

APPA6.05 SGW2828-EVK LoRaWAN Connection on The Things Network (TTN)

Mar 2023 V1.0

Introduction

The SGW2828-01A LoRa Module (SGW2828-01A) integrates the Semtech SX1276 long-range low-power transceiver and RF power amplifier with STMicroelectronics' MCU. SGW2828-01A is proven to enable connectivity over 20km line-of-sight, over 5km in dense urban areas and through at least 10 concrete walls (on-site testing conducted in Hong Kong) at 30dBm Tx power maximum, with fast frequency hopping and high sensitivity. Supporting LoRaWAN®, the global de-facto standard for the Internet of Things, SGW2828-01A supports connection to two LoRaWAN-based networks: The Things Network (TTN) and the Helium Network. SGW2828-01A is available in the SGW2828 LoRa Module EVK (SGW2828-EVK) for immediate application deployment.

This application note describes the procedures to connect the SGW2828-EVK to TTN and provides the AT command sets to enable LoRaWAN applications via TTN. This application note includes the use of a TTN Gateway (RAK831 LPWAN Gateway Concentrator Module with Raspberry Pi Model 3B) but any connected TTN-enabled Gateway that is in the vicinity to detect the SGW2828-EVK would support the same purpose.

Contents

1. Getting Started: Required Tools	2
2. Operation Guide	
2.1. Prepare Hardware	2
2.2. Add SGW2828-EVK on TTN Console	4
2.3. AT Commands to Join Network and Send Message	6
2.4. AT Commands for Device EUI, Application EUI, Application Key and Network Key	7
2.5. Enable SGW2828-EVK to TTN Connection without PC	8
3. Other AT Commands Set	9

1. Getting Started: Required Tools:

- a. [SGW2828-EVK LoRa Evaluation Kit](#), including
 - +2dBm SMA antenna (915MHz)
 - Micro-USB cable
 - SGW2828-EVK PC Tool V1.4.1 (also downloadable at <https://sgwireless.com/static/tools/SGW2828-PC-Tool.7z>)
- b. TTN Gateway – Used in this application note is the RAK831 LPWAN Gateway Concentrator Module V4.3.0 with Raspberry Pi Model 3B
 - RAK831 firmware: V4.3.0
 - Raspberry Pi OS Full (32-bit): Debian 11.5 with desktop
- c. PC with Windows 10 or above
- d. The Things Network ID account for TTN Console

2. Operation Guide to join TTN:

2.1. Prepare Hardware:

1. Using the micro-USB cable, connect the SGW2828-EVK with the antenna to the PC (Figure 1). Toggle the power switch to ON.

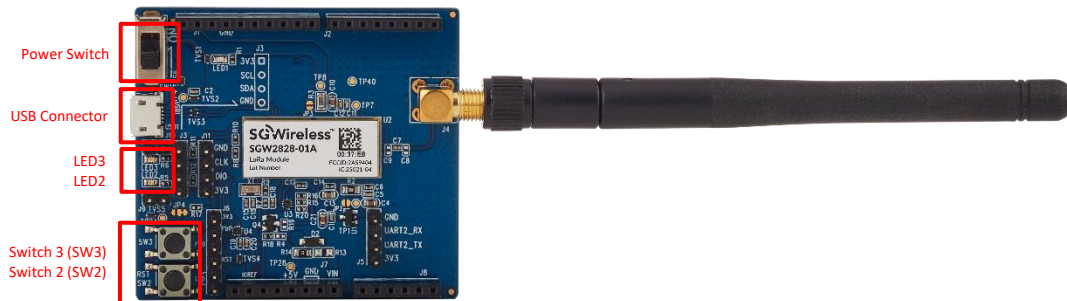


Figure 1: SGW2828-EVK

2. On your PC, open up Device Manager > Ports (COM & LPT) to determine the COM port number to which the SGW2828-EVK is connected (Figure 2).

