

# Application Note

## SmartSnippets™ Power Profiler Calibration

AN-B-051

### Abstract

*The SmartSnippets™ toolbox is used to generate power profiling data and can be used by the developer to estimate the energy costs for his application. However, SmartSnippets may require some calibration to get more accurate results in power profiling, as sometimes the development kit hardware components can measure slightly differently for various reasons. Therefore it is recommended to tune SmartSnippets to the actual development kit that is used. This document steps through the process of calibration for Pro and Expert development kits.*

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**SmartSnippets™ Power Profiler Calibration****1 Terms and Definitions**

Dev Kit	Development Kit
GND	Ground
DMM	Digital Multi-Meter

**2 References**

- [1] DA14580, Datasheet, Dialog Semiconductor.
- [2] AN-B-015, DA14580 Supply current measurements, Application Note, Dialog Semiconductor.
- [3] UM-B-034, Bluetooth Smart Development Kit - Pro, User Manual, Dialog Semiconductor.
- [4] UM-B-014, Bluetooth Smart Development Kit - Expert, User Manual, Dialog Semiconductor.

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## SmartSnippets™ Power Profiler Calibration

### 3 Introduction

The DA1458x development kits along with the [SmartSnippets™](#) toolbox provide the developer with the energy consumption estimates for the application. To generate the power profile [SmartSnippets](#) uses offset currents and a multiplication factor. Sometimes this may not be accurate enough and needs calibration, which is specific for a given development kit. As the hardware components vary slightly in value and performance, each development kit behaves slightly differently. In order to compensate for these variations, the [SmartSnippets](#) tool has to be tuned for the DA14580 Pro and Expert development kits as described in the following sections.

## SmartSnippets™ Power Profiler Calibration

### 4 PRO DevKit Calibration

The following calibration is performed on a DA14580DEVKT-P\_VB and some of the steps may vary slightly depending on which version of the development board is used. The primary objective is to remove all unnecessary power consuming modules connected via jumpers to minimize the energy consumption as much as possible and keep it to something that can be estimated with known loads.

#### 4.1 Development Kit Preparation

Follow the next steps to configure the development kit to have only the necessary jumpers connected to isolate the power profiling and keep the energy consumption to a calculated amount by minimizing the paths of consumption.

1. Remove all jumpers from the development kit except the following ones and make sure these jumpers are connected as specified.
  - a. J1: Power measurement input (pins 1-2, 3-4)
  - b. J10: Measurement trigger
  - c. J11: Input power source (pins 1-2)
2. Remove the DA14580 daughter card.
3. Configure the DMM to measure DC current (DCI) mode and connect the DMM test leads to pin 7 and pin 23 of J5. This configuration resembles a fly-wire with DMM in the path.

This setup closes the circuit between the ground and supply voltage for the DA14580 via pushbutton SW3. This provides us with the current measurements later in the calibration process passing through a known load R58 that we can switch in on demand. Only 4 jumpers and a fly-wire (DMM leads) are connected on the PRO kit. This calibration does not need the coin cell battery.

