How to realize Low Current Measurement with Agilent B2901/02/11/12A

The Agilent B2901/02/11/12A has higher current measurement resolution (10 fA for B2911/12A, 100 fA for B2901/02A) so that it has the capability to make a low current measurement (less than a nanoamp) accurately. However, it is necessary to take care of the following five points in order to realize accurate low current measurements.

- Using N1294A Banana to Triax Adaptor properly
- Performing Self-calibration on Agilent B2901/02/11/12A
- Using 10 nA Minimum Current Measurement Range
- Using Appropriate Measurement Speed
- Using Appropriate Measurement Trigger Delay Time

Using N1294A Banana to Triax Adaptor properly

N1294A-001 Banana to Triax Adaptor for 2-wire (non Kelvin) connection is used to change the output terminal connectors from banana types to triaxial types. The figure below shows the connection inside the adaptor. The center conductor and the middle layer conductor of the High triaxial terminal are connected to High Force and Guard banana terminals respectively. Both the center conductor and the middle layer conductor of the Low triaxial terminal are connected to Low Force banana terminal. The outer conductors of the both triaxial terminals are connected to Ground banana terminal.

The connection between the output terminals of B2901/02/11/12A Series and the N1294A Banana to Triax Adaptor is tight so that the N1294A should be pushed into the output terminals strongly. Otherwise, the poor connection between them affects the measurement results.
Performing Self-calibration on B2901/02/11/12A

It is recommended to perform Self-calibration before starting the measurement to ensure its performance in your environment especially in the case of low current measurements. The result of Self-calibration will be stored into the non-volatile memory and is used for the measurements.

Step 1. If you aren’t on the top of the Function menu, press repeatedly to return to the top level.

Step 2. Press More… System Cal/Test Self-Cal and then press OK to perform a self calibration.

(1) Press More...
(2) Press System
(3) Press Cal/Test
(4) Press Self-Cal
(5) Press OK
Using 10 nA Minimum Current Measurement Range

In the default setting, the B2901/02/11/12A performs the current measurement using 1 uA current minimum measurement range with AUTO range operation. With AUTO range operation, the B2901/02/11/12A selects the proper range for the measurement with specified minimum measurement range so that you don’t need to take care about it unless you need to make the sub-nA current measurement accurately. If you need to make a low current measurement accurately, take the following steps to configure to use 10 nA current minimum measurement range with AUTO range operation. For B2901/02A, 100 nA current minimum measurement range with AUTO range operation should be used because they don’t have 10 nA current range.

Step 1. Rotate and press \[ \text{AUTO} \] to edit the current measurement range operation, and then select \[ \text{AUTO} \] to set it to AUTO.

Step 2. Rotate and press \[ \text{10nA} \] to edit the current minimum measurement range, and then select \[ \text{10nA} \] to set it to 10 nA (select \[ \text{100nA} \] to set it to 100 nA for B2901/02A).
Using Appropriate 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 B2901/02/11/12A to meet a variety of the requirement to the measurement conditions. In the case of low current measurements, it is recommended to set Measurement Speed parameter to AUTO(Default), NORMAL, LONG or MANUAL with 1 PLC or more aperture time. Here, PLC stands for power line cycle and the specified number of power line cycles is used per a measurement.

For example, let’s try to change the measurement speed to NORMAL to make a measurement more carefully. If you select NORMAL, the aperture time is set to 1 PLC.

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

Step 2. Press to edit the measurement speed, and then select to set the measurement speed to NORMAL. (If you can’t see in Assist keys, press to change the keys shown in Assist keys.)

Using Appropriate Measurement Trigger Delay Time

Generally speaking, the measurement path has some stray impedance, which causes the leakage current and the dielectric absorption when applying the voltage. In order to wait for their being settled down, it is necessary to wait for an appropriate time before starting the measurements. The required wait time before the measurement depends on the voltage step. The larger voltage step becomes, the longer the required wait time becomes.

The wait time before the measurement can be specified by the measurement trigger delay time which can be displayed in Trigger Sub-panel in Single View, although Range Sub-Panel is shown in the default condition. In the default setting, the trigger type is set to the automatic trigger type (AUTO) so that you can’t specify any number for the parameter.
For example, let’s try to set the measurement trigger delay time to 100 ms to wait 100 ms before the measurement.

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

**Step 2.** Press to show Trigger Sub-Panel. (If you can’t see in Assist keys, press to change the keys shown in Assist keys.)

**Step 3.** Press to edit the trigger type, and then select to set the trigger type to MANUAL.

**Step 4.** Rotate to select the measurement trigger delay time and set it to 100 ms.

Note) Source and Measurement Trigger Count should be the same number as Sweep Points for Sweep Measurement. On the other hands, it should be 1 for a Single Point Measurement.

Now you’ve configured 100 ms measurement trigger delay time.
Measurement Result Comparison

LED IV Measurements are made to see the parameter dependency with changing each parameter setting.

Effect of Performing Self Calibration

Measurement Result Difference in Current Minimum Measurement Range Setting

Measurement Result Difference in Measurement Speed Setting
Measurement Result Difference in Measurement Trigger Delay Time Setting

(1) 0 ms Measurement Trigger Delay Time
(2) 100 ms Measurement Trigger Delay Time
(3) 200 ms Measurement Trigger Delay Time
(4) 500 ms Measurement Trigger Delay Time