iNode LoRa USB

user manual

1. INTRODUCTION

We would like to introduce you to the family of iNode devices operating in LoRa® technology and with the **LoRaWAN®** protocol.

iNode LoRa USB allows you to configure and receive data from iNode LoRa devices.

Based on Wikipedia about LoRa® :

LoRa® (Long Range) uses license-free sub-gigigahertz radio frequency bands (so-called ISM band), such as 169 MHz, 433 MHz, 868 MHz (Europe) and 915 MHz (North America). The data transmission rate in the LoRa® system is between 0.3 kb / s and 37.5 kb / s. Because of the techniques used to minimize the use of energy, LoRa® is not suitable for real-time services, but only for applications in which delays can be tolerated.

The adopted network topology is the so-called star-of-stars - the central element is surrounded by intermediate elements - so-called gateways, which communicate with end devices. The higher the number of end devices in a cell, the lower the network throughput.

In the radio layer, LoRa® uses the CSS (chirp spread spectrum) modulation technique developed by Semtech , which has the ability to receive a signal below the noise level.

Pros and cons

LoRa® modulation is characterized by low energy demand of the device used for communication. This protocol adapts the transmitter power and transmission speed to the current propagation conditions (wave propagation). In practice, this means a long working time of the sensor on one battery.

LoRa® modulation has a range of up to several kilometers. In this respect, it prevails over solutions such as Bluetooth and WiFi.

The use of LoRa® technology does not involve license fees for frequencies. The technology LoRa® used unlicensed frequency band (433 MHz, 868 MHz and 915 MHz). The technology LoRa® can connect multiple devices, making this protocol suited for use as a communication solution for cities.

The downside of LoRa® modulation is the speed of data transmission. It is in the range of 0.3-37,5 kbps. It prevents devices from sending large data, but allows the sensor network to work.

Another limitation of the LoRa network is the high price of communication modules.

2. Connecting iNode LoRa USB

To launch **iNode LoRa USB**, follow these steps:

- Connect the LoRa antenna to the device. If it has a radiator, it should be placed vertically.
- Install the **iNode LoRa Monitor** application to configure sensors from the **iNode LoRa** family: **iNode LoRa EM**, **iNode LoRa T**, **iNode LoRa HT**. Thanks to the WebUSB functionality, it works in Chrome or Chromium browsers on various operating systems, such as Android OS, Linux or Windows 10, and works directly with USB adapters: **iNode LoRa USB** or **iNode LoRa GSM MQTT** . In other browsers, e.g. FireFox, it is necessary to use the **iNode Hub Server** application for Windows 10.

3. MONITOR

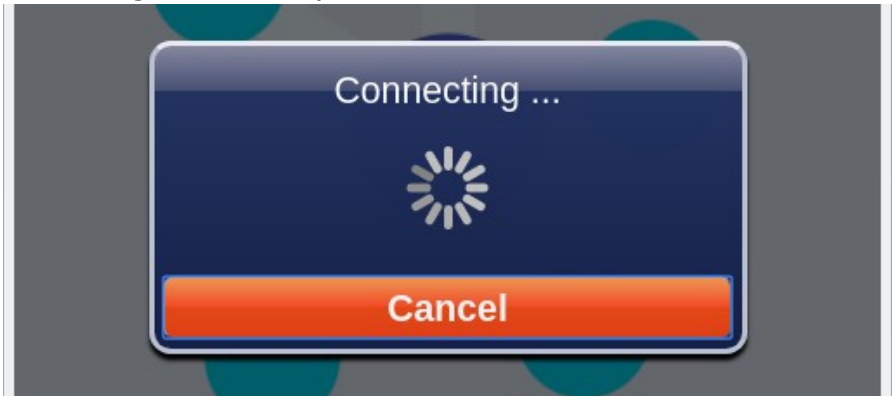
In this mode, **iNode LoRa Monitor** shows from which devices **iNode LoRa** adapter receives broadcast frames. Whether this is in GFSK or in LoRa depends on the adapter configuration. Each type of **iNode LoRa** device has a different icon.

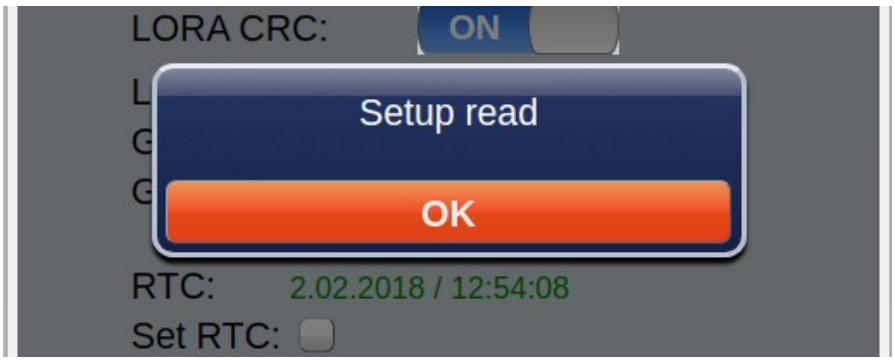
Scanning effect in LoRa.

Scanning effect in GFSK.

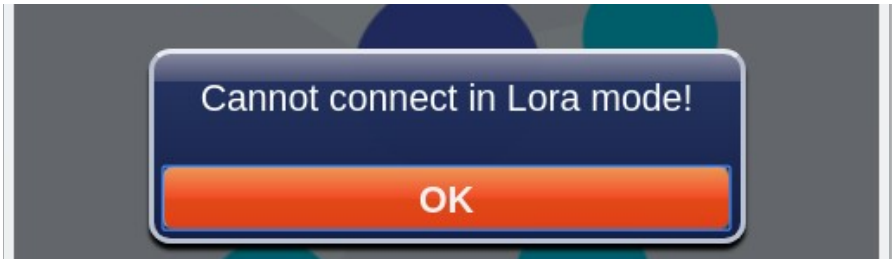
Depending on whether the scan is in GFSK or LoRa, there may be other devices in the list.

