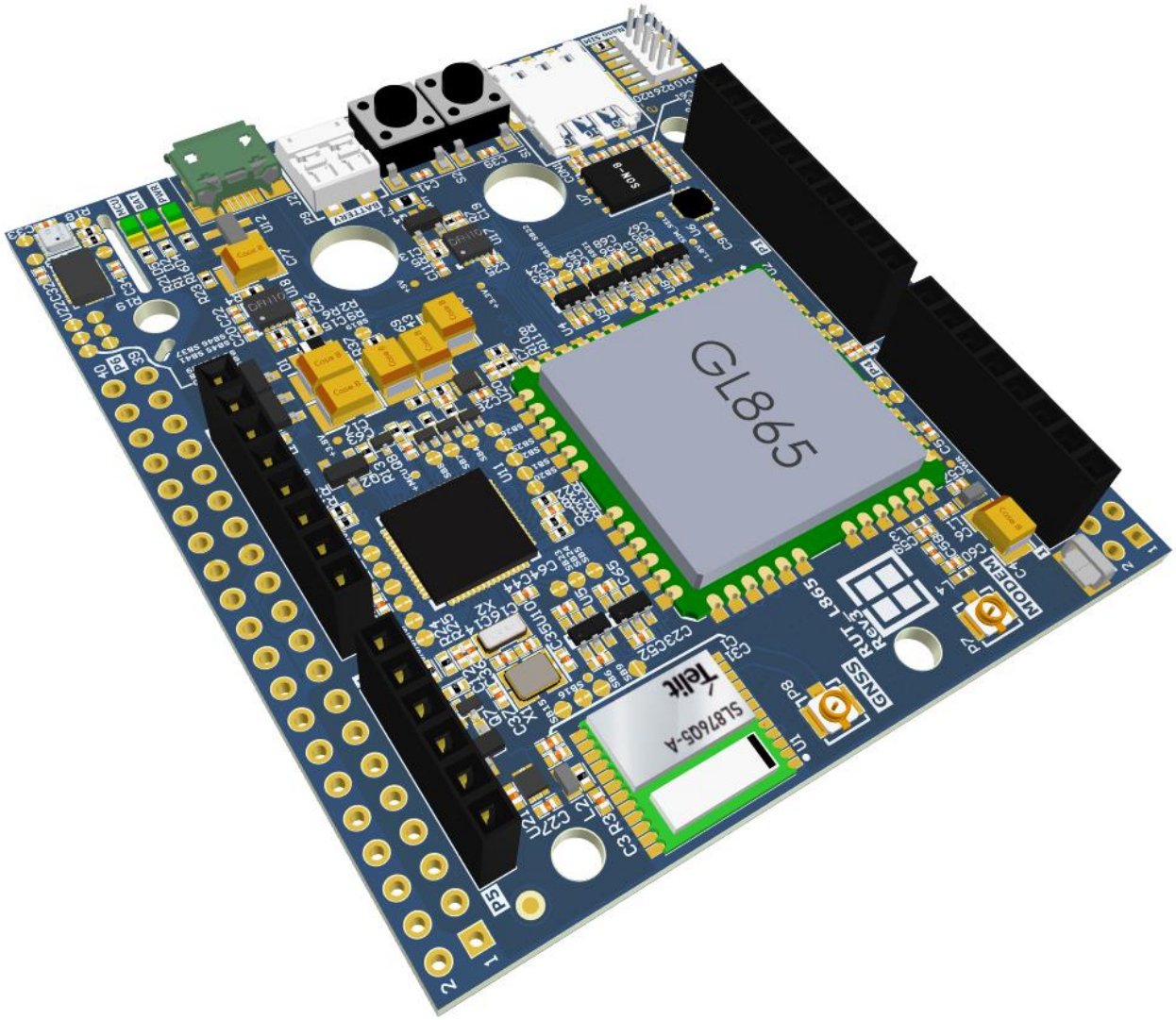
RUT2CLOUD User's Manual



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Versions

Version	Date	Author	Rationale
0.1	January 7, 2019	Gintaras Drukteinis	First draft
0.2	January 14, 2019	Gintaras Drukteinis	Data added, design modified.
0.3	May 07, 2019	Gintaras Drukteinis	Embedded SIMs selection has changed.

Introduction

RUT2CLOUD evaluation kit has been designed by Rutronik for IoT cloud connectivity projects development and promotion. Low power Renesas Synergy S3A7 MCU and Li-ION battery charger enables the board to be used for portable and battery powered applications. The power source for the Telit modem is switched between USB and battery automatically by the circuit on board. The MCU, modem, GNSS module and sensors might be evaluated independently.

Features

- Telit GL865 DUAL V3.1 Cellular Modem (NL865 4G optional).
- Telit SL876Q5-A GNSS Module.
- Nano SIM card slot and eSIM (optional).
- Renesas S3A7 MCU: ARM Cortex-M4F, 1MB Flash, 192KB RAM, 16KB Data Flash, QFN-64 Package.
- BOSCH Sensors BME280 (temperature, pressure, humidity,) and BMX055 (accelerometer, gyroscope, magnetometer).
- USB or Battery power source automatic selection.
- ISL9203A Battery charger 1.5A Li-ion.
- ISL80103 LDO 3A.
- ISL9021AIRUNZ LDO 250mA 3.3V.
- ISL9021AIRUCZ LDO 250mA 1.8V.
- ISL84467 Quad SPDT Analog Switch.
- Micro USB 2.0 Full-Speed connectivity.
- U.FL Sockets for cellular modem and GNSS module's external antenna.
- Molex Mini Lite-Trap battery connector.
- ARM JTAG Header: 10-pin, 1.27mm pitch, 2 rows.

