

# LoRa® Remote Power Switch

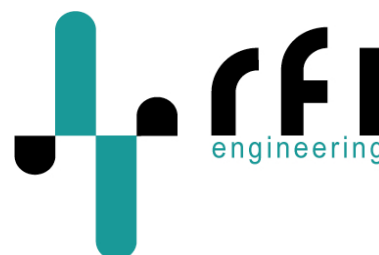
Device for remotely controlling  
industrial and home appliances

## Quick Installation Guide



Author  
Hardware Release  
Quick Install Guide Version  
Date  
Covering Product code

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**RE.11.LRSI**



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## 2 Revision History

Revision	Reason	Author	Date
1.0	First version for RPSW software release 1.37, configurator release 1.01 and hardware release 1.2 (Early Bird)	IvL	12 May 2019

### 3 Introduction

The LoRa® Remote Power Switch (RE.11.LRSI) is a device for remotely controlling industrial and home appliances. The unit features one IEC-C14 input connector, and one IEC-C13 output connector so that it easily fits into any environment.

Applications include the remote control of heating in vacation homes, lighting, engine pre-heaters, aviation engine heaters, irrigation systems, water well pumps, pumping stations, cabin heaters, resetting remote servers, enabling and disabling security systems, access control of gates and garage doors. Communication to the RE.11.LRSI is done using the integrated LoRaWAN transceiver. All you need to do connect the RE.11.LRSI to a private or public LoRaWAN network. Connect your appliance to the power outlet and you have your appliance under control.

This document provides information on the following topics:

- LoRa Remote Power Switch configuration using the Configurator.
- LoRa Remote Power Switch configuration using the Command Line Interface (CLI).
- Troubleshooting.
- Firmware update.

#### 3.1 Check Your Package Contents

These are the items included with your LoRa® Remote Power Switch purchase:



Power Switch with embedded 868MHz LoRa antenna



Power Cord with C13 – C14 connectors

## 4 Connecting the LoRa RPSW to a LoRaWAN network

Before the LoRa Remote Power Switch can communicate with a LoRaWAN network you will need to register your device with its Device EUI. Although the RPSW comes with a Device EUI pre-provisioned, it can be altered by the user. Dependent on the network you are connecting to, you might have to alter the Device EUI.

