RAK3172 Module Quick Start Guide

This guide covers the following topics:

- RAK3172 as a Stand-Alone Device Using RUI3
- RAK3172 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 steps in the installation guide of the RAK3172 WisDuo LPWAN Module, make sure to prepare the necessary items listed below:

Hardware

- RAK3172 WisDuo LPWAN Module
- Computer
- USB to UART TTL adapter

Software

- Download and install the Arduino $\mathsf{IDE}\, \square$.

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 the JSON URL below.

https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package_rakwire

After that, you can then add RAKwireless RUI STM32 Boards via Arduino board manager.

RAK Serial Port Tool

 Z

List of Acronyms

Acronym	Definition
DFU	Device Firmware Upgrade
JTAG	Joint Test Action Group
LoRa	Long Range
ΟΤΑΑ	Over-The-Air-Activation (OTAA)
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
MSB	Most Significant Bit
LNS	LoRaWAN Network Service

Product Configuration

RAK3172 as a Stand-Alone Device Using RUI3 Hardware Setup

The RAK3172 requires a few hardware connections before you can make it work. The bare minimum requirement is to have the power section properly configured, reset button, antenna, and USB connection.

WARNING

Firmware update is done via UART2 pins. If you will connect the module to an external device that will be interfacing with UART2, 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 UART2 before connecting the module to the PC (via USB-UART converter) for the FW update process.

An alternative option to update firmware aside from UART2 is to use SWD pins (SWCLK & SWDIO). This method will require you to use external tools like ST-LINK and RAKDAP1.



Figure 1: RAK3172 Minimum 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 has a module variant with an IPEX connector where you can connect the LoRa antenna, as shown in **Figure 3**. If the RAK3172 module you ordered is the variant with no IPEX connector, you need to ensure that there is an external antenna connected to the **RF pin** (Pin 12) of the module.



Figure 3: IPEX Connector of RAK3172 for LoRa Antenna

📝 NOTE

Detailed information about the RAK3172 LoRa antenna can be found on the antenna datasheet \square .

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 is based on RUI3, which allows you to develop your own custom firmware to connect sensors and other peripherals to it. To develop using your custom firmware using the Arduino IDE, you need to first add RAKwireless RUI STM32 boards to the Arduino board manager, which will be discussed in this guide. You can then use [RUI3 APIs] (https://docs.rakwireless.com/RUI3/Arduino-API/) for your intended application. You can upload the custom firmware via UART. The AT commands of RAK3172 are still available even if you compile custom firmware via RUI3. You can send AT commands via a UART2 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 successfully installed, you can now configure the IDE to add the RAK3172 to its board selection by following these steps.

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

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File	Edit Sketch	Tools Help			
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	Open Recent	; >			
	Sketchbook	>			^
	Examples	>	re, to run once:		
	Close	Ctrl+W			
	Save	Ctrl+S			
	Save As	Ctrl+Shift+S	e, to run repeatedly:		
	Page Setup	Ctrl+Shift+P			
	Print	Ctrl+P			
	Preferences	Ctrl+Comma			
	Quit	Ctrl+Q			
					~
1				O (Release) on C	OM40

Figure 4: Arduino preferences

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

Preferences		×			
Settings Network					
Sketchbook location:					
C:\Users\msam\Documents		Browse			
Editor language:	System Default v (requires restart of Arduino)				
Editor font size:	12				
Interface scale:	✓ Automatic 100 ÷ % (requires restart of Arduino)				
Theme:	Default theme \lor (requires restart of Arduino)				
Show verbose output during:	Compilation upload				
Compiler warnings:	None 🗸				
Display line numbers	Enable Code Folding				
Verify code after upload	Use external editor				
Check for updates on sta	artup Save when verifying or uploading				
Use accessibility features	s				
Additional Boards Manager UR	RLs:				
More preferences can be edited directly in the file					
C:\Users\msam\AppData\Loca	cal\Arduino 15\preferences.txt				
(edit only when Arduino is not	ot running)				
	ОК	Cancel			

Figure 5: Modifying Additional Board Manager URLs

3. Copy the URL below 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**.

json https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package_rakwire

Sketch_nov26a Arduino 1.8.16	-	- 0	×
			ø
sketch_nov26a			
<pre>void setup() { // put your setup code here, to run o </pre>	noe: Preferences X		^
}	Settings Network		
<pre>void loop() { // put your main code here, to run re</pre>	Sketchbook location: C:\Users\msam\Documents Browse		
}	Editor language: System Default (requires restart of Arduino)	×	
	Enter additional URLs, one for each row		
	https://raw.githubusercontent.com/RAKWireless/RAKwireless-Arduino-BSP-Index/main/package_rakwireless.com_rui_index.json		
	Click for a list of unofficial boards support URLs OK Cancel		
	Additional Boards Manager URLs: More preferences can be edited directly in the file C: Users/msam/AppData/Local/Arduino 15/preferences. bxt (edit only when Arduino is not running)		
	OK Cancel		~

Figure 6: Add additional board manager URLs

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

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File Edit Sketch Too	ols Help				
	Auto Format	Ctrl+T			Ø
	Archive Sketch				
sketch_nov26a	Fix Encoding & Reload				
<pre>void setup()</pre>	Manage Libraries	Ctrl+Shift+I			^
// put your	Serial Monitor	Ctrl+Shift+M			
}	Serial Plotter	Ctrl+Shift+L			
<pre>void loop() {</pre>	WiFi101 / WiFiNINA Firmware Updat	er			
// put your	Board: "Arduino Uno"	3	Boards Manager		
}	Port: "COM4"	3	Arduino AVR Boards >		
	Get Board Info		ESP32 Arduino >		
	Programmer	3	RAKwireless ESP32 Modules >		
	Burn Bootloader		RAKwireless nRF Modules >		
			Rakwireless Raspberry Modules >		
			RAKwireless RUI nRF Modules		
					~

Figure 7: Opening Arduino boards manager

- 6. 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.
- 7. Click on the area highlighted in blue to select **RAKwireless RUI STM32 Boards**. Install the latest version of the **RAKwireless RUI STM32 Boards** by clicking on **Install** button.

💿 Boards Manager 🛛 🗙
Type All RAK RAKwireless RUI nRF Boards by RAKwireless Boards included in this package: RAK4631. Online Help More Info
RAKwireless RUI STM32 Boards by RAKwireless Boards included in this package: RAK3172-E, RAK3272-SiP. Online Help More Info
Close



Configure RAK3172 on Boards Manager

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



Figure 9: Selecting RAK3172 Module

RAK3172 COM Port on Device Manager

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



Figure 10: Device manager ports (COM & LPT)

Compile an Example with Arduino LED Breathing

 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. You need to add two LEDs to the bare minimum schematic of the RAK3172 module, as shown in Figure 11.





- 2. Launch Arduino IDE and configure WisDuo RAK3172 Evaluation Board on board selection. See Figure 9.
- 3. Connect the RAK3172 via UART and check RAK3172 COM Port. See Figure 10.
- 4. Open the **Tools** Menu and select a COM port. **COM28** is currently used.

🥺 sketch_nov26a	Arduino 1.8.16						- 0		ľ
ile Edit Sketch 1	Tools Help								
	Auto Format	Ctrl+T							
	Archive Sketch								ľ
sketch_nov26a	Fix Encoding & Reload								2
<pre>void setup()</pre>	Manage Libraries	Ctrl+Shift+I							
// put your	Serial Monitor	Ctrl+Shift+M							
}	Serial Plotter	Ctrl+Shift+L							
<pre>void loop() {</pre>	WiFi101 / WiFiNINA Firmware Updater								
// put your	Board: "WisDuo RAK3172 Evaluation Board"	· >							
ł	Debug: "Level 0 (Release)"	>							
·	Port	3	Serial ports						
_	Get Board Info		COM28						
	Programmer	>							
	Burn Bootloader								
							_	_	
1					WisDuo RAK3	172 Evaluation Board, Level	D (Release) o	on COM	40

Figure 12: Select COM port

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

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File Edit Sketch Tool	s Help	
	2 Verify	P
sketch_dec02a		
<pre>void setup() {</pre>	• COM28 X	^
// put your set	Send	
}		
<pre>void loop() { // put your mai</pre>		
}		
	Autoscroll Show timestamp Newline v 115200 baud v	
		~
1	WisDue RAK3172 I	Evaluation Board, Level 0 (Release) on COM28

Figure 13: 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 14**.

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}	at+ver=?			
void loop() {				
// put your mai				
}				
	Autoscroll Show timestamp Newline V 115200 baud V Clear output			
				~

Figure 14: Send AT command

🥯 sketch_dec02a Ard	ino 1.8,16		- 0	×
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sketch_dec02a				
<pre>void setup() {</pre>	😇 COM28 — 🗆	×		^
// put your set	sen	ad		
}		~		
<pre>void loop() [// put your mai</pre>	AI+VER=3.2.0+user OK			
}				
	Autoscroll Show timestamp Newline V 115200 baud V Clear output	ut		
				~
9	Wisbus F	RAK3172 Evaluation Board. Le	vel 0 (Release) on (COM28

Figure 15: Arduino serial monitor COM28

7. Open Arduino_Led_Breathing example code.

🥺 sketch_nov26a	Arduino 1.8.16					5 X	
File Edit Sketch	Tools Help			Arduino Analog			
New	Ctrl+N			Arduino Bit And Byte		ø	
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Sketchbook	د	>		Arduino Interrupt			^
Examples	;	A		Arduino Led Breathing			
Close	Ctrl+W	05.Control >		Arduino Random			
Save	Ctrl+S	05.Sensors		Arduino_Serial			
Save As	Ctrl+Shift+S	07.Display		Arduino_Time			
Page Setup	Ctrl+Shift+P	08.Strings		BLE Beacon			
Print	Ctrl+P	09.05B		BLE_Beacon_Custom_Payload			
		10.StarterKit_BasicKit		BLE_Configuration			
Preferences	Ctrl+Comma	TLArduinoise 2		BLE Customer Service			
Quit	Ctrl+Q	Examples for any board		BLE_Scanner			
		Adafruit Circuit Playground >		BLE_Uart			
		Bridge >		LoRaWan_ABP			
		Ethernet >		LoRaWan_Class_B			
		Firmata >		LoRaWan_Info			
		LiquidCrystal >		LoRaWan_Multicast			
		SD >		LoRaWan_OTAA			
		Servo >		LoRaWan P2P			
		Stepper >		RAK4631			
		Temboo >		System Custom ATCMD			
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		PAK WisPlack PI II gramples	Application Scopario	▼			
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Figure 16: Arduino Led Breathing example

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



Figure 17: Verify the example code

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

NOTE:

RAK3172 should automatically go to BOOT mode when the firmware is uploaded via Arduino IDE.

If BOOT mode is not initiated, pull to ground the RESET pin twice (or double click the reset button if available) to force BOOT mode.

S Arduino_Led_Breathing Arduino 1.8.16	-	٥	×
File Edit Sketch Tools Help			
🕑 📀 🗈 🖸 Upload			Ø
Arduino_Led_Breathing			•
<pre>int val = 0; // variable to write the LED pin bool state = false; bool ledSwitch = false; void valChage() { state = !state; if (val == 0) ledSwitch = !ledSwitch; } void setup() { serial.begin(115200); delay(5000); Serial.println("RAKwireless Arduino LED Breathing Example"); yimMode (BLUE_LED, OUTPUT); jimMode (BLUE_LED, OUTPUT); } void loop()</pre>			•
<pre>{ // put your main code here, to run repeatedly: if (val == 0 val == 255) valchage(); // To determine to make the led lighter or darker if (state) </pre>			v
1 WisDuo RAK3172 Evaluation Board, Leve	IO (Relea	ise) on CC	M28

Figure 18: Upload the example code

10. If the upload is successful, you will see the **Upgrade Complete** message.

🤕 Arduino_Led_Breathing Arduino 1.8.16	– Ø ×
File Edit Sketch Tools Help	
	<mark>ይ</mark>
Arduino_Led_Breathing	T
0	^
int val = 0; // variable to write the LED pin	
<pre>bool state = false;</pre>	
<pre>bool ledSwitch = false;</pre>	
<pre>void valChage()</pre>	
state = !state;	
ledswitch = :ledswitch;	
3	
void setun()	
Serial.begin(115200);	
delay(5000);	
<pre>Serial.println("RAKwireless Arduino LED Breathing Example");</pre>	
Serial.println("");	
// put your setup code here, to run once:	
<pre>pinMode (GREEN_LED, OUTPUT);</pre>	
<pre>pinMode(BLUE_LED, OUTPUT);</pre>	
1	
1 // nut your main code here to run repeatedly.	
) for $a = 0 val = 255$	
valChage();	
// To determine to make the led lighter or darker	~
Done uploading.	
Device is in boot mode	^
Upgrade Complete	
	×
c	>
1	WisDuo RAK3172 Evaluation Board, Level 0 (Release) on COM28

Figure 19: Device programmed successfully

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

RAK3172 I/O Pins and Peripherals

This section discusses how to use and access RAK3172 pins using the RUI3 API. It shows basic code on using digital I/O, analog input, UART, and I2C.



Figure 20: Available Peripherals and Digital I/O pins in RAK3172 module

How to Use Digital I/O

You can use any of the pins below as Digital Pin.

Pin Name	Alternative Pin Usage
PA0	
PA1	
PA4	SPI
PA5	SPI
PA6	SPI
PA7	SPI
PA8	
PA9	I2C_SCL

PA15







The pins listed below must not be used.

Pin name	Pin Usage
PA2	UART2_TX
PA3	UART2_RX
PA13	SWDIO
PA14	SWCLK

Pin name	Pin Usage
PB8	RAK3172 Internal
PB12	Internal 10k pull-up resistor for RAK3172 high frequency variant (8xx - 9xx Mhz) or pull-down resistor for RAK3172 low frequency variant (4xx Mhz)

- Use Arduino digitalRead ^I to read the value from a specified Digital I/O pin, either HIGH or LOW.
- Use Arduino digitalWrite ☐ to write a HIGH or a LOW value to a Digital I/O pin.

VOTE:

The GPIO Pin Name is the one to be used on the digitalRead and digitalWrite and NOT the pin numbers.

Example code

void setup()	С
<pre>{ pinMode(PA0, OUTPUT); //Change the P0_04 to any digital pin you want. Also, you can set th }</pre>	iis to
<pre>void loop() {</pre>	
digitalWrite(PA0,HIGH); //Change the PA0 to any digital pin you want. Also, you can set th delay(1000); // delay for 1 second	is to
digitalWrite(PA0,LOW); //Change the PA0 to any digital pin you want. Also, you can set thi delay(1000); // delay for 1 second	s to.
}	

How to Use Analog Input

You can use any of the pins below as Analog Input.

Analog Port	Pin Name
ADC1	PB3
ADC2	PB4

Use Arduino analogRead [⊥] to read the value from the specified Analog Input pin.



Figure 22: Available Analog pins in RAK3172

Example code



How to Use Serial Interfaces

UART

There are two UART peripherals available on the RAK3172 module. There are also different Serial Operating Modes \square possible in RUI3, namely Binary Mode \square , AT Mode \square , and Custom Mode \square .

Serial Instance Assignment

Default Mode

Serial Port	Serial Instance Assignment	Default Mode
UART1 (pins 4, 5)	Serial1	Custom Mode
UART2 (pins 1, 2)	Serial	AT Command



Figure 23: Available UART pins in RAK3172

Example Code



I2C

There is one I2C peripheral available on RAK3172.

I2C Pin Number

I2C Pin Name

PA12

I2C_SCL

I2C Pin Number	I2C Pin Name
PA11	I2C_SDA

• Use Arduino Wire [™] library to communicate with I2C devices.



Figure 24: Available I2C pins in RAK3172

Example Code

Make sure you have an I2C device connected to specified I2C pins to run the I2C scanner code below:

```
#include <Wire.h>
void setup()
 Wire.begin();
 Serial.begin(115200);
 while (!Serial);
 Serial.println("\nI2C Scanner");
void loop()
 byte error, address;
 int nDevices;
 Serial.println("Scanning...");
 nDevices = 0;
  for(address = 1; address < 127; address++ )</pre>
   // a device did acknowledge to the address.
   Wire.beginTransmission(address);
   error = Wire.endTransmission();
   if (error == 0)
     Serial.print("I2C device found at address 0x");
     if (address<16)
       Serial.print("0");
     Serial.print(address, HEX);
     Serial.println(" !");
     nDevices++;
   else if (error==4)
     Serial.print("Unknown error at address 0x");
     if (address<16)
       Serial.print("0");
     Serial.println(address,HEX);
  if (nDevices == 0)
   Serial.println("No I2C devices found\n");
 else
   Serial.println("done\n");
 delay(5000);
```

The Arduino Serial Monitor shows the I2C device found.



SPI

If your RUI3 project uses SPI, then PA4 to PA7 pins are reserved for RUI3 SPI interface.

NOTE:

PA13 and PA14 pins are reserved for SWD debug interface. Check the Connect to the RAK3172 section.

LoRaWAN Example

This example illustrates how to program RAK3172 module as a stand-alone LoRaWAN end-device via RUI3 Arduino APIs 🗹 . To use RAK3172 module as a LoRaWAN end-device, it needs to be within reach of a working LoRaWAN gateway registered to a LoRaWAN network server (LNS) or with a built-in network server.

NOTE:

If you are new to LoRaWAN, here are a few good references about LoRaWAN and gateways:

- LoRaWAN 101

- Things to Consider When Picking A LoRaWAN Gateway

RAKwireless LoRaWAN gateway models like WisGate Edge ☑ have built-in network servers. It is also common that the LoRaWAN network server is external or in the cloud. The popular LoRaWAN network server in the cloud that you can use for free (but offers enterprise service, too) is TTN ☑ .

