

# RAK3172 Evaluation Board Quick Start Guide

This guide covers the following topics:


- [RAK3172-E as a Stand-Alone Device Using RUI3](#)
- [RAK3172-E as a LoRa/LoRaWAN Modem via AT Command](#)
- [Connecting to The Things Network \(TTN\)](#)
- [Connecting with Chirpstack](#)
- [LoRa P2P Mode](#)

## Prerequisites

### What Do You Need?

Before going through the step in the installation guide of the RAK3172 Evaluation Board, make sure to prepare the necessary items listed below:

### Hardware

- [RAK3172 Evaluation Board](#) 
- Computer with a USB port
- USB cable

### Software


- Download and install the [Arduino IDE](#)  .

#### WARNING

*If you are using Windows 10.* Do **NOT** install the Arduino IDE from the Microsoft App Store. Instead, install the original Arduino IDE from the Arduino official website. The Arduino app from the Microsoft App Store has problems using third-party Board Support Packages.

- Add [RAK3172 as a supported board in Arduino IDE](#) by updating Board Manager URLs in **Preferences** settings of Arduino IDE with this JSON URL `https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package_rakwireless.com_rui_index.json` . After that, you can then add **RAKwireless RUI STM32 Boards** via Arduino board manager.
- [RAK Serial Port Tool](#) 

#### NOTE:

[CH340 USB-Serial Driver](#)  must be installed manually for Windows 10 users having USB connection issues.

## List of Acronyms

Acronym	Definition
DFU	Device Firmware Upgrade
JTAG	Joint Test Action Group
LoRa	Long Range
OTAA	Over-The-Air-Activation
ABP	Activation-By-Personalization (ABP)
TTN	The Things Network
DEVEUI	Device EUI (Extended Unique Identification)
APPEUI	Application EUI (Extended Unique Identification)
APPKEY	Application Key
DEVADDR	Device Address
NWKSKEY	Network Session Key
APPSKEY	Application Session Key
P2P	Point-to-Point

## Product Configuration

### RAK3172-E as a Stand-Alone Device Using RUI3

#### Hardware Setup

The RAK3172-E requires a general-purpose computer USB port via a micro USB cable. You can use any serial communication tool, but it is recommended to use the [RAK Serial Port Tool](#) .

#### WARNING

Firmware update is done via USB port. If you will connect the module to an external device that will be interfacing with USB, take extra precautions in your board design to ensure you can still perform FW update to it. There should be a way in your board design that can disconnect the external device to RAK3172-E USB before connecting the module to the PC via USB for the FW update process.

An alternative option to update firmware aside from USB is to use SWD pins (SWCLK & SWDIO). This method will require you to use external tools like ST-LINK or RAKDAP1.

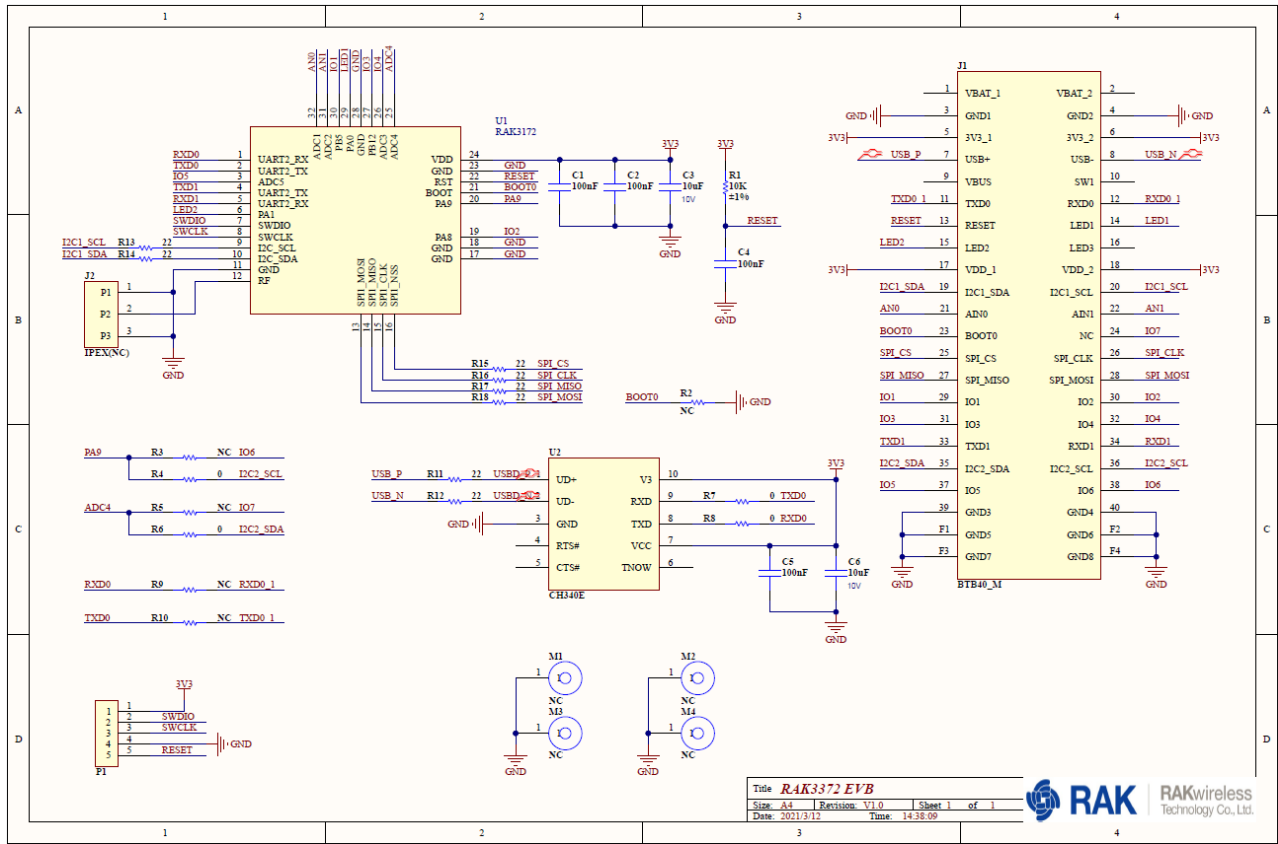


Figure 1: RAK3172 Evaluation Board schematic

Ensure that the antenna is properly connected to have a good LoRa signal. Also, note that you can damage the RF section of the chip if you power the module without an antenna connected to the IPEX connector.



Figure 2: LoRa Antenna

RAK3172-E has an IPEX connector where you can connect the LoRa antenna, as shown in Figure 3.

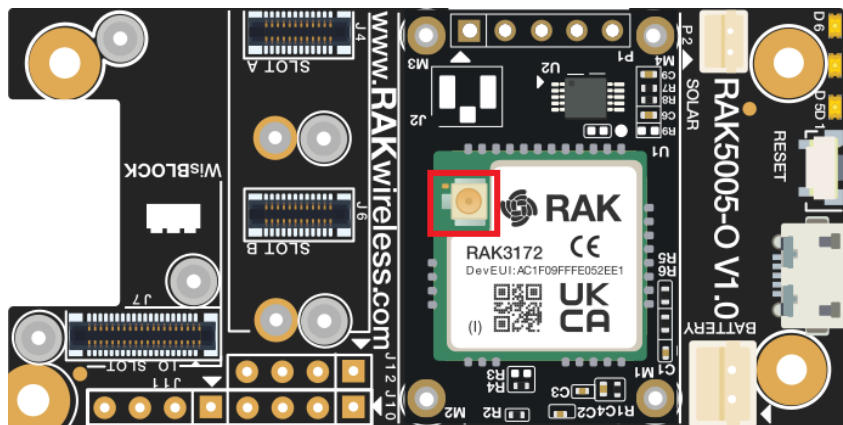


Figure 3: IPEX Connector of RAK3172-E for LoRa Antenna

**NOTE**

Detailed information about the RAK3172 LoRa antenna can be found on the [antenna datasheet](#) .

**WARNING**

When using the LoRa transceiver, make sure that an antenna is always connected. Using this transceiver without an antenna can damage the module.

## Software Setup

The default firmware of RAK3172-E is based on RUI3, which allows you to develop your custom firmware to connect sensors and other peripherals to it. To develop your custom firmware using Arduino IDE, you need first to add **RAKwireless RUI STM32 Boards** in the Arduino board manager, which will be discussed in this guide. You can then use RUI3 APIs for your intended application. You can upload the custom firmware via USB. The AT commands of RAK3172 is still available even if you compile custom firmware via RUI3. You can send AT commands via USB connection.

## RAK3172 RUI3 Board Support Package in Arduino IDE

If you don't have an Arduino IDE yet, you can download it on the [Arduino official website](#) and follow the installation procedure in the [miscellaneous section](#) of this document.

**NOTE**

**For Windows 10 and up users:** If your Arduino IDE is installed from the Microsoft App Store, you need to reinstall your Arduino IDE by getting it from the Arduino official website. The Arduino app from the Microsoft App Store has problems using third-party Board Support Packages.

Once the Arduino IDE has been installed successfully, you can now configure the IDE to add the RAK3172 in its board selection by following these steps.

1. Open Arduino IDE and go to **File > Preferences**.

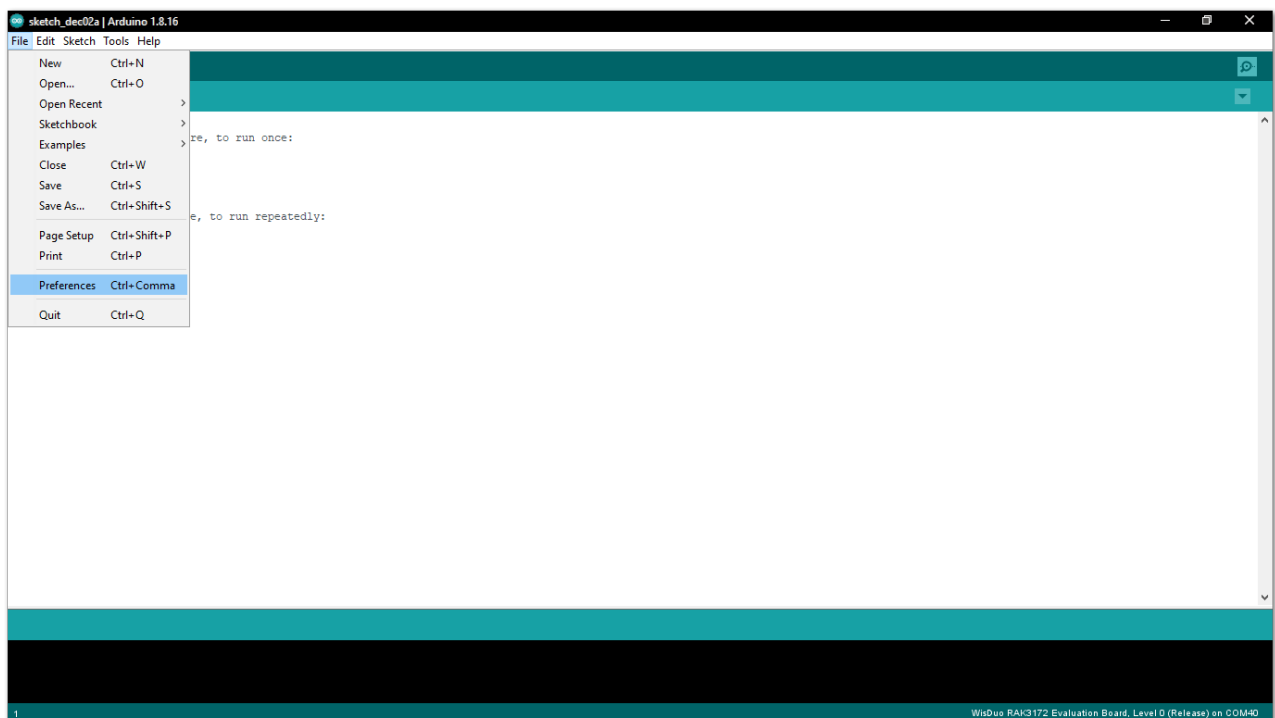


Figure 4: Arduino preferences

2. To add the RAK3172-E to your Arduino Boards list, edit the **Additional Board Manager URLs** and click the icon, as shown in **Figure 5**.



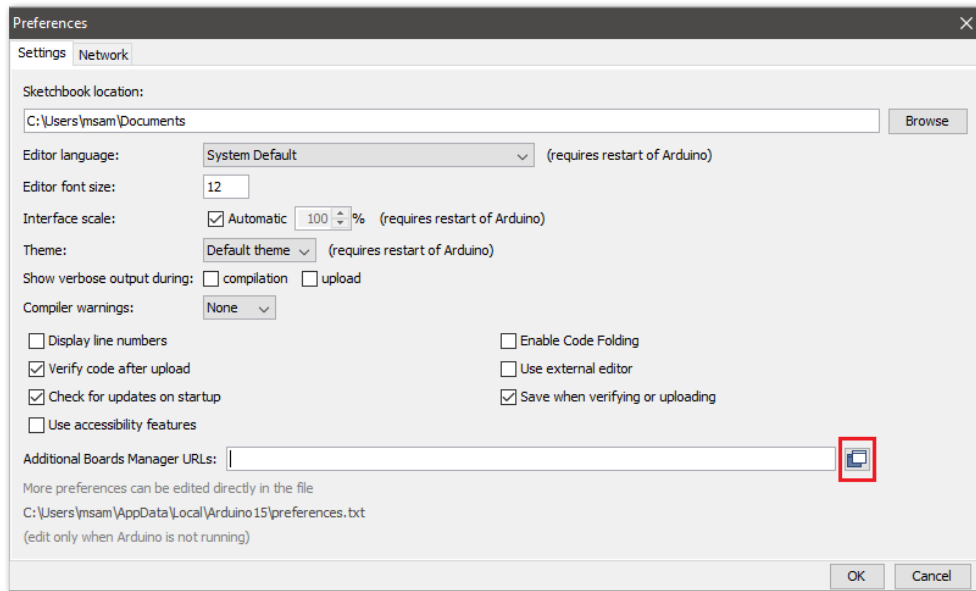


Figure 5: Modifying Additional Board Manager URLs

- Copy the URL [https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package\\_rakwireless.com\\_rui\\_index.json](https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package_rakwireless.com_rui_index.json) and paste it on the field, as shown in Figure 6. If there are other URLs already there, just add them on the next line. After adding the URL, click OK.

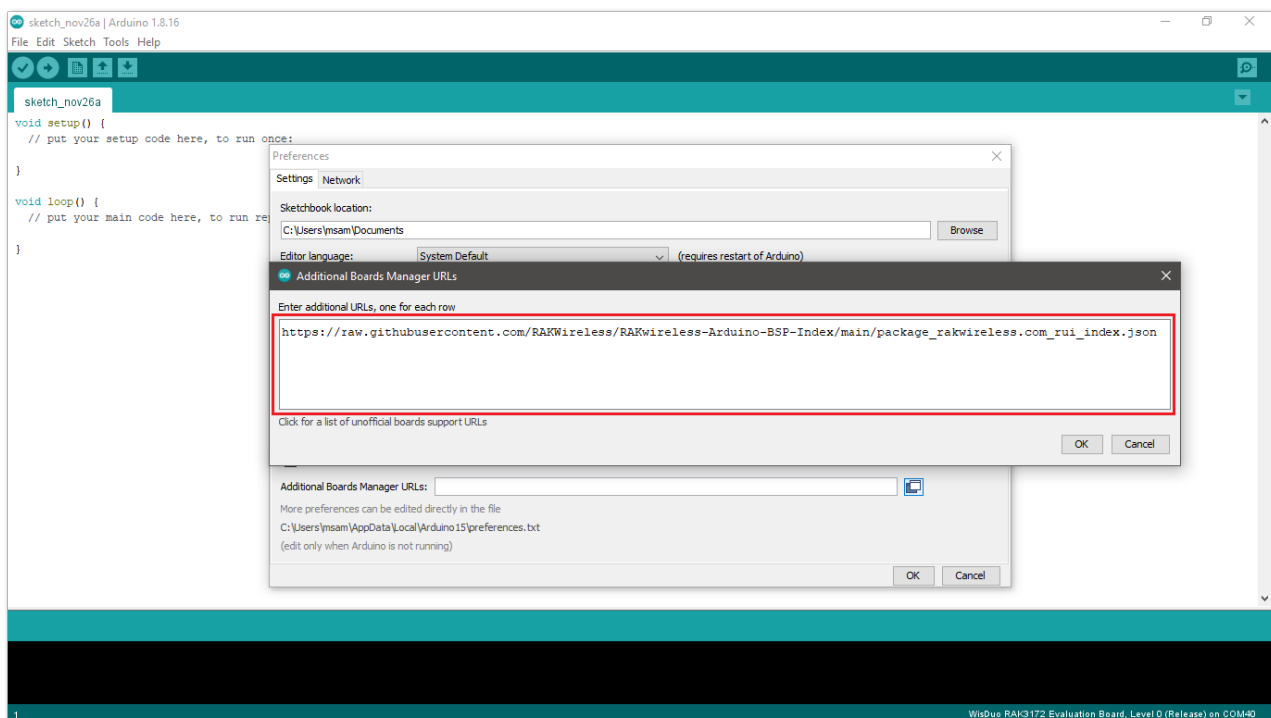


Figure 6: Add additional board manager URLs

- Restart the Arduino IDE.
- Open the Boards Manager from Tools Menu.

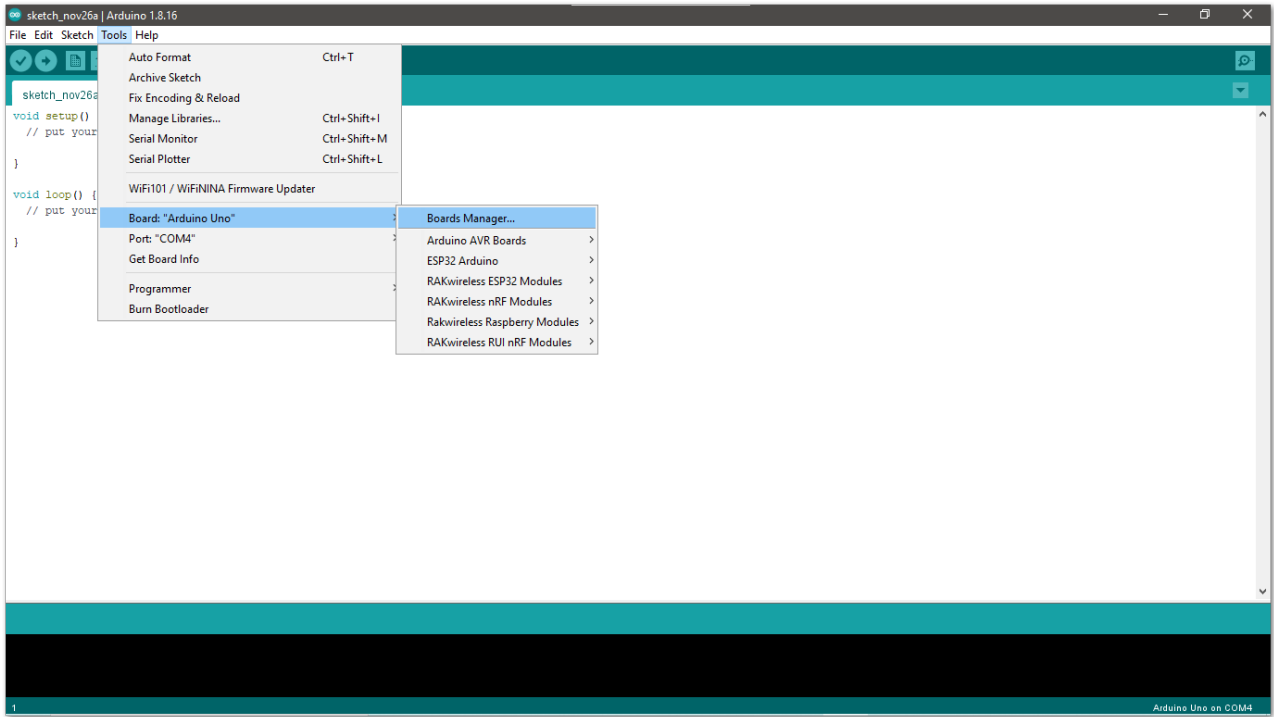


Figure 7: Opening Arduino boards manager

- Write **RAK** in the search bar, as shown in **Figure 8**. This will show the available RAKwireless module boards that you can add to your Arduino Board list. Select and install the latest version of the **RAKwireless RUI STM32 Boards**.

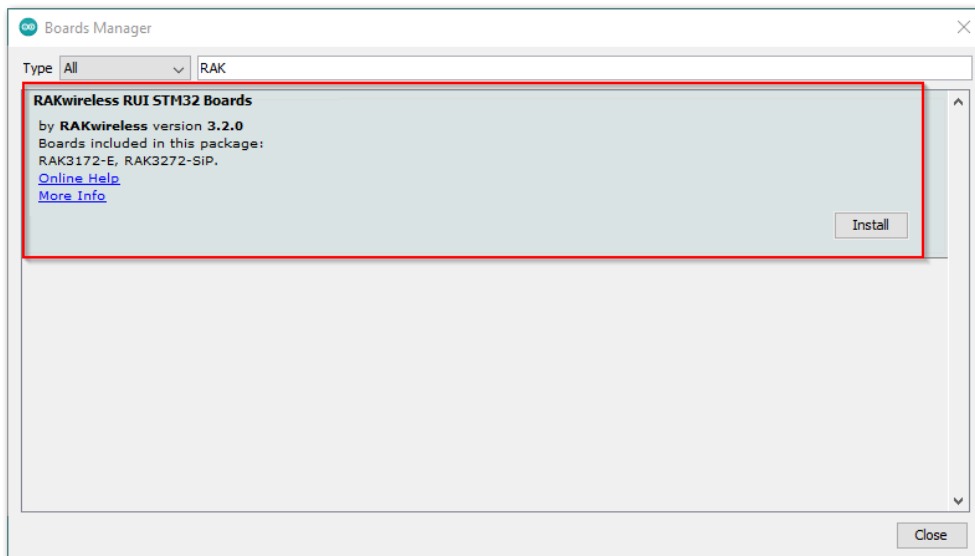


Figure 8: Installing RAKwireless RUI STM32 boards

- Once the BSP is installed, select **Tools > Boards Manager > RAKWireless RUI STM32 Modules > WisDuo RAK3172 Evaluation Board**. The RAK3172 Evaluation board uses RAK3172 WisDuo module.

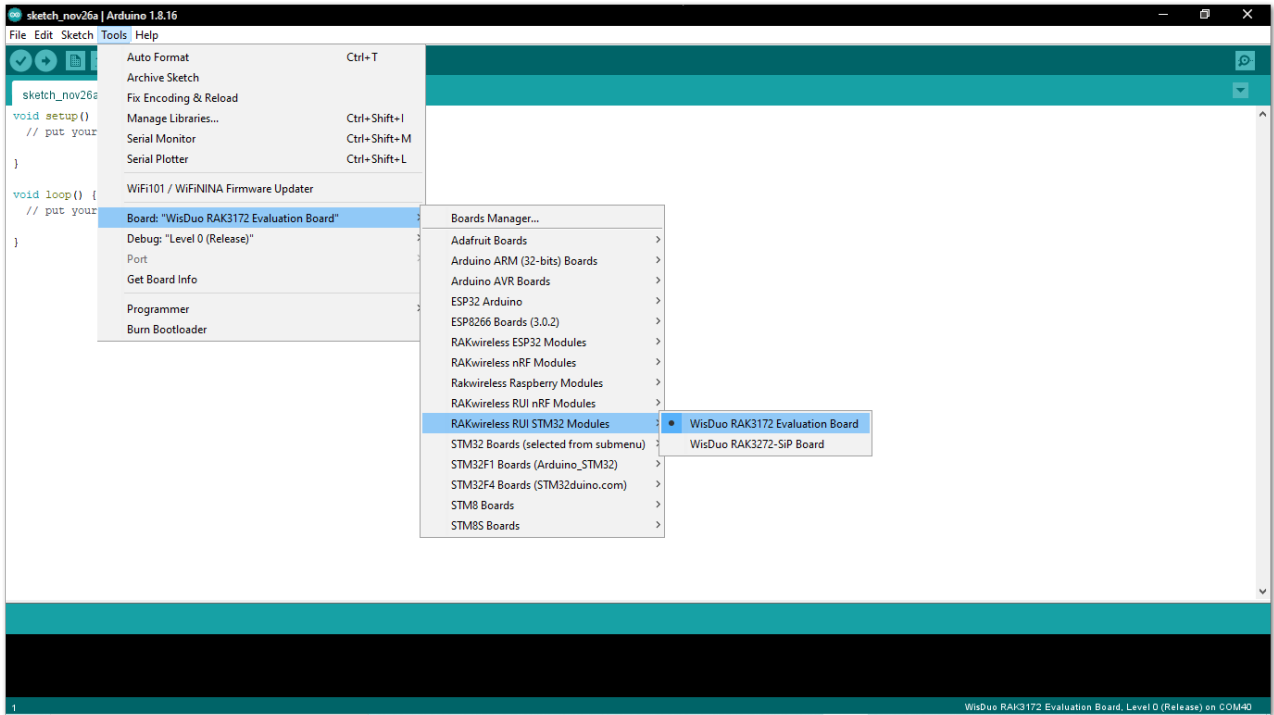


Figure 9: Selecting RAK3172 Evaluation Board

## Compile an Example with Arduino LED Breathing

1. After completing the steps on adding your RAK3172 to the Arduino IDE, you can now try to run a simple program to test your setup. Your RAK3172 evaluation board already has two LEDs to test. The LEDs can be found near the reset button and USB connector, as shown in **Figure 10**.

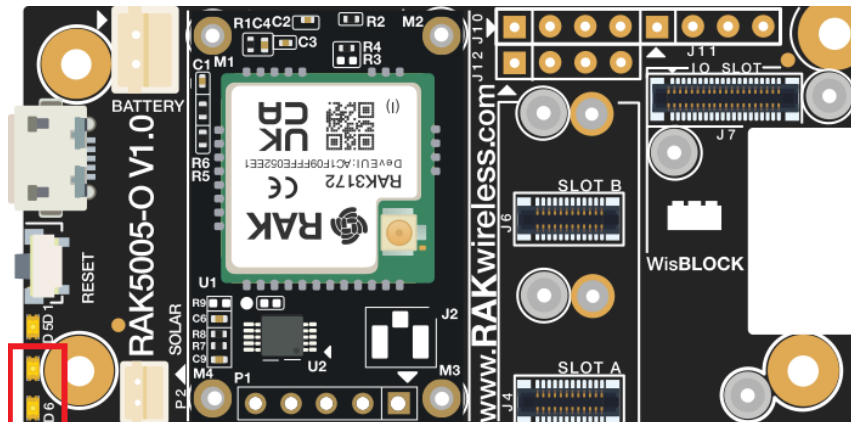


Figure 10: RAK3172 Evaluation Board LEDs

2. Connect the RAK3172-E via USB and check RAK3172 COM Port using Windows **Device Manager**. Double-click the reset button if the module is not detected.

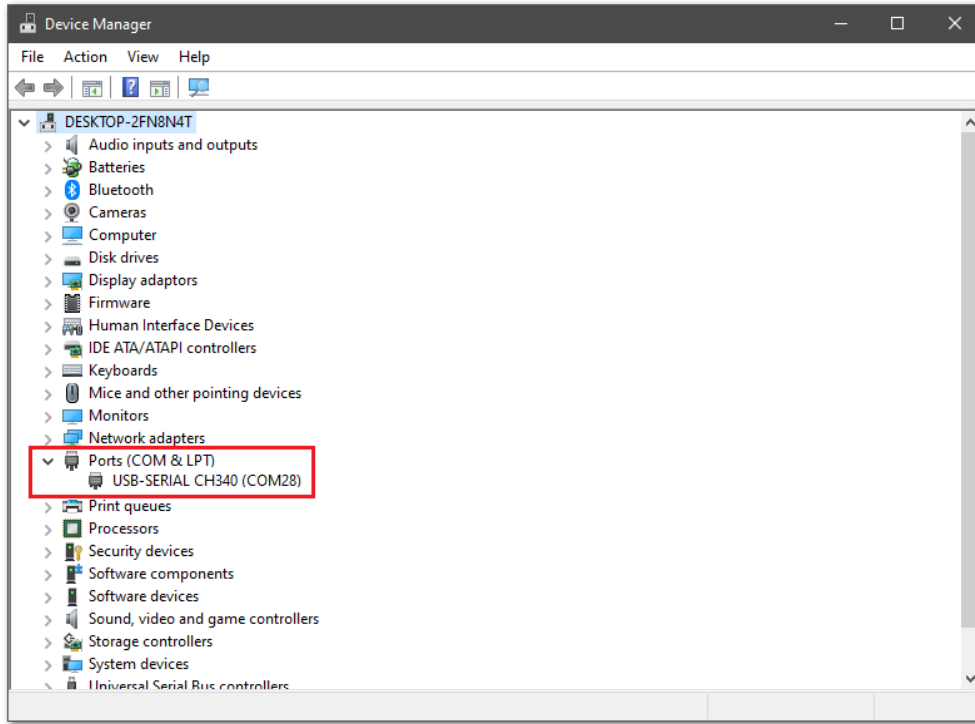


Figure 11: Device manager ports (COM & LPT)

3. Choose RAK3172-E on board selection select via **Tools > Boards Manager > RAKWireless RUI STM32 Modules > WisDuo RAK3172 Evaluation Board**.

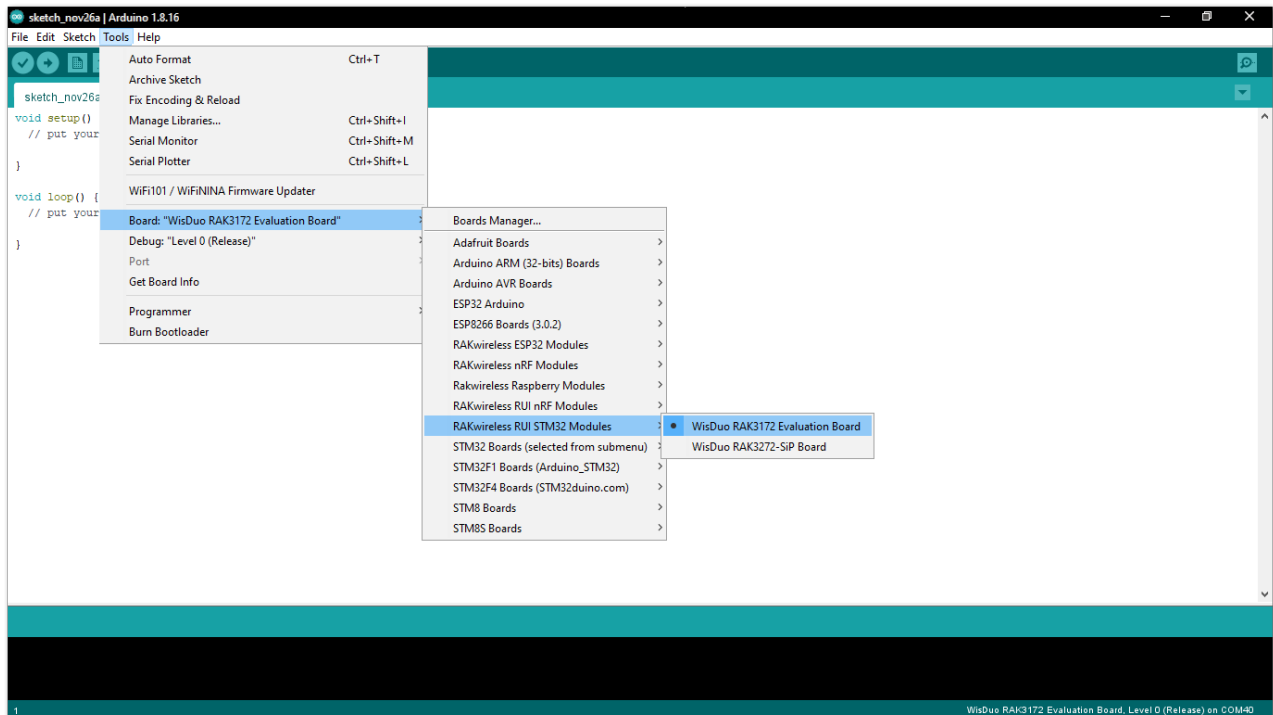


Figure 12: Selecting RAK3172 Evaluation Board

4. Open **Tools** Menu and select a COM port. **COM28** is currently used.

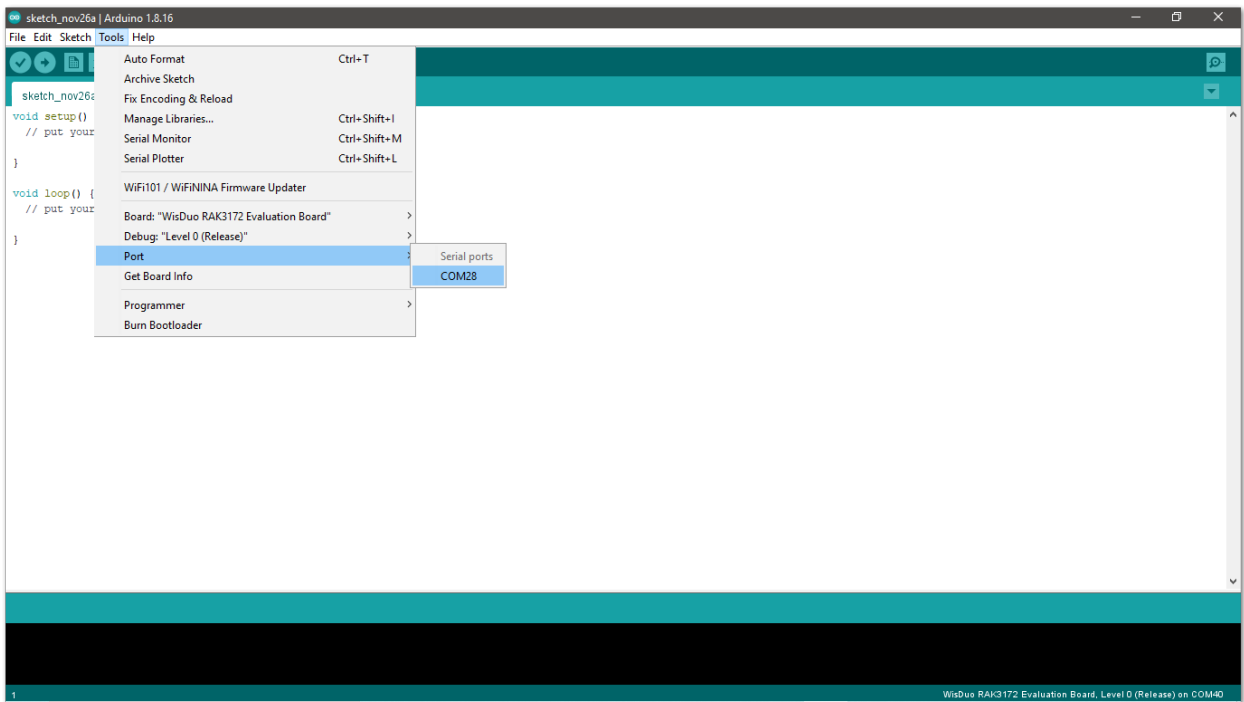


Figure 13: Select COM port

5. You can see the serial monitor icon and click it to connect the COM port.

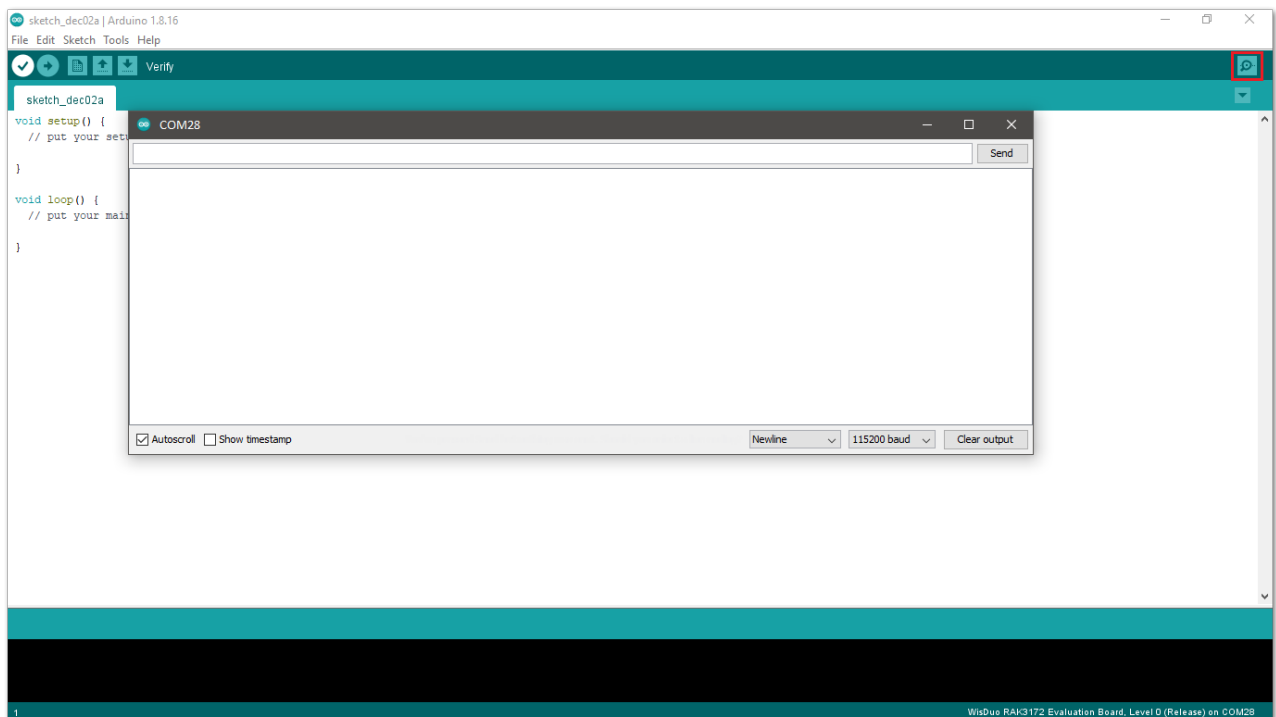


Figure 14: Open Arduino serial monitor

6. If the connection is successful, you can send AT Commands to RAK3172. For example: To check the RUI version, type `AT+VER=?` on the text area, then click on the **Send** button, as shown in **Figure 15**.

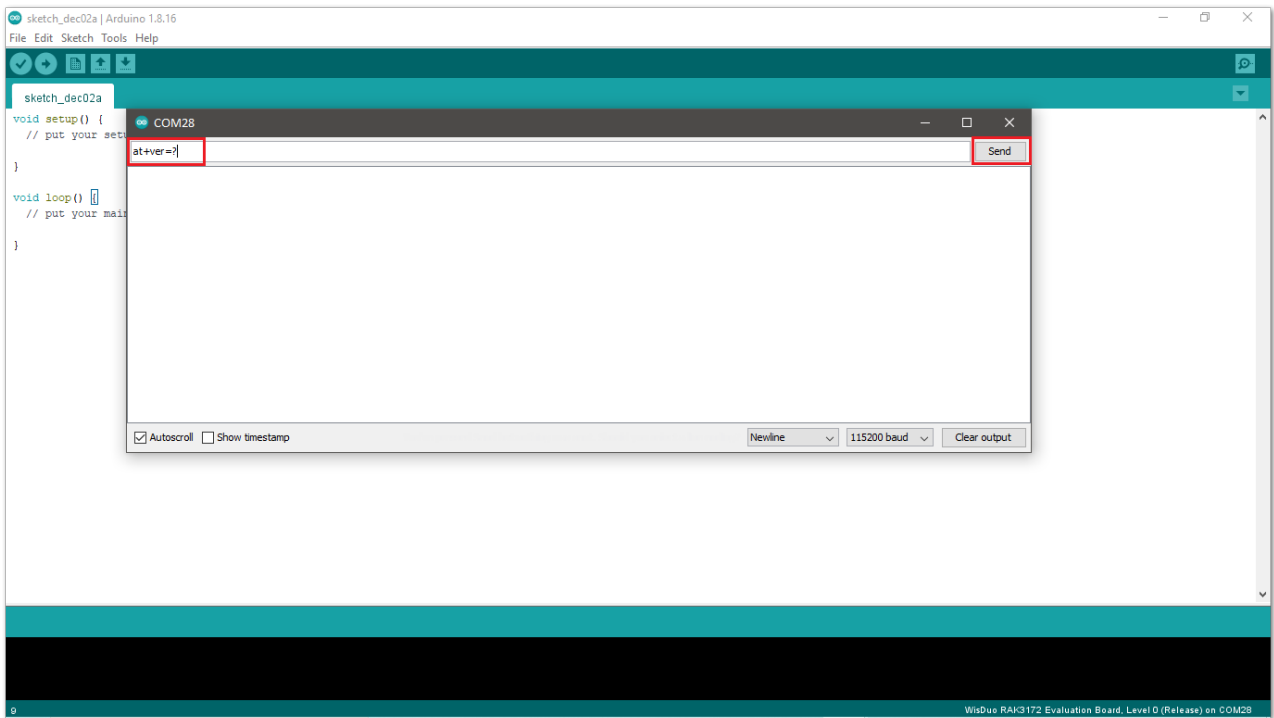


Figure 15: Send AT command

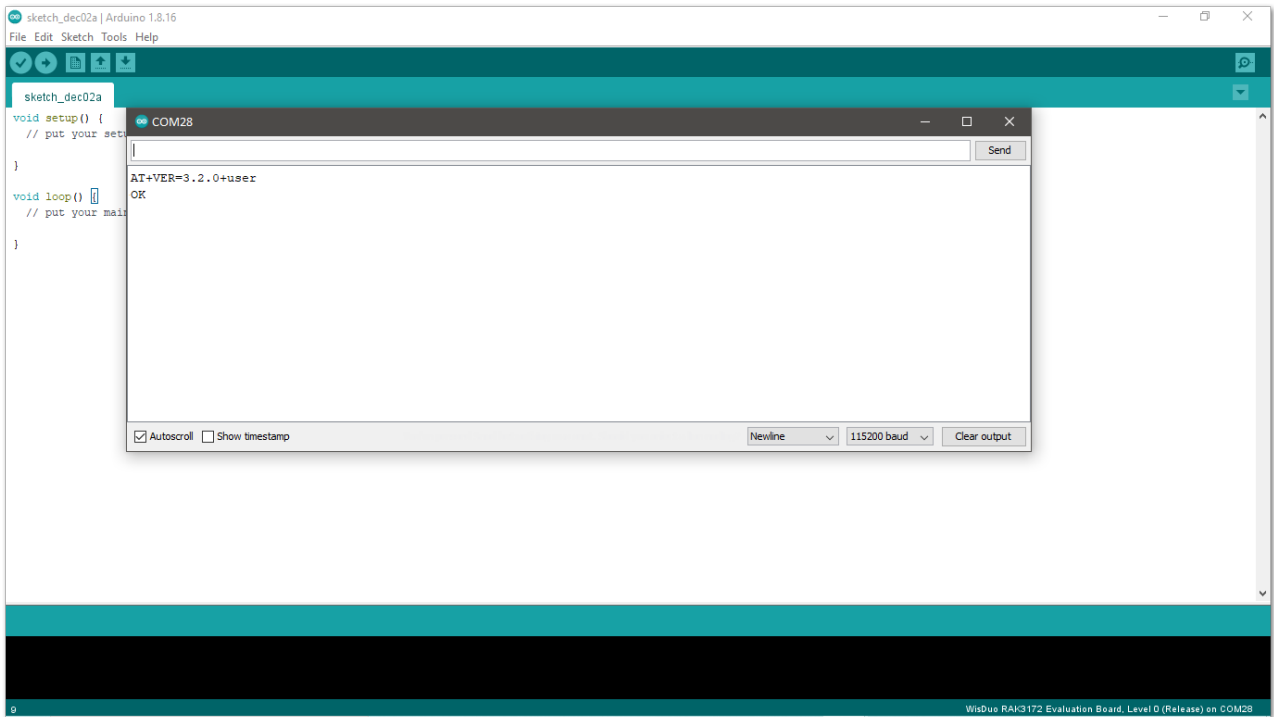


Figure 16: Arduino serial monitor COM28

7. Open **Arduino\_Led\_Breathing** example code.

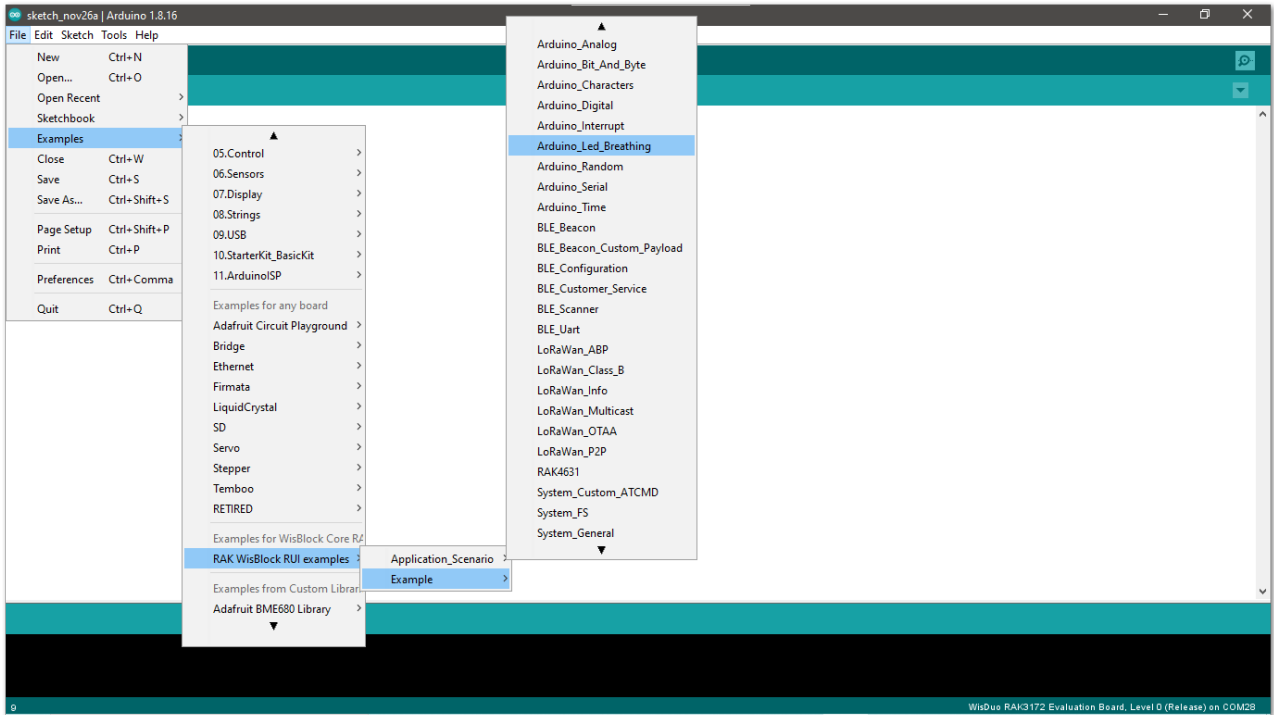


Figure 17: Arduino Led Breathing example

8. Click on the **Verify** icon to check if you have successfully compiled the example code.

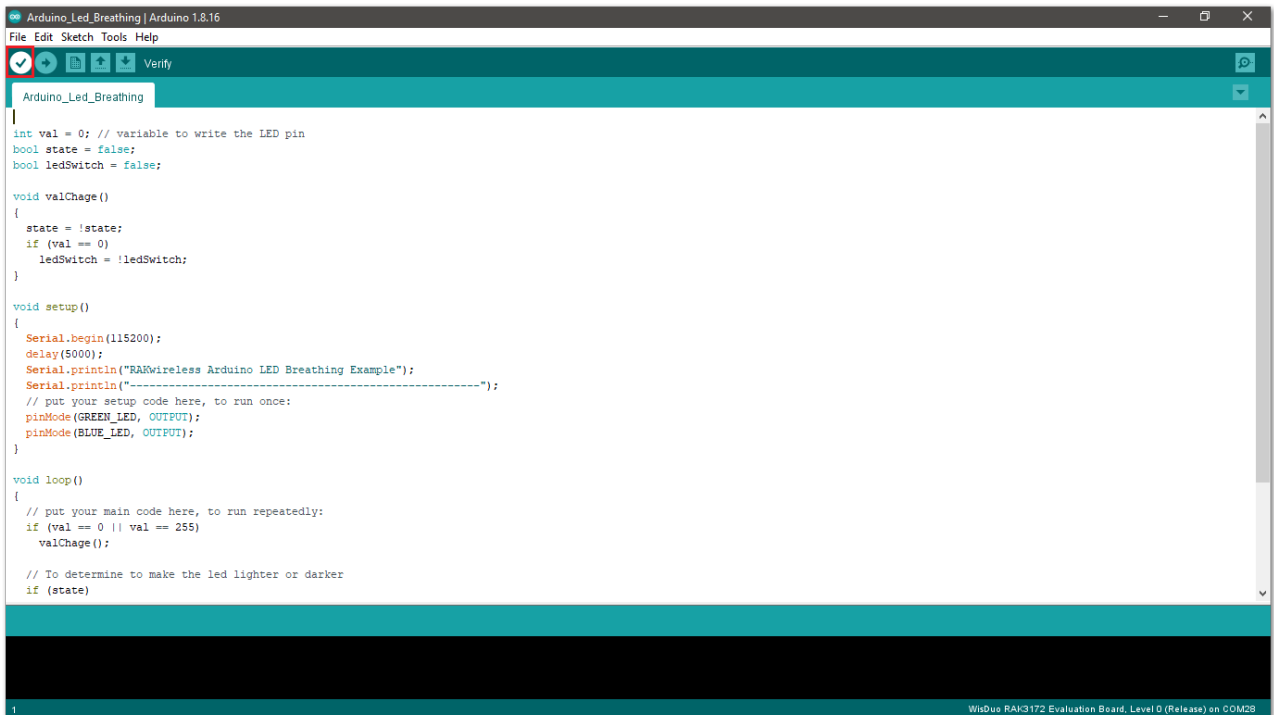


Figure 18: Verify the example code

9. Click the **Upload** icon to send the compiled firmware to your RAK3172.

**NOTE:**

RAK3172-E should automatically go to BOOT mode when the firmware is uploaded via Arduino IDE. If BOOT mode is not initiated, you can manually send `AT+BOOT` command to start bootloader mode.

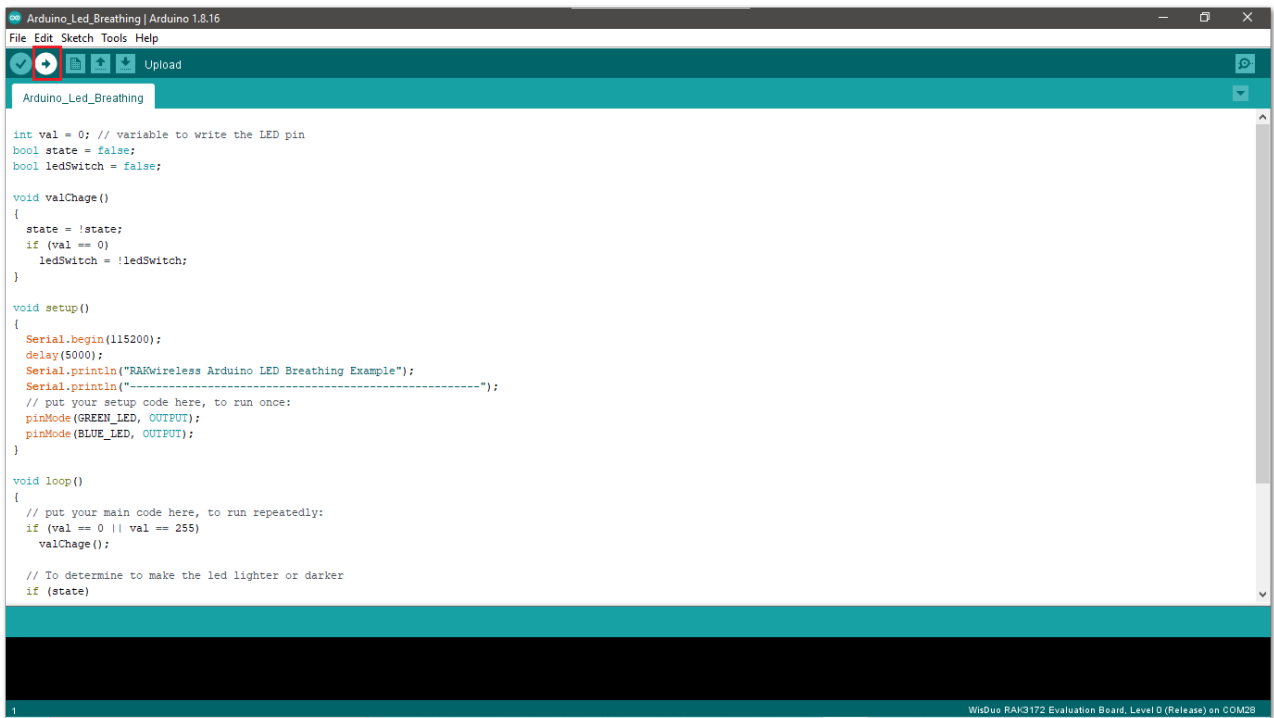


Figure 19: Upload the example code

10. If the upload is successful, you will see the **Device programmed** message.

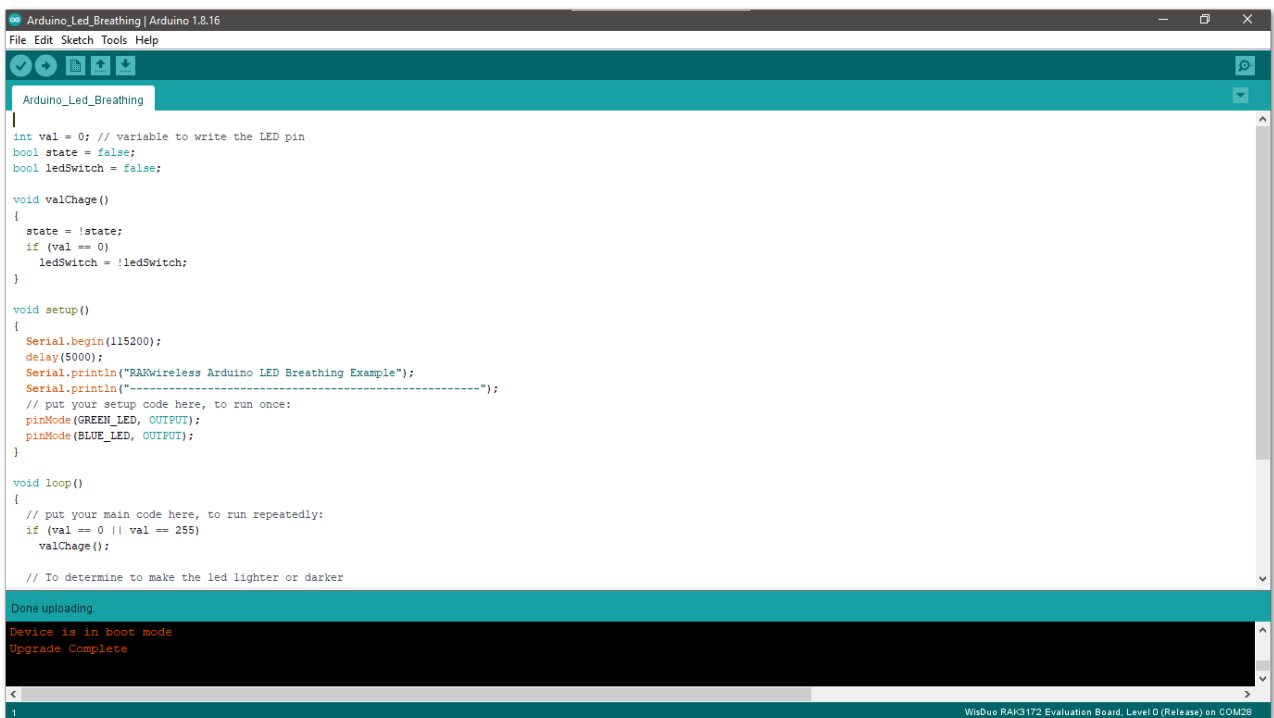


Figure 20: Device programmed successfully

11. After the Device Programmed is completed, you will see that LEDs are blinking.

## RAK3172-E as a LoRa/LoRaWAN Modem via AT Command

### AT Command via the USB

RAK3172 evaluation board can be configured using AT commands via the USB interface. Connect the RAK3172 evaluation board to your computer's USB port and a serial terminal tool. You can use the [RAK Serial Port Tool](#) , so you can easily send AT commands and view the replies from the console output. The RAK Serial Port Tool commands still uses the RUI V2 AT commands by default. You can modify it to have RUI3 AT commands and then save it.



**⚠ WARNING**

Firmware update and AT command functionality are done via USB pins. If you will connect the module to an external host MCU that will send AT commands via USB, take extra precautions in your board design to ensure you can still perform FW update to it. There should be a way in your board design that can disconnect the host MCU UART to connect to RAK3172-E USB before connecting the module to the PC via USB for the FW update process.

An alternative option to update firmware aside from USB is to use SWD pins (SWCLK & SWDIO). This method will require you to use external tools like ST-LINK or RAKDAP1.

## Connect to the RAK3172 Evaluation Board

1. Connect the RAK3172 evaluation board to the general-purpose computer USB port via a micro USB cable, as shown in **Figure 21**.

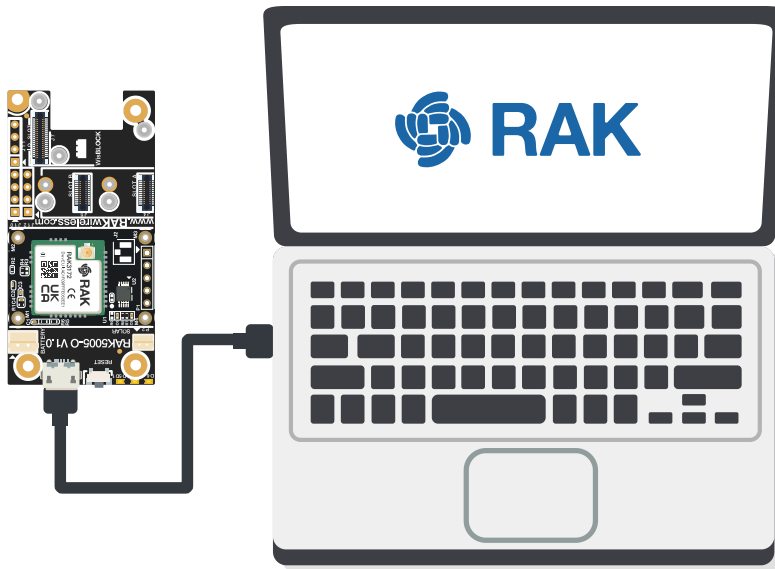


Figure 21: RAK3172 EVB Connection

2. Any serial communication tool can be used; but, it is recommended to use the [RAK Serial Port Tool](#) .
3. Configure the serial communication tool by selecting the proper port detected by the computer and configure the link as follows:
  - Baud Rate: **115200 baud**
  - Data Bits: **8 bits**
  - Stop Bits: **1 stop bit**
  - Parity: **NONE**

## RAK3172 Evaluation Board Configuration for LoRaWAN or LoRa P2P

To enable the RAK3172 module as a LoRa P2P module or a LoRaWAN end-device, the module must be configured and parameters must be set by sending AT commands. You can configure the RAK3172 in two ways:

- [LoRaWAN End-Device](#) - RAK3172-E as LoRaWAN IoT device.
- [LoRa P2P](#) - Point-to-point communication between two RAK3172 evaluation boards.

## Configuring RAK3172-E as LoRaWAN End-Device

To enable the RAK3172-E breakout board as a LoRaWAN end-device, a device must be registered first in the LoRaWAN network server. This guide will cover both TTN and Chirpstack LoRaWAN network servers and the

associate AT commands for the RAK3172-E.

This guide covers the following topics:

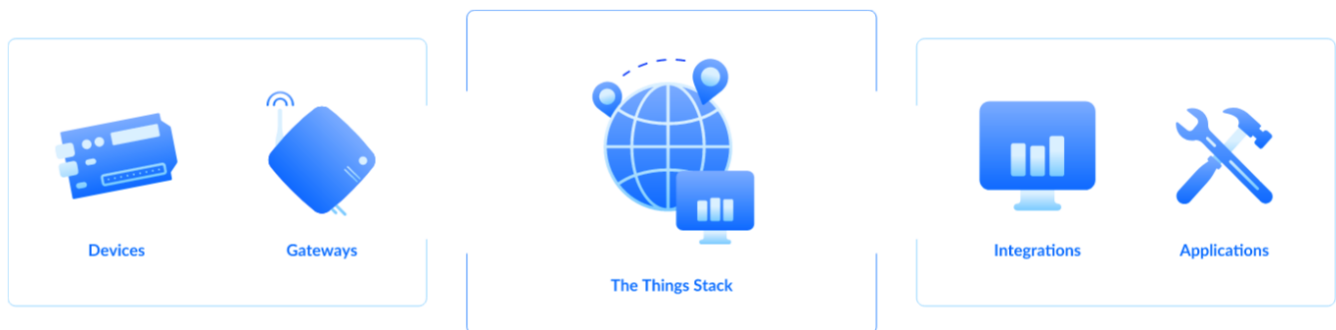
- [TheThingsNetwork Guide](#) - How to login, register new accounts and create new applications on TTN.
- [RAK3172-E TTN OTAA Guide](#) - How to add OTAA device on TTN and what AT commands to use on RAK3172 OTAA activation.
- [RAK3172-E TTN ABP Guide](#) - How to add ABP device on TTN and what AT commands to use on RAK3172 ABP activation.
- [Chirpstack Guide](#) - How to create new applications on Chirpstack.
- [RAK3172-E Chirpstack OTAA Guide](#) - How to add OTAA device to Chirpstack and what AT commands to use on RAK3172 OTAA activation.
- [RAK3172-E Chirpstack ABP Guide](#) - How to add ABP device on Chirpstack and what AT commands to use on RAK3172 ABP activation.

## Connecting to The Things Network (TTN)

In this section, a quick tutorial guide will show how to connect the RAK3172 Evaluation Board to the TTN platform.

 **NOTE:**

In this guide, you need to have a working gateway that is connected to TTN or you have coverage of the TTN community network.



**Figure 22:** RAK3172 in the context of the TTN

As shown in **Figure 22**, The Things Stack (TTN V3) is an open-source LoRaWAN Network Server suitable for global, geo-distributed public and private deployments as well as for small, local networks. The architecture follows the LoRaWAN Network Reference Model for standards compliancy and interoperability. This project is actively maintained by [The Things Industries](#) .

LoRaWAN is a protocol for low-power wide-area networks. It allows for large-scale Internet of Things deployments where low-powered devices efficiently communicate with Internet-connected applications over long-range wireless connections.

The RAK3172 Evaluation Board can be part of this ecosystem as a device, and the objective of this section is to demonstrate how simple it is to send data to The Things Stack using the LoRaWAN protocol. To achieve this, the RAK3172 Evaluation Board must be located inside the coverage of a LoRaWAN gateway connected to The Things Stack server.

## Registration to TTN and Creating LoRaWAN Applications

1. The first step is to go to [The Things Network](#) and sign up an account shown in **Figure 23**. Then select a cluster as shown in **Figure 25**.

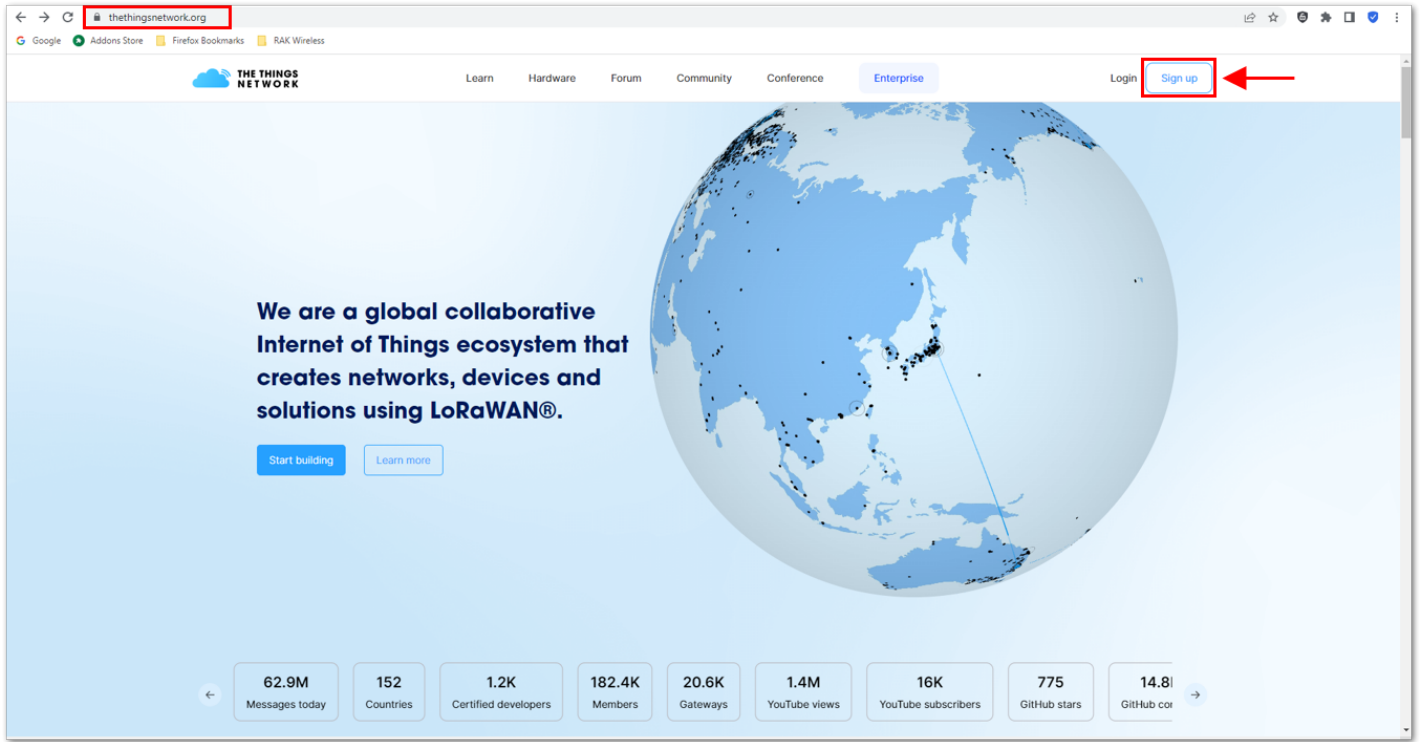


Figure 23: Signing up an account in TTN

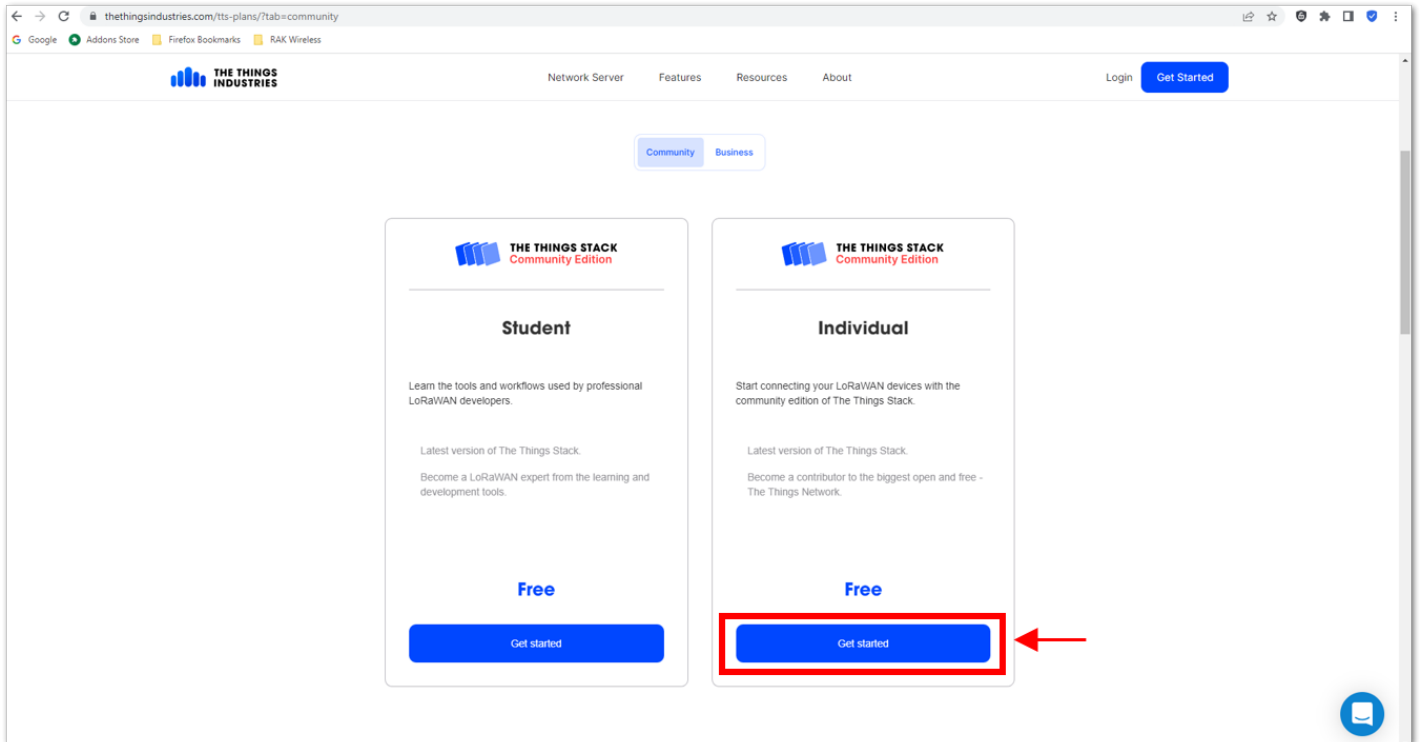


Figure 24: Signing up an account in TTN

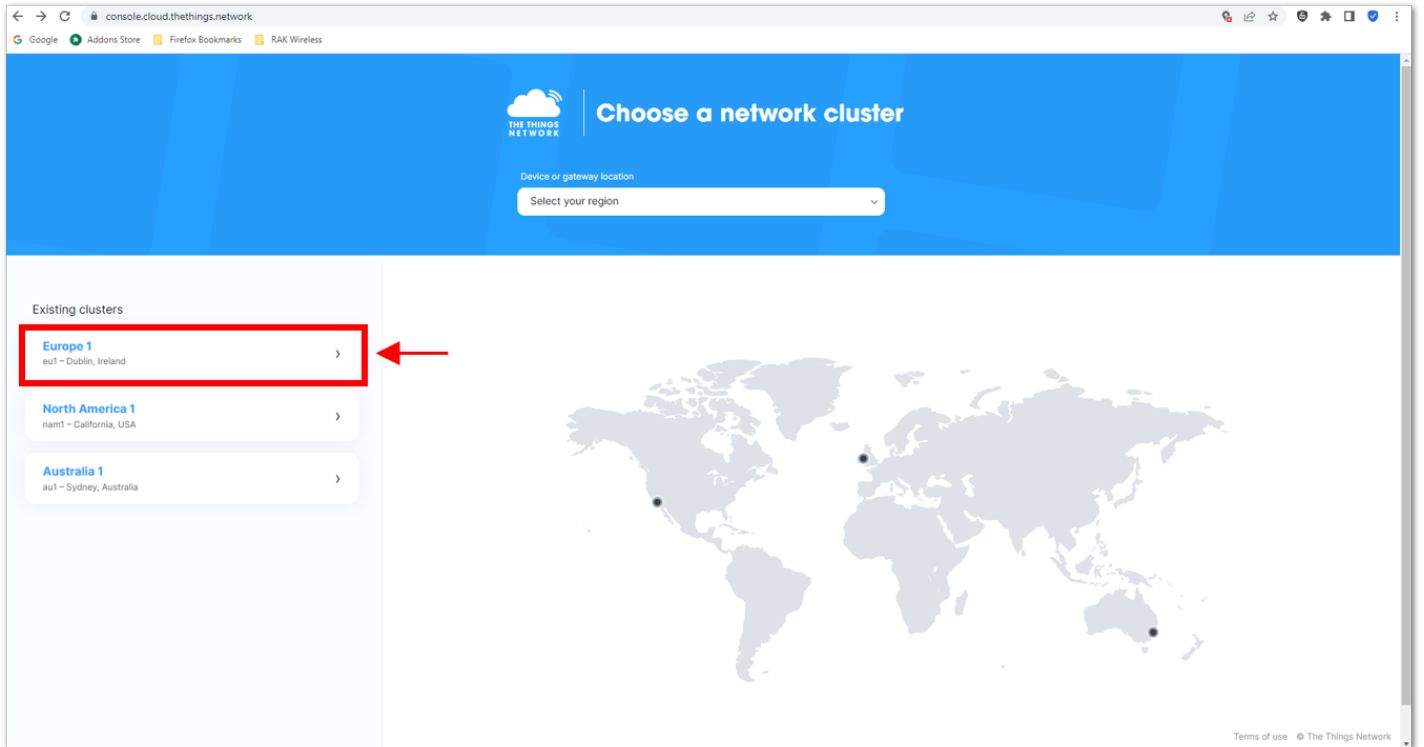


Figure 25: Selecting Cluster in TTN

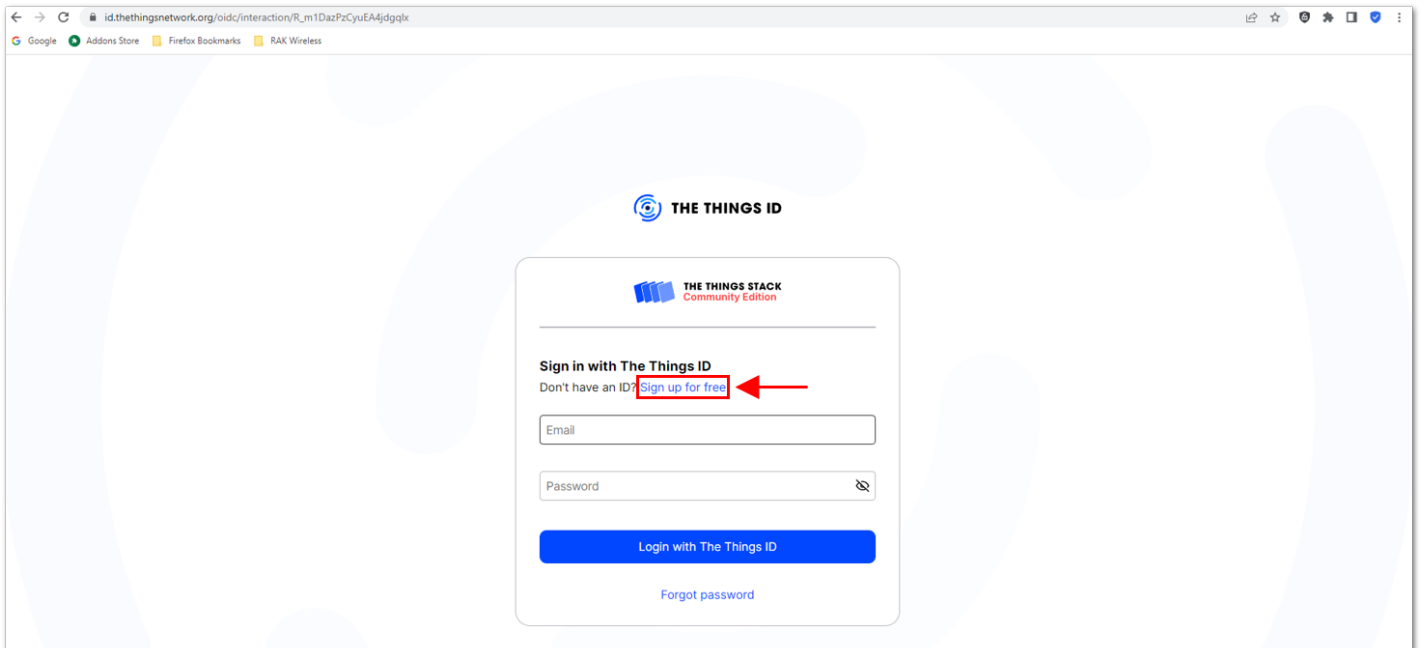


Figure 26: Signing up through the Things ID

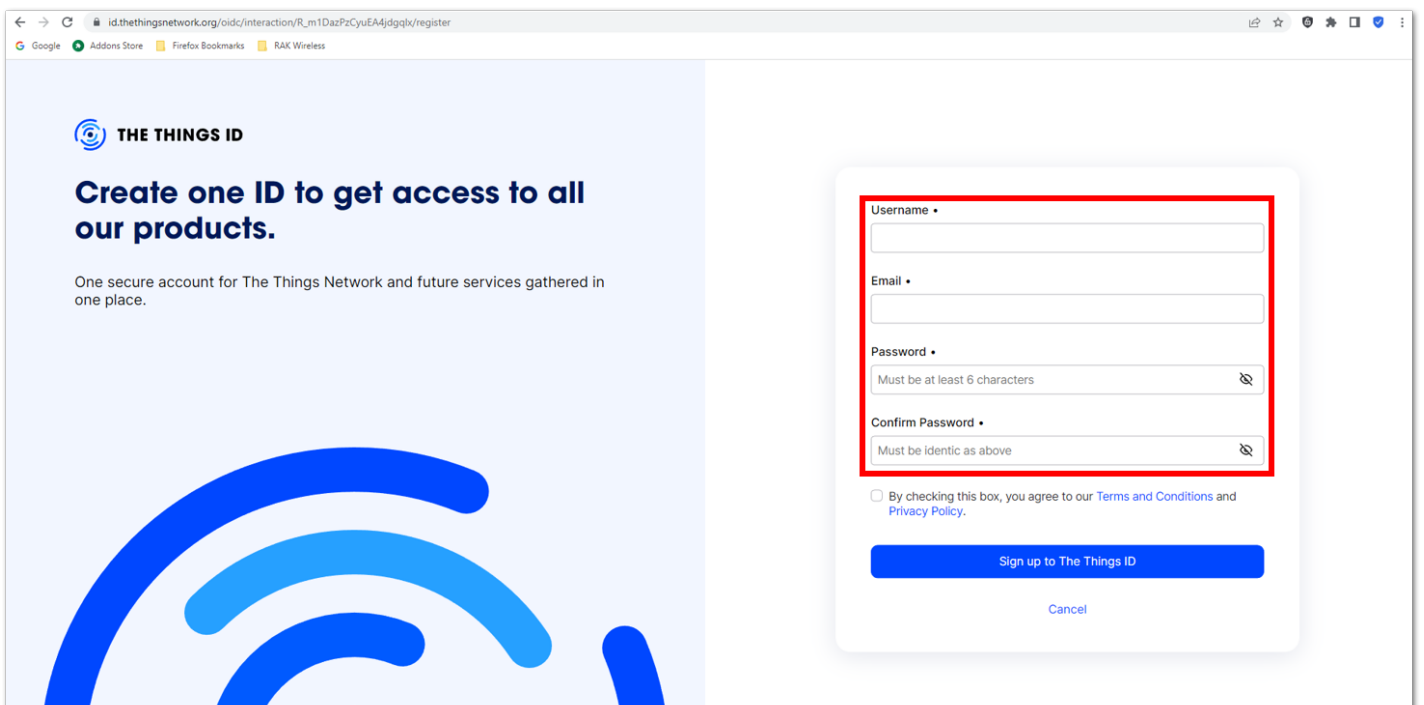
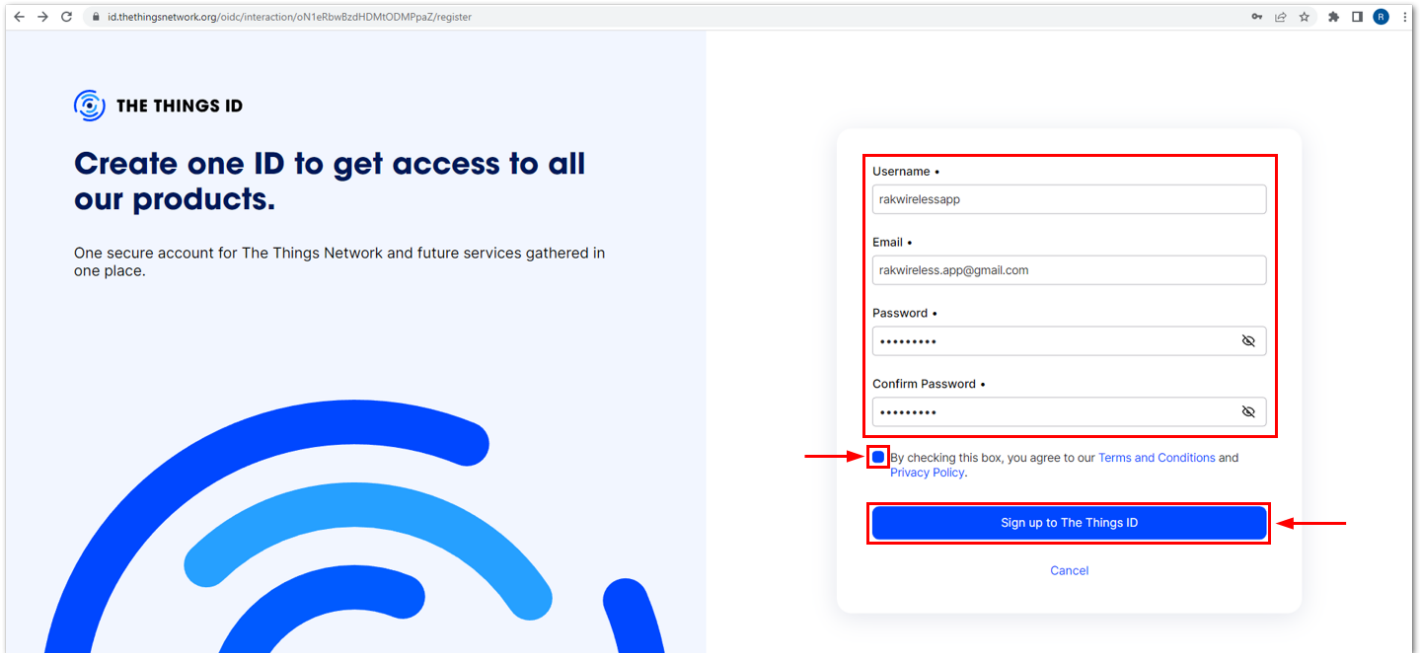


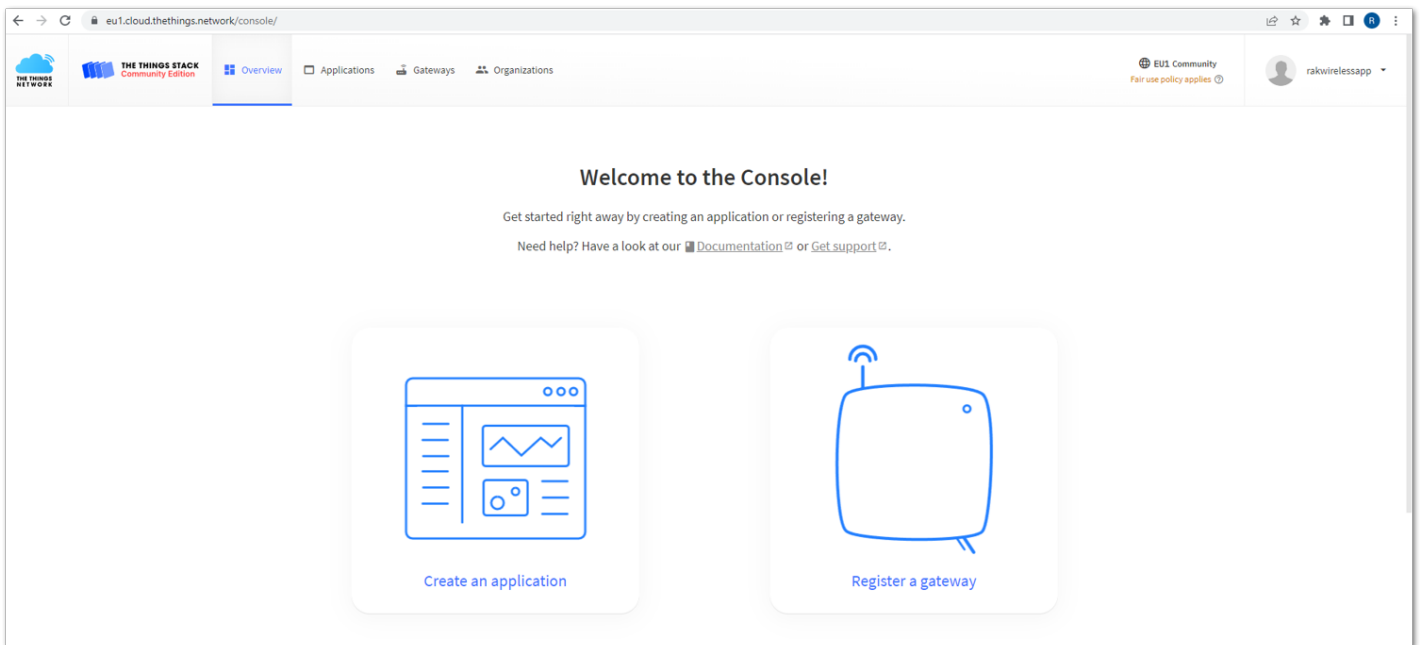
Figure 27: Creation of an account through the Things ID



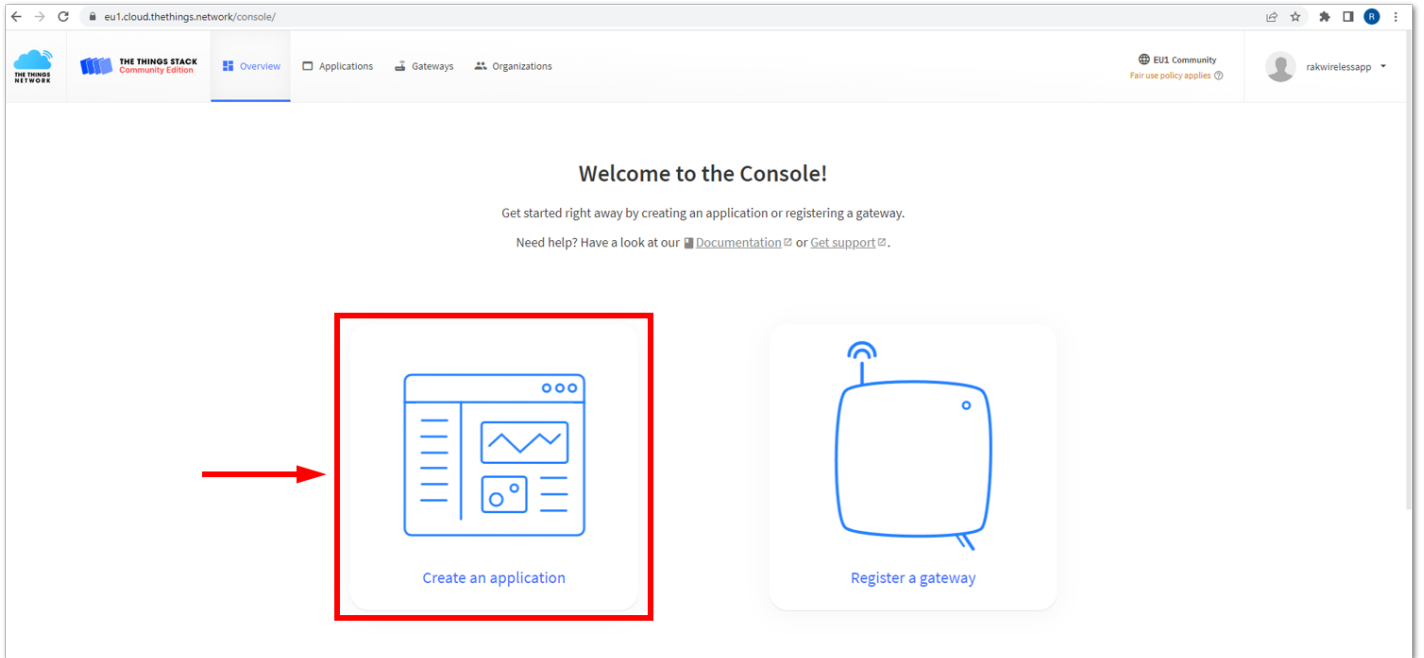
**Figure 28:** Creation of an account through the Things ID

You can use the same login credentials on the TTN V2 if you have one. If you have no account yet, you need to create one.

