

# **LoRa APRS**

## **iGate / Digipeater *Firmware Manual* V3.1.2**

### **CA2RXU**

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# 1. LoRa APRS iGate/Digipeater

This *LoRa APRS iGate/Digipeater* firmware supports *ESP32* (and all its family), *NRF52840* and *RP2040* based boards using *LoRa* as a carrier of APRS packets.

As an *iGate*, it connects to the internet over WiFi and to APRS-IS feed, uploads all received packets (GPS positions, messages, status, objects and telemetry). It includes a WebUI for the station configuration and management. It also receives packets from APRS-IS to be transmitted over *LoRa* to nearby stations and always checks whether the addressee of the packet has been recently heard before transmitting.

As a *Digipeater*, it repeats all received packets that follow the APRS path repetitions format. It includes a 30 seconds buffer to avoid retransmitting the same packet payload once it has been repeated/transmitted. It also features an *Ultra Eco Mode*, which consumes between ~7mA and ~13mA depending on the board used.

Both modes (*iGate* or *Digipeater*) have the possibility to send also weather telemetry packets.

This firmware was developed in full compliance with *APRS* rules and protocols and future versions will continue to follow this standards.

This firmware is released under the GPL-3.0 licence, which requires anyone who uses it, in whole or in part, to share it under the same licence and with proper reference to this firmware.

*If you have any correction or info that should be added here let me know in the issues of the repository.*

I hope you enjoy using this firmware. 73! — **CA2RXU**, Valparaíso, Chile

You can support this project to continue to grow:



## 2. Installation Process

The board flashing process is done using a [WebFlasher Webpage](#) where you'll find all the available boards for LoRa APRS iGate/Digipeater. The flashing process should be performed only with *Google Chrome* Browser.

### 2.1 Select your board

Select the board you will flash (and check also for the QRG "working frequency" of the board used as some boards needs this defined before flashing).

### 2.2 Select the Version

It's allways recommended to use the latest version (V3.1.2 at this moment).

### 2.3 Select the Type

There are two ways to flash a board:

- **Factory Reset** : Used when flashing the firmware for the first time or when you want to erase all configuration data and restore the board to its factory default values.
- **Firmware Uptade**: Used only to update the firmware version while keeping the configuration values intact. When updating from previous versions, the firmware checks the configuration data stored in the internal memory and updates names and variables as needed for the new version. The old data is preserved and not erased.

### 2.4 Flashing the board

There are four main boards groups and each of them are flashed in its own way:

Group 1 and 2:

- **ESP32**: Open [WebFlasher Webpage](#), select the board, version and flashing type. Connect the board over USB to your PC, Press the green "*Flash Firmware*" button and follow the process.
- **ESP32-S3, ESP32-S2, ESP32-C3**: Open [WebFlasher Webpage](#), select the board, version and flashing type. Connect the board over USB to your PC, press BOOT button (don't release it yet), press RST/Reset button, release RST/Reset button and release BOOT button (now it's ready for flashing). Press the green "*Flash Firmware*" button and follow the process. Sometimes after flashing process is done you need to press RST/Reset button once.

After *Firmware Update* board will work just as before. After *Factory Reset* a WiFi AP *NOCALL-10 AP* will be created (*password = 1234567890*). Connect to it with your Phone or Pc and open in your browser 192.168.4.1 to continue with the [configuration process](#).

Group 3 and 4:

- **NRF52840 and RP2040**: Open [WebFlasher Webpage](#), select the board. A new webpage will open where you need to download the latest version UF2 file for the board. Connect the board over USB to your PC, press two times the RST/Reset button to enter the *flashing mode* of the board. A new folder/device will appear on the PC. Paste the UF2 firmware file in it and the board will reboot. Follow the instructions of the webpage to input the configuration data. Arduino IDE or VSCODE are recommended as Serial input for the configuration process.

## 3. Configuration Process

### 3.1 Top Menu

CA2RXU's LoRa iGate   Configuration   Update OTA   Backup ▾   Device ▾   Received packets

Save

- **Configuration:** Returns to configuration if other windows are being used.
- **Update OTA:** Jumps into the "/IP\_OF\_THE\_BOARD/update" to perform OTA update.
- **Backup:** *Download* a .json file with the configuration of the board or *Restore* loading a .json file to iGate with pre-saved info for faster configuration reloading.
- **Device:** lets you reset the board.
- **Received Packets:** shows the latest 20 Rx packets.
- **Save:** Save all the configuration from this webpage into the board and reboot.

### 3.2 Station Configuration

#### Station

Add your Ham callsign and SSID.

You can leave a comment describing your station.

In the bottom there is a field for personal note that can only be seen in WEB GUI.

Callsign - SSID

NOCALL-10

Beacon Comment

LoRa APRS

Beacon Path

WIDE1-1

Symbol

Red diamond with L



Latitude

0.0

Longitude

0.0

Personal Note

A couple of words

☐ Send Status at each Boot

Status

Custom Status

- **Callsing** and **SSID** : It should be a valid Ham Op Callsign (4 to 6 (char/num) or LoRa Tx won't be enabled. SSID could be omitted but if present it must be a number from 0-99 (0-15 is recommended to follow AX.25 packets, example AB1CDE-10. Also: AB1CDE-1 is not the same as AB1CDE-01).
- **Beacon Comment**: Any Comment with less than 50 characters long. The shorter the better.
- **Beacon Path**: Recommended WIDE1-1.
- **Symbol**: Select one of the four provided which reflect the use case:
  - Black Diamond + L : Rx iGate
  - Red Diamond + L : Rx+Tx iGate
  - Green Star + L : Digipeater Mode
  - Blue Circle + L : iGate/Digipeater with Wx Tx
- **Latitude** and **Longitude**: insert GPS values in degrees (the ones from Google Map, 7 decimals work better).
- **Personal Note**: Add some words to identify the stations besides just its Callsign. This is only for internal management.
- **Status**: You can add a custom status to be sent at each board boot.

### 3.3 WiFi Access



#### WiFi Access

Add all Wi-Fi Networks intended to be used.

Add network

Add your *WiFi* info : *SSID + Password*. You can add more than one WiFi (but never leave the first one empty if you want to only use the second inserted WiFi). If you add more than one WiFi connection the board will iterate over them until it gets connected.