To correctly run this example, it is necessary to configure the LoRaWAN parameters and create an OTAA application on your LoRaWAN gateway.

Register the LoRaWAN Gateway on TTNv3 Community Edition

After configuring your gateway, you need to register it in TTNv3:

- 1. Log in to the TTNv3 Network Server with a web browser.
- North America I[™]
- Australia I
- 2. Navigate to the Console page and click on gateway icon, as shown in Figure 25.



Figure 25: TTNv3 gateway registration and configuration

3. On **General Settings**, enter the **Gateway ID**, **Gateway EUI**, and **Gateway Name**. This information is available in your LoRaWAN gateway configuration. Select the **Gateway Server address** according to the region where the LoRaWAN gateway will be installed.

	Add gateway - Console - The Thi X	+					l i		- 0	×
\leftarrow \rightarrow	C 🖞 https://nam1.cl	loud.thethings.net	work/console/gatew				A" to	€ @	InPrivate	
THE THINGS NET WORK	THE THINGS STACK Community Edition	Overview	Applications	🝶 Gateways	Organizations	🕀 NAM1 (Fair use polic	Community y applies ⑦			¥
	Add gateway									
	General settings									
	Gateway ID ⊘ *			_						
	my-new-gateway									
	Gateway EUI ⊘									
	Gateway EUI									
	Gateway name 🗇									
	My new gateway									
	Gateway description ⑦									
	Description for my new gat	teway								
	Optional gateway description	on; can also be used	to save notes about t	he gateway						
	Gateway Server address									
	nam1.cloud.thethings.net	work								

Figure 26: TTNv3 gateway registration and configuration

4. Select the **Frequency plan** for your region (with used by TTN), then click on the **Create gateway** button. This will add a new gateway to TTNv3.

	Add gateway - Console - The Thi x +												-	ð	×					
\leftarrow	← → C 🗄 https://nam1.cloud.thethings.network/console/gateways/add										ŵ	ť≡	œ	InPrivate						
		LoRaWAN options																		
		Frequency plan ③* Select																		
		Schedule downlink late ⑦																		
		Enabled																		
		Enable serv	erver-side	buffer of downlin	messages															
		Enforce dut	duty cycle	0																
		🔽 Enabled	oled																	
		Recommend	ended for	all gateways in or	ler to respect s	pectrum regulation	ns													
		Schedule ar	e any time	delay ⑦*																
		530 milliseconds V																		
		Configure g	e gateway	delay (minimum:	130ms, default:	: 530ms)														
		Gateway	ay upda	tes																
		Automatic u	tic update:	5																
		Enabled	oled																	
		Gateway car	can be up	dated automatica	lly															
		Channel																		
		Stable																		
		Channel for	for gatewa	y automatic upda	tes															
		Create	ite gatewa	y																

Figure 27: TTNv3 add new Gateway

Register the Device on TTNv3

The next step is to follow the procedure described in the section TTN OTAA Device Registration.

Uploading LoRaWAN Example to RAK3172

After a successful registration of the RAK3172 device on the LNS, you can now proceed with running the LoRaWAN OTAA demo application example.

- 1. Launch Arduino IDE and configure WisDuo RAK3172 Evaluation Board on board selection. See Figure 9.
- 2. Connect the RAK3172 via UART and check RAK3172 COM Port. See Figure 10.
- 3. Open the example code under RAK WisBlock RUI examples: File -> Examples -> RAK WisBlock RUI examples -> Example -> LoRaWan_OTAA.

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File Edit Sketch Tools Help					
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Sketchbook	>	_			l
Examples	▲ · · · · · · · · · · · · · · · · · · ·				l
Close Ctrl+W	01.Basics	>			l
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Save As Ctrl+Shift+S	03.Analog	>	Arduino_Analog		l
	04.Communication	>	Arduino_Bit_And_Byte		ĺ
Page Setup Ctrl+Shift+P	05.Control	>	Arduino_Characters		
Print Ctrl+P	06.Sensors	>	Arduino_Digital		
Preferences Ctrl+Comma	07.Display	>	Arduino_Interrupt		
	08.Strings	>	Arduino_Led_Breathing		
Quit Ctrl+Q	09.USB	>	Arduino_Random		
	10.StarterKit_BasicKit	>	Arduino_Serial		
******	* 11.ArduinoISP	>	Arduino_Time		
#define OTAA_BAND (RA	K		LoRa_P2P		
#define OTAA APPEUL (0x	Examples for any board		LoRaWan_ABP		
#define OTAA_APPKEY {0x	Adafruit Circuit Playground	0xAB, 0xF7, 0x15, 0x8	LoRaWan_Class_B		
	Bridge	>	LoRaWan Info		
/** Packet buffer for den	d Ethernet	>	LoRaWan Multicast		
uinco_t coilected_data[04	J Firmata	>	LoRaWan OTAA		
void recvCallback(SERVICE	LiquidCrystal	>	RAK3172-F		
{	SD		RAK3272-SiP		
if (data->BufferSize >	0 Stepper	>	System ATCMD Permission		
for (int $i = 0; i < d$	a Temboo	>	System Custom ATCMD		
Serial.printf("%x",	RETIRED	> /	System General		
}	Examples for WisDuo RAK3172 Evaluation Board		System_Ocheran		
	RAK WirPlock RUL examples	Application Stepario	System_rowersave		l
		Apprication_cenario	System_Jendl_LOCK		ľ
	· · · · · · · · · · · · · · · · · · ·	example	System_timer		

- 4. In the example code, you need to modify the device EUI **OTAA_DEVEUI**, the application EUI **OTAA_APPEUI**, and the application key **OTAA_APPKEY**.
- The OTAA_DEVEUI parameter should match the device EUI registered in your network server. Note that your RAK3172 module has a sticker with a QR code printed on it. You can use the QR code information to configure the OTAA_DEVEUI parameter. The OTAA_DEVEUI format is MSB first.



 The OTAA_APPEUI parameter. This parameter should also be the same as the APPEUI in the network server you configured.



• Another important parameter to change is the application key **OTAA_APPKEY**. This parameter should also be the same as the **APPKEY** in the network server you configured. The **OTAA_APPKEY** format is MSB first.

// OTAA 4	Application	Kev MSB												
#define (OTAA_APPKEY	{0xB4,	0x85,	0x7E,	0×FE,	0x1C,	0×B5,	0x15,	0xEB,	0x44,	0×61,	0x0D,	0×9B	, 0
👳 LoRaWan_OTAA Arduin	io 1.8.19											-	Ō	×
File Edit Sketch Tools He	elp													
VODEN														9.
LoRaWan_OTAA														•
<pre>#define OTAA_PERIOD /************************************</pre>	(20000)]						
LoRaWAN band setti RAM_REGION_EU433 RAM_REGION_EU433 RAM_REGION_EU433 RAM_REGION_EU436 RAM_REGION_EU436 RAM_REGION_EU515 RAM_REGION_EU515 RAM_REGION_AU515 RAM_REGION_AU515 define OTAA_DEVEU1 \$define OTAA_DEVEU1 \$define OTAA_APPKEY	Ing: 5 6 6 7 6 7 7 7 7 7 7 7 7 7 7 7 7 7	7E, 0xD0, 0x04, 0 7E, 0xD0,0x03, 0x FE, 0x1C, 0xB5, 0	xF1, 0xC0} AB, 0xA2} x15, 0xEB, 0x	:44, 0x61, C)x0D, 0x9B, 0	0x20, 0x6A,	0xF3, 0x3&}							
/** Packet buffer for uint8_t collected_dat	<pre>r sending */ ta[64] = { 0 }; putce LOPA RECEIVE T *</pre>	data)												
<pre>void recvCallback(SER { if (data->BufferSiz Serial.println("S for (int i = 0; i Serial.printf("</pre>	<pre>xvict_LORA_RECEIVE_T * ze > 0) { Something received!"); i < data->BufferSize; i "%x", data->Buffer[i]);</pre>	aata) ++) {												

Figure 29: Configuring DEVEUI, APPEUI and APPKEY

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

This guide uses US915 regional band, so you need to update the band in the code as well. In addition to that, you also need to set up the channel mask (channels 8 to 15 are the most commonly used channels in the US915 band).

```
if (!api.lorawan.band.set(OTAA_BAND)) {
   Serial.printf("LoRaWan OTAA - set band is incorrect! \r\n");
   return;
}
uint16_t maskBuff = 0x0002;
if (!api.lorawan.mask.set(&maskBuff)) {
   Serial.printf("LoRaWan OTAA - set mask is incorrect! \r\n");
   return;
}
```

NOTE:

RAK3172 supports the following regions:

- RAK_REGION_EU433 = 0
- RAK_REGION_CN470 = 1
- RAK_REGION_RU864 = 2
- RAK_REGION_IN865 = 3
- RAK_REGION_EU868 = 4
- RAK_REGION_US915 = 5
- RAK_REGION_AU915 = 6
- RAK_REGION_KR920 = 7
- RAK_REGION_AS923 = 8
- RAK REGION AS923-2 = 9
- RAK_REGION_AS923-3 = 10
- RAK_REGION_AS923-4 = 11

e LoRaWan_OTAA Arduino 1.8.19	- 0	×
		ø
LoRaWan_OTAA		
<pre>if (!api.lorawan.appeui.set(node_app_eui, 8)) { Serial.printf("LoRaWan OTAA - set application EUI is incorrect! \r\n"); return; } if (!api.lorawan.appkey.set(node_app_key, 16)) { Serial.printf("LoRaWan OTAA - set application key is incorrect! \r\n"); return; } if (!api.lorawan.deui.set(node_device_eui, 8)) { Serial.printf("LoRaWan OTAA - set device EUI is incorrect! \r\n"); return; }</pre>		
<pre>if (!api.lorawan.band.set(OTAA_BAND)) { Serial.printf("LoRaWan OTAA - set band is incorrect! \r\n"); return; uintl6_t maskBuff = 0x0002; if (!api.lorawan.mask.set(imaskBuff)) { Serial.printf("LoRaWan OTAA - set mask is incorrect! \r\n"); return; } }</pre>		
<pre>if (!api.lorawan.deviceClass.set(RAK_LORA_CLASS_A)) { Serial.printf("LoRaWan OTAA - set device class is incorrect! \r\n"); return; if (!api.lorawan.njm.set(RAK_LORA_OTAA)) // Set the network join mode to OTAA { </pre>		
1	WisDuo RAK3172 Evaluation Board, Level 0 (Release) on (сом4

Figure 30: Updating to US915 and setting up channel mask

NOTE:

- Make sure you have configured the correct RAK board before uploading the code. See Configure RAK3172 on Boards Manager section.
- Also, check RAK3172 COM Port on Device Manager section.
- 4. Open the **Tools** Menu and select a COM port. **COM28** is currently used.

🥯 sketch_nov26a A	rduino 1.8.16					- 0	×
File Edit Sketch To	ols Help						_
	Auto Format	Ctrl+1					P
sketch_nov26a	Fix Encoding & Reload						
void setup()	Manage Libraries	Ctrl+Shift+I					^
// put your	Serial Monitor	Ctrl+Shift+M					
}	Serial Plotter	Ctrl+Shift+L					
<pre>void loop() {</pre>	WiFi101 / WiFiNINA Firmware Updater						
// put your	Board: "WisDuo RAK3172 Evaluation Board						
}	Debug: "Level 0 (Release)"	>					
	Port	2	Serial ports				
	Get Board Info		COM28				
	Programmer	>					
	Burn Bootloader						
							~
1					WisDuo RAK3172 Evaluation Board, L	evel O (Release) on C	OM40

Figure 31: Select COM port

The last step is to upload the code by clicking the Upload icon on Arduino IDE. Take note that you should select the right board and COM port.



Figure 32: Uploading the code

6. You should now be able to see the console logs using the serial monitor of Arduino IDE. Sometimes COM port will be disconnected, so you won't be able to see the terminal output immediately. You can reconnect the module or try to push the reset button to see the terminal output.

👳 сом4			—		×
1					Send
Wait for LoRaWAN join RAKwireless LoRaWan OTAA Example					
Wait for LoRaWAN join+EVT:JOINED					1
Duty cycle is ON					
Packet is CONFIRMED					
Device Address is 260CD248					
Uplink period is 20000ms					
Current Work Mode: LoRaWAN.					
Data Packet:					
0x74 0x65 0x73 0x74					
Sending is requested					
Successfully sent					
+EVT:SEND_CONFIRMED_OK					
Autoscroll Show timestamp	Both NL & CR	v 115200 baud	~	Clear o	utput



7. Check on the LoRaWAN network TTN console logs if your device has been successfully joined with the join-request and join-accept messages.

nt	lorawan-devices	Time	Туре	Data previ	ew			Verbose stream 🔵	× Ł Export as JSON	II Pause	Clear
-		↓ 16:18:50	Schedule data downlink for	DevAddr:	26 0C 40 29	↔ 🖷	Rx1 Delay: 5				
	Overview	↑ 16:18:50	Forward uplink data message	DevAddr:	26 0C 40 29	↔ 🖺	MAC payload:	74 65 73 74 🗘 🖺	FPort: 2 Data rate:	SF7BW125 S	NR: 7.5 RSS
1	End devices	↑ 16:18:50	Successfully processed dat…	DevAddr:	26 0C 40 29	↔ 🖺					
	Live data	↓ 16:18:25	Schedule data downlink for…	DevAddr:	26 OC 40 29	↔ 🖺	Rx1 Delay: 5				
		↑ 16:18:25	Forward uplink data message	DevAddr:	26 0C 40 29	•	MAC payload:	74 65 73 74 💠 🖺	FPort: 2 Data rate:	SF7BW125 S	NR: 9.8 RSS
<>	Payload formatters 🗸 🗸	↑ 16:18:25	Successfully processed dat…	DevAddr:	26 0C 40 29	•					
٦, T	Integrations 🗸	↓ 16:18:00	Schedule data downlink for…	DevAddr:	26 0C 40 29	•	Rx1 Delay: 5				
*	Collaborators	↑ 16:17:59	Forward uplink data message	DevAddr:	26 OC 40 29	•	MAC payload:	74 65 73 74 😣 🖺	FPort: 2 Data rate:	SF10BW125	SNR: 11.2 R
01	API keys	个 16:17:59	Successfully processed dat	DevAddr:	26 0C 40 29	•					
\$	General settings	16:17:45	Console: Stream reconnected	The strea	am connection	has be	en re-established	d			
		16:17:38	Console: Stream connection	The conne	ection was clo	osed by	the stream provi	ider			
		↑ 16:17:31	Forward join-accept message	DevAddr:	26 0C 40 29	•					
		⊕ 16:17:29	Accept join-request	DevAddr:	26 0C 40 29	↔ 🖺]				
		<i>≡</i> 16:11:47	Console: Events cleared	The event	s list has be	en cle	ared				

Figure 34: TTN console log

The modified LORAWAN_OTAA project is available below.

```
#define OTAA_PERIOD (20000)
  LoRaWAN band setting:
    RAK_REGION_EU433
    RAK_REGION_CN470
    RAK_REGION_RU864
    RAK_REGION_IN865
    RAK_REGION_EU868
    RAK_REGION_US915
    RAK_REGION_AU915
    RAK_REGION_KR920
#define OTAA_BAND (RAK_REGION_US915)
#define OTAA_DEVEUI {0x70, 0xB3, 0xD5, 0x7E, 0xD0, 0x04, 0xF1, 0xC0}
#define OTAA_APPEUI {0x70, 0xB3, 0xD5, 0x7E, 0xD0,0x03, 0xAB, 0xA2}
#define OTAA_APPKEY {0xB4, 0x85, 0x7E, 0xFE, 0x1C, 0xB5, 0x15, 0xEB, 0x44, 0x61, 0x0D, 0x9B, 0>
uint8_t collected_data[64] = { 0 };
void recvCallback(SERVICE_LORA_RECEIVE_T * data)
 if (data->BufferSize > 0) {
   Serial.println("Something received!");
   for (int i = 0; i < data->BufferSize; i++) {
     Serial.printf("%x", data->Buffer[i]);
   Serial.print("\r\n");
void joinCallback(int32_t status)
 Serial.printf("Join status: %d\r\n", status);
void sendCallback(int32_t status)
 if (status == 0) {
   Serial.println("Successfully sent");
   Serial.println("Sending failed");
void setup()
 Serial.begin(115200, RAK_AT_MODE);
 Serial.println("RAKwireless LoRaWan OTAA Example");
 Serial.println("------
 uint8_t node_device_eui[8] = OTAA_DEVEUI;
 // OTAA Application EUI MSB first
 uint8_t node_app_eui[8] = OTAA_APPEUI;
```

```
uint8_t node_app_key[16] = OTAA_APPKEY;
if (!api.lorawan.appeui.set(node_app_eui, 8)) {
 Serial.printf("LoRaWan OTAA - set application EUI is incorrect! \r\n");
if (!api.lorawan.appkey.set(node_app_key, 16)) {
 Serial.printf("LoRaWan OTAA - set application key is incorrect! \r\n");
if (!api.lorawan.deui.set(node_device_eui, 8)) {
 Serial.printf("LoRaWan OTAA - set device EUI is incorrect! \r\n");
if (!api.lorawan.band.set(OTAA_BAND)) {
 Serial.printf("LoRaWan OTAA - set band is incorrect! \r\n");
uint16_t maskBuff = 0x0002;
if (!api.lorawan.mask.set(&maskBuff)) {
 Serial.printf("LoRaWan OTAA - set mask is incorrect! \r\n");
if (!api.lorawan.deviceClass.set(RAK_LORA_CLASS_A)) {
 Serial.printf("LoRaWan OTAA - set device class is incorrect! \r\n");
if (!api.lorawan.njm.set(RAK_LORA_OTAA)) // Set the network join mode to OTAA
 Serial.printf
  ("LoRaWan OTAA - set network join mode is incorrect! \r\n");
if (!api.lorawan.join()) // Join to Gateway
 Serial.printf("LoRaWan OTAA - join fail! \r\n");
 return;
while (api.lorawan.njs.get() == 0) {
 Serial.print("Wait for LoRaWAN join...");
  api.lorawan.join();
  delay(10000);
if (!api.lorawan.adr.set(true)) {
 Serial.printf
  ("LoRaWan OTAA - set adaptive data rate is incorrect! \r\n");
if (!api.lorawan.rety.set(1)) {
  Serial.printf("LoRaWan OTAA - set retry times is incorrect! \r\n");
 return;
}
if (!api.lorawan.cfm.set(1)) {
 Serial.printf("LoRaWan OTAA - set confirm mode is incorrect! \r\n");
  return:
```

```
Serial.printf("Duty cycle is %s\r\n", api.lorawan.dcs.get()? "ON" : "OFF"); // Check Duty Cycle
 Serial.printf("Packet is %s\r\n", api.lorawan.cfm.get()? "CONFIRMED" : "UNCONFIRMED");
 uint8_t assigned_dev_addr[4] = { 0 };
  api.lorawan.daddr.get(assigned_dev_addr, 4);
 Serial.printf("Device Address is %02X%02X%02X%02X\r\n", assigned_dev_addr[0], assigned_dev_addr
 Serial.printf("Uplink period is %ums\r\n", OTAA_PERIOD);
 Serial.println("");
 api.lorawan.registerRecvCallback(recvCallback);
 api.lorawan.registerJoinCallback(joinCallback);
 api.lorawan.registerSendCallback(sendCallback);
void uplink_routine()
 uint8_t data_len = 0;
 collected_data[data_len++] = (uint8_t) 't';
 collected_data[data_len++] = (uint8_t) 'e';
 collected_data[data_len++] = (uint8_t) 's';
 collected_data[data_len++] = (uint8_t) 't';
 Serial.println("Data Packet:");
 for (int i = 0; i < data_len; i++) {
   Serial.printf("0x%02X ", collected_data[i]);
 Serial.println("");
 if (api.lorawan.send(data_len, (uint8_t *) & collected_data, 2, true, 1)) {
   Serial.println("Sending is requested");
 } else {
   Serial.println("Sending failed");
void loop()
  static uint64_t last = 0;
 static uint64_t elapsed;
 if ((elapsed = millis() - last) > OTAA_PERIOD) {
   uplink_routine();
   last = millis();
 api.system.sleep.all(OTAA_PERIOD);
}
```

