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SMART COMMUNICATION

redz-sc.com hi@redz-sc.com

TLM Series LoRaWAN EndNode Modems

Modbus TCP or RTU Field Device Scheduler
to LoRaWAN Server Data Send Function
TCP or RS232/RS485 Field Device
to LoRaWAN Server Transparent Data Send Function

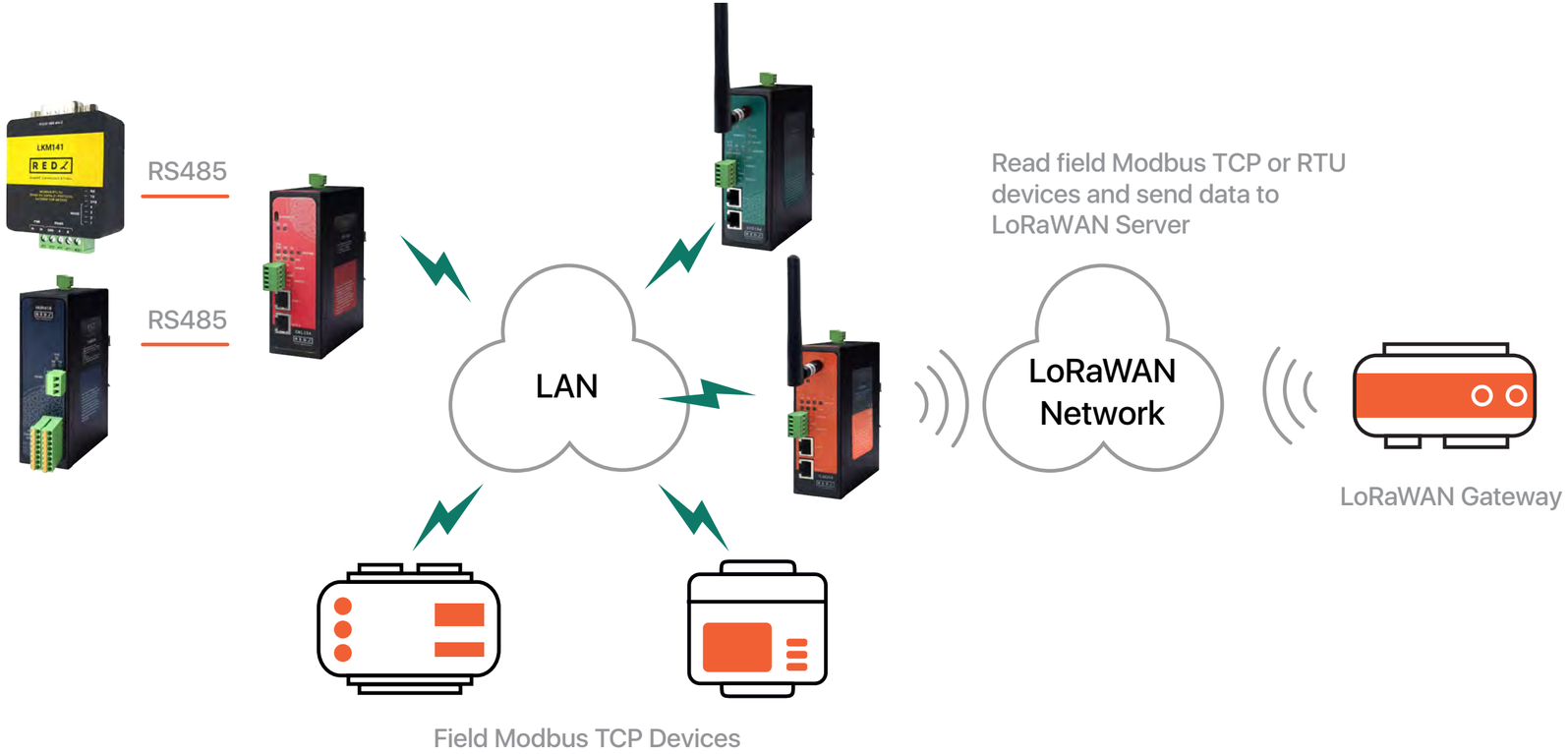
with 2 × 10/100Base-T(x) Ports,
1 × RS232 and 1 × RS485 Serial Ports
and option for BPL (Broadband Power Line Link)

TLM Series LoRaWAN EndNode Modems can create a link between field devices and LoRaWAN server.

