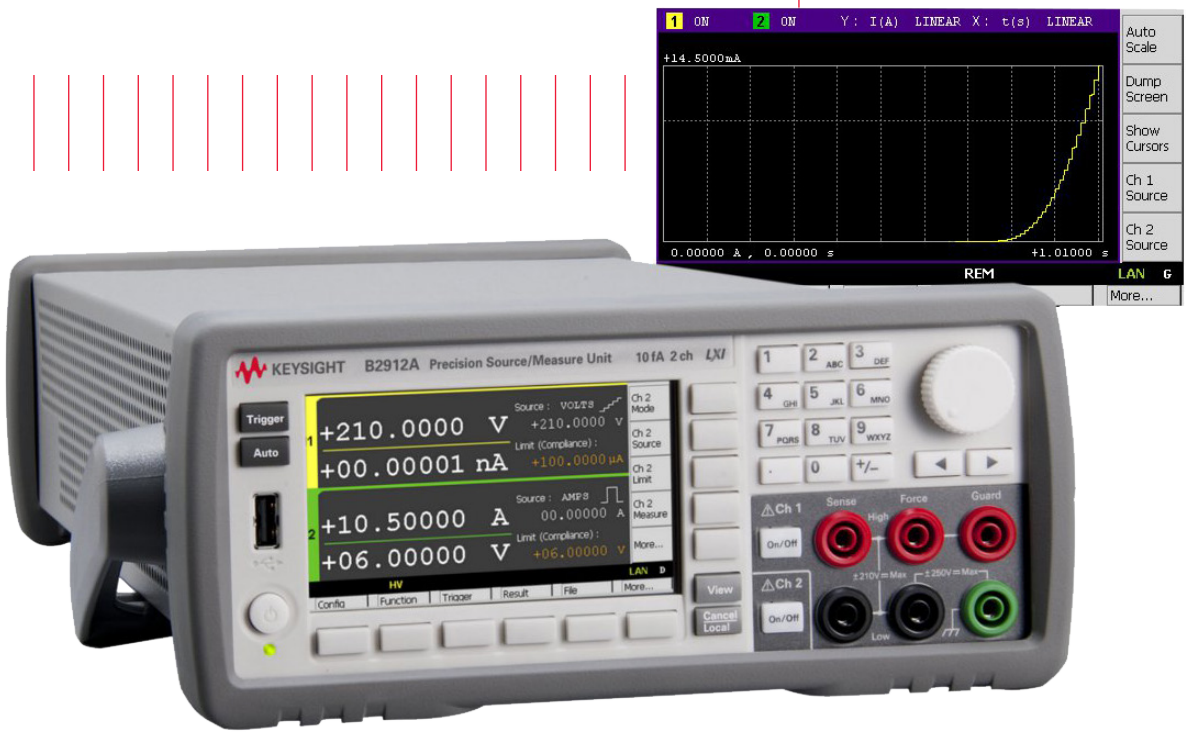
Keysight Technologies

Making Time Domain Measurement with Staircase Source Using SMU

B2900A Precision Source/Measure Unit

Demo Guide



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Introduction

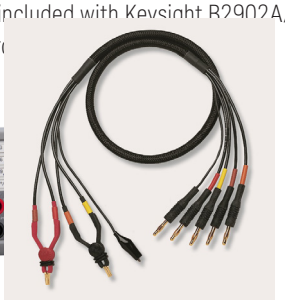
The Keysight B2900A Series Precision Source/Measure Unit (SMU) is a compact and cost-effective bench-top SMU with the capability to output and measure both voltage and current. The B2900A Series SMU enables you to make a wide range of current versus voltage (IV) measurements more accurately and quickly than ever before. In addition, the B2900A Series SMU 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 you can make a time domain measurement with sourcing staircase current or voltage using the B2900A Series SMU

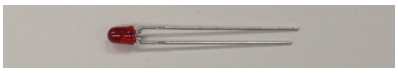
Required Instrument and Accessories

All of the accessories required to perform the demos described in this demonstration guide are provided in a demo kit that is included with Keysight B2902A/12A demo units. The kit includes items such as a Kelvin Pr

