

TLM Series LoRa Based Gateway with 2 x 10/100Base-T(x) Ports, 1 x RS232 and 1 x RS485 Serial Ports and/or BPL (Broadband Power Line Link) User Manual

1. About TLM Series LoRa Based RF Gateway



TLM Series LoRa Based RF Gateways are designed for industrial-grade Radio Frequency (RF) communication and particularly for facilities of rugged industry and infrastructure. TLM Series LoRa Based RF Gateways are tailored to perform various features such as wide temperature range, wide power input range and several connectivity ports. Thus, TLM Series LoRa Based RF Gateways are the best choice for facility management, sewage treatment, power utility, telecommunication, transportation and all other applications that require industrial Radio Frequency (RF) connectivity.

TLM Series which have REDZ Broadband Power Line (BPL) link allows devices to communicate with full transparent TCP/IP standard over Low Voltage power lines and allows easy connection between TCP/IP based terminals without use of extra cables.

TLM Series RF Gateways can create a LoRa Based RF network and connect Serial and/or ETH based devices with each other. All communication can be done over Radio Frequency network, based on LoRa standard. TLM Series LoRa Based RF Gateways can act as TCP to Lora Gateway as TCP Server, TCP to Lora Gateway as TCP Client or Serial to LoRa Gateway all in one device. Typical applications: Automated Meter reading, Wireless networks, Home – Building – Industrial Automation, Remote Control, Wireless Sensors, Telemetry, Wireless Alarm and Security Systems...

2. Hardware Features

TLM Series LoRa Based RF Gateways have the versions with and without BPL (Broadband Power Line) Link.

2.1 Features

- Supports 2 x 10/100Base-T(X) ports
- Supports Full/Half-Duplex, auto MDI/MDI-X on each port
- Supports 1 x RS232 and 1 x RS485 Serial Connection up to 921600 Baud
- Embedded web interface for ease of use

- REDZ special design, plug and play Server-Client Operating Modes
- Instant switch between operating modes with buttons
- Up to 10 client connection in Server Mode
- DHCP Server Capability
- Easy to follow Device Status on web interface
- 868MHz LoRa based Radio Frequency (RF) Communication
- LoRa Rx Group Address and Device Address Configurable
- LoRa Tx Group Address and Device Address Configurable
- LoRa Signal Bandwidth Configurable: 125, 250, 500 kHz
- LoRa Radio Power Configurable between 5dBm (~3mW) to 20dBm (100mW)
- Easy to follow LoRa data packages on web interface
- Black List and White List based LoRa package filter
- Firmware Upgrade over Web
- 2 firmware storage capability on same device (1 active only)
- AC or DC wide range power options
- Wide operating temperature range from -25 to 70 °C AC and -40 to 85 °C DC power input versions
- Rugged Metal IP-40 housing design
- DIN-Rail mounting

2.2 Extra Features for Models with BPL

- Supports 2 x 10/100Base-T(X) ports + 1 x BPL link
- Wide range 3 phase AC input
- Supports up to 30Mbps PHY rate on BPL with Up to 10 hops and 1000 nodes

- Up to 432 sub-carriers from 2 to 28MHz analog bandwidth
- Support LDPC-C FEC with 128-bit AES core
- Plug and play with Master/Slave selection via web interface

3. Installation

Each device has a Din-Rail kit on rear panel. The Din-Rail kit helps device to fix on the Din-Rail. Slant the switch and mount the metal spring to Din-Rail.

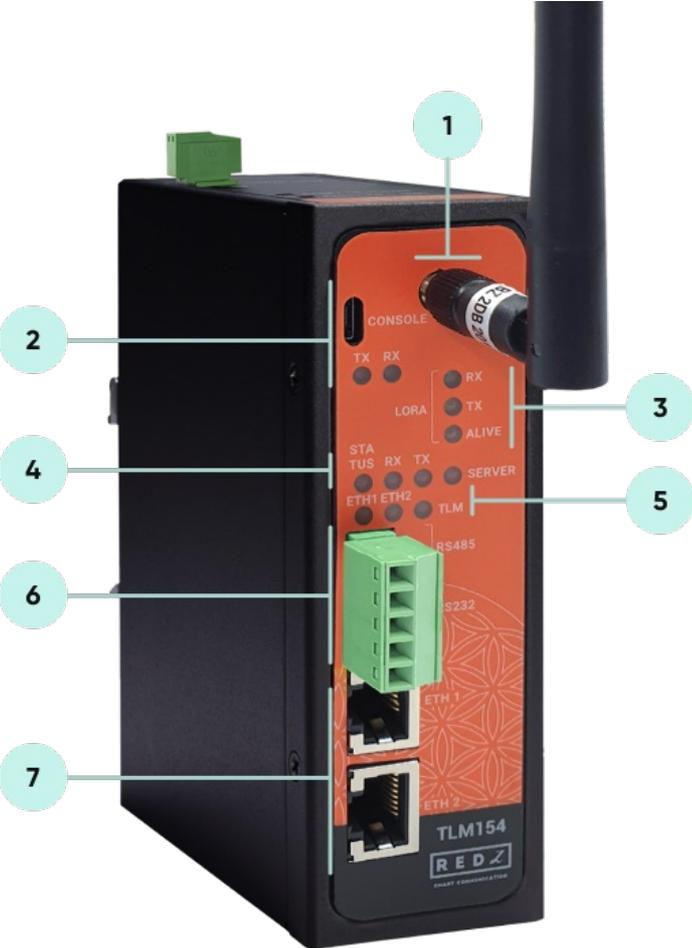


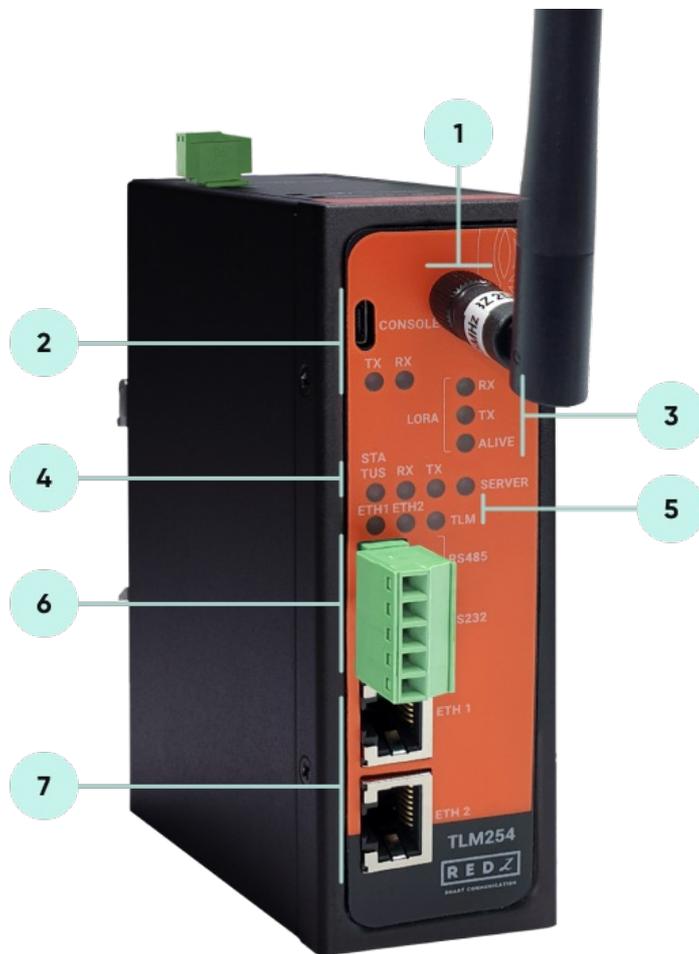
Then Push the switch toward the Din-Rail until you heard a "click" sound.



4. Front Panel Description

4.1 TLM154 & TLM254





1. Standard SMA female Antenna interface, 50 ohm
2. Micro USB Console port for LOG in 115200 baud
Console Tx and Rx Blinks when data transmission occurs
3. LoRa Activity LEDs
ALIVE: Blinks during normal operation
LoRa Tx and Rx Blinks when data transmission occurs
4. Device Status LEDs
STATUS: Blinks based on device operation
 - When TCP line used blinks during no connection and keeps ON after TCP connection
 - When Serial line used keeps ON
 Device Tx and Rx Blinks when data transmission occurs
SERVER: Keeps ON after selecting Server from REDZ special

design, plug and play Server-Client Operating Modes. Keeps OFF if Client operating Mode selected

5. ETHERNET Activity LEDs for port 1, 2 and TLM device itself. Blinks during ethernet activity

6. 5 pin Terminal Block

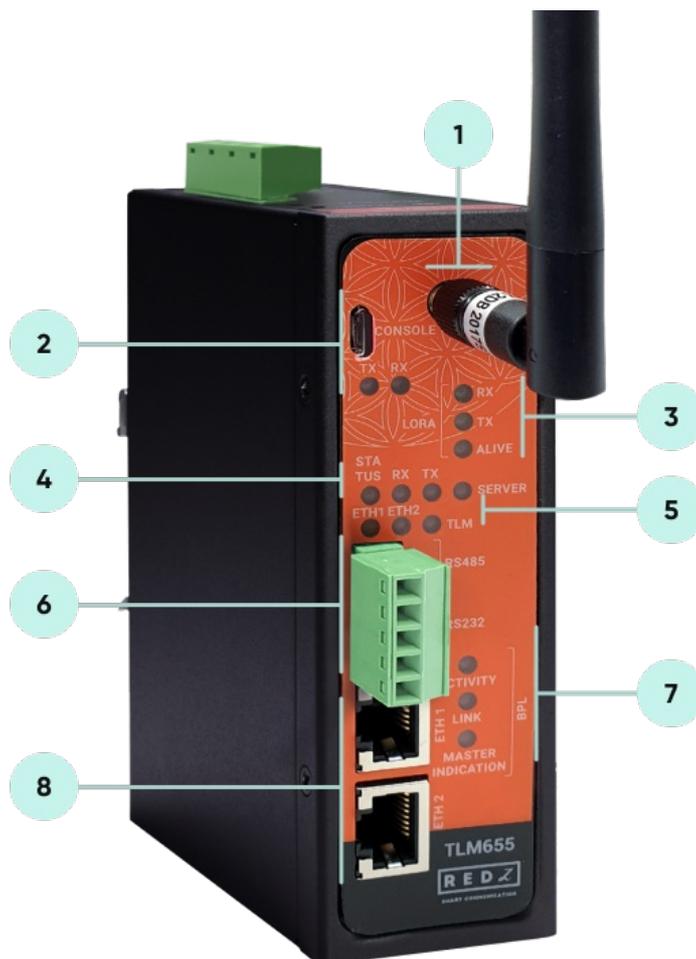
RS232: Tx, Rx and GND pins

RS485: A, B and GND pins

Can be activated over web interface and baud rate/data type configurable

7. 10/100Base-T(X) Ethernet ports

4.2 TLM655



1. Standard SMA female Antenna interface, 50 ohm

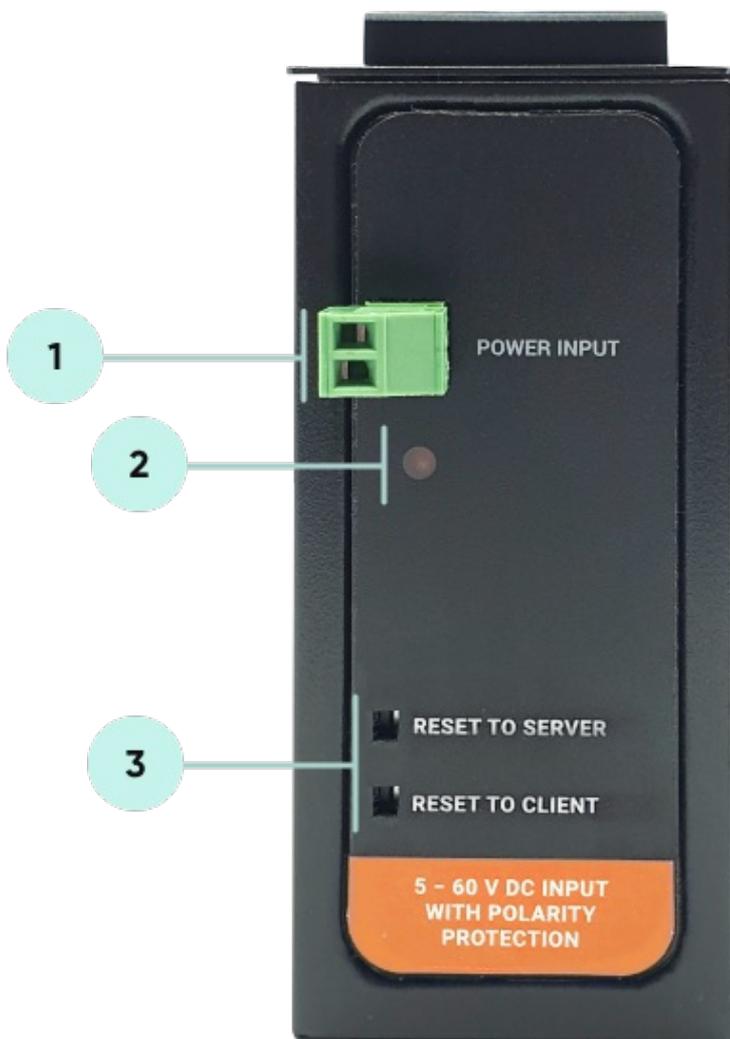
2. Micro USB Console port for LOG in 115200 baud
Console Tx and Rx Blinks when data transmission occurs
3. LoRa Activity LEDs
ALIVE: Blinks during normal operation
LoRa Tx and Rx Blinks when data transmission occurs
4. Device Status LEDs
STATUS: Blinks based on device operation
 - When TCP line used blinks during no connection and keeps ON after TCP connection
 - When Serial line used keeps ONDevice Tx and Rx Blinks when data transmission occurs
SERVER: Keeps ON after selecting Server from REDZ special design, plug and play Server-Client Operating Modes. Keeps OFF if Client operating Mode selected
5. ETHERNET Activity LEDs for port 1, 2 and TLM device itself. Blinks during ethernet activity
6. 5 pin Terminal Block for Serial Line
RS232: Tx, Rx and GND pins
RS485: A, B and GND pins
Can be activated over web interface and baud rate/data type configurable
7. BPL Status LEDs
ACTIVITY: Blinks during BPL Ethernet activity
LINK: LED Turns ON if the link can be established over BPL
MASTER INDICATION: LED Turns ON if the device is configured and

powered as "BPL Master" device

8. 10/100Base-T(X) Ethernet ports

5. Top Panel Description

5.1 TLM154



1. Power Input DC: 5-60V DC. Polarity protected so that the power input can be connected in any direction
2. Power LED: Turns ON when there is power in device

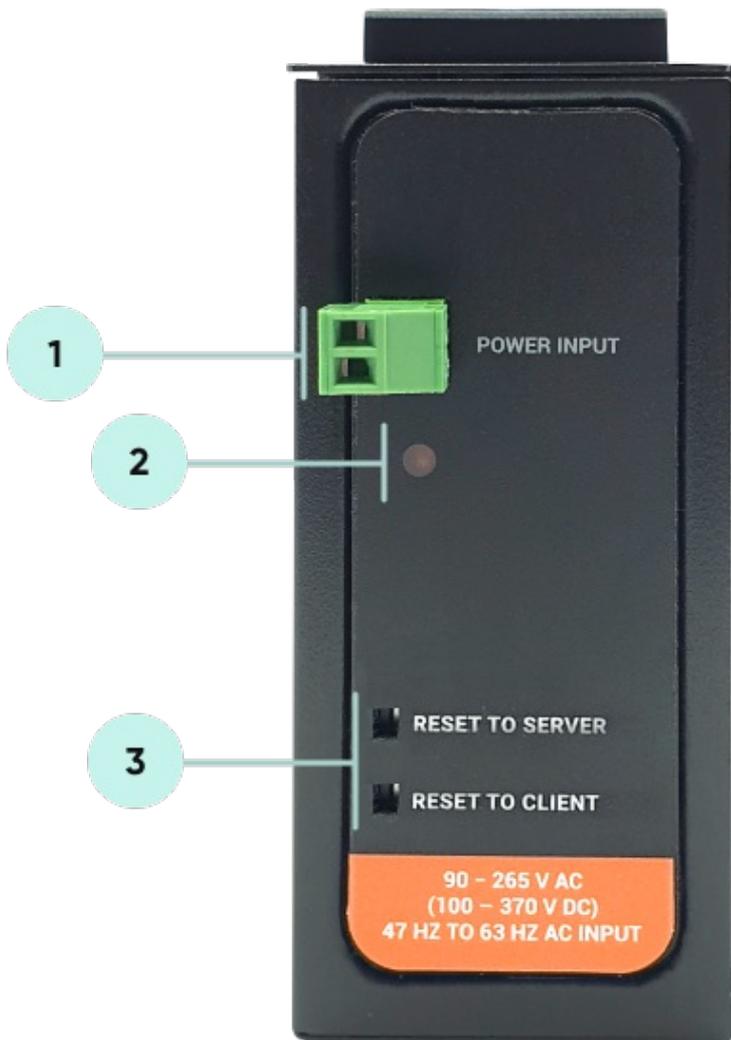
3. Reset Buttons

RESET TO SERVER: Resets the device to factory setting as Server from REDZ special design, plug and play Server-Client Operating Modes

RESET TO CLIENT: Resets the device to factory setting as Client from REDZ special design, plug and play Server-Client Operating Modes

Rest can be done at any time by pushing any of the button for 5 seconds.

