ELA INNOVATION

User guide

LORA TAGS

LoRaWAN™

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1. About this document

This document describes how to configure and use downlink commands in ELA Innovation's line of LoRa products.

2. Applicable product(s)

LoRa ID

IDF32002

LoRa TEMP

IDF32003

LoRa HOME

IDF32004

LoRa n'TRACK

IDF32005

3. General

When using LoRaWAN technology, three aspects are indispensable for communication: “DEVEUI” for identifying the device, and two keys – NwkSkey for authentication, and AppsKey for encryption. There are two methods for providing this information to both the device and the server.

- Activation By Personalization: APB
- Over the Air Activation: OTAA

The LoRa tag’s firmware uses the OTAA method, as it is more secure. This method requires the device to have the following three identifiers available:

- **DEVEUI:** globally unique device identifier
- **APPEUI**: globally unique identifier for pairing server
- **APPKEY**: 128-bit encryption key for pairing the device with the application server

Specific to the LoRaWAN protocol standard, these three identifiers can be configured via NFC. The APPKEY parameter is only accessible for **WRITING** via the NFS interface.

Using this approach, the device executes a pairing procedure with the network (JOIN REQUEST). During the procedure, the LoRa device and the network generate the essential DevAddr, NwkSKey, and AppSKey information automatically. The procedure of the JOIN REQUEST can be viewed on the tag via a high brightness LED. When the flashing Led stops, it indicates the successful pairing on the network (JOIN ACCEPT).

4. Parameter list

Parameter	Min / Max	Description
Name	Up to 20 characters	Tag name
Enable	True/False	Application activation False = application deactivated True = Application activated
Power	{14,12,10,8,6,4}	LoRa transmission power in dBm
LoRa class	{“A”, “C”}	Define the LoRaWAN device class
LoRa DR Mode	{0, 1, 2, 3, 4, 5, 6, 0xFF}	LoRa interface data rate 0 = DR0 .. 6 = DR6 0xFF = ADR (adaptative data rate)
Lora Ack	True/False	Configuration of frame acknowledgment False = Acknowledgment and retransmission deactivated True = Acknowledgment and retransmission activated
DEVEUI	64 bits	DevEUI address of LoRa module in the following format: “XXXXXXXXXXXXXXXX”
AppEUI	64 bits	AppEUI (JoinEUI) for LoRa server in the following format: “XXXXXXXXXXXXXXXX”
AppKEY	128 bits	AppKEY for LoRa server in the following format: “XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX”