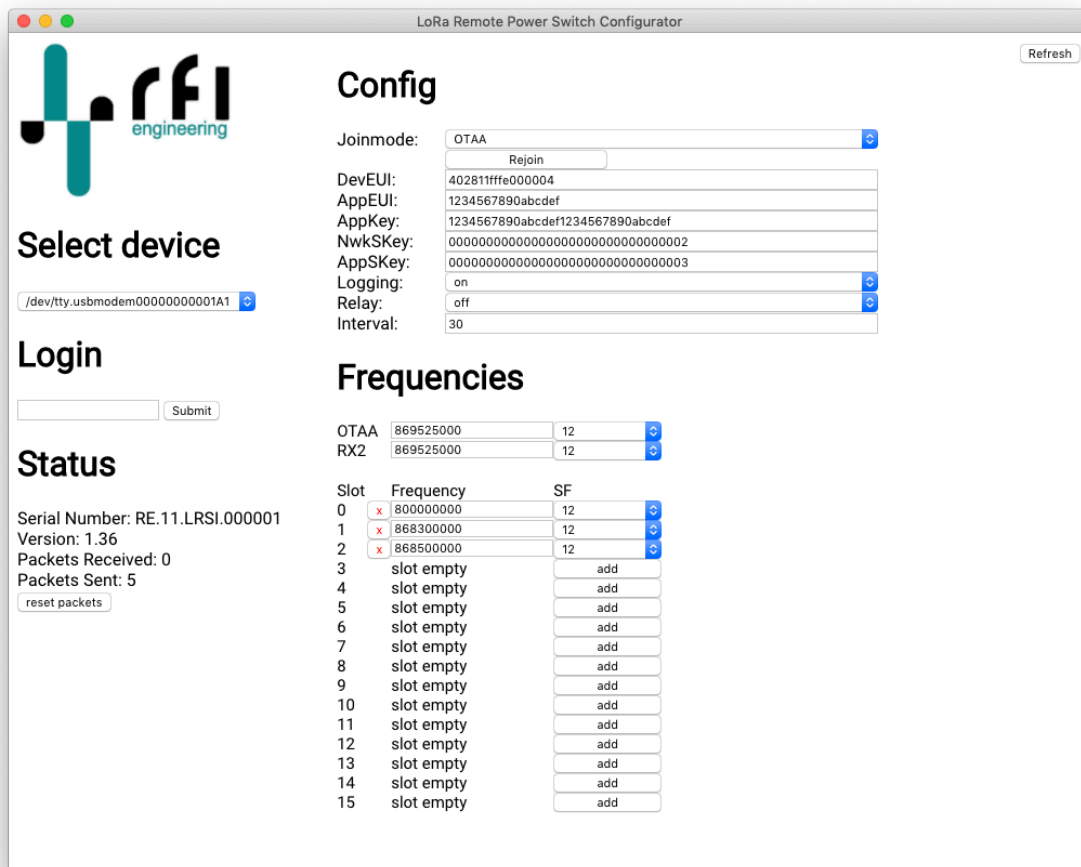
### 4.1 USB Interface

Configuration of the RPSW is done using the USB interface. The micro-USB connector on the RPSW acts as a virtual serial port when connected to a laptop or PC. RFI Engineering provides a **Configurator Tool** for both Windows as well as MAC OS to configure the device. The latest version of this Configuration Tool can be downloaded from [www.rfi-engineering.com](http://www.rfi-engineering.com). Navigate to the LORA REMOTE POWER SWITCH product page to find the download links.

If you don't want to use the configuration tool, you can also use a terminal emulator (for example putty on Windows) to configure the RPSW using simple command line interface (CLI) commands.

### 4.2 Configurator Tool

Using the Configurator Tool, it is possible to alter the Device EUI, Application EUI and Application Key.



The screenshot shows the 'LoRa Remote Power Switch Configurator' application window. It features a sidebar on the left with the RFI Engineering logo and navigation links: 'Select device', 'Login', and 'Status'. The 'Status' section displays device information: Serial Number: RE.11.LRSI.000001, Version: 1.36, Packets Received: 0, and Packets Sent: 5, along with a 'reset packets' button. The main area is titled 'Config' and contains several sections: 'Joinmode' (set to OTAA), 'Rejoin' (button), 'DevEUI' (402811ffe000004), 'AppEUI' (1234567890abcdef), 'AppKey' (1234567890abcdef1234567890abcdef), 'NwkSKey' (00000000000000000000000000000002), 'AppSKey' (00000000000000000000000000000003), 'Logging' (on), 'Relay' (off), and 'Interval' (30). Below these is the 'Frequencies' section, which includes 'OTAA' and 'RX2' frequency settings (both 869525000) and a table for slot frequencies and SF values. The table has columns for Slot, Frequency, and SF, with slots 0-2 populated and slots 3-15 marked as 'slot empty'.

Slot	Frequency	SF
0	800000000	12
1	868300000	12
2	868500000	12
3	slot empty	add
4	slot empty	add
5	slot empty	add
6	slot empty	add
7	slot empty	add
8	slot empty	add
9	slot empty	add
10	slot empty	add
11	slot empty	add
12	slot empty	add
13	slot empty	add
14	slot empty	add
15	slot empty	add

For the Configurator Tool to connect to your RPSW it needs to be connected to the correct serial port and you will have to fill in the password in the **Login** box. The default password is: **rfi123**.

### 4.3 Command Line Interface (CLI)

The RPSW supports a Command Line Interface (CLI) to configure the unit. In principle this is the same interface over which the Configurator Tool operates. The Configurator Tool issues the same CLI commands as you would type in manually on this interface.

However, the CLI can also be used to troubleshoot the RPSW. This troubleshooting function is currently not supported by the Configurator Tool but might be useful for the initial setup of the RPSW. One example is the **logging** function, which will show you what packets the RPSW is sending and receiving.

CLI commands are entered on a single line and can have multiple options. Pressing [ENTER] will execute the command.