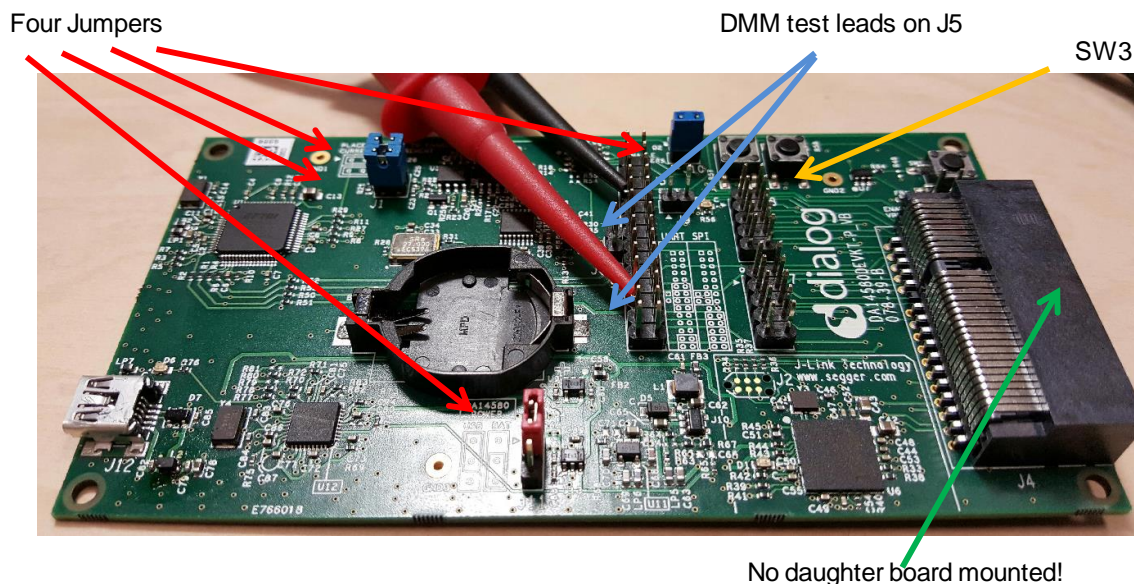


Figure 1: DA14580 PRO Kit Motherboard Connections for Calibration

## SmartSnippets™ Power Profiler Calibration

### 4.2 SmartSnippets Tool Preparation

Start SmartSnippets in UART/SPI mode, and open the power profiler. Go to the configuration dialog by pressing the **Config** button.

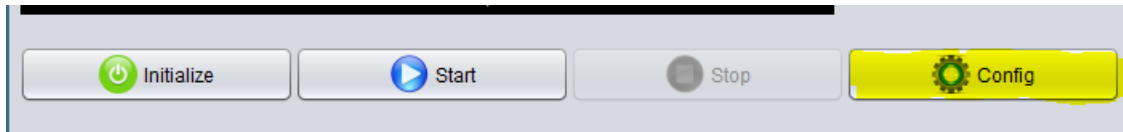


Figure 2: SmartSnippets Power Profiler Action Buttons

Make sure that the settings match with the highlighted entries of this screenshot and then click **OK**.