**NOTE:** use only 2.4GHz WiFi AP as ESP32 based boards don't connect to 5GHz WiFi APs.

### 3.4 APRS-IS



#### APRS-IS

Enter you APRS-IS server and credentials.



Enable APRS-IS connection



Gate APRS-IS Messages to RF



Gate APRS-IS Objects to RF

Server

rotate.aprs2.net

Port

14580

Passcode

XYZVW

Filter

m/10

- **Enable APRS-IS Connection:** To upload all Rx LoRa packets.
- **Gate APRS-IS Messages to RF:** Tx message packets from APRS-IS to LoRa Stations nearby.
- **Gate APRS-IS Objects to RF:** Tx objects packets from APRS-IS to LoRa Stations nearby.
- **Server:** write your preferred APRS-IS server (Default rotate.aprs2.net)
- **Port:** 14580 (don't change it unless your Server uses another port).
- **Passcode:** APRS-IS passcode generated with your Callsign (Google it ;) )
- **Filter:** Recommended *t/m/AB1CDE-10/10* , being *AB1CDE-10* your callsign) (more info [here](#))

### 3.5 Beacons

**Beaconing**  
 Set APRS beacon attributes.

☐ Send beacon via APRS-IS
 ☐ Send beacon via RF

Send beacon now

Beacon Interval  

15

minutes

☐ Send Real-GPS Beacon (Only for Boards with GPS Modules)
 ☐ Send Real-GPS Beacon with Ambiguity (~ 1 Km of Random Error)

- **Send beacon to APRS-IS:** Enable to send station beacon with gps data via TCP/IP/Internet.
- **Send beacon via RF:** Enable to send station beacon with gps data over RF/LoRa.
- **Send Beacon Button:** Send station beacon without waiting for interval time (for testing).
- **Beacon Interval:** Time between beacons (Default is 15 min minimum).
- **Send Real-GPS Beacon:** Boards with built-in GPS can now send real gps positions for a mobile iGate deployment.
- **Send Real-GPS Beacon with Ambiguity:** Generate 1Km forced error on mobile iGates.

### 3.6 Black List

#### Black List

Add Callsigns with space between them to Blacklist them (\* wild card allowed)

Blacklist

- Add Callsigns to avoid processing its beacons. Adding *AB1CDE-7* will make iGate/Digi hear the station but don't repeat his packets (*Digipeater*) or upload to APRS-IS (*iGate*).
- Wild Card is allowed (Example: *AB1CDE\** will block all SSID of the station AB1CDE).

### 3.7 Digipeating

#### Digipeating

Define the Digipeater mode

Repeater Mode

Eco Mode (Requires Digipeating enabled and APRS-IS connection disabled).

Digipeater Modes :


- **OFF** (No digipeating)
- **WIDE1**, for WIDE1-1 digipeating.
- **WIDE2**, for WIDE2-n + WIDE1-1 digipeating. (Not recommended unless it's really needed as WIDE1-1 is more than enough for most cases).

EcoMode :

- A) **OFF / Normal Mode**: Has Serial Output and WiFiAP to access WebUI. (*NOTE*: it uses over 200mA at idle because of WiFiAP).
- B) **Ultra Eco Mode**: WiFiAP, Serial Output and Display are disabled. This mode makes the board lightSleep and keeps the LoRa module listening for packets. As a packet is received it wakes the board and repeats it. The boards return to sleep and waits for a LoRa packet. (*NOTE*: uses ~7mA at idle). To exit *Ultra Eco Mode* please define it as only *Digipeater* (not *iGate*) before saving with UEM.
- C) **OFF / Normal Mode without WiFiAP**: Serial Output still enabled. (No access to WebUI as WiFiAP is disabled, *NOTE*: uses between 70-85mA at idle).

ADDITIONAL INFO: This Eco Modes can be changed with [Queries](#) to the station.

### 3.8 LoRa

 **LoRa**

Config LoRa APRS Xmitting settings.

☐ Enable LoRa TX

☒ Enable LoRa RX

Tx Frequency

Hz

Rx Frequency

Hz

Predefined speeds

▾

Bandwidth

▾

Spreading Factor

▾

Coding Rate


▾

Power

dBm

- **Enable LoRa Tx:** Activate transmission. (*NOTE:* only for valid callsign).
- **Enable LoRa Rx:** Activate reception. (Default is true).
- **Tx Frequency:** Transmission frequency.
- **Rx Frequency:** Reception frequency (If “*Rx Freq*” is not the same as “*Tx Freq*”, it must have 125KHz difference per bandwidth).
- **Predefined Speeds:** Select one of them for fast configuration.
- **Bandwidth:** For advanced config of LoRa module.
- **Spreading Factor:** For advanced config of LoRa module.
- **Coding Rate:** For advanced config of LoRa module.
- **Power:** For advanced config of LoRa module.

### 3.9 Display

 **Display**

OLED screen configuration.

☒ Always On

☐ Turn 180°

Display Timeout


seconds

Remember Station Time

minutes

- **Always On:** If disabled the display will turn *On* only when packet is received. (LoRa/APRS-IS).
- **Display Timeout:** Time before turning display *Off* after receiving a packet.
- **Turn 180:** Turn 180 degrees the display/screen.
- **Remember Station Time:** Time the iGate/Digipeater remembers a station before transmitting packets from APRS-IS to it.

### 3.10 Battery



#### Battery

Battery Monitor & Health

Max Voltage on input pin is 3.3V.

Calculate voltage divider accordingly.

☐ Send Internal Voltage
   
☐ (Send Voltage As Telemetry)

☐ Monitor Internal Voltage Health

Internal Sleep Voltage
 

2.9

volts

☐ Send External Voltage

☐ Monitor External Voltage Health

External Sleep Voltage
 

10.9

volts

External Voltage Pin

34

External Voltage divider R1
 

100.0

kOhm

External Voltage divider R2
 


27.0

kOhm

- **Send Internal Voltage** from boards with internal battery connector.
- **Send External Voltage** from external batteries (Max 15V with predefined 100K+27K Voltage divider).
- **Send Internal (and/or External Voltage) as Encoded Telemetry** in one single GPS Beacon Packet.
- **External Voltage Pin definition.**
- **Monitor Internal Voltage Health:** Monitors the internal battery voltage, and if it drops below the *Internal Sleep Voltage* threshold, the board will enter deep sleep mode for 30 min. This helps to prevent complete drainage of the battery when no sunlight is available to recharge it.
- **Monitor External Voltage Health:** Monitors the external battery voltage, and if it drops below the *External Sleep Voltage* threshold, the board will enter deep sleep mode for 30 min. This helps to prevent complete drainage of the battery when no sunlight is available to recharge it.