RAK3172 as a LoRa/LoRaWAN Modem via AT Command

AT Command via UART2

RAK3172 module can be configured using AT commands via the UART2 interface. You need a USB to UART TTL adapter to connect the RAK3172 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 UART2 pins. If you will connect the module to an external host MCU that will send AT commands via UART2, 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 UART2 before connecting the module to the PC (via USB-UART converter) for the FW update process.

An alternative option to update firmware aside from UART2 is to use SWD pins (SWCLK & SWDIO). This method will require you to use external tools like ST-LINK and RAKDAP1.

Connect to the RAK3172

1. Connect the RAK3172 to the serial port of a general-purpose computer (USB port) using a USB to UART TTL adapter like RAKDAP1^C, as shown in **Figure 35**.



Figure 35: RAK3172 Module 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 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 as LoRaWAN IoT device.
- LoRa P2P Point-to-point communication between two RAK3172 modules.

Configuring RAK3172 as LoRaWAN End-Device

To enable the RAK3172 module 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 associated AT

commands for the RAK3172.

This guide covers the following topics:

- The Things Network Guide How to log in, register new accounts and create new applications on TTN.
- RAK3172 TTN OTAA Guide How to add OTAA device on TTN and what AT commands to use on RAK3172 OTAA activation.
- RAK3172 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 Chirpstack OTAA Guide How to add OTAA device to Chirpstack and what AT commands to use on RAK3172 OTAA activation.
- RAK3172 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 module to the TTN platform.

NOTE:

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



Figure 36: RAK3172 EVB in the context of the TTN

As shown in **Figure 36**, 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 compliance and interoperability. This project is actively maintained by The Things Industries 2.

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 WisDuo module 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 WisDuo module 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 37. Then select a cluster as shown in Figure 39.



Figure 37: Signing up an account in TTN

← → ♂ ⓐ thethingsindustries.com/tts-plans/?tab=community			L ^e	e 🖈 🕲 🗰 🖬 🦁 e	
G Google 🔕 Addons Store 📃 Firefox Bookmarks 📒 RAK Wireless					
UDD THE THINGS	Network Server Feature	is Resources About	Login Get Started		•
	Community	Business			ł
	THE THINGS STACK	THE THINGS STACK			
					I
	Student	Individual			
	Sidem	maividual			1
	Learn the tools and workflows used by professional	Start connecting your LoRaWAN devices with the			
	LoRaWAN developers.	community edition of The Things Stack.			
	Latest version of The Things Stack.	Latest version of The Things Stack.			
	Become a LoRaWAN expert from the learning and	Become a contributor to the biggest open and free -			
	development loois.	The things network.			
	Free	Free			
	riee	Fiee			
	Get started	Get started	←		
				0	
				9	

Figure 38: Signing up an account in TTN

← → C console.cloud.thethings.network	🔒 🖻 🖈 🖬 💙 😫
🔓 Google 🔕 Addons Store 📒 Firefox Bookmarks 📒 RAK Wireless	
	e or gateway location tect your region
Existing clusters Europe 1 > eut - Dublin, Ireland > North America 1 > nam1 - California, USA > Australia 1 > au1 - Sydney, Australia >	
	Terms of use

Figure 39: Selecting Cluster in TTN

← → C		ià 🕁 🖨 🛎 🔲 😕 :
G Gooole Addons Store Firefox Bookmarks RAK Wireless		
	() THE THINGS ID	
	THE THINGS STACK	
	Community Edition	
	Sign in with The Things ID	
	bon thave an be sign up to nee	
	Email	
	Paceword 8	
	Login with The Things ID	
	Forgot password	

Figure 40: Signing up through the Things ID

id.thethingsnetwork.org/oidc/interaction/R_m1DazPzCyuEA4jdgqtx/register		🖻 🖈 🕲 🇯
🛇 Addons Store 🔋 Firefox Bookmarks 🔋 RAK Wireless		
(THE THINGS ID		
Create one ID to get access to all our products.	Username •	
One secure account for The Things Network and future services gathered in one place.	Email •	
	Password •	
	Must be at least 6 characters	
	Confirm Password •	
	Must be identic as above	8
	 By checking this box, you agree to our Terms and Privacy Policy. 	Conditions and
	Sign up to The Things ID	
	Cancel	

Figure 41: Creation of an account through the Things ID



Figure 42: 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**.

$\leftrightarrow \rightarrow c$	eu1.cloud.thethings.ne	twork/console/							🖻 🖈 🗯 🖬 🚯 🗄
THE THINGS NETWORK	THE THINGS STACK Community Edition	Overview	Applications	🛁 Gateways	* Organizations			EU1 Community Fair use policy applies (*)	rakwirelessapp •
					Weld Get started right away Need help? Have a	come to the (y by creating an applica look at our <u>II Docume</u>	Console! ation or registering a gateway. n <u>tation</u> ^{III} or <u>Get support</u> II.		
				Create	ooo oo		Register a gateway		

Figure 43: The Things Stack Platform

\leftrightarrow \rightarrow C \cong eu1.cloud.thethings.net	etwork/console/				🖻 🖈 🗯 🖬 📵 🗄
THE THINGS STACK Community Edition	Cverview Applicat	ions 📑 Gateways 🚢 Organizations		EU1 Community Fair use policy applies ⑦	rakwirelessapp •
		Welcome Get started right away by creat Need help? Have a look at or	to the Console! ing an application or registering a gateway. ar I Documentation @ or <u>Get support</u> @.		
		ooo Image: Im	Register a gateway		

Figure 44: 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**.

$\leftrightarrow \rightarrow c$	eu1.cloud.thethings.ne	twork/console/app	plications/add		🖻 🛧 🛊 🗊 🖪 📵	1.1
THE THINGS NETWORK	THE THINGS STACK Community Edition	Overview	Applications	EU1 Community No SLA applicable ⑦	rakwirelessapp	•
			Create application Within applications, you can register and manage end devices and their network data. After setting up your device fleet, use one of our many integration options to pass relevant data to your external services. Learn more in our guide on Adding <u>Applications</u> (0).			
			Application ID *			
			my-new-application			
			Application name			
			My new application			
			Description			
			Description for my new application			
			Øptional application description; can also be used to save notes about the application			
			Create application			

Figure 45: Details of the TTN application

Within applications, yo	u can register and manage end devices and their network data. After setting up your device fleet, use one of our many
Learn more in our guid	e on M Adding Applications C.
Application ID*	
lorawan-new-device	
Application name	
LoRaWAN Devices Ap	plication
Description	
This application invol	ves <u>LoRaWAN</u> devices.
Optional application d	escription; can also be used to save notes about the application

Figure 46: 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 47**.

\leftrightarrow \rightarrow C $$ eu1.cloud.thethings.ne	etwork/console/applications/lorawan-new-device 🗠 🖈 🗊 🔲 📵										
THE THINGS STACK	E Overview Applications 🗟 Gateways 🕮 Organizations										
			Applications > LoRaWAN De	vices Application							
LORAWAN Devices Application											
Overview			ID: lorawan-new-de								
🙏 End devices			• No recent activity 🗇 👗 1 Collabo								
💷 Live data											
<> Payload formatters ~			General information	lorawan-new-device		Live data 23:48:46 lorawan-ne_ Cre	See all activity →				
			Created at	lan 11 2023 23:40:46	-	-					
Collaborators			Last undated at	lan 11, 2022 22:40:46							
O 101 km			Last updated at	381111,202323.40.40							
WT API Keys											
General settings											
			End devices (0)			Q Search	=+ Import end devices + Register end device	◀──			
			ID ¢	Name ¢	DevEUI	JoinEUI	Last activity 🗢				
	No items found										

Figure 47: Register end device

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

THE THINGS NETWORK	THE THINGS STACK Community Edition	Overview	Applications	🚡 Gateways 🏛 Organizations	EU1 Community No SLA applicable (2)	rakwirelessapp 👻			
LoRaWAN Devices Application				Applications > LoRaWAN Devices Application > End devices					
	verview ud devices			Register end device Does your end device have a QR code? Scan It to speed up onboarding.					
🗐 Li	ve data	Scan end device QR code							
<> Pa	yload formatters 🗸 🗸	End device type							
大 In	tegrations 🗸								
41 Co	llaborators	Select the end device in the LoRaWAN Device Repository Enter end device specifics manually							
OT AF	1 keys	End device brand 🗇 *							
🗘 Ge	eneral settings	Type to search \checkmark Cannot find your exact end device? <u>Get help here</u> and try enter end device specifics manually option above.							

Figure 48: 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.
| 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 Scan end device QR code Device registration help End device type Input Method Select the end device in the LoRaWAN Device Repository Select the end device in the LoRaWAN Device Repository Select Frequency plan * Select Regional Parameters version * | Applications > LoRaWAN Devices Application > End devices | |
|--|--|--|
| Register end device have a QR code? Scan it to speed up onboarding. Image: Constraint of the speed up on the | | |
| 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 Imput Method (*) Enter end device specifics manually Frequency plan (*) Select Select Select Select Select Select Select Select | | |
| 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 LoRaWAN version Select Regional Parameters version * Select Select | Register end device | |
| Dees your end device have a QR code/ Scan it to speed up onboarding. | | |
| ⓐ Device registration help ∅ End device type Input Method ⑦ Select the end device in the LoRaWAN Device Repository Enter end device specifics manually Frequency plan ③* Select LoRaWAN version ③* Select Select Select Select Select | 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 Select LoRaWAN version * Select Regional Parameters version * Select | Scan end device QR code | |
| End device type Input Method ⑦ Select the end device in the LoRaWAN Device Repository Enter end device specifics manually Frequency plan ③* Select V Regional Parameters version ③* Select V | | |
| Input Method ③ Select the end device in the LoRaWAN Device Repository Enter end device specifics manually Frequency plan ③ * Select LORAWAN version ③ * Select Regional Parameters version ③ * Select Select | End device type | |
| Input Method ③ Select the end device in the LoRaWAN Device Repository Enter end device specifics manually Frequency plan ③ * Select LoRaWAN version ③ * Select Regional Parameters version ③ * Select Select | | |
| Select the end device in the LoRaWAN Device Repository • Enter end device specifics manually Frequency plan ③ * Select LoRaWAN version ③ * Select Select ✓ Regional Parameters version ③ * Select | Input Method 🗇 | |
| Enter end device specifics manually Frequency plan ③ * Select LoRaWAN version ③ * Select V Regional Parameters version ③ * Select | Select the end device in the LoRaWAN Device Repository | |
| Frequency plan ③ * Select LoRaWAN version ③ * Select Y Regional Parameters version ③ * Select | Enter end device specifics manually | |
| Select \vdots LoRaWAN version ③ * \vdots Select \vdots Regional Parameters version ③ * \vdots Select \vdots | Frequency plan ⑦* | |
| LoRaWAN version ③ * Select Regional Parameters version ③ * Select | Select V | |
| Select \viscolution Regional Parameters version @ * Select \viscolution | LoPaWAN version @ * | |
| Select V | | |
| Regional Parameters version (*) * | Select | |
| Select V | Regional Parameters version ⑦ * | |
| | Select 🗸 🗸 | |
| | | |
| | | |



Applications > LoRaWAN Devices Application > End devices	
Register end device	
Register end device	
Does your end device have a QR code? Scan it to speed up onboarding	le series and s
Scan end device QR code	
End device type	
Input Method 💿	
Select the end device in the LoRaWAN Device Repository	
 Enter end device specifics manually 	
Frequency plan ⑦ *	
Europe 863-870 MHz (SF9 for RX2 - recommended)	א
LORAWAN version (2) *	
Select	/
Regional Parameters version ⑦*	

Figure 50: 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
End device type
Input Method 🗇
O Select the end device in the LoRaWAN Device Repository
Enter end device specifics manually
Frequency plan 🗇 *
Europe 863-870 MHz (SF9 for RX2 - recommended)
LoRaWAN version @*
LoRaWAN Specification 1.0.3
Regional Parameters version 🗇 *
RP001 Regional Parameters 1.0.3 revision A 🛛 🗸
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 51: 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
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)
LoRaWAN version \odot *
LoRaWAN Specification 1.0.3
Regional Parameters version 🗇 *
RP001 Regional Parameters 1.0.3 revision A 🛛 🗸
Show advanced activation, LoRaWAN class and cluster settings 🗸
Provisioning information
JoinEUI () *
 ▶ 98 98 99 99 99 99 99 99 99 90 00 Confirm
To continue, please enter the JoinEUI of the end device so we can determine onboarding options

Figure 52: Setting up for your device

4. 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.
	Scan end device QR code
	End device type
	Input Method 🗇
	O Select the end device in the LoRaWAN Device Repository
	Enter end device specifics manually
	Frequency plan 🛞 *
	Europe 863-870 MHz (SF9 for RX2 - recommended)
	LoRaWAN version () *
	LoRaWAN Specification 1.0.3
	Regional Parameters version 🗇 *
	RP001 Regional Parameters 1.0.3 revision A
_	Show advanced activation, LoRaWAN class and cluster settings V
	Provisioning information
	JoinEUI () *
	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 53: Setting up for your device

Show advanced activation. LoRaWAN class and cluster settings A
Activation mode 🗇
 Over the air activation (OTAA)
Activation by personalization (ABP)
O Define multicast group (ABP & Multicast)
Additional LoRaWAN class capabilities 🗇
 None (class A only)
Network defaults ⑦
 ▶ 🔽 Use network's default MAC settings
Cluster settings 🗇
Skip registration on Join Server
Provisioning information
JoinEUI () *
00 00 00 00 00 00 Confirm
To continue, please enter the JoinEUI of the end device so we can determine onboarding options

Figure 54: 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. Click Generate in AppKey tab 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.

JoinEUI 💿 *			
00 00 00 00 00 00 00 00	Reset		
This end device can be registered on th	e network		
DevEUI 🗇 *			
AC 15 09 FF FE 05 37 76	Generate 0/50 used		
AppKey ⑦*			
		ϕ Generate	
End device ID ⑦ *			
eui-ac1f09fffe053776			
This value is automatically prefilled usi	ng the DevEUI		
After registration			
 View registered end device 			
O Register another end device of this	type		

Figure 55: Setting up for your device

Inia FIII @ *		
JOINEUL		
00 00 00 00 00 00 00	90 00 Reset	
This end device can be regis	tered on the network	
DevEUI ⑦ *		
AC DE 09 EE EE 05 D	7 TC Generate 0/50 used	
AppKey ⑦*		
	••••••••••••••••••••••••••••••••••••••	
End device ID ⑦ *		
eui-ac1f09fffe053776		
This value is automatically p	refilled using the DevEUI	
After registration		
• View registered end dev	ice	
O Register another end de	vice of this type	

Figure 56: 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 100 00 00 00 00 00 00 00 00 00 000 0/50 used		
AppKey ⑦ *		
44 D1 14 08 58 31 FD 21 65 C9 C8 1C 87 87 AE 86	🗘 Generate	te
End device ID ⑦ *		
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 57: 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 58**.

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 58.

