

TLM Series LoRa Radio Modems 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 RF Modems



TLM Series LoRa Radio Modems are designed for industrial-grade Radio Frequency (RF) communication and particularly for facilities of rugged industry and infrastructure. TLM Series LoRa Radio Modems are tailored to perform various features such as wide temperature range, wide power input range and several connectivity ports. Thus, TLM Series LoRa Radio Modems 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 LoRa Radio Modems 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 Radio Modems 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
- DHCP Server Capability
- Supports 1 x RS232 and 1 x RS485 Serial Connection up to 460800 Baud
- Embedded web interface for ease of use
- Up to 10 client connection in Server Mode
- 2 different Gateway Operating Modes:
 - Transparent Communication - TCP to TCP, TCP to Serial, Serial to Serial
 - Modbus TCP to RTU Conversion
- Creates Radio Network:
 - Point to point
 - Point to multi point - Broadcast
 - Point to multi point - TCP Socket to target address mapping based data transfer
- 868MHz or 2.4GHz LoRa based Radio Frequency (RF) Communication
- 128 bit AES Encryption and Decryption on over the air communication
- 868MHz Version:
 - LoRa Signal Bandwidth Configurable: 125, 250, 500 kHz
 - LoRa Radio Power Configurable between 5dBm (~3mW) to 20dBm (100mW)
 - LoRa or FSK Selectable Modulation Options
- 2.4GHz Version:

LoRa Signal Bandwidth Configurable: 200, 400, 800, 1600 kHz

LoRa Radio Power Configurable between -18dBm (~0,02mW) to 13dBm (~20mW)

LoRa or FLRC Selectable Modulation Options

- LoRa Rx Group Address and Device Address Configurable
- LoRa Tx Group Address and Device Address Configurable
- Easy to follow LoRa data packages on web interface
- Easy to follow Device Status 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.

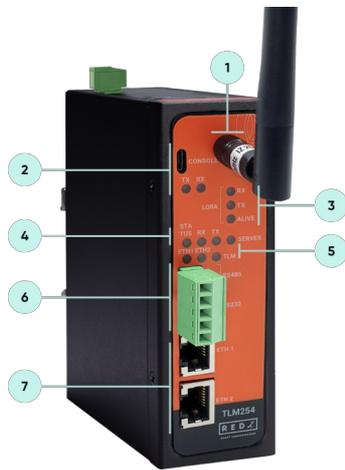


Then Push the switch toward the Din-Rail until you heard a "click" sound.



4. Front Panel Description

4.1 TLM154 & TLM254 & TLM194 & TLM294



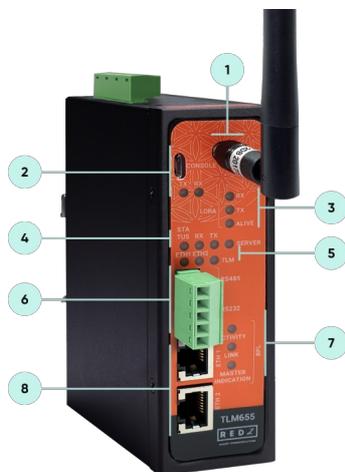
1. Standard SMA Antenna interface, 50 ohm, female for TLM154 and TLM254 and male for TLM194 and 294



NOTE: TLM194 and TLM294 2.4GHz version has SMA Male Antenna

2. Micro USB or USB Type-C 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 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 & TLM695



1. Standard SMA Antenna interface, 50 ohm, female for TLM655 and male for TLM695

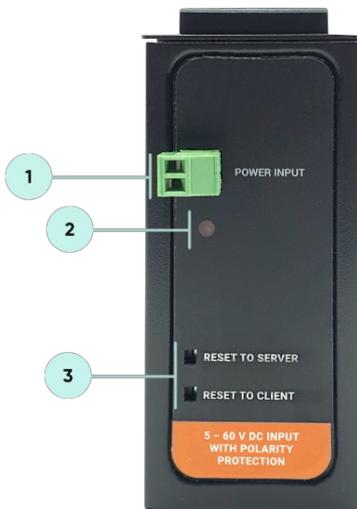


NOTE: TLM695 2.4GHz version has SMA Male Antenna

2. Micro USB or USB Type-C 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 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

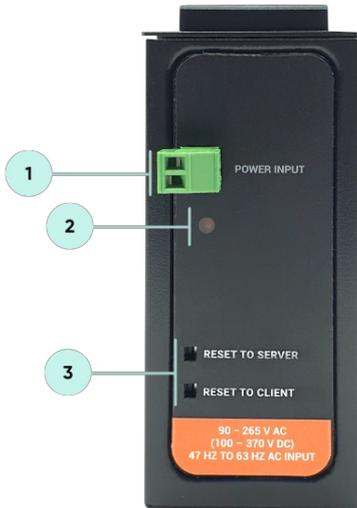
5. Top Panel Description

5.1 TLM154 & TLM194



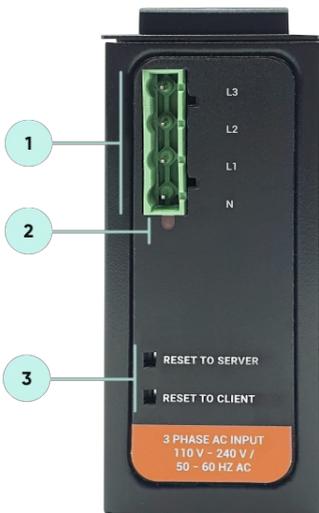
1. Power Input DC: 5-48V DC (max. 60V). Polarity protected so that the power input can be connected in any direction
2. Power LED: Turns ON when there is power in device
3. Reset Buttons
RESET TO SERVER: Resets the device to factory setting as Server from Server-Client Operating Modes
RESET TO CLIENT: Resets the device to factory setting as Client from Server-Client Operating Modes
Reset can be done at any time by pushing any of the button for 5 seconds.

5.2 TLM254 & TLM294



1. Power Input AC: 100 – 240V AC (120 – 370V DC), 50Hz to 60Hz 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 Server-Client Operating Modes
 RESET TO CLIENT: Resets the device to factory setting as Client from Server-Client Operating Modes
 Reset can be done at any time by pushing any of the button for 5 seconds.

5.3 TLM655 & TLM695



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 Server-Client Operating Modes
 RESET TO CLIENT: Resets the device to factory setting as Client from Server-Client Operating Modes
 Reset can be done at any time by pushing any of the button for 5 seconds.



NOTE1: BPL Model can be purchased in 2 versions:

1. P-N Model: Phase to neutral model (Standart Model). That version gets power from terminal pins 1 and 2 from phase and neutral. It can also transmit

data from that pins and other pins usage is optional (Ex: Master can be connected to all phases and slaves can be connected to relevant phases)

2. P-P Model: Phase to phase model. That version also gets power from terminal pins 1 and 2 from phase and neutral. Data transmission only done through terminal pins 3 and 4. Phase to phase connection can be done to data transmission pins for better performance.

If not used then phase and neutral can still be connected for data transmission for terminal pins 3 and 4.



NOTE2: BPL Model can be purchased in DC model as well:

This model will be same as "P-P Model"(Phase to phase model) on data connection and gets **12V DC power** from terminal pins 1 and 2. Data transmission only done through terminal pins 3 and 4.

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



NOTE1: BPL Model can be purchased in 2 versions:

1. P-N Model: Phase to neutral model (Standard Model). That version gets power from terminal pins 1 and 2 from phase and neutral. It can also transmit data from that pins and other pins usage is optional (Ex: Master can be connected to all phases and slaves can be connected to relevant phases)

2. P-P Model: Phase to phase model. That version also gets power from terminal pins 1 and 2 from phase and neutral. Data transmission only done

through terminal pins 3 and 4. Phase to phase connection can be done to data transmission pins for better performance.
If not used then phase and neutral can still be connected for data transmission for terminal pins 3 and 4.



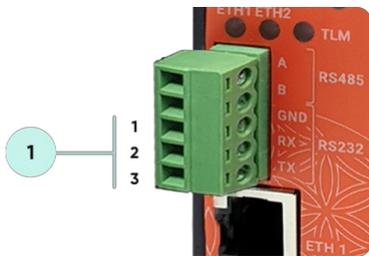
NOTE2: BPL Model can be purchased in DC model as well:

This model will be same as "P-P Model"(Phase to phase model) on data connection and gets 12V DC power from terminal pins 1 and 2. Data transmission only done through terminal pins 3 and 4.

8. Serial Cables

TLM Series LoRa Based RF Gateways have 1 x RS232 and 1 x RS485 port. Serial line can be connected other serial devices such as RTUs, PLCs, energy meters or any other field device.

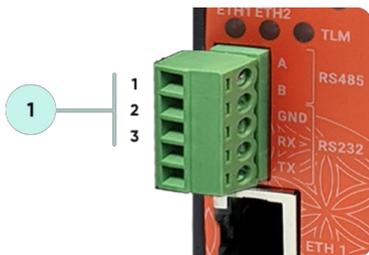
8.1 RS232 Cable Pin Assignments



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)

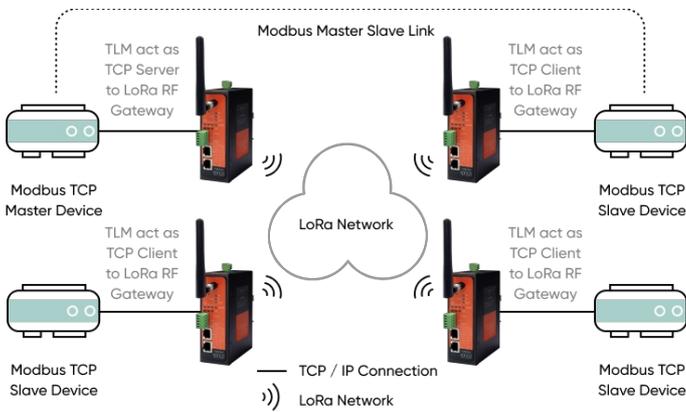
Pin Number	Description
1	A
2	B
3	GND (Suggested to use)

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.

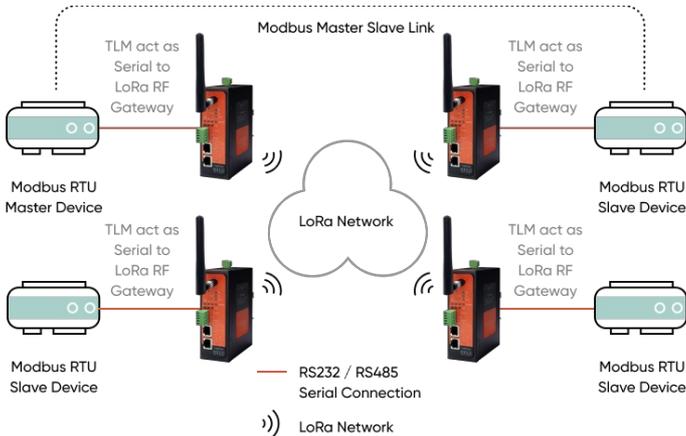


TLM act as TCP Server to LoRa RF Gateway configured as Server Mode, Local ETH client device is connected to TLM Server (User must enter TLM IP and NON TLM port in local device). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group Address + 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.