The icon  allows establishing connection with the **iNode LoRa** device. This is only possible if the adapter is in GFSK mode and the device you want to connect to also works in this mode. Due to the fact that GFSK modulation enables faster data transmission than LoRa modulation, it was used in **iNode LoRa** sensors to configure and replace firmware.





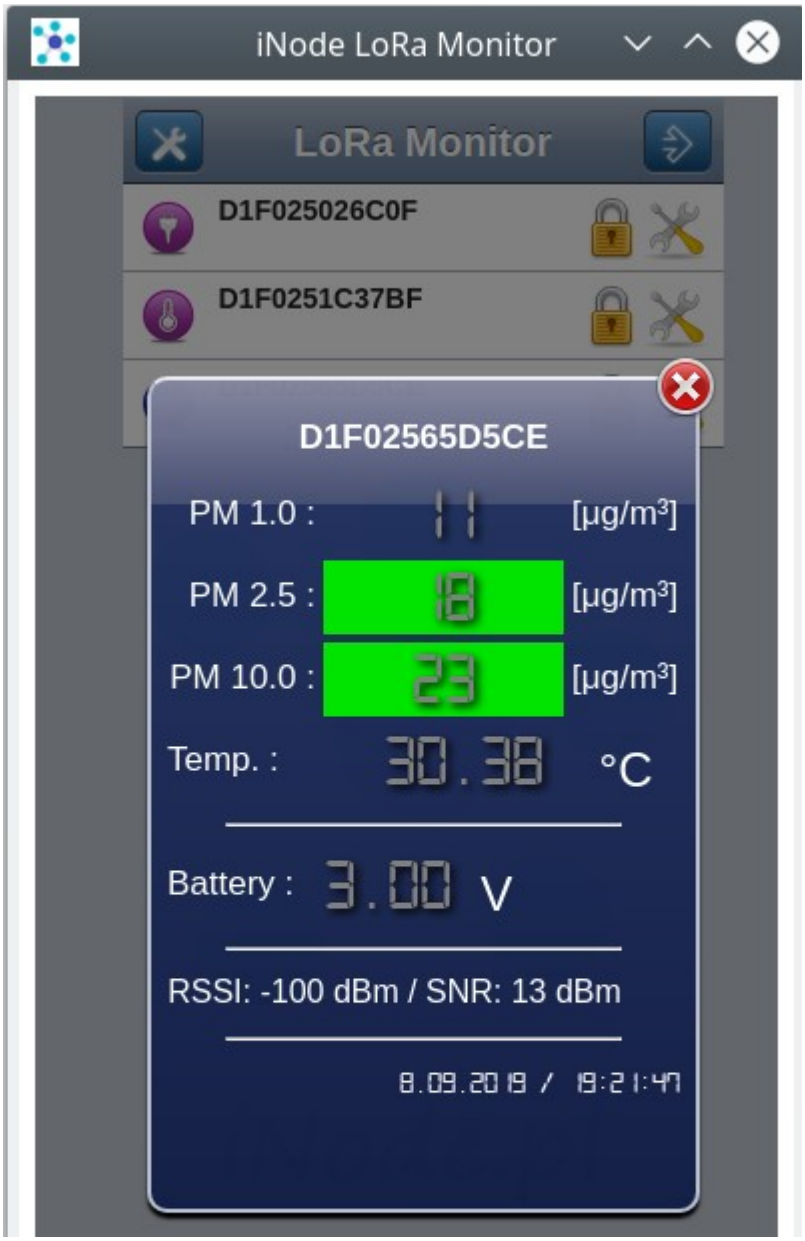
Otherwise, the message *Cannot connect in Lora mode!* will appear.



Based on Wikipedia about GFSK:

GFSK (Gaussian FSK) - a variation of FSK modulation, used for wireless communication within DECT systems, Bluetooth and Z-Wave devices, in which electromagnetic waves in the shape of a Gaussian curve are used. Logical "1" is represented by a positive carrier frequency deviation, and "0" as a negative deviation. In the Bluetooth system, the minimum frequency deviation is 115 kHz. Smoothing of the edges of the impulses is carried out using a Gaussian filter, the effect of which is to reduce the width of the signal spectrum; the next stage is FSK modulation.

iNode LoRa Monitor shows a unique device address on the list of scanned devices. After selecting particular device, a window appears showing the data sent in the broadcast frame received from it.

