Getting Started Guide for Edge AI Processing using RSL10 Sensor Kit

December, 2021 – Rev. 1

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Introduction

The Edge-AI processing demo with RSL10 sensor kit uses the Tinkerkit Braccio robot arm. The RSL10 sense board is mounted on the robot arm to capture various pose and gesture sensor data using data collection firmware and Data Capture Lab. This data is used to train a classification model using Analytics Studio. The model is programmed onto RSL10 sense board using knowledge pack firmware to detect real time classifications i.e. poses and gestures. Detailed description on how to use data collection firmware with Data Capture Lab and knowledge pack generation using Analytics Studio can be found on SensiML's website.

This user guide describes firmware toolchain installation and verification of onsemi.SensiML CMSIS pack. The CMSIS pack contains example project for data collection and knowledge pack generation using RSL10 sense board (RSL10-SENSE-GEVK). Detailed description about RSL10 Evaluation board and RSL10 Sense board can be found in following links:

1. RSL10 Getting Started User Guide
2. RSL10 Sense board
3. BHI160 Motion Sensor API calls

User Guide

Hardware Requirements and Setup

Option A

1. RSL10-SENSE-DB-GEVK (Include RSL10 sense board with JTAG connector and separate J-Link debugger along with JTAG ribbon cable)
2. RSL10-SIP-001-GEVB (Has on-board J-Link debugger)

Option B

1. RSL10-SENSE-GEVK (Does **not** come with 10-pin JTAG connector populated on the board. Needs to be purchased separately and soldered on to the board.)
2. RSL10-SIP-001-GEVB (Has on-board J-Link debugger)
3. 10-pin JTAG connector (Digi-key Electronics , Mouser Electronics)
4. JTAG ribbon cable (Digi-key Electronics , Mouser Electronics)

1. **RSL10-SENSE-GEVK / RSL10-SENSE-DB-GEVK:** RSL10 Sense board
   RSL10-SENSE-GEVK board can be used for "rsl10_data_collection" project. The sense board is used for reading sensor data (Gravity, Gyroscope) using BHI160 chip. The sensor data is sent to RSL10 evaluation board over Bluetooth.

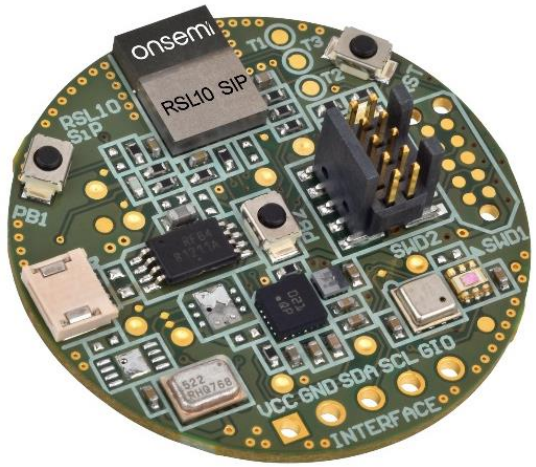

Figure 1. RSL10 Sense Board (RSL10-SENSE-GEVK)

2. **RSL10-SIP-001-GEVB:** RSL10 Evaluation board

RSL10 Evaluation board can be used for "rsl10_ble_link" project. This board will act as a communication link between the host (PC/Data Capture Lab) and the sense board (RSL10-SENSE-GEVK).

Figure 2. RSL10 Evaluation Board (RSL10-SIP-001-GEVB)

3. **SEGGER J-Link or JTAG connector and ribbon cable**

a. External Segger J-link can be used to flash either of the boards above.
b. RSL10 Evaluation board has on-board j-link debugger. It does not need an external one for flashing and debugging.
c. The on-board J-Link Debugger can be used to flash any other RSL10 board. Remove jumper from header P10 from RSL10-SIP-001GEVB to flash RSL10-SENSE-GEVK. Connect ribbon cable from 10-pin JTAG connector P2 (RSL10-SIP-001GEVB) to 10-pin connector on RSL10-SENSE-GEVK. Connect USB cable to the computer and follow instructions for flashing the board.

