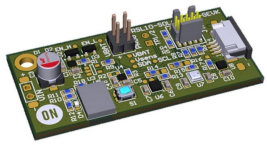

ON Semiconductor EVBUM2623 RSL10 Solar Cell Multi-Sensor Platform User Guide

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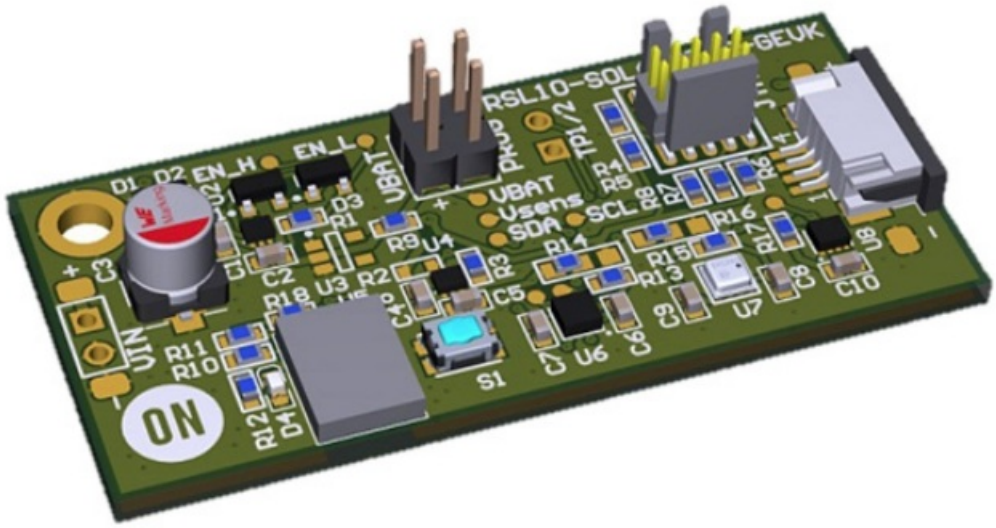
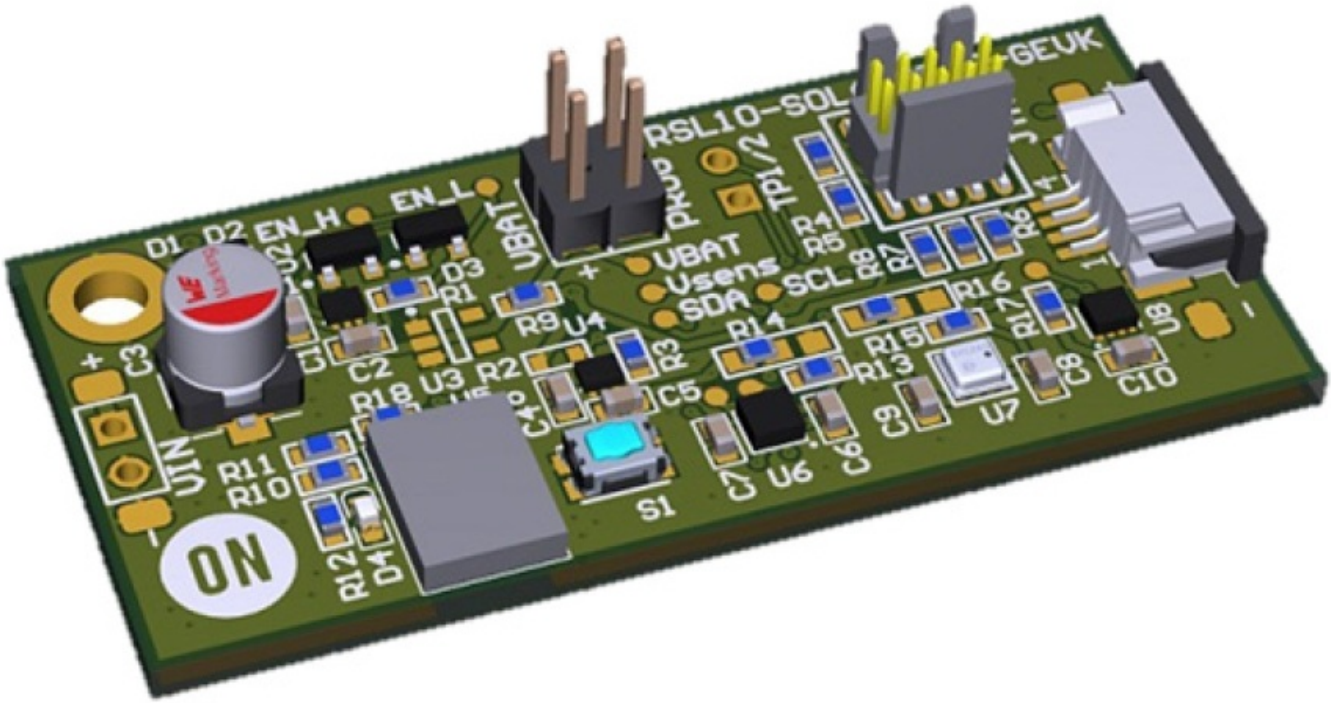