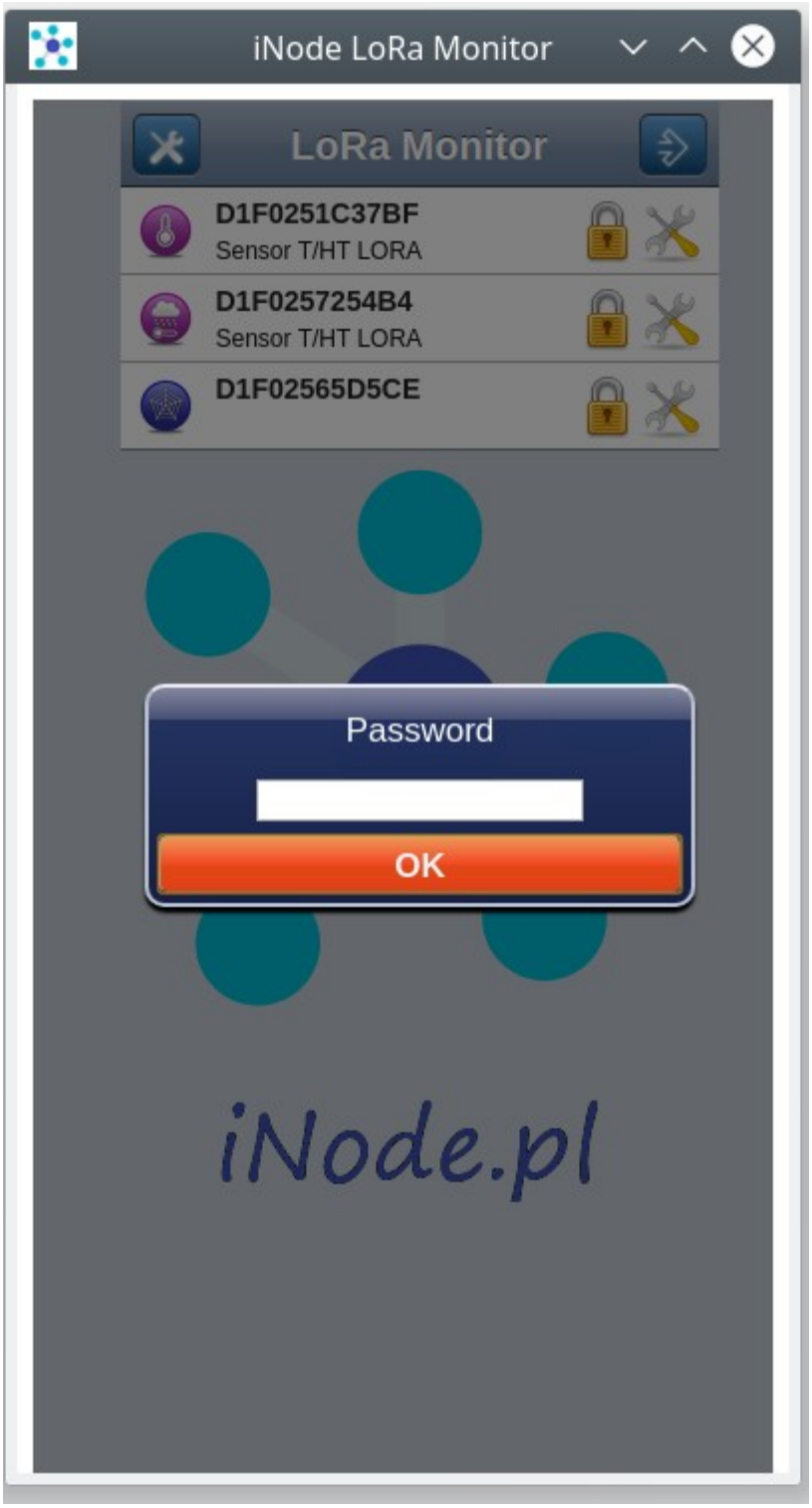


If the **iNode LoRa** device is battery powered, you can see information about the battery voltage. This voltage is measured during transmitting a broadcast frame with LoRa modulation. In idle mode and GFSK one it is higher. The minimum voltage at which **iNode LoRa** devices can work is 1.8V.

In addition, information about the level of the received signal is provided - RSSI and the signal-to-noise ratio - SNR (only in LoRa).

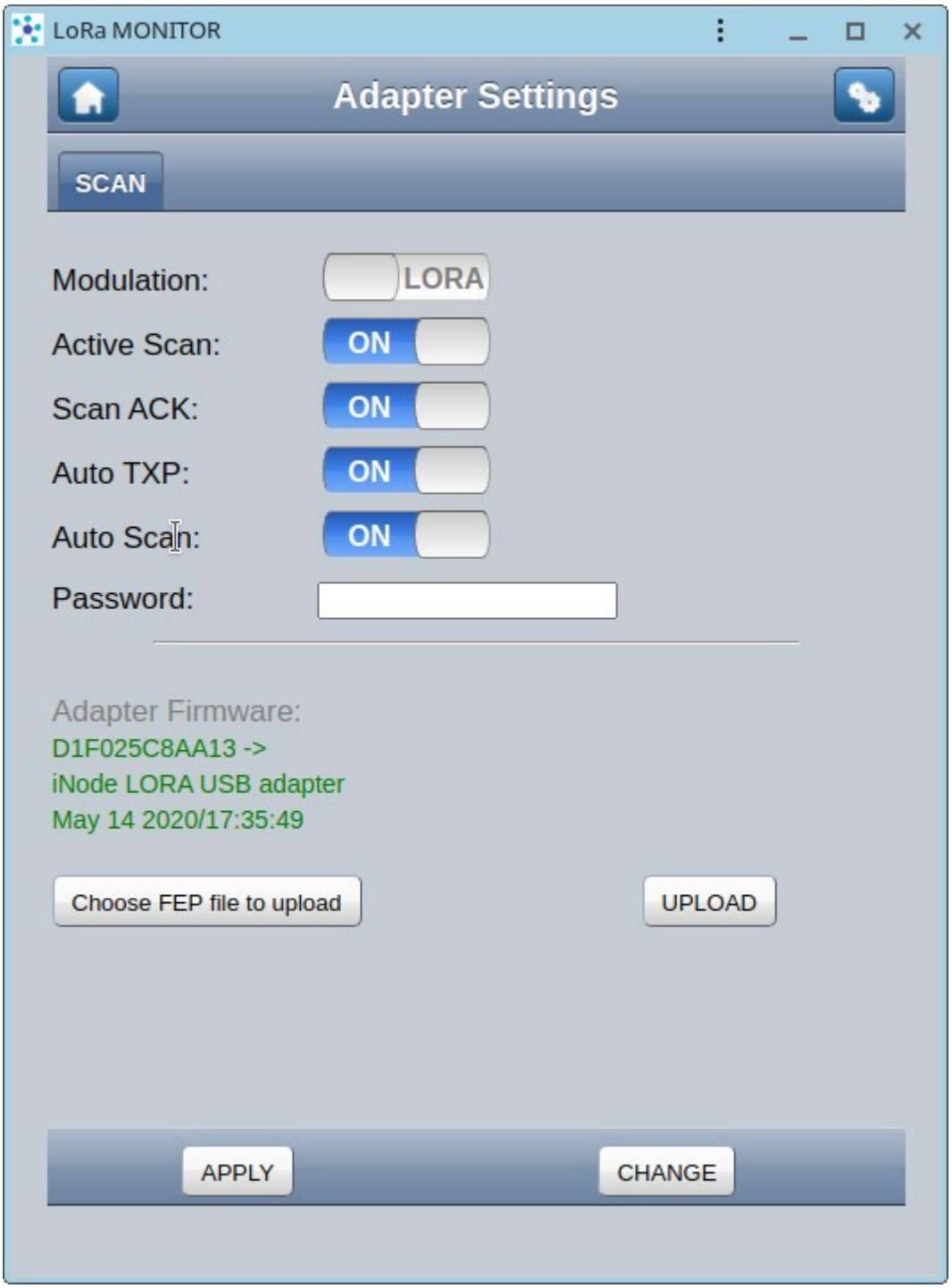
At the very bottom on the right is the date and time of receipt of the last broadcast frame.

