1 2AXVJ4500407 User Manual

Document	**TowerlinQ FCC R2 manual**
Model	**4500407**
Part Number	**TQ-03-3-DOC**
Version/Name	**UM**
Variant	**FCC**

Page Content

2 Disclaimers

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MUST ACCEPT ANY INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDERSIRED OPERATION.

NOTE: TOWERIQ, INC. IS NOT RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

2.1 FCC RF Exposure Limits

THIS UNIT COMPLIES WITH FCC RF EXPOSURE LIMITS FOR AN UNCONTROLLED ENVIRONMENT. TO COMPLY WITH FCC RF EXPOSURE LIMIT REQUIREMENTS, ANTENNAS MUST BE OPERATED AT A MINIMUM DISTANCE OF 5.04 CM OR 0.166’ BETWEEN THE RADIATOR AND ANY PERSON’S BODY.

2.2 PART 90 Signal Booster

THIS IS A 90.219 CLASS A DEVICE

WARNING, This is **NOT** a **CONSUMER** device. It is designed for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS**. You **MUST** have an **FCC LICENSE** or express consent of an FCC Licensee to operate this device. You **MUST** register Class A signal booster (as defined in 47 CFR 90.219) online at http://www.fcc.gov/signal-booster/registration Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

2.2.1 Default antenna and devices statement

THIS DEVICE IS INTENDED TO BE UTILIZED WITH THE ANTENNAS AND COUPLING DEVICES LISTED BELOW. UTILIZING ALTERNATIVE ANTENNAS AND COUPLING DEVICES MAY RESULT IN UNINTENDED PERFORMANCE. SELECT THE APPROPRIATE ANTENNAS FOR YOUR APPLICATION WHEN ORDERING, THE UNIT DOES NOT SHIP WITH DEFAULT ANTENNAS.

	Part Number	Order	Description
1	4500104	TPP.50-10164-01.00	Antenna, Dipole, Omni-Directional, 470-512MHz (RED)
2	4500108	TPP.50-10363-01.00	Antenna, Ceiling Mount, 480-490MHz (White)
3	4500241	TGP.51-10293-01.00	Jumper, Coaxial Cable, (1.0 Meter, N-Male Straight, N-Male Straight)

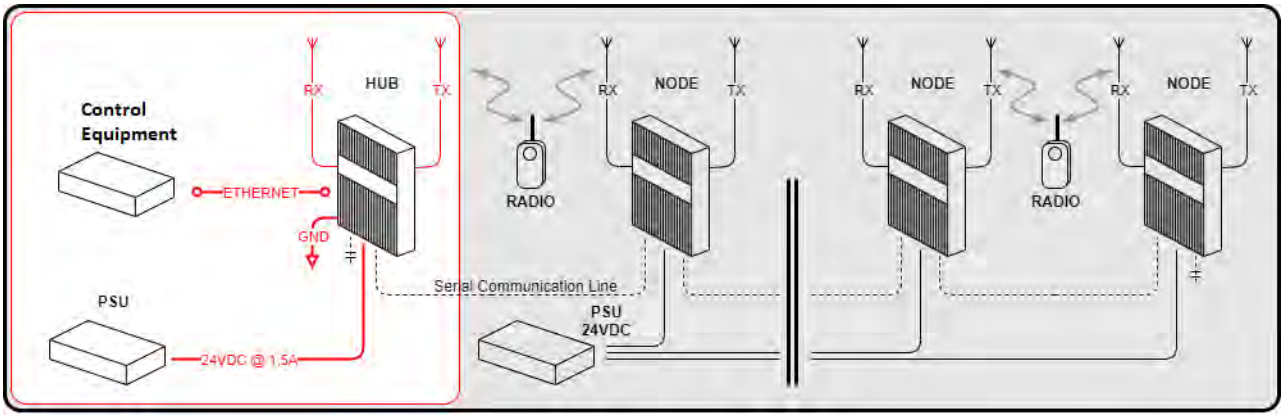
2.2.2 Electrical connections

ALL MANIPULATIONS WITH ELECTRICAL CONNECTIONS, INCLUDING POWER SUPPLY, TX/RX LOAD, MEASUREMENT DEVICES, SHOULD BE PERFORMED **ONLY** AFTER POWER SUPPLY UNIT IS SWITCHED OFF OR DISCONNECTED, AND THE TRANSMITTER OUTPUT POWER IS SET TO **LOW** (REFER TO THE RADIO SETTINGS SECTION IN THE PRESENT MANUAL).

3 TowerlinQ system composition

Structural diagram of typical system is provided below on Figure below, where:

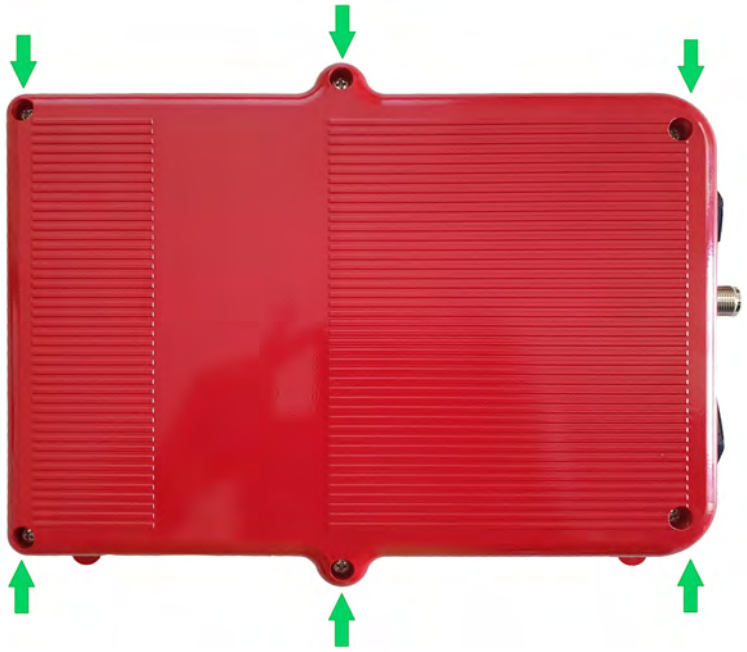
- PSU - DC Power Supply with 24VDC @ 1,5A output
- GND - Grounding
- HUB - Controlling Node (main device of the network)
- NODE – Regular or Agent Node
- LINE – Serial Communication Line.



4 Establishing electrical connections

4.1 Opening and closing the enclosure cover

To get access to internal components of the device, the front cover must be detached. It is fixed to the main body with 6 screws. Use X-tipped screwdriver to twist them out.



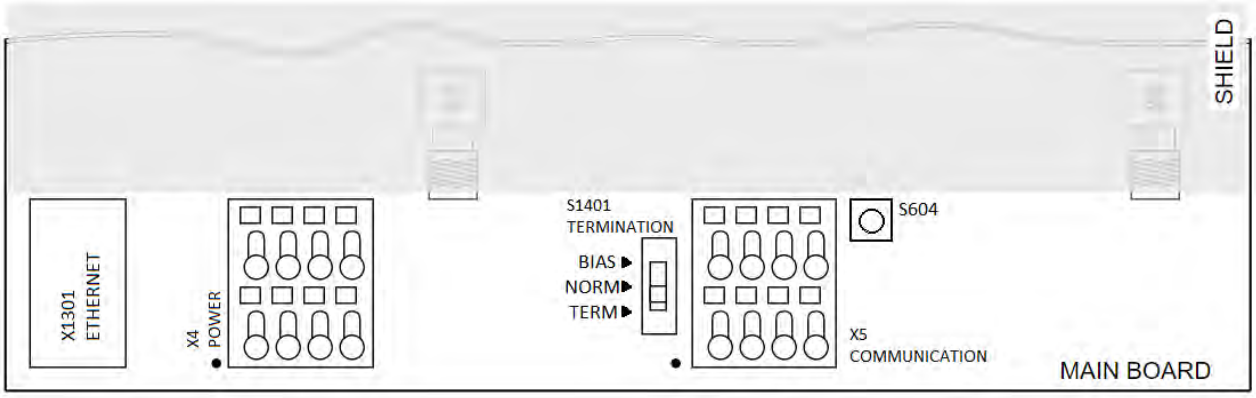
After releasing all screws, pull the front cover to open the enclosure. Keep in mind that there is no additional cover fixture means and the part can fall out if the device is positioned vertically.