THE THINGS STACK Community Edition	Overview Applie	ations 🗳 Gateways 🗮 Organiz	zations		EU1 Community No SLA applicable (7)	rakwirelessapp 🔹
LORAWAN Devices Application		Applications > LoRaWAN De	evices Application > End devices > eui-ac1f00fffe053776			
Overview		eui-ac1f09f	fffe053776 ⁵³⁷⁷⁶			
🙏 End devices		↑ n/a 🔸 n/a 🔹 No activi	ity yet ⊘			
😑 Live data		Overview Live data	Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity \rightarrow	
		End device ID	eui-ac1f09fffe053776	80:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
Or API keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
General settings		Regional Parameters version Created at	RP001 Regional Parameters 1.0.3 revision A 🖷			
		Activation information		Location	Change location settings →	
		AppEUI DevEUI	00 00 00 00 00 00 00 00 00 00 00 00 00			
		АррКеу				
		Session information This device has not joined the	e network yet	No location information available		
		MAC data				

Figure 58: OTAA device successfully registered to TTN

OTAA Configuration for TTN

The RAK3172 module can be configured using WisToolBox to do the OTAA configuration. **WisToolBox** is a software tool that supports **RAK3172** module. It automatically detects the RAK3172 module once it is connected to the PC. Below are the options in WisToolBox where 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 the 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 59: CONNECT DEVICE

3. Then select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT**, as shown in **Figure 60**.

Wis ToolBox =	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 > 0 0 0 0	
Dashboard		Connectio	on settings
Templates		Port	COM12 V
Firmware		Device	Unidentified Select manually
DEVICES		Baud Rate	115200 ~
(≠) RAK3172 COM13 ▲		Byte Size	8 ~
		Parity	None ~
		Stop Bits	1 2
		e c	ONNECT
		C/	NCEL

Figure 60: Setting up your device

s ToolBox =	
Dashboard	
emplates	Port
rmware	Device rak3172
	Baud Rate 115200 ~
	Byte Size 8 ~
	Parity None ~
	Stop Bits 1 2
	CANCEL
S RAK ID	

Figure 61: Setting up your device

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

Wis ToolBox =			
Dashboard		WisDuo LPWAN Module for LoRaWAN	()∮) LORAWAN ■ 100%
Templates		MODEL RAK3172 EUI 00 AT DEFAULT	PORT COM13
Firmware			
DEVICES			
()≠1) RAK3172 COM13 ▲			
(?) 🐼 🏟 RAK ID	[®]		

Figure 62: Device seen from WisToolBox dashboard

5. Then click **PARAMETERS** configure your RAK3172.

ToolBox	P 🚳 RAK	WisDuo LP LoRaWAN	WAN Module for	>
emplates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	STATUS	(1997) - 🔳 100%	
		DEVICE EUI	00	D
		MODEL	rak3172	
сом13 🛦	DEVICE INFO	FIRMWARE	RUI_3.5.4_RAK3172-E AT DEF	AULT
_	PARAMETERS	HARDWARE ID	stm32wle5xx	Q
	ADVANCED	LAST SYNC	1/19/2023, 3:03:56 PM	С
	FIRMWARE			
		DOCUMEN	TATION [2	
nak id				

Figure 63: Setting up your device

- 6. Click **Global settings** to set the network mode to **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 bands, you can choose among active regions based on your location.
- LoRa network mode: LoRaWAN
- LoRaWAN join mode: OTAA
- LoRaWAN region: EU868

		Device Parameters Sync less then 1 min ago C
Dashboard	Pak 🎯 🗳	SAVE AS TEMPLATE APPLY A TEMPLATE
Templates Firmware		
DEVICES		 LoRaWAN keys, ID, EUI
()≠1) RAK3172 COM13 ▲	DEVICE INFO	
	PARAMETERS	(i) Data on LoRa® network
	ADVANCED	 LoRa[®] network management
		Generic LoRaWAN instructions ✓
		 LoRaWAN multicast group
(?) (RAK ID		 Custom Commands

Figure 64: Global settings

					_ 🗆 ×
		Device Param	neters	Sync less	then 1 min ago C
Dashboard	🔛 🍥 RAK 🛔	SAVE AS TEMP	LATE	APPLY A T	EMPLATE
Templates	RAK3172 CE				
Firmware		Global settings			^
	(P) • • • • • • • • • • • • • • • • • • •	Network mode	LoRaWAN		P2P
DEVICES		Join mode	ΟΤΑΑ	_	ABP
() MAK3172 COM13 ▲	DEVICE INFO	oom mode			
	PARAMETERS	Active region	EU868	~	
	ADVANCED		<u></u>		
	FIRMWARE				
		 LoRaWAN keys, 	ID, EUI		~
		 Data on LoRa[®] r 	network		~
🤊 💮 🏟 RAK ID		 LoRa[©] network 	management		\checkmark

Figure 65: Global settings

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

Wis ToolBox =		Device Param	neters	Sync less then 1 min ago
Dashboard	🚰 🏟 RAK 🛛	SAVE AS TEMP	LATE	APPLY A TEMPLATE
Templates Firmware	RAK3172 CE Deve UI: AC1F09FFFE052B2E	 Global settings 		^
		Network mode	LoRaWAN	P2P
DEVICES		Join mode	ΟΤΑΑ	ABP
()≠1) RAK3172 COM13 ▲	DEVICE INFO			
	PARAMETERS	Active region	EU868	~
	ADVANCED			
	FIRMWARE	→ 🕡 LoRaWAN keys,	ID, EUI	~
		ĵ Data on LoRa [⊗] n	network	~
(?) 🔕 🚳 RAK ID		 LoRa[®] network 	management	~

Figure 66: LoRaWAN keys, ID, EUI

Wis ToolBox =		Device Parar	neters	_ \Box $ imes$ Sync less then 1 min ago $ C$
Dashboard	🔛 🏟 RAK 👔	SAVE AS TEMP	PLATE	APPLY A TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	Join mode	ΟΤΑΑ	ABP
for Liumware	(P) 👬 ČÀ	Active region	EU868	~
DEVICES				
()≠1) RAK3172 COM13 ▲	DEVICE INFO	i LoRaWAN keys	, ID, EUI	^
	PARAMETERS	Application FLU		00000
	ADVANCED	Application EOI	000000000000000000000000000000000000000	
	FIRMWARE	Application key	@ 00000000 00000000	0000000000000 32/32
		Device EUI	00000000000	00000
		Network ID		
?	1 Command MODEL RAK3172	PORT COM13		APPLY COMMAND

Figure 67: Setting up your device

 Then go back to the console where your RAK3172 end-device is created previously. Copy the credentials from there since it will be used in the WisToolBox dashboard. Once encoded into the dashboard, click APPLY COMMAND to update your device, as shown in Figure 75.

VOTE:

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

THE THINGS STACK Community Edition	Overview Applications	🔒 Gateways 🛛 🚢 Organi.	tations		EU1 Community No SLA applicable ⑦	rakwirelessapp •
LORAWAN Devices Application		Applications > LoRaWAN De	vices Application > End devices > eui-ac1f09fffe053776			
Cverview Cverview Cuerview Live data		eui-ac1f09f ID: eui-ac1f09ffe0 ↑ n/a ↓ n/a • No activ Overview Live data	ffe053776 ⁵³⁷⁷⁶ Lyyet ① Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity \rightarrow	
		End device ID	eui-ac1f09fffe053776	00:36:54 Create end device		
2 Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
Or API keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
General settings		Regional Parameters version Created at	AP001 Regional Parameters 1.0.3 revision A			
		Activation information		Location	Change location settings \rightarrow	
		AppEUI	00 00 00 00 00 00 00 00 00 00 00 00 00			
		DevEUI	AC 1F 69 FF FE 65 37 76			
		АррКеу	🖺 🛛			
		Session information This device has not joined the	network yet	No location information available		
		MAC data				

Figure 68: Your created OTAA device from your console

• For Application EUI (AppEUI)

THE THINGS STACK Community Edition	Overview Applications	🛁 Gateways 🛛 🚢 Organiza	tions		EU1 Community No SLA applicable (2)	rakwirelessapp 🔹
11 LoRaWAN Devices Application		Applications > LoRaWAN Dev	<pre>ices Application > End devices > eui-ac1f09fffe053776</pre>			
Overview		ID: eui-ac1f09ffe05	fe053776 ³⁷⁷⁶			
🙏 End devices		↑ n/a ↓ n/a 🔹 No activit	y yet 🗇			
📃 Live data		Overview Live data	Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity \rightarrow	
た Integrations ~		End device ID	eui-ac1f09fffe053776	🚭 00:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
Or API keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
General settings		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
		Created at	Jan 12, 2023 00:36:54			
		Activation information		Location	Change location settings \rightarrow	
	\rightarrow	AppEUI	00 00 00 00 00 00 00 00 00 00 00 00 00			
		DevEUI	AC 17 39 FF FE 05 37 76			
		АррКеу	••••••			
		Session information		No location information available		
		This device has not joined the r	network yet			
		MAC data				
		Download MAC data		y v		

Figure 69: Copying the AppEUI credential from TTN to WisToolBox

Wis ToolBox =		Device Param	Leters Sync less then 1 min ago
Dashboard	💾 🏟 RAK 👔	SAVE AS TEMP	LATE APPLY A TEMPLATE
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	Join mode	OTAA ABP
् Firmware		Active region	EU868 ~
DEVICES			
()≠1) RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys, 	ID, EUI
	PARAMETERS		000000000000000000000000000000000000000
	ADVANCED	Application EOI	
	FIRMWARE	Application key	@ 000000000000000000000000000000000000
		Device EUI	000000000000 (16/16
		Network ID	
? 🐼 🔹 RAK ID	1 Command MODEL RAK3172	PORT COM13	APPLY COMMAND

Figure 70: Copying the AppEUI credential from TTN to WisToolBox

• For Application key (AppKey)

THE THINOS STACK Community Edition	Overview Applications	🔏 Gateways 🛛 🚢 Organiza	ations		EU1 Community No SLA applicable ⑦	rakwirelessapp 👻
LoRaWAN Devices Application		Applications > LoRaWAN Dev	vices Application > End devices > eui-aclf09fffe053776			
Overview		iD: eui-ac1f09ff	ffe053776 ³³⁷⁷⁶			
🙏 End devices		↑n/a ↓n/a •Noactivit	ty yet ③			
Elve data		Overview Live data	Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity →	
え Integrations ~		End device ID	eui-ac1f09fffe053776	00:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
O API keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
General settings		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
		Created at	Jan 12, 2023 00:36:54			
		Activation information		Location	$Change \ location \ settings \rightarrow$	
		AppEUI	00 00 00 00 00 00 00 00 💿			
		DevEUI	AC OF FF FE 65 37 76			
	\rightarrow	АррКеу				
		Session information		No location information available		
		This device has not joined the	network yet			
		MAC data				
		Download MAC data		D BU		

Figure 71: Copying the AppKey credential from TTN to WisToolBox

Wis ToolBox =		Device Param	neters s	_ 🗌 X
Dashboard	🔛 🍥 RAK	SAVE AS TEMPI	LATE	PLY A TEMPLATE
Templates Firmware	RAK3172 CE Deve UI: AC1F09FFFE052B2E	Join mode	ΟΤΑΑ	ABP
'area'		Active region	EU868 ~	
DEVICES				
()#) RAK3172 COM13 ▲	DEVICE INFO	LoRaWAN keys,	ID, EUI	^
	PARAMETERS			
	ADVANCED	Application EUI	000000000000000000000000000000000000000	16/16
	FIRMWARE	Application key 🔶	ी 44D11	32/32
		Device EUI	000000000000000000000000000000000000000	(16/16)
		Network ID		
? 🛞 🚳 RAK ID	1 Command MODEL RAK3172	PORT COM13		APPLY COMMAND

Figure 72: Copying the AppKey credential from TTN to WisToolBox

• For Device EUI (DevEUI)

THE THINOS STACK Community Edition	Overview Applications	👗 Gateways 🛛 🗮 Organiz	ations		EU1 Community No SLA applicable ⑦	rakwirelessapp 💌
III LORAWAN Devices Application		Applications > LoRaWAN Dev	vices Application > End devices > eui-ac1f09fffe053776			
Overview		eui-ac1f09ff ID: eui-ac1f09fffe05	ffe053776 ³³⁷⁷⁶			
👃 End devices		↑n/a ↓n/a • No activit	ty yet 💿			
Live data		Overview Live data	Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity →	
大 Integrations ~		End device ID	eui-ac1f09fffe053776	00:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
Ov API keys		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
General settings		Created at	Jan 12, 2023 00:36:54			
		Activation information		Location	Change location settings \rightarrow	
		AppEUI	00 00 00 00 00 00 00 00 00 00 00 00 00			
	\rightarrow	DevEUI	AC C = 09 FF FE CS 37 76			
		АррКеу	🖺 📀			
		Session information		No location information available		
		This device has not joined the	network yet			
		MAC data				
		Download MAC data				

Figure 73: Copying the DevEUI credential from TTN to WisToolBox

Wis ToolBox =		Device Parar	meters Sync le	X
Dashboard	🚞 🍥 RAK 🛔	SAVE AS TEMP	PLATE APPLY A	TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	Join mode	OTAA	ABP
رِبِ Firmware		Active region	EU868 ~	
DEVICES				
()#) RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys 	, ID, EUI	^
	PARAMETERS	Application ELU	000000000000000000000000000000000000000	16/16
	ADVANCED	Application EOI	000000000000000000000000000000000000000	18/18
	FIRMWARE	Application key	44D11	32/32
		Device EUI 🔶	AC 091111055776	(16/16)
		Network ID		
⑦	1 Command MODEL RAK3172	PORT COM13	AP	PLY COMMAND

Figure 74: Copying the DevEUI credential from TTN to WisToolBox

• WisToolBox Dashboard

Wis ToolBox =				_ 🗆 ×
		Device Para	meters	Sync less then 1 min ago $ C$
Dashboard	🔛 🏟 RAK 🛔	SAVE AS TEN	IPLATE	APPLY A TEMPLATE
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	Join mode	ΟΤΑΑ	ABP
Eirmware		Active region	EU868	~
DEVICES				
() RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys 	s, ID, EUI	^
	PARAMETERS	Application 511		
	ADVANCED	Application EUI	000000000000000000000000000000000000000	
	FIRMWARE	Application key	J 44D1	32/32
		Device EUI	AC	53776 (16/16)
		Network ID		
7 🛞 🐠 RAK ID	1 Command MODEL RAK3172	PORT COM13		APPLY COMMAND

Figure 75: 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**.

Wis ToolBox ≡		
Dashboard	Commands applied to RAK3172 WisDuo LPWAN Module	
© Templates	TOP LORAWAIN	
{} Firmware	Oevice EUI	Successful 15:42
DEVICES	Application key	Successful 15:42
()≠1) RAK3172 COM13 ▲		
? ⊘ 🏟 RAK ID	CLOSE	

Figure 76: Summary of commands

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

Wis ToolBox =		Device Paran	neters	X
Dashboard	Par 🖗 🖗	SAVE AS TEMP	LATE	PPLY A TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFe052B2E			
Firmware		 Global settings 		^
		Network mode	LoRaWAN	P2P
DEVICES (≠) RAK3172 COM13 ▲	DEVICE INFO	Join mode	ΟΤΑΑ	ABP
	PARAMETERS	Active region	EU868 ~	
	ADVANCED			
	FIRMWARE	 LoRaWAN keys, 	ID, EUI	^
		Application EUI	00	0 16/16
		Application key	ط 44D1	502165C9C010 32/32
🤊 🛞 🌘 RAK ID		Device EUI	AC	16/16

Figure 77: Successfully configured OTAA device via WisToolBox dashboard

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

		Device Parameters	X Sync less then 1 min ago C
Dashboard	🚰 🍥 RAK 🛛	SAVE AS TEMPLATE	APPLY A TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	 LoRaWAN keys, ID, EUI 	^
Loc Firmware		Application EUI 00	16/16
DEVICES		Application key	14D1 32/32
()≠) RAK3172 COM13 ▲	DEVICE INFO	Device EUI AC	(16/16)
	PARAMETERS		
	ADVANCED	Network ID 0000	
	FIRMWARE		
		 Data on LoRa[®] network 	^
		Confirm mode	
		Confirm status	
		LoRaWAN join settings	~
🧿 🔗 🐠 RAK ID		→ [JOIN NETWORK

Figure 78: Joining mode of your OTAA device

				_ 🗆 X	
Wts ToolBox ≡		Device Parameters	s	Sync less then 1 min ago 💍	
Dashboard	🚰 🏟 RAK 🛛	SAVE AS TEMPLA	TE	PPLY A TEMPLATE	
 Templates 	RAK3172 CE				
Firmware		 Global settings 		^	
	(P) 🖸 💐 CA	Network mode	LoRaWAN	P2P	
DEVICES		Join mode	ΟΤΑΑ	ABP	
(**) RAK3172 COM13 🛓	DEVICE INFO				
	PARAMETERS	Active region	EU433 ~		
	ADVANCED				
	FIRMWARE	 LoRaWAN keys, ID, EUI 		^	
		An effective PLU			
→	③ WisDuo LPWAN Module for LoRaWAN - Join Network State St	etwork : Joined	Fotor in HEX characters value	×	
	WisDuo LPWAN Module for LoRaWAN - Join Ne	etwork : Joined	78 1 2010 1 2010 1010 1010 1010	×	
	WisDuo LPWAN Module for LoRaWAN - Join Network : Joined X				
? 🔕 🔹 🔹	WisDuo LPWAN Module for LoRaWAN - Join Net	etwork : Joined		×	

Figure 79: OTAA device successfully joined the TTN server

↑ n/a ↓ n/a • Last activ Overview Live data	ity 2 minutes ago ③ Messaging Location Payload formatters Clair	ming	General settings							
General information			 Live data 					s	ee all :	activit
End device ID	eui-ac1f09fffe053776	6	↑ 10:52:46	Forward join-accept	message	DevAddr:	26 OD	F3 C5	\diamond	
Frequency plan	Furne 863-870 MHz (SEQ for DV2 - recommen	I	⊕ 10:52:44	Accept join-request	DevAddr	26 0D F3	C5 <	> l		
requercy plan			↑ 10:49:15	Forward join-accept	message	DevAddr:	26 OD	E5 57	\diamond	
LoRaWAN version	LoRaWAN Specification 1.0.3		⊕ 10:49:13	Accept join-request	DevAddr:	26 0D E8	57 <	>		
Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A	6	↑ 10:48:56	Forward join-accept	message	DevAddr:	26 OD	E2 D8	\circ	
Constant at	lan 07, 0000 10/00/51		⊕ 10:48:54	Accept join-request	DevAddr:	26 0D E2	D8 <	>		
Activation information AppEUI DevEUI	00 00 00 00 00 00 00 00 00 00 00 00 00		Location				Chan	ge loca	ition s	etting

Figure 80: 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.