Keysight B2902A/12A
Precision Source/Measure Unit



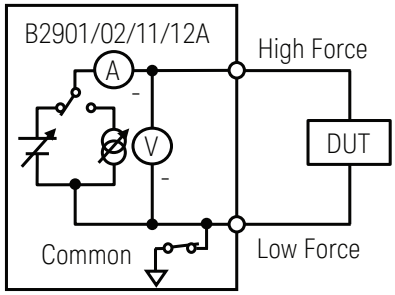
11059A Kelvin Probe Set



LED

Concept

Figure 1 illustrates the connection diagram used in the demo to make a time domain measurement of voltage with sourcing staircase sweep current to an LED using the B2900A Series SMU



DUT	: LED
Source Mode	: Voltage
Start Value	: 0 V
Stop Value	: 2 V
Points	: 101
Current Limit	: 100 mA

Figure 1. Connection diagram

Figure 2 shows the timing chart for the time domain measurement with staircase source with the front panel operation. In this case, the specified source value is sourced immediately after turning on On/Off . Then, when you press Trigger , the instrument will make a time domain measurement with staircase source. Because the B2900A series SMU has an independent trigger system for each of the source and measurement function, the multiple measurements can be made during each step of staircase source. If it is necessary, you can specify any measurement trigger delay time which is the wait time before making a measurement. The measurement time consists of Measurement Speed and some overhead time. Measurement Speed is the parameter specified by the user. Overhead time includes the time to change the measurement range, etc.

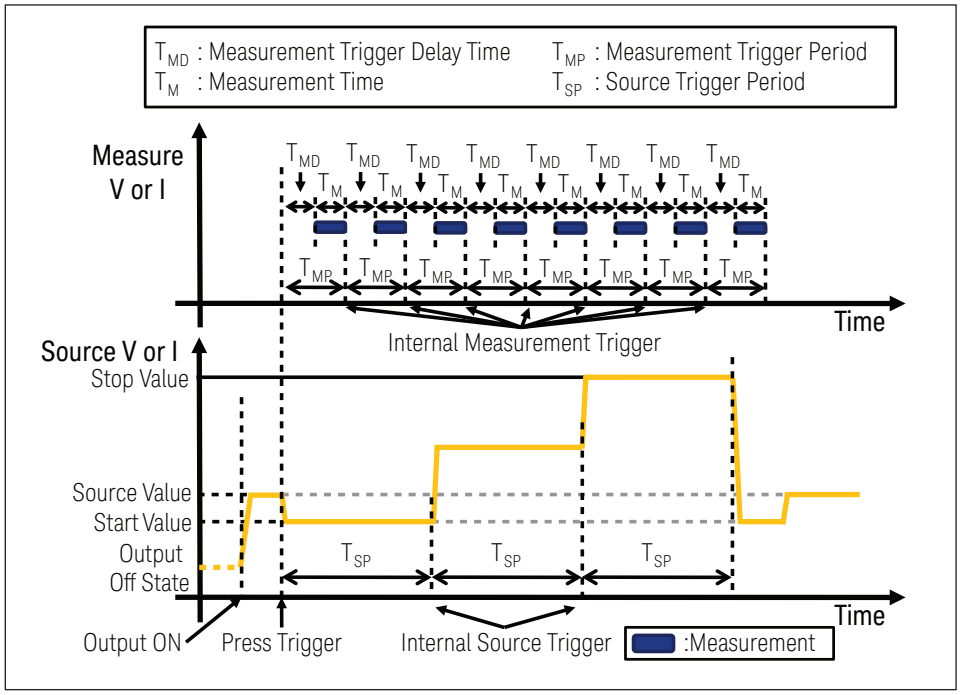
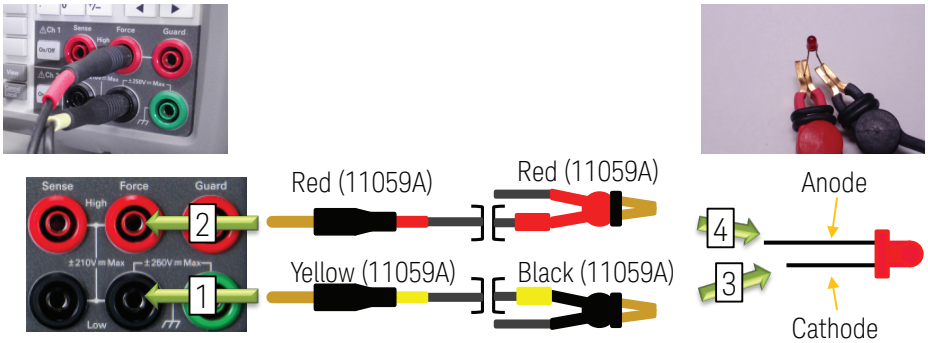