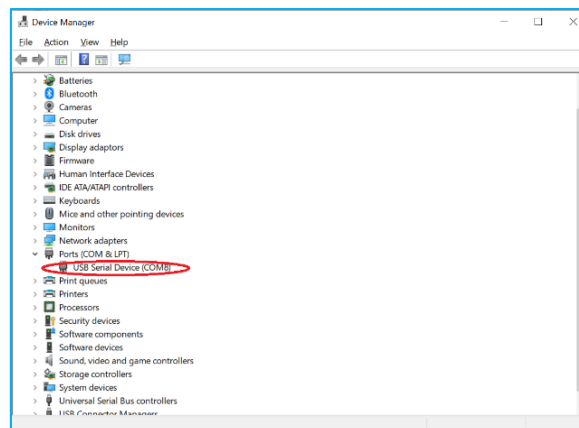


Figure 2: SGW2828-EVK PC Tool COM Port Selection

- Open up the SGW2828-EVK PC Tool. Choose the COM port number with the connected SGW2828-EVK and click 'Connect' (Figure 3).

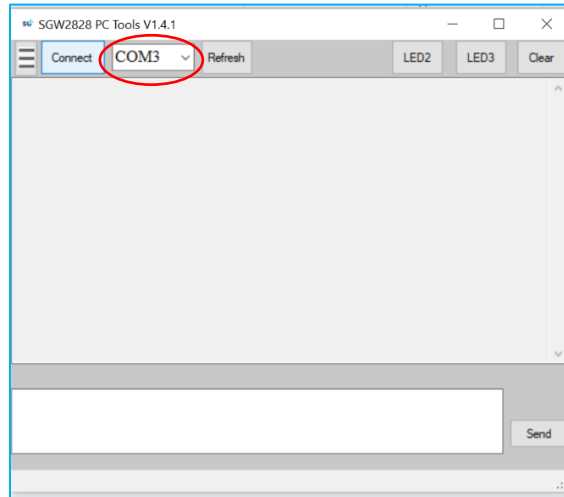


Figure 3: SGW2828-EVK PC Tool COM Port Selection and Connection

Note: The SGW2828-EVK PC Tool includes an engineering mode to enable AT commands. Access as needed at Menu > Mode > Engineering Mode (Figure 4).

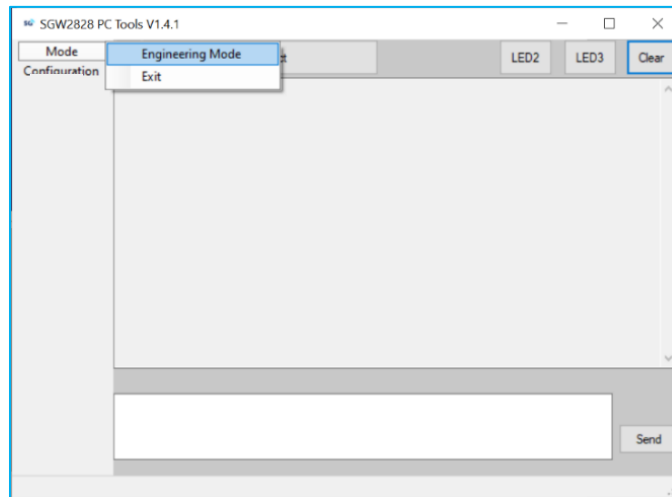


Figure 4: Toggle to Engineering Mode

2.2. Add SGW2828-EVK on TTN Console

1. Power up the TTN Gateway.
2. Login to the [TTN Console](#). Open the application to which you wish to add the SGW2828-EVK.
3. Click End devices > + Register end device (Figure 5).