CONNECT DEVICE

Figure 81: CONNECT DEVICE

3. Select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT**, as shown in **Figure 83**.

Setting up your device
Figure 82: Setting up your device
Setting up your device
Figure 83: Setting up your device
4. Once done, RAK3172 will appear in the dashboard, then select it.
Device seen from WisToolBox dashboard
Figure 84: Device seen from WisToolBox dashboard
5. Then click ADVANCED .
Setting up your device
Figure 85: Setting up your device
6. Once done, click OPEN CONSOLE to do the configuration.
POPEN CONSOLE
Figure 86: OPEN CONSOLE
Opening the Console terminal of WisToolBox
Figure 87: Opening the Console terminal of WisToolBox
Dpening the Console terminal of WisToolBox
Figure 88: 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.



SAK®	Documentation	Center
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Setting up your Console
Figure 91: Setting up your Console
3. Then configure the LoRaWAN join mode to OTAA. You can check what parameter you will input by typing AT+NJM? and then Enter into the console terminal. For OTAA, you should input AT+NJM=1 and then press
Enter, as shown in Figure 92.
Setting up your Console
Figure 92: Setting up your Console
Setting up your Console

Figure 93: Setting up your Console

Setting up your Console

Figure 94: Setting up your Console

9. Once done, set 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 bands, 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 C . 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				

RU864

2

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
Setting up your Console	Figure 95: Setting up your Console
Setting up your Console	
Setting up your Console	Figure 96: Setting up your Console
	Figure 97: Setting up your Console

10. Then next to this will be updating the OTAA credentials of your device. First on this list 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 and press Enter.

THE THINGS STACK	Overview Applications	🚊 Gateways 🛛 🗮 Organiz	ations			EU1 Community No SLA applicable ⑦	rakwirelessapp •
LoRaWAN Devices Application		Applications > LoRaWAN Dev	vices Application > End devices > eui-ac1f09fffe053	776			
		eui-ac1f09ff	ffe053776				
Overview		ID: eul-ac1f09fffe05	3776				
👗 End devices		∱n/a ↓n/a •Noactivit	ty yet 🕥				
🔲 Live data		Overview Live data	Messaging Location Payload formatters C	laiming	General settings		
<> Payload formatters ~		General information			Live data	See all activity \rightarrow	
		End device ID	eui-ac1f09fffe053776	6	00:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen	n_ 🖷			
Or API keys		LoRaWAN version	LoRaWAN Specification 1.0.3	1			
General settings		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision /	A 🛍			
		Created at	Jan 12, 2023 00:36:54				
		Activation information			Location	Change location settings →	
		AppEUI	00 00 00 00 00 00 00 00	•			
		DevEUI	AC 1F 69 FF FE 65 37 76	•			
		АррКеу	•••••	≣ ⊘			
		Session information			No location information available		
		This device has not joined the	network yet				
		MAC data					
		Download MAC data					

Figure 98: Your created OTAA device from your TTN console

Setting up your Console

Setting up your Console

Figure 100: Setting up your Console

Setting up your Console

Figure 101: Setting up your Console

THE THINGS STACK	Overview Applications	🛋 Gateways 🛛 🎎 Organizations			EU1 Community No SLA applicable ⑦	rakwirelessapp 👻
11 LORaWAN Devices Application		Applications > LoRaWAN Devices Application > End devices > eui-aclfo	fffe053776			
Cverview Cverview Cue the devices Cue the data		eui-ac1f09fffe053776 ID: eui-ac1f09fffe053776 ↑ n/a ↓ n/a → No activity yet © Overview Live data Messaging Location Payload formatter	s Claiming	General settings		
Payload formatters The grations The grations Collaborators API keys General settings		General information End device ID Frequency plan Europe 863-878 Mtz (SF9 for RX2 - xn LoftaWAN version LoftaWAN version Regional Parameters version RPB01 Regional Parameters 1.0.3 zev Created at Jan 12, 2022 003654	sion A E	• Live data © 80:36:54 Create end device	See all activity →	
	→	Activation information AppEUI 09 09 09 09 09 09 09 09 09 09 09 09 09	0 5 0 5 5 0 5	Location No location information available	Change location settings -	

Figure 102: Copying the AppEUI credential from TTN to WisToolBox

Setting up your Console

Figure 103: Setting up your Console

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

• For Application key (AppKey)

Setting up your Console

Figure 104: Setting up your Console

Setting up your Console

Figure 105: Setting up your Console

Setting up your Console

Figure 106: Setting up your Console

THE THINGS NETWORK	THE THINOS STACK Community Edition	Overview Applications	🗳 Gateways 🛛 🗮 Organiz	ations		EU1 Community No SLA applicable rakwirelessapp	•
Lo	RaWAN Devices Application		Applications > LoRaWAN Dev	vices Application > End devices > eui-ac1f09fffe053776			
. 0v	erview		eui-ac1f09ff ID: eul-ac1f09fffe05	fe053776 ³⁷⁷⁶			
A En	d devices		↑ n/a ↓ n/a • No activit	y yet 🛞			
🗐 Liv	e data		Overview Live data	Messaging Location Payload formatters Claiming	General settings		
<> Paj	yload formatters 🗸 🗸		General information		Live data	See all activity \rightarrow	
大 Int	egrations ~		End device ID	eui-acif09fffe053776	C 00:36:54 Create end device		
41 Col	llaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
OT AP	l keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
🔅 Ge	neral settings		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
			Created at	Jan 12, 2023 00:36:54			
			Activation information		Location	Change location settings →	
			AppEUI	60 60 60 60 60 60 60 60 60 60 60 60 60 6			
			DevEUI	AC 17 69 FF FE 65 37 76			
		\rightarrow	АррКеу				
			Session information		No location information available	Sector States	
			This device has not joined the	network yet			
			MAC data				

Figure 107: Copying the AppKey credential from TTN to WisToolBox

Setting up your Console

Figure 108: Setting up your Console

• For Device EUI (DevEUI)

Setting up your Console

Figure 109: Setting up your Console

Setting up your Console

Figure 110: Setting up your Console

THE THINGS STACK Community Edition	E Overview App	plications 🚢 Gateways 🚢 Organizat	tions		EU1 Community No SLA applicable ⁽³⁾	rakwirelessapp •
LoRaWAN Devices Application		Applications > LoRaWAN Devi	<pre>ices Application > End devices > eui-ac1f09fffe053776</pre>			
Overview		ID: eul-ac1f09fffe053	fe053776 ³⁷⁷⁶			
🙏 End devices		↑ n/a 🔸 n/a 🔹 No activity	/ yet 💿			
Elve data		Overview Live data N	Messaging Location Payload formatters Claiming	General settings		
<> Payload formatters ~		General information		Live data	See all activity \rightarrow	
犬 Integrations ~		End device ID	eui-ac1f09fffe053776	3 00:36:54 Create end device		
Collaborators		Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen_			
Or API keys		LoRaWAN version	LoRaWAN Specification 1.0.3			
General settings		Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
		Created at	Jan 12, 2023 00:36:54			
		Activation information		Location	Change location settings \rightarrow	
		AppEUI	00 00 00 00 00 00 00 00 👘			
		DevEUI	AC 17 00 FF FE 05 37 76			
		АррКеу				
		Session information		No location information availab	ble	
		This device has not joined the n	ietwork yet			
		MAC data				
		🛓 Download MAC data		Y V'		

Figure 111: Copying the DevEUI credential from TTN to WisToolBox

Setting up your Console

Figure 112: Setting up your Console

12. 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.

Setting up your Console

Figure 113: Setting up your Console

Setting up your Console

PARAMETERS

Figure 115: PARAMETERS

Global settings and LoRaWAN keys, ID, EUI

Figure 116: Global settings and LoRaWAN keys, ID, EUI

Global settings and LoRaWAN keys, ID, EUI details

Figure 117: 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 back to the WisToolBox console and type **AT+JOIN**. Edit it to **AT+JOIN=1** and 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.
Х	Auto-join config - 1: auto-join on power-up, 0: no auto-join
у	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:

VOTE:

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.

Joining mode using WisToolBox Console

Figure 118: Joining mode using WisToolBox Console

Divining mode using WisToolBox Console

Figure 119: Joining mode using WisToolBox Console

Joining mode using WisToolBox Console

Figure 120: Joining mode using WisToolBox Console

Joining mode using WisToolBox Console

Figure 121: Joining mode using WisToolBox Console

Figure 121: Joining mode using WisToolBox Console

Figure 121: Joining mode using WisToolBox Console

Figure 122: OTAA device successfully joined the network

CTAA device successfully joined the network

Figure 123: OTAA device successfully joined the network

15. With the end-device properly joined to 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

CTAA device sending payload to the network

Figure 124: OTAA device sending payload to the network

CTAA device sending payload to the network

Figure 125: OTAA device sending payload to the network

CTAA device sending payload to the network

Figure 126: OTAA device sending payload to the network

CTAA device sending payload to the network

Figure 127: OTAA device sending payload to the network

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

CTAA Test Sample Data Sent Viewed in TTN

Figure 128: 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 to which you want your device to be added. Then click + **Register end device**, as shown in **Figure 129**.

← → C 🗎 eu1.cloud.thethings.ne	twork/console/app	lications/lorawan-ne	w-device					년 ☆ 🛊 🎫 🛙 🖪 🗄
THE THINGS STACK Community Edition	Cverview	Applications	🛁 Gateways 🛛 🚢 Organiz	ations			EU1 Community Fair use policy applies (*)	rakwirelessapp •
LoRaWAN Devices Application			Applications > LoRaWAN De	evices Application				
Overview			LORAWAN D ID: lorawan-new-d	Devices Application				
📩 End devices			 No recent activity ③ 			🙏 0 Er	nd devices 🚓 1 Collaborator 🛛 🗛 0 API keys	
 Eive data Payload formatters ~ 			General information Application ID	lorawan-new-device	6	• Live data	See all activity \rightarrow pplication	
♣ Collaborators			Created at Last updated at	Jan 11, 2023 23:40:46 Jan 11, 2023 23:40:46				
• API keys								
			End devices (0)			Q Search =+	Import end device + Register end device	←
			ID ¢	Name ¢	DevEUI	JoinEUI	Last activity 🌣	
					No items	found		

Figure 129: Adding ABP Device

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

THE THINGS NET WORK	THE THINGS STACK Community Edition	Uverview	Applications	🚡 Gateways 🕮 Organizations	EU1 Community No SLA applicable ⑦	rakwirelessapp 🔻
👥 Lol	RaWAN Devices Application			Applications > LoRaWAN Devices Application > End devices		
Uve	rview			Register end device		
🙏 End	devices			Does your end device have a QR code? Scan it to speed up onboarding.		
💷 Live	data					
<> Pay	load formatters 🗸 🗸			End device type		
犬 Inte	grations 🗸			Input Method \odot		
🚢 Col	aborators			Select the end device in the LoRaWAN Device Repository Enter end device specifics manually		
OT API	keys			End device brand (2) *		
🤹 Ger	eral settings			Type to search		

Figure 130: 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.
Register end device Does your end device have a QR code? Scan it to speed up onboarding.
Register end device Does your end device have a QR code? Scan it to speed up onboarding.
Does your end device have a QR code? Scan it to speed up onboarding.
Does your end device have a QR code? Scan it to speed up onboarding.
Scan end device QR code
End device type
Input Method 🗇
Select the end device in the LoBaWAN Device Repository
Enter and device specific manually
Frequency plan ⑦ *
Select
LoRaWAN version \odot *
Select V
Regional Parameters version @ *
Colort
Selection
To continue, please enter versions and frequency plan information

Figure 131: 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 <u>■ Device registration help</u> [□]
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)
LoRaWAN version ⑦*
Select 🗸
Regional Parameters version ⑦*
Select 🗸
To continue, please enter versions and frequency plan information



Register end device
Does your end device have a QR code? Scan it to speed up onboarding.
C Scan end device QR code
End device type
Input Method \odot
Select the end device in the LoRaWAN Device Repository
Enter end device specifics manually
Frequency plan 🗇 *
Europe 863-870 MHz (SF9 for RX2 - recommended)
Lokawaw Specification 1.0.3
Regional Parameters version \odot *
RP001 Regional Parameters 1.0.3 revision A
Show advanced activation, LoRaWAN class and cluster settings ~
Provisioning information
JoinEUI 🕲 *
Confirm
To continue place entropies to infill of the and device on us an determine aphendian actions
 to continue, prease entre une some on the end device so we can determine onboarding options

Figure 133: 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**.

Does your end device have a QR code? Scan it to spe	ed up onboarding.
Scan end device QR code	<u>ition help</u> Ø
End device type	
Input Method 🗇	
Select the end device in the LoRaWAN Device Re	pository
 Enter end device specifics manually 	
Frequency plan ⑦*	
Europe 863-870 MHz (SF9 for RX2 - recommended)	
LoRaWAN version ⑦ *	
LoRaWAN Specification 1.0.3	
Regional Parameters version ⑦*	
RP001 Regional Parameters 1.0.3 revision A	
Show advanced activation, LoRaWAN class and clust	<u>ter settings</u> ~
Provisioning information	
JoinEUI ⑦*	

Figure 134: Setting up for your device

<u>SI</u>	how advanced activation, LoRaWAN class and cluster settings A
A	ctivation mode 🗇
	• Over the air activation (OTAA)
	Activation by personalization (ABP)
0	Define multicast group (ABP & Multicast)
A	dditional LoRaWAN class capabilities 🗇
	None (class A only)
N	etwork defaults 🗇
	Use network's default MAC settings
C	luster settings 🗇
	Skip registration on Join Server
Р	rovisioning information
)L	oinEUI⊘*
	Confirm
Т	o continue, please enter the JoinEUI of the end device so we can determine onboarding options

Figure 135: Setting up for your device

 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 the Provisioning information section. Then click Register end device.

VOTE:

 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)	
Network defaults 🗇	
Use network's default MAC settings	
Cluster settings 🗇	
Skip registration on Join Server	
DavEll	
DevEUI ⑦ Ø/50 Device address ⑦* Ø/50 Constraint Ø/50 AppSKey ⑦* Ø NwkSKey ⑦* Ø	C Generate
DevEUI ⑦	used ♀ Generate ♀ Generate
DevEUI ⑦ Ø/50 Device address ⑦* Ø/50 Device address ⑦* Ø/50 AppSKey ⑦* Ø NwkSKey ⑦* Ø End device ID ⑦*	 Ø Generate Ø Generate
DevEUI ⑦ Ø/50 Device address ⑦* Ø/50 Device address ⑦* Ø/50 AppSKey ⑦* Ø/50 NwkSKey ⑦* Ø/50 End device ID ⑦* Ø/50	used C Generate G Generate
DevEUI ⑦ Constraints Device address ⑦* Constraints Device address ⑦* Constraints Device address ⑦* Constraints Device address ⑦* Constraints Device ID ⑦* This value is automatically prefilled using the DevEUI	 used Generate Generate
DevEUI ⑦ Control Cont	 Ø Generate Ø Generate
DevEUI ⑦ Control Cont	used C Generate C Generate



FIONSIONING	nformation
DevEUI 💿	
AC 1F 09 FF	CEC 05. 36 0P1 🗘 Generate 0/50 used
Device address ②	*
	🗘 Generate
AppSKey 🗇 *	
	••••••••••••••••••••••••••••••••••••••
NwkSKey ⑦*	
	••••••••••••••••••••••••••••••••••••••
End device ID ⑦ *	
eui-ac1f09fffe053	i6df
This value is auton	natically prefilled using the DevEUI
This value is auton	natically prefilled using the DevEUI
This value is auton After registration • View registere	atically prefilled using the DevEUI

Figure 137: Setting up for your device

BAK Documentation Center

DevEUI ⑦	
AC Generate 0/50 used	1
Device address ⑦ *	
•••••• 🗘 Generate	
AppSKey ⑦ *	
	· · Ø Generate
NwkSKey ⑦ *	
	· · · Ø 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 	

Figure 138: Setting up for your device

Provisioning information	
DevEUI 🗇	
AC 15 09 15 15 05 30 01	
Device address [®] *	
26 00 52 00 Generate	
AppSKey ⑦ *	
\checkmark Generate	-
NwkSKey ② *	
🤣 Generate	
End device ID 🗇 *	
eui-ac1f09fffe0536df	
This value is automatically prefilled using the DevEUI	
After registration	
View registered end device	
O Register another end device of this type	
Register end device	

Figure 139: Setting up for your device

Deveol (2)							
AC 18 09 P		ϕ Generate	0/50 used				
Device address	⊘*						
26 08 52 0	\circ ϕ Generate						
AppSKey ⑦ *							
1F FA AG 8				🗘 Generate			
NwkSKey ⑦*							
				ϕ Generate			
End device ID @)*						
eui-ac1f09fffe	0536df						
This value is aut	tomatically prefilled	using the DevEUI					
After registratio	on						
• View registe	ered end device						
Register and	other end device of t	this type					

Figure 140: Setting up for your device

Provisioning information	
DevEUI 🗇	
AC 15 69 FF FE 65 36 DF	
Device address ⑦*	
26 Generate	
AppSKey ⑦ *	
1F FA A6 81 6F 7D 3E CE 3A AA 11 A5 EA 88 18 4C	🗘 Generate
NwkSKey ⑦ *	
92 DD C9 51 85 9F 78 31 F6 85 47 96 CC FA 81 07	🗘 Generate
End device ID ⑦ *	
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 141: 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 142**.

