Quick-Connect IoT BLE Environmental Sensor Hub

This quick start guide walks through the process of loading the Quick-Connect IoT BLE Environmental Sensor Hub demo on the RA2L1. The demo showcases reading temperature and humidity data from the HS3001 sensor into the RA2L1 microcontroller, and this data is then sent to the DA14531MOD Bluetooth module. The Bluetooth module packetizes the data and sends it to a smartphone application allowing the end user to see the temperature and humidity data wirelessly from the kit on their smartphone. Instructions for loading the example project are included at the end of this guide as a next step after running the demo.

Target Devices

- RA2L1 MCU (R7FA2L1AB2DFP)
- HS3001 Temperature/Humidity Sensor (HS3001)
- DA14531MOD SmartBond TINY™ Module (DA14531MOD)

Contents

1. Kit Contents

To set up this demo, the following components are needed.

- Hardware
- Software

Ensure the Pmod boards are connected in the correct order, including on the correct Pmod ports. Connect the micro USB cable between the EK-RA2L1 MCU board and the Windows PC.

1.1 Hardware Components

- EK-RA2L1 (RTK7EKA2L1S00001BE)
- HS3001 Pmod (US082-HS3001EVZ)
- Pmod Interposer Board (US082-INTERPEVZ)
- DA14531MOD SmartBond TINY™ Bluetooth Pmod (US159-DA14531EVZ)
- Micro USB cable

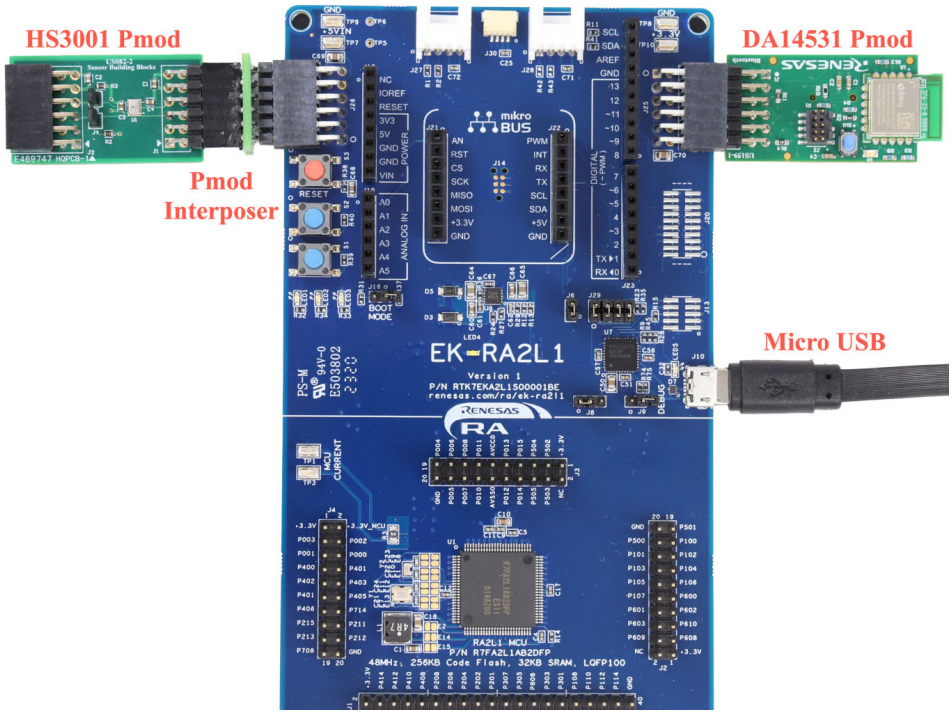


Figure 1. Hardware Components

1.2 Software Components

Table 1 shows the software that is needed. The demo and application project are both contained inside the **Quick-Connect_IoT_BLE_Environmental_Sensor_Hub.zip** file that accompanies this guide.