Field devices with TCP/IP connectivity can be read via Modbus TCP protocol and data can be sent to LoRaWAN Server. Field devices with RS232/RS485 Serial interface can be read via Modbus RTU protocol and data can be sent to LoRaWAN Server as well.
Up to 64 Modbus devices in the field can be connected to LoRaWAN Server via TLM Series LoRaWAN EndNode Modems. Modbus Query interval and LoRaWAN minimum data send interval can easily be configured for each query on TLM web interface and user can also configure Modbus Query for each device by selecting address, function code, data address, total number of data and time out interval.

Function codes
1: Read Coils Status
2: Read Input Status
3: Read Holding Registers
4: Read Input Registers
are supported.

LoRaWAN Downlink messages can be used to send Custom Modbus Commands remotely to control field TCP/IP and RS232/RS485 devices from LoRaWAN Server Side.



Function codes 1-2-3-4 are supported and additionally:
5: Force Single Coil
6: Preset Single Register are supported for remote control.

Transparent connection between field devices and applications and LoRaWAN server is also available. In this function, TCP/IP or RS232/RS485field devices can send data to LoRaWAN Server as it is.

Typical applications: Automated Meter reading, Home – Building – Industrial Automation, Wireless Sensors, Telemetry...

TLM models with Broadband Power Line (BPL) link can 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.

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Main 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
- **Radio Band Options:**
  865MHz
  IN 865 MHz – India, LoRaWAN RF Communication
  868MHz
  EU 868 MHz – Europe, LoRaWAN RF Communication
  915MHz
  US 915 MHz – Covers US 902-928MHz ISM Band, LoRaWAN RF Communication 923MHz
  AS 923 MHz – BN 923 MHz – Brunei, LoRaWAN RF Communication
  AS 923 MHz – KH 923 MHz – Cambodia, LoRaWAN RF Communication
  AS 923 MHz – ID 923 MHz – Indonesia, LoRaWAN RF Communication
  AS 923 MHz – JP 920 MHz – Japan, LoRaWAN RF Communication
  AS 923 MHz – LA 923 MHz – Laos, LoRaWAN RF Communication
  AS 923 MHz – NZ 915 MHz – New Zealand, LoRaWAN RF Communication
  AS 923 MHz – SG 920 MHz – Singapore, LoRaWAN RF Communication
  AS 923 MHz – TW 922 MHz – Taiwan, LoRaWAN RF Communication
  AS 923 MHz – TH 920 MHz – Thailand, LoRaWAN RF Communication
  AS 923 MHz – VN 920 MHz – Vietnam, LoRaWAN RF Communication

- **3 Main Device Functions:**
  - LoRaWAN Modbus TCP Scheduler
  - LoRaWAN Modbus RTU Scheduler
  - LoRaWAN Transparent Mode (Transparent bridge between LoRaWAN and TCP/IP or RS232/RS485 Serial Side)
- **Up to 64 device connections in Modbus TCP or RTU Scheduler modes**
- **Up to 10 device connections in Transparent TCP/IP mode**
- **Modbus Function Code (Function Codes 1-2-3-4 are supported), Register Address, Total Register Number, Query Interval, Time Out durations and Minimum Interval for LoRaWAN Data Send can be defined for each field device seperately.**
- **Downlink Message supported for remote control of field Modbus TCP or RTU Devices. Modbus Function Codes 1-2-3-4-5-6 are supported as downlink Modbus Command.**
- **Built in LoRaWAN Duty Cycle Check for EU868 and AS923 Models**
- **Built in LoRaWAN Payload Size Check Function. User can read any data in any size, TLM will automatically split based on Maximum Payload Size allowed and Duty Cycle Block Times.**
- **Sub-Band Mask Configurable for US915 Model**
- **Activation Over Air (OTAA) or Activation by Personalization (ABP) Selectable**
- **User defined LoRAWAN Port**
- **Adaptive Data Rate functionality**
- **Selectable Uplink Data Rate**
- **Selectable Power Level**
- **LoRaWAN Class C and Class A support**

- Easy monitor of transmitted data on web interface
- Easy to follow Device Status on web interface
- Easy to follow LoRaWAN packages on web interface
- Black List and White List based TCP/IP connection filter in transparent mode
- 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