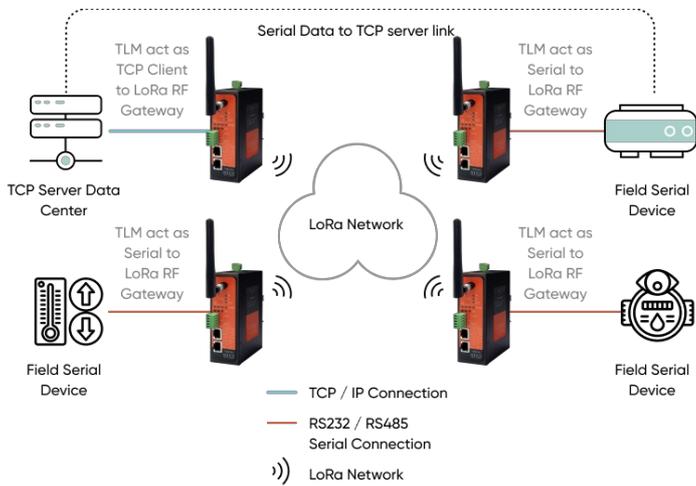


TLM act as Serial to LoRa RF Gateway configured as Client Mode (Client mode suggested to use in serial communication since TCP server capabilities will not be used), Serial communication is enabled and settings are done based on field device. LoRa communication configuration must be same along the Lora 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.

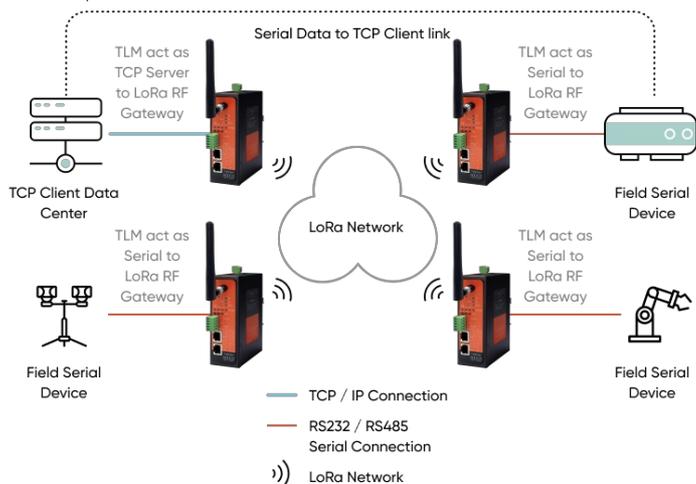


TLM act as TCP Client to LoRa RF Gateway configured as Client Mode, Remote TCP Server Data Center IP and port must be configured in TLM device so that TLM can connect. LoRa communication configuration must be same along the LoRa network. TLM will expect LoRa packages from configured Group Address + Device 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.

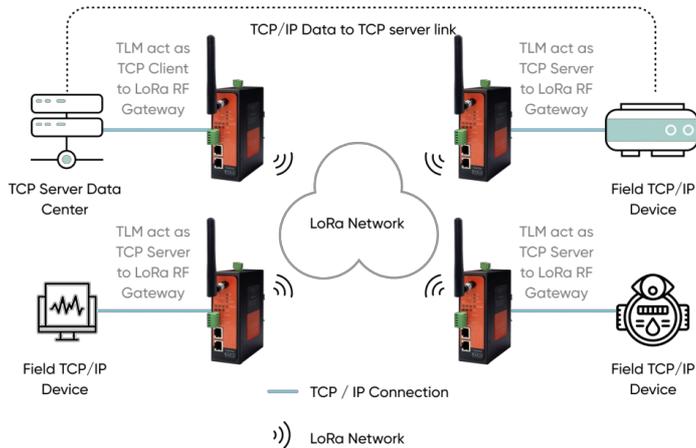


TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Remote TCP Client Data Center is connected to TLM Server (User must enter TLM IP and NON TLM port in data center). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group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

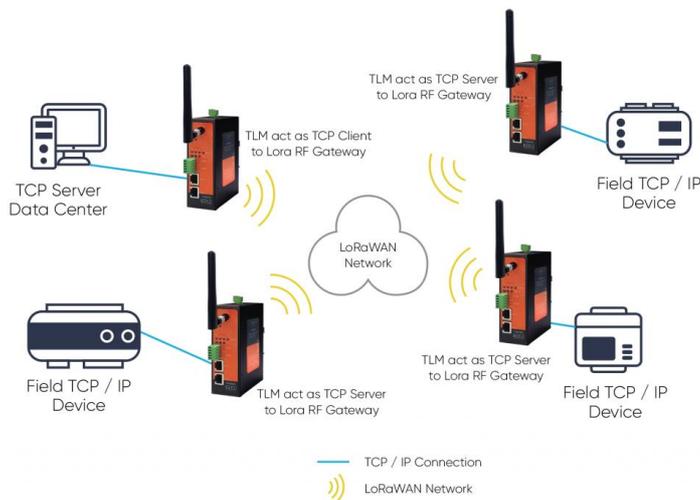


TLM act as TCP Client to LoRa RF Gateway configured as Client Mode. Remote TCP Server Data Center IP and port must be configured in TLM device so that TLM can connect. LoRa communication configuration must be same along the LoRa network. TLM will expect LoRa packages from configured Group Address + Device 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 TCP/IP 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.

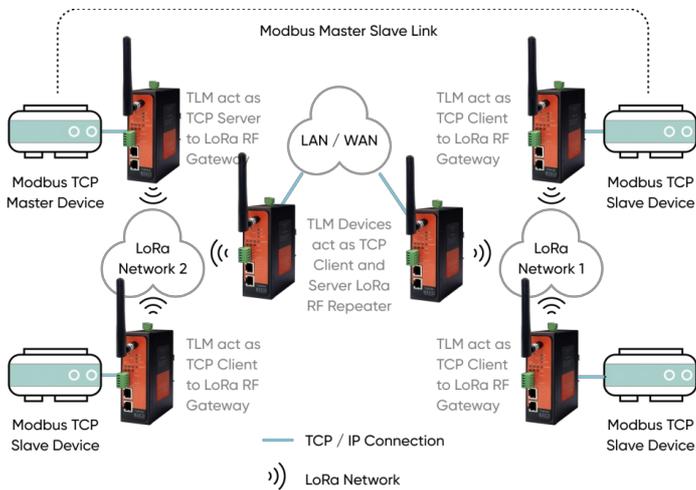


TLM act as TCP Server to LoRa RF Gateway configured as Server Mode. Remote TCP Client Data Center is connected to TLM Server (User must enter TLM IP and NON TLM port in data center). LoRa communication configuration must be same along the LoRa network. TLM will send LoRa packages to configured Tx Group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

9.8 TCP IP Communication over RF Network – Based on Socket to Target Device Mapping List

TLM Series LoRa Based RF Gateways can link TCP/IP devices and create a Radio network. In standart usage point to multipoint connection uses broadcasting the data and receiveing the response only to master TLM device. This needs an address based protocol running on Radio network. However if TCP Socket to Target Remote Device List is activated, Master TLM can send all data from specified socket to specified target device.

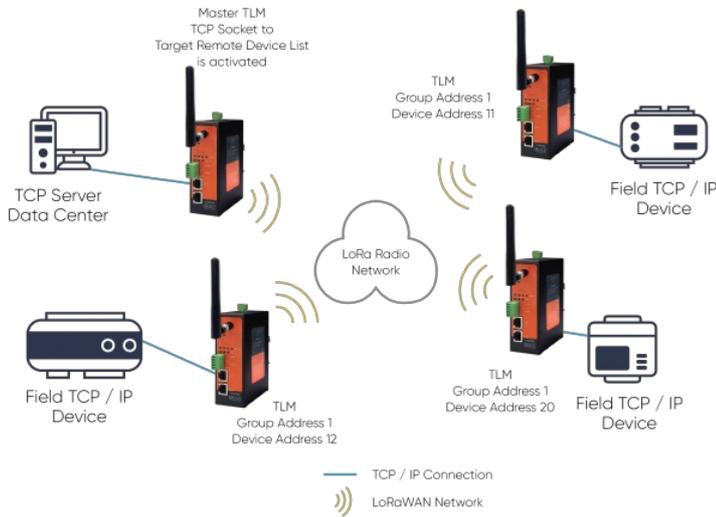
Master TLM is set to TCP Server Mode and (probably) transparent Operation Mode is selected since the protocol planned to be used has no address based control (Modbus has address based control). User then can list the mapping as follows

Enable TCP Socket to Target Device Matching List

TCP Socket to Target Remote Device List

	TCP Port	Target Group Address	Target Device Address
01.	5001	1	11
02.	5002	1	12
03.	5003	1	13
04.	5004	1	14
05.	5005	1	15
06.	5006	1	16
07.	5007	1	17
08.	5008	1	18
09.	5009	1	19
10.	5010	1	20

Then if an application connect TLM from socket 5001, all data received will be sent to TLM with Group Address 1 and Device Address 11. In same manner if an application connect TLM from socket 5010, all data received will be sent to TLM with Group Address 1 and Device Address 20. User can change the Group Addresses and Device Addresses or TCP Sockets freely.