THE THINGS STACK Community Edition	Uverview	Applications	🔒 Gateways	A Organizations			EUI Community No support plan ③				
LoRaWAN Devices Application				Applications > LoRaWAN Devices Application > End devices > eul-ac1R0#Re038def							
Cverview				eui-ac1f09fffe0536df ID: eui-ac1f0fffe0536df							
Live data				↑ n/a ↓ n/a • No activit Overview Live data	↑ n/a ↓ n/a ↓ No activity yet ① Overview Live data Messaging Location Payload formatters General settings						
<> Payload formatters ~ \$\mathcal{L}\$ Integrations ~				General information End device ID	eui-acii09fffe0836df	Live data 1 23:23:20 Create end device DevAddr: 26 08 52 DC ○ 1 1	iee all activity →				
Collaborators API keys Convolution				Frequency plan LoRaWAN version Regional Parameters version	Europe 863-870 HHz (SF9 for RX2 - recommen.						
General settings				Created at	Jan 16, 2023 23:23:20	Location Change loc	cation settings				
				AppEUI DevEUI	n/a [AC] O [%]						
				Session information Session start	Jan 16, 2023 23:23:21	No location information available	55				
				Device address NwkSKev	26						
				SNwkSIntKey	······ • • • • • • • • • • • • • • • •						
				NwkSEncKey AppSKey	····· · · · · · · · · · · · · · · · ·						

Figure 142: ABP device successfully registered to TTN

ABP Configuration for TTN

The RAK3172 module can be configured using WisToolBox to do the ABP configuration. **WisToolBox** is a software tool that supports **RAK3172** module. It automatically detects the RAK3172 module once it is connected to the PC. Below are the options in WisToolBox where 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 the 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 the **CONNECT DEVICE** button to launch the WisToolBox Dashboard.



Figure 143: CONNECT DEVICE

3. Select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT**, as shown in **Figure 145**.

Wis ToolBox =		X
Dashboard	Connectio	on settings
Templates	Port	COM12 ~
Firmware	Device	Unidentified Select manually
	Baud Rate	115200 ~
DEVICES (폐) RAK3172 COM13 ▲	Byte Size	8 ~
	Parity	None ~
	Stop Bits	1 2
	<i>ೇ</i> c	ONNECT
	CA	NCEL

Figure 144: Setting up your device

Wis ToolBox 🛛 🗏		
Dashboard	Connection set	tings
Templates	Port COM	113 ~
Firmware	Device rak3	172
	Baud Rate 1152	200 ~
	Byte Size 8	~
	Parity Non	e ~
	Stop Bits 1	2
	CANCEL	
⑦		

Figure 145: Setting up your device

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

Wis ToolBox =	000000000000000000000000000000000000000	00000		×
Dashboard	WisDuo LPWAN Module for LoRaWAN	() LORAWAN	■ 100%	
Templates		(Toll)		
Firmware				
DEVICES				
()≠1) RAK3172 COM13 ▲				
🤊 ⊘ 🏟 RAK ID				

Figure 146: 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.

ToolBox	P 🚳 RAK	WisDuo LP LoRaWAN	WAN Module for	>
emplates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	STATUS	(1997) - 🔳 100%	
		DEVICE EUI	00	D
		MODEL	rak3172	
сом13 🛦	DEVICE INFO	FIRMWARE	RUI_3.5.4_RAK3172-E AT DEF	AULT
_	PARAMETERS	HARDWARE ID	stm32wle5xx	Q
	ADVANCED	LAST SYNC	1/19/2023, 3:03:56 PM	С
	FIRMWARE			
		DOCUMEN	TATION [2	
nak id				

Figure 147: 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 bands, you can choose among active regions based on your location.
- LoRa network mode: LoRaWAN
- LoRaWAN join mode: ABP
- LoRaWAN region: EU868

Wis ToolBox =		Device Parameters Sync less then 1 min ago C	×
Dashboard	🔛 🏟 RAK	SAVE AS TEMPLATE APPLY A TEMPLATE	
Templates Firmware	RAK3172 CE DevE UI: AC1F09FFF6052B2E UI: AC1F09FFF6052B2E UK (P) 0 2 4 CA	Global settings ✓]
DEVICES	L	 LoRaWAN keys, ID, EUI 	
()≠1) RAK3172 COM13 ▲	DEVICE INFO	Date on LoDe® activation	
	PARAMETERS		
	ADVANCED	⑦ LoRa [©] network management ∨	
		 Generic LoRaWAN instructions ~ 	
		① LoRaWAN multicast group ~	
(?) (() (*******************************		 Custom Commands ~ 	

Figure 148: Global settings

Wis ToolBox =		_
		Device Parameters Sync less then 1 min ago C
Dashboard	🔛 🍥 RAK	SAVE AS TEMPLATE APPLY A TEMPLATE
Templates	RAK3172 CE	
Firmware		③ Global settings ^
		Network mode LoRaWAN P2P
DEVICES		Join mode OTAA ABP
()≠1) RAK3172 COM13 ▲	DEVICE INFO	
	PARAMETERS	Active region EU868 ~
	ADVANCED	
	FIRMWARE	
		 LoRaWAN keys, ID, EUI
		⑦ Data on LoRa [©] network ∨
		 LoRa[®] network management
? 🐼 🏟 RAK ID	1 Command MODEL RAK3172	PORT COMI3 A APPLY COMMAND

Figure 149: Global settings

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

Wis ToolBox =		Device Param	leters	X	
Dashboard	💾 🏟 RAK	SAVE AS TEMPLATE APPLY A		APPLY A TEMPLATE	
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E				
Firmware		 Global settings 		^	
		Network mode	LoRaWAN	P2P	
		Join mode	OTAA	ABP	
COMISE	PARAMETERS	Active region	FU868	~	
	ADVANCED	heareregion			
	FIRMWARE	 LoRaWAN keys, ID, EUI ~ Data on LoRa[®] network ~ LoRa[®] network management ~ 			
? 🛞 🏟 RAK ID	1 Command MODEL RAK3172	PORT COM13		APPLY COMMAND	

Figure 150: LoRaWAN keys, ID, EUI

Wis ToolBox =		Device Parame	eters	Sync less then 1 min ago
Dashboard	💾 🏟 RAK 🛔	SAVE AS TEMPLA	APPLY A TEMPLATE	
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	Join mode	OTAA	ABP
Firmware		Active region	EU868	~
EVICES				
ศ) RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys, IE 	D, EUI	^
	PARAMETERS			
	ADVANCED	Application session key	000000000000000000000000000000000000000	000000000000000000000000000000000000000
	FIRMWARE	Device address	0000000	8/8
		Network session key	000000000000000000000000000000000000000	00000000000000000000
		Network ID	000000	
? 🔕 🏟 RAK ID	1 Command MODEL RAK3172	PORT COM13		APPLY COMMAND

Figure 151: Setting up your device

 Then go back to the 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 159.

NOTE:

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



Figure 152: Your created ABP device from your console

• For Application session key (AppSKey)

THE THINGS NETWORK	THE THINOS STACK Community Edition	Overview	Applications	📾 Gateways	A Organizations			EU1 Community No support plan ()
LoRa	WAN Devices Application			_	Applications > LoRaWAN Dev	vices Application > End devices > eui-ac1f09fffe0536df		
Covers	/iew levices				eui-ac1f09ff ID: eui-ac1f09fffe05 ↑n/a ↓n/a • No activit	ffe0536df ^{Sedf} ∫y yet ☉		
🗐 Live d	lata				Overview Live data	Messaging Location Payload formatters General set	lings	
<> Paylo	ad formatters ~				General information	au1-an11001114053641	Live data See all activity 21/31/20 Create and device Devalder: 26 08 52 DC (2) (6)	-
🕰 Collai	borators				Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen		
O+ API ka	tys				LoRaWAN version	LoRaWAN Specification 1.0.3		
🔅 Gener	ral settings				Regional Parameters version Created at	RPDD1 Regional Parameters 1.0.3 revision A		
					Activation information		Location Change location settings	-
					AppEUI DevEUI	n/a [AC] O ()		
					Session information			
					Session start	Jan 16, 2023 23:23:21	No location information available	
					NwkSKey	•••		
					SNwkSIntKey	•••••••••••••••••••••••••••••••••••••••		
					NwkSEncKey	••••••		
					AppSKey			



		Device Parame	eters	🗌 X	
Dashboard	Part 🖗 🖗	SAVE AS TEMPLATE		APPLY A TEMPLATE	
() Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	loin mode	ОТАА	APD	
Firmware		Active region	EU868	→ Abr	
DEVICES					
() RAK3172 COM13 ▲	DEVICE INFO	① LoRaWAN keys, ID, EUI			
	PARAMETERS				
	ADVANCED	Application session key	1FFA	SECESAAA11ASEABOI	
	FIRMWARE	Device address	0000000	8/8	
		Network session key	000000000000000000000000000000000000000	0000000000000 32/32	
		Network ID			
(7) (2) (10) (10) (10) (10) (10) (10) (10) (10					
	4 Commands in queue MODEL RA	K3172 PORT COM13	^	APPLY COMMANDS	

Figure 154: Copying the AppSKey credential from TTN to WisToolBox

• For Device address
THE THINGS NETWORK	THE THINOS STACK Community Edition	S Overview	Applications	🔒 Gateways	A Organizations				EU1 Community No support plan (*)	rakwirelessapp 👻
LoRa	WAN Devices Application				Applications > LoRaWAN Dev	vices Application > End devices > eui-ac1f09fffe0536df				
					eui-ac1f09ff	ffe0536df				
Cverv	/lew				ID: eui-ac1f09fffe05	36df				
🙏 End d	levices				↑n/a ↓n/a •Noactivit	ty yet ⊙				
🗐 Live d	lata				Overview Live data	Messaging Location Payload formatters General set	tings			
<> Paylo	ad formatters 🗸 🗸				General information		• Live data	See all activity -		
犬 Integr	rations ~				End device ID	eui-acif09fffe0536df	23:23:20 Create end device DevAddr: 26 08 52 0	0 0 1		
2 Collat	borators				Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen				
O- API ke	1/5				LoRaWAN version	LoRaMAN Specification 1.0.3				
Canar	ral rations				Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A				
Gener	an ann agus agus agus agus agus agus agus agus				Created at	Jan 16, 2023 23:23:20				
					Activation information		Location	Change location settings –		
					AppEUI	n/a				
					DevEUI	AC 0.000 0 0				
					Session information	Jan 16, 2023 23:23:21				
				\rightarrow	Device address	26 🗘 👘	No location information available			
					NwkSKey					
					SNwkSIntKey					
					NwkSEncKey	••••••				
					AppSKey	••••••				



		Device Parame	eters	_ 🗌 X
Dashboard	Part 🚳 🖗	SAVE AS TEMPLA	ΔTE	APPLY A TEMPLATE
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	lais mode	0744	405
C: Firmware		Join mode Active region	EU868	~ ABP
DEVICES				
() RAK3172 COM13 ▲	DEVICE INFO	🚯 LoRaWAN keys, ID), EUI	^
	PARAMETERS			
	ADVANCED	Application session key	1FFA 0816F7D	3ECE3AAA11A5EAB01(32/32)
	FIRMWARE	Device address	26)85200	(8/8)
		Network session key	0000000000	0000000000000 32/32
		Network ID		
? 🔊 🏟 RAK ID	Commands in queue MODEL RA	AK3172 PORT COM13	^	APPLY COMMANDS

Figure 156: Copying the Device address credential from TTN to WisToolBox

• For Network session key (NwkSKey)

THE THINGS STACK	😫 Overview 🗖 Applications 📑 Gateway	AL Organizations	EUI Community No support plan ③
LoRaWAN Devices Application		Applications > LoRaWND Devices Application > End devices > exi+cc100MHedS36df	
Overview A End devices		eul-aclf09fffe0536df Brei-aclf09fffe0536df ↑ nà + Na achthyst ©	
Live data		Ownerse Unitable Persaging Coston Payload commans General information End device ID ext-at1092ffe60536df Image: Coston Image: Coston Image: Coston See at Frequency plan Excope 883-070 Mitz (SV9 for 802 - recommen. Image: Coston Image: Cos	Ladody –
		Created at Jan 14, 2023 223230 Activation Information Creation Charge location AppELI n/b Image: Comparison of the compa	settings
		Sension start Jan 14, 2023 232321 Dension address 24 NakSSflow/ ••••••••••••••••••••••••••••••••••••	



Wis ToolBox =		Device Parame	eters	_ C ×
Dashboard	Part 🖗 🔛	SAVE AS TEMPLA	ITE	APPLY A TEMPLATE
Templates	RAK3172 CE DevE UI: AC1F09FFFE052B2E	loin mode	ΟΤΑΑ	ABP
Eirmware		Active region	EU868	~
DEVICES				
() RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys, ID), EUI	^
	PARAMETERS			
	ADVANCED	Application session key	1FFA	ECE3AAA11A5EAB01 32/32
	FIRMWARE	Device address	26	8/8
	_	→ Network session key	92DD	7831F68E4700CCF4 32/32
		Network ID		
?	4 Commands in queue MODEL F	AK3172 PORT COM13	^	APPLY COMMANDS

Figure 158: Copying the NwkSKey credential from TTN to WisToolBox

• WisToolBox Dashboard

		Device Param	eters	_ C ×
Dashboard	💾 🏟 RAK	SAVE AS TEMPL	ATE	APPLY A TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	Join mode	ΟΤΑΑ	ABP
Firmware		Active region	EU868	~
DEVICES				
()#) RAK3172 COM13 ▲	DEVICE INFO	 LoRaWAN keys. II 	D. EUI	^
	PARAMETERS	0,-,-,-	-, ·	
	ADVANCED	Application session key	1FFA	CE3AAA11ASEAB01 32/32
	FIRMWARE	Device address	26	8/8
		Network session key	92DD	01F68E4796CCFA 32/32
		Network ID		
?	4 Commands in queue	EL RAK3172 PORT COM13	$ \rightarrow $	APPLY COMMANDS

Figure 159: 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**.

Wis ToolBox =						
Dashboard	Commands applied to RAK3172 WisDuo LPWAN Module					
Templates	for LoRaWAN					
Firmware	Soin mode	Successful	16:55			
DEVICES (⊮) RAK3172 COM13 ▲	Application session key	Successful	16:55			
	Device address	Successful	16:55			
	Network session key	Successful	16:55			
? 😞 🏟 RAK ID	CLOSE					

Figure 160: Summary of commands

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

Wis ToolBox =		Dovico Paramo	ators	
Dashboard	Par 🖗 🖗	SAVE AS TEMPLA	ATE	APPLY A TEMPLATE
Templates	RAK3172 CE Deve UI: AC1F09FFFE052B2E	 Global settings 		<u>^</u>
e: Firmware	(P) 🔤 ČÀ	Network mode	LoRaWAN	P2P
evices Ø RAK3172 COM13 ▲	DEVICE INFO	Join mode	OTAA	ABP
	PARAMETERS	Active region	EU868	~
	ADVANCED			
	FIRMWARE	i LoRaWAN keys, ID), EUI	^
		Application session key	1FFA	283AAA11A5EAB01 32/32
		Device address	26085200	8/8
		Network session key	92DD	31F68E479600FA 32/32
		Network ID		

Figure 161: 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 the **CONNECT DEVICE** button to launch the WisToolBox Dashboard.

CONNECT DEVICE

Figure 162: CONNECT DEVICE

3. Select your target port where your **RAK3172** is connected. Once recognized, click **CONNECT**, as shown in **Figure 164**.

Setting up your device

Figure 163: Setting up your device

Setting up your device

Figure 164: Setting up your device

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

Device seen from WisToolBox dashboard

Figure 165: Device seen from WisToolBox dashboard

5. Then click **ADVANCED**.

Setting up your device

Figure 166: Setting up your device

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



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.



 Then configure the LoRaWAN join mode to ABP. You can check what parameter you will input by typing AT+NJM?, and then Enter into the console terminal. For ABP, you should input AT+NJM=0, and then press Enter as shown in Figure 173.

Setting up your Console

Setting up your Console

Figure 174: Setting up your Console

Setting up your Console

Figure 175: Setting up your Console

Once done, set up your LoRaWAN region to EU868. You can check what parameter you will input by typing AT+BAND?, and 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 bands, 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

Code	Regional Band
11	AS923-4
Setting up your Console	Figure 176: Setting up your Console
Setting up your Console	Figure 177: Setting up your Console
Setting up your Console	Figure 178: 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.