Figure 2. Timing chart for the time domain measurement with staircase sweep source

Setup

1. Connect the **yellow banana plug** to the **Ch 1 Low Force** Terminal.
2. Connect the **red banana plug** to the **Ch1 High Force** Terminal.
3. Clip the **LED cathode** terminal with the **black gold-plated tweezers**.
4. Clip the **LED anode** terminal with the **red gold-plated tweezers**.



LAB: Make Time Domain Measurement with Staircase Source Using SMU

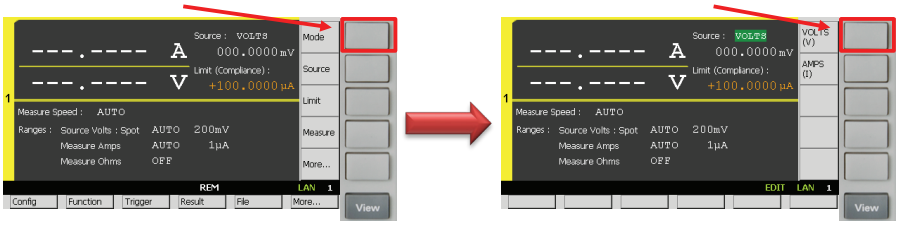
Demonstration

1. Change View mode to Channel 1 Single View

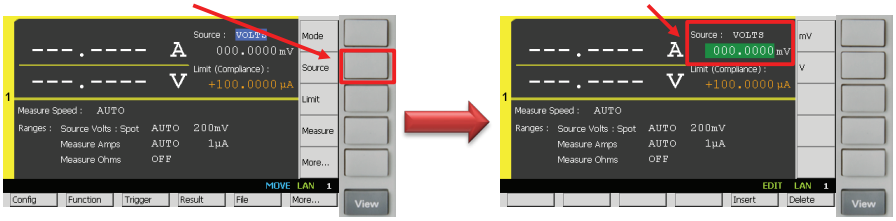
1) Press View repeatedly until the Channel 1 **Single View** is displayed.

2. Configure the condition for Time Domain Measurement

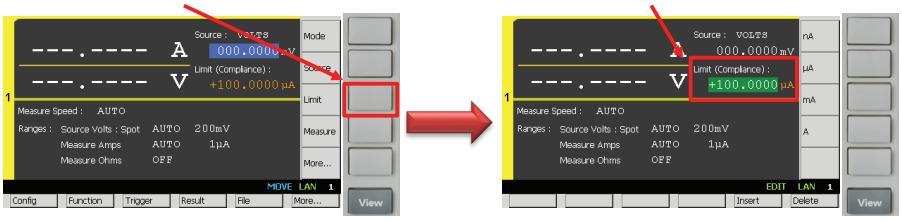
1) Press Mode to edit the **Source function**, and then select VOLTS (V) to set the **Source function** to **Voltage source**.



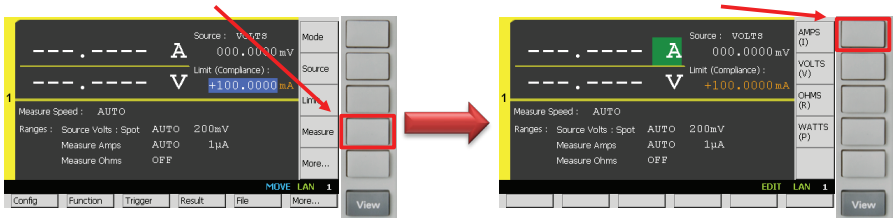
2) Press Source to edit the **Source value**, and then enter **0 V** to set the **Source value** to **0 V.**



3) Press Limit to edit the **Limit value**, and then enter **100 mA** to set the **Limit value** to **100 mA**.