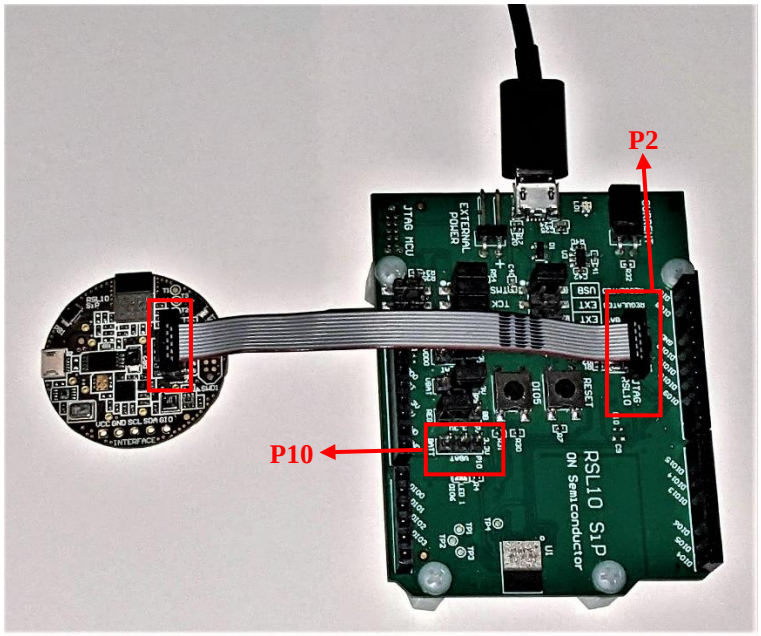

Figure 3. Flashing RSL10 sense board using RSL10 Evaluation board

Install Toolchain for Firmware Development

1. Register and Log in to **MyON** account here.
2. Download and install "**ON Semiconductor IDE**".
3. Download and install base "**RSL10 CMSIS Pack**".
    a. To install the CMSIS pack open CMSIS Pack Manager. Click on the icon "Open Perspective" as shown below and select "CMSIS Pack Manger".

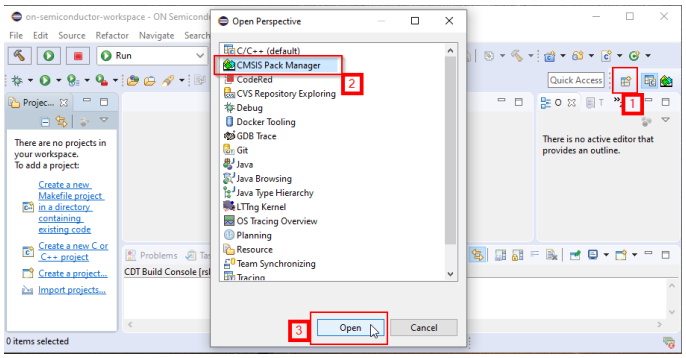

Figure 4. Open CMSIS Pack Manager

    b. Click on the icon "Import Existing Packs…" to import the CMSIS pack downloaded earlier. Select "Open" to install the pack.

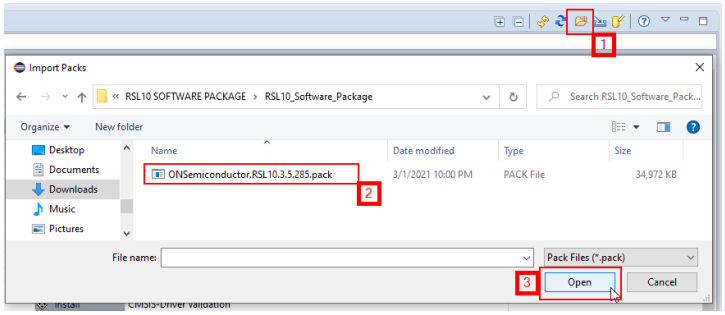

Figure 5. Import Existing CMSIS Pack

4. Download and install latest version of "**ARM CMSIS Pack**" as per step 3.
5. Download and install latest version of "**ARM CMSIS-FreeRTOS Pack**" as per step 3.
6. Download and install following packs from Technical Documents section as per step 3.
    a. "**Bluetooth IoT Development Kit CMSIS Pack**"
    b. "**onsemi.RSL10SensiML Pack**"
7. Download and install latest version of "**J-Link Software and Documentation pack**".
8. Once all the packs are installed, this is what CMSIS pack perspective should look like.

