

# Zero Carbon LoRa® Evaluation Board Tutorial

The Zero Carbon LoRa® Evaluation Board features proprietary indoor/outdoor tracking functionality (LoRa Cloud<sup>#1</sup>) that uses Wi-Fi scanning and GNSS reception to estimate geographical location (latitude and longitude). With the addition of a sensor (SPI/I2C<sup>#2</sup>), the board can acquire sensor data at the same time.

**#1: The usage procedures and operation of the Zero Carbon LoRa® Evaluation Board in this document might differ from the recommendations of the manufacturer (SEMTECH) (as of March 18<sup>th</sup>, 2022).**

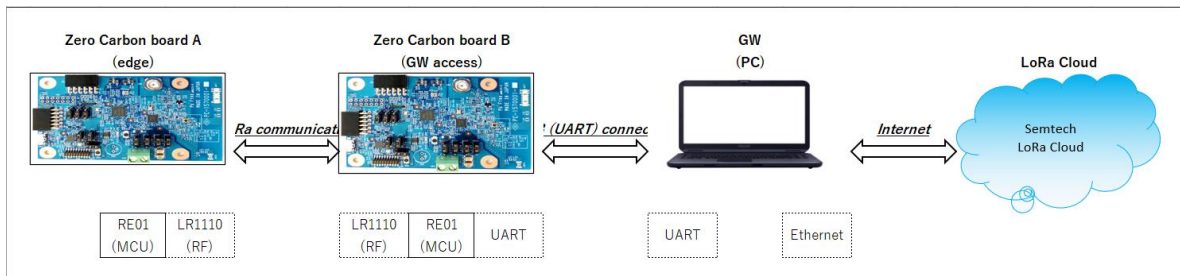
**#2: A temperature and humidity sensor (HS3001) is provided as standard.**

## Contents

- 0. System Configuration
- 1. Preparing the Hardware
- 2. Preparing the Software
- 3. Setting up a LoRa® Cloud Account
- 4. Setting up the Application Environment on the PC
- 5. Zero Carbon LoRa® Evaluation Board Jumper and Switch Layout Diagram
- 6. Updating the LoRa LR1110 Firmware (Common to Zero Carbon Boards A and B)
- 7. Updating the Renesas RE01 Firmware (Common to Zero Carbon Boards A and B)
- 8. Setting up Charging (Zero Carbon Board A (Edge) Only)
- 9. Setting up the Connections of the Zero Carbon Board B (GW Access)
- 10. Using the System
- 11. Troubleshooting
- 12. Setting up the Development Environment

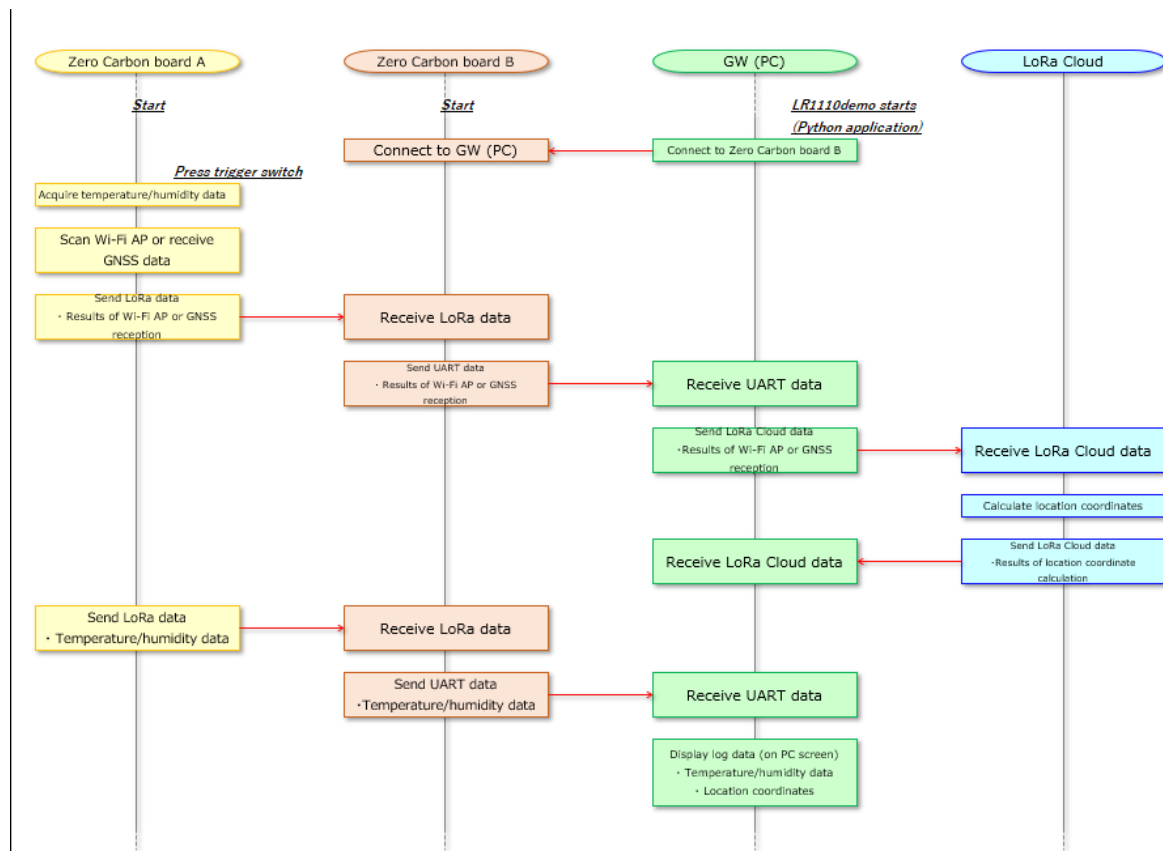
- 13. Creating a Project in Renesas Flash Programmer
- 14. About the Patch Command

## 0. System Configuration



## 0-1. Flowchart

The following flowchart provides a simplified explanation of the code's behavior.



## 0-1. Links

Related section	Subject	Link
2-1.	Renesas RE01 Microcontroller Firmware	<a href="#">Zero Carbon LoRaEva FW-Hex</a>
	LoRa LR1110 Firmware Update Tool	<a href="#">Zero Carbon LoRaEva Tool</a>
2-2.	LoRa LR1110 Firmware	<a href="https://github.com/Lora-net/radio_firmware_images/tree/master/lr1110/transceiver">https://github.com/Lora-net/radio_firmware_images/tree/master/lr1110/transceiver</a>
2-3.	Renesas RE01 Microcontroller Firmware Updater	<a href="#">Renesas Flash Programmer (Programming GUI)</a>
4.	Documentation for Setting up the Application Environment on the PC	<a href="#">LR1110GeolocDemoUserGuide_v1.0.pdf</a>
4-1.	Package Base for Setting up the Application Environment on the PC	<a href="https://github.com/Lora-net/lr1110_evk_demo_app/wiki/Software-packages">https://github.com/Lora-net/lr1110_evk_demo_app/wiki/Software-packages</a>
4-7.	Package for Setting up the Application Environment on the PC	<a href="#">Zero Carbon LoRaEva lr1110 demo app</a>

## 1. Preparing the Hardware

1. Zero Carbon LoRa® Evaluation Board × 2 (one each of Zero Carbon Board A and B)
2. USB Type-A to Micro-B cable × 2 (for connecting Zero Carbon boards A and B)
3. PC (for running applications and connecting to LoRa Cloud)
4. Internet connection environment (LoRa Cloud connection)

### Other Recommended Products

No.	Item	Manufacturer	Model
1	Dipole antenna for LoRa LR1110	Linx Technologies Inc.	ANT-916-CW-HWR-RPS-ND
2	Connector conversion cable for dipole antenna	Antenna Technology Inc.	CSBMS156C-ANT-125N
3	GPS antenna	Taoglas Limited	AA.170.301111
4	Solar panel (for outdoor use)	Panasonic	AM-1815CA
5	Solar panel (for indoor use)	TDK	BCS4430B6

## 2. Preparing the Software

### 2-1. Download the firmware and associated tools for the RE01 microcontroller (0-1. Links)

1. Zero Carbon board A (edge): ZeroCarbon\_TxFW.hex
2. Zero Carbon board B (GW access): ZeroCarbon\_RxFW.hex
3. LR1110 firmware update: ZeroCarbon\_Ir1110\_FWupdate.hex
4. LR1110 firmware update tool: ZeroCarbon\_Ir1110\_FWUpdater.exe

### 2-2. Download the firmware for the LR1110 transceiver (0-1. Links)

The binary file (*.bin*) and header file (*.h*) work as set. You must download both files.

- Ir1110\_transceiver\_0307.bin
- Ir1110\_transceiver\_0307.h

**Note: Download version 0307 even if a newer version is available.**

### 2-3. Download the Renesas Flash Programmer software used to flash the RE01 microcontroller firmware (0-1. Links)

- Note: This step requires user registration.

## 3. Setting up a LoRa® Cloud Account

### 3-1. Register a Lora Cloud account to use for tracking (geolocation).

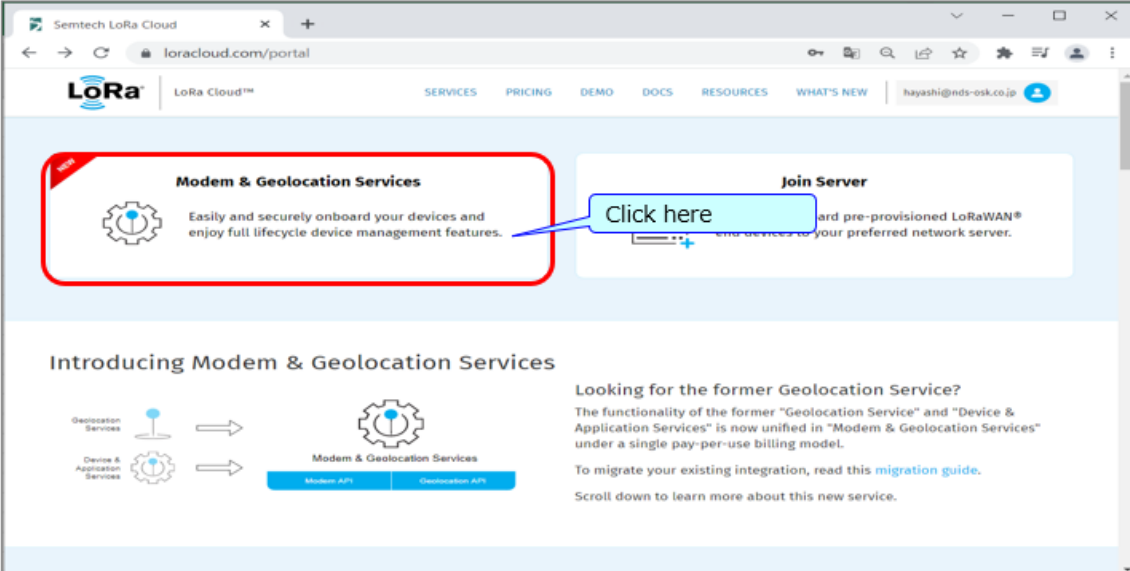
- <https://www.loracloud.com>

Note: The Lora Cloud service has a free tier for evaluation purposes.