2. Now that you are logged in to the platform, the next step is to create an application. Click **Create an application**.

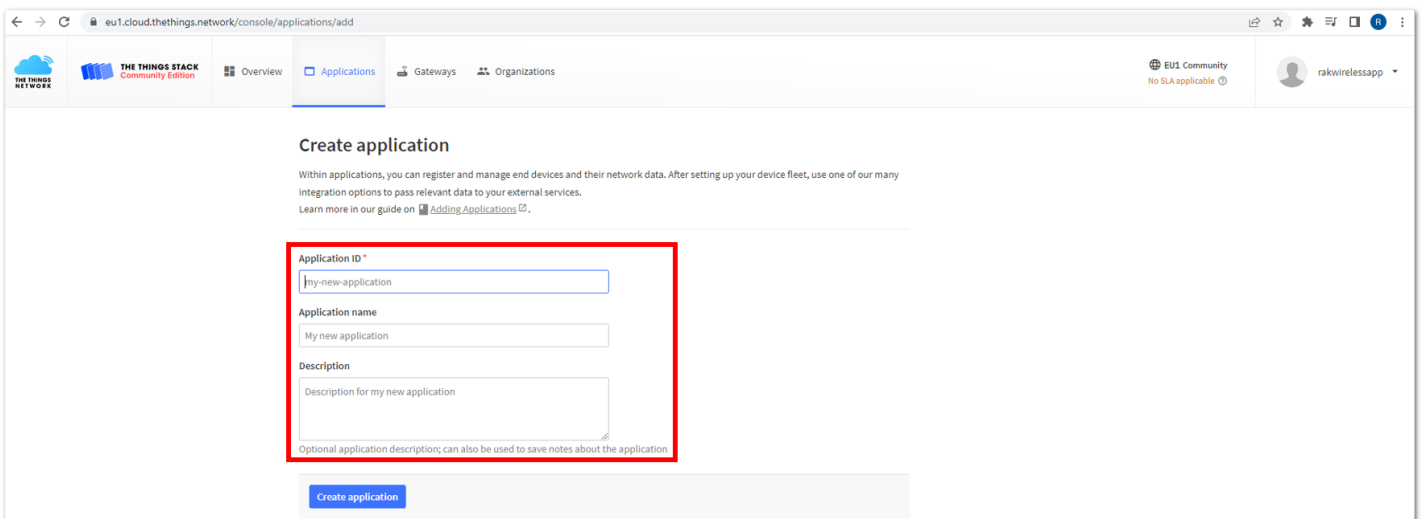


**Figure 29:** The Things Stack Platform

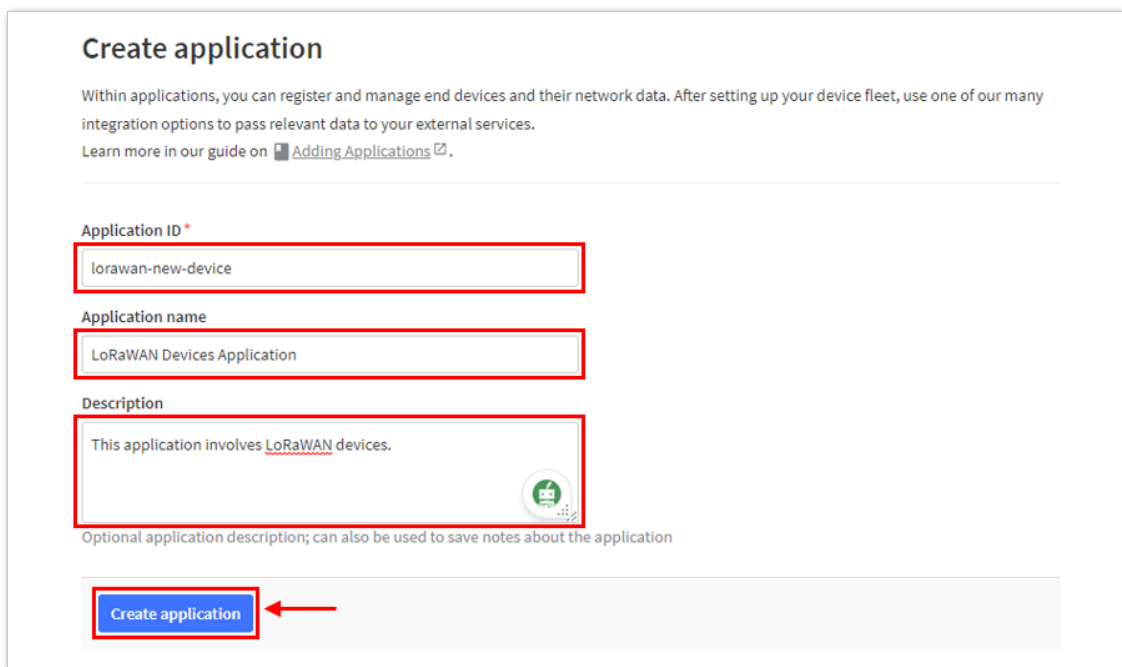


**Figure 30:** Creating TTN application for your LoRaWAN devices

3. To have an application registered, input first the specific details and necessary information about your application then click **Create application**.



**Figure 31:** Details of the TTN application



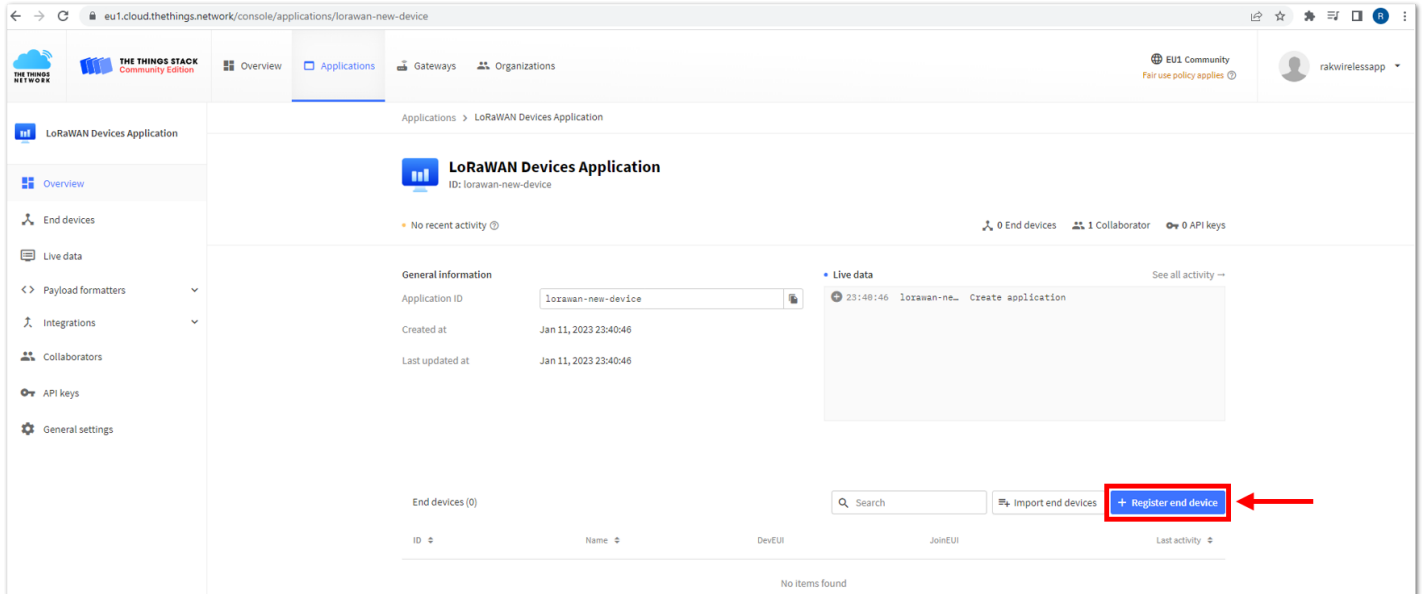
**Figure 32:** Details of the TTN application

4. If you have no error on the previous step, you should now be on the application console page. The next step is to add end-devices to your TTN application.

LoRaWAN specifications enforce that each end-device has to be personalized and activated. There are two options in registering devices depending on the activation mode selected. Activation can be done either via Over-The-Air-Activation (OTAA) or Activation-By-Personalization (ABP).

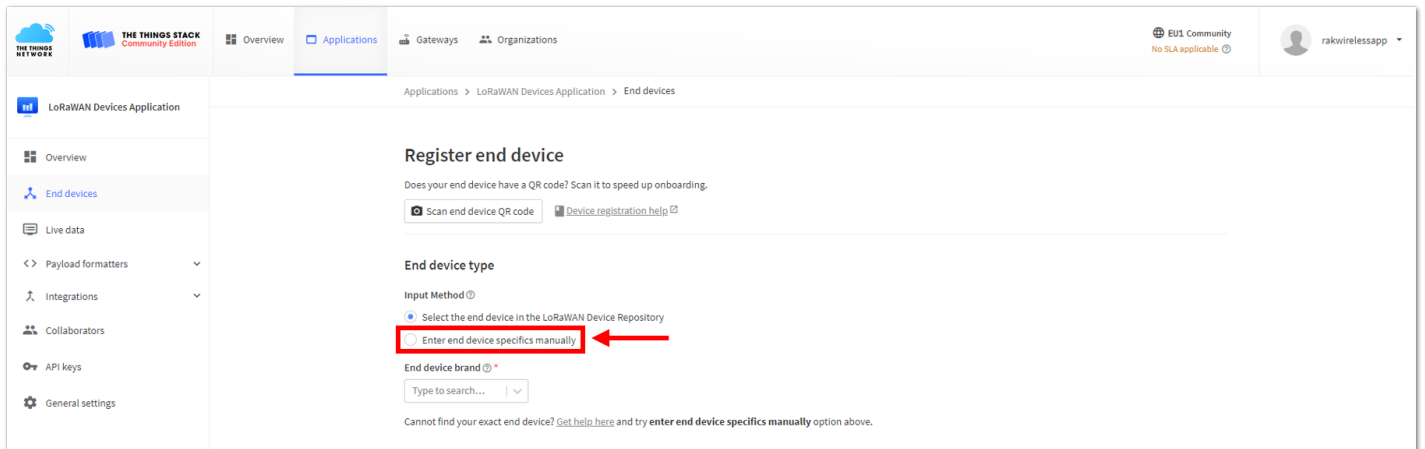
## TTN OTAA Device Registration

1. Go to your application console to register a device. To start adding an OTAA end-device, click **+ Register end device**, as shown in **Figure 33**.



**Figure 33:** Register end device

2. To register the board, click the **Enter end device specifics manually**.



**Figure 34:** Enter end device specifics manually

3. Next step is to set up **Frequency plan**, compatible **LoRaWAN version**, and **Regional Parameters version** supported. Then provide the **JoinEUI** credentials by entering zeroes into it.

Applications > LoRaWAN Devices Application > End devices

### Register end device

Does your end device have a QR code? Scan it to speed up onboarding.

[Scan end device QR code](#) [Device registration help](#)

#### End device type

Input Method

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan \*

LoRaWAN version \*

Regional Parameters version \*

To continue, please enter versions and frequency plan information

**Figure 35:** Setting up for your device

Applications > LoRaWAN Devices Application > End devices

### Register end device

Does your end device have a QR code? Scan it to speed up onboarding.

[Scan end device QR code](#) [Device registration help](#)

#### End device type

Input Method

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan \*

LoRaWAN version \*

Regional Parameters version \*

To continue, please enter versions and frequency plan information

**Figure 36:** Setting up for your device

### Register end device

Does your end device have a QR code? Scan it to speed up onboarding.

[Scan end device QR code](#) [Device registration help](#)

#### End device type

Input Method

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan \*

LoRaWAN version \*

Regional Parameters version \*

[Show advanced activation, LoRaWAN class and cluster settings](#)

#### Provisioning information

JoinEUI \*

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

**Figure 37:** Setting up for your device



**Register end device**

Does your end device have a QR code? Scan it to speed up onboarding.

[Device registration help](#)

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**End device type**

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ \*

LoRaWAN Specification 1.0.3 | v

Regional Parameters version ⓘ \*

RP001 Regional Parameters 1.0.3 revision A | v

[Show advanced activation, LoRaWAN class and cluster settings](#) v

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**Provisioning information**

JoinEUI ⓘ \*

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

**Figure 38:** Setting up for your device

- Then click **Show advanced activation, LoRaWAN class and cluster settings**. Configure the activation mode by selecting **Over the air activation (OTAA)** and Additional LoRaWAN class capabilities to **class A only**. Then click **Confirm**.

**Register end device**

Does your end device have a QR code? Scan it to speed up onboarding.

[Device registration help](#)

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**End device type**

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ \*

LoRaWAN Specification 1.0.3 | v

Regional Parameters version ⓘ \*

RP001 Regional Parameters 1.0.3 revision A | v

v

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**Provisioning information**

JoinEUI ⓘ \*

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

**Figure 39:** Setting up for your device

Show advanced activation, LoRaWAN class and cluster settings ^

Activation mode ⓘ

- Over the air activation (OTAA)
- Activation by personalization (ABP)
- Define multicast group (ABP & Multicast)

Additional LoRaWAN class capabilities ⓘ

None (class A only) | v

Network defaults ⓘ

- Use network's default MAC settings

Cluster settings ⓘ

- Skip registration on Join Server

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Provisioning information

JoinEUI ⓘ \*

00 00 00 00 00 00 00 00 Confirm

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

Figure 40: Setting up for your device

5. Once done, provide the DevEUI credentials of your device into the **DevEUI** portion. This will automatically generate the specific End device ID of your board. Then click **Generate** under **AppKey** under Provisioning information section. Then click **Register end device**.

**NOTE:**

- The **AppEUI**, **DevEUI**, and **AppKey** are hidden in this section as these are unique from a specific device. The **DevEUI** credential is unique to every RAK3172 device. Also, you should generate your own **AppEUI** and **AppKey** credentials for your specific device and application.
- The **AppEUI** is the same as **JoinEUI**.

Provisioning information

JoinEUI ⓘ \*

00 00 00 00 00 00 00 00 Reset

This end device can be registered on the network

DevEUI ⓘ \*

AC Generate 0/50 used

AppKey ⓘ \*

.. .. . Generate

End device ID ⓘ \*

eui-ac1f09ffe053776

This value is automatically prefilled using the DevEUI

After registration

- View registered end device
- Register another end device of this type

Register end device

Figure 41: Setting up for your device

**Provisioning information**

JoinEUI ⓘ \*

00 00 00 00 00 00 00 00 Reset

This end device can be registered on the network

DevEUI ⓘ \*

AC 00 00 00 00 00 00 00 00 Generate 0/50 used

AppKey ⓘ \*

..... Generate

End device ID ⓘ \*

eui-ac1f09fffe053776

This value is automatically prefilled using the DevEUI

After registration

View registered end device

Register another end device of this type

Register end device

**Figure 42:** Setting up for your device

**Provisioning information**

JoinEUI ⓘ \*

00 00 00 00 00 00 00 00 Reset

This end device can be registered on the network

DevEUI ⓘ \*

AC 00 00 00 00 00 00 00 00 Generate 0/50 used

AppKey ⓘ \*

44 D1 00 00 00 00 00 00 00 00 Generate

End device ID ⓘ \*

eui-ac1f09fffe053776

This value is automatically prefilled using the DevEUI

After registration

View registered end device

Register another end device of this type

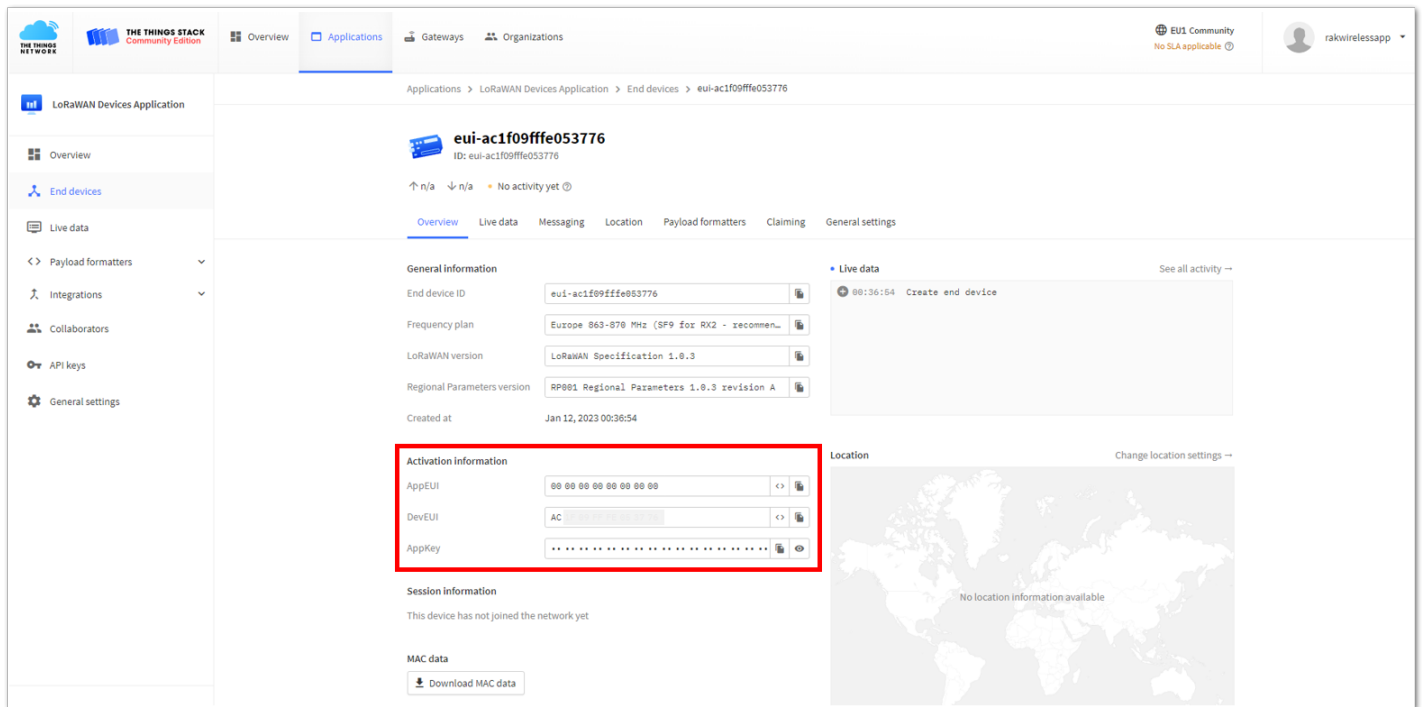
Register end device

**Figure 43:** Register end device

6. You should now be able to see the device on the TTN console after you fully register your device, as shown in **Figure 44**.

**NOTE:**

- The **AppEUI**, **DevEUI**, and **AppKey** are the parameters that you will need to activate your LoRaWAN end-device via OTAA. The **AppKey** is hidden by default for security reasons, but you can easily show it by clicking the show button. You can also copy the parameters quickly using the copy button.
- The three OTAA parameters on the TTN device console are MSB by default.
- These parameters are always accessible on the device console page, as shown in **Figure 36**.



**Figure 44:** OTAA device successfully registered to TTN

## OTAA Configuration for TTN

The RAK3172 evaluation board can be configured using WisToolBox to do the OTAA configuration. **WisToolBox** is a software tool that supports **RAK3172** module. It automatically detects RAK3172 evaluation board once connected to PC. Below are the options in WisToolBox that the OTAA configuration can be done.

- [OTAA Configuration for TTN via WisToolBox UI](#)
- [OTAA Configuration for TTN via WisToolBox Console](#)

## OTAA Configuration for TTN via WisToolBox UI

The **RAK3172** should have correct OTAA credentials to connect to TTN. This can be done using **WisToolBox UI**. Below are the steps on setting up your **RAK3172** using **WisToolBox**.

1. Connect your **RAK3172** with your chosen WisBlock base board to the PC via USB cable and open the **WisToolBox** application.
2. Click **CONNECT DEVICE** button to launch the WisToolBox Dashboard.

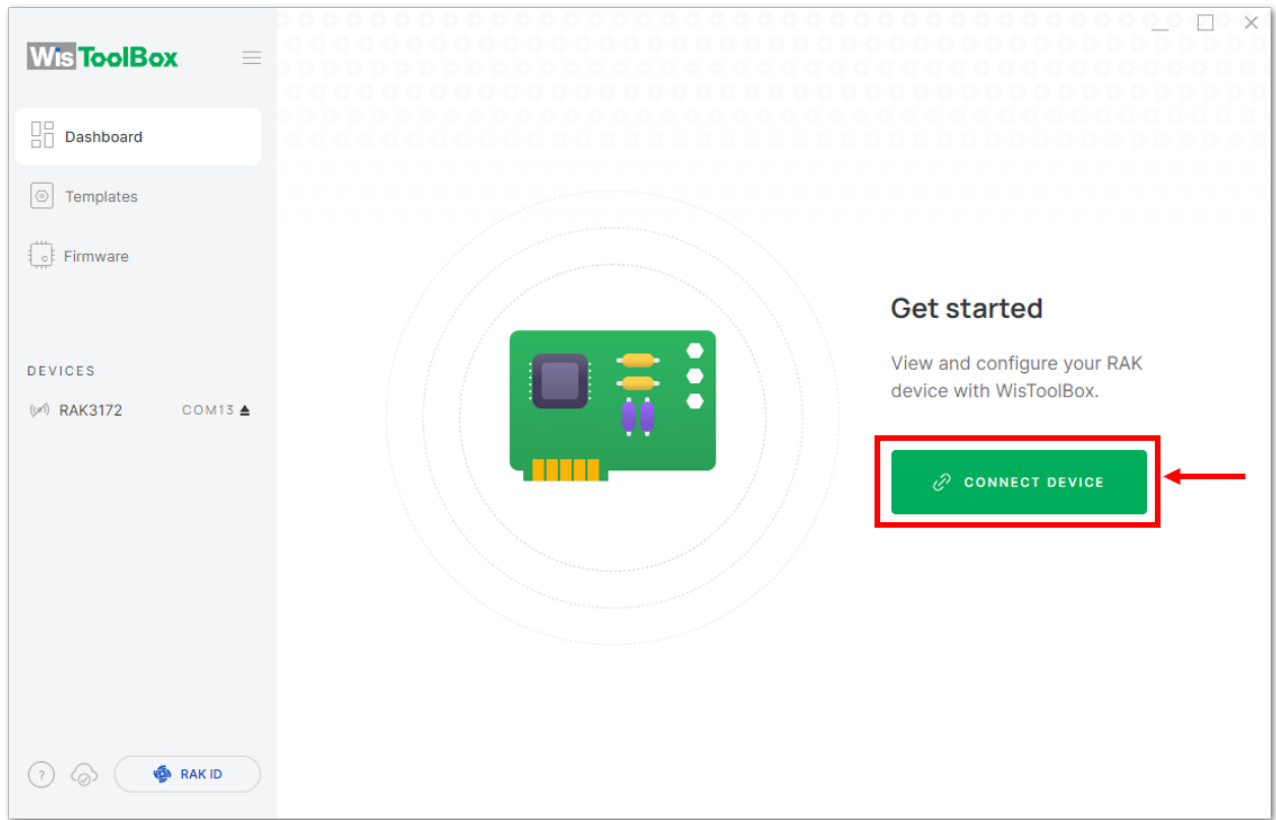


Figure 45: CONNECT DEVICE

3. Then select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT** as shown in **Figure 47**.

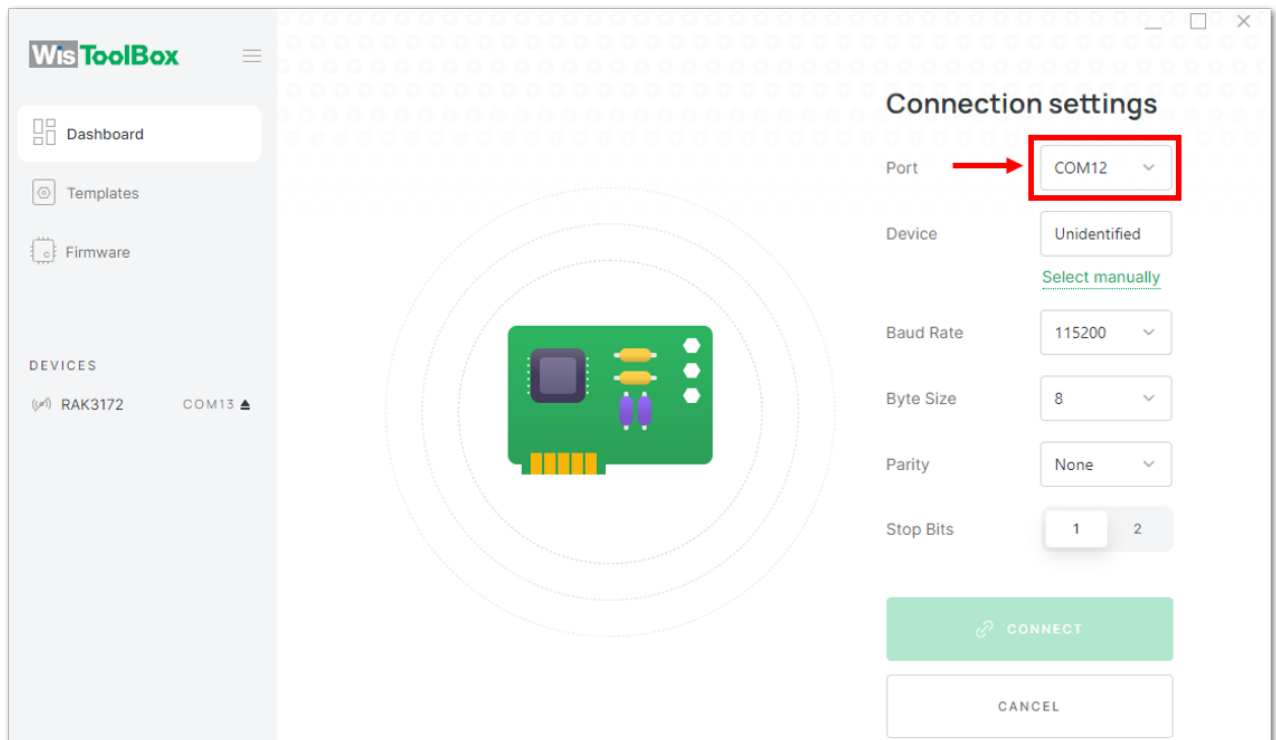


Figure 46: Setting up your device

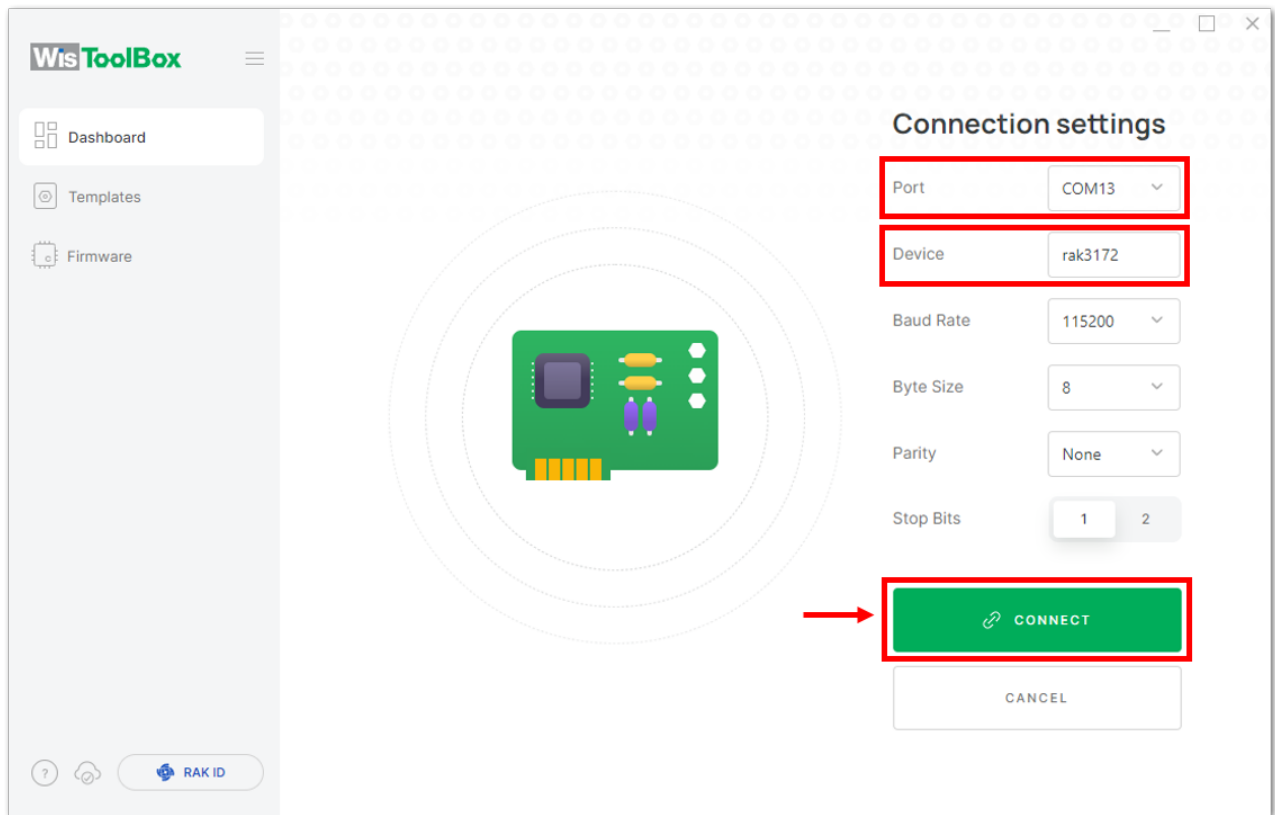


Figure 47: Setting up your device

4. Once done, **RAK3172** will appear in the dashboard then select it.

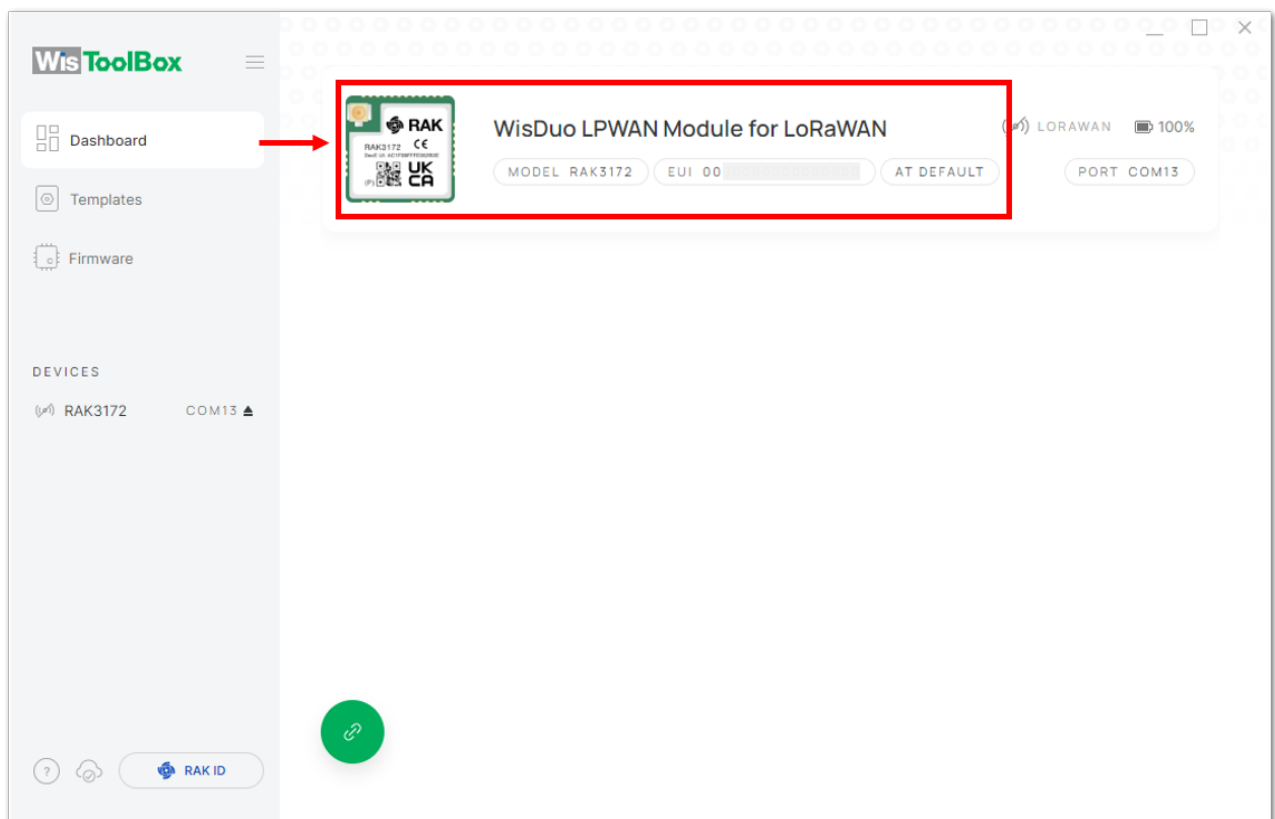


Figure 48: Device seen from WisToolBox dashboard

5. Then click **PARAMETERS** to do the configuration in your RAK3172.

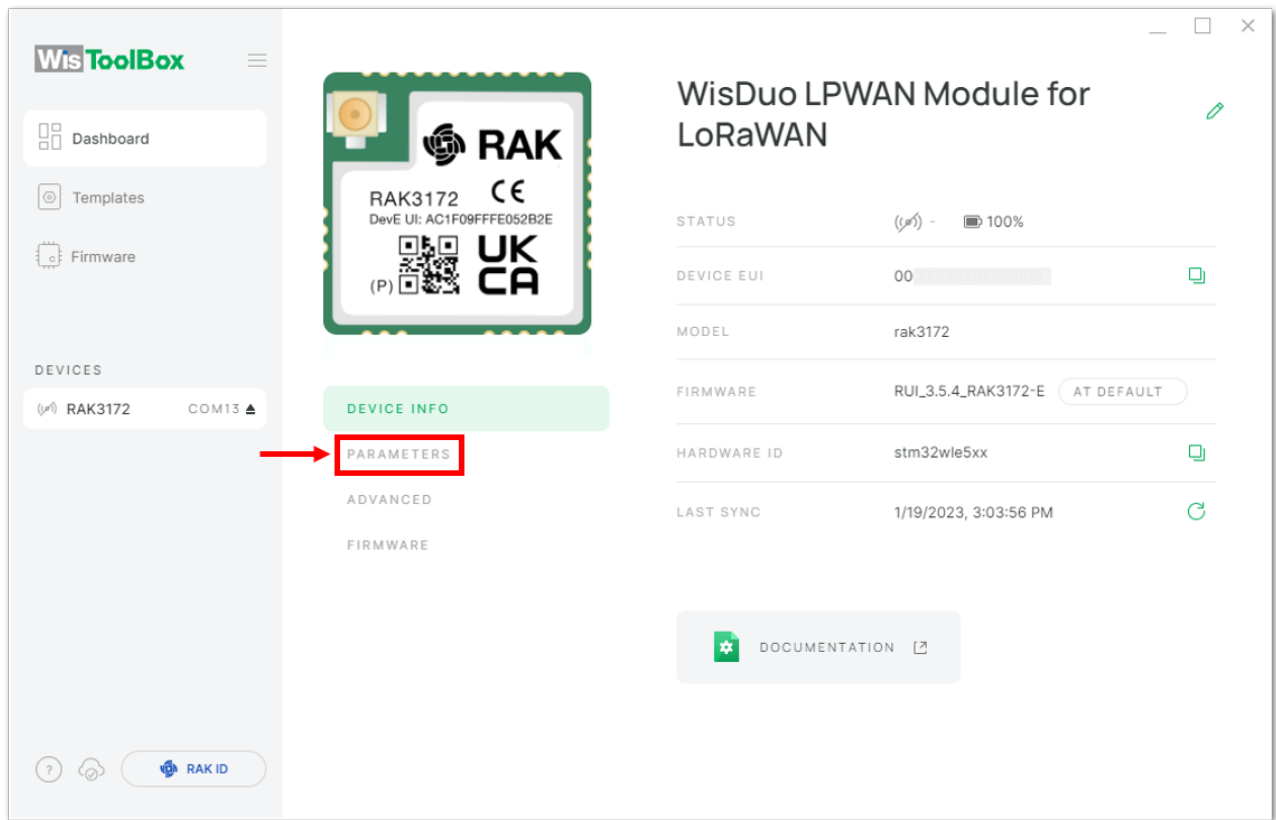


Figure 49: Setting up your device

6. Click **Global settings** to set the network mode into **LoRaWAN** and join mode to **OTAA**. Make sure that the active region is using **EU868** for this configuration. If you wish to work on other regional band, you can choose among active regions based on your location.

- LoRa network mode: **LoRaWAN**
- LoRaWAN join mode: **OTAA**
- LoRaWAN region: **EU868**

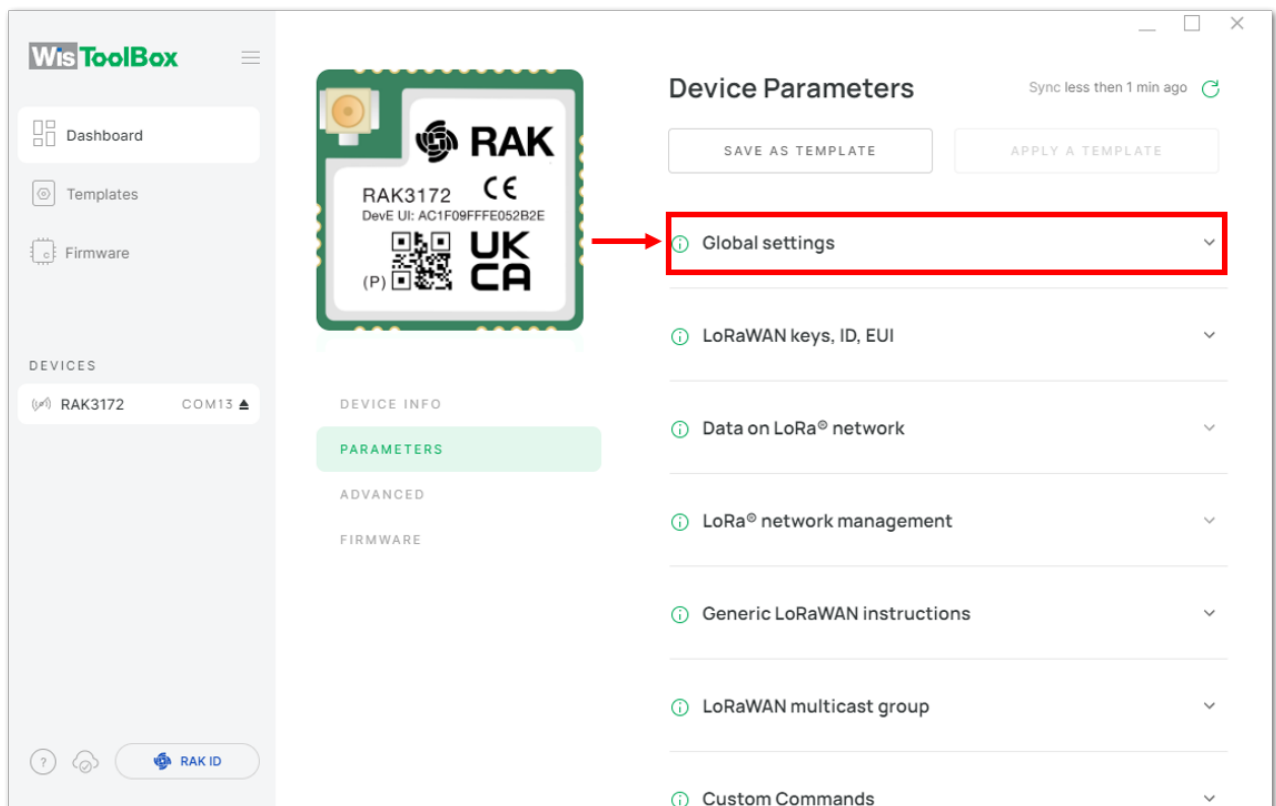


Figure 50: Global settings

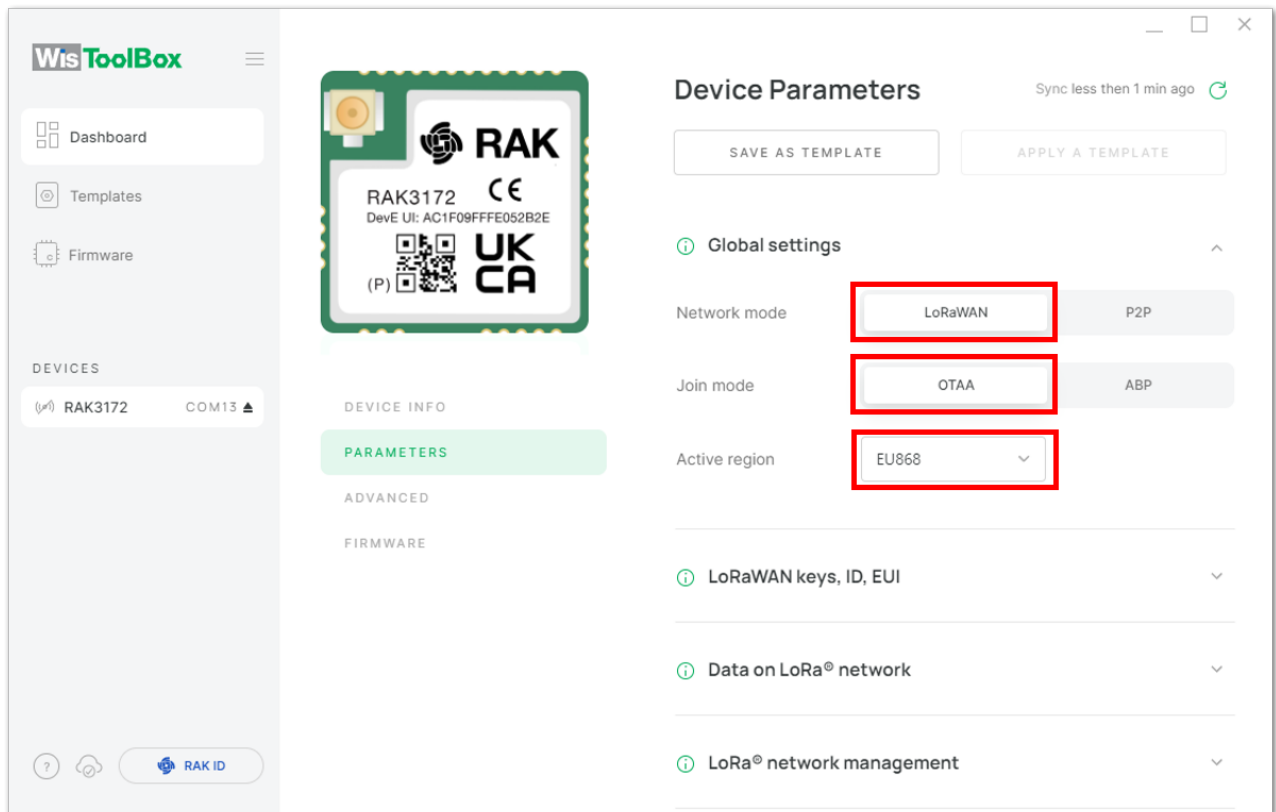


Figure 51: Global settings

7. Then click **LoRaWAN keys, ID, EUI** to configure the **Application EUI (AppEUI)**, **Application key (AppKey)** and **Device EUI (DevEUI)**.

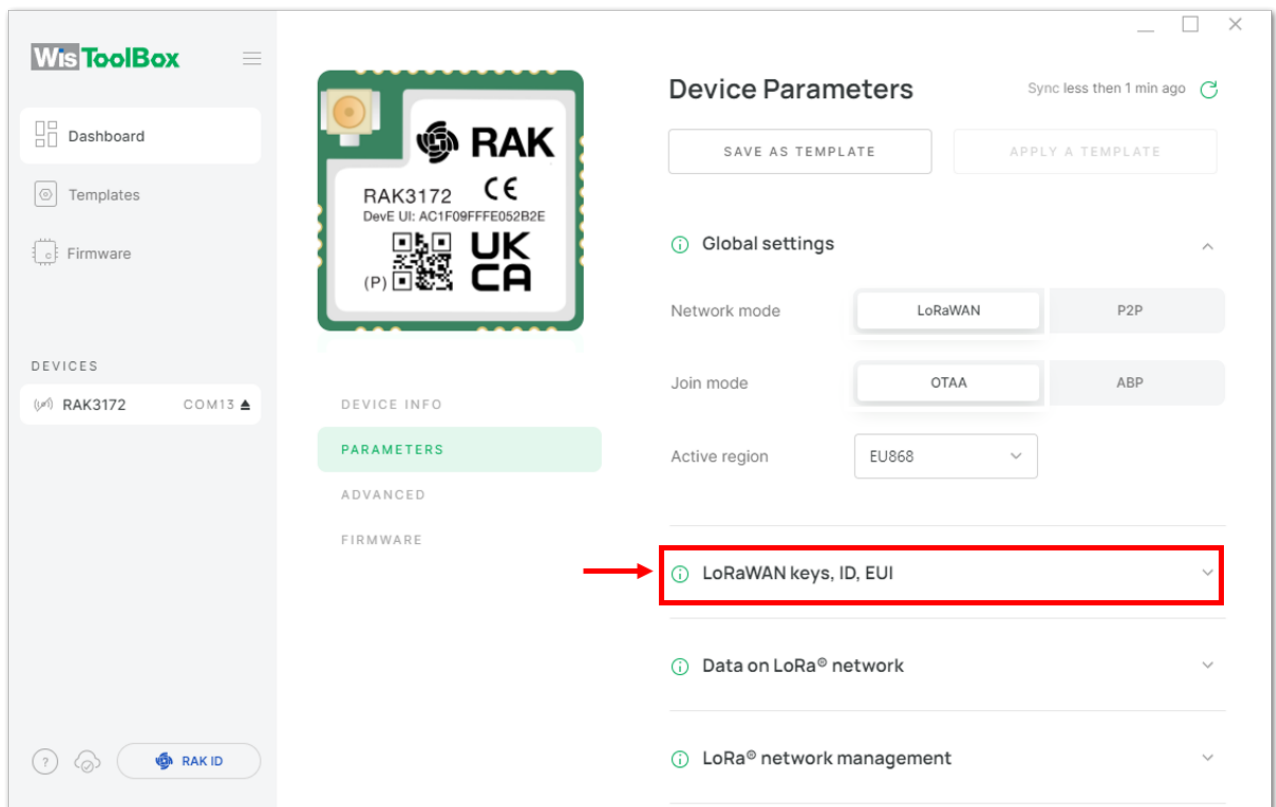


Figure 52: LoRaWAN keys, ID, EUI



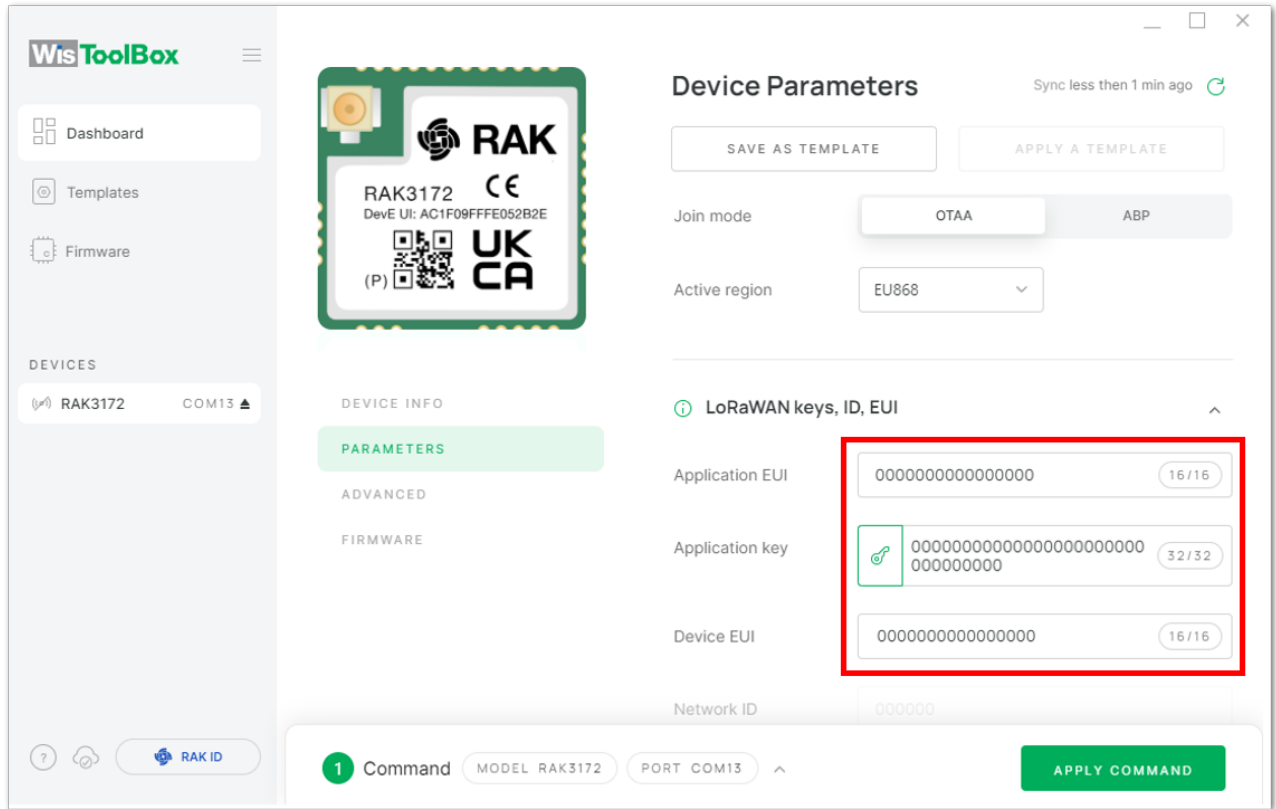


Figure 53: Setting up your device

8. Then go back to console where your RAK3172 End device is created previously. Then copy all the credentials from there. Those will be the ones to be used also in the WisToolBox dashboard. Once encoded into the dashboard, click **APPLY COMMAND** to update your device as shown in **Figure 61**.

**NOTE:**

- The **AppEUI**, **DevEUI**, and **AppKey** are hidden in this section as these are unique from a specific device.

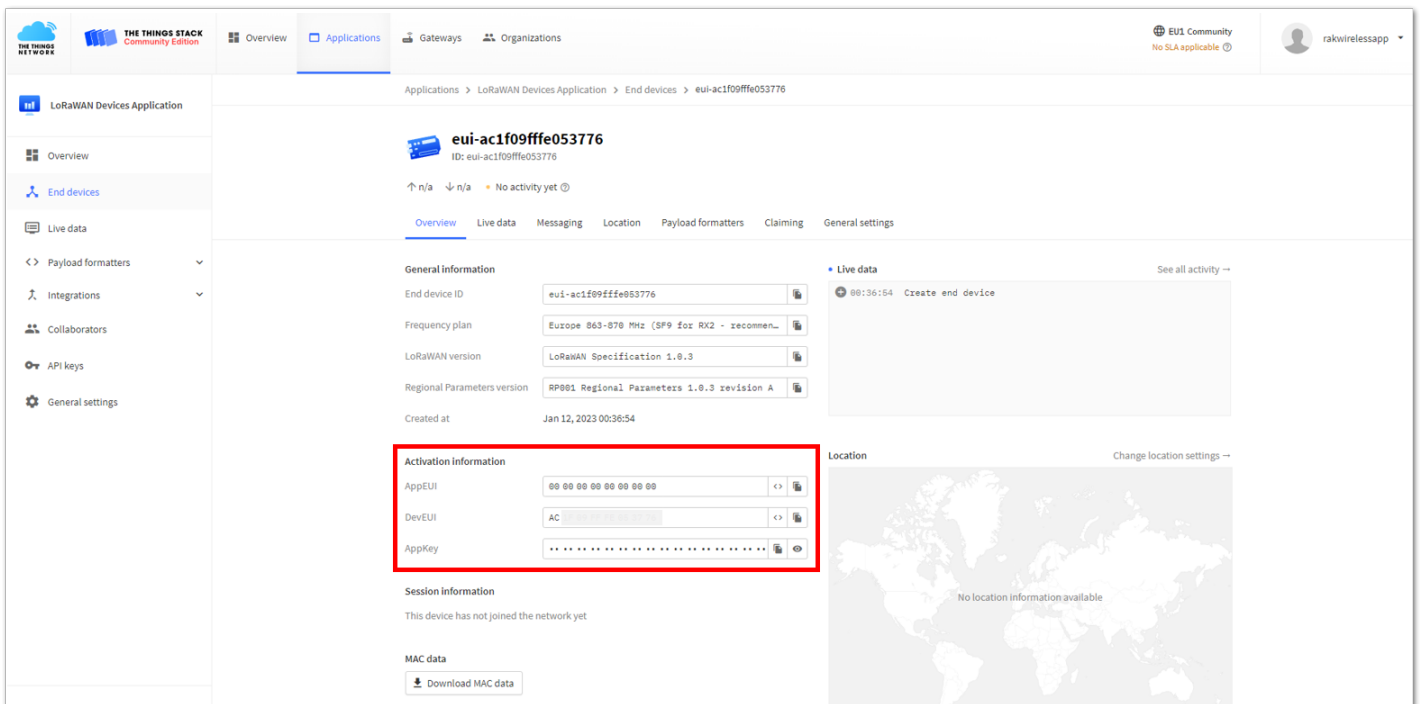


Figure 54: Your created OTAA device from your console

- For **Application EUI (AppEUI)**

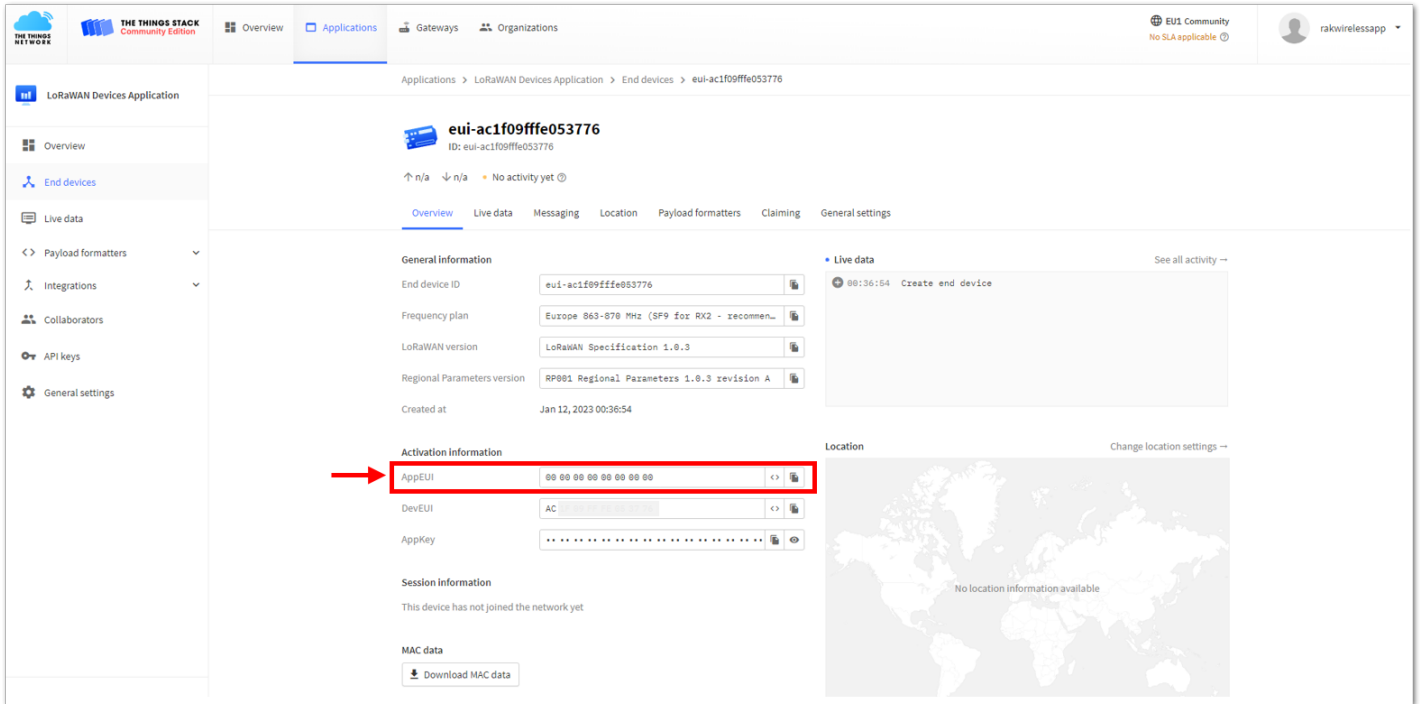


Figure 55: Copying the AppEUI credential from TTN to WisToolBox

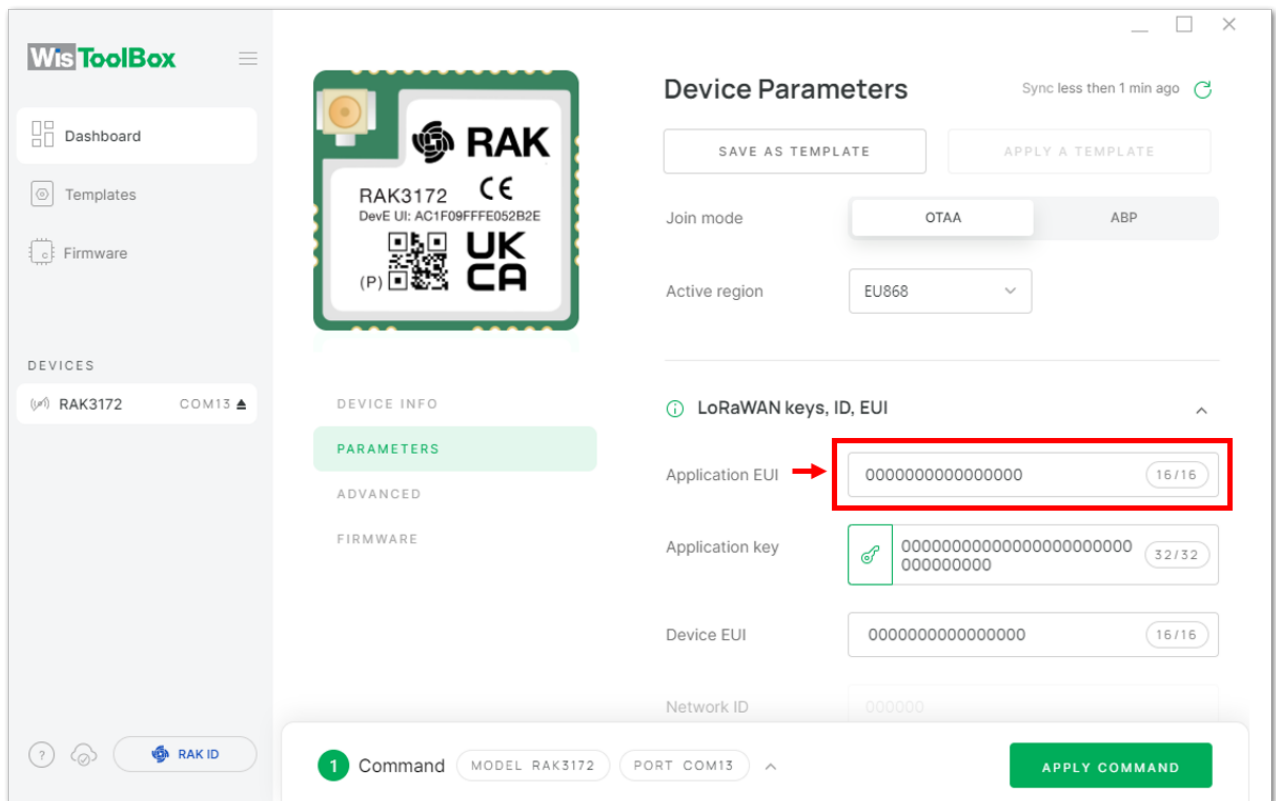


Figure 56: Copying the AppEUI credential from TTN to WisToolBox

- For Application key (AppKey)

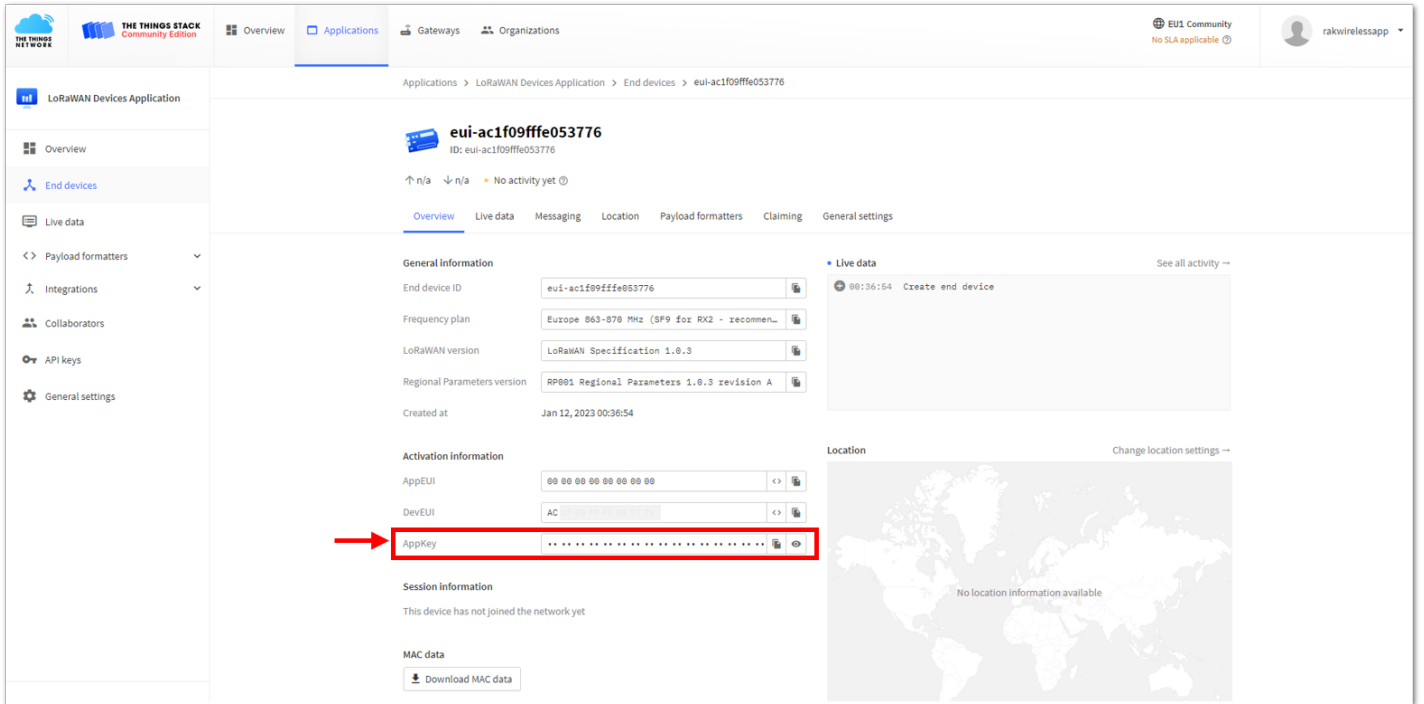


Figure 57: Copying the AppKey credential from TTN to WisToolBox

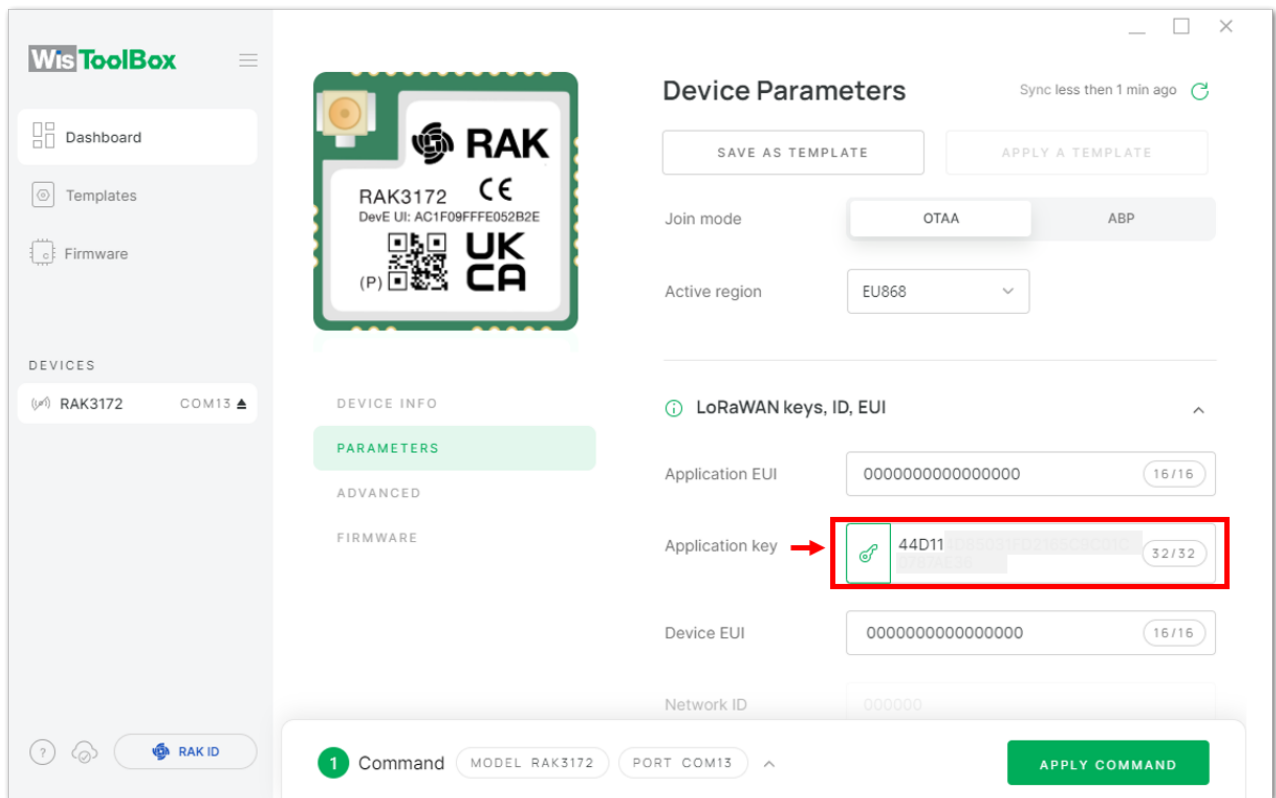


Figure 58: Copying the AppKey credential from TTN to WisToolBox

- For Device EUI (DevEUI)

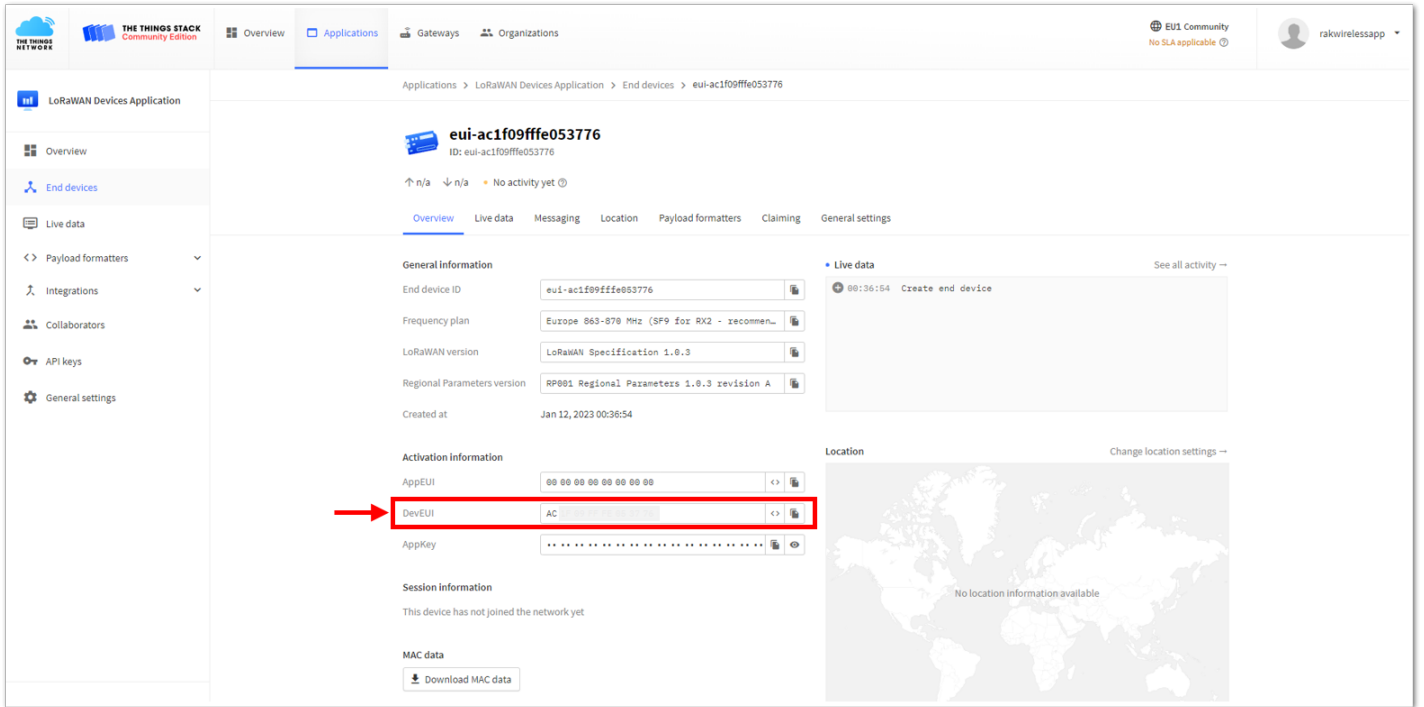


Figure 59: Copying the DevEUI credential from TTN to WisToolBox

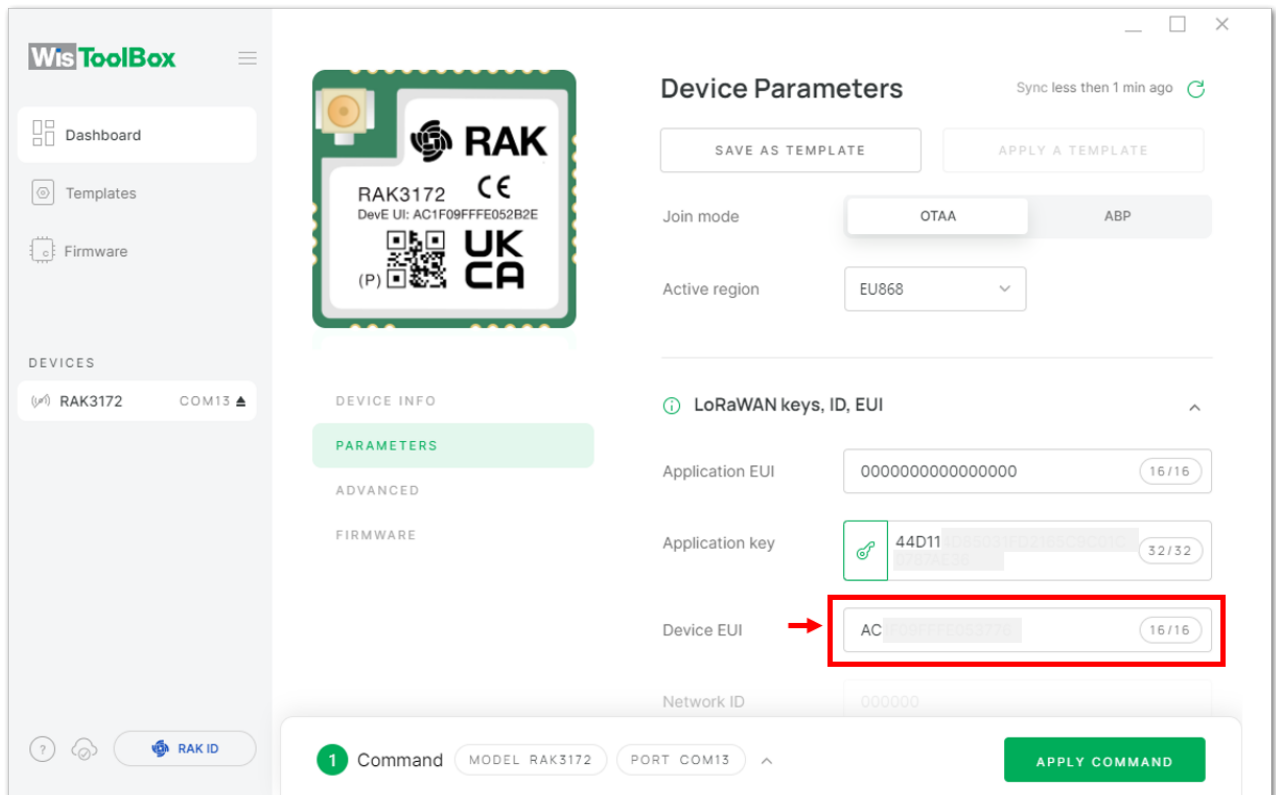


Figure 60: Copying the DevEUI credential from TTN to WisToolBox

- **WisToolBox Dashboard**

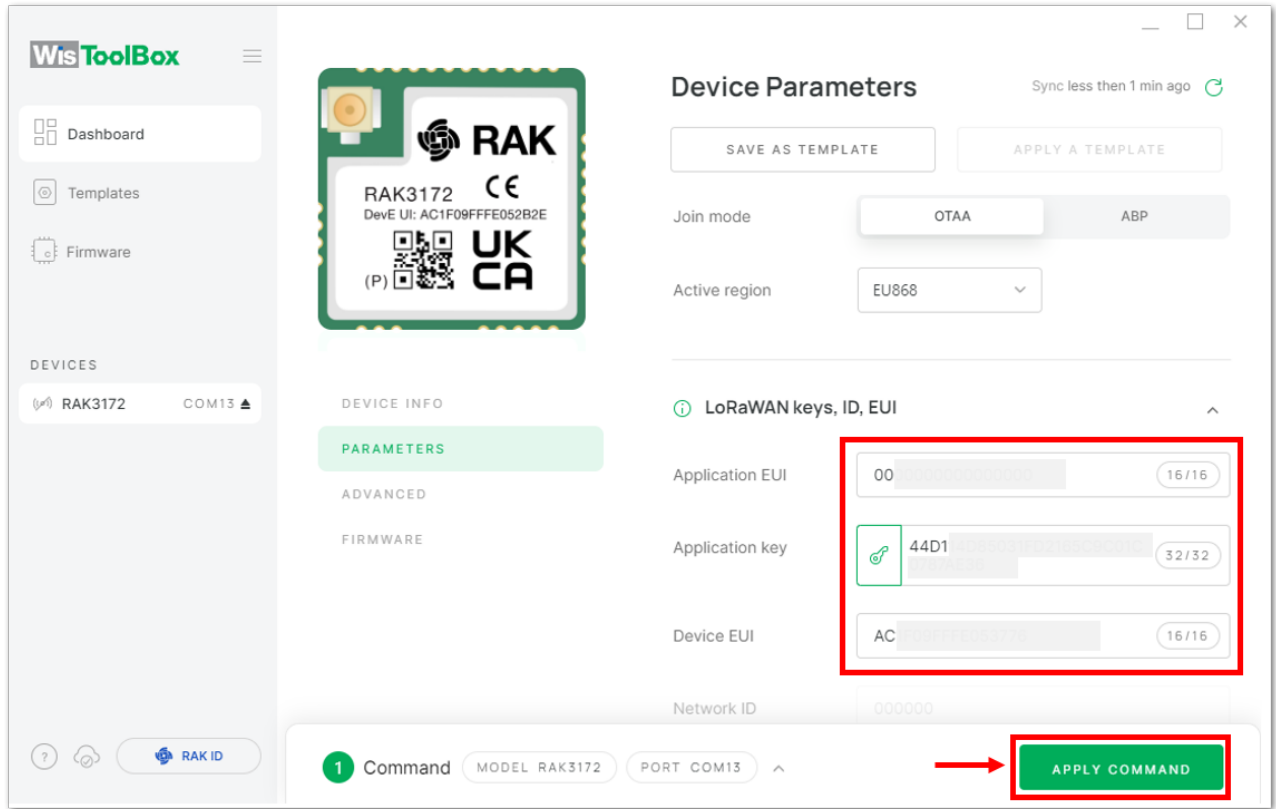


Figure 61: Used credentials from your console in WisToolBox dashboard

9. Once done, you will see the summary of commands that is applied to your device. Then click **CLOSE**.

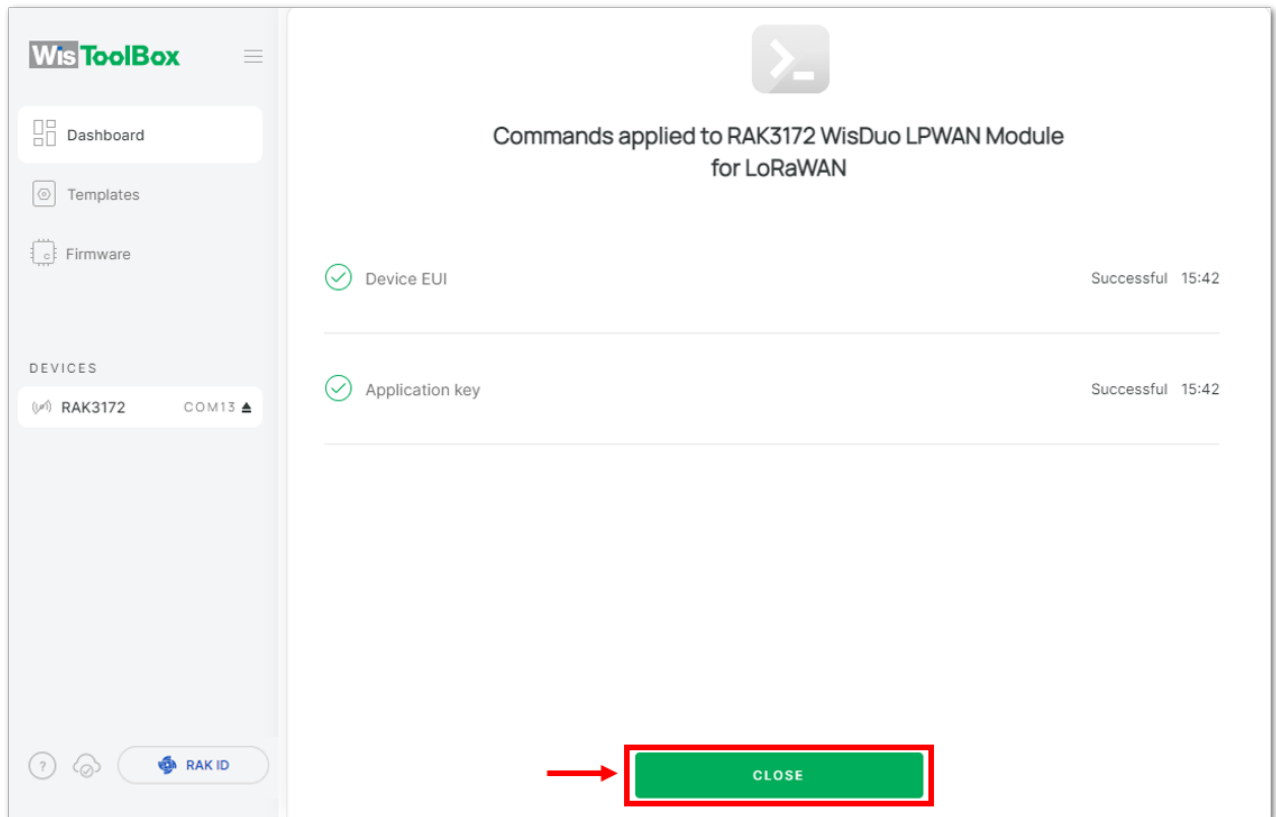


Figure 62: Summary of commands

10. Now you will see it returns back to the dashboard with updated credentials of your device.

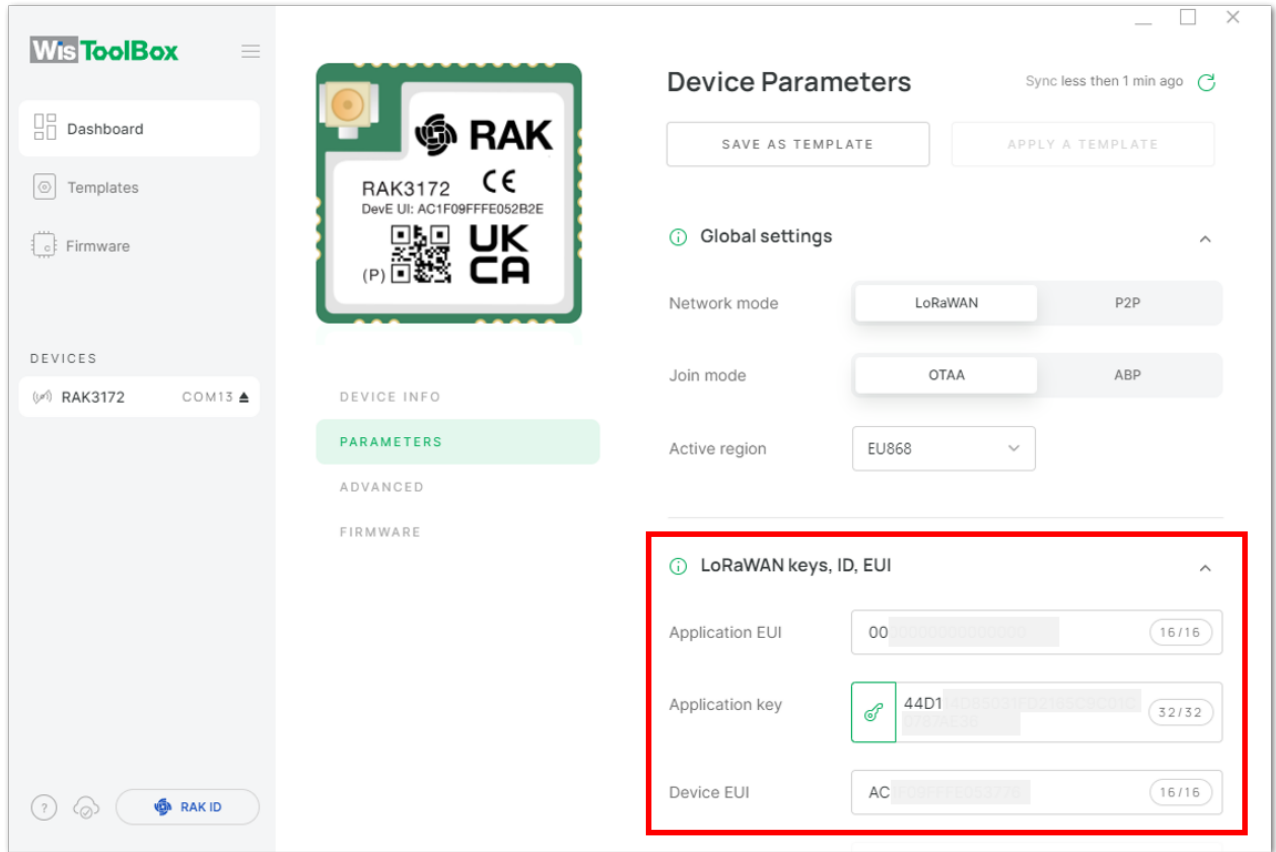


Figure 63: Successfully configured OTAA device via WisToolBox dashboard

- After your device's credentials update, it can now join the network. To do this, you need to go to **Data on LoRa network** under **PARAMETERS**. Then click the **JOIN NETWORK** under **LoRaWAN join settings**. After a few seconds, it will notify you that your OTAA device already joined the TTN server. You can also to your TTN console if your device has successfully joined the TTN.