The icon  allows you to enter the password necessary to establish a GFSK connection. By default, after the first scan of a device with a given address, it is an empty string. The application remembers entered passwords in the browser database.



4. iNode LoRa USB adapter settings

To configure the **iNode LoRa USB** adapter, go to the icon  This is only possible if the communication with the adapter is correct. After reading the settings from the adapter, the following screen will appear with the ***SCAN*** tab selected by default. The ***APPLY*** button changes settings only until the power is turned off or the adapter is reset. The ***CHANGE*** button changes them permanently and saves them in non-volatile memory. Return to ***MONITOR*** mode is also possible after selecting the icon 



4.1 SCAN

This tab allows you to configure the adapter scan parameters and replace the firmware.

4.1.1 Modulation

iNode LoRa USB adapter can receive data by radio using two modulation methods: GFSK or LoRa. GFSK is narrowband modulation and has, with the same transmit power, a smaller range than LoRa. In the case of devices of the **iNode LoRa** family, it is used for configuration and firmware replacement, as it ensures higher speed of data transfer. LoRa is a broadband modulation developed by Semtech. It is characterized by the fact that the receiver can receive a signal that is below the noise level.

4.1.2 Active Scan

Depending on the configuration, **iNode LoRa** devices can send, apart from one data packet (so-called broadcast frame) via GFSK, an additional type of packet (so-called active response). The device name is sent in this frame, which the user can change according to his needs. In addition to the unique device address, its name will appear in the **iNode LoRa Monitor** application.

4.1.3 Scan ACK

After enabling this mode of operation, if the adapter works in LoRa, it sends automatically after receiving the broadcast frame, confirmation of its receipt to the sender.

4.1.4 Auto TXP

After activating this mode of operation, if the adapter works in LoRa, it sends automatically after receiving the broadcast frame, confirmation of its receipt to the sender so that it can adjust its transmission power to the ambient conditions.

4.1.5 Auto Scan

After activating this mode of operation and saving it in the adapter, if the adapter is connected to the USB connector, it will immediately go into scan mode. To avoid buffer overflow in the adapter when no application is receiving data from it, USB data transfer is disabled by default. To activate them you must either configure the COM port parameters or send some data to the adapter.

4.1.6 Password

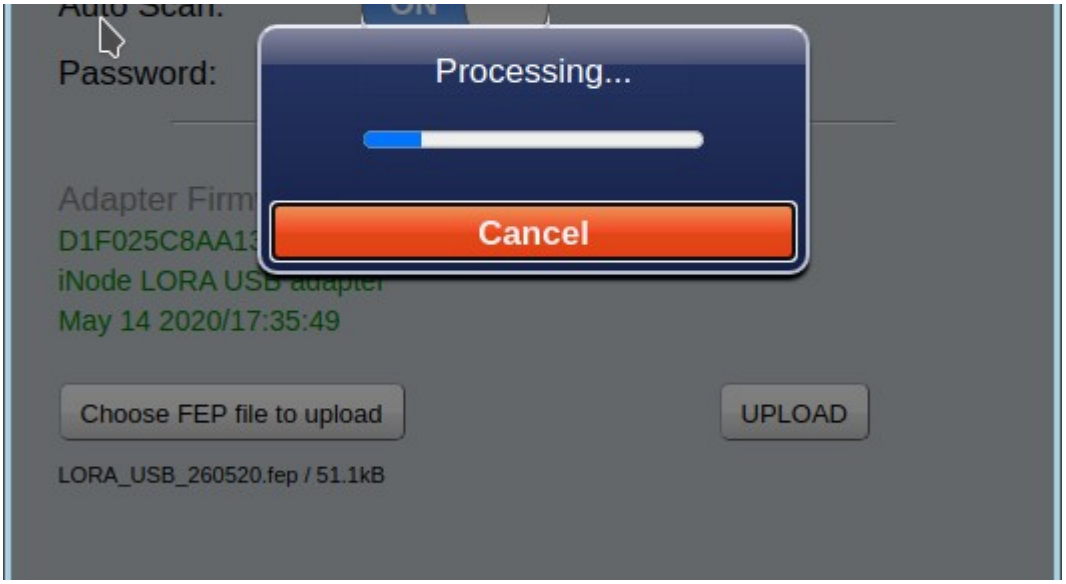
In this window, you can enter a password to limit access to the adapter configuration. At this time this functionality is not active.

4.1.7 Firmware Adapter

This part of the tab displays information about the firmware located in the adapter and its address . After pressing the ***Choose FEP file to upload*** button , the system browser window will appear for choosing a firmware file. Files with firmware for **iNode LoRa** devices have the extension .fep and contain information for which device they are intended. Therefore, it is not possible to upload to the device firmware intended for another.