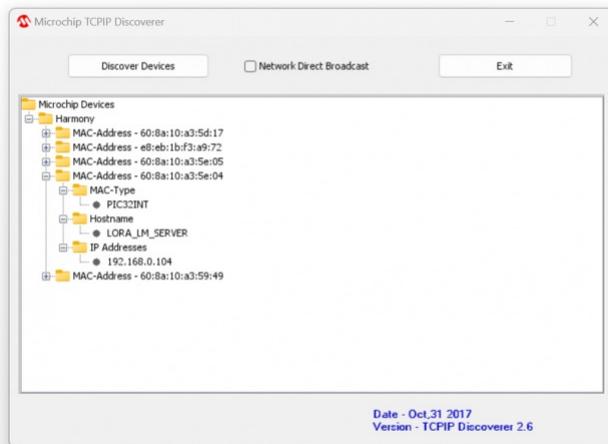


10. Configuration via WEB Interface

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**

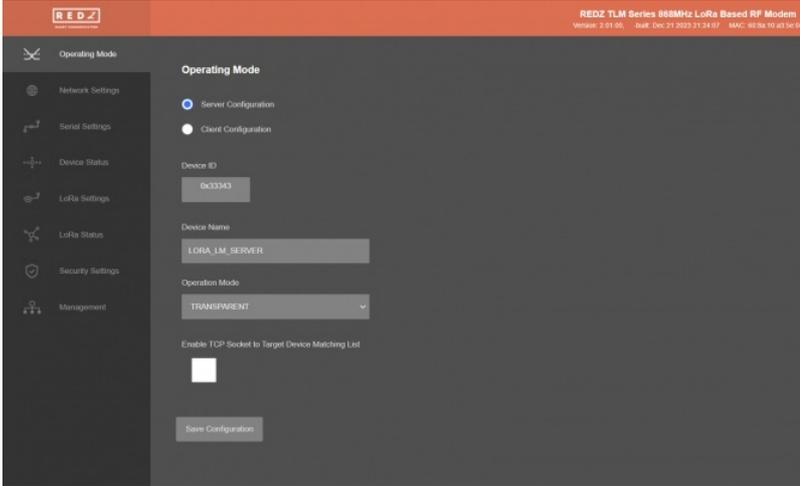
Oturum açın

http://192.168.0.104
Bu siteye bağlantınız gizli değil

Kullanıcı adı:

Şifre:

Main screen of device will appear with following information:



Firmware Info, MAC details and Device Name on top

Menu Items on left

Menu Item details in center

10.2 MENU: Operating Mode

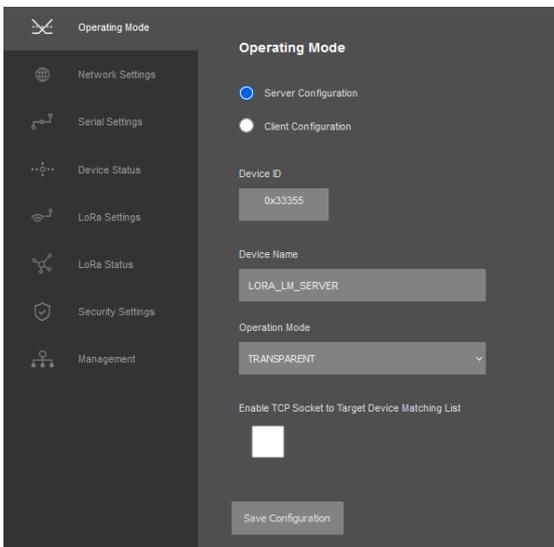
From this menu user may select the operating mode of the device.

There are 2 different Gateway Operating Modes:

- Transparent Communication - TCP to TCP, TCP to Serial, Serial to Serial
Modbus TCP to RTU Conversion

TLM can create following networks:

- Point to point
Point to multi point - by Broadcasting the data from Master TLM to Slave TLMs
Point to multi point - TCP Socket to target address mapping based data transfer from Master to Slave TLMs
- 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 ID" field is the unique Device ID of TLM device itself, based on LoRa Module serial number.

"Device Name" field is used to identify device.

"Operation Mode" field is used to select device behaviour. If "TRANSPARENT" selected, then all data received from LoRa side will be sent to Gateway side (TCP or Serial based on user settings) as it is.

If "Modbus TCP to RTU" is selected, then all data received from LoRa side will be sent to Serial side by converting Modbus TCP package to Modbus RTU format. It is not available if serial side is NOT enabled and can only be used for Modbus protocol

"Enable TCP Socket to Target Device Matching List" is used for enabling or disabling TCP socket to Remote Target Device list. TLM Series LoRa Based RF Gateways can link TCP/IP devices and create a Radio network. In standard usage point to multipoint connection uses broadcasting the data and receiving the response only to master TLM device. This needs an address based protocol running on Radio network. However if TCP Socket to Target Remote Device List is activated, Master TLM can send all data from specified socket to specified target device.

Master TLM is set to TCP Server Mode and transparent Operation Mode is selected since the protocol planned to be used has no address based control (Modbus has address based control). User then can list the mapping as follows:

Enable TCP Socket to Target Device Matching List



TCP Socket to Target Remote Device List

	TCP Port	Target Group Address	Target Device Address
01.	5001	1	11
02.	5002	1	12
03.	5003	1	13
04.	5004	1	14
05.	5005	1	15
06.	5006	1	16
07.	5007	1	17
08.	5008	1	18
09.	5009	1	19
10.	5010	1	20

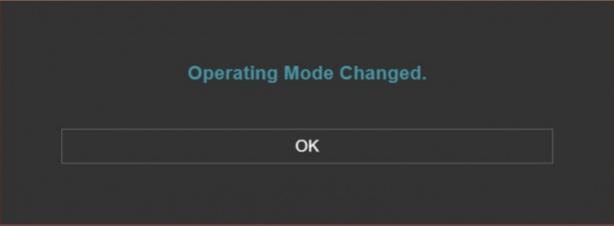
Then if an application connect TLM from socket 5001, all data received will be sent to TLM with Group Address 1 and Device Address 11. In same manner if an application connect TLM from socket 5010, all data received will be sent to TLM with Group Address 1 and Device Address 20. User can change the Group Addresses and Device Addresses or TCP Sockets freely.

When all settings done, click "Save Configuration" to save settings.



Save Configuration

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



Operating Mode Changed.

OK



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.

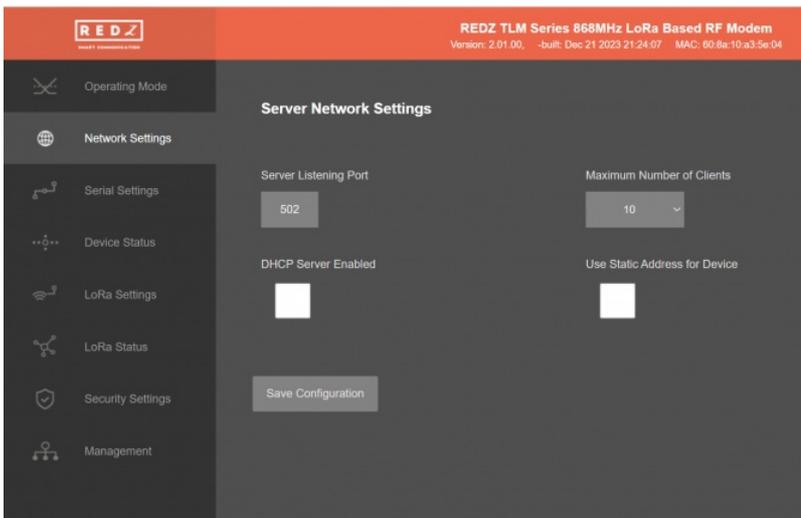


NOTE 2: Settings will be applied once the device is rebooted from web interface or repowered manually.

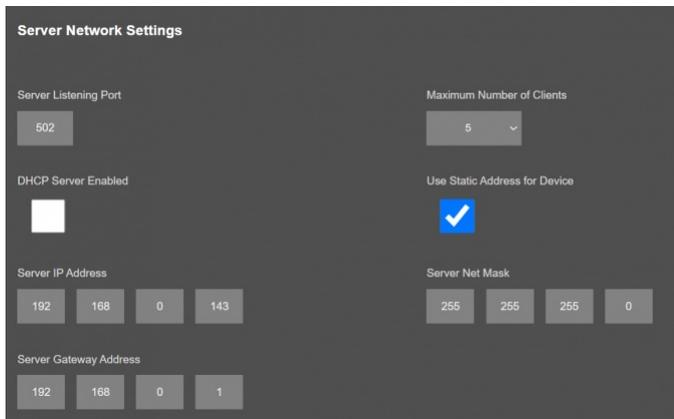
10.3 MENU: Network Settings – Server

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

- User can change TCP Listening port for field devices.
- User can 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 "Server Network Settings" part.



"Listening Port": TCP Port that TLM uses for incoming connections. Remote devices can use TLM IP and this port to connect to TLM for Radio communication.

"Maximum Number of Clients": Maximum numbers of incoming connections accepted. TLM can accept up to 10 simultaneous connection and all devices can send TCP data to Radio network.

"Use Static Address for Device": Set a static TCP IP for TLM from this part. Enable and enter network settings and TLM will be available to connect from this static IP locally or remotely (gateway must be set properly for remote WAN connection).

Following parameters available if "DHCP Server" setting is enabled. This is used if DHCP server is needed in network. TLM can distribute IP to field devices

connected to it in this way.

DHCP Server Enabled

Use Static Address for Device

Server IP Address: 192 168 1 1

Server Net Mask: 255 255 255 0

Server Gateway Address: 192 168 1 1

DHCP Server Primary DNS Address: 192 168 1 1

DHCP Server Range Start Address: 192 168 1 100

DHCP Server Secondary DNS Address: 192 168 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.

BPL Operating Mode

NODE

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.

Save Configuration

Network Settings Changed.

OK



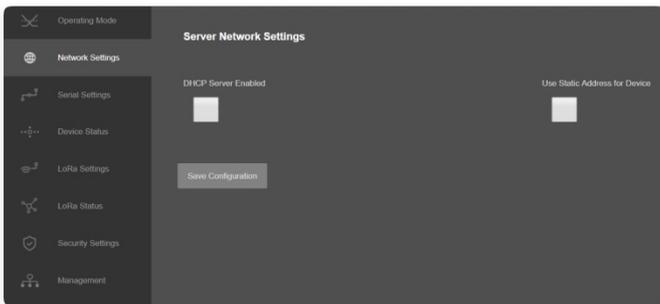
NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time.



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



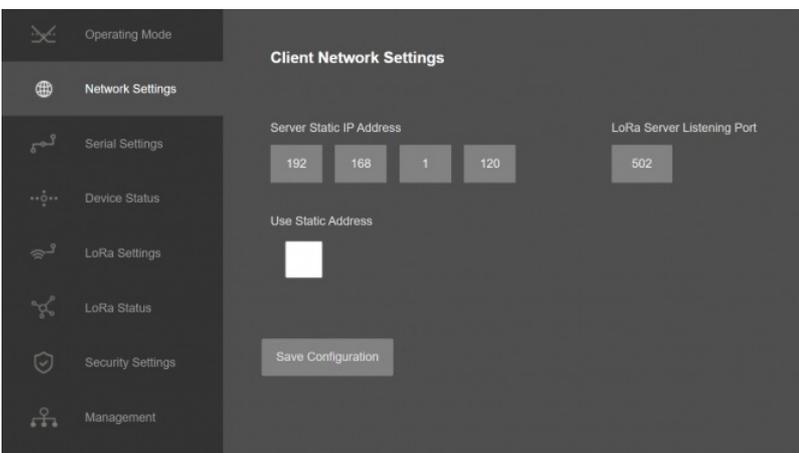
NOTE 3: If one of the Serial connections is enabled the device will act as Serial to LoRa RF Gateway and only following menu items will be available on this menu.