4) Press Measure to configure the **Measurement parameter**, and then select AMPS (I) to set the **Measurement parameter** to **Current**



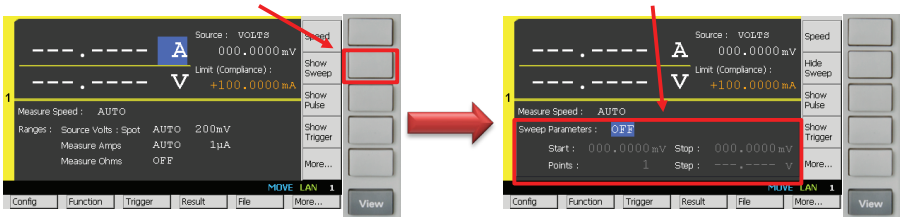
Objective

This demo illustrates the function to make a time domain measurement of voltage with sourcing staircase voltage to an LED using a Source/Measure Unit.

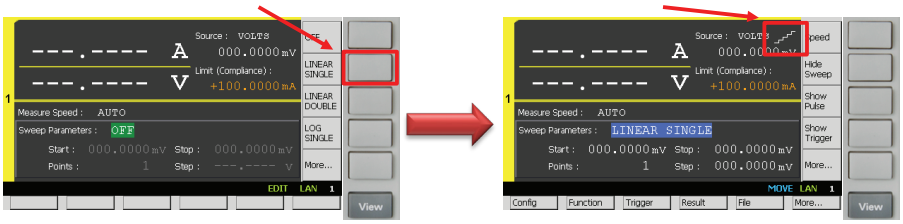
Procedure

1. Change View mode to Channel 1 Single View
2. Configure the condition for Time Domain Measurement
3. Change View mode to Graph View
4. Perform the measurement
5. View the measurement result graph
6. View the list of measurement results
7. (Optional) Configure the measurement speed
8. (Optional) Configure to use AUTO measurement range operation

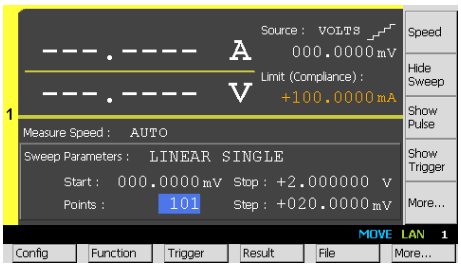
5) Press More... to change the keys shown in Assist keys, and then press Show Sweep to show **Sweep Sub-Panel**.



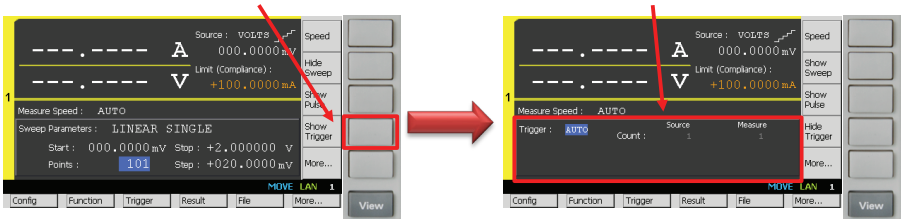
6) Press  , then press LINEAR SINGLE to turn on **Single Linear Sweep Mode**. After turning on **Single Linear Sweep Mode**, you can see **Source Shape** which shows the single linear sweep mode.



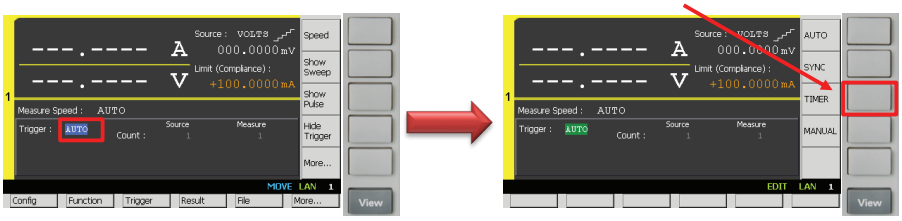
7) Rotate  to select Channel 1 Sweep Parameters and set them up as below. (Start: 0 V, Stop: 2 V, Points: 101, Step: 20 mV)



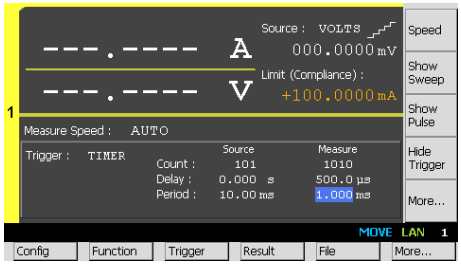
8) Press Show Trigger to show **Trigger Sub-Panel**.