When you press the ***UPLOAD*** button, a window will appear showing the progress of sending the firmware to the device.

Make sure that the device does not have a SIM card at the time, because the power consumption of the modem in it may be too high for the USB port to which **iNode LoRa USB** is connected. The result will be a power cut when replacing the firmware, which may result in a device failure.



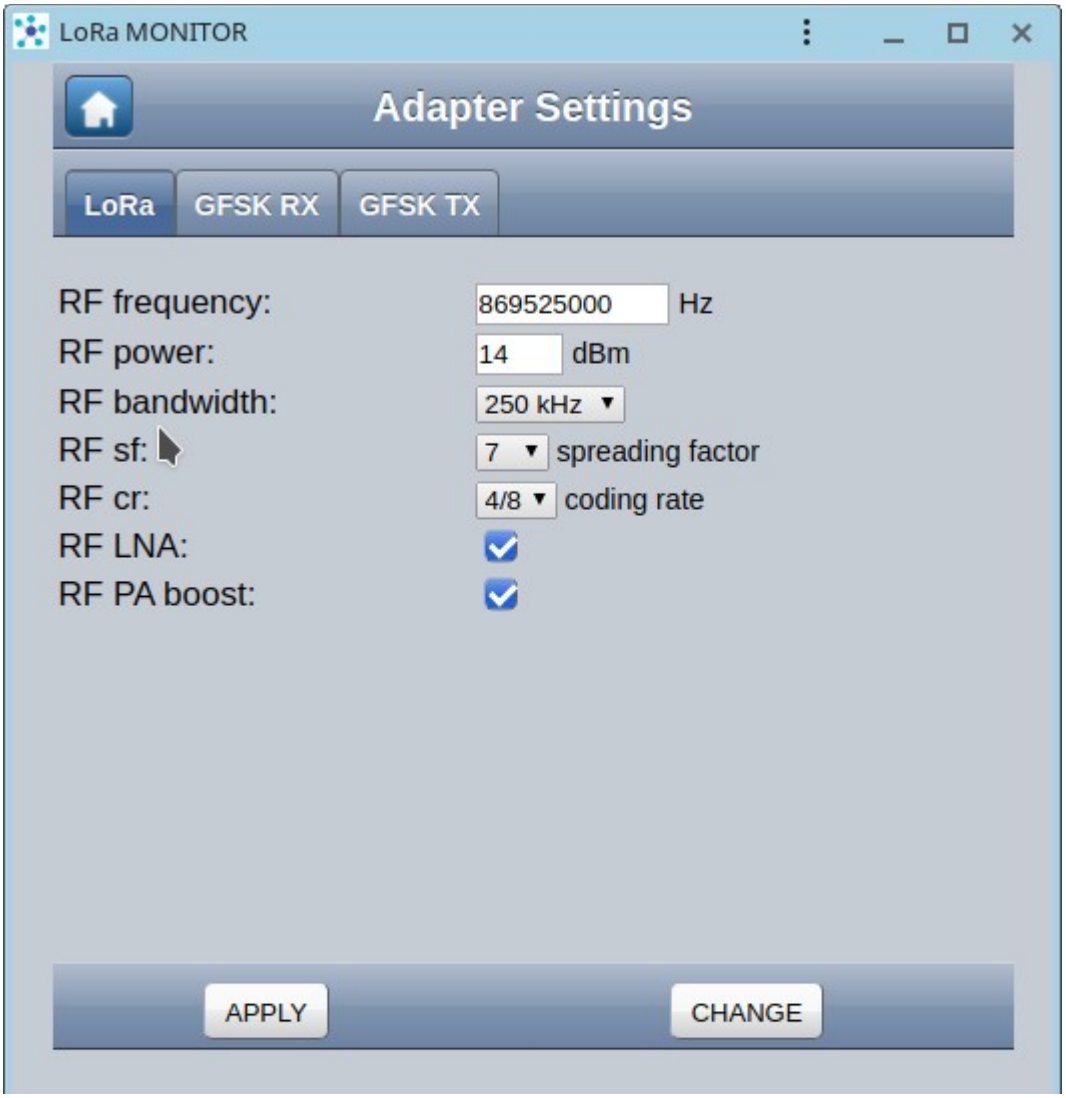
When the firmware is sent, information about the data transfer speed and the ***RESET*** button will appear.

After pressing the ***RESET*** button the firmware will be replaced, the device will restart and be connected again to the **iNode LoRa Monitor** application.

After selecting the button  the **iNode LoRa Monitor** application will allow you to configure the RF (radio) parameters of the device.