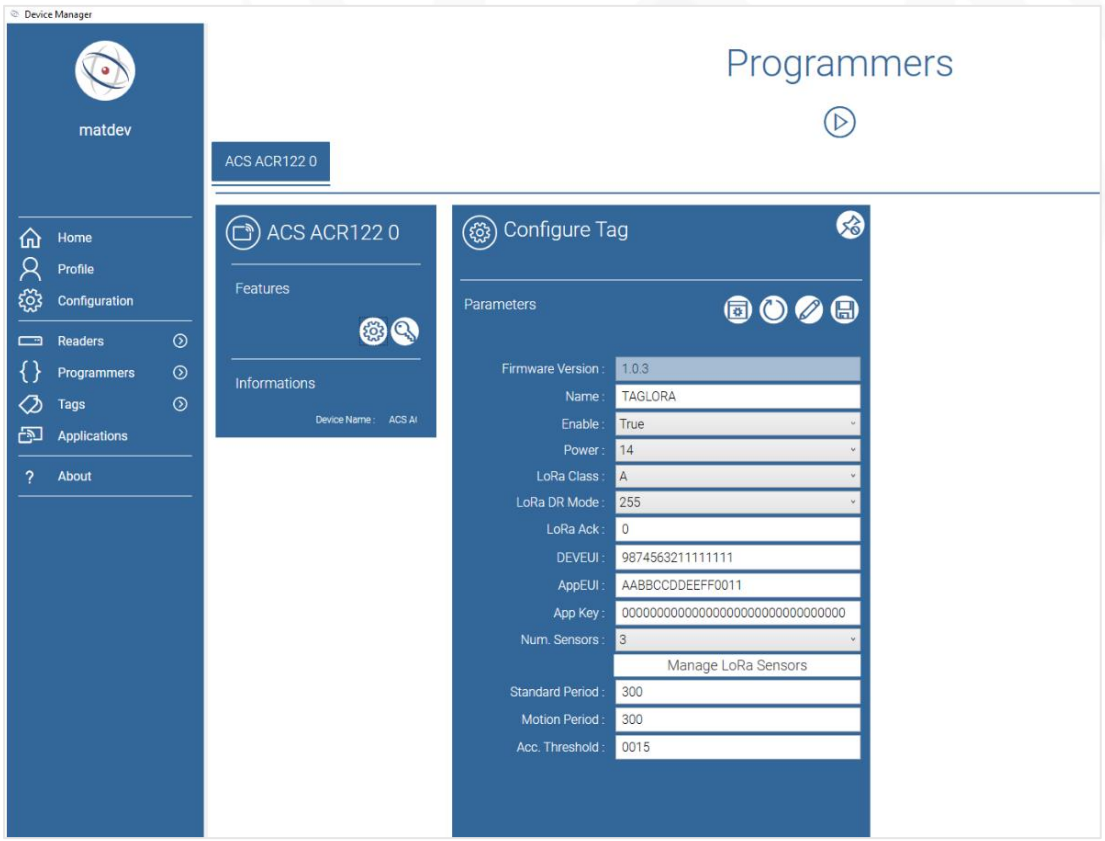
Num. Sensors	{0, 1, 2, 3, 4, 5, 6, 7}	Number of sensors used by the tag.
Sensor1	T, RHT, MAG, MOV, ANG, LUX, GPS	Format of first sensor used on the card. (optional field depending on Num. Sensors)
…	…	…
SensorN	T, RHT, MAG, MOV, ANG, LUX, GPS	Format of Nth sensor used on the card. (optional field depending on Num. Sensors)
Standard period	60 / 86400	Emission period in seconds in “Standard” mode (no movement detected)
Motion period	60 / 86400	Emission period in seconds in “Motion” mode (movement detected)
Acceleration limit	NA	Motion detection limit in hexadecimal

Table 1: Parameter list

5. Tag configuration

NFC configuration is performed by using both the Device Manager application and ACR122U NFC reader, which is used to write data to the tag’s NFC 2K chip.

In order to have all tag configuration parameters at your disposal, you must use an up-to-date version of Device Manager (version ≥ 1.3.3).