THE THINGS STACK	Cverview	Applications	🛋 Gateways	A Organizations				EU1 Community No support plan ⁽²⁾	rakwirelessapp -
11 LoRaWAN Devices Application			-	Applications > LoRaWAN De	vices Application > End devices > eui-ac1f09fffe0536df				
Cverview				eui-ac1f09ff ID: eui-ac1f09fffe05	ffe0536df ^{Sledf}				
End devices End devices				↑ n/a ↓ n/a • No activi Overview Live data	ty yet ⊕ Messaging Location Payload formatters General sett	lings			
<> Payload formatters \$\overline\$ Integrations <>				General information End device ID	eui-acif09fffe0536df	• Live data © 23:23:20 Create end device DevAddr: 260	See all activity		
Collaborators				Frequency plan	Europe 863-870 NHz (SF9 for RK2 - recommen				
🔅 General settings				Regional Parameters version Created at	RP001 Regional Parameters 1.0.3 revision A 🐚				
				Activation information		Location	Change location settings →		
				AppEUI DevEUI	n/a AC O 6				
				Session information					
				Session start	Jan 16, 2023 23:23:21		and the second		
				Device address	26	No tocation information av	litable		
				NwkSKey	••••••				
				SNwkSIntKey	••••••				
				NwkSEncKey	••••••				
				AppSKey	••••••				

Figure 179: Your created ABP device from your TTN console

Setting up your Console	
	Figure 180: Setting up your Console
Setting up your Console	
	Figure 181: Setting up your Console
Setting up your Console	
	Figure 182: Setting up your Console

THE THINGS STACK Community Edition	S Overview Application	s 🛋 Gateways	2 Organizations			EUI Community No support plan ①	sapp 👻
LoRaWAN Devices Application			Applications > LoRaWAN De	vices Application > End devices > eui-ac1f09fffe0538df			
Cverview			Eui-ac1f09ff ID: eui-ac1f09fffe05	ffe0536df ^{Sedf}			
🙏 End devices			↑ n/a ↓ n/a • No activit	ty yet 🗇			
Live data			Overview Live data	Messaging Location Payload formatters General setti	ngs		
<> Payload formatters ~			General information		Live data	See all activity →	
犬 Integrations ~			End device ID	eui-acif09fffe0536df	Q 23:23:20 Create end device DevAddr: 26 08 52	10 ↔ M	
2. Collaborators			Frequency plan	Europe 863-870 MHz (SF9 for RX2 - recommen)			
Ow API keys			LoRaWAN version	LoRaWAN Specification 1.0.3			
🔅 General settings			Regional Parameters version	RP001 Regional Parameters 1.0.3 revision A			
			Created at	Jan 16, 2023 23:23:20			
			Activation information		Location	Change location settings \rightarrow	
			AppEUI	n/a			
			DevEUI	▲ AC 100000000000000000000000000000000000			
			Session information				
			Session start	Jan 16, 2023 23:23:21	No location information available		
			Device address	26 00000 🗘 🕼			
			NwkSKey				
			SNwkSIntKey	••••••			
			NwkSEncKey	••••••			
		\rightarrow	AppSKey				



Setting up your Console

Figure 184: Setting up your Console

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

Setting up your Console	
	Figure 185: Setting up your Console
Setting up your Console	
	Figure 186: Setting up your Console
Setting up your Console	

Figure 187: Setting up your Console

THE THINGS THE CO	THINGS STACK	Uverview	Applications	🛁 Gateways	2 Organizations			EU1 Community No support plan (*)	rakwirelessapp •
LoRaWAN Devices A	pplication			-	Applications > LoRaWAN Dev	rices Application > End devices > eul-ac1f09fffe0536df			
Cverview					eui-ac1f09ff ID: eui-ac1f09fffe053	ffe0536df _{36df}			
Live data					↑n/a ↓n/a •Noactivity Overview Live data	y yet ⊕ Messaging Location Payload formatters General set	tings		
<> Payload formatters	×				General information End device ID	eui-acif09fffe0536df	Livedata See all activit @ 23:23:20 Create end device DevAddr: 26 08 52 DC ↔ @	/	
Collaborators					Frequency plan LoRaWAN version	Europe 863-870 NHz (SF9 for RX2 - recommen.)			
General settings					Regional Parameters version Created at	RP001 Regional Parameters 1.0.3 revision A			
					Activation information	nía	Location Change location setting	:→	
					DevEUI				
					Session information Session start	Jan 16, 2023 23:23:21			
				\rightarrow	Device address	26 0000	No location information available		
				-	NwkSKey	••••••			
					SNwkSIntKey	•••••••••••••••••••••••••••••••••••••••			
					NwkSEncKey	····· § 0			
					npponey				



Setting up your Console

Figure 189: Setting up your Console

• For Network session key (NwkSKey)

Setting up your Console

Setting up your Console

Figure 191: Setting up your Console

Setting up your Console

Figure 192: Setting up your Console

THE THINGS STACK Community Edition	🚦 Overview 🔲 Applications 🛋 Gateways	AL Organizations	EU1 Community No support plan ①
11 LoRaWAN Devices Application		Applications > LoRaWAW Devices Application > End devices > eu+ac100ffe0336df	
Overview End devices		eui-ac1f09fffe0536df Rt eui-ac1509fffe0536df ↑ re/a - 4-re/a - Koasthityyst ©	
Live data		Overview Live data Messaging Location Payload formatters General settings	
Payload formatters X Integrations Collaborators API keys General settings		General Information Lot data Security End device ID et-st109ffffe0366f frogenery plan frogenery plan frogenery plan for data 2212120 Create and device for data 20 60 62 02 (shriy -
	→	DefUl AC O No Restor Information Session dark Jan 16, 2022 22:23:21 Device address 26 O No Restor Information numbers NukSfired/Sey O O No Restor Information numbers NukSfired/Sey O O No Restor Information numbers AppSiley O O O O O O O O O O O O O O O O O O O	

Figure 193: Copying the NwkSKey credential from TTN to WisToolBox

Setting up your Console

13.

Figure 194: 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.

Setting up your Console
Figure 195: Setting up your Console
Setting up your Console
Figure 196: Setting up your Console
PARAMETERS
Figure 197: PARAMETERS
Global settings and LoRaWAN keys, ID, EUI
Figure 198: Global settings and LoRaWAN keys, ID, EUI
Global settings and LoRaWAN keys, ID, EUI details
Figure 199: Global settings and LoRaWAN keys, ID, EUI details
Now you have a configured ABP device using WisToolBox Console. ABP-configured devices are directly tied to the network once done with the above procedures so the joining procedure is not needed.

14. Now, you can try sending the 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

ABP device sending payload to the network
Figure 200: ABP device sending payload to the network
ABP device sending payload to the network
Figure 201: ABP device sending payload to the network
ABP device sending payload to the network
Figure 202: ABP device sending payload to the network
Figure 202: ABP device sending payload to the network
Figure 203: ABP device sending payload to the network
15. You can see the data sent by the RAK3172 module on the TTN device console *Live data* section. Also, the *Last seen* info should be a few seconds or minutes ago.
ABP Test Sample Data Sent Viewed in TTN

Figure 204: ABP Test Sample Data Sent Viewed in TTN

Connecting with ChirpStack

This section shows how to connect the RAK3172 module to the ChirpStack platform.



Figure 205: RAK3172 Module in the Context of the ChirpStack Platform

The ChirpStack, previously known as the LoRaServer project, provides open-source components for building LoRaWAN networks. In the case of TTN, the RAK3172 module is located in the periphery and will transmit the data to the backend servers through a LoRa gateway. Learn more about ChirpStack

NOTE:

It is assumed that you are using a 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. In a 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 module

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 206.

€	ChirpStack				? \varTheta admin	
	Network-servers	Applications	Applications			+ CREATE
R	Gateway-profiles					
E.	Organizations	ID	Name	Service-profile	Description	
Ť	All users	1	арр	service-profile	арр	
chirp	pstack -				Rows per page: 10 ▼ 1-	1 of 1 < >
¢	Org. settings					
*	Org. users					
±≡	Service-profiles					
크는	Device-profiles					
R	Gateways					
	Applications					
٣	Multicast-groups					

Figure 206: Application Section

By default, you should create a new application, although you can reuse existing ones. For this setup, create a new Application by clicking on the CREATE button and filling in the required parameters, as shown in Figure 207 and Figure 208.

€	ChirpStack	Q. Search organization, application, gateway or device 🕜 😝 admin
	Network-servers Gateway-profiles	Applications / Create
	Organizations	
<u>*</u>	All users	Application name * The name may only contain words, numbers and dashes.
chirp	stack -	
۵	Org. settings	Application description * Service-profile *
<u>.</u>	Org. users	Select service-profile
±≡	Service-profiles	The service-profile to which this application will be attached. Note that you can't change this value after the application has been created. Payload codec
	Device-profiles	None Re defining a payload codes. ChiroStack Application Server can encode and decode the binary device payload for you important note: the payload fields have moved to the device-profile. For backward-compatibility and migration existing codes settings are still vielble.
R	Gateways	Codec settings on the device-profile have priority over the application codec settings.
	Applications	CREATE APPLICATION
2	Multicast-groups	

Figure 207: 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: Field is to select the system profile.

• Payload codec: It is the parsing method for selecting load data, such as parsing LPP format data.

€	ChirpStack	Q Search organization, application, gateway or device 3 e admin
• ®	Network-servers Gateway-profiles	Applications / Create
•	Organizations All users	Application name * rak_node_test The name may only contain words, numbers and dashes.
chirp	stack 👻	Application description *
۵	Org. settings	Service-profile *
•	Org. users	service-profile The service-profile to which this application will be attached. Note that you can't change this value after the application has been created.
*≡	Service-profiles	Payload codec
	Device-profiles	Note Py defining a payload codes, ChirpStack Application Server can encode and decode the binary device payload for you.Important note: the payload fields have moved to the device-profile. For backward-compatibility and migration, existing codes settings are still visible. Codes settings on the device-profile have priority over the application codes settings.
R	Gateways	
	Applications	CREATE APPLICATION
9	Multicast-groups	

Figure 208: 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 209** and **Figure 210**.
- 2. Once done, click the "+ CREATE" button.

€	ChirpStack				Q Search organization, application, gateway or device	? 🖯 admin		
	Network-servers	4	pplications				+ CREATE	
R	Gateway-profiles							
E	Organizations		ID	Name	Service-profile	Description		
-	All users		1	app service-profile		арр		
chir	pstack +		2	rak_node_test	service-profile	test		
٠	Org. settings					Rows per page: 10 💌	1-2 of 2 < >	
-	Org. users							
±≡	Service-profiles							
븊	Device-profiles							
R	Gateways							
	Applications							
2	Multicast-groups							

Figure 209: List of Applications Created

								_
	Network-servers Gateway-profiles	Applications / r	ak_node_test				DELE	TE
Ð	Organizations	DEVICES	APPLICATION CONFIGURATION INTEGRATIONS	FUOTA				
•	All users							TF
chir	ostack -						1 oner	
٠	Org. settings	Last seen	Device name	Device EUI	Link margin	Battery		
*	Org. users					Rows per page: 10 👻 0-0 of 0	$\langle \rangle$	
±=	Service-profiles							
	Device-profiles							
\bigcirc	Gateways							
	Applications							
٣	Multicast-groups							

Figure 210: Device Tab of an Application

3. Once inside the **DEVICES** tab, create a new device (LoRaWAN node) by clicking on the "+ **CREATE**" button.

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€	ChirpStack			Q Search organization, application, gatew	ay or device 🕜 😝 admin
81 81 81	Network-servers	Applications / rak pade test			T DELETE
\bigcirc	Gateway-profiles	Applications / Tak_noue_test			
	Organizations	DEVICES APPLICATION CONFIGURATION INTEGRATIONS	FUOTA		
<u>*</u>	All users				
chirp	ostack 👻				+ CREATE
¢	Org. settings	Last seen Device name	Device EUI	Link margin	Battery
<u>.</u>	Org. users			Rows pe	rr page: 10 ▼ 0-0 of 0 < >
≛≡	Service-profiles				
	Device-profiles				
R	Gateways				
	Applications				
9	Multicast-groups				

Figure 211: Add a New Device

€	ChirpStack	Q. Search organization, application, gateway or device	e ad	lmin
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
•	Organizations All users	GENERAL VARIABLES TAOS		
chirp	stack +	Device name * The name may only contain words, numbers and dashes.		- 1
۵	Org. settings	Device description *		
*	Org. users			
±≡	Service-profiles	Device EUI *	вС	>
井	Device-profiles	Device-profile * Device-profile		
\mathbb{R}	Gateways			
	Applications	Disable frame-counter validation Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
Ψ	Multicast-groups	CREA	TE DEVIC	æ

Figure 212: 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 builtin 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.

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∉	ChirpStack	Q Search organization, application, gateway or device e admin
R	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create
)•	Organizations All users	OENERAL VARIABLES TAGS Device name *
chirp Chirp	Org. settings	rak_node The name may only contain words, numbers and dashes. Device description* Tet
• =	Org. users Service-profiles	Device EUI* 5E 9D 1E 08 57 CF 25 F1 MSB C
₩ ®	Device-profiles Gateways	Device-profile* perice-profile_otaa
ي ا	Applications Multicast-groups	device_profile_otaa
		CREATE DEVICE

Figure 213: Generate a New Device EUI

Chirpstack OTAA Device Registration

1. If you have selected **DeviceProfile_OTAA**, as shown in **Figure 214**, then after the device is created, an Application Key must be also created for this device.

€	ChirpStack	Q Search organization, application, gateway or device 🕑 😁	admin
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create	
•	Organizations All users	GENERAL VARIABLES TAOS Device name*	
chirp	ostack -	rak_node	
¢	Org. settings	Device description * test	
*	Org. users	Device STL*	_
≞≡	Service-profiles	5E 9D 1E 08 57 CF 25 F1 MSB	C
븊	Device-profiles	Device_profile_otaa	
R	Gateways		
	Applications	Disable frame-counter validation Note that disabiling the frame-counter validation will compromise security as it enables people to perform replay-attacks.	
ψ	Multicast-groups	CREATE DE	VICE

Figure 214: 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 215**.

€	ChirpStack	Q Search organization, application, gateway or device	?	e admin
	Network-servers	Applications / rak node test / Devices / rak node		DELETE
R	Gateway-profiles			
₽	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
*	All users			
chirp	ostack 👻	Application key * F9 21 D5 0C D7 D0 2E E3 C5 E6 14 21 54 F2 74 B2	G	8
۵	Org. settings	For LoRaWAN 1.0 devices. In case your device supports LoRaWAN 1.1, update the device-profile first.		
*	Org. users	Gen Application key MSB	G	8
<u>_</u> ≡	Service-profiles	For LoRaWAN 1.0 devices. This key must only be set when the device implements the remote multicast setup specification / firmware updates over the air (FUOTA). Else leave this field blank.		
幸	Device-profiles		SET DEV	CE-KEYS
R	Gateways			
	Applications			
2	Multicast-groups			



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

€	ChirpStack				Q Search organization, application, gateway or	device		? 8	admin
	Network-servers	Applications / ra	uk node test						DELETE
\bigcirc	Gateway-profiles	Applications / Ta	in_indie_test						
	Organizations	DEVICES	APPLICATION CONFIGURATION INTEG	SRATIONS FUOTA					
<u>.</u>	All users							_ ·	
chirp	ostack -							+ (CREATE
۵	Org. settings	Last seen	Device name	Device EUI	Link margin		Battery		
<u>•</u>	Org. users	n/a	rak_node	5e9d1e0857cf25f1	n/a		n/a		
≛≡	Service-profiles				Rows per page	10 🖛	1-1 of 1	<	>
큪	Device-profiles								
\bigcirc	Gateways								
	Applications								
٣	Multicast-groups								

Figure 216: 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 217.

€	ChirpStack	Q Search organization, application, gateway or device	?	😫 admin
	Network-servers	Applications / rak_node_test / Devices / rak_node		DELETE
R	Gateway-profiles			
E	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE		
•	All users			
chir	ostack 👻	Application key * 19 21 d5 0c d7 d0 2e e3 c5 e6 14 21 54 12 74 b2	G	9
\$	Org. settings	For LoRaWAN 1.0 devices. In case your device supports LoRaWAN 1.1, update the device-profile first.		
-	Org. users	Gen Application key		0
.≞≡	Service-profiles	For LoRaWAN 1.0 devices. This key must only be set when the device implements the remote multicast setup specification / firmware updates over the air (FUOTA). Else leave this field blank.		
幸	Device-profiles		SET DEV	CE-KEYS
R	Gateways			
	Applications			
2	Multicast-groups			

Figure 217: Application Key Associated with the New Device

VOTE:

Standard OTAA mode requires the **Device EUI**, **Application Key**, and **Application EUI**, but in 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 module supports a series of AT commands to configure its internal parameters and control the functionalities of the module.

1. To set up the RAK3172 module to join the Chirpstack using OTAA, start by connecting the RAK3172 module to the Computer (see Figure 35) 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:



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

You will receive or 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 218**.

NOTE:

If there is no 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.

	Command	
	LOSE 01 at+version	SEND
RECEIVING	RECV 02 at+get_config=device:status	SEND
	□ 03 at+set_config=device:sleep:0	SEND
ок	□ 04 at+set_config=device:restart	SEND
	05 at+set_config=device:gps:1	SEND
ОК	06 at+set_config=lora:work_mode:0	SEND
AT	07 at+set_config=lora:join_mode:0	SEND
	□ 08 at+set_config=lora:class:0	SEND
ок	□ 09 at+set_config=lora:region:EU868	SEND
	□ 10 at+set_config=lora:confirm:1	SEND
	□ 11 at+set_config=lora:ch_mask:0:0	SEND
	□ 12 at+set_config=lora:dev_eui:	SEND
	□ 13 at+set_config=lora:app_eui:	SEND
	□ 14 at+set_config=lora:app_key:	SEND
	□ 15 at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
	at+set_config=lora:apps_key:	SEND
	18 at+set_config=lora:send_interval:	SEND
ENDING(With \r\n)	□ 19 at+get_config=lora:status	SEND
AT	☑ 20 at+get_config=lora:channel	SEND
s	All/None	SAVE

Figure 218: 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.