Overview

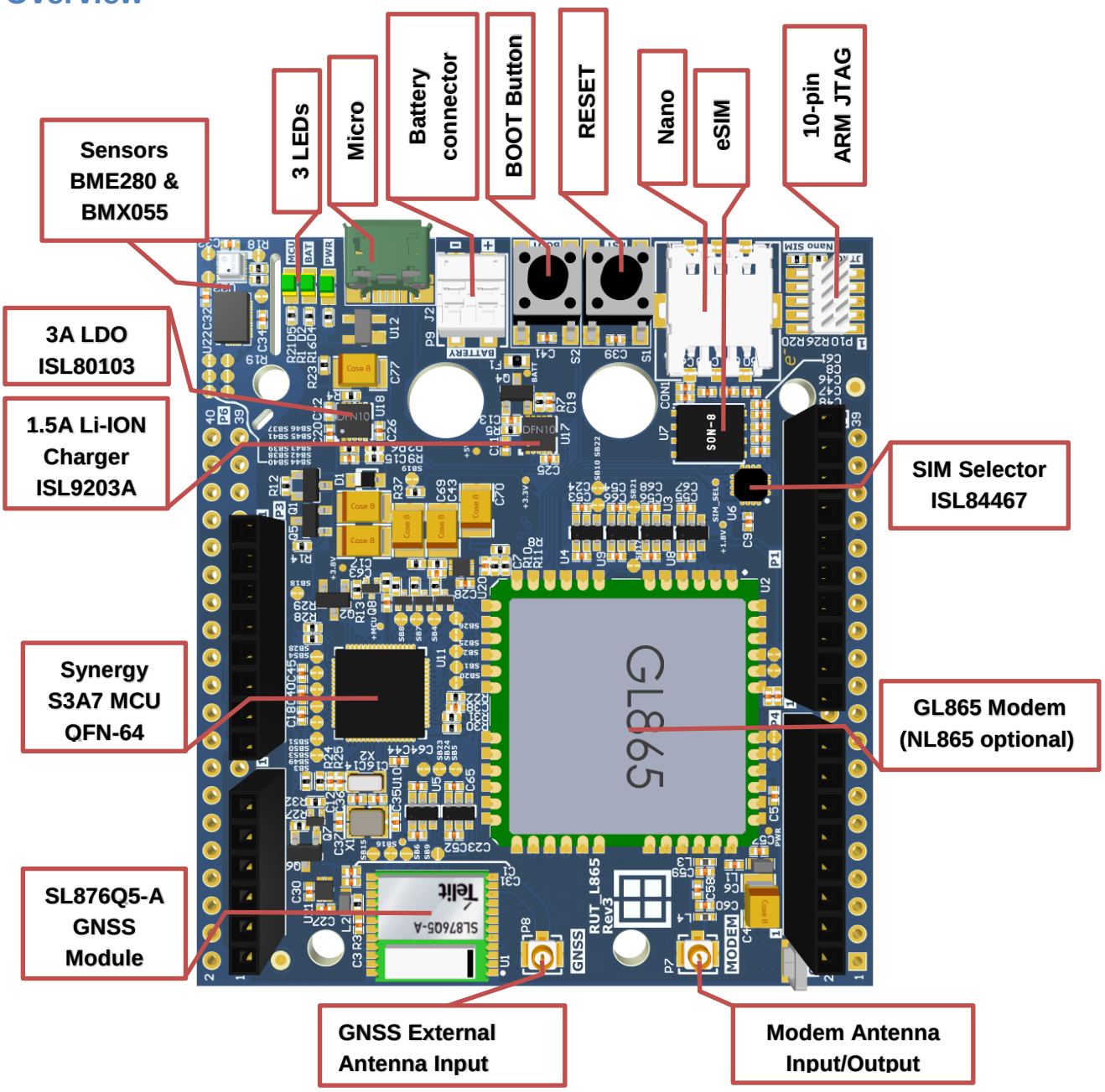

Fig. 1. RUT2CLOUD Evaluation board's layout.