10.4 MENU: Network Settings – Client

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

- User can change TCP IP address of Remote TCP Server that TLM will connect.
- User can change TCP Port of Remote TCP Server that TLM will connect.
- User can force device to a static IP.



"Server Static Ip Address": Remote TCP IP adress that TLM will try to connect automatically.

"Listening Port": Remote TCP Port that TLM will try to connect automatically.

"Use Static Address": Set a static TCP IP for TLM from this part. Enable and enter network settings and TLM will be available to connect from this static IP locally or remotely (gateway must be set properly for remote WAN connection).

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

Use Static Address

Client IP Address

192	168	1	100
-----	-----	---	-----

Client Net Mask

255	255	255	0
-----	-----	-----	---

Client Gateway Address

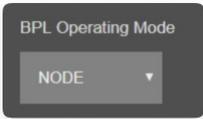
192	168	1	1
-----	-----	---	---

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

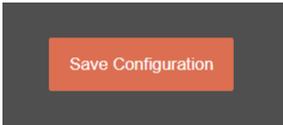
■ User can select operating mode of BPL either MASTER or NODE.



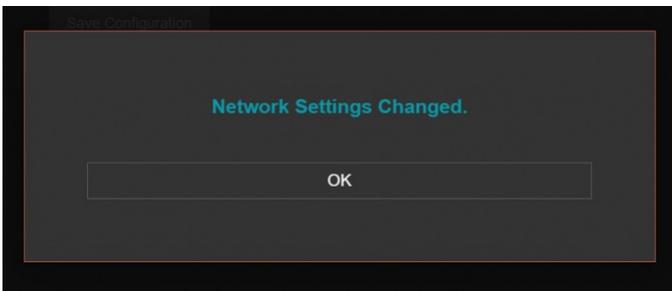
NOTE: Standard firmware of REDZ BPL supports up to 10 hops and 1000 nodes. Only 1 device can be MASTER in same network. If the device is in client mode, it is suggested to use "NODE" as setting.



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.





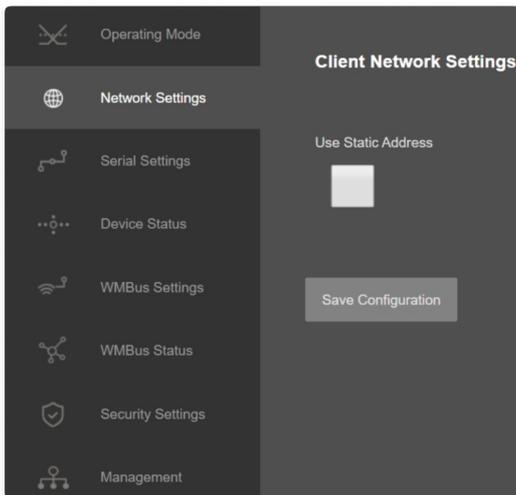
NOTE 1: TLM Series LoRa Based RF Gateways can keep configuration of 2 different modes in its memory and once the configuration enabled, its already saved settings will be applied. Device can act as Server or Client at a time.



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



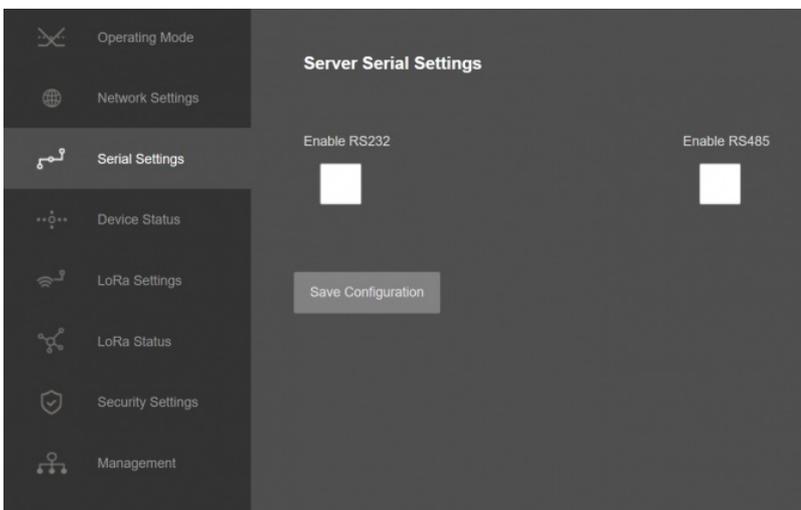
NOTE 3: If one of the Serial connections is enabled the device will act as Serial to LoRa RF Gateway and only following menu items will be available on this menu.



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 RS485 line and can set baud rate and data type for serial line.



Following settings are available for serial line.

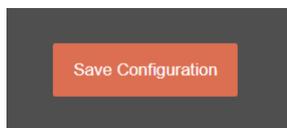


"Baud rate": Serial communication baud rate selection.

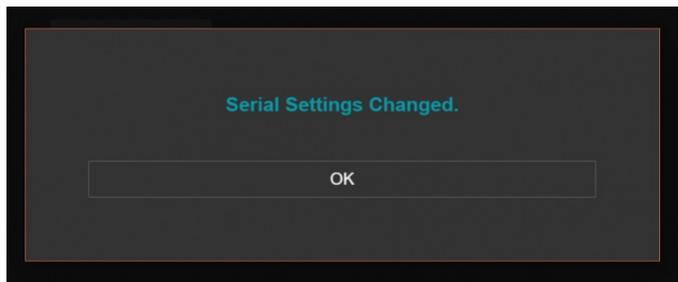
"Line Control": Serial communication data type selection in form of Data bits-Parity-Stop bits. Available options are:

- 7_EVEN_1 (Not used in Modbus)
- 8_NONE_1
- 9_NONE_1
- 8_EVEN_1
- 8_EVEN_2
- 8_ODD_1
- 8_ODD_2
- 8_NONE_2
- 9_NONE_2

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

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 and communication details.

The screenshot shows the 'Device Status' page for a server. The sidebar on the left lists the following menu items: Operating Mode, Network Settings, Serial Settings, Device Status (highlighted), LoRa Settings, LoRa Status, Security Settings, and Management. The main content area is titled 'Server Status' and contains the following data:

- IP Address:** 192.168.0.104
- App Status:** SERVING_CONNECTIONS
- Log Status:** LOG_STATE_TRYWRITELOG
- Log Counter:** 13
- N. of Module UART Errors:** 0
- N. of Module UART Input Overflow Errors:** 0
- N. of CRC Errors on LoRa Messages:** 0
- N. of Incorrect LoRa Characters Received:** 0
- N. of TCP Disconnections:** 0
- N. of TCP Output Full Errors:** 0
- N. of LoRa Messages Retries:** 0
- N. of Gateway Input Overflow Errors:** 0
- N. of LoRa Messages Received Correctly:** 0
- N. of LoRa Messages Sent Correctly:** 0
- N. of Gateway Messages Received Correctly:** 0
- N. of Gateway Messages Sent Correctly:** 0

Below the statistics is a 'Connections' section with a table:

Ip Address	Incoming Port
01.	
02.	
03.	
04.	
05.	

At the bottom of the page, there are two buttons: 'Reset Logs' and 'Refresh Status'.

"IP Address": TCP/IP address of TLM itself.

"App Status": It shows current status of TLM application. "SERVING CONNECTIONS" means device is ready for normal operation.

"Log Status": It is only available when "Log" is enabled from "Management" menu and shows current status of TLM logging. "LOG_STATE_TRYWRITELOG" means normal operation.

"Log Counter": It is only available when "Log" is enabled from "Management" menu and shows how many log lines has been transfered till now.

"N. of Module UART Errors": Number of module uart errors. Device will enter "Reboot State" if this number is above 20.

"N. of Module UART Input Overflow Errors": Number of module input overflow errors.

"N. of CRC Errors on LoRa Messages": Number of CRC errors during getting LoRa packages.

"N. of Incorrect LoRa Characters Received": Number of Incorrect characters received during getting LoRa packages.

"N. of TCP Disconnections": Number of TCP disconnections from TLM. Not available if one of serial line is enabled.

"N. of TCP Output Full Errors": Number of TCP output full errors during trying to send data to TCP side. Device will enter "Reboot State" if this number is above 5. Not available if one of serial line is enabled.

"N. of Module Serial Errors": Number of serialuart errors. Device will enter "Reboot State" if this number is above 20. Only available if one of serial line is enabled.

"N. of LoRa Messages Retries": Number of LoRa packages tried to sent after a failiure.

"N. of Gateway Input Overflow Errors": Number of Serial side input overflow errors both on RS232 and RS485 or TCP side input overflow errors based on TLM gateway settings.

"N. of LoRa Messages Received Correctly": Number of LoRa packages received successfully over the LoRa Radio Network.

"N. of LoRa Messages Sent Correctly": Number of LoRa packages sent to LoRa Radio Network successfully.

"N. of Gateway Messages Received Correctly": Number of data packages received from Serial RS232 and RS485 side or TCP side based on TLM gateway settings.

"N. of Gateway Messages Sent Correctly": Number of data packages sent to Serial RS232 and RS485 side or TCP side based on TLM gateway settings.

In "Connections" part:

Device can show up to 10 lines in this part based on "Maximum Number of Clients" setting under "Network Settings" Menu.

"Ip Address": Is the TCP IP address of client connected to TLM.

"Incoming Port": Is the TCP Port of socket used by client connected to TLM.

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. "Reset Logs" button will reset device status parameres.



NOTE 1: "Connections" 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.



NOTE 2: "Client Operation Mode" has similar status menu. In client configuration TLM will connect remote TCP IP and port of device, thus status menu will have extra item to show remote IP of the target TCP device.