Introduction

The RSL10 Solar Cell Multi−Sensor Platform (RSL10−SOLARSENS−GEVK) is a comprehensive development platform for battery−free IoT applications for smart buildings, smart homes, and Industry 4.0 verticals. Based on the industry's lowest power Bluetooth® Low Energy radio (RSL10), the board features sensors for environmental and motion sensing (BMA400−a smart 3−axis accelerometer, BME280− a smart environmental sensor, and the NCT203 wide−range digital temperature sensor).

The board also features a low-weight, low-profile 47 F storage capacitor; a programming and debug interface; and a connected solar cell.
Since the device harvests energy from a low current source, it is important to minimize leakage of the overall system during operation and standby. Along with other energy-efficient devices, an ultra−low quiescent current LDO (NCP170) on the board significantly minimizes leakage.



Hardware Description

Default Configuration

The development platform includes solar multi-sensor board hardware and a connected solar cell. If you need to reconnect the solar cell or would like to work with another solar cell than the one provided out of the box, follow the guidelines in the section 'Powering the Board'.

In addition to the RSL10 SIP (System−in−Package), the following sensors are present on the board.

- BMA400, 3−Axis Smart Accelerometer
- BME280, Environmental Sensor (temperature, humidity, pressure)
- NCT203, Wide−range (−40 to 125°C) Temperature

Sensor
The platform also features an ultra−low quiescent LDO (NCP170) and a 100 F capacitor to store energy.

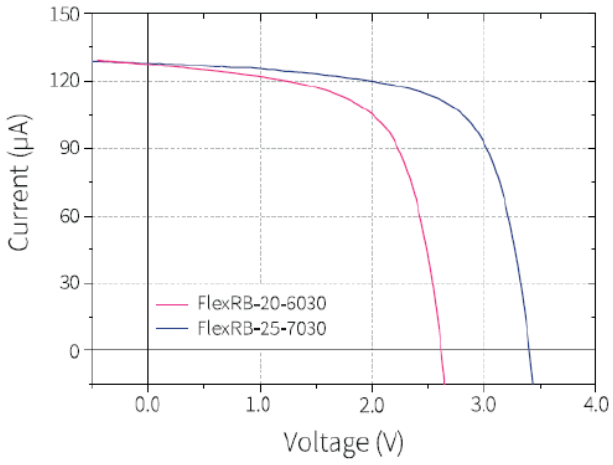
Powering the Board
The board is powered by a solar cell. The default solar cell used is Ribes Tech FlexRB−25−7030, which has a typical operating voltage of 3 V. The circuitry is protected by a clamp at 3 V, and the operating domain is 1.6 V to 2.65 V. Below 1.6 V, no transmission is allowed and the device is harvesting energy; Above 2.65 V, the device starts to operate and depletes energy buffering down to 1.6 V.

For more information about the power regulation section, refer to Continuous Harvesters and ON Semiconductor's Low−Power RF Technology Close the Gap in Environmental and Accelerometer Sensors for IoT (TND6285/D). The powering cell or its equivalent can be mounted either by soldering both terminals or with the ZIF interface.