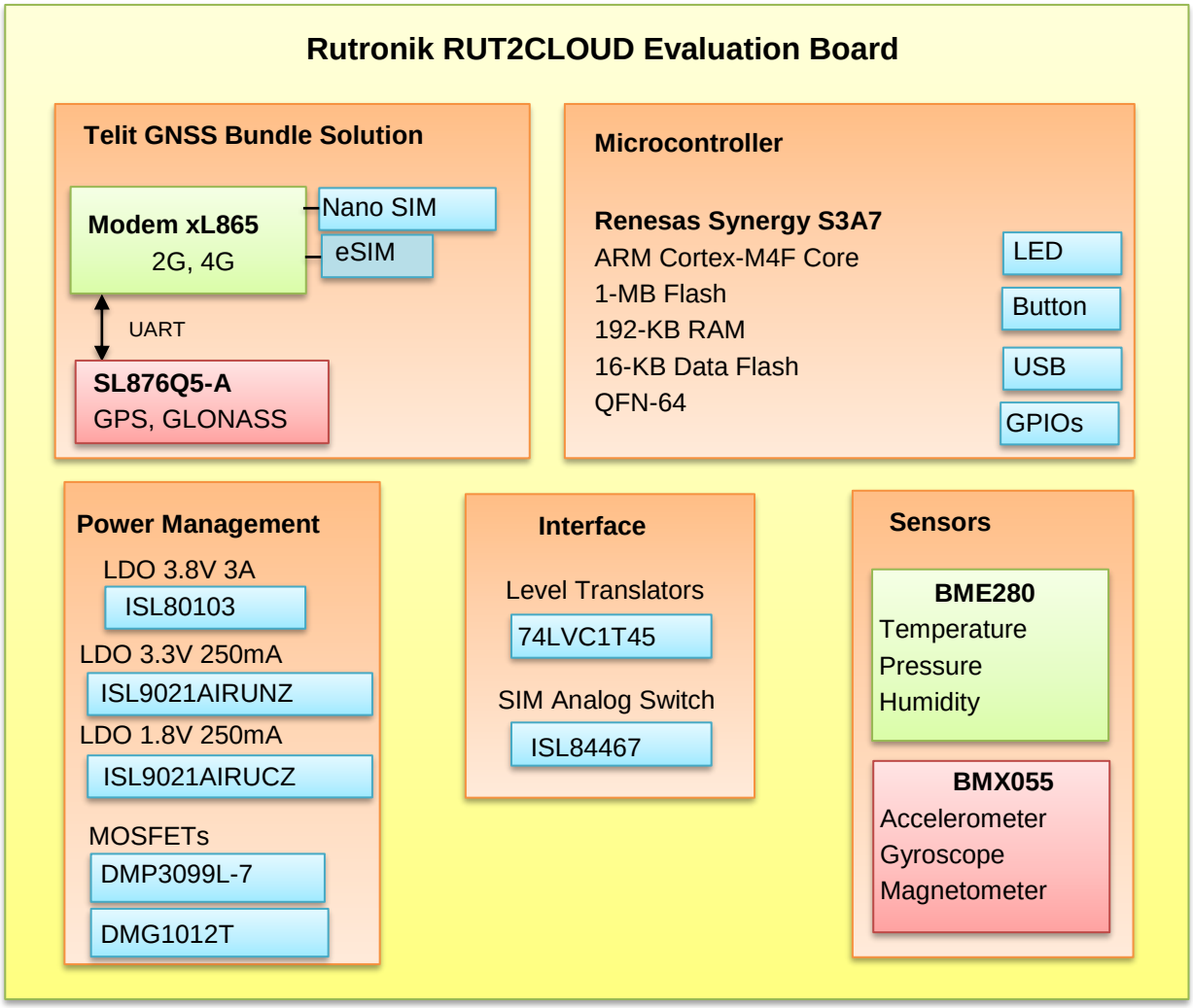

Fig. 2. RUT2CLOUD Evaluation board's block diagram.

Demo Firmware

RUT2CLOUD comes with already preprogramed demo firmware for Telit modem control and sensors monitor via Micro USB port.

By default GNSS module is bundled together with modem, thus it can be controlled via xL865 modem.

Demo firmware acts like USB Bridge between USB and COM or IIC simultaneously. Each time USB is connected to PC, two virtual COM devices are detected: one for xL865 modem and another for IIC sensors. In order to be able to operate the demo kit, following software is needed:

- Synergy USB CDC Driver.
- Telit AT Controller.
- Rutronik Sensor Monitor application.

Synergy USB CDC driver's installation manual is provided by Renesas: Look for Application note R11AN0303EU0100 "Installing Synergy Signed USB CDC Driver".

Tellit AT Controller software and manuals are provided by the Telit Company. The application may be downloaded after login here: https://www.telit.com/support-training/download-zone/ (path: Software→Cellular→Software Tools).

Rutronik Sensors Monitor application for Windows OS may be find in github: https://github.com/RutronikKaunas/rut2cloud_sensor_monitor

No installation is required.

Recommended steps for launch RUT2CLOUD with demo firmware:

1. Install Synergy CDC Driver and Renesas e2 Studio.
2. Attach RUT2CLOUD Micro USB port to PC and push the "Reset" button shortly. Wait for device installation to finish.
3. Identify the USB Serial Devices installed on yours PC.
4. Launch the application (Tellit AT Controller or Rutronik Sensors Monitor). Please use only one application at a time.
5. Select the appropriate serial port and continue to operate the application selected.