5.2 TLM254



1. Power Input AC: 90 - 265V AC (100 - 370V DC), 47Hz to 63Hz AC input

2. Power LED: Turns ON when there is power in device

3. Reset Buttons

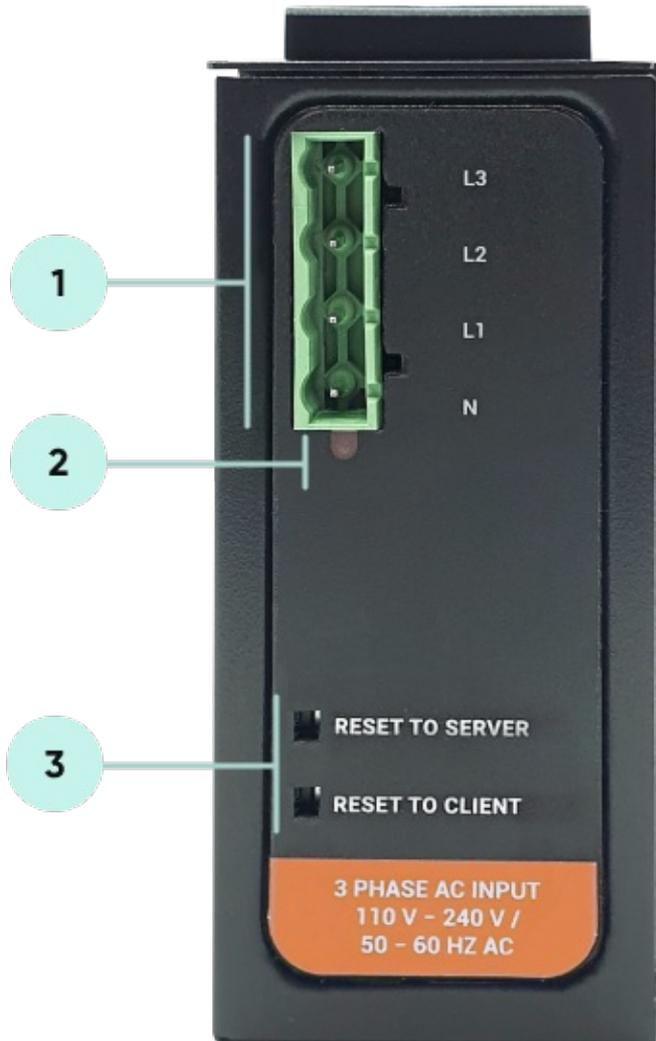
RESET TO SERVER: Resets the device to factory setting as Server from REDZ special design, plug and play Server-Client Operating Modes

RESET TO CLIENT: Resets the device to factory setting as Client from REDZ special design, plug and play Server-Client Operating

Modes

Reset can be done at any time by pushing any of the button for 5 seconds.

5.3 TLM655



1. Power Input AC: 3 phase input, 110V–240V/50–60Hz. It is also ok to connect only single phase to the device such as L1-N connection only.

AC Power supply use L1-N only. Phase 2-3 connections are used to BPL signal transmission.

2. Power LED: Turns ON when there is power in device

3. Reset Buttons

RESET TO SERVER: Resets the device to factory setting as Server from REDZ special design, plug and play Server-Client Operating Modes

RESET TO CLIENT: Resets the device to factory setting as Client from REDZ special design, plug and play Server-Client Operating Modes

Rest can be done at any time by pushing any of the button for 5 seconds.

6. Ethernet Cables

TLM Series LoRa Based RF Gateways have standard Ethernet ports. According to the link type, the switches use CAT 3, 4, 5, 5e UTP cables to connect to any other network device (PCs, servers, switches, routers, or hubs).

6.1 Cable Type and Specifications

Cable	Type	Max. Length	Connector
10BASE-T	Cat. 3, 4, 5 100-ohm	UTP 100 m (328 ft)	RJ-45
100BASE-TX	Cat. 5 100-ohm UTP	UTP 100 m (328 ft)	RJ-45

6.2 ETH Cable Pin Assignments

With 100BASE-TX/10BASE-T cable, pins 1 - 2 are used for transmitting data and pins 3 - 6 are used for receiving data.

Pin Number	Description
------------	-------------

1	TD+
2	TD-
3	RD+
4	Not Used
5	Not Used
6	RD-
7	Not Used
8	Not Used

7. System Comparison Between CAT5 and BPL Links

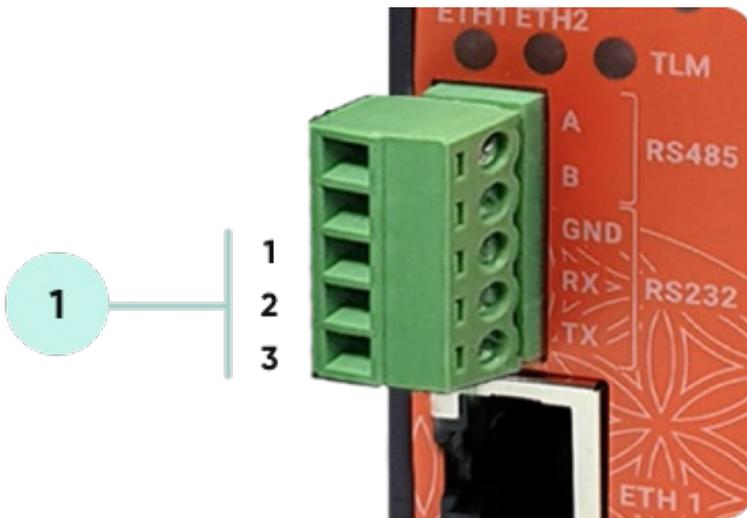
	CAT5 Based System	BPL Link Based System
Media	CAT5	Power Line
Bandwidth	100Mbps	Up to 30Mbps
Re-Wire	Yes	No, Using existing Power Line
Span	<100m	<600m
Multiple Nodes	N/A	Up to 10 hops/1000 nodes
Encryption	Yes, but difficult to configure	Yes, Plug & Play
Installment	Difficult	Easy, simply user power line
Installment Cost	High	Low
Total Cost	High	Low

8. Serial Cables

TLM Series LoRa Based RF Gateways have 1 x RS232 and 1 xRS485 port. Serial line can be connected other serial devices such as RTUs, PLCs,

energy meters or any other field device.

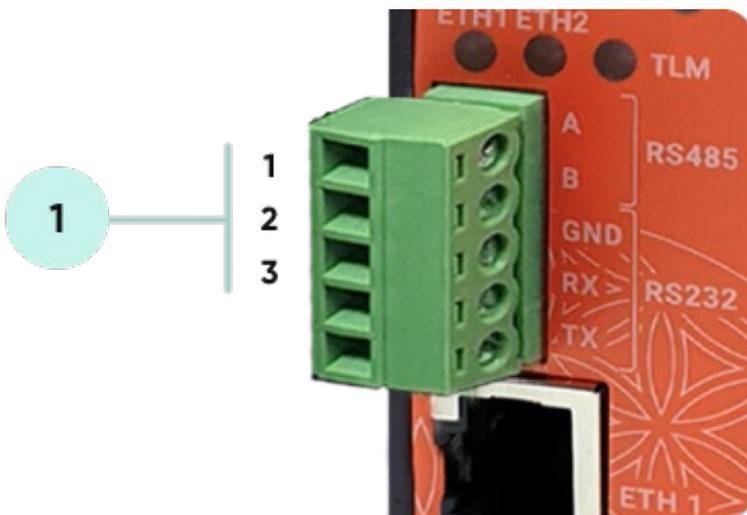
8.1 RS232 Cable Pin Assignments



1. Terminal connector for 3 wire Tx-Rx-GND RS232 data transmission

Pin Number	Description
1	GND
2	Rx
3	Tx

8.2 RS485 Cable Pin Assignments



1. Terminal Connector for 2 wire RS485 connection and GND (if needed)

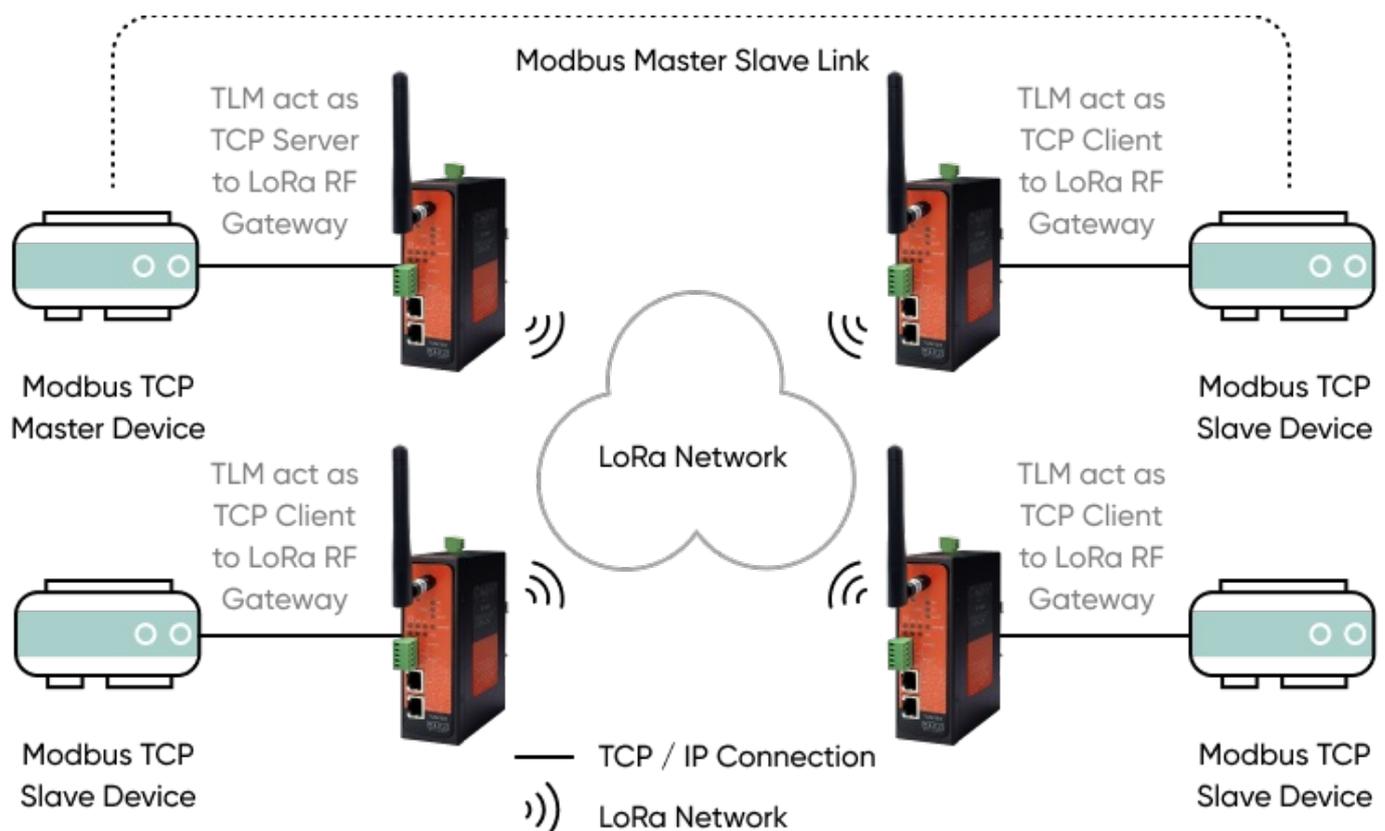
Pin Number	Description
1	A
2	B
3	GND (Suggested to use)

9. Usage Scenarios and Connection Diagrams

Some of the usage scenarios of TLM Series LoRa Based RF Gateways are described below. Usages are not limited to that examples and user may create their own usage scenario.

9.1 TCP IP Communication over RF Network

TLM Series LoRa Based RF Gateways can link TCP/IP devices and create a network over RF. For example, with TLM Series LoRa Based RF Gateways users can connect Modbus TCP devices such as RTUs or PLCs with each other over RF network and create wireless automation.

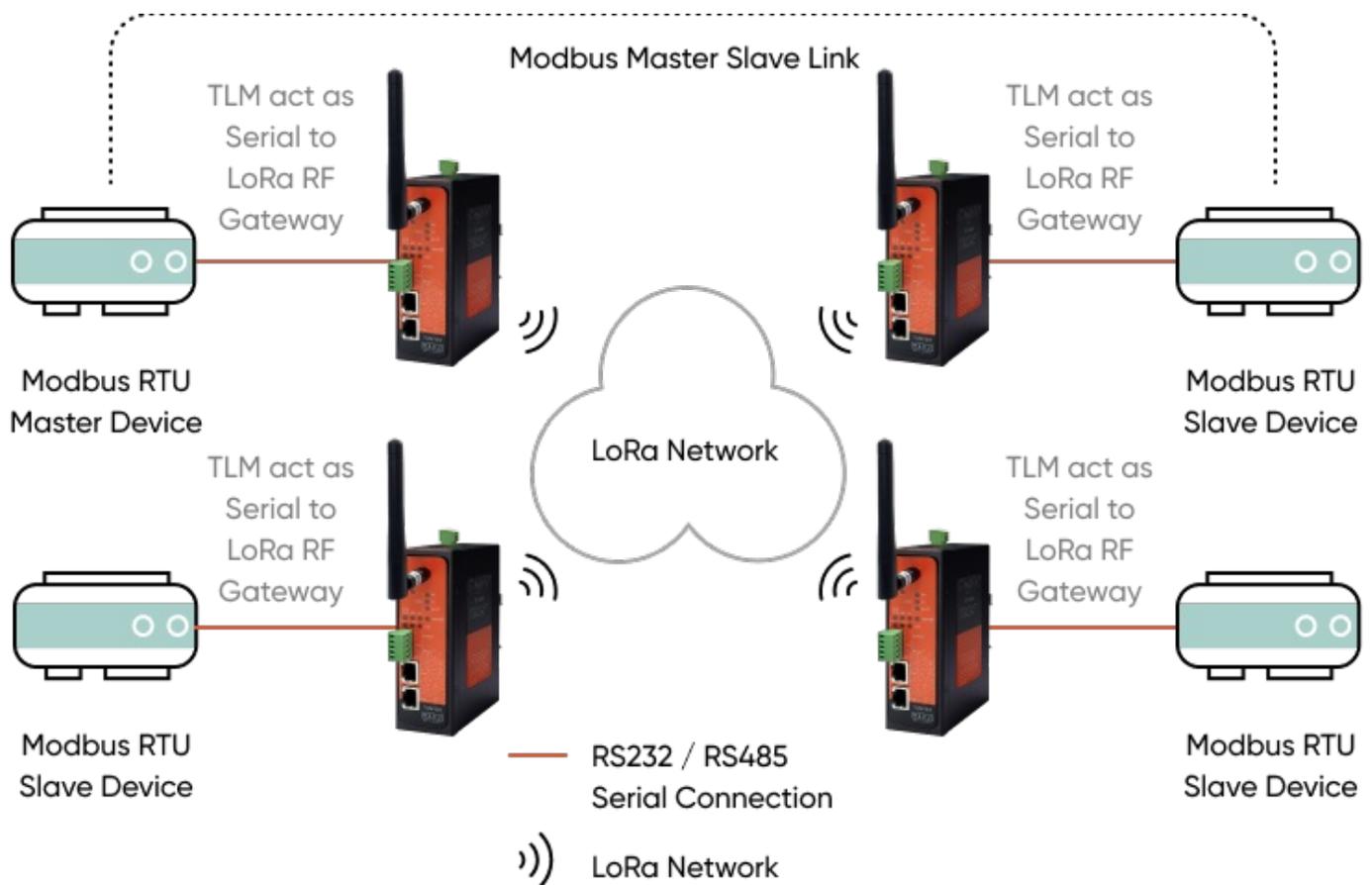


TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Local ETH client device is connected to TLM Server (User must enter TLM IP and NON TLM port in local device). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0xFF and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x01 and 0x0001.

