

TLM Series LoRa Radio Modems

LoRa to TCP/UDP Server Gateway and Client Gateway

LoRa to SERIAL Device Gateway with Modbus TCP to RTU conversion

LoRa Repeater

868 MHz or 2.4 GHz LoRa radio

2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485, and models with a BPL (Broadband Power Line) link



The TLM Series LoRa RF Modems build a private radio network between Ethernet devices and RS232 / RS485 serial devices. Two or more modems exchange data over LoRa; each modem connects the radio network to its own Ethernet port or serial port. The data passes unchanged, so any protocol can be carried. For Modbus the modem can also convert between Modbus TCP and Modbus RTU.

Four Device Functions

- 1 LoRa to TCP/UDP Server Gateway:**
waits for up to 10 TCP clients (for example a SCADA or a PC program) and passes data between them and the radio network.
- 2 LoRa to TCP/UDP Client Gateway:**
connects by itself to up to 10 TCP or UDP devices and passes data between them and the radio network.
- 3 LoRa to SERIAL Device Gateway:**
passes data between an RS232 or RS485 device and the radio network, optionally with Modbus TCP to RTU conversion, Modbus RTU master to TCP conversion or IEC 62056-21 Mode C baud switching.
- 4 LoRa Repeater:**
receives the LoRa packets addressed to it (or broadcast) and sends them again, to extend the distance between modems that cannot hear each other.

Key Figures

Up to 15 km

Distance in line of sight, 868 MHz models (radio module datasheet)

More than 12 km

Distance in line of sight, 2.4 GHz models (radio module datasheet)

156 dB / 142 dB

Link budget (up to), 868 MHz / 2.4 GHz models

128-bit AES

Encryption of the radio data

Up to 10

TCP clients at the same time, server gateway function

300 to 460800 baud

RS232 or RS485 serial port

Main Features

LoRa radio

- 868 MHz models: LoRa or FSK modulation, LoRa bandwidth 125, 250 or 500 kHz, radio power 5 dBm (about 3 mW) to 20 dBm (100 mW).
- 2.4 GHz models: LoRa or FLRC modulation, LoRa bandwidth 200, 400, 800 or 1600 kHz, radio power -18 dBm (about 0.02 mW) to 13 dBm (about 20 mW).
- Sensitivity down to -138 dBm (868 MHz models) and -130 dBm (2.4 GHz models).
- 128-bit AES encryption of the radio data; all modems of one network use the same radio settings and, if AES encryption is used, the same key.
- Radio network: point to point, point to multipoint (broadcast) and point to multipoint with a TCP socket to target device list.
- Configurable receive and transmit group address and device address.
- Acknowledged transmission (C-Data); Listen Before Talk (LBT) setting on the 868 MHz models - the radio module of the 2.4 GHz models listens before talk by itself.
- Discovery of the other TLM modems of the same LoRa network, with their signal levels, addresses and settings; remote ping and link test tools for installation.

Modbus and serial

- One RS232 and one RS485 serial port (one of them is used at a time), 300 to 460800 baud.
- The serial gateway can also convert Modbus TCP to Modbus RTU and Modbus RTU to Modbus TCP.
- Modbus TCP to RTU: the Unit ID becomes the slave address; optionally Modbus exception 0x0B (gateway target device failed to respond) when a slave does not answer.
- IEC 62056-21 Mode C baud switching in the serial gateway.

Network and management

- Two 10/100Base-T(X) Ethernet ports on a built-in Ethernet switch.
- Embedded web interface for all settings and for status and traffic information.
- Modbus Unit ID routing and UDP server mode in the server gateway.
- DHCP server; NTP time synchronization.
- White list and black list filter for LoRa packets.
- Firmware update over the web interface; two firmware images are stored, one of them is active.

Extra Features of the TLM655 and TLM695 (BPL)

- Two 10/100Base-T(X) Ethernet ports plus one BPL link.
- Up to 30 Mbps PHY rate on the power line, up to 10 hops and 1000 nodes.
- Up to 432 sub-carriers in the 2 to 28 MHz band; OFDM, CSMA/CA.
- LDPC-C forward error correction with a 128-bit AES core.
- AC versions with phase to neutral (P-N) or phase to phase (P-P) data connection; DC version (9 - 36 V DC) with P-P.
- Plug and play: the only BPL setting is BPL Operating Mode (MASTER or NODE) on the Network Settings page.

Conformity

- 868 MHz models: radio module pre-certified according to EN 300 220.
- 2.4 GHz models: radio module pre-certified according to EN 300 328.