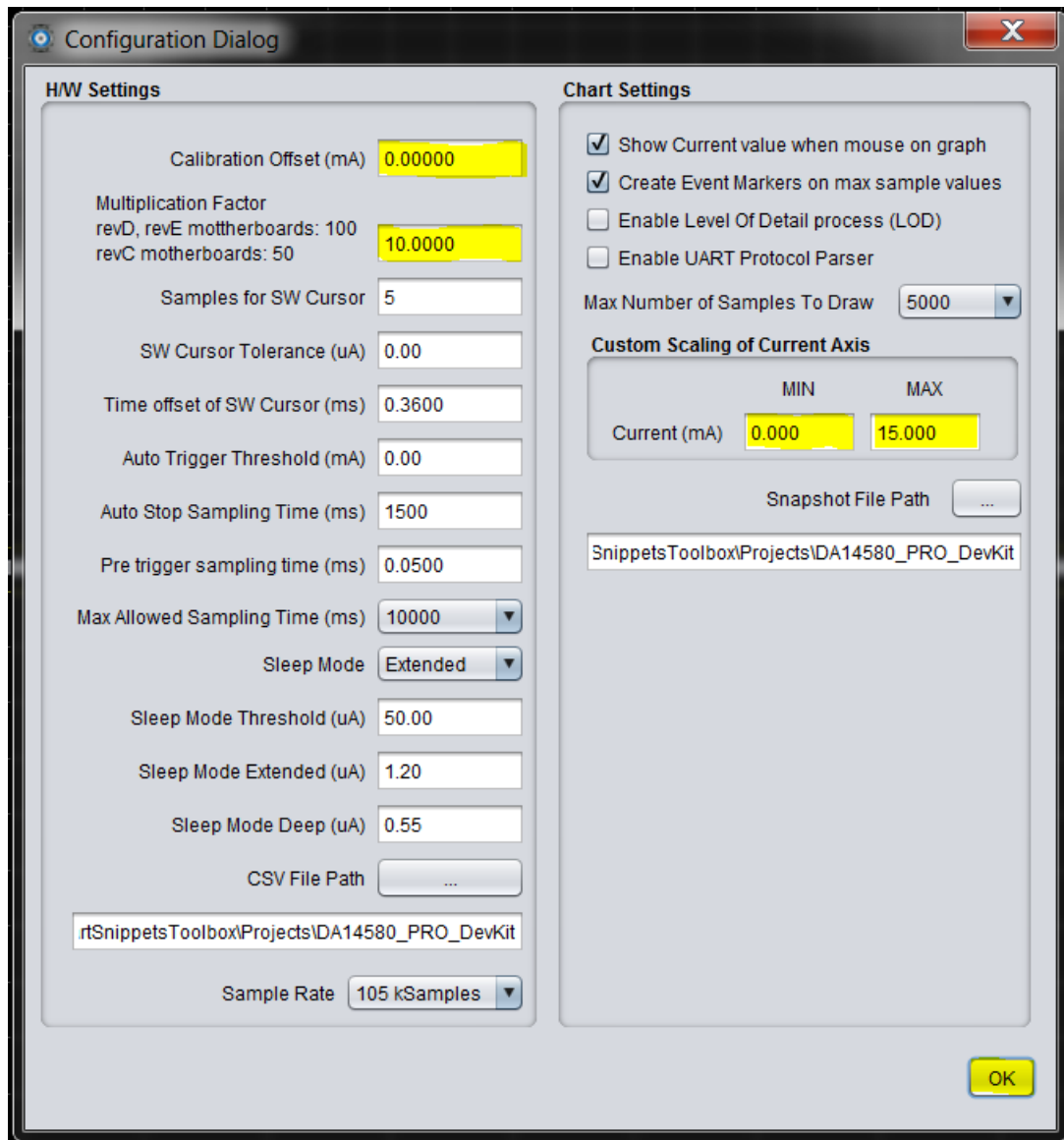
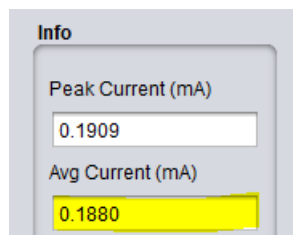


Figure 3: SmartSnippets Power Profiler Configuration Window

## SmartSnippets™ Power Profiler Calibration

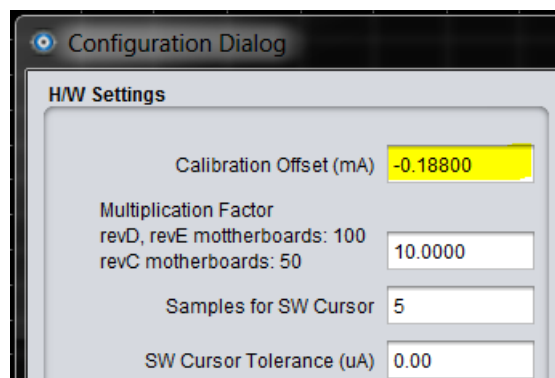
### 4.3 Calibration Process

1. Initialize and start the power profiler and let it run for a few seconds. Then press **Stop**. Copy the *Avg Current (mA)* value from the info bezel to the Windows clipboard.