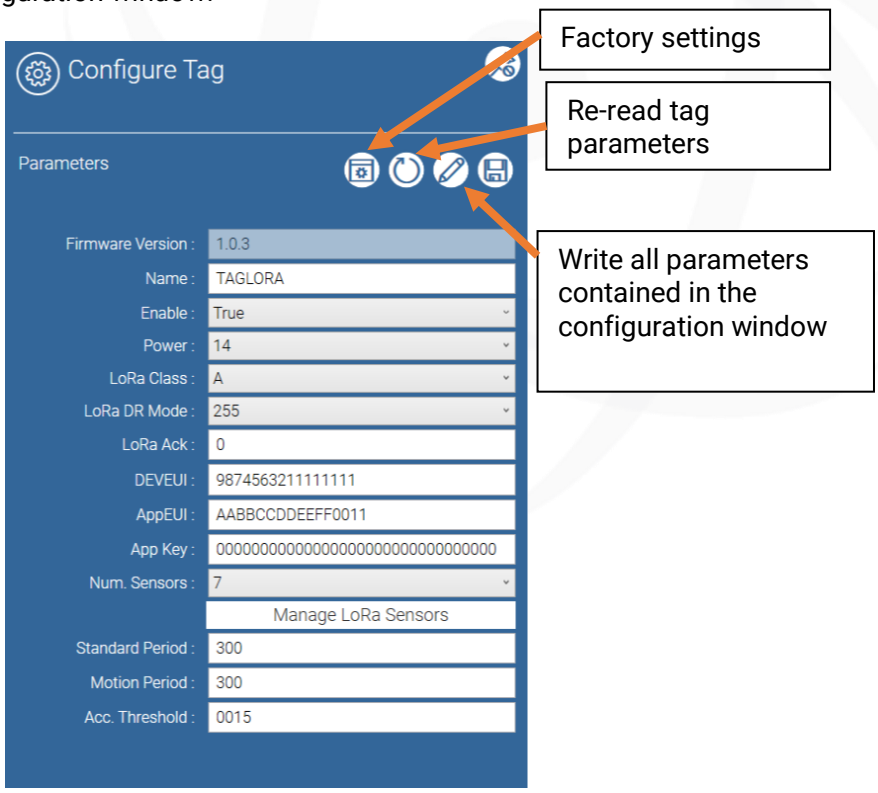


The Device Manager application and User Guide are available in the ELA Innovation download space:

- https://elainnovation.com/downloads.html
- https://elainnovation.com/Local/ela/files/1305/User_guide_Device_Manager_EN.pdf

The green LED lights up when the LoRa tag is placed on the NFC reader:

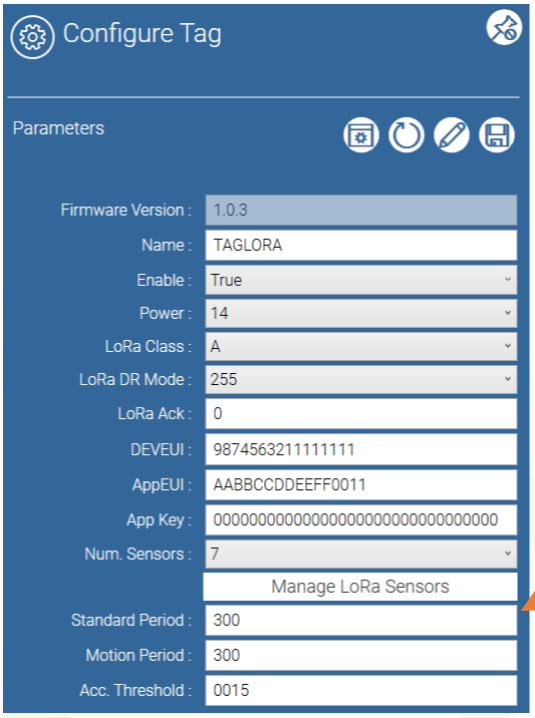
LoRa tag configuration window:



Information about **Num. Sensors** and **SensorN** :

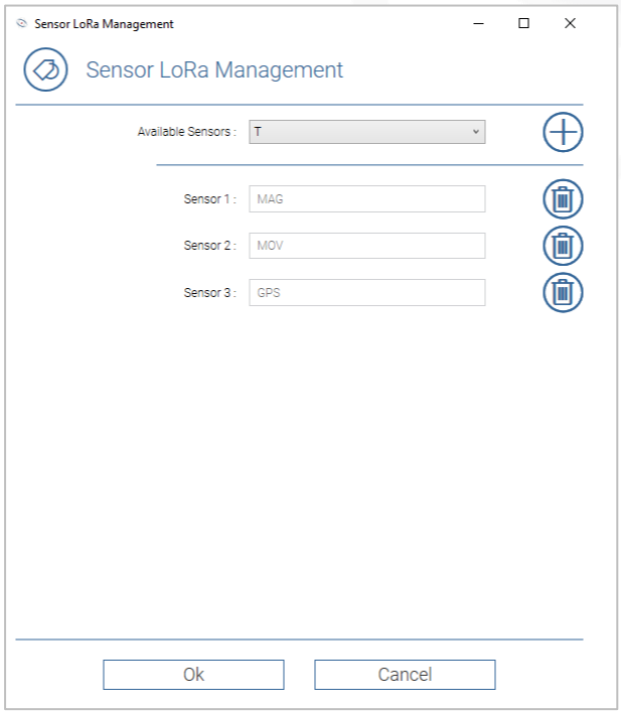
Using the NFC interface, you may choose zero, one, or several sensors to be managed by the firmware. When you choose the number of functioning sensors via “Nbr.Sensors”, you must also enter each sensor being used via the “Manage LoRa Sensors” icon.