Server IP Address

192.168.0.120

10.7 MENU: LoRa Settings – 868MHz Version

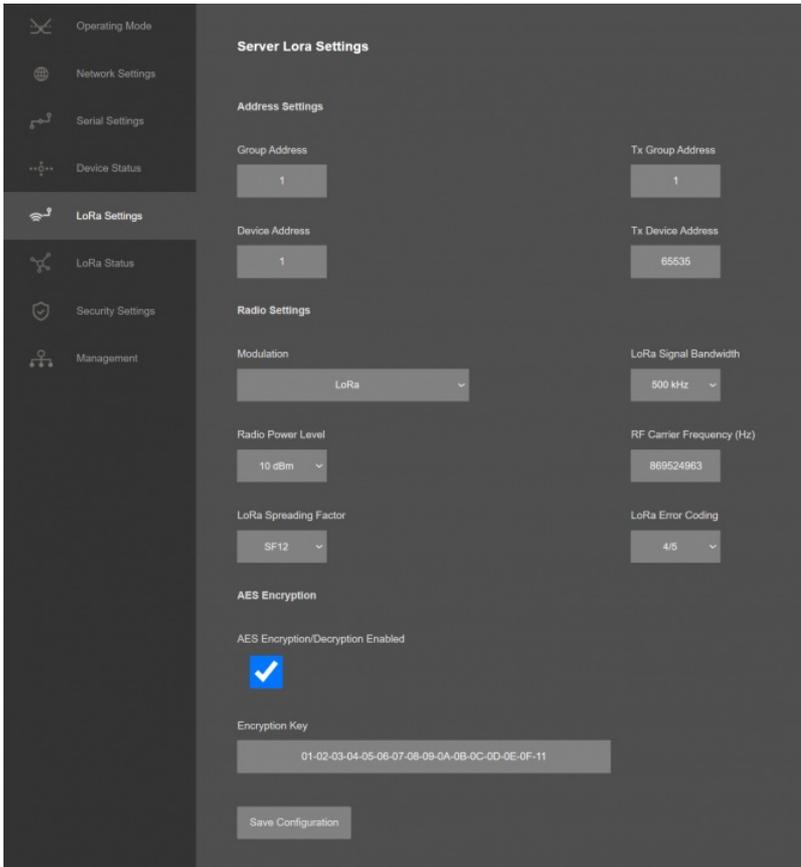
From this menu user may change LoRa RF parameters.

- 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.

- Modulation can be changed either LoRa or FSK
- Radio Power Level can be changed
- Radio Frequency can be changed within Frequency 863.062.500Hz to 869.937.500Hz
- LoRa Signal Bandwidth, spreading factor and Error Coding can be changed
- FSK Data Rate can be changed (if FSK Modulation selected)
- AES 128bit encryption and decryption can be activated and the key can be entered

TLM uses same AES Key for encrypting and decrypting the data. This Key must be same in same group of RF network.



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

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 (Rs), 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.

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

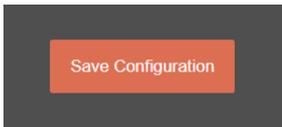
2	4/6	1,5
3	4/7	1,75
4	4/8	2

Following parameters are available for "FSK" modulation.

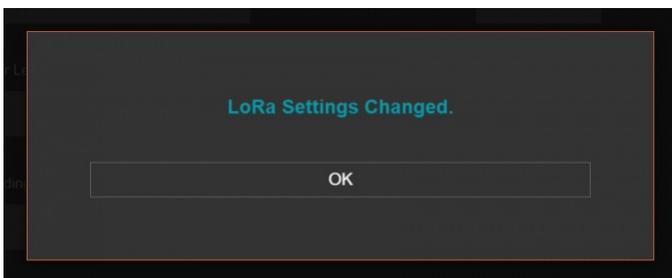
Data Rate can be selected as 50000, 100000 or 250000bps.



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

10.8 MENU: LoRa Settings – 2.4GHz Version

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.

- Modulation can be changed either LoRa or FLRC
- Radio Power Level can be changed
- Radio Frequency can be changed within Frequency 2.402.000.137Hz to 2.479.999.939Hz

- LoRa Signal Bandwidth, spreading factor and Error Coding can be changed
- FLRC Signal Bandwidth and Error Coding can be changed (if FLRC Modulation selected)
- AES 128bit encryption and decryption can be activated and the key can be entered

TLM uses same AES Key for encrypting and decrypting the data. This Key must be same in same group of RF network.

TLM uses Semtech's patented LoRa modulation technique well as FLRC (Fast Long Range Communication) 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
203	5
203	12
406	5
406	12
812	5
812	12
1625	5
1625	12

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.

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

TLM offers four bandwidth options of 203 kHz, 406 kHz, 812 kHz and 1,625 kHz with spreading factors ranging from 5 to 12.

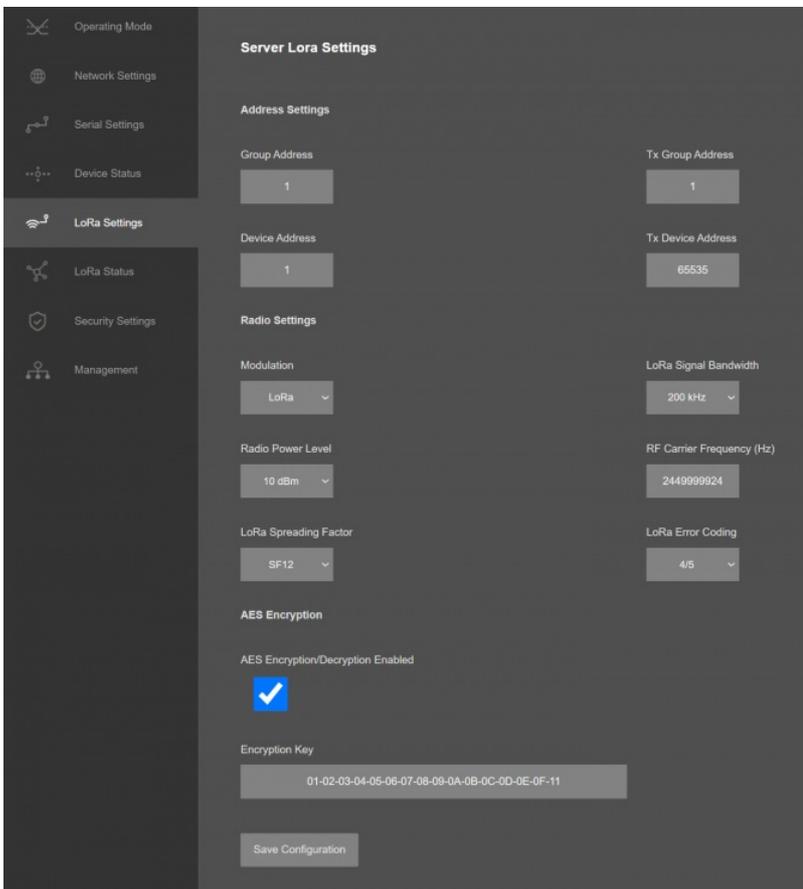
The spread spectrum LoRa modulation is performed by representing each bit of payload information by multiple chips of information. The rate at which the spread information is sent is referred to as the symbol rate (Rs), the ratio between the nominal symbol rate and chip rate is the spreading factor and 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
5	32
6	64
7	128
8	256
9	512
10	1024
11	2048
12	4096

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.

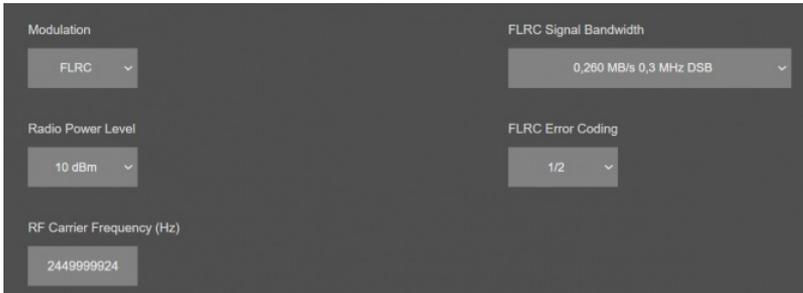
To further improve the robustness of the radio link, TLM provides cyclic error coding with different coding rates. With using this coding scheme forward error detection and correction can be applied.

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

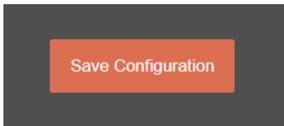


Following parameters are available for "FLRC" modulation.

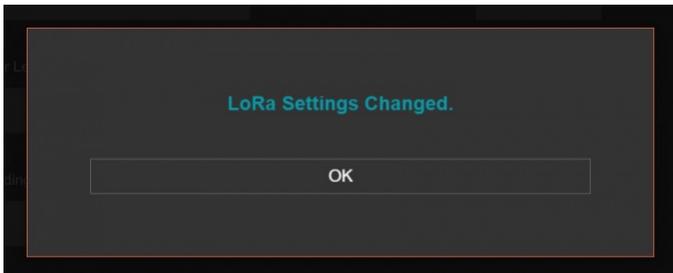
Data Rate can be selected between 0,260 MB/s to 1,300 MB/s



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.

"Destination Device Address": The target device address of the received message. User may see from this value if received message is a broadcast message or not.

"Payload in Hex": TLM will show the received message as Hexadecimal bytes in this part. This can be used for diagnostic purposes and to confirm if the package received correctly from LoRa Radio Network.

"Payload in ASCII": TLM will show the received message as ASCII characters in this part. This can be used for diagnostic purposes and to confirm if the package received correctly from LoRa Radio Network.

In "Latest Message Received - Gateway Side" part:

"Payload in Hex": TLM will show the received message as Hexadecimal bytes in this part. This can be used for diagnostic purposes and to confirm if the package received correctly from LoRa Radio Network.

"Payload in ASCII": TLM will show the received message as ASCII characters in this part. This can be used for diagnostic purposes and to confirm if the package received correctly from LoRa Radio Network.

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.

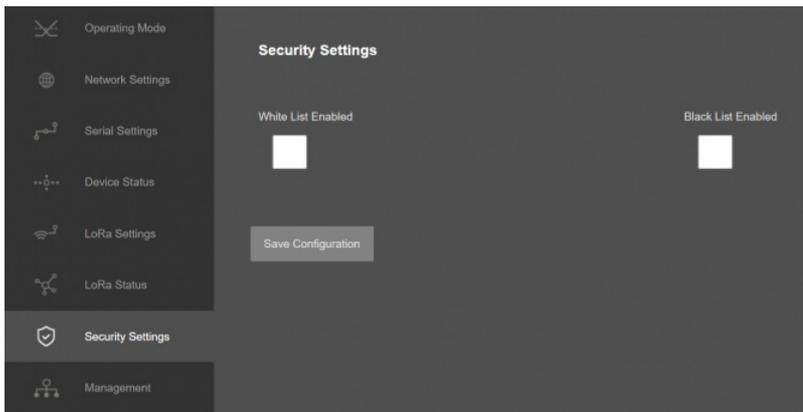


NOTE: This page has same options both for Server and Client operating modes.

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.