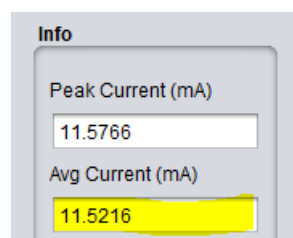
**Figure 4: Power Profiler Initial Current Readings for PRO Kit**

2. Reopen the configuration dialog and paste the average current into the *Calibration Offset (mA)* window. Change the sign to reflect a negative (-) value.



**Figure 5: PRO Kit Offset Current Calibration**

3. Press **OK** to close the configuration dialog.
4. Press and keep holding the button SW3 on the PRO development kit. Start the power profiler and let it run for a few seconds. Stop the power profiler and read the average current. The average current should read between 9 mA and 13 mA.



**Figure 6: PRO Kit Current Readings with SW3 Pressed**

5. Record the *Avg Current (mA)* and *DMM Current (mA)* values while the switch SW3 is pressed. Then calculate the Multiplication Factor (MF) using the following equation:

$$\mathbf{MF = 10 * (DMM Current / Avg Current)}$$

6. In this case the recorded current values are as follows:

$$\text{SmartSnippets Avg Current} = 11.5216 \text{ mA}$$

$$\text{DMM Current reading} = 11.610 \text{ mA}$$

7. Calculate the multiplication factor using the above recorded values:

$$\text{MF} = 10 * (11.610 \text{ mA} / 11.5216 \text{ mA}) = 10.0767$$

## SmartSnippets™ Power Profiler Calibration

8. This MF value must be placed in the *Multiplication Factor* field of the configuration dialog:

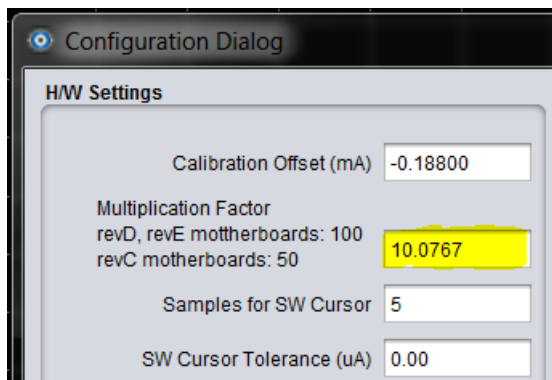


Figure 7: PRO Kit Multiplication Factor Calibration

9. Run the power profiler with these settings and SW3 pressed. The *Avg current (mA)* value should be very close to the 11.610 mA value obtained by DMM readings.

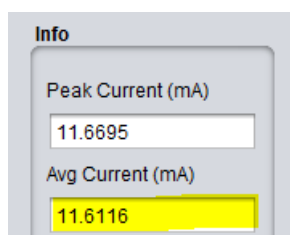


Figure 8: PRO Kit Current Readings after Calibration



## SmartSnippets™ Power Profiler Calibration

### 5 EXPERT Kit Calibration

The following calibration is performed on a DA14580 Motherboard rev. C1 and some of the steps may vary slightly depending on which version of the development board is used. The primary objective is to remove all unnecessary power consuming modules connected via jumpers to minimize the energy consumption as much as possible and keep it to something that can be estimated with known loads.

#### 5.1 Dev Kit Preparation

Follow the next steps to configure the development kit to have only the necessary jumpers connected to isolate the power profiling and keep the energy consumption to a calculated amount by minimizing the paths of consumption.

1. Remove all the jumpers from the board except the following and make sure these jumpers are connected in the specified way.
  - a. J13: Input power source (connect pins 3-4).
  - b. J7: Power measurement input (1-2, 3-4).
  - c. J10: Power measurement trigger (populate).
  - d. J23: LDO voltage selection (populate for Buck mode).
2. Remove the DA14580 daughter card.
3. Configure a DMM in DC current (DCI) mode and connect the test leads to pin-5 of J16 (switch K2) and pin-2 of J14 (input voltage).

The jumper J23 sets the input supply voltage to ~3 V, effectively operating in Buck mode. The Expert kit is also capable of operating in Boost mode where the input supply voltage is 1.5 V (not required for calibration).