TLM act as TCP Client to LoRa RF Gateway configured as Client Mode, Field devices are listening on their Modbus TCP port so that field device IP and port must be configured in TLM. LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0x0001 for sending packages back only to TLM connected to Modbus TCP Master device.

9.2 Serial Communication over RF Network

TLM Series LoRa Based RF Gateways can link RS232 and/or RS485 serial devices and create a network over RF. For example, with TLM Series LoRa Based RF Gateways users can connect RS232 and/or RS485 Modbus RTU/ASCII devices such as RTUs or PLCs with each other over RF network and create wireless automation.



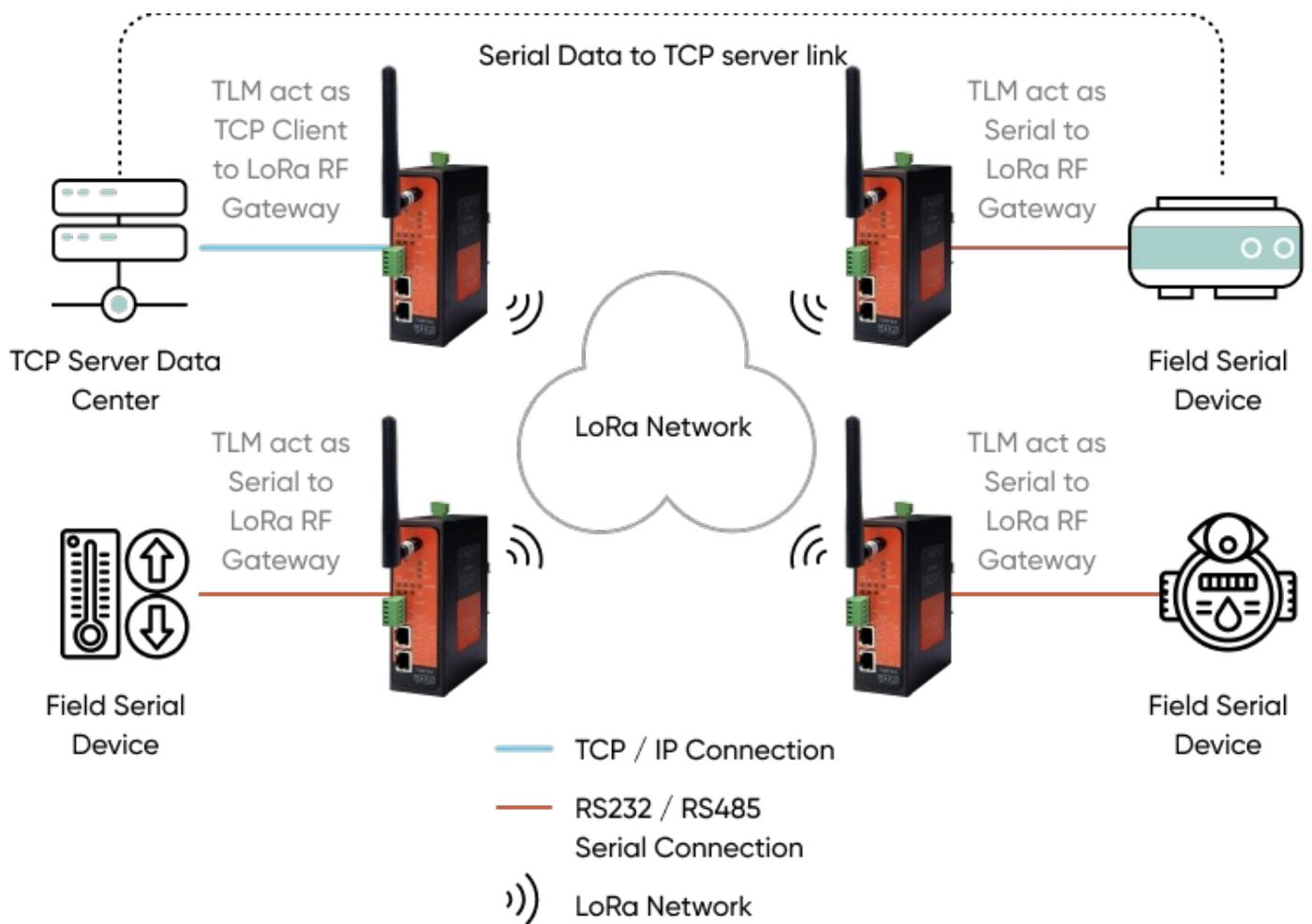
TLM act as Serial to LoRa RF Gateway configured as Client Mode (Client mode suggested to use in serial communication since TCP server capabilities will not be used), Serial communication is enabled and settings are done based on field device. LoRa communication configuration must be same along the Lora network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0xFF and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x01 and 0x0001.

TLM act as Serial to LoRa RF Gateway configured as Client Mode, Serial communication is enabled and settings are done based on field device. LoRa communication configuration must be same along the Lora network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0x0001 for sending packages back only to TLM device connected to Modbus RTU master device.

9.3 Send/Receive Serial Device Data with TCP Server

TLM Series LoRa Based RF Gateways can link RS232 and/or RS485 serial devices and create a network over RF and serial device data can be send to a TCP server. The communication works bidirectionally. For example, with TLM Series LoRa Based RF Gateways users can connect

RS232 and/or RS485 serial devices such as Data Loggers or Field Sensors over RF network and create a communication infrastructure to send their data to a TCP server.

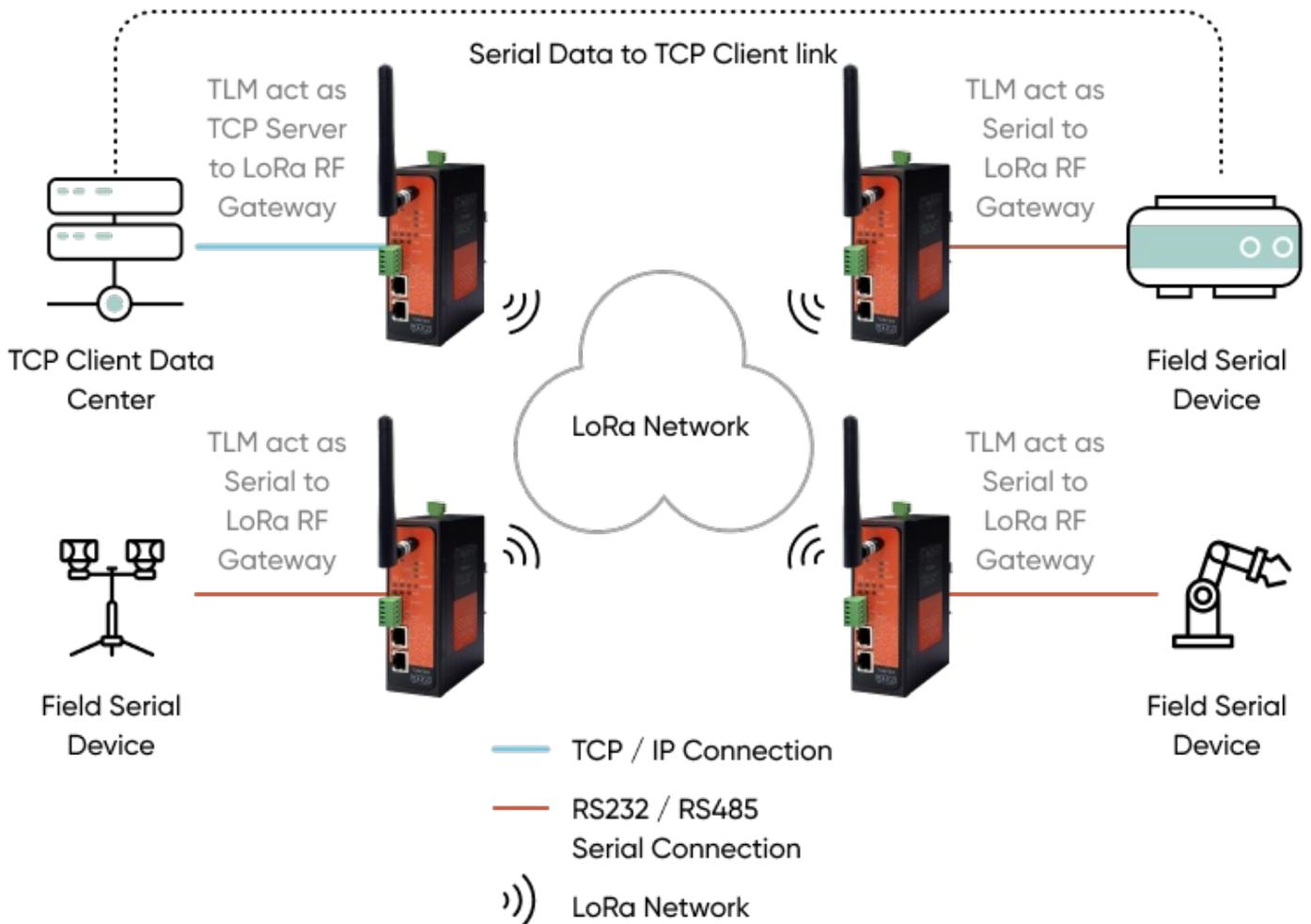


TLM act as TCP Client to LoRa RF Gateway configured as Client Mode, Remote TCP Server Data Center IP and port must be configured in TLM device so that TLM can connect. LoRa communication configuration must be same along the LoRa network. TLM will expect LoRa packages from configured Group Address + Device Address combination. User may define 0x01 and 0x0001 for ease of use. If Tx Group Address + Tx Device Address will be used (if server will also send data to field devices) it can be set as broadcast address. (0xFF and 0xFFFF)

TLM act as Serial to LoRa RF Gateway configured as Client Mode, Serial communication is enabled and settings are done based on field device. LoRa communication configuration must be same along the Lora network. TLM will send LoRa packages to configured Tx Group Adress + Tx Device Address combination. In that example user may define 0x01 and 0x0001 for sending packages back only to TLM connected to remote data center server device.

9.4 Send/Receive Serial Device Data with TCP Client

TLM Series LoRa Based RF Gateways can link RS232 and/or RS485 serial devices and create a network over RF and serial devices can be controlled from a TCP client center. The communication works bidirectionally. For example, with TLM Series LoRa Based RF Gateways users can connect RS232 and/or RS485 serial devices such as Data Loggers or Field controllers such as contactors over RF network and create a communication infrastructure to control device operation over a TCP client center.



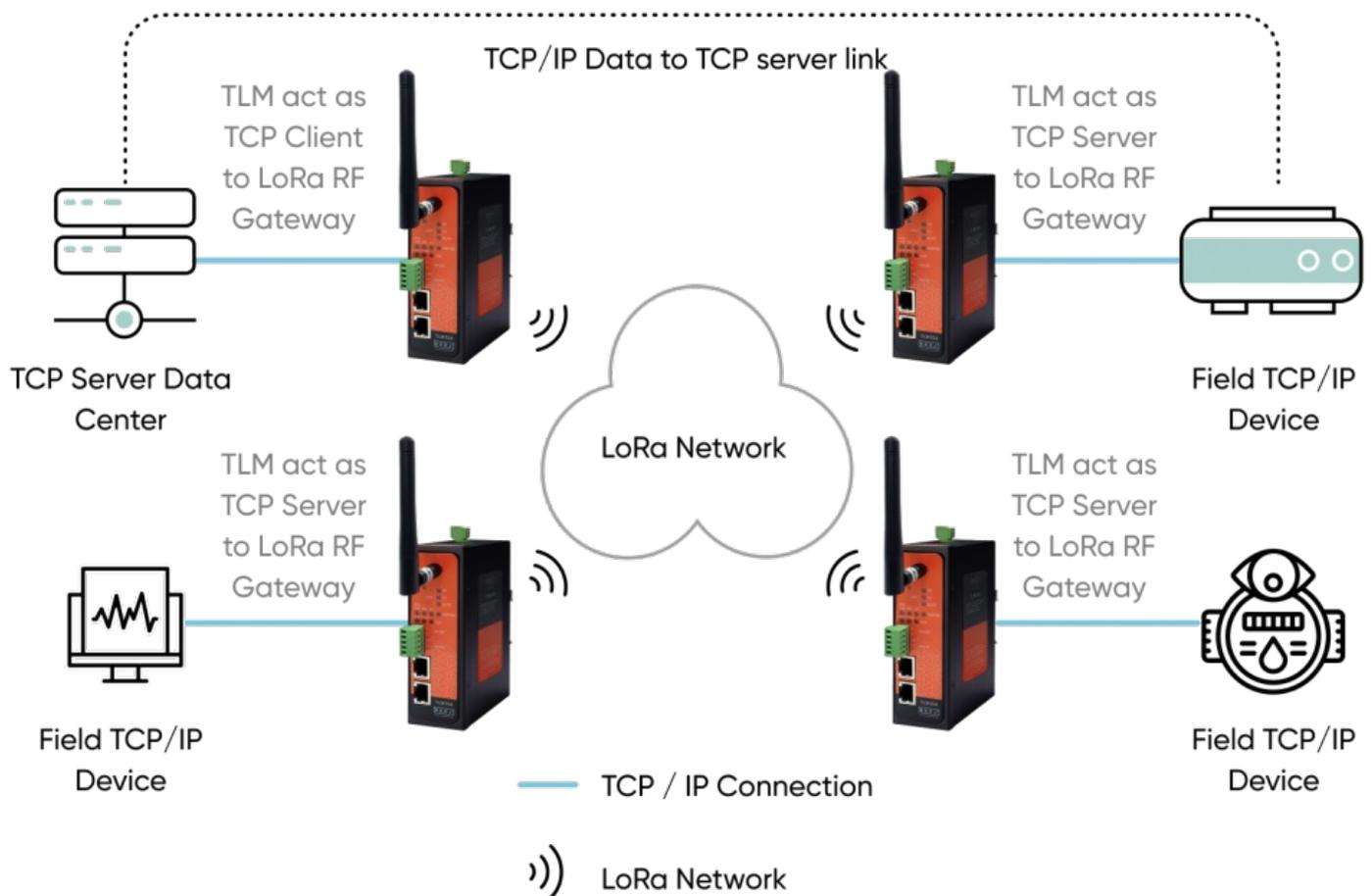
TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Remote TCP Client Data Center is connected to TLM Server (User must enter TLM IP and NON TLM port in data center). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0xFF and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x01 and 0x0001.

TLM act as Serial to LoRa RF Gateway configured as Client Mode, Serial

communication is enabled and settings are done based on field device. LoRa communication configuration must be same along the Lora network. TLM will send LoRa packages to configured Tx Group Adress + Tx Device Address combination. In that example user may define 0x01 and 0x0001 for sending packages back only to TLM connected to remote data center server device.