**NOTE:** Don't enable **Monitoring Internal/External Voltage Monitoring** without Battery (or Voltage) connected or the board will boot right into *sleepMode*.

### 3.11 Wx Telemetry

 **WX Telemetry**

Define Wx telemetry

☐ Activate Wx Telemetry (Requires a BME/BMP280, BME680 or Si7021 sensor).

Height Correction (Above Sea-Level)

0

meters


Temperature Correction

0.0

C°

- **Enable Wx Telemetry:** The board will scan *I2C* and autodetect *BME280*, *BMP280*, *BME680* or *Si7021* supported modules. *NOTE:* when enabled *Symbol* will change to *Blue Circle + L*. This is required for *aprs.fi* and some apps to recognize Wx packet.
- **Height Correction:** Change it to have accurate Pressure readings.
- **Temperature Correction:** Change it if you see your boards with shifted values.

### 3.12 Syslog

 **Syslog**

Broadcast the system log over the network.

☐ Enable syslog

Server

lora.link9.net

Port

1514

☐ Log Beacon over TCP/IP

- **Enable Syslog.**
- **Server:** IP of the server. (default is *lora.link9.net*, a great project from *@madspy*)
- **Port:** Port of the server. (default is 1514)
- **Log Beacon over TCP/IP:** Send also the station beacon to syslog if only *APRS-IS TCP/IP* is enabled.

### 3.13 TNC



#### TNC

TNC and KISS  
configuration

Server will be available at port **8001**

- ☐ Enable TNC server
- ☐ Enable Serial KISS
- ☐ Accept own frames via KISS

- **Enable TNC Server.**
- **Enable Serial KISS packets.**
- **Accept own frames via KISS** (when your TNC app uses same Calling-SSID as the LoRa iGate).

### 3.14 MQTT



#### MQTT

Set your MQTT server

☐ Enable

Server

Topic

Default is **aprs-igate**

Username


Password

Port

Default is **1883**

- **Enable MQTT.**
- **Server:** IP of the MQTT Broker.
- **Topic:** “*aprs-igate*” by default if no topic is written.
- **Username** and **Password:** Username and Password to connect to MQTT Broker. If MQTT Broker has not username/password leave it empty as it can also connect to a open MQTT Broker.
- **Port:** use your defined port for MQTT Broker. Default is 1883.

### 3.15 Reboot Time

 **Reboot Time**


☐ Reboot Mode Active

Time before forced Reboot

hours

- **Reboot Mode Active:** Enables the automatic reboot process after *Time before forced Reboot* time.
- **Time before forced Reboot:** in hours (min = 6 hrs).

### 3.16 WiFi Auto AP

 **WiFi Auto AP**

Add your password and WiFi AP timeout to auto access point. Auto AP will start if there is no WiFi connection. Timeout will count from startup or last client disconnected.


Password

WiFi AP timeout to search again for available WiFi's (in minutes)

Set to 0 if you don't want WiFi AP to stop.

- **Password:** WiFiAP *password* for iGate/Digipeater if WiFi connection is lost. (Default is "1234567890").
- **WiFiAP Timeout:** Minutes before searching again for available WiFi connections. (Default 10 min).

### 3.17 OTA

 **OTA**


Set your username and password to allow firmware updating over-the-air.

Username

Password

Add **Username** and **Password** if you need more security before entering the OTA Update webpage.

### 3.18 Admin

**Admin**

Set your username and password to allow access to the web interface.

☐ Web interface authentication


Username

admin

Password

Activate the user authentication process to enter WebUI. Default is false. Change User and Password if needed.

### 3.19 Remote Management

**Remote Management**


Manage Station via APRS Messages. Leave empty to disable!

Callsign-SSID of Managers, space separated, trailing \* wildcard allowed (ex: AB1CDE-9, AB1CDE\*)

☒ Managers commands only via RF (not APRS-IS)

Add Callsigns of stations that will be granted to change configuration of the iGate/Digipeater. (Example: adding *AB1CDE-7*). Wildcard is allowed (Example: *AB1CDE\**, this will block all SSID of the station AB1CDE). **Managers commands only via RF**: enabled means it won't accept management from packets coming from APRS-IS, and only allows them from RF/LoRa to change configurations of the station.

### 3.20 NTP

**NTP**

Set your GMT Time Zone.

GMT Time Correction for accurate Local Time

0

hours

Edit the GMT Offset for your timezone.

### 3.21 Experimental



#### Experimental

You can test new features.

Use at your own risk!

When "only" iGate Mode loses WiFi, it will change into a Digipeater Mode and after 15 min check if WiFi available and return to "only" iGate Mode.



Backup Digipeater Mode

- **BackUp Mode:** if iGate loses WiFi and APRS-IS connection it will change into Digirepeater Station. If Wifi and APRS-IS connection returns it returns to iGate Mode.

***Remember to press the "SAVE" button to save the all configuration modifications on the board. It will reboot, connect to your WiFi and be accessible in the IP showed on the OLED Screen.***

## 4. Supported sensors for telemetry.

LoRa modules allow us to add modules to our boards and send telemetry and weather packets over APRS. At this time there are 3 ways to send this telemetry packets over APRS:

- Weather Packet: it can transmit rain, wind speed and direction, temperature, humidity, relative pressure and more. Check [APRS101.pdf](#) (page 62) and [APRS1.2 Addendum](#) to see how this packet is constructed. *NOTE: the correct symbol is required for it to be decoded as a weather packet.*
- Base91 encoded Telemetry: this is added after the comment in the beacon packet of the station. Check [this page](#) for explanation how its constructed.
- Classic Telemetry: not currently implemented to avoid sending more packets than needed. (soon to be added to future versions of the firmware).

Most sensors are connected using I2C protocol and the board scans for them if enabled on the WebUI. The firmware then determines which data can be gathered and sent automatically for each connected sensor.

The recommended minimal transmission interval for telemetry packets is at a 10 minutes, as APRS.fi and other app won't decode them at a faster rate.