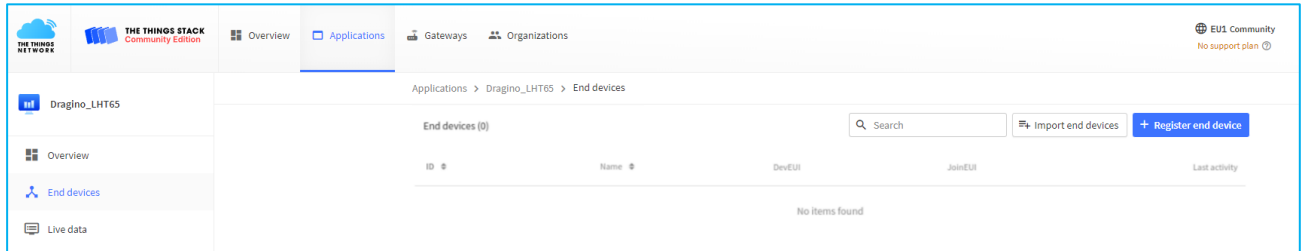


Figure 5: Register SGW2828-EVK on TTN console

4. Click Enter end device specifics manually and select the following (Figure 6):
 - **Frequency plan: Asia_915-928 MHz (AS923 Group 1) with only default channels.** (*same frequency as the Gateway for communication*)
 - **LoRaWAN version: LoRaWAN Specification 1.0.3.**
 - **Regional Parameters version: Defaults to RP001 Regional Parameters 1.0.3 revision A.**
 - **Provisioning Information** by OTAA is obtained by entering **commands** in the SGW2828-EVK PC Tool Engineering Mode (Menu > Mode > Engineering Mode):
 - **JoinEUI: AT+APPEUI=?**
 - **DevEUI: AT+DEUI=?**
 - **AppKey: AT+APPKEY=?**
 - **End Device ID:** Automatically generated upon entering above information, or you can also enter your own.
Remarks: Guideline on choosing unique ID at <https://www.thethingsindustries.com/docs/reference/id-eui-constraints/>.
 - Click Register end device.

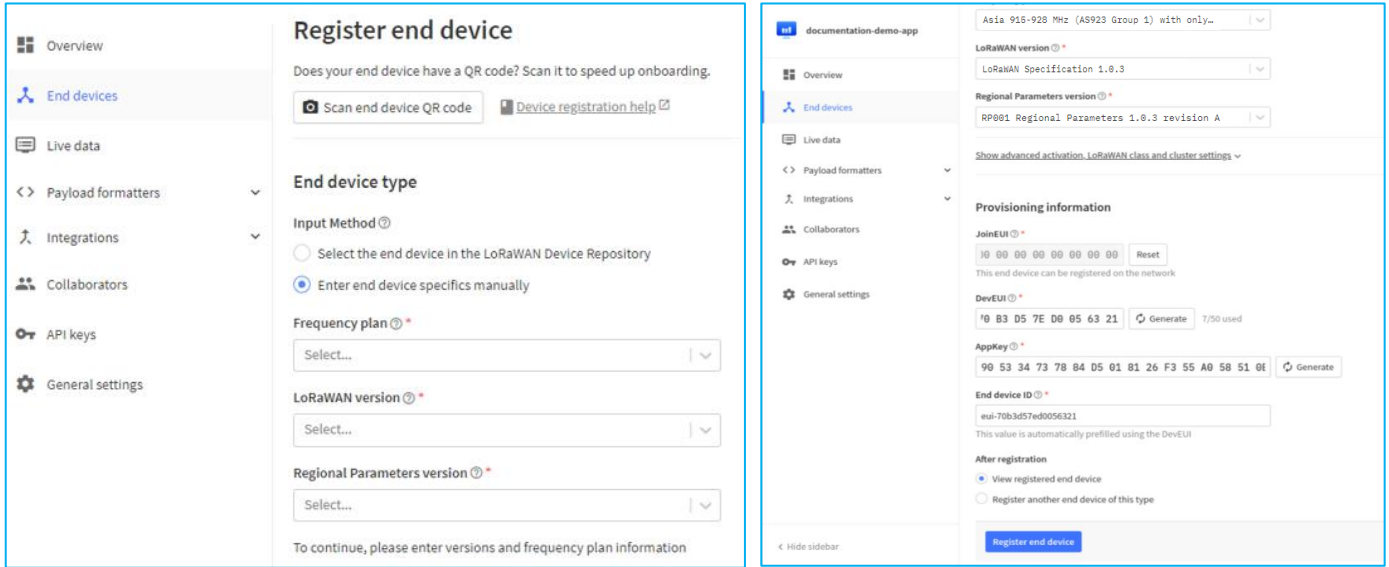


Figure 6: Register SGW2828-EVK on TTN console by manually adding

Note: You can optionally set the location of the SGW2828-EVK. Click Change location settings and set location by putting a pin on the map widget, or entering the Latitude, Longitude and Altitude values (Figure 7).