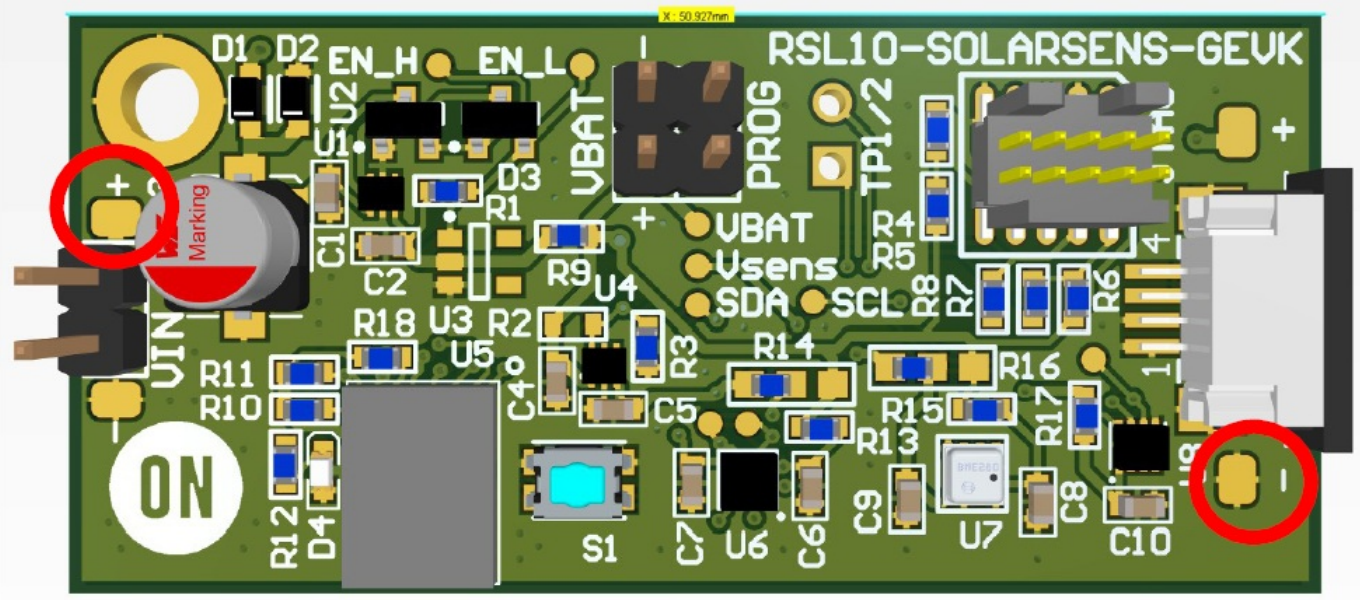
WARNING: ENSURE THE POLARITY OF THE PCB IS CORRECT WITH RESPECT TO ONE OF THE CELLS.

ELECTRICAL SPECIFICATIONS

FlexRB-20-6030		
Working voltage		min 1.8 V (200 lux)
		min 2.0 V (1000 lux)
Working current	min 12 µA	typ 16 µA (200 lux)
	min 60 µA	typ 80 µA (1000 lux)
Maximum voltage		max 2.9 V (1 sun)
Maximum current		max 4 mA (1 sun)
FlexRB-25-7030		
Working voltage		min 2.2 V (200 lux)
		min 2.5 V (1000 lux)
Working current	min 12 µA	typ 16 µA (200 lux)
	min 60 µA	typ 80 µA (1000 lux)
Maximum voltage		max 3.6 V (1 sun)
Maximum current		max 4 mA (1 sun)



Electrical Specifications of the Ribes Tech FlexRB−25−7030 Solar Cell



Operations

Normal Operations

Every transmission is signed with a LED pulse (LED D4 located just at the Left of RSL10). In case no transmission is seen or if the device looks to be hooked in out−of−operation hit the Reset button (S1) and wait for a few seconds.

In normal lighting conditions, the LED will blink faster than once per second.

Operating Conditions

The device has been tested under the following lighting conditions:

COMMON LIGHTING OPERATING CONDITIONS

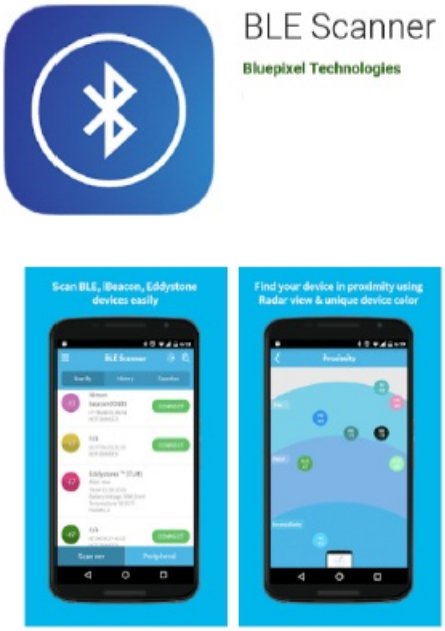
	Light Source	**Time**	**Solar Cell Facing**	**Sensor Location**	**Lux Level** (Note 1)
Cloudy Winter	Natural	11:00 am	Sky	Office, Near Window	415
“	“	“	Indoor	Office, Near Window	230
“	“	“	Outdoor	Office, Near Window	630
“	“	3:40 pm	Indoor	Office desk	200
“	Ceiling Neon	11:00 am	Ceiling	Office Corridor	340
“	“	“	Whitewall	Office Corridor	220
“	“	“	Ground	Office Corridor	140 (Note 2)
“	“	4:30 pm	Ceiling	Office desk	250
“	Natural	9:00 am	Window	Automotive Dashboard	700
“	“	“	Ground	“	350
“	“	“	Front seat	“	400

1. Lux levels are measured with the uncalibrated IoS® App from Velux on iPhone® 6.
2. Under similar lighting conditions, the device should automatically start up and begin transmitting sensor data. For more information on sensor operations, refer to the section ‘Firmware Implementation’.