Extra Features for Models with BPL (Broadband Powerline)

- 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

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Technical Specifications

Connectors and Ports

SMA Antenna Connector for LoRa	1 Standard SMA female interface, 50 ohm
Console Port	Micro USB or USB Type-C connection for LOG in 115200 baud
10/100T(X) RJ45 Ports	Ethernet Connection on 2 ports
Serial Ports	5 pin wired Terminal Connection Tx, Rx, GND for RS232 A and B for RS485
Reset Buttons	Reset to Client and Reset to Server Operating modes buttons

Ethernet Switch Technology

Ethernet Standards	IEEE 802.3 for 10Base-T IEEE 802.3u for 100Base-T(X) IEEE 802.3x Flow Control
Mac Table	1K MAC address entry
Processing	Store-and-Forward
Memory	448K bits packet buffer memory

LoRa Technology - Common Features For All Frequencies

Based on	STM32L151CxU6Axx Pre-Certified according to EN 300 220
Sensitivity	Down to -138 dBm
Link Budget	Up to 156 dB
Communication Distance	Up to 15 km (Line of Sight)
Typical Communication Distance Indoor/Urban	> 2 km
LoRaWAN Activation Options	Activation Over Air (OTAA) Activation by Personalization (ABP) User Selectable
LoRaWAN Port	User Selectable
Adaptive Data Rate	Available
LoraWAN Class	Class A Class C
Time Synchronization	TLM synchronizes its time with LoRaWAN Server right after it is connected to LoRaWAN Server

LoRa Technology - 865MHz Version

Uplink Data Rate	SF12 / 125 kHz / 250 bps SF11 / 125 kHz / 440 bps SF10 / 125 kHz / 980 bps SF9 / 125 kHz / 1760 bps SF8 / 125 kHz / 3125 bps SF7 / 125 kHz / 5470 bps FSK 50k / NA / 50000 bps
Tx Power Level	0 to 22dBm Configurable

LoRa Technology - 868MHz Version

Uplink Data Rate	SF12 / 125 kHz / 250 bps SF11 / 125 kHz / 440 bps SF10 / 125 kHz / 980 bps SF9 / 125 kHz / 1760 bps SF8 / 125 kHz / 3125 bps SF7 / 125 kHz / 5470 bps SF7 / 250 kHz / 11000 bps FSK 50k / NA / 50000 bps
Tx Power Level	0 to 16dBm Configurable

LoRa Technology – 915MHz Version

Uplink Data Rate	SF10 / 125 kHz / 980 bps SF9 / 125 kHz / 1760 bps SF8 / 125 kHz / 3125 bps SF7 / 125 kHz / 5470 bps SF8 / 500 kHz / 12500 bps SF12 / 500 kHz / 980 bps SF11 / 500 kHz / 1760 bps SF10 / 500 kHz / 3900 bps SF9 / 500 kHz / 7000 bps SF8 / 500 kHz / 12500 bps SF7 / 500 kHz / 21900 bps
Tx Power Level	0 to 22dBm Configurable

LoRa Technology – 923MHz Version

Uplink Data Rate	SF10 / 125 kHz / 980 bps SF9 / 125 kHz / 1760 bps SF8 / 125 kHz / 3125 bps SF7 / 125 kHz / 5470 bps
Tx Power Level	0 to 16dBm Configurable

BPL (Broadband Powerline) Technology for BPL Models

PHY Data Rate	Up to 240 MHz
MAC Layer Protocol	CSMA/CA
Modulation Technology	OFDM-432
VLAN	IEEE802.1q/ IEEE802.1p/ IEEE802.3d

NTP Time Synchronization

NTP is used to syncronize device time after a manual or system triggered restart and it only takes place if NTP time is available and device time difference from NTP time is + or - 24 Hours.

Device synchronize time with LoRaWAN Server as well after first succesfull connection and it has higher priority than NTP time synchronization.

LoRaWAN Downlink Characteristics

Downlink Messages	Modbus Commands are supported as Downlink Message for Modbus TCP and RTU Scheduler Function. Downlink Messages are sent to field TCP/IP or RS232/RS485 serial device as it is in Transparent Data Send Function.
Function Codes for Modbus TCP and RTU Scheduler	Read Coil Status (FC=1) Read Input Status (FC=2) Read Holding Registers (FC=3) Read Input Registers (FC=4) Force Single Coil (FC=5) Preset Single Register (FC=6) are supported.