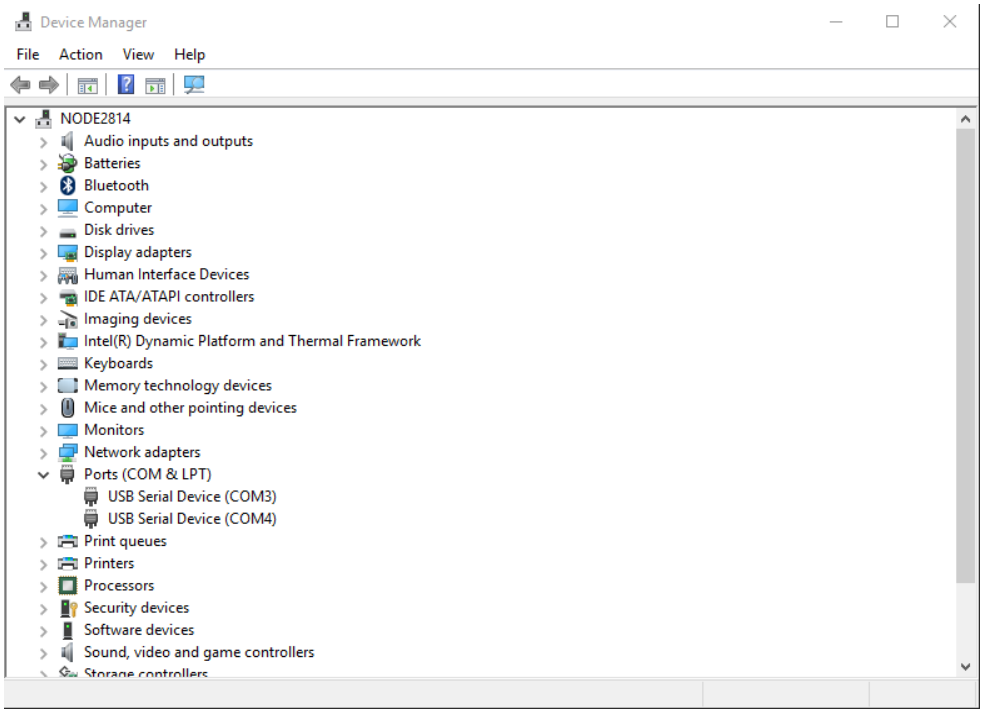

Fig. 3. Two USB Serial Devices are seen if driver is installed correctly.

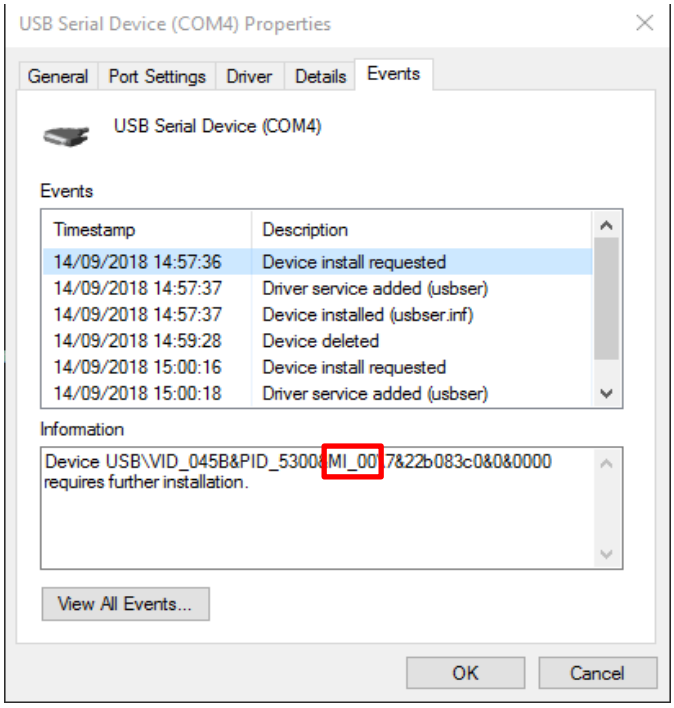

Fig. 4. Device identification.

USB Serial Devices could be identified by its ID as it shown in *Fig. 4.* **MI_00** is for modem and **MI_02** is for IIC sensors.

Fig. 5. Telit AT Controller connected with compatible USB Serial Device.