Technical Data

LoRa radio	868 MHz models: TLM154, TLM254, TLM655	2.4 GHz models: TLM194, TLM294, TLM695
Frequency range	863.0625 to 869.9375 MHz	2402.000137 to 2479.999939 MHz
Modulation	LoRa or FSK	LoRa or FLRC
LoRa bandwidth	125, 250, 500 kHz	200, 400, 800, 1600 kHz
LoRa spreading factor	SF7 to SF12	SF5 to SF12
Transmit power	5 to 20 dBm	-18 to 13 dBm
Sensitivity	down to -138 dBm	down to -130 dBm
Link budget	up to 156 dB	up to 142 dB
Communication distance	up to 15 km line of sight	more than 12 km line of sight
User data per LoRa packet	229 bytes	109 bytes
Encryption	128-bit AES	128-bit AES
Antenna	SMA female, 50 ohm	SMA male, 50 ohm
Certification	Radio module pre-certified according to EN 300 220	Radio module pre-certified according to EN 300 328

Sensitivity, link budget and distance are the values of the radio module datasheets.

Hardware	DC models: TLM154, TLM194	AC models: TLM254, TLM294	BPL models: TLM655, TLM695
			
Ethernet	2 x 10/100Base-T(X), RJ-45, built-in switch	2 x 10/100Base-T(X), RJ-45, built-in switch	2 x 10/100Base-T(X) + 1 x BPL link
Serial	1 x RS232 and 1 x RS485 (one at a time), 300 - 460800 baud	1 x RS232 and 1 x RS485 (one at a time), 300 - 460800 baud	1 x RS232 and 1 x RS485 (one at a time), 300 - 460800 baud
Console port	USB Type-C (micro USB on earlier hardware), 115200 baud, FTDI; log output only	USB Type-C (micro USB on earlier hardware), 115200 baud, FTDI; log output only	USB Type-C (micro USB on earlier hardware), 115200 baud, FTDI; log output only
Power input	5 - 48 V DC (60 V maximum)	100 - 240 V AC (120 - 370 V DC), 50 / 60 Hz	Three-phase AC, 110 - 240 V, 50 / 60 Hz (power on L1 and N), or 9 - 36 V DC (DC version)
Protection	Reverse polarity; thermal shutdown and current limit	Isolation more than 4200 Vrms (5 mA, 1 min); insulation class II	AC: short circuit, overload and over voltage; isolation class II; 3 kV AC input to output
Enclosure	Metal, IP40	Metal, IP40	Metal, IP40
Mounting	DIN rail	DIN rail	DIN rail
Dimensions (w x d x h)	43 x 95 x 124 mm	43 x 95 x 124 mm	43 x 95 x 124 mm
Weight	about 400 g	about 400 g	about 400 g
Operating temperature	-40 to +85 C	-25 to +70 C	-25 to +70 C (AC versions), -40 to +85 C (DC version)
Storage temperature	-65 to +150 C	-40 to +85 C	-65 to +150 C
Operating humidity	5 to 95 %, non-condensing	10 to 95 %, non-condensing	5 to 95 %, non-condensing