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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 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

de	Regional Band	
	AS923-3	
	AS923-4	
RAK SERIAL PORT TOOL	- D	×
	Command	
	BaudRate:)600 ▼ CLOSE	ND
RECEIVING	CLEAR RECV 02 at+get_config=device:status	ND
AT	↑ □ 03 at+set_config=device:sleep:0 SE	ND
	04 at+set_config=device:restart SE	ND
ок	05 at+set_config=device:gps:1 SE	ND
AT+NWM=1	06 at+set_config=lora:work_mode:0 SE	ND
	07 at+set_config=lora;join_mode:0 SE	ND
ок	08 at+set_config=lora:class:0	ND
AT+NJM=1	□ 09 at+set_config=lora:region:EU868 SE	ND
	□ 10 at+set_config=lora:confirm:1 SE	ND
ок	11 at+set_config=lora:ch_mask:0:0 SE	ND
AT+CLASS=A	12 at+set_config=lora:dev_eui: SE	ND
	□ 13 at+set_config=lora:app_eui: SE	ND
ок	□ 14 at+set_config=lora:app_key: SE	ND
AT+BAND=4	□ 15 at+set_config=lora:dev_addr: SE	ND
	□ 16 at+set_config=lora:nwks_key: SE	ND
ок	□ 17 at+set_config=lora:apps_key: SE	ND
	↓ □ 18 at+set_config=lora:send_interval: SE	ND
SENDING(With \r\n)	at+get_config=lora:status	ND
	20 at+get_config=lora:channel SE	ND
	SEND All/None SA	VE

Figure 219: 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.

VOTE:

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.

RAK SERIAL PORT TOOL				- 0
		Comm	and	
RAK COM: COM12 BaudRate: 1600	CLOSE	☑ 01	at+version	SEND
RECEIVING	CLEAR RECV	☑ 02	at+get_config=device:status	SEND
AT+CLASS=A	^	03	at+set_config=device:sleep:0	SEND
		04	at+set_config=device:restart	SEND
ок		05	at+set_config=device:gps:1	SEND
AT+BAND=4		06	at+set_config=lora:work_mode:0	SEND
		07	at+set_config=lora:join_mode:0	SEND
ок		08	at+set_config=lora:class:0	SEND
AT+DEVEUI=5E9D1E0857CF25F1		09	at+set_config=lora:region:EU868	SEND
		10	at+set_config=lora:confirm:1	SEND
ок		11	at+set_config=lora:ch_mask:0:0	SEND
AT+APPEUI=5E9D1E0857CF25F1		12	at+set_config=lora:dev_eui:	SEND
		13	at+set_config=lora:app_eui:	SEND
ок		14	at+set_config=lora:app_key:	SEND
AT+APPKEY=F921D50CD7D02EE3C5E6142154F274B2		15	at+set_config=lora:dev_addr:	SEND
		16	at+set_config=lora:nwks_key:	SEND
ок		17	at+set_config=lora:apps_key:	SEND
	~	18	at+set_config=lora:send_interval:	SEND
, SENDING(With \r\n)		19	at+get_config=lora:status	SEND
AT+APPKEY=F921D50CD7D02EE3C5E6142154E274B2		⊋ 20	at+get_config=lora:channel	SEND

Figure 220: 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				
NOTE: AT+JOIN comman interval, and the nu parameter values. AT+JOIN and AT+	d parameters are optional. You can configure the settings for auto-join, reattempt mber of join attempts if your application needs it. If not configured, it will use the default -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.			
х	Auto-ioin config - 1: auto-ioin on power-up. 0: no auto-ioin			

- y Reattempt interval in seconds (7-255) 8 is the default.
- z Number of join attempts (0-255) 0 is the default.

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

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 Chirpstack. It is also important to check that all your OTAA parameters (DEVEUI and APPKEY) are correct, using the 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.

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

AT+SEND=2:12345678

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

RAK SERIAL PORT TOOL	-	\Box \times
	Command	
Section COM: COM12 BaudRate:)600 CLOSE	☑ 01 at+version	SEND
RECEIVING CLEAR RECV	☑ 02 at+get_config=device:status	SEND
^	03 at+set_config=device:sleep:0	SEND
ок	04 at+set_config=device:restart	SEND
AT+APPEUI=5E9D1E0857CF25F1	05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
ОК	07 at+set_config=lora:join_mode:0	SEND
AT+APPKEY=F921D50CD7D02EE3C5E6142154F274B2	08 at+set_config=lora:class:0	SEND
	09 at+set_config=lora:region:EU868	SEND
ОК	10 at+set_config=lora:confirm:1	SEND
AT+JOIN=1:0:10:8	11 at+set_config=lora:ch_mask:0:0	SEND
	12 at+set_config=lora:dev_eui:	SEND
ОК	13 at+set_config=lora:app_eui:	SEND
+EVT:JOINED	14 at+set_config=lora:app_key:	SEND
AT+SEND=2:12345678	15 at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
ОК	17 at+set_config=lora:apps_key:	SEND
×	18 at+set_config=lora:send_interval:	SEND
SENDING(With \r\n)	19 at+get_config=lora:status	SEND
AT+SEND=2:12345678	☑ 20 at+get_config=lora:channel	SEND
SEND	All/None	SAVE
Time 00:00:00 PASS: 0 FAIL: 0 SW_Version: V1.2.1 Make:2018-12	2-24 28/04/2021 5:28:32 AM	

Figure 221: OTAA Test Sample Data Sent via RAK Serial Port Tool

On the ChirpStack platform, you should see the join and uplink messages in the **LORAWAN FRAMES** tab, as shown in **Figure 222**. By convention, messages sent from nodes to gateways are considered as **Uplinks** while messages sent by gateways to nodes are considered as **Downlinks**.

€	ChirpStack								? 🔒 admin
	Network-servers	Applications / J	ak node test / D	evices / rak node					DELETE
R	Gateway-profiles	Approaction (critico y rait_riodo					
	Organizations	DETAILS	CONFIGURATION	KEYS (OTAA)	ACTIVATION	DEVICE DATA	LORAWAN FRAMES	FIRMWARE	
•	All users								
chirp	ostack -							(?) HELP II PAUSE DOWNLOAD	D CLEAR
۵	Org. settings	UPLINK	5:42:43 PM	UnconfirmedDataUp	018153f7				~
•	Org. users	DOWNLINK	5:42:17 PM	JoinAccept					~
±≡	Service-profiles	UPLINK	5:42:17 PM	JoinRequest	5e9d1e0857cf25f1				~
쿺는	Device-profiles								
R	Gateways								
	Applications								
٣	Multicast-groups								

Figure 222: 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 223**, then the ChirpStack platform will assume that this device will join the LoRaWAN network using the ABP mode.

NOTE:

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

€	ChirpStack	Q. Search organization, application, gateway or device	e admin	
R	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / Create		
•	Organizations All users	OENERAL VARIABLES TAOS		
chirp	ostack -	rak_node The name may only contain words, numbers and dashes.		
۵	Org. settings	Device description " Test		
*	Org. users	Device FUI*		
≛≡	Service-profiles	5e 9d 1e 08 57 cf 25 f1 Ms	вC	
	Device-profiles	Device-profile * device_profile.abp	-	
R	Gateways			
	Applications	Disable frame-counter validation Note that disabling the frame-counter validation will compromise security as it enables people to perform replay-attacks.		
λ	Multicast-groups	OREA	TE DEVICE	

Figure 223: 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

€	ChirpStack	Q Search organization, application, gateway or device edmin
	Network-servers Gateway-profiles	Applications / rak_node_test / Devices / rak_node
H	Organizations	DETAILS CONFIGURATION KEYS (OTAA) ACTIVATION DEVICE DATA LORAWAN FRAMES FIRMWARE
<u>.</u>	All users	
chirp	stack -	Device address * 26 01 1a 19 MSB C
۵	Org. settings	Network session key (LoRaWAN 1.0) *
<u>.</u>	Org. users	c2 80 cb 8d 1d f6 88 bc 18 60 1a 97 02 5c 54 88 MSB C 🗋 🗞
±≡	Service-profiles	Application session key (LoflaWAN 1.0)* 4d 42 ec 5c af 97 f0 3d 83 3c da f5 00 3f 69 e1 MSB C 🗋 🇞
	Device-profiles	Uplink frame-counter *
R	Gateways	0
	Applications	Downlink frame-counter (network) * 0
2	Multicast-groups	(RE)ACTIVATE DEVICE

Figure 224: 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

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1. To set up the RAK3172 module to join the Chirpstack using ABP, start by connecting the RAK3172 module to the Computer (see Figure 35) 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 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, as shown in **Figure 225**.

NOTE:

If there is no 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.

	Command	
RAK COM: COM3 - BaudRate:)600 - CLOSE	■ 01 at+version	SEND
EIVING CLEAR REC	✓ 02 at+get_config=device:status	SEND
	03 at+set_config=device:sleep:0	SEND
	04 at+set_config=device:restart	SEND
	05 at+set_config=device:gps:1	SEND
	06 at+set_config=lora:work_mode:0	SEND
	07 at+set_config=lora:join_mode:0	SEND
	08 at+set_config=lora:class:0	SEND
	09 at+set_config=lora:region:EU868	SEND
	10 at+set_config=lora:confirm:1	SEND
	□ 11 at+set_config=lora:ch_mask:0:0	SEND
	12 at+set_config=lora:dev_eui:	SEND
	□ 13 at+set_config=lora:app_eui:	SEND
	□ 14 at+set_config=lora:app_key:	SEND
	□ 15 at+set_config=lora:dev_addr:	SEND
	□ 16 at+set_config=lora:nwks_key:	SEND
	□ 17 at+set_config=lora:apps_key:	SEND
	18 at+set_config=lora:send_interval:	SEND
DING(With \r\n)	□ 19 at+get_config=lora:status	SEND
	20 at+get_config=lora:channel	SEND
SEND	☐ All/None	SAVE

Figure 225: 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

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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 Commands 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

	Regional Band
	KR920
	AS923-1
	AS923-2
	AS923-3
	AS923-4
RECEIVING RECEIVING AT OK AT+NWM=1 OK AT+NJM=0 OK AT+CLASS=A OK	500 CLOSE Image: attraction of the second seco

Figure 226: 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 the 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

RAK SERIAL PORT TOOL		- 0
	Command	
RAK COM: COM12 V BaudRate:)600 V CLOSE	☑ 01 at+version	SEND
RECEIVING CLEAR RECV	☑ 02 at+get_config=device:status	SEND
AT+CLASS=A	□ ⁰³ at+set_config=device:sleep:0	SEND
	□ 04 at+set_config=device:restart	SEND
ок	05 at+set_config=device:gps:1	SEND
AT+BAND=4	□ 06 at+set_config=lora:work_mode:0	SEND
	07 at+set_config=lora:join_mode:0	SEND
ок	08 at+set_config=lora:class:0	SEND
AT+DEVADDR=26011AF9	09 at+set_config=lora:region:EU868	SEND
	□ 10 at+set_config=lora:confirm:1	SEND
ок	□ 11 at+set_config=lora:ch_mask:0:0	SEND
AT+APPSKEY=4D42EC5CAF97F03D833CDAf5003F69E1	□ 12 at+set_config=lora:dev_eui:	SEND
	□ 13 at+set_config=lora:app_eui:	SEND
ок	14 at+set_config=lora:app_key:	SEND
AT+NWKSKEY=C280CB8D1DF688BC18601A97025C5488	□ 15 at+set_config=lora:dev_addr:	SEND
	16 at+set_config=lora:nwks_key:	SEND
ок	□ 17 at+set_config=lora:apps_key:	SEND
v	18 at+set_config=lora:send_interval:	SEND
sENDING(With \r\n)	□ 19 at+get_config=lora:status	SEND
AT+NWKSKEY=C280CB8D1DE688BC18601A97025C5488	☑ 20 at+get_config=lora:channel	SEND

Figure 227: Configuring LoRa Parameters

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

AT+JOIN=1:0:10:8	
NOTE: AT+JOIN comminterval, and the parameter values AT+JOIN and A	and parameters are optional. You can configure the settings for auto-join, reattempt number of join attempts if your application needs it. If not configured, it will use the default S. AT+JOIN=1 also share the common functionality of trying to join the network.
Join command format	T AT+JOIN=w:x:y:z
w	Join command - 1: joining, 0: stop joining.
х	Auto-join config - 1: auto-join on power-up, 0: no auto-join
У	Reattempt interval in seconds (7-255) - 8 is the default.
Z	Number of join attempts (0-255) - 0 is the default.

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

SENDING(With \r\n)

AT+SEND=2:12341234

LoRa P2P Mode

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

END=2:12341234		
mmand format: AT+SEND= <port>:<payload></payload></port>		
RAK SERIAL PORT TOOL		- 🗆 ;
S RAK COM: COM12 - BaudRate: 3600 - CLOSE	Command	
	✓ 01 at+version	SEND
CLEAR RECV	v 02 at+get_config=device:status	SEND
or	at+set_config=device:sleep:0	SEND
	04 at+set_config=device:restart	SEND
AT +APPSKET=4D42EC5CAP97F03D833CDAT5003F09ET	06 sty set_config=device:gps:1	SEND
OK	07 at set config-lora:work_mode:0	SEND
	at set_conig=iora;join_mode:0	SEND
AT + NWKSKET - C200CB0DTDF000BC1000TA97023C3400	0 00 at l set config=lora:class:0	SEND
OK	10 at set config=lora;region:20000	SEND
0N AT + IOIN-1:0:10:8		SEND
	12 at+set_config=lora.ch_mask.o.o	SEND
TEVISONNED	□ 13 at+set_config=lora.dev_edi.	SEND
or	14 at+set_config=lora:app_eu:	SEND
AT + SEND-2-12241224	□ 15 at set config=lora.app_key.	SEIND
ATT3END-2.12341234		SEND
	Li i v at+set_coniig=iora:nwks_key:	SEND

 18
 at+set_config=lora:send_interval:

 19
 at+get_config=lora:status

SAVE

☑ 20 at+get_config=lora:channel

□ All/None

This section will show you how to set up and connect two RAK3172 units to work in the LoRa P2P mode. The configuration of the RAK3172 units is done by connecting the two modules to a general-purpose computer using a USB-UART converter. The setup of each RAK3172 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.

Figure 228: ABP Test Sample Data Sent via RAK Serial Port Tool

SEND

Time 00:00:00 | PASS: 0 | FAIL: 0 | SW_Version: V1.2.1 | Make:2018-12-24 28/04/2021 5:36:45 AM

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



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 .

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Wis ToolBox ≡	Device Console	Wis ToolBox ≡	Device Console
Dashboard		Dashboard	
Templates		Templates	
Firmware		Firmware	
DEVICES		DEVICES	
G RAK3172 COM12 ▲	ATE enabled	■ RAK3172 COM12 ▲	ATE disabled
7 🛆 🔹 🔹 RAK ID	23:55 AT Input Command 23:55 OK Response	(?) 🖉 🔹 RAK ID	00:16 OK AT

Figure 229: at+version command response

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

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

CLOSE CLEAR RECV

NWM parameter mode o	an be either 0=LoRa P2P or 1=Lo	DRaWAN.
Wis ToolBox ≡	Device Console	RAK SERIAL PORT TOOL
Dashboard		RECEIVING CLEAR REC
 Templates 		AT+NWM=0 RAKwireless RAK3172-E Example
Firmware		Current Work Mode: LoRa P2P.
DEVICES		
■ RAK3172 COM12 ▲	Device 1 (Transmitter)	Device 2 (Receiver)
	00:49 AT+NWM=0 00:49 RAKwireless RAK3172-E Example	SENDING(With \r\n)
(?) 🙆 🏟 RAK ID	00:49 Current Work Mode: LoRa P2P. 00:53 DISCONNECTED Type command to send_	AT+NWM=0 SEND Time 00:00:00 PASS: 0 FAIL: 0 SW_Version: V1.2.1 Make:20
	Figure 230: P2F	P Mode

AK Documentation Center

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 modules. The parameters should be exactly the same in 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 parameters changed.

Wis ToolBox ≡	Device Console	RAK COM: COM11 · BaudRate: 15200 · CLOSE
Dashboard		RECEIVING CLEAR RECV
Templates		AT+VER=3.4.2-rui3_22q1_update.112
Firmware		AT+P2P=868000000;7:125:0:10:14
		ОК
DEVICES		
■ RAK3172 COM12 ▲	Device 1 (Transmitter)	Device 2 (Receiver)
7 🛆 🔹 RAK ID	01:18 AT+VER=3.4.2-rui3_22q1_update.112 01:18 OK 01:20 AT+P2P=868000000:7:125:0:10:14 01:20 OK Type command to send_	I SENDING(With \r\n) AT+P2P=868000000;7:125:0:10:14 SEND Time 00:00:00 PASS: 0 FAIL: 0 SW_Version: V1.2.1 Make:2018-12

Figure 231: Configuring P2P in both RAK3172 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 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. They 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 switches 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>

MOTE:

- AT_PARAM_ERROR is returned when setting the wrong or malformed value.
- AT_BUSY_ERROR is returned if the device is still in RX mode and you try to send or reconfigure the 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, then the AT command should be AT+PSEND = 03AA32.



Figure 232: Configuring P2P in both RAK3172 Module

Miscellaneous

Upgrading the Firmware

If you want to upgrade to the latest version of the firmware of the module, 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 updates?

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 UART2

Minimum Hardware and Software Requirements

Refer to the table for the minimum hardware and software required to perform the firmware upgrade via UART2:

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

Firmware Upgrade Procedure

Execute the following procedure to upgrade the firmware in Device Firmware Upgrade (DFU) mode through the UART2 interface.

NOTE:

RAK3172 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 I I
- 3. Connect the RAK3172 module with a computer through a USB to TTL. Refer to Figure 35.
- 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 fails, check your current baud rate setting using the 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 233: Device Firmware Upgrade Tool

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



Figure 234: Select firmware

6. Click the **Upgrade** button to upgrade the device. After the upgrade is complete, the RAK3172 will be ready to work with the new firmware.



Figure 235: Firmware upgrading



Figure 236: Upgrade successful

Arduino Installation

Refer to Software section.

Last Updated: 4/24/2023, 7:45:53 AM