To close the device back, put the front cover onto the enclosure body, adjust its position to the perimeter rib, twist in and tighten the 6 screws.

4.2 Recognizing connection terminals

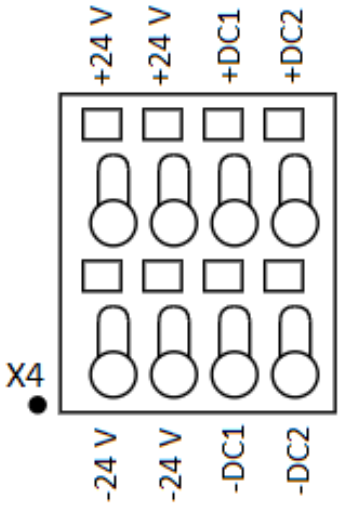
Most of wires and cables are connected to the terminals on the lower side of the main board. This part of the board is not covered by the shield, that allows to make connection as easy as possible.

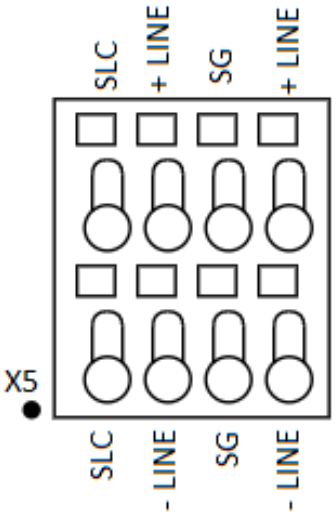
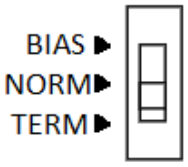
The components on the open part of the board are shown on the following Figure



Terminals and Contacts purposes are described in the tables below:

X1301 ETHERNET	**Description**
100BASE-TX	PC or Switch/Router connection port

X4 POWER	**Description**
	1. [-24V] - negative DC power supply 2. [+24V] - positive DC power supply 3. [-24V] - negative DC power supply 4. [+24V] - positive DC power supply 5. [-DC1] - negative input of dry contact 1 6. [+DC1] - positive input of dry contact 1 7. [-DC2] - negative input of dry contact 2 8. [+DC2] - positive input of dry contact 2

X5 COMMUNICATION	Description
	1. [SLC] - not connected 2. [SLC] - not connected 3. [-LINE] - negative Serial Communication Line input 4. [+LINE] - positive Serial Communication Line input 5. [SG] - Serial Communication Line grounding 6. [SG] - Serial Communication Line grounding 7. [-LINE] - negative Serial Communication Line output 8. [+LINE] - positive Serial Communication Line output
S1401 TERMINATION	**Description**
	Serial Communication Line termination modes: 1. [BIAS] - SLC is biased (required for a device in Hub role) 2. [NORM] - both lines open (required for a device in Regular Node role, connected in the middle of nodes chain) 3. [TERM] - SLC terminated (required for a device in Regular Node role, connected at the end of nodes chain)

4.3 Preparing DC Power Supply unit

Before powering the device with DC Power Supply unit (PSU) read and follow its user manual concerning safety and cabling. Make sure that PSU can produce 24VDC @ 1,5A at its output.

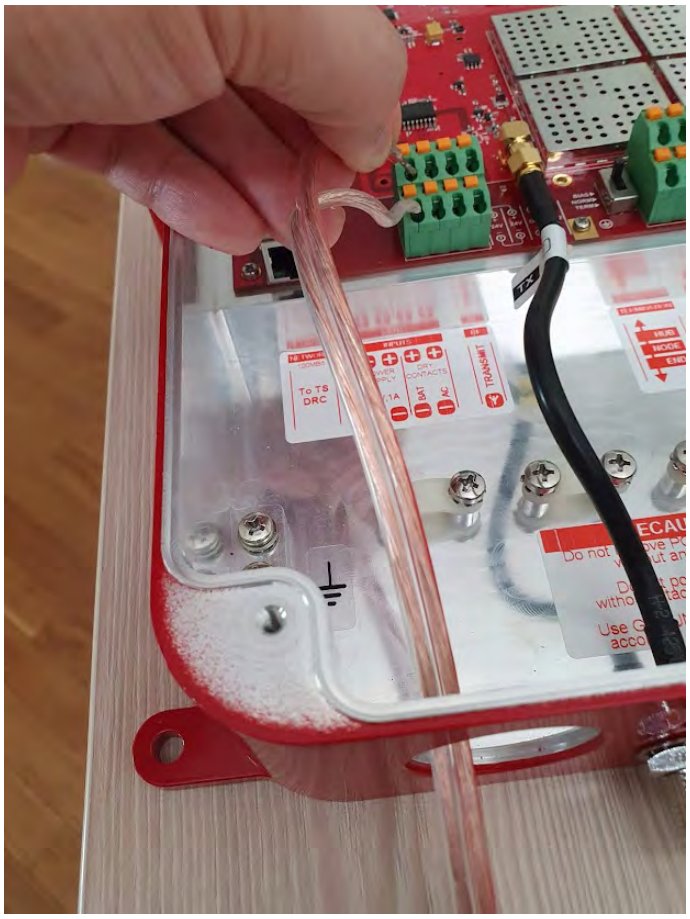
4.4 Connecting the power supply

To connect the power supply to the device, make the following steps:

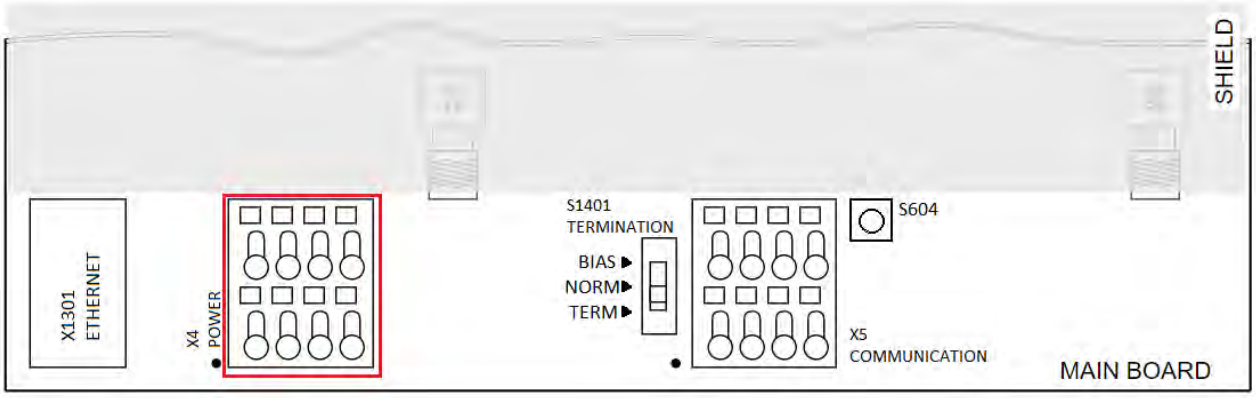
1. Take off the enclosure cover if attached.

