Bridge LR

Bridge LR is a bridge that converts RS-485 physical environment to wireless long range network LoRa™. The device is completely configurable by the PC application, used to setup any parameter of RS-485 serial port or LoRa™ radio.

The solution has a master bridge connected to RS-485 Modbus RTU master, and as many slave bridges as communication bus we want to monitor. It's possible to connect up to 32 devices in each communication bus.

The communication between master and slaves is completely transparent to allow an easy installation. However, it is required to control the time between messages on transmission, and timeout time between Modbus master and final sensors. Recommended time for both parameters is 3 seconds.

Bridge LR standard maximum communication's range are 1 km indoor and up to 