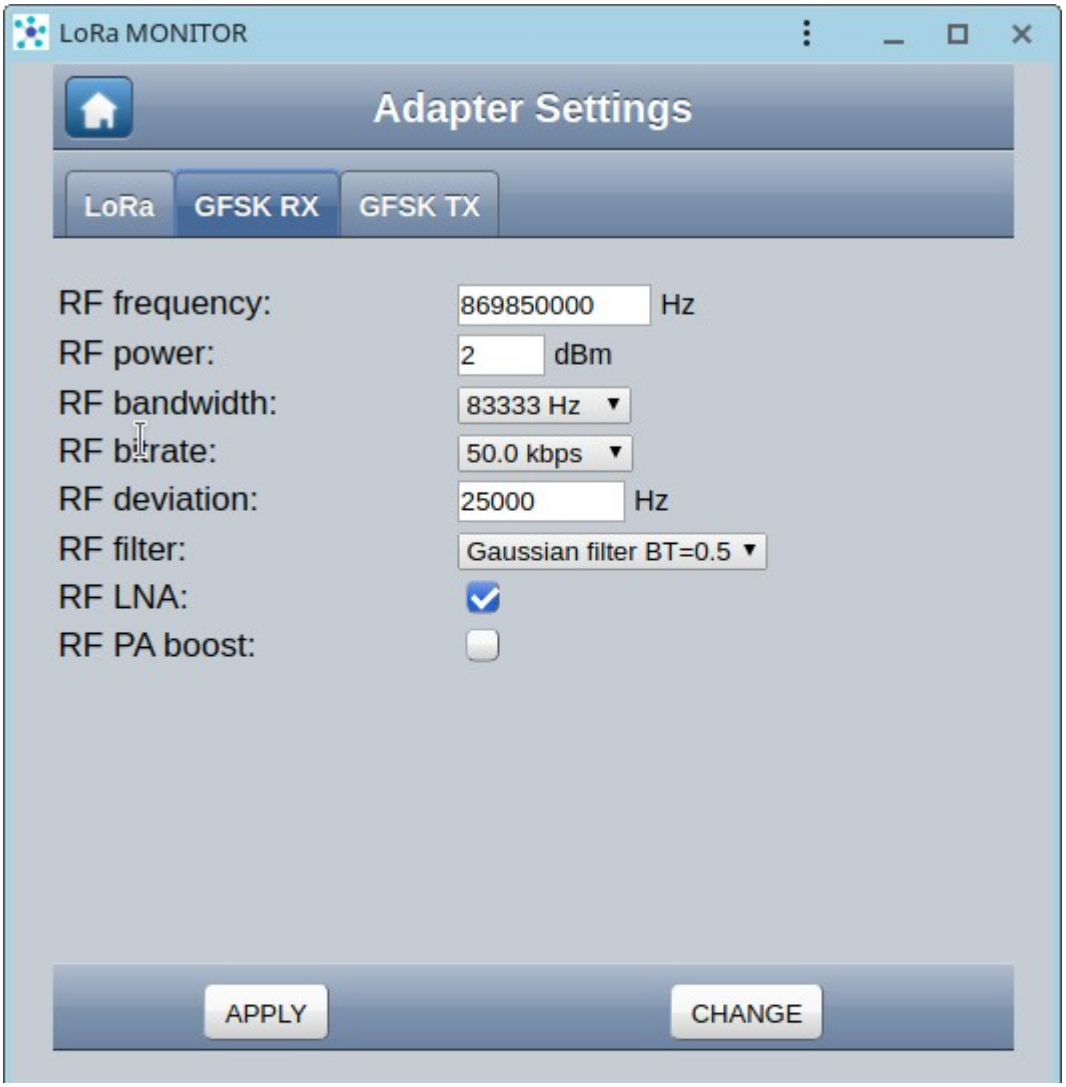
4.2 LoRa

This tab allows you to change the adapter LoRa modulation parameters. Please note that these parameters must be the same in the sending **iNode LoRa** device, otherwise the adapter will not receive any data from it. Below all parameters information is displayed, what is the maximum permissible value of DC factor in a given frequency band, and what is obtained by the device - LORA TX DC. This information is only helpful and the user should confirm it with the regulator. The maximum output power allowed in Europe by ETSI is +14 dBm.