Firmware Implementation

Default Configuration

The development platform is loaded with a preconfigured operating setting where both onboard temperature sensors are polled once at a time alternatively, and temperature information Loss is sent via a default Eddystone beacon format. A freely available smartphone application like BLE Scanner (Available on the IoS App Store or Google® Play) can be used to display the received beacon packets.



Prerequisites

1. Install the 64–bit version of Java from https://www.java.com/en/download/
2. Install J–Link Version 6.32i or later from https://www.segger.com/downloads/jlink (select J–Link software and documentation pack)
3. Download and install “ON Semiconductor IDE Installer” from https://www.onsemi.com/PowerSolutions/product. do?id=RSL10
    - Download the “RSL10 SDK Getting Started Guide” and RSL10 CMSIS pack under “RSL10 Software Package” from the above site. All of these are highlighted in the picture below. Save the CMSIS pack in a folder, for example, C:\cmsis_packs

4. Download the B–IDK CMSIS pack from https://www.onsemi.com/B–IDK and save it in the same folder as the RSL10 CMSIS pack (see 3. above)
5. The CMSIS pack at item 4. is dependent on ARM CMSIS pack as well. Please install ARM CMSIS pack 5.5.1 or higher after downloading from: https://github.com/ARM–software/CMSIS_5/relea ses.
6. CMSIS pack at item 4. is also dependent on ARM CMSIS – FreeRTOS version 10.2.0 or higher for users exposed to design the code under FreeRTOS with RSL10: https://github.com/ARM–software/CMSIS–FreeR TOS/releases.

Importing the CMSIS–Packs

1. Launch the RSL10 ON Semiconductor IDE
   NOTE: Please import the RSL10 CMSIS pack first as the B–IDK CMSIS pack (step 4 in the Prerequisites section) depends on the RSL10 CMSIS pack (step 3a in the Prerequisites section).
2. Refer to Chapter 3 of the RSL10 SDK Getting Started Guide (step 3a) for step–by–step instructions on importing the CMSIS packs.

