# 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.

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### 0. System Configuration



#### 0-1. Flowchart

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



### 0-1. Links

section	Subject	Link
2-1.	Renesas RE01 Microcontroller Firmware	Zero Carbon LoRaEva FW-Hex
	LoRa LR1110 Firmware Update Tool	Zero Carbon LoRaEva Tool
2-2.	LoRa LR1110 Firmware	https://github.com/Lora- net/radio_firmware_images/tree/master/Ir1110/transceiver
2-3.	Renesas RE01 Microcontroller Firmware Updater	Renesas Flash Programmer (Programming GUI)
4.	Documentation for Setting up the Application Environment on the PC	LR1110GeolocDemoUserGuide_v1.0.pdf
4-1.	Package Base for Setting up the Application Environment on the PC	https://github.com/Lora- net/lr1110_evk_demo_app/wiki/Software-packages
4-7.	Package for Setting up the Application Environment on the PC	Zero Carbon LoRaEva Ir1110 demo app

#### **1. Preparing the Hardware**

- 1. Zero Carbon LoRa<sup>®</sup> 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	Linx Technologies	ANT-916-CW-HWR-
	LR1110	Inc.	RPS-ND
2	Connector conversion cable for dipole antenna	Antenna Technology	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.



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

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	This is your first step in enabling your geolocation solution. Navigate in the menu	
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DEVICE OWNERS	Manage your devices	
	In the documentation section you will find a wide set of API's as well as a	
MANAGE TOKENS	migration guide that explains how Modern & Geolocation Services combines the	
MANAGE DEVICES	Services (DAS) under a simplified pricing structure.	
DOCUMENTATION		
	Pricing	
	For Pricing information click here	
	Get Started	
	Read the documentation to learn more about the Modern & Geolocation Services API.	

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

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

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

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### 3-3. Create a new Manage Token and copy it to the clipboard. https://www.loracloud.com/portal/modem\_services/tokens

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

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

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

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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**.

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

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#### 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 (Ir1110\_evk\_demo\_app\_v3.1.0.zip) to the local disk. Ir1110\_evk\_v3.1.0.bin

Ir1110evk-3.1.0.tar.gz

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

4-4. Move to the folder in which the file Ir1110evk-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:

> Ir1110demo --version

> usbconnectioncheck --version

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

C:\Users\xxxxx\AppData\Local\Programs\Python\PythonXX\Lib\site-packages\Ir1110evk

- Note: Replace *xxxxxx* with your username.
- Note: Interpret Python*XX* 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 (Ir1110evk).

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 Ir1110\_evk\_demo\_app-master.zip file
- Copy the Ir1110evk folder from Ir1110\_evk\_demo\_app-master\host to the following folder:

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

- Note: Replace *xxxxxx* with your username.
- Note: Interpret Python XX 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



#### Jumper and switch settings

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



a. Settings when using energy harvesting devices

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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





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.

📕 Renesas Flash Programmer V3.08.03 (無償版)	-	-		×
ファイル(F) デバイス情報(D) ヘルプ(H)				
操作 操作設定 ブロック設定 接続設定 ユニークコード				
プロジェクト情報 現在のプロジェクト: ET_IoT_TrialTestrpj マイクロコントローラ: RE				
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CRC-32	9C1579E2	370	π	1
フラッシュ操作  消去 >> 書き込み >> ベリファイ				
スタート(S)				
Renesas Flash Programmer V3.08.03 [1 July 2021] (無償版) プロジェクトをロードします。(C:¥Users¥¥Documents¥Renesas Flash Programmer ¥ET_IoT_TrialTest <i>r</i> pj)	•¥V3.08¥ET	_LoT_Tri	alTest	
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### 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.

🛃 LR1110 Updater	- 🗆 ×
LR1110 Updater	
Binany file	
C#Tool#Ir1110_transceiver_0306.bin Browse	COM Port
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Header file	
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Idle	Opdate
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## 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.

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#### 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:

- <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:

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 = 6gGnss = 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\xxxxxx\AppData\Local\Programs\Python\Python39\Scripts\
   C:\Users\xxxxxx\AppData\Local\Programs\Python\Python39\
   Note: The preceding paths are for Python 3.9.

境変数名の編集	×
C:¥Users¥ {AppData¥Local¥Programs¥Python¥Python39¥Scripts¥	新規(N)
C:¥Users¥¥AppData¥Local¥Programs¥Python¥Python39¥	
%USERPROFILE%¥AppData¥Local¥Microsoft¥WindowsApps	編集(E)
C:¥Program Files (x86)¥GnuWin32¥bin	
C:¥Users¥ <b>4</b> PpData¥Local¥Programs¥Microsoft VS Code¥bin	参照(B)
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OK	キャンセル

- Creating a Project in Renesas Flash Programmer
   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.

Renesas Flash Program	nmer V3.09.00	-		
アイル(F) ヘルプ(H)				
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プロジェクト情報 現在のプロジェクト: マイクロコントローラ:				
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フラッシュ操作				
	スタート(S)			-
esas Flash Programmer	V3.09.00 [1 Oct 2021]			
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4. Create a new project.

🜠 Renesas Flash Programmer V3.08.03 (無價版)	_		×	
ファイル(F) ヘルブ(H) 新しいブロジェクトを作成(N) From the File menu, select	t New Project	:		
プロジェクトを開く(O) プロジェクトを保存(S)				
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ファイルパスワード設定(P)	4	照(B)		
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1. Enter the project settings.

	📕 新しいプロジェクトの作成	ē		_		×	
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	通信		Specify	the folder ir	n which to	o create the pro	oject
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	Clic	k here after selecting	COM port	赛続(O)	キャンセ	IL(C)	

2. Enter the port settings.

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COM5 : L	ISB Serial Port ISB Serial Port	Select the is connect	port to w	/hich th	e board	)
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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.

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プロジェクト情報				
マイクロコントローラ(M):	RE ~			
プロジェクト名(N):	ET_IoT_TrialTest			
作成場所(F):	hi¥Documents¥Renesas Flash Programmer¥V3.00	3	参照(B)	
通信 ツール(T): COM port ツール詳細(D)	✓ インタフェース(D: 2 wire UART ✓ 番号: COM5 Click here 接続(O)	)	キャンセル	r(c)

2. Confirm that the connection was successful.

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		rammer	V3.08.03 (	(無1員)(双)					
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