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SMART COMMUNICATION

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TLM Series LoRaWAN EndNode Modems

Modbus RTU and Modbus TCP Scheduler: field device data to the LoRaWAN network server
TCP Server, TCP Client and SERIAL Device Gateway: data passed to the LoRaWAN network server as it is
EU 868, IN 865, US 915 and AS 923 MHz models

2 x 10/100Base-T(X) Ethernet ports, 1 x RS232 and 1 x RS485 serial ports, option for BPL (Broadband Power Line) link

The TLM Series LoRaWAN EndNode Modems create a link between field devices and a LoRaWAN network server. They read field Modbus RTU devices on the RS232 / RS485 port or Modbus TCP devices on the network and send the data to the LoRaWAN server; LoRaWAN downlink messages carry Modbus commands back to the field devices. As a gateway the modem sends the data of TCP/IP or RS232 / RS485 devices to the LoRaWAN server as it is.

Five Device Functions

1. **LoRaWAN to Modbus RTU Scheduler:** reads up to 128 Modbus RTU query rows on the RS232 or RS485 port and sends the replies as LoRaWAN uplinks.
2. **LoRaWAN to Modbus TCP Scheduler:** reads up to 128 Modbus TCP query rows (IP address and TCP port of each row) and sends the replies as LoRaWAN uplinks.
3. **LoRaWAN to TCP Server Gateway:** TCP clients (up to 10) connect to the modem; their data goes to the LoRaWAN server, downlinks go back to them.
4. **LoRaWAN to TCP Client Gateway:** the modem connects to a remote TCP server and passes data between it and the LoRaWAN server.
5. **LoRaWAN to SERIAL Device Gateway:** passes data between an RS232 or RS485 device (300 to 460800 baud) and the LoRaWAN server.

Key Figures

EU868 / IN865 / US915 / AS923
LoRaWAN band of the model; the frequency plan is selected on the web page

128 Modbus rows
Modbus RTU or Modbus TCP, each row with its own query and LoRaWAN send interval

Up to 15 km
radio range in line of sight (radio module datasheets)

Event uplinks
per row, on a change or a threshold, besides the periodic uplink

Class A / Class C
OTAA or ABP activation, with or without ACK

300 - 460800 baud
RS232 or RS485 serial port (SERIAL Device Gateway)

Main Features

Modbus scheduler

- Up to 128 query rows; each row: slave address, function code 01 to 04, data address, number of data, query interval, time out and LoRaWAN send interval.
- Modbus RTU rows: RS232 or RS485 for each row, 9600, 19200, 38400, 57600 or 115200 baud with 8_NONE_1, 8_EVEN_1, 8_ODD_1 or 8_NONE_2.
- Modbus TCP rows: IP address and TCP port for each row; up to 10 TCP connections at the same time.
- Downlink Modbus commands from the LoRaWAN server: function codes 1-2-3-4-5-6, 15 and 16.
- Event uplink for each row: on a change or on a threshold with hysteresis (U16, S16, U32, S32 or Float32 value).
- Error uplink for each row: a Modbus exception when there is no valid reply (code 0x0B; 0x0A when the TCP connection fails).
- Time option for each row: the age of the reading (seconds) is added to the uplink.

LoRaWAN

- Activation over the air (OTAA) or by personalization (ABP); Class A or Class C; data transmission with or without ACK.
- Adaptive Data Rate, selectable uplink data rate and Tx power level (EIRP), LoRaWAN port 2 to 255.
- At most one uplink every 10 seconds; data larger than the maximum payload size is split into several uplinks; the duty cycle limit of the region applies.
- Device EUI read from the radio module and shown on the LoRa Settings page.

Network and management

- DHCP client or static address; DHCP server; NTP time synchronization.
- Embedded web interface; Device Status cards for LoRaWAN, LoRa Radio, the function in use and the serial line, with the age of the last uplink; a Scheduler Rows view of every Modbus row.
- Firmware update over the web interface; two firmware banks in the device, the other firmware can be started again.
- Configuration backup and restore as a file.
- Log output to the console port, a UDP server or a syslog server (RFC 3164).
- White list and black list IP filter (TCP Server Gateway); password protected web interface.