3. Once all packs are successfully imported, they can be viewed from the CMSIS pack manager perspective as shown below.

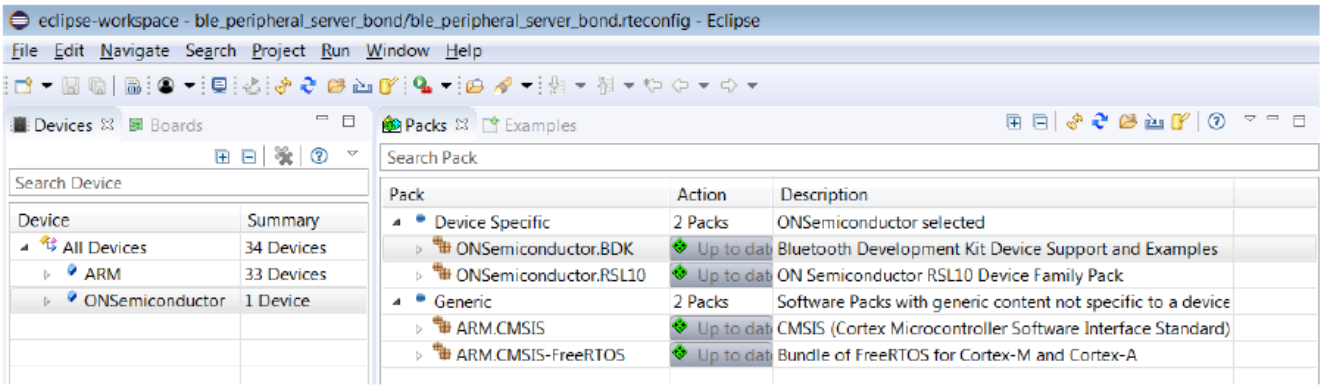
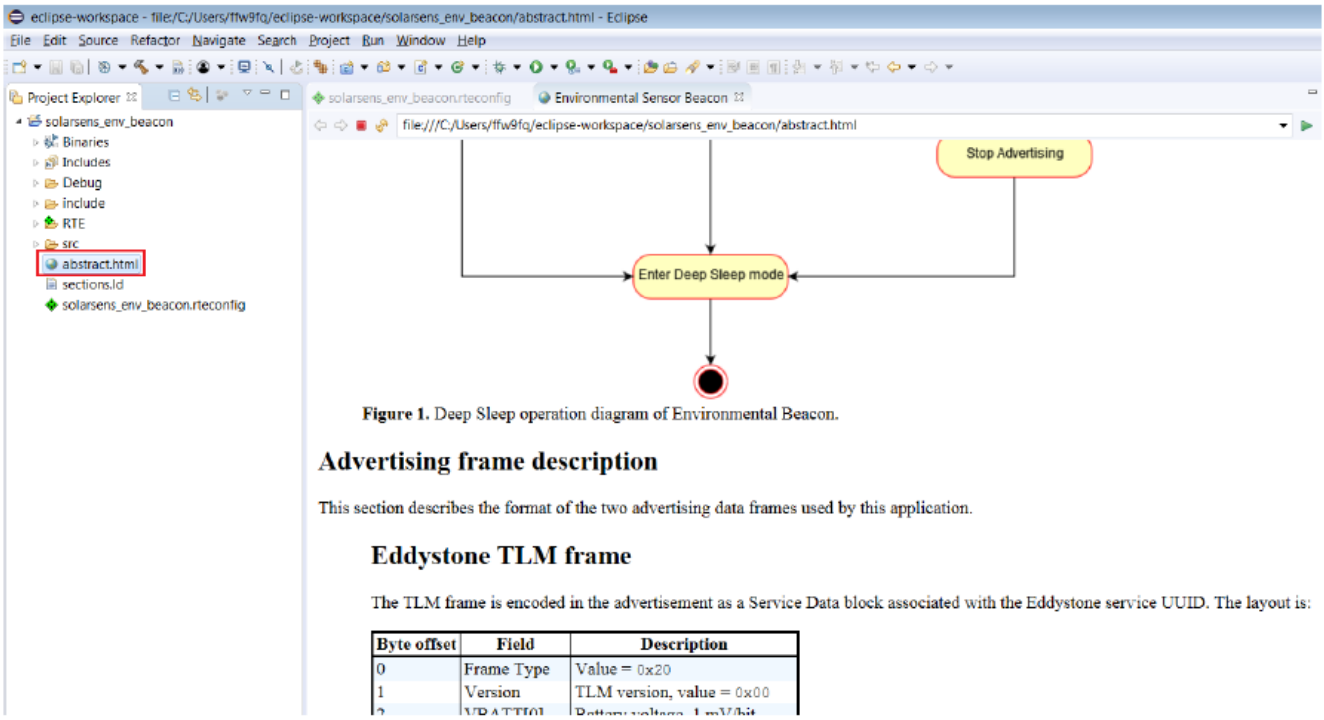


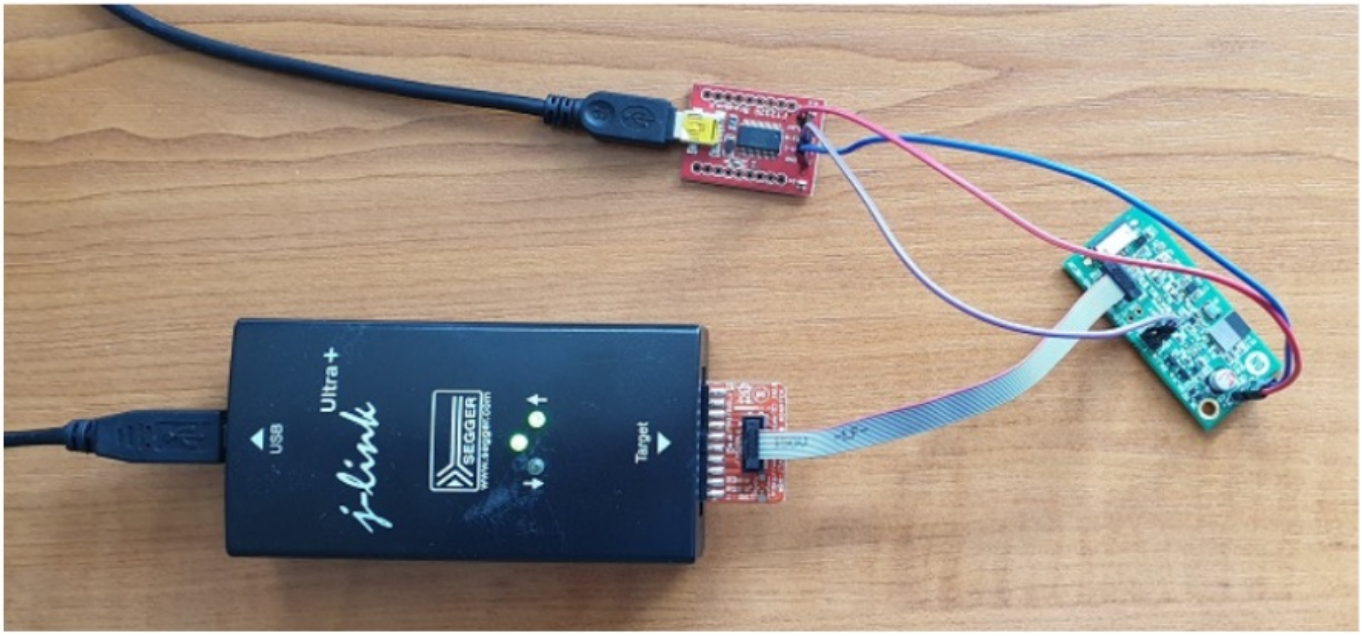
Figure 6. CMSIS Pack Manager Perspective