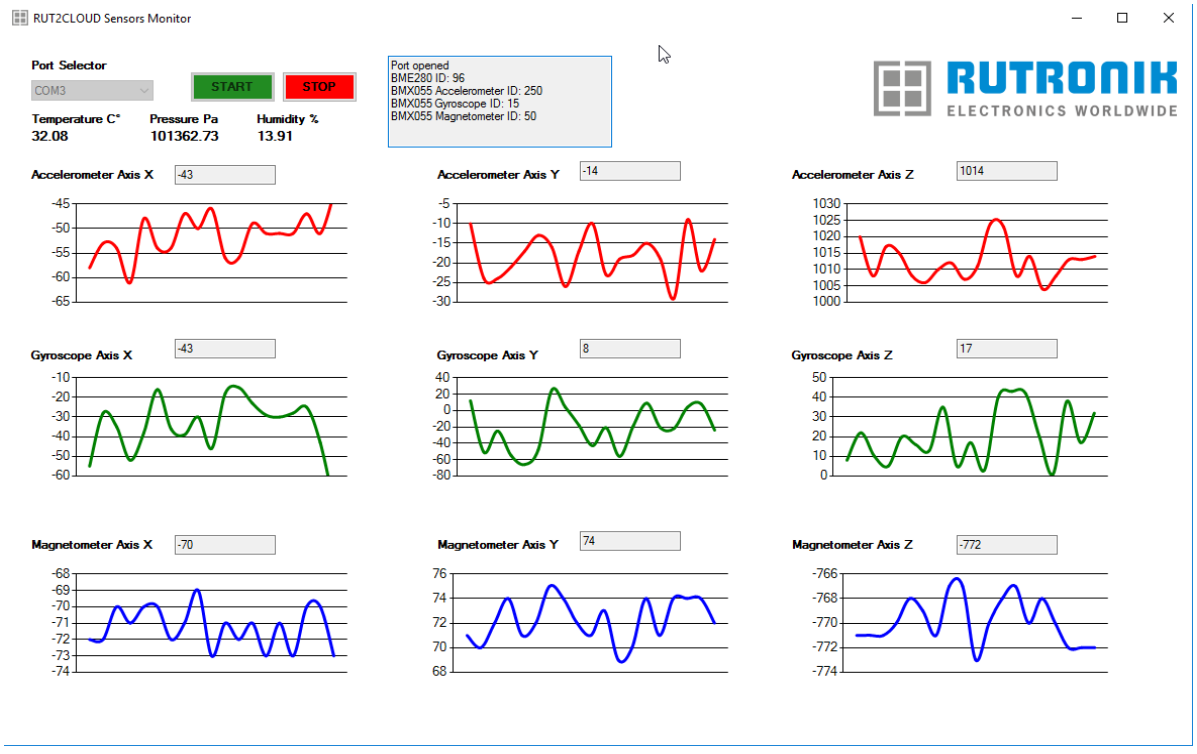

Fig. 6. Rutronik Sensors Monitor application.

Programming via Micro USB port

RUT2CLOUD Board could be programmed using "Renesas Flash Programmer" via USB port.

The "Renesas Flash Programmer (Programming GUI)" and documentation is provided by Renesas.

RUT2CLOUD Board has to be set to "USB Boot Mode" before using the application. In order to do that, do the following steps:

1. Install the latest "Renesas Flash Programmer" (it comes with drivers).
2. Attach USB port to the PC.
3. Press and hold the "BOOT" button and while holding press the "RST" button once.
4. Wait for the "Synergy USB Boot" device is detected and installation is finished by yours machine.
5. Setup the firmware to connect to the "Synergy USB Boot" COM port, select the Intel hex or Motorola s binary source file and proceed with programming.

Note: The "BOOT" button must be kept pressed before the programming starts and during the programming!

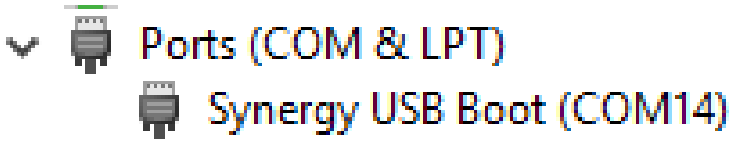

Fig. 7. USB Boot device detected and installed successfully.

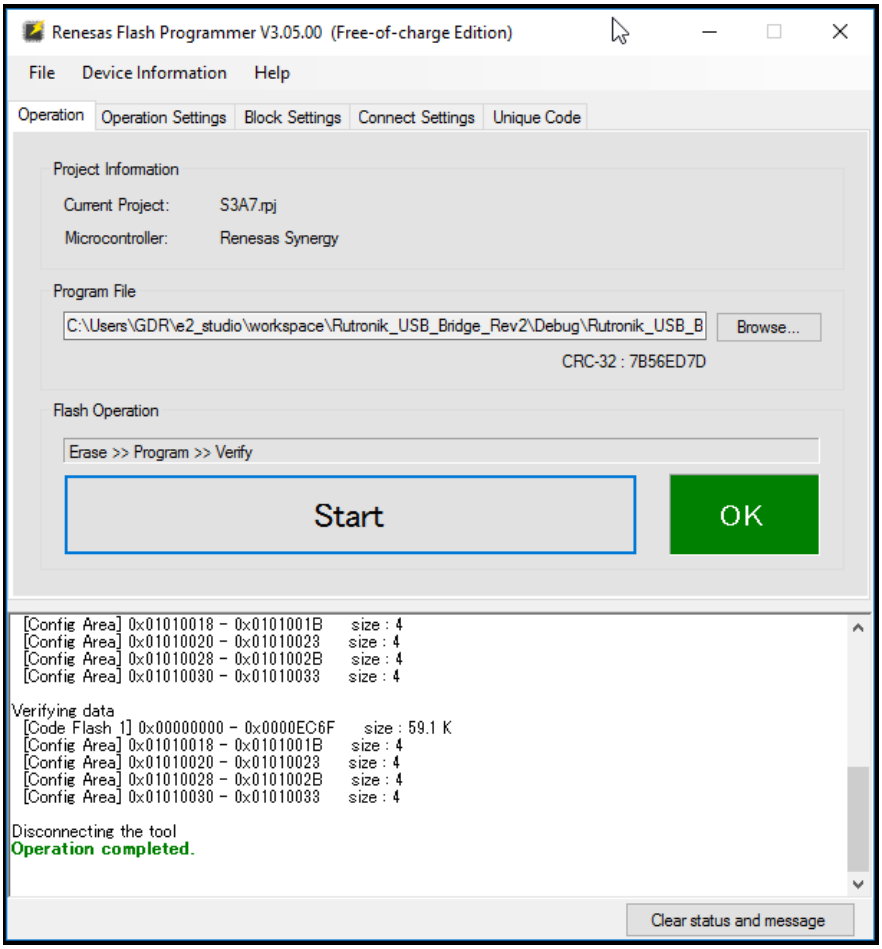

Fig. 8. Renesas Flash Programmer view after successful programming.