Extra Features of the BPL Models (TLM745, TLM755, TLM765, TLM775)

- 2 x 10/100Base-T(X) ports + 1 x BPL link; wide range 3 phase AC input.
- Up to 30 Mbps PHY rate on BPL with up to 10 hops and 1000 nodes.
- Up to 432 sub-carriers from 2 to 28 MHz analog bandwidth; LDPC-C FEC with 128-bit AES core.
- Plug and play; master or node selected on the web interface.
- Power and data: the AC power supply uses L1-N only; phase 2-3 connections are used for BPL signal transmission.

Technical Data

LoRaWAN radio	EU 868 MHz	IN 865 MHz	US 915 MHz	AS 923 MHz
Models	TLM354, TLM454, TLM755	TLM344, TLM444, TLM745	TLM364, TLM464, TLM765	TLM374, TLM474, TLM775
Frequency plan	EU868; EU868 with RX2 SF9	IN865; IN865 with RX2 SF8	US915, sub-band mask selectable	AS923 plans: Brunei, Cambodia, Indonesia, Japan, Laos, New Zealand, Singapore, Taiwan, Thailand, Vietnam
Uplink data rate	SF12 to SF7 / 125 kHz (250 to 5470 bps)	SF12 to SF7 / 125 kHz (250 to 5470 bps); FSK 50 kbps	SF10 to SF7 / 125 kHz (980 to 5470 bps); SF8 / 500 kHz (12500 bps)	SF10 to SF7 / 125 kHz (980 to 5470 bps)
Tx power level (EIRP)	0 to 16 dBm	0 to 22 dBm	0 to 20 dBm	0 to 16 dBm
Sensitivity	down to -138 dBm	down to -138 dBm	down to -138 dBm	down to -138 dBm
Link budget	up to 156 dB	up to 156 dB	up to 155 dB	up to 155 dB
Communication distance	up to 15 km line of sight	up to 15 km line of sight	up to 15 km line of sight	up to 15 km line of sight
Radio module output power (conducted)	19.0 dBm typical	19.0 dBm typical	17.5 dBm typical; 18.07 / 18.26 dBm maximum (125 / 500 kHz)	17.5 dBm typical; 18.07 / 18.26 dBm maximum (125 / 500 kHz)
Antenna	SMA female, 50 ohm	SMA female, 50 ohm	SMA female, 50 ohm	SMA female, 50 ohm