9) Press  to edit the **Trigger type**, and then select TIMER to set the **Trigger type** to **TIMER**.



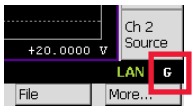
10) Rotate  to select Channel 1 Trigger Parameters and set them up as below. Source Trigger Count should be the same number as Sweep Points. Measurement Trigger Count defines the number of sampling and Measurement Trigger Period defines the interval of sampling.
(Source Trigger Count: 101, Measurement Trigger Count: 1010, Source Trigger Period: 10 ms, Measurement Trigger Delay Time: 500 us, Measurement Trigger Period: 1 ms)



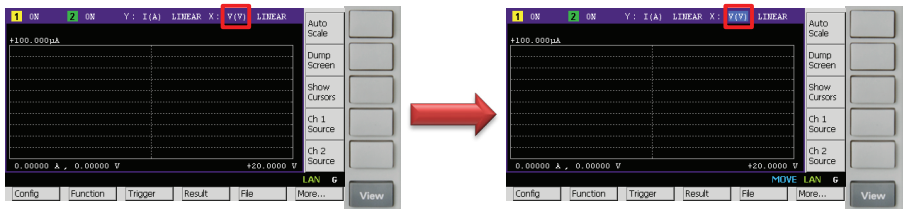
Now you've configured a 1 ms measurement trigger period for a sampling measurement. The measurement will be performed every 1 ms periodically. However, please note that a FIXED current measurement range operation will be used to control the trigger period strictly. The measurement range is selected by Limit value. In this example, a 100 mA measurement range will be used.

3. Change View mode to Graph View

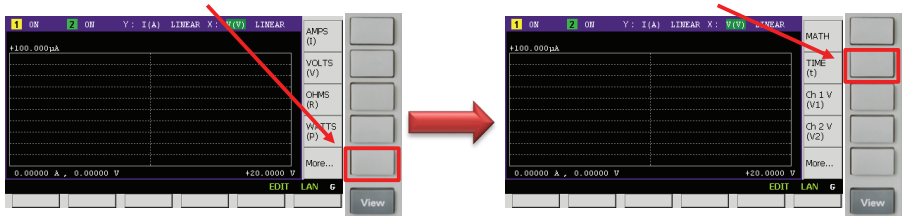
1) Press View repeatedly until **Graph View** is displayed.



2) Rotate and press  to edit the **X-axis data type**.



3) Press More... , and then select TIME (t) to set the **X-axis data type** to **Time**.

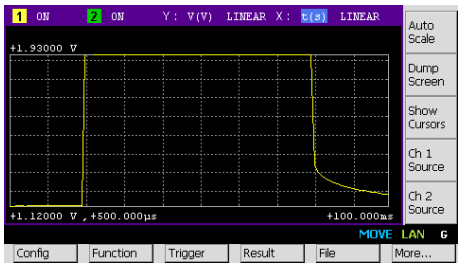


4. Perform the measurement

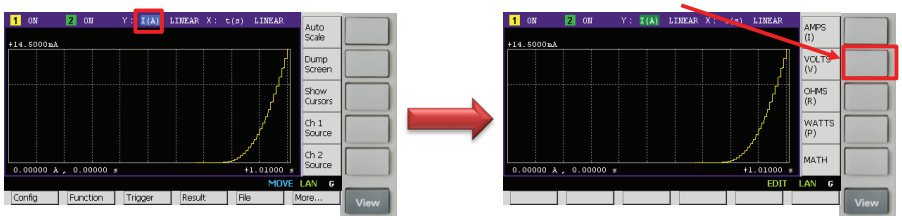
1) Press On/Off to source the voltage specified by the Source value, and then press Trigger to perform a measurement.
(The status information will show ARM during the measurement.)