### 3-2. Create a new owner.

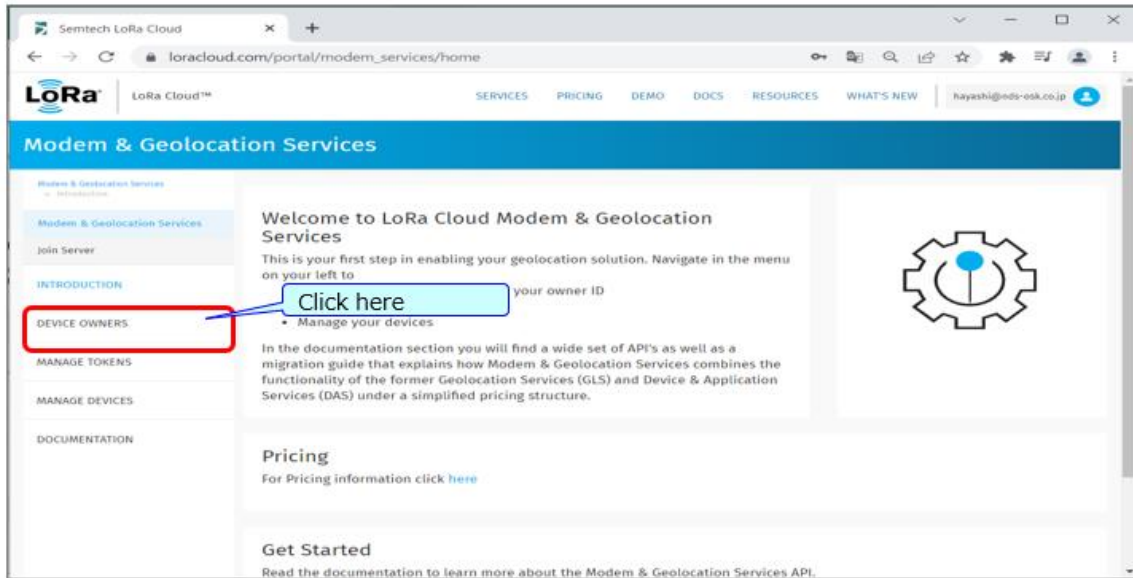
- <https://www.loracloud.com/portal>

#### 3-2-1 Click *Modem & Geolocation Services*.

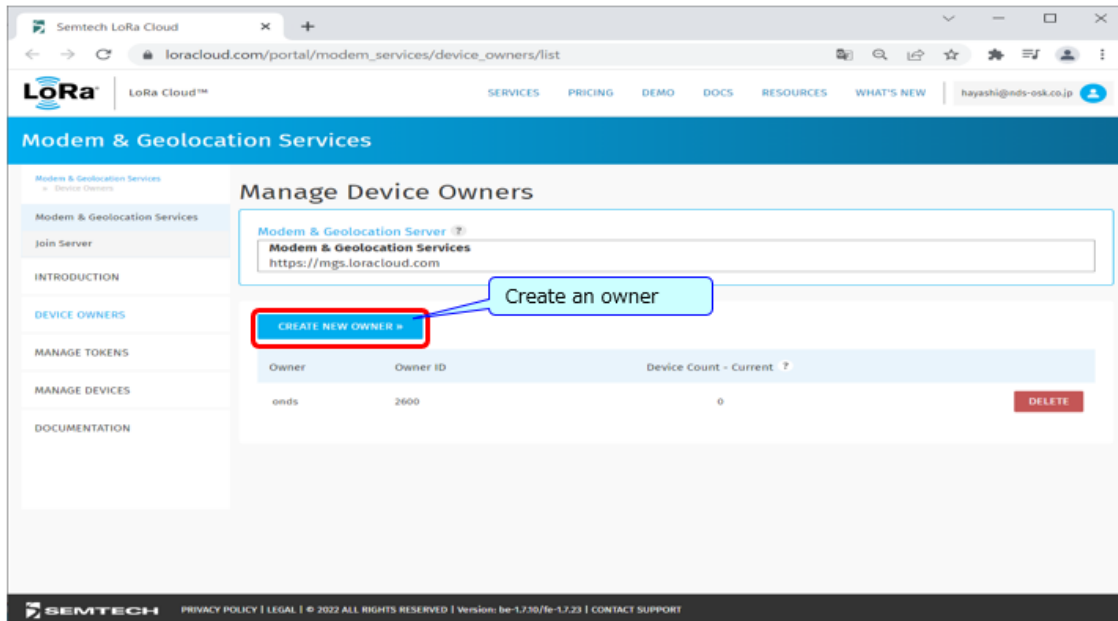


The screenshot shows the Semtech LoRa Cloud portal at [loracloud.com/portal](https://loracloud.com/portal). The page features a navigation bar with links for SERVICES, PRICING, DEMO, DOCS, RESOURCES, and WHAT'S NEW. A user profile for 'hayashi@nds-osk.co.jp' is visible in the top right. The main content area is divided into two primary sections: 'Modem & Geolocation Services' and 'Join Server'. The 'Modem & Geolocation Services' section is highlighted with a red border and contains the text: 'Easily and securely onboard your devices and enjoy full lifecycle device management features.' A blue callout box with the text 'Click here' points to a link in this section. Below this, there is a section titled 'Introducing Modem & Geolocation Services' which includes a diagram showing the migration of 'Geolocation Services' and 'Device & Application Services' into the unified 'Modem & Geolocation Services' block, which includes 'Modem API' and 'Geolocation API'. To the right of this diagram, there is a section titled 'Looking for the former Geolocation Service?' which explains that the functionality of the former 'Geolocation Service' and 'Device & Application Services' is now unified in 'Modem & Geolocation Services' under a single pay-per-use billing model. It also provides a link to a 'migration guide' and instructs users to scroll down for more information.

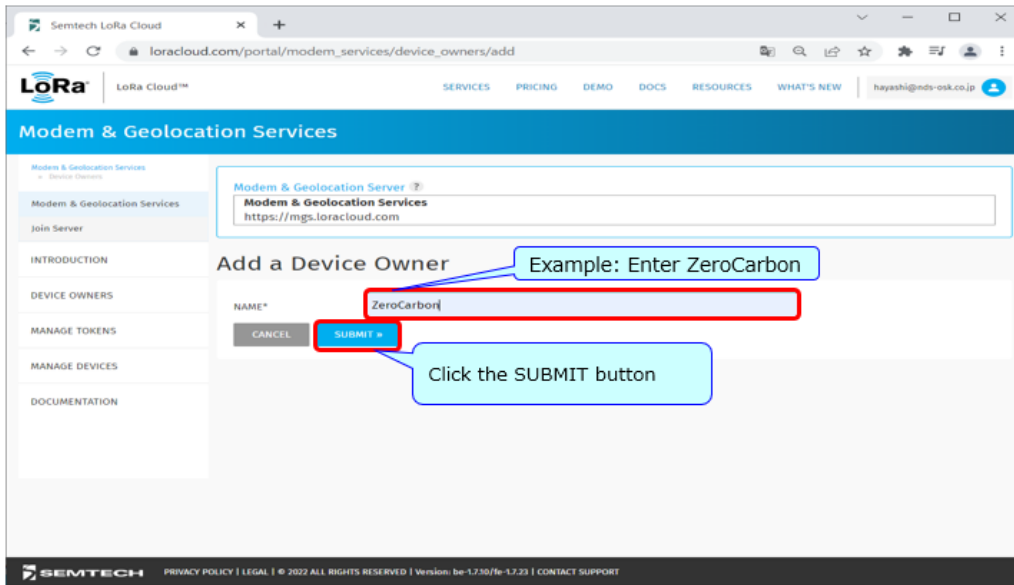
### 3-2-2 Click **DEVICE OWNERS**.



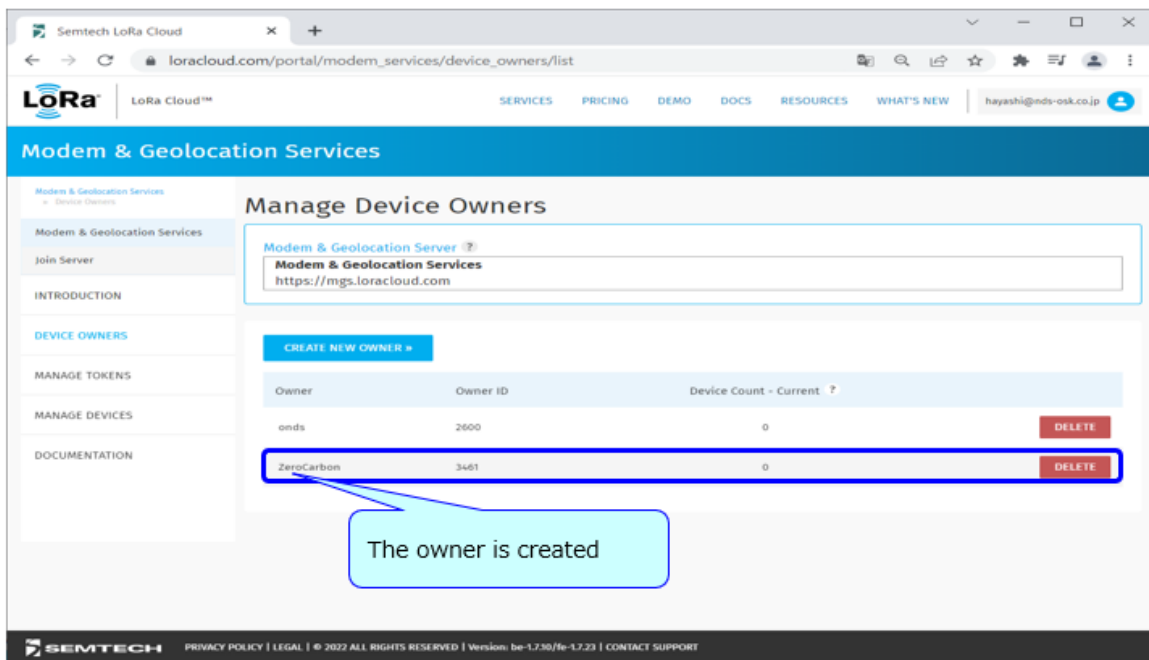
### 3-2-3 Click **CREATE NEW OWNER** to begin creating a new owner.



3-2-4 Enter the name of the owner in the **NAME** field and then click **SUBMIT**.



3-2-5 The new owner is now added.