#### 4.3.1 Logging in over CLI

When connected to the serial interface on the RPSW pressing [ENTER] a couple of times gives you a login prompt. For example:

```
Password: Permission denied, please try again.  
Password: Permission denied, please try again.  
Password: Permission denied, please try again.  
Password:
```

Enter your password, followed by [ENTER] to log in. The default password is; **rfi123**

```
Password: rfi123Logged in  
CMD >
```

Once logged in you should see the command prompt: CMD >

#### 4.3.2 Getting help on CLI commands

The CLI has a help function that is accessed using **?** or **help**. For example:

```
CMD > help  
  
*** RFI Engineering B.V. LoRa Remote Power Switch ***  
Version 1.36 (Early Bird), Compiled [Jun 15 2019 13:56:45]  
The LoRa parameters of the RPSW  
get lora  
set mode <OTAA>/<ABP>  
set DevEUI <value>, where value is 16 hex characters  
set AppEUI <value>, where value is 16 hex characters  
set AppKey <value>, where value is 32 hex characters  
set NwkSKey <value>, where value is 32 hex characters  
set AppSKey <value>, where value is 32 hex characters  
set DevAddr <value>, where value is 8 hex characters  
  
The frequency parameters of the RPSW  
get freq  
set freq <slot> <frequency> <SF>  
where <slot> is 0..15  
      <frequency> is frequency in Hz  
      <SF> is spreading factor 7..12  
set freq <slot> <delete>  
set OTAAfreq <frequency> [SF], where frequency is in Hz and SF is spreading factor  
7..12  
set RX2freq <frequency> [SF], where frequency is in Hz and SF is spreading factor  
7..12  
  
The advanced parameters of the RPSW  
[DISABLED] set ADR <on>/<off> [DISABLED]  
set interval <seconds>, where seconds can be 30 - 3600
```

```
set logging <on>/<off>
set relay <on>/<off>
set password <password>, password can be 3 to 30 characters
reset counters, to reset the LoRa packet up and down counters
reset factory, to reset the unit to factory defaults and then reboot
reboot
exit, to log out

OK
CMD >
```

## 5 Configuring the LoRa Remote Power Switch

The LoRa RPSW connects to a local LoRaWAN network using either Over The Air Activation (OTAA) or Authorization by Personalization (ABP). In order to connect to a LoRaWAN network using OTAA the LoRa RPSW needs to be provisioned with:

- A configurable **DevEUI** - a 16 digit code uniquely identifying the LoRa RPSW (printed on the label)
- A configurable **AppEUI** - a 16 digit code uniquely identifying the website that data will be sent to
- A configurable **AppKey** - a 32 digit code that authenticates the LoRa RPSW to the website and network server

After the above keys have been configured, the LoRa RPSW will attempt to join local LoRa networks by transmitting OTAA join requests. Any network that hears the join requests and has knowledge of the LoRa RPSW's DevEUI, AppEUI and AppKey, will allow the LoRa RPSW to join the network and transmit data.

Once joined, LoRa RPSW repeats the OTAA process once every 30000 (30k) upload messages by default. This re-negotiates encryption keys for enhanced security, and ensures continued operation in the event of a network losing the keys (for instance, if the device is mistakenly deleted). In this default setting this means that the RPSW re-negotiates the LoRa keys every 11 days.

### 5.1 Relay Toggle via LoRaWAN

You can toggle the relay to the off or on position by sending 00 or 01 as payload in the LoRa message. Sending **00** turns the relay **off**. Sending **01** turns the relay **on**.

### 5.2 Relay State Messages via LoRaWAN

The RPSW sends the relay state every 30 seconds over the LoRaWAN interface. The interval is controlled by the 'interval' setting in the RPSW, the default setting is 30 seconds.