2. Twist out the left Heyco plug.

2. Pull power cable through the opening at the bottom of enclosure inside as shown on the following figures.



3. Find ***X4*** *8-pin spring clamp terminal block* marked red on the Figure below;



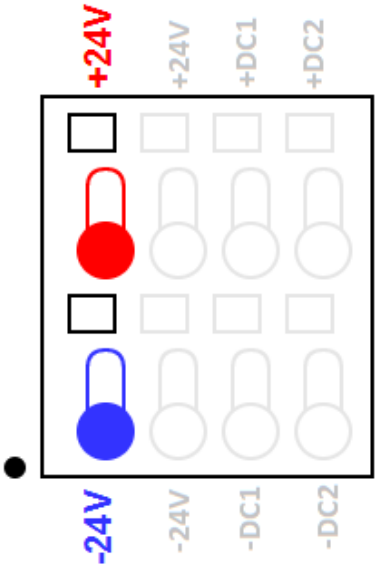
NOTE: Terminal block pin assignment diagram is printed on the board surface adjacent to the block. It is located to the right from the terminal block.

ATTENTION! Be sure that the PSU is powered OFF!

Do not connect power cables to the Main Board in case of PCB protection shield removed!

4. Attach the power cable to the dedicated contacts of **X4** spring clamp terminal block as it explain below;

- **Positive** polarity wire (+24V) must be connected to the terminal hole marked **2** (upper row);
- **Negative** polarity wire (-24V) must be connected to the terminal hole marked **1** (lower row);



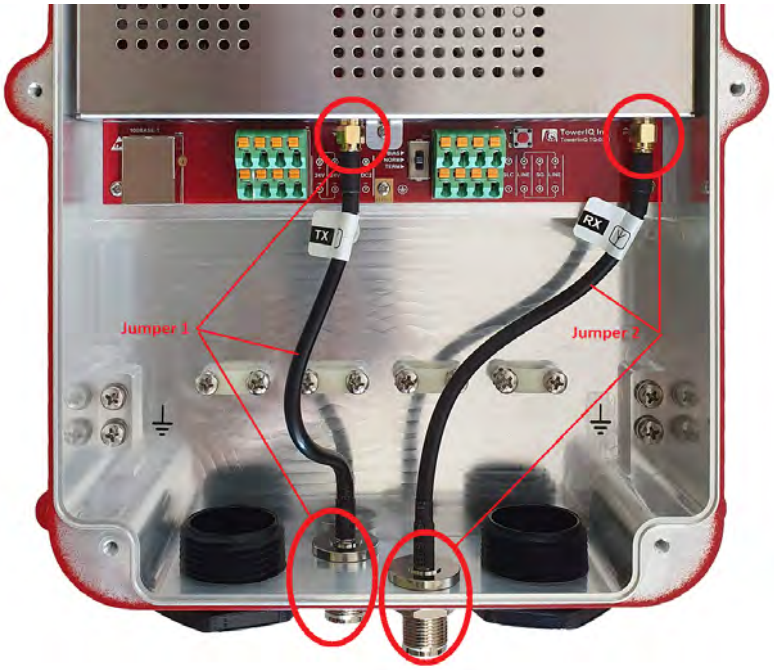
4.5 Antennas connection

The device has two N-connectors at the bottom of the enclosure. These connectors are intended for connecting receiving (Rx) and transmitting (Tx) antennas with coaxial cables provided along with the rest of equipment.

To connect antennas follow the next steps:

- Find N-connectors at the bottom of enclosure as it showed on a Figure above;
- Attach coaxial cables of Tx antenna to the appropriate connector;
- Attach coaxial cables of Rx antenna to the appropriate connector.

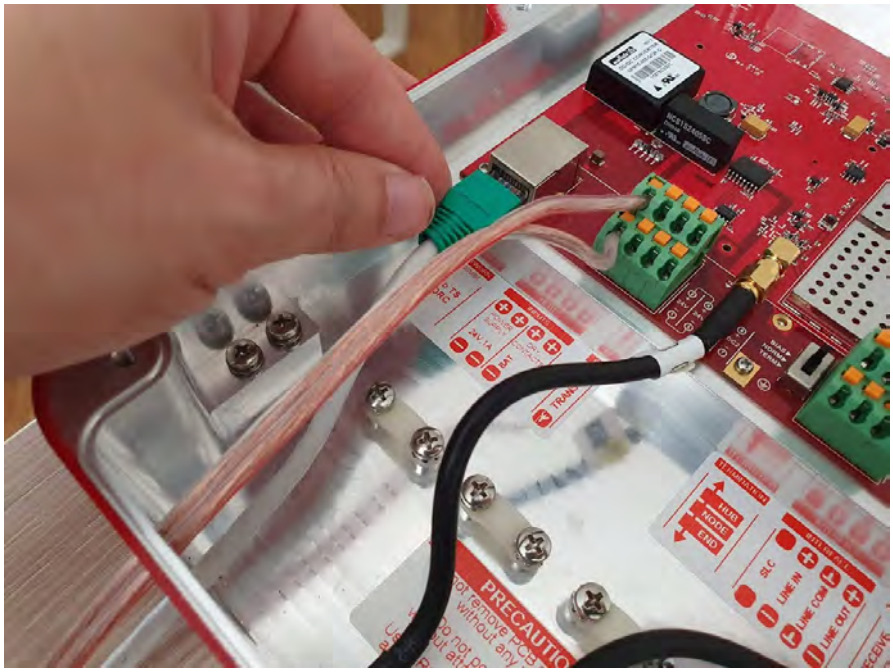
ATTENTION: To ensure the correct operation of RF modules and UHF signal transmission to antennas, make sure the internal RF cables are installed as shown and firmly fixed.



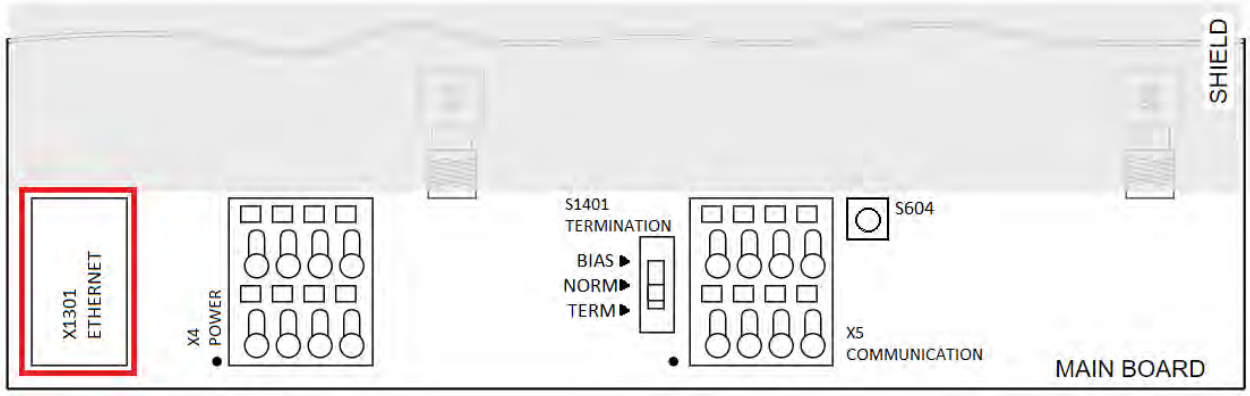
4.6 Establishing Ethernet connection

For system managing, tuning and operation an Ethernet connection must be established. Do this by following steps:

- Remove enclosure cover if present;
- Pull one of the end of the ethernet cable through the opening at the bottom of enclosure inside as shown on the Figure below;



- Find 100Base-T socket which is marked red on a Figure below on the PCB inside of the enclosure;
- Plug in RJ45 connector of the pulled Ethernet cable into the socket.