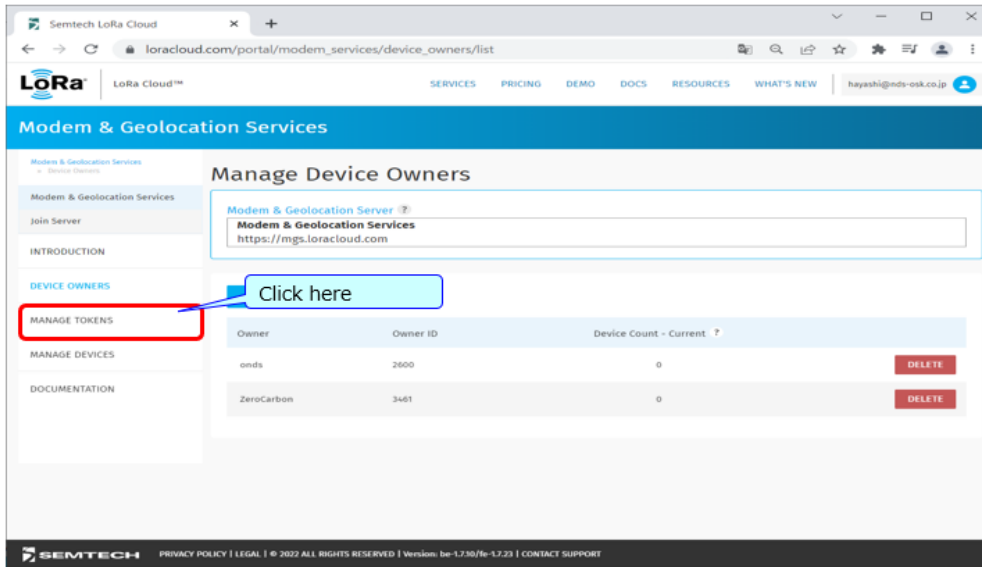




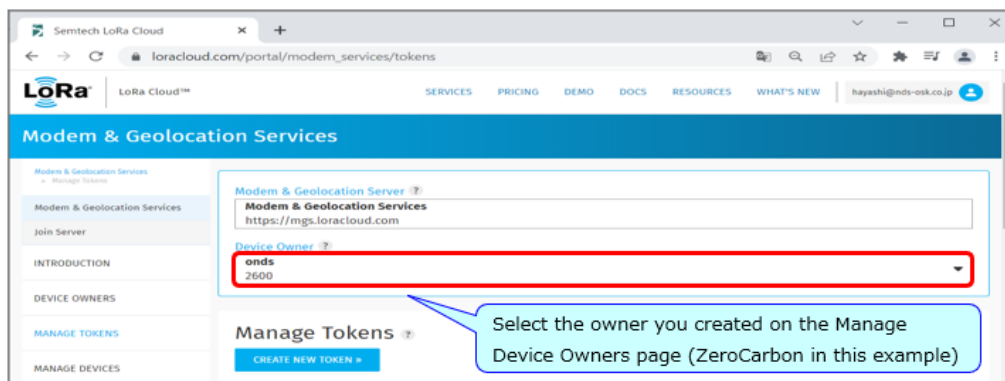
### 3-3. Create a new Manage Token and copy it to the clipboard.

- [https://www.loracloud.com/portal/modem\\_services/tokens](https://www.loracloud.com/portal/modem_services/tokens)

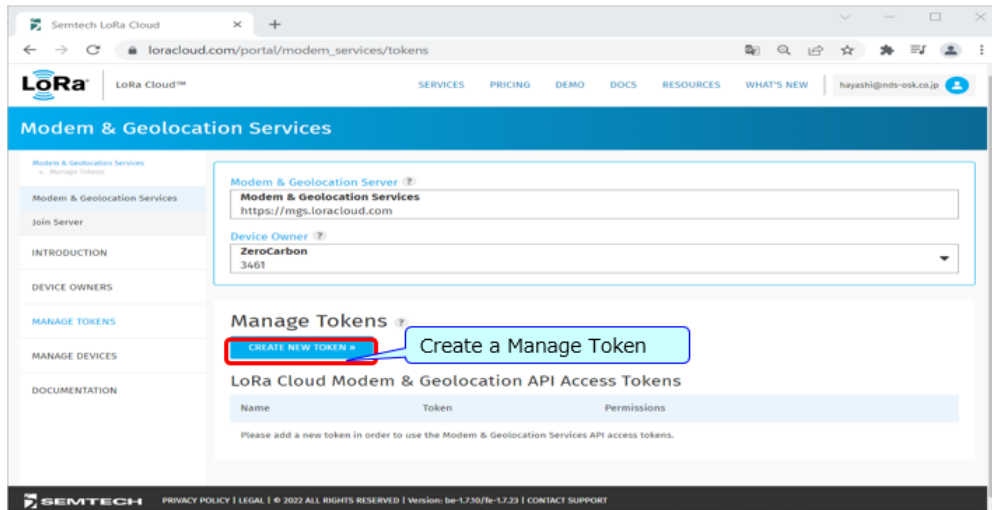
#### 3-3-1 Click **MANAGE TOKENS**.



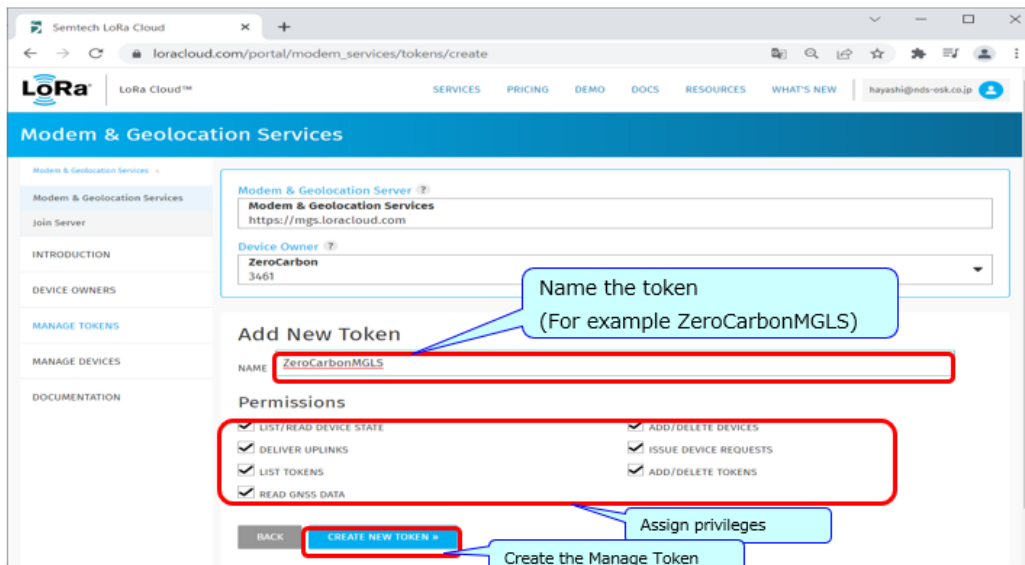
#### 3-3-2 Select the owner you added in 3-2-5.



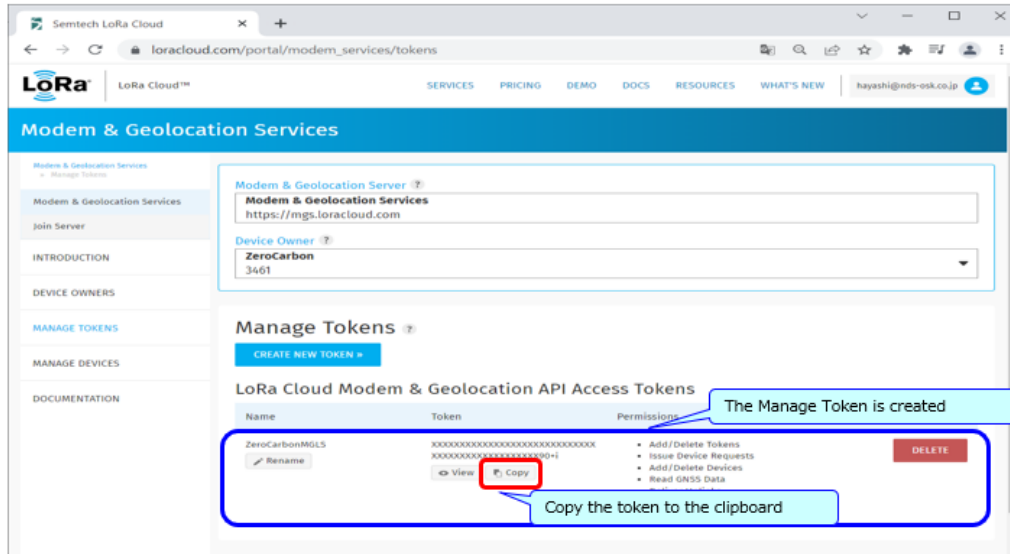
3-3-3 Click **CREATE NEW TOKEN** to create a new token.



3-3-4 Enter the name of the token in the **NAME** field, set the permissions of the token, and then click **CREATE NEW TOKEN**.



3-3-5 A new Manage Token is created. Click the **Copy** button to copy the token to the clipboard.



#### 4. Setting up the Application Environment on the PC

- To use the software, you must have **Python 3.5** or later installed.
- Reference information is available at the following URL:
  - [LR1110GeolocDemoUserGuide\\_v1.0.pdf](#)
  - Read from
    - 4.1.1 Ensure You Can Run Python to
    - 4.3.2.1 Using The Usbconnectioncheck Software

##### 4-1. Download the package base for the PC application environment.

Download the **Version 3.1.0** software package from the URL in 0-1. Links.

Note: Although *Section 3 LR1110 EVK Software Package* of the file [LR1110GeolocDemoUserGuide\\_v1.0.pdf](#) contains a link to the software package, use the link in 0-1. Links instead.

lr1110\_evk\_demo\_app\_v3.1.0.zip

##### 4-2. Unzip the downloaded file (lr1110\_evk\_demo\_app\_v3.1.0.zip) to the local disk.

lr1110\_evk\_v3.1.0.bin

lr1110evk-3.1.0.tar.gz

#### 4-3. Open Command Prompt.

#### 4-4. Move to the folder in which the file lr1110evk-3.1.0.tar.gz is stored, and execute the following commands:

```
> python -m pip install --user --upgrade setuptools wheel
```

```
> pip install lr1110evk-3.1.0.tar.gz
```

#### 4-5. Check the version by executing the following commands:

```
> lr1110demo --version
```

```
> usbconnectioncheck --version
```

#### 4-6. Delete the following folder.

```
C:\Users\xxxxxx\AppData\Local\Programs\Python\PythonXX\Lib\site-packages\lr1110evk
```

- Note: Replace xxxxxx with your username.
- Note: Interpret PythonXX as the version of Python you are using.  
Example: Read as Python310 when using Python 3.10.x