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

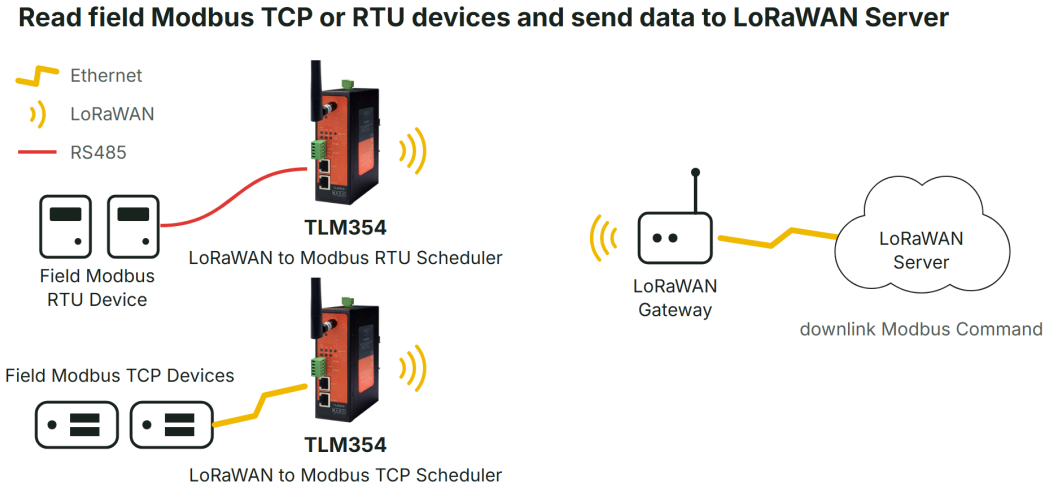
Hardware	DC models: TLM344, TLM354, TLM364, TLM374	AC models: TLM444, TLM454, TLM464, TLM474	BPL models: TLM745, TLM755, TLM765, TLM775
Ethernet	2 x 10/100Base-T(X)	2 x 10/100Base-T(X)	2 x 10/100Base-T(X) + 1 x BPL link
Serial	1 x RS232 + 1 x RS485; 300 - 460800 baud (SERIAL Device Gateway), 9600 - 115200 baud (Modbus RTU rows)	1 x RS232 + 1 x RS485; 300 - 460800 baud (SERIAL Device Gateway), 9600 - 115200 baud (Modbus RTU rows)	1 x RS232 + 1 x RS485; 300 - 460800 baud (SERIAL Device Gateway), 9600 - 115200 baud (Modbus RTU rows)
Console port	Micro USB or USB Type-C, log, 115200 baud	Micro USB or USB Type-C, log, 115200 baud	Micro USB or USB Type-C, log, 115200 baud
Power input	5-48V DC (allows up to 60 V DC)	100 - 240V AC (120 - 370V DC), 50 Hz to 60 Hz	3 phase, 110 - 240 V, 50 - 60 Hz; also made with 9 - 36 V DC power
Protection	Reverse polarity; thermal shutdown and current limit	Isolation > 4200 Vrms, 5 mA, 1 min; insulation class II	-
Enclosure	Metal, IP 40	Metal, IP 40	Metal, IP 40
Mounting	DIN rail	DIN rail	DIN rail
Dimensions	43 x 95 x 124 mm (w x d x h)	43 x 95 x 124 mm (w x d x h)	43 x 95 x 124 mm (w x d x h)
Weight	approx. 400 g	approx. 400 g	approx. 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	10% 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
TLM344	**865 MHz**	●			●	●	
TLM444	**865 MHz**		●		●	●	
TLM745	**865 MHz**			●*	●	●	●
TLM354	**868 MHz**	●			●	●	
TLM454	**868 MHz**		●		●	●	
TLM755	**868 MHz**			●*	●	●	●
TLM364	**915 MHz**	●			●	●	
TLM464	**915 MHz**		●		●	●	
TLM765	**915 MHz**			●*	●	●	●
TLM374	**923 MHz**	●			●	●	
TLM474	**923 MHz**		●		●	●	
TLM775	**923 MHz**			●*	●	●	●

* TLM745, TLM755, TLM765 and TLM775 are also made with a 9 - 36 V DC power input (P-P data connection).

Typical Application



Typical application - field Modbus TCP and Modbus RTU devices read by the modem; the data goes through a LoRaWAN gateway to the LoRaWAN network server.

With LoRaWAN to Modbus RTU Scheduler the modem reads the Modbus RTU devices on its RS485 or RS232 port; with LoRaWAN to Modbus TCP Scheduler it reads the Modbus TCP devices on the LAN. The replies are sent as LoRaWAN uplinks through a LoRaWAN gateway; the LoRaWAN network server can send Modbus commands back as downlinks.

Typical applications: automated meter reading, home, building and industrial automation, wireless sensors, telemetry.

Ordering Information

TLM344: 865 MHz LoRaWAN EndNode 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)

TLM444: 865 MHz LoRaWAN EndNode 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

TLM745-PN-AC: 865 MHz LoRaWAN EndNode 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

TLM745-PP-AC: 865 MHz LoRaWAN EndNode 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

TLM745-PP-DC: 865 MHz LoRaWAN EndNode 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

TLM354: 868 MHz LoRaWAN EndNode 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)

TLM454: 868 MHz LoRaWAN EndNode 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

TLM755-PN-AC: 868 MHz LoRaWAN EndNode 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

TLM755-PP-AC: 868 MHz LoRaWAN EndNode 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

TLM755-PP-DC: 868 MHz LoRaWAN EndNode 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

TLM364: 915 MHz LoRaWAN EndNode 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)

TLM464: 915 MHz LoRaWAN EndNode 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

TLM765-PN-AC: 915 MHz LoRaWAN EndNode 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

TLM765-PP-AC: 915 MHz LoRaWAN EndNode 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

TLM765-PP-DC: 915 MHz LoRaWAN EndNode 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

TLM374: 923 MHz LoRaWAN EndNode 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)

TLM474: 923 MHz LoRaWAN EndNode 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

TLM775-PN-AC: 923 MHz LoRaWAN EndNode 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

TLM775-PP-AC: 923 MHz LoRaWAN EndNode 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

TLM775-PP-DC: 923 MHz LoRaWAN EndNode 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