

RSL10-COIN-GEVB Programming

Overview

RSL10-COIN-GEVB is a Bluetooth® beacon board featuring RSL10, the industry's lowest power [Bluetooth 5 SoC](#), and [N34TS108](#), a low-energy temperature sensor. This board is battery powered and advertises temperature, UID and URL as beacon packets. Furthermore, RSL10-COIN-GEVB supports Firmware over-the-air (FOTA) and is CMSIS-Pack compliant.

Required Hardware & Equipment

Table 1. HARDWARE DETAILS RSL10-COIN-GEVB

Chip Variant	RSL10 6x6 QFN NCH- RSL10-101Q48-ABG
Antenna Type	PCB Antenna
Debugging Options	6-pin needle connector 1-pin from Interface header (UART TX) No reset button
User Input	Battery holder button
IO Header	3 V, GND, I ² C, 1xGPIO
External Wake-up Sources (for down to 25nA operation)	Batt. holder button N34TS108 /ALERT signal GIO_SPARE
Temperature Sensor	N34TS108
Board Supply Range	1.4–3.6 V

Software

The RSL10-COIN-GEVB software is based on B-IDK and CMSIS pack which allow for rapid development of various use cases. In order to set up the package refer to the Prerequisites section of the Bluetooth Low Energy IoT Development Kit (B-IDK) Getting Started Guide <https://www.onsemi.com/pub/Collateral/EVBUM2589-D.PDF>

Firmware

This section outlines the several existing use cases for the firmware, its dependencies and how to set it up to begin using RSL10-COIN-GEVB.



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EVAL BOARD USER'S MANUAL

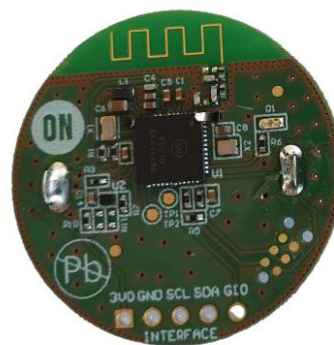


Figure 1. Top View



Figure 2. Bottom View

Eddystone Beacon Application

Initial firmware application for the board with basic Eddystone Beacon functionality.

Features:

- FOTA enabled
- Non-connectable advertising mode with up to 3 Eddystone Beacon slots
- Power-off mode with minimal power consumption

Dependencies:

- FOTA library
- Bootloader

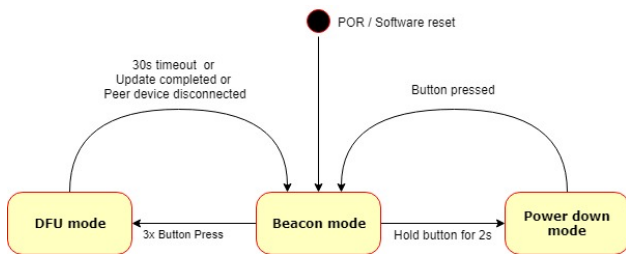


Figure 3. Eddystone Beacon Application Power Modes

Default operation mode of the board is to act as an Eddystone Beacon with non-connectable advertising. Based on compile time configuration the board will be able to transmit any combination of the following Eddystone frames:

- Eddystone URL – Contains encoded URL that points to a single web page. Default URL will be pointing to <https://onsemi.com/b-idk> web page. This packet frame is recognized by both Android™ and iOS® as a physical web beacon.
- Eddystone UID – Transmits a unique identifier of given device and consists of 10 byte Namespace ID and 6-byte Instance ID. By default the namespace will be generated from truncated hash of fully-qualified domain name of beacon.rsl10-coin-gevb.onsemi.com and instance id will be identical to BD address. This can be configured to other values.
- Eddystone TLM – Unencrypted telemetry frame is used to periodically transmit battery voltage, measured beacon temperature, number of transmitted adv. Packets and time since power-on.

Eddystone is configured using slots. Each slot is standalone and has its own configuration that allows to set:

- Eddystone packet type – URL, UID or TLM along with type specific parameters.
- Slot Advertising interval – From 0.1 s up to 5 seconds.
- TX power level – From -17 dBm up to 6 dBm.

All of these parameters are customizable per slot. By default the application will come with 3 slots, one for URL, UID and TLM, that will be configurable using CMSIS Configuration Wizard. Slots can be easily customized directly in code to fit any other scenarios like advertising multiple URL beacons.

Custom Device Name packet format will be also available to transmit user-friendly device name.