#### 4-7. Download the latest version of the Renesas application environment package (lr1110evk).

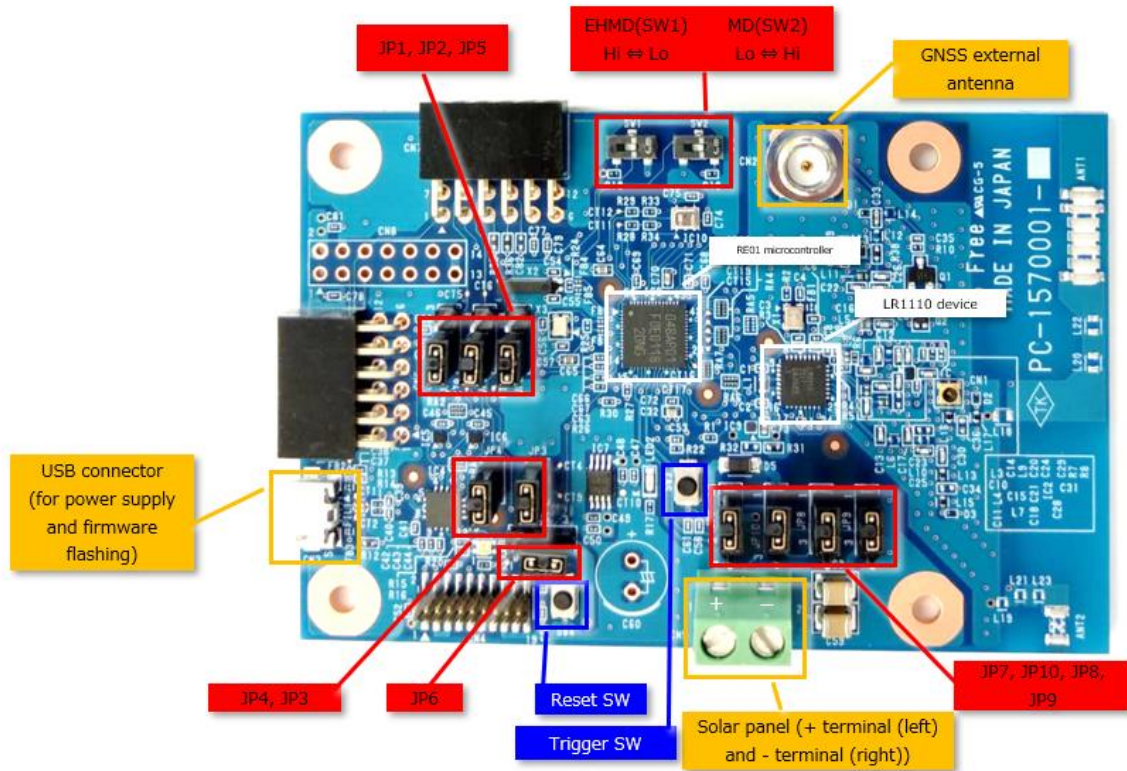
Download the PC application environment package from the URL in [0-1. Links](#).

- Download the file by selecting **Download ZIP** from the **Code** drop-down list
- Unzip the lr1110\_evk\_demo\_app-master.zip file
- Copy the lr1110evk folder from lr1110\_evk\_demo\_app-master\host to the following folder:

```
C:\Users\xxxxxx\AppData\Local\Programs\Python\PythonXX\Lib\site-packages
```

- Note: Replace xxxxxx with your username.
- Note: Interpret PythonXX as the version of Python you are using.  
Example: Read as Python310 when using Python 3.10.x

## 5. Zero Carbon LoRa® Evaluation Board Jumper and Switch Layout Diagram



Pre

- Jumper and switch settings

Jumper and switch settings

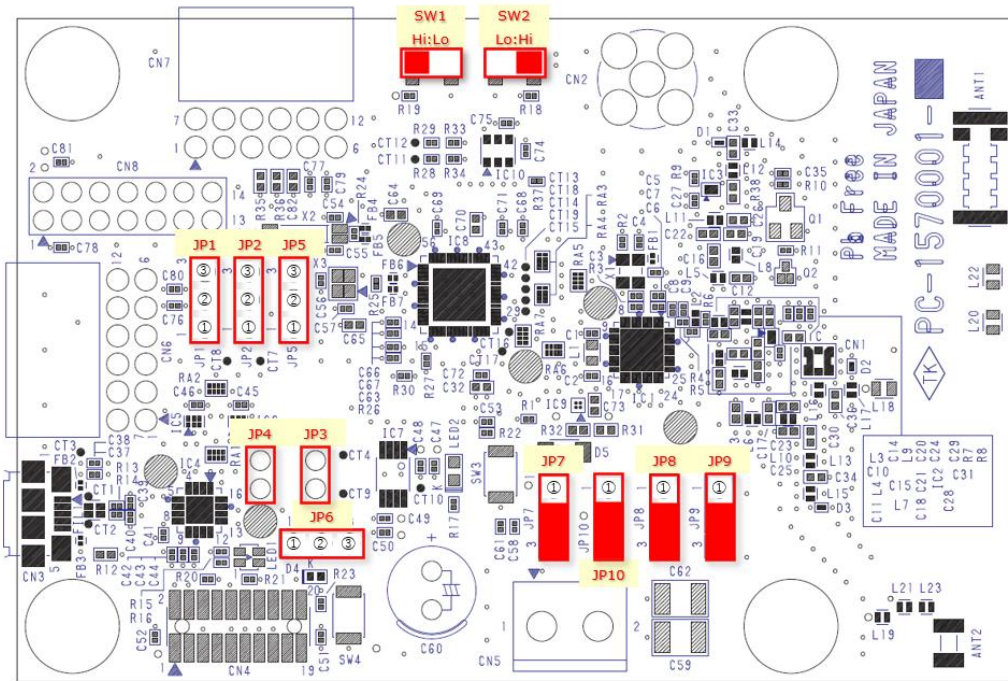
a. When using energy harvesting devices (Driven by rechargeable battery)		b. When using USB fast charging		c. When using a USB power supply	
JP/SW	State	JP/SW	State	JP/SW	State
JP1	OPEN	JP1	OPEN	JP1	OPEN
JP2	OPEN	JP2	OPEN	JP2	OPEN
JP3	OPEN	JP3	OPEN	JP3	SHORT
JP4	OPEN	JP4	OPEN	JP4	OPEN
JP5	OPEN	JP5	OPEN	JP5	OPEN
JP6	OPEN	JP6	1-2	JP6	1-2
JP7	2-3	JP7	2-3	JP7	1-2
JP8	2-3	JP8	2-3	JP8	1-2
JP9	2-3	JP9	2-3	JP9	1-2
JP10	2-3	JP10	1-2	JP10	2-3
SW1(EHMD)	Hi	SW1(EHMD)	Hi	SW1(EHMD)	Lo
SW2(MD)	Hi	SW2(MD)	Hi	SW2(MD)	Hi

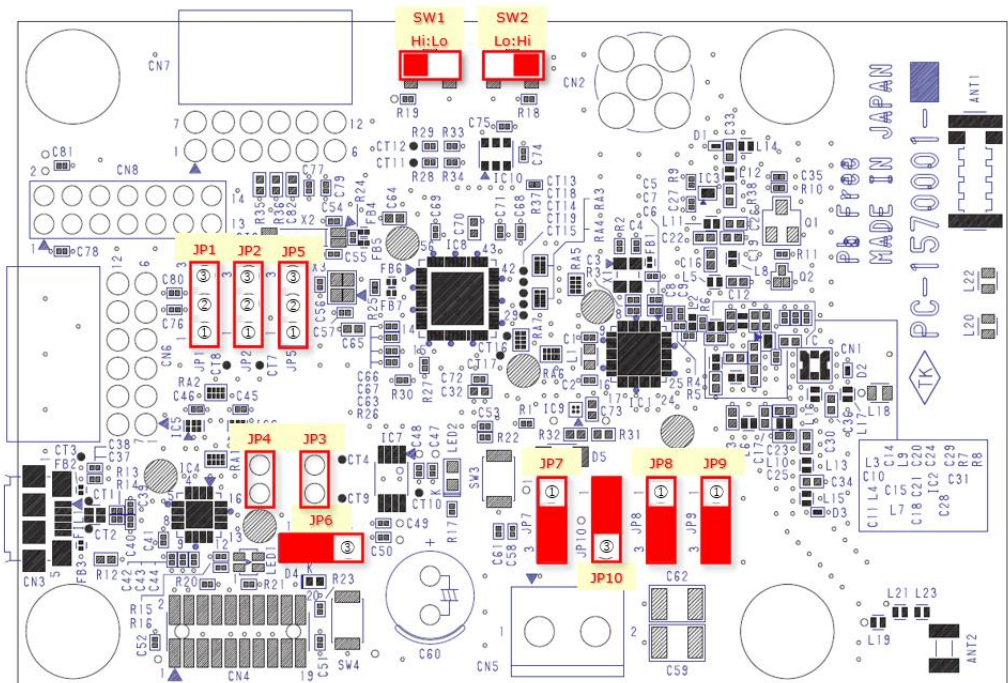
d. When flashing the RE01 from RFP (RE01 flashing)		e. When flashing the LR1110 FW		f. When using USB to communicate and using a power supply	
JP/SW	State	JP/SW	State	JP/SW	State
JP1	1-2	JP1	2-3	JP1	2-3
JP2	1-2	JP2	2-3	JP2	2-3
JP3	SHORT	JP3	SHORT	JP3	SHORT
JP4	SHORT	JP4	SHORT	JP4	SHORT
JP5	OPEN	JP5	OPEN	JP5	OPEN
JP6	1-2	JP6	1-2	JP6	1-2
JP7	1-2	JP7	1-2	JP7	1-2
JP8	1-2	JP8	1-2	JP8	1-2
JP9	1-2	JP9	1-2	JP9	1-2
JP10	2-3	JP10	2-3	JP10	2-3
SW1(EHMD)	Lo	SW1(EHMD)	Lo	SW1(EHMD)	Lo
SW2(MD)	Lo	SW2(MD)	Hi	SW2(MD)	Hi

- Red markings on the jumpers indicate a short or 1-2 connection or 2-3 connection

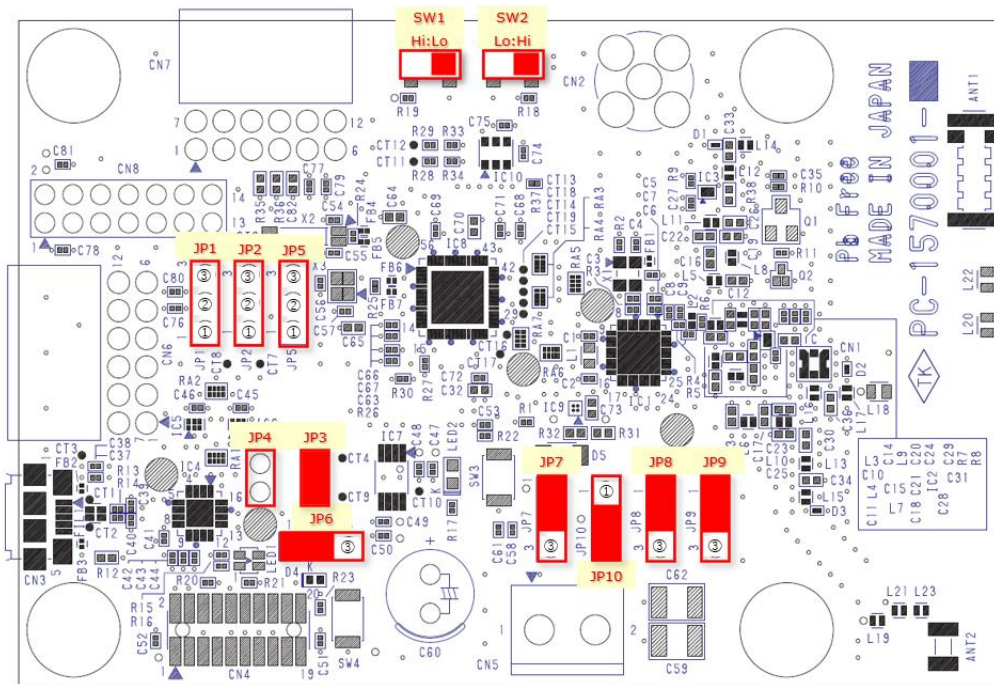
- a. Settings when using energy harvesting devices