The RPSW reports the state of the relays as follows:

```
00 indicates relay off,
01 indicates relay on.
```

The interval between sending the state messages can be set between 30 seconds and 3600 seconds (1 hour). Use the command **set interval <seconds>**, where seconds can be 30 – 3600 to set the interval. For example:

```
CMD > set interval 60
Setting interval to 60 seconds
OK
```

## 6 Troubleshooting

The RPSW contains a logging function that shows exactly what the RPSW is doing. This function can be accessed on the CLI. In order to switch the logging function on you issue the following command: **set logging on** [ENTER]

For example:

```
CMD > set logging on
Setting LoRaWAN package logging on
OK
```

From then on, the RPSW provides logging information on the CLI interface. The setting is preserved through reboots and power cycles. So, in order to stop the logging function, you will have to give the command: **set logging off** [ENTER]

For example:

```
CMD > set logging off
Setting LoRaWAN package logging off
OK
```

### 6.1 Example of a successful OTAA JOIN request

When the RPSW is switched on and configured for the first time it starts sending out OTAA Join requests. When no valid OTAA Join reply is received, the RPSW issues a new OTAA Join request every 30 seconds until a valid reply is received.

The following log shows a successful OTAA Join Request:

```
CMD > Sending OTAA JOIN on channel: [0] frequency: [868100000 Hz] SF: [12]
'-> DevAddr: [051F1DFF] pktUp: [8] RawMsg:
[00050000fdff112840050000fdff112840b16949c75722]
Waiting for OTAA JOIN Accept on frequency: [869525000 Hz] SF: [12]
Waiting for OTAA JOIN Accept on frequency: [868100000 Hz] SF: [12]
Waiting for OTAA JOIN Accept on frequency: [869525000 Hz] SF: [12]
|-> DevAddr: [051F1DFF] pktDown: [0] RawMsg:
[20e193fc3de977ed66dbe48c2cb074bf5f130102ba17b44a26e6b2f3df61cf1e8d]
|-> SNR: [12] Packet RSSI: [-77] RSSI: [-120]
Received an OTAA JOIN Accept
|-> DevAddr: [051F1DFF]
|-> NwkSKey: [24C3FF16159EEE909B8584A80E00123C]
|-> AppSKey: [BAAC56E1BACE062B0A9D137D11771375]
|-> RX2 SF : [SF7]
'-> RXdelay: [5 seconds]
```

You can check if the RPSW attached to the network OK by giving the **get lora** command.

```
CMD > get lora

Serial number   : [RE.11.LRSI.000005]
LoRaWAN settings
LoRaWAN join mode: [OTAA]
DevEUI is set to : [402811FFFD000005]
AppEUI is set to : [402811FFFD000005]
AppKey is set to : [b1a449831cc7b24e63c5f935a363bbad]
NwkSKey is set to : [24C3FF16159EEE909B8584A80E00123C]
AppSKey is set to : [BAAC56E1BACE062B0A9D137D11771375]
DevAddr is set to : [051F1DFF]
Joined OTAA     : [000002] World: Actility
Last msg rcvd by : [1] gateway with [25dB] margin

RPSW state
LoRa logging is : [on]
Relay state is   : [off]
```



```
Relay interval   : [30 seconds]
Packets Sent     : [6]
Packets Received : [0]
```

In the example you can see that the RPSW connected to a network from Activity [000002] and is received by 1 gateway with 25dB margin.

## 6.2 Checking how many gateways received the RPSW messages

The RPSW periodically checks if it is being received by the network server. It does this by sending a LinkCheckReq MAC command together with a Relay state message.

When a LinkCheckReq is received by the network server via one or multiple gateways, it responds with a LinkCheckAns command. In the reply, the network server indicates the demodulation margin in dB and the number of gateways that successfully received the last LinkCheckReq command.

The first LinkCheckReq is sent immediately following a successful OTAA Join.