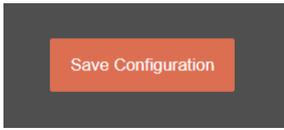
White List Address Table
0x0000

In this page user can enter decimal values and page will format it to

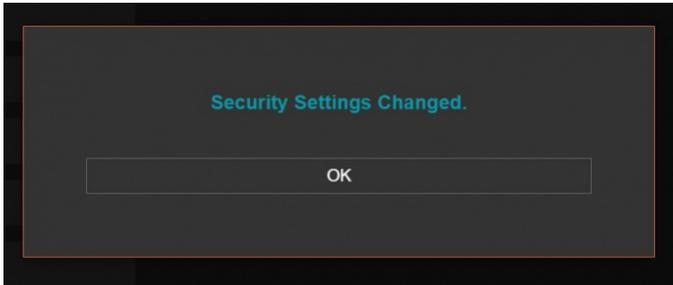
hexadecimal automatically after cursor is moved out of scope.



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



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.

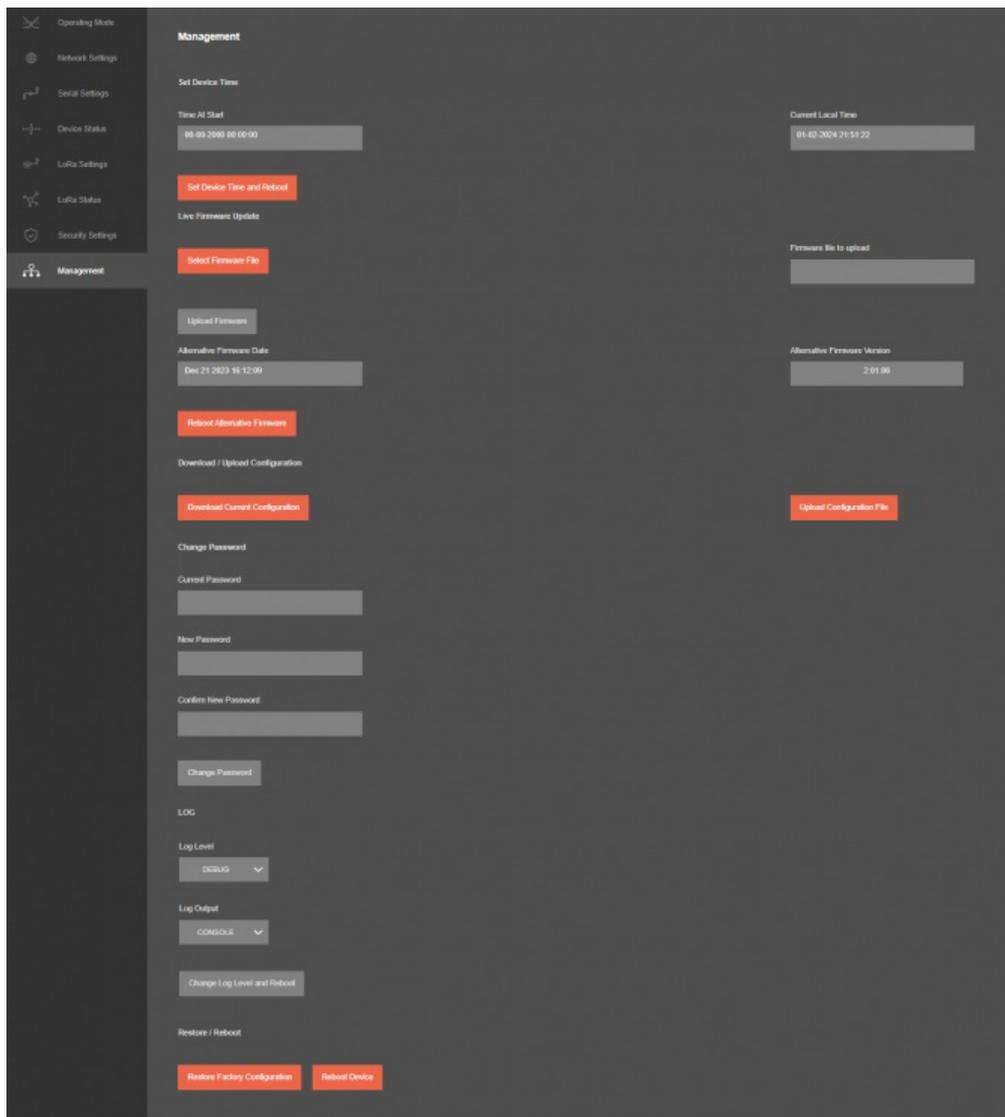
The device restarts itself every 86400 seconds (which means every 24 hours). There are also timeout restart routines in Server mode during listening clients and in Client Mode trying to connect to the server. (both preset to 10 minutes which means device will restart system if fails to connect a server 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 USB type-C or micro USB port of the device which is recognized as Virtual COM port in PC. LOG to remote UDP server is also available. If set to UDP server, then LKM will send LOG data to remote UDP server device.

- 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.

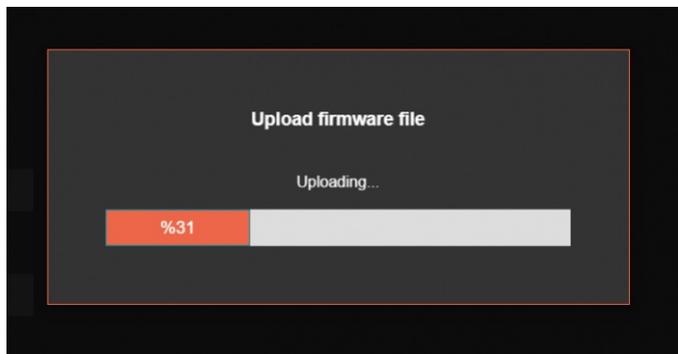


In "Live Firmware Update" part:

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

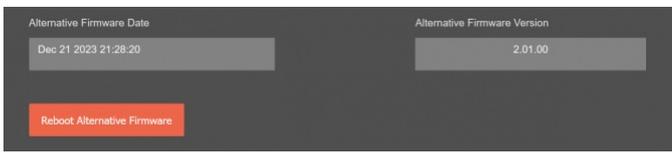


Then "Upload Firmware" button must be clicked. TLM will start to upload file and show status on pop up screen.

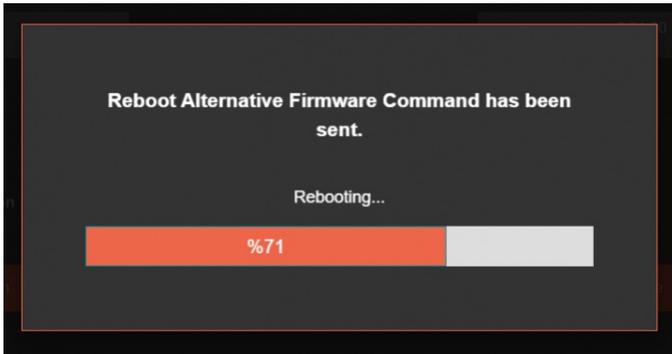


Click "Close" when finished. If somehow LKM fails to upload, refresh webpage and try again please.

After successful upload, TLM will show "Alternative Firmware Date" and "Alternative Firmware Version" data.



Click "Reboot Alternative Firmware" and TLM will reboot with new firmware and show status on screen.



This will take 5 seconds only. Please wait .

Check firmware details from upper part of main screen please if the update firmware procedure finalized properly.



NOTE 1: User must refresh cache of their browser by clicking CTRL+F5 after a successful firmware change so that it will force browser to reload web interface (with latest updates/changes).



NOTE 2: In major updates user must also reset device to factory settings.

In "Download / Upload Configuration" part:

User download current configuration of the device to a file or restore a previously defined configuration to device from file.

"Download Current Configuration": Downloads the configuration to a file. It uses "Device Name" for file name and the extensions will be "*.zcfg".

"Download Configuration File": Uploads the configuration from "*.zcfg" file.

In "Log" part:

User may activate Logging and see details of operation. There are different levels of Log with different amount of data.

"None": Logging is closed

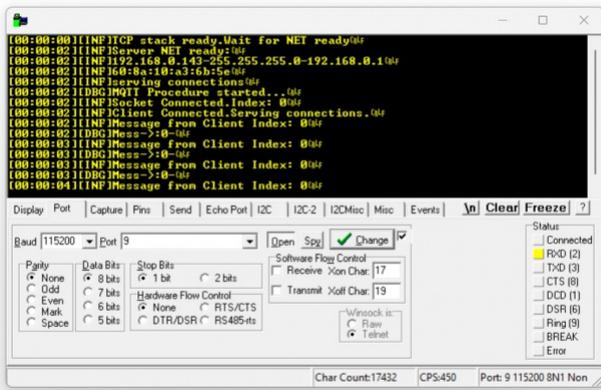
"Error": Only errors in systems will be logged

"Info": General info and errors will be logged

"Debug": All details regarding device operation will be logged

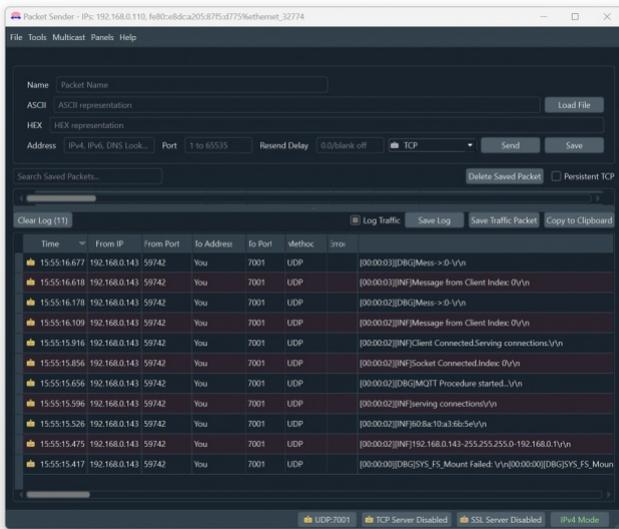
If "Console" is selected as output of Log, then micro USB or USB Type-C port of device will be used for logging. Proper cable must be connected and a terminal should be used to receive Log data. As an example "RealTerm" tool can be used.

Simply select COM port and set baud rate 115200 and data type 8N1 and then click open. Device will send log data.



If "UDP Server" is selected as output of Log, then proper tool must be used to get log data. User must set "UDP Server IP" and "UDP Server Port". Device will send Log to that address. As an example "Package Sender" tool can be used.

Click "File" and then "Settings". Enable "UDP Server" and set the port. Device will send Log data to UDP server.



Here is a video example to enable UDP log and receive data via UDP Server software. Video is created with CKL series but applies to all series.