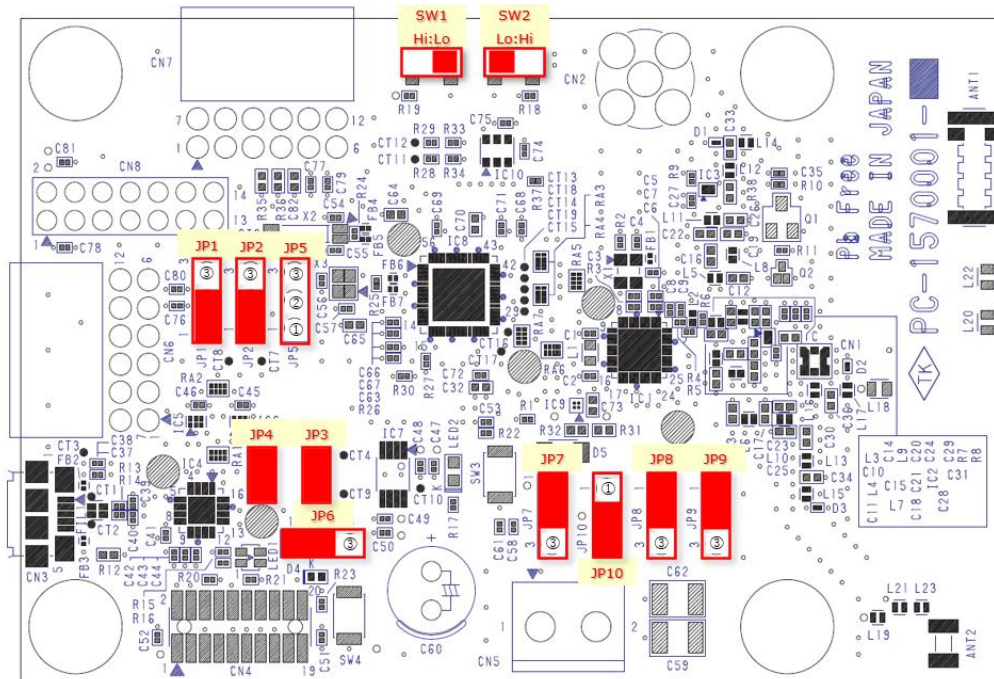
- b. Settings when using USB fast charging



- c. Settings when using a USB power supply

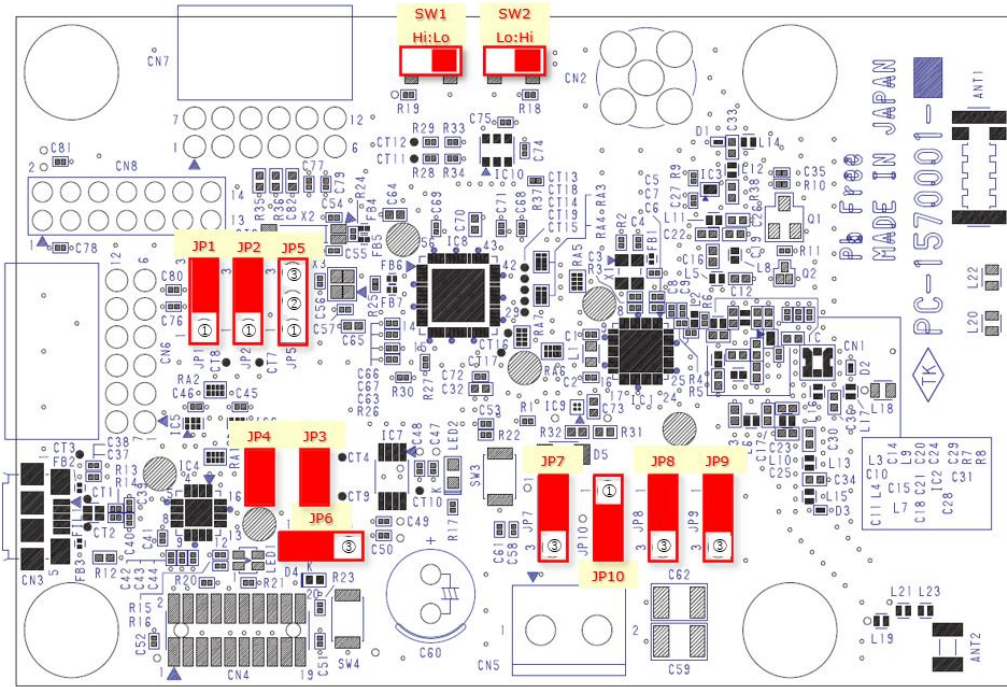


- d. Settings when flashing the RE01 from RFP and using a power supply



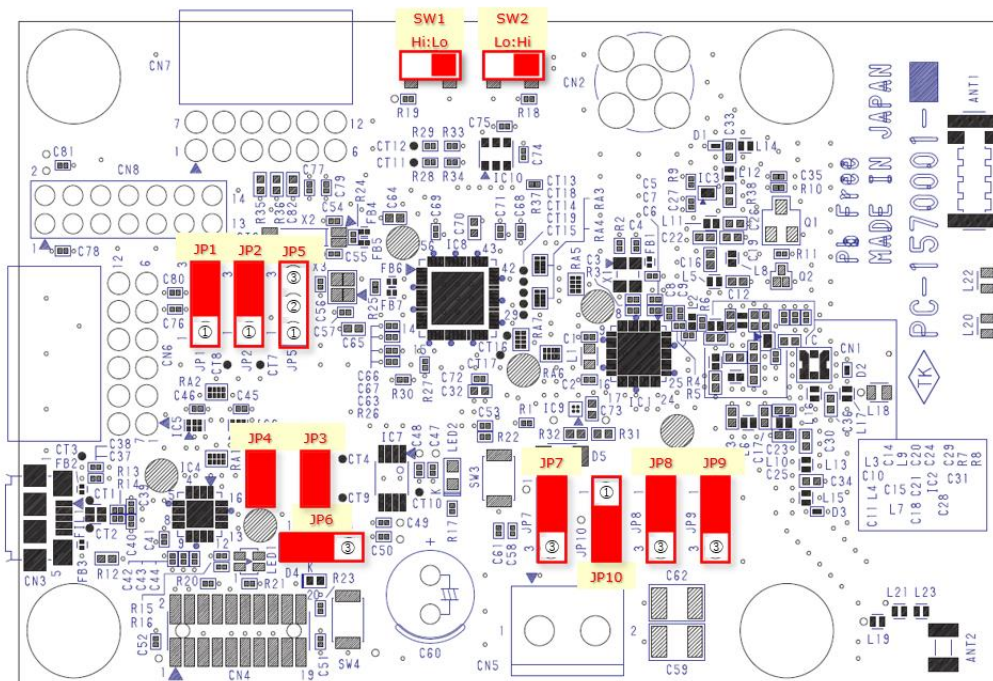


- e. Settings when flashing the LR1110 FW (USB communication) and using a power supply



Preprint

- f. Settings when using USB to communicate and using a power supply



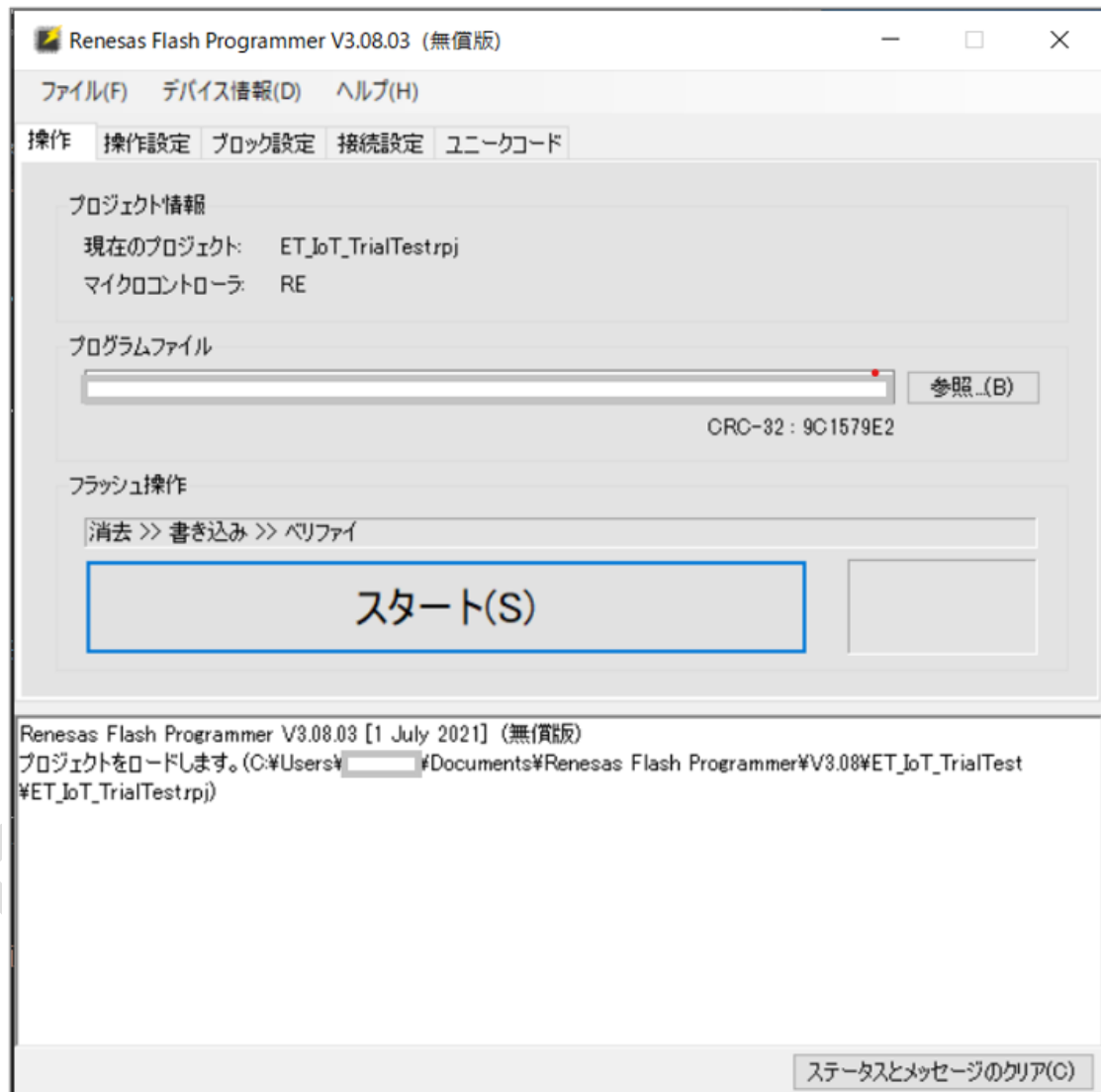
## 6. Updating the LoRa LR1110 Firmware (Common to Zero Carbon Boards A and B)

Note: When using Renesas Flash Programmer to flash the firmware for the first time, perform the initial setup with reference to 13. [Creating a Project in Renesas Flash Programmer](#).