9.5 Send/Receive TCP/IP Device Data with TCP Server

TLM Series LoRa Based RF Gateways can link TCP/IP devices and create a network over RF and their device data can be send to a TCP server. The communication works bidirectionally. For example, with TLM Series LoRa Based RF Gateways users can connect TCP/IP devices such as Data Loggers or RTUs over RF network and create a communication infrastructure to send their data to a TCP server.



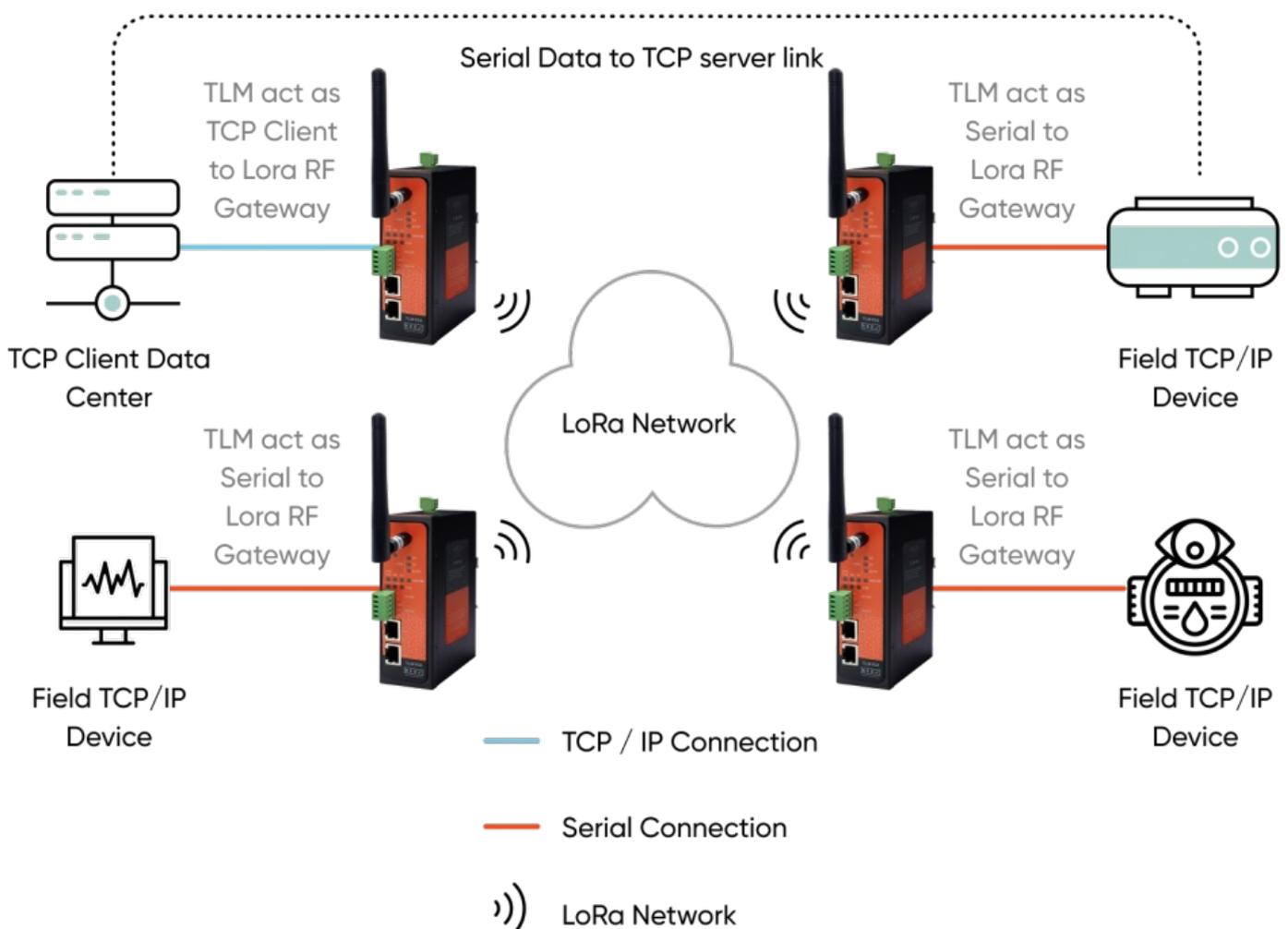
TLM act as TCP Client to LoRa RF Gateway configured as Client Mode. Remote TCP Server Data Center IP and port must be configured in TLM device so that TLM can connect. LoRa communication configuration must be same along the LoRa network. TLM will expect LoRa packages from configured Group Address + Device Address combination. User may define 0x01 and 0x0001 for ease of use. If Tx Group Address + Tx Device Address will be used (if server will also send data to field devices) it can be set as broadcast address (0xFF and 0xFFFF)

TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Local ETH client device is connected to TLM Server (User must enter TLM

IP and NON TLM port in local device). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0x0001 for sending back to only TLM connected to TCP Server Data Center.

9.6 Send/Receive Serial Device Data with TCP Client

TLM Series LoRa Based RF Gateways can link Serial devices and create a network over RF and devices can be controlled from a TCP client center. The communication works bidirectionally. For example, with TLM Series LoRa Based RF Gateways users can connect TCP/IP devices such as Data Loggers, Energy Analyzers or RTUs over RF network and create a communication infrastructure to query the device data over a TCP client center.



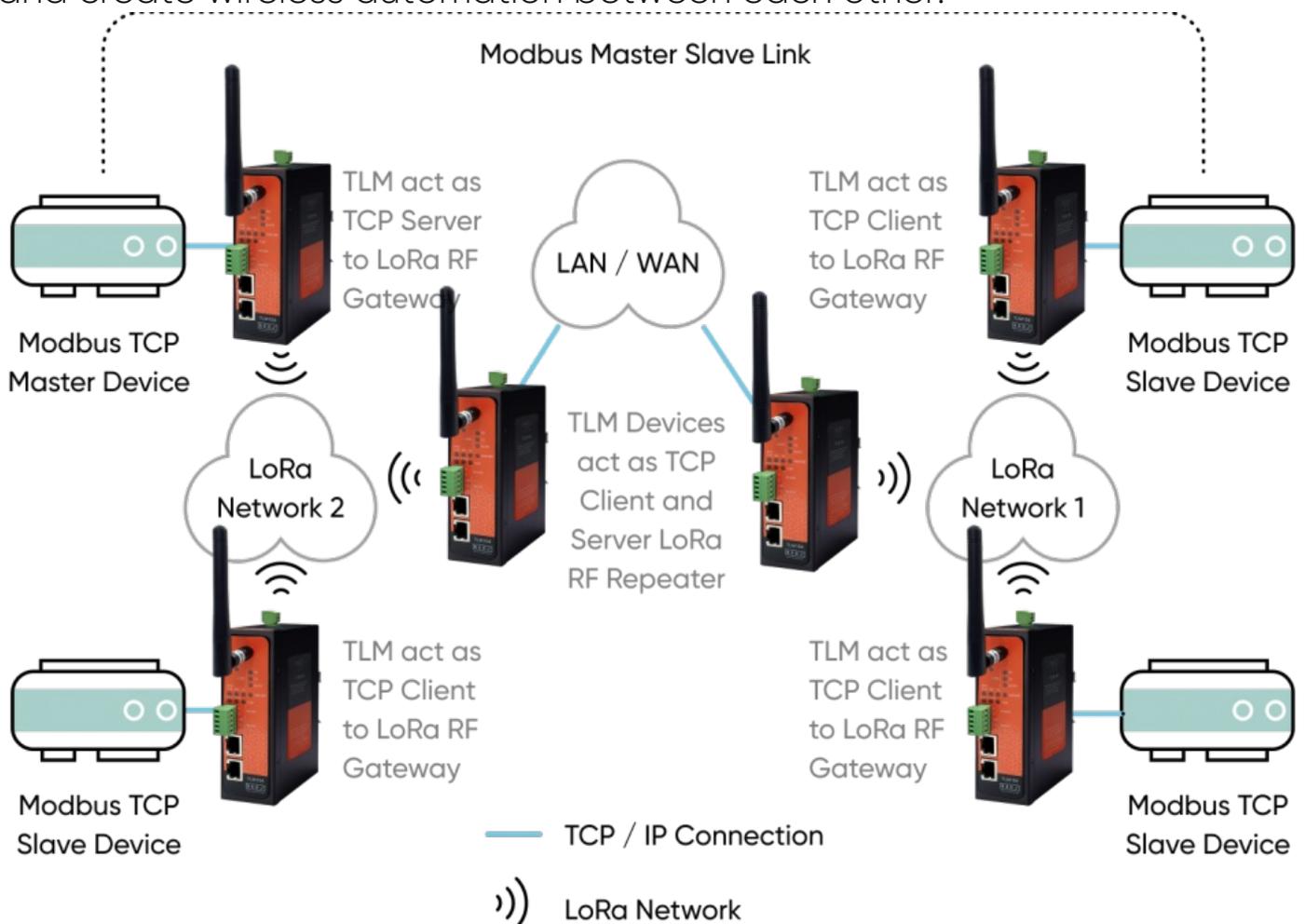
TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Remote TCP Client Data Center is connected to TLM Server (User must enter TLM IP and NON TLM port in data center). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address

combination. User may define 0xFF and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x01 and 0x0001.

TLM act as TCP Client to LoRa RF Gateway configured as Client Mode, Field devices are listening on their TCP port so that field device IP and port must be configured in TLM. LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0x0001 for sending packages back only to TLM connected to Modbus TCP Client data center.

9.7 Send/Receive Data Between 2 Different LoRa RF Networks

TLM Series LoRa Based RF Gateways can link 2 different RF network over TCP/IP LAN or WAN network. This helps to extend RF network without distance limit. Communication works bidirectionally. For example, with TLM Series LoRa Based RF Gateways users can connect Modbus TCP devices such as RTUs or PLCs with each other over 2 different RF network and create wireless automation between each other.



TLM act as TCP Server to LoRa RF Gateway configured as Server Mode in

network 2. Local ETH client device is connected to TLM Server (User must enter TLM IP and NON TLM port in local device). LoRa communication configuration must be same along the LoRa network 2. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x02 and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network 2). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x02 and 0x0001. This way we grouped this LoRa Network as Group Address 2.

TLM act as TCP Server to LoRa RF Gateway configured as Server Mode in network 1 too. Network 1 Server TLM and Network 2 Client TLM devices can connect to each other in TLM auto connection mode automatically to repeat signals in same network (REDZ special design, plug and play Server-Client Operating Modes). If in they are in different network routing settings must be done properly and NAT must be configured in WAN routers. LoRa communication configuration must be same along the LoRa network 1. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0xFFFF for broadcasting (send LoRa packages to all LoRa devices in LoRa Network 1). TLM will get LoRa packages from Group Address + Device Address combination and user may keep as default: 0x01 and 0x0001. This way we grouped this LoRa Network as Group Address 1.

TLM act as TCP Client to LoRa RF Gateway configured as Client Mode, Field devices are listening on their Modbus TCP port so that field device IP and port must be configured in TLM. LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + Tx Device Address combination. User may define 0x01 and 0x0001 for sending packages back only to TLM act as Server device in Network 1. Also, user may define 0x02 and 0x0001 for sending packages back only to TLM connected to Modbus TCP Master device in Network 2.

10. Configuration via WEB Interface

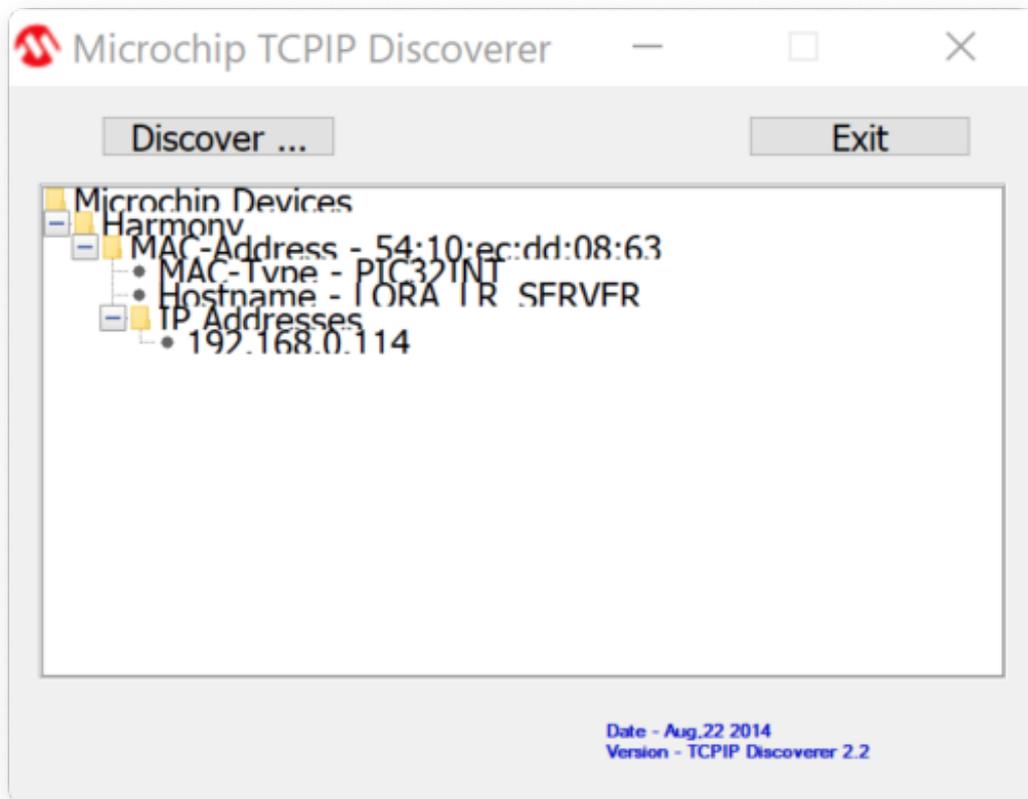
TLM Series LoRa Based RF Gateways can be configured over web interface.

Device will get IP from DHCP client when connected to a network. User

can use discovery tool to see IP of the device.



Once the IP of the device is set, user may login the device by simply typing the Ip address of device.



NOTE 1: TLM default firmware runs with DHCP off and expects an IP lease. If user need static IP or prefers DHCP on during start up, additional firmware is available.



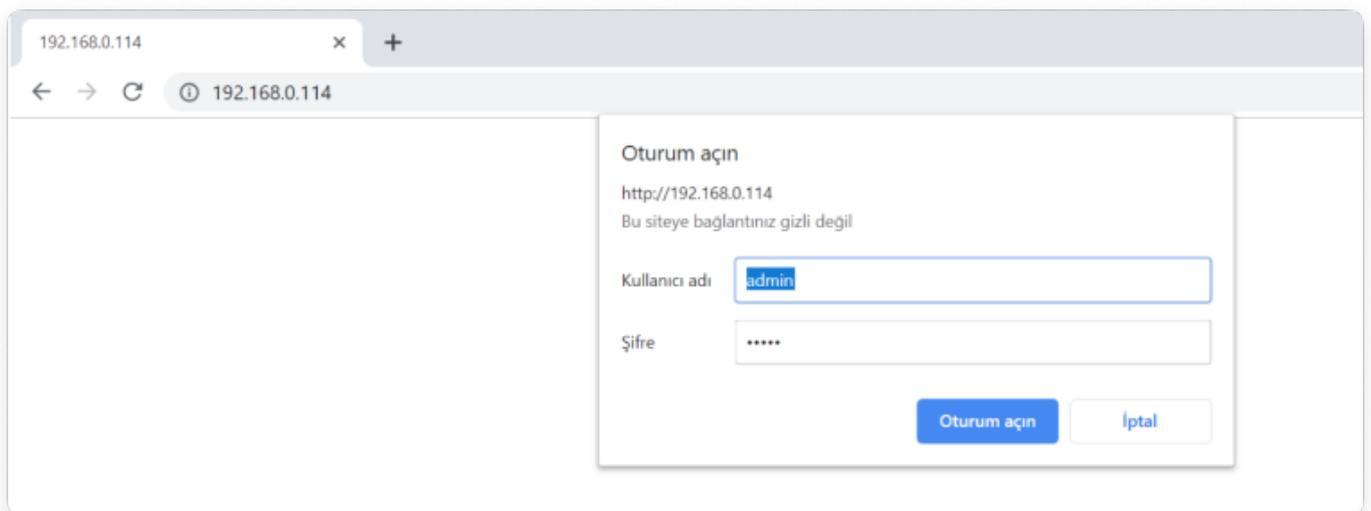
NOTE 2: If there is no DHCP server in LAN, REDZ device will get default 192.168.1.1 IP if it is set as Server Mode. It will get default 192.168.1.100 IP if it is set as Client mode.