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

11. Modbus Communication Example

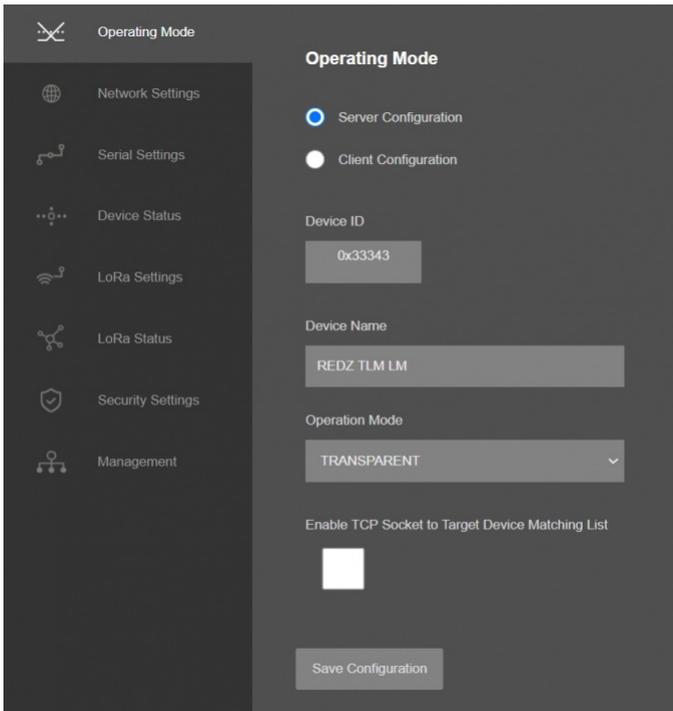
TLM Series LoRa Radio Modems can create a LoRa Based RF network and connect Serial and/or ETH based devices with each other. In this chapter we will communicate between

- Modbus TCP - Master Device
- Modbus RTU - Slave Device

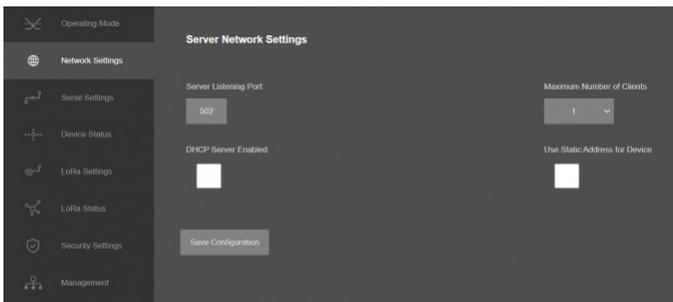
We will use Modbus simulator as Modbus RTU device and "Modbus Poll" software as Modbus TCP master device in this application

11.1 Modbus TCP Master Device Settings

TLM will listen TCP IP connections from the TCP Port set in "Network Settings" Menu. So we will set TLM in "Server Configuration" and set "Operation Mode" as "TRANSPARENT" since we don't need and change in protocol and we want it to be transferred over LoRa Radio Network as it is.



The listening TCP port will be "502" as per settings in "Network Settings" Menu.



User may increase "Maximum Number of Clients" if there is more than 1 master in the application.

Serial ports will be closed since we will connect via Modbus TCP Master Device.



TLM device and group address will be 1.

Target Group will be same group and it will be 1. Target device will be 2 and we will enter this to remote Modbus RTU device that we will remote read over LoRa Radio Network.



NOTE: Target Device Address must be 65535 (Broadcast address) if there are more than 1 Modbus device to be read in LoRa Radio Network.

User may change "Radio Power Level" if there is too much distance between TLMs and "LoRa Spreading Factor" can be changed to "SF12" for example for higher bandwidth (that needs better radio link).



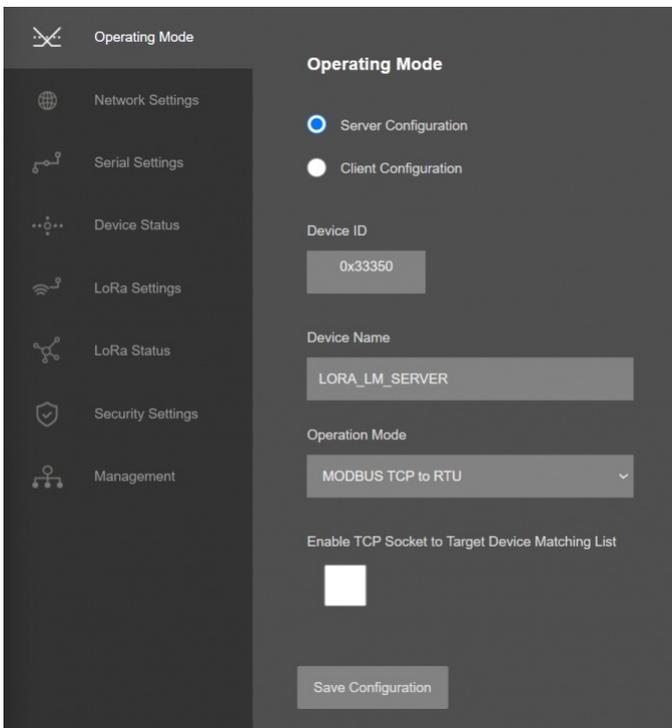
NOTE: If there is no signal coverage, please try to increase "Radio Power Level" and use "SF7" and if possible use at least 1 higher gain antenna that can be mounted on a pole for master TLM device.

LoRa Settings must be same for all device in same LoRa Radio Network.

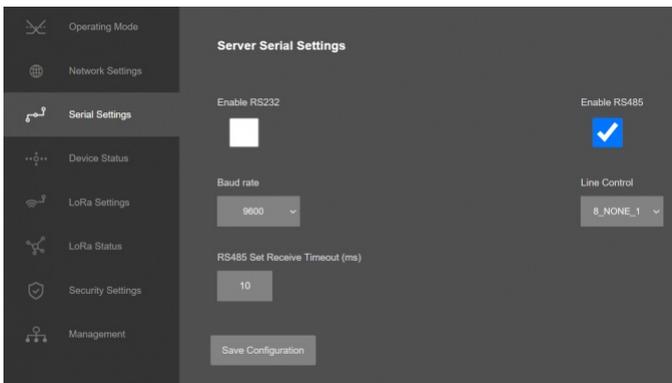
Those settings will be enough for TLM Modbus TCP side master device.

11.1 Modbus RTU Slave Device Settings

TLM will get LoRa packages over the air and transfer those packages to local Modbus RTU slave device. So we will set TLM in "Server Configuration" and set "Operation Mode" as "Modbus TCP to RTU" since we need and change in Modbus TCP frame to Modbus RTU frame and transfer to local Modbus RTU slave device.



Serial port must be enabled since we will connect via Modbus RTU Slave Device. In this example we will use 9600-8N1 for Modbus RTU Slave device connection.



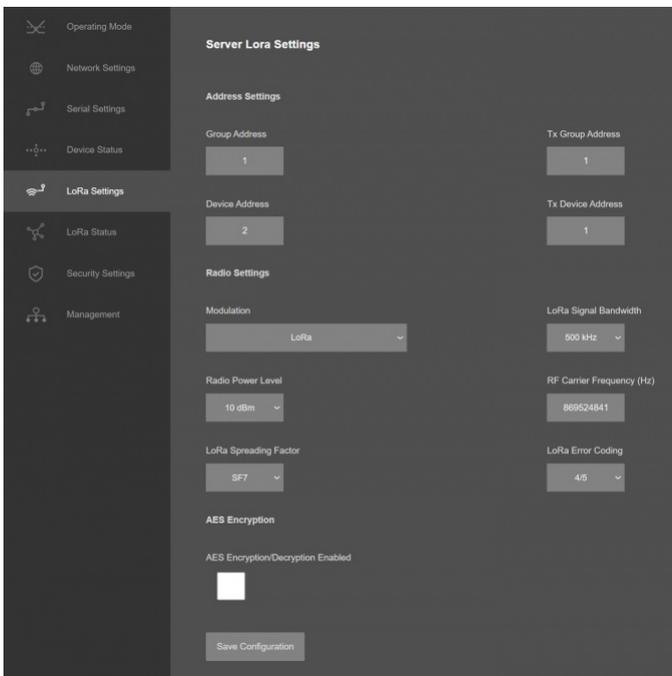
TLM group address will be 1, same as Master TLM.

TLM device address will be 2, it will be different than the master TLM.



NOTE: Master TLM send packages to target 2 or 65535 (Broadcast address) if there are more than 1 Modbus device to be read in LoRa Radio Network. In both cases slave TLM will get message.

Target Group will be same group and it will be 1. Target device will be 1 since the master TLM address is 1. That means slave TLM can only send data to master.



User may change "Radio Power Level" if there is too much distance between TLMs and "LoRa Spreading Factor" can be changed to "SF12" for example for higher bandwidth (that needs better radio link).



NOTE: If there is no signal coverage, please try to increase "Radio Power Level" and use "SF7" and if possible use at least 1 higher gain antenna that can be mounted on a pole for master TLM device.

LoRa Settings must be same for all device in same LoRa Radio Network.

Those settings will be enough for TLM Modbus RTU side slave device.

11.3 Modbus TCP Master – Modbus RTU Slave Communication

TLM Series LoRa Radio Modems are now ready for communication between

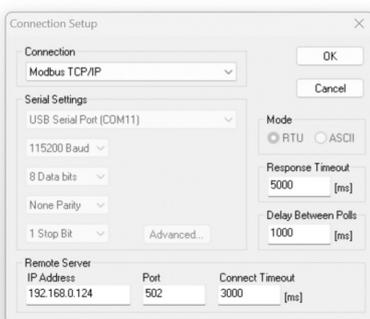
- Modbus TCP – Master Device
- Modbus RTU – Slave Device

Modbus RTU slave device address is 5 and we will read 5 register starting from register address 7.

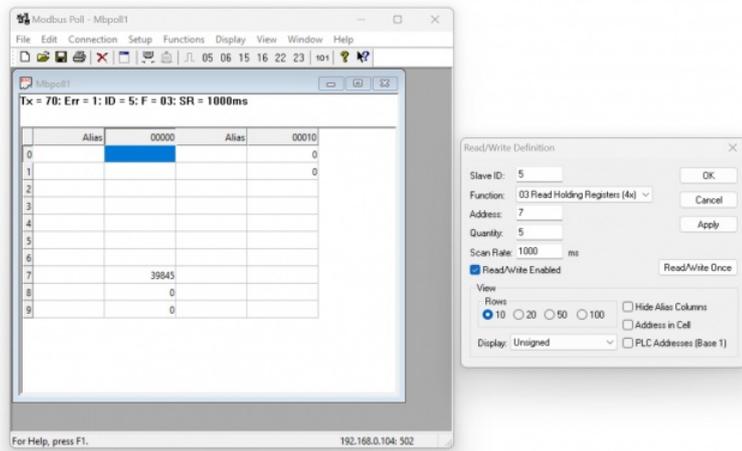
Enter IP and port of Master TLM to Modbus TCP software and set "response timeout" and "delay between polls" according to LoRa network needs.