### 6-1. First, flash the RE01 microcontroller with the updated LR1110 firmware downloaded as the third item in 2-1.

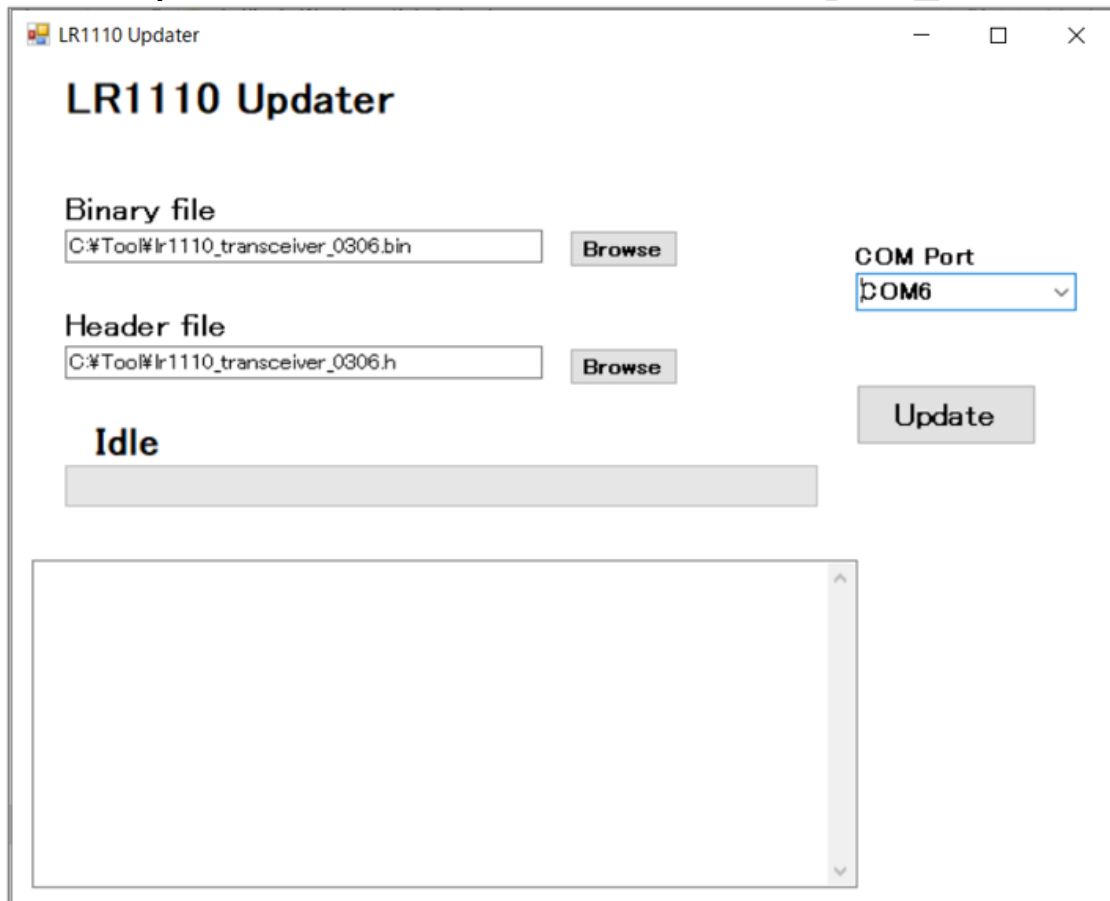
- As the jumper and switch settings, use 5. *d. Settings when flashing the RE01 from RFP and using a power supply.*
- Use the USB cable to connect the board to the PC.
- Start RFP (Renesas Flash Programmer) downloaded in 2-3 and flash the RE01 microcontroller with the updated LR1110 firmware downloaded as the third item in 2-1.
- Select the number of the COM port to which the board is connected in the **Tool Details** dialog box accessed from the **Connect Settings** tab.

- On the **Operation** tab, click **Browse** beside the **Program File** field and select the updated LR1110 firmware downloaded as the third item in 2-1.
- Click the **Start** button under **Flash Operation**  
Note: If an error occurs, press the Reset button on the board and then immediately click **Start**.



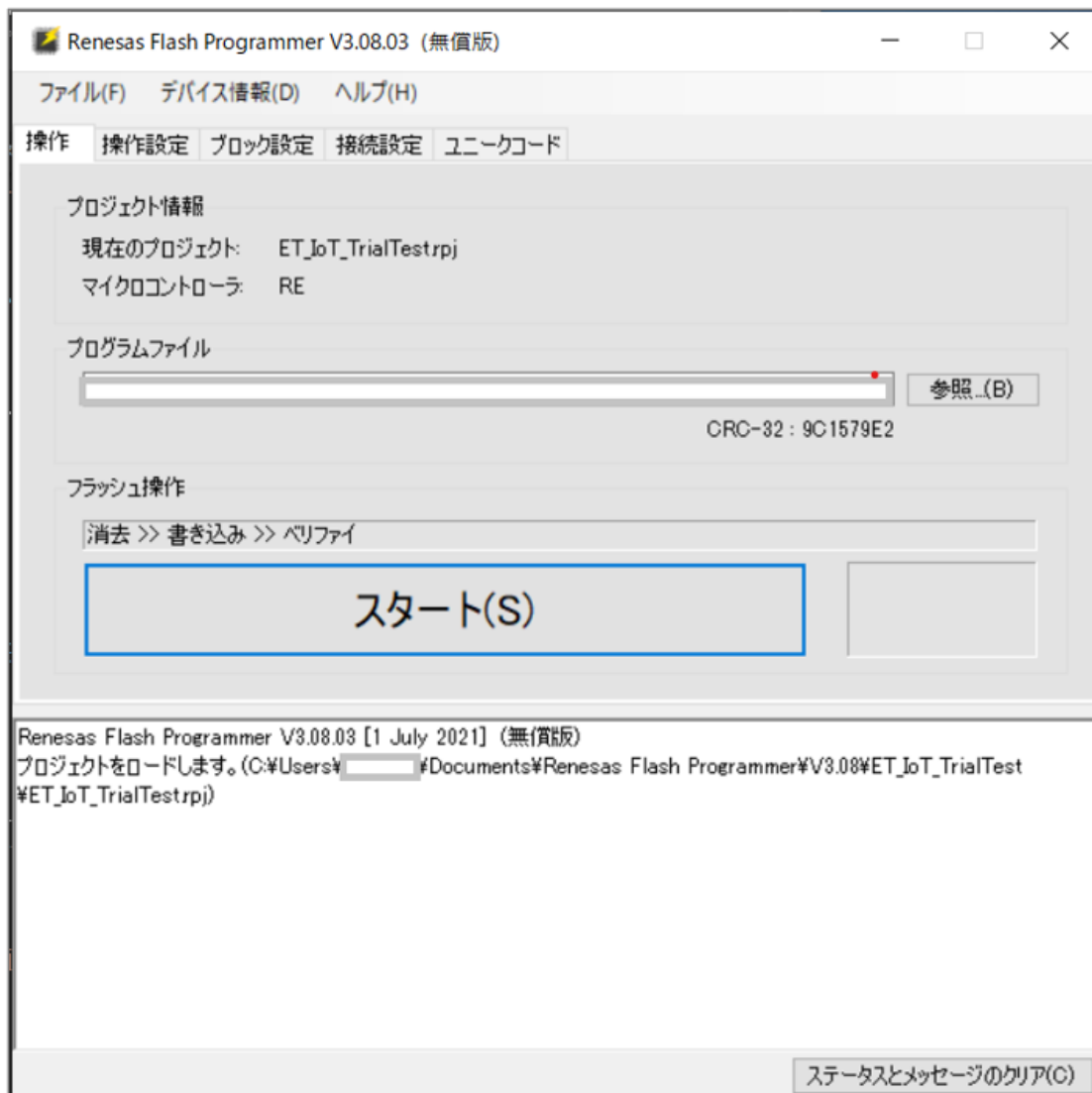
## 6-2. Update the LR1110 device by flashing the LR1110 firmware (2-2)

- As the jumper and switch settings, use 5. e. *Settings when flashing the LR1110 FW (USB communication) and using a power supply.*
- Use the USB cable to connect the PC and the board.
- Start the LR1110 firmware updater you downloaded as the fourth item in 2-1 and flash the device with the LR1110 firmware (2-2).
- Select the number of the COM port to which the board is connected.
- Select the *.bin* and *.h* files for the LR1110 firmware (2-2).
- Click the **Update** button.



## 7. Updating the Renesas RE01 Firmware (Common to Zero Carbon Boards A and B)

- As the jumper and switch settings, use 5. *d. Settings when flashing the RE01 from RFP and using a power supply.*
- Use the USB cable to connect the board to the PC.
- Start RFP (Renesas Flash Programmer) downloaded in 2-3 and flash the RE01 microcontroller with the firmware for transmission (downloaded as the first item in 2-1) or reception (downloaded as the second item in 2-1).
  - Select the number of the COM port to which the board is connected in the **Tool Details** dialog box accessed from the **Connect Settings** tab.
  - On the **Operation** tab, click **Browse** beside the **Program File** field and select the firmware for transmission (downloaded as the first item in 2-1) or reception (downloaded as the second item in 2-1).
  - Click the **Start** button under **Flash Operation**  
Note: If an error occurs, press the Reset button on the board and then immediately click **Start**.



## 8. Setting up Charging (Zero Carbon Board A (Edge) Only)

### 8-1. Charging with energy harvesting devices (using a solar panel to charge the rechargeable battery)

- Connect the solar panel to the Zero Carbon board A (edge), taking care not to reverse the connections to the + and - terminals.

- As the jumper and switch settings, use 5. a. *Settings when using energy harvesting devices.*  
Note: The rechargeable battery will take some time to charge.

## 8-2. USB fast charging (using USB charging to charge a rechargeable battery)

- As the jumper and switch settings, use 5. b. *Settings when using USB fast charging.*
- Connect the USB cable to the PC and then to the Zero Carbon board A (edge).

## 9. Setting up the Connections of the Zero Carbon Board B (GW Access)

### 9-1. Serial PC connection and USB power supply

- As the jumper and switch settings, use 5. f. *Settings when using USB to communicate and using a power supply.*
- Connect the USB cable to the PC and then to the Zero Carbon board B (GW access).