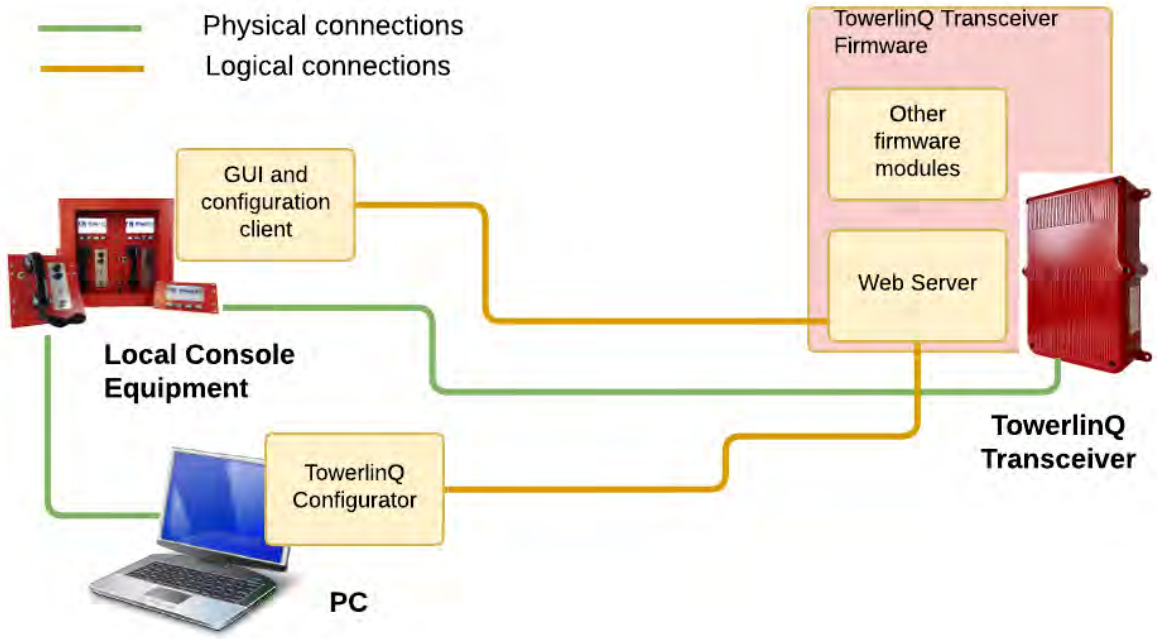


5 Configuring and managing devices

Configuration procedure allows to change default settings (system mode, channels frequencies, etc) of the TowerlinQ system and particular devices.

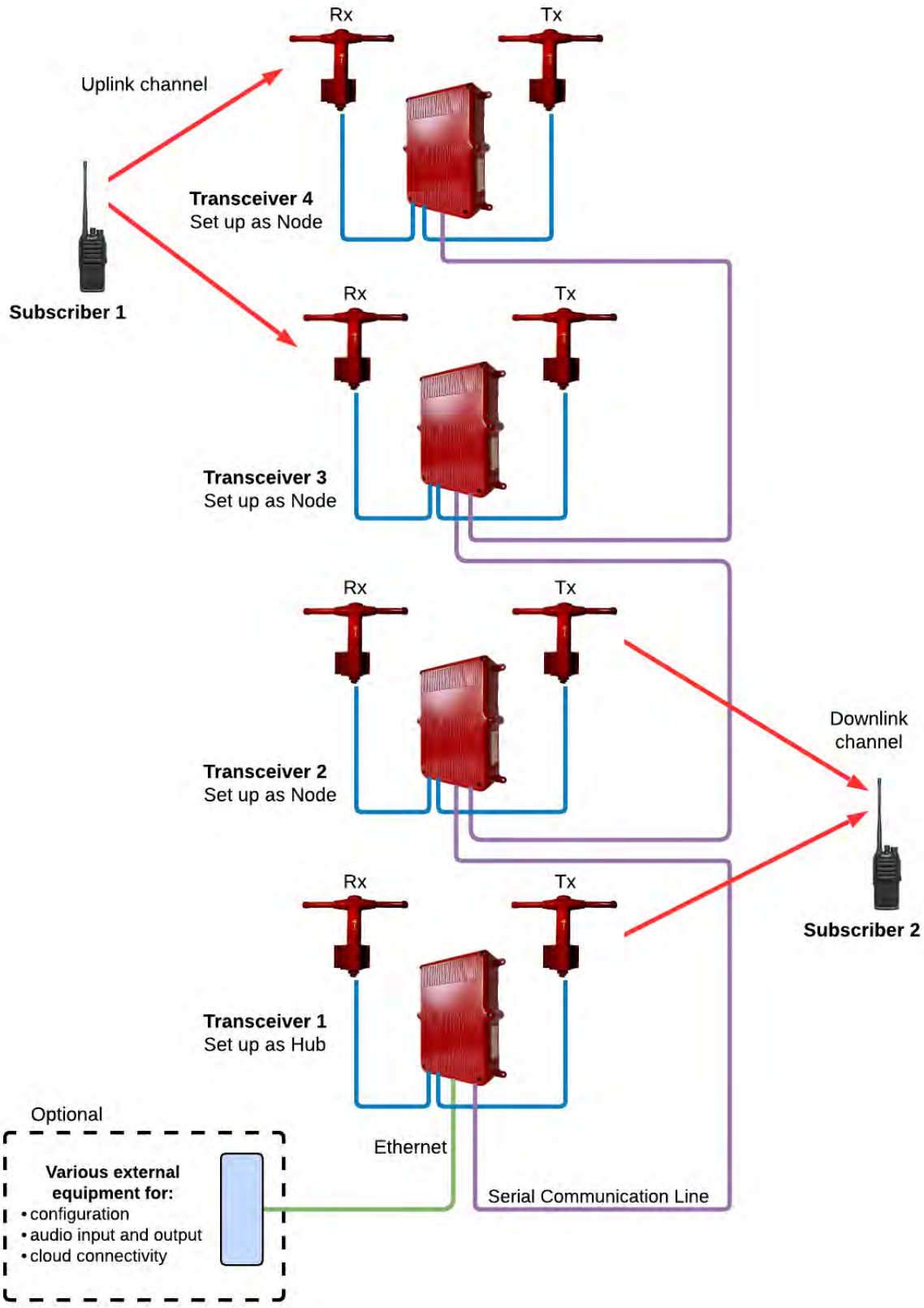
The tool for configuration is a software module named TowerlinQ Configurator. It's a web application running in a browser on the PC used for configuration. TowerlinQ Configurator connects to the web server, executed inside the transceiver's firmware to exchange data for setup and configuration.

There are two possible ways to configure the system and devices.



- to establish a direct Ethernet connection from a local console to the particular device (the Hub) via the switch and use the UI of the local software built into the console to view the configuration of the system
- to establish an Ethernet connection from the PC to the hub via the local console and use a web browser running on the PC to open and operate TowerlinQ Configurator

If the actual TowerlinQ system consists of a plenty of Transceivers, the Ethernet connection is established to one of them, the Hub. Others are considered as Nodes, and being controlled by the Hub, which applies all necessary settings to each Node through Serial Communication Line cabling.


Rx
Tx
Uplink channel
Transceiver 4
Set up as Node
Subscriber 1
Rx
Tx
Transceiver 3
Set up as Node
Rx
Tx
Transceiver 2
Set up as Node
Downlink
channel
Subscriber 2
Rx
Tx
Transceiver 1
Set up as Hub
Optional
Ethernet
Various external
equipment for:
• configuration
• audio input and output
• cloud connectivity
Serial Communication Line

6 Configuring via LAN Ethernet connection

To configure a device using a local PC, you first have to ensure that the Ethernet connection between the device and the switch is properly established (see the appropriate chapter of this user manual). Then use another Ethernet cable to connect the PC to the switch.