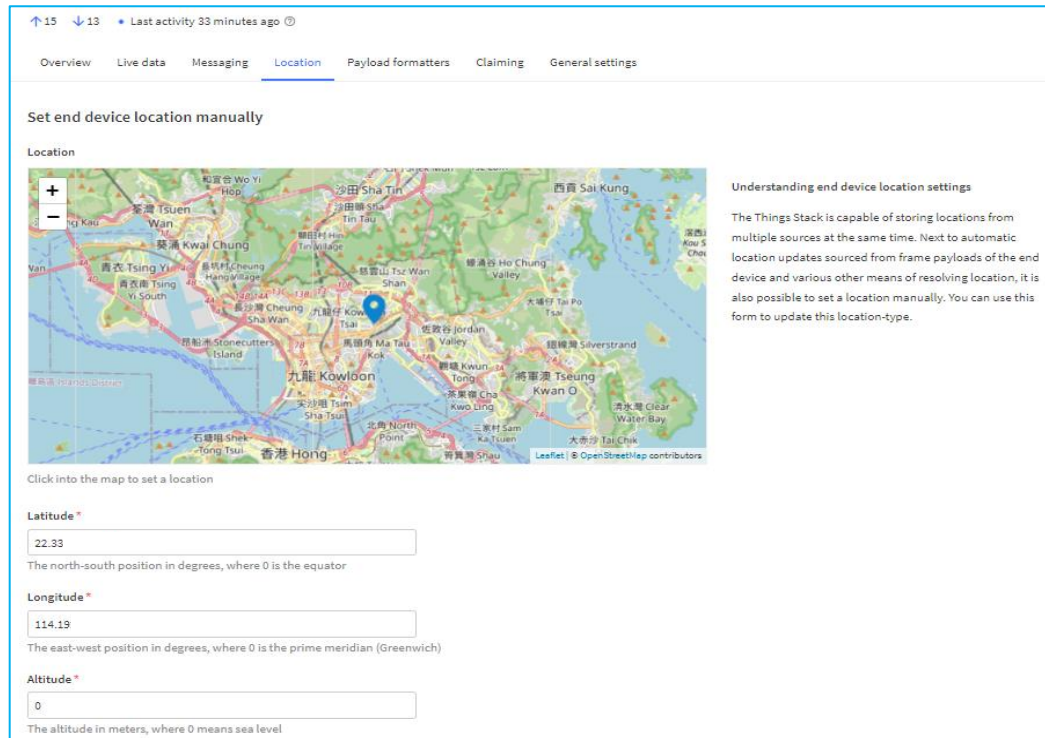


Figure 7: Set SGW2828-EVK location

2.3. AT Commands to Join Network and Send Message

1. Connection to TTN Gateway: **AT+JOIN=1**

'Accept join-request' is shown on the TTN Console when the connection is successfully established (Figure 8).

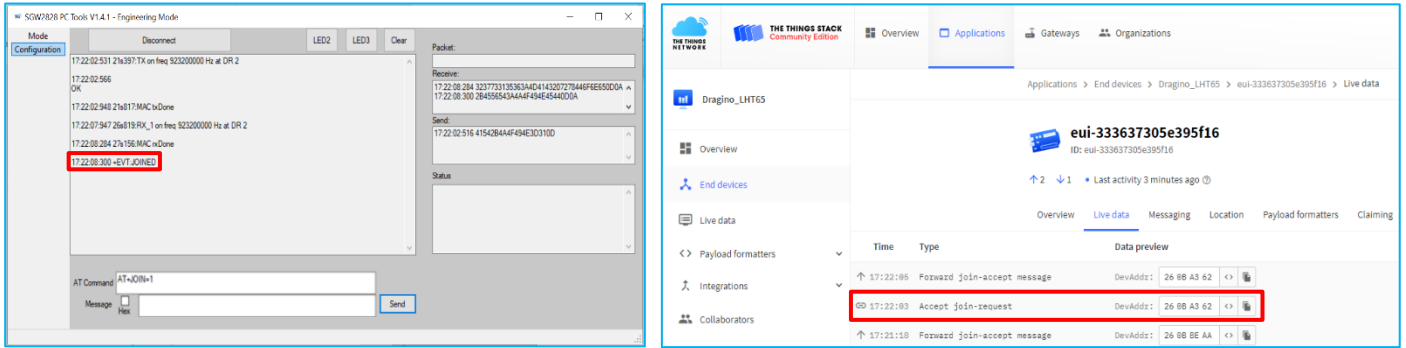


Figure 8: AT Command for Join Network

2. Send Hex data message: **AT+SEND=portnumber:confirmedmode:message** (Figure 9), or Send ASCII data message: **AT+SNDTXT=portnumber:confirmedmode:message**

- Port Number to distinguish message type: 1-223
- Mode to determine if system acknowledgement is required: 0: unconfirmed, 1: confirmed

For instance, when you type AT+SEND=88:1:1234, you will see both uplink and downlink acknowledgement of on the TTN Console that the message “1234” has been sent.