Led Indicators

Power indicator	Power LED
10/100T(X) Indicators	Activity LEDs: ETH1, ETH2 and TLM (Activity of device itself)
System Indicators	Status LED, Tx and Rx of data LEDs and Server LED (LED ON: Server Operating Mode, LED OFF: Client Operating Mode)
Console Indicators	Tx and Rx of data LEDs

Modbus Characteristics

Modbus Protocol	Modbus TCP or RTU Selectable by User
Modbus Devices	Up to 64 Modbus command can be defined by User
Modbus Address	Independently selectable by User
Modbus Function Code	Read Coil Status (FC=01) Read Input Status (FC=02) Read Holding Registers (FC=03) Read Input Registers (FC=04) Selectable
Modbus Command Setting	Register Adress Total Number of Registers Query Interval Time Out LoRaWan Minimum Data Send Interval Independently Selectable for each command
Modbus RTU Serial Settings	Serial interface RS232 or RS485 Serial data settings and Baud Rate Independently Selectable for each command
Modbus TCP Settings	TCP/IP and TCP Port Settings Independently Selectable for each command

Power - DC Models

Input Range	5-48V DC wide range Power Input (Allows up to 60 V DC)
Reverse Polarity Protection	Available
Thermal Shutdown and Current Limit Protection	Available

Physical & Environmental Characteristics DC Models

Enclosure	Metal, IP 40
Dimensions	43 × 95 × 124 (w × d × h) mm
Weight	~ 400 gr
Storage Temperature	– 65 to 150 °C
Operating Temperature	– 40 to 85 °C
Operating Humidity	5% to 95% Non-condensing

Power – AC Models

Input Range	100 - 240V AC (120 – 370V DC), 50Hz to 60Hz AC input
Isolation	Fully Isolated >4200Vrms, 5mA 1 Min
Insulation	Class II

Physical And Environmental Characteristics AC Models

Enclosure	Metal, IP 40
Dimensions	43 x 95 x 124 (w x d x h) mm
Weight	~400gr
Storage Temperature	-40 to 85 °C
Operating Temperature	-30 to 70 °C
Operating Humidity	10% to 95% Non-condensing

Power – BPL Models

Input Range	3 Phase Input, 110V–240V 50Hz to 60Hz AC input
Power and Data	AC Power supply use L1-N only. Phase 2-3 connections are used for BPL signal transmission.

Physical And Environmental Characteristics BPL Models

Enclosure	Metal, IP 40
Dimensions	43 x 95 x 124 (w x d x h) mm
Weight	~400gr
Storage Temperature	-65 to 150 °C
Operating Temperature	-40 to 85 °C
Operating Humidity	5% to 95% Non-condensing

BPL Models 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 phase to phase connection is not avilable then phase and neutral can still be connected for data transmission for terminal pins 3 and 4.

BPL Models 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 9-36V DC power from terminal pins 1 and 2 to power up device itself. Data transmission only done through terminal pins 3 and 4.

Ordering Information

TLM344: 865MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM444: 865MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM745: 865MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM354: 868MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM454: 868MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM755: 868MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM364: 915MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM464: 915MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM765: 915MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM374: 923MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
2x 10/100 T(x) ETH ports, 1 x RS232 & 1 x RS485, 5-48V (max. 60V) DC Power Input

TLM474: 923MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

TLM775: 923MHz LoRaWAN EndNode Modem with Modbus TCP/RTU Scheduler,
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

Product Comparison

Model	865MHz LoRaWAN	868MHz LoRaWAN	915MHz LoRaWAN	923MHz LoRaWAN	5-48V (max. 60V) DC Power input	100 - 240V AC (120 – 370V DC), 50Hz to 60Hz AC Power Input	3 Phase AC Power input, 110V240V/ 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
TLM344	●				●			●	●	
TLM444	●					●		●	●	
TLM745	●						●	●	●	●
TLM354		●			●			●	●	
TLM454		●				●		●	●	
TLM755		●					●	●	●	●
TLM364			●		●			●	●	
TLM464			●			●		●	●	
TLM765			●				●	●	●	●
TLM374				●	●			●	●	
TLM474				●		●		●	●	
TLM775				●			●	●	●	●