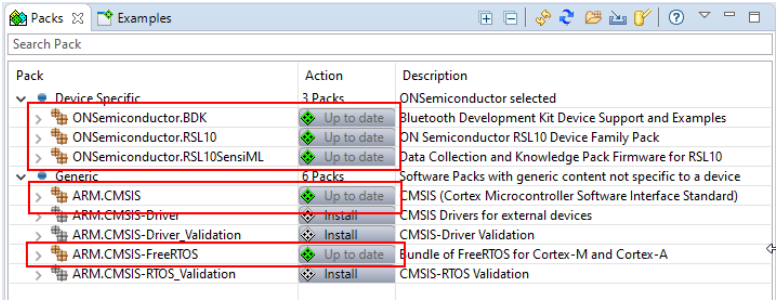

Figure 6. Installed CMSIS Packs

9. **(Optional)** Any serial terminal program such as CoolTerm, TeraTerm, etc. Serial terminal can be used to verify data collection and knowledge pack firmware. Although, Data Capture Lab and open-gateway has better readability of the data and model detection.

Import and Compile an Example Project from CMSIS Pack

1. Select RSL10SensiML pack from CMSIS pack manager. Open the drop-down for “Examples”. Right-click on the preferred example project. Select “Copy”. This will import a copy of that example project into the workspace.

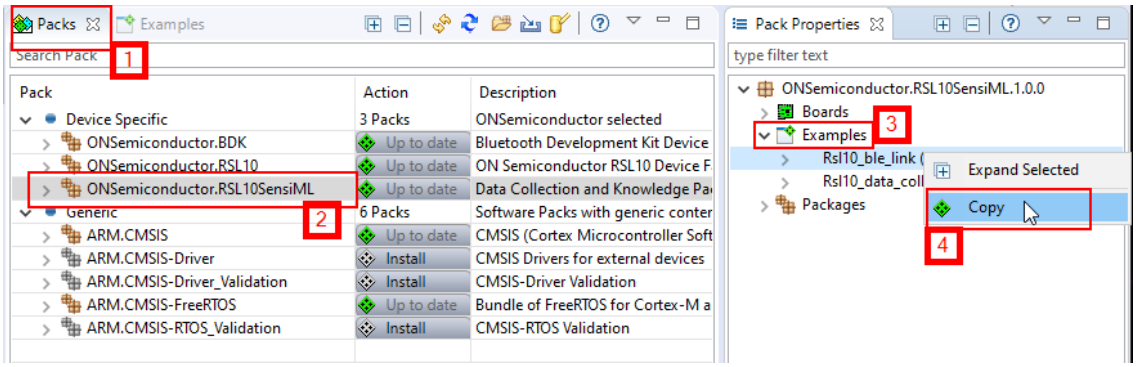

Figure 7. Copy Example Project

2. Right-click on the project name in Project Explorer and select “Build Configurations” to “Release” or “Debug”. Next, select “Build Project” to compile the project.