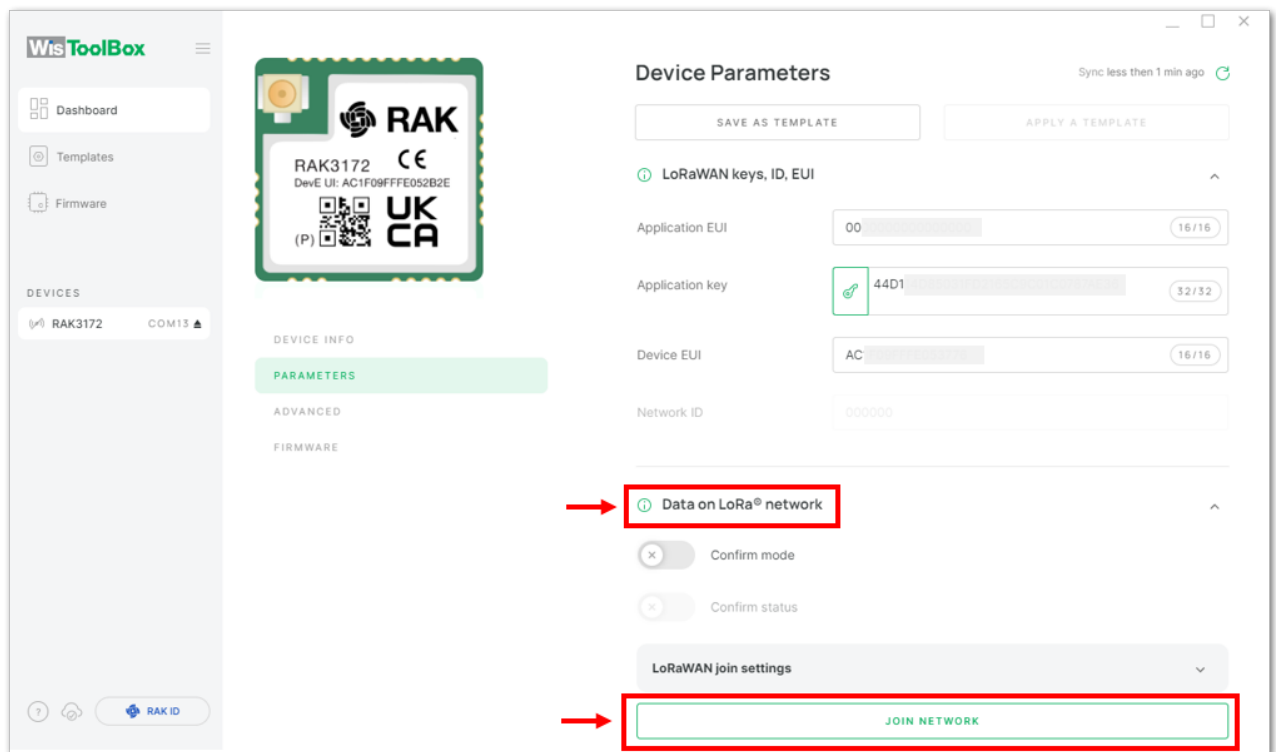


Figure 64: Joining mode of your OTAA device

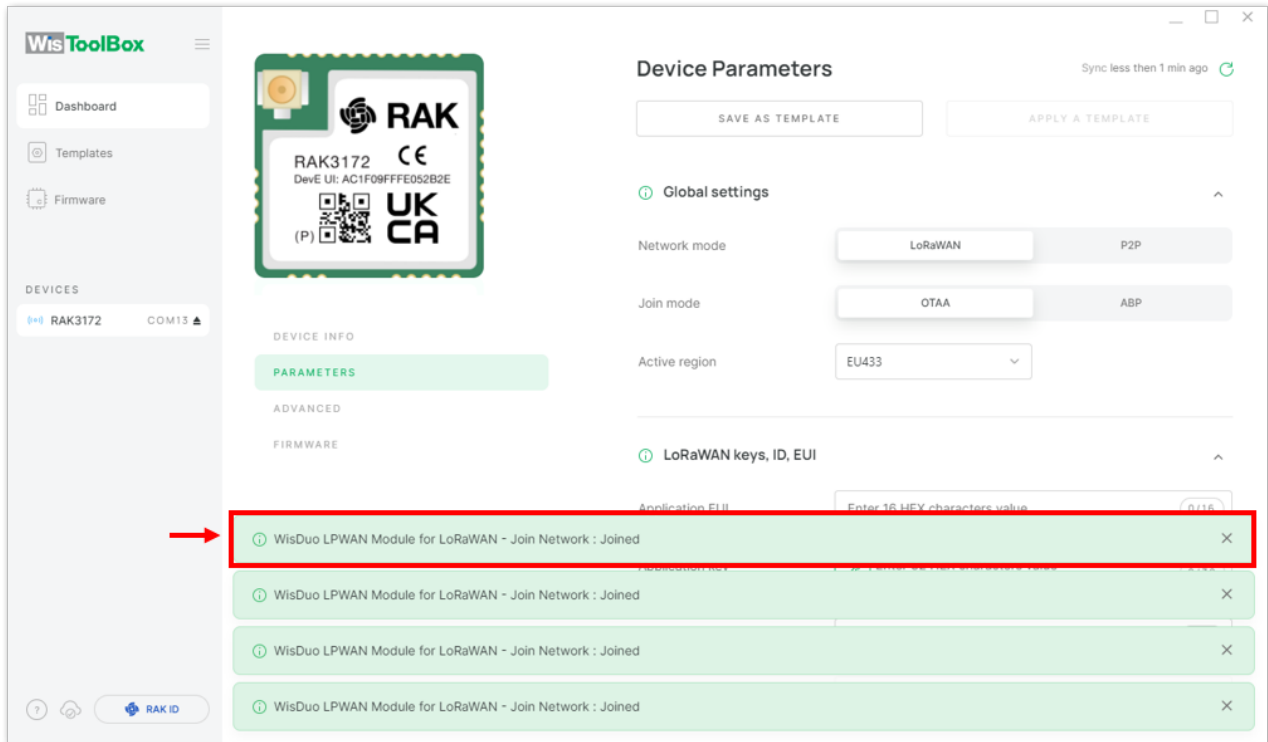


Figure 65: OTAA device successfully joined the TTN server

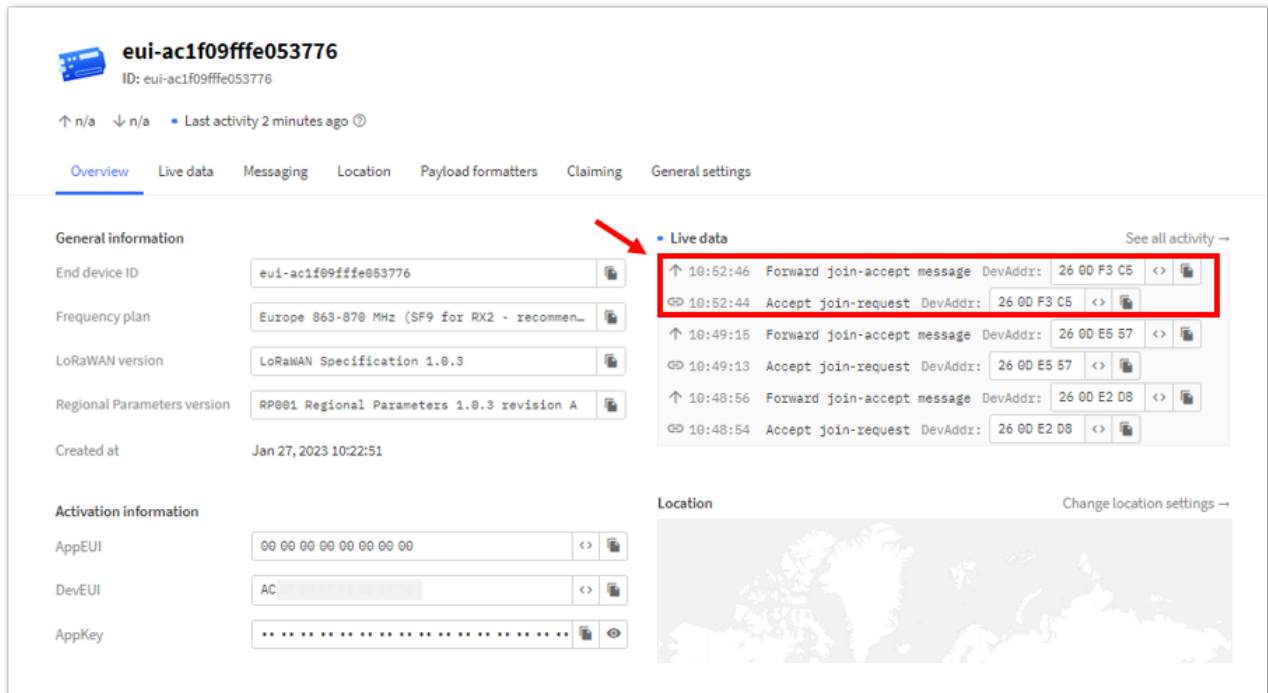


Figure 66: OTAA device successfully joined the TTN server

## OTAA Configuration for TTN via WisToolBox Console

Here's another way of OTAA configuration using **WisToolBox Console**. Below are the steps on setting up your **RAK3172** using **WisToolBox Console**.

1. Connect your **RAK3172** with your chosen WisBlock base board to the PC via USB cable and open the **WisToolBox** application.
2. Click **CONNECT DEVICE** button to launch the WisToolBox Dashboard.

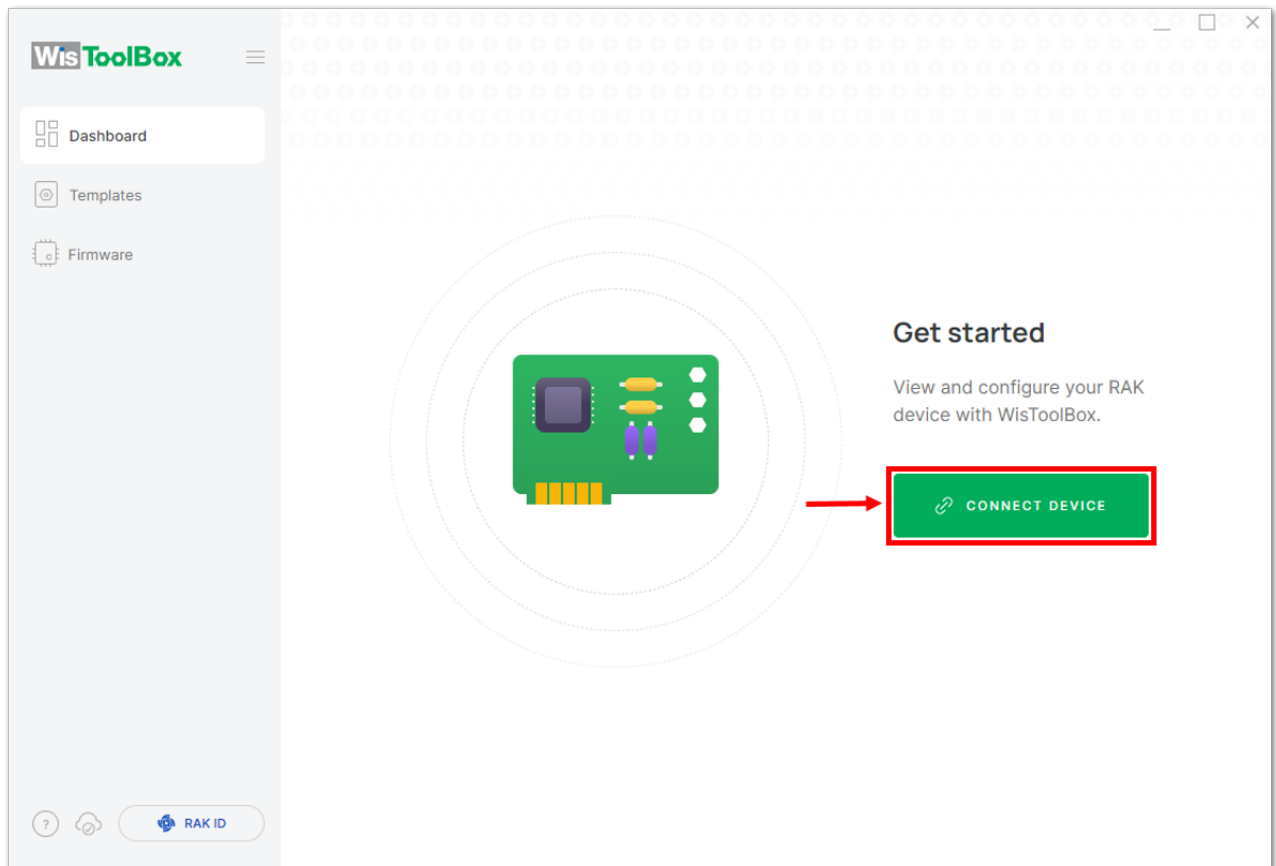


Figure 67: CONNECT DEVICE

3. Then select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT** as shown in **Figure 69**.

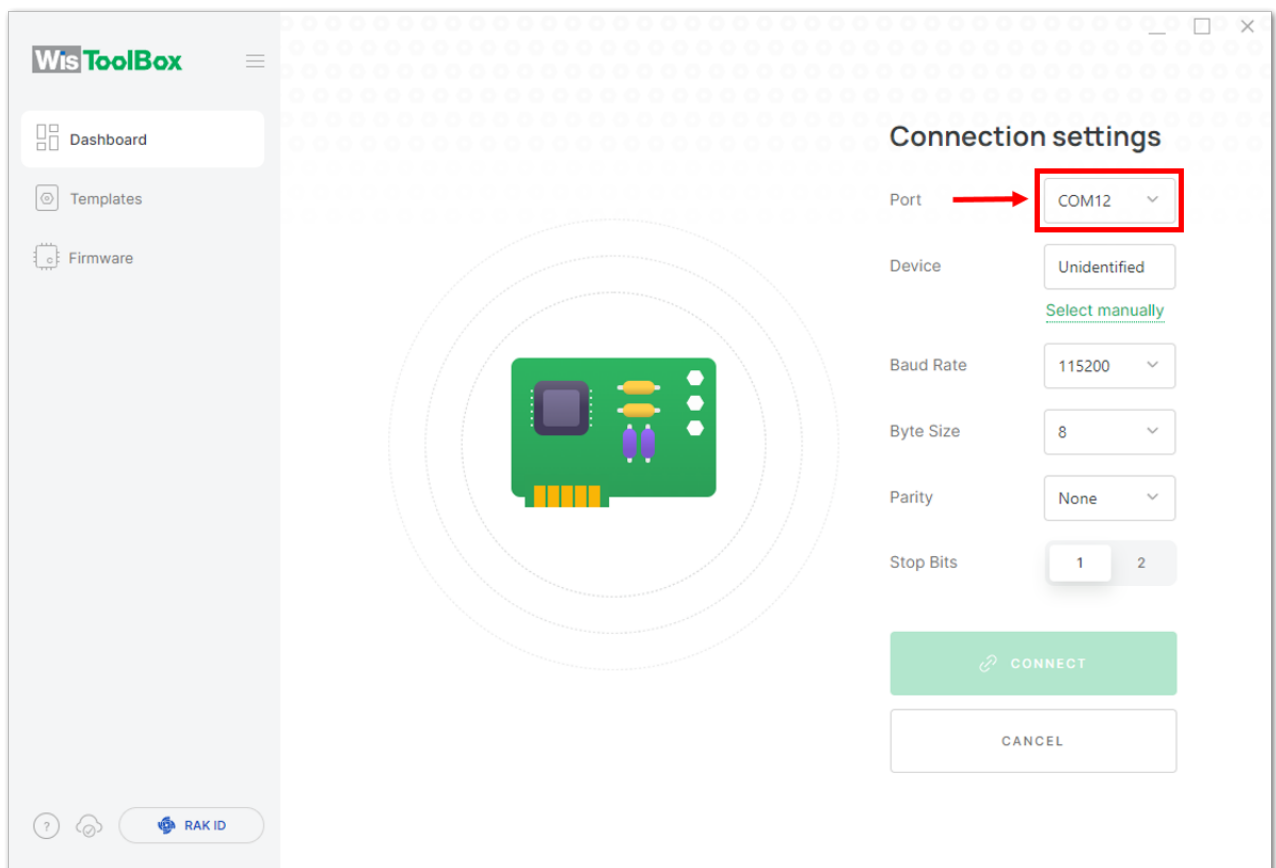


Figure 68: Setting up your device



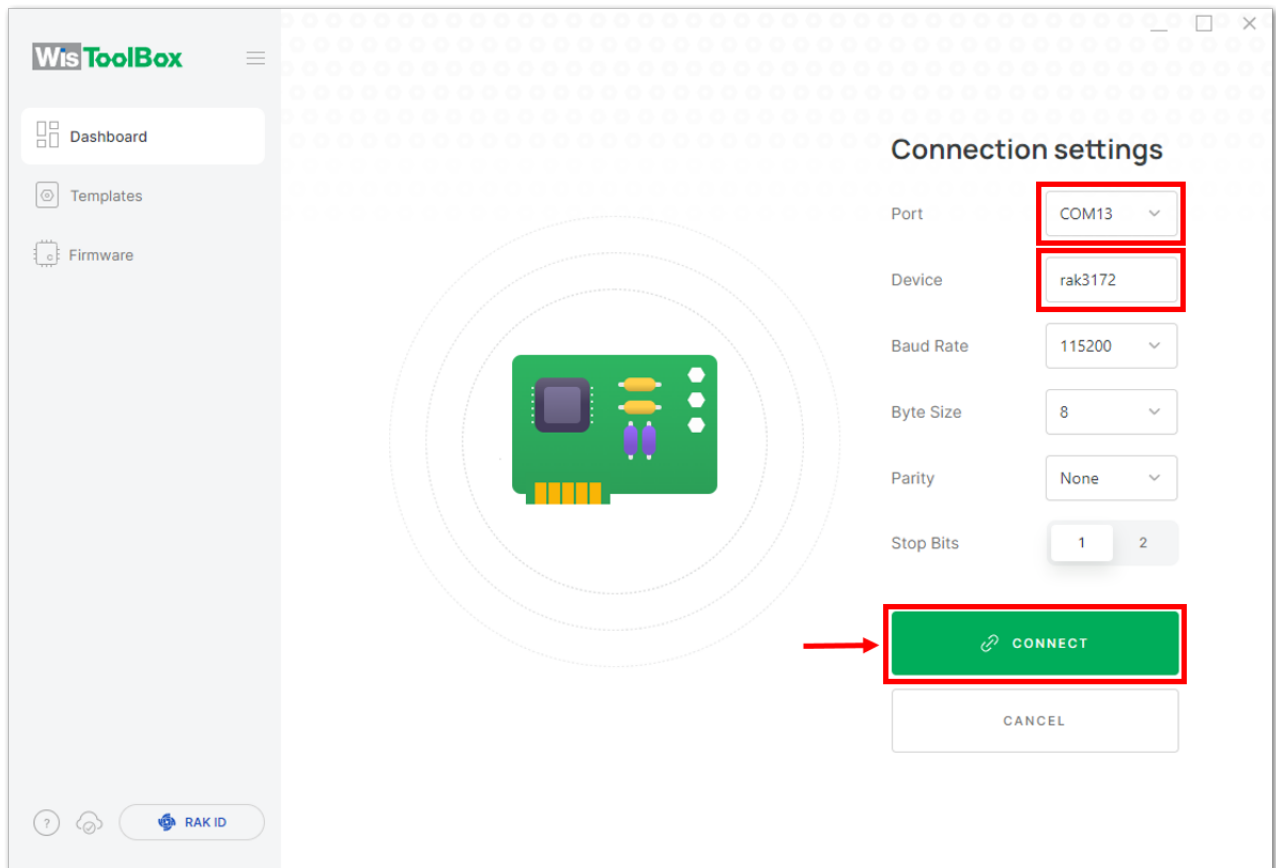


Figure 69: Setting up your device

4. Once done, **RAK3172** will appear in the dashboard then select it.

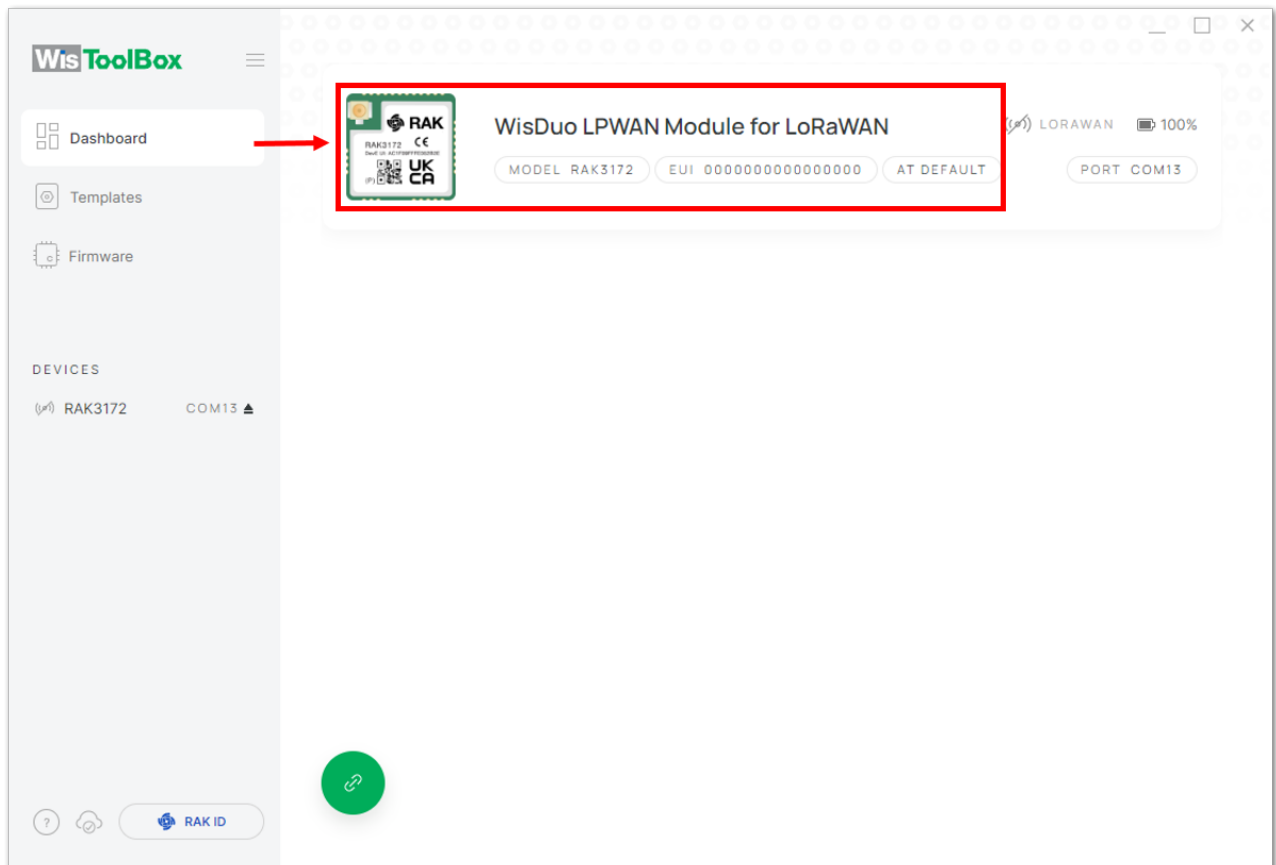


Figure 70: Device seen from WisToolBox dashboard

5. Then click **ADVANCED**.

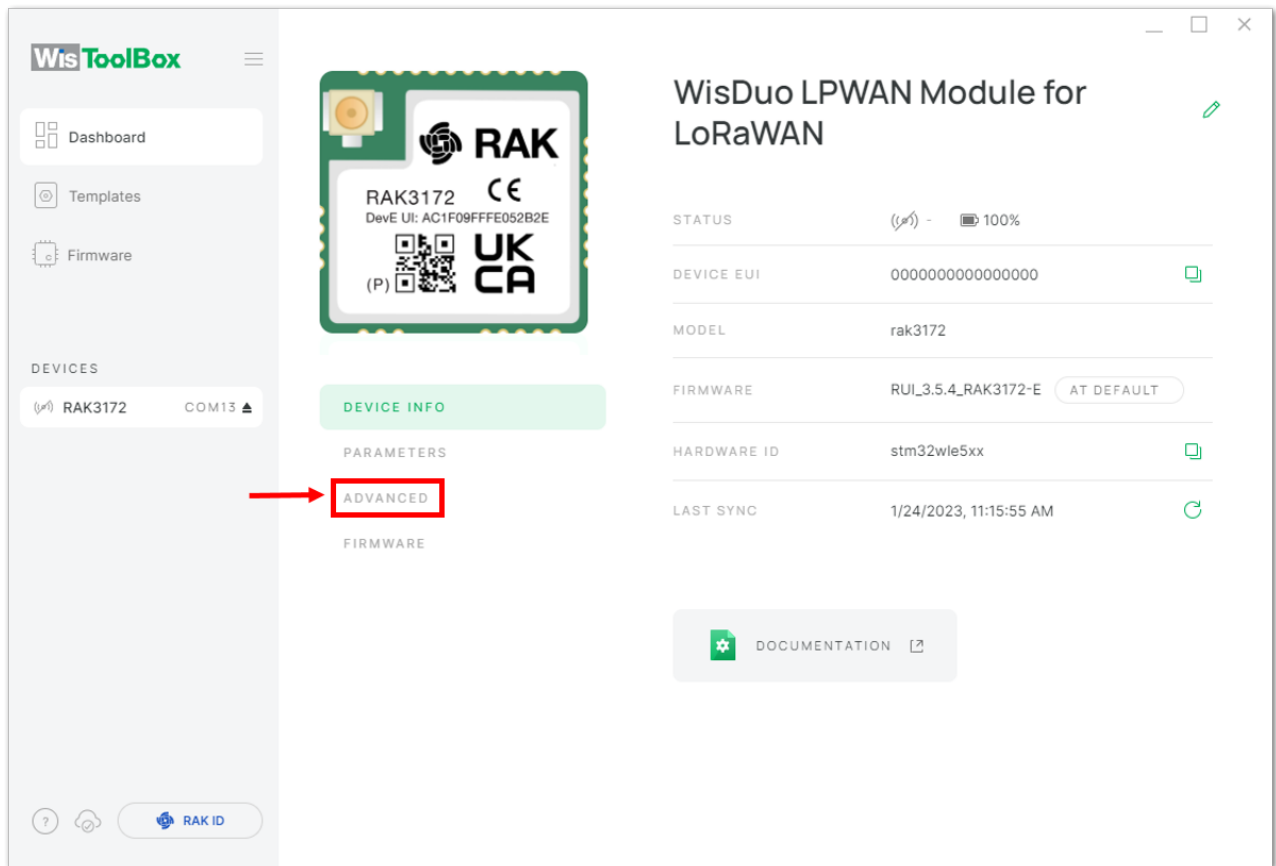


Figure 71: Setting up your device

6. Once done, click **OPEN CONSOLE** to do the configuration.

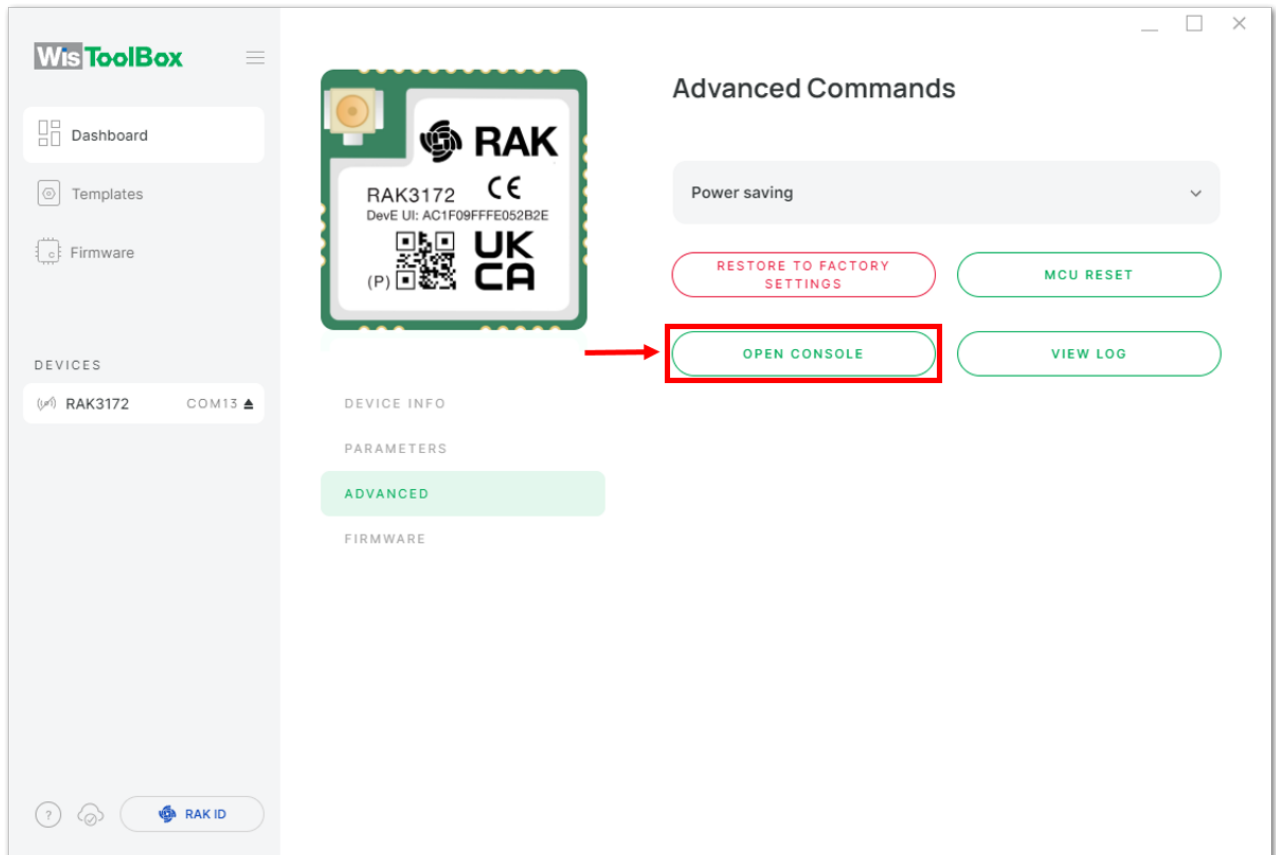


Figure 72: OPEN CONSOLE

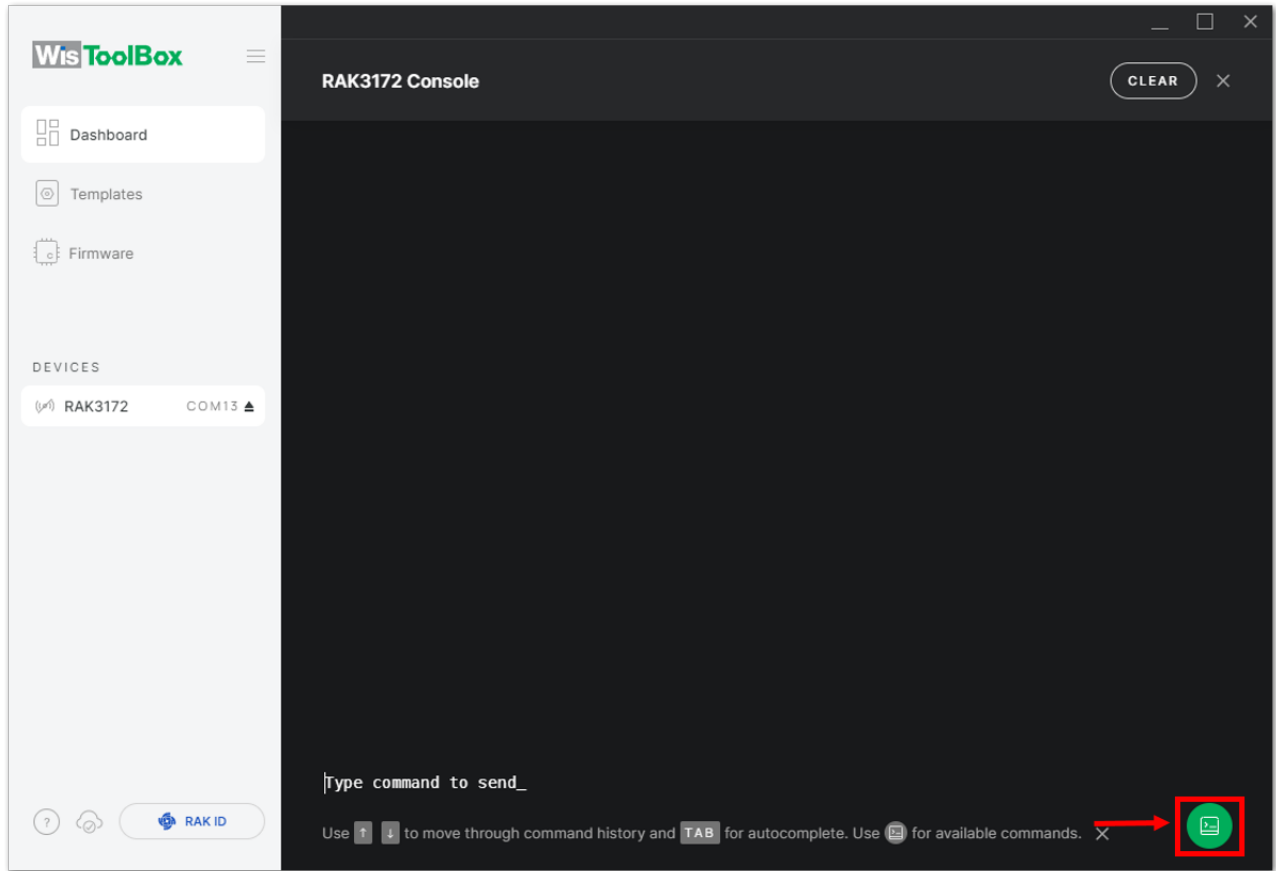


Figure 73: Opening the Console terminal of WisToolBox

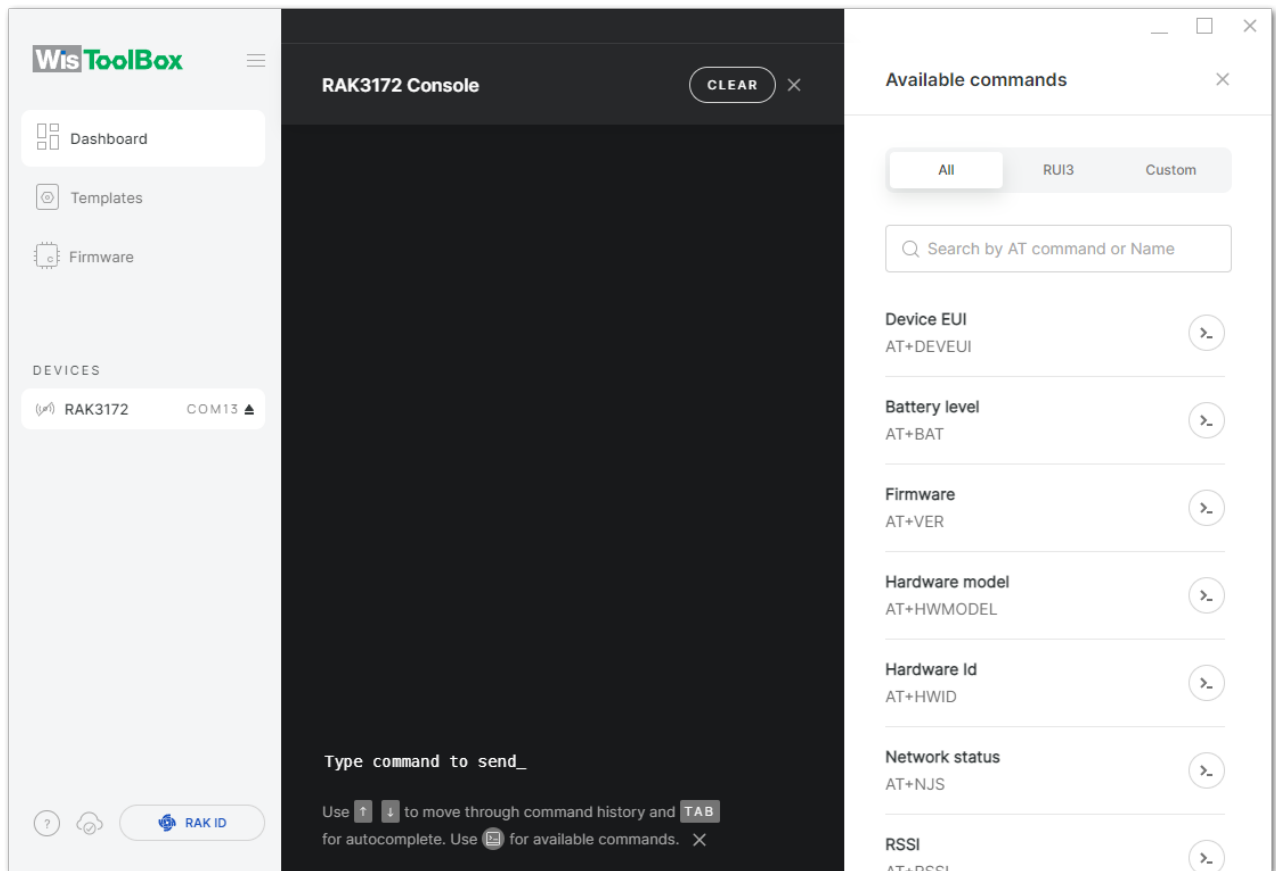


Figure 74: Opening the Console terminal of WisToolBox

7. To start the configuration, type **ATE** so you can echo the commands you input during your configuration. Then press **Enter**.

It is recommended to start by testing the console and verify that the current configuration is working by sending these two AT commands:

```
AT
```

ATE

ATE is useful for tracking the commands and troubleshooting.

You will receive OK when you input the two commands. After setting ATE, you can now see all the commands you input together with the replies.

**NOTE:**

If there is no OK or any reply, check if the device is powered correctly. If you are getting power from a USB port, ensure that you have a good USB cable.

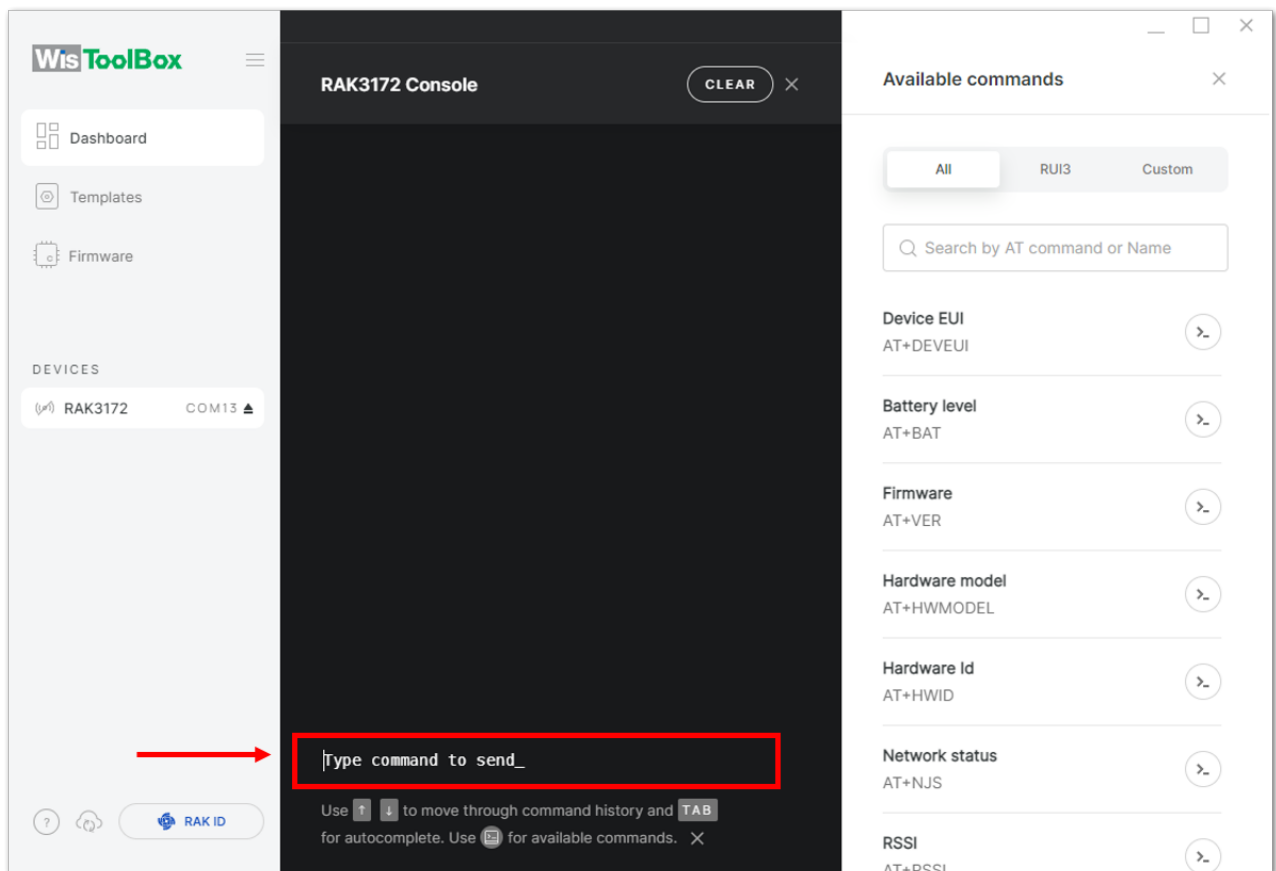


Figure 75: Setting up your Console

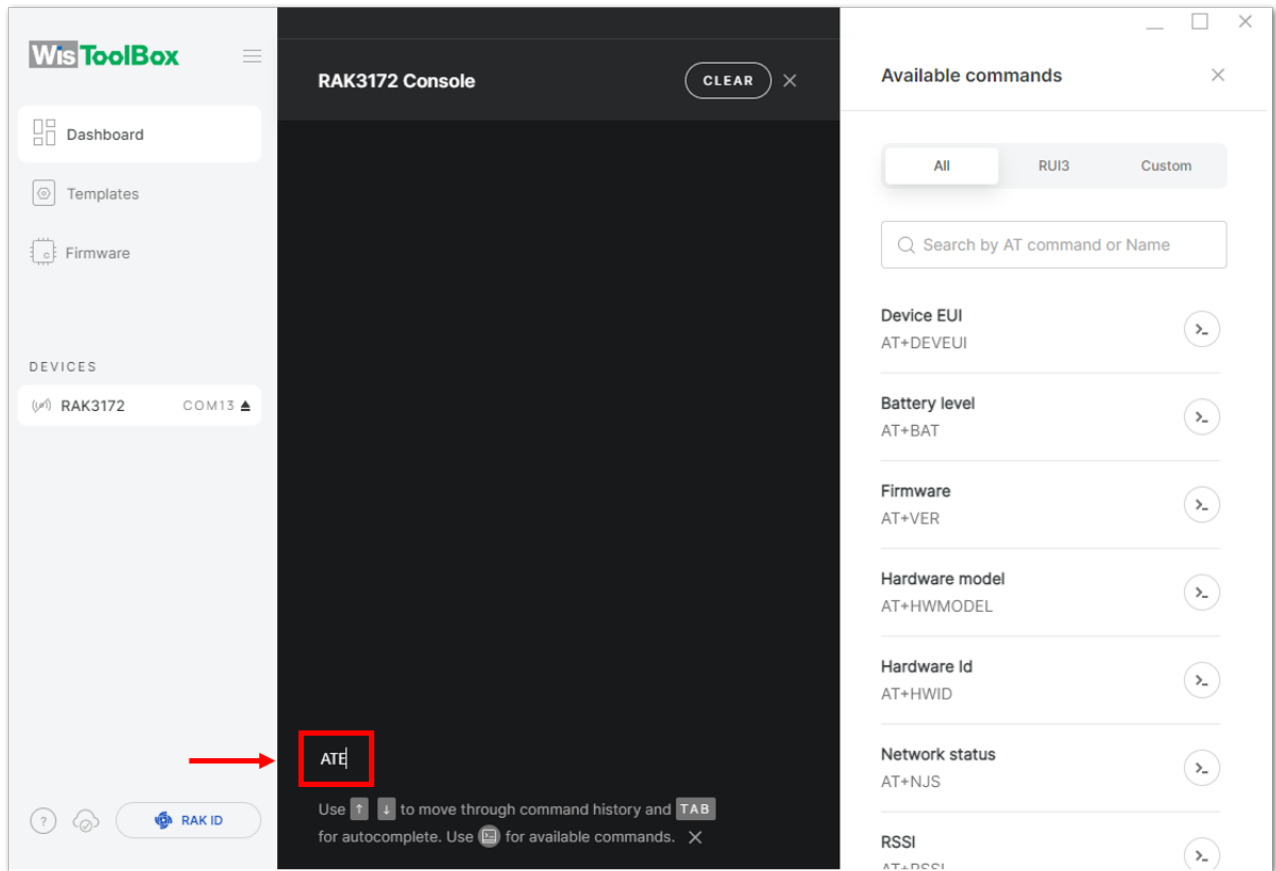


Figure 76: Setting up your Console

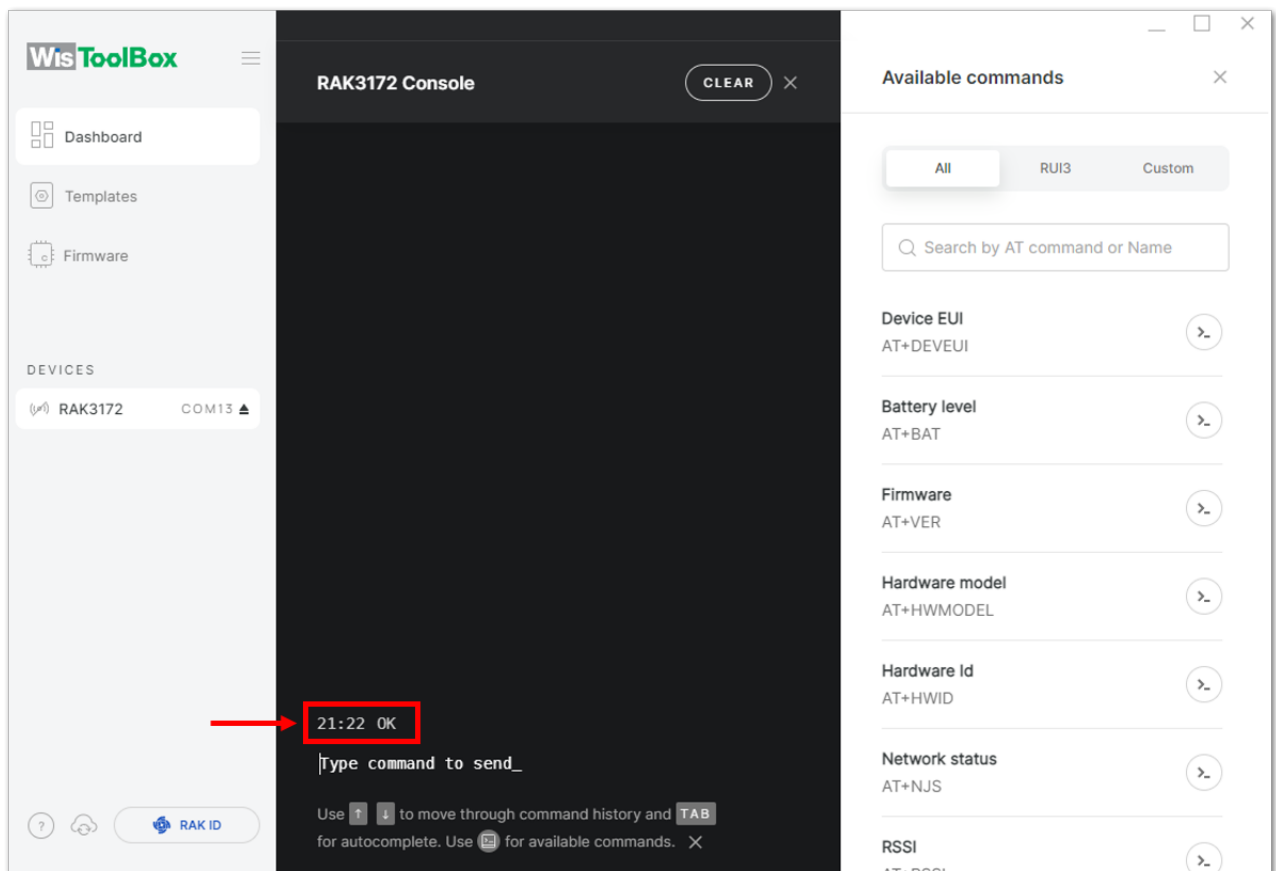


Figure 77: Setting up your Console

8. Then configure the LoRaWAN join mode to **OTAA**. You can check what parameter you will input by typing **AT+NJM?** then **Enter** into the console terminal. For **OTAA**, you should input **AT+NJM=1** then press **Enter** as shown in **Figure 80**.

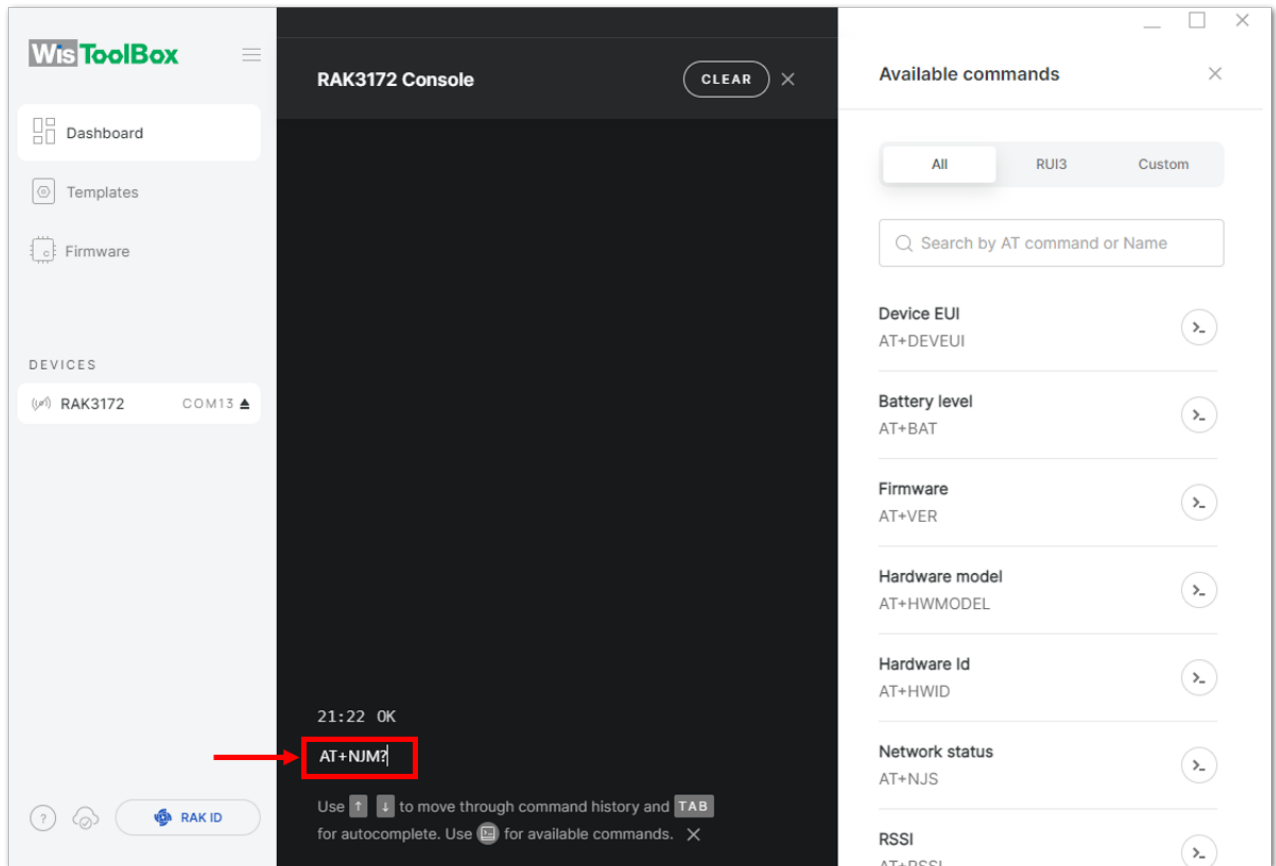


Figure 78: Setting up your Console

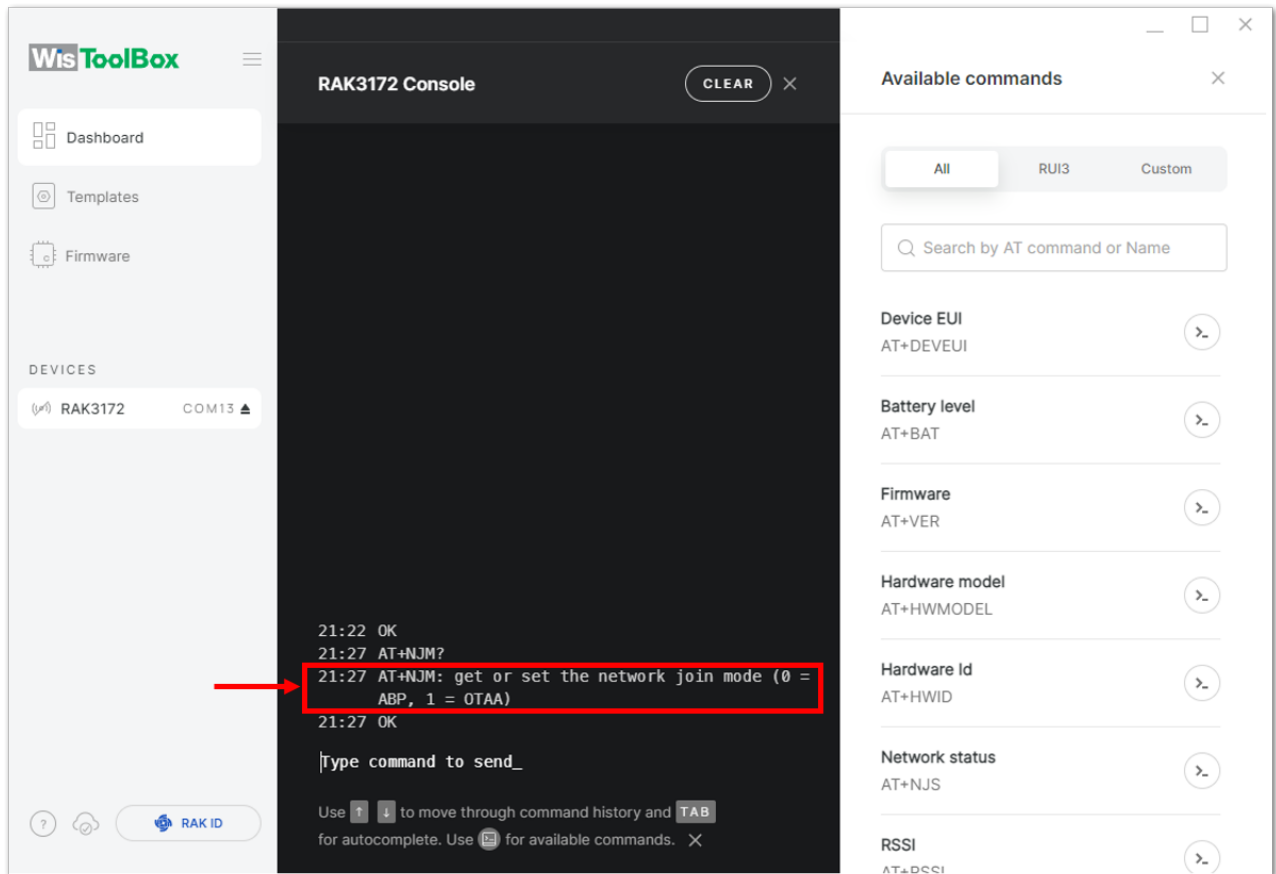


Figure 79: Setting up your Console

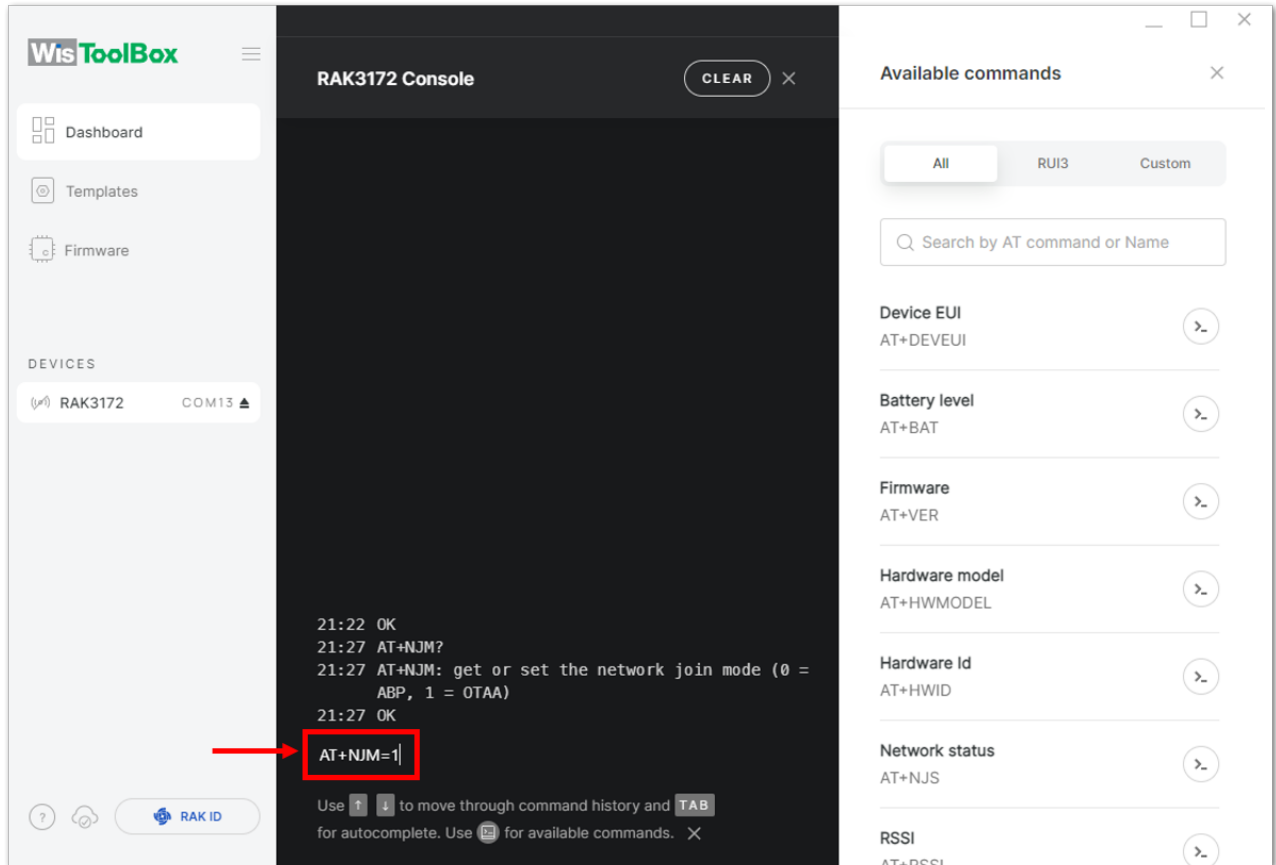


Figure 80: Setting up your Console

9. Once done, set-up your LoRaWAN region to EU868. You can check what parameter you will input by typing **AT+BAND?** then **Enter** into the console terminal. For **EU868**, you should input **AT+BAND=4** then press **Enter**. If you wish to work on other regional band, you may check the list of band parameter options below.

Set the frequency/region to EU868.

```
AT+BAND=4
```

**NOTE:**

Depending on the Regional Band you selected, you might need to configure the sub-band of your RAK3172 to match the gateway and LoRaWAN network server. This is especially important for Regional Bands like US915, AU915, and CN470.

To configure the masking of channels for the sub-bands, you can use the `AT+MASK` command that can be found on the [AT Command Manual](#) .

To illustrate, you can use sub-band 2 by sending the command `AT+MASK=0002` .

**List of band parameter options**

Code	Regional Band
0	EU433
1	CN470
2	RU864

Code	Regional Band
3	IN865
4	EU868
5	US915
6	AU915
7	KR920
8	AS923-1
9	AS923-2
10	AS923-3
11	AS923-4

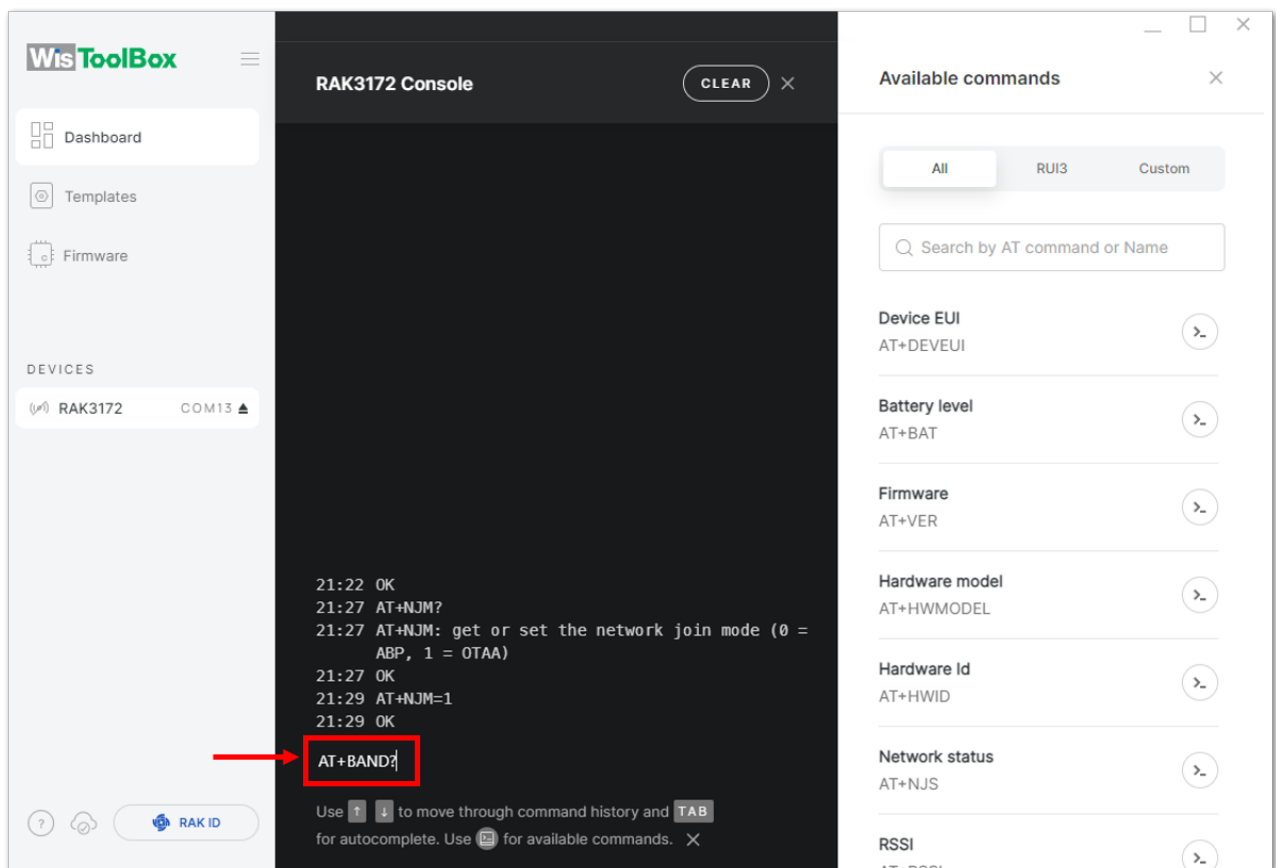


Figure 81: Setting up your Console



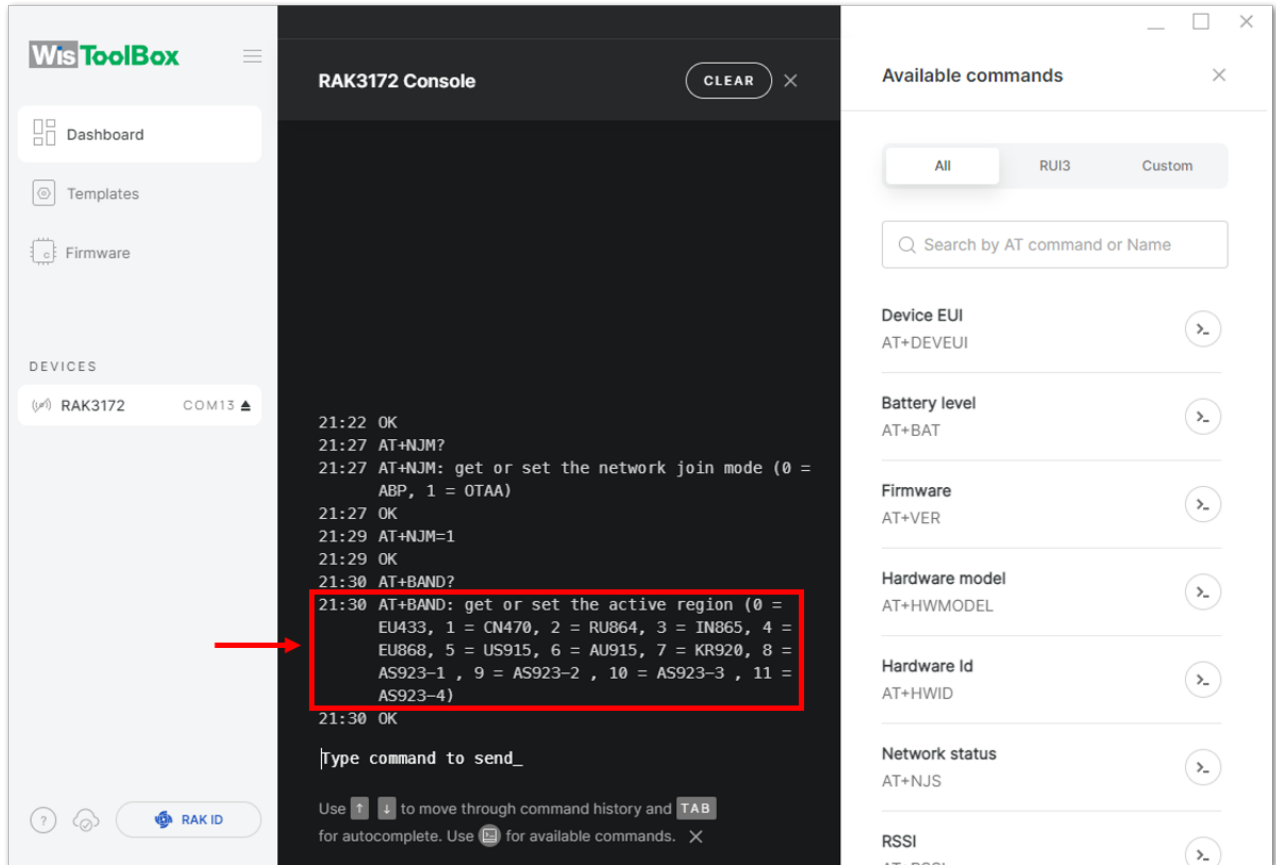


Figure 82: Setting up your Console

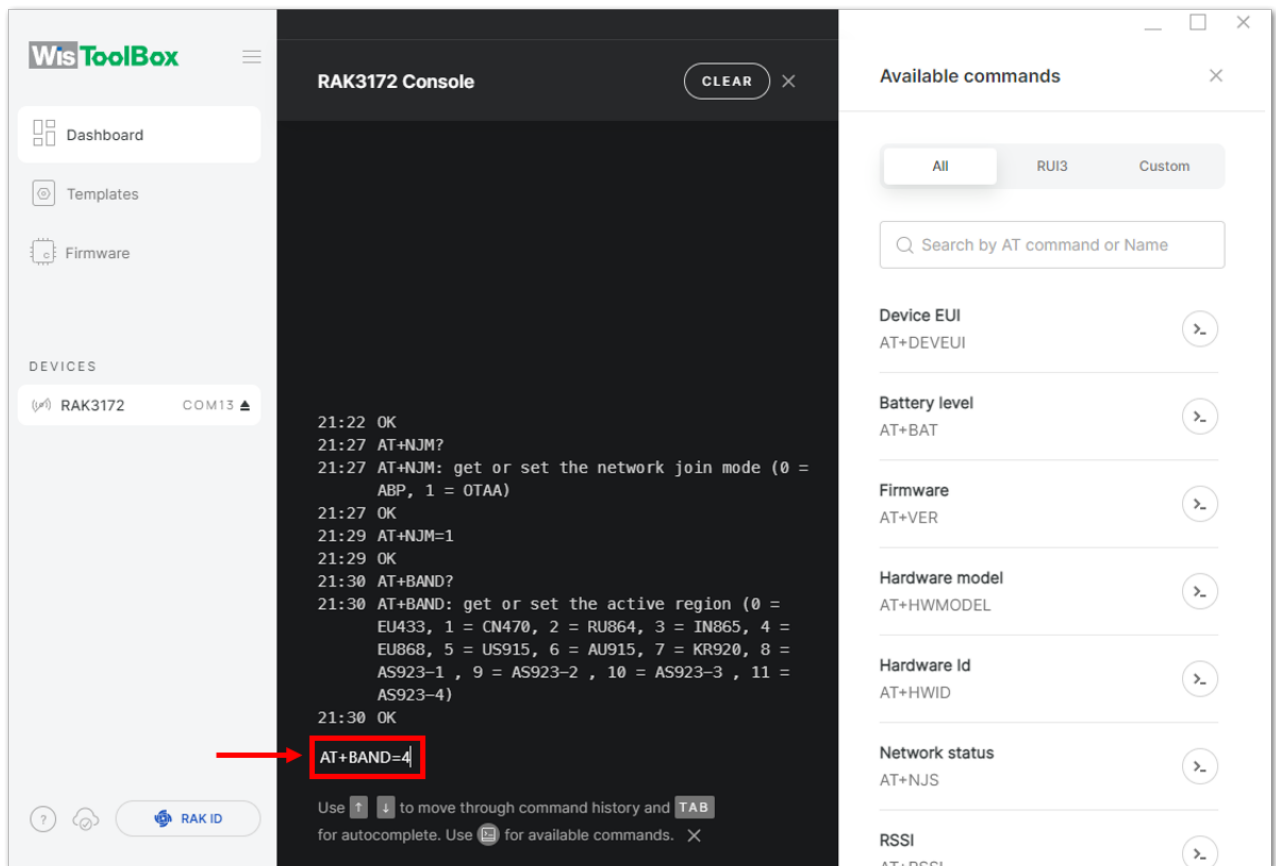
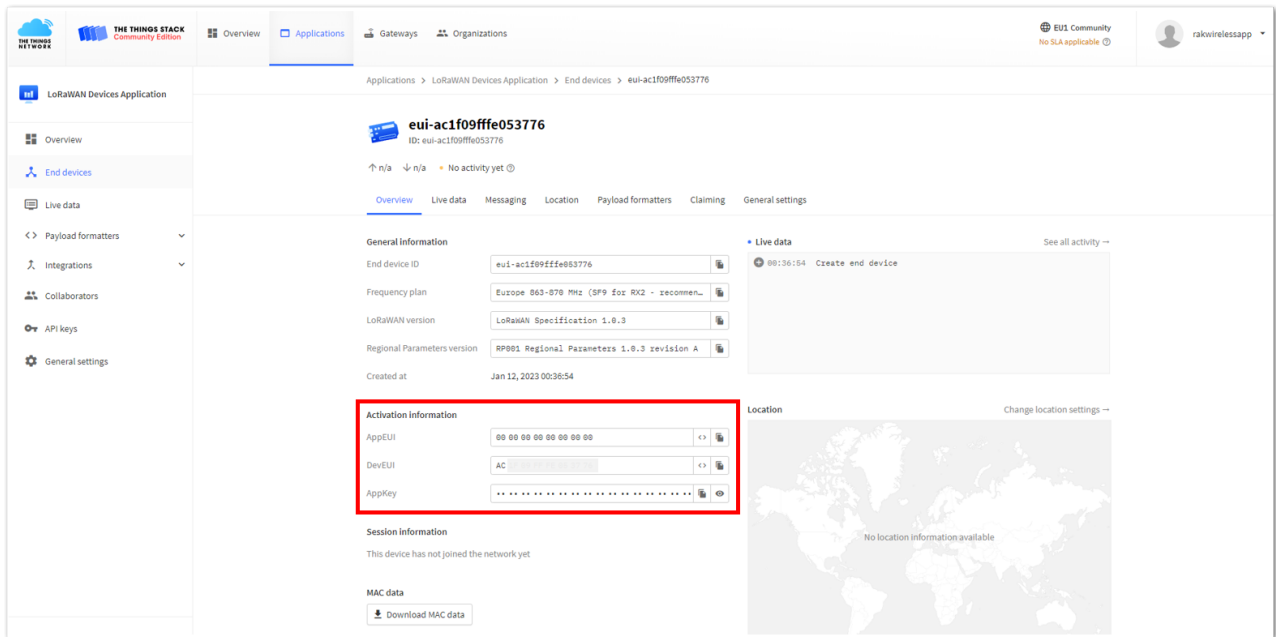
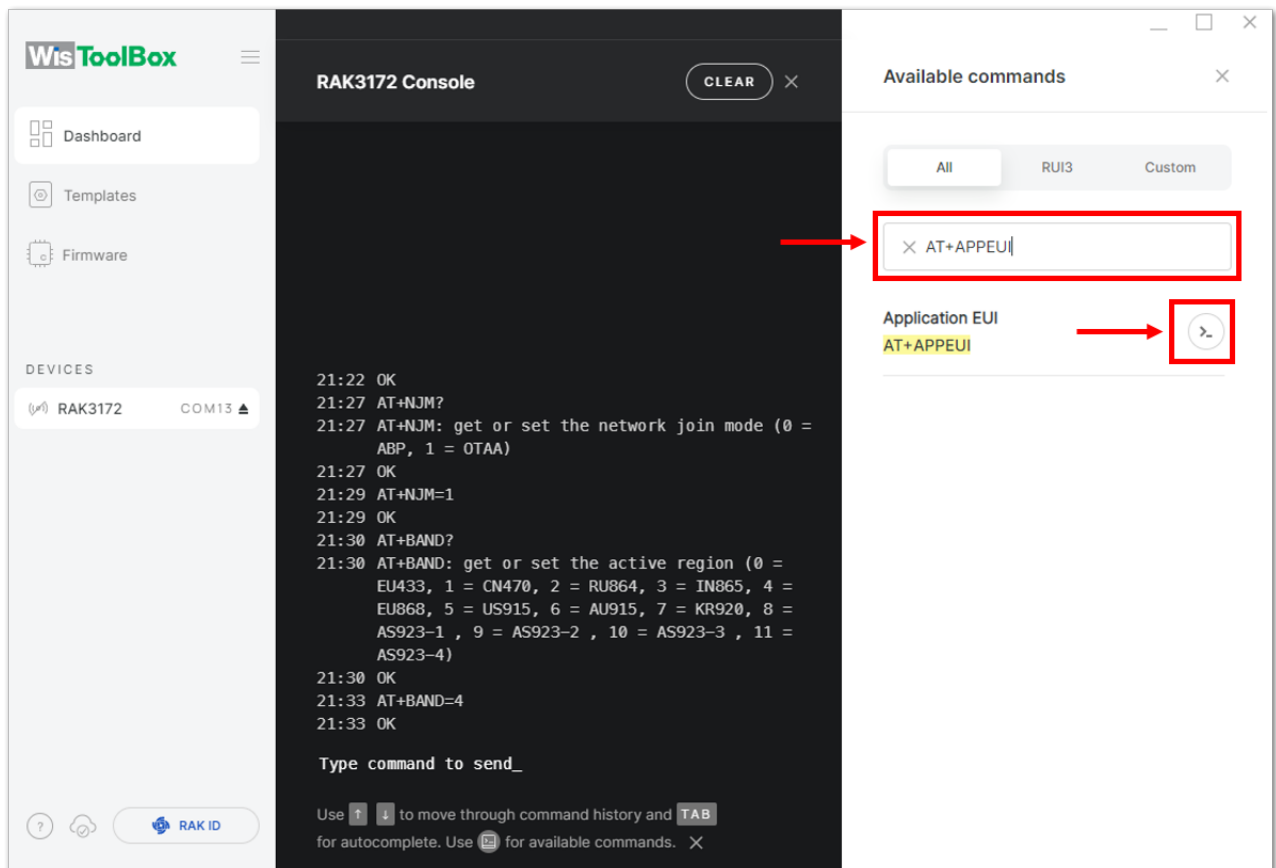


Figure 83: Setting up your Console

10. Then next to this will be updating the OTAA credentials of your device. First to this will be the **Application EUI (AppEUI)**. Go back to your console where your RAK3172 End device was created to copy the AppEUI credential then paste it to the WisToolBox Console then press **Enter**.