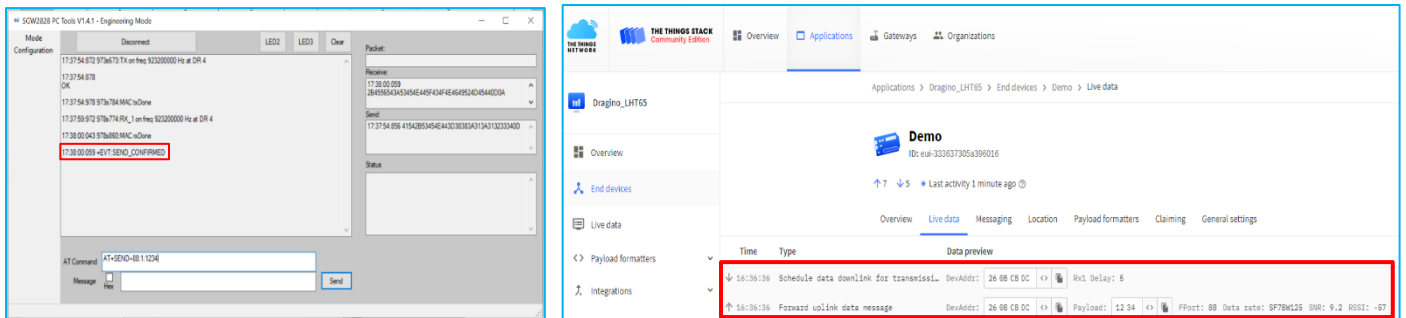


Figure 9: AT Command for send message

2.4. AT Commands for Device EUI, Application EUI, Application Key and Network Key

The Device EUI, Application EUI, Application Key and Network Key can be changed at any time and will reset back to default after power cycled. Alternatively, the parameter can be fixed by saving it into EEPROM. Enter **commands** in the SGW2828-EVK PC Tool Engineering Mode:

	System Command	Command
1	Device EUI <ul style="list-style-type: none"> Get DEUI Set DEUI 	AT+DEUI=? AT+DEUI=DEUI
	Device EUI in EEPROM <ul style="list-style-type: none"> Set DEUI in EEPROM Activate DEUI in EEPROM De-active DEUI in EEPROM and use default value 	AT+EEDEUI=DEUI AT+USE_EEDEUI=1 AT+USE_EEDEUI=0
2	Application EUI <ul style="list-style-type: none"> Get APPEUI Set APPEUI 	AT+APPEUI=? AT+APPEUI=APPEUI
	Application EUI in EEPROM <ul style="list-style-type: none"> Set APPEUI in EEPROM Activate APPEUI in EEPROM De-active APPEUI in EEPROM and use default value 	AT+EEAPPEUI=APPEUI AT+USE_EEAPPEUI=1 AT+USE_EEAPPEUI=0
3	Application Key <ul style="list-style-type: none"> Get APPKEY Set APPKEY <i>Remarks: Application key can only be set before network join.</i>	AT+APPKEY=? AT+APPKEY=APPKEY
	Application Key in EEPROM <ul style="list-style-type: none"> Set APPKEY in EEPROM Activate APPKEY in EEPROM De-active APPKEY in EEPROM and use default value 	AT+EEAPPKEY=APPKEY AT+USE_EEAPPKEY=1 AT+USE_EEAPPKEY=0
4	Network Key <ul style="list-style-type: none"> Get NWKKEY Set NWKKEY <i>Remarks: Network key will be stored and no reset is needed after power reset.</i>	AT+NWKKEY=? AT+NWKKEY=NWKKEY

Remarks:

- The “:” symbol must be added between each pair of digits when setting the parameters.
- The SGW2828-EVK must be power cycled after writing any parameter in the EEPROM.
- OTAA LoRaWAN 1.0.x does not require NWKKEY setting, it is generated in network server and SGW2828-EVK uses the AppNonce value in join-accept message to generate the same key.