Telit GNSS Bundle Solution

RUT2CLOUD demo kit's hardware and firmware is configured to be in "Telit Bundle Solution" configuration by default. Thus Telit GNSS module can be managed using AT commands that are sent to Telit cellular module. In case the configuration has been lost, it can be restored using AT commands sequence written below.

```
AT$GPSD=5
AT$GPSGPIO=2,1,0,0
AT$GPSSERSPEED=9600
AT$GPSP=1
AT$GPSSAV
AT#REBOOT
```

Fig. 9. GL865 V3.1 and SL876Q5-A Bundle AT commands sequence.

In order to have bundle configuration the cellular and GNSS modules are connected via circuit breakers SB11, SB12, SB13, SB14. GNSS module may be evaluated separately if all these circuit breakers are cut.

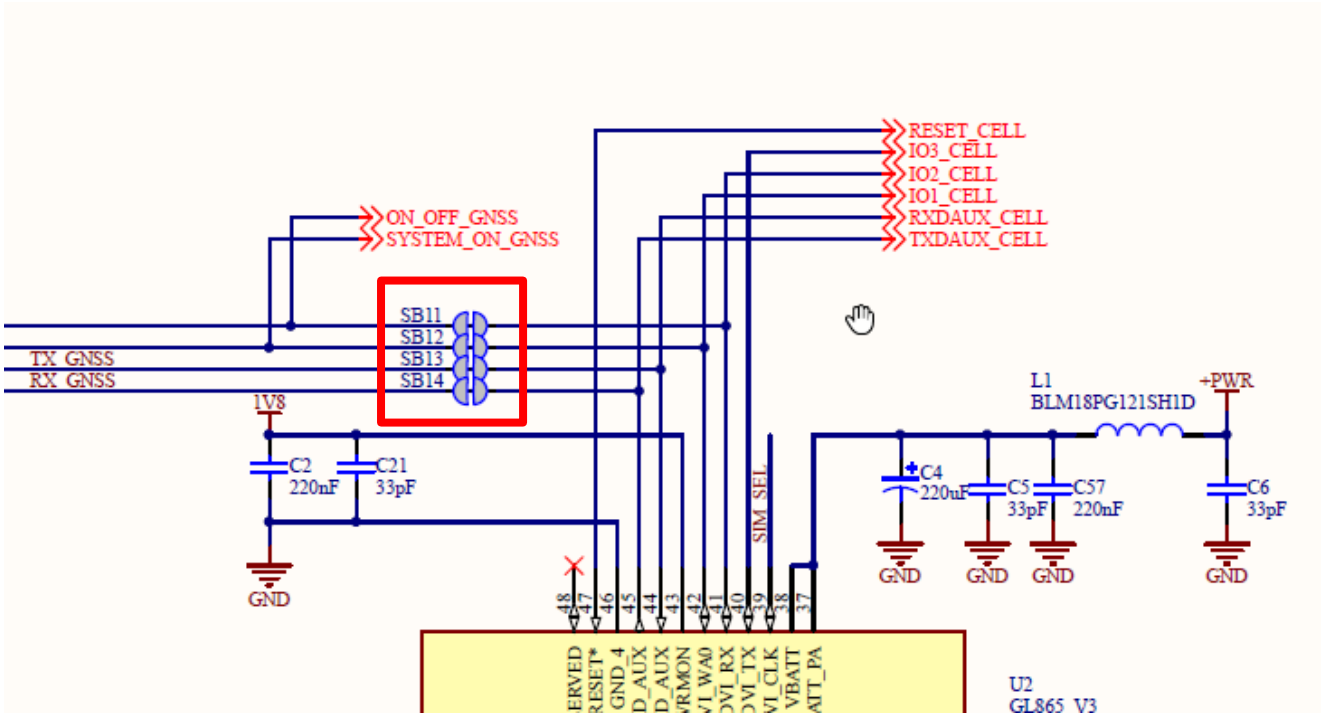

Fig. 10. GL865 V3.1 and SL876Q5-A hardware configuration

SIM Card's Selection

RUT2CLOUD Modem has two SIM cards. One is Nano SIM and another is embedded SIM. The analog switch ISL84467 is used to select between SIM cards. Nano SIM is always selected by default every time the system is powered up. In order to select Embedded SIM (or eSIM), AT commands sequence has to be executed as shown below.

```
AT#SIMDET=0
AT#GPIO=4,1,1
(wait aprox. 5 seconds)
AT#SIMDET=1
```

Fig. 11. Embedded SIM card's selection

```
AT#SIMDET=0
AT#GPIO=4,1,0
(wait aprox. 5 seconds)
AT#SIMDET=1
```

Fig. 12. Nano SIM card's selection

External Antennas

Cellular Antenna

An antenna must be connected to modem's U.FL socket. The antenna requirements are shown below:

GL865 V3.1 ANTENNA REQUIREMENTS	
Frequency range	Depending by frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth	70 MHz in GSM850, 80 MHz in GSM900, 170 MHz in DCS & 140 MHz PCS band
Impedance	50Ω
Input power	> 2 W
VSWR absolute max	≤ 10:1 (limit to avoid permanent damage)
VSWR recommended	≤ 2:1 (limit to fulfill all regulatory requirements)

Fig. 13. Typical U.FL connector

Molex cellular quad band antenna (Part No.: 146185-0100) is recommended for RUT2CLOUD board.