5. View the measurement result graph

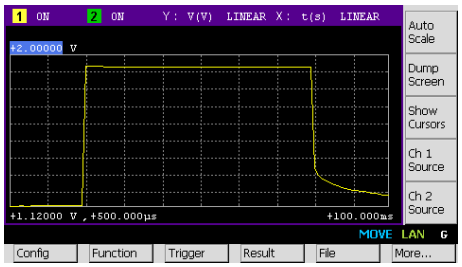
1) Press Auto Scale to adjust the scale of the graph after finishing the measurement.
Now you can see the measurement result on the GUI of the B2900A series SMU as below.



2) Rotate and press to edit the **Y-axis data type**, and then select VOLTS (V) to set the **Y-axis data type** to **Voltage**.



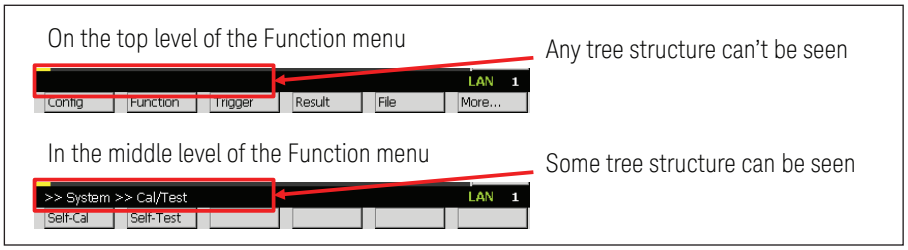
Now you can see the measured voltage, which is sourced to the device, on the GUI of the B2900A series SMU as below.



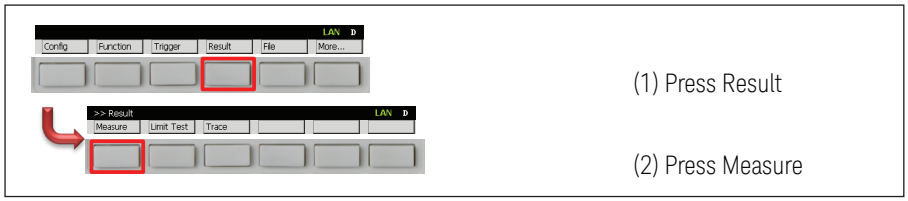
6. View the list of measurement results

The measurement results including the measurement time stamp can be referred by the following steps.

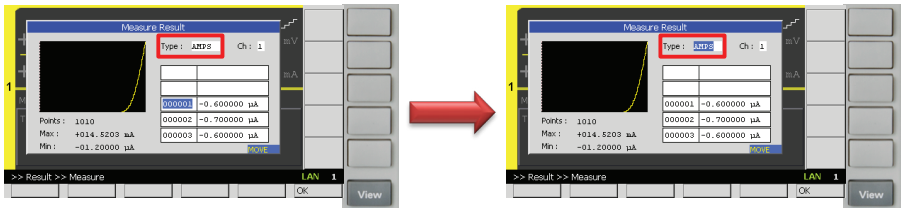
1) If you aren't on the top of the Function menu, press Cancel Local repeatedly to return to the top level.



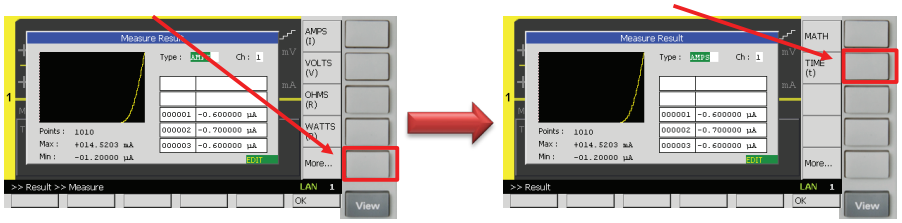
2) If you'd like to see the list of the measurement result, press Result, then press Measure to open **Measure Result dialogue**.



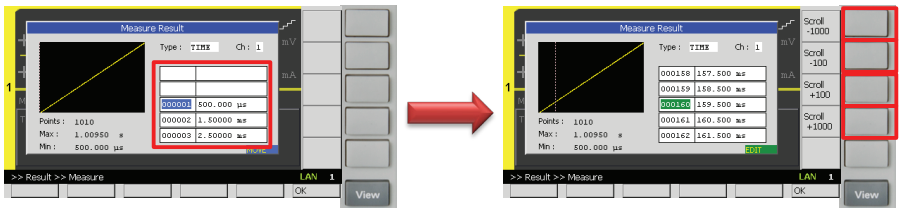
3) Rotate and press  to select the **Data Type field**.