Table 1. Software

Category	Item	Remark
Demo	Quick_Connect_IoT_BLE_Environmental_Sensor_Hub.zip	Located in the demo/ folder
e^2 studio project	Quick_Connect_IoT_BLE_Environmental_Sensor_Hub.zip	Project can be directly imported to e^2 studio and the FSP (v3.1 and higher)
Mobile Application	Dialog SmartConsole for iOS	Applications available globally on Google Play and Apple App Store.
	Dialog SmartConsole for Android	

2. Features

- System power supplied by micro USB cable
- RA2L1 MCU reads measured data from HS3001 temperature and humidity sensor
- BLE connectivity to the mobile application via DA14531MOD module
- Smartphone application displays raw humidity and temperature values in string format

3. Flash the Demo Image

When the hardware is connected correctly, the demo application image needs to be flashed to the RA2L1 MCU. By default, the firmware on the DA14531 Pmod was pre-programmed at the factory with a serial port service. This demo uses this default BLE image and profile for ease of use.

3.1 Unzip the Project Contents

Start by unzipping the **Quick_Connect_IoT_BLE_Environmental_Sensor_Hub.zip** file. This zip archive contains both the demo binary image (and associated scripts and programming libraries) along with the application project source code that was used to generate the demo image.

3.2 Erase the RA2L1 MCU Flash Memory

When unzipped, run the **Erase Device.bat** batch file script in the demo directory by double-clicking on it. This erases the contents of the flash on the RA2L1 MCU.

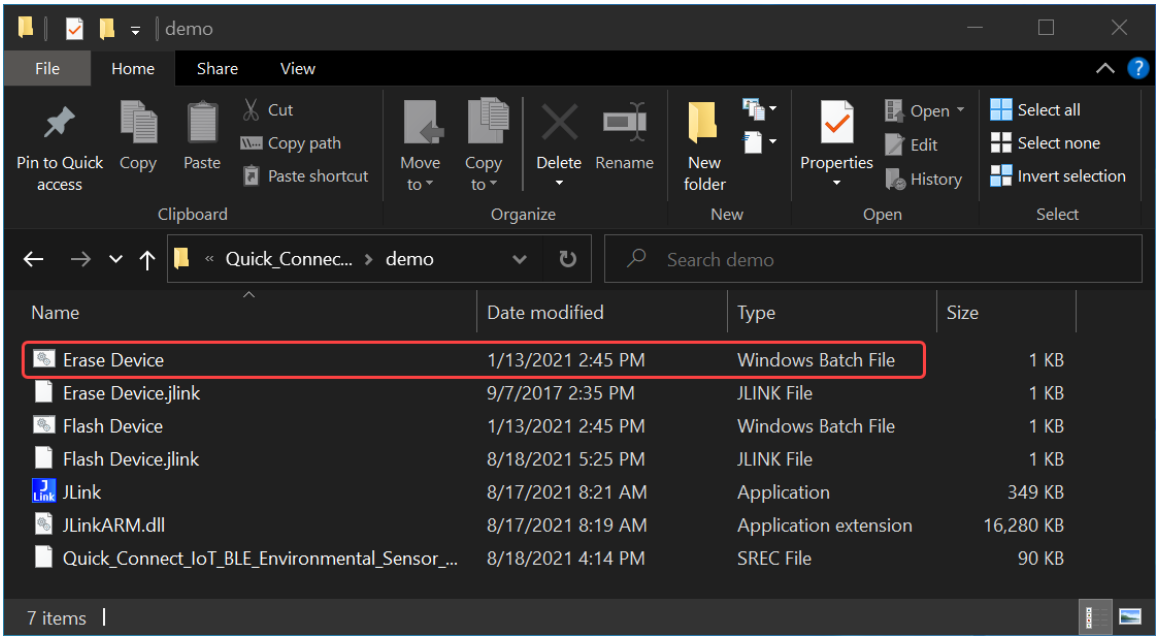


Figure 2. Demo Directory - Erase Device

3.3 Program the Demo Binary Image

Program the RA2L1 MCU with the demo image. Run the **Flash Device.bat** batch file script in the demo directory by double-clicking on it. This flashes the **Quick_Connect_IoT_BLE_Environmental_Sensor_Hub srec** file into the RA2L1 internal flash memory.