GNSS Antenna

Since SL876Q5-A has internal antenna the GNSS external antenna is not necessary unless user cuts the SB16 and solders the SB15 circuit breaker. U.FL external antenna accepts GNSS signals in the range of 1561 MHz to 1606 MHz at a level between -125 dBm and -151 dBm into 50 Ω impedance. Molex GPS and Wi-Fi Combo antenna might be used (Part No.: 146186-0100).

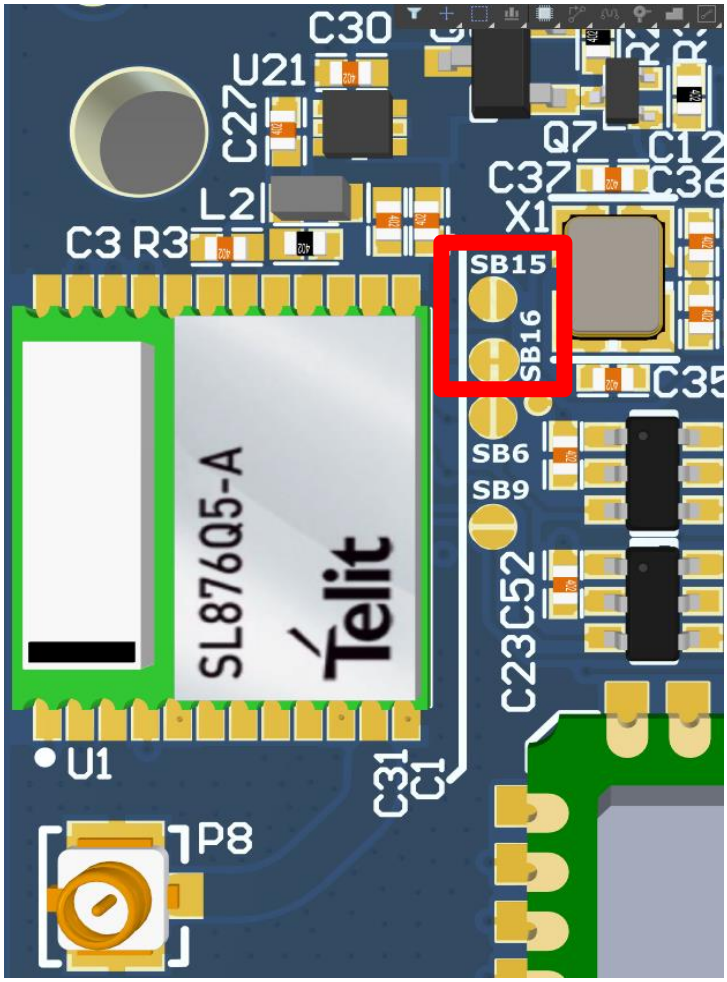

Fig. 14. GNSS External antenna configuration: SB15 - short, SB16 -

Li-ion Battery Charger

Though the ISL9203A is capable to deliver 1.5A to the Li-ion battery, the current is decreased to 444mA in order not to overload USB host. If RUT2CLOUD board is powered from external 5V power source or more powerful USB host is used, the current may be increased by changing the resistor R7 value. The charge current may by calculated using the equation given below:

$$I_{REF} = \frac{0.8\text{V}}{R_{IREF}} \times 10^5 (A)$$

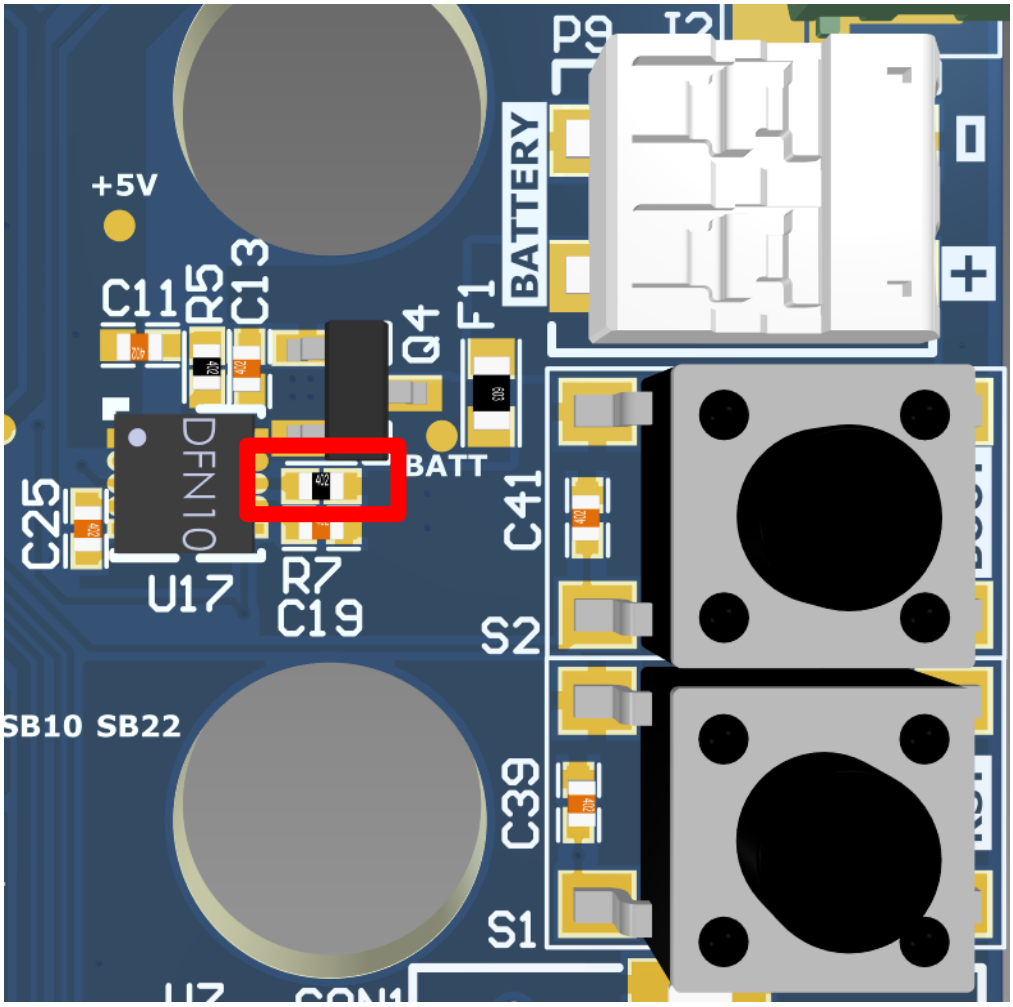

Fig. 15. Charge current programming resistor R7

Code examples

All available code examples for this board can be downloaded from GitHub:

https://github.com/RutronikKaunas

RUT2CLOUD code example list:

- Telit IoT Portal uploader example:
  https://github.com/RutronikKaunas/rut2cloud_uploader
- Basic SMS Controlled GNSS tracker demo:
  https://github.com/RutronikKaunas/rut2cloud_tracker
- RUT2CLOUD USB Bridge demo:
  https://github.com/RutronikKaunas/rut2cloud_usb_bridge

Telit IoT Portal view only account:

User name: rutronik_lt@rutronik.com

Password: Rutron1k_user

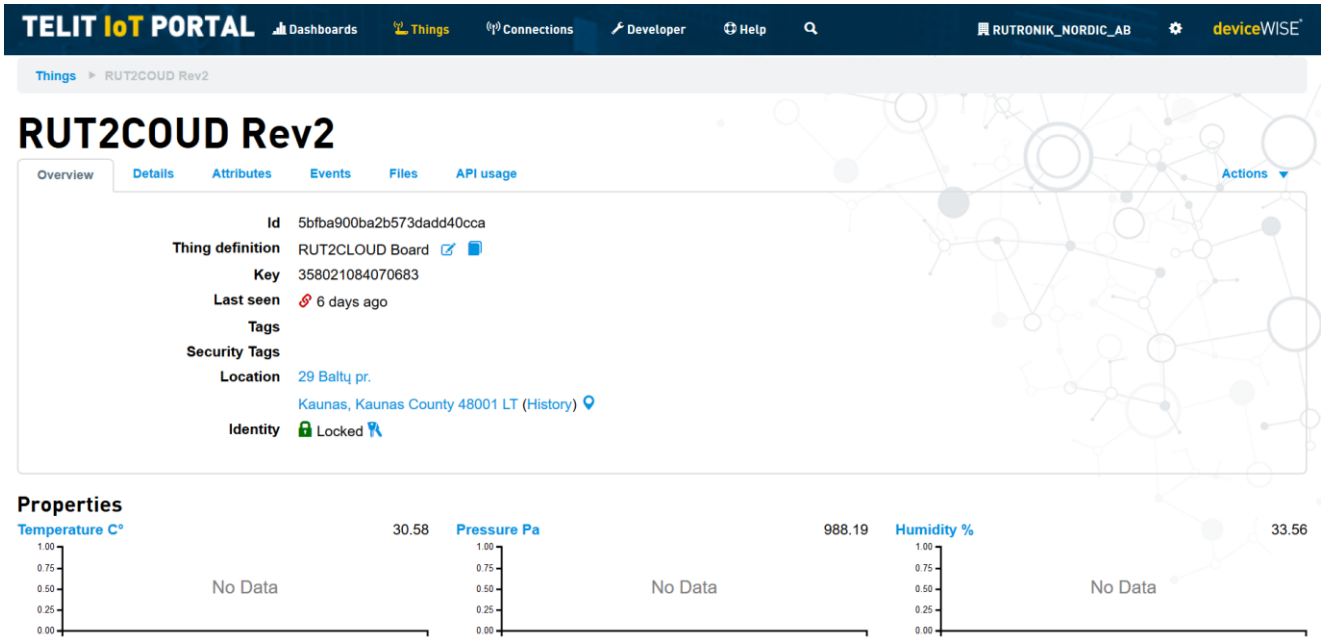

Fig. 16. Telit IoT Portal Things review