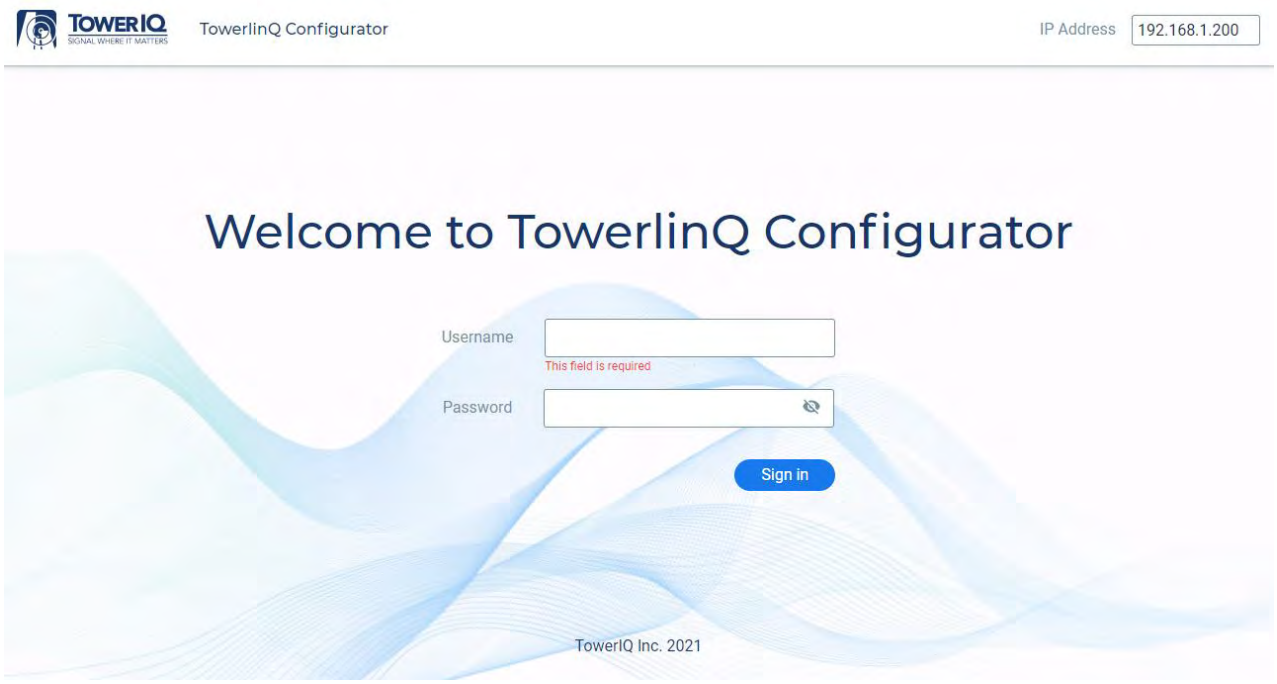
To start configuring, power ON the transceiver.

6.1 Connecting and logging in

Follow the next steps to connect and login to TowerlinQ Configurator:

1. Open the web browser;
2. Open the local ***tqconfig.html*** file to access the TowerlinQ Configurator UI
3. Fill the ***192.168.1.200*** value into ***IP adress*** field
4. Fill username and password into the corresponding fields
5. Press ***Sign in***

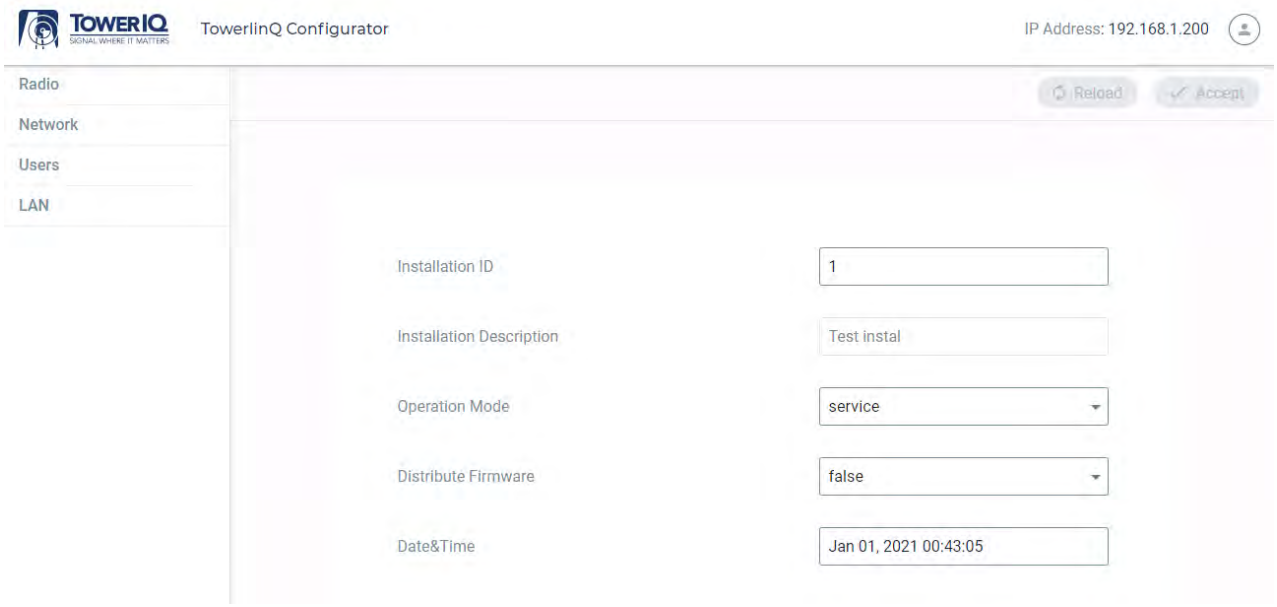
Note: The default username – admin, password – 123.



6.2 Main page

After signing in you will see the initial page of TowerlinQ Configurator. The initial page is also available by clicking the TowerIQ logo.

The page is split into two panels. The left panel contains menu and the right contains data fields.



The data fields:

- Installation ID - installation identifier (number)
- Installation description - comment (text label)
- Operation mode - the TowerlinQ system operation mode.
- Distribute firmware - maintenance only
- Date& Time - Hub's local day and time

6.3 Operation modes

TowerlinQ system can function in two operation modes, Network and Service.

Service mode is a special maintenance mode used for deployment, configuration and troubleshooting. All Nodes' radio channels are disabled in this mode. It's possible to read, change and write system configuration, including radio channels receiving (uplink) and transmitting (downlink) frequencies.

Network mode is the mode of system regular operation, in one of the following Radio modes: Standby, Monitoring and Active. In Network mode most of the settings are disabled, to change them user has to switch to Service mode.

To switch to Service mode for setup, proceed the following steps:

1. click on TowerIQ Logo in the topbar
2. choose **service** option from **Operation mode** drop-down
3. click ***Accept*** button

To enable the TowerlinQ radios and make the system functional, it's necessary to change the operation mode to Network. For this, proceed the following steps:

1. Press the TowerIQ logo in top bar left.
2. Change ***Operation mode*** setting to ***network***.
3. Click ***Accept*** button.

Note: all radio setting should be made before the system get Network operation mode