The DMM test leads connect the pushbutton K2 to the input supply voltage of the DA14580. This allows us to use the 1 k $\Omega$  resistor from the pushbutton K2 to GND as a known load that we can switch in on demand.

Only five jumpers and the DMM test leads are connected to the Expert kit. The battery is not needed for this calibration.

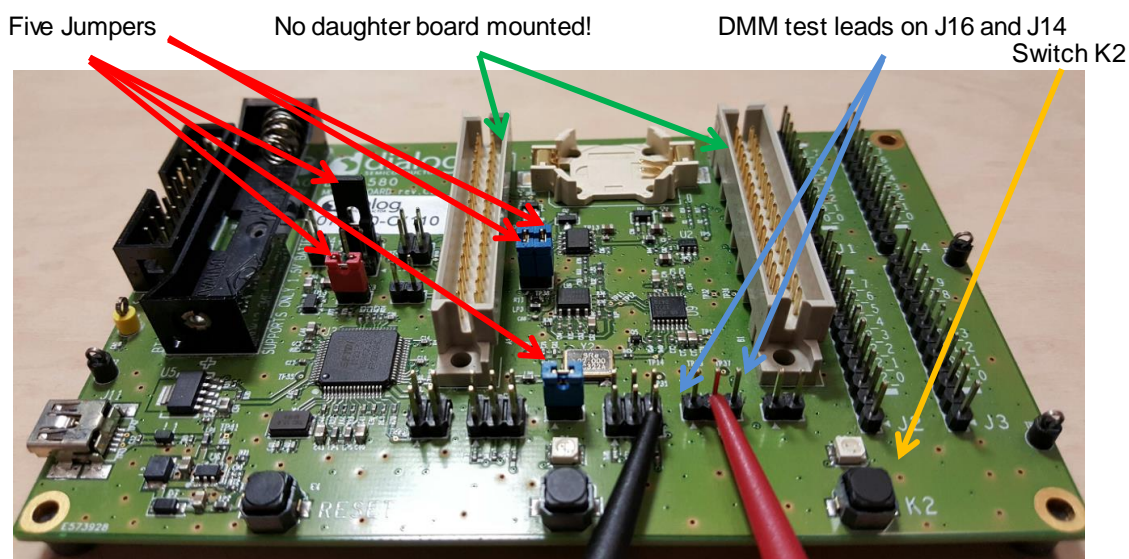


Figure 9: DA14580 EXPERT Kit Motherboard Connections for Calibration

## SmartSnippets™ Power Profiler Calibration

### 5.2 SmartSnippets Tool Preparation

Start SmartSnippets in UART/SPI mode, and open the power profiler. Go to the configuration dialog by pressing the **Config** button.

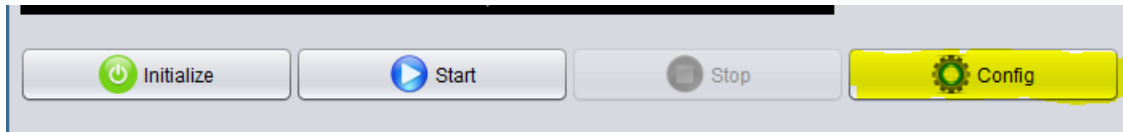


Figure 10: SmartSnippets Power Profiler Action Buttons

Make sure that the settings match with the highlighted entries of this screenshot and then click **OK**.