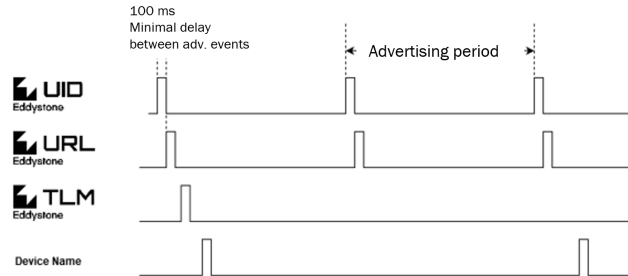


Figure 4. Example Beacon Slot Configuration with 4 Active Slots Transmitting UID, URL, TLM and Device Name Frames

Temperature measurements will be carried out only if Eddystone TLM frames are enabled. To reduce power consumption the temperature will be updated at separate low-duty sampling rate which will be higher than BLE advertising interval. Temperature sampling rate will be configurable from 1 up to 60 minutes. Temperature will be measured during first advertising interval after sample interval expires. Optionally high-duty temperature measurement option can be provided to measure on every TLM advertising event.

Power Down mode is available to minimize power consumption when advertising is not required and board can remain idle. Power down mode can be entered by pressing the battery holder button for more than 2 seconds. Power down mode can be exited only by external interrupt caused by press of battery holder button. No state is retained during power-down mode (no RAM retention, boot from flash) and is treated similarly to PoR when returning to normal operation. Number of adv. packets and time since power-on will be reset upon wake-up.

Optionally the state and time since power on can be retained during power down mode at the cost of enabling RTC and 8 kB RAM retention (increase of deep sleep current of RSL10 from 25 nA to 100 nA).

Beacon mode enters deep sleep mode between advertising intervals. During deep sleep 32 kHz oscillator, RTC counter will be enabled and at least 32 kB of RAM retained or 16 kB if light BLE stack is used.

DFU mode is used to update device firmware using FOTA protocol provided by RSL10 SDK. DFU mode can be entered from Beacon mode by pressing the battery holder

button three times in quick succession (max 1 s between button presses). When DFU mode is entered the board is restarted and DFU component takes full control for 30 seconds allowing any device to connect and initiate the firmware update process. If no update attempt or connection is made in 30 seconds the board resets and returns back to Beacon mode. Number of send adv. packets and time since power on will be reset. DFU mode timeout can be increased as necessary. The application will return back to Beacon Mode as well if peer device disconnects or FOTA firmware update was successful.

Reading Eddystone Frames with Mobile App

Eddystone data frames can be captured by generically available beacon apps. RSL10 Sensor Beacon https://play.google.com/store/apps/details?id=com.onsemi.ble_on_v0_3&hl=en_US is available for Android. Other examples can be and BLE Scanner, or Beacon scanner for Android and iOS.



Figure 5. RSL10 Sensor Beacon App

CMSIS Pack Configuration Wizard

Within the CMSIS software package the Configuration Wizard is available for RSL10-COIN-GEVB allowing the modification of the firmware and advertising patterns with a GUI without need for programming as shown in Figure 5 and Figure 7.

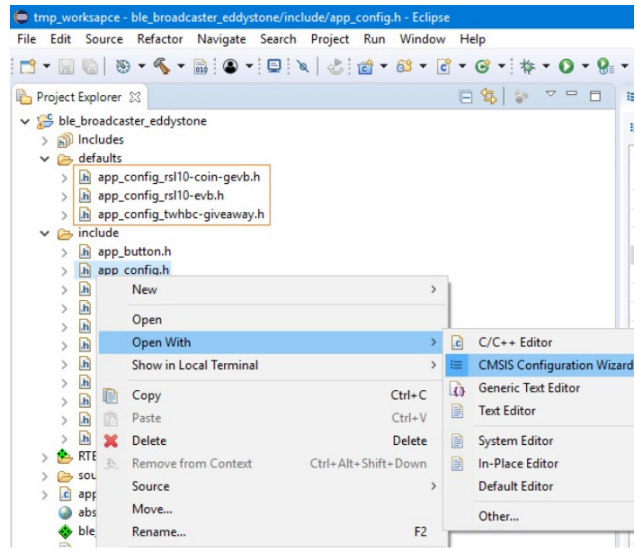


Figure 6. app_config.h File Opened in CMSIS

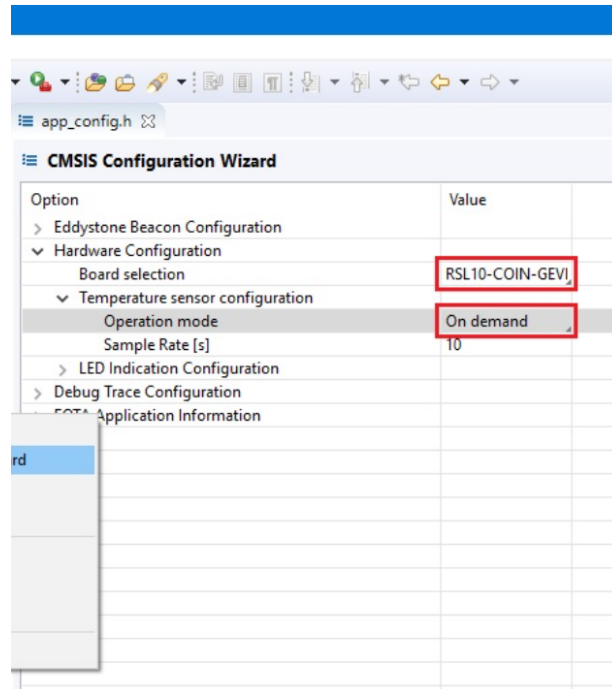


Figure 7. CMSIS Configuration Wizard

FOTA Library

This library is required to enable FOTA functionality and reduces the size of application image by reusing BLE stack functions from FOTA image. Custom build of FOTA image will be required to adjust for different pin mappings of the

board. If possible the FOTA image will be reconfigured to use Light version of BLE stack to reduce BLE stack size and number of RAM blocks that need to be retained during deep sleep cycles of Beacon mode.

Updating Firmware over FOTA

This section describes how to update device firmware by using FOTA and second BLE capable device that initiates the process.

• Using RSL10 FOTA Mobile Application

This method requires an Android or iOS device with RSL10 FOTA application installed. See [Additional Resources](#) section for download links for both apps or scan below QR Code from an Android or iOS device.

Steps:

1. Build project.
2. Copy the generated ble_broadcaster_eddystone.fota file (or any other .fota image to be loaded) into your mobile phone. This FOTA image as well as others are available on the RSL10-COIN-GEVB website <https://www.onsemi.com/support/evaluation-board/rsl10-coin-gevb>. Different images can be loaded to test FOTA functionality.
3. Open the RSL10 FOTA application in your phone.
4. Switch the RSL10-COIN-GEVB board into DFU mode by quickly pressing the button 3 times. Transition to DFU mode will be indicated by 0.5 s flash of green LED
5. Find device named ON FOTA RSL10 in the list of scanned devices in RSL10 FOTA app https://play.google.com/store/apps/details?id=com.onsemi.fota&hl=en_US.

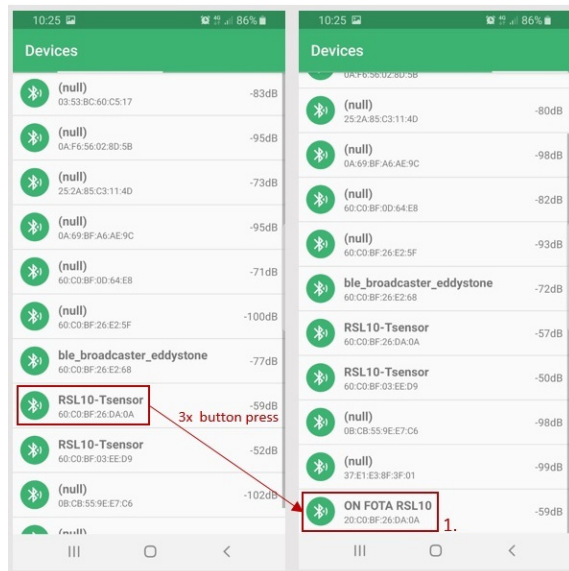


Figure 8. Update Process of a Temperature Coin with the RSL10 FOTA Application (1/2)

6. Click on it to go to firmware update screen and in File section click SELECT FILE and select the copied ble_broadcaster_eddystone.fota
7. Click on CONNECT to connect to target device. Versions of firmware in the device and in Fota image will be shown.
8. Click UPDATE button to start the DFU process and wait until it is completed.

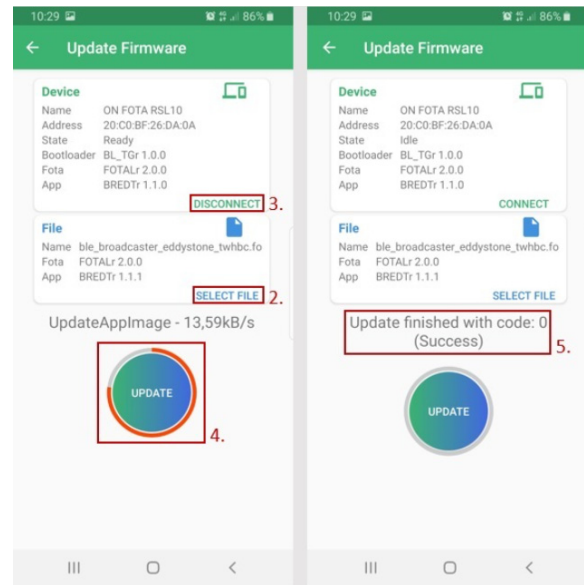


Figure 9. Update Process of a Temperature Coin with the RSL10 FOTA Application (2/2)

Updating Firmware with Bootloader and Debugger

This section describes how to generate and flash an image into an empty or erased development board with a SEGGER J-Flash (part of J-Link debugger installation).

The RSL10 Standalone Flash Loader utility from the RSL10 Software Utility Apps package is also required. It can be downloaded from <https://www.onsemi.com/rsl10>.

Using SEGGER J-Flash to merge images.

1. Build project and copy generated ble_broadcaster_eddystone.fota file into your preferred working directory.
2. Rename the .fota file by changing the file extension into .bin
3. Copy bootloader image file bootloader.bin for your board from Device/RSL10/bootloader_image/\$BOARD_NAME folder of BDK CMSIS-Pack and place it inside your working directory.
4. Open J-Flash by searching J-Flash in start menu or launching it from J-Link installation directory.
5. Select Create a new project and click Start J-Flash.

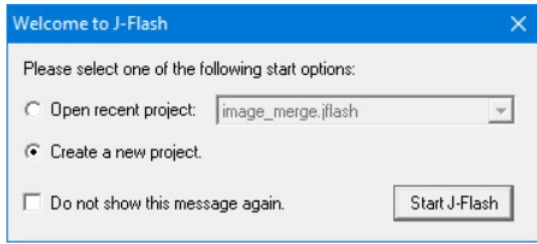


Figure 10. Start J-Flash

6. Select ON Semiconductor RSL10-COIN-GEVB as Target Device and leave other settings as is.

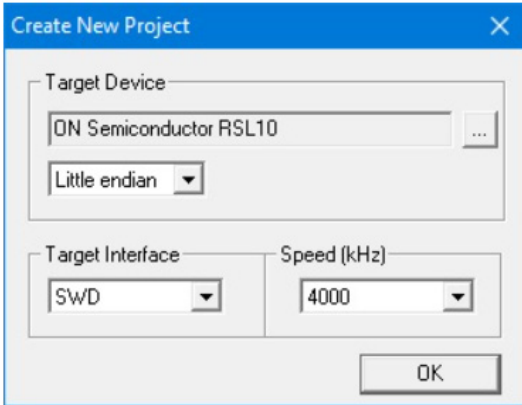


Figure 11. Selecting ON Semiconductor RSL10 Target Device

7. Use File → Open data file... menu, select bootloader.bin from your working directory and enter 0x100000 as start address.

8. Use File → Merge data file...menu, select the renamed ble_broadcaster_eddystone.bin file from your working directory and enter 0x102000 as start address.
9. Use File → Save data file as... menu, select Intel Hex file (.hex) as file type and save it as flash_image.hex file.
10. Load the flash_image.hex file into development board using the RSL10 Standalone Flash Loader Utility and J-Link debug probe with respective debugging adapter or On-Board Debugger in case of RSL10 Evaluation Board.

Additional Resources

For additional information about the use of FOTA refer to: readme_ble_peripheral_server_hrp_fota.md file in the ble_peripheral_server_fota sample application for more details about FOTA implementation.

- RSL10 Firmware Over The Air Users Guide PDF in the documentation folder of RSL10 CMSIS-Pack
- [RSL10 FOTA](#) mobile application for Android devices
- [RSL10 FOTA](#) mobile application for iOS devices
- [RSL10 Sensor Beacon](#) mobile application for Android for displaying of Eddystone beacon data
- [Eddystone Specification](#)
- [Eddystone URL](#) frame specification
- [Eddystone UID](#) frame specification
- [Unencrypted Eddystone TLM](#) frame specification

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