10.1 Connecting Web Interface

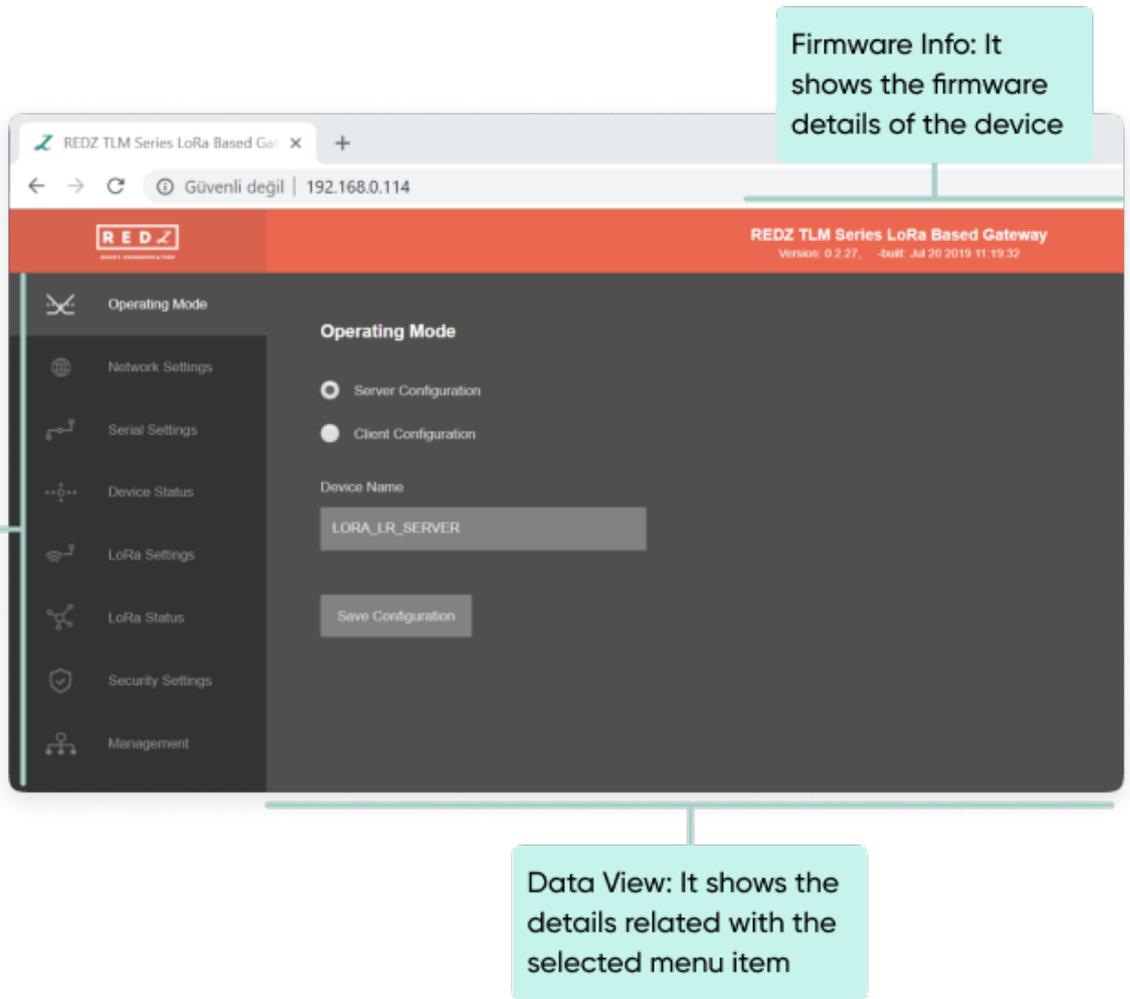
Simply write IP of the device to the http client. Google Chrome is suggested to use. Login screen will pop up.

Default user name: **admin**

Default password: **admin**



Main screen of device will appear with following information:

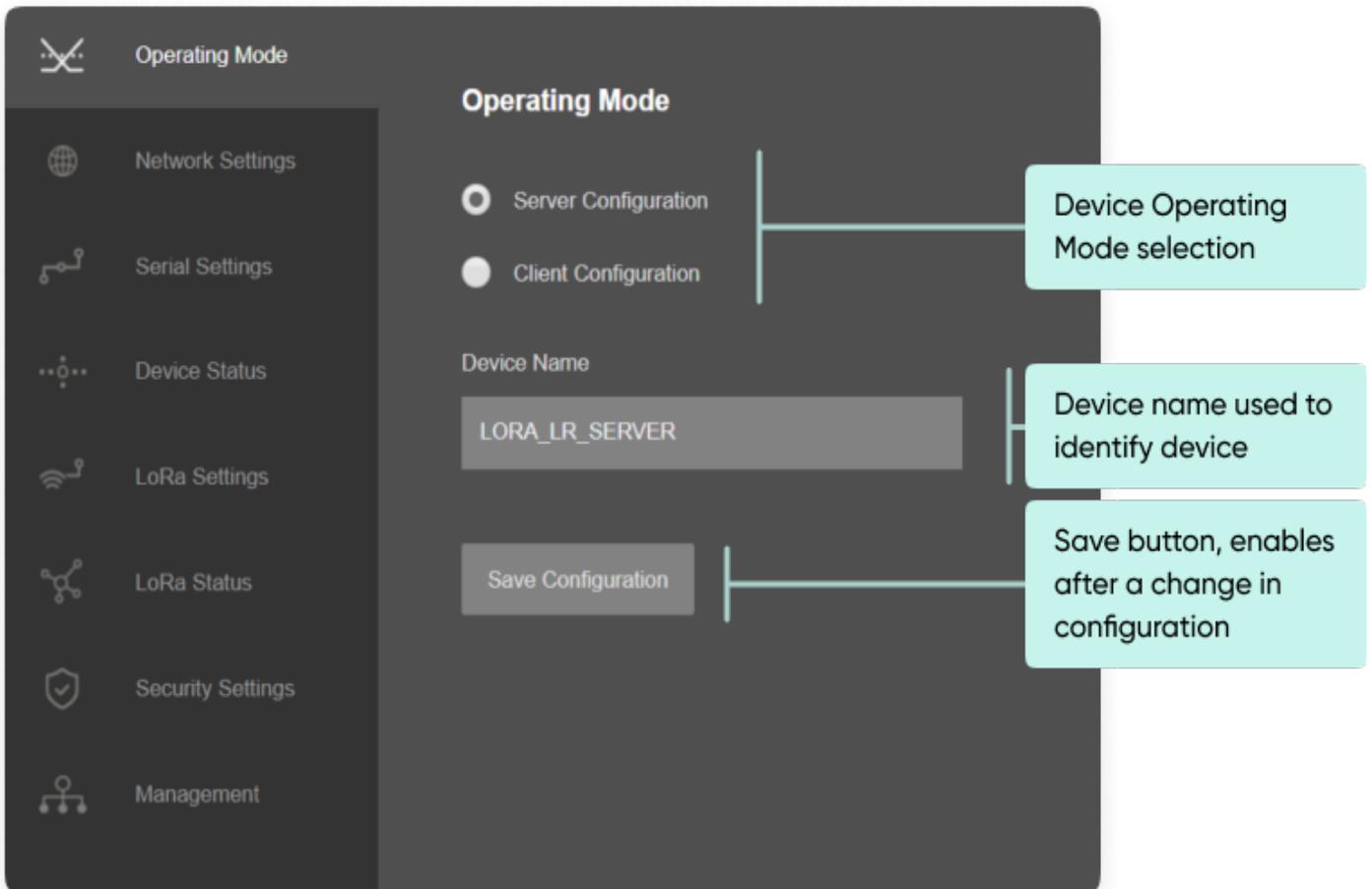


10.2 MENU: Operating Mode

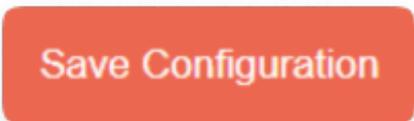
From this menu user may select the operating mode of the device.

- TLM can act for example TCP server and wait for TCP socket connection. This way the received TCP data will be transferred to LoRa Network and vice versa. Set "Server Configuration" in this case.
- If Set to Client Mode TLM will connect to a TCP server and yet again the received TCP data will be transferred to LoRa Network and vice versa. Set "Client Configuration" in this case.
- When serial connection will be preferred and device will act as Serial to RF network gateway, the Operating Mode can keep either as Server or Client, it does not affect and we suggest it to keep as Client. Set "Client Configuration" in this case.

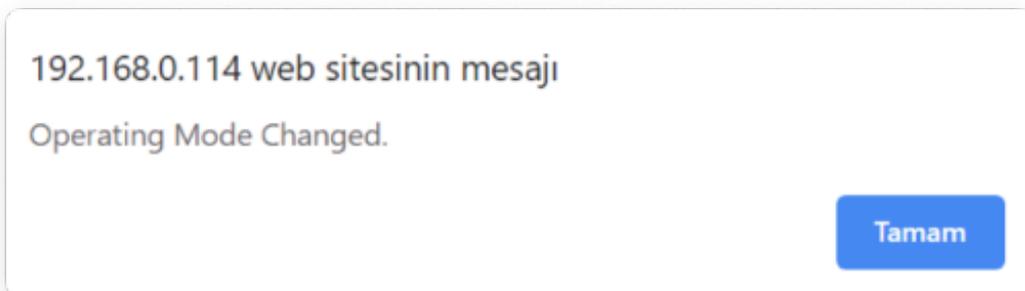
"Device Name" field is used to identify device and also used during REDZ special design, plug and play Server-Client Operating Modes.



Once the setting has been changed, "Save Configuration" button will be enabled.



After clicking button system will tell if the settings applied successfully or not.





NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time.

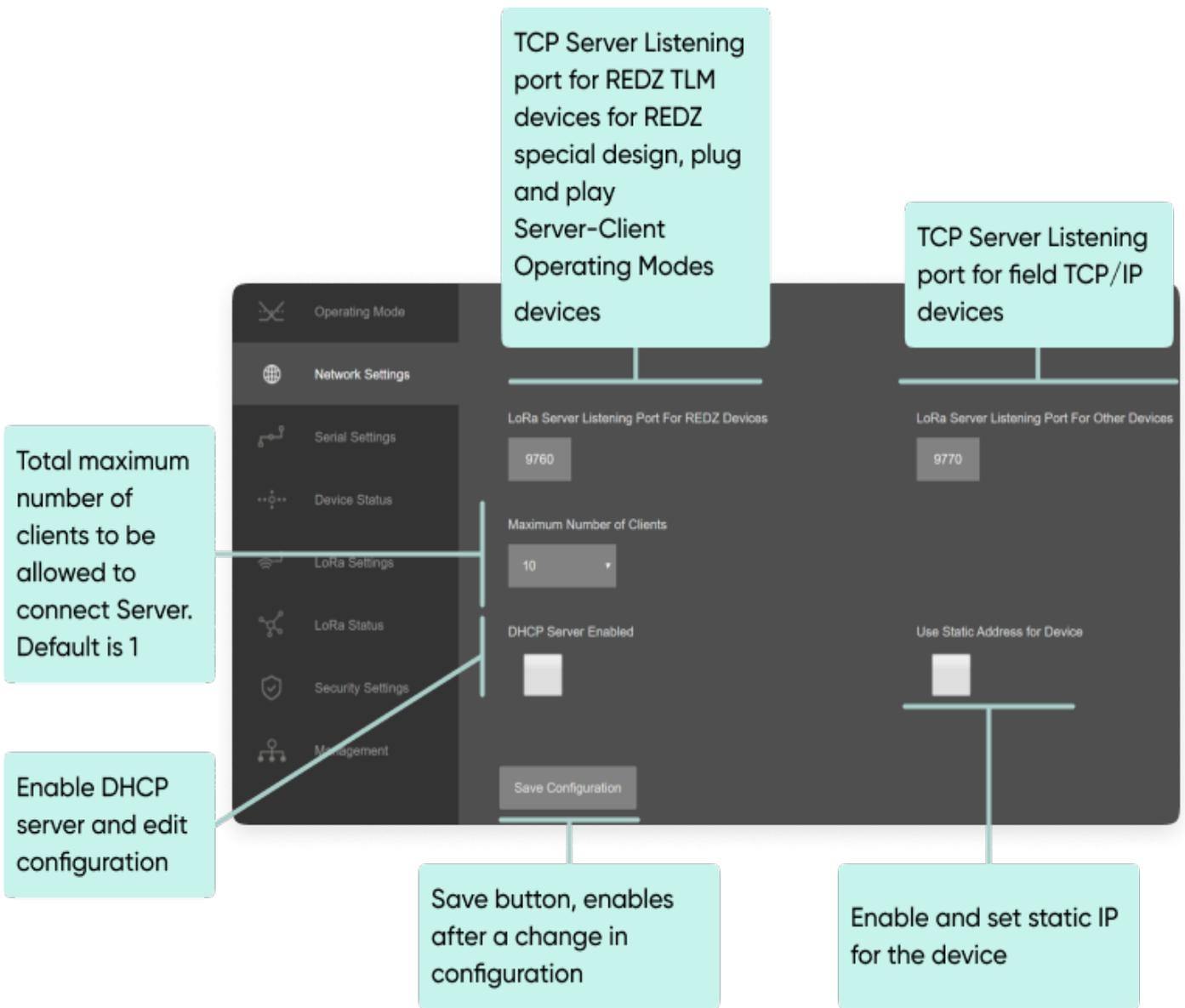


NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.

10.3 MENU: Network Settings – Server

From this menu user may change the network settings of the device.

- User can change TCP Listening port for field devices.
- User can change TCP Listening port for TLM field devices for REDZ special design, plug and play Server-Client Operating Modes.
- User can select maximum number of clients allowed to connect device.
- User can activate DHCP server.
- User can force device to a static IP.



Following parameters and static IP settings available for "DHCP Server" setting.

The image shows a detailed view of the DHCP Server configuration settings:

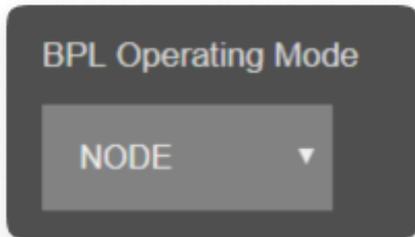
- DHCP Server Enabled:**
- Use Static Address for Device:**
- Server IP Address:** 192, 168, 1, 1
- Server Net Mask:** 255, 255, 255, 0
- DHCP Server Range Start Address:** 192, 168, 1, 100
- DHCP Server Gateway Address:** 192, 168, 1, 1
- DHCP Server Primary DNS Address:** 192, 168, 1, 1
- DHCP Server Secondary DNS Address:** 1, 168, 1, 1

Also if the device has Broadband Power Line (BPL) option:

User can select operating mode of BPL either MASTER or NODE.



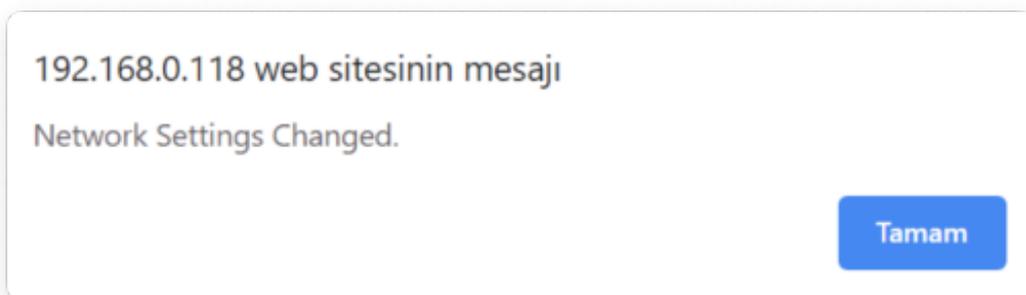
NOTE: Standard firmware of REDZ BPL supports up to 10 hops and 1000 nodes. Only 1 device can be MASTER in same network.