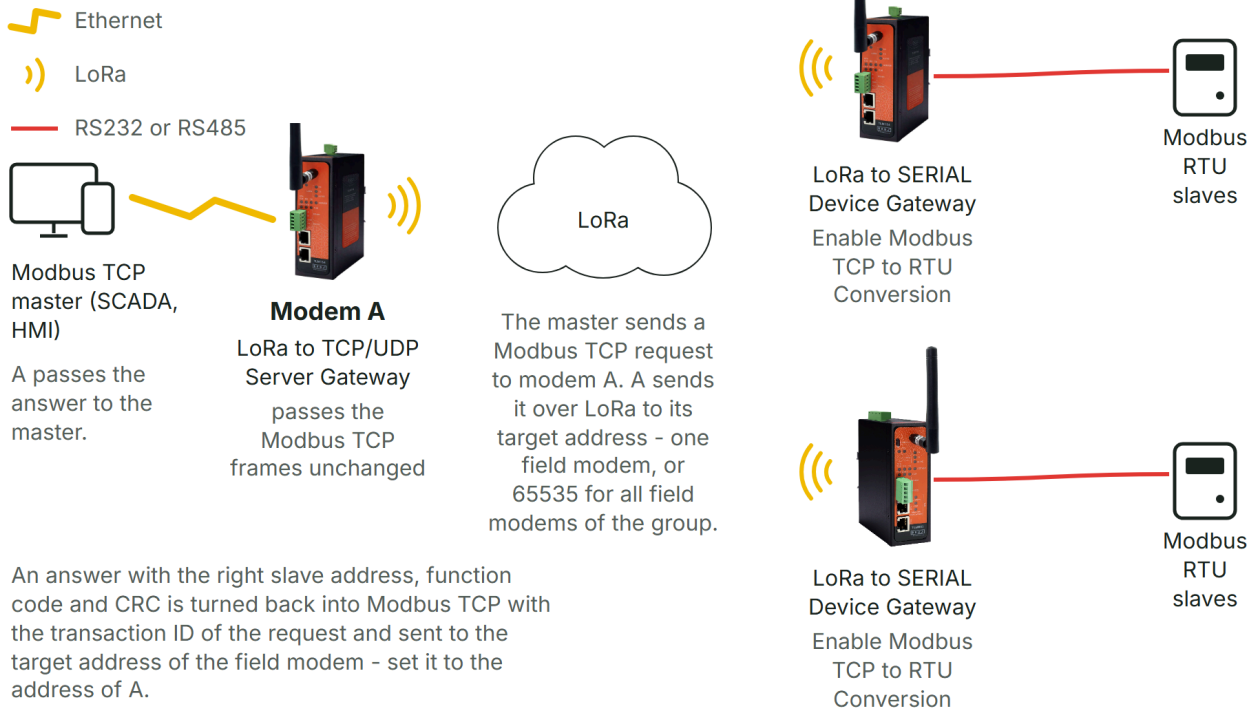
Product Comparison

Model	Radio	5 - 48 V DC (60 V maximum)	100 - 240 V AC (120 - 370 V DC), 50 / 60 Hz	Three-phase AC, 110 - 240 V, 50 / 60 Hz	2 x 10/100Base-T(X) Ethernet	1 x RS232 and 1 x RS485	BPL link
TLM154	868 MHz	●			●	●	
TLM254	868 MHz		●		●	●	
TLM655	868 MHz			● *	●	●	●
TLM194	2.4 GHz	●			●	●	
TLM294	2.4 GHz		●		●	●	
TLM695	2.4 GHz			● *	●	●	●

* TLM655 and TLM695 are also made with a 9 - 36 V DC power input (P-P data connection).

Typical Application

Modbus TCP master to Modbus RTU slaves



Typical application - Modbus TCP master to Modbus RTU slaves

A Modbus TCP master (SCADA, HMI) reads Modbus RTU slaves in the field. Modem A next to the master works as LoRa to TCP/UDP Server Gateway and passes the Modbus TCP frames unchanged. The field modems work as LoRa to SERIAL Device Gateway with Enable Modbus TCP to RTU Conversion and convert between Modbus TCP and Modbus RTU on their serial line.

Typical applications: automated meter reading, wireless networks, home, building and industrial automation, remote control, wireless sensors, telemetry, wireless alarm and security systems.

Ordering Information

TLM154: 868 MHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485, 5 - 48 V DC power input (60 V maximum)

TLM254: 868 MHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485, 100 - 240 V AC (120 - 370 V DC), 50 / 60 Hz power input

TLM655-PN-AC: 868 MHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, three-phase AC power input, 110 - 240 V, 50 / 60 Hz, phase to neutral (P-N) data connection

TLM655-PP-AC: 868 MHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, three-phase AC power input, 110 - 240 V, 50 / 60 Hz, phase to phase (P-P) data connection

TLM655-PP-DC: 868 MHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, 9 - 36 V DC power input, phase to phase (P-P) data connection

TLM194: 2.4 GHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485, 5 - 48 V DC power input (60 V maximum)

TLM294: 2.4 GHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485, 100 - 240 V AC (120 - 370 V DC), 50 / 60 Hz power input

TLM695-PN-AC: 2.4 GHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, three-phase AC power input, 110 - 240 V, 50 / 60 Hz, phase to neutral (P-N) data connection

TLM695-PP-AC: 2.4 GHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, three-phase AC power input, 110 - 240 V, 50 / 60 Hz, phase to phase (P-P) data connection

TLM695-PP-DC: 2.4 GHz LoRa RF Modem, 2 x 10/100Base-T(X) Ethernet ports and 1 x BPL (Broadband Power Line) link, 1 x RS232 and 1 x RS485, 9 - 36 V DC power input, phase to phase (P-P) data connection