Example 1: LoRa TEMP, using only the temperature sensor: Num. Sensors = 1 and Sensor 1 = “T”



Select the number of sensors

Click on “Manage LoRa Sensors” to choose one of the available sensors.



Choose the sensor and add it by clicking on ⊕.

If necessary, click on the trash can to delete selected sensors

Complete LoRa tag configuration by clicking on the “Write” button.

6. “LoRa Reception” mode

The LoRaWAN protocol offers two-way communication, which means that you can transfer data to the LoRa device.

In reception mode, the tag interprets downlink messages received by the LoRaWAN module and executes the associated actions. In Class A, reception mode is activated right after transmission. Class C allows reception at any time, but it consumes significantly more power than Class A.

List of applicable commands:

COMMANDS	***ACTIONS***	***REKATED PRODUCTS***
LED_ON	Switch on the LED (blinking)	LoRa ID LoRa TEMP LoRa HOME LoRa n’TRACK
LED_OFF	Turn the LED off	LoRa ID LoRa TEMP LoRa HOME LoRa n’TRACK
LED_ON XXXX	Switch on the LED (XXXX in seconds)	LoRa ID LoRa TEMP LoRa HOME LoRa n’TRACK
Classe A	Switch to the class A	LoRa ID LoRa TEMP LoRa HOME LoRa n’TRACK
Classe C	Switch to the class C	LoRa ID LoRa TEMP LoRa HOME LoRa n’TRACK

Downlink message format:

LoRa tag (TAGLORA) downlink frame format				
Fixed length				*Variable length*
ELA header 2 bytes	FW_rev 1 byte	Protocol_rev 1 byte	CmdInfo 1 byte	CmdData 0-16 bytes

Table 2: Downlink frame format

Field description:

Field	Length	Description
ELA header	2 bytes	Field reserved for information to be defined
FW_rev	1 byte	TAGLORA firmware version
Protocol_rev	1 byte	TAGLORA protocol version (frame format)
CmdInfo	1 byte	Information about the command type Bits 7-4: command type • 0: LED • 1: Buzzer • 2: Reserved • 3: LoRa class • 4-15: Reserved Bits 3-0: Number of bytes in CmdData field • 0-15: Number of bytes in CmdData field
CmdData	0-16 bytes	Command parameters

Table 3: Field description

6.1 LED activation

The parameters for the LED activation command are as follows:

CmdInfo	CmdData
0x02 Bits 7-4 = 0, bits 3-0 =2	Duration of LED activation in seconds, on a 16-bit unsigned integer

Table 4: LED command

Example of a LED activation command:

- 000102030200**20**: LED blink (1 Hz) for 32 seconds.

As soon as this command is received, the tag activates the LED for the period specified in the *CmdData* field.

6.2 Changing LoRaWAN Class

The parameters for the Class change command are as follows:

CmdInfo	CmdData
0x31 Bits 7-4 = 2, bits 3-0 = 2	LoRa Class on an 8-bit unsigned integer • 0x00 = Class A • 0x01 = Class B (not currently supported) • 0x02 = Class C • 0x03 to 0xFF = not supported

Table 5: LoRaWAN Class command

Example of a command to change LoRaWAN Class:

- 000102033102: Switch to Class C.

As soon as this command is received, the tag modifies its operating Class based on the value provide specified in the *CmdData* field. This change implies a new OTAA procedure with the server.

7. "LoRaWAN Transmission" mode

Based on the sensor information obtained during the configuration NFC, the tag will create the frame to be transmitted. The radio frame emission can be viewed on the tag via a short activation of a LED intended for this purpose.