Recommended sensors (always chose the 3.3V version):

- BME280
- BMP280
- BME680
- Si7021

Go to the [APPENDIX 2](#) to see the wiring/pinout to connect this sensors to the boards.

## 5. Queries

The firmware allows the board, as iGate or Digipeater, to receive queries through a message from any APRS station over LoRa(RF) or TCP/IP(Internet). It will answer to the sender also with a message (and *ack* if present):

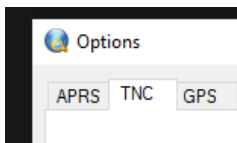
- **?APRS?** (or **HELP**) : station answers is all (or most) of the available queries on the firmware.
- **?APRSV** : station answers the version of the firmware running on the iGate.
- **?APRSP** : station answers the latitude and longitude of iGate (only 2 decimals).
- **?APRSL** : station answers the list of station listened in the last 30 minutes (or the Remember-Station-Time).
- **?APRSSR** : station answers the Signal Report (RSSI, SNR and Frequency Error/Shift) for the last packet (which would be the same query message).
- **?EM=?** : Digirepeater answers the Digi EcoMode Status.
- **?EM=ON** : Digirepeater starts Digi Ultra EcoMode (no WiFi/WiFiAP, Oled/Tft Screen, Led and also lower CPU Frequency Speed). The answer shows new state.
- **?EM=OFF** : Digirepeater exists Digi Ultra EcoMode (starts WiFiAP, Oled/Tft Screen). Answer shows new state.
- **?TX=?** : Station answers whether Tx is enabled or not.
- **?TX=ON** : Station activates Tx for Digipeater/iGate. Answer shows new state.
- **?TX=OFF** : Station deactivates Tx for Digipeater/iGate. Answer shows new state.
- **?COMMIT** : Station saves Tx and EcoMode on internal memory so that, even if board reboot, changes are not lost. Answer confirms action.

## 6. TNC Configuration

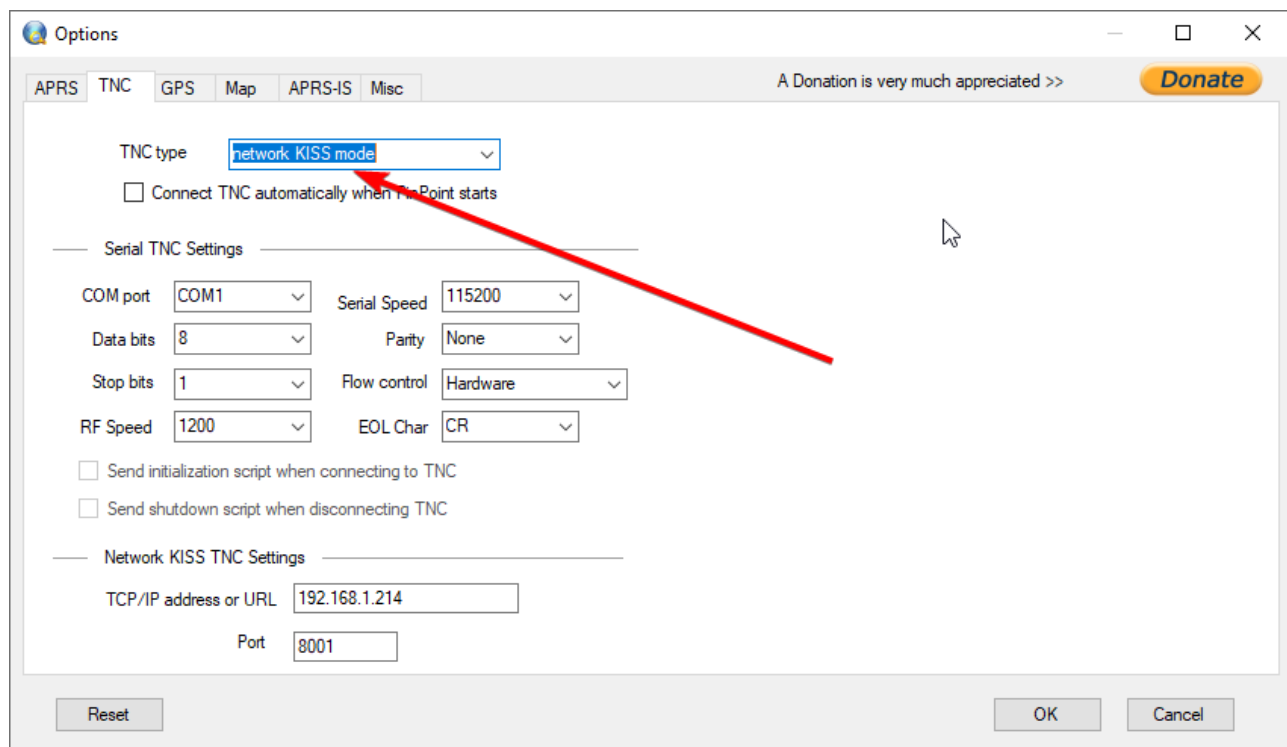
### 6.1 Pinpoint APRS

Download the app [here](#).

A) Open Tools -> Options -> TNC (you can click F2 button)



B) Set TNC type: "network KISS mode" for TNC server (via WiFi) or "serial KISS mode" for Serial KISS (via USB cable)



### C) Set your LoRa IP

The screenshot shows the 'Options' dialog box with the 'TNC' tab selected. The 'TNC type' is set to 'network KISS mode'. Under 'Serial TNC Settings', the 'COM port' is 'COM19', 'Serial Speed' is '115200', 'Data bits' is '8', 'Parity' is 'None', 'Stop bits' is '1', 'Flow control' is 'Hardware', 'RF Speed' is '1200', and 'EOL Char' is 'CR'. Under 'Network KISS TNC Settings', the 'TCP/IP address or URL' is '192.168.1.214' and the 'Port' is '8001'. Red arrows point from the text 'LoRa IP' to the IP address field and from 'port 8001' to the Port field. The 'Donate' button is visible in the top right corner.