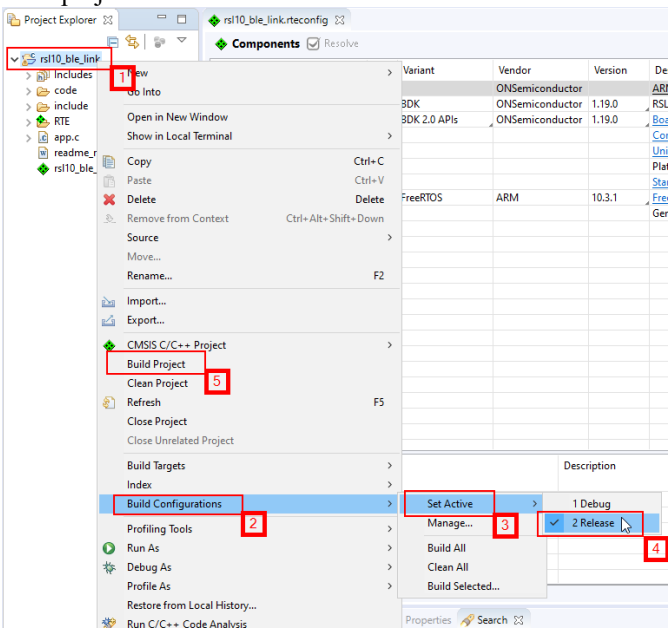

Figure 8. Set Build Configuration for a Project

Flash and/or Debug the Example

1. Create Run/Debug configuration for the project. Select “Run” -> “Run Configurations…”.

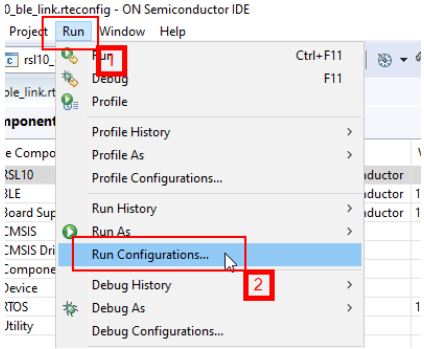

Figure 9. Open Run Configurations

2. Double-click on “GDB SEGGER J-Link Debugging”. This will generate a default configuration. Under “Main” tab, select the Project. Provide the .elf file path at “C/C++ Application”. Depending on the build configuration it can be “Release/<project_name.elf>” or “Debug/<project_name.elf>”. Or add a variable to select automatically, “${config_name:${project_name}}/<project_name.elf>”. Select “Apply”.