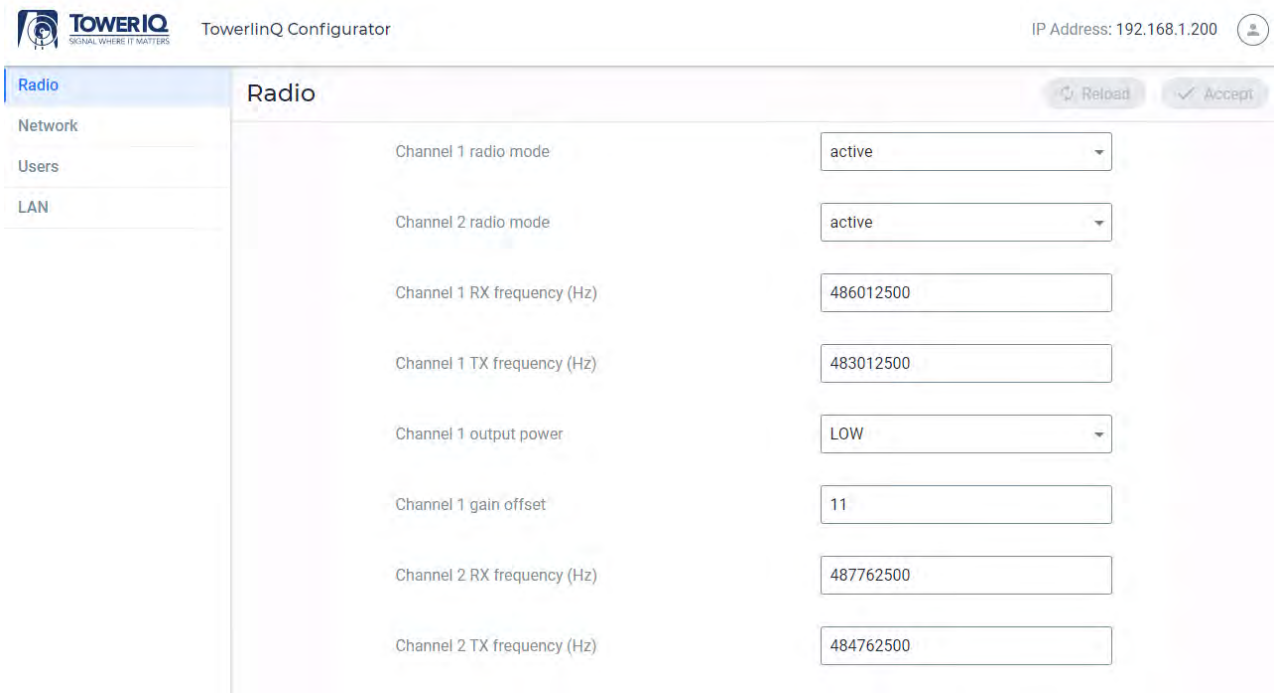
6.4 Radio settings

This section helps set up the values of operation for both radio channels of the transceiver.

The appropriate root tab contains the values being applied to both channel units simultaneously, and two child tabs to set up values applicable to individual channels separately.

To edit common parameters proceed the following steps:

1. Click on ***Radio settings*** menu item in the sidebar.
2. Do the necessary settings.
3. Press ***Accept*** to apply the settings made, or ***Reload*** button to disregard them (and thus reload them from the device).



The parameters available for editing in this section are:

- Radio modes for channel 1 and 2, there are 3 possible options for each:
  - Standby - the default radio mode. All nodes' radios are turned off, no radio signal reception or transmission occurs, only network communication, synchronization and control data exchange is kept. This mode is typical for normal everyday status of the system and building, when no emergency happens.
  - Monitoring - hub's and nodes' radio receivers are enabled while transmitters are disabled. The network communication protocol provides synchronization and control data exchange. The signal received by any node is available externally on Hub's command interface (Ethernet). This mode can be used in emergency or testing scenarios if only listening the first responders radios with their native coverage is needed. No retransmission and thus additional coverage extension is provided in this mode.
  - Active - each node enables its radios and starts to receive and transmit radio signals. This mode is used in the case of emergency, when first responders team arrives and starts to use the system. Also can be activated for system testing.
- Channel 1 and 2 receive frequency in Hz - should be the multiple of channel spacing and within upper and lower frequency limits

- Channel 1 and 2 transmit frequency in Hz - should be the multiple of channel spacing and within upper and lower frequency limits
- Channel 1 and 2 transmitter output power level:
  - OFF - 0
  - LOW - +17 dBm
  - MID - +18.5 dBm
  - HIGH - +20 dBm
- Channel 1 and 2 gain offset - gain calibration constants
- Receiver squelch level in dBm - the minimum input signal power to be received (-100 … -50 dBm)
- Channel spacing - the channel frequency bandwidth, can be set to 12.5 kHz, 20 KHz or 25 kHz.
- Receiver CTCSS frequency
- Transmitter CTCSS frequency
- Preemphasis filter On/Off
- Deemphasis filter On/Off

The CTCSS frequencies listed in appendix A.

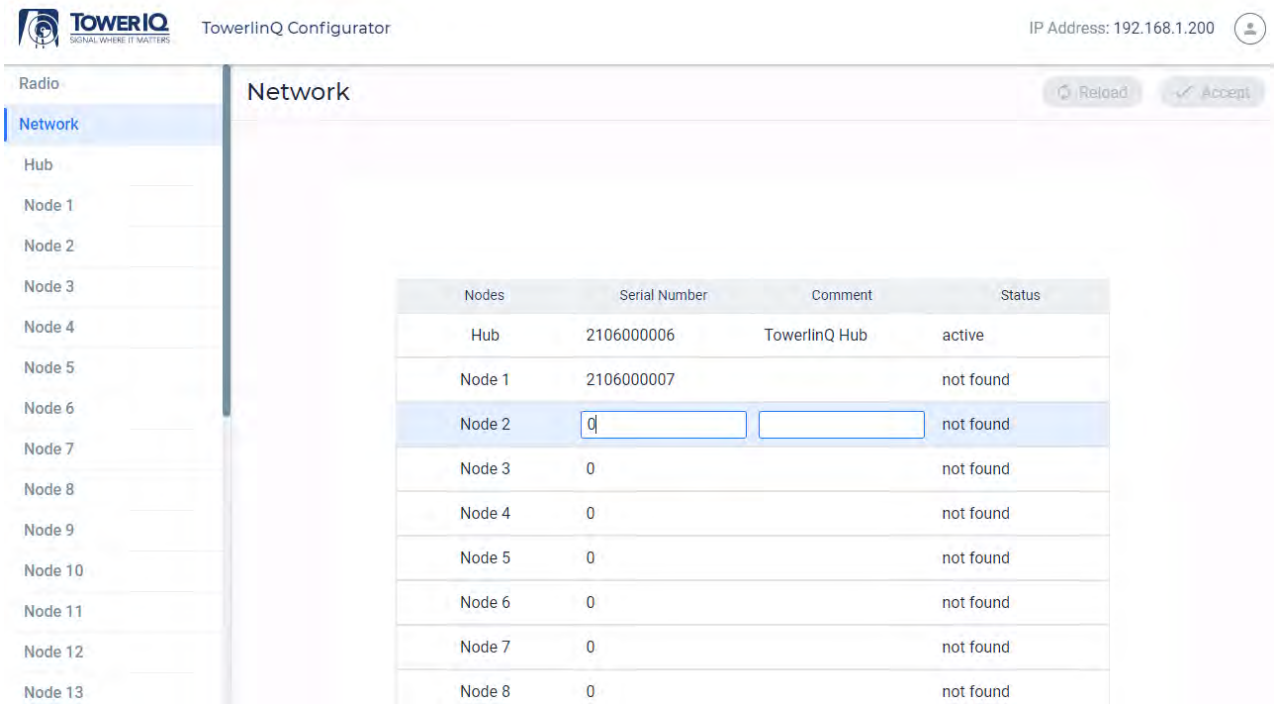
Note: Preemphasis and deemphasis filters are applied only to the voice stream transmitted to or received from DRC.

6.5 Networking

To operate in the TowerlinQ system, each transceiver device has to be enlisted in the network and assigned to the Hub or Node role.

For proper assignment, you need to have the list of serial numbers of devices, connected to the system, and the understanding, which one is connected to the external equipment, being the first in the SCL chain. This one is the Hub, others are Nodes.

TowerlinQ Configurator app comes with pre-designed framework of the system structure, designed as the table on ***Network*** tab, including Hub and Node 1 - Node 24 placeholders. Adding a device to the system means putting its serial number into the appropriate slot of the table.



To add a device, perform the following steps:

1. Click anywhere on the row, corresponding to the role of the device you want to add. ***Serial number*** and ***Comment*** fields will become editable.
2. Type in the serial number of the device in ***Serial number*** field.
3. Optionally, add any comment to ***Comment*** field.
4. Proceed to the next device.
5. After finishing with all devices, press ***Accept*** to apply the settings made, or ***Reload*** button to disregard them (and thus reload them from the device).