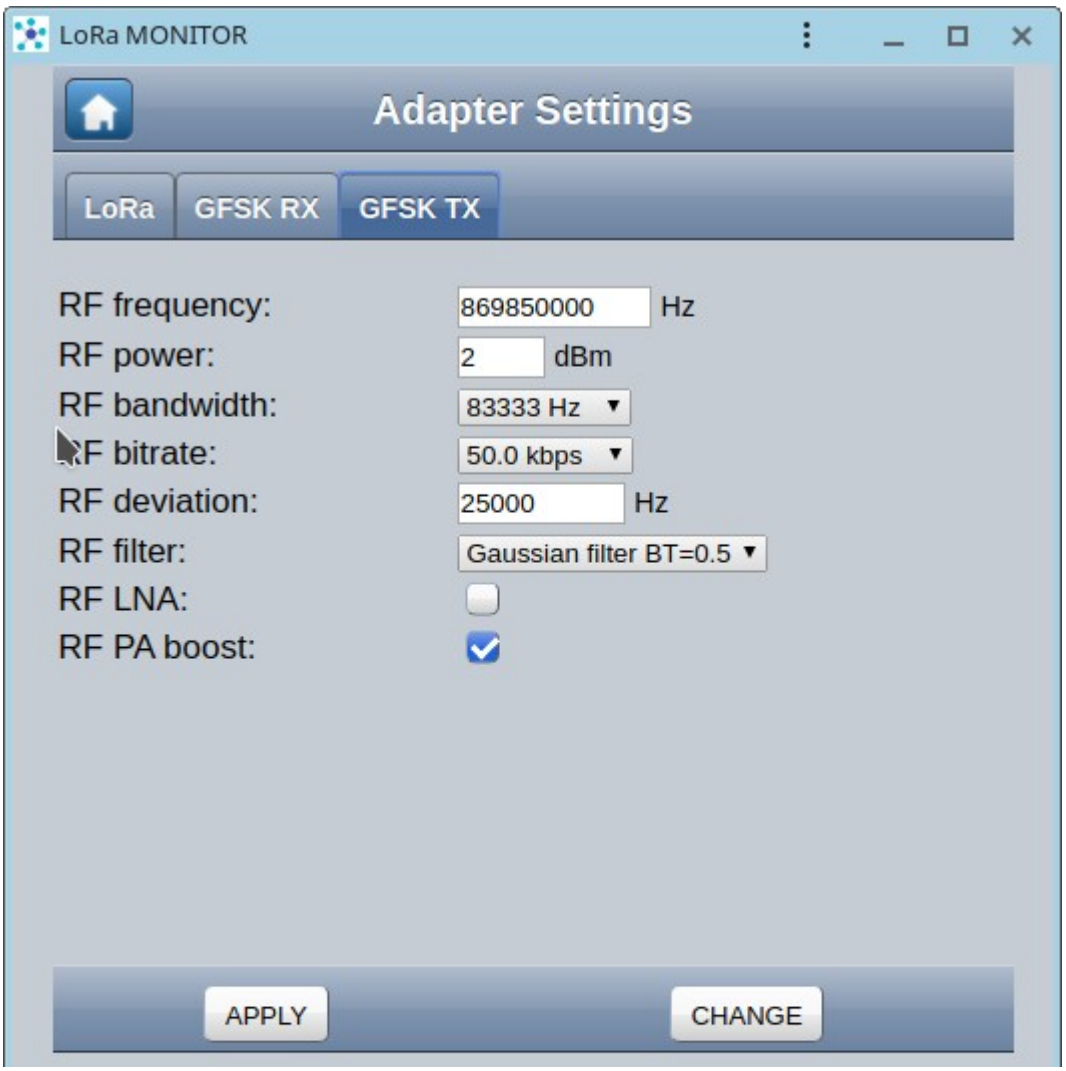
4.3 GFSK RX

This tab allows you to change the GFSK modulation parameters of the device in RX mode, i.e. receiving data. Please note that these parameters must be the same (GFSK TX) in **iNode LoRa** devices, otherwise the adapter will not receive any data from them.



4.4 GFSK TX

This tab allows you to change the GFSK modulation parameters of the device in TX mode, i.e. sending data. Please note that these parameters must be the same (GFSK RX) in **iNode LoRa** devices, otherwise they will not receive any data from the **iNode LoRa USB**. Below all parameters information is displayed, what is the maximum permissible value of DC coefficient in a given frequency band, and what is obtained by the device - GFSK TX DC. This information is only helpful and the user should confirm it with the regulator. The maximum output power allowed in Europe by ETSI is +14 dBm.



5. Data frame in GFSK or LoRa mode

The LoRa USB adapter in GFSK or LoRa scan mode sends following HCI frames:

043E290201007F48A80425F0D11D19FF909B00C0000000094183621745AC752779028A89417CF8D020A02EF

043E1E0201047F48A80425F0D112110953656E736F7220542F4854204C4F5241EF

The first one contains data from the broadcasting frame and the second one from the answer to the active query from the iNode LoRa HT sensor.

5.1 HCI frame with scan results (GFSK and LoRa)

043E290201007F48A80425F0D11D19FF909B00C0000000094183621745AC752779028A89417CF8D020A02EF

043E29

04 → HCI packet indicator: 0x04 EVENT
3E → event_code = 0x3E → LE EVENTS
29 → HCI parameter total length → 0x29 = 41

0201007F48A80425F0D11D

02 → Subevent_Code = 0x02 → LE Advertising Report event
01 → Num_Reports = 0x01 → number of responses in event (always 1)
00 → Event_Type[i] = 0x00 → connectable uni-directed advertising (ADV_IND)
7F → SNR [dBm]; in GFSK mode not available (value 127)
48A80425F0D1 → Address[i] = D1F02504A848 (Public Device Address) - MAC address of device
1D → Length_Data[i] = 0x1D = 29 (length of the Data[i] field)

19FF909B00C0000000094183621745AC752779028A89417CF8D

19 → 0x19 → Length = 25
FF → EIR Data Type = 0xFF - «Manufacturer Specific Data» tag
909B → 0x9B90 **iNode LoRa HT** identifier; bit 2=1 → range 3.3V – 3.69V; bit 2=0 → range 1.8V – 3.3V; bits from 4 to 7 sensor type:
  0x9 → Si7021
  0xD → Si7050
  0xE → Si7051
  0xA → Si7053
  0xB → Si7054
  0xC → Si7055
00C0 → 0xC000 - the four oldest bits value of 0xC is the battery voltage coded: 0xC=12 -> Vbat=(12-2)*10=100% - I.e. 3.00V; we convert

the percentage into voltage according to the formula:
(((Vbat*1.2V)/100)+1.8V) – range 1.8V – 3.3V;
(((Vbat*0.3V)/100)+3.3V) – range 3.3V – 3.69V;

0000 → 0x0000 → alarm flags (not used)
0000 → 0x0000 → not used
9418 → 0x1894 = 6292 → temperature [°C]=((172.5*t)/16384.0)-46.85;
((172.5*6292)/16384.0)-46.85 = 19.40 °C
3621 → 0x2136 = 8502 → relative humidity [%] =
((125.0*h)/16384.0)-6.0; ((125.0*8502)/16384.0)-6.0 = 58.87 %
745AC752 → 0x5A7452C7 = 1517572807 → time stamp in seconds
(Unix timestamp) → 2018-02-02T12:00:07+00:00
779028A89417CF8D → 0x8DCF1794A8289077 → digital signature

020A02

02 → 0x02 → Length = 2
0A → EIR Data Type = 0x0a → «Tx Power Level» tag
02 → 0x02 = 2dBm

EF → RSSI[i] = 0xEF → RSSI = -17dBm (signed integer); Range: -127 < N < +20dBm; 127 RSSI is not available

5.2 HCI frame with active query response (GFSK)

043E1E0201047F48A80425F0D112110953656E736F7220542F4854204C4F5241EF

043E1B

04 → HCI packet indicator: 0x04 EVENT
3E → event_code = 0x3e → LE EVENTS
1E → HCI parameter total length → 0x1E = 30

0201047F48A80425F0D112

02 → Subevent_Code = 0x02 → LE Advertising Report event
01 → Num_Reports = 0x01 → number of responses in event (always 1)
04 → Event_Type[i] = 0x00 → connectable uni-directed advertising (ADV_IND)
7F → SNR; in GFSK mode not available (value 127)
48A80425F0D1 → Address[i] = D1F02504A848 (Public Device Address) - MAC address of the device
12 → Length_Data[i] = 0x12 = 18 (length of the Data[i] field)

110953656E736F7220542F4854204C4F5241

11 → 0x11 → Length = 17
09 → EIR Data Type = 0x09 - «Complete Local Name» tag
53656E736F7220542F4854204C4F5241 → Sensor T/HT LORA

