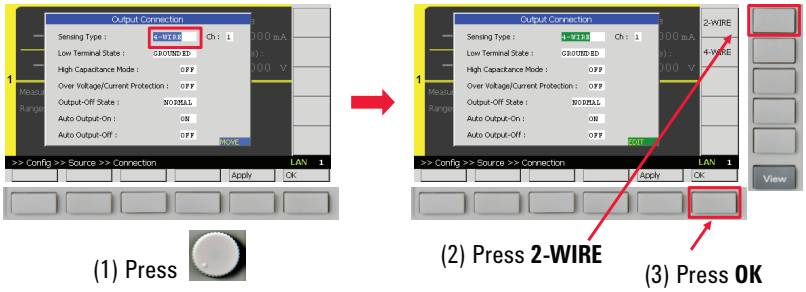
3. Perform the measurement via 2-wire connection

a. Press Ch1 On/Off to turn off Channel 1 Output relay.

b. Press Config , Source , and then press Connection to display **Output Connection dialogue**.

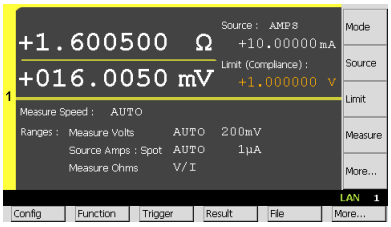
LAB 2: Make an Accurate Low Resistance Measurement (continued)

c. Press  , 2-WIRE, and then press OK to configure to use 4-wire connection.



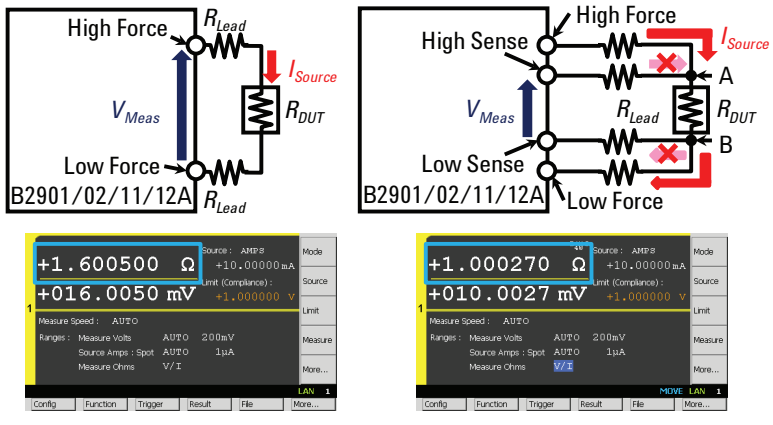
d. Press Ch1 On/Off to turn on Channel 1 Output relay.

e. Press Trigger to perform a single point measurement.



4. Compare two results

a. Compare two results to see the effect of 4-wire connection. The result with 4-wire connection is 1 Ohm, while the one with 2-wire connection is 1.6 Ohm. The difference, that is 0.6 Ohm, should be the residual lead resistance on the measurement cables.



a) Result with 2-wire connection b) Result with 4-wire connection

The result with 2-wire connection includes the residual lead resistance R_{Lead}.

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