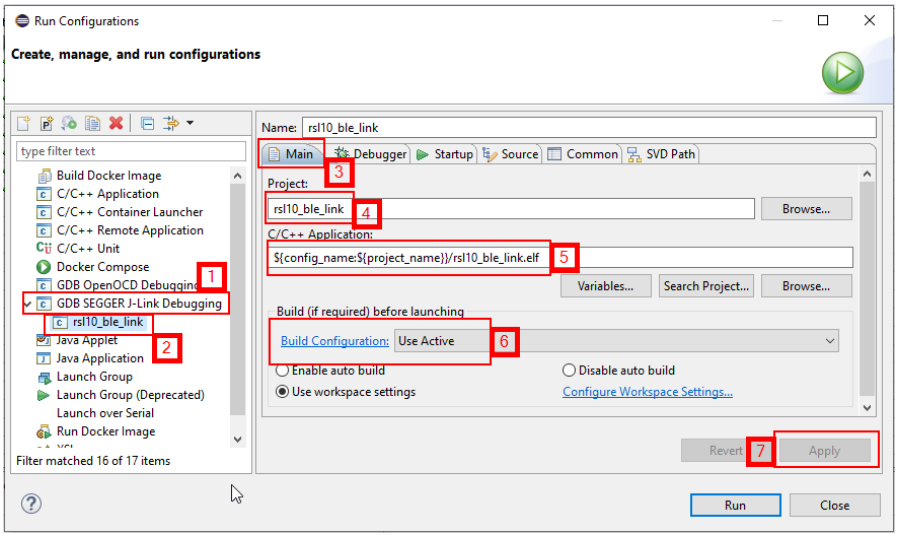

Figure 10. Create Run Configuration

3. Under “Debugger” tab, Update “Device Name” to RSL10. Select “Apply” and “Close”.

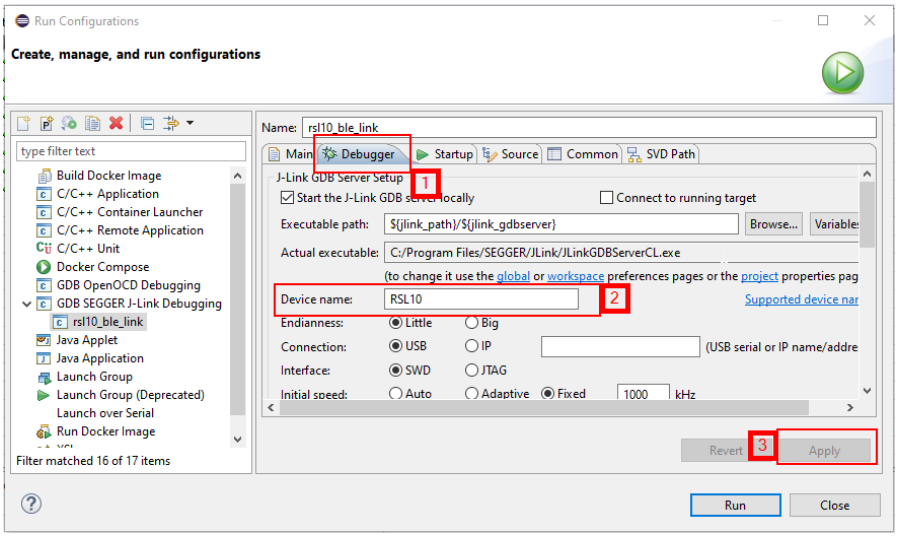

Figure 11. Add Device name

4. To flash the board, click green play button looking icon in “Run” mode.

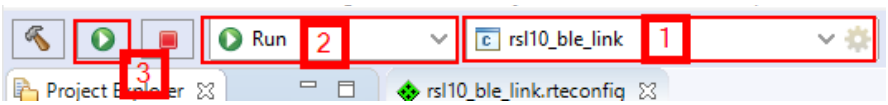

Figure 12. Run the configuration to Flash

5. To debug, click green bug looking icon in “Debug” mode.

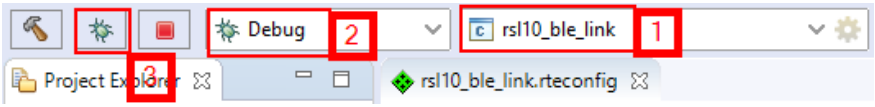

Figure 13. Start Debug configuration

6. Detailed instructions about using the IDE can be found in RSL10 Getting Started Guide.

Verify Data Collection Firmware

1. Compile and flash “rsl10_ble_link” example project on “RSL10-SIP-001GEVB” board.
2. Compile and flash “rsl10_data_collection” example project on “RSL10-SENSE-GEVK” board with DATA_COLLECTION variable defined in “include/sensor_config.h”.
3. Once RSL10-SENSE-GEVK is flashed, put the jumper back on header P10 so that RSL10-SIP-001GEVB is powered.
4. Reset RSL10 from both boards by pushing reset buttons.
5. DIO6 LED on RSL10-SIP-001GEVB board will continue to blink until RSL10-SENSE-GEVK i.e. peer Bluetooth device is connected.
6. Blue LED on RSL10-SENSE-GEVK will continue to blink until RSL10-SIP-001GEVB i.e. peer Bluetooth device is connected.
7. Once both the boards are powered and have made Bluetooth connection, DIO6 LED on RSL10-SIP-001GEVB board will be ON steady. LED on RSL10-SENSE-GEVK will blink based on sensor data.
8. To verify UART functionality, connect RSL10-SIP-001GEVB to a serial terminal like putty, coolTerm, TeraTerm, etc. with baudrate of 460,800.
9. If both the boards have correct firmware and are connected with each other over Bluetooth, serial terminal should print sensor JSON configuration every 1 second.