**Figure 84:** Your created OTAA device from your TTN console



**Figure 85:** Setting up your Console

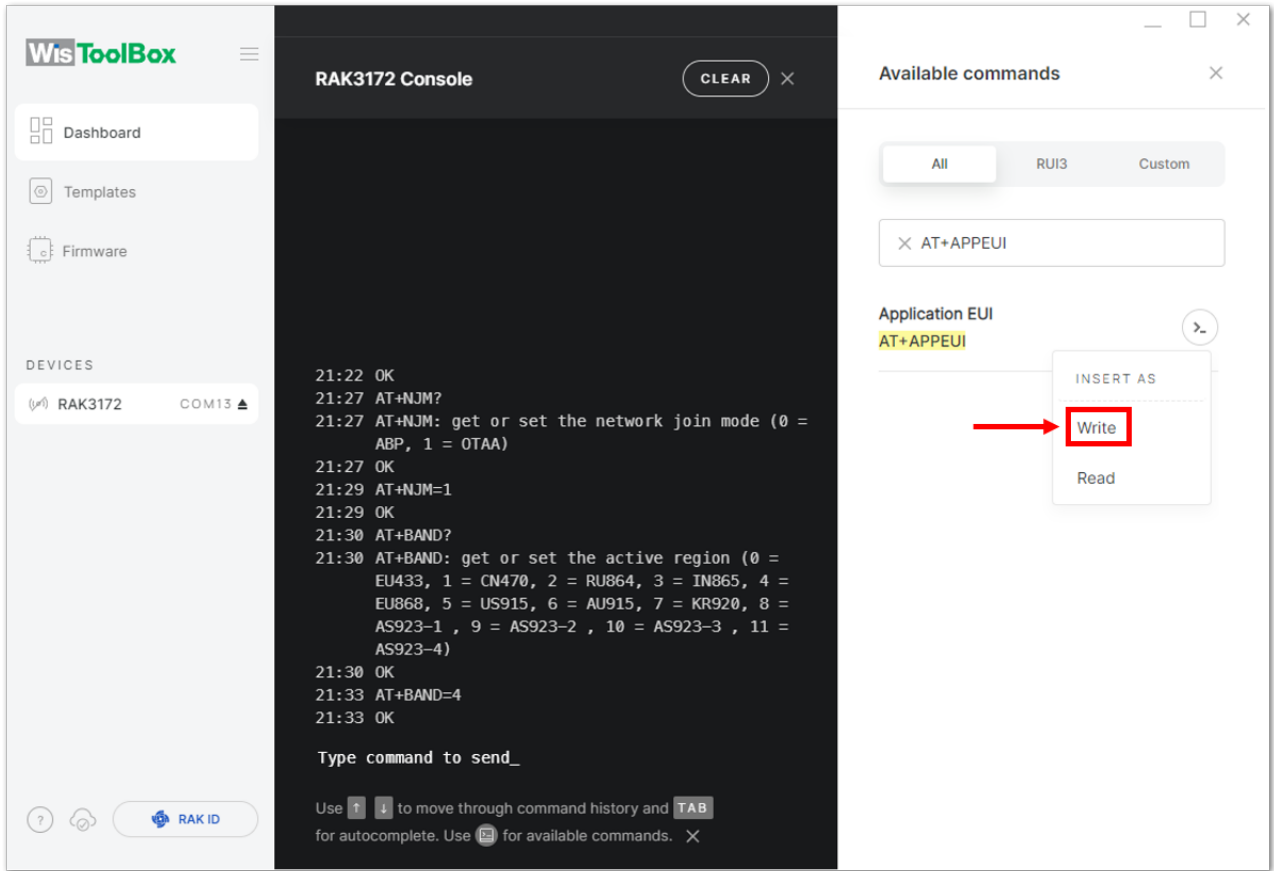


Figure 86: Setting up your Console

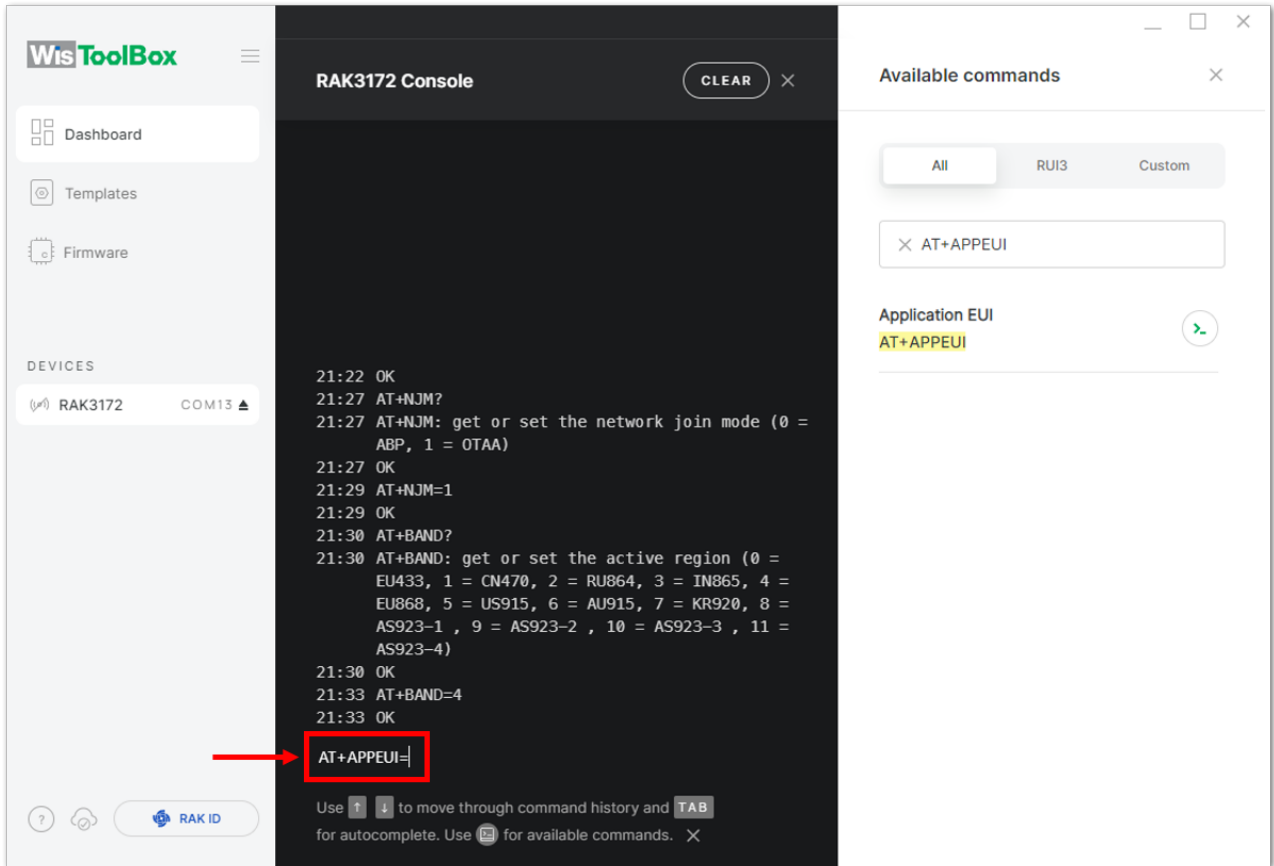


Figure 87: Setting up your Console

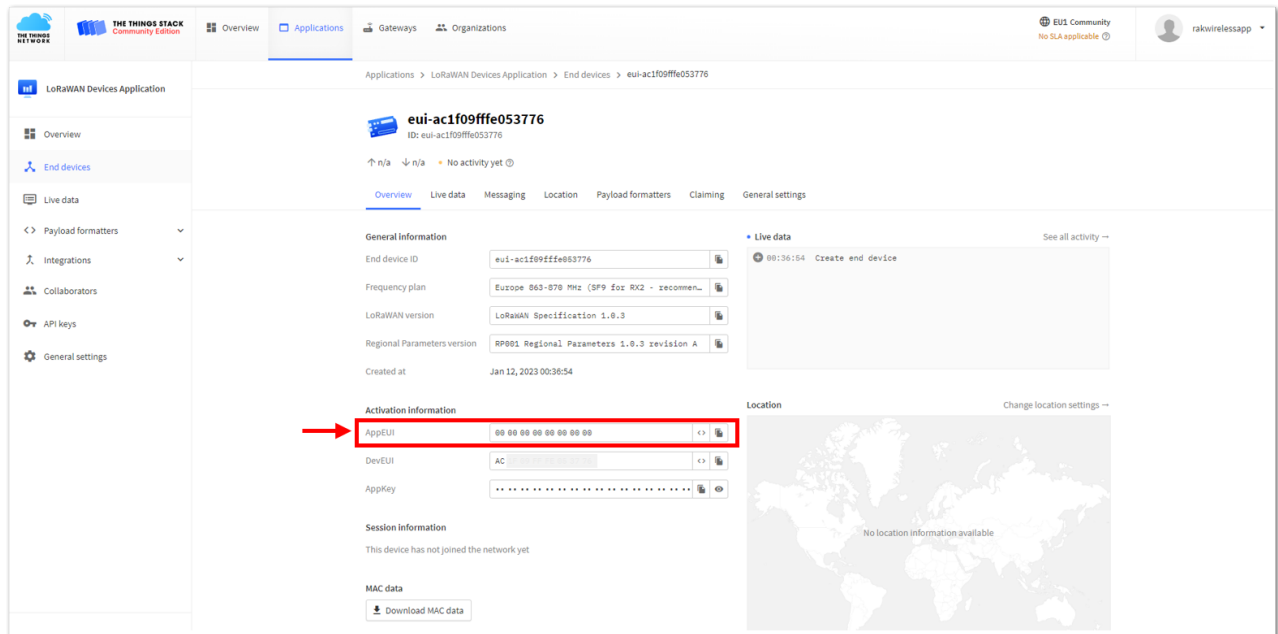


Figure 88: Copying the AppEUI credential from TTN to WisToolBox

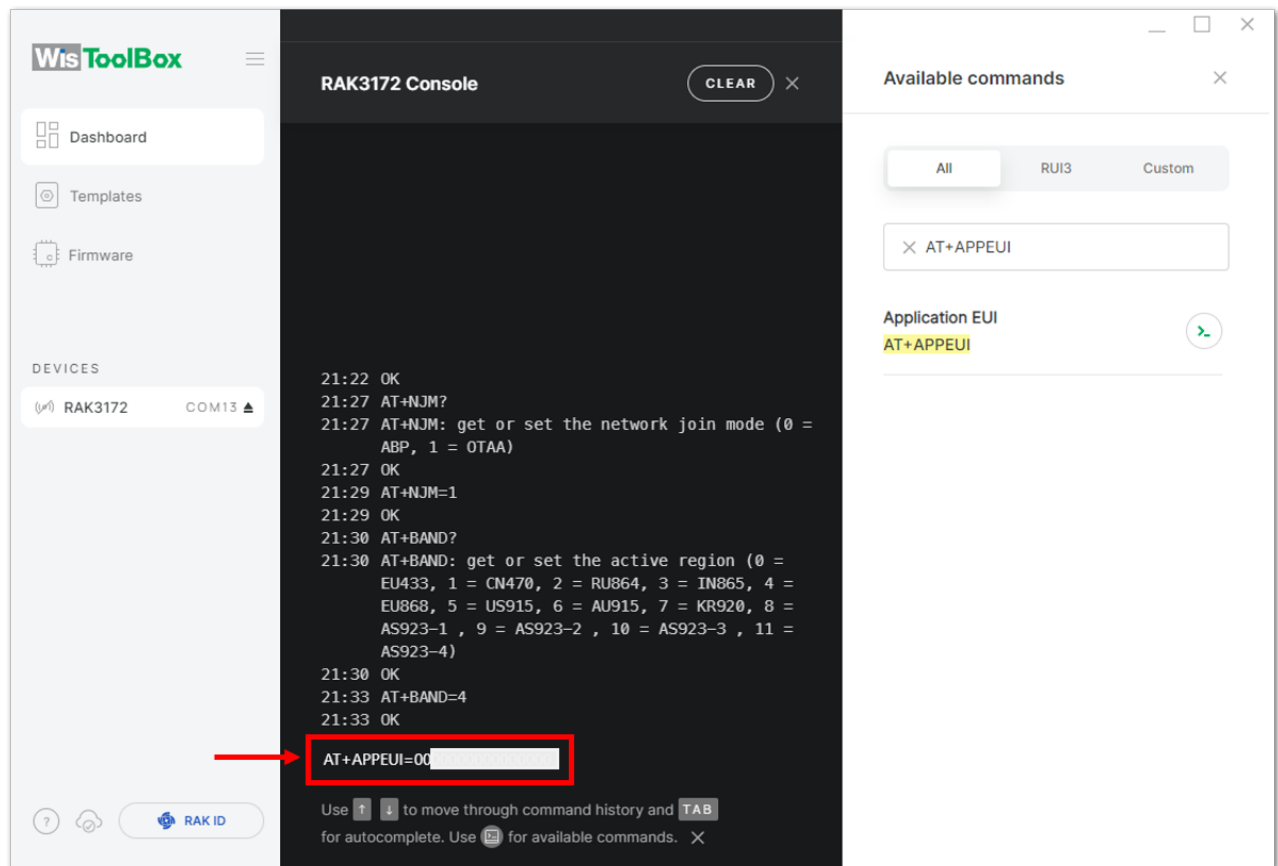


Figure 89: Setting up your Console

11. Once done, do the same procedure to **Application key (AppKey)** and **Device EUI (DevEUI)**.

- **For Application key (AppKey)**

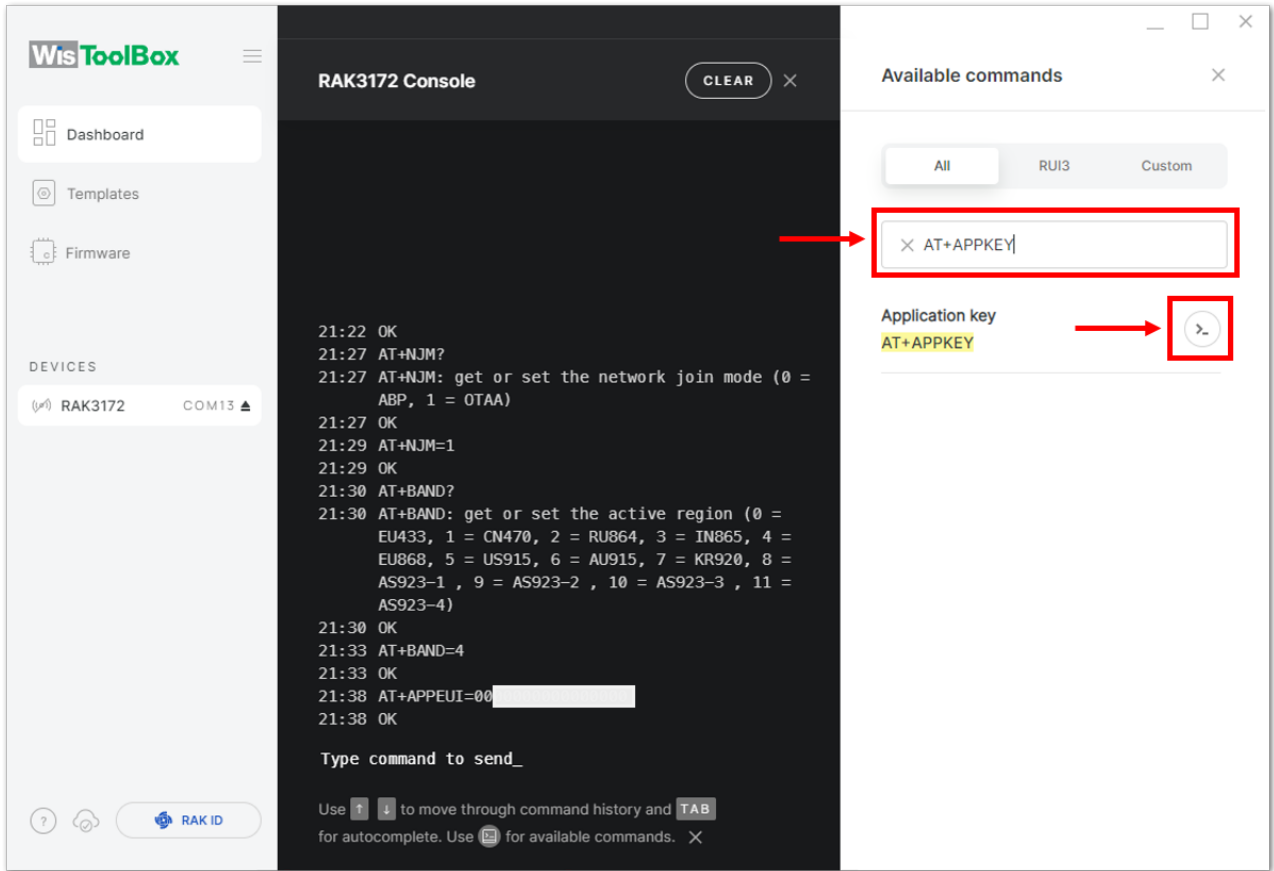


Figure 90: Setting up your Console

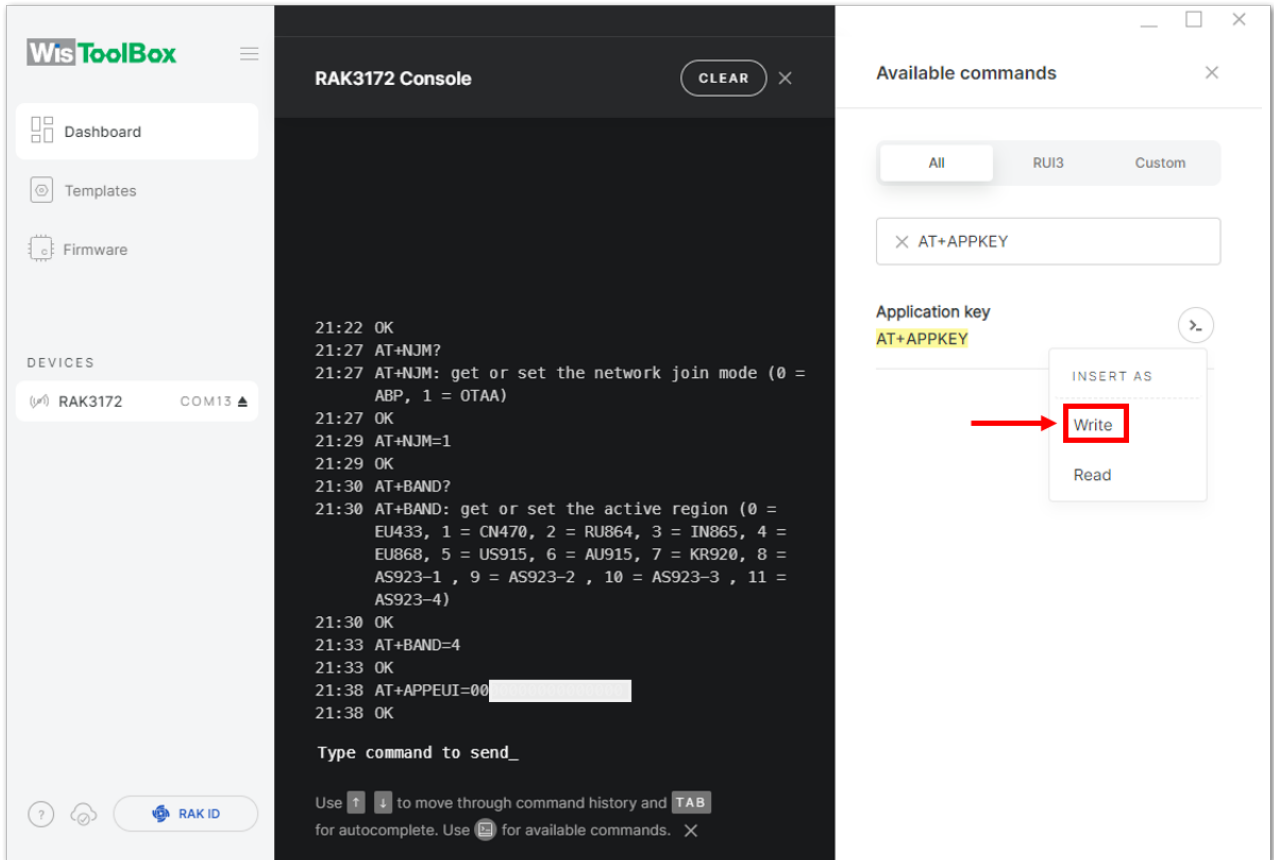


Figure 91: Setting up your Console

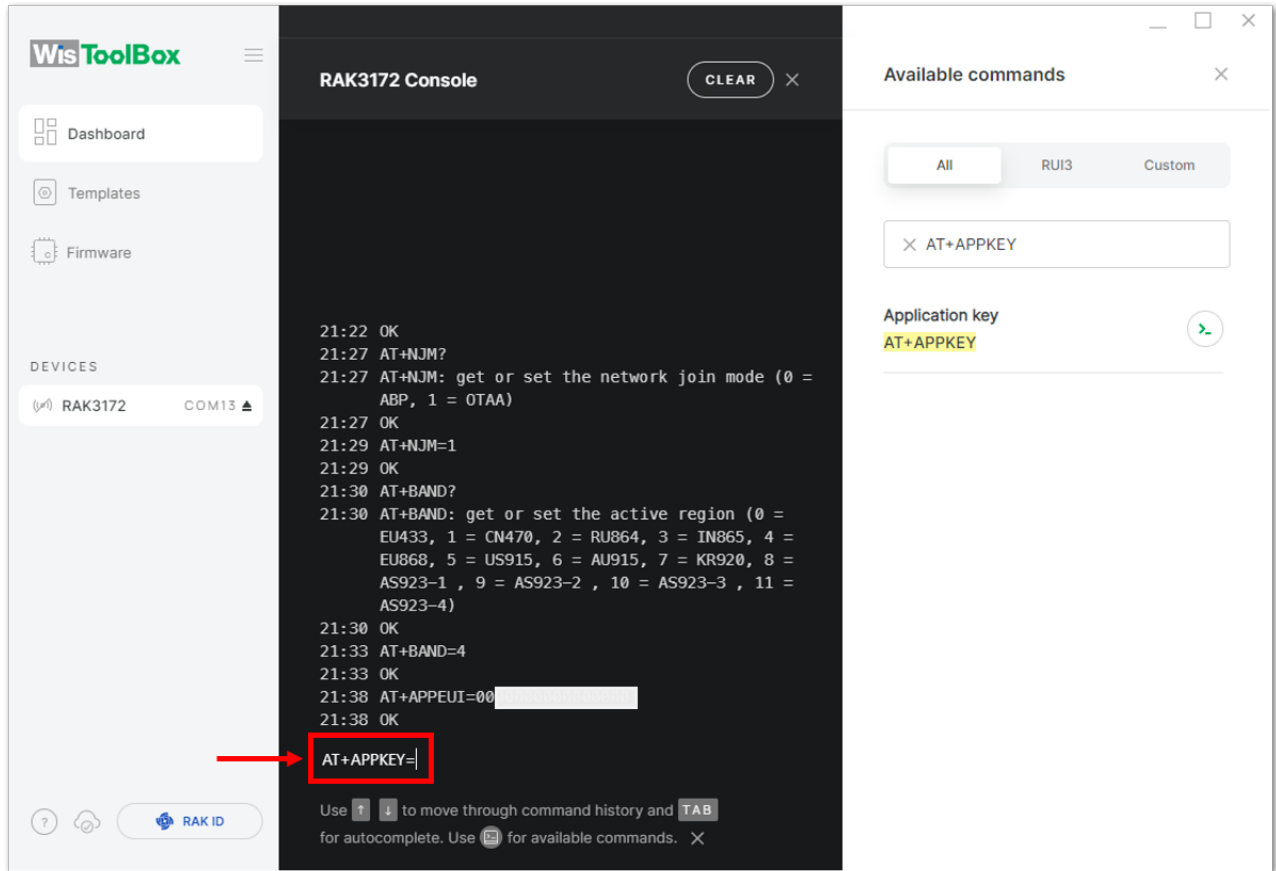


Figure 92: Setting up your Console

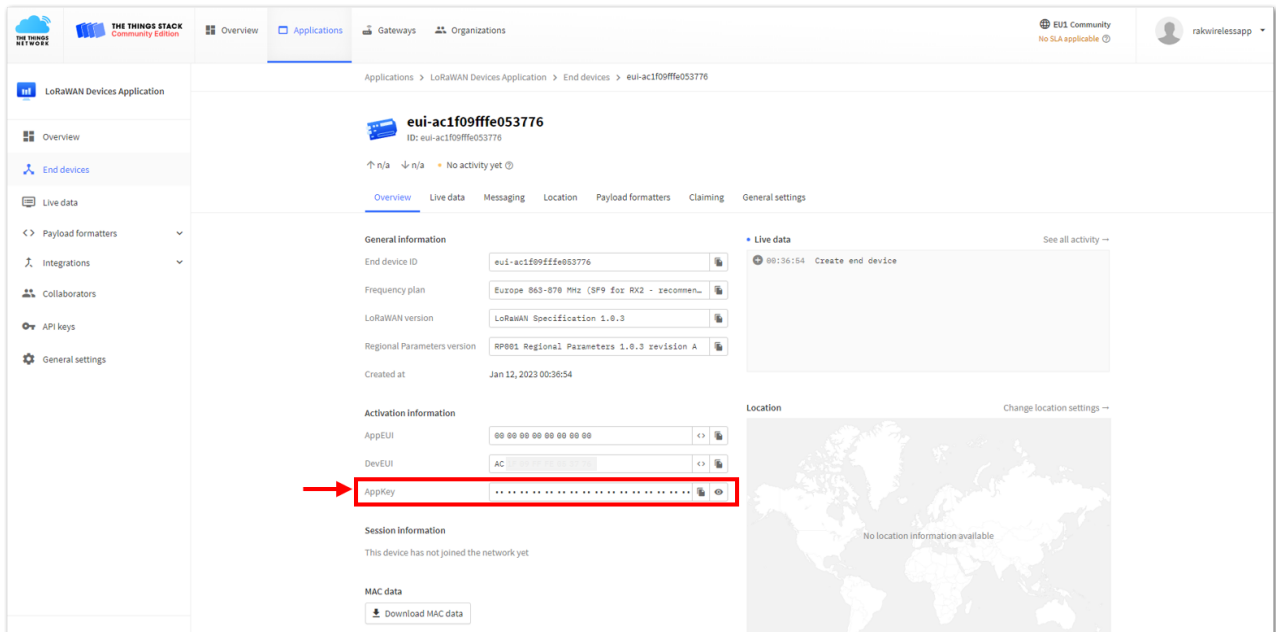


Figure 93: Copying the AppKey credential from TTN to WisToolBox

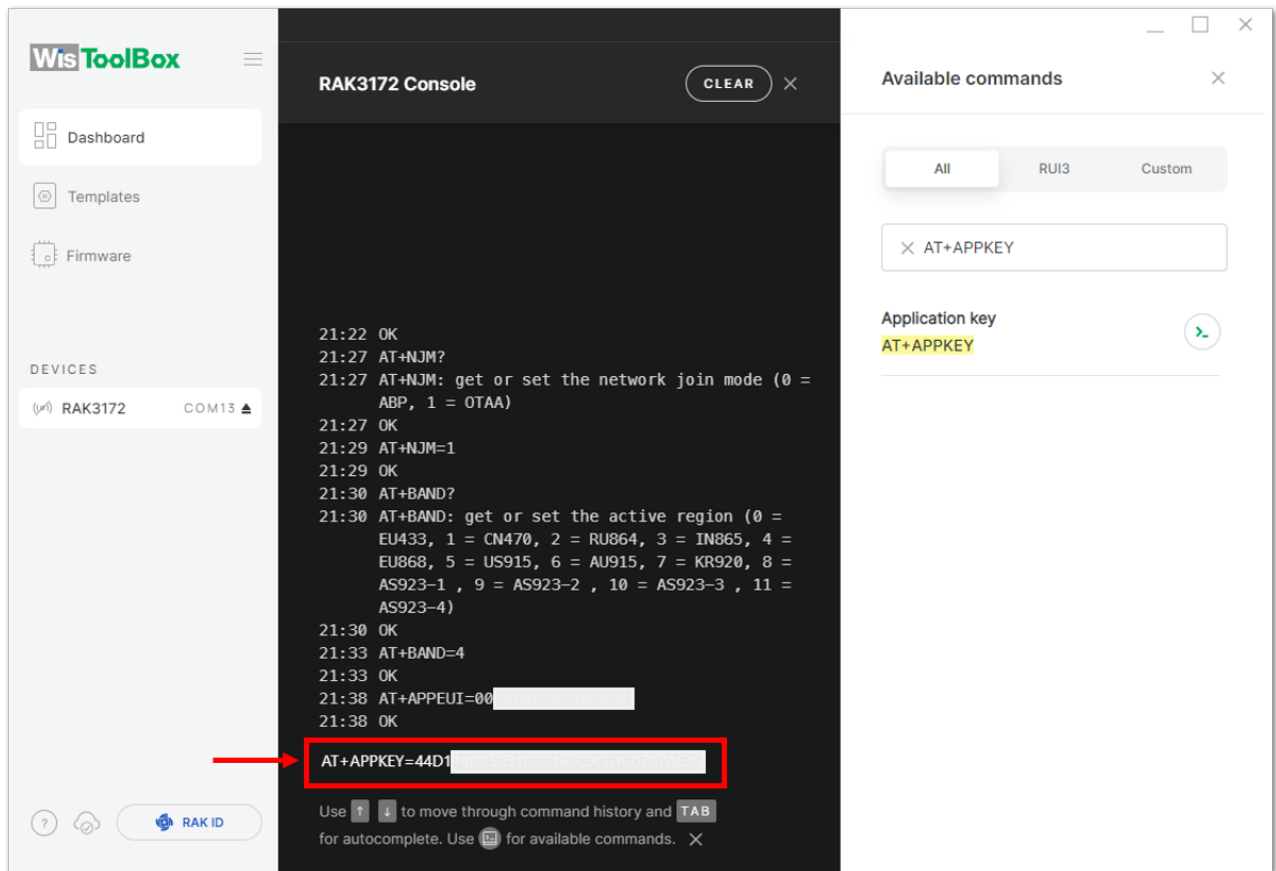


Figure 94: Setting up your Console

- For Device EUI (DevEUI)

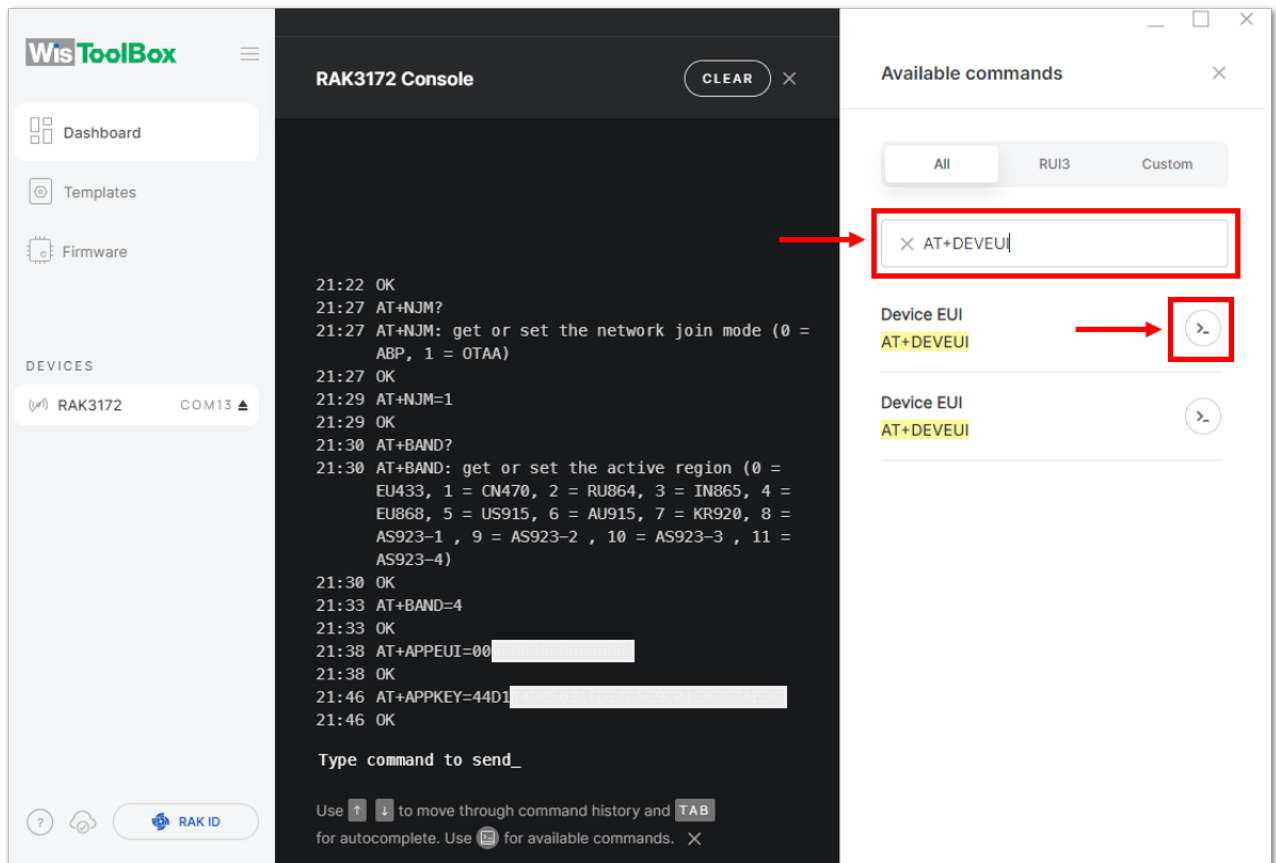


Figure 95: Setting up your Console

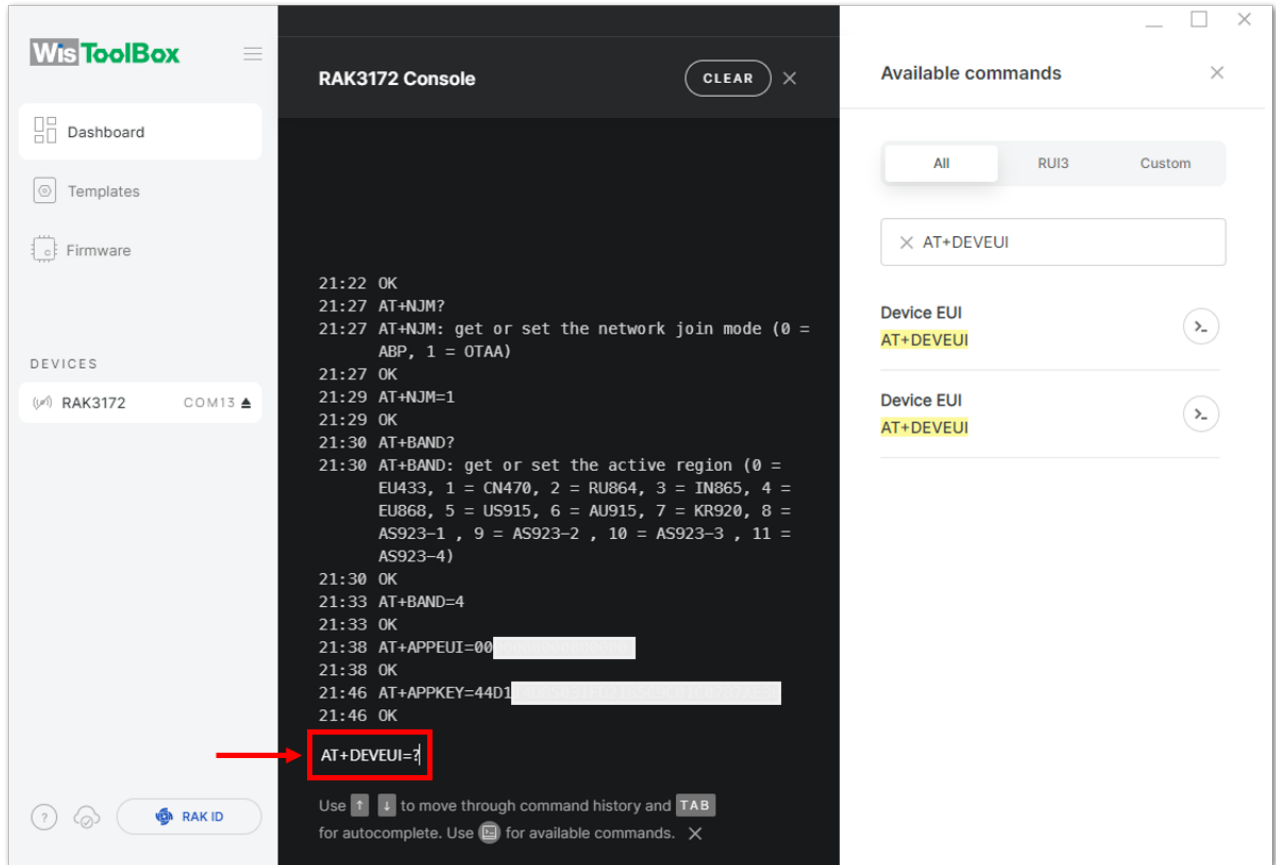


Figure 96: Setting up your Console

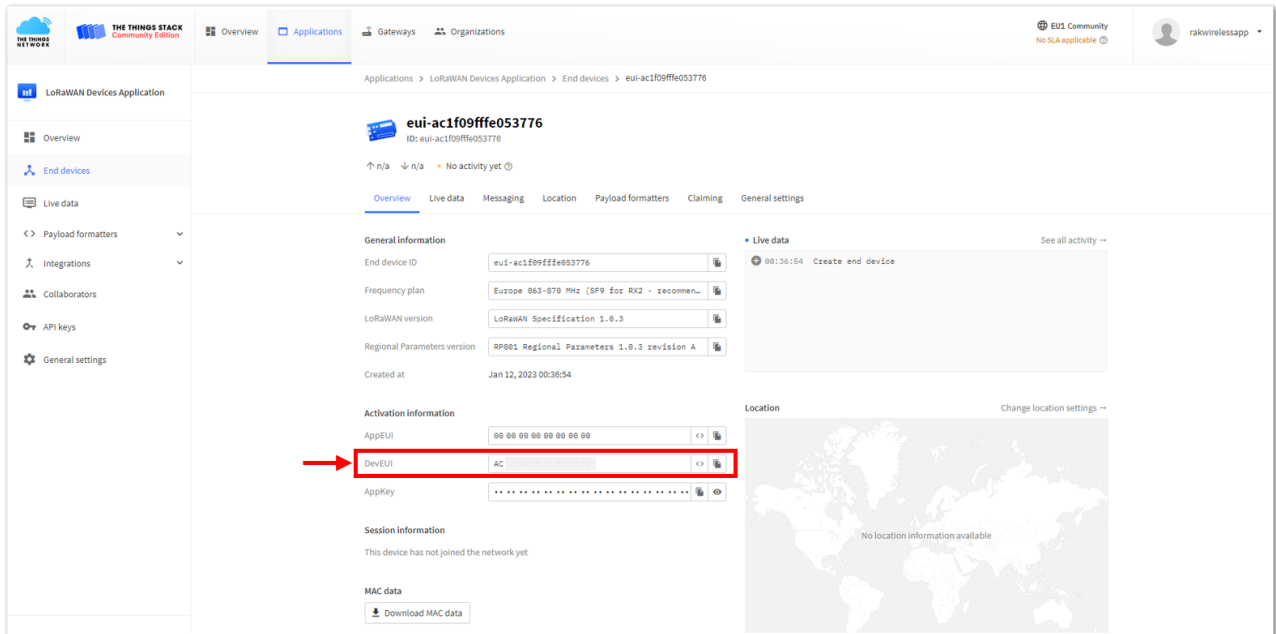


Figure 97: Copying the DevEUI credential from TTN to WisToolBox



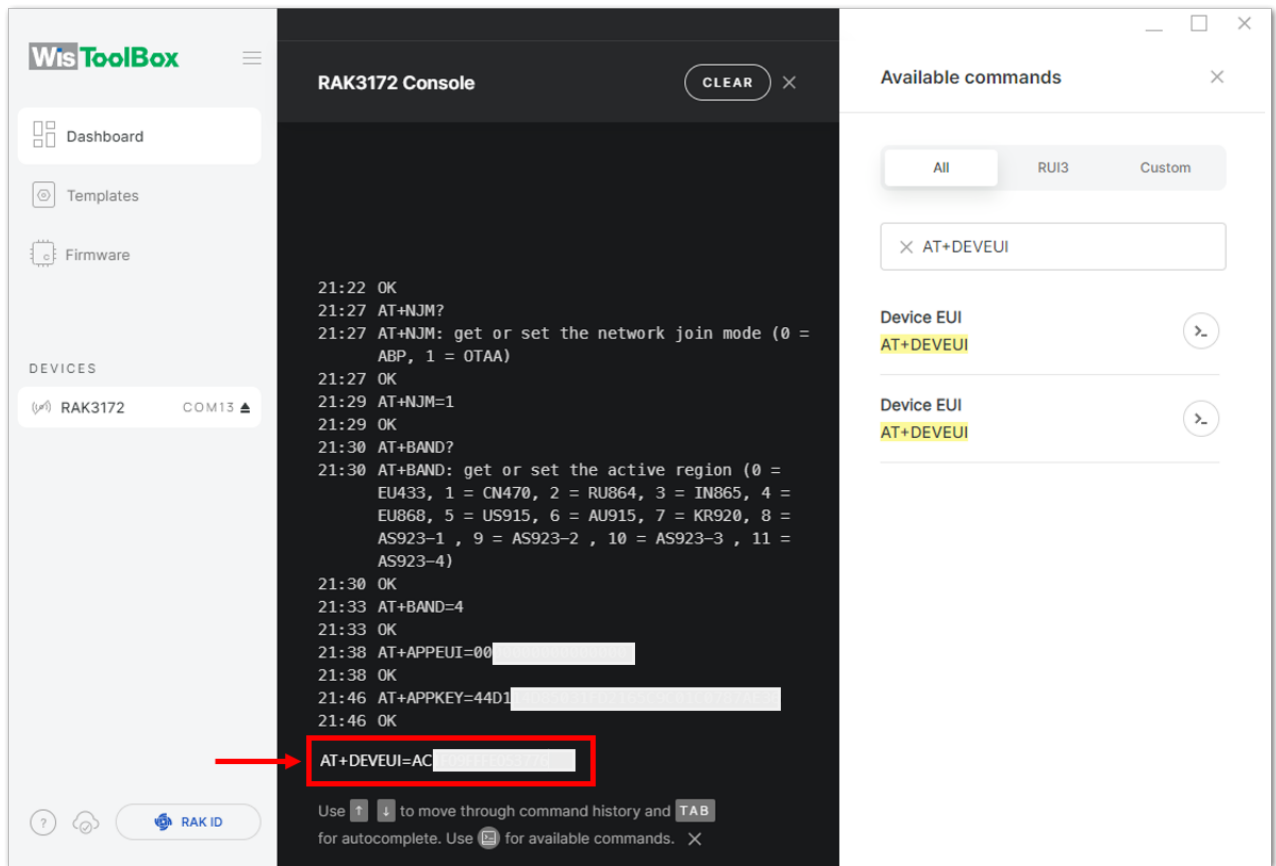


Figure 98: Setting up your Console

- Once done, click **Dashboard** to check the updated credentials of your OTAA device. Click **PARAMETERS** to open the **Global Settings** and **LoRaWAN keys, ID, EUI** and check whether these portions are updated.

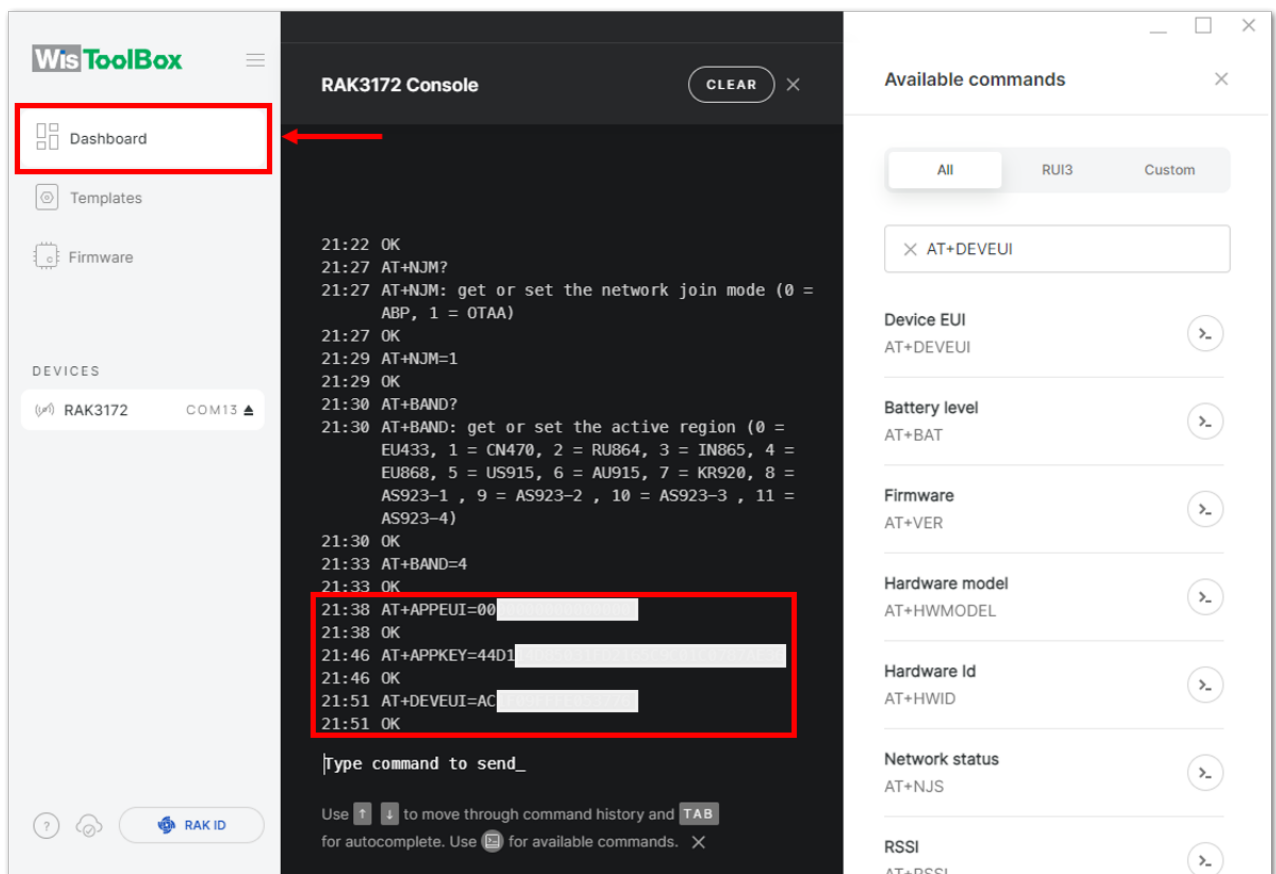


Figure 99: Setting up your Console

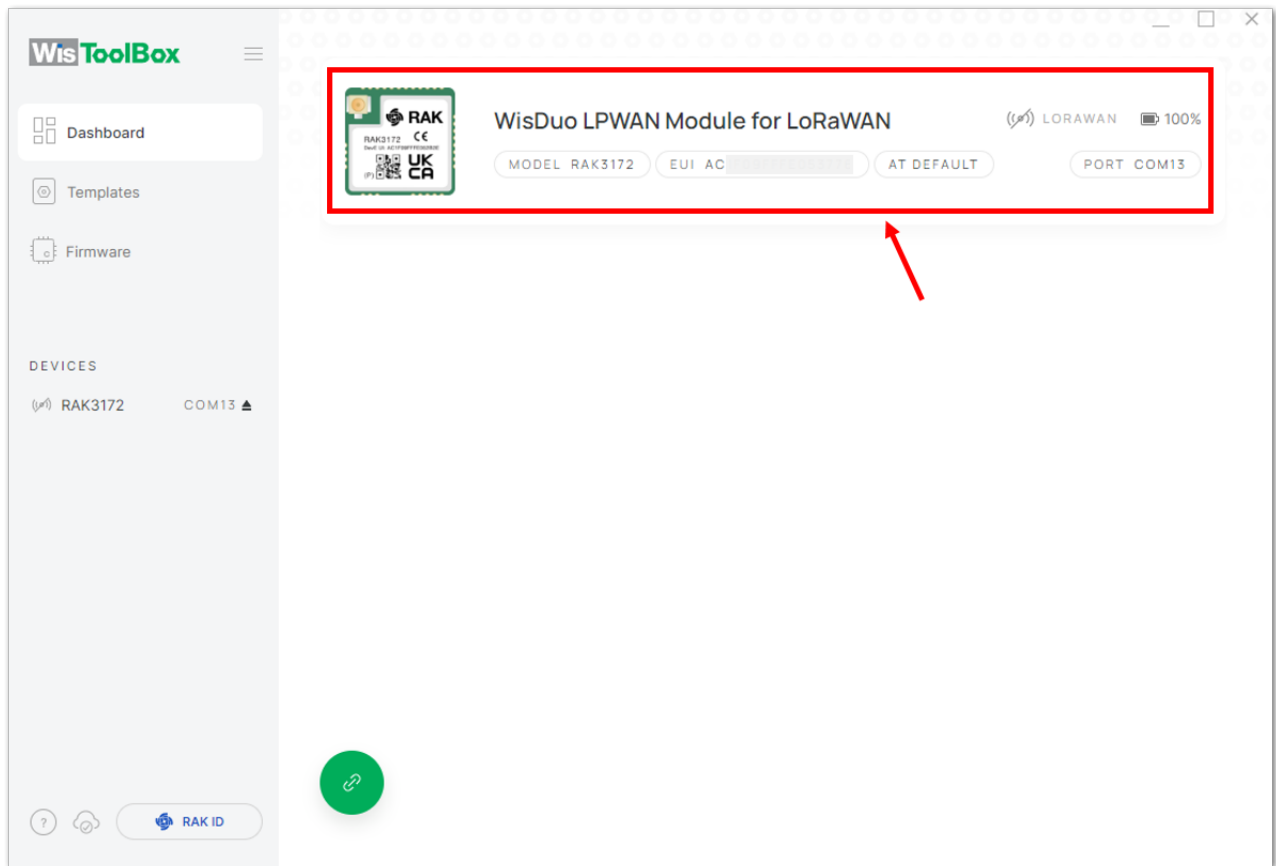


Figure 100: Setting up your Console

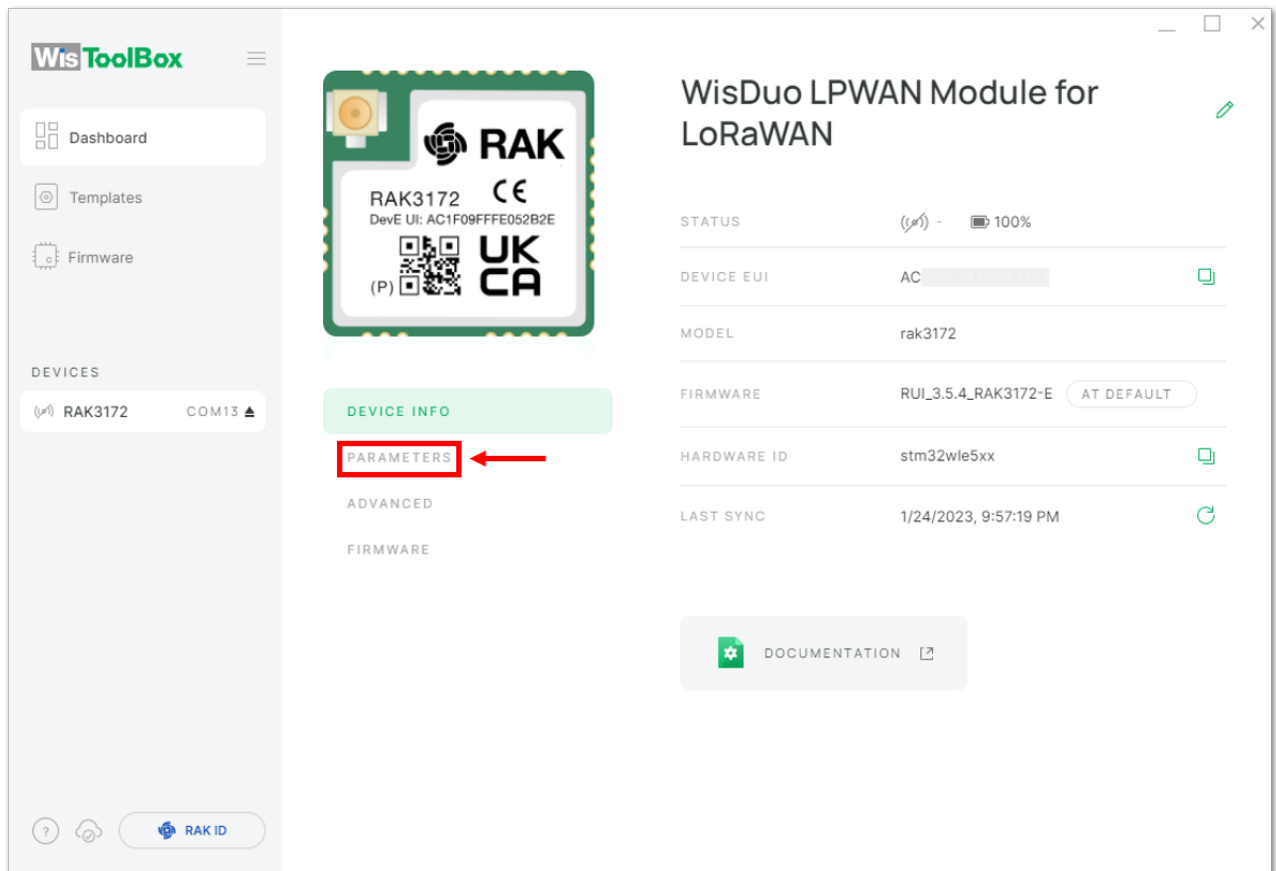


Figure 101: PARAMETERS

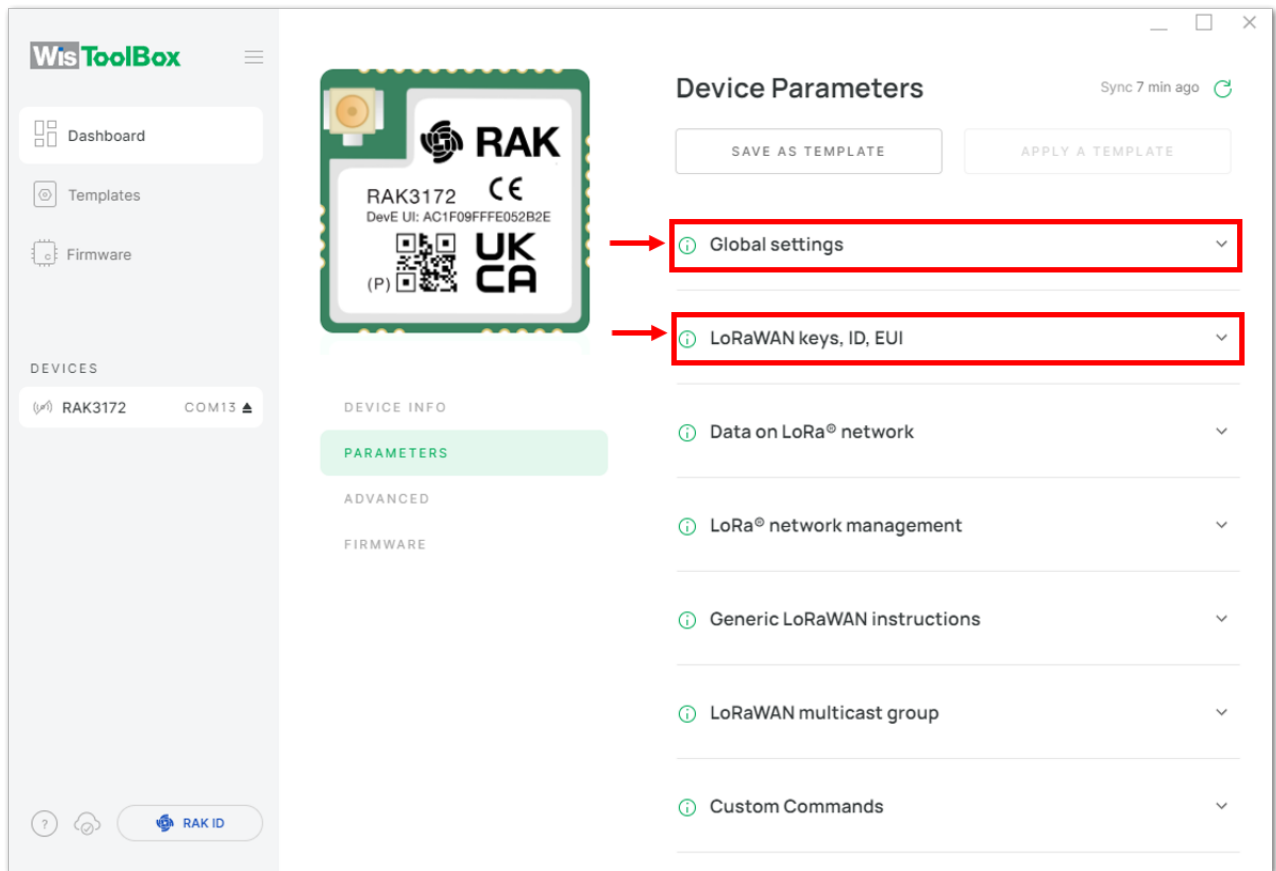


Figure 102: Global settings and LoRaWAN keys, ID, EUI

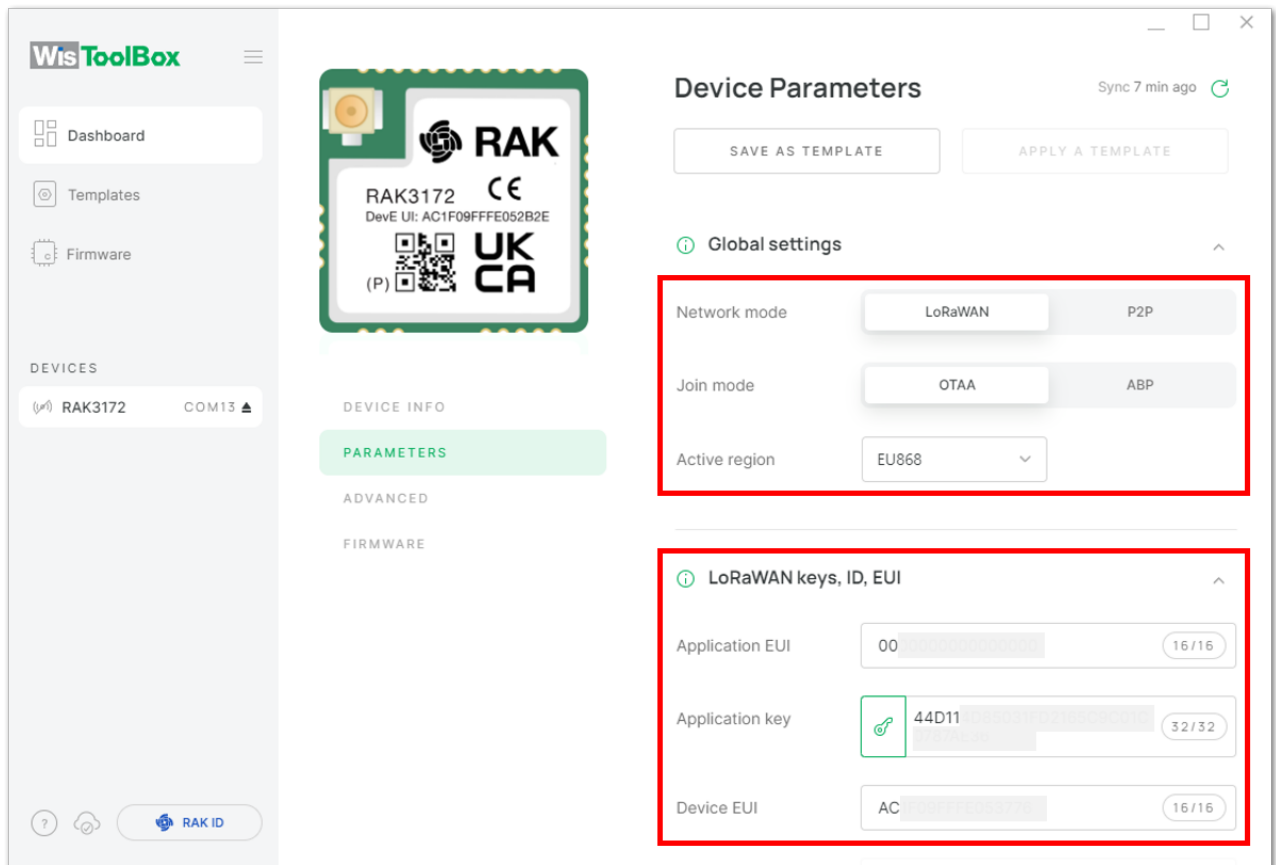


Figure 103: Global settings and LoRaWAN keys, ID, EUI details

13. Now you have a configured OTAA device using WisToolBox Console. You can now join the network using the WisToolBox console.

14. To do this, you need to go again to WisToolBox console and type **AT+JOIN**. Then edit it to **AT+JOIN=1** then press **Enter** to join the network.

**NOTE:**

`AT+JOIN` command parameters are optional. You can configure the settings for auto-join, reattempt interval, and the number of join attempts if your application needs it. If not configured, it will use the default parameter values.

`AT+JOIN` and `AT+JOIN=1` also share the common functionality of trying to join the network.

Join command format: `AT+JOIN=w:x:y:z`

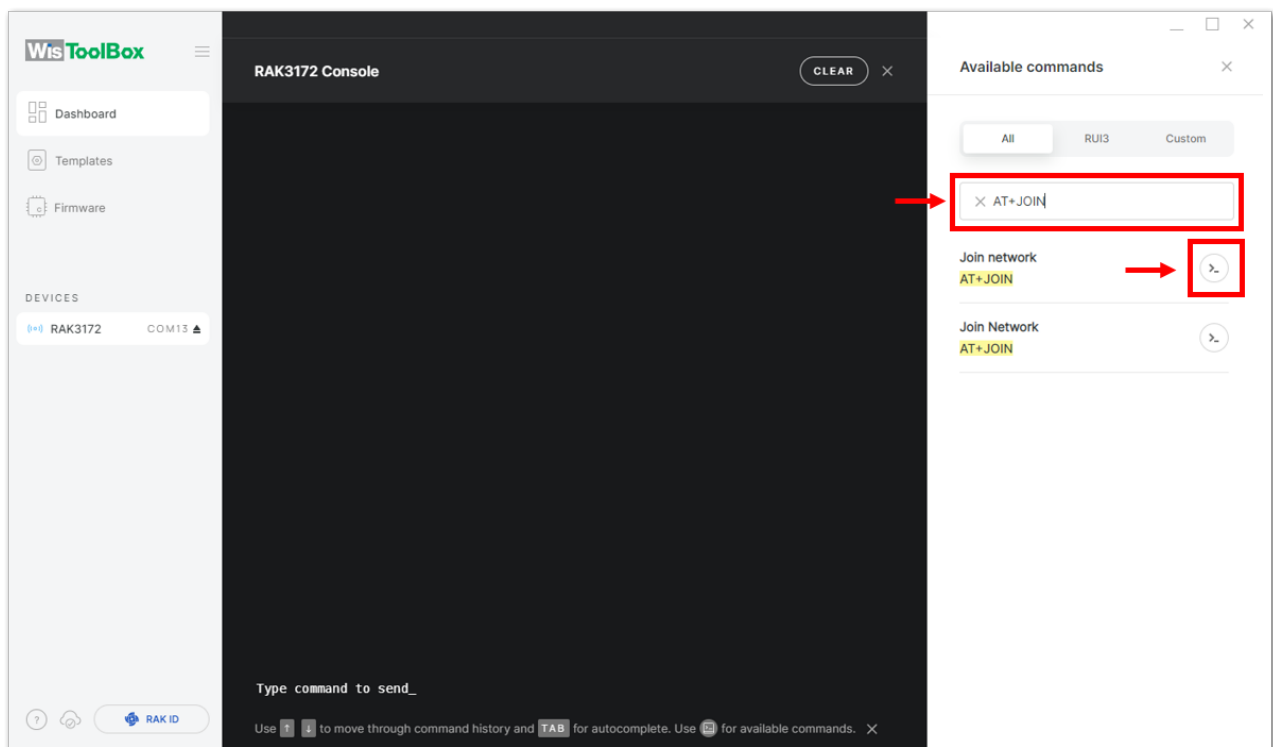
Parameter	Description
w	Join command - 1: joining, 0: stop joining.
x	Auto-join config - 1: auto-join on power-up, 0: no auto-join
y	Reattempt interval in seconds (7-255) - 8 is the default.
z	Number of join attempts (0-255) - 0 is default.

After 5 or 6 seconds, if the request is successfully received by a LoRa gateway, you should see `+EVT: JOINED` status reply, as shown in the figure below:

**NOTE:**

If the OTAA device failed to join, you need to check if your device is within reach of a working LoRaWAN gateway that is configured to connect to TTN. It is also important to check that all your OTAA parameters (DEVEUI, APPEUI, and APPKEY) are correct using the `AT+DEVEUI=?`, `AT+APPEUI=?`, and `AT+APPKEY=?` commands. Lastly, ensure that the antenna of your device is properly connected.

After checking all the things above, try to join again.



**Figure 104:** Joining mode using WisToolBox Console

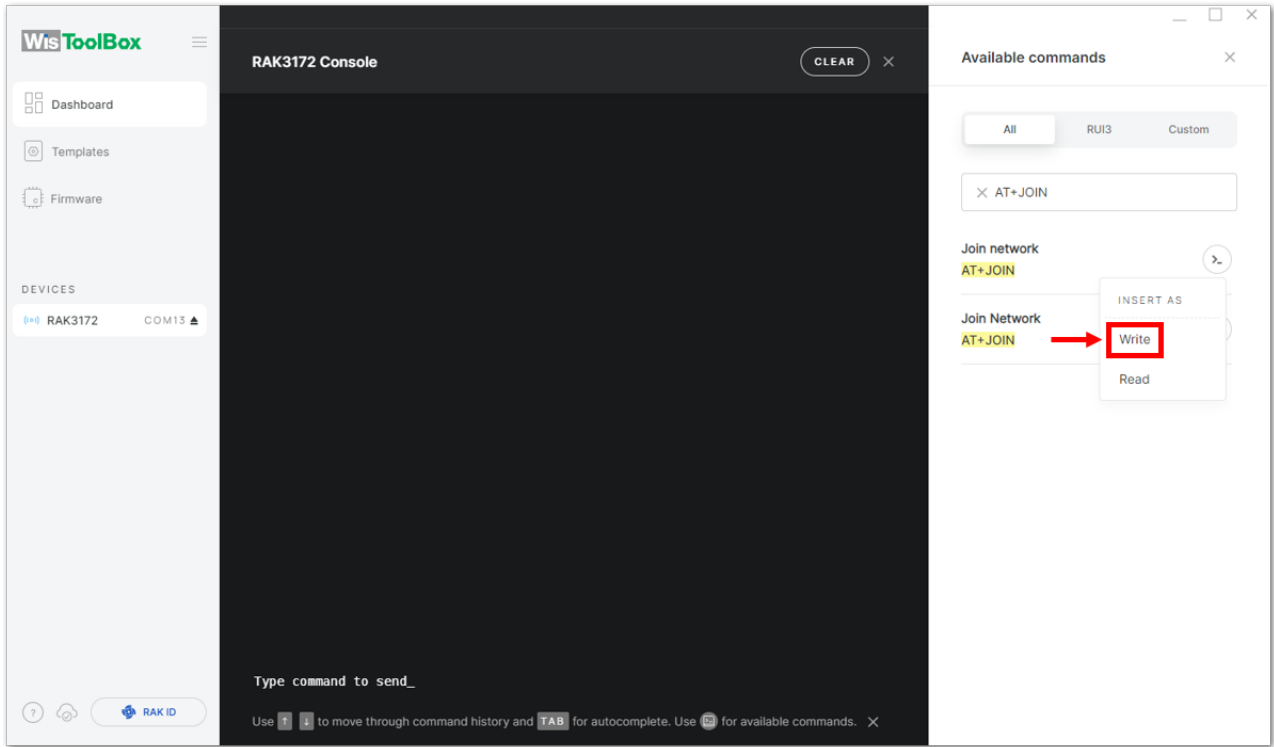


Figure 105: Joining mode using WisToolBox Console

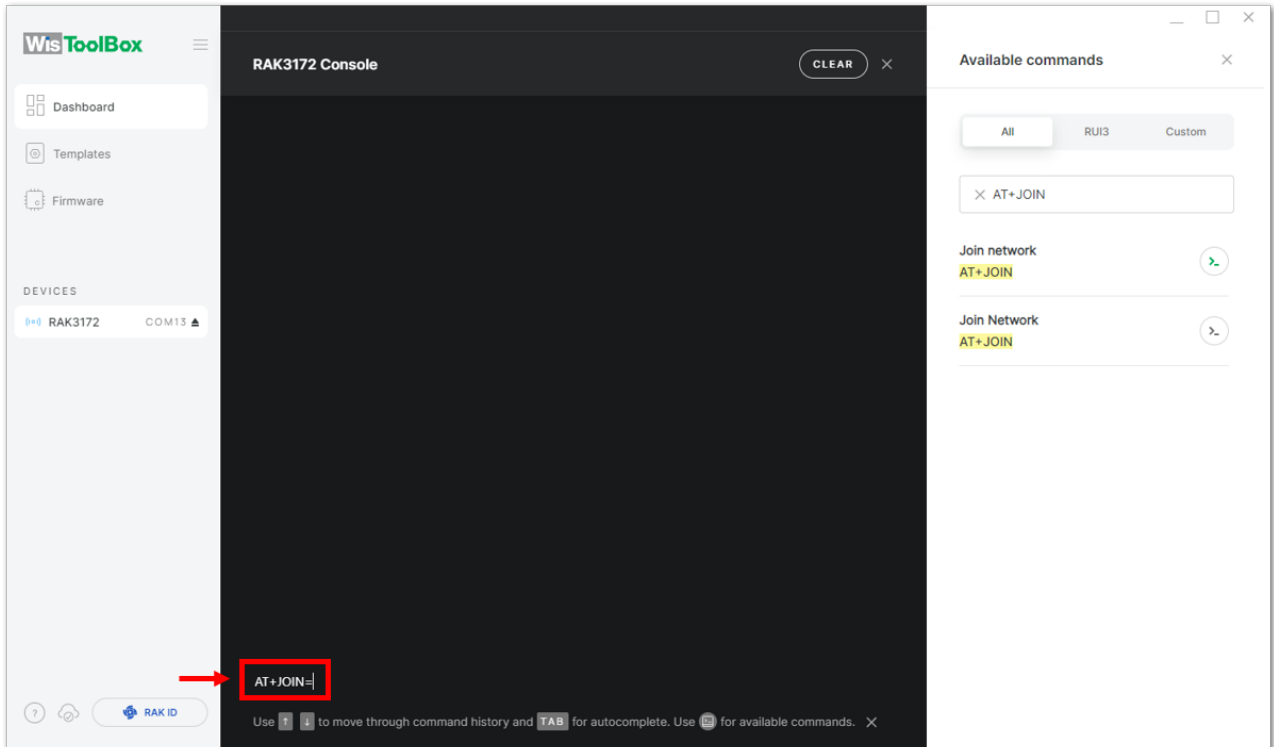


Figure 106: Joining mode using WisToolBox Console

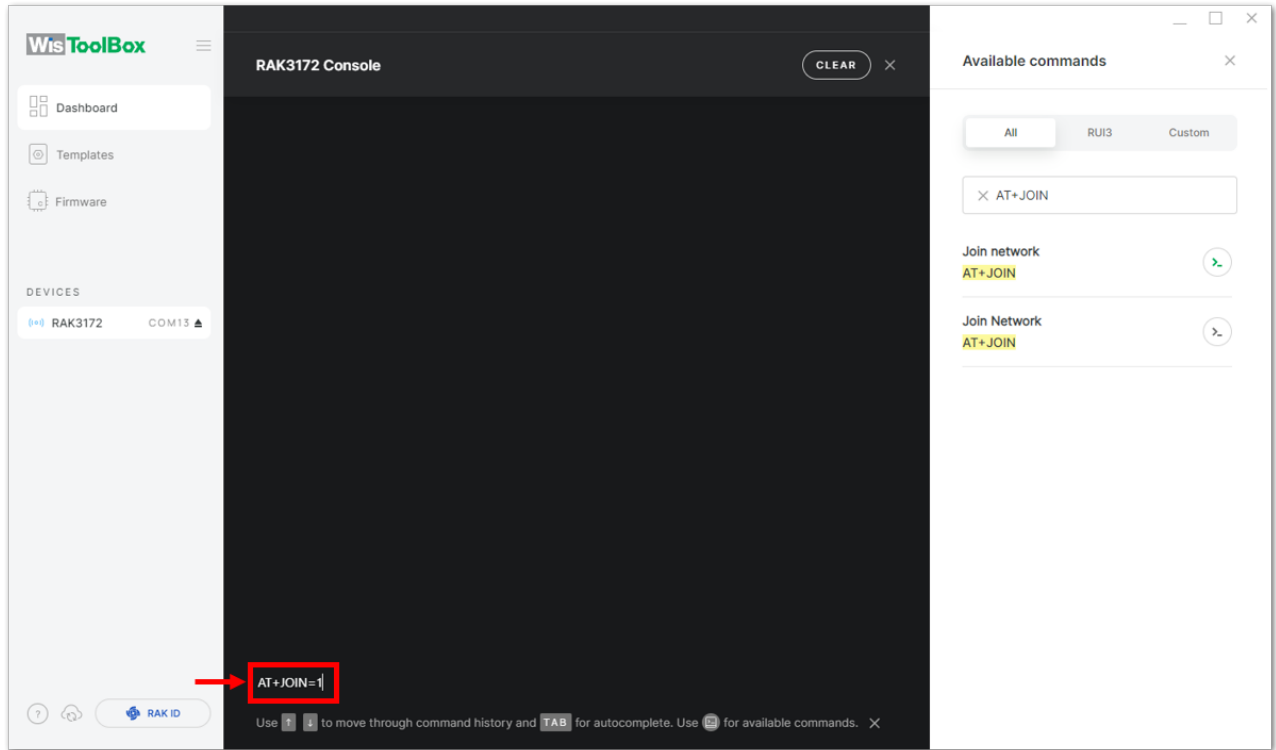


Figure 107: Joining mode using WisToolBox Console

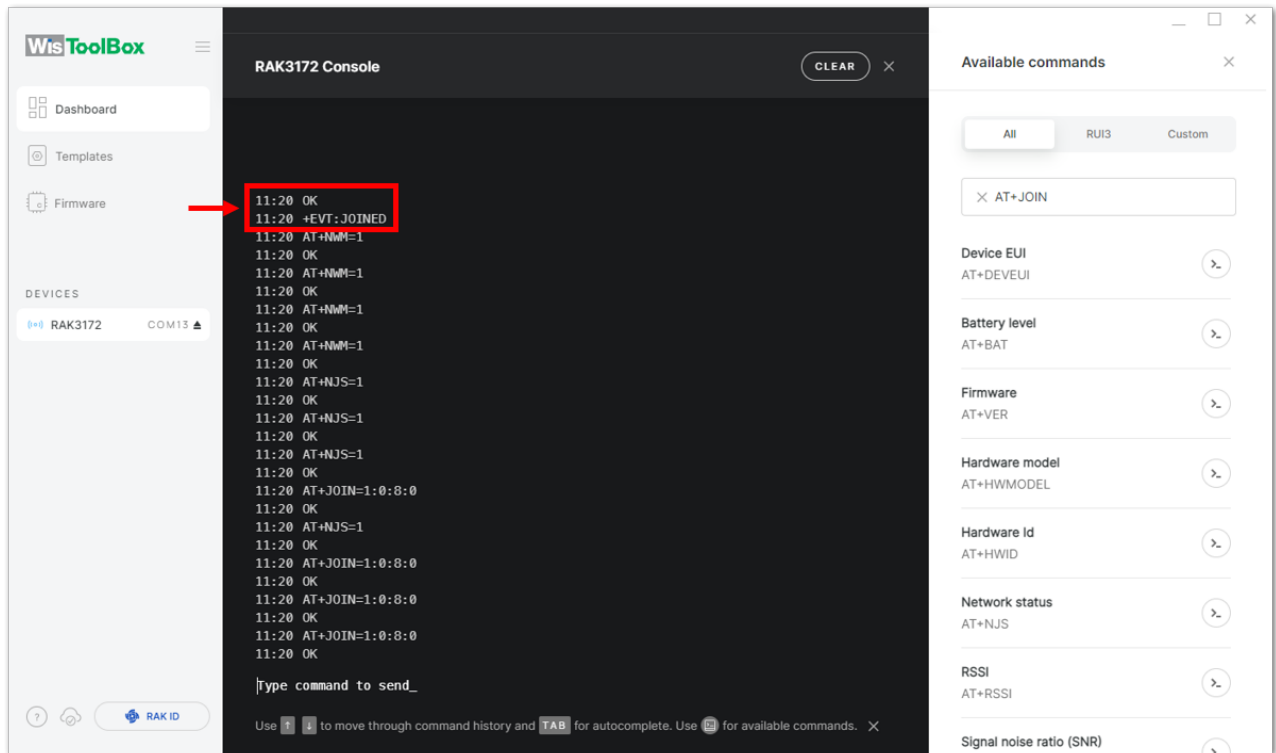


Figure 108: OTAA device successfully joined the network

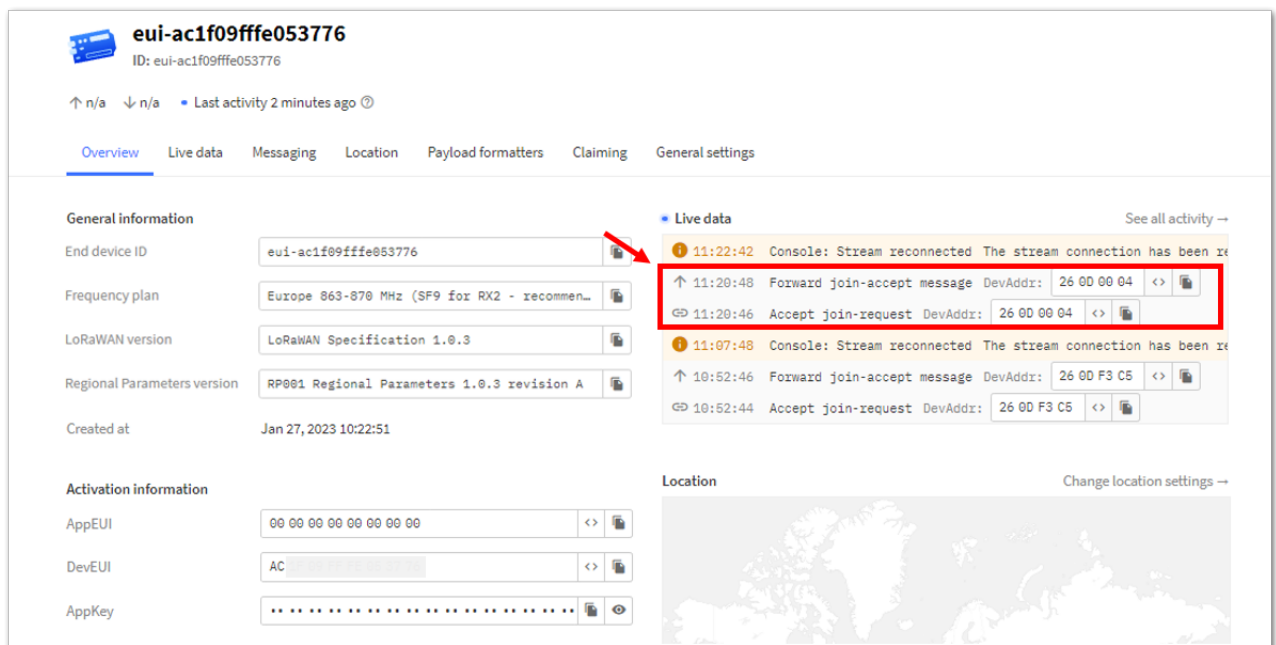


Figure 109: OTAA device successfully joined the network

15. With the end-device properly joined the TTN, you can now try to send some payload after a successful join.  
 Send command format: `AT+SEND=<port>:<payload>`

AT+SEND=2:12345678

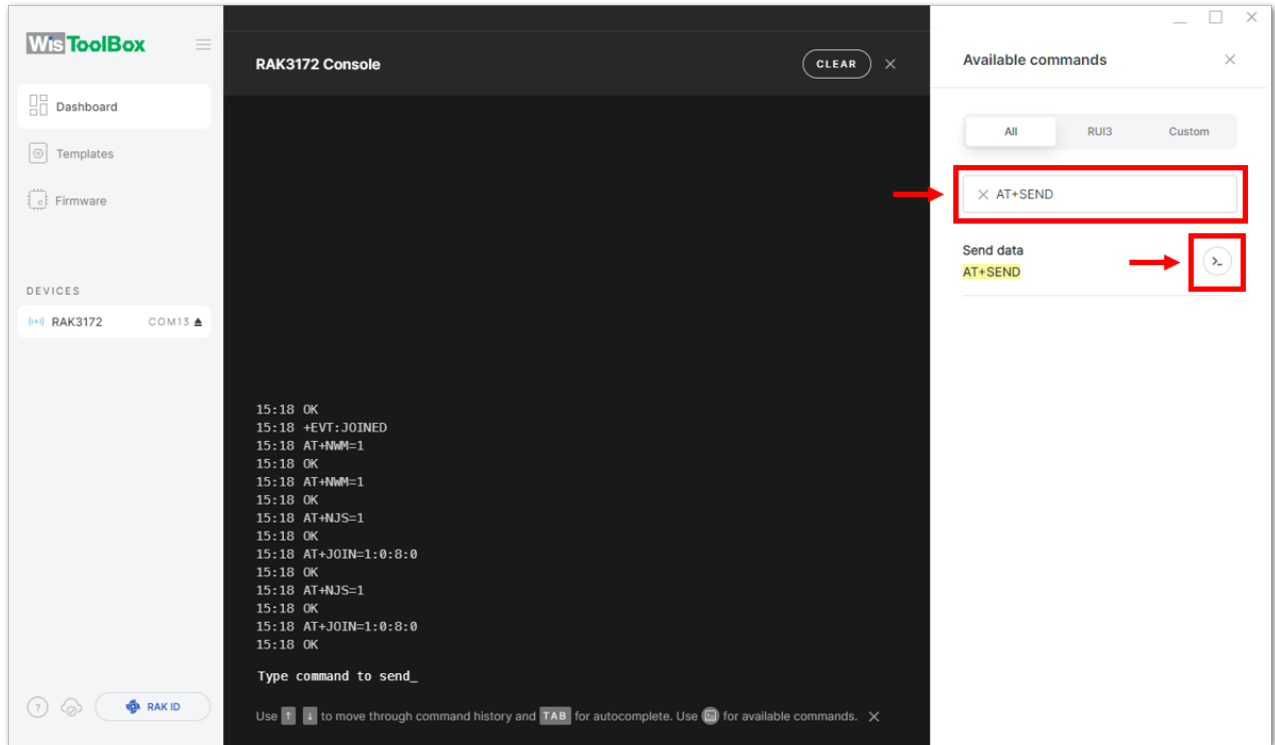


Figure 110: OTAA device sending payload to the network

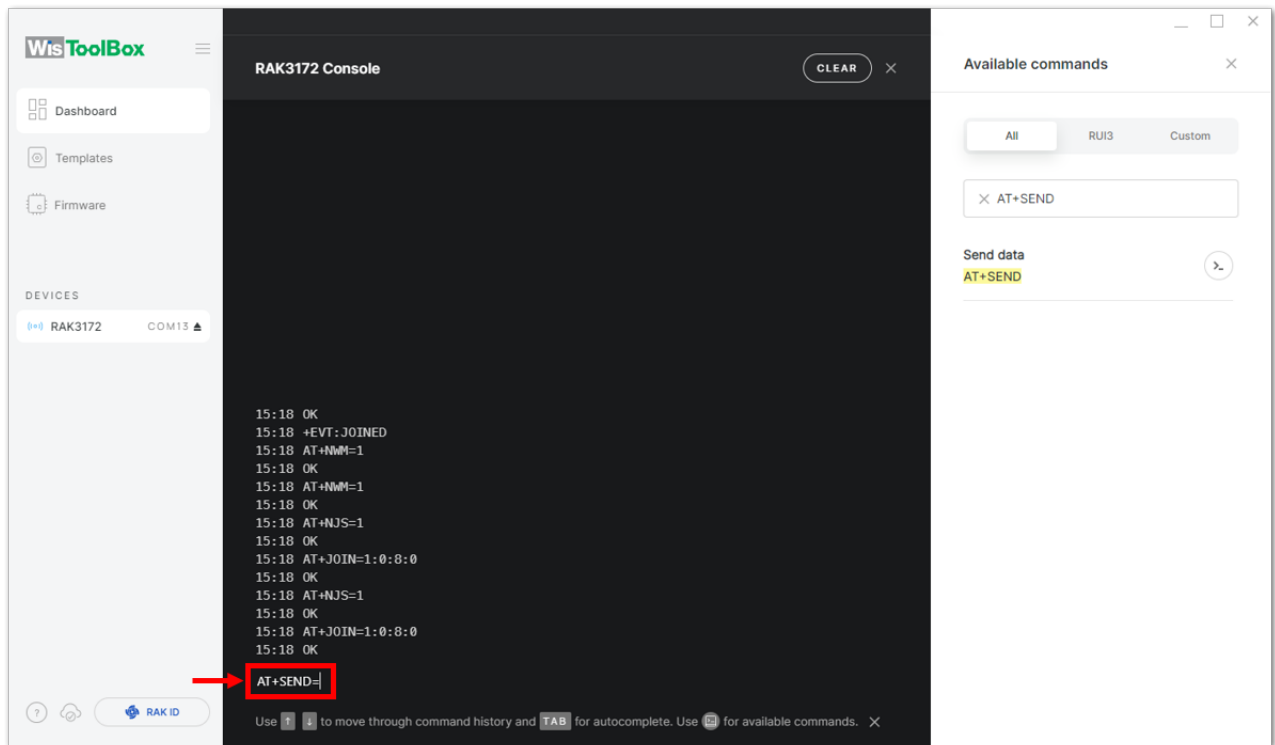


Figure 111: OTAA device sending payload to the network

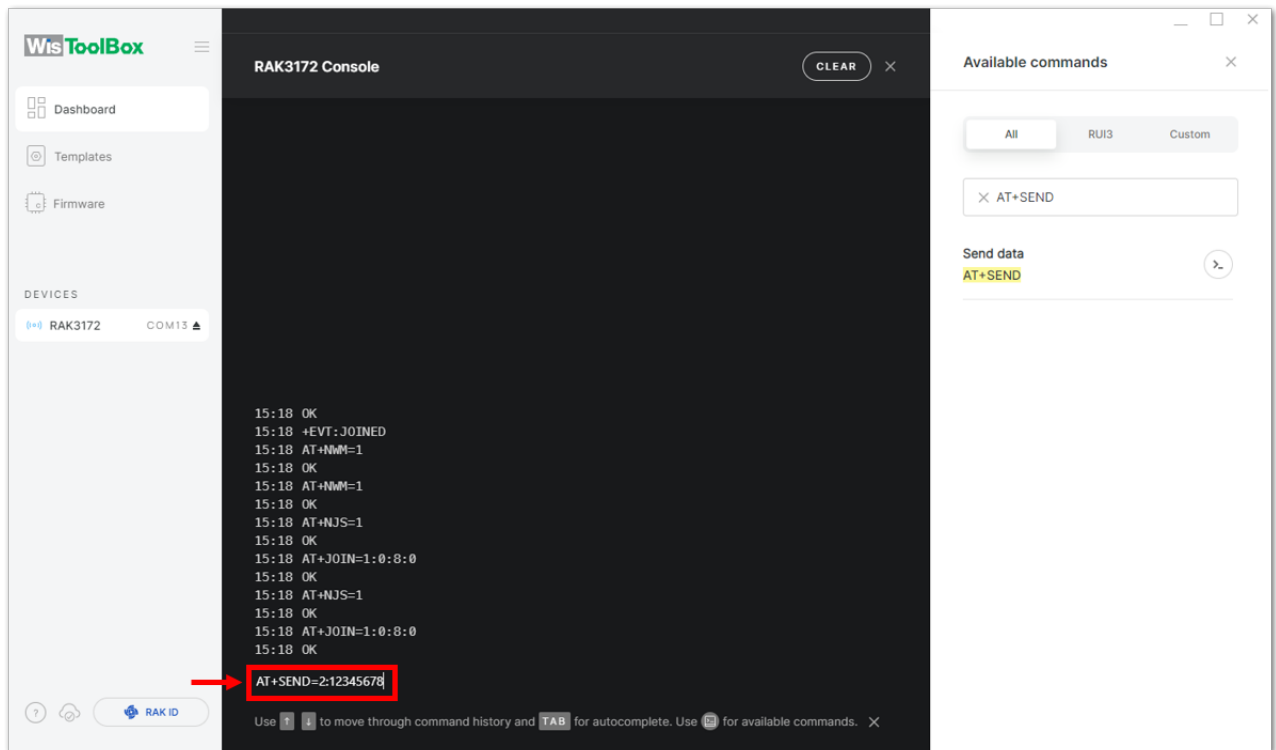


Figure 112: OTAA device sending payload to the network

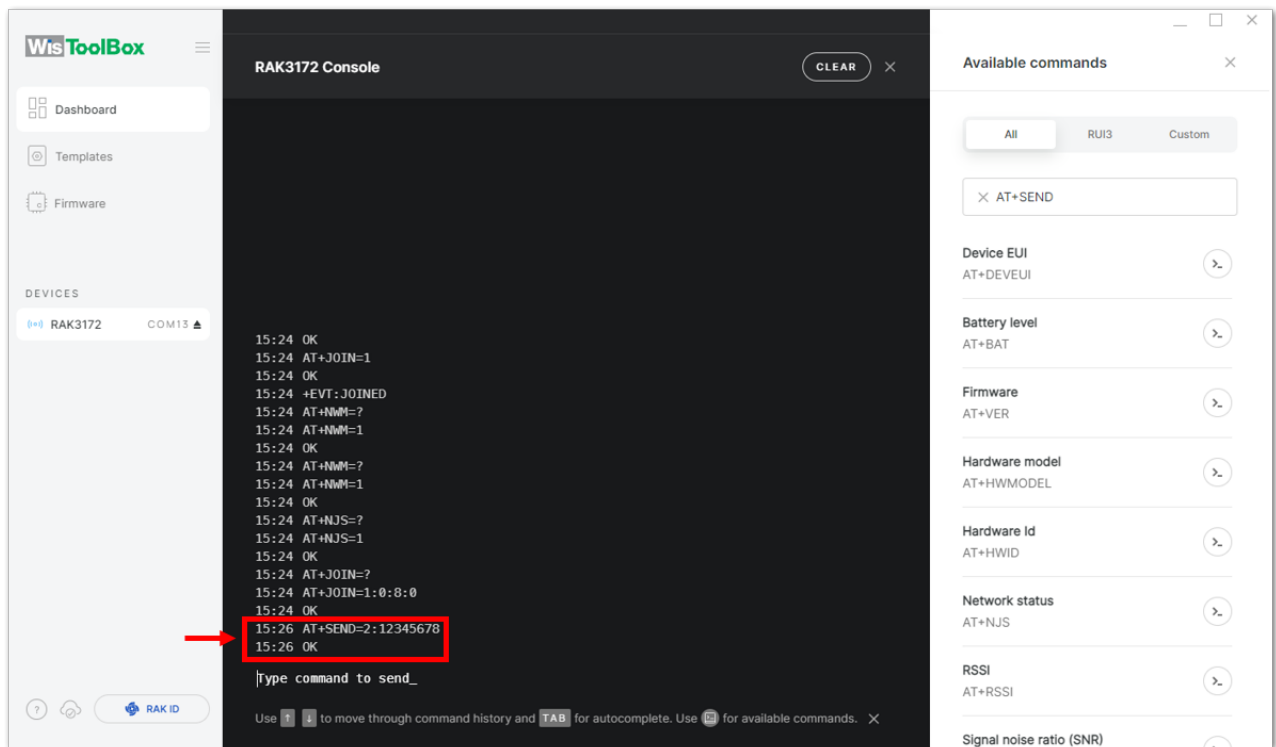


Figure 113: OTAA device sending payload to the network

16. You can see the data sent by the RAK3172 evaluation board on the TTN device console *Live data* section. Also, the *Last seen* info should be a few seconds or minutes ago.