Once the setting has been changed, "Save Configuration" button will be enabled.

Save Configuration

After clicking button system will tell if the settings applied successfully or not.





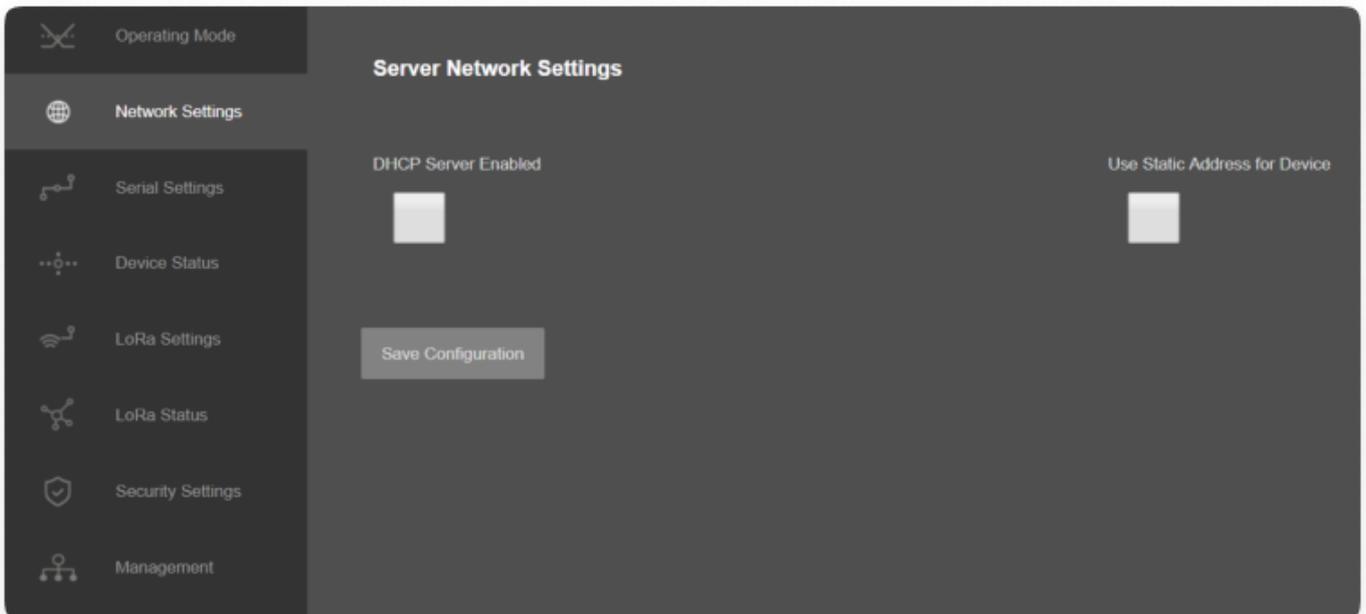
NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time.



NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.



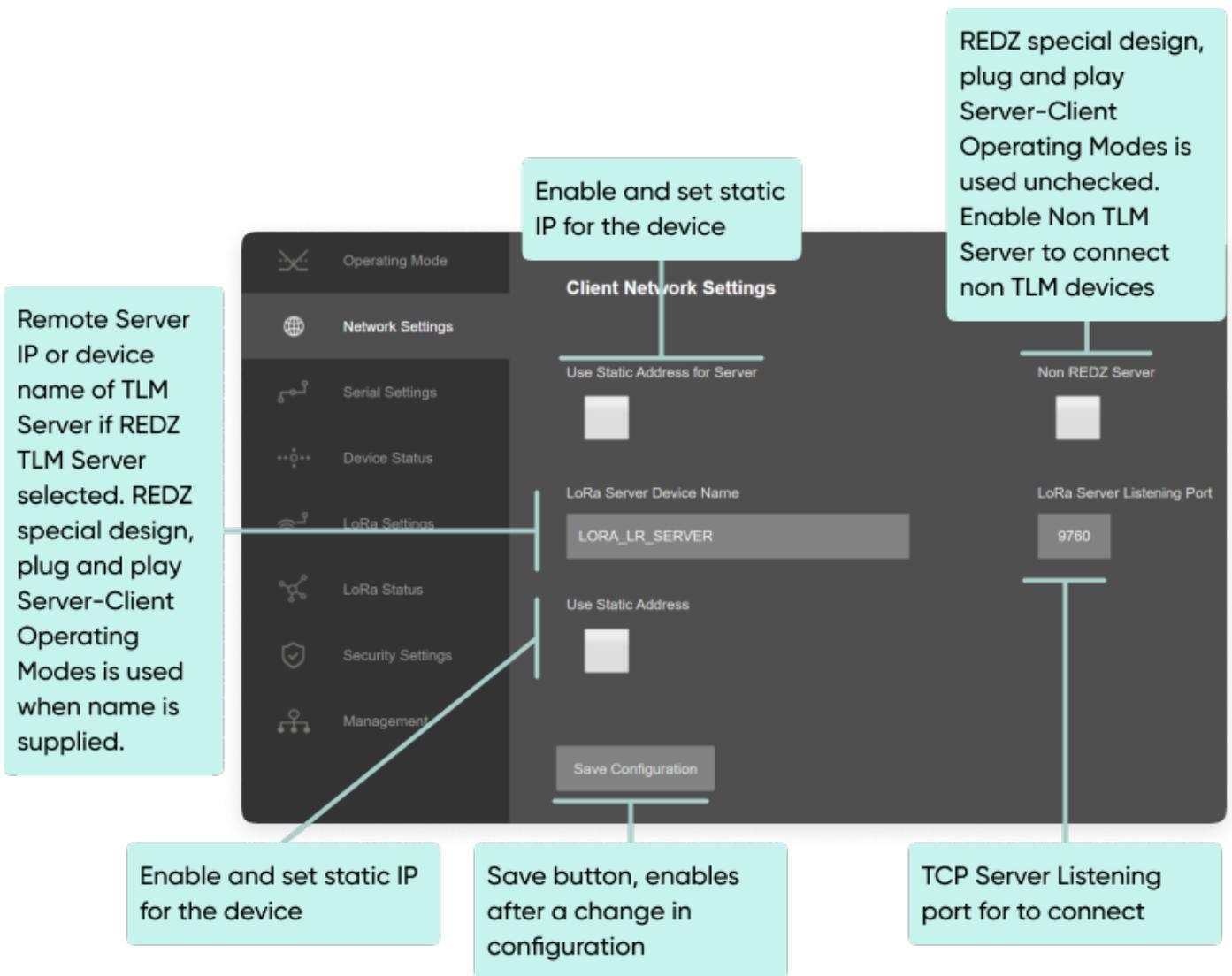
NOTE 3: If one of the Serial connections is enabled the device will act as Serial to LoRa RF Gateway and only following menu items will be available.



10.4 MENU: Network Settings – Client

From this menu user may change the network settings of the device.

- User can select server to apply REDZ special design, plug and play Server-Client Operating Modes or manually enter IP of Server.
- User can define if the server is REDZ device and supports REDZ special design, plug and play Server-Client Operating Modes.
- User can change TCP Server Listening port.
- User can force device to a static IP.



Following parameters and static IP settings available for "Use Static IP Address" setting.

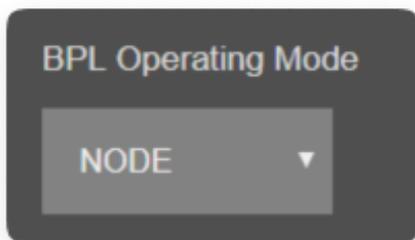


Also if the device has Broadband Power Line (BPL) option:

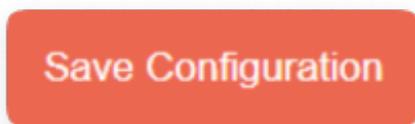
User can select operating mode of BPL either MASTER or NODE.



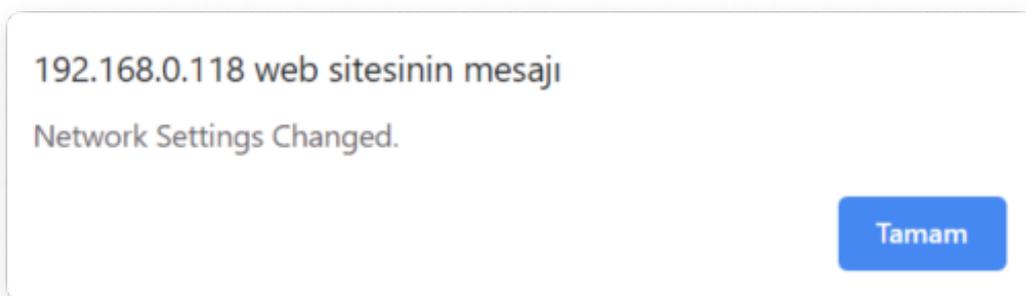
NOTE: Standard firmware of REDZ BPL supports up to 10 hops and 1000 nodes. Only 1 device can be MASTER in same network. If the device is in client mode, it is suggested to use "NODE" as setting.



Once the setting has been changed, "Save Configuration" button will be enabled.



After clicking button system will tell if the settings applied successfully or not.





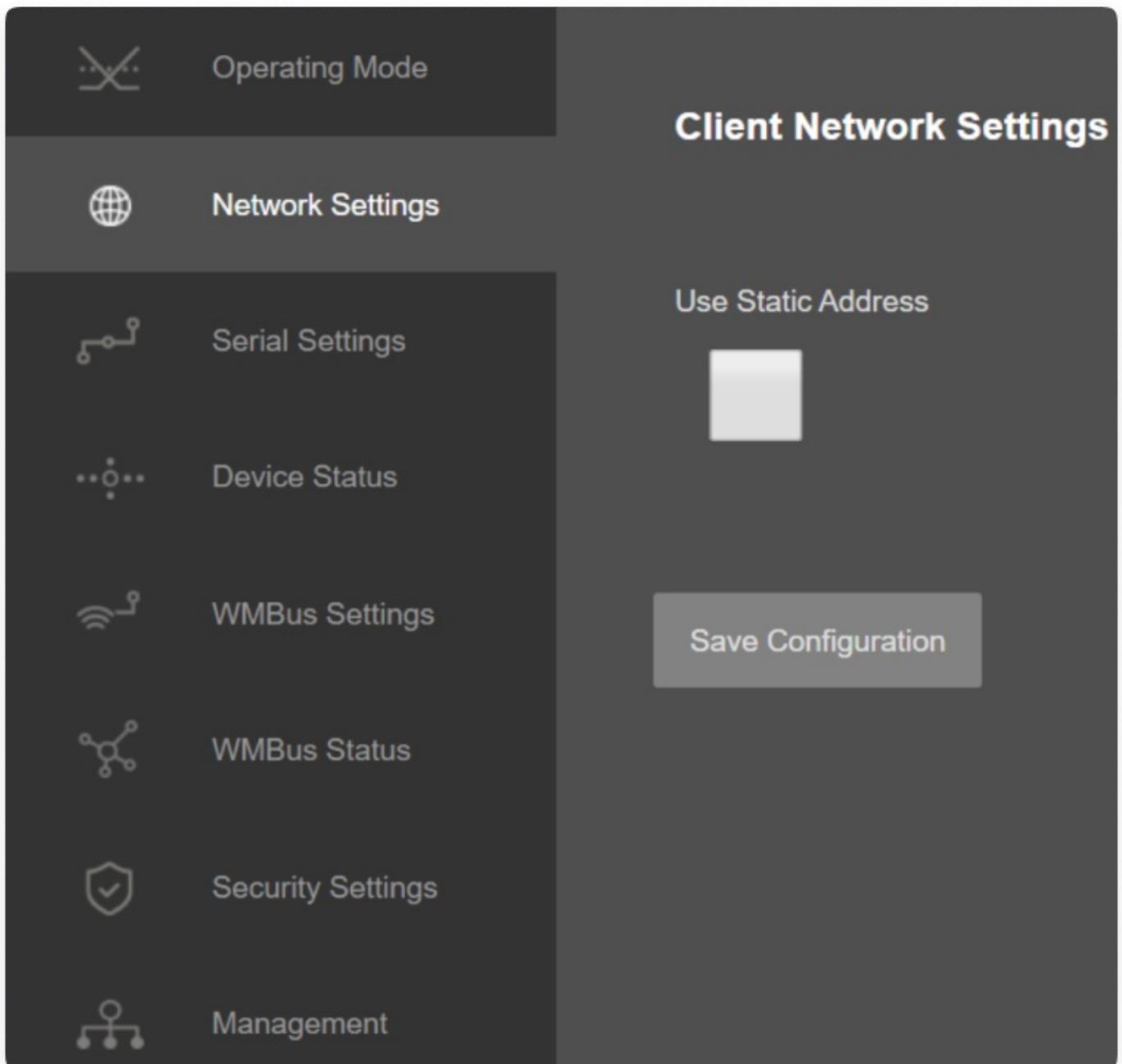
NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time.



NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.



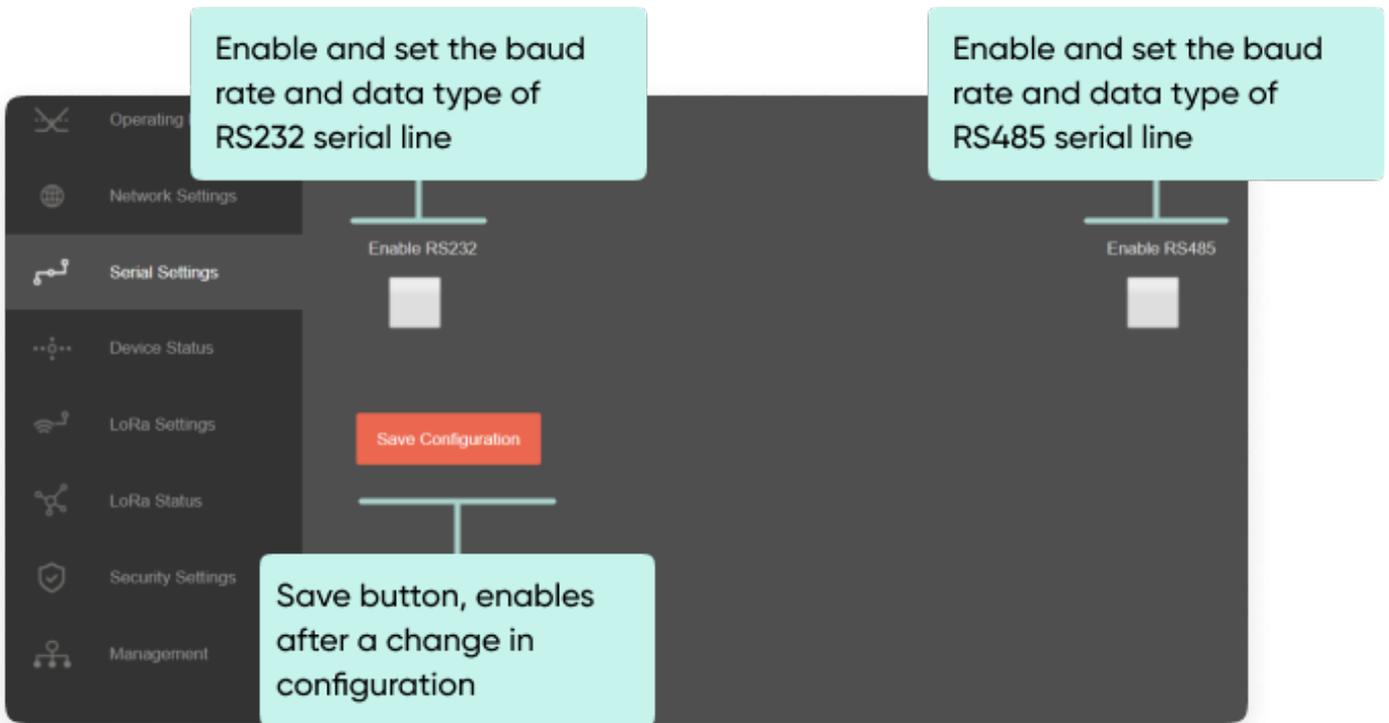
NOTE 3: If one of the Serial connections is enabled the device will act as Serial to LoRa RF Gateway and only following menu items will be available.