EF → RSSI[i] = 0xEF → RSSI = -17dBm (signed integer); Range: -127 < N < +20dBm; 127 RSSI is not available

6. TECHNICAL SPECIFICATIONS

GFSK/LoRa radio parameters:

- RX/TX:
  - ISM: 868 MHz;
- output power (minimum / maximum):
  - ISM: 2dBm / 20dBm;
- modulation:
  - GFSK;
  - LoRa - CSS (chirp spread spectrum) modulation;
- internal antenna (basic version):
  - 868 and 915MHz dual (wideband) ISM band SMD chip antenna;
  - frequency: 858 - 928 MHz;
  - average gain: -2,5dBi;
- external antenna:
  - SMA antenna connector- female;
  - frequency: 868 MHz;
  - average gain: 3dBi;

GFSK/LoRa:

- configurable from PC:
  - GFSK modulation: frequency, power, bandwidth, bit rate, deviation;
  - LoRa modulation: frequency, power, bandwidth, sf, cr;
  - TX power in range from +2dBm to +20dBm;
  - device access password;

Power supply:

- 5VDC;

Housing:

- metal;
- dimensions: 55 mm x 20 mm x 15 mm (LxWxH);

Others:

- firmware upload and configuration option via USB – WebUSB feature;
- USB 2.0 connector;
- LED;
- operating temperature: from -30 to 65°C;
- humidity: 35-90% RHG;
- weight: 15 g ;

Equipment:

- external antenna (SMA version). ISM 866 MHz, 2dBi gain, with SMA male plug connector;

Software:

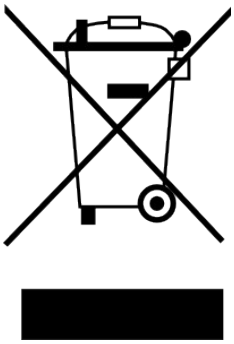
- Google CHROME: Android OS, Linux, Windows 10;

Chipset:

- STM32L082;
- SX1276;

The manufacturer reserves the right to change device and software parameters as well as introduce other construction solutions.

7. CORRECT PRODUCT REMOVAL (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)



The packaging materials are 100% suitable for use as a secondary raw material. The packaging should be disposed of in accordance with local regulations. Keep packaging materials out of the reach of children as they pose a source of danger. The marking on the product or in related texts indicates that the product should not be disposed of with other household waste after it has expired. To avoid harmful effects on the environment and human health due to uncontrolled waste disposal, please separate the product from other types of waste and recycle responsibly to promote the reuse of material resources as a permanent practice.

Correct disposal of the device:

- Pursuant to the WEEE Directive 2012/19 / EU, the symbol of the crossed wheeled waste container means all electrical and electronic devices subject to selective collection.
- After the end of its useful life, this product must not be disposed of as normal household waste, but should be sent to a collection point for the recycling of electrical and electronic equipment. This is indicated by the symbol of the crossed-out wheeled waste container, placed on the product or in the operating instructions or packaging.
- The materials used in the device are reusable according to their designation. Thanks to the reuse, use of materials or other forms of use of used devices, you make a significant contribution to the protection of our natural environment.
- For information on the appropriate disposal point for used electrical and electronic equipment, please contact your local municipality administration or the device seller.
- Used, fully discharged batteries and accumulators must be disposed of in specially marked containers, taken to special waste collection points or sellers of electrical equipment.
- Users in companies should contact their supplier and check the terms of the purchase contract. The product should not be disposed of with other household waste.

Numer Deklaracji 7/02/2018 Data wystawienia Deklaracji 03.02.2018 r.
Number of declaration of Conformity *Date of issue of declaration*

DEKLARACJA ZGODNOŚCI UE RED

UE RED DECLARATION OF CONFORMITY

Producent / *Manufacturer*:

ELSAT s.c.

(nazwa producenta / producer's name)

ul.Warszawska 32E/1, 05-500 Piaseczno k/Warszawy

(adres producenta / producent's address)

niniejszym deklaruje, że następujący wyrób:
declare, under our responsibility, that the electrical product:

iNode LoRa USB **0xB800, 0xB800 SMA**

(nazwa wyrobu / product's name) *(model / model)*

spełnia wymagania następujących norm zharmonizowanych:
to which this declaration relates is in conformity with the following harmonized norm:

Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz):

PN-EN 62479:2011

Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz**:**

ETSI EN 300 220-1 V 3.1.1:2017-02

ETSI EN 300 220-2 V 3.1.1:2017-02

Radio Spectrum ISM (Article 3.2 of the RED directive)**:**

ETSI EN 300 328 V2.1.1:2016-11

EMC (Article 3.1.b of the RED directive):

ETSI EN 301 489-1 V2.1.1:2016-11

ETSI EN 301 489-3 V2.1.1:2016-11

ETSI EN 301 489-17 V3.1.1:2016-11

Safety (Article 3.1.a of the RED directive):

PN-EN 62368-1:2015-03

Health (Article 3.1.a of the RED directive):

PN-EN 62311:2008

RoHs:

PN-EN IEC 63000:2019-01

jest zgodny z postanowieniami następujących dyrektyw Unii Europejskiej:
is compatible with the following European Union directives:

Dyrektywa RED 2014/53/UE
Dyrektywa EMC 2014/30/UE
Dyrektywa LVD 2014/35/UE
Dyrektywa RoHS 2011/65/UE

Procedura oceny zgodności: wewnętrzna kontrola produkcji zgodnie z załącznikiem II RED
Acceptance procedure: internal production control in accordance with Annex II of the RED Directive

03.02.2018 r. Robert Kujda

Piaseczno k/Warszawy Współwłaściciel

(data i miejscowość / date and place) *(podpis i stanowisko / signature and function)*

RoHS 2 2011/65/EU