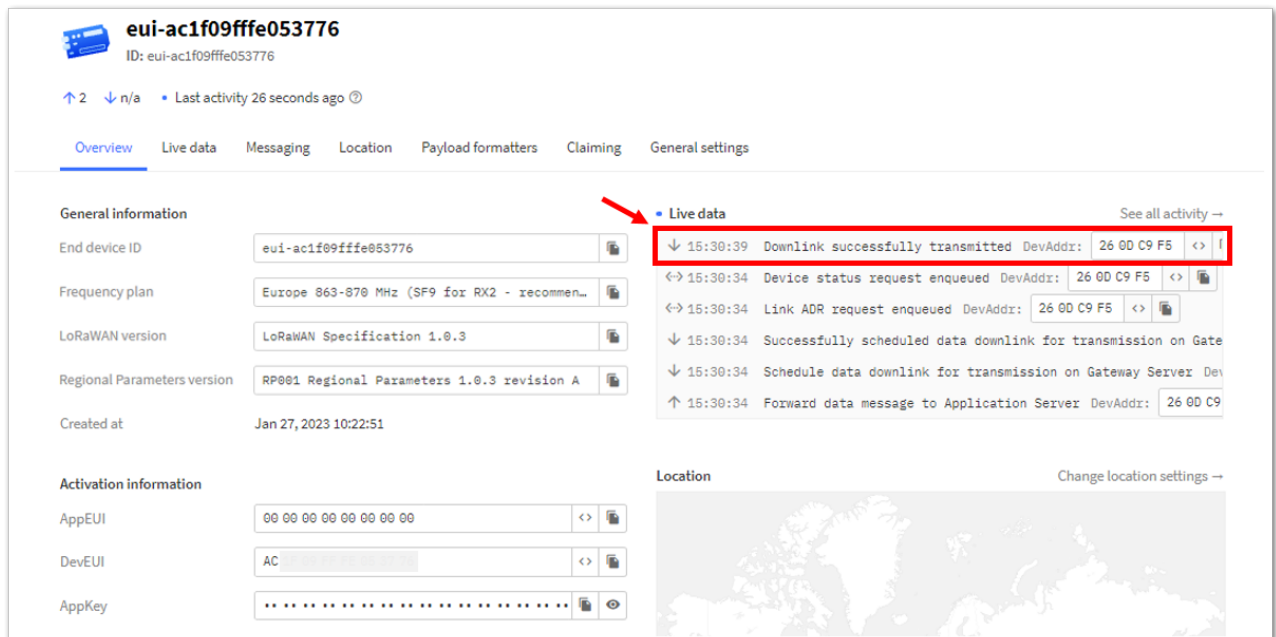


Figure 114: OTAA Test Sample Data Sent Viewed in TTN

## TTN ABP Device Registration

1. To register an ABP device, go to your application console and select the application where you want your device to be added. Then click **+ Register end device**, as shown in **Figure 115**.

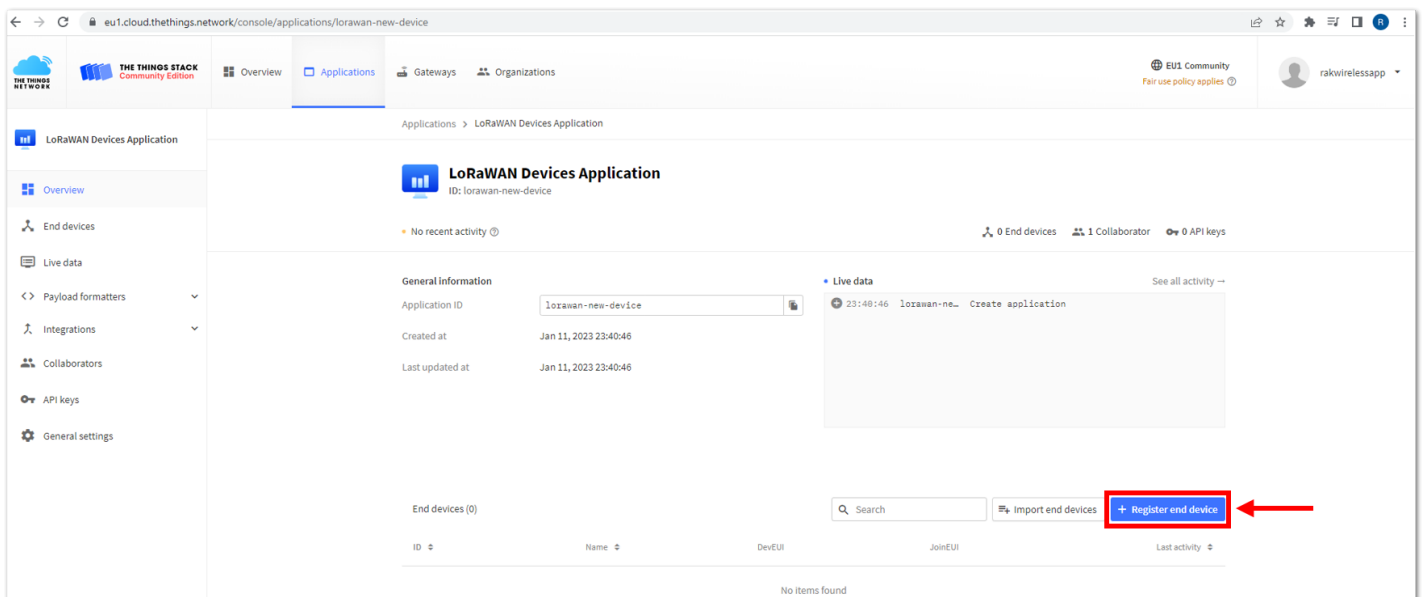


Figure 115: Adding ABP Device

2. To register the board, click the **Enter end device specifics manually**.

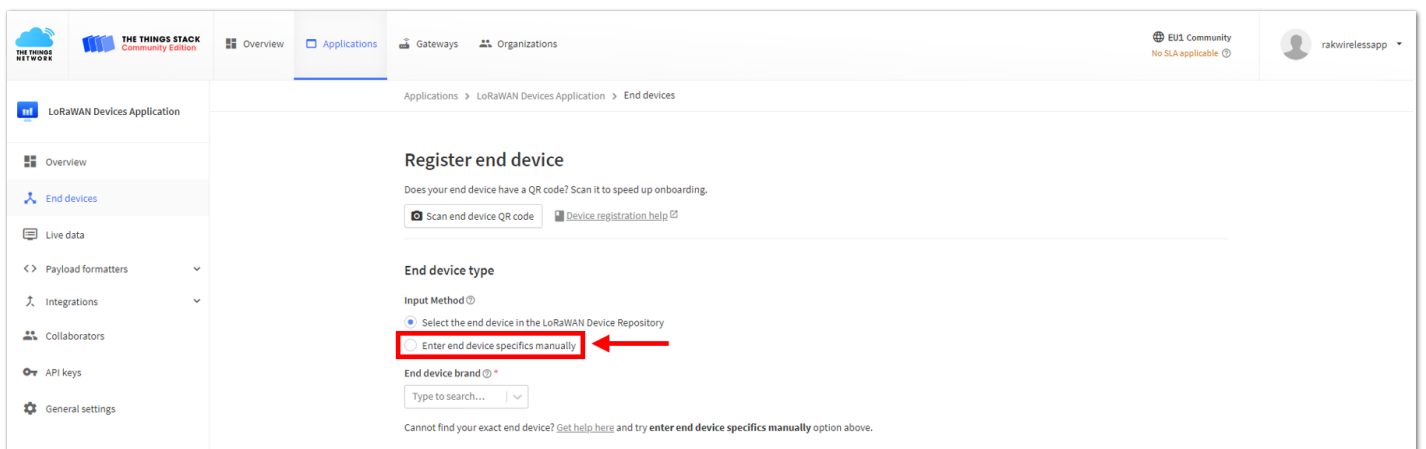


Figure 116: Enter end device specifics manually

3. Next step is to set up **Frequency plan**, compatible **LoRaWAN version**, and **Regional Parameters version** supported.

Applications > LoRaWAN Devices Application > End devices

### Register end device

Does your end device have a QR code? Scan it to speed up onboarding.

[Scan end device QR code](#) [Device registration help](#)

#### End device type

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Select... | v

LoRaWAN version ⓘ \*

Select... | v

Regional Parameters version ⓘ \*

Select... | v

To continue, please enter versions and frequency plan information

Figure 117: Setting up for your device

Applications > LoRaWAN Devices Application > End devices

### Register end device

Does your end device have a QR code? Scan it to speed up onboarding.

[Scan end device QR code](#) [Device registration help](#)

#### End device type

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ \*

Select... | v

Regional Parameters version ⓘ \*

Select... | v

To continue, please enter versions and frequency plan information

Figure 118: Setting up for your device

**Register end device**

Does your end device have a QR code? Scan it to speed up onboarding.

---

**End device type**

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ \*

LoRaWAN Specification 1.0.3 | v

Regional Parameters version ⓘ \*

RP001 Regional Parameters 1.0.3 revision A | v

[Show advanced activation, LoRaWAN class and cluster settings](#) v

---

**Provisioning information**

JoinEUI ⓘ \*

..... Confirm

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

**Figure 119:** Setting up for your device

4. Then click **Show advanced activation, LoRaWAN class and cluster settings**. Configure the activation mode by selecting **Activation by personalization (ABP)** and Additional LoRaWAN class capabilities to **class A only**.

**Register end device**

Does your end device have a QR code? Scan it to speed up onboarding.

---

**End device type**

Input Method ⓘ

Select the end device in the LoRaWAN Device Repository

Enter end device specifics manually

Frequency plan ⓘ \*

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ \*

LoRaWAN Specification 1.0.3 | v

Regional Parameters version ⓘ \*

RP001 Regional Parameters 1.0.3 revision A | v

[Show advanced activation, LoRaWAN class and cluster settings](#) v

---

**Provisioning information**

JoinEUI ⓘ \*

..... Confirm

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

**Figure 120:** Setting up for your device

Show advanced activation, LoRaWAN class and cluster settings ^

Activation mode ⓘ

Over the air activation (OTAA)

Activation by personalization (ABP)

Define multicast group (ABP & Multicast)

Additional LoRaWAN class capabilities ⓘ

None (class A only) | v

Network defaults ⓘ

Use network's default MAC settings

Cluster settings ⓘ

Skip registration on Join Server

---

Provisioning information

JoinEUI ⓘ \*

..... Confirm

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

Figure 121: Setting up for your device

5. Once done, provide the DevEUI credentials of your device into the **DevEUI** portion. This will automatically generate the specific End device ID of your board. Then click **Generate** under **Device address**, **AppSKey** and **NwksKey** under Provisioning information section. Then click **Register end device**.

**NOTE:**

- The **DevEUI**, **Device address**, **AppSKey**, and **NwksKey** are hidden in this section as these are unique from a specific device. The **DevEUI** credential is unique to every RAK3172 device. Also, you should generate your own **Device address**, **AppSKey**, and **NwksKey** credentials for your specific device and application.

Activation mode ⓘ

Over the air activation (OTAA)

Activation by personalization (ABP)

Define multicast group (ABP & Multicast)

Additional LoRaWAN class capabilities ⓘ

None (class A only) | v

Network defaults ⓘ

Use network's default MAC settings

Cluster settings ⓘ

Skip registration on Join Server

---

Provisioning information

DevEUI ⓘ

..... Generate 0/50 used

Device address ⓘ \*

..... Generate

AppSKey ⓘ \*

..... Generate

NwksKey ⓘ \*

..... Generate

End device ID ⓘ \*

my-new-device

This value is automatically prefilled using the DevEUI

After registration

View registered end device

Register another end device of this type

Register end device

Figure 122: Setting up for your device

**Provisioning information**

DevEUI ⓘ  
AC 1F 09 FF FE 05 36 DF Generate 0/50 used

Device address ⓘ \*  
.. .. .. . Generate

AppSKey ⓘ \*  
.. .. .. .. .. Generate

NwkSKey ⓘ \*  
.. .. .. .. .. Generate

End device ID ⓘ \*  
eui-ac1f09fffe0536df  
This value is automatically prefilled using the DevEUI

After registration  
 View registered end device  
 Register another end device of this type

Register end device

Figure 123: Setting up for your device

**Provisioning information**

DevEUI ⓘ  
AC 1F 09 FF FE 05 36 DF Generate 0/50 used

Device address ⓘ \*  
.. .. .. . Generate

AppSKey ⓘ \*  
.. .. .. .. .. Generate

NwkSKey ⓘ \*  
.. .. .. .. .. Generate

End device ID ⓘ \*  
eui-ac1f09fffe0536df  
This value is automatically prefilled using the DevEUI

After registration  
 View registered end device  
 Register another end device of this type

Register end device

Figure 124: Setting up for your device

**Provisioning information**

DevEUI ⓘ  
AC   0/50 used

Device address ⓘ\*  
26

AppSKey ⓘ\*  
  ←

NwkSKey ⓘ\*

End device ID ⓘ\*  
  
This value is automatically prefilled using the DevEUI

After registration  
 View registered end device  
 Register another end device of this type

Figure 125: Setting up for your device

**Provisioning information**

DevEUI ⓘ  
AC   0/50 used

Device address ⓘ\*  
26

AppSKey ⓘ\*

NwkSKey ⓘ\*  
  ←

End device ID ⓘ\*  
  
This value is automatically prefilled using the DevEUI

After registration  
 View registered end device  
 Register another end device of this type

Figure 126: Setting up for your device

**Provisioning information**

DevEUI ⓘ  
  0/50 used

Device address ⓘ\*

AppKey ⓘ\*

NwkKey ⓘ\*

End device ID ⓘ\*  
  
This value is automatically prefilled using the DevEUI

After registration

View registered end device  
 Register another end device of this type

←

**Figure 127:** Register end device

6. You should now be able to see the device on the TTN console after you fully register your device, as shown in **Figure 128**.

The screenshot shows the TTN console interface for a LoRaWAN device. The breadcrumb trail is: Applications > LoRaWAN Devices Application > End devices > eui-ac1f09fffe0536df. The device name is **eui-ac1f09fffe0536df** with ID: eui-ac1f09fffe0536df. The status is 'No activity yet'. The 'Activation information' section is highlighted with a red box and contains the following data:

Field	Value
AppEUI	n/a
DevEUI	AC
Session start	Jan 16, 2023 23:23:21
Device address	26
NwkSKey	.....
S/NwkSIntKey	.....
NwkSEncKey	.....
AppSKey	.....

**Figure 128:** ABP device successfully registered to TTN

## ABP Configuration for TTN

The RAK3172 evaluation board can be configured using WisToolBox to do the ABP configuration. **WisToolBox** is a software tool that supports **RAK3172** module. It automatically detects RAK3172 evaluation board once connected to PC. Below are the options in WisToolBox that the ABP configuration can be done.

- [ABP Configuration for TTN via WisToolBox UI](#)
- [ABP Configuration for TTN via WisToolBox Console](#)

## ABP Configuration for TTN via WisToolBox UI

The **RAK3172** should have correct ABP credentials to connect to TTN. This can be done using **WisToolBox**. Below are the steps on setting up your **RAK3172** using **WisToolBox**.

1. Connect your **RAK3172** with your chosen WisBlock base board to the PC via USB cable and open the **WisToolBox** application.
2. Click **CONNECT DEVICE** button to launch the WisToolBox Dashboard.

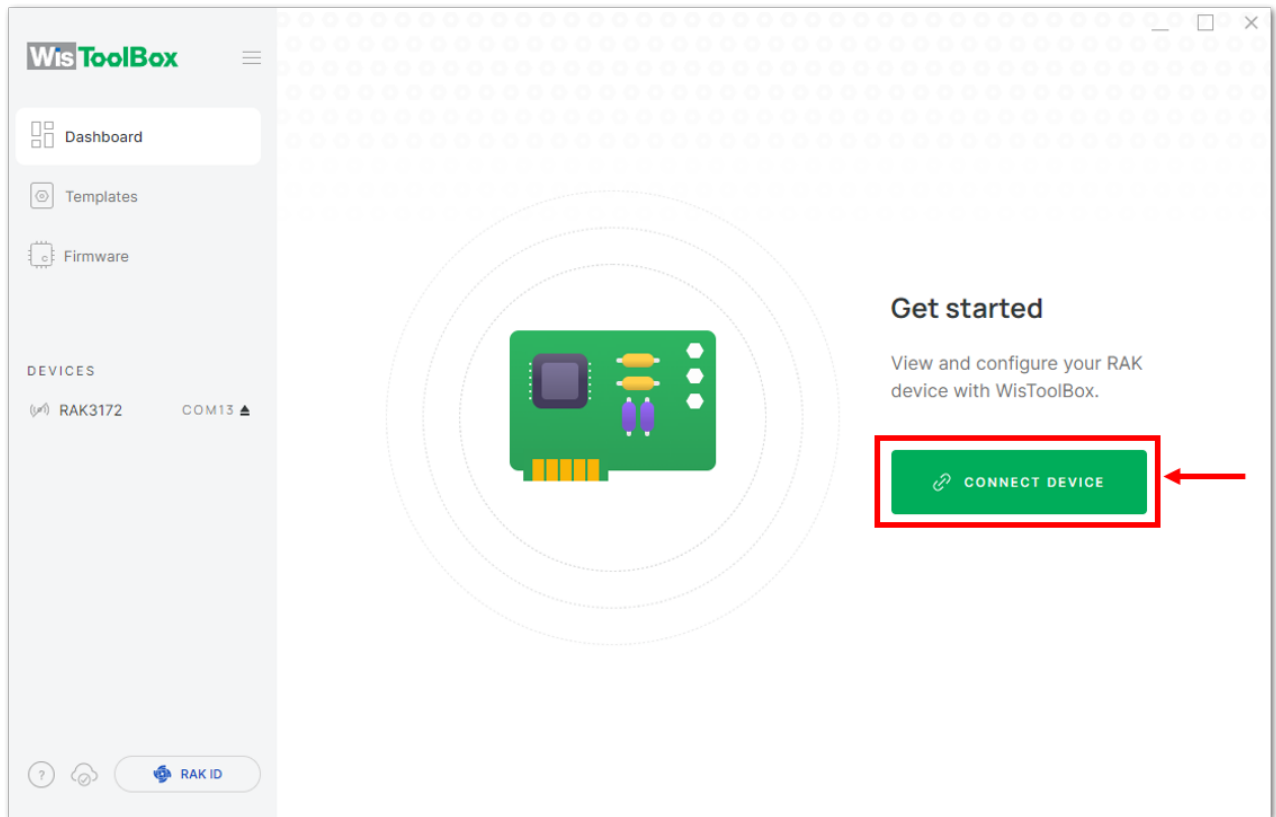


Figure 129: CONNECT DEVICE

3. Then select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT** as shown in **Figure 131**.

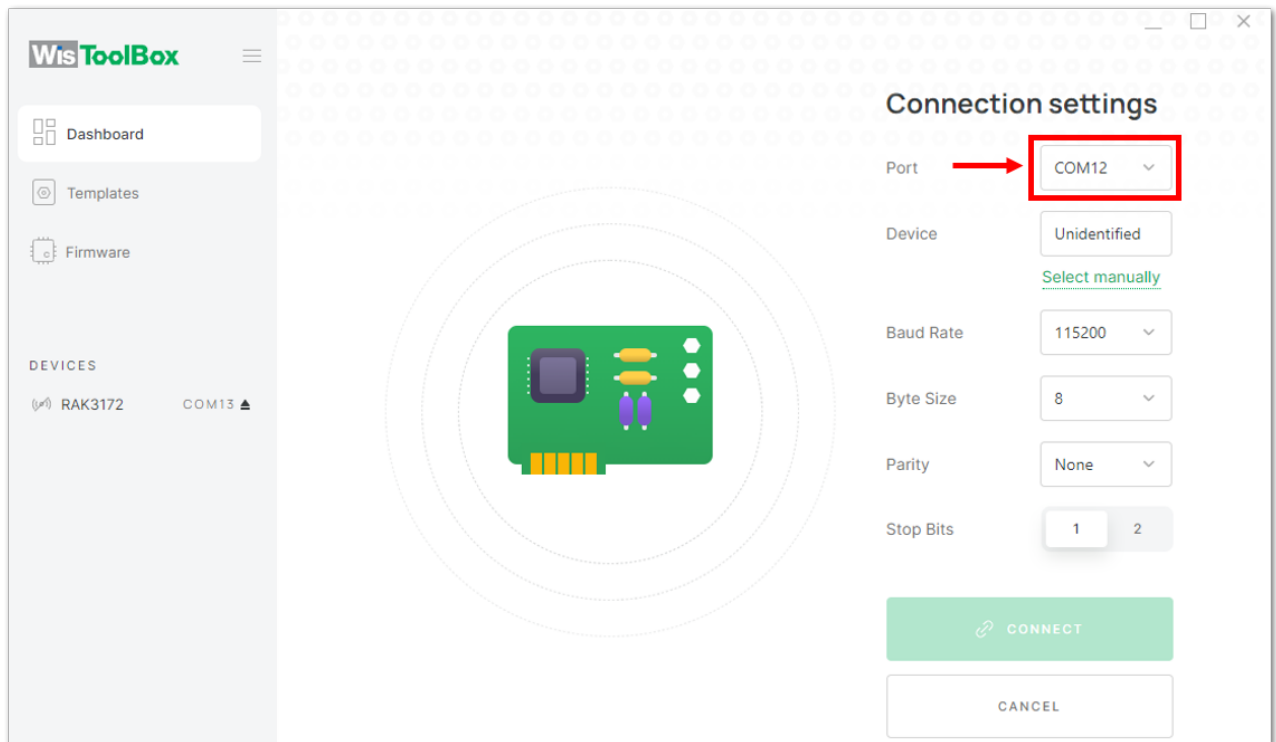


Figure 130: Setting up your device



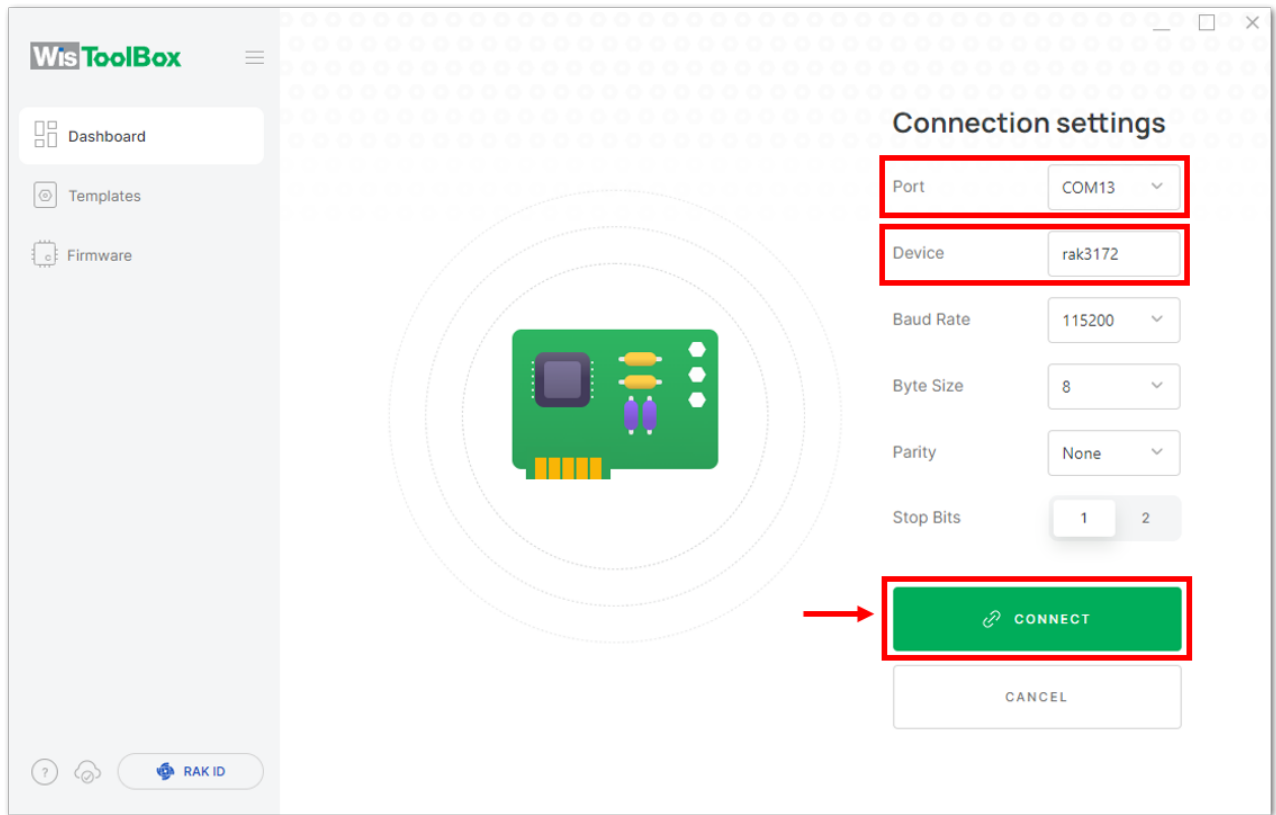


Figure 131: Setting up your device

4. Once done, **RAK3172** will appear in the dashboard then select it.

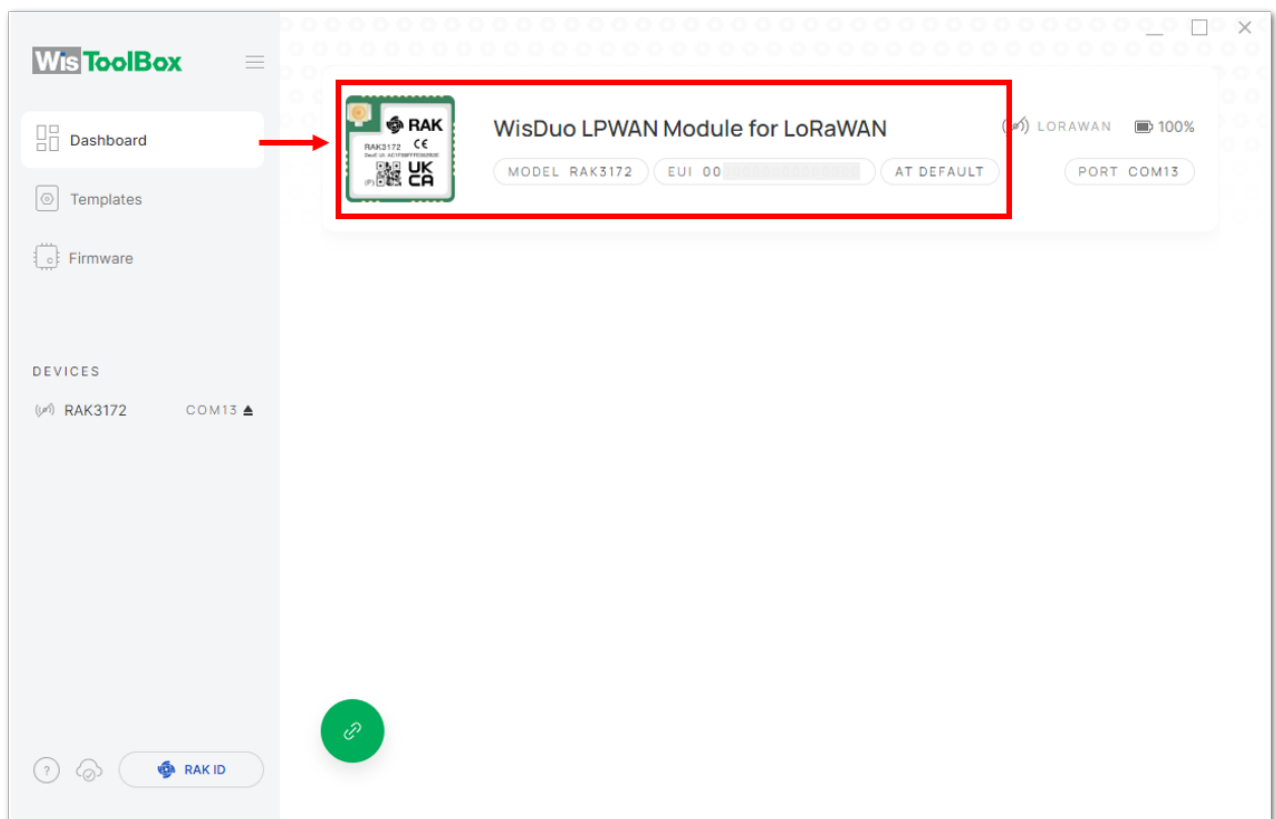


Figure 132: Device seen from WisToolBox dashboard

5. Then click **PARAMETERS** to do the configuration in your RAK3172.

**NOTE:**

- The **AppSKey**, **Device address**, and **NwksKey** are hidden in this section as these are unique from a specific device.

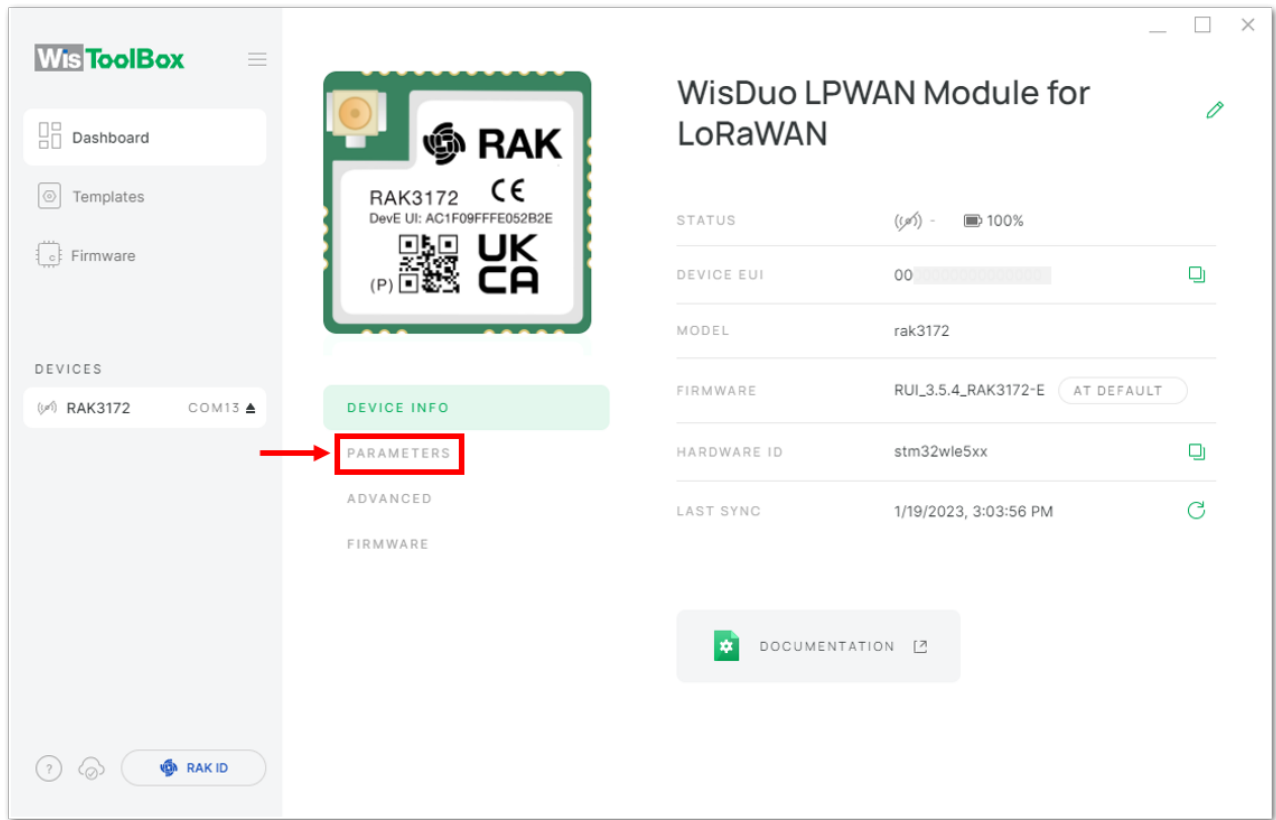


Figure 133: Setting up your device

6. Click **Global settings** to set the network mode into **LoRaWAN** and join mode to **ABP**. Make sure that the active region is using **EU868** for this configuration. If you wish to work on other regional band, you can choose among active regions based on your location.

- LoRa network mode: **LoRaWAN**
- LoRaWAN join mode: **ABP**
- LoRaWAN region: **EU868**

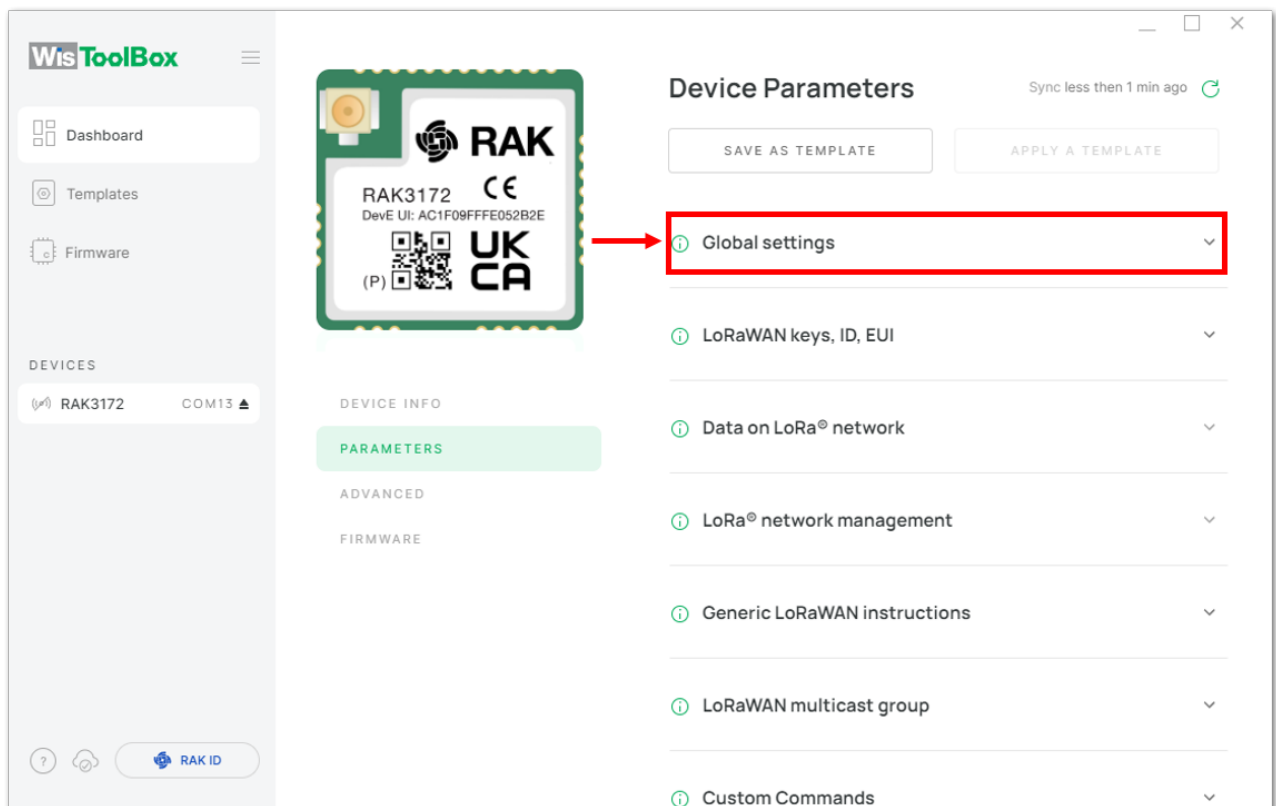


Figure 134: Global settings

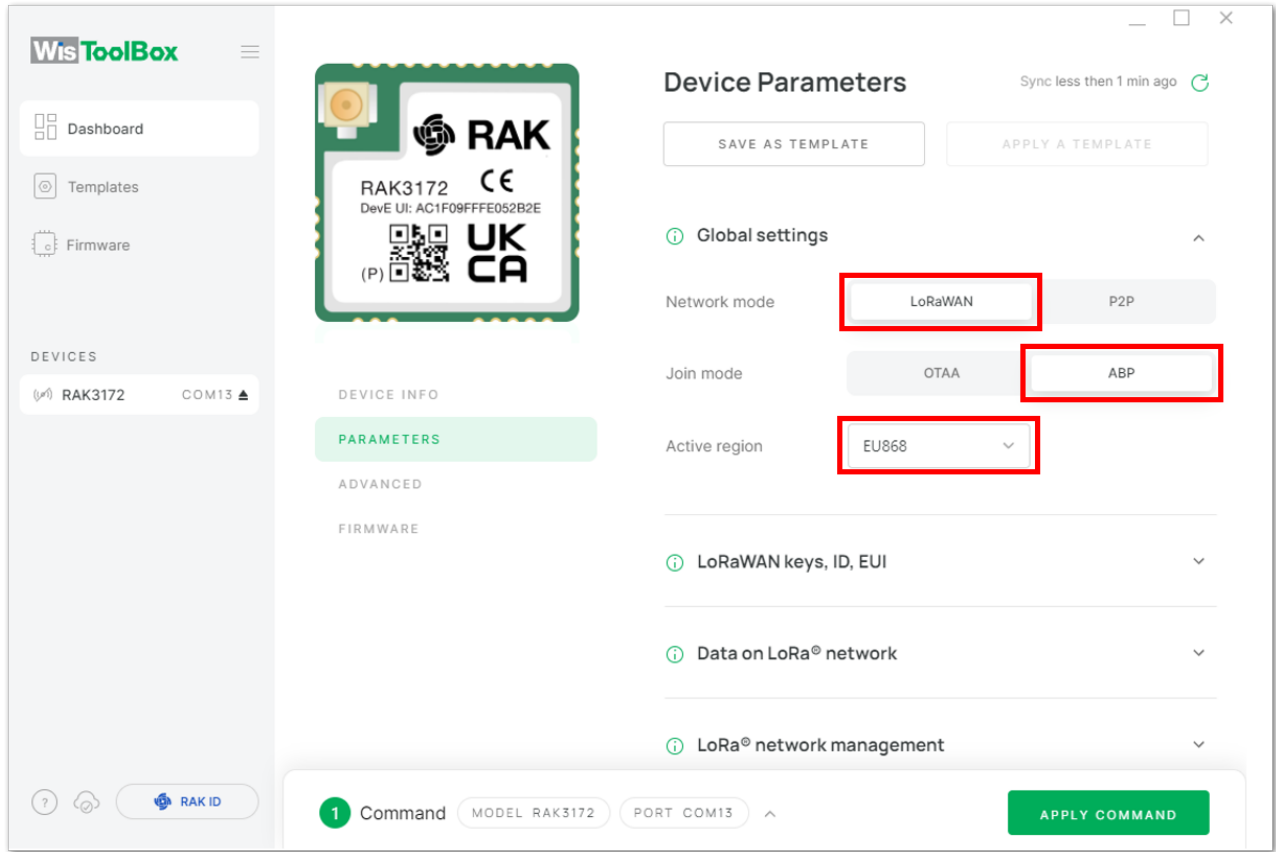


Figure 135: Global settings

7. Then click **LoRaWAN keys, ID, EUI** to configure the **Application session key (AppSKey)**, **Device address** and **Network session key (NwkSKey)**.

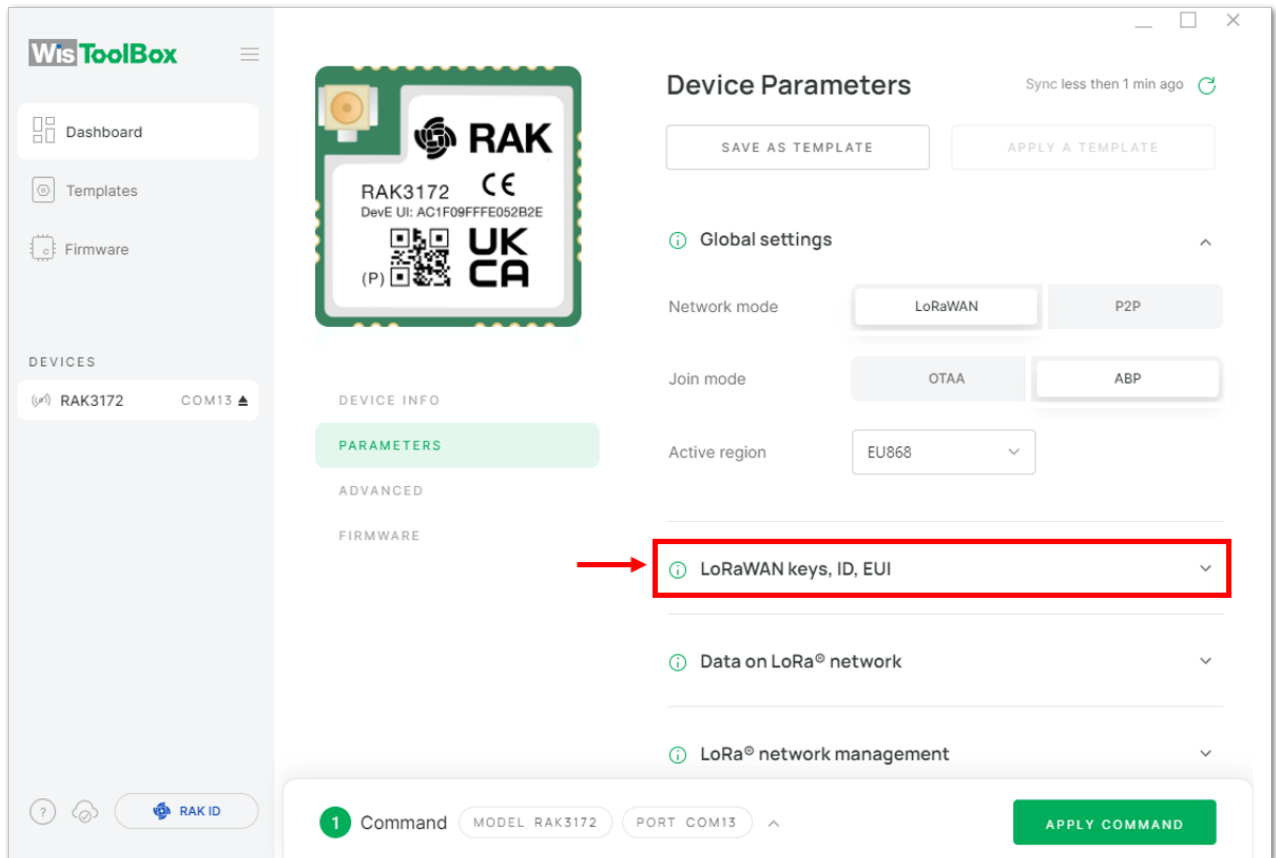


Figure 136: LoRaWAN keys, ID, EUI

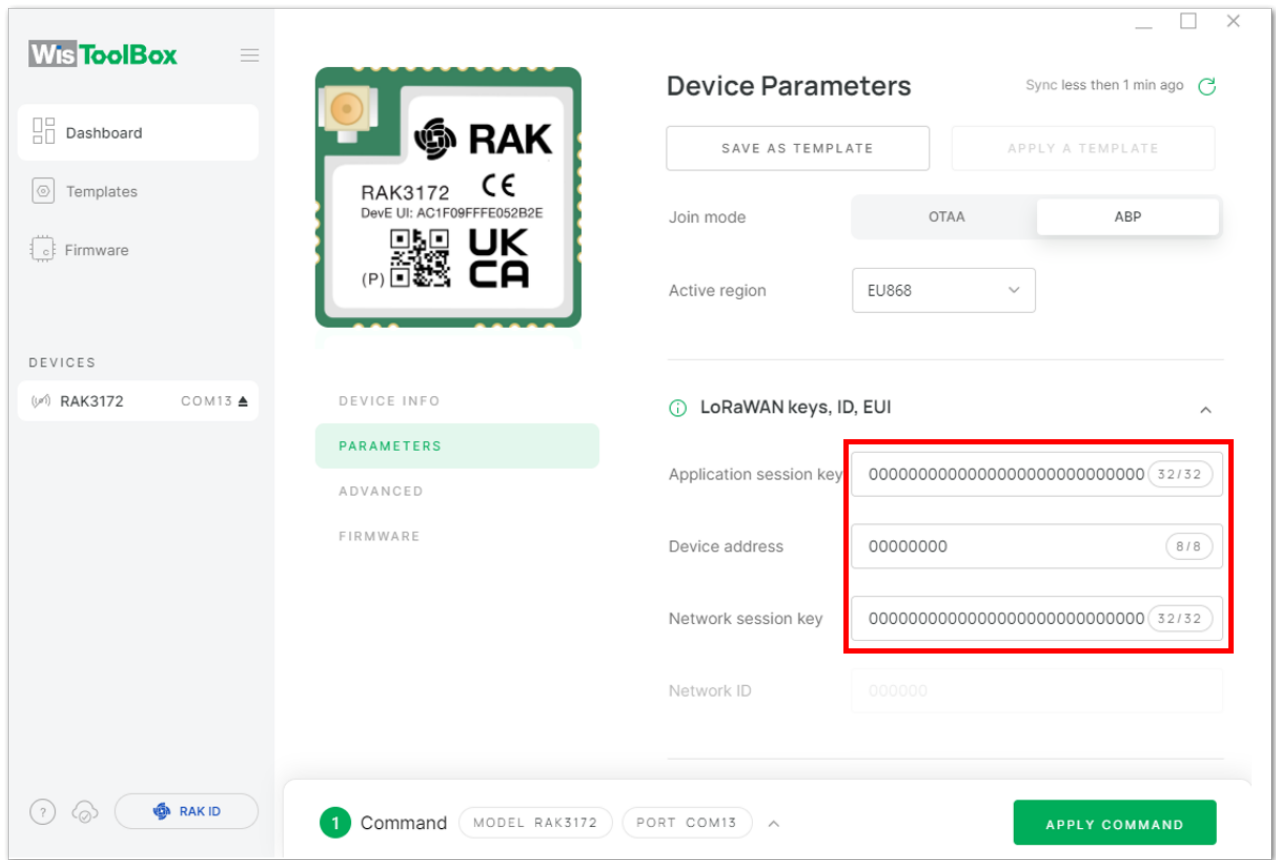


Figure 137: Setting up your device

8. Then go back to console where your RAK3172 End device is created previously. Then copy all the credentials from there. Those will be the ones to be used also in the WisToolBox dashboard. Once encoded into the dashboard, click **APPLY COMMANDS** to update your device as shown in **Figure 145**.

**NOTE:**

- The **AppSKey**, **Device address**, and **NwkSKey** are hidden in this section as these are unique from a specific device.

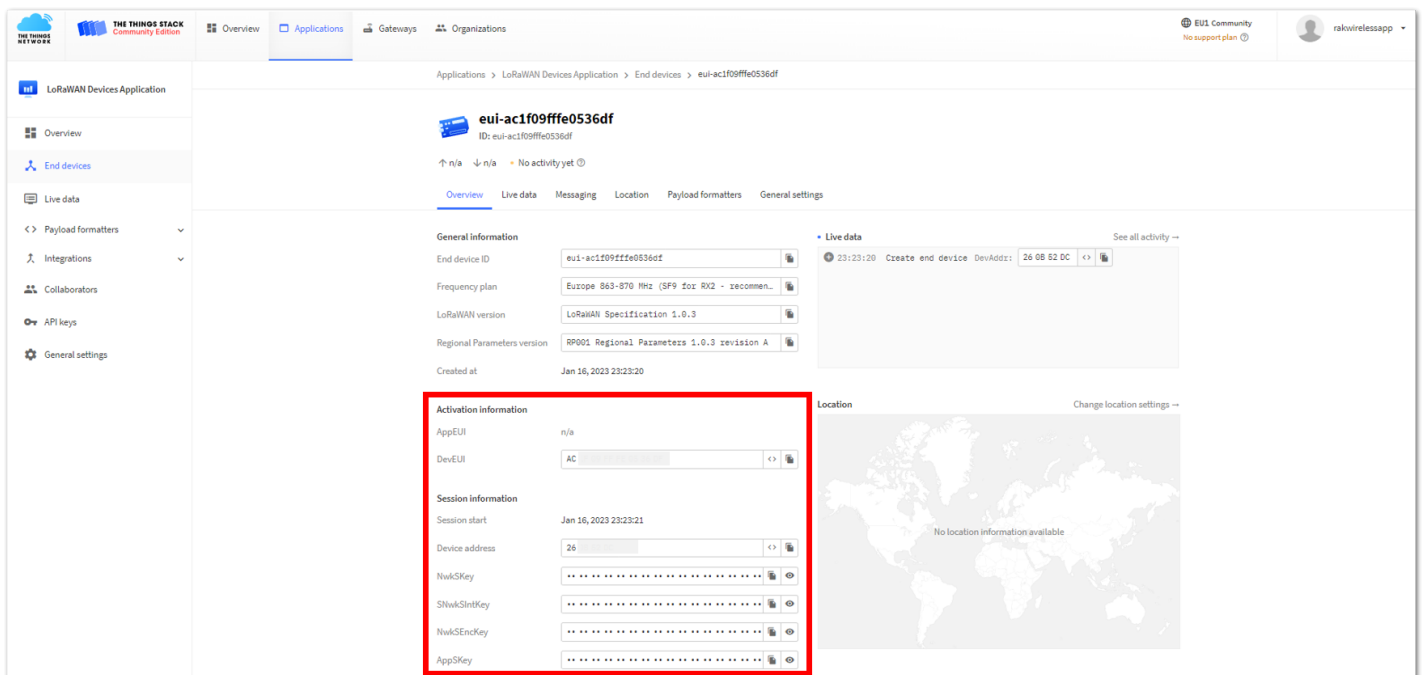


Figure 138: Your created ABP device from your console

- For Application session key (AppSKey)

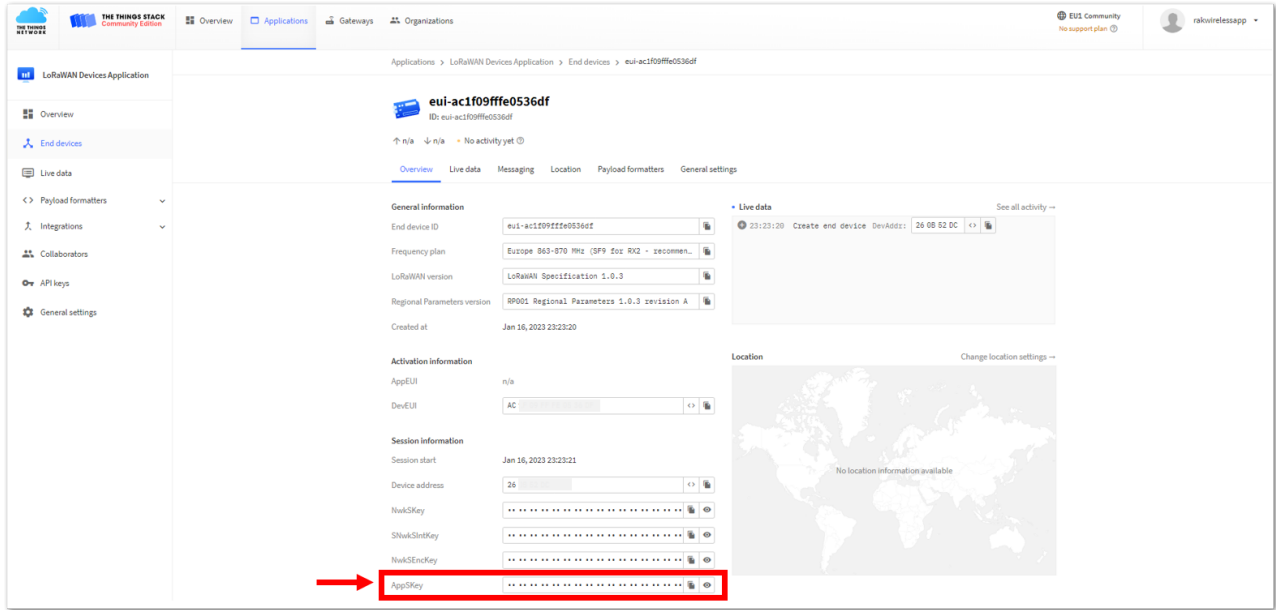


Figure 139: Copying the AppSKey credential from TTN to WisToolBox

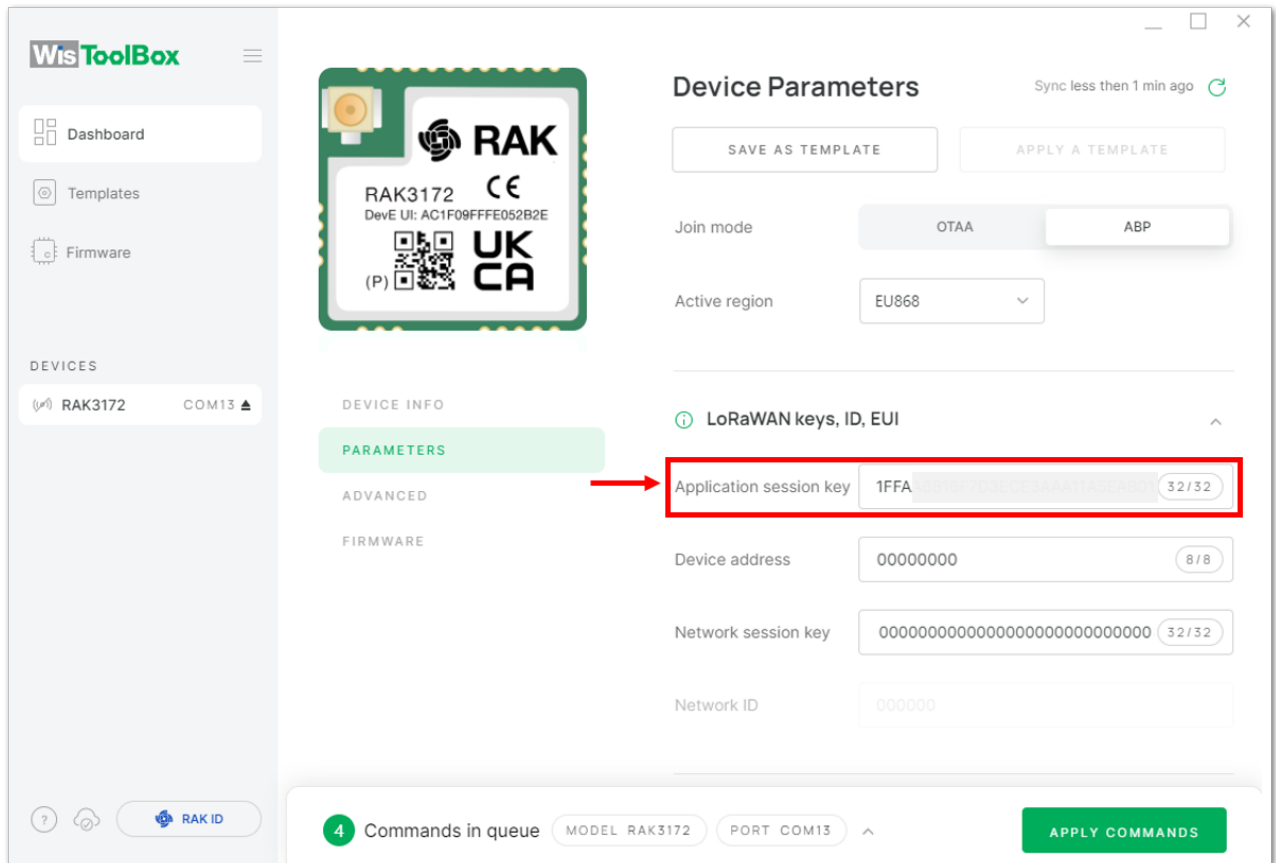


Figure 140: Copying the AppSKey credential from TTN to WisToolBox

- For Device address

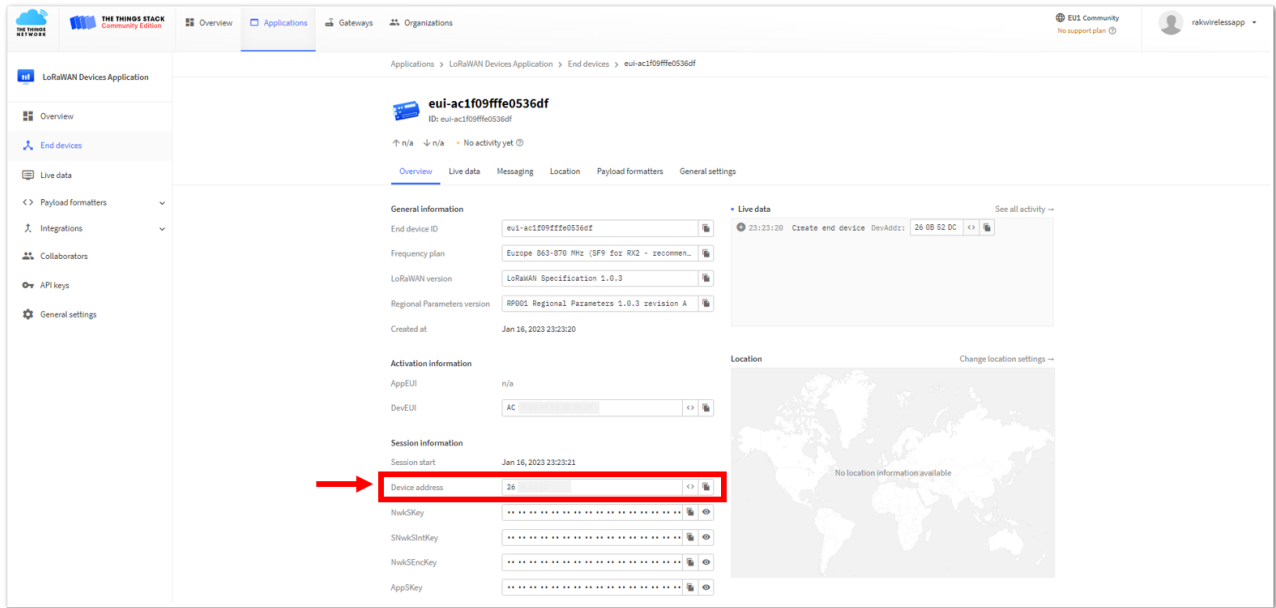


Figure 141: Copying the Device address credential from TTN to WisToolBox

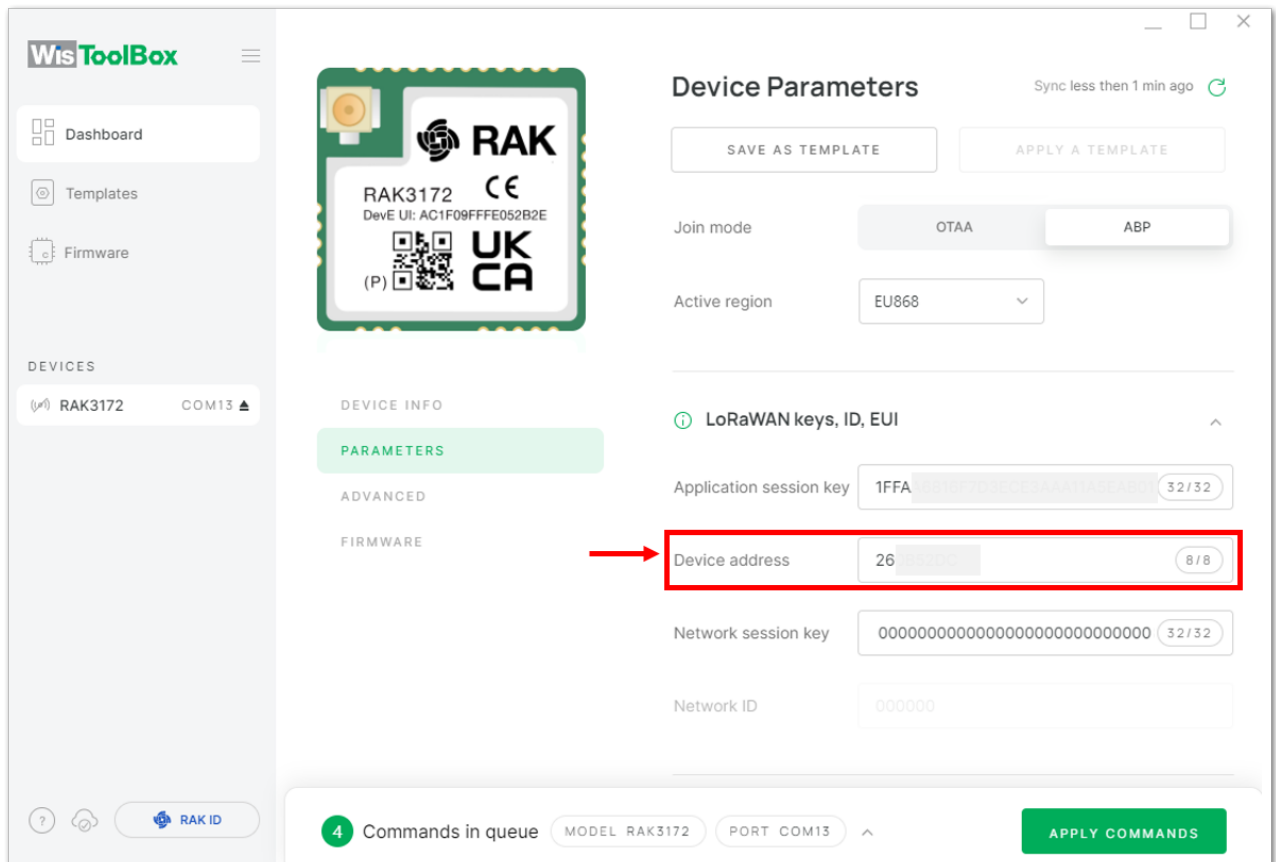


Figure 142: Copying the Device address credential from TTN to WisToolBox

- For Network session key (NwksKey)

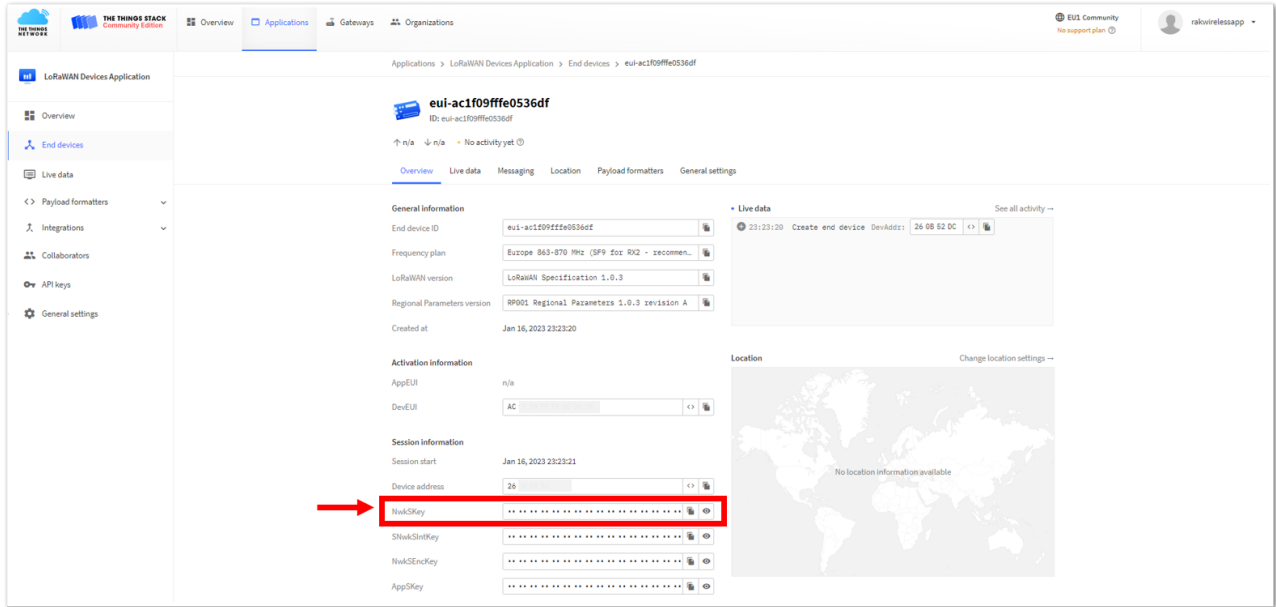


Figure 143: Copying the NwkSKey credential from TTN to WisToolBox

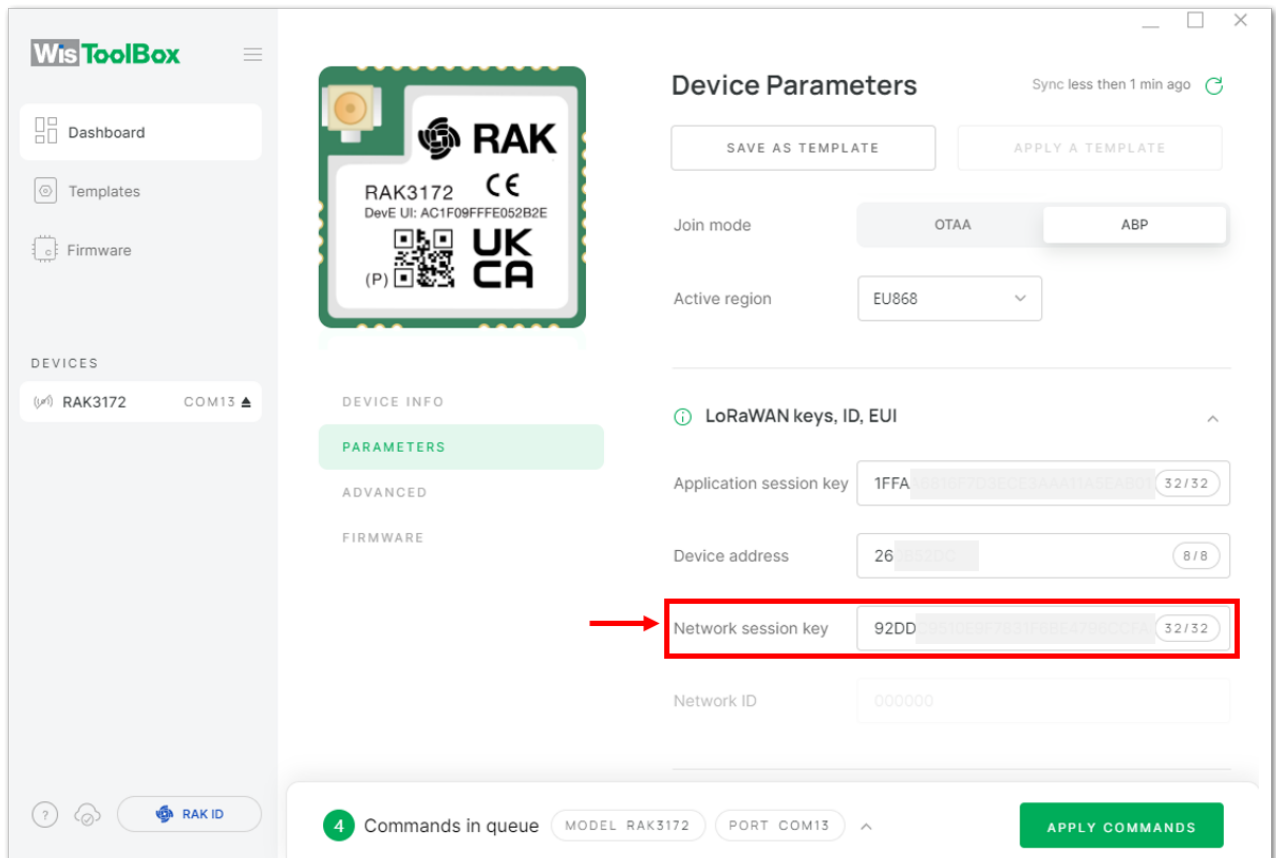


Figure 144: Copying the NwkSKey credential from TTN to WisToolBox

- **WisToolBox Dashboard**

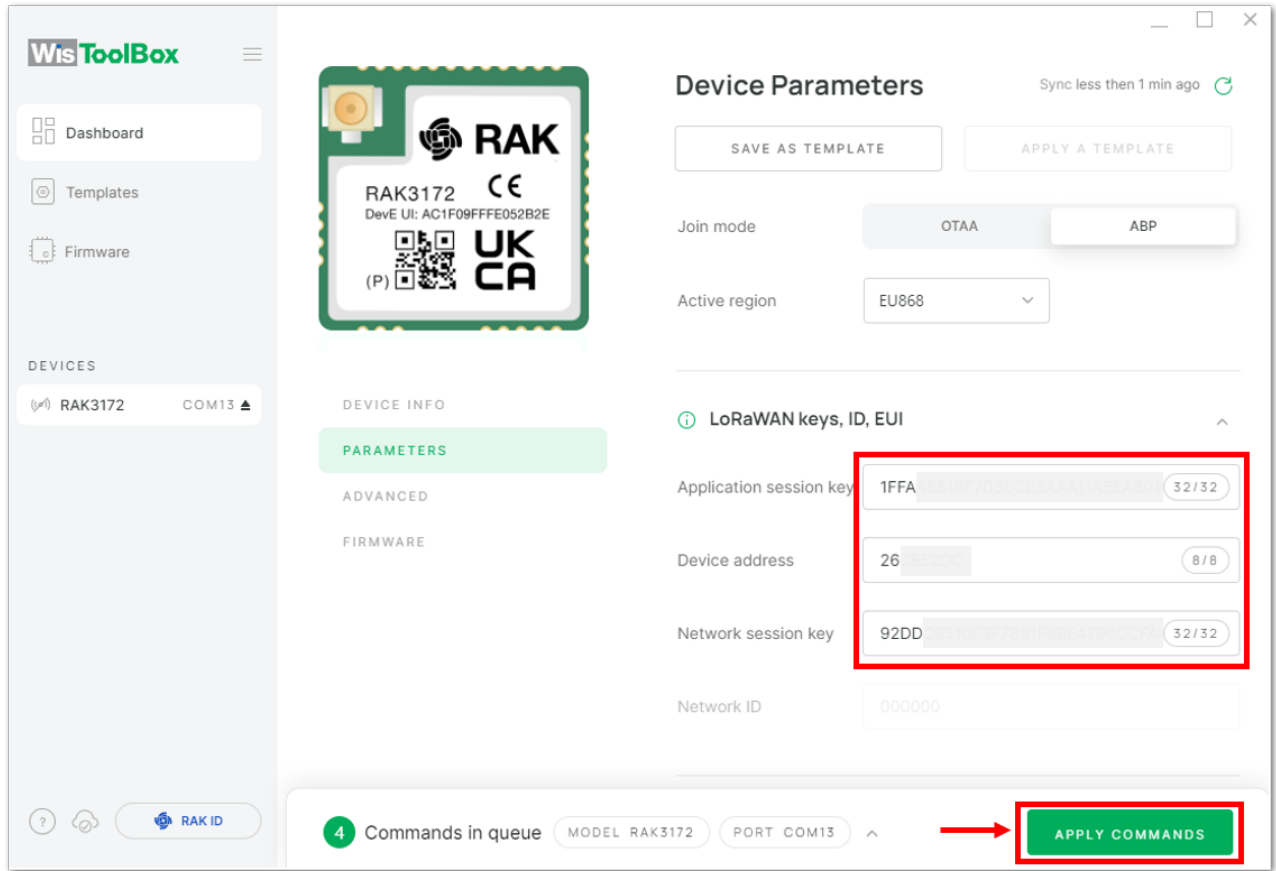


Figure 145: Used credentials from your console in WisToolBox dashboard

9. Once done, you will see the summary of commands that is applied to your device. Then click **CLOSE**.

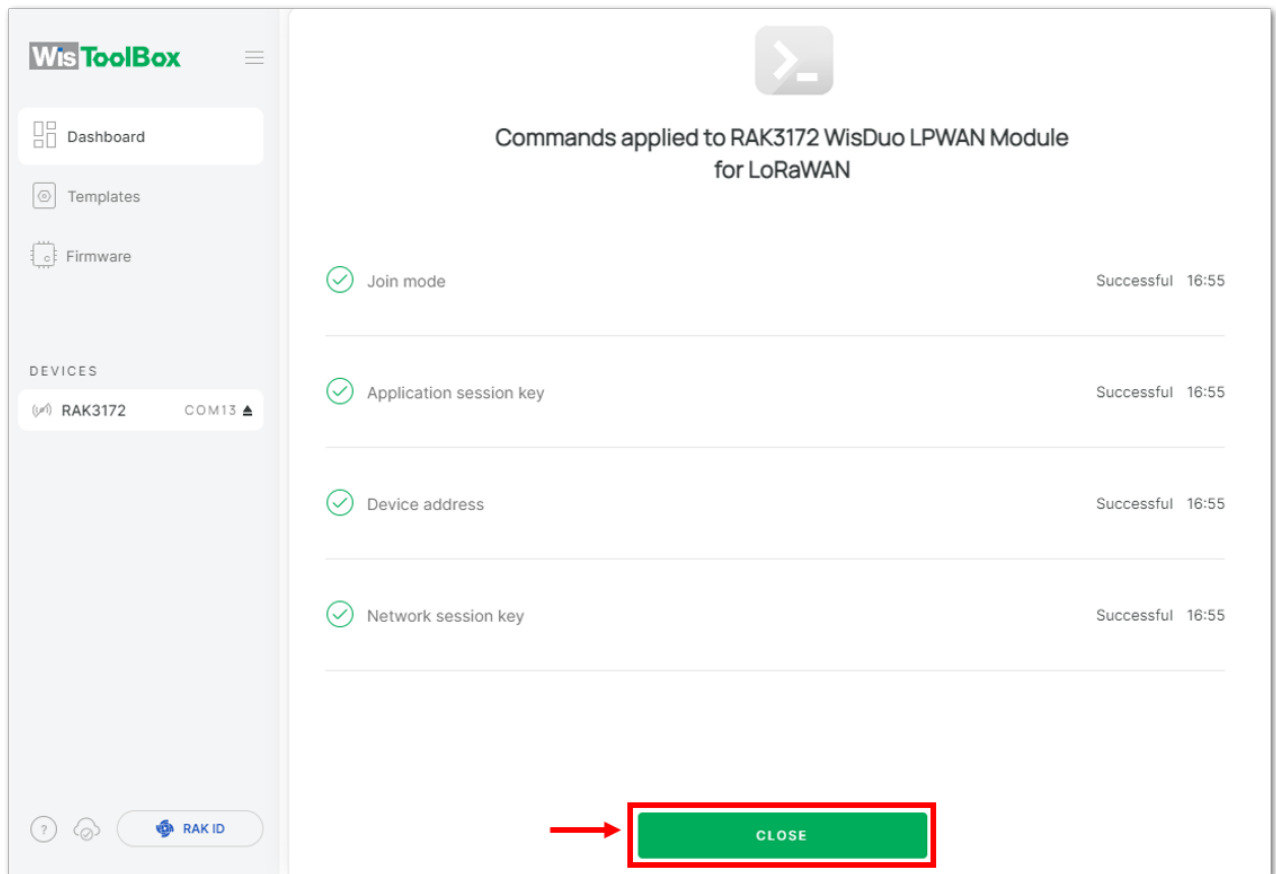


Figure 146: Summary of commands

10. Now you will see it returns back to the dashboard with updated credentials of your device.



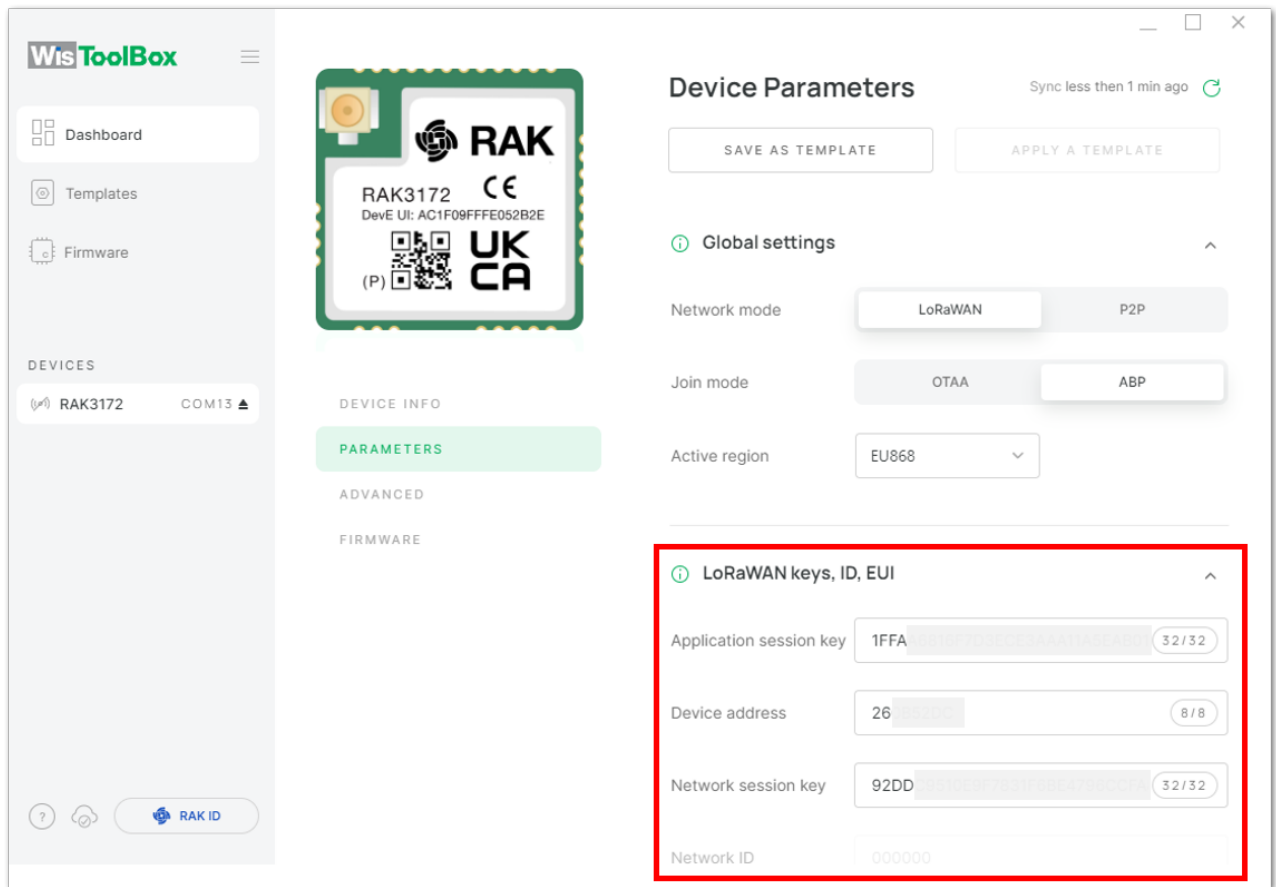


Figure 147: Successfully configured ABP device via WisToolBox dashboard

## ABP Configuration for TTN via WisToolBox Console

Here's another way of ABP configuration using **WisToolBox Console**. Below are the steps on setting up your **RAK3172** using **WisToolBox Console**.

1. Connect your **RAK3172** with your chosen WisBlock base board to the PC via USB cable and open the **WisToolBox** application.
2. Click **CONNECT DEVICE** button to launch the WisToolBox Dashboard.