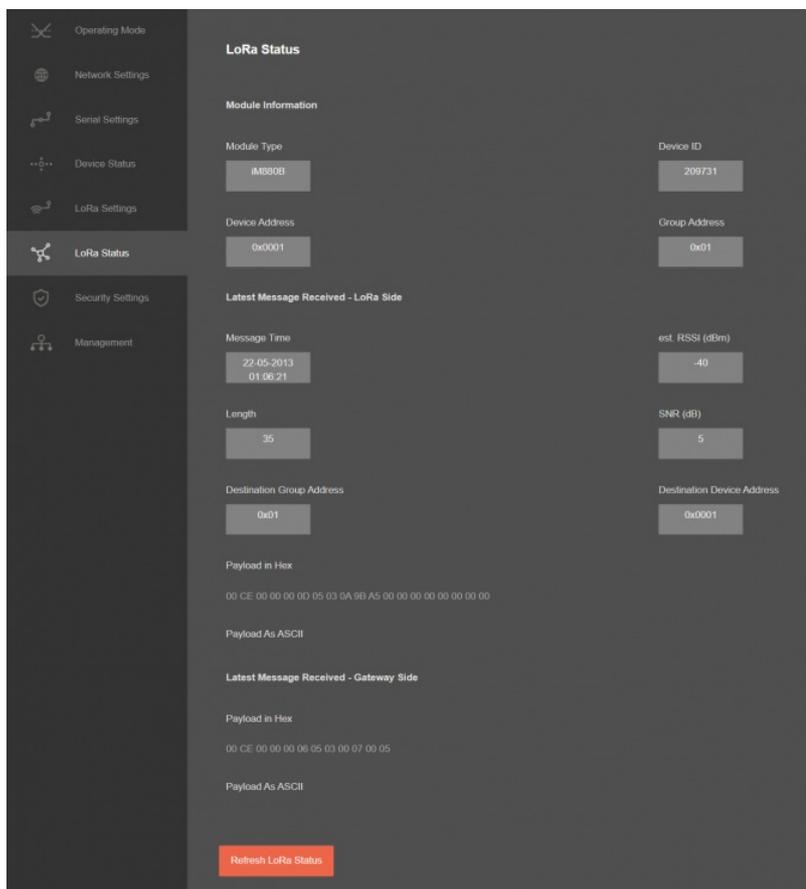
NOTE: Please remember LoRa is relatively slow network, so you can set "response timeout" 5000ms and "delay between polls" 1000ms and even more for longer distances.



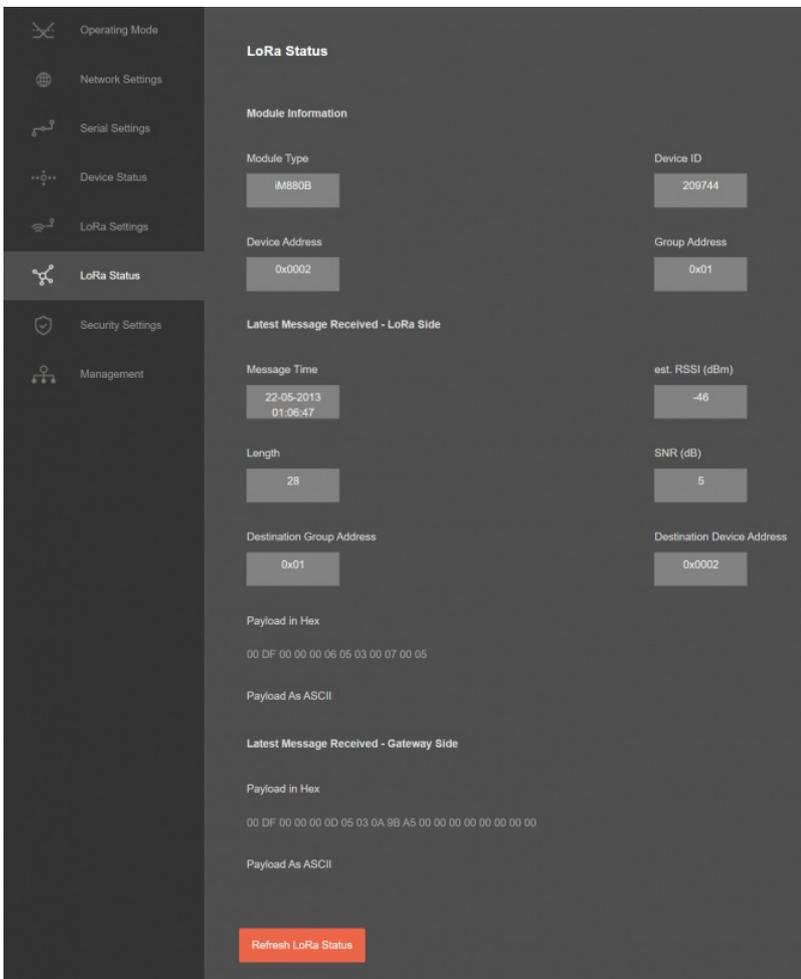
Click "OK" once finished. Software may try to connect, meanwhile please update settings as per your Modbus RTU slave device. In our example Modbus RTU slave device address is 5 and we will read 5 register starting from register address 7.



Now the software will read Modbus values. Master TLM side is Modbus TCP, Slave TLM side is Modbus RTU. You can monitor LoRa Status either on Master TLM Modbus TCP side:



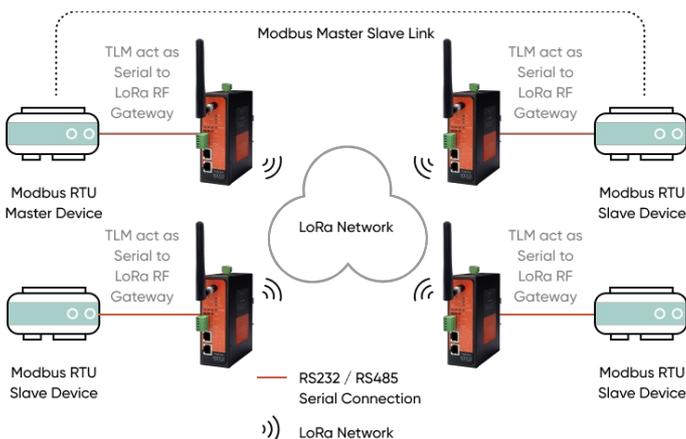
Or you can monitor LoRa Status on Slave TLM Modbus RTU side:



12. I/O Mirror Application for HUR series with TLM LoRa RF Modems Example

11.1 I/O Mirror Application Between 2 HUR Series Modbus TCP Remote I/O Devices over LoRa 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.

HUR Series Modbus TCP Remote I/O Devices Output versions can duplicate input value of Input versions. Outputs can be 5-275V AC-DC, 100mA Digital Optocoupler Output or 5Amperes 250VAC/30VDC Relay Output or 4-20mA Analog Output. Following devices can be used as output device for this application:

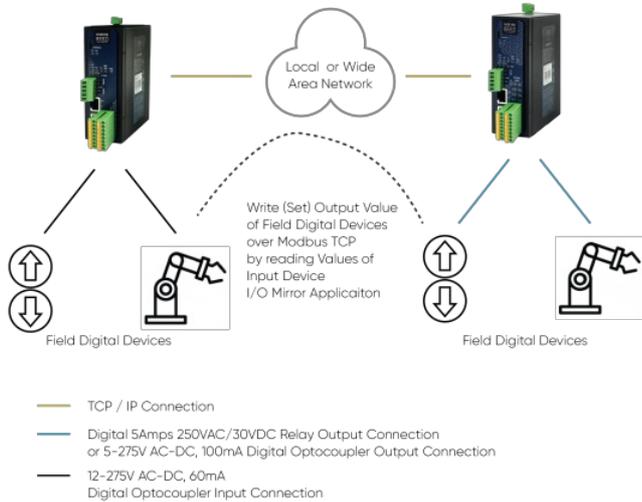
- HUR158 and HUR258 with 8 Channel 5-275V AC-DC, 100mA Digital Optocoupler Output

- HUR168 and HUR268 with 8 Channel Digital 5Amps 250VAC/30VDC Relay Output
- HUR595 and HUR695 with 5 Channel 4-20mA Analog Output

Inputs can be 12-275V AC-DC, 60mA Digital Optocoupler Input or 4-20mA Analog Input. Following devices can be used for this application:

- HUR358 and HUR458 with 8 Channel 12-275V AC-DC, 60mA Digital Optocoupler Input
- HUR558 and HUR658 with 8 Channel 0-10V and 0-20mA Selectable Analog Input

As expected, Analog devices can pair with each other and Digital devices can pair with each other.



NOTE: I/O Mirror Application can be done between same I/O devices which means Analog devices can pair with each other and Digital devices can pair with each other.

11.2 I/O Mirror Application Example Between 2 HUR Series Analog Input and Analog Output Devices

Here is an example video for I/O Mirror application between

- HUR558 and HUR658 with 8 Channel 0-10V and 0-20mA Selectable Analog Input

The Analog Current value we input from Analog In HUR is set to Analog Out HUR via TLM Series LoRa RF Modems.

Here is the video for configurations:

13. Ordering Information

TLM154: 868MHz LoRa RF Modem, 2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM254: 868MHz LoRa RF Modem, 2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 100 - 240V AC (120 - 370V DC), 50Hz to 60Hz AC Power Input

TLM655: 868MHz LoRa RF Modem, 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

TLM194: 2.4GHz LoRa RF Modem, 2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM294: 2.4GHz LoRa RF Modem, 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 100 - 240V AC (120 - 370V DC), 50Hz to 60Hz AC Power Input

TLM695: 2.4GHz LoRa RF Modem, 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

14. Product Selection

Model	Operating Frequency	5-48V (max.60V) DC Power Input	100 - 240V AC (120 - 370V DC), 50Hz to 60Hz 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	BPL (Broadband Power Line) Link
TLM154	868MHz	X			X	X	
TLM254	868MHz		X		X	X	
TLM655	868MHz			X	X	X	X
TLM194	2.4GHz	X			X	X	
TLM294	2.4GHz		X		X	X	
TLM695	2.4GHz			X	X	X	X