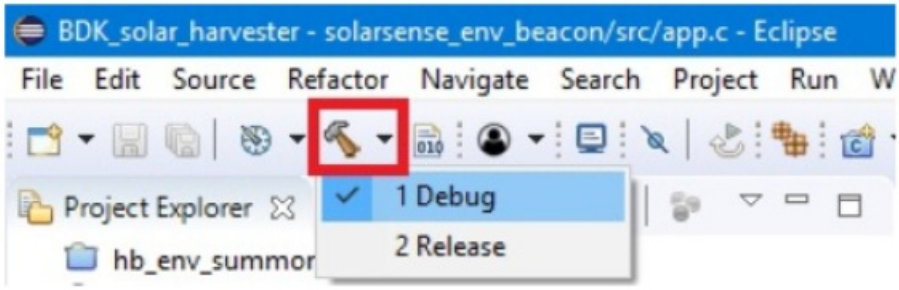
Since the board does not provide a debugging probe, a compatible standalone debugging probe is required. This can be any SEGGER J–Jink debug probe with a 10–pin Cortex® Debug connector adapter.

The board comes with a Ribes Tech solar cell attached. For the purposes of debugging and re–flashing the board, it is required to disconnect the solar cell from the board. The external power source needs to be connected to either of the VIN connectors. The power source can be alternatively connected to the VBAT header for the purpose of detailed power consumption analysis of RSL10 and associated sensors.

An example setup for debugging is shown in Figure 9 where the board is powered by 3.3 V from a UART to USB converter and also uses the PROG header as a UART TX line. For power measurements, the converter should be replaced by an appropriate power consumption meter, and both debug probe and UART should be disconnected.



Build Configurations
The project provides two build configurations that can be selected and built using the Build Selector in the Toolbar.



Debug
This configuration should be used for debugging purposes only.

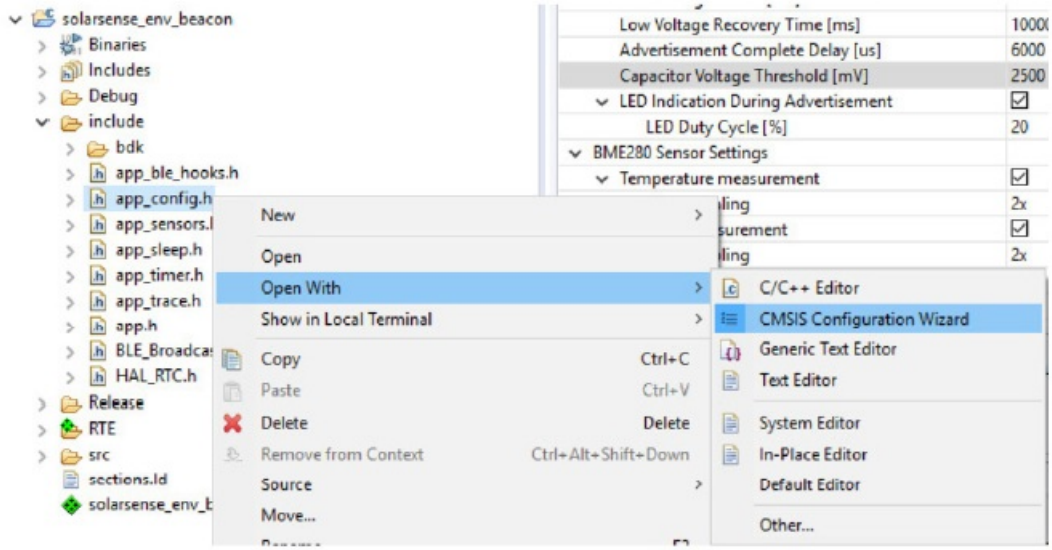
- Binary with debugging symbols (-O0 -g3).
- Trace messages printed over UART peripheral using PROG DIO pad (Header J8, DIO12). Configuration for this port is: 230400 bps, 8N1, no flow control.