## 10. Using the System

### 10-1. Change the current directory to the LR1110 directory created in 4. *Setting up the Application Environment on the PC, and execute the following command:*

```
> Lr1110Demo -d <COM_PORT> <COORDINATES_ASSISTED_LR1110>  
<COORDINATES_EXACT> <MANAGE TOKEN>
```

Command example:

```
> Lr1110Demo -d COM4 34.70210993807373,135.4958717974474,1  
34.64588733864984,135.51443499143957,17 Ayyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy
```

- <COM\_PORT>  
The PC port number to which Zero Carbon board B (GW access) is connected
- <COORDINATES\_ASSISTED\_LR1110>  
Specify the location (latitude, longitude, and elevation) of the Zero Carbon board B (GW access)

The format is *latitude,longitude,elevation*

You can acquire latitude and longitude by right-clicking the Google Maps window.

Because Google Maps does not provide elevation data, specify an arbitrary value.

- <COORDINATES\_EXACT>  
Specify a location (latitude, longitude, and elevation) several tens of kilometers away from the Zero Carbon board B (GW access)  
The format is the same as for COORDINATES\_ASSISTED\_LR1110.
- <MANAGE TOKEN>  
Use the Manage Token acquired in 3-3-5.

Example of command execution:

```
> Lr1110Demo -d COM4 34.70210993807373,135.4958717974474,1
34.64588733864984,135.51443499143957,17 Ayyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy
GNSS Demo Start
Command (1 .. Start without Almanac, 2 .. Download Almanac, 3 .. End Program) :1
Test Host handler
Reply3 b'demooglog\r\x00'
```

Note: At the "Command (1 .. Start without Almanac, 2 .. Download Almanac, 3 .. End Program) :" prompt, enter 1 to select the "1 .. Start without Almanac" option.

## 10-2. Operate the Zero Carbon board A (edge).

- Wait 30 seconds after booting the board.
- Press the trigger switch.  
Data is exchanged among the Zero Carbon board A (edge), Zero Carbon board B (GW access), GW (PC), and LoRa Cloud to calculate the location of the device  
(Communication takes approximately 30 seconds).

Example: After program execution, log data like the following is output:

- When determining latitude and longitude based on Wi-Fi access points

```
DATE : 2022-mm-dd 11:52:08.589493
gTemp = 26.19
gHumi = 61.67
gLati = 34.690048
gLong = 135.533182
gEdgerssi= -29.0
gGwrssi = -31.0
```



gWifi = 6  
gGnss = 0

- When determining latitude and longitude based on data from GNSS satellites

DATE : 2022-mm-dd 13:46:26.000950

gTemp = 26.72  
gHumi = 60.83  
gLati = 34.69021  
gLong = 135.5343  
gEdgerssi= -99.0  
gGwrssi = -102.0  
gWifi = 0  
gGnss = 18

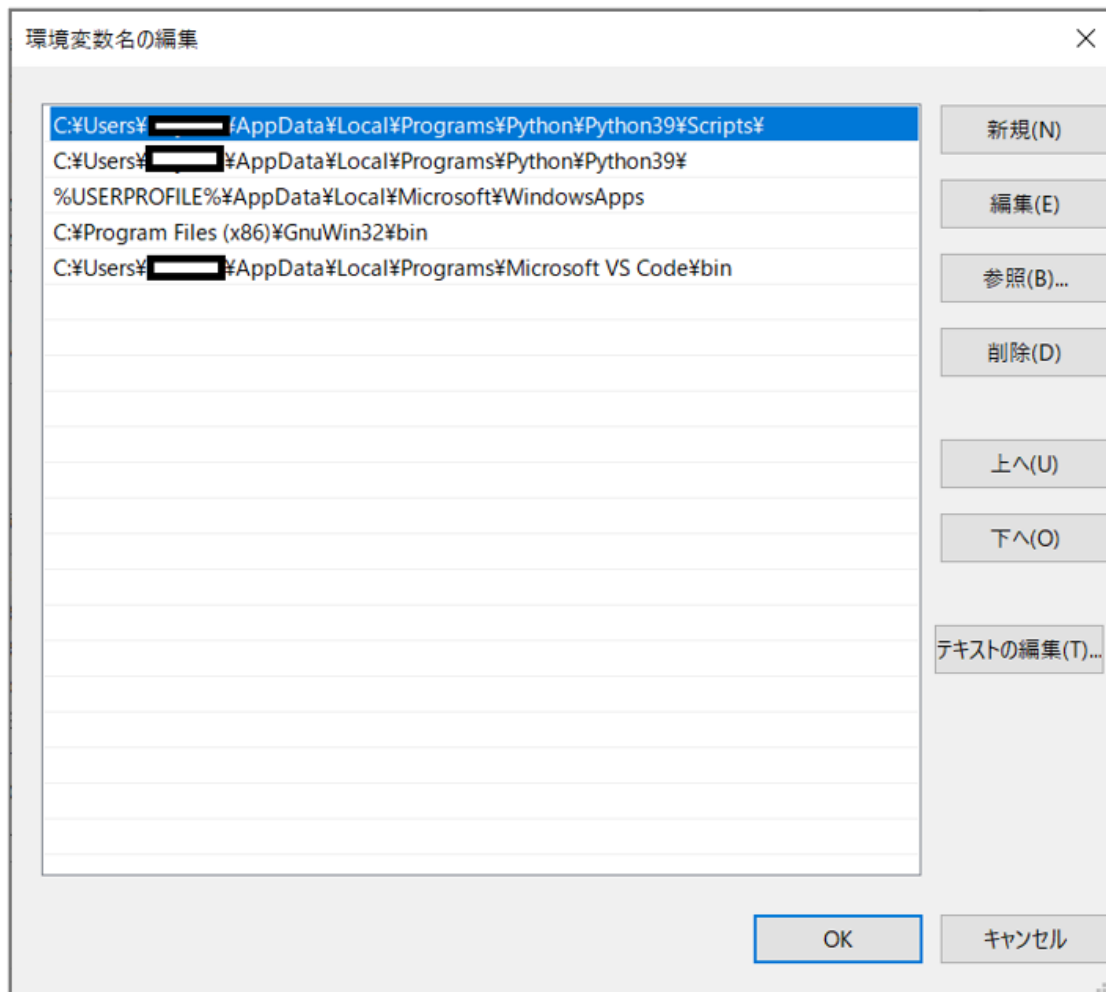
- gLati and gLong indicate latitude and longitude, respectively.
- You can display the location in [Google Maps](#) by entering 34.690048 and 135.533182 as a comma-separated value (34.690048,135.533182) in the **Search Google Maps** field at the top left of the page.

## 11. Troubleshooting

### 11-1. The system does not recognize python version 3.5 or later.

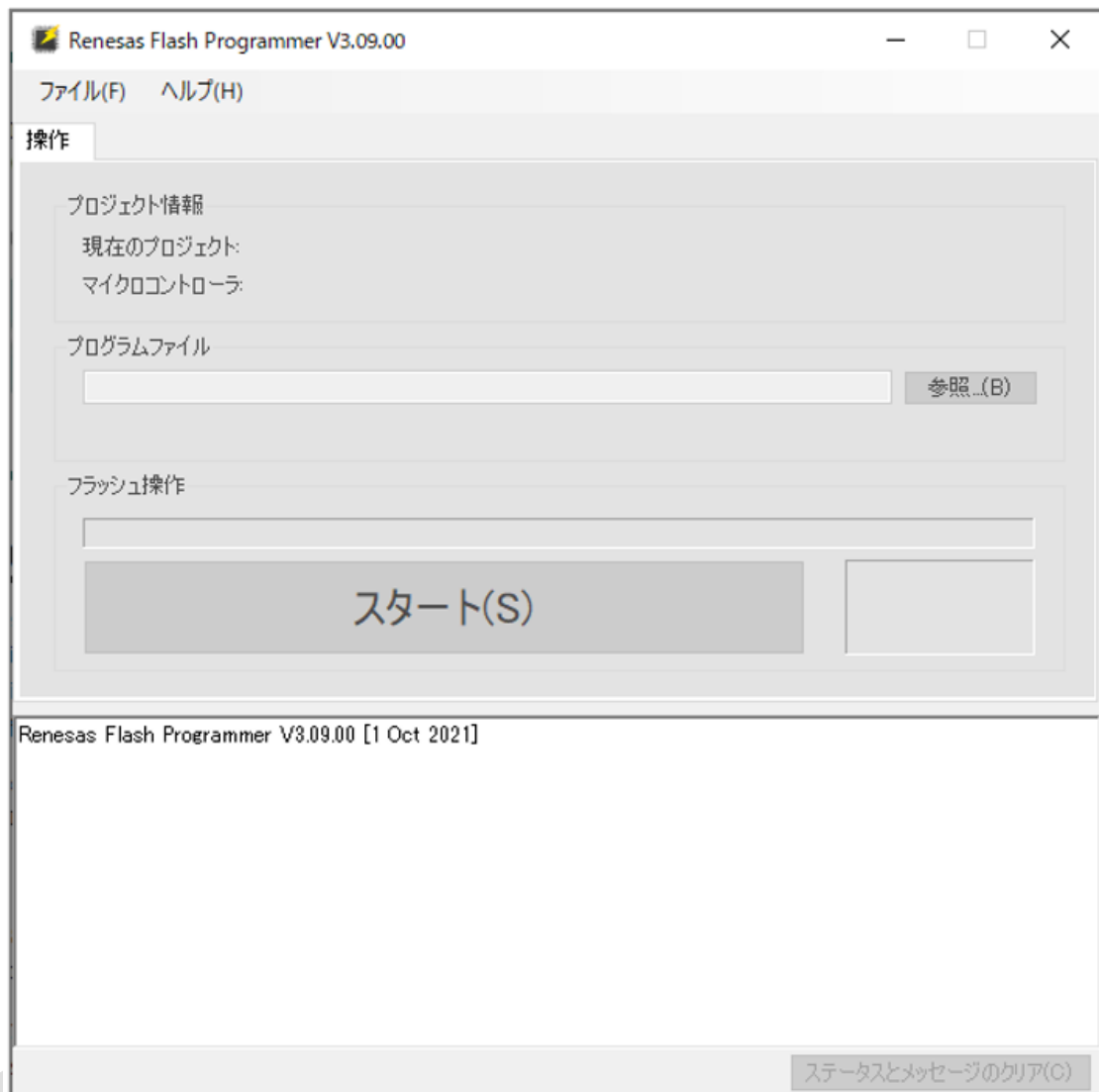
The PATH environment variable of the OS might not point to the path of the version of python you installed.

- In the **System** area of the **Control Panel**, click **Advanced system settings** and **Environment Variables** and then edit the **PATH** environment variable.
- Add the following paths, and use the **Move Up** button to ensure these paths are referenced before paths to other Python versions.  
C:\Users\xxxxxxx\AppData\Local\Programs\Python\Python39\Scripts\  
C:\Users\xxxxxxx\AppData\Local\Programs\Python\Python39\  
Note: The preceding paths are for Python 3.9.