4) Press More... to change the keys shown in Assist keys, and then press TIME (t) to select **Time** as the **Data type**.



5) Rotate and press  to select the **Data field**. Then rotate  to scroll the data list.



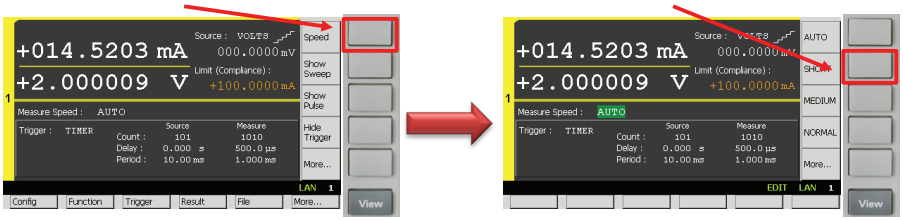
7. (Optional) Configure the measurement speed

In the default setting, the instrument selects the appropriate measurement speed and range automatically to get the fine accuracy. However, you can also specify these parameters on the GUI of the B2900A series SMU to meet a variety of the requirement to the measurement conditions.

For example, let's try to change the measurement speed to SHORT to make a measurement more quickly. If you select SHORT, the aperture time is set to 0.01 PLC. Here, PLC stands for power line cycle and the specified number of power line cycles is used per a measurement.

1) Press View repeatedly until the Channel 1 **Single View** is displayed.

2) Press Speed to edit the **Measurement speed**, and then select SHORT to set the **Measurement speed** to **SHORT**. (If you can't see Speed in Assist keys, press More... to change the keys shown in Assist keys.)



Controlling the B2900A Series SMU using SCPI commands

If you prefer to control the B2900A Series SMU remotely using SCPI remote commands, then the following material explains how to do this.

The series of commands shown in group “A” configure the sweep condition. Next the series of commands shown in group “B” configure the trigger condition. Finally, the series of commands shown in group “C” should be sent to initiate the channel to output signal.

B2900A Series SMU SCPI command example

```
*RST

:SOUR:FUNC:MODE VOLT                    :TRIG:SOUR TIM
:SOUR:VOLT 0                            :TRIG:TRAN:COUN 101
:SENS:FUNC 'CURR'                       :TRIG:TRAN:TIM 1E-2
:SENS:CURR:PROT 0.1                     :TRIG:TRAN:DELAY 0          } B
:SOUR:FUNC:SHAP DC                      :TRIG:ACQ:COUN 1010
:SOUR:VOLT:MODE SWE         } A         :TRIG:ACQ:DELAY 5E-4
:SOUR:SWE:SPAC LIN                      :TRIG:ACQ:TIM 1E-3
:SOUR:VOLT:STAR 0
:SOUR:VOLT:STOP 2                       :OUTP ON
:SOUR:VOLT:POIN 101                     :INIT (@1)          } C
```

Optionally, a command shown in “D” configure the measurement integration condition.

B2900A Series SMU SCPI command example

```
7. (Optional) Configure the measurement speed

   :SENS:VOLT:NPLC 0.01                                     D
```

Conclusion

The Keysight B2900A Series Precision Source/Measure Unit (SMU) is a compact and cost-effective bench-top SMU with the capability to output and measure both voltage and current. Configuring the B2900A series SMU properly enables you not only to make a simple current versus voltage (IV) measurement, but also to make a time domain measurement with sourcing staircase sweep current or voltage as if it were an oscilloscope.

B2900 Precision Instrument Family

The B2900 family contains products that perform both precision sourcing and precision measurement. **www.keysight.com/find/b2900a**

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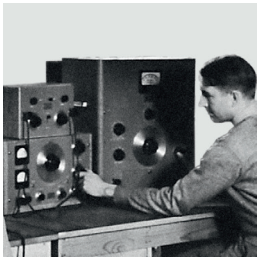

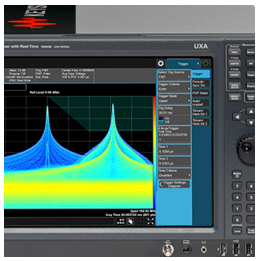

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