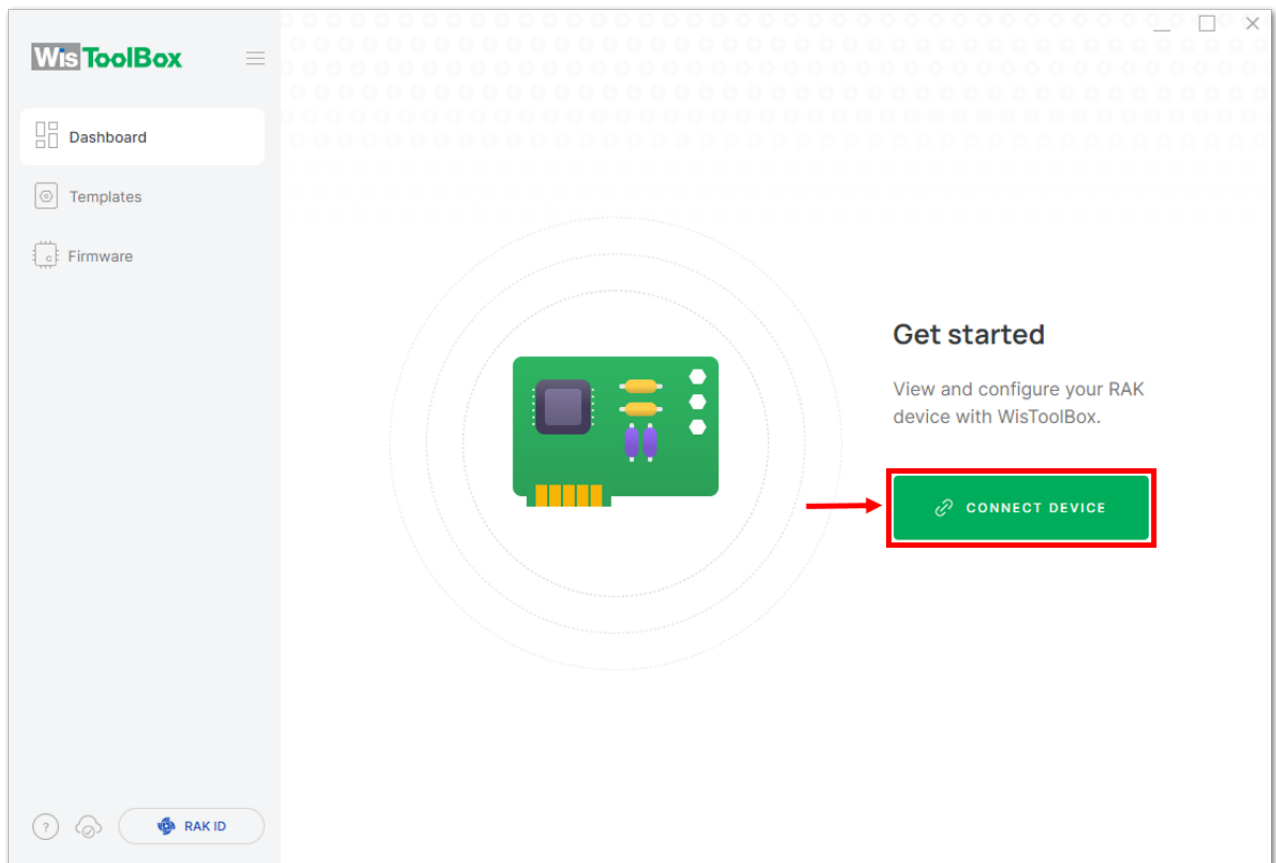
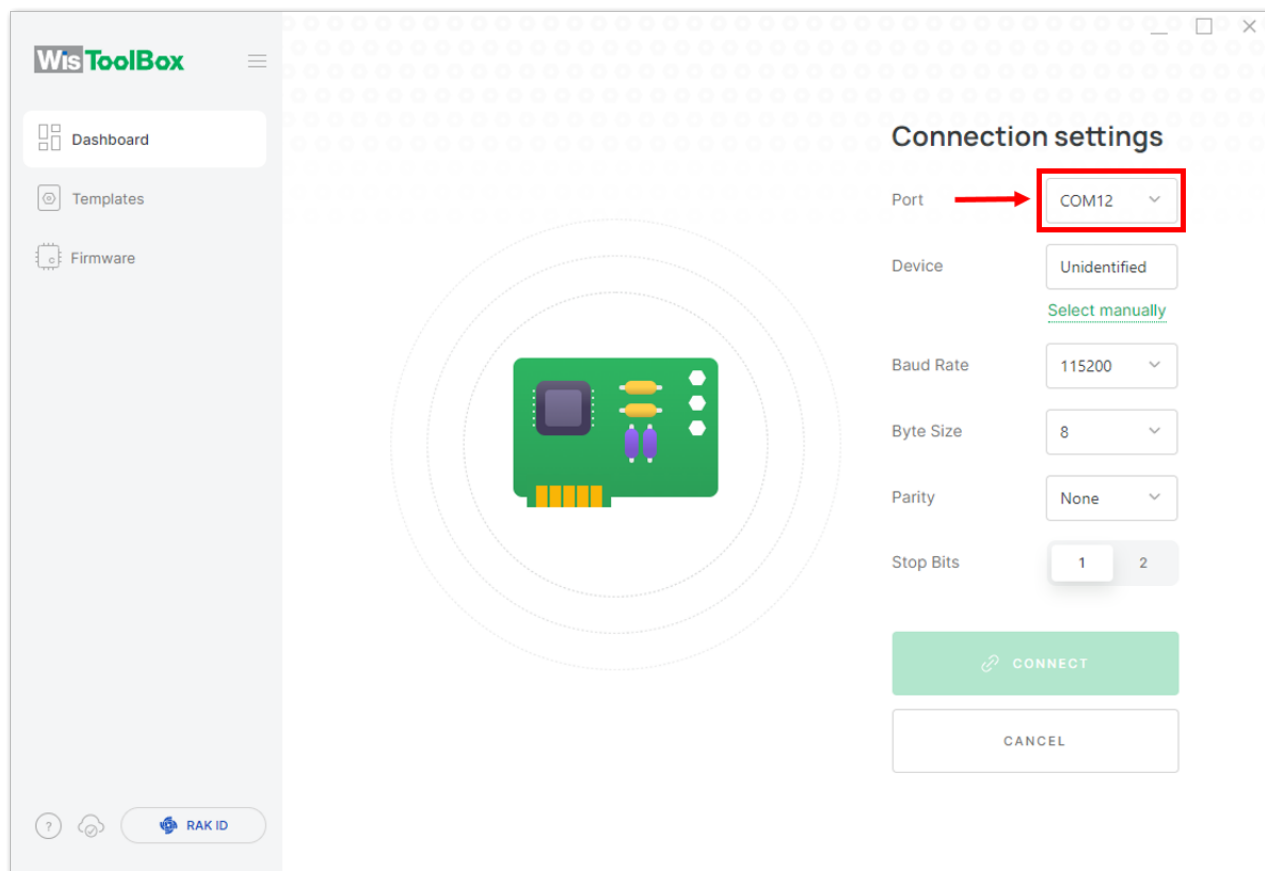
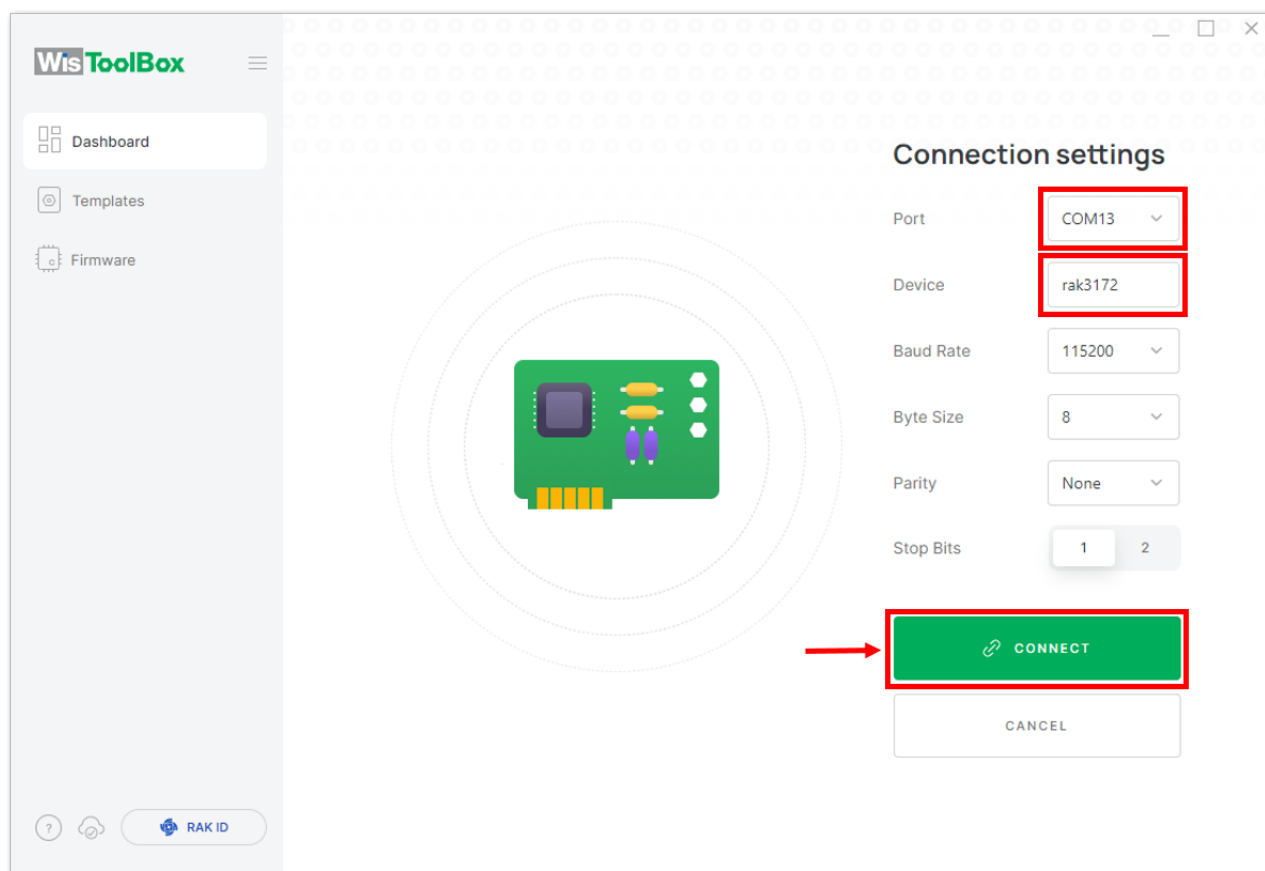


Figure 148: CONNECT DEVICE

3. Then select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT** as shown in **Figure 150**.



**Figure 149:** Setting up your device



**Figure 150:** Setting up your device

4. Once done, **RAK3172** will appear in the dashboard then select it.

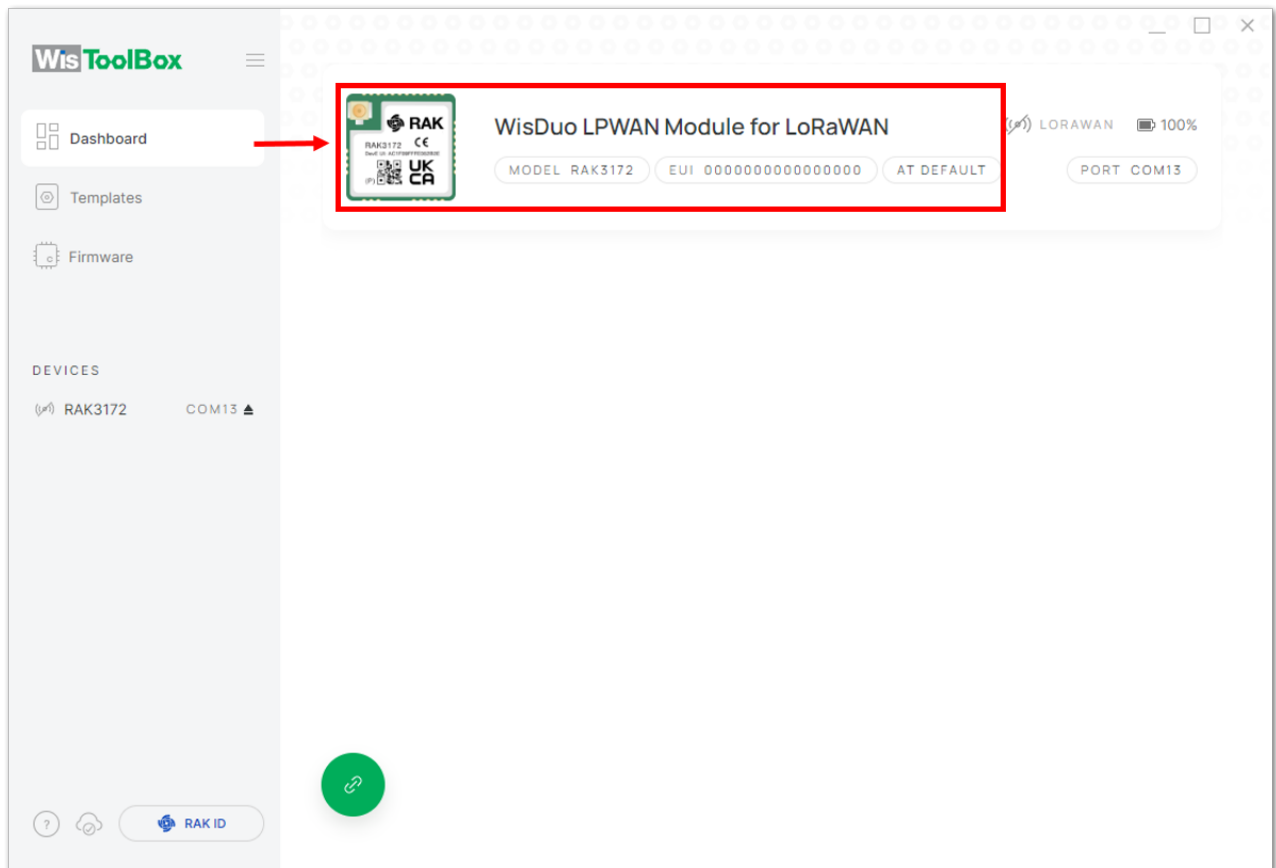


Figure 151: Device seen from WisToolBox dashboard

5. Then click **ADVANCED**.

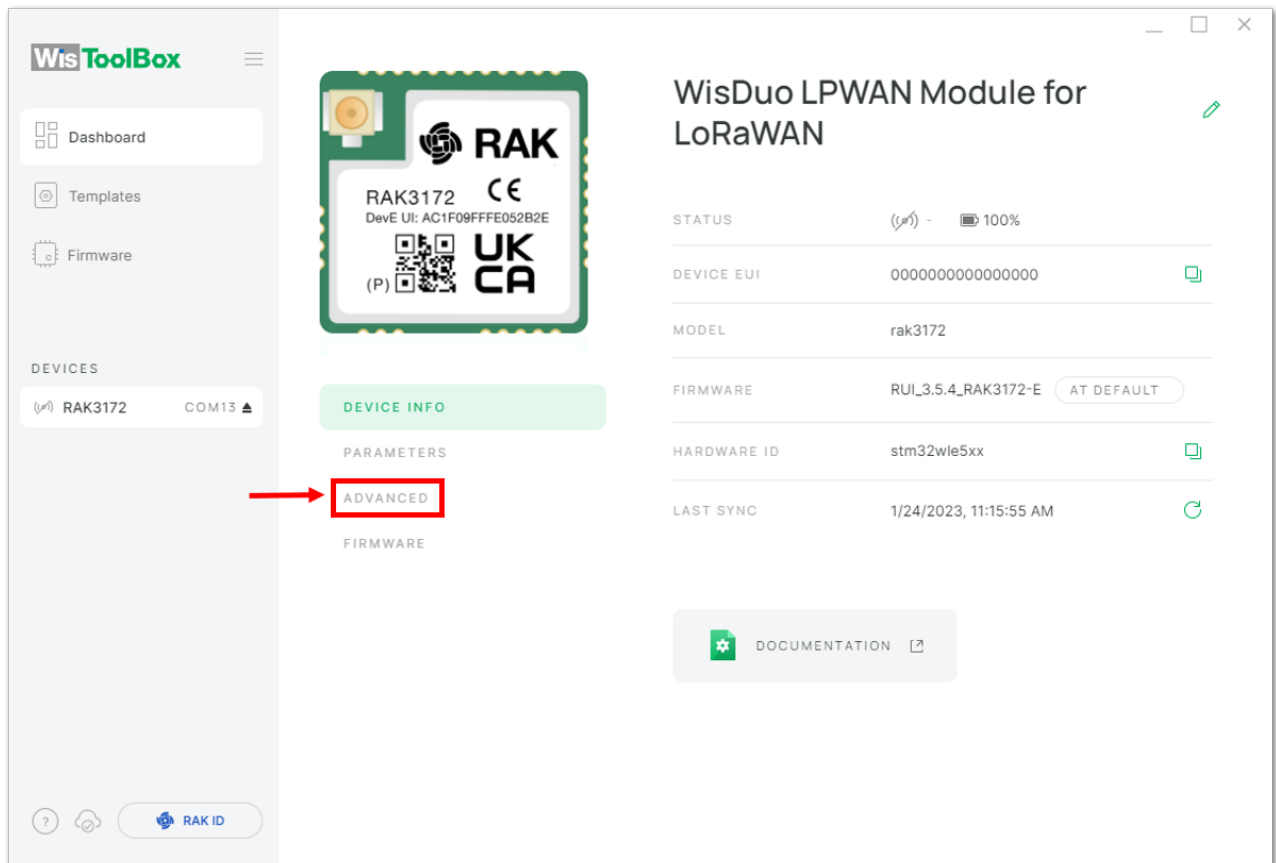


Figure 152: Setting up your device

6. Once done, click **OPEN CONSOLE** to do the configuration.

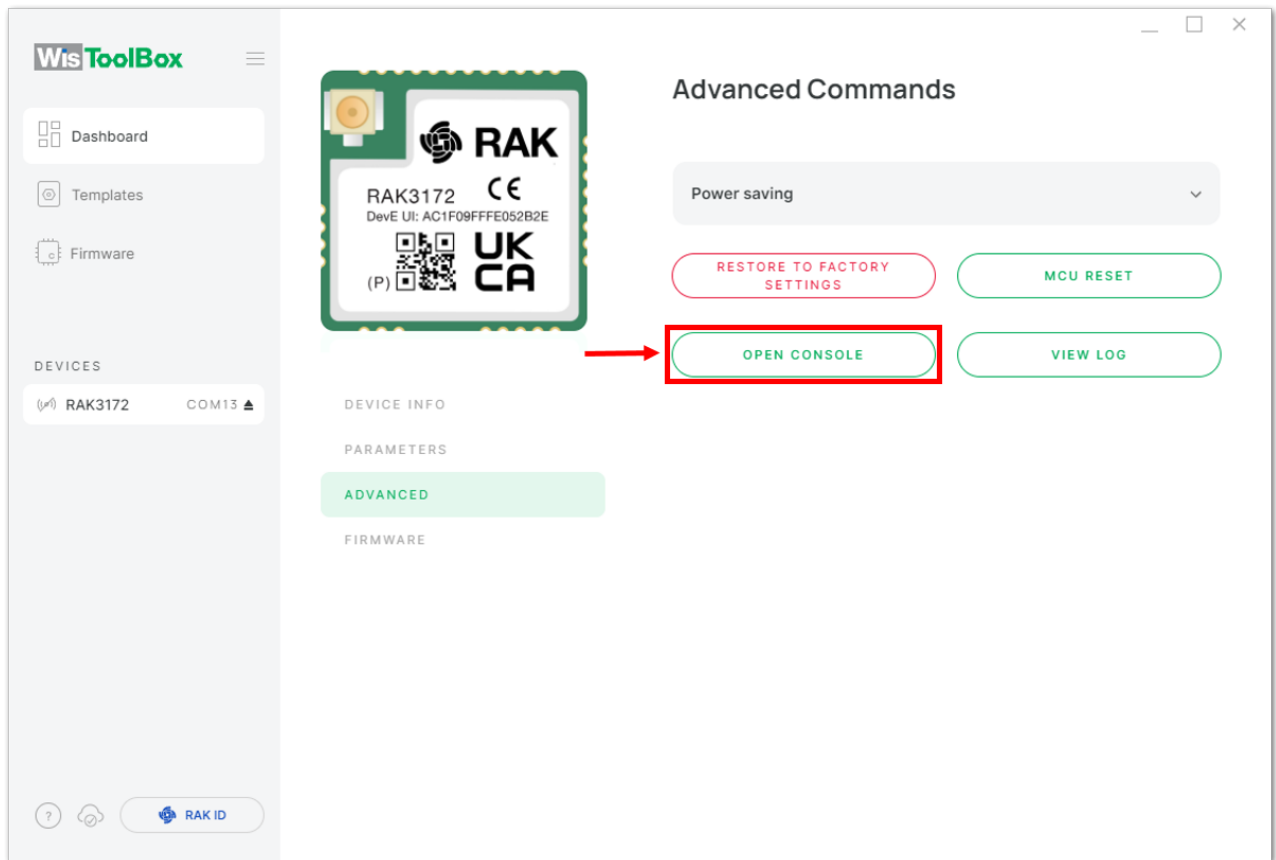


Figure 153: OPEN CONSOLE

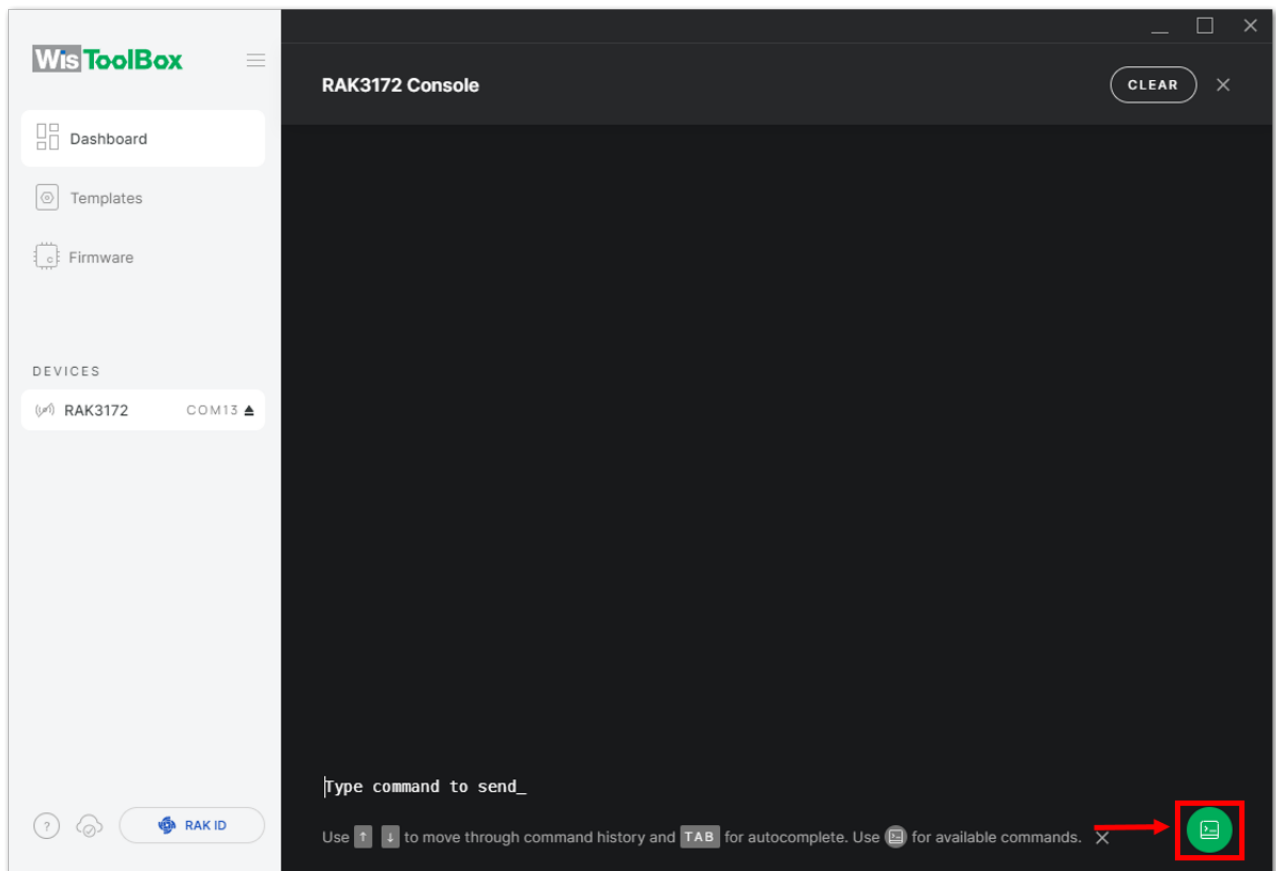


Figure 154: Opening the Console terminal of WisToolBox

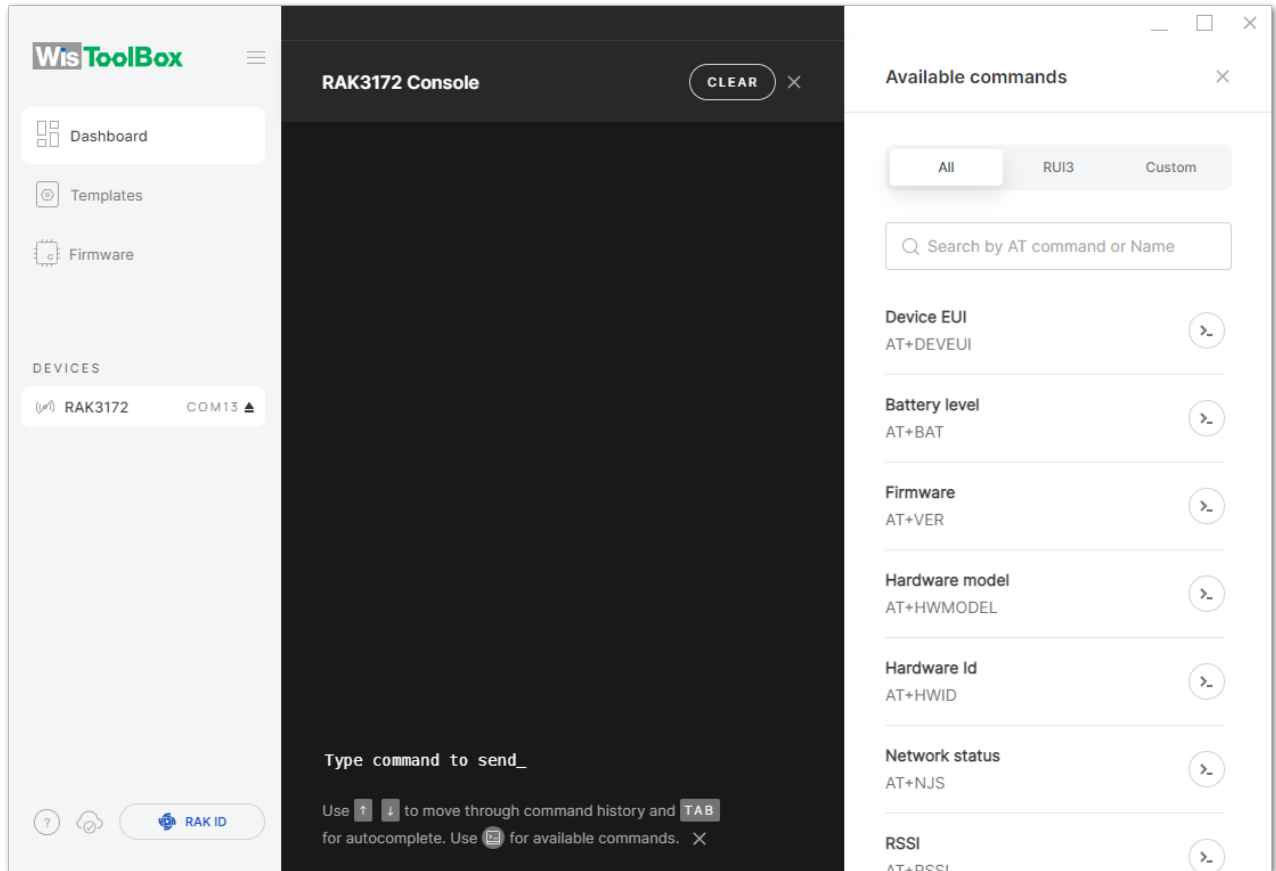


Figure 155: Opening the Console terminal of WisToolBox

7. To start the configuration, type **ATE** so you can echo the commands you input during your configuration. Then press **Enter**.

It is recommended to start by testing the console and verify that the current configuration is working by sending these two AT commands:

```
AT
```

```
ATE
```

**ATE** is useful for tracking the commands and troubleshooting.

You will receive **OK** when you input the two commands. After setting **ATE**, you can now see all the commands you input together with the replies.

**NOTE:**

If there is no **OK** or any reply, check if the device is powered correctly. If you are getting power from a USB port, ensure that you have a good USB cable.

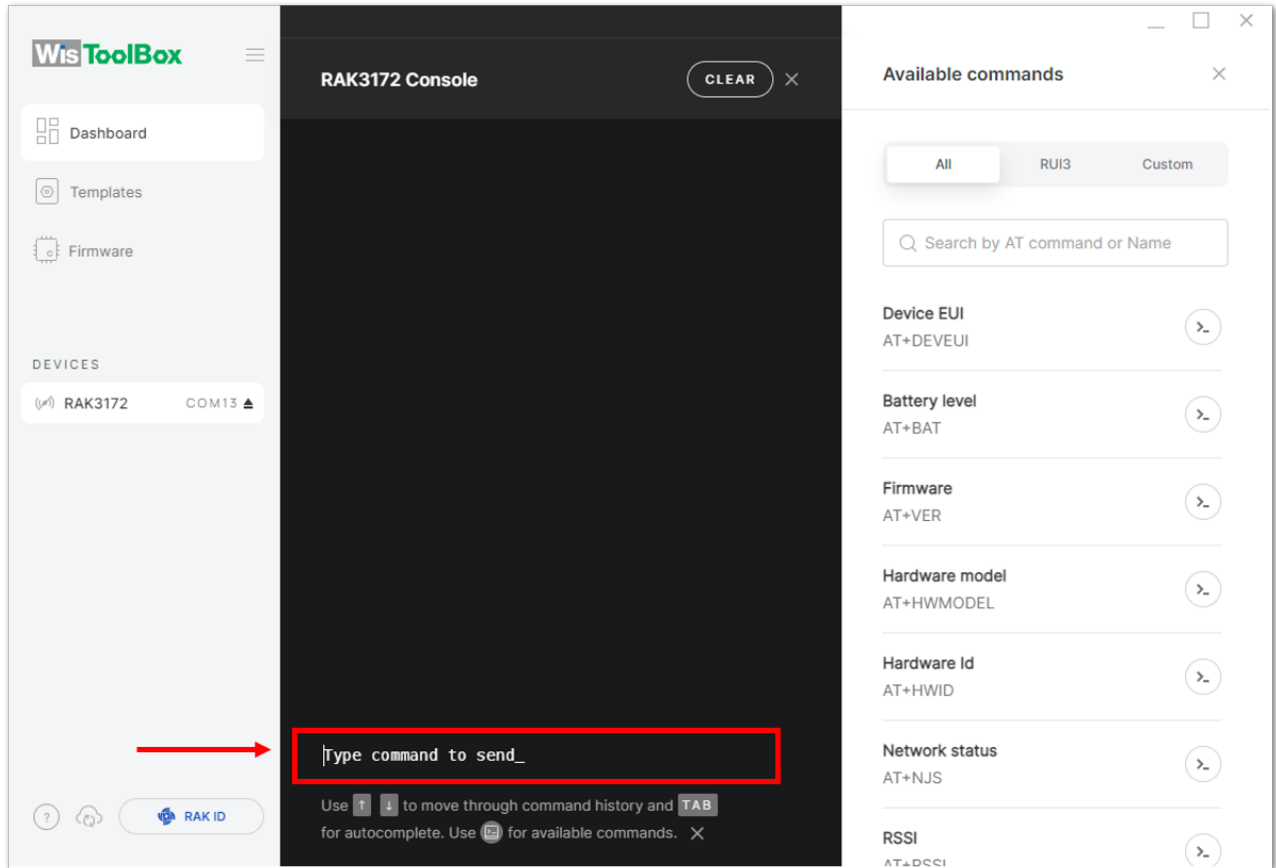


Figure 156: Setting up your Console

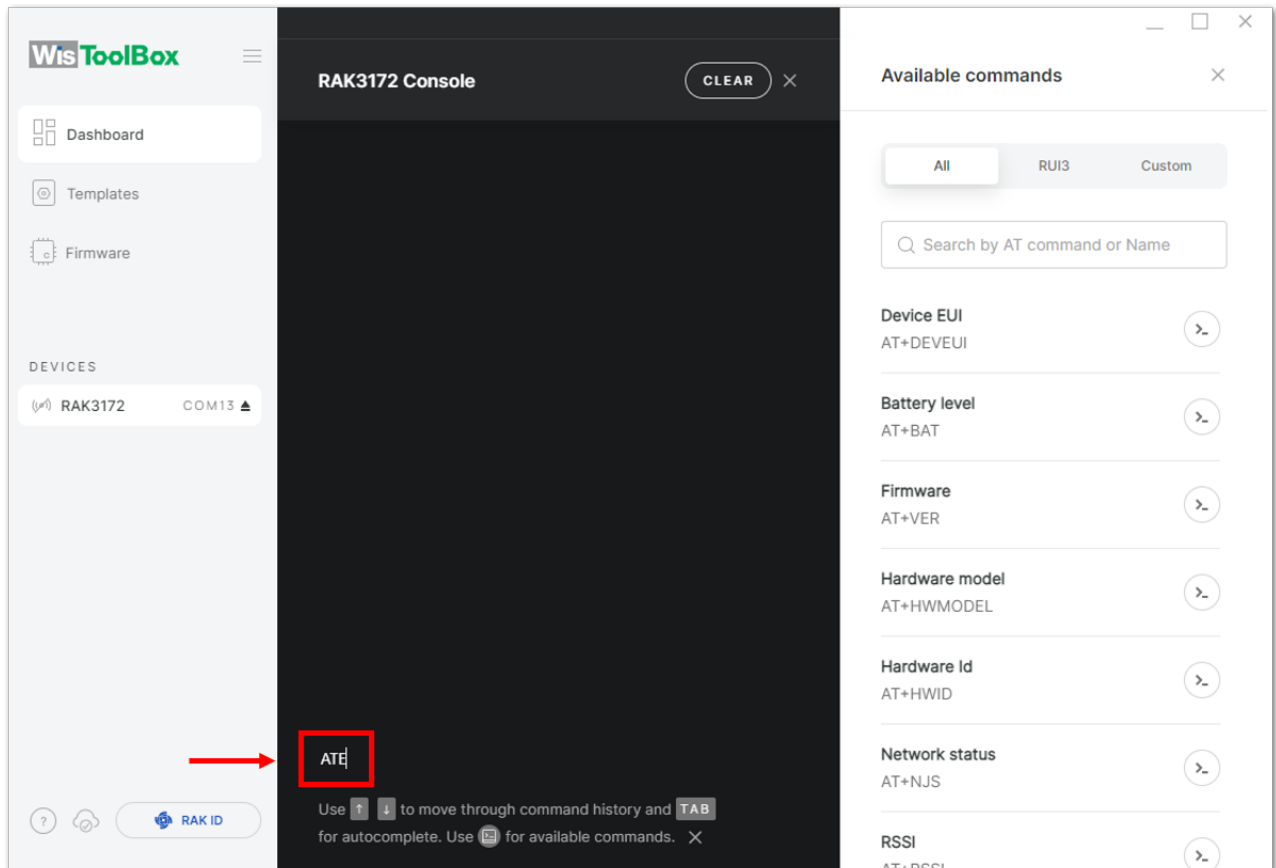


Figure 157: Setting up your Console

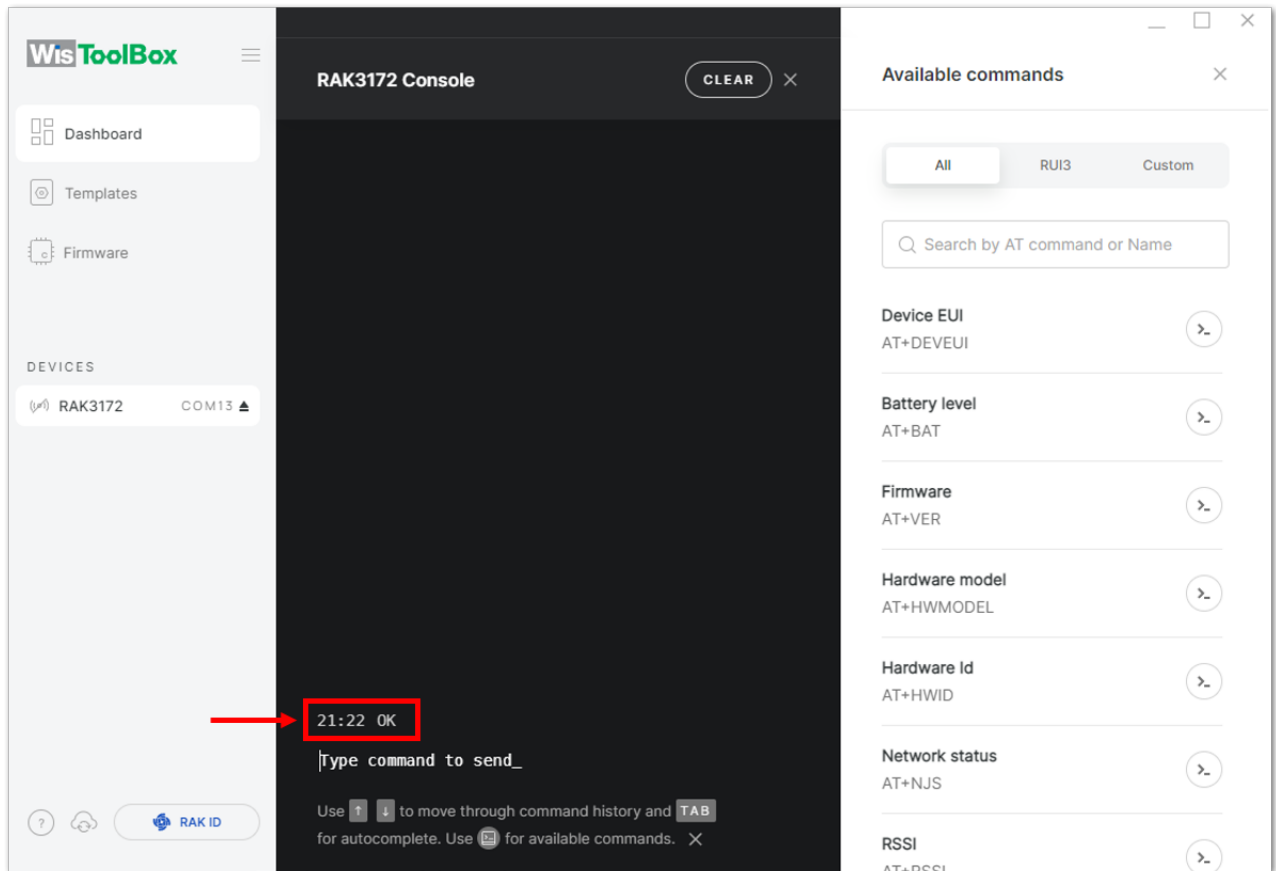


Figure 158: Setting up your Console

8. Then configure the LoRaWAN join mode to **ABP**. You can check what parameter you will input by typing **AT+NJM?** then **Enter** into the console terminal. For **ABP**, you should input **AT+NJM=0** then press **Enter** as shown in **Figure 161**.

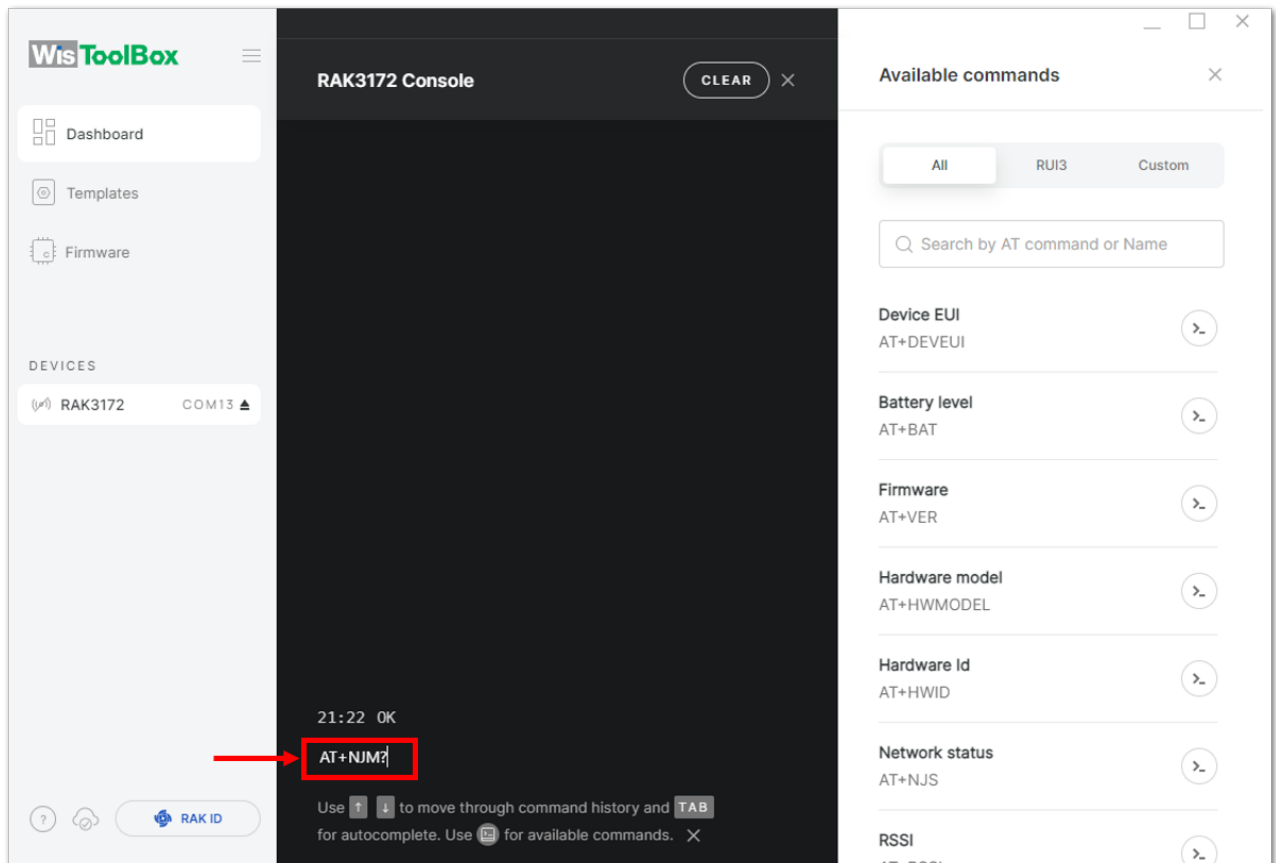


Figure 159: Setting up your Console

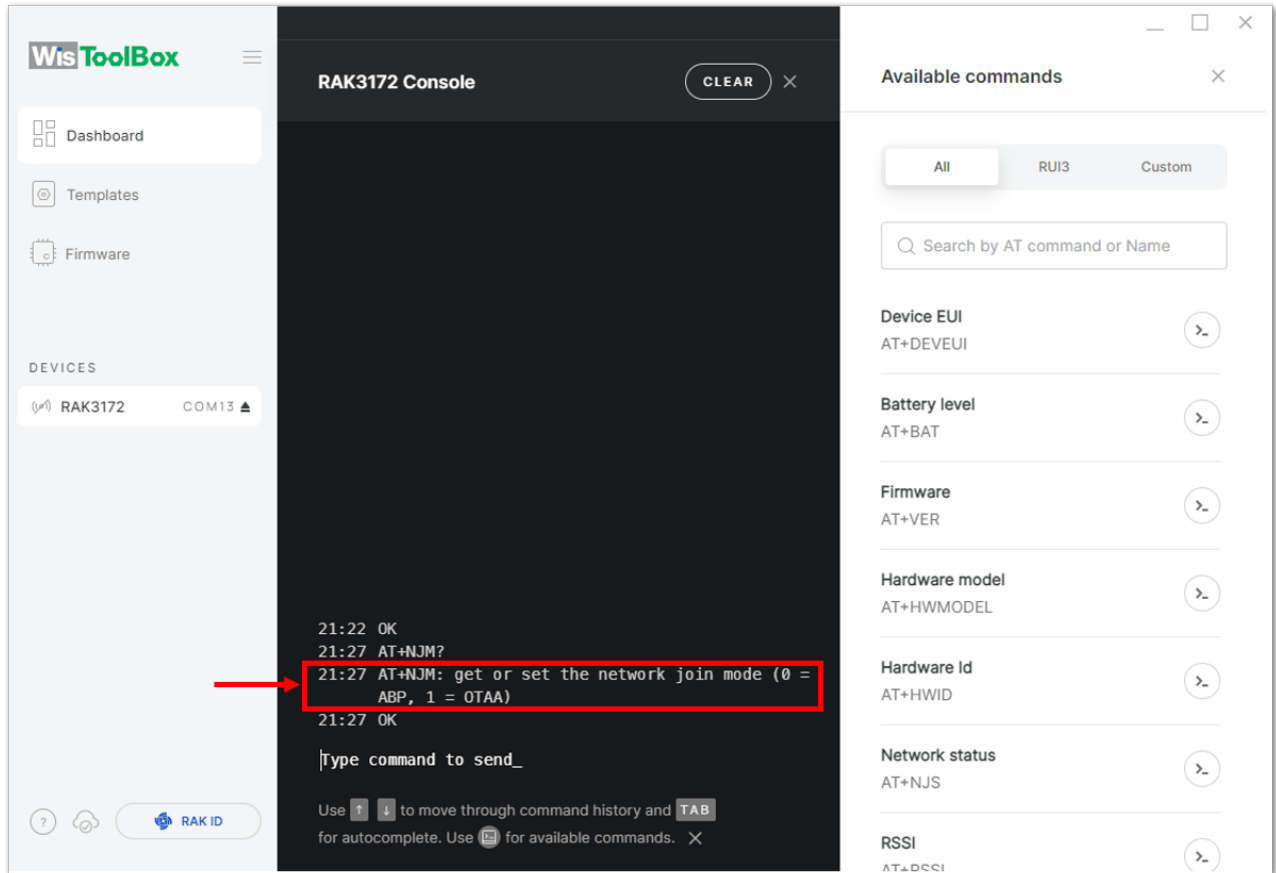


Figure 160: Setting up your Console

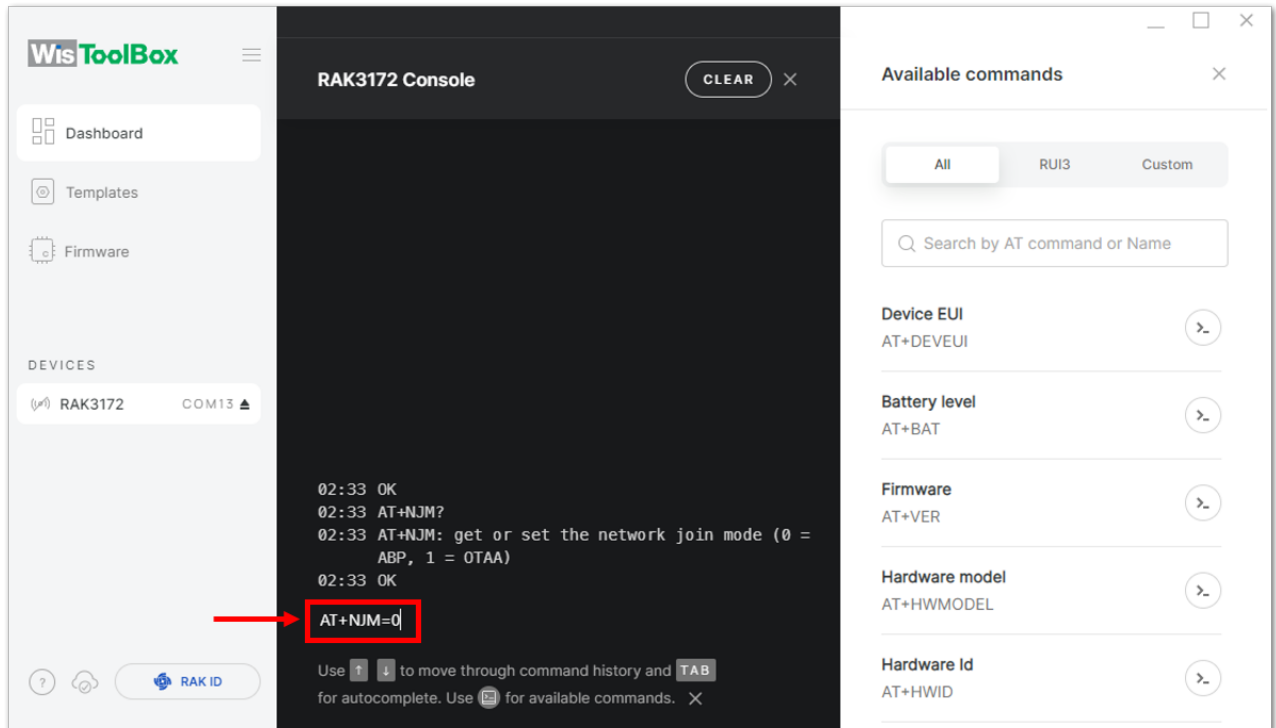


Figure 161: Setting up your Console

9. Once done, set-up your LoRaWAN region to EU868. You can check what parameter you will input by typing **AT+BAND?** then **Enter** into the console terminal. For **EU868**, you should input **AT+BAND=4** then press **Enter**. If you wish to work on other regional band, you may check the list of band parameter options below.

Set the frequency/region to EU868.

```
AT+BAND=4
```



 **NOTE:**

Depending on the Regional Band you selected, you might need to configure the sub-band of your RAK3172 to match the gateway and LoRaWAN network server. This is especially important for Regional Bands like US915, AU915, and CN470.

To configure the masking of channels for the sub-bands, you can use the `AT+MASK` command that can be found on the [AT Command Manual](#) .

To illustrate, you can use sub-band 2 by sending the command `AT+MASK=0002` .

### List of band parameter options

Code	Regional Band
0	EU433
1	CN470
2	RU864
3	IN865
4	EU868
5	US915
6	AU915
7	KR920
8	AS923-1
9	AS923-2
10	AS923-3
11	AS923-4

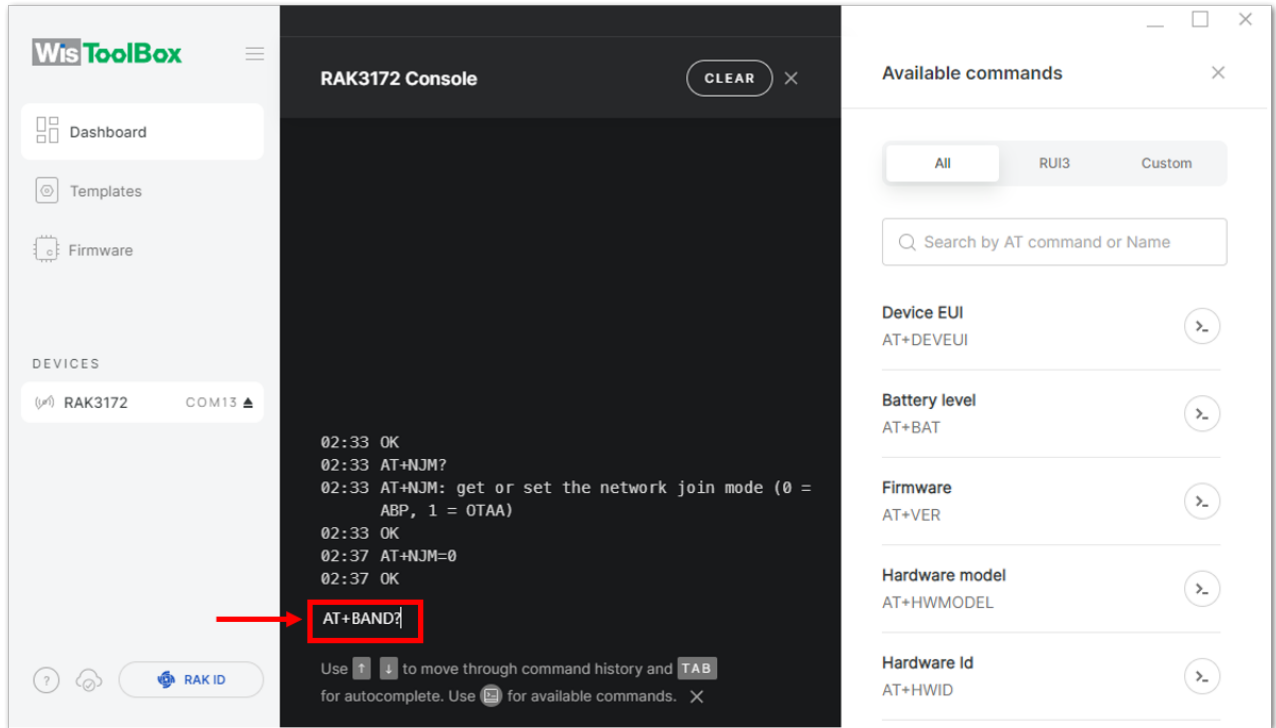


Figure 162: Setting up your Console

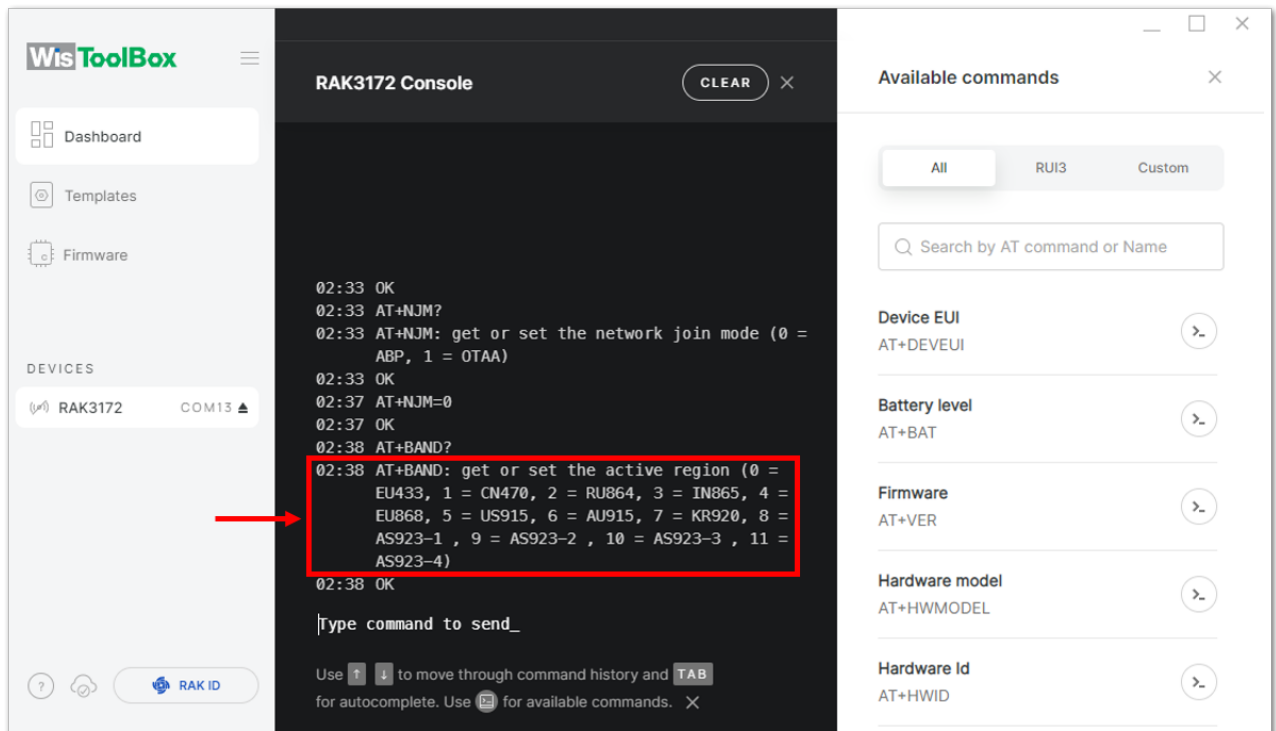


Figure 163: Setting up your Console

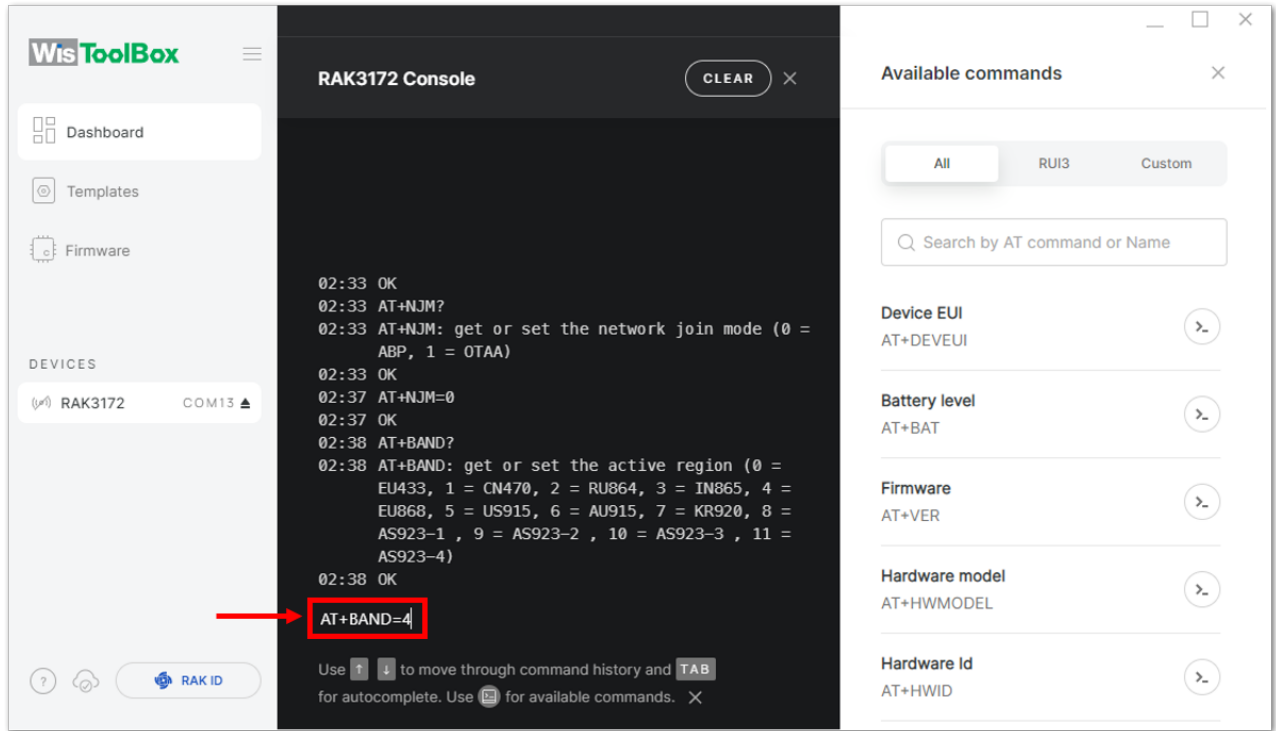


Figure 164: Setting up your Console

10. Then next to this will be updating the ABP credentials of your device. First to this will be the **Application session key (AppSKey)**. Go back to your console where your RAK3172 End device was created to copy the AppSKey credential then paste it to the WisToolBox Console then press **Enter**.

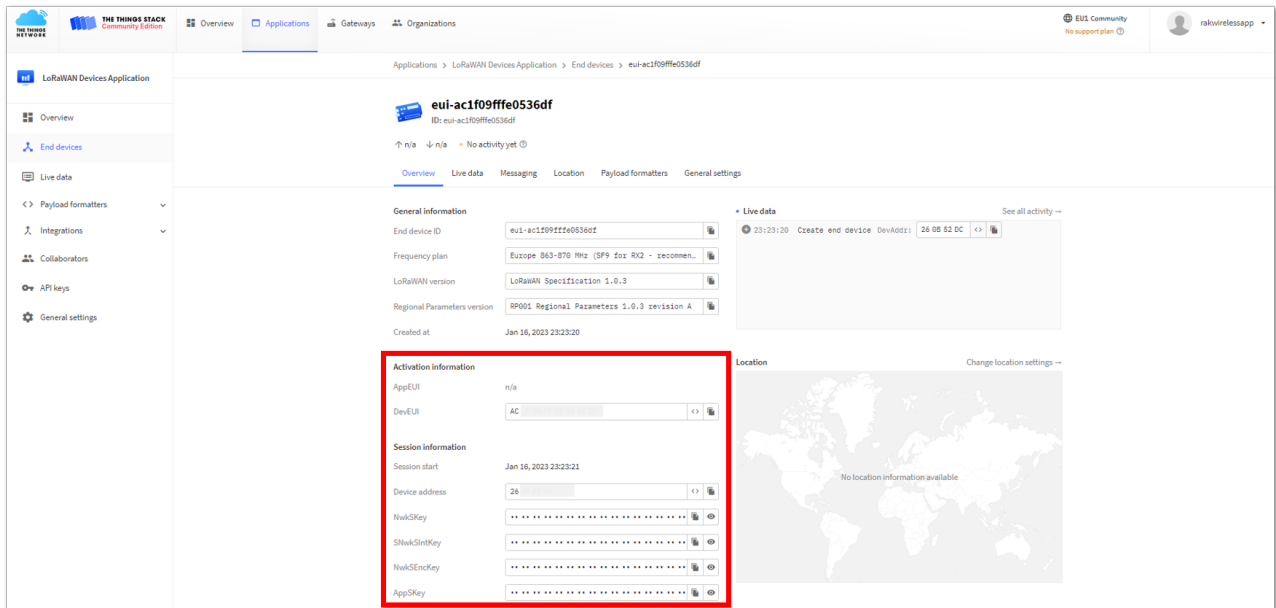


Figure 165: Your created ABP device from your TTN console

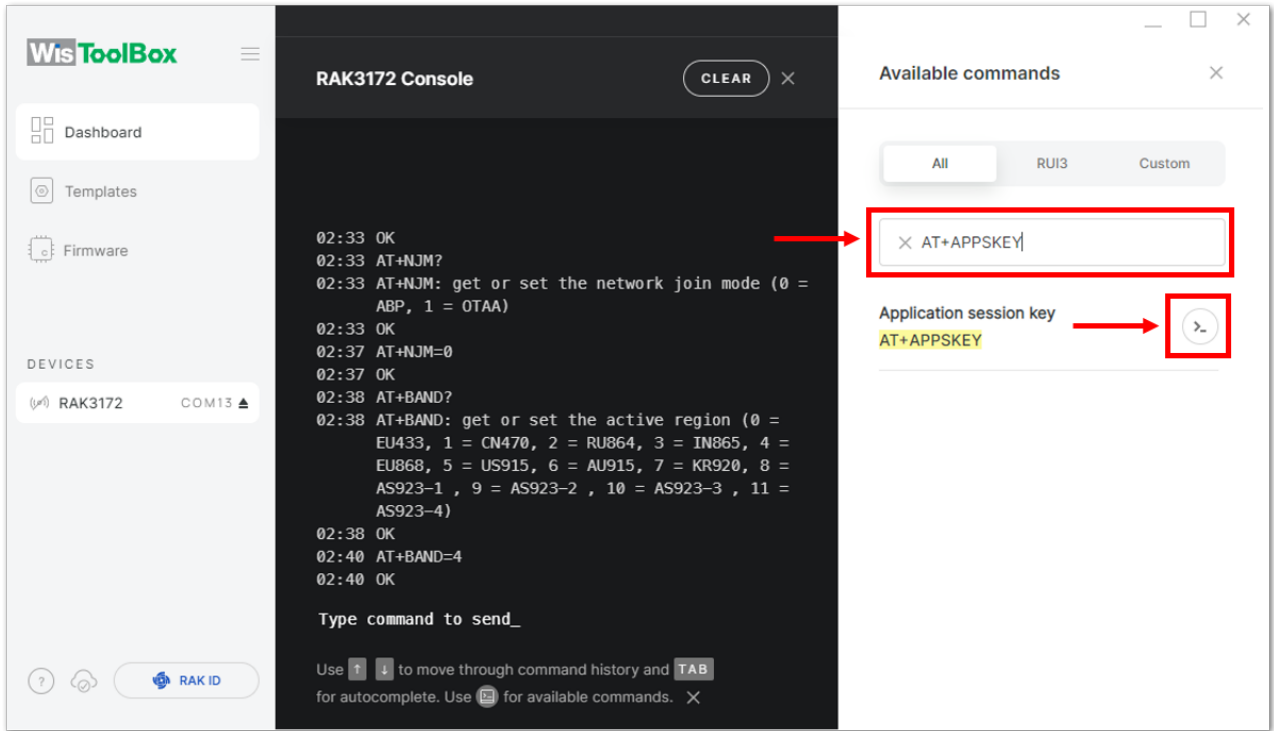


Figure 166: Setting up your Console

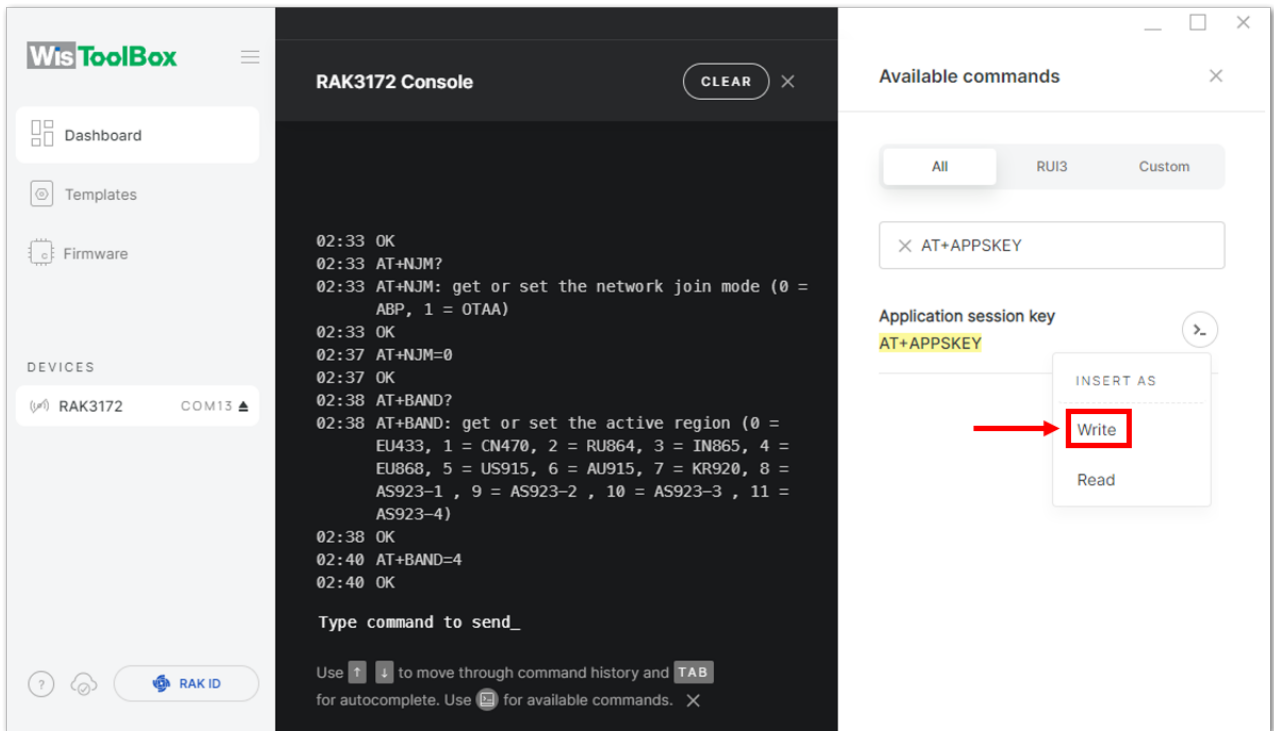


Figure 167: Setting up your Console

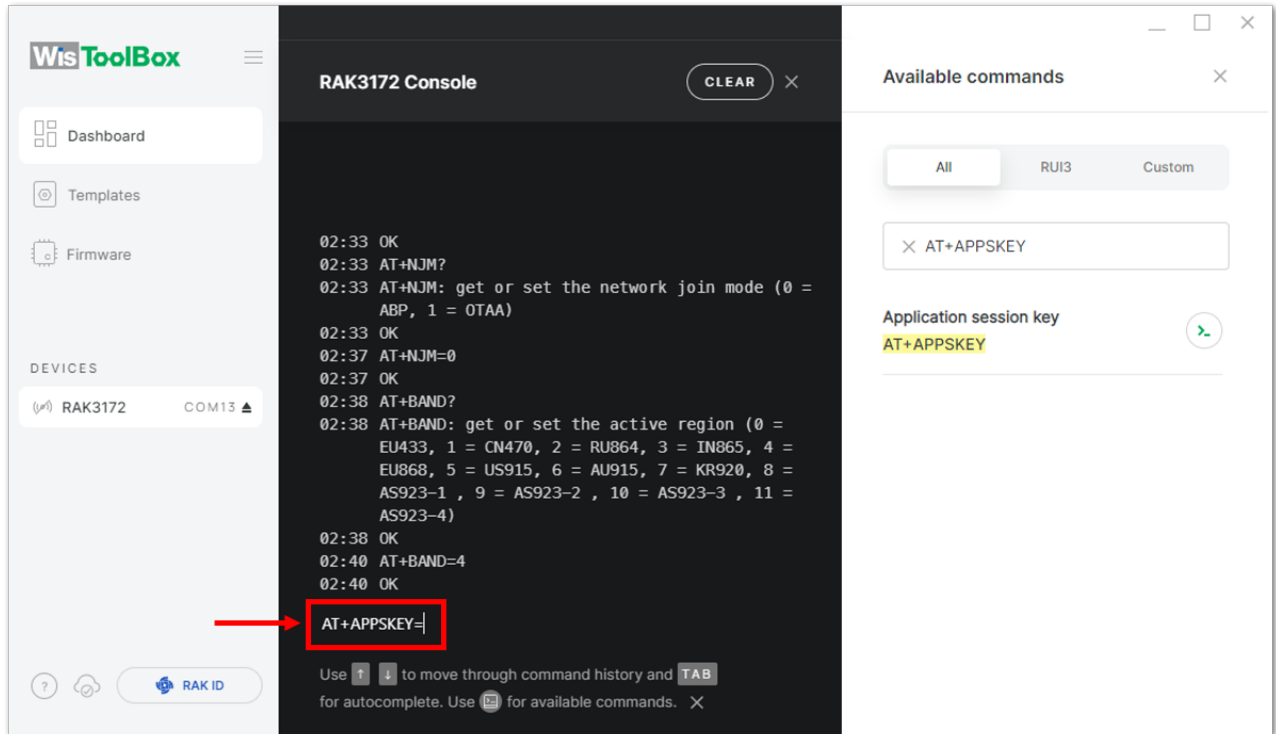


Figure 168: Setting up your Console

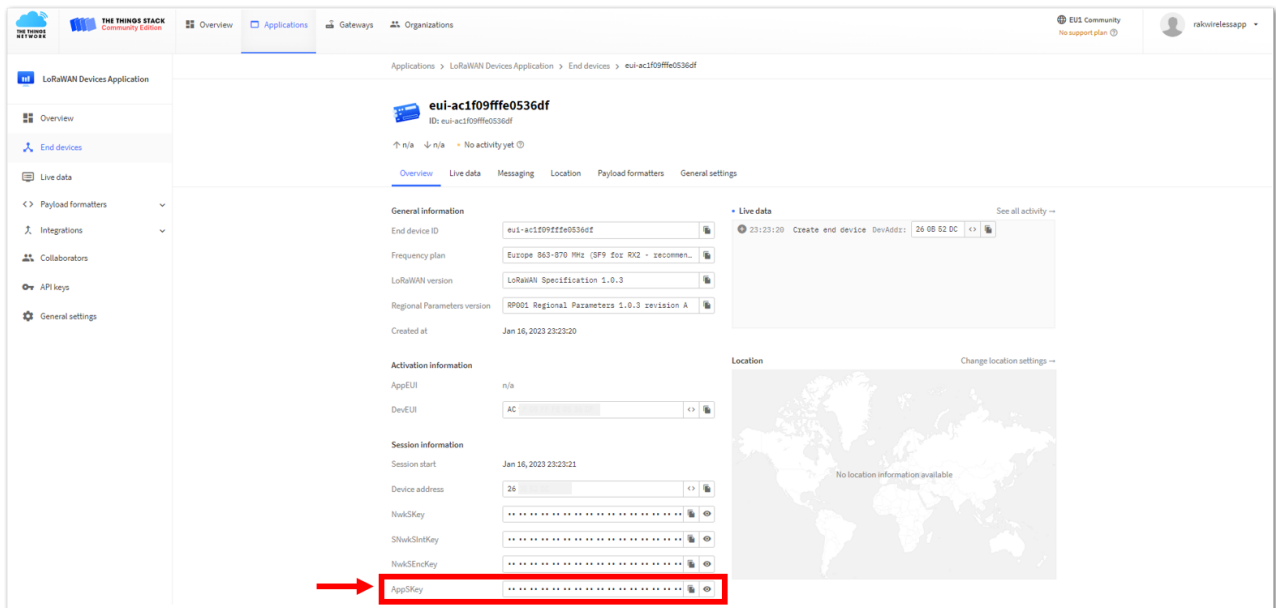


Figure 169: Copying the AppSKey credential from TTN to WisToolBox

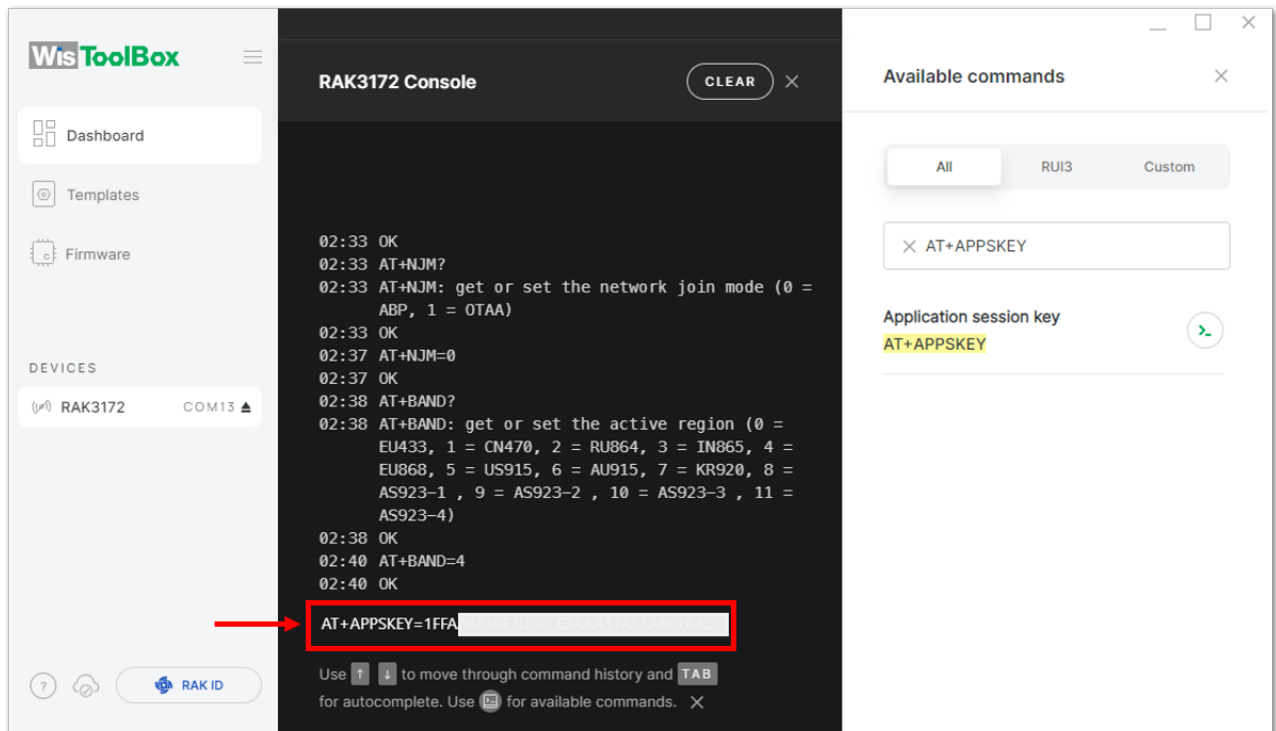


Figure 170: Setting up your Console

11. Once done, do the same procedure to **Device address** and **Network session key (NwkSKey)**.

- For Device address

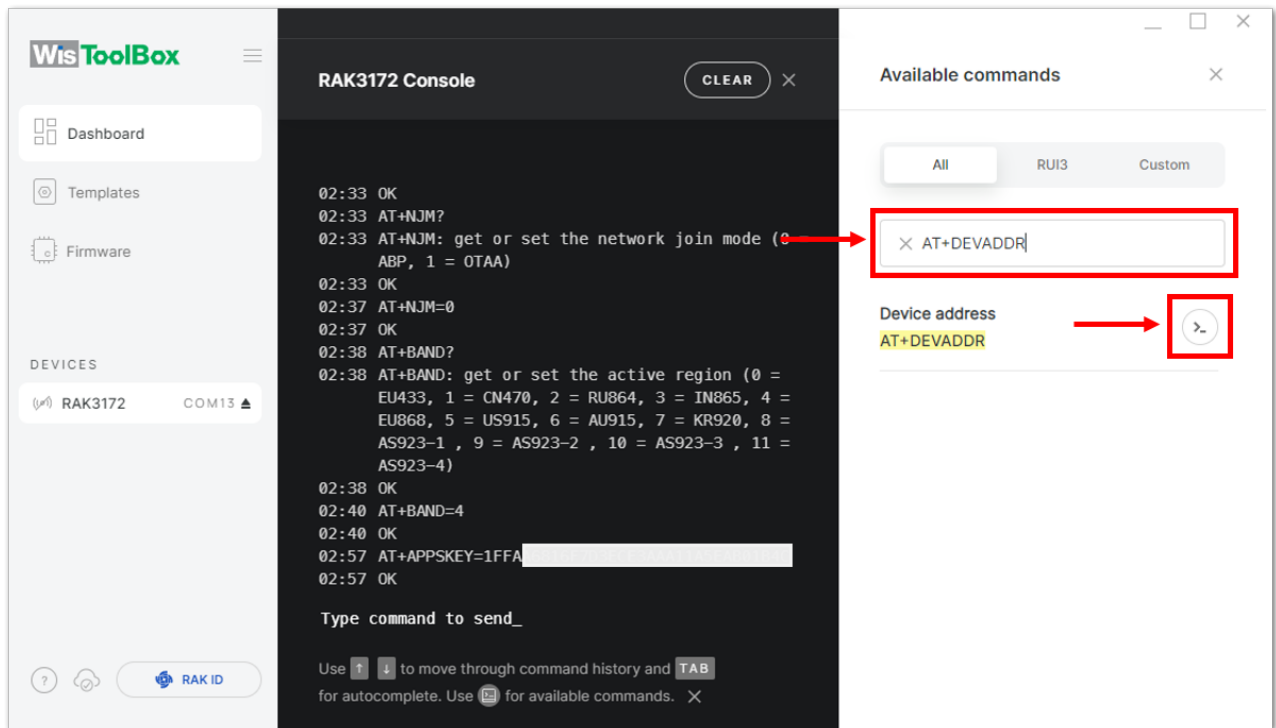


Figure 171: Setting up your Console

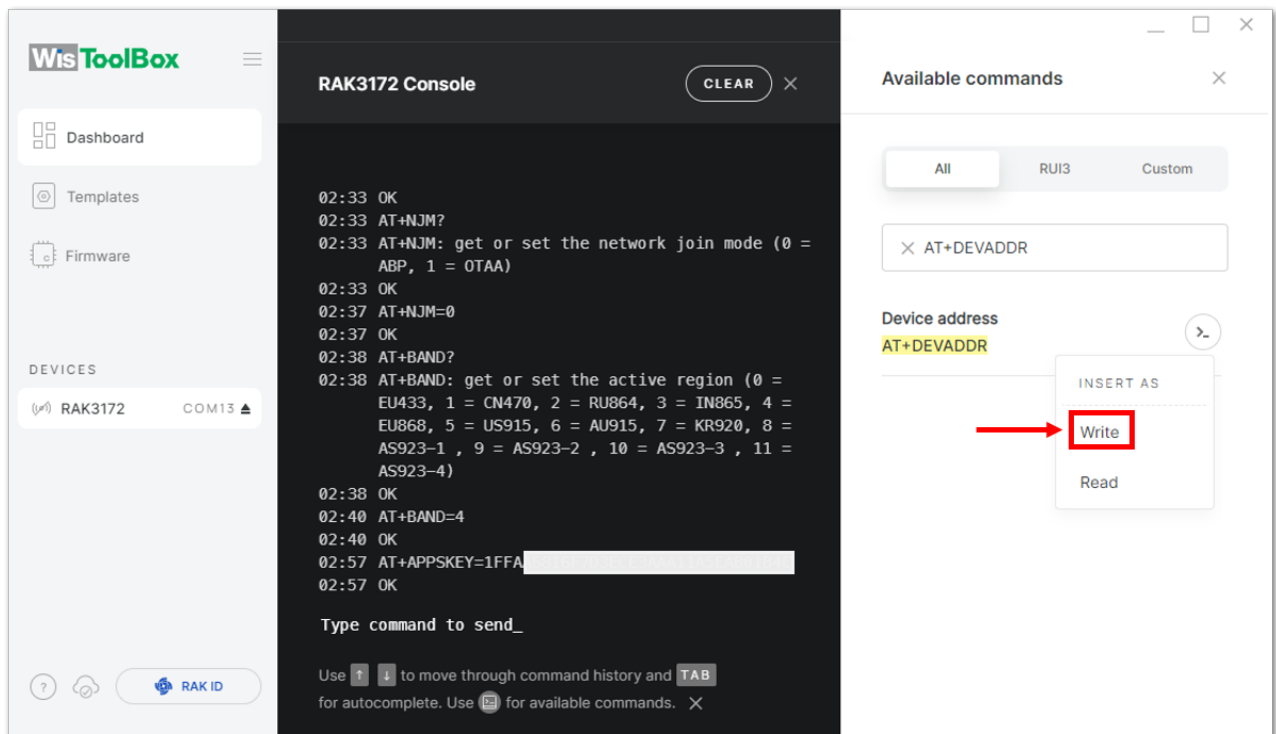


Figure 172: Setting up your Console

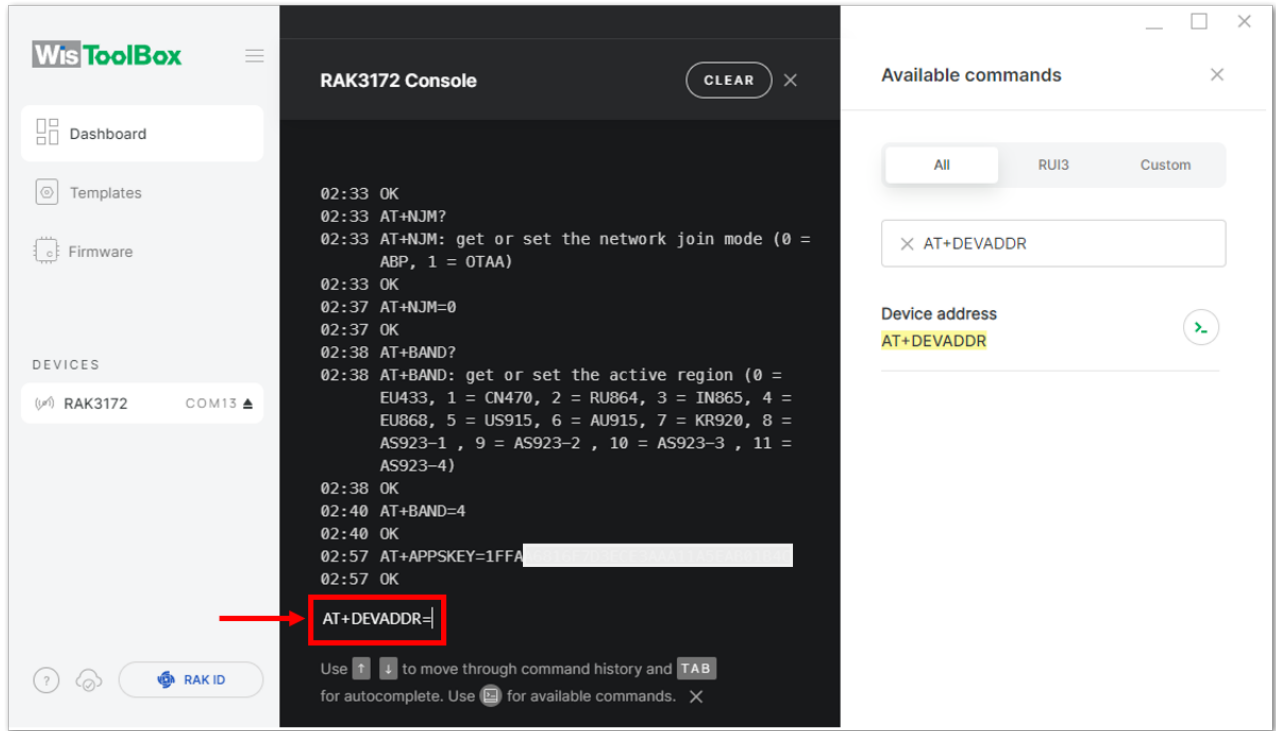


Figure 173: Setting up your Console

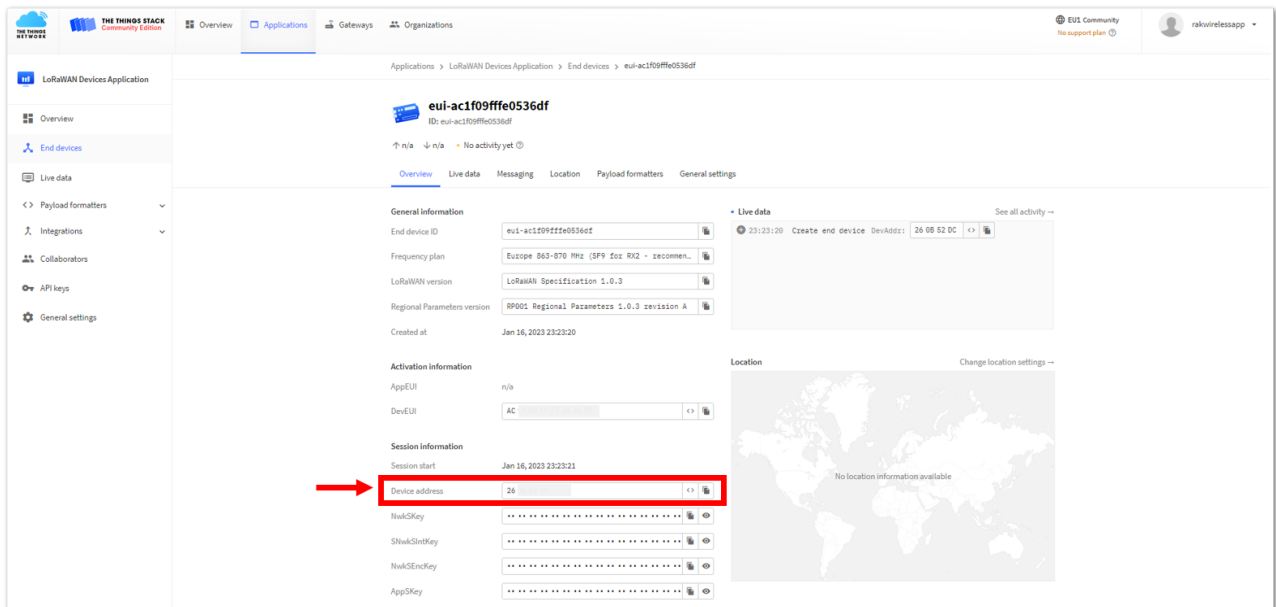


Figure 174: Copying the Device address credential from TTN to WisToolBox

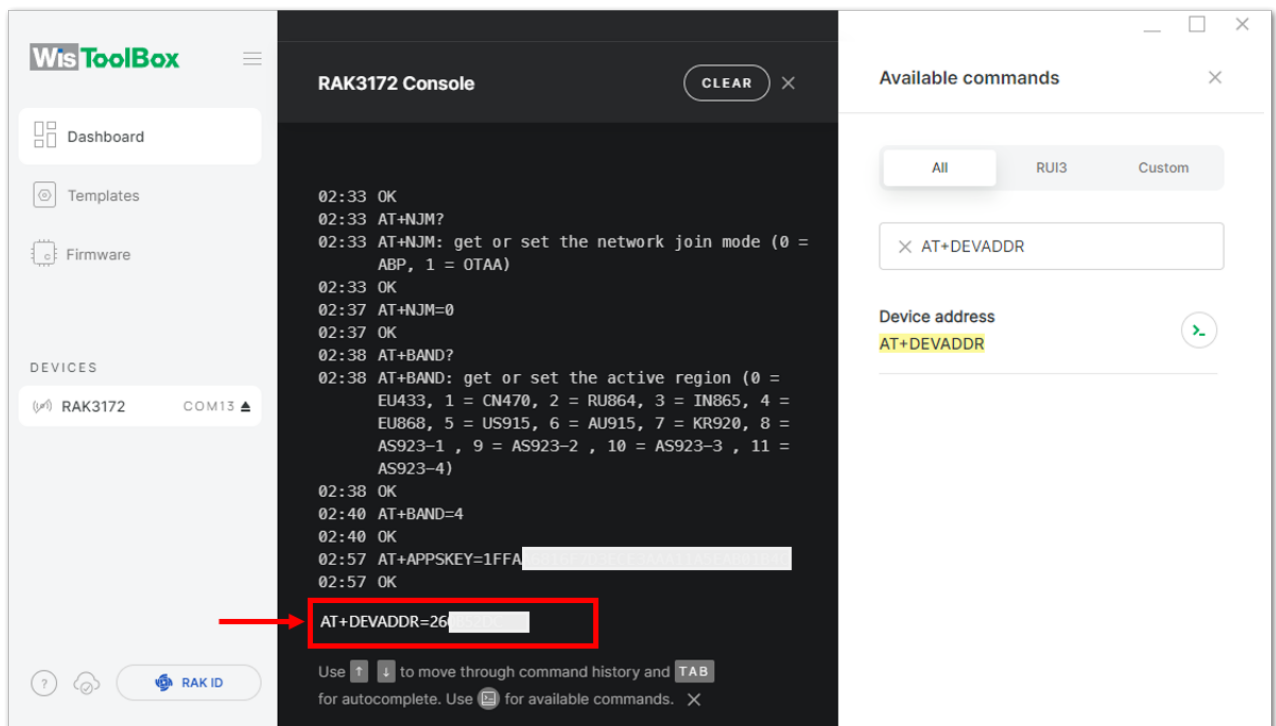


Figure 175: Setting up your Console

- For Network session key (NwkSKey)