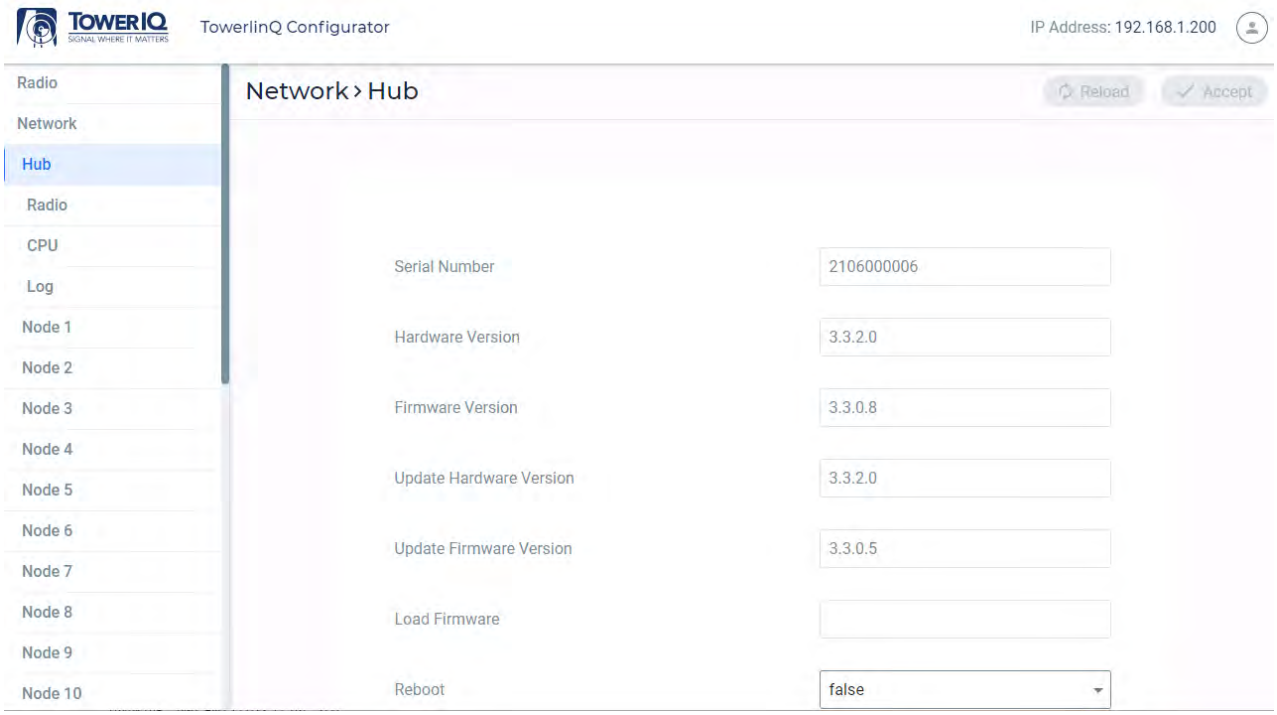
If there is just one transceiver in the system, its role is Hub, it should be registered in the appropriate row.

The sequence of devices in Node 1 - Node 24 is not obligatory to match the sequence of their electrical connection in SCL bus chain, but it is recommended to keep them aligned for managing convenience.

6.6 Hub and Node's information

The TowerlinQ network should contain one Hub and up to 24 Nodes.

The framework list of the devices in the system is displayed also as a list of nested tabs in **Network** section on sidebar. Clicking on any of them will open the window with the appropriate device's properties.



General properties including serial number, firmware and hardware versions, etc., are available after clicking on Hub or Node # item directly:

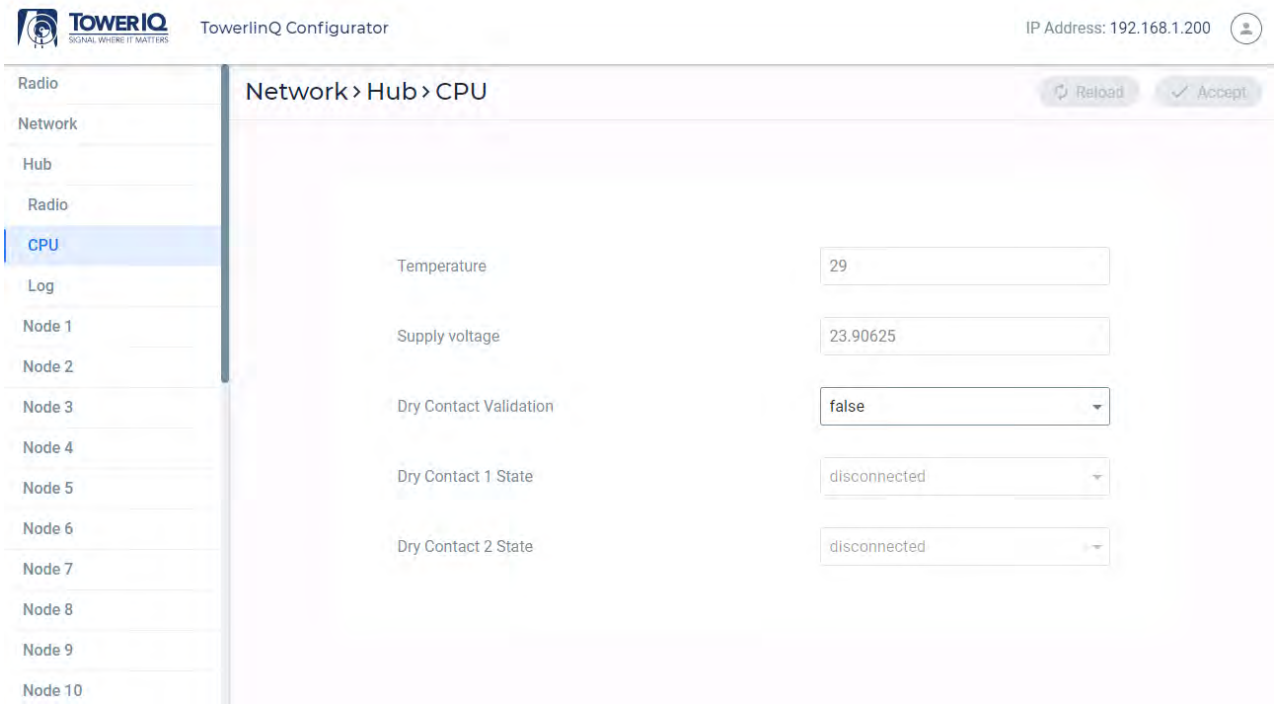
Additional settings are available for Hub and each Node: Radio, CPU, Log.

6.6.1 Radio

This menu shows the particular Node's radio settings in the form similar to common Radio parameters (see above). Normally the Radio setting should be the same for all Nodes in the system. The differences could occur only in case of communication errors.

6.6.2 CPU

This menu shows the state of particular Node controls, sensor, etc.