For example:

```
CMD > Sending OTAA JOIN on channel: [1] frequency: [868300000 Hz] SF: [12]
'-> DevAddr: [00000000] pktUp: [0] RawMsg:
[00e34900f07ed5b370000000faff1428404a03d2d0a808]
Waiting for OTAA JOIN Accept on frequency: [869525000 Hz] SF: [12]
Waiting for OTAA JOIN Accept on frequency: [868300000 Hz] SF: [12]
|-> DevAddr: [00000000] pktDown: [0] RawMsg:
[20f8a0d1e373c5d41de628244f85dd18b7390c87b8794e9ca9b70770791f7c4848]
|-> SNR: [12] Packet RSSI: [-74] RSSI: [-119]
Received an OTAA JOIN Accept
|-> DevAddr: [48E06EC8]
|-> NwkSKey: [144F682B1D16713A385563A2A07D4C31]
|-> AppSKey: [9AE2F081587A49DE0C3124EDAA5E58EA]
|-> RX2 SF : [SF12]
'-> RXdelay: [0 seconds]

Sending Relay state message on channel: [0] frequency: [868100000 Hz] SF: [12]
'-> DevAddr: [48E06EC8] pktUp: [0] RawMsg: [40c86ee0482100000201ce9039e974]
Listening for reply to our Relay state message on frequency: [869525000 Hz] SF: [12]
Listening for reply to our Relay state message on frequency: [868100000 Hz] SF: [12]
|-> DevAddr: [48E06EC8] pktDown: [0] RawMsg: [a0c86ee048040000060207026b5e8d85]
|-> SNR: [-5] Packet RSSI: [-121] RSSI: [-120]
|-> Received MAC command [DevStatusReq]
|-> Received MAC command [LinkCheckAns]
Listening for reply to our Relay state message on frequency: [869525000 Hz] SF: [12]
```

You can force the RPSW to send a LinkCheckReq message by giving the following command: **linkcheck**. The LinkCheckReq command is sent together with the next relay state message to the network server.

For example:

```
CMD > linkcheck
Scheduling a [LinkCheckReq] MAC message to network server
OK
CMD >
Sending Relay state message on channel: [2] frequency: [868500000 Hz] SF: [12]
'-> DevAddr: [48E06EC8] pktUp: [10] RawMsg: [40c86ee048210a000201877df6482e]
Listening for reply to our Relay state message on frequency: [869525000 Hz] SF: [12]
Listening for reply to our Relay state message on frequency: [868500000 Hz] SF: [12]
|-> DevAddr: [48E06EC8] pktDown: [2] RawMsg: [60c86ee048030300020102a3c6d8cf]
|-> SNR: [-6] Packet RSSI: [-122] RSSI: [-118]
|-> Received MAC command [LinkCheckAns]
Listening for reply to our Relay state message on frequency: [869525000 Hz] SF: [12]
```

The last received LinkCheckAns is decoded and stored in the RPSW. It can be seen when typing the command: **get lora**. The status information is displayed in the line: Last msg rcvd by : [2] gateways with [1dB] margin

#### For example:

```
CMD > get lora

Serial number      : [RE.11.LRSI.000005]
LoRaWAN settings
LoRaWAN join mode: [OTAA]
DevEUI is set to  : [402814FFFA000000]
AppEUI is set to  : [70B3D57EF00049E3]
AppKey is set to  : [14ED42F530B4B3252C6E553199867FE1]
NwkSKey is set to: [144F682B1D16713A385563A2A07D4C31]
AppSKey is set to: [9AE2F081587A49DE0C3124EDAA5E58EA]
DevAddr is set to: [48E06EC8]
Joined OTAA       : [000024] World: Gimasi
Last msg rcvd by : [2] gateways with [1dB] margin

RPSW state
LoRa logging is   : [on]
Relay state is    : [off]
Relay interval    : [30 seconds]
Packets Sent      : [18]
Packets Received  : [3]
```

### 6.3 Reset to factory defaults

You can reset the RPSW to factory default settings by giving the command: **reset factory**. This command resets all keys and counters to zero. It also resets the devEUI to the factory default setting, i.e. the value it is indicated on the bottom of the unit. The DevEUI for LoRa devices from RFI Engineering all start with 402814, the Organizationally Unique Identifier (OUI) of the company.

## 7 RPSW firmware upgrade

The firmware of the RPSW can be updated using the USB port. You have to put the unit in Device Firmware Upgrade (DFU) mode in order to flash the device with new firmware.

To put the RPSW in DFU mode disconnect the unit from the mains power. Insert a small pin (for example a paper clip or similar) in the hole at the bottom of the unit to press the button. While keeping the button depressed power the unit on. You can then release the button. No LEDs on the side of the unit are lit, and the unit is now in DFU mode.

Using DFU utils (available for Windows, MAC OS and Linux) you can flash new firmware into the unit. New firmware releases can be found on [www.rfi-engineering.com](http://www.rfi-engineering.com).

Press button for DFU mode