Options

APRS TNC GPS Map APRS-IS Misc

A Donation is very much appreciated >> [Donate](#)

TNC type: network KISS mode

☐ Connect TNC automatically when PinPoint starts

Serial TNC Settings

COM port: COM19 Serial Speed: 115200

Data bits: 8 Parity: None

Stop bits: 1 Flow control: Hardware

RF Speed: 1200 EOL Char: CR

☐ Send initialization script when connecting to TNC

☐ Send shutdown script when disconnecting TNC

Network KISS TNC Settings

TCP/IP address or URL: 192.168.1.214

Port: 8001

Reset OK Cancel

### D) or Serial port related to TNC type you selected previously.

The screenshot shows the 'Options' dialog box with the 'TNC' tab selected. The 'TNC type' is set to 'serial KISS mode'. Under 'Serial TNC Settings', the 'COM port' is 'COM19', 'Serial Speed' is '115200', 'Data bits' is '8', 'Parity' is 'None', 'Stop bits' is '1', 'Flow control' is 'Hardware', 'RF Speed' is '1200', and 'EOL Char' is 'CR'. Under 'Network KISS TNC Settings', the 'TCP/IP address or URL' is '192.168.1.214' and the 'Port' is '8001'. Red arrows point from the text 'LoRa serial port' to the 'COM port' field and from 'LoRa serial speed' to the 'Serial Speed' field. The 'Donate' button is visible in the top right corner.

Options

APRS TNC GPS Map APRS-IS Misc

A Donation is very much appreciated >> [Donate](#)

TNC type: serial KISS mode

☐ Connect TNC automatically when PinPoint starts

Serial TNC Settings

COM port: COM19 Serial Speed: 115200

Data bits: 8 Parity: None

Stop bits: 1 Flow control: Hardware

RF Speed: 1200 EOL Char: CR

☐ Send initialization script when connecting to TNC

☐ Send shutdown script when disconnecting TNC

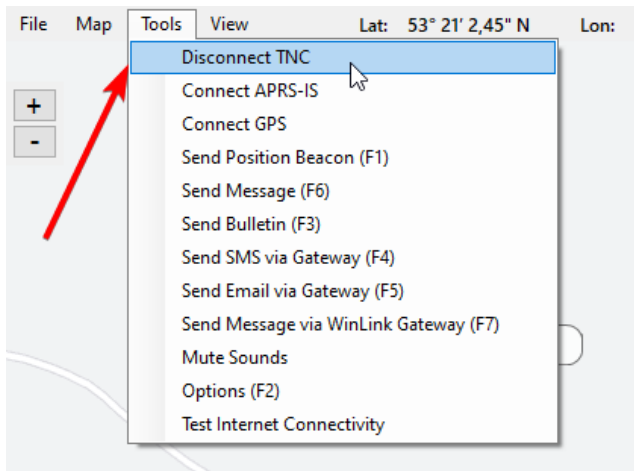
Network KISS TNC Settings

TCP/IP address or URL: 192.168.1.214

Port: 8001

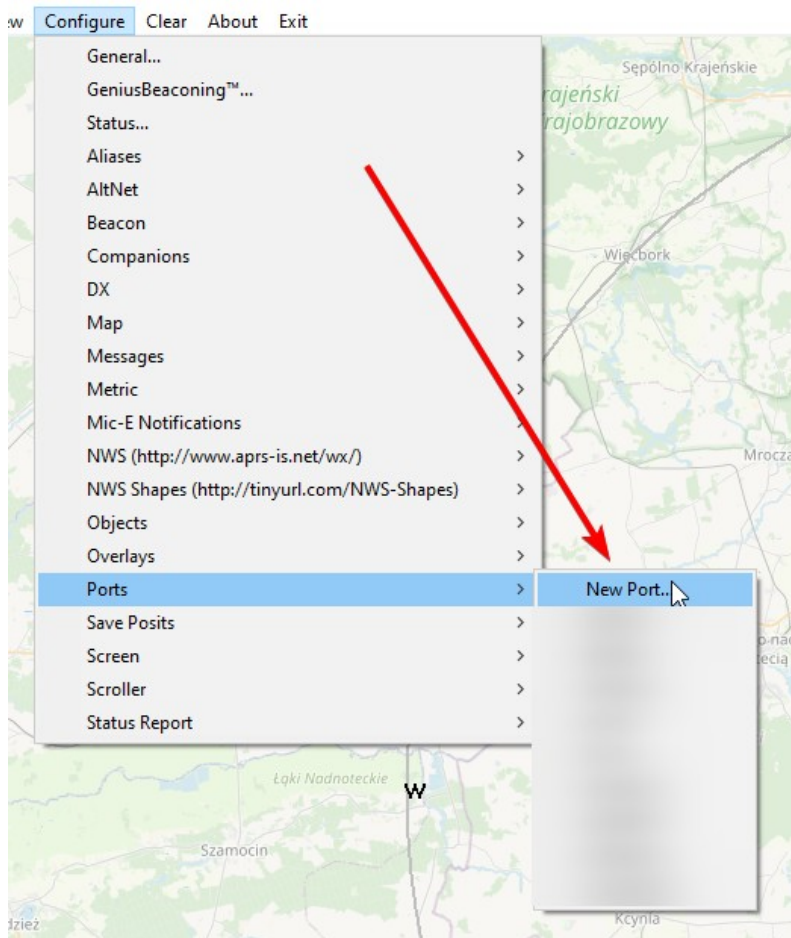
Reset OK Cancel

E) After adding port you can connect or disconnect TNC in Tools -> Connect/Disconnect TNC.



## 6.2 APRSIS32

A) Click Configure -> Ports -> New Port



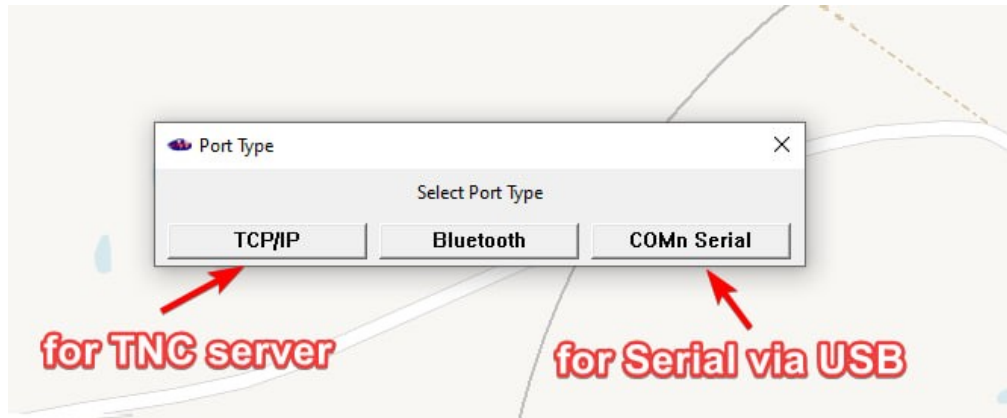
B) Set port type as "Simply (KISS)" and set port name as you want