2.5. Enable SGW2828-EVK to TTN Communication without PC:

Once you have added the SGW2828-EVK on the TTN Console, provided that you are in vicinity of a TTN Gateway, you can enable TTN connection and send message without the need of a PC.

	LED 1	LED 2	LED 3
Regular Operation			
Power On	On	Flashing	Off
Connection			
Connection Success	On	On	On
Connection Fail	On	Flashing	Off
Send Message			
Sent Success	On	On	On
Sent Fail	On	On	Flashing

1. SGW2828-EVK's LED2 and LED3 remain off when power up.
2. Connection to TTN via LoRaWAN gateway:

Press SW3 once to send join network request. Both LED2 and LED3 will light up upon join success.

Remarks: Please allow approximately 5 seconds for the server to acknowledge the join request.

Remarks: LED 2 indicates TTN connection success; while LED 3 indicates acknowledgement success data sent.

Remarks: Should the join connection be unsuccessful, please repeat Step 2.

3. Send message:

Press SW3 can send a default 8-byte message, if success message is sent, LED3 will light up again and you can see message "1234567890ABCDEF" on TTN console.

Remarks: Please allow approximately 5 seconds for the server to acknowledge the send request.

Remarks: Should the sent request be unsuccessful, please repeat Step 3.

4. System reset:

Should you wish to conduct SGW2828-EVK system reset during your development process, press SW2 to conduct.

3. Other AT Commands Set

<u>System Command</u>	<u>Command</u>
General Commands	
Get or set verbose level AT+VL	Read Command AT+VL=?
	Execution Command AT+VL=<Level> Where: <ul style="list-style-type: none"> • <Level> = 0 - 3
LoRaWAN Network Management Commands	
Get firmware version AT+VER	Execution Command AT+VER=?
Get or set the adaptive data rate functionality AT+ADR	Read Command AT+ADR=?
	Execution Command AT+ADR=<ADR> Where: <ul style="list-style-type: none"> • <ADR> = 0: off, 1: on
Get or set data rate AT+DR	Read Command AT+DR=?
	Execution Command AT+DR=<DataRate> Where: <ul style="list-style-type: none"> • <DataRate> = Window data rate 2 - 7
Get or set active regions AT+BAND	Read Command AT+BAND=?
	Execution Command AT+BAND=<BandID> Where: <ul style="list-style-type: none"> • <BandID> = Active region, 0:AS923, 1:AU915, 6:KR920, 8:US915
Get or set the LoRa class AT+CLASS	Read Command AT+CLASS=?
	Execution Command AT+CLASS=<Class> Where: <ul style="list-style-type: none"> • <Class> = LoRa class, A or C

<u>System Command</u>	<u>Command</u>
LoRaWAN Network Management Commands	
Get or set duty cycle setting AT+DCS	Read Command AT+DCS=?
	Execution Command AT+DCS=<DutyCycle> Where: • <DutyCycle> = ETSI DutyCycle, 0: Off; 1: On
Get or set the join delay on Rx window 1 AT+JN1DL	Read Command AT+ JN1DL=?
	Execution Command AT+JN1DL=<Delay> Where: • <Delay> = Delay in ms
Get or set the join delay on Rx window 2 AT+JN2DL	Read Command AT+JN2DL=?
	Execution Command AT+ JN2DL=<Delay> Where: • <Delay> = Delay in ms
Get or set the delay of the Rx window 1 AT+RX1DL	Read Command AT+RX1DL=?
	Execution Command AT+RX1DL=<Delay> Where: • <Delay> = Delay in ms
Get or set the delay of the Rx window 2 AT+RX2DL	Read Command AT+RX2DL=?
	Execution Command AT+RX2DL=<Delay> Where: • <Delay> = Delay in ms
Get or set the data rate of the Rx window 2 AT+RX2DR	Read Command AT+RX2DR=?
	Execution Command AT+RX2DR=<DataRate> Where: • < DataRate> = Rx2 window DataRate, 2 - 7
Get or set the frequency of the Rx window 2 AT+RX2FQ	Read Command AT+RX2FQ=?
	Execution Command AT+RX2FQ=<Freq> Where: • <Freq> = Freq in Hz