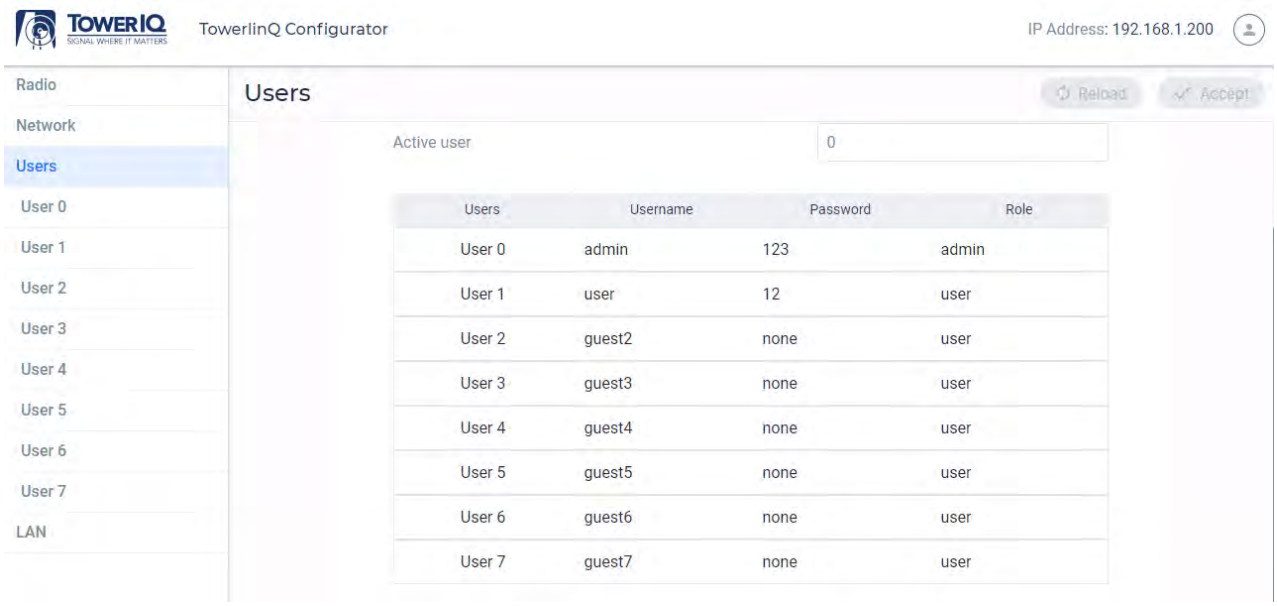
- Temperature - the Node's case internal temperature
- Supply voltage - the power supply voltage measured by the Node
- Dry contact 1 and 2 state - the state of dry contacts
- Dry contact validation - TBD

6.6.3 Log

TBD

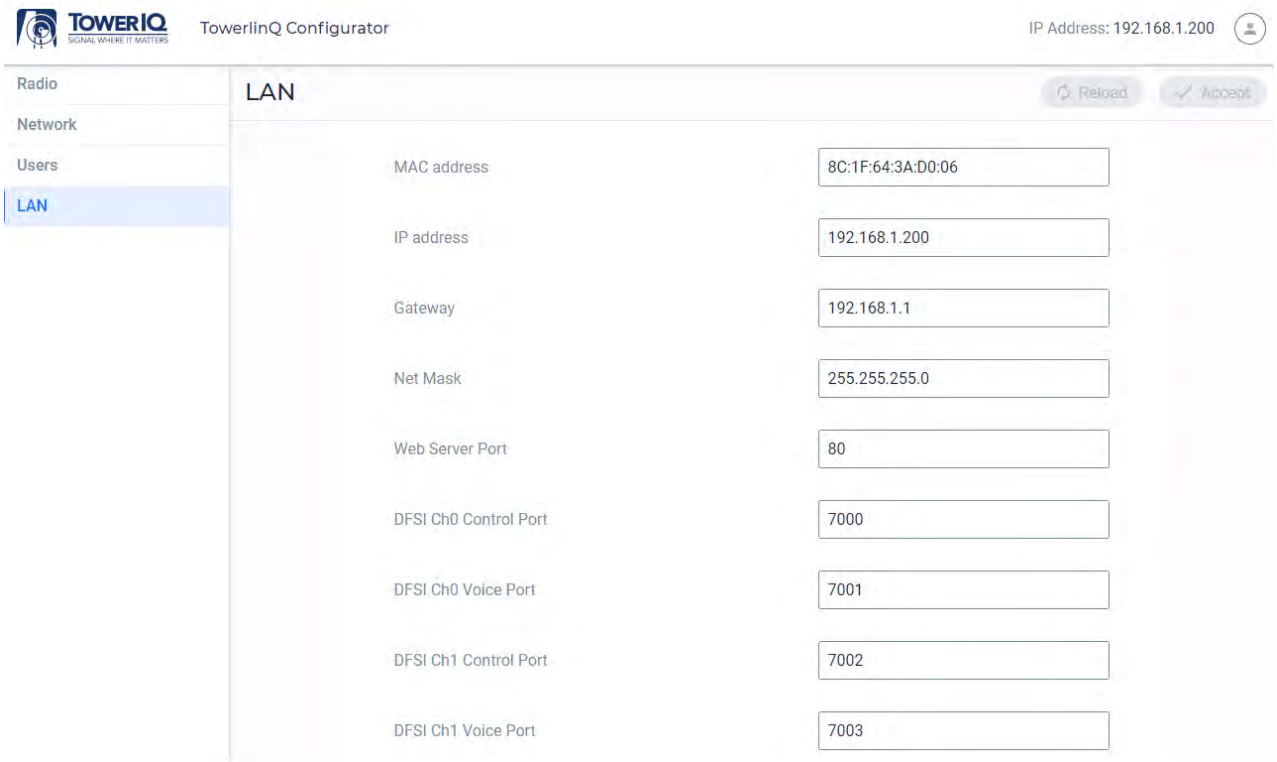
6.7 Users

The menu item Users shows the list of authorized users, their usernames, passwords and roles. This object is allowed for administrators only.



6.8 LAN

The LAN page contains local area network and DFSI protocol settings.



7 Specifications

7.1 Operating limits

Correct operation of the device outside these limits is not implied.

Parameter	Min	Max	Unit	Note
Temperature	0	+50	°C	
Humidity	0	93	%	@ 32 °C
DC Supply voltage	10	36	V	
Maximum continuous input to RX Antenna port		+6	dBm	
TX Antenna VSWR		1.5:1		

7.2 Operating Characteristics

Parameter	Value	Unit	Note
Frequency range UL	450 … 520	MHz	
Frequency range DL	450 … 520	MHz	
Number of frequency channels	2		
Channel spacing	25, 20, 12.5	kHz	
Modulation type	20K0F3E, 16K0F3E, 11K0F3E		
Output power	+17, +18.5, +20	dBm	per channel
Sensitivity	-100	dBm	

Parameter	Value	Unit	Note
Selectivity	60	dB	100kHz offset
Max RF input power	+6	dBm	
No damage max RF input power	+10	dBm	
AGC threshold	-70	dBm	
AGC range	84	dB	
Spurious emissions			FCC meet
System group delay	20	ms	
Antenna impedance	50	Ohm	
Nominal power supply voltage	24	VDC	
Max power consumption in Active mode	13.5	W	
Max power consumption in Service mode	1.5	W	

7.3 Mechanical

Parameter	Value	Unit
RF connector type	N	
Dimensions (W x D x H)	322,5 x 235 x 68,7 / 12.70 x 9.25 x 2.70	mm / in
Weight	3.55	kg
Enclosure	IP66	

8 Appendix A. CTCSS Frequencies

67.0Hz	69.3Hz	71.9Hz	74.4Hz	77.0Hz
79.7Hz	82.5Hz	85.4Hz	88.5Hz	91.5Hz
94.8Hz	97.4Hz	100.0Hz	103.5Hz	107.2Hz
110.9Hz	114.8Hz	118.8Hz	123.0Hz	127.3Hz
131.8Hz	136.5Hz	141.3Hz	146.2Hz	151.4Hz
156.7Hz	159.8Hz	162.2Hz	165.5Hz	167.9Hz
171.3Hz	173.8Hz	177.3Hz	179.9Hz	183.5Hz
186.2Hz	189.9Hz	192.8Hz	196.6Hz	199.5Hz
203.5Hz	206.5Hz	210.7Hz	218.1Hz	225.7Hz
229.1Hz	233.6Hz	241.8Hz	250.3Hz	254.1Hz

9 Appendix B. TowerlinQ Configurator testing notice

TowerlinQ Configurator has been tested with:

Browser	**Version, Build**	**OS**
Google Chrome	91.0.4472.106 (Official Build)	Windows (64-bit)