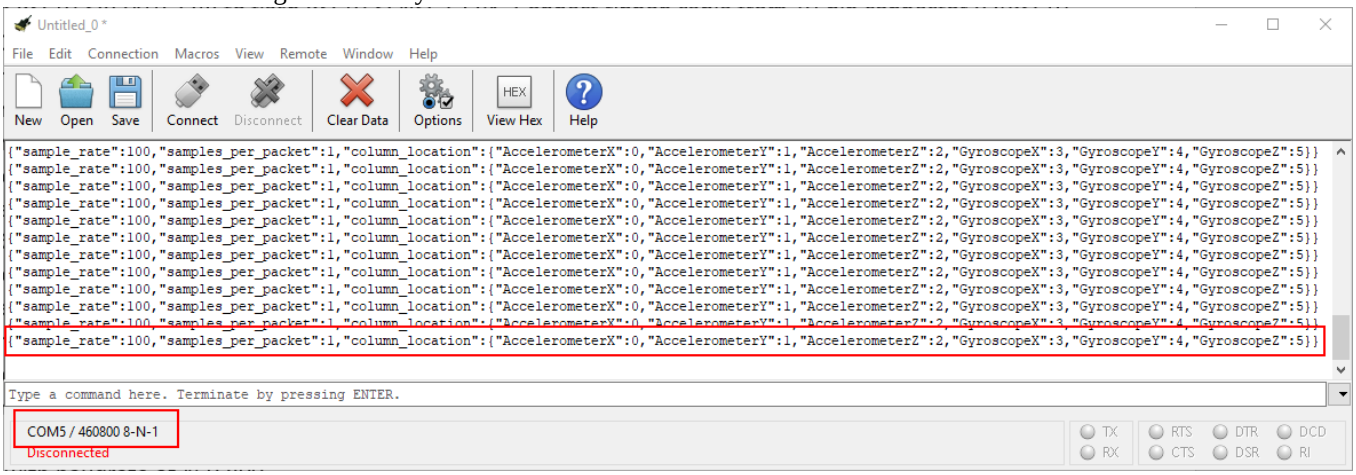

Figure 14. Sensor JSON Configuration from Data Collection Firmware

10. The boards are now ready to connect with Data Capture Lab for data collection.

Verify Knowledge Pack Firmware

1. Compile and flash “rsl10_ble_link” example project on “RSL10-SIP-001GEVB” board.
2. Download knowledge pack files from Analytics Studio for RSL10.
3. Copy and replace following files and folders in “rsl10_data_collection” example project from knowledge pack:
    a. include/ sensor_config.h
    b. lib/sensiml/ kb.h
    ……./ kb_debug.h
    ……./ kb_define.h
    ……./ kb_typedefs.h
    ……./ model_json.h
    ……./ model.json
    ……./ libsensiml.a
4. **NOTE**: “code/sml_recognition_run.c” runs the model and prints JSON formatted model and classification messages over serial terminal. If using multi-model knowledge pack, modify “sml_recognition_run.c” to run the particular model. By default, model 0 is executed.
5. Compile and flash “rsl10_data_collection” example project on “RSL10-SENSE-GEVK” board with KNOWLEDGE_PACK variable defined in “include/sensor_config.h”.
6. Once RSL10-SENSE-GEVK is flashed, put the jumper back on header P10 so that RSL10 on RSL10-SIP-001GEVB is powered.
7. Reset RSL10 from both boards by pushing reset buttons.
8. Once both the boards are powered and have made Bluetooth connection, DIO6 LED on RSL10-SIP-001GEVB board will be ON steady. LED on RSL10-SENSE-GEVK will blink based on sensor data.
9. To verify UART functionality, connect RSL10-SIP-001GEVB to a serial terminal like putty, coolTerm, TeraTerm, etc. with baudrate of 460,800.
10. If both the boards have the correct firmware and are connected with each other over Bluetooth, serial terminal should print JSON formatted model and classification messages.