<u>System Command</u>	<u>Command</u>
LoRaWAN Network Management Commands	
Get or set the transmit power AT+TXP	Read Command AT+TXP=? Execution Command AT+TXP=<Power> Where: <ul style="list-style-type: none"> • <Power> = Transmit power, 0 - 7 (Valid range according to region)
Radio Tests Commands	
Start RF tone test AT+TTONE	Execution Command AT+TTONE
Start the RF RSSI tone test AT+TRSSI	Execution Command AT+TRSSI
Get or set the config LoRa RF test AT+TCONF	Read Command AT+TCONF=? Execution Command AT+TCONF=<Freq>:<Pow>:<Bw>:<Sf>:4/<Cr>: <Lna>:<Pa>:<Mod>:<Paylen>:<Freqdev>: <Lowdropt>:<BT> Where: <ul style="list-style-type: none"> • <Freq> = Frequency in Hz • <Pow> = Power in dBm • <Bw> = Bandwidth in kHz • <Mod> = Modulation, 0: FSK, 1: Lora, 2: BPSK • <Paylen> = PayloadLen in Bytes • <Freqdev> = FskDeviation in Hz • <Lowdropt> = 0: Off, 1: On, 2: Auto • <BT> = BTproduct, 0: no Gaussian Filter Applied, 1: BT=0,3, 2: BT=0,5, 3: BT=0,7, 4: BT=1
Sets the number of packets to be sent for PER RF Tx test. AT+TTX	Execution Command AT+TTX=<PacketNb> Where: <ul style="list-style-type: none"> • <PacketNb> = Nb of packets sent
Sets the number of packets to be received for PER RF Rx test. AT+TRX	Execution Command AT+TRX=<PacketNb> Where: <ul style="list-style-type: none"> • <PacketNb> = Nb of packets expected
Information Command	
Gets the battery level AT+BAT	Execution Command AT+BAT=?

Useful Links

1. SG Wireless SGW2828-EVK official product page: <https://www.sgwireless.com/product/SGW2828-EVK>
2. SG Wireless SGW2828-01A official product page: <https://www.sgwireless.com/product/SGW2828>
3. Semtech SX1276 official product page: <https://www.semtech.com/products/wireless-rf/lora-transceivers/sx1276>
4. STMicroelectronics MCU STM32L072KBU6 official product page: <https://www.st.com/en/microcontrollers-microprocessors/stm32l072kb.html>
5. TTN Gateway (RAK831 LPWAN Gateway Concentrator Module with Raspberry Pi Model 3s): <http://www.thethingsnetwork.org/docs/gateways/rak831/>
6. The Things ID sign-up page: https://id.thethingsnetwork.org/oidc/interaction/Uz_QyTi9f_bR9cmIQV2nl/register

Revision History

Revised	Version	Description
14-Mar-2023	1.0	Initial document release

Contact Us:

Website: <https://sgwireless.com/>

LinkedIn: <https://www.linkedin.com/company/sgwireless/>

Twitter: [@sgwirelessIoT](https://twitter.com/sgwirelessIoT)

Information in this document is provided solely to enable authorized users or licensees of SG Wireless products. Do not make printed or electronic copies of this document, or parts of it, without written authority from SG Wireless.

SG Wireless reserves the right to make changes to products and information herein without further notice. SG Wireless makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SG Wireless assume any liability arising out of the application of any product and specifically disclaims any and all liability, including without limitation consequential or incidental damages. SG Wireless does not convey any license under its patent rights nor the rights of others. SG Wireless products may not be used in life critical equipment, systems or applications where failure of such equipment, system or application would cause bodily injury or death. SG Wireless sells products pursuant to standard Terms and Conditions of Sale which may be found at <https://www.sgwireless.com/page/terms>.

SG Wireless may refer to other SG Wireless documents or third-party products in this document and users are requested to contact SG Wireless or those third parties for appropriate documentation.

SG Wireless™ and the SG and SG Wireless logos are trademarks and service marks of SG Wireless Limited. All other product or service names are the property of their respective owners.

© 2023 SG Wireless Limited. All rights reserved.