Sending of trace messages over UART slows down the execution of the program which might impact performance in some cases.

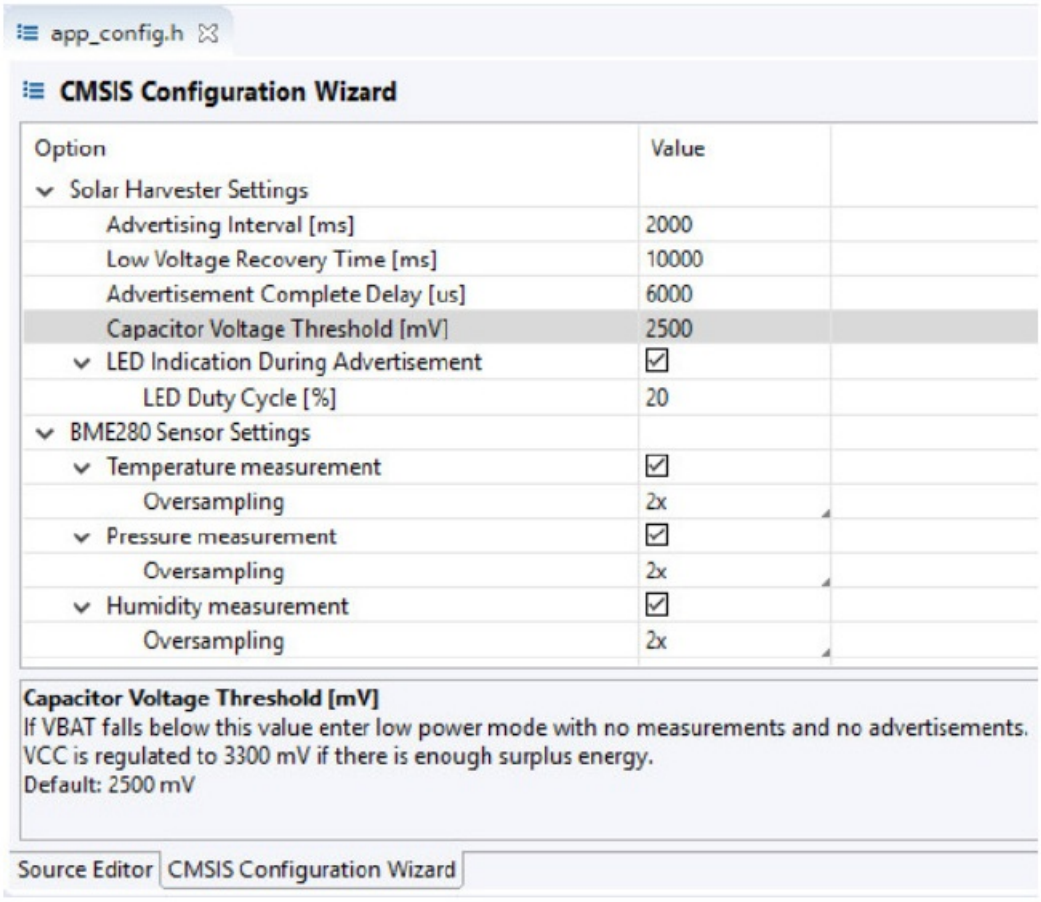
Release
This configuration should be used for power consumption measurements and production builds.

- Optimized for speed, no debug symbols (-O2).
- Trace messages are disabled.

CMSIS Configuration Header
The project provides a configuration header app_config.h located in the included folder of the project. This header can be opened by using CMSIS Configuration wizard editor as shown in Figure 10. The Configuration Wizard allows some predefined program parameters to be changed without changing the code directly. All options provide short descriptions and check for valid setting value ranges.