New RFPort

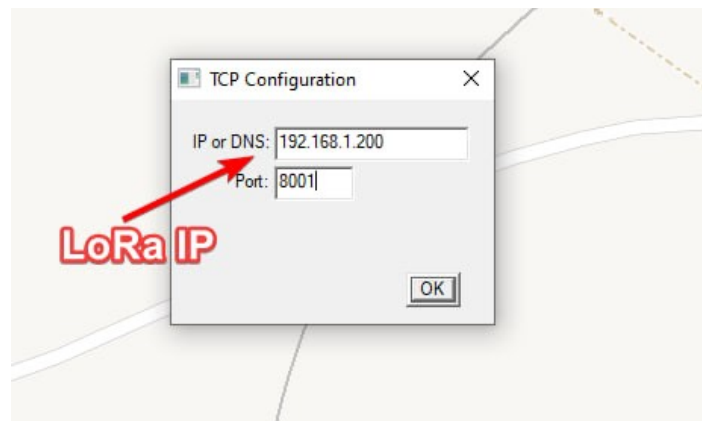
Type:

Name:

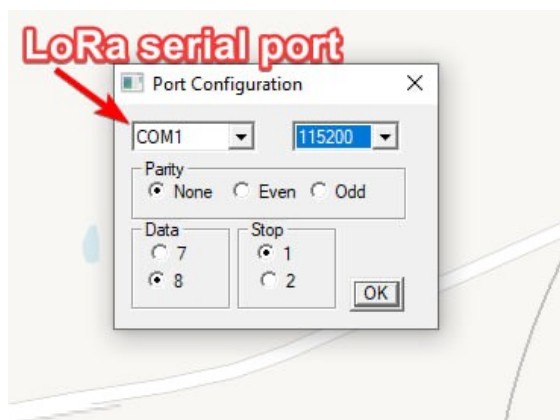
C) Select port type: TCP/IP for TNC server (via WiFi) or COM Serial for Serial KISS (via USB cable)



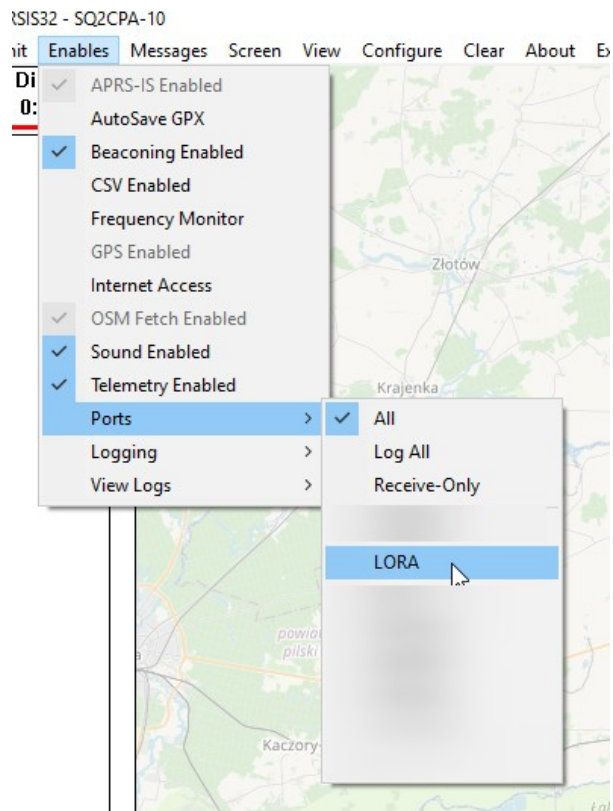
D) Set your LoRa IP



E) or Serial port related to port type you selected previously.