10.5 MENU: Serial Settings

From this menu user may activate RS232 or RS485 connection. Once serial connection enabled, the device will act as Serial to LoRa RF Gateway and TCP Server and Client options will be disabled. Yet again web interface with basic network settings will be accessible.

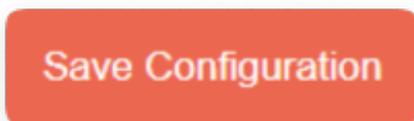
- User can select to activate RS232 line and can set baud rate and data type for serial line.
- User can select to activate RS485line and can set baud rate and data type for serial line.



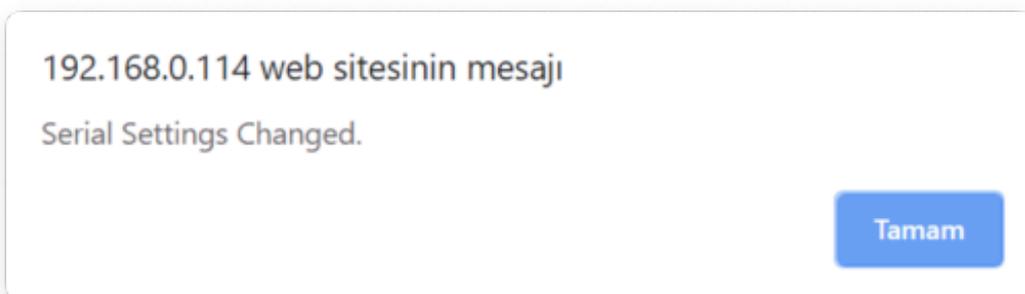
Following settings are available for serial line.



Once the setting has been changed, "Save Configuration" button will be enabled.



After clicking button system will tell if the settings applied successfully or not.





NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time. Lets say TCP Server enabled in Server operating mode and RS232 serial line enabled in Client operating mode on same device, the device can switch between to settings simply by changing the mode.



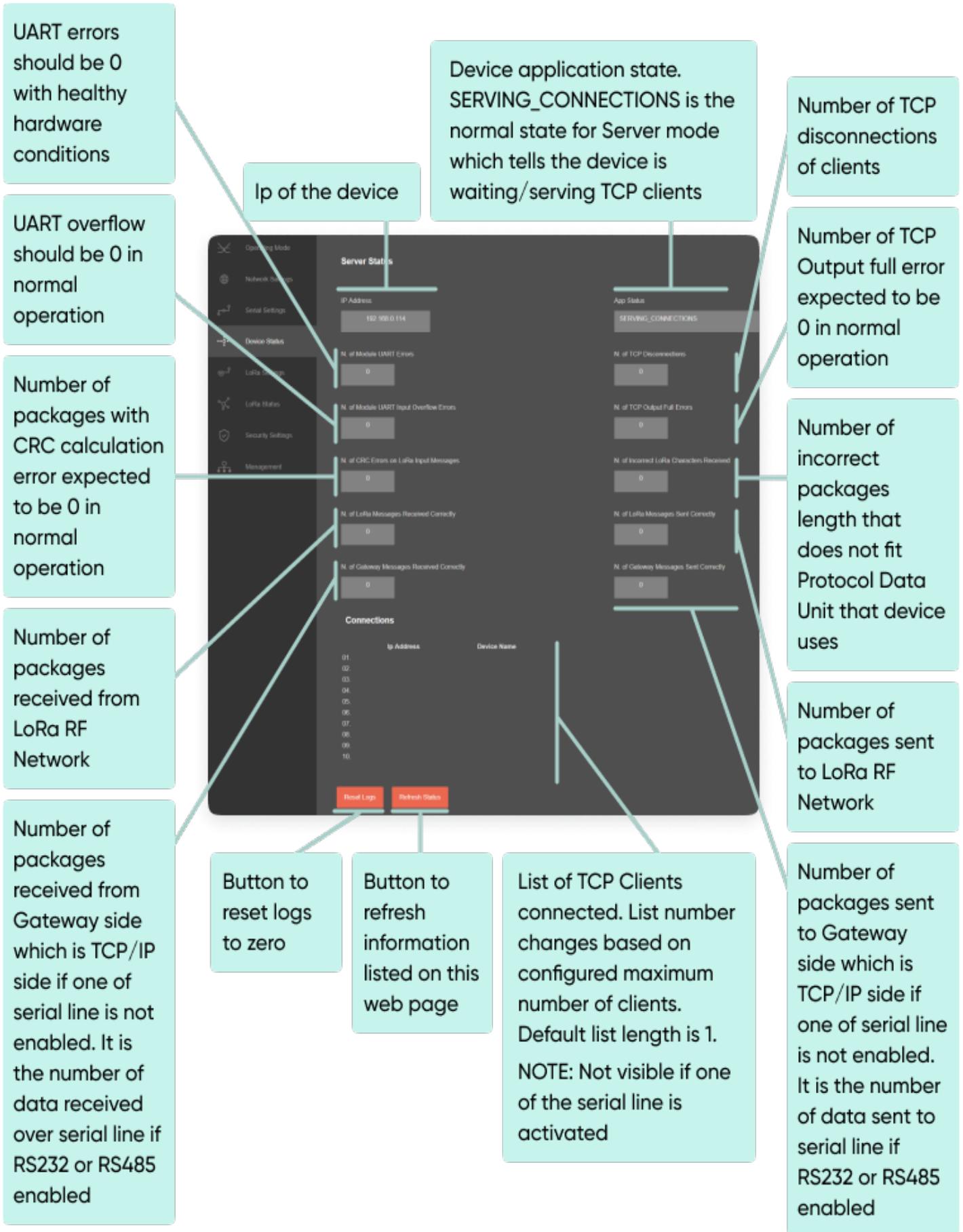
NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.



NOTE 3: This page has same settings both for Server and Client operating modes.

10.6 MENU: Device Status – Server

From this menu user may monitor device status and statistics based on operating mode of device. The page also helps users to check device health.



After clicking "Refresh Status" button, system will reload data only and will not reload page. Button will be disabled during reload for an instance. If timeout occurs during the reload, the button will be enabled again with

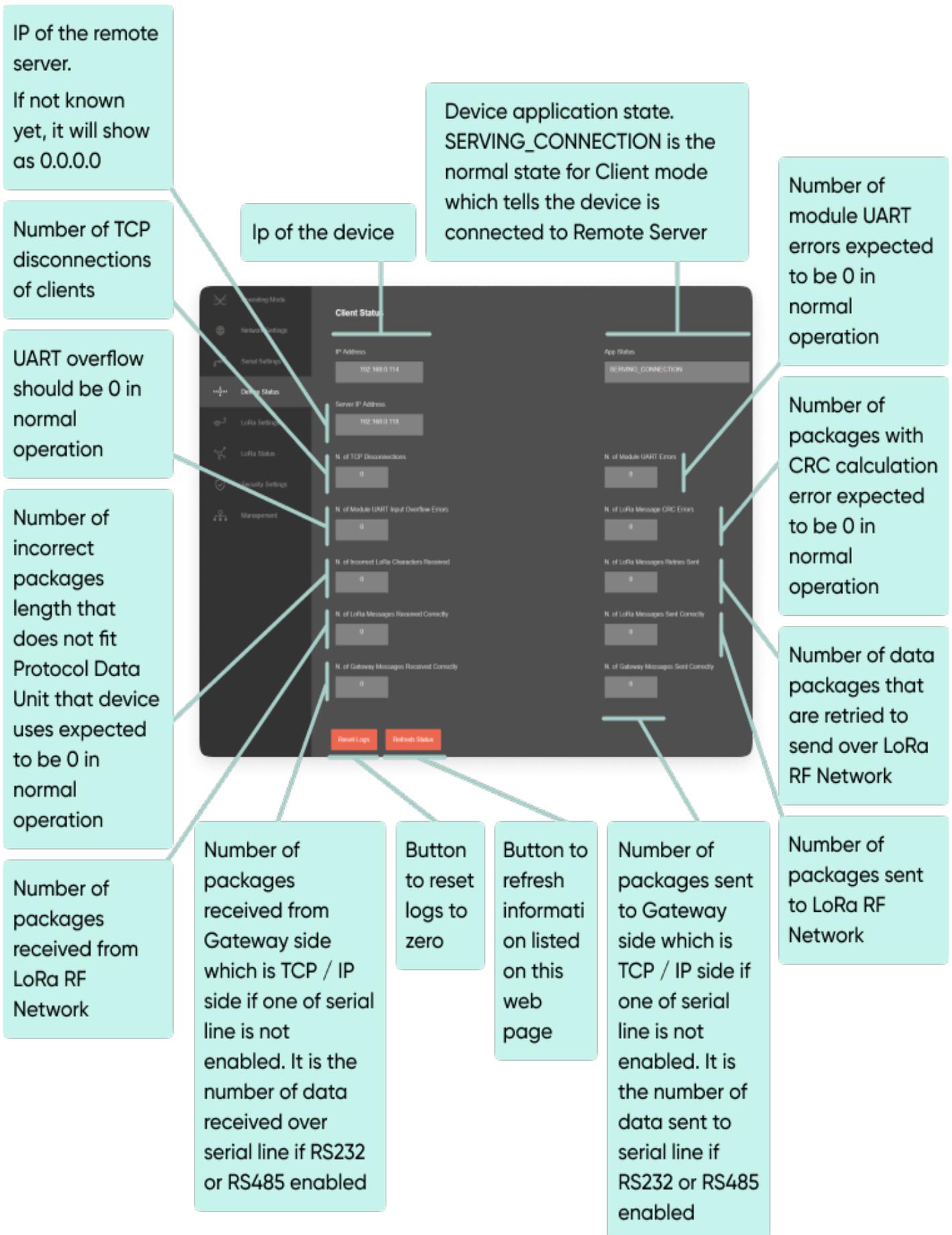
warning of timeout. In normal operation reload of status data will be done immediately



NOTE: Connected client list will not be visible if one of the serial line is activated and device is set to act as Serial to LoRa RF Gateway.

10.7 MENU: Device Status – Client

From this menu user may monitor device status and statistics based on operating mode of device. The page also helps users to check device health.



After clicking "Refresh Status" button, system will reload data only and will not reload page. Button will be disabled during reload for an instance. If timeout occurs during the reload, the button will be enabled again with warning of timeout. In normal operation reload of status data will be

done immediately.

10.8 MENU: LoRa Settings

From this menu user may change LoRa RF parameters.

- Group Address and Device Address can be changed for the device itself
- Tx Group Address and Tx Device Address is for the Tx Group. TLM can make link with only Tx Group Address and can send data to Tx Device Address in that Group

65535 which is 0xFFFF in Hexadecimal is broadcast address and can be used to send data to all devices in that group.

- LoRa Signal Bandwidth and spreading factor can be changed

TLM uses Semtech's LoRa proprietary spread spectrum modulation technique. This modulation, in contrast to conventional modulation techniques, permits an increase in link budget and increased immunity to in-band interference. It achieves sensitivities 8 dB better than FSK modulation.

LoRa also provides significant advantages in both blocking and selectivity, solving the traditional design compromise between range, interference immunity and energy consumption.

TLM offers three bandwidth options of 125 kHz, 250 kHz, and 500 kHz with spreading factors ranging from 7 to 12.

The spread spectrum LoRa modulation is performed by representing each bit of payload information by multiple chips of information. The rate at which the spread information is sent is referred to as the symbol rate (R_s), the ratio between the nominal symbol rate and chip rate is the spreading factor and represents the number of symbols sent per bit of information. The range of parameters which can be configured are given in the following tables.

Spreading Factor	Chips/Symbol	SNR/[dB]
7	128	-7,5
8	256	-10

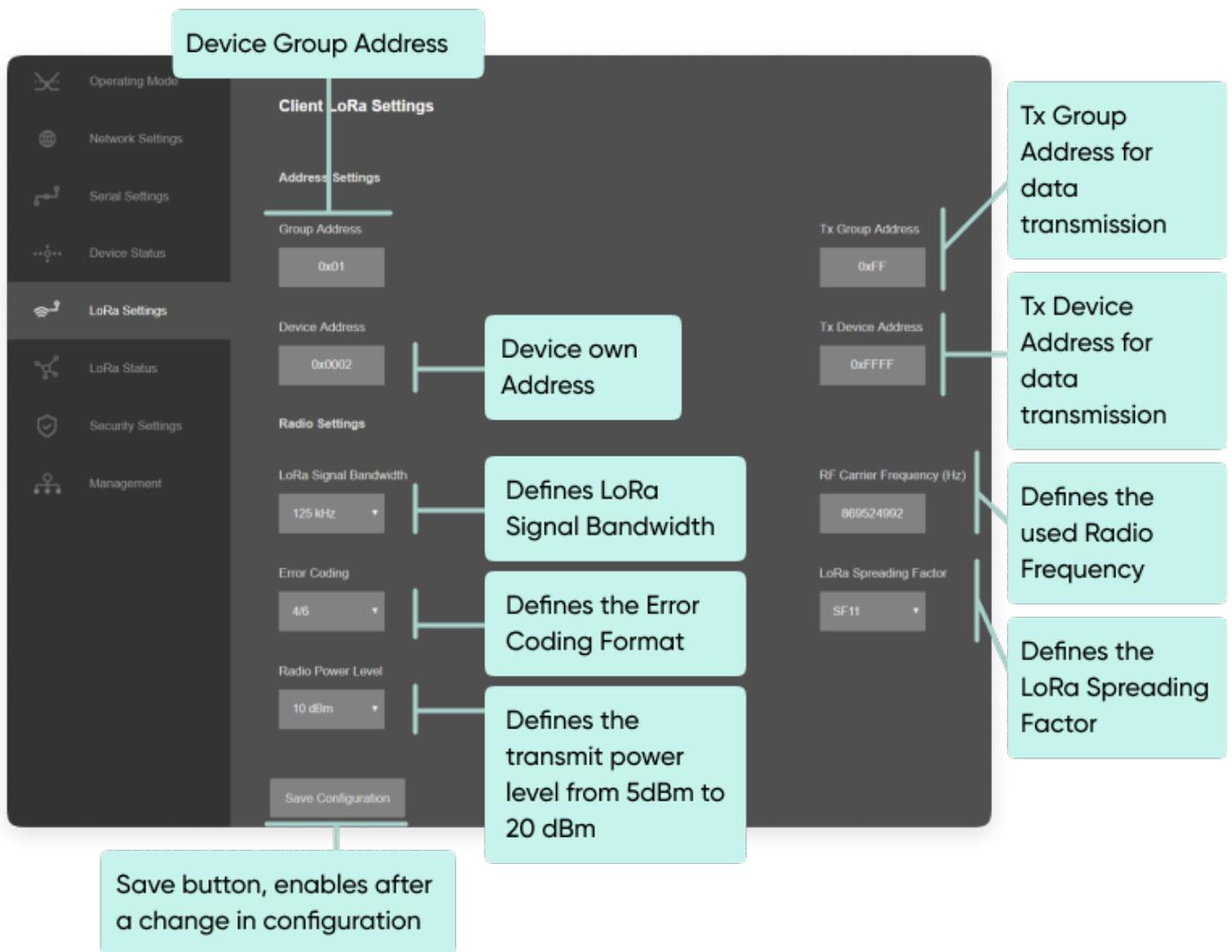
9	512	-12,5
10	1024	-15
11	2048	-17,5
12	4096	-20

Note that the spreading factor must be known in advance on both transmit and receive sides of the radio link as different spreading factors are orthogonal to each other. Note also the resulting signal to noise ratio (SNR) required at the receiver input. It is the capability to receive signals with negative SNR that increases the sensitivity, so link budget and range, of the LoRa receiver.