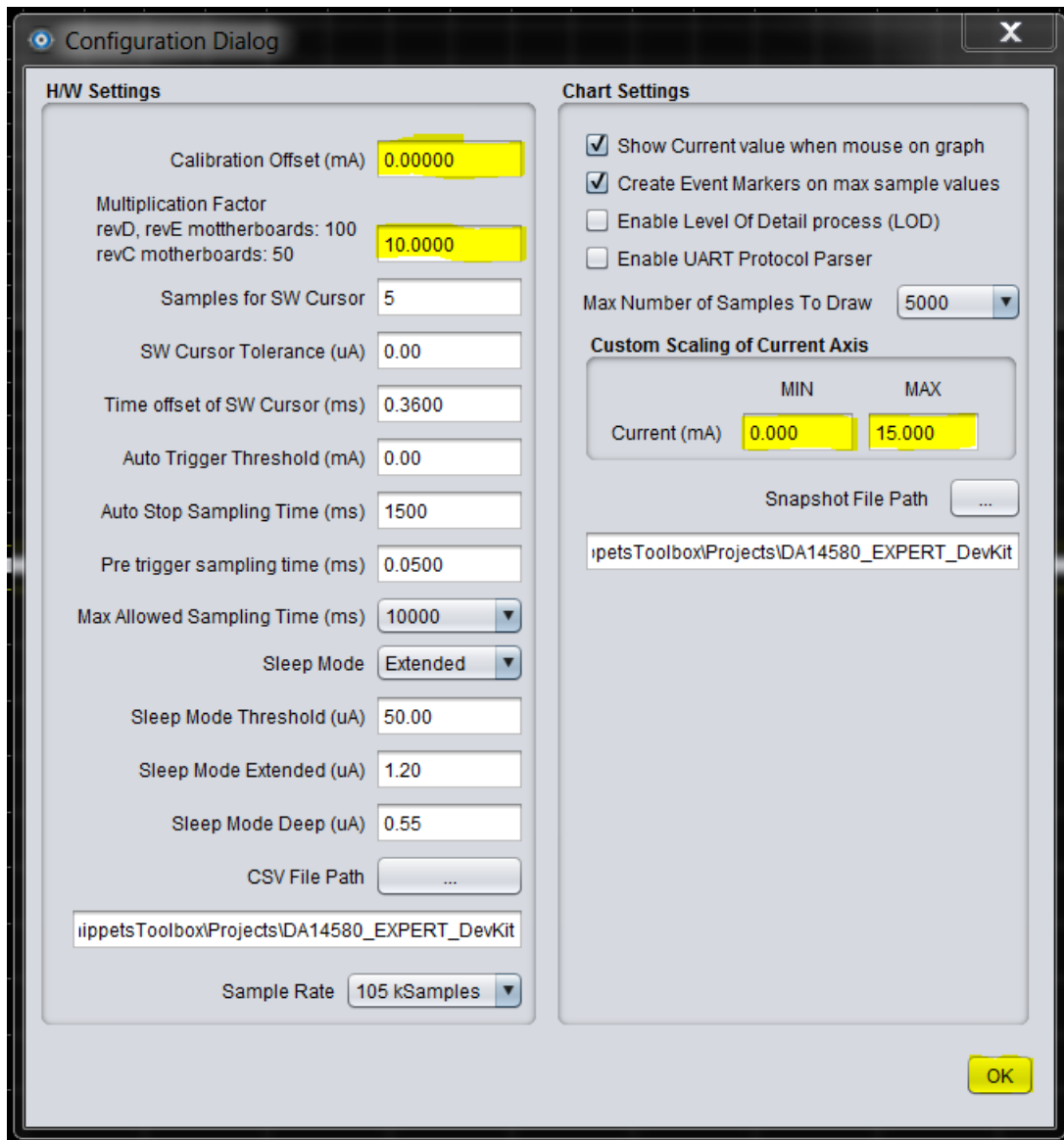
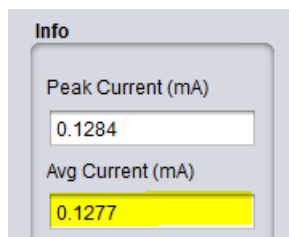