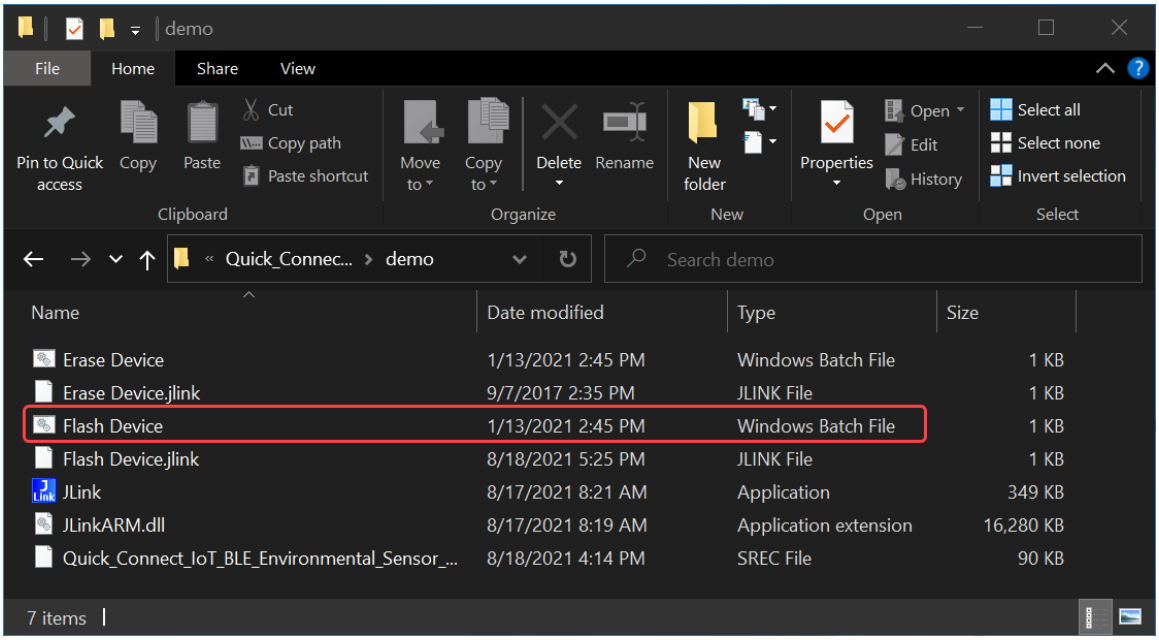


Figure 3. Demo Directory - Flash Device

3.4 Power Cycle the System

To synchronize the system, everything must be completely power-cycled. Unplug the micro-USB cable from the EK-RA2L1 development kit and plug it back in to reapply power.

4. Download the Smartphone Application

Sensor data that is transmitted over Bluetooth Low Energy is displayed on a smartphone application. The mobile applications are available globally in both the Apple App Store and Google Play Store. They can be downloaded for the aforementioned smartphones from the following links:

Download on the App Store

Figure 4. Apple App Store QR Code

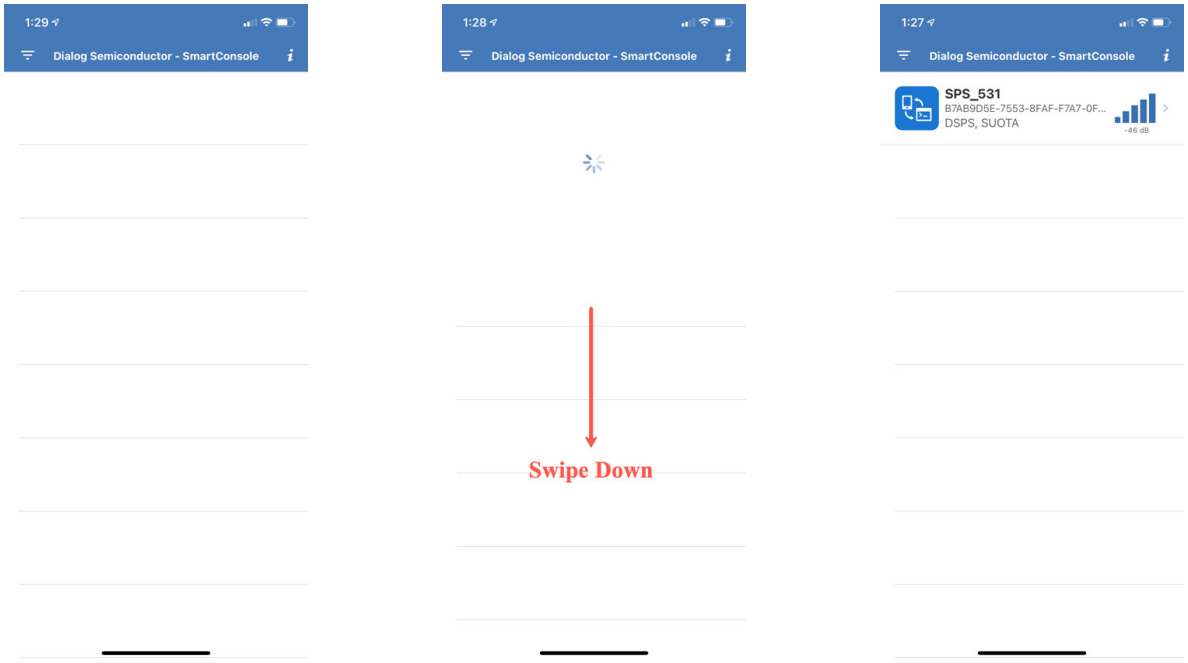
GET IT ON Google Play

Figure 5. Google Play QR Code

5. Run the Demo Setup

5.1 Connect to the Device

Open the SmartConsole application on your smartphone. If the device SPS_531 is not displayed, swipe down on the application to refresh the BLE device list. Click on the SPS_531 device to initiate a connection with the device.



5.2 View Sensor Data

When the mobile device makes a connection to the platform, humidity and temperature data is shown in the console. You can apply a hot or cold energy source to the HS3001 sensor to see changes and fluctuations in the readings.

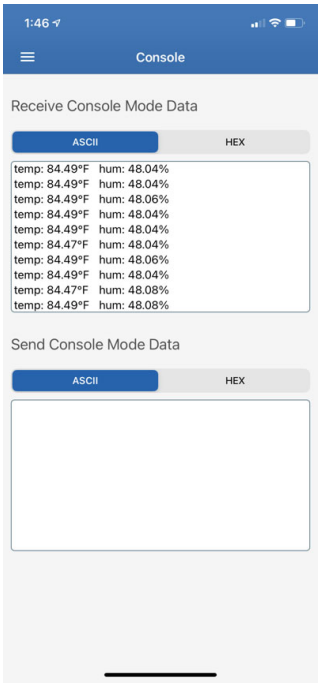


Figure 6. Receive Console Mode Data

5.3 Exiting the Application

To disconnect from the development platform, click on the menu icon in the upper left corner (see Figure 7). Select **Disconnect** in the bottom left corner. At any time, you can repeat the steps in this section to reconnect to the device. **Note:** When the device is connected via Bluetooth Low Energy to a mobile device, you cannot connect any other device to it until the first mobile device has been disconnected.

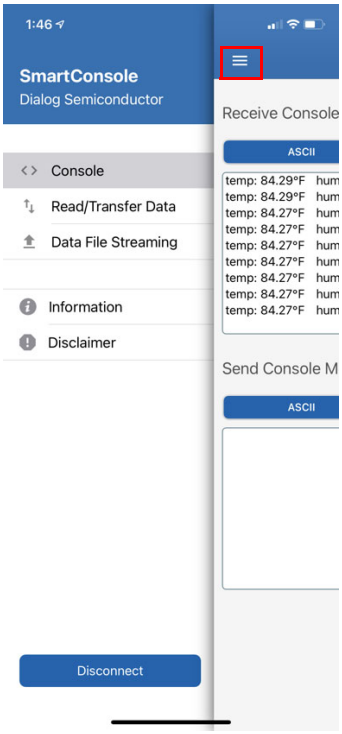


Figure 7. SmartConsole

6. Starting Development With the Application Project

The source code used to create the demo project is also included in the zip bundle. This project can be imported into the RA Flexible Software Package (FSP), version 3.1 or higher. The FSP needs to be downloaded and installed on a Windows or Linux machine. The e^2 studio IDE is included as part of the FSP install. See Additional Information for more information on the FSP and how it can be downloaded and installed to your local machine.

7. Revision History

Revision	Date	Description
1.00	Aug 30, 2021	Initial release.

Appendix

Additional Information

Product Reference	Company
Quick-Connect	Renesas
RA2L1 MCU	Renesas
EK-RA2L1	Renesas
RA Flexible Software Package (FSP)	Renesas
DA14531MOD	Dialog
MIKROE BLE TINY CLICK with DA14531MOD	Mikroe
HS3001	Renesas

Technical Updates / Technical News

(The latest information can be downloaded from the Renesas Electronics Website.)

Website and Support

Renesas Electronics Website

Support

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

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