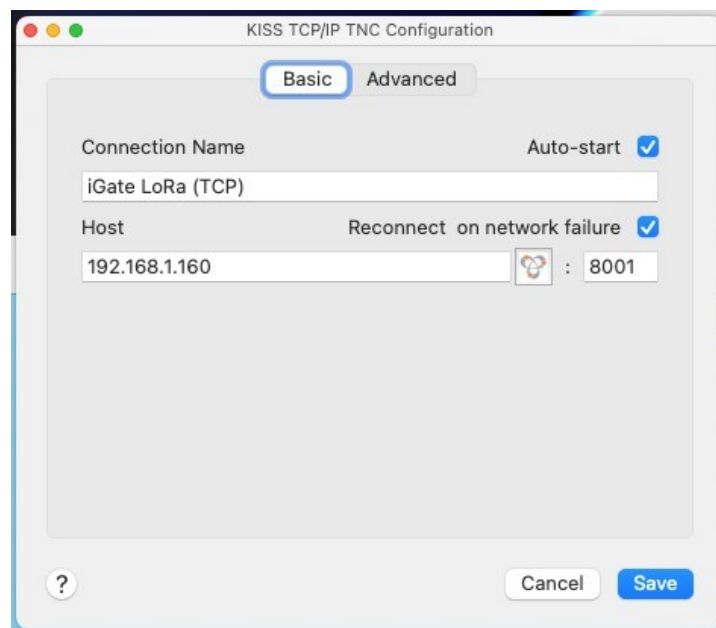
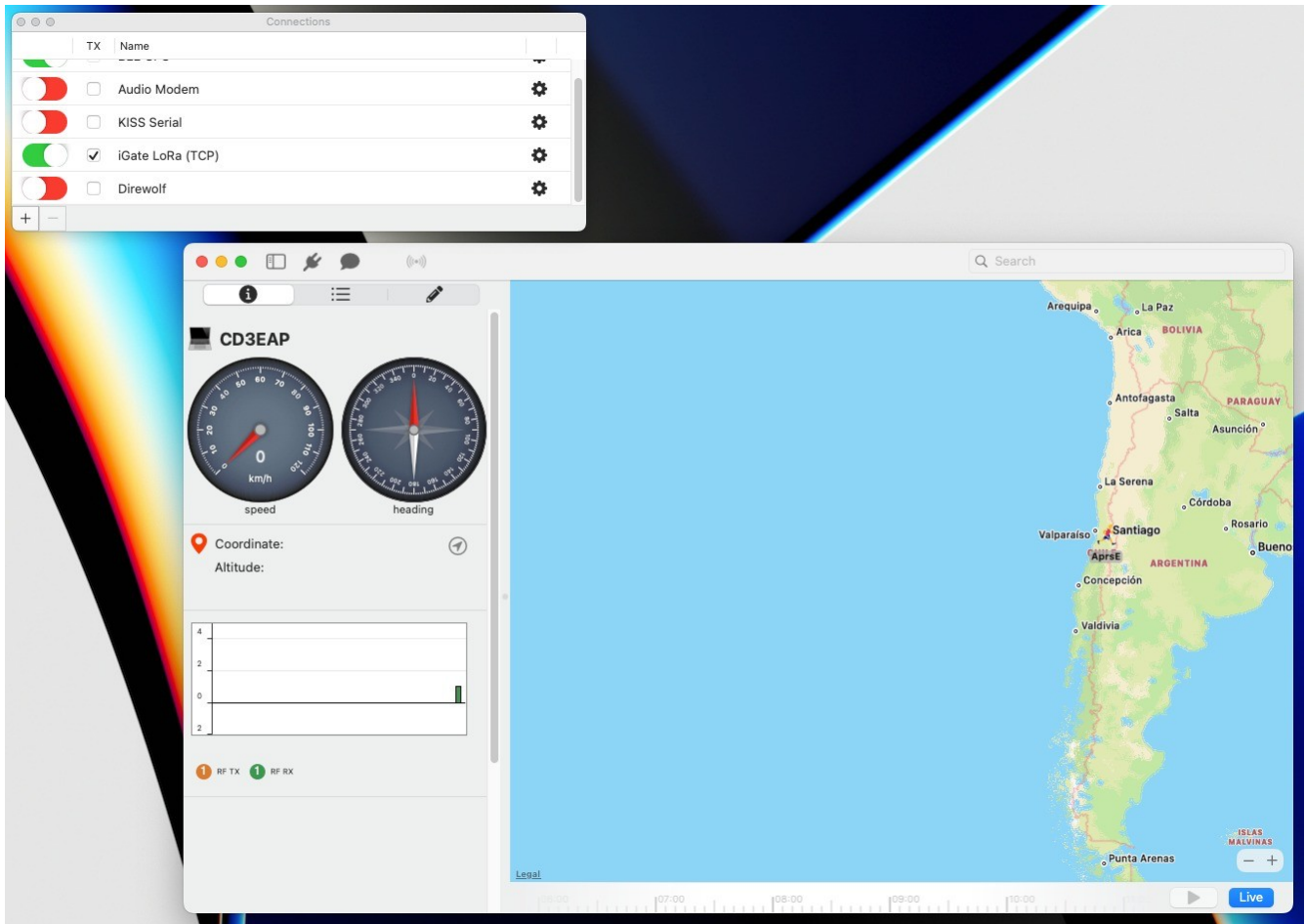
F) After adding port you can enable or disable it in Enables -> Ports



## 6.3 QTH

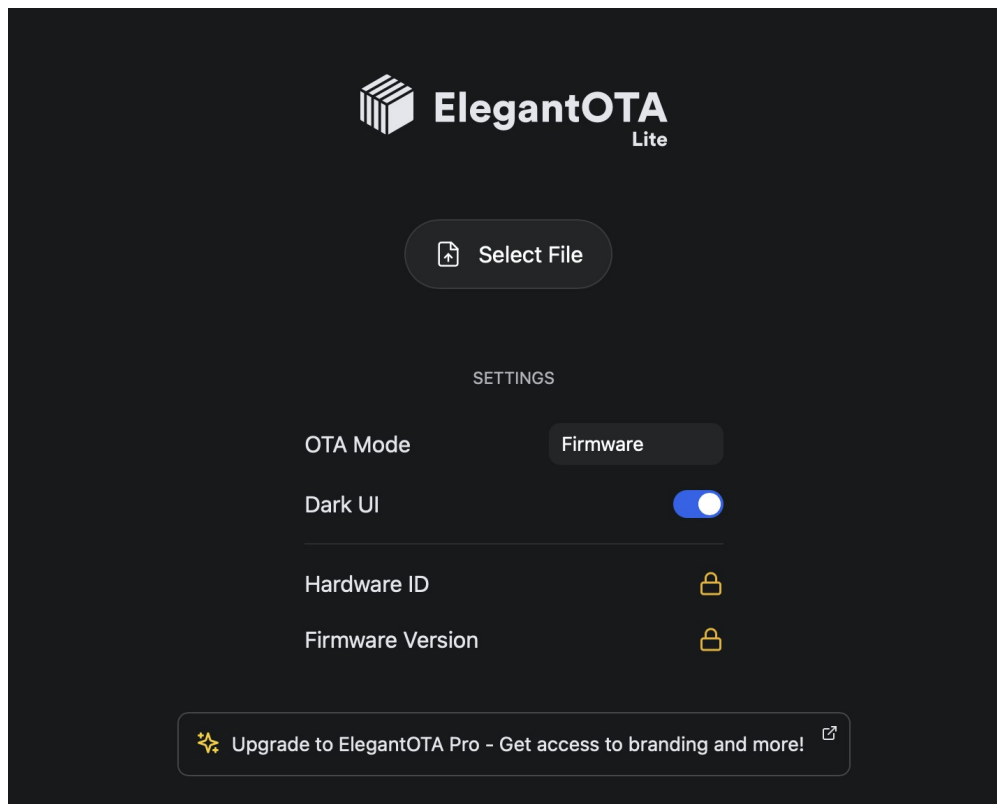
Download the app [here](#).

A) Use TNC tcp/ip.



## 7. OTA Updates

On every *Release* of the *LoRa APRS iGate/Digipeater* firmware the files will be saved on [Github Release Page](#). There you'll find the latest firmware for each board as a *.zip* file. Download it, decompress it and you will find inside *ota\_update.bin* file. Go into the configuration WebUI and press *Update OTA*. There you can upload the new firmware and the board will update to the new version.