Figure 11: SmartSnippets Power Profiler Configuration Window

## SmartSnippets™ Power Profiler Calibration

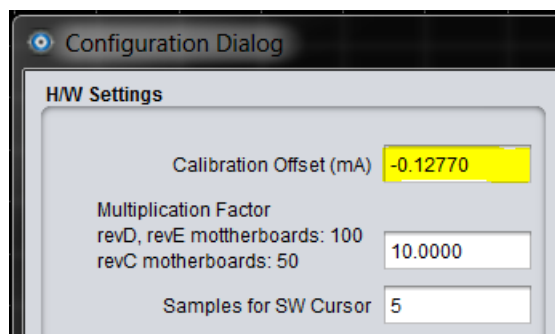
### 5.3 Calibration Steps

1. Initialize and start the power profiler and let it run for a few seconds. Then press **Stop**. Copy the *Avg Current (mA)* value from the info bezel to the Windows clipboard.



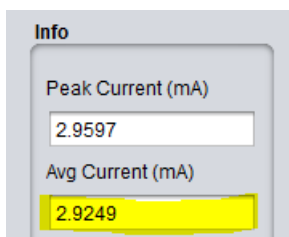
**Figure 12: Power Profiler Initial Current Readings for EXPERT Kit**

2. Reopen the configuration dialog and paste the average current into the *Calibration Offset (mA)* window. Change the sign to reflect a negative (-) value.



**Figure 13: EXPERT Kit Offset Current Calibration**

3. Press **OK** to close the configuration dialog.
4. Press and keep holding the button K2 on the EXPERT development kit. Start the power profiler and let it run for a few seconds. Stop the power profiler and read the average current.



**Figure 14: EXPERT Kit Current Readings with SW3 Pressed**

5. Record this *Avg Current (mA)* and *DMM Current (mA)* while the switch K2 is pressed, since we need it to calculate the Multiplication Factor (MF) using the following equation.

$$MF = 10 * ( DMM \text{ Current} / Avg \text{ Current} )$$

6. In this case the recorded current values are as follows:

SmartSnippets Avg Current = 2.9249 mA

DMM Current reading = 2.953 mA

7. Calculate the multiplication factor using the above recorded values:

$$MF = 10 * ( 2.953 \text{ mA} / 2.9249 \text{ mA} ) = 10.0961$$

## SmartSnippets™ Power Profiler Calibration

- This MF value must be placed in the *Multiplication Factor* field of the configuration dialog:

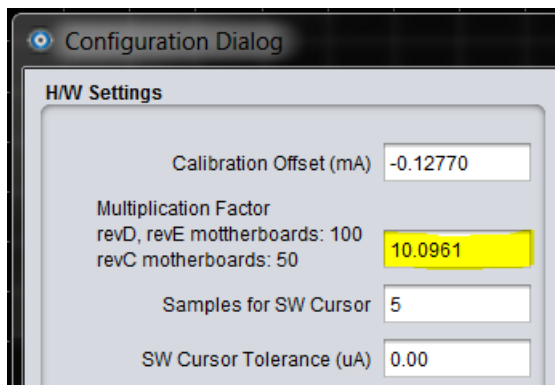


Figure 15: EXPERT Kit Multiplication Factor Calibration

- Run the power profiler with these settings and SW3 pressed. The *Avg current (mA)* should be very close to the 2.953 mA value obtained by DMM readings.

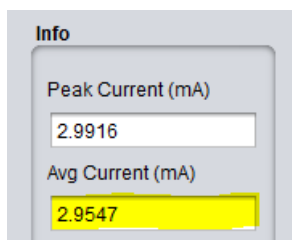


Figure 16: EXPERT Kit Current Readings after Calibration

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**SmartSnippets™ Power Profiler Calibration**

**Revision History**

<b>Revision</b>	<b>Date</b>	<b>Description</b>
1.0	04-Jan-2017	Initial version.

## SmartSnippets™ Power Profiler Calibration

### Status Definitions

Status	Definition
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APPROVED or unmarked	The content of this document has been approved for publication.

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