Champ	Valeur du champ	Information du champ
Header Ela	0x0103	Field reserved, not editable
FW_rev	0x01	TAGLORA firmware version, not editable
Protocol_rev	0x01	TAGLORA protocol version, not editable
Frame_cnt	0xXXXXXX	Counter of the number of frame transmission attempts by the tag since the last JOIN sequence (application start or stop)
Frame_type	0xXX	Frame information Bits 7-4: frame type • 0: Standard mode periodic frame • 1: Motion mode periodic frame • 2: Non periodic detection frame for magnetic state change • 3: Non periodic motion detection frame • 4-15: RFU Bits 3-0: Number of sensors • 0: no sensors (advertising frame) 1-15: number of sensors in the frame
SensorInfo	0xXX	Information about the sensor Bits 7-4: Sensor type • 0: Temperature (T) • 1: Humidity/temperature (RTH) • 2: magnetic Hall effect (MAG) • 3: Movement (MOV) • 4: 3D Accelerometer (ANG) • 5: Luminosity (LUX) • 6: Geolocation (GPS) • 7-15: RFU Bits 3-0: Number of information bytes for the sensor (length of SensorData field) 0-15: Number of information bytes for the sensor
SensorData	0xXXXX	Sensor values

- Example with “LoRa TEMP” format:

Raw data :

0x01030101 00009C 01 02 0AAB

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x00009C	156 frames transmit of the TAG
1	0x01	Standard mode periodic frame, number of sensors= 1
1	0x02	Sensor Temperature
2	0x0AAB	Data sensor 0x0AAB=2731 * 0,01°C = **27,31°C**

Note:

- for a negative temperature, 2’s complement is made: 27.31°C will be 55F5

- Example with “LoRa HOME” format:

Raw data :

0x10301010000030313 0B3829 22 0003 54 0000F760

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x00009c	156 frames transmit of the TAG
1	0x03	Standard mode periodic frame, number of sensors= 3
1	0x13	Sensor RHT
3	0x0B3829	Temperature: 0x0B38=2872 * 0,01°C = **28,72°C**
		Humidity: 0x29= 41% RH
1	0x22	Sensor MAG
2	0x0003	Event counter (15MSB) = 1 magnetic field detection
		Current status (LSB)= 1 magnet detected
1	0x54	Sensor LUX
4	0x0000F760	Luminosity: 0xF760= 63328 * 0.01 lux = 633.28 lux

- Example with “LoRa ID » format:

Raw data :

0x10301010000041 22 22 0018 32 000B

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x000041	65 frames transmit of the TAG
1	0x22	Non periodic detection frame for magnetic state change, number of sensors= 2
1	0x22	Sensor MAG
2	0x0018	Event counter (15MSB): 24 magnetic field detection
		Event status (LSB)= 0 no magnet detected
1	0x32	Sensor MOV
2	0x000B	Overflow counter stored in 15 MSB: 5 motion detections
		Event status (LSB)= 1 detected motion

- Example with “LoRa n’TRACK”:

Raw data :

0x10301010000013322000032005 76D4074A455422E78F5003C000F46

Details:

LEN.	TYPE	VALUE	
4	0x01030101	Field reserved	
3	0x000020	32 frames transmit of the TAG	
1	0x33	Non periodic motion detection frame, number of sensors = 3	
1	0x22	Sensor MAG	
2	0x0000	Event counter (15MSB): no magnetic field detection	
		Event status (LSB)= 0 no magnet detected	
1	0x32	Sensor MOV	
2	0x000B	Overflow counter stored in 15 MSB: 5 motion detections	
		Event status (LSB)= 1 detected motion	
1	0x6D	Sensor GPS	
13	0x4074A455422E78F5003C000F46	Longitude	0x4074A455 = 3.82253
		Latitude	0x422E78f5=43.6181
		Altitude	003C= 60 mètres
		Velocity	000F=15*0.1km/h=1.5km/h
		Info	0b01= FIX valid
			0x6= 6 satellites

Note:

Longitude and latitude are coded in hexadecimal. To convert the data into GPS coordinates, use the hexadecimal conversion to a float (sign, exponents, mantisse). These coordinates are in decimal degrees (DD). A brief flashing of the LED is provided to indicate the geolocation search.