**NOTE:** Some boards require that *RST/Reset* is pressed (or to power cycle the board) to start with new firmware.

## 8. Received Packets

On the *Received Packets* window you will see the latest received packets of your board with its timestamp, RSSI and SNR.

### Last 10 received packets list

Time	Frame	RSSI	SNR
09:34:41	CA2WKT-9>APLRT2,XQ3PCN-3*!/_2z'CmQ	-127	-10.25
09:34:59	CA2WKT-9>APLRT2,XQ3PCN-3*!/_3"6CIQPedro QAP 147.600 MHz battery=4.30V	-128	-12
09:35:17	CA2WKT-9>APLRT2,XQ3PCN-3*!/_3"ICfQ	-126	-11.5
09:36:02	CA2WKT-9>APLRT2,XQ3PCN-3*!/_3"bCnQ	-127	-11.5
09:37:11	CE3DY-10>APLRG1,XQ3PCN-3*!/_A**	-127	-11.75
09:38:06	CA2WKT-9>APLRT2,XQ3PCN-3*!/_3#dD+Q	-126	-10
09:41:38	CE2PEY-10>APLRG1,XQ3PCN-3*;}CA2JOT>APRS,TCPIP,CE2PEY-10*;;EL-CA2JOT*111111z3303.23S107126.31W0146.290MHz T000 R39k Conferencia REDCHILE www.redchile.org	-126	-10.5
09:43:03	CE2PEY-10>APLRG1,XQ3PCN-3*;}CE2BMA>APRS,TCPIP,CE2PEY-10*;;EL-CE2BMA*111111z3303.08S107122.96W0146.440MHz T000 R21k Conferencia REDCHILE www.redchile.org	-125	-10.75
09:43:30	XQ3PCN-3>APLRG1,WIDE1-1:=3258.57SL07100.80W#DIGI LORA CERRO EL ROBLE	-126	-11.5

**NOTE 1:** Timestamp depends on your *NTP* configuration (timezone offset vs *UTC*).

**NOTE 2:** List refresh automatically every 15 seconds.

# Appendix 1: Supported Boards

## LILYGO

TTGO Lora32 V1.6.1 or V2.1

TTGO Lora32 T3S3 V1.2

TTGO T-Beam V1, V1.1, V1.2, V1 with SX1268 and V1.2 with SX1262 and S3 Supreme V3

TTGO T-Deck Plus (and the regular version with added GPS module)

## HELTEC

WiFi LoRa32 V2, V3, V3.2

Wireless Stick and Wireless Stick Lite V3 (with and without display attached)

Wireless Tracker

HT-62CT

Wireless Paper V.1

MeshNode T114 (as Digipeater)

## RAK WIRELESS

RAK4631 + RAK19003 or RAK19007 (as Digipeater)

## QRP LABS

LightGateway 1.0 and LightGateway Plus 1.0

## XIAO – SEED STUDIO

XIAO ESP32S3 + WIO SX1262 LoRa Module

## WAVESHARE

Waveshare RP2040 LoRa (as Digipeater)

## DIY Versions

Faketec V3 + HT-RA62 (as Digipeater)

ESP32 + 100mW LoRa (SX1276/SX1278) or 1W LoRa (E22 400M30S/900M30S or E220 400M30S)

ESP32C3 + 1W LoRa (E22 400M30S/900M30S)

ESP32 + 100mW LoRa (SX1276/SX1278) + A7670 A/E/G (LTE/4G module)

OctopusLab LoRa (ESP32C3 + 1W LoRa Module)

OE5HWN MeshCom board

TROY LoRa APRS board

WEMOS LOLIN32 OLED + SX1278, WEMOS D1-R32 + RA02 and WEMOS S2 MINI + SX1278

## Appendix 2: Telemetry board wiring/pinout

### LILYGO

TTGO Lora32 V1.6.1 or V2.1, TTGO Lora32 T3S3 V1.2, TTGO T-Beam V1, V1.1, V1.2, V1 (w/ SX1268) and V1.2 (w/ SX1262) use I2C protocol to connect telemetry module (SDA=21, SCL=22).

*NOTE: T-Beam S3 Supreme V3 and TTGO T-Deck Plus (and the regular version) don't have spare pins available for telemetry module add-ons.*

### HELTEC

WiFi LoRa32 V2 uses I2C protocol to connect telemetry module (SDA=4, SCL=15).

WiFi LoRa32 V3 and V3.2, Wireless Stick Lite V3 (with and without display attached) all use I2C protocol to connect telemetry module (SDA=41 and SCL=42).

Wireless Stick uses I2C protocol to connect telemetry module (SDA=17, SCL=18).

Wireless Tracker uses I2C protocol to connect telemetry module (SDA=7, SCL=6).

MeshNode T114 uses I2C protocol to connect telemetry module (SDA=16, SCL=13).

*NOTE: HT-62CT and Wireless Paper V.1 don't have spare pins available for telemetry module add-ons.*

### RAK WIRELESS

RAK4631 + RAK19003 or RAK19007 use internal I2C with SLOT-C for BME680 (RAK19003)

### QRP LABS

LightGateway 1.0 and LightGateway Plus 1.0 use I2C protocol to connect telemetry module (SDA=3 and SCL=4).

### DIY Versions

ESP32 + 100mW LoRa (SX1276/SX1278), 1W LoRa (E22 400M30S/900M30S or E220 400M30S), ESP32 + 100mW LoRa (SX1276/SX1278) + A7670 A/E/G (LTE/4G module), OE5HWN MeshCom board, TROY LoRa APRS board and WEMOS D1-R32 + RA02 all use I2C protocol to connect telemetry module (SDA=21, SCL=22).

OctopusLab LoRa (ESP32C3 + 1W LoRa Module) uses I2C protocol to connect telemetry module (SDA=0, SCL=1).

WEMOS LOLIN32 OLED + SX1278 uses I2C protocol to connect telemetry module (SDA=5, SCL=4).

WEMOS S2 MINI + SX1278 uses I2C protocol to connect telemetry module (SDA=11, SCL=12).

*NOTE: XIAO ESP32S3 + WIO SX1262 LoRa Module, Waveshare RP2040 LoRa, Faketec V3 + HT-RA62, ESP32C3 + 1W LoRa (E22 400M30S/900M30S) don't have spare pins available for telemetry module add-ons.*