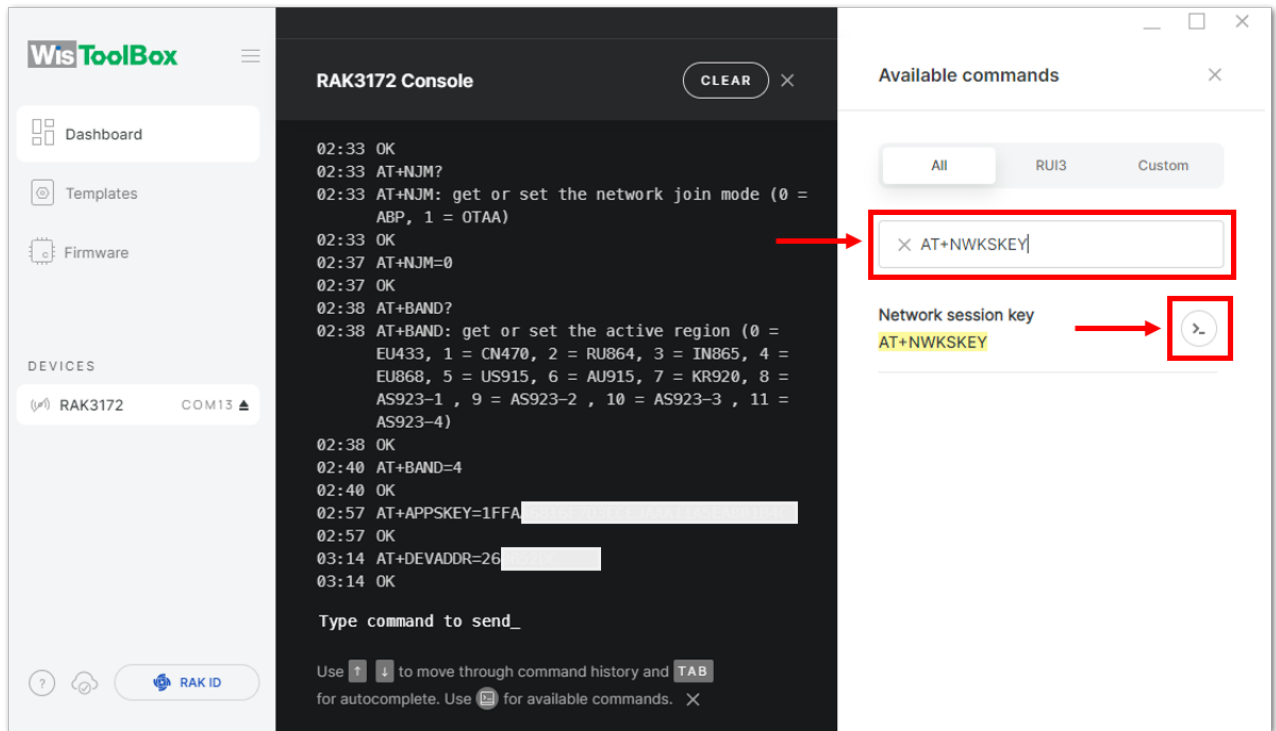


Figure 176: Setting up your Console

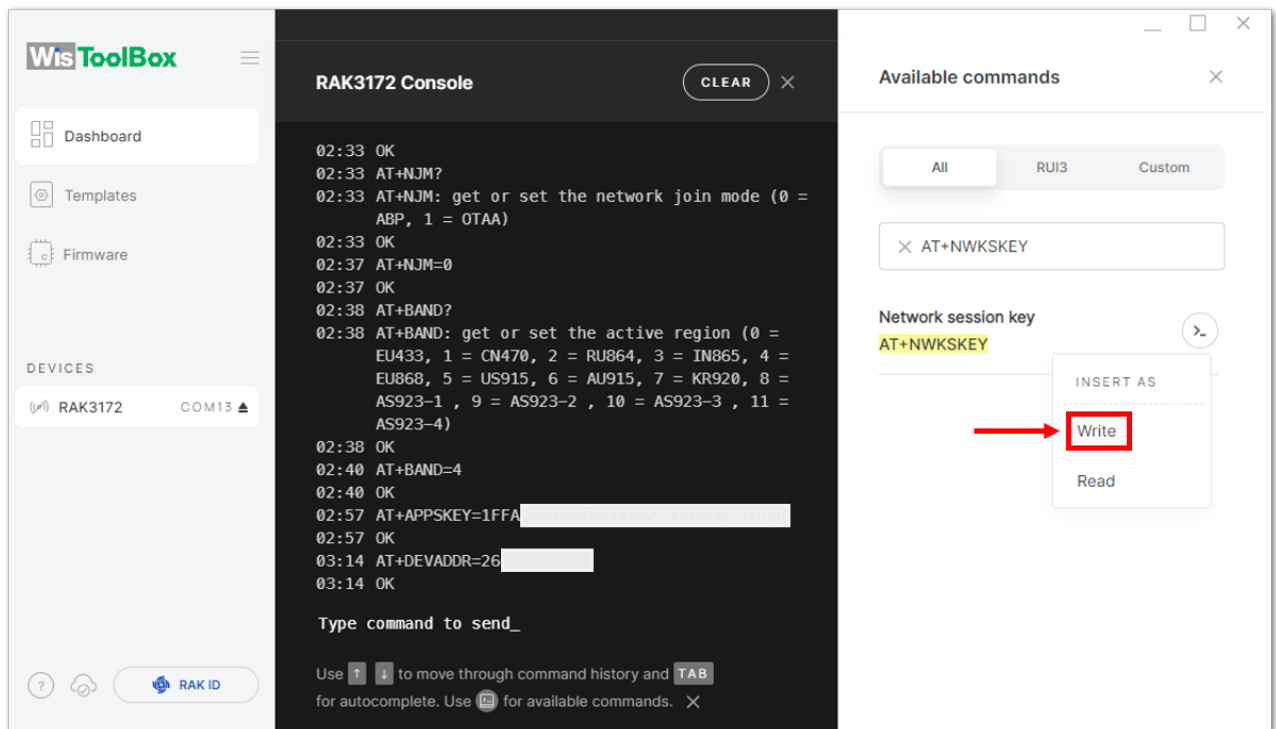


Figure 177: Setting up your Console



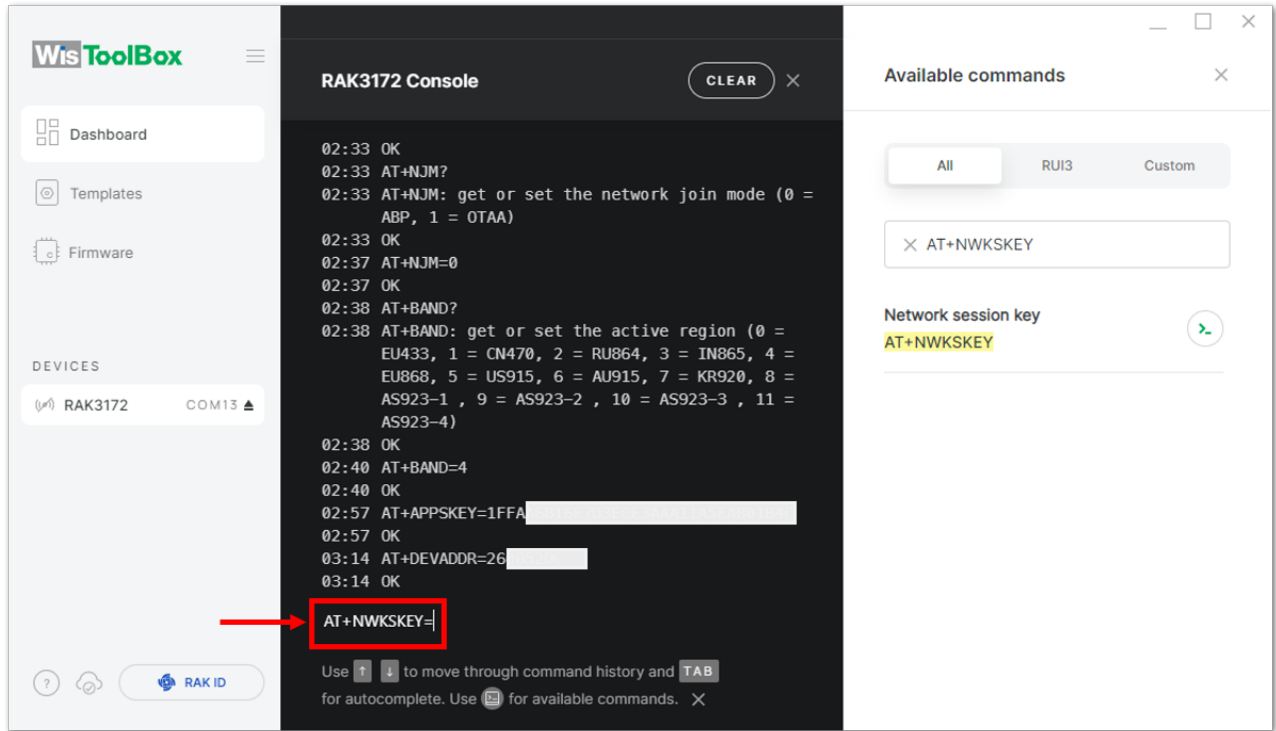


Figure 178: Setting up your Console

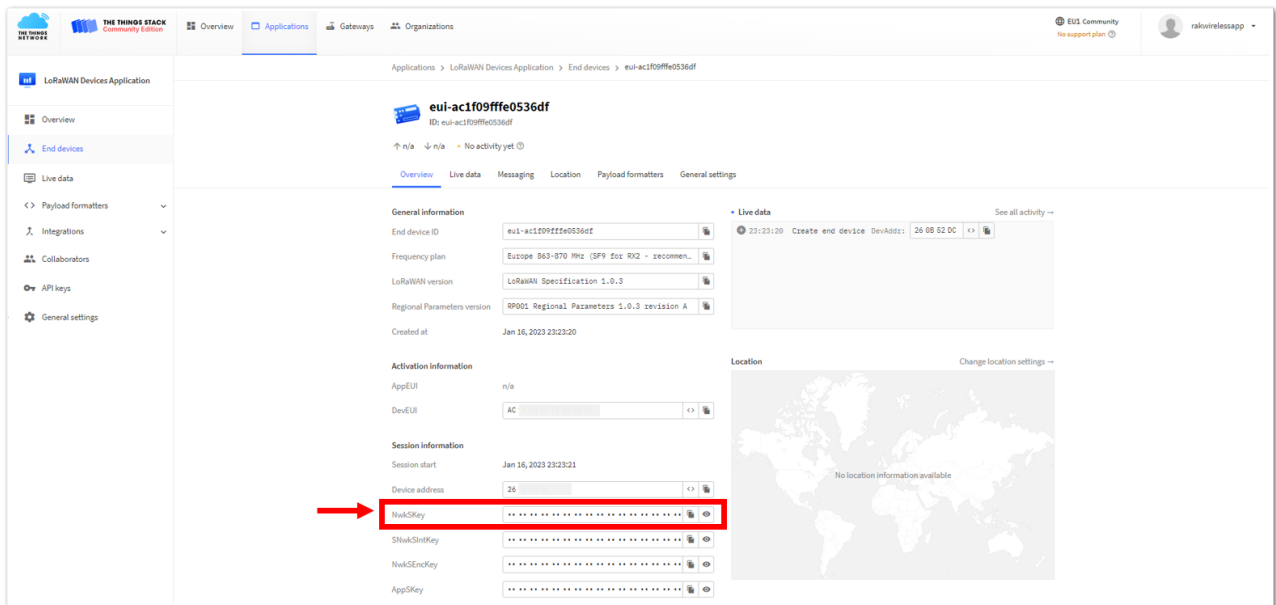


Figure 179: Copying the NwkSKey credential from TTN to WisToolBox

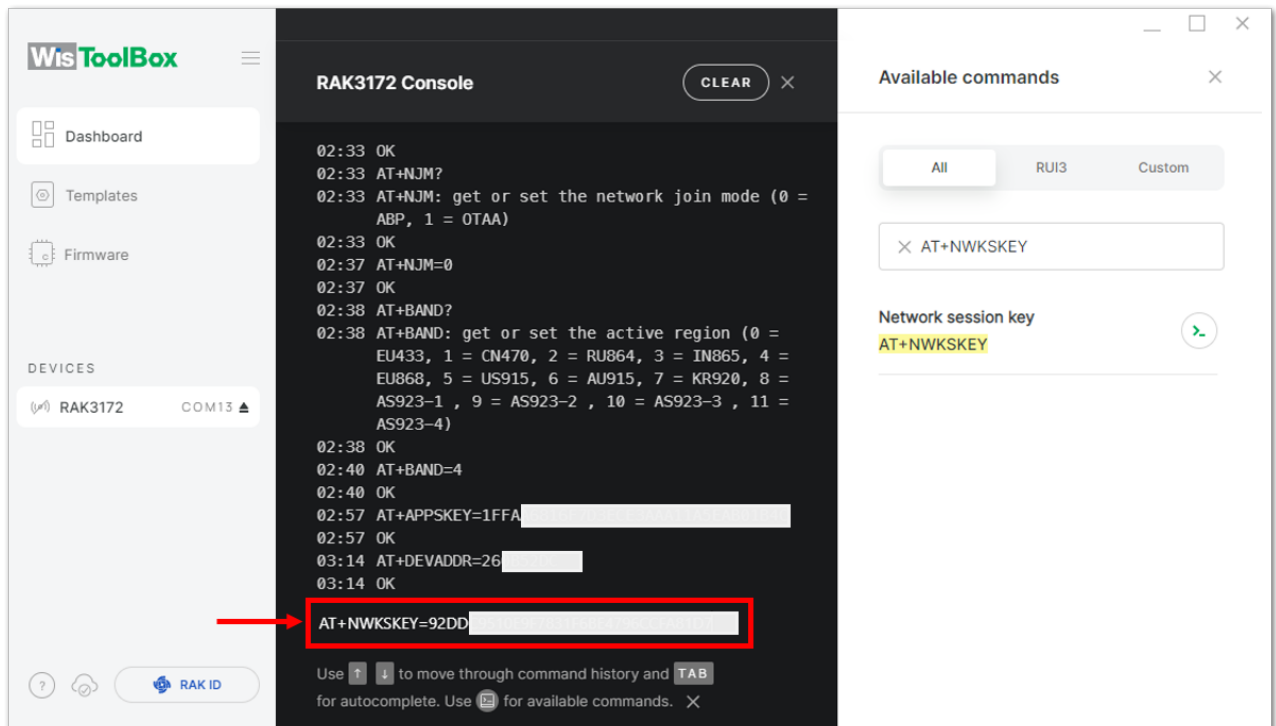


Figure 180: Setting up your Console

12. Once done, click **Dashboard** to check the updated credentials of your ABP device. Click **PARAMETERS** to open the **Global Settings** and **LoRaWAN keys, ID, EUI** and check whether these portions are updated.

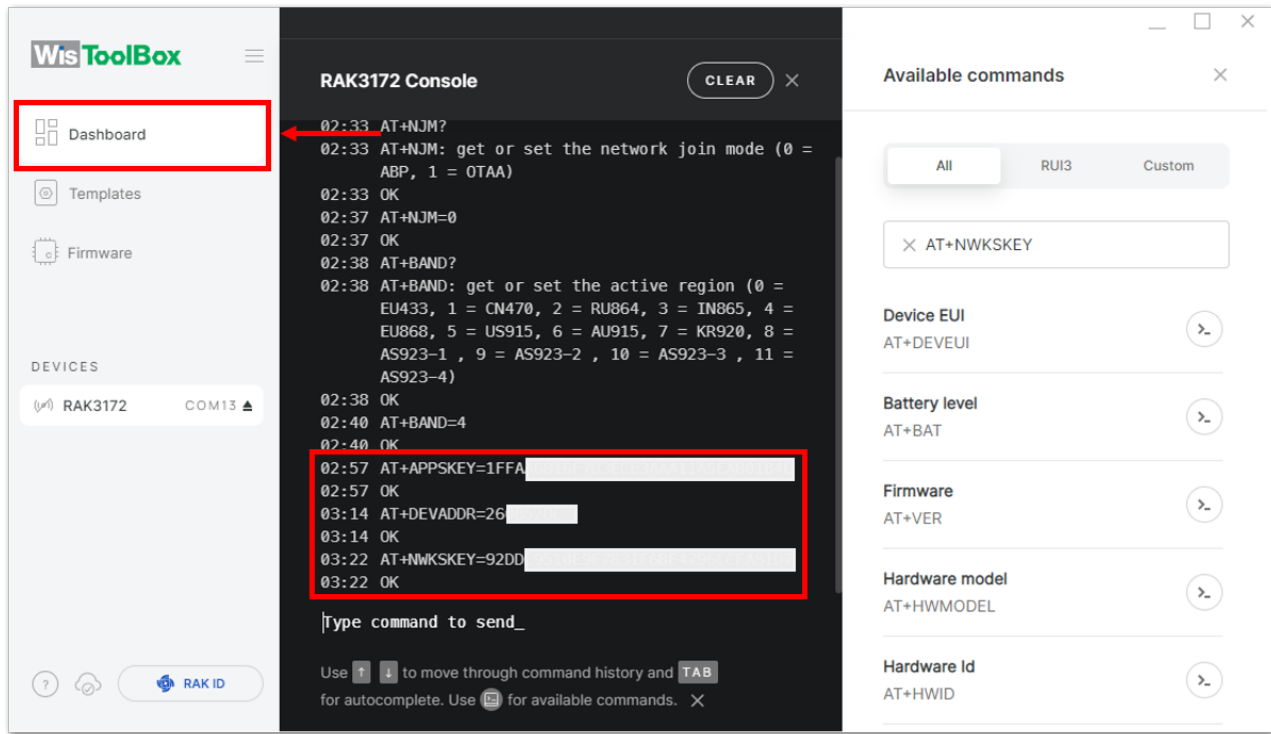


Figure 181: Setting up your Console

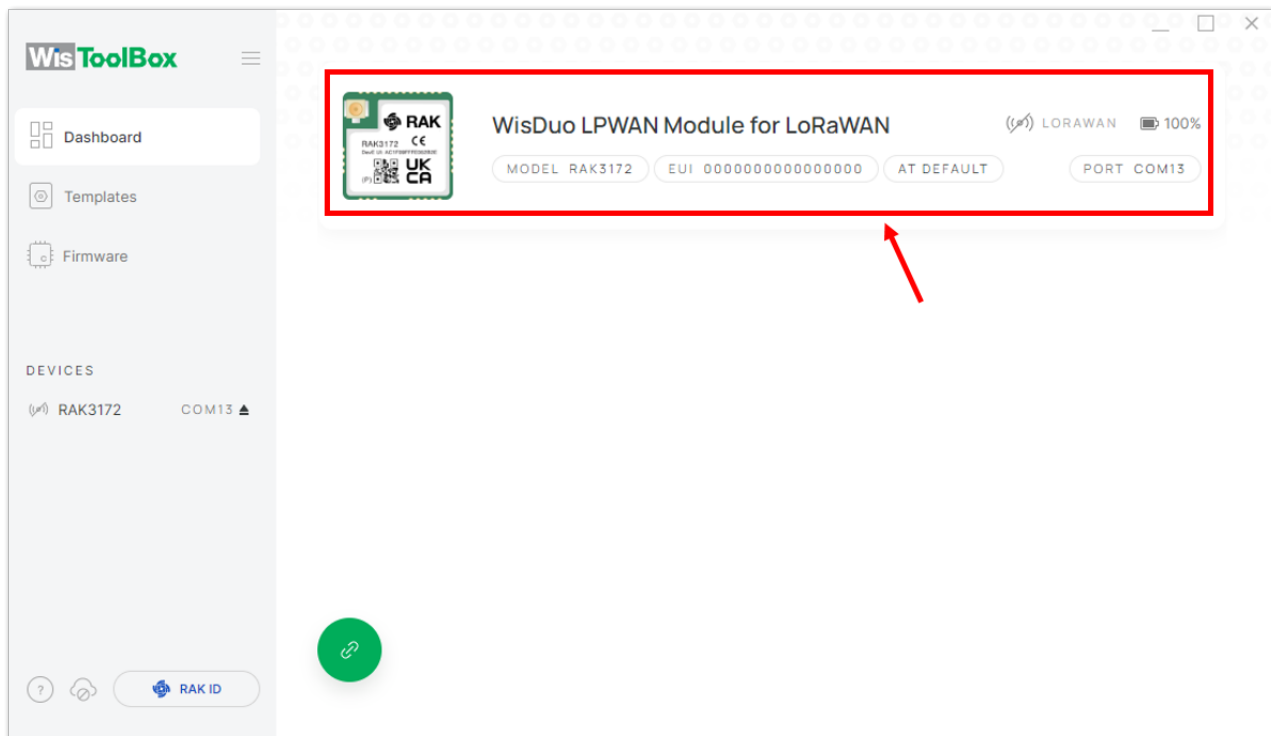


Figure 182: Setting up your Console

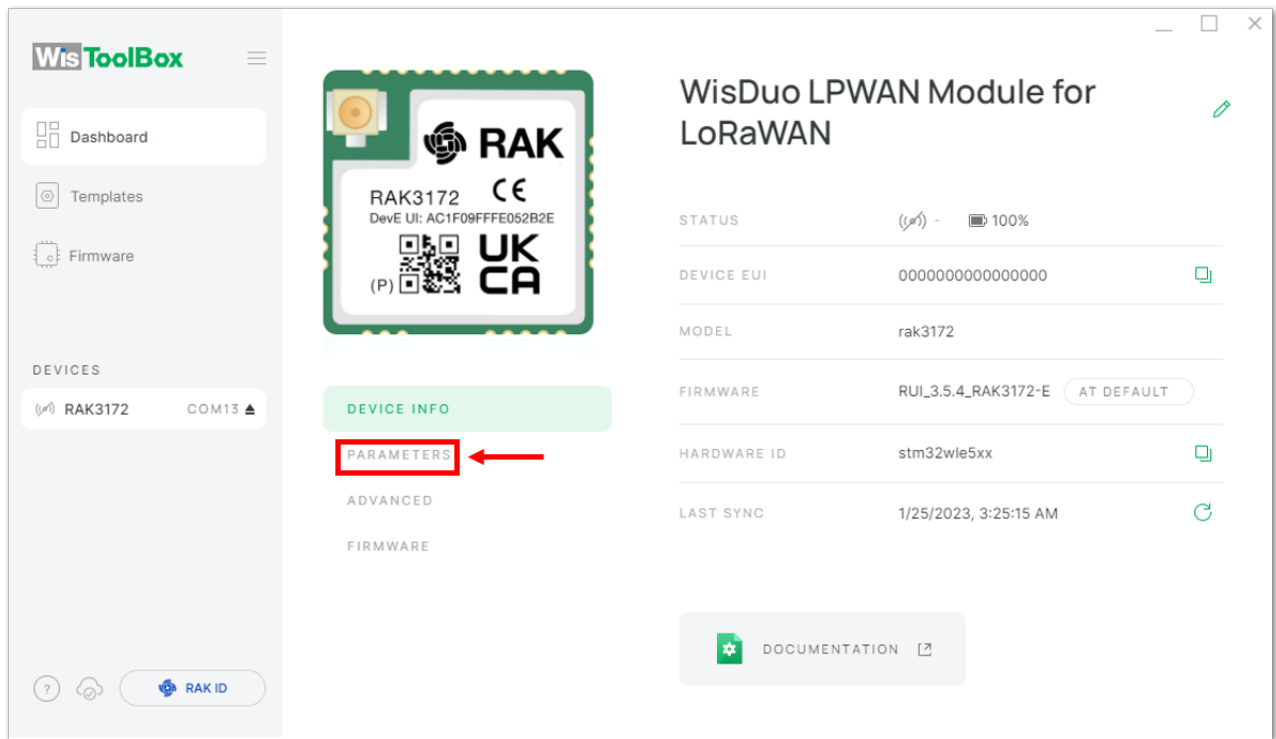


Figure 183: PARAMETERS

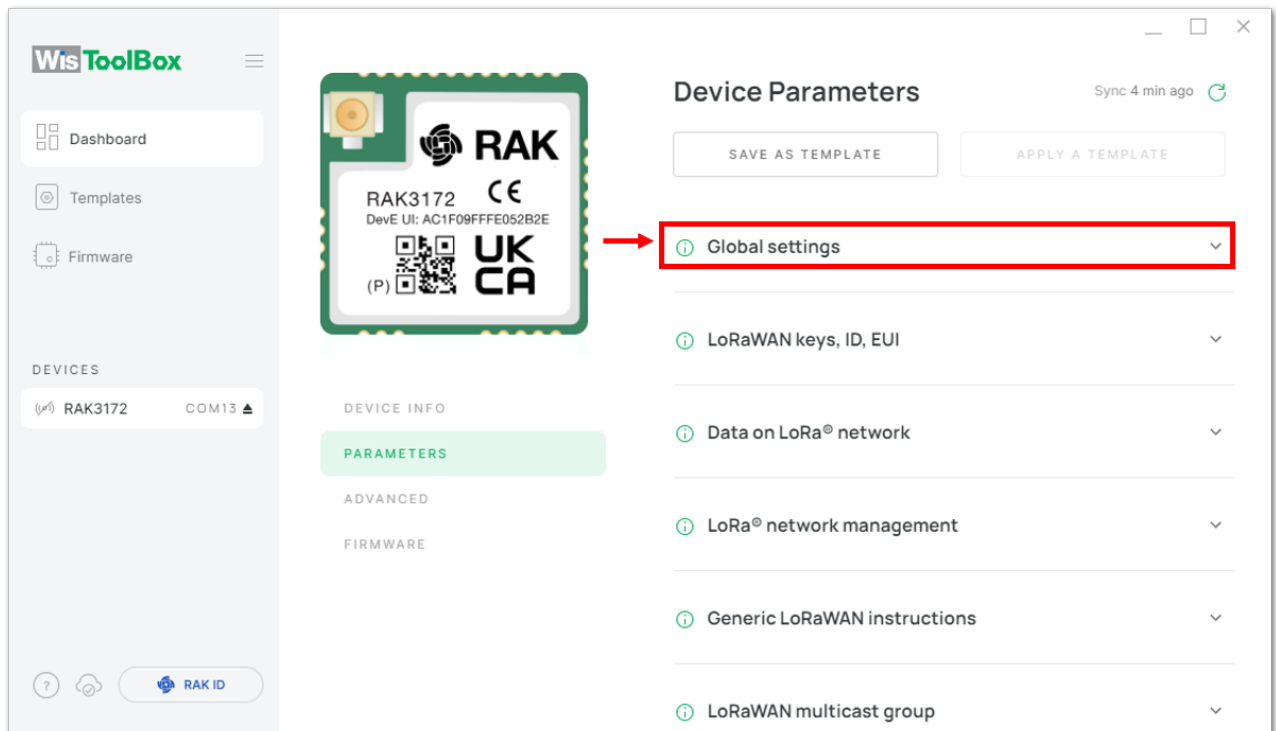


Figure 184: Global settings and LoRaWAN keys, ID, EUI

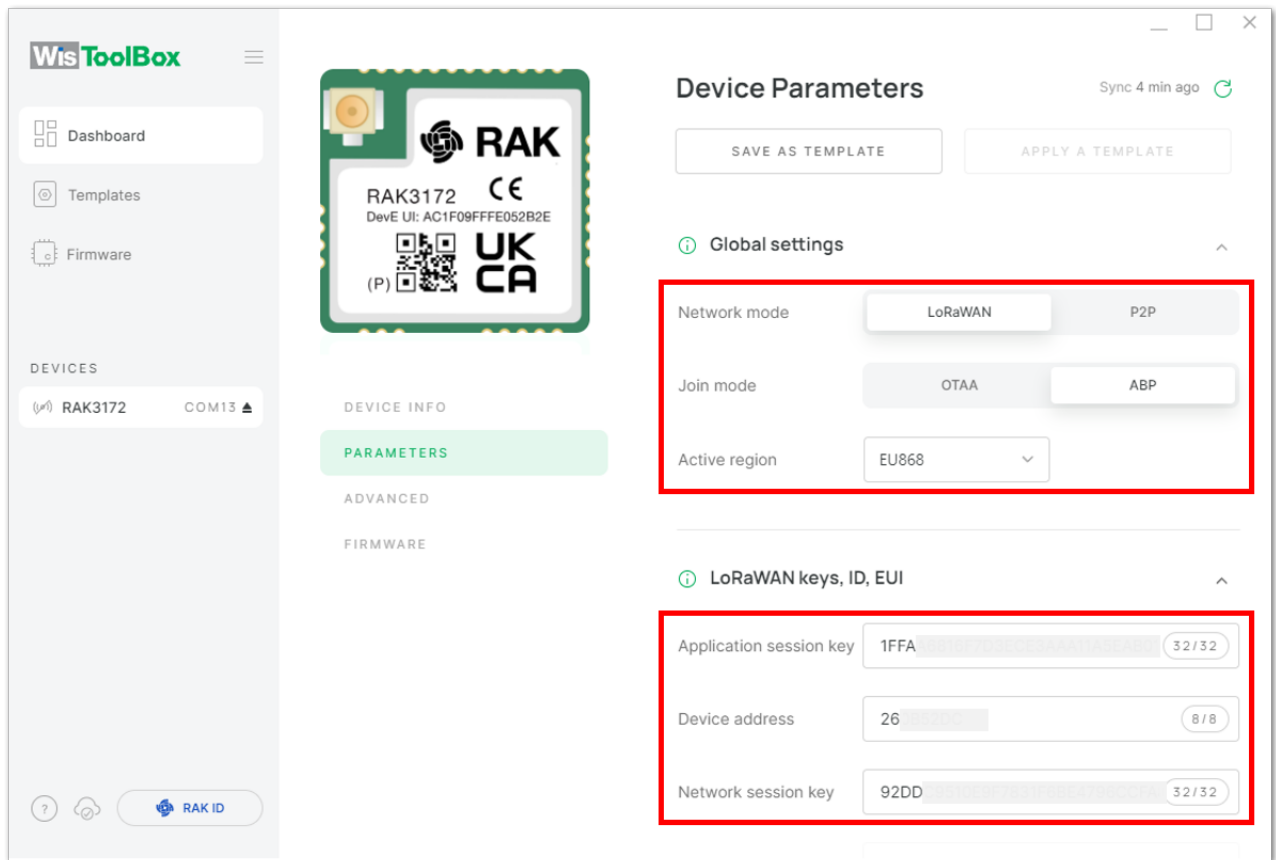


Figure 185: Global settings and LoRaWAN keys, ID, EUI details

13. Now you have a configured ABP device using WisToolBox Console. **ABP-configured devices** are directly tied to network once done with the above procedures so joining procedure is not needed.
14. Now you can try sending payload to TTN. Open again the terminal console of WisToolBox to send some payload using it. Send command format: `AT+SEND=<port>:<payload>`

```
AT+SEND=2:12345678
```

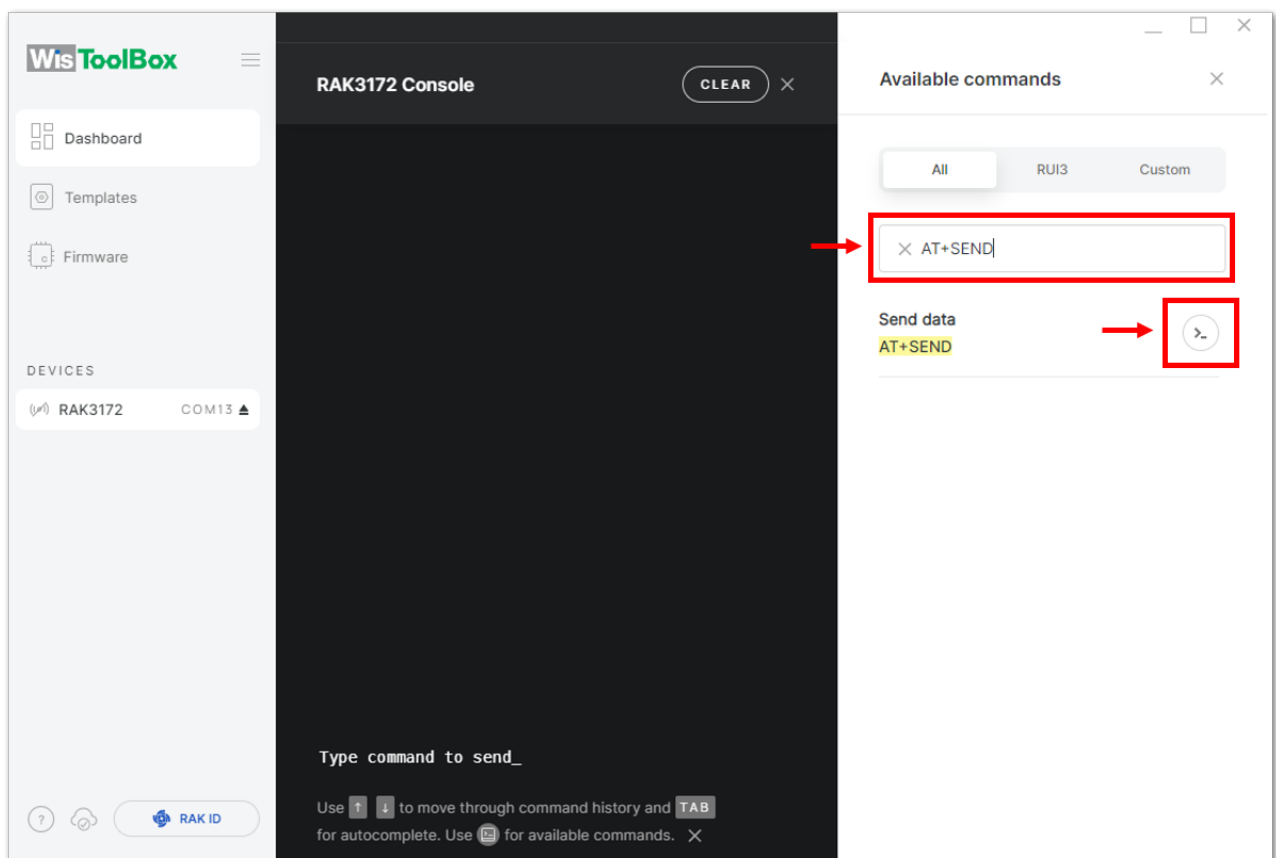


Figure 186: ABP device sending payload to the network

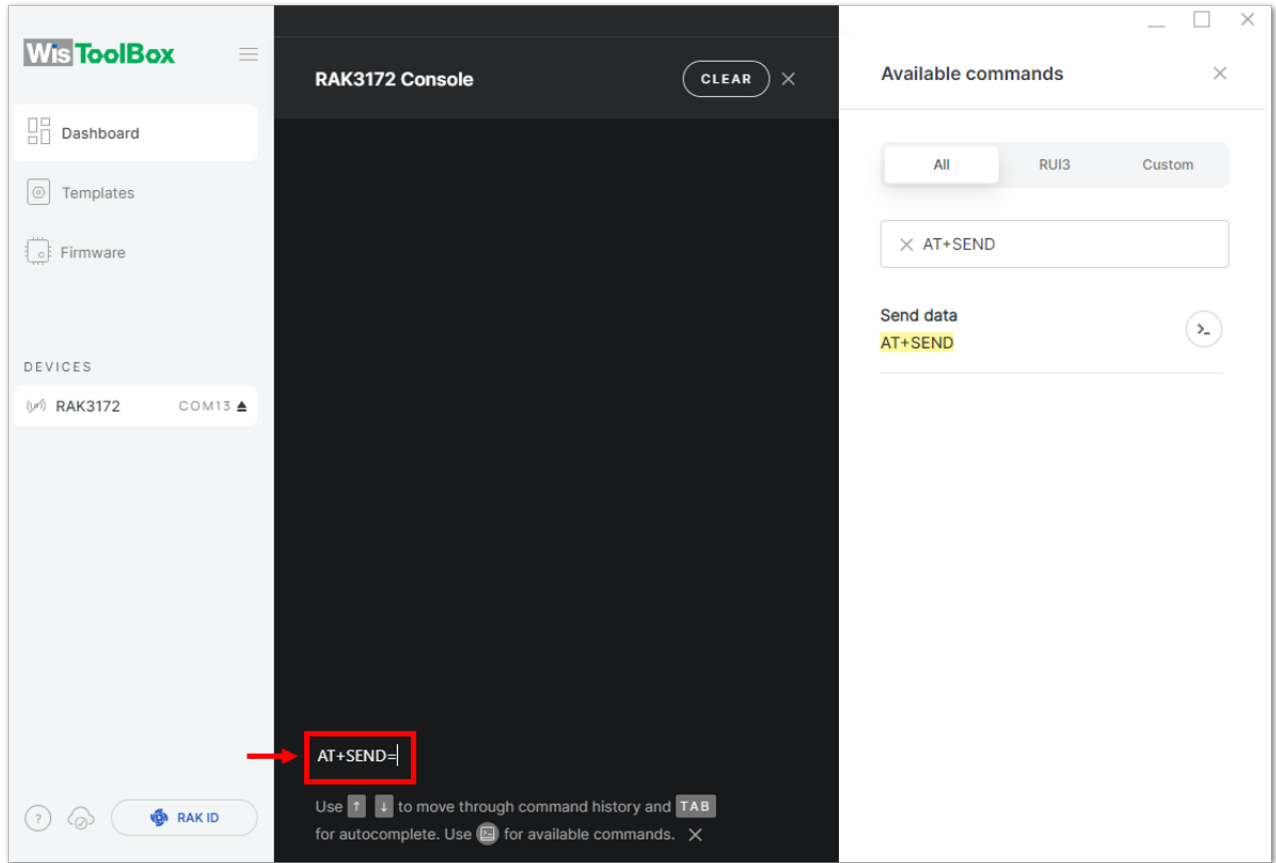


Figure 187: ABP device sending payload to the network

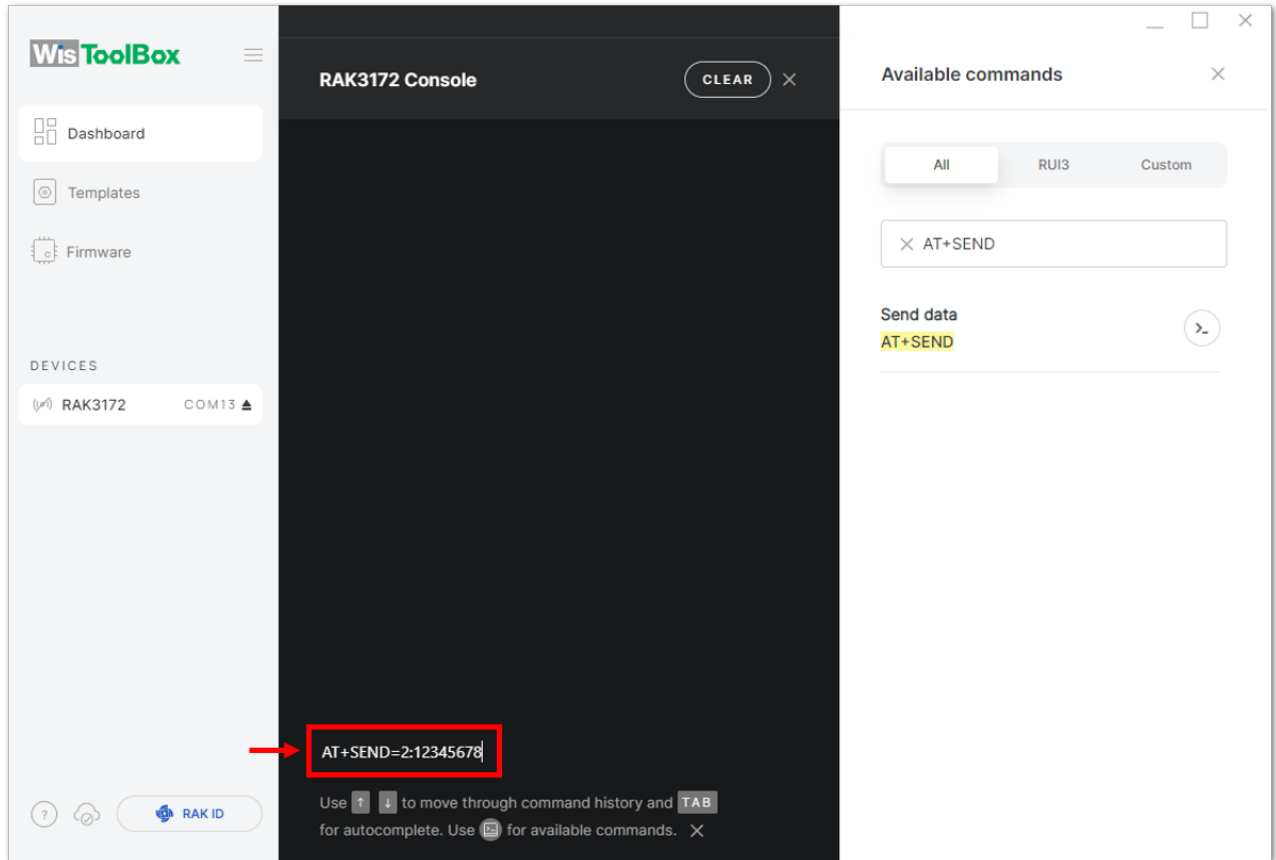


Figure 188: ABP device sending payload to the network

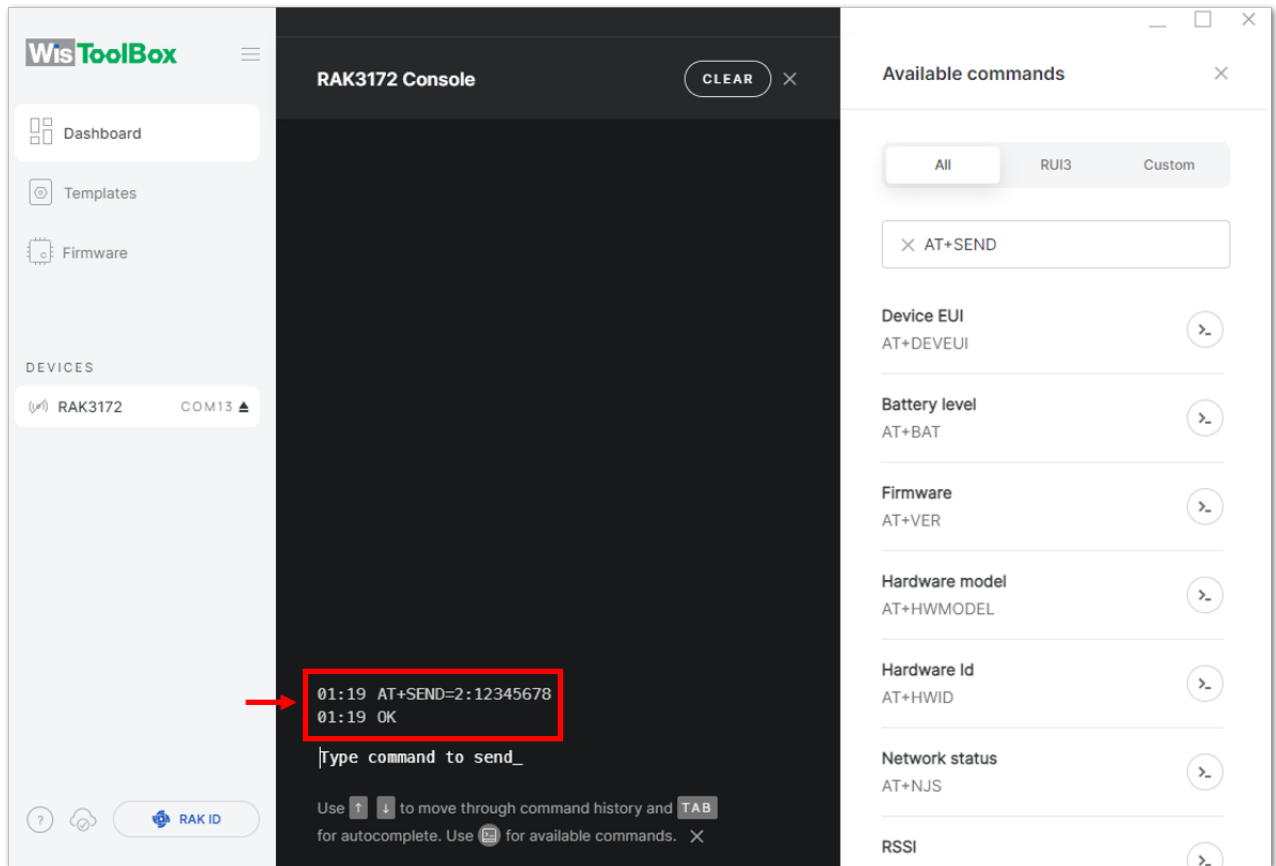


Figure 189: ABP device sending payload to the network

15. You can see the data sent by the RAK3172 evaluation board on the TTN device console *Live data* section. Also, the *Last seen* info should be a few seconds or minutes ago.

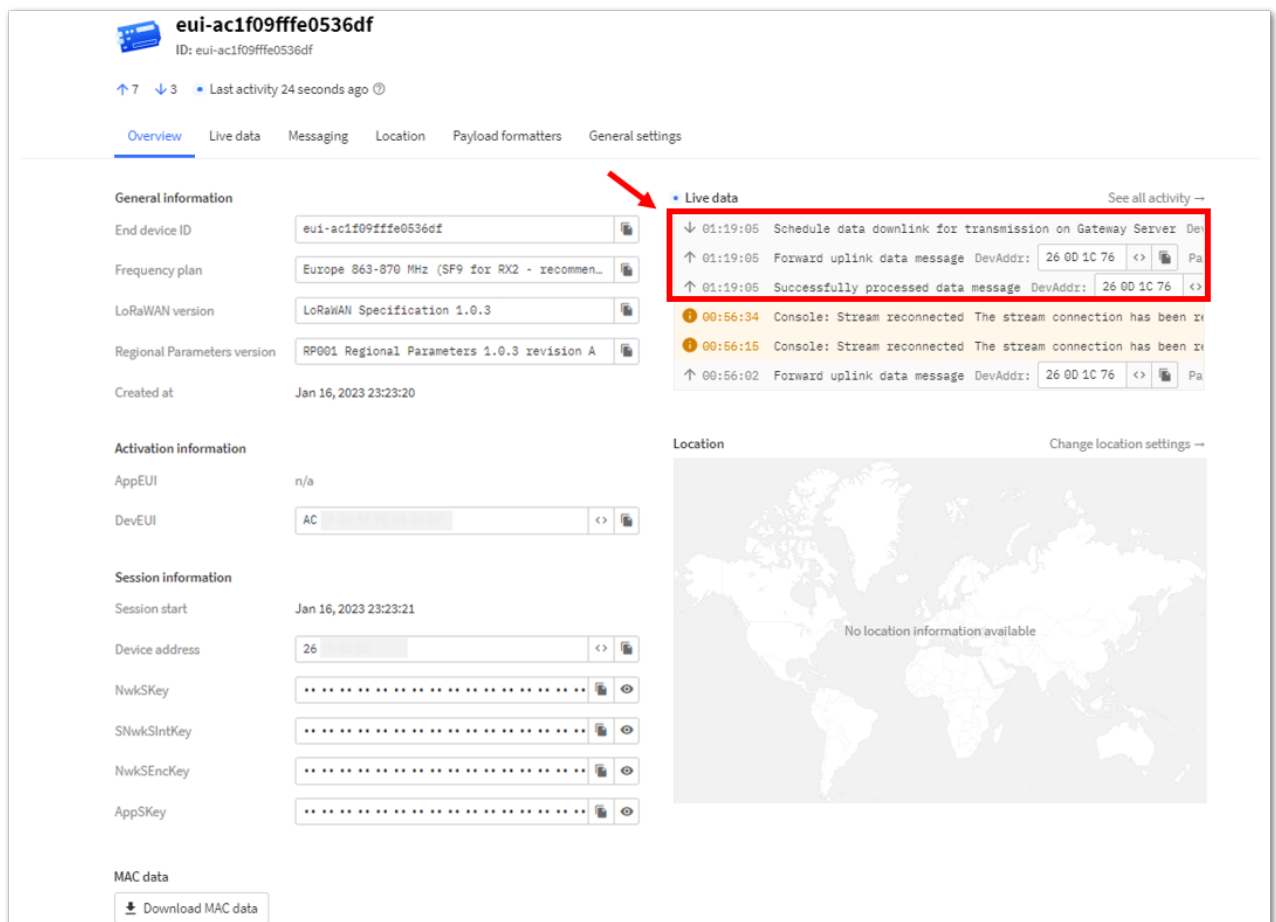


Figure 190: ABP Test Sample Data Sent Viewed in TTN

>

## Connecting with ChirpStack

This section shows how to connect the RAK3172 Evaluation Board to the ChirpStack platform.

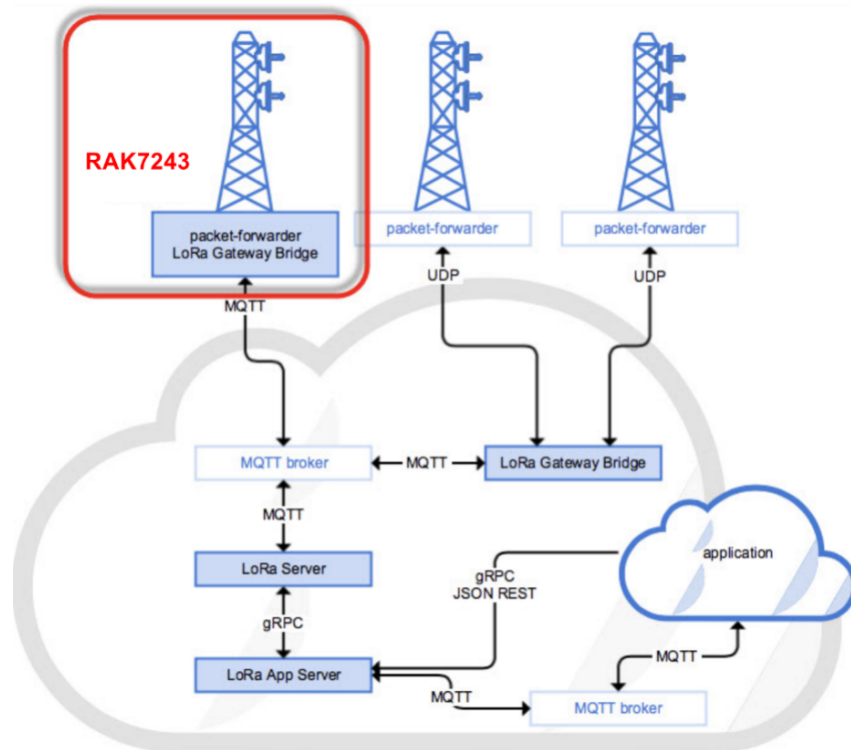


Figure 191: RAK3172 Evaluation board in the Context of the ChirpStack Platform

The ChirpStack or previously known as the LoRaServer project provides open-source components for building LoRaWAN networks. Like the case of TTN, the RAK3172 Evaluation Board is located in the periphery and will transmit the data to the backend servers through a LoRaWAN gateway. Learn more about [ChirpStack](#) .

**NOTE:**

It is assumed that you are using RAK Gateway and its built-in ChirpStack. Also, the gateway with the ChirpStack must be configured successfully. For further information, check the RAK documents for more details.

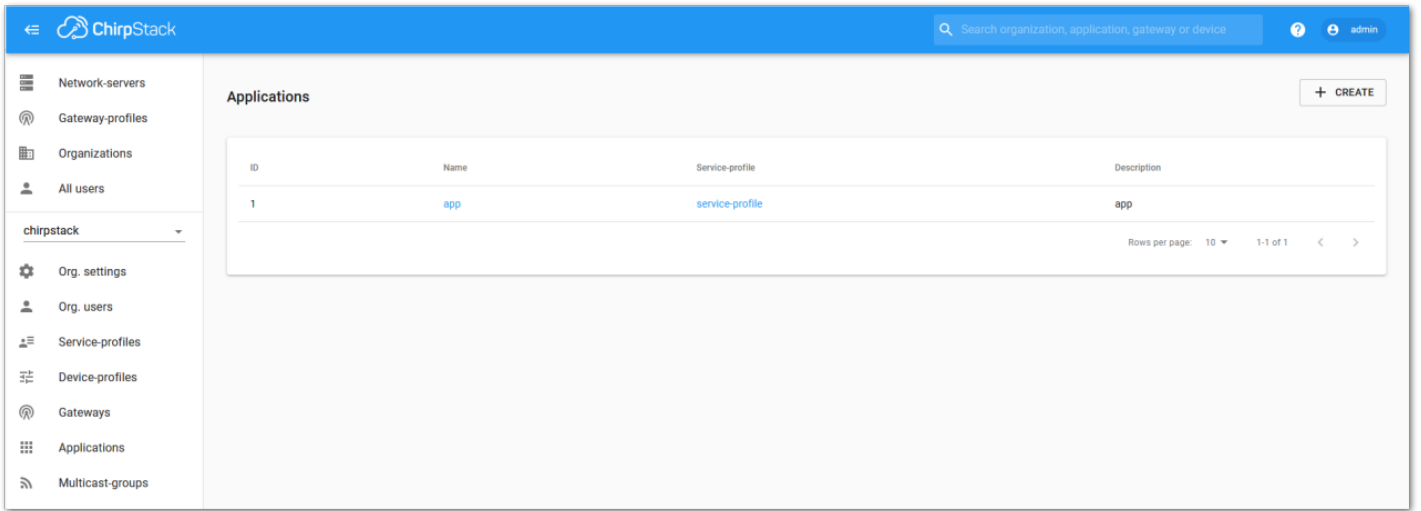
- In summary, these are the requirements:
  1. Have ChirpStack online gateway, the frequency band of the nodes should be consistent with the frequency band of the gateway in use.
    - [Connect the Gateway with Chirpstack](#)
  2. The RAK Serial Port Tool provided by RAK
  3. RAK3172 Evaluation Board

**NOTE:**

The frequency band used in the demonstration is EU868. Use a high-frequency version of RAK3172. The product number should be "RAK3172 (H)".

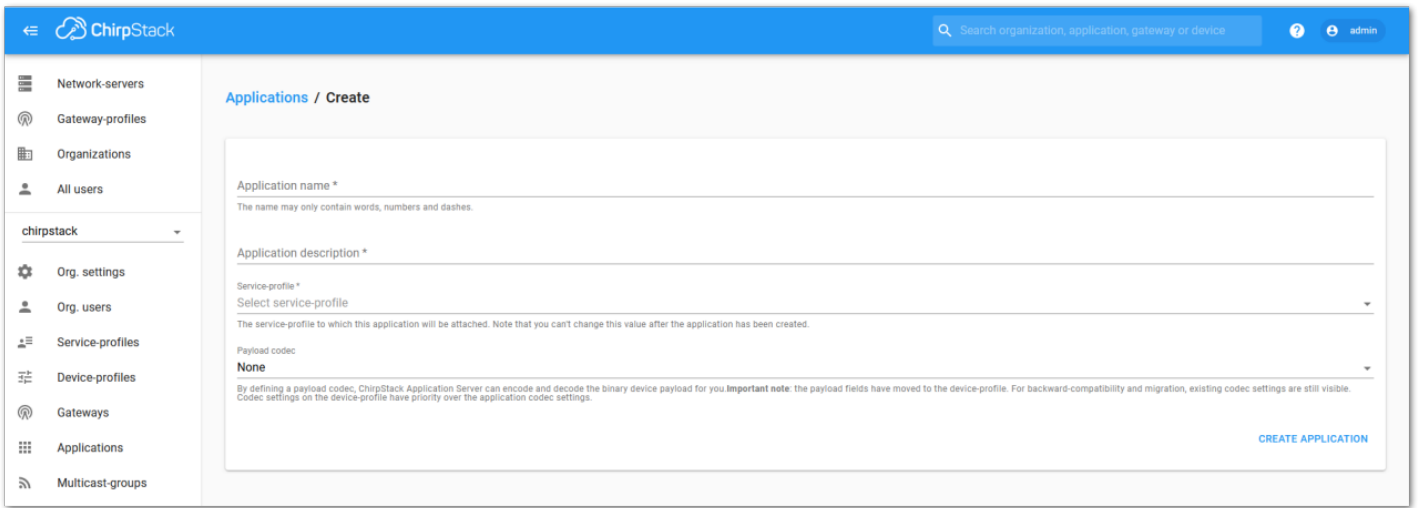
## Create a New Application

1. Log in to the ChirpStack server using your account and password.
2. Go to the Application section, as shown in **Figure 192**.



**Figure 192:** Application Section

3. By default, you should create a new application, although you can reuse the existing ones. For this setup, create a new Application by clicking on the “**CREATE**” button, and filling the required parameters, as shown in **Figure 193** and **Figure 194**.

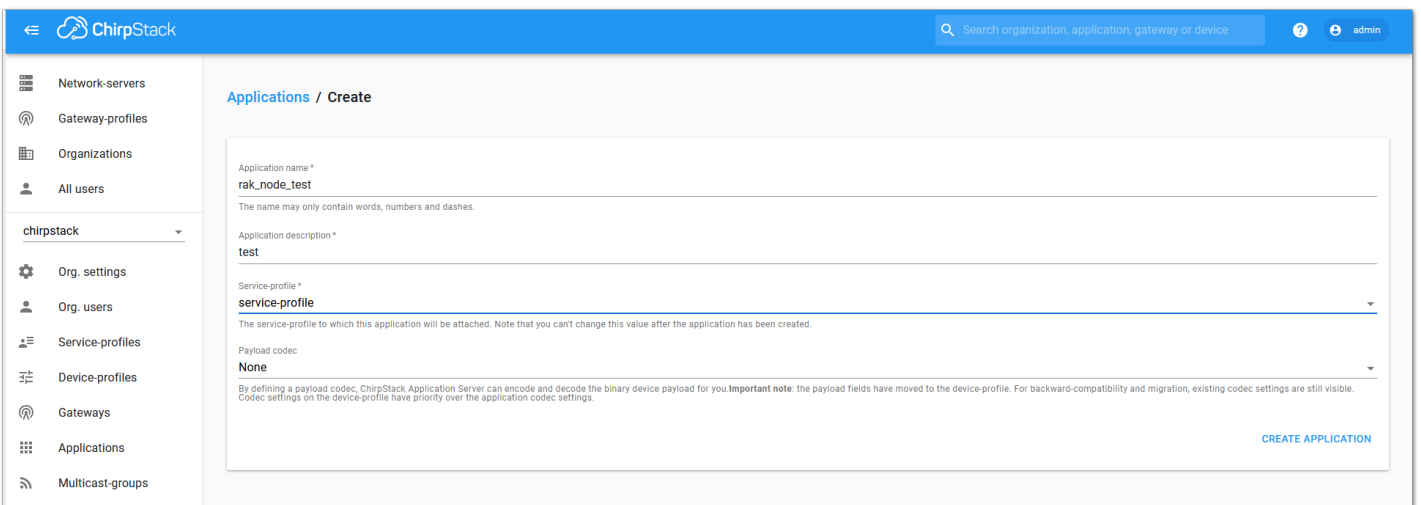


**Figure 193:** Creating a New Application

- For this setup, create an Application named “**rak\_node\_test**”.

ChirpStack LoraServer supports multiple system configurations, with only one by default.

- **Service profile:** The field is to select the system profile.
- **Payload codec:** It is the parsing method for selecting load data such as parsing LPP format data.

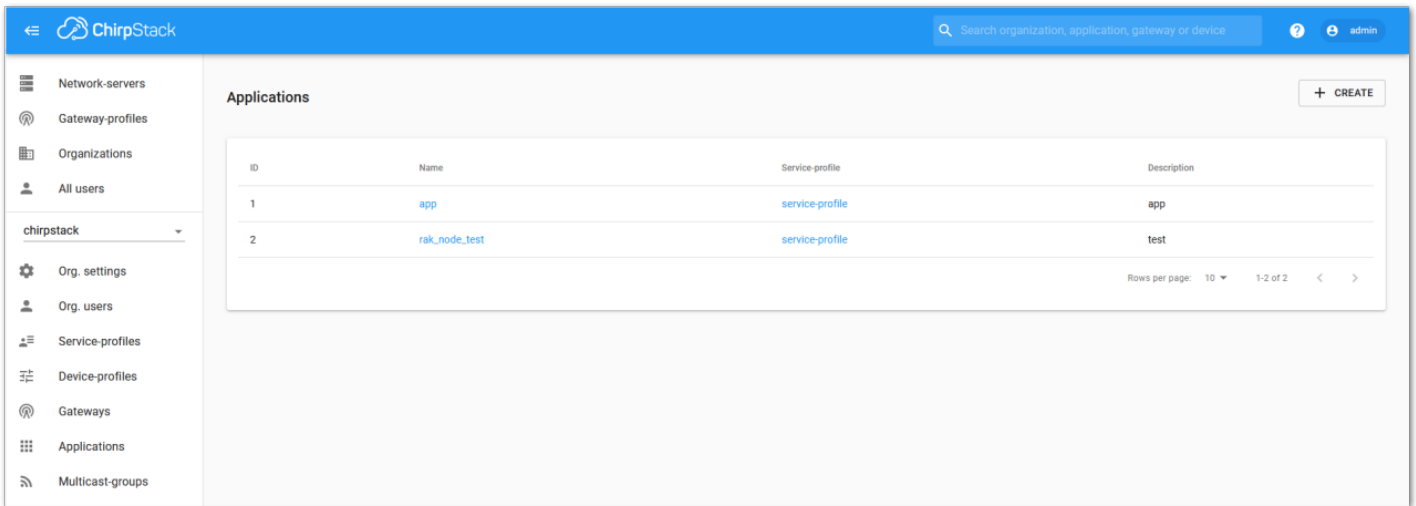


**Figure 194:** Filling Parameters of an Application

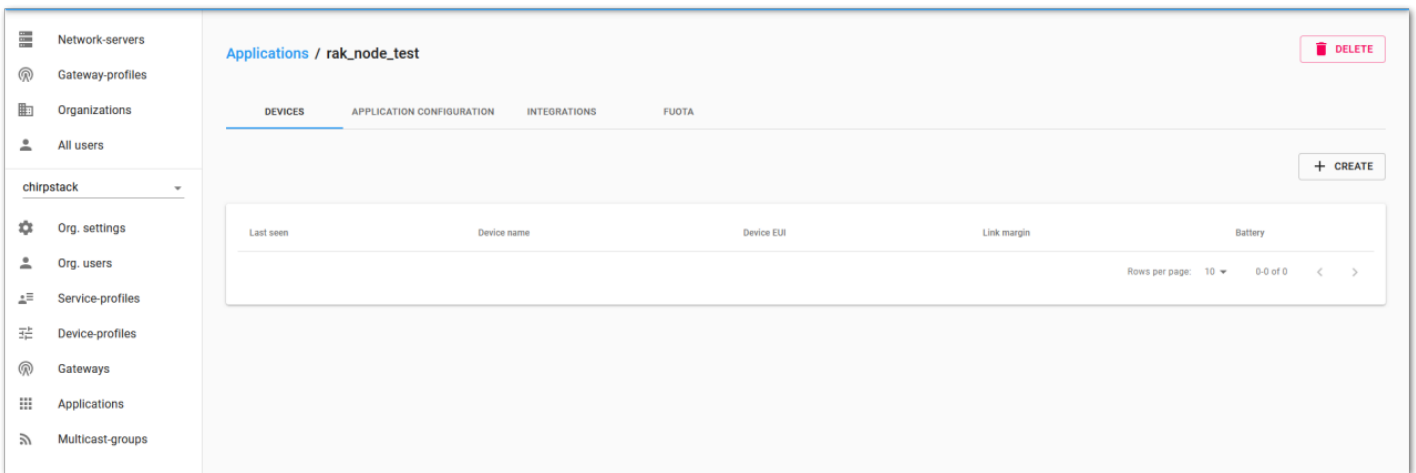
## Register a New Device



1. Choose the **Application** created in the previous step, then select the **DEVICES** tab, as shown in **Figure 195** and **Figure 196**.
2. Once done, click “+ **CREATE**”.

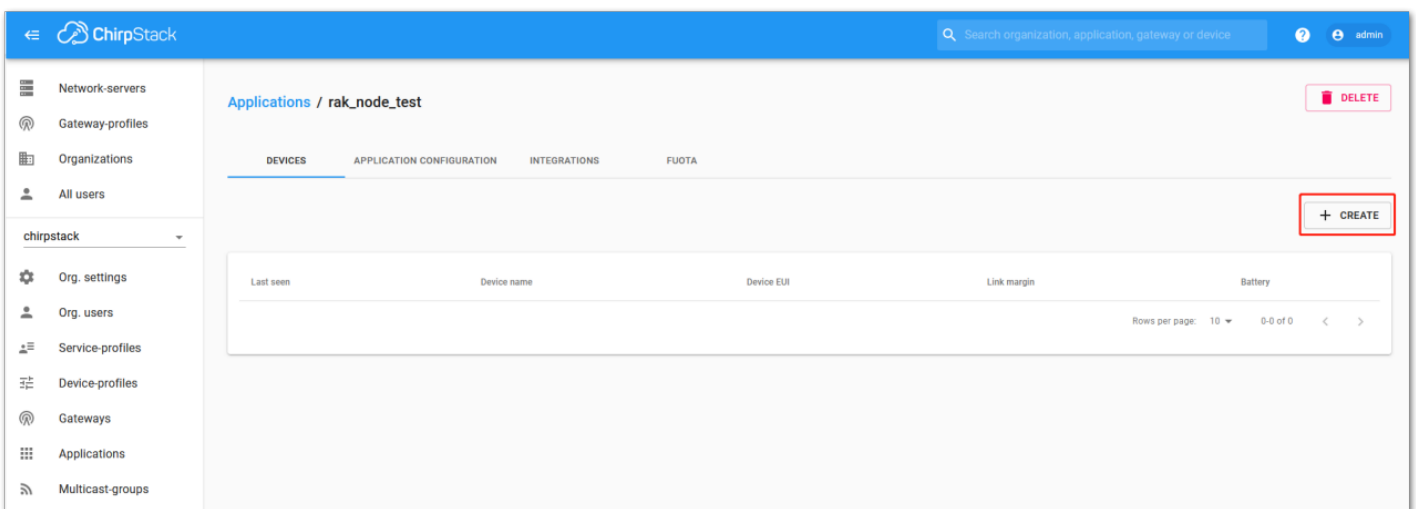


**Figure 195:** List of Applications Created

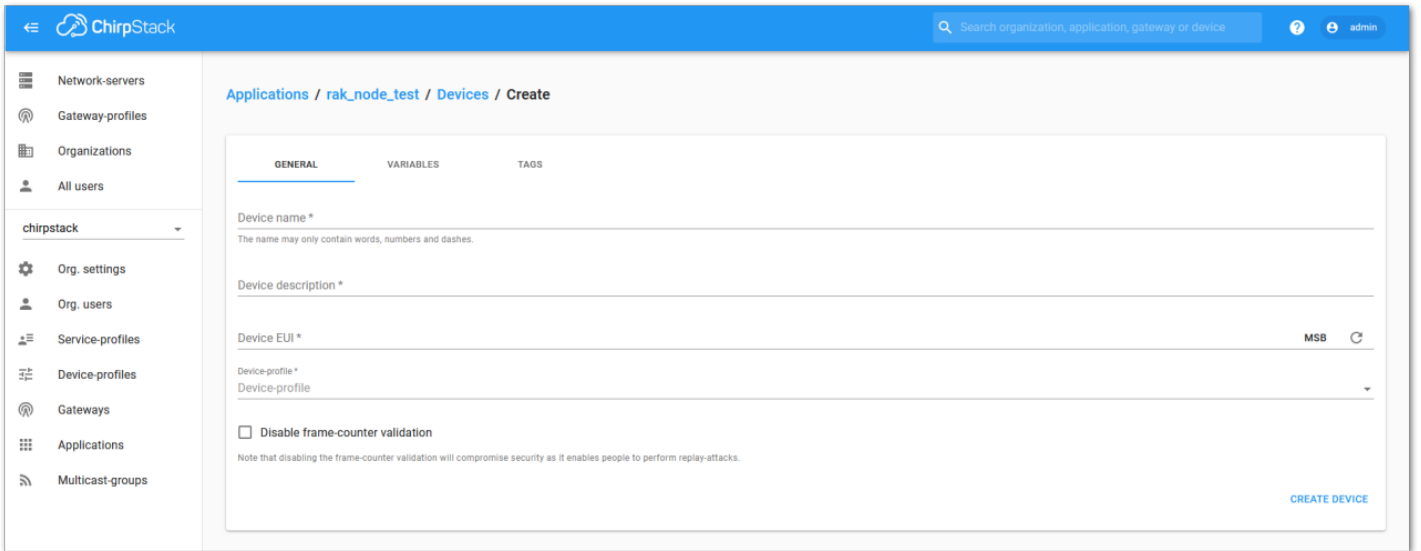


**Figure 196:** Device Tab of an Application

3. Once inside of the **DEVICE** tab, create a new device (LoRaWAN node) by clicking on the “+ **CREATE**” button.



**Figure 197:** Add a New Device



**Figure 198:** Chirpstack Adding Node into the RAK3172 Module

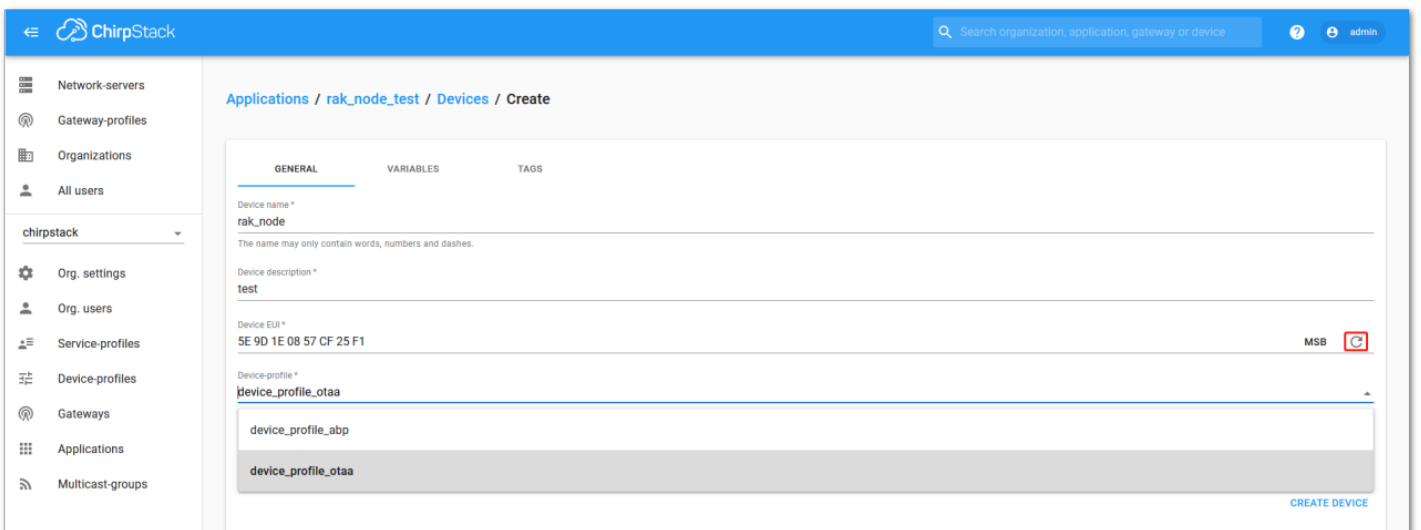
6. Once the node is created, fill in the necessary data. You can generate a Device EUI automatically by clicking the following icon, or you can write a correct Device EUI in the edit box.

Fill in the parameters requested:

- **Device name and Device description:** These are descriptive texts about your device.
- **Device EUI:** This interface allows you to generate a Device EUI automatically by clicking the generate icon. You can also add a specific Device EUI directly in the form.
- **Device Profile:**
  - If you want to join in OTAA mode, select “**DeviceProfile\_OTAA**”.
  - If you want to join in ABP mode, select “**DeviceProfile\_ABP**”.

**NOTE:**

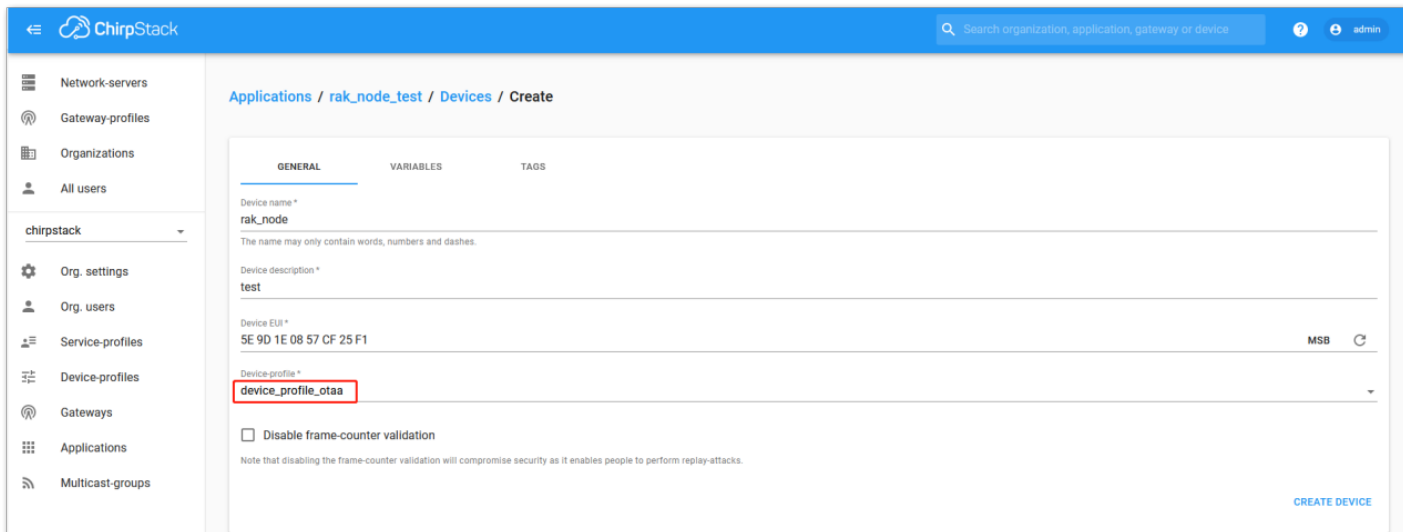
- Device profiles **DeviceProfile\_OTAA** and **DeviceProfile\_ABP** are only available if you are using the built-in Chirpstack LoRaWAN Server of RAK Gateways.
- If you have your own Chirpstack installation, you can set up the device profile with **LoRaWAN MAC version 1.0.3** and **LoRaWAN Regional Parameters revision B** to make it compatible with RAK3172.



**Figure 199:** Generate a New Device EUI

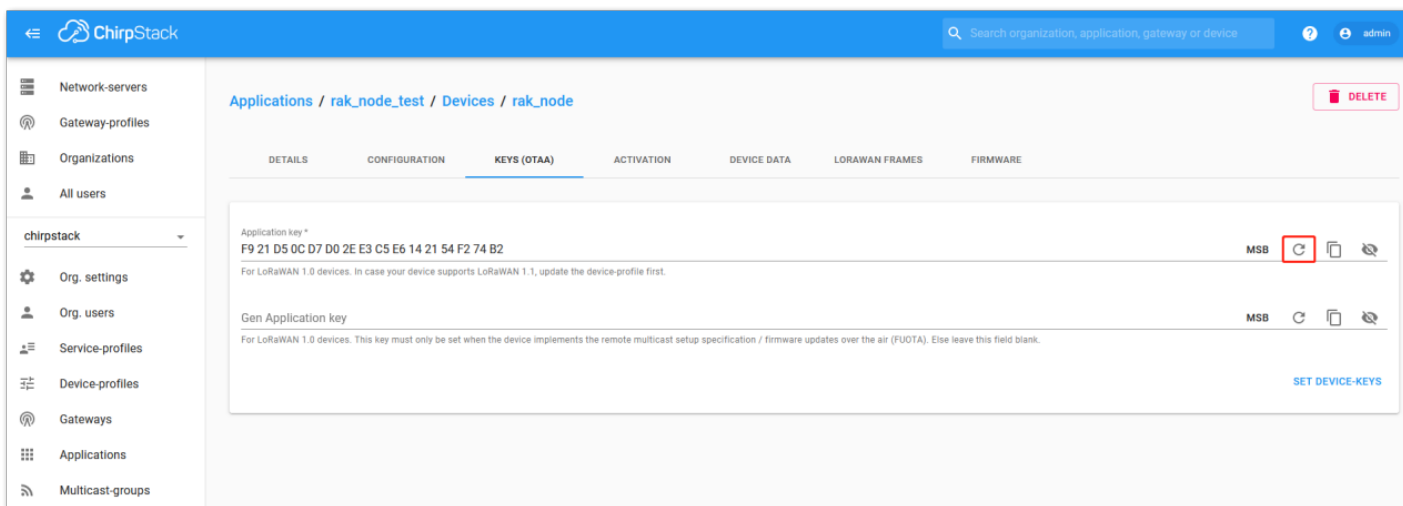
## Chirpstack OTAA Device Registration

1. If you have selected “**DeviceProfile\_OTAA**”, as shown in **Figure 200**, then after the device is created, an Application Key must be also created for this device.



**Figure 200:** Chirpstack OTAA Activation

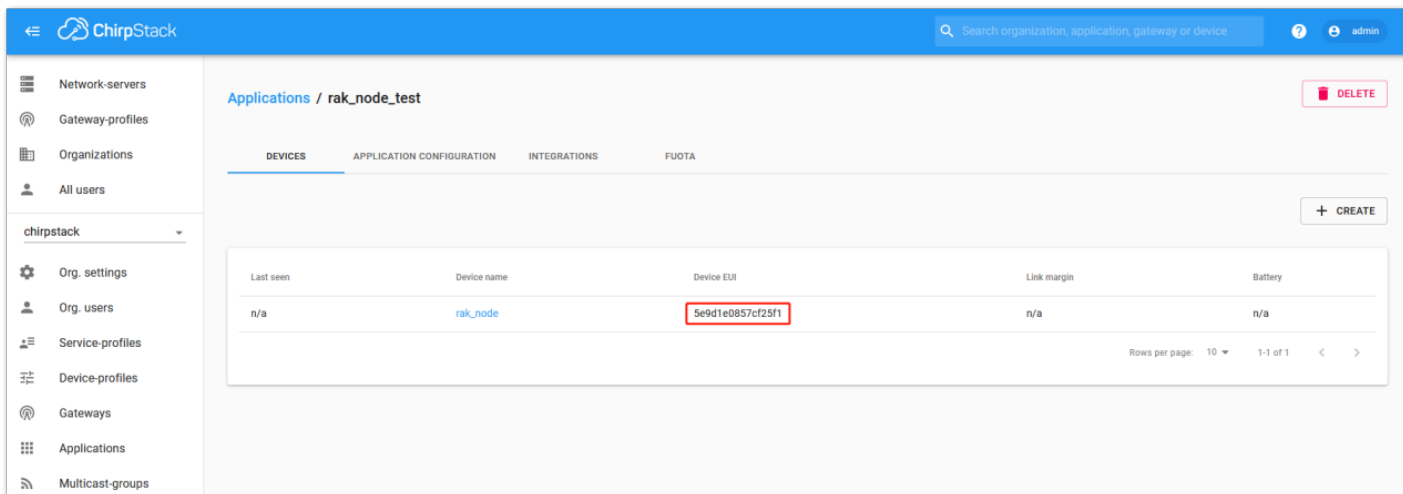
2. A previously created Application Key can be entered here, or a new one can be generated automatically by clicking the icon highlighted in red in **Figure 201**:



**Figure 201:** Chirpstack OTAA Set Application Keys

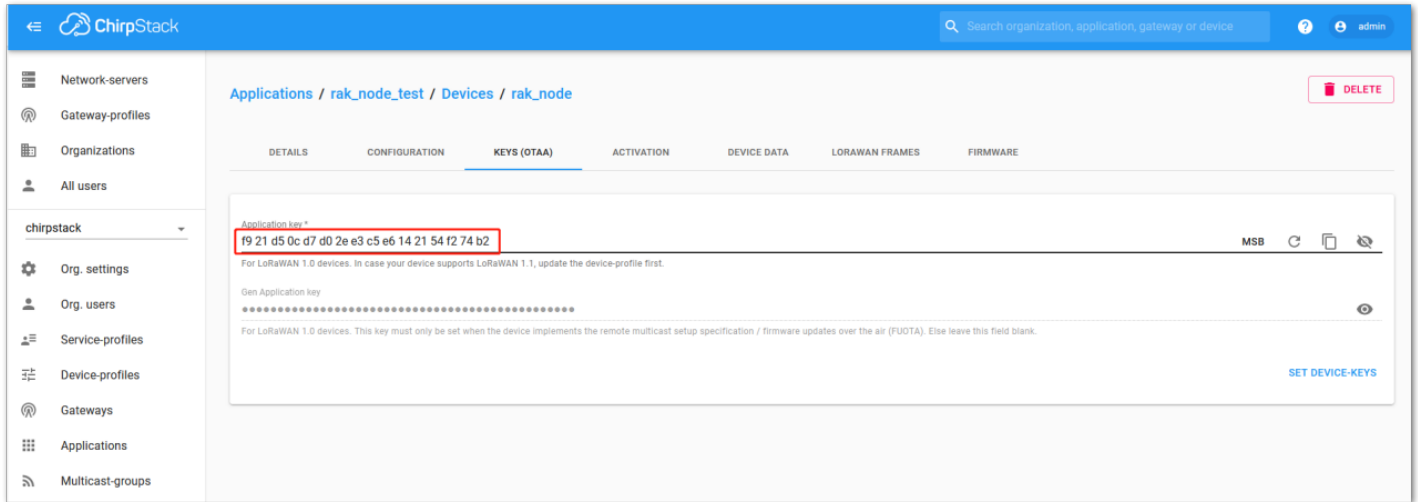
3. Once the Application Key is added to the form, the process can be finalized by clicking on the “**SET DEVICE-KEYS**” button.