- LoRa error coding can be changed

To further improve the robustness of the radio link, TLM provides cyclic error coding with different coding rates. With using this coding scheme forward error detection and correction can be applied.

Coding Rate	Chips/Symbol	Overhead Ratio
1	4/5	1,25
2	4/6	1,5
3	4/7	1,75
4	4/8	2



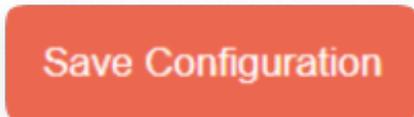
TLM uses Semtech's patented LoRa modulation technique which combines spread spectrum modulation and forward error correction techniques to increase the range and robustness of radio communication links compared with traditional FSK or OOK based modulation. Typically examples of TLM receive performances are given in the following table.

Signal Bandwidth/[kHz]	Spreading Factor	Sensitivity/[dBm]
125	7	-123
125	12	-138
250	7	-121
250	12	-135
500	7	-116
500	12	-130

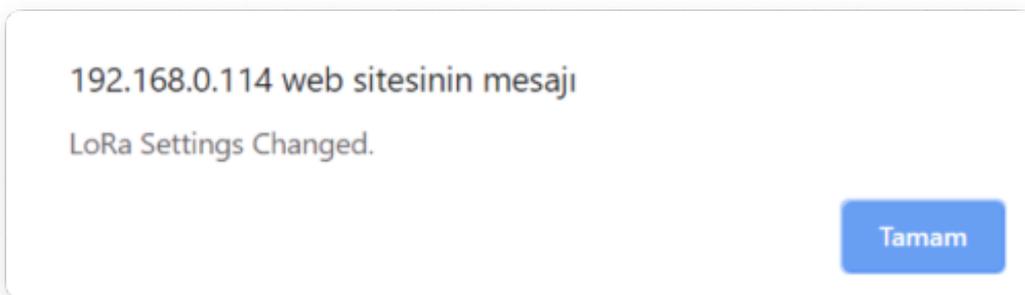
In this page user can enter decimal values and page will format it to hexadecimal automatically after cursor is moved out of scope.



Once the setting has been changed, "Save Configuration" button will be enabled.



After clicking button system will tell if the settings applied successfully or not.



NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time. This way different LoRa settings can be stored in 2 different operating modes.



NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.



NOTE 3: This page has same settings both for Server and Client operating modes

10.9 MENU: LoRa Status

From this menu user may monitor LoRa status and package details. Package from gateway side comes from either TCP/IP or RS232/RS485 serial line based on operating mode of device. The page also helps users to diagnose radio communication health.

Signal to noise ratio (dB) of last package received from LoRa side
 Typical LoRa SNR values are between: -20dB and +10dB
 A value closer to +10dB means the received signal is less corrupted
 LoRa can demodulate signals which are -7.5 dB to -20 dB below the noise floor

Serial Number of LoRa module used in TLM

Device Group Address

LoRa Module used in TLM

Device own Address

Date and time when last LoRa package received

Package length of last package received from LoRa side

Destination group address of last package received from LoRa side

Received Signal Strength Indicator [dBm] of last package received from LoRa side
 The value is between -30 and -120
 If RSSI=-30dBm: signal is strong.
 If RSSI=-120dBm: signal is weak

Destination device address of last package received from LoRa side



Button to refresh information listed on this web page

Data received visualization in ASCII and PDU in HEXADECIMAL format of last package received from Gateway side which is either TCP/IP or RS232/RS485 serial line based on operating mode of device

Data received visualization in ASCII and PDU in HEXADECIMAL format of last package received from LoRa side

After clicking "Refresh LoRa Status" button, system will reload data only and will not reload page. Button will be disabled during reload for an instance. If timeout occurs during the reload, the button will be enabled again with warning of timeout. In normal operation reload of status data

will be done immediately.

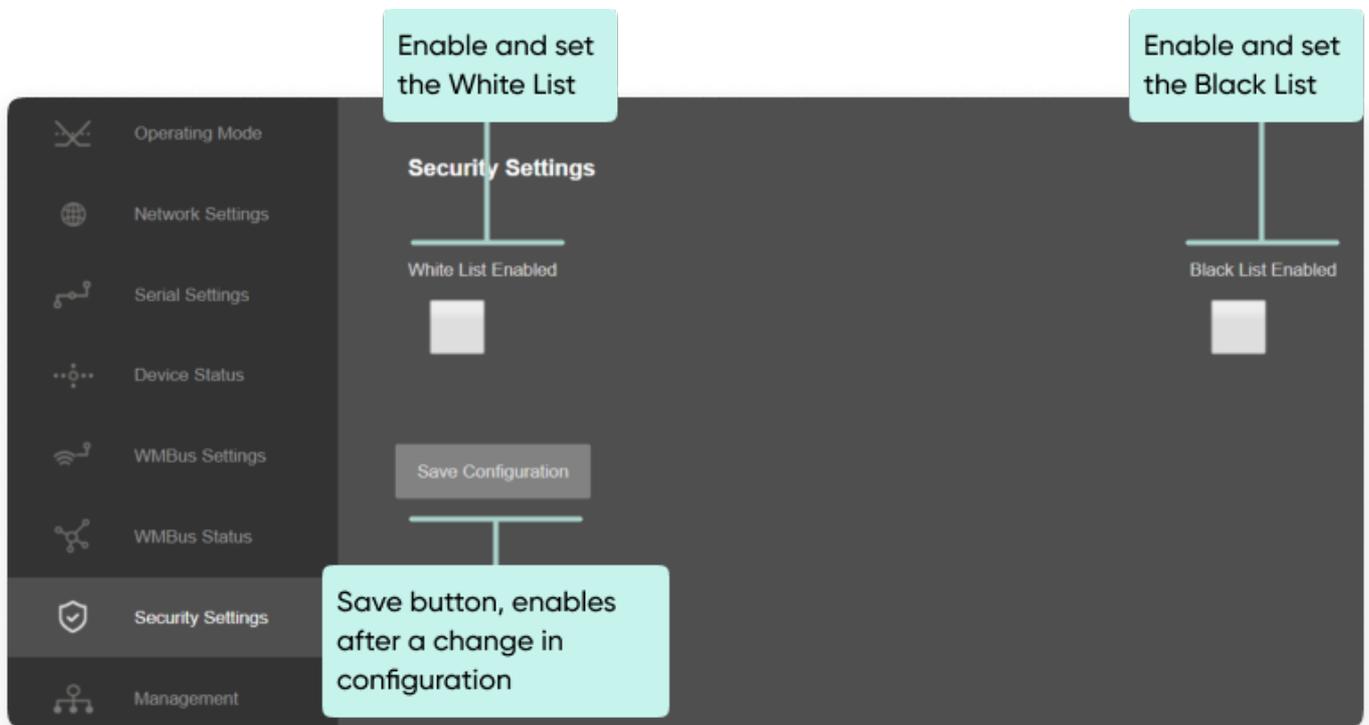


NOTE: This page has same options both for Server and Client operating modes.

10.10 MENU: Security Settings

From this menu user may activate LoRa RF communication package filter based on White list (accepted packages from Rx Address) or Black list (rejected packages from Rx Address).

- User can select to activate White List and TLM device will accept LoRa packages only from the devices with addresses stated in the list.
- User can select to activate Black List and TLM device will accept all LoRa packages except from the devices with addresses stated in the list.

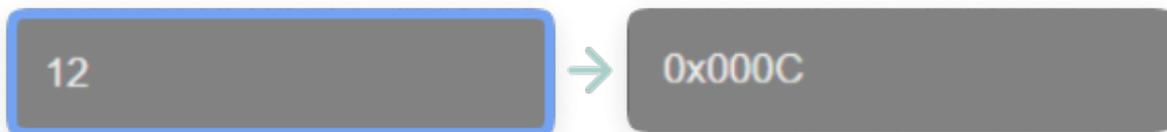


Following settings are available for any of the list.

White List Address Table

0x0000

In this page user can enter decimal values and page will format it to hexadecimal automatically after cursor is moved out of scope.

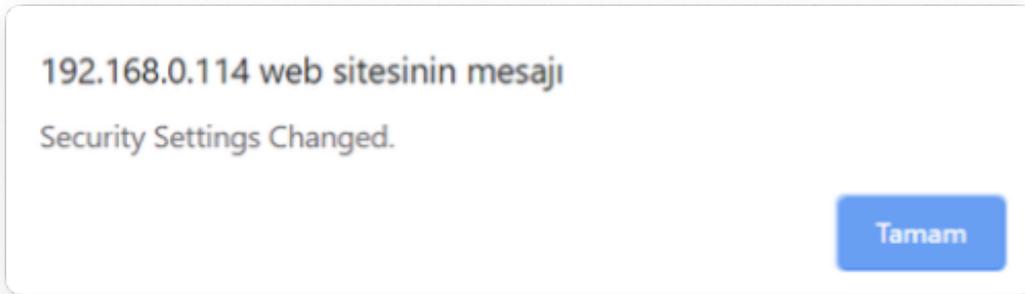


Once the setting has been changed, "Save Configuration" button will be enabled.

Save Configuration

After clicking button system will tell if the settings applied successfully or

not.



NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time. That means users can configure different configuration settings for different operating modes and switch between each other in an instant.



NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.



NOTE 3: This page has same settings both for Server and Client operating modes.

10.11 MENU: Management

From this menu user may change parameters or send command to device

- User can change system time. There is no battery inside the device so clock will be lost after a power down and will set to default.

The device restarts itself every 86400 seconds (which means every 24 hours). There are also timeout restart routines in Server mode during listening clients and in Client Mode trying to connect to the server. (both preset to 10 minutes which means device will restart system if fails to connect a server in Client mode or a client do not connect in preset time in Server mode)

- User can change firmware of device. REDZ TLM LoRa Based RF Gateways has easy to use firmware capability and system can store 2 firmware at memory. After a firmware change, user can restore back old firmware anytime needed.

After a firmware change old configuration will be used for minor changes. If a major change occurs system will restore to factory default configuration.

- User can change the login information.
- User can change the debug level of the device. REDZ TLM LoRa Based RF Gateways series has micro USB and gives log in 115200 - 8N1 format.

Any terminal program can be used to listen the LOG over micro USB port of the device which is recognized as Virtual COM port in PC.

- User can restore to factory settings and force device to reboot. Factory settings restored for Client if the device in Client mode and factory settings are restored for Server if the device in Server mode.

System shows date and time at load time of the page.
Reload page to see updated time.

Current local time shows the PC time. User can set the
TLM date and time based on shown PC time.

The device sets the date and time and reboots.

Select firmware
file and click
upload button.
Page will show
information that
firmware is
loaded.

Then firmware
date and
version can be
seen and that
firmware can be
rebooted

System will store
previous
firmware used
and can be
restored back
at any time

Change system
login
information

Select LOG
level
DEBUG will
show all
available log
and NONE will
close LOG

The screenshot shows a web interface for device management. On the left is a sidebar menu with items: Operating Mode, Network Settings, Serial Settings, Device Status, LoRa Settings, LoRa Status, Security Settings, and Management. The main content area is titled 'Management' and contains several sections: 'Set Device Time' with fields for 'Time At Start' (26-07-2019 14:45:55) and 'Current Local Time' (26-07-2019 15:20:53), and a 'Set Device Time and Reboot' button; 'Live Firmware Update' with a 'Select Firmware File' button, an 'Upload Firmware' button, and a 'Reboot Alternative Firmware' button; 'Change Password' with fields for 'Current Password', 'New Password', and 'Confirm New Password', and a 'Change Password' button; and 'LOG' with a 'Log Level' dropdown menu (set to 'DEBUG') and a 'Change Log Level' button. At the bottom are two buttons: 'Restore Factory Configuration' and 'Reboot Device'. Callout boxes with lines pointing to these sections provide detailed instructions for each function.

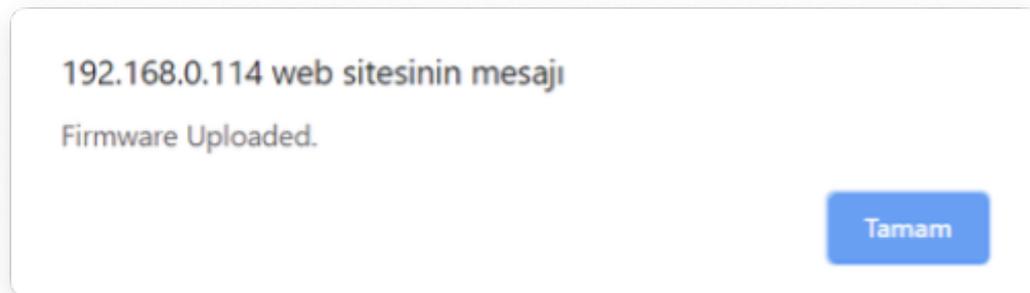
Reset device to factory settings
and force to reboot. Factory
settings restored for Client if the
device in Client mode and factory
settings are restored for Server if
the device in Server mode

Force device to reboot

Firmware upgrade is possible only with files that REDZ supplied. Once the file selected, TLM shows selected file:



Then "Upload Firmware" button must be clicked. Then user must wait until page shows the result:



This make take few seconds only. Please wait .

Then system will show the firmware date and version and user can reboot that firmware.



Typical log for the system is shown below:

The screenshot shows a terminal window with a black background and yellow text. The logs display the following information:

```
[00-00-2000 00:00:00][ INFO]TCP stack ready.Wait for NET ready\r\n[00-00-2000 00:00:00][ INFO]Will continue with module query\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Get device info OK\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Get Firmware info OK\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Firmware Name:\r\n[00-00-2000 00:00:00][ INFO]26.06.2017WiMOD_Lr_Base\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Firmware Version:\r\n[00-00-2000 00:00:00][ INFO]1.14\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Firmware Build Count:95\r\n[00-00-2000 00:00:00][ DEBUG]LORA Module:Will send RTC Request\r\n[00-00-2000 00:00:00][ INFO]LORA Module:Get device time ok\r\n[00-00-2048 00:00:00][ INFO]Go to OPENING_UDP_SOCKET\r\n[00-00-2048 00:00:00][ INFO]Go to Serving connection.
```

Below the terminal is a configuration panel with the following settings:

- Baud: 115200
- Port: 2
- Open: Spy: Change:
- Parity: None, Odd, Even, Mark, Space
- Data Bits: 8 bits, 7 bits, 6 bits, 5 bits
- Stop Bits: 1 bit, 2 bits
- Hardware Flow Control: None, RTS/CTS, DTR/DSR, RS485-rts
- Software Flow Control: Receive Xon Char: 17, Transmit Xoff Char: 19
- Winsock is: Raw, Telnet
- Status: Connected, RXD (2), TXD (3), CTS (8), DCD (1), DSR (6), Ring (9), BREAK, Error

At the bottom, there is a status bar with the text: "You can use ActiveX automation to control me!" Char Count:1586 CPS:0 Port: 2 115200 8N1 Non



NOTE: This page has same settings both for Server and Client operating modes.

11. Ordering Information

TLM154: 868MHz LoRa based gateway, 2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-60V DC Power Input

TLM254: 868MHz LoRa based gateway, 2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 90 - 265V AC (100 - 370V DC), 47Hz to 63Hz AC Power Input

TLM655: 868MHz LoRa based gateway, 2x 10/100 T(x) ETH ports + 1 x BPL (Broadband Power Line) Link, 1 x RS232 & 1 x RS485, 3 Phase AC Power Input, 110V-240V/50-60Hz

12. Product Selection

Model	5-60V DC Power Input	90 - 265V AC (100 - 370V DC), 47Hz to 63Hz AC Power Input	3 Phase AC Power input, 110V-240V/50-60Hz AC Power Input	2 x 10/100 T(x) ETH Ports	1 x RS232 and 1 x RS485 Serial Ports	Instant Switch to Client or Server Operating Modes with Button	BPL (Broadband Power Line) Link
TLM154	X			X	X	X	
TLM254		X		X	X	X	
TLM655			X	X	X	X	X