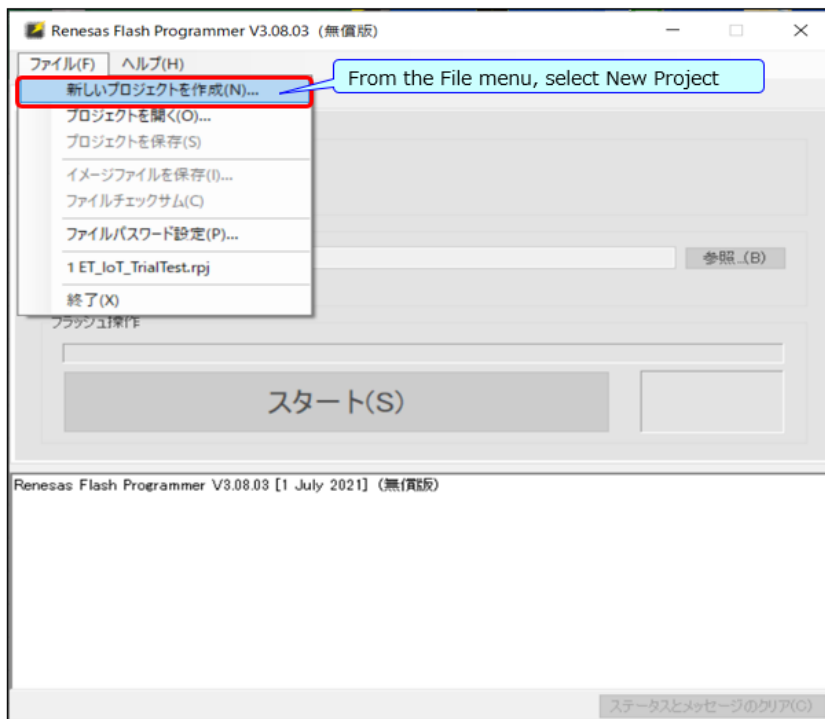


## 12. Creating a Project in Renesas Flash Programmer

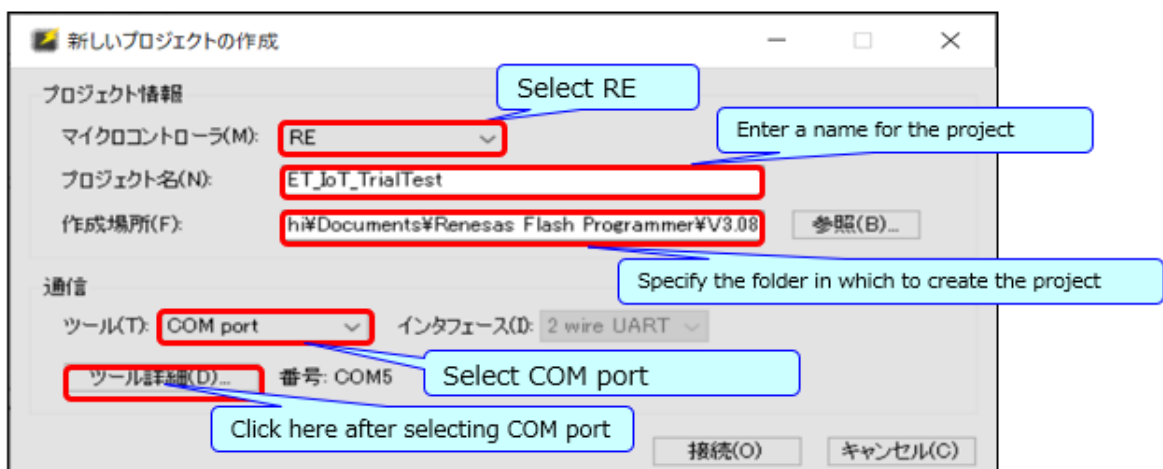
1. As the jumper and switch settings, use 5. d. *Settings when flashing the RE01 from RFP and using a power supply.*
2. Use a USB cable to connect the Zero Carbon LoRa® Evaluation Board to the PC.
3. Open Renesas Flash Programmer.



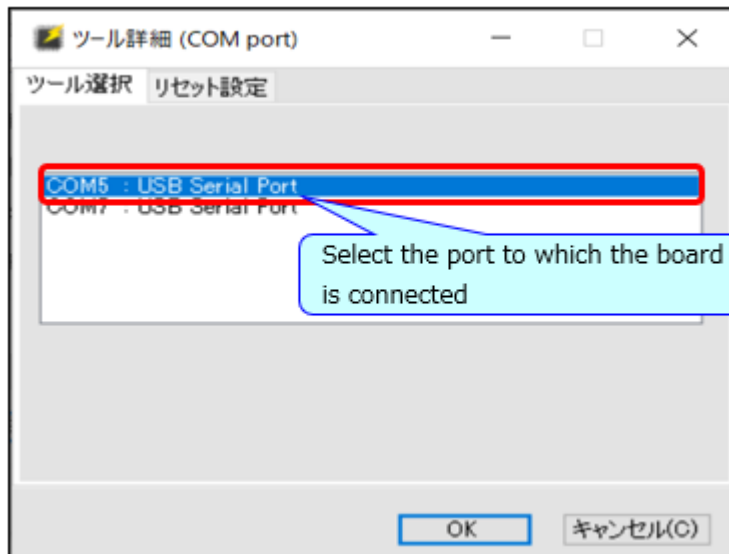
4. Create a new project.



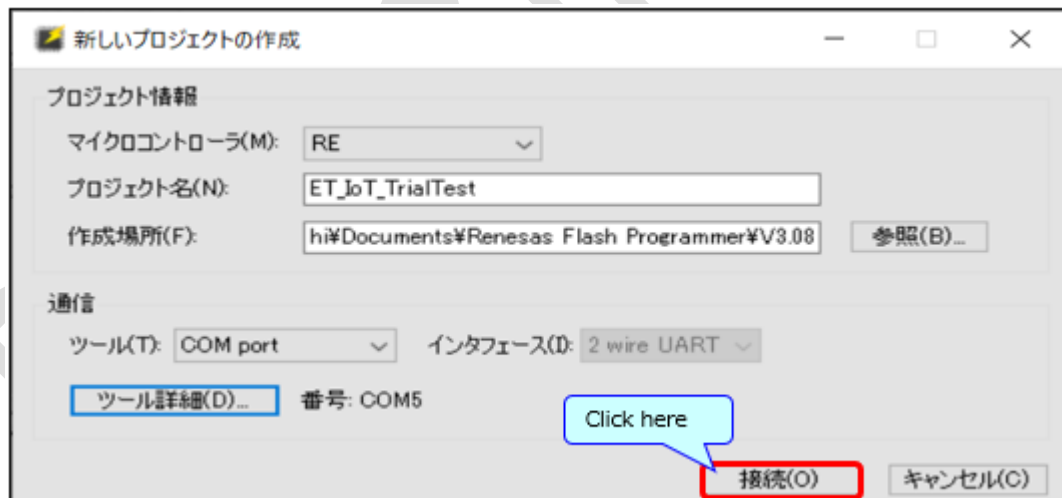
1. Enter the project settings.



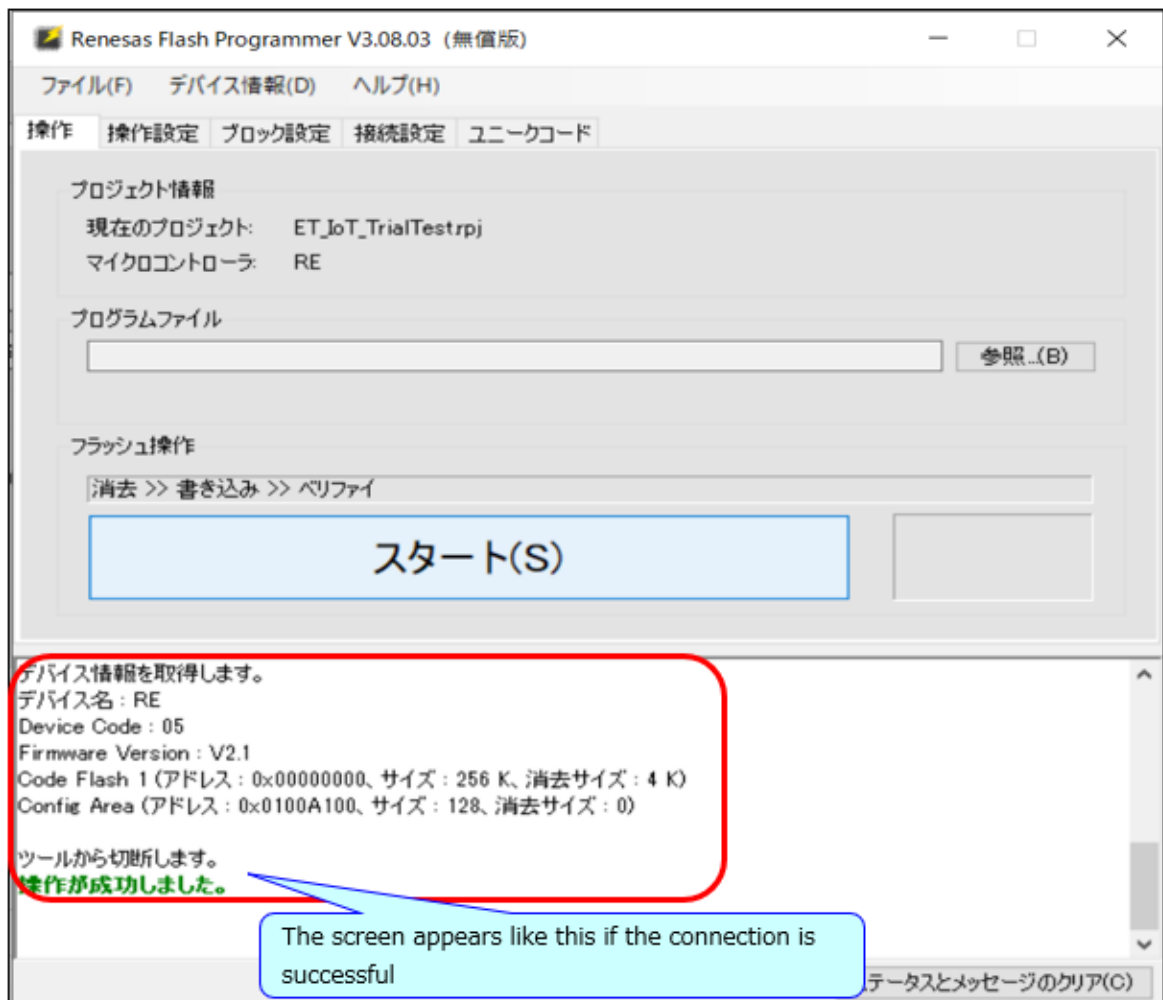
2. Enter the port settings.



1. Connect the Zero Carbon LoRa® Evaluation Board. Press the reset switch on the Zero Carbon LoRa® Evaluation Board, and then immediately click the **Connect** button.



2. Confirm that the connection was successful.



PRE