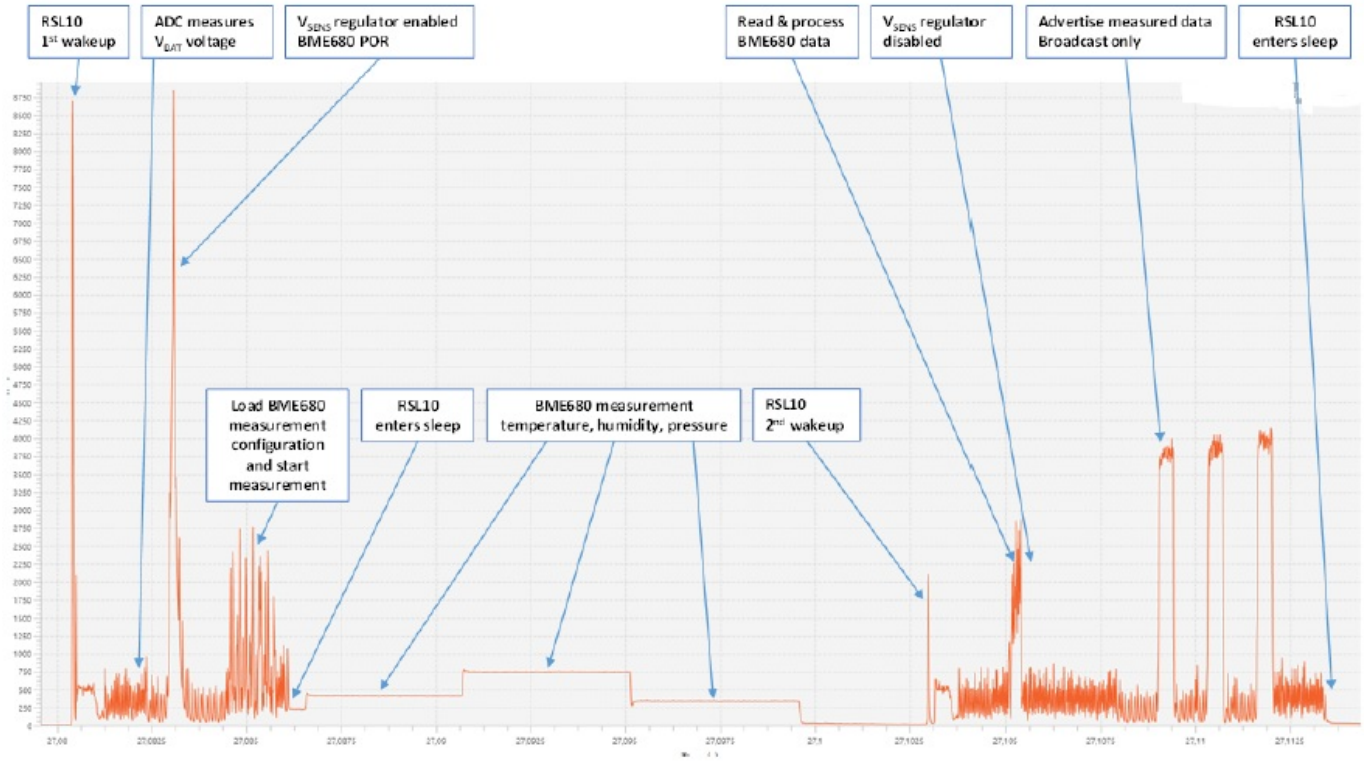


Selecting CMSIS Configuration Wizard as the Default Editor for app_config.h File



CMSIS Configuration Wizard with Available Program Settings

Figure 12 shows the current consumption of the board during a sensor measurement event, followed by an advertisement of measured data. During this event, a total of 60 µJ of energy was used to both measure sensor data and advertise the results. If sensor measurement is not scheduled and the board only advertises, the energy consumption is reduced to 20 µJ.



Typical Operation Cycle with Sensor Measurement and Advertising (3 V power supply, advertising interval set to 1 s, and sensor measurement during every advertising interval).

Debugging / Flashing
Refer to the RSL10 SDK Getting Started Guide Section 4.4 for instructions on how to create debugging configurations and flash the program onto RSL10.

for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by ON Semiconductor shall not constitute any representation or warranty by ON Semiconductor, and no additional obligations or liabilities shall arise from ON Semiconductor having provided such information or services.

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This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by ON Semiconductor to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

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For more information and documentation, please visit **www.onsemi.com**.

Documents / Resources

	**ON Semiconductor EVBUM2623 RSL10 Solar Cell Multi-Sensor Platform** [pdf] User Guide EVBUM2623 RSL10 Solar Cell Multi-Sensor Platform, EVBUM2623, RSL10 Solar Cell Multi-Sensor Platform, Cell Multi-Sensor Platform, Multi-Sensor Platform

References

- Intelligent Power and Sensing Technologies | onsemi
- Intelligent Power and Sensing Technologies | onsemi
- onsemi Product Portfolio
- SEGGER - The Embedded Experts - Downloads - J-Link / J-Trace