- As shown in **Figure 202**, a new device should be listed in the DEVICES tab. The most important parameters, such as the Device EUI are shown in the summary.



**Figure 202:** Chirpstack OTAA List of Device in the Device Tab

4. To end the process, it is a good practice to review that the Application Key is properly associated with this device. The Application Key can be verified in the **KEYS(OTAA)** tab, as shown in **Figure 203**.



**Figure 203:** Application Key Associated with the New Device

**NOTE:**

Standard OTAA mode requires the **Device EUI**, **Application Key**, and **Application EUI**, but in the ChirpStack's implementation, only the Device EUI and the Application Key are mandatory. The Application EUI is not required and not recorded in the Application tab. Nevertheless, you can reuse the Device EUI as the Application EUI during the configuration on the side of the node.

## OTAA Configuration for Chirpstack

The RAK3172 Evaluation Board supports a series of AT commands to configure its internal parameters and control the functionalities of the board.

1. To set up the RAK3172 Evaluation Board to join the Chirpstack using OTAA, start by connecting the RAK3172 Evaluation Board to the Computer (see **Figure 21**) and open the RAK Serial Port Tool. Select the right COM port and set the baud rate to 115200.

It is recommended to start by testing the serial communication and verify that the current configuration is working by sending these two AT commands:

```
AT
```

```
ATE
```

`ATE` will echo the commands you input to the board which is useful for tracking the commands and troubleshooting.

You will receive `OK` when you input the two commands. After setting `ATE`, you can now see all the commands you input together with the replies. Try again `AT` and you should see it on the terminal followed by `OK`, as shown in **Figure 204**.

**NOTE:**

If you haven't received an `OK` or any reply, you need to check if the wiring of your UART lines is correct and if the baud is correctly configured to 115200. Also, you can check if the device is powered correctly. If you are getting power from a USB port, ensure that you have a good USB cable.

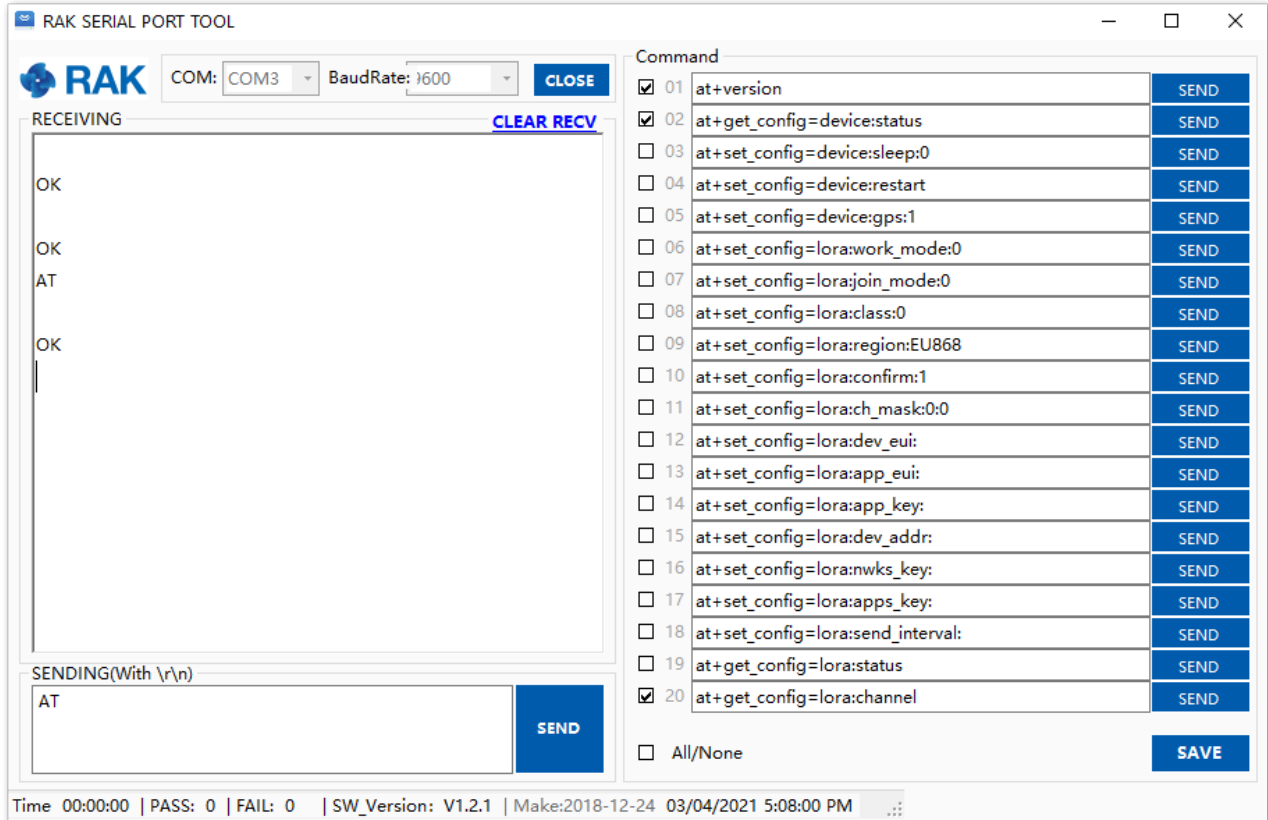


Figure 204: at+version command response

2. The next step is to configure the OTAA LoRaWAN parameters in RAK3172:

- LoRa work mode: **LoRaWAN**
- LoRaWAN join mode: **OTAA**
- LoRaWAN class: **Class A**
- LoRaWAN region: **EU868**

Set the work mode to LoRaWAN.

```
AT+NWM=1
```

Set the LoRaWAN activation to OTAA.

```
AT+NJM=1
```

Set the LoRaWAN class to Class A.

```
AT+CLASS=A
```

Set the frequency/region to EU868.

AT+BAND=4

 **NOTE:**

- Depending on the Regional Band you selected, you might need to configure the sub-band of your RAK3172 to match the gateway and LoRaWAN network server. This is especially important on Regional Bands like US915, AU915, and CN470.
- To configure the masking of channels for the sub-bands, you can use the `AT+MASK` command that can be found on the [AT Command Manual](#) .
- To illustrate, you can use sub-band 2 by sending the command `AT+MASK=0002` .

**List of band parameter options**

Code	Regional Band
0	EU433
1	CN470
2	RU864
3	IN865
4	EU868
5	US915
6	AU915
7	KR920
8	AS923-1
9	AS923-2
10	AS923-3
11	AS923-4

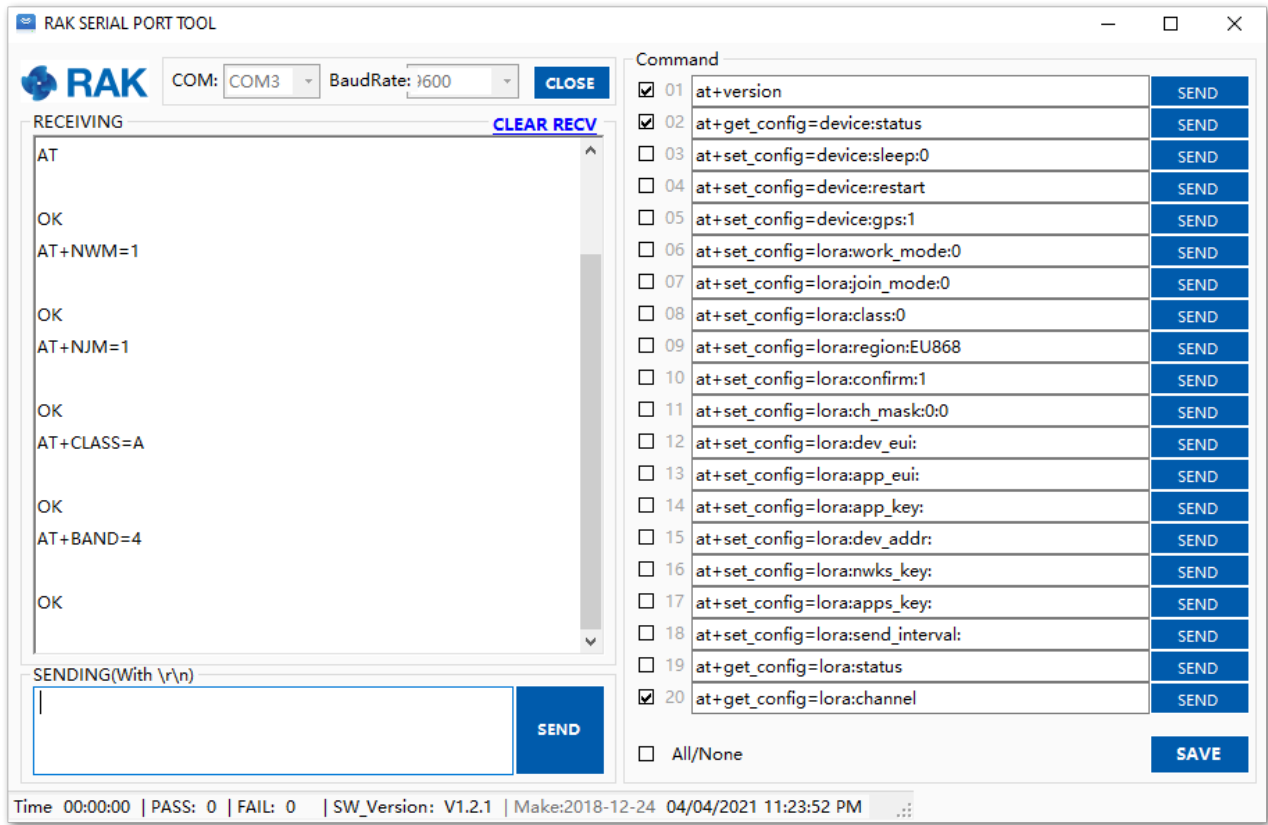


Figure 205: Configuring LoRa Parameters

3. After the configuration of the LoRaWAN parameters, the next step is to set up the DevEUI and AppKey. You need the use the values from the Chirpstack device console.

**NOTE:**

The Application EUI parameter is not required in the ChirpStack platform; therefore, it is possible to use the same id as the Device EUI.

- Device EUI: **5E9D1E0857CF25F1**
- Application EUI: **5E9D1E0857CF25F1**
- Application Key: **F921D50CD7D02EE3C5E6142154F274B2**

Set the Device EUI.

```
AT+DEVEUI=5E9D1E0857CF25F1
```

Set the Application EUI.

```
AT+APPEUI=5E9D1E0857CF25F1
```

Set the Application Key.

```
AT+APPKEY=F921D50CD7D02EE3C5E6142154F274B2
```

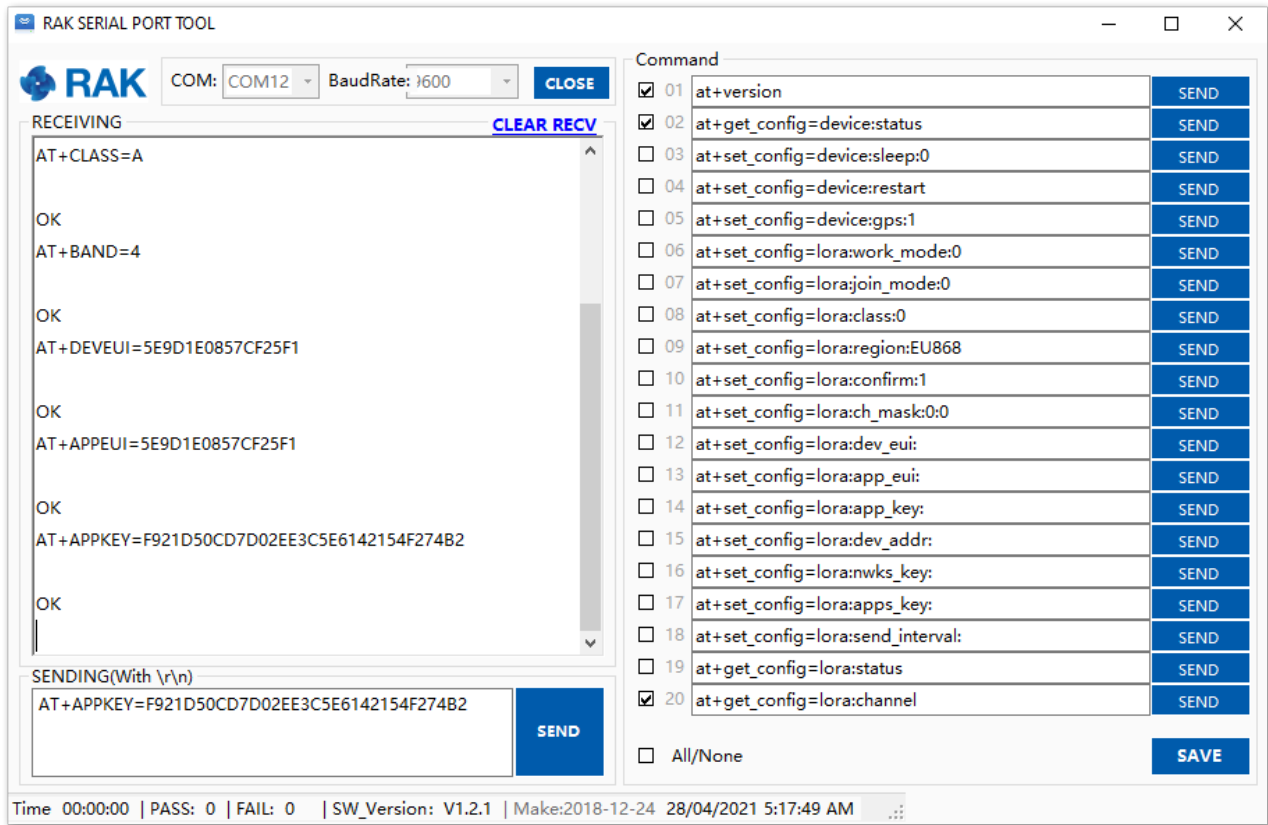


Figure 206: Configuring LoRa Parameters

4. After EUI and key configuration, the device can now join the network and send some payload.

```
AT+JOIN=1:0:10:8
```

Join command format: `AT+JOIN=w:x:y:z`

Parameter	Description
w	Join command - 1: joining, 0: stop joining.
x	Auto-join config - 1: auto-join on powerup, 0: no auto-join
y	Reattempt interval in seconds (7-255) - 8 is the default.
z	Number of join attempts (0-255) - 0 is default.

5. After 5 or 6 seconds, if the request is successfully received by a LoRaWAN gateway, then you should see JOINED status reply.

**NOTE:**

- If the OTAA device join failed, you need to check if your device is within reach of a working LoRaWAN gateway that is configured to connect to Chirpstack. It is also important to check that all your OTAA parameters (DEVEUI and APPKEY) are correct by using `AT+DEVEUI=?` and `AT+APPKEY=?` commands. Lastly, ensure that the antenna of your device is properly connected.
- After checking all the things above, try to join again.

6. With the end-device properly activated, you can now try to send some payload after successful join.



AT+SEND=2:12345678

Send command format: `AT+SEND=<port>:<payload>`

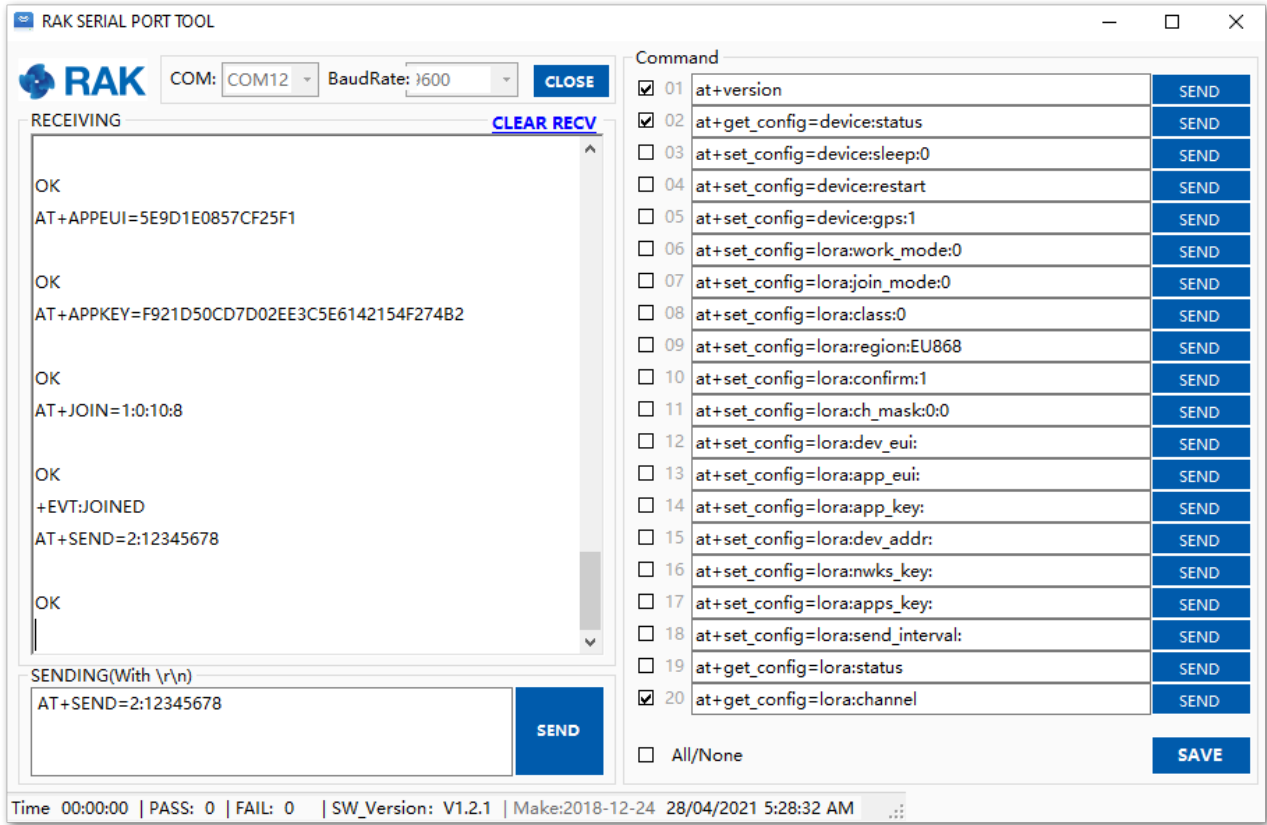


Figure 207: OTAA Test Sample Data Sent via RAK Serial Port Tool

7. On the ChirpStack platform, you should see the join and uplink messages in the LORAWAN FRAMES tab, as shown in **Figure 208**. By convention, messages sent from nodes to gateways are considered as **Uplinks** while messages sent by gateways to nodes are considered as **Downlinks**.

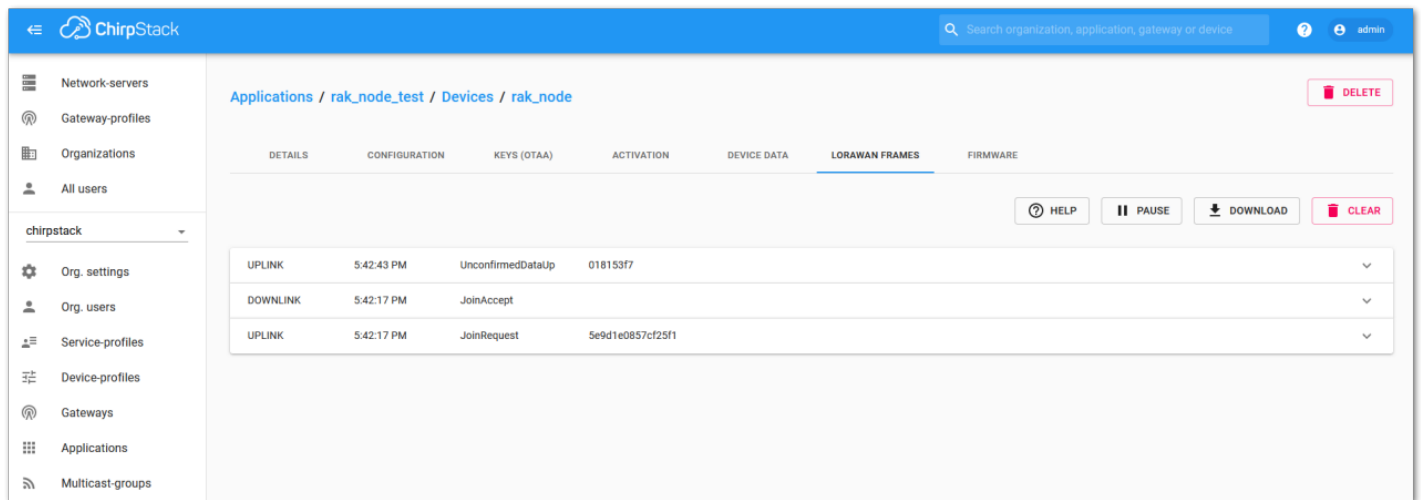


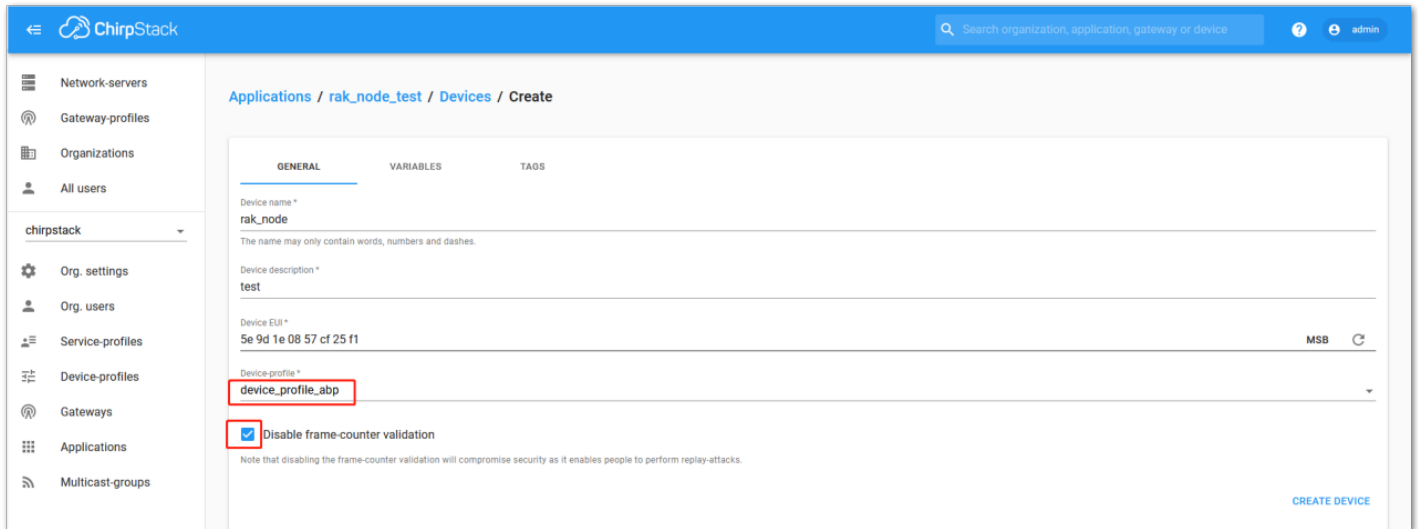
Figure 208: Chirpstack Data Received Preview

## Chirpstack ABP Device Registration

1. During the registration of a new device, if you select “**DeviceProfile\_ABP**”, as shown in **Figure 209**, then the ChirpStack platform will assume that this device will join the LoRaWAN network using the ABP mode.

**NOTE:**

Check “**Disable counting frame verification**”. During the test, when the board is restarted, the frame counting number will be also be restarted from zero. This would cause a synchronization problem with the ChirpStack server treating it as a replay attack. For the testing purpose, it is safe to disable this feature, but remember to activate it in a production environment.

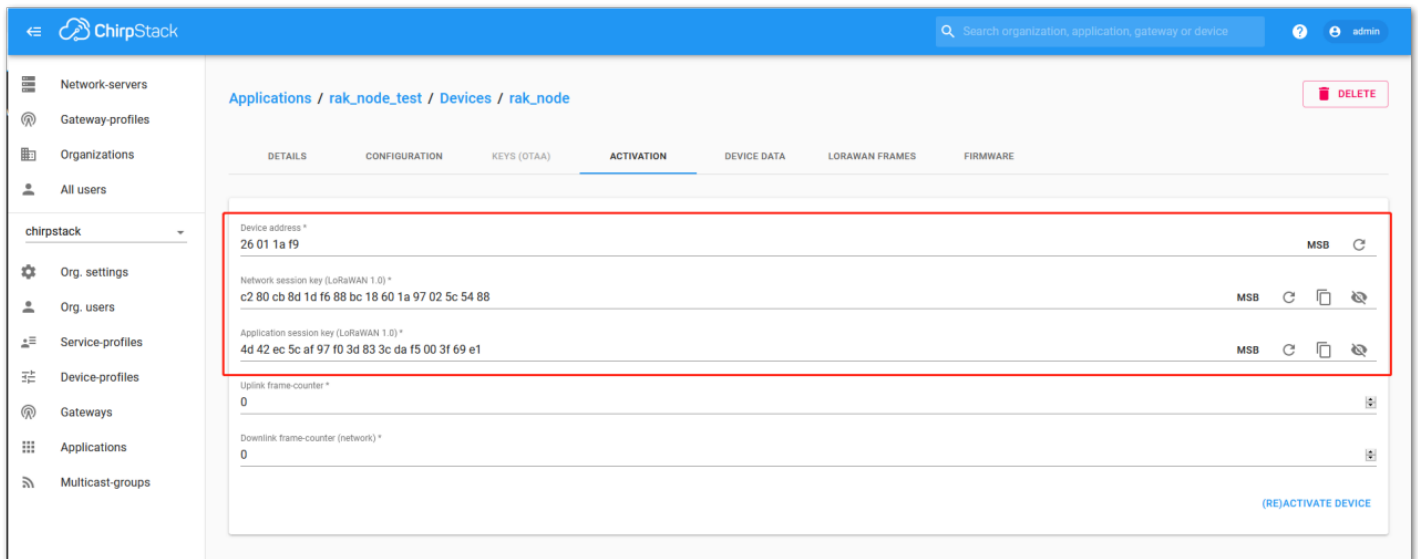


**Figure 209:** ChirpStack Console, Configuring a Device

2. After selecting the ABP mode, the following parameters appear in the Activation tab:

Then, you can see that there are some parameters for ABP in the “**ACTIVATION**” item:

- **Device address**
- **Network Session Key**
- **Application Session Key**



**Figure 210:** Chirpstack ABP Activation Parameters Needed

3. The parameters can be generated as random numbers by the platform or can be set with user values. Once these parameters are filled in properly, the process is completed by clicking on the “**ACTIVATE DEVICE**” button.

## ABP Configuration for Chirpstack

1. To set up the RAK3172 Evaluation Board to join the Chirpstack using ABP, start by connecting the RAK3172 Evaluation Board to the Computer (see **Figure 21**) and open the RAK Serial Port Tool. Select the right COM port and set the baud rate to 115200.

It is recommended to start by testing the serial communication and verify that the current configuration is working by sending these two AT commands:

```
AT
```

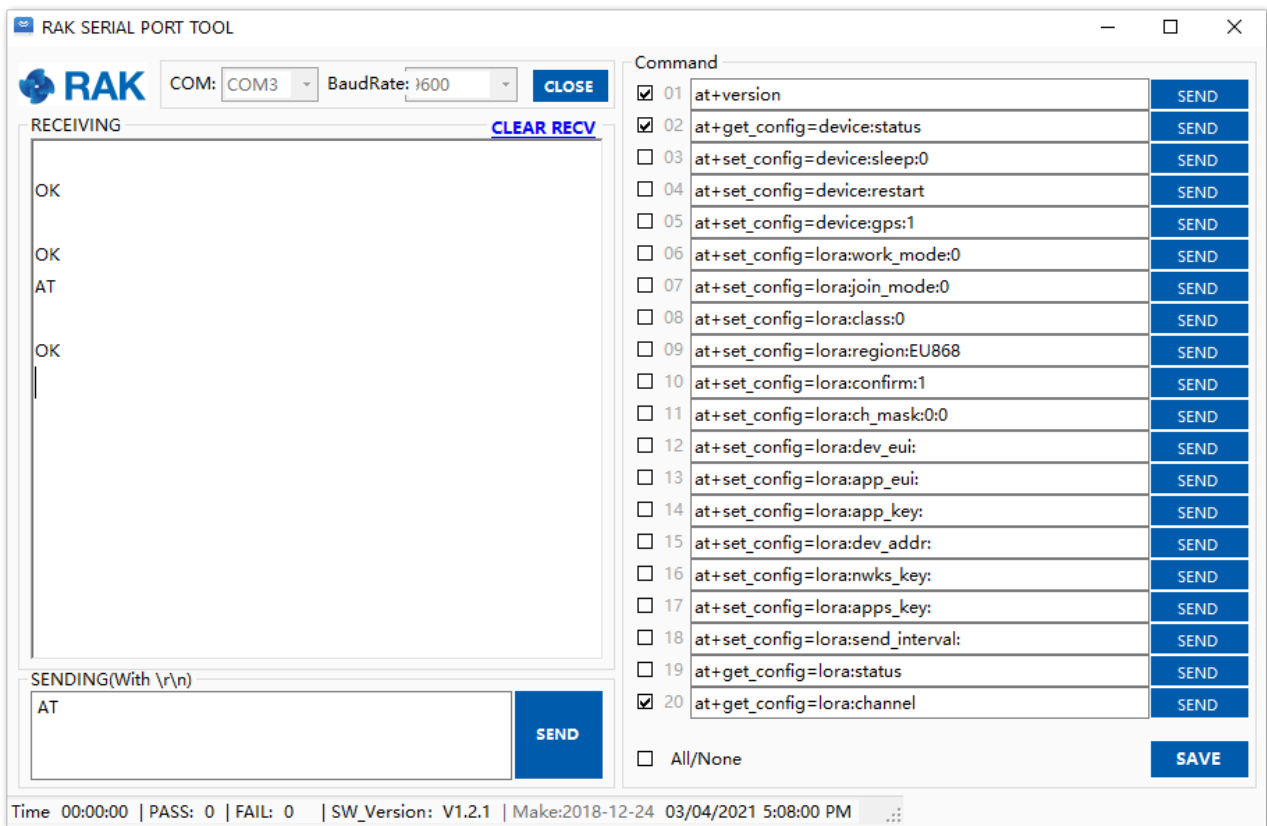
```
ATE
```

`ATE` will echo the commands you input to the board which is useful for tracking the commands and troubleshooting.

You will receive `OK` when you input the two commands. After setting `ATE`, you can now see all the commands you input together with the replies. Try again `AT` and you should see it on the terminal followed by `OK`, as shown in **Figure 211**.

**NOTE:**

If you haven't received an `OK` or any reply, you need to check if the wiring of your UART lines is correct and if the baud is correctly configured to 115200. Also, you can check if the device is powered correctly. If you are getting power from a USB port, ensure that you have a good USB cable.



**Figure 211:** at+version command response

2. The next step is to configure the ABP LoRaWAN parameters in RAK3172:

- LoRa work mode: **LoRaWAN**
- LoRaWAN join mode: **ABP**
- LoRaWAN class: **Class A**
- LoRaWAN region: **EU868**

Set the work mode to LoRaWAN. It can be set to P2P as well but by default, the device is in LoRaWAN mode.

```
AT+NWM=1
```

Set the LoRaWAN activation to ABP.

```
AT+NJM=0
```

Set the LoRaWAN class to Class A.

```
AT+CLASS=A
```

Set the frequency/region to EU868.

```
AT+BAND=4
```

 **NOTE:**

Depending on the Regional Band you selected, you might need to configure the sub-band of your RAK3172 to match the gateway and LoRaWAN network server. This is especially important on Regional Bands like US915, AU915, and CN470.

To configure the masking of channels for the sub-bands, you can use the `AT+MASK` command that can be found on the [AT Command Manual](#) .

To illustrate, you can use sub-band 2 by sending the command `AT+MASK=0002` .

**List of band parameter options**

Code	Regional Band
0	EU433
1	CN470
2	RU864
3	IN865
4	EU868
5	US915
6	AU915
7	KR920

Code	Regional Band
8	AS923-1
9	AS923-2
10	AS923-3
11	AS923-4

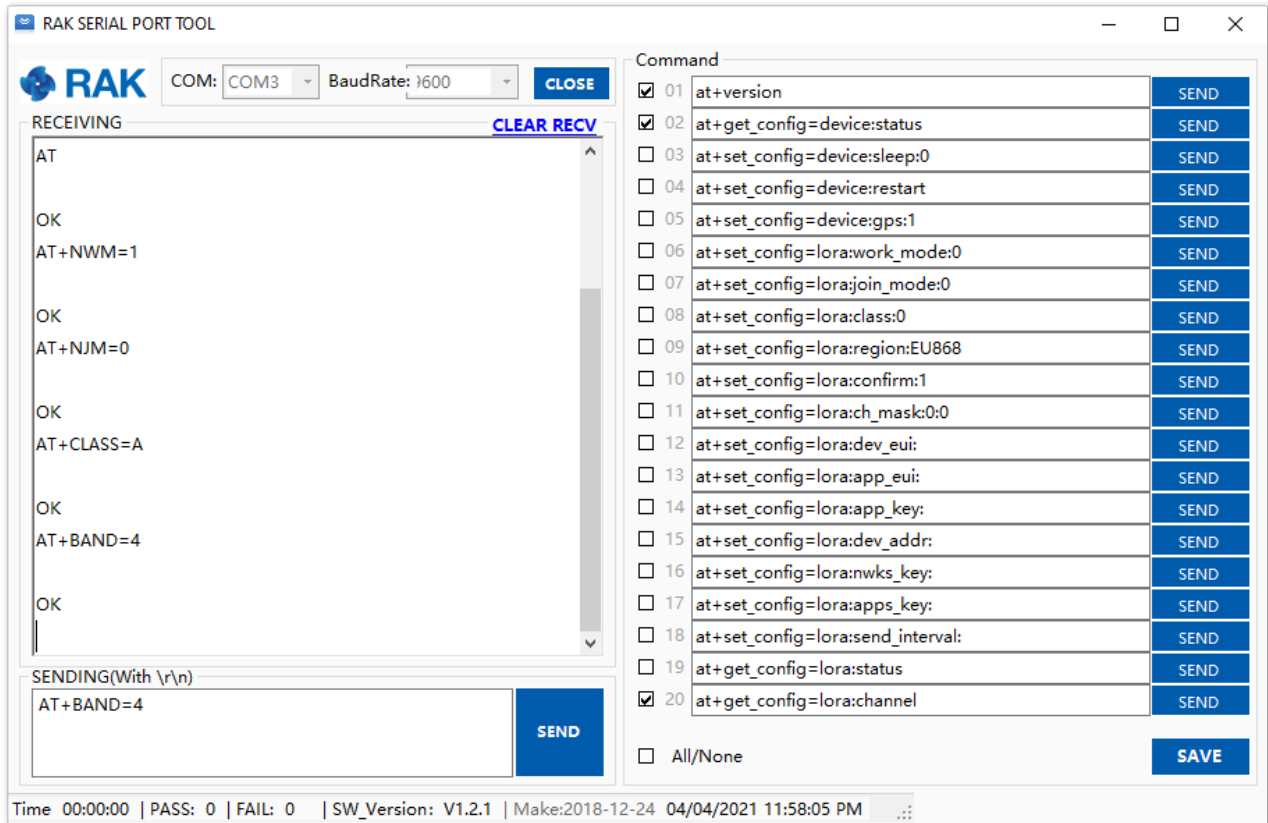


Figure 212: Configuring LoRa Parameters

3. After the configuration of the LoRaWAN parameters, the next step is to set up the device address and session keys. You need to use the values from the TTN device console.

- Device Address: **26011AF9**
- Application Session Key: **4D42EC5CAF97F03D833CDAf5003F69E1**
- Network Session Key: **C280CB8D1DF688BC18601A97025C5488**

Set the Device Address.

```
AT+DEVADDR=26011AF9
```

Set the Application Session Key.

```
AT+APPSKEY=4D42EC5CAF97F03D833CDAf5003F69E1
```

Set the Network Session Key.

```
AT+NWKSKEY=C280CB8D1DF688BC18601A97025C5488
```

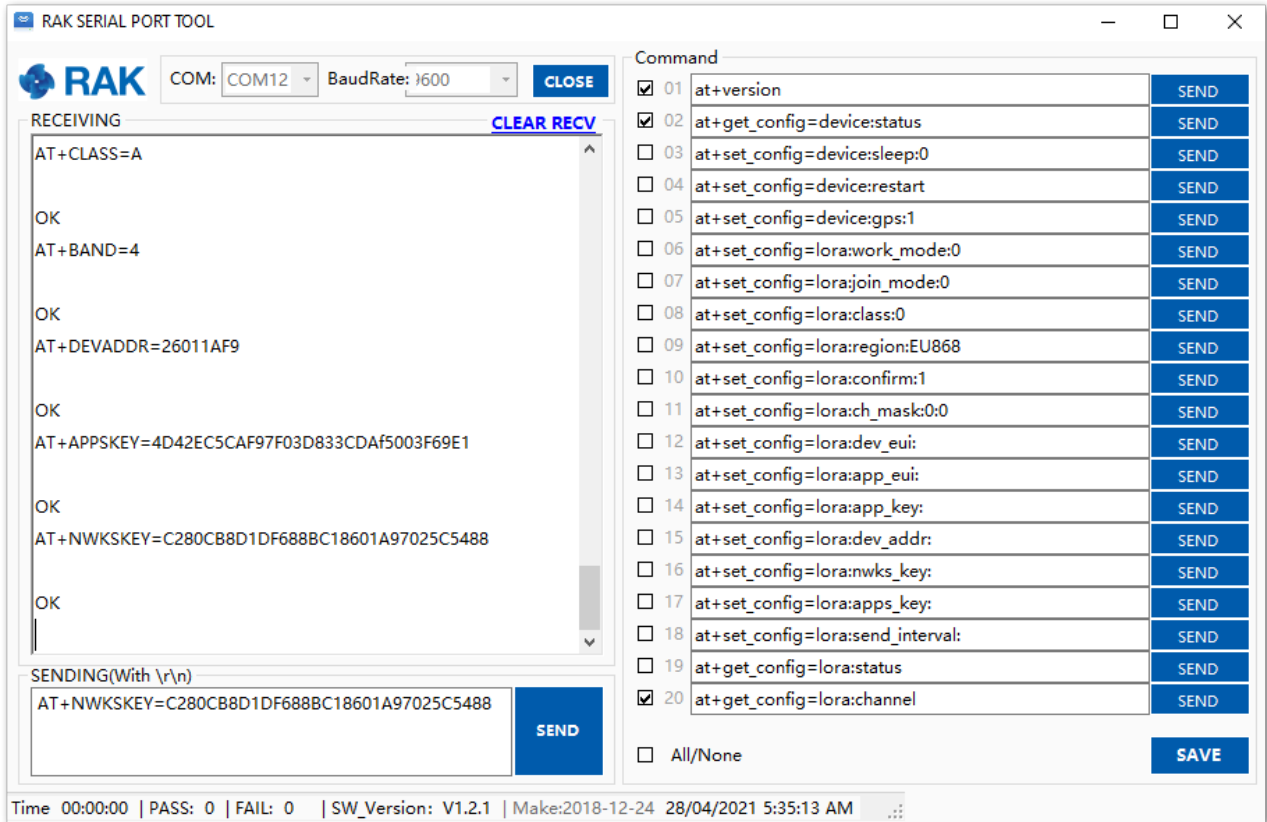


Figure 213: Configuring LoRa Parameters

4. After EUI and keys configuration, the device can now join the network and send some payload.

```
AT+JOIN=1:0:10:8
```

Join command format: `AT+JOIN=w:x:y:z`

Parameter	Description
w	Join command - 1: joining, 0: stop joining.
x	Auto-join config - 1: auto-join on power-up, 0: no auto-join
y	Reattempt interval in seconds (7-255) - 8 is the default.
z	Number of join attempts (0-255) - 0 is default.

5. After 5 or 6 seconds, if the request was successfully received by a LoRaWAN gateway, then you should see JOINED status reply.

You can now try to send some payload after successful join.

```
AT+SEND=2:12341234
```

Send command format: `AT+SEND=<port>:<payload>`

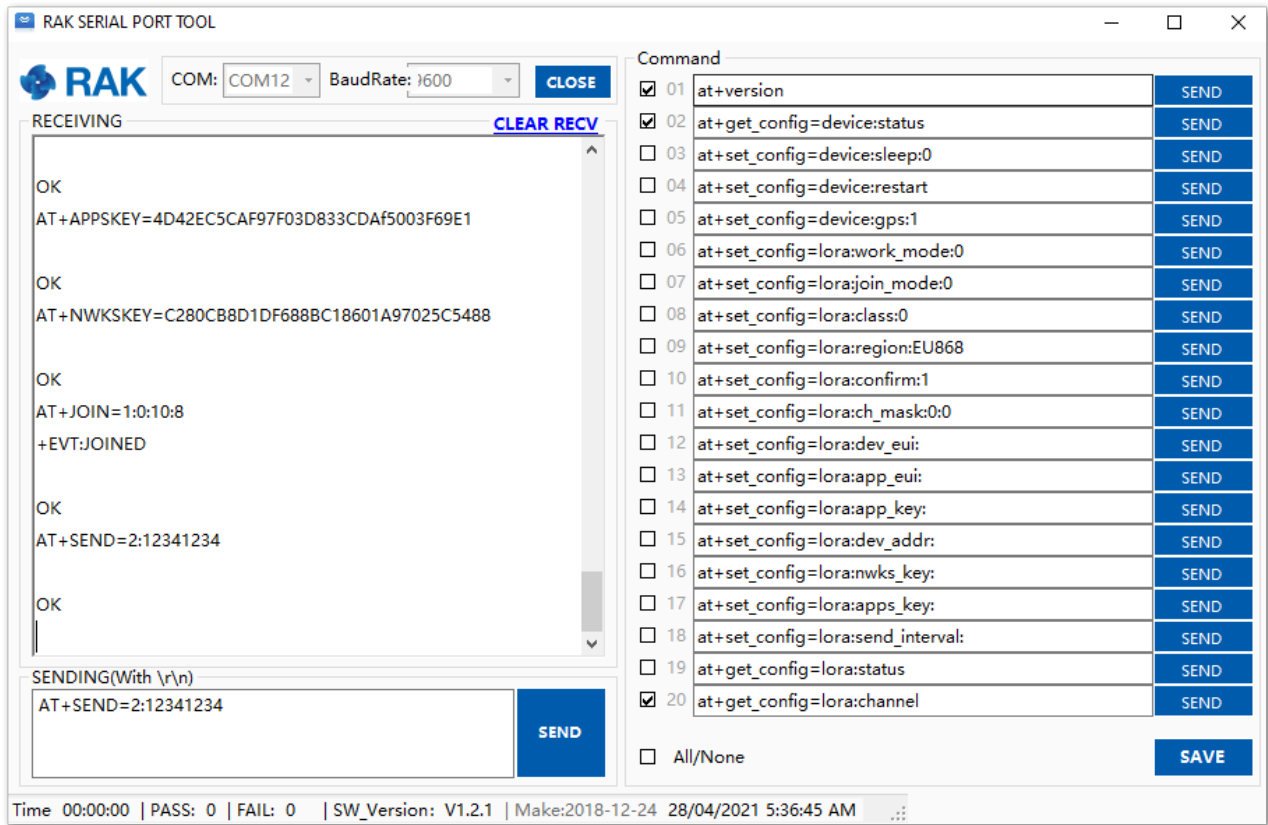


Figure 214: ABP Test Sample Data Sent via RAK Serial Port Tool

## LoRa P2P Mode

This section will show you how to set up and connect two RAK3172-E units to work in the LoRa P2P mode. The configuration of the RAK3172-E units is done by connecting the two modules to a general-purpose computer using a USB-UART converter. The setup of each RAK3172-E can be done separately, but testing the LoRa P2P mode will require having both units connected simultaneously. This could be done by having one computer with two USB ports or two computers with one USB port each.

It is recommended to start by testing the serial communication and verify the current configuration is working by sending these two AT commands:

AT

ATE

ATE will echo the commands you input to the module, which is useful for tracking the commands and troubleshooting.

You will receive OK when you input the two commands. After setting ATE, you can now see all the commands you input together with the replies.

Try again AT and you should see it on the terminal followed by OK.

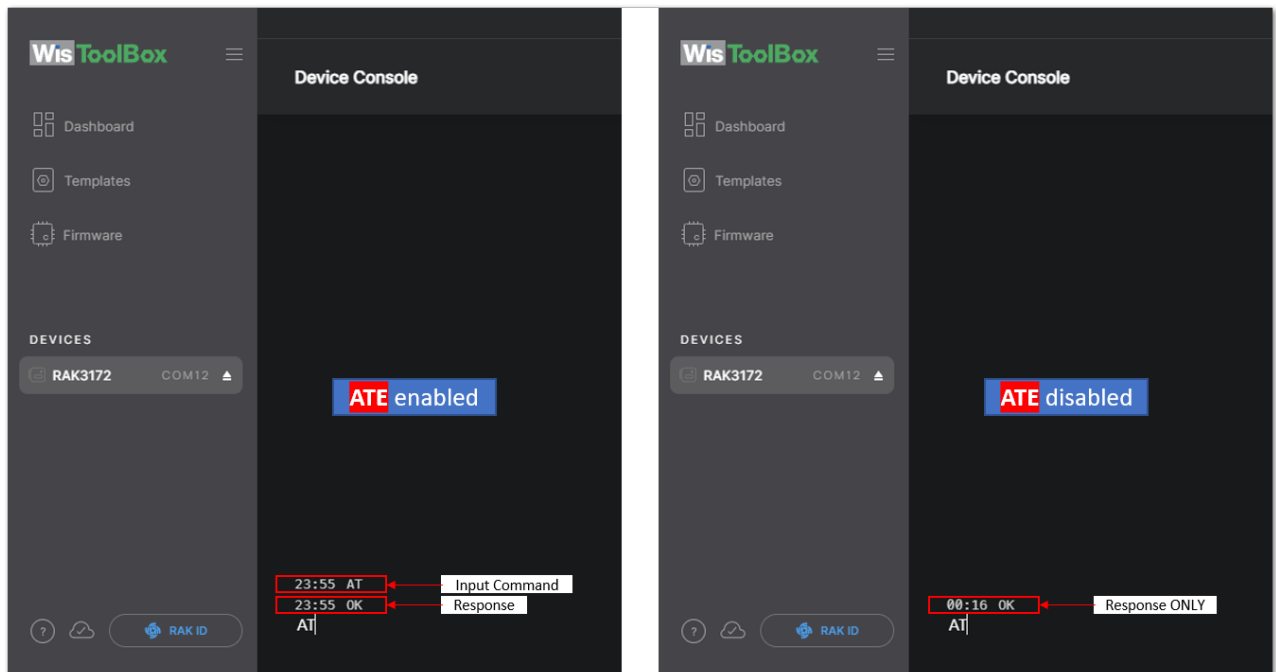


Figure 215: at+version command response

1. On setting-up the RAK3172-E to work in LoRa P2P mode, you need to change the LoRa network work mode command on both RAK3172-E modules.

```
AT+NWM=0
```

AT+NWM parameter mode can be either 0=LoRa P2P or 1=LoRaWAN.

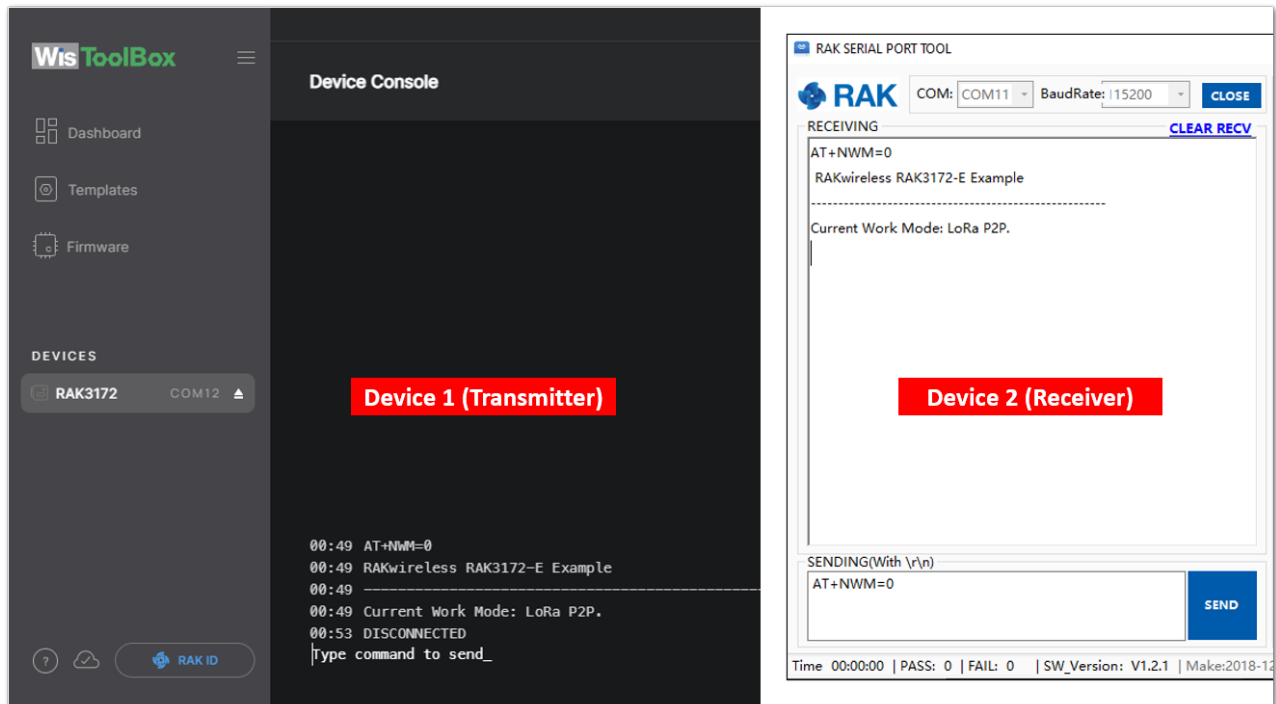


Figure 216: P2P Mode

**NOTE:**

- The device will start automatically if you change modes from LoRaWAN to LoRa P2P and vice-versa.
- You might need to input the `ATE` command again to ensure that your succeeding commands on P2P mode echo on the terminal.

2. You need to input the P2P setup on both RAK3172-E modules. The parameters should be exactly the same on the two modules.



```
AT+P2P=868000000:7:125:0:10:14
```

For this P2P setup, the LoRa parameters are the following:

- Link frequency: **868000000 Hz**
- Spreading factor: **7**
- Bandwidth: **125 kHz**
- Coding Rate: 0 = **4/5**
- Preamble Length: **10**
- Power: **14 dBm**

**NOTE:**

Refer to the P2P Mode section of the [AT command documentation](#) to learn more about the definition of the parameters used and the individual commands if you want specific parameter changed.

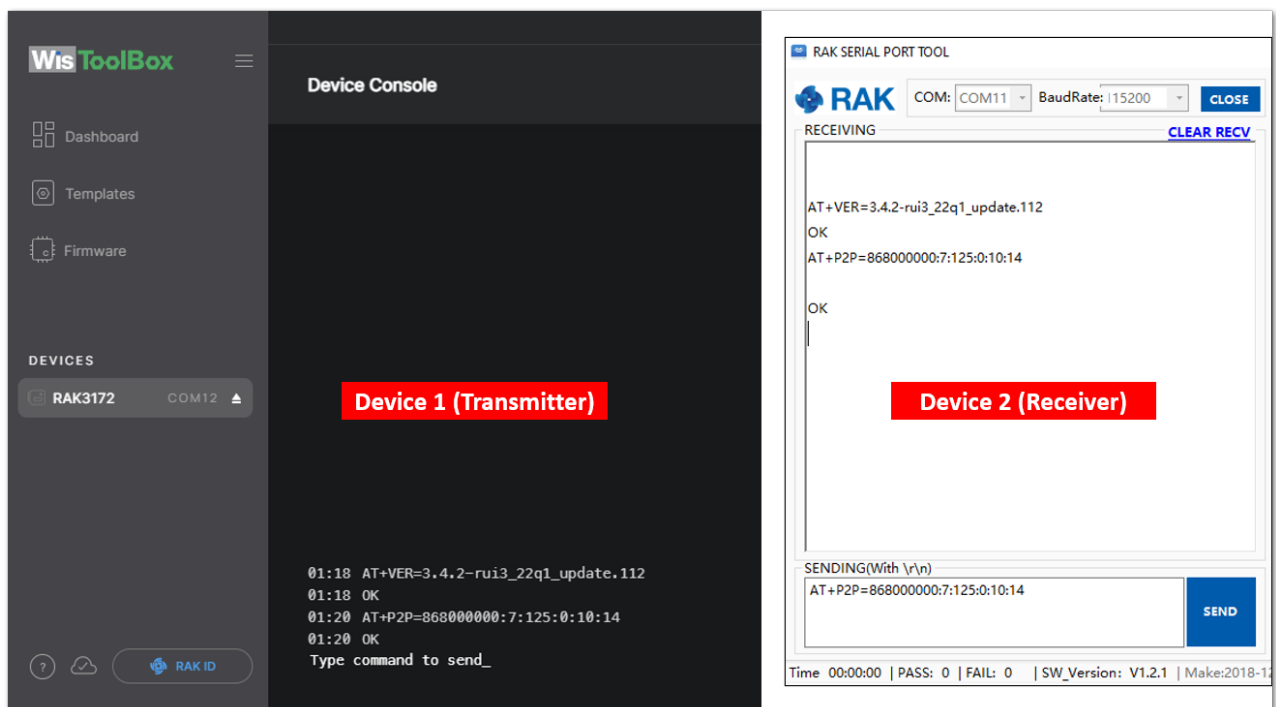


Figure 217: Configuring P2P in both RAK3172-E Module

3. To set one module as the receiver (RX), you need to set the value of the P2P receive command.

**NOTE:**

LoRa P2P default setting is Transmitter (TX) mode. This consumes lower power compared to Receiver (RX) mode where the radio is always listening for LoRa packets.

a. P2P LoRa RX configurable duration value is from 1 to 65533 ms. In this example, the device will listen and wait for LoRa P2P Packets for 30000 ms or 30 seconds. It will automatically disable RX mode and switch to TX mode after the timeout. If the device did not receive any packets within the time period, then the callback after timeout is

```
+EVT:RXP2P RECEIVE TIMEOUT .
```

```
AT+PRECV=30000
```

b. If the `AT+PRECV` value is set to **65535**, the device will listen to P2P LoRa packets without a timeout, but it will stop listening once a P2P LoRa packet is received. After done receiving the packets, it will disable RX mode and

automatically switch to TX mode again.

```
AT+PRECV=65535
```

c. If the `AT+PRECV` value is set to **65534**, the device will continuously listen to P2P LoRa packets without any timeout. The will continuously stay in RX mode until `AT+PRECV` is set to **0**.

```
AT+PRECV=65534
```

d. If the `AT+PRECV` value is set to **0**, the device will stop listening to P2P LoRa packets. It disables LoRa P2P RX mode and switch to TX mode.

```
AT+PRECV=0
```

4. With one module configured as Transmitter (TX) and the other device will be the Receiver (RX), you can now try to send or transmit P2P payload data.

```
AT+PSEND= <payload>
```

**NOTE:**

- `AT_PARAM_ERROR` is returned when setting wrong or malformed value.
- `AT_BUSY_ERROR` is returned if the device is still in RX mode and you try to send or reconfigure RX period. If the `AT+PRECV` command is set to **65534**, you need to execute first `AT+PRECV=0` to be able to configure again the TX and RX state and avoid `AT_BUSY_ERROR`.
- `<payload>` : 2~500 digit length, must be an even number of digits and character 0-9, a-f, A-F only, representing 1~256 hexadecimal numbers. For example, if the payload is like `0x03, 0xAA, 0x32`, therefore the AT command should be `AT+PSEND = 03AA32`.

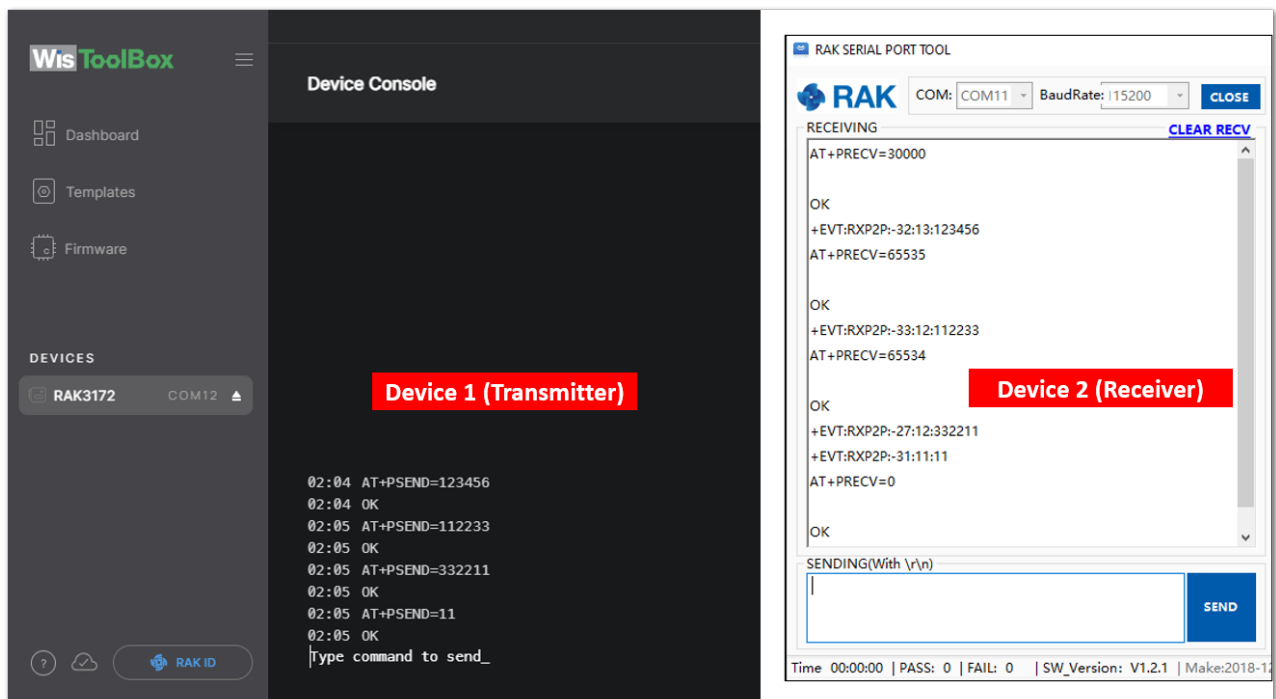


Figure 218: Configuring P2P in both RAK3172-E Module

## Miscellaneous

### Upgrading the Firmware

If you want to upgrade to the latest version firmware of the board, you can follow this section. The latest firmware can be found in the software section of [RAK3172 Datasheet](#).

 **NOTE:**

**What if the RAK3172 module stops responding to AT commands and firmware update?**

You can recover your device by using the `.hex` file in the datasheet and uploading it using STM32CubeProgrammer. The guide on updating STM32 firmware using STM32CubeProgrammer can be found in the [Learn section](#).

 **WARNING**

Uploading the `.hex` file via STM32CubeProgrammer will erase all configured data on the device.

### Firmware Upgrade Through USB

#### Minimum Hardware and Software Requirements

Refer to the table for the minimum hardware and software required to perform the firmware upgrade via USB.

Hardware/Software	Requirement
Computer	A Windows/Ubuntu/Mac computer
Firmware File	Bin firmware file downloaded from the website
Others	A USB cable

### Firmware Upgrade Procedure

Execute the following procedure to upgrade the firmware in Device Firmware Upgrade (DFU) mode through the USB interface.

 **NOTE:**

RAK3172-E should automatically go to BOOT mode when the firmware is uploaded via RAK DFU Tool or WisToolBox.

If BOOT mode is not initiated, you can manually send `AT+BOOT` command to start bootloader mode.

1. Download the latest application firmware of the RAK3172.
  - [RAK3172 Firmware](#)
2. Download the RAK Device Firmware Upgrade (DFU) tool.
  - [RAK Device Firmware Upgrade \(DFU\) Tool](#)

3. Connect the RAK3172 Evaluation Board with a computer through a USB cable. Refer to [Figure 21](#).
4. Open the Device Firmware Upgrade tool. Select the serial port and baud rate (115200) of the module and click the "Select Port" button.

**NOTE:**

If your firmware upload always fail, check your current baudrate setting using `AT+BAUD=?` command and use that baud rate value in the RAK DFU Tool. You can also check if you selected the right COM port.

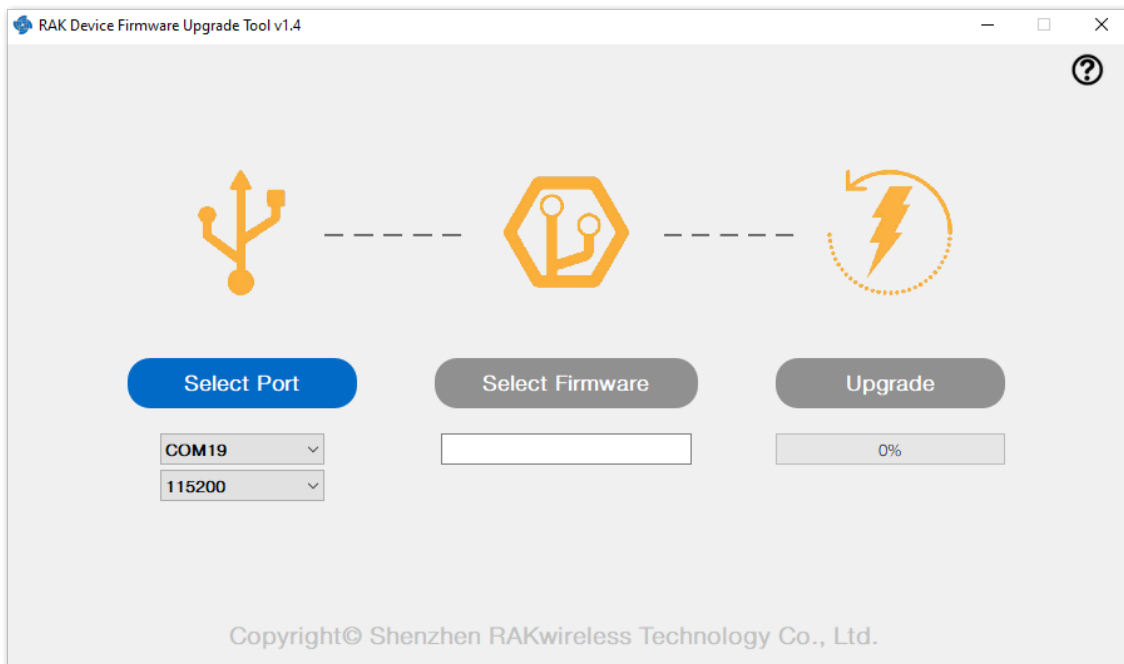


Figure 219: Device Firmware Upgrade Tool

5. Select the application firmware file of the module with the suffix ".bin".

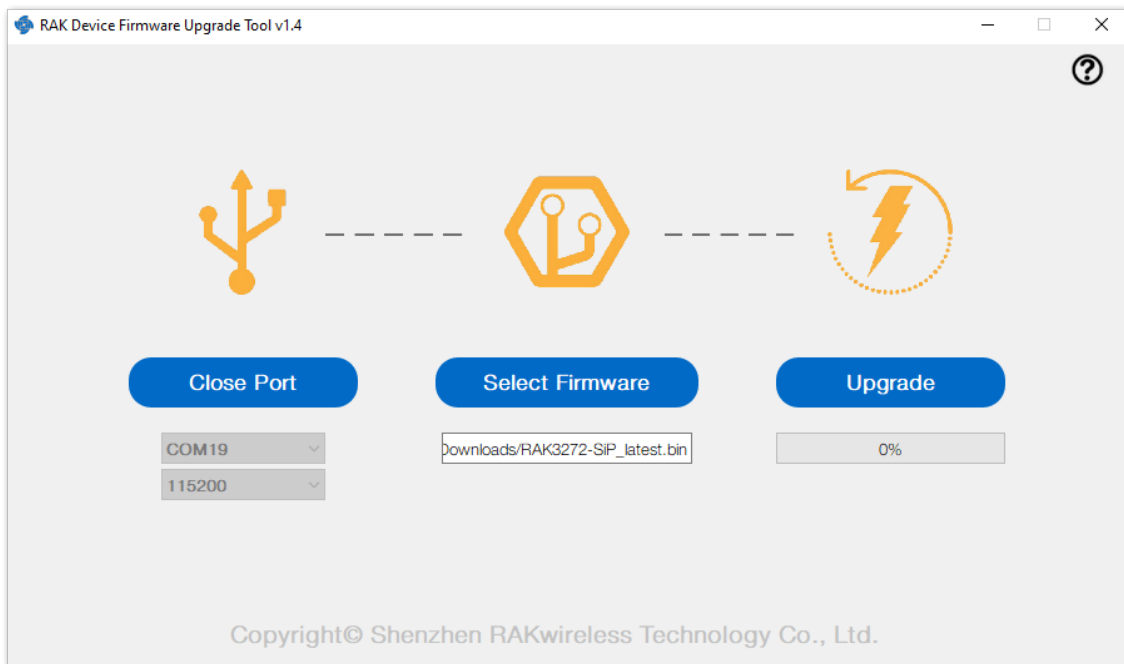


Figure 220: Select firmware

6. Click the "**Upgrade**" button to upgrade the device. After the upgrade is complete, the RAK3372 will be ready to work with the new firmware.

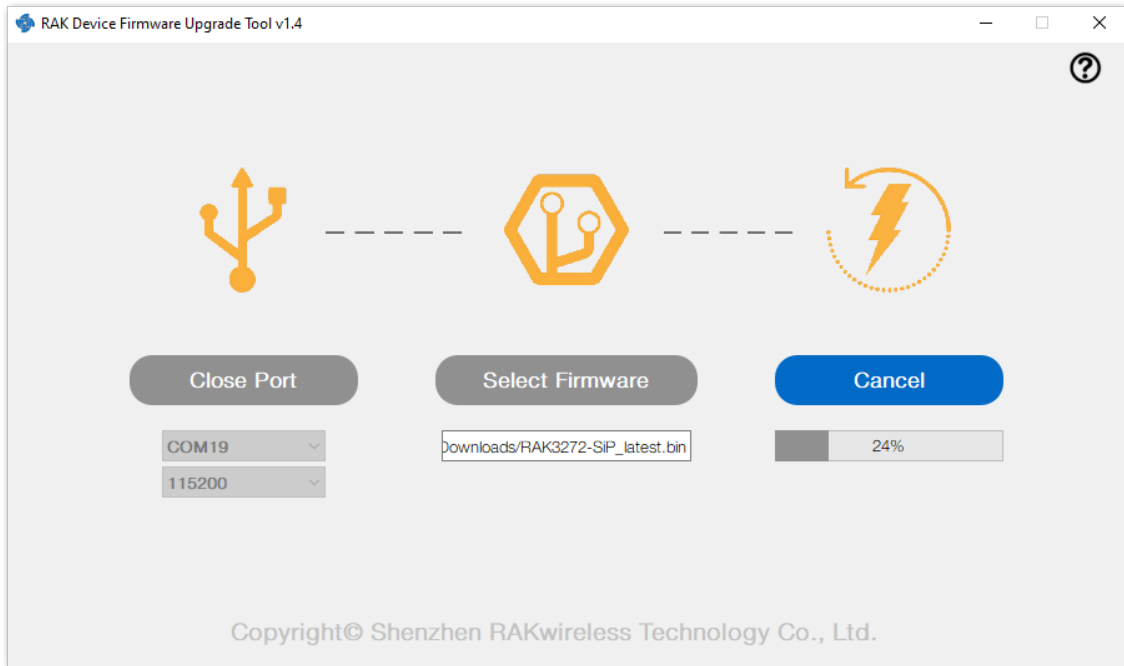


Figure 221: Firmware upgrading

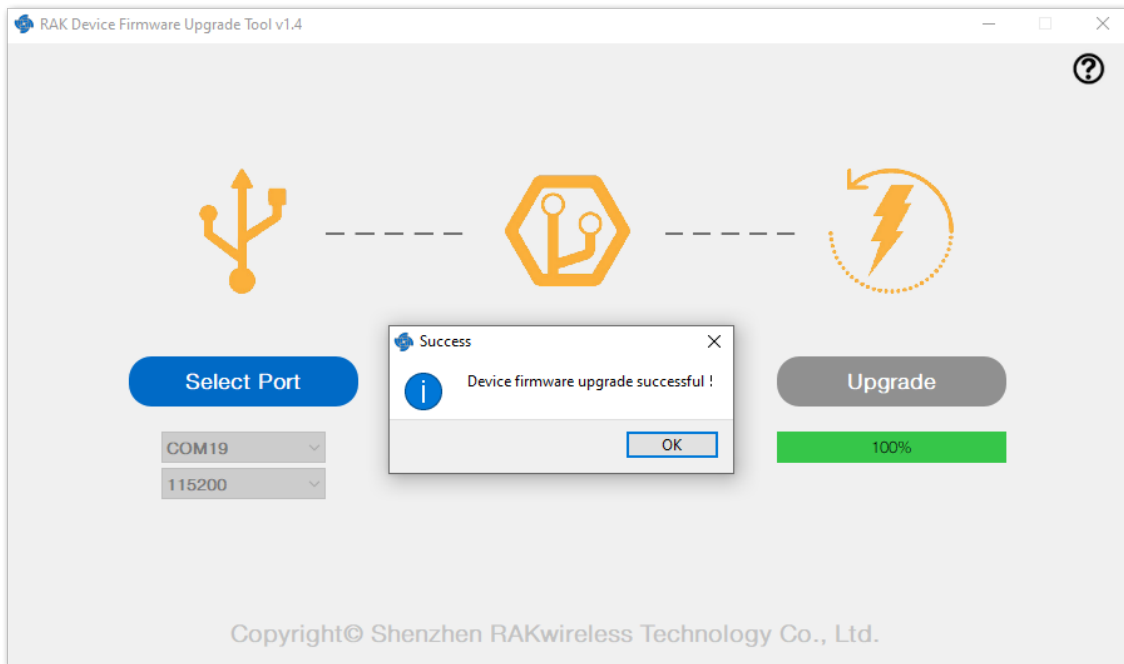


Figure 222: Upgrade successful

## Arduino Installation

Go to the [Arduino official website](#) and download the Arduino IDE. You can see the multiple versions available for Windows, Linux, and Mac OS X. Choose the correct version of Arduino IDE and download it.

Figure 223: Arduino IDE latest version

## For Windows

**NOTE**

**For Windows 10 users:** Do **NOT** install the Arduino IDE from the Microsoft App store. Install the original Arduino IDE from the Arduino official website instead, since the Arduino app from the Microsoft App Store has problems using third-party Board Support Packages.

1. Install the Arduino IDE, which you just downloaded, on your Windows PC.
2. Click **I Agree** then **Next** to proceed.

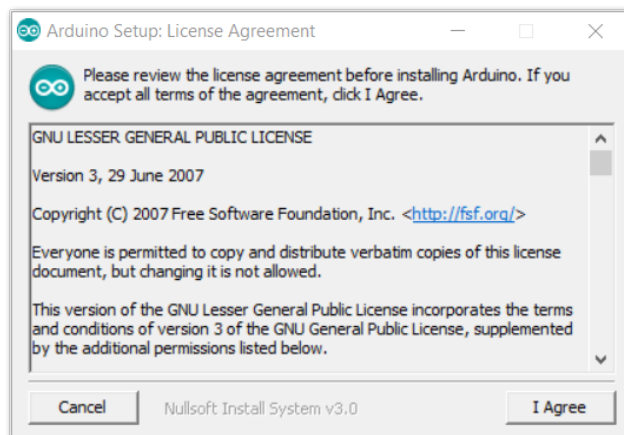


Figure 224: Arduino setup license agreement

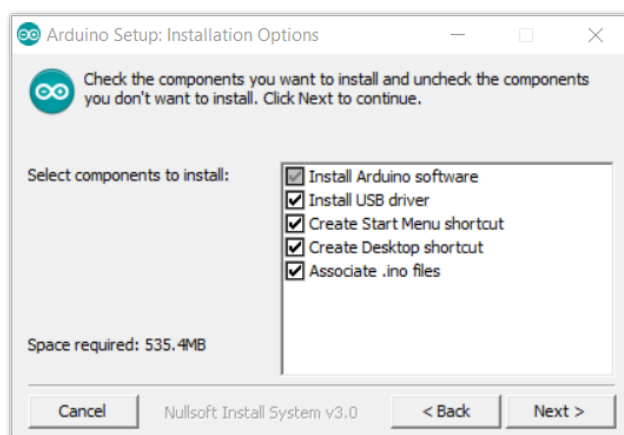
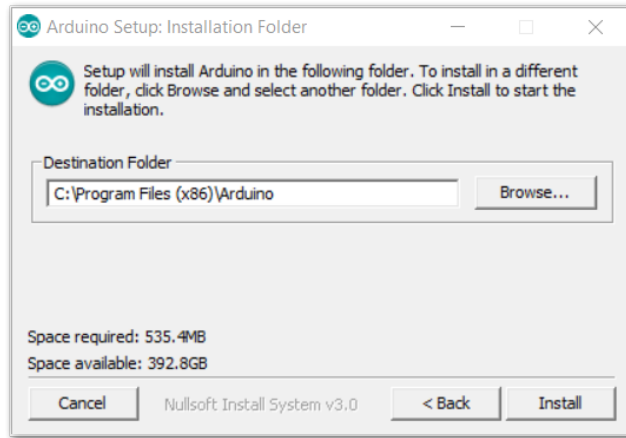
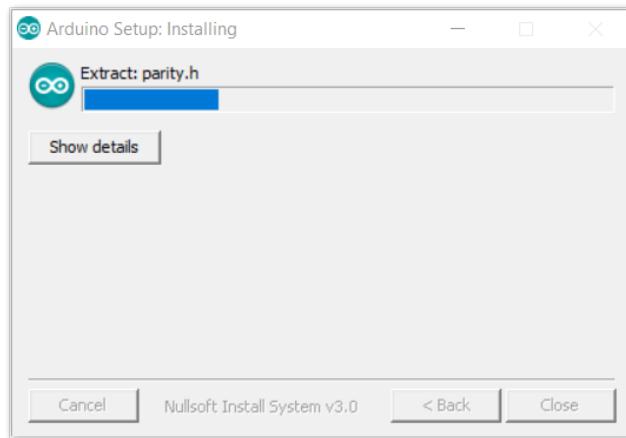


Figure 225: Arduino setup installation options

3. Click **Install**.

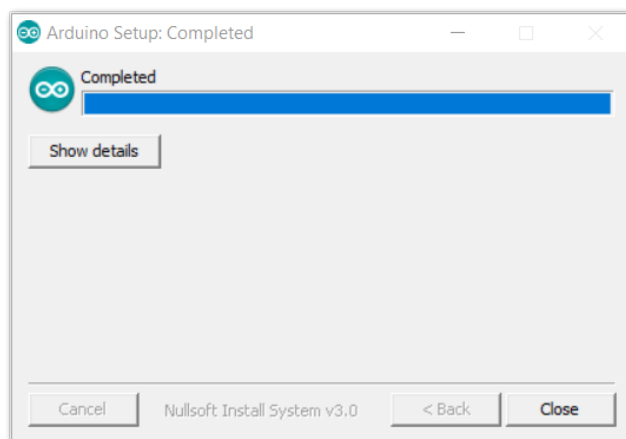


**Figure 226:** Installing Arduino IDE



**Figure 227:** Ongoing installation

After 100% progress, the Arduino IDE has been installed successfully.



**Figure 228:** Successful installation

## For Linux

First, you need to check the compatibility with your system and choose between the 32-bit, 64-bit, and ARM versions of the Arduino IDE for Linux.

### Installing via a tarball

After downloading the correct Arduino version, open a terminal, then run `ls` to check the installation file on the download folder.

```
msam@msam-s145: ~/Desktop/Downloads
msam@msam-s145:~/Desktop/Downloads$ ls
arduino-1.8.16-linux64.tar.xz
msam@msam-s145:~/Desktop/Downloads$
```

Figure 229: Check the download folder

A tarball is a type of compressed folder, like a `.zip` file, commonly used to distribute software in Linux. To extract the files from the tarball, change the directory to where the downloaded tarball is, then run:

```
tar xvf arduino-version.xz
```

```
msam@msam-s145: ~/Desktop/Downloads
msam@msam-s145:~/Desktop/Downloads$ tar xvf arduino-1.8.16-linux64.tar.xz
```

Figure 230: Tarball extract command

When the tar command finishes, run `ls` again. A folder named **arduino-version** will be created.

```
msam@msam-s145: ~/Desktop/Downloads
msam@msam-s145:~/Desktop/Downloads$ ls
arduino-1.8.16  arduino-1.8.16-linux64.tar.xz
msam@msam-s145:~/Desktop/Downloads$
```

Figure 231: Arduino install folder created



Change the current directory and go to the newly created folder directory. There will be a file named `install.sh` in the folder. Execute `sudo ./install.sh` to install the Arduino IDE.

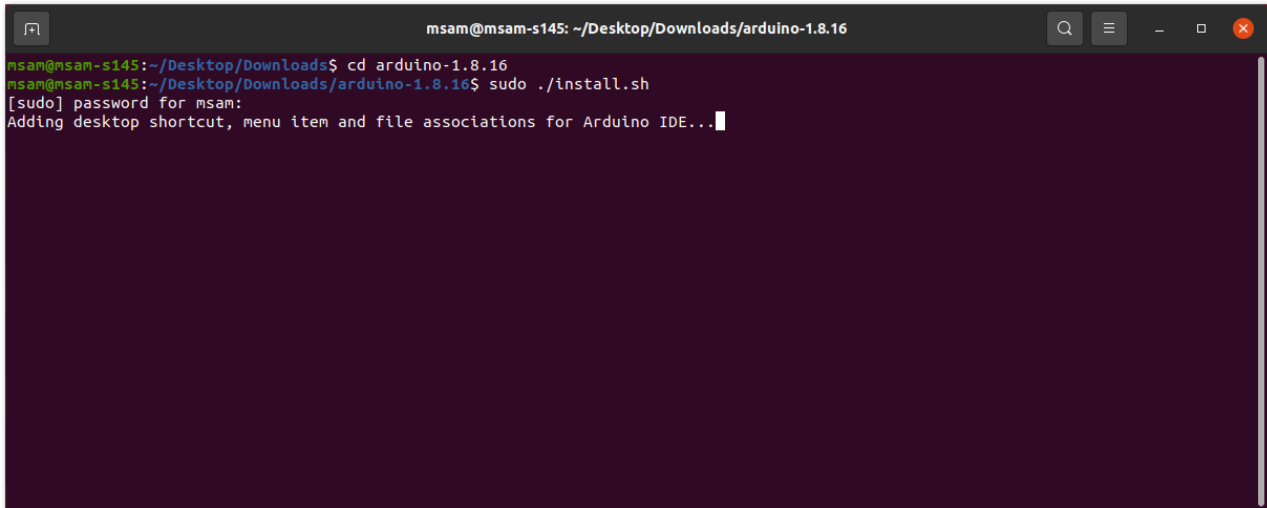


Figure 232: Arduino install script running

The `sudo` command temporarily elevates privileges allowing the installer to complete sensitive tasks without logging in as the root user.

## For Mac OS X

In Mac OS X, the same as Linux, there is no installation process. It is just a process of decompression, then you can open Arduino IDE successfully.

## Arduino IDE Parts Guide

Figure 233 shows the five (5) parts of Arduino IDE.

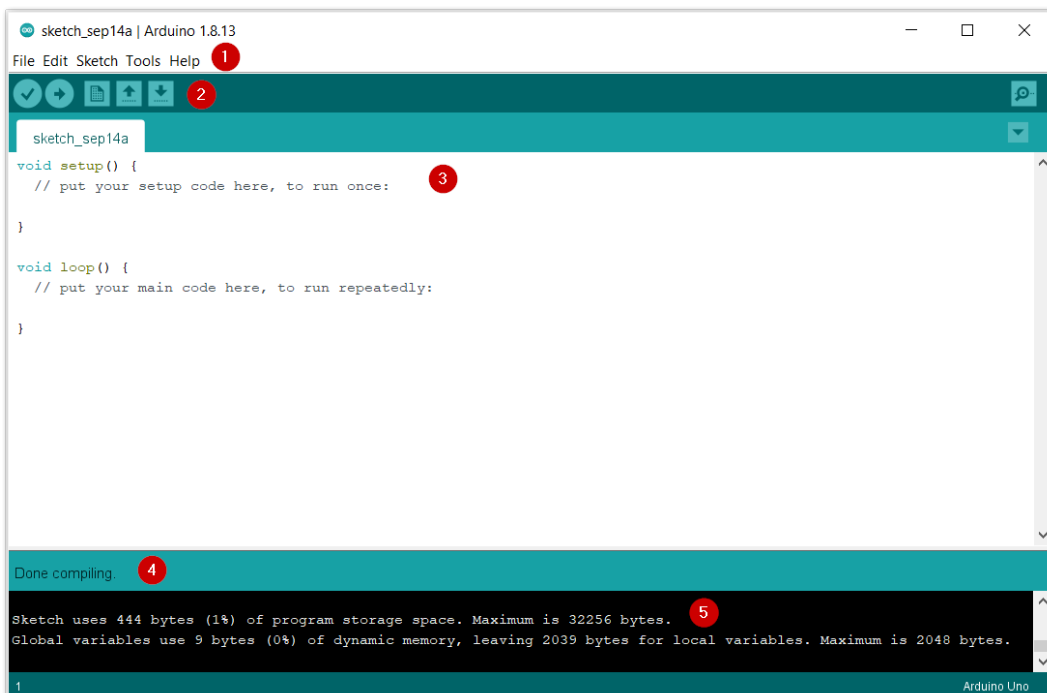


Figure 233: Arduino IDE

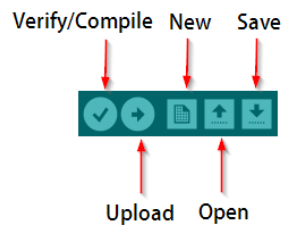
### 1. IDE Option Menu

You can configure some general parameters such as the serial port, the board information, the libraries, the edit parameters, and so on.

### 2. Operating Buttons

The operating buttons have five operations:

- **Verify/Compile** the source code;
- **Upload** the compiled code into WisBlock;
- **Open** a **New** Arduino IDE window or existing application;
- **Save** the current application.



**Figure 234:** Operating buttons

### 3. Code Area

You can edit the source code, which will be compiled and uploaded into WisBlock later in this area.

### 4. State Area

5. **Output Message Area** You can see the output message in this area, whether it's failure or success information.