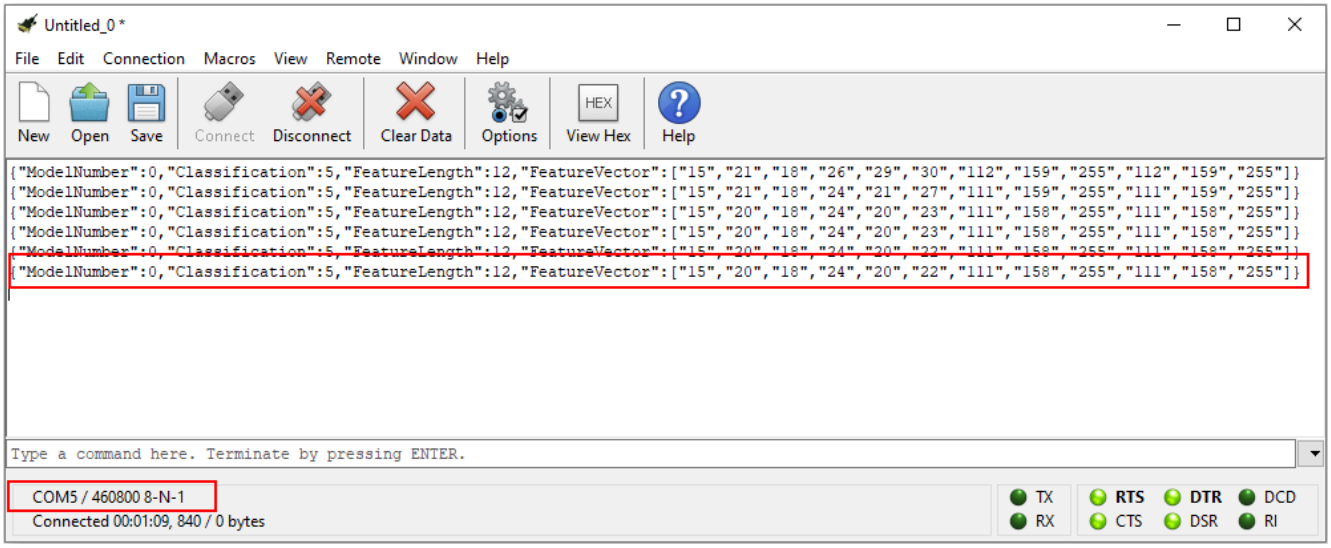

Figure 15. JSON Formatted Model and Classification messages from Knowledge pack Firmware

11. Knowledge pack firmware can be tested with Open Gateway software provided by SensiML for easier readability of model and classification detection.

Appendix

Enclosure for RSL10-SENSE-GEVK

3D printable enclosure files for RSL10 sense board can be found in onsemi.SensiML CMSIS pack.

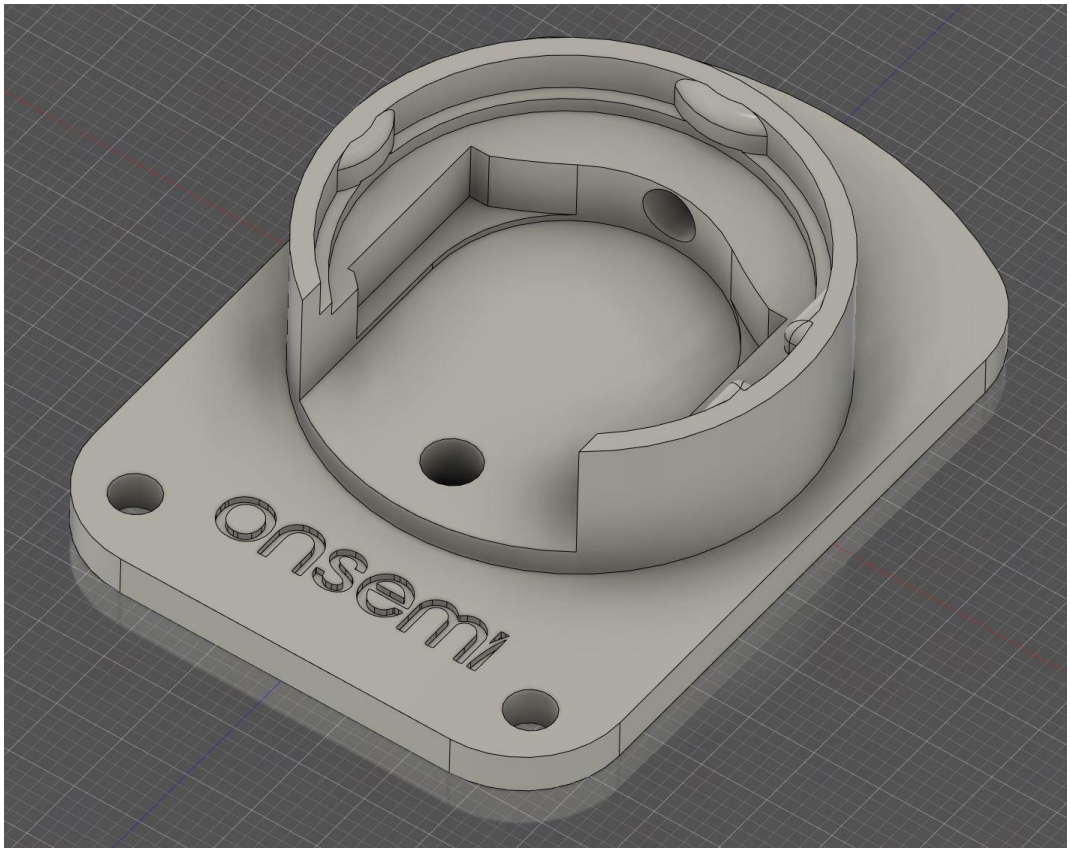

Figure 16. 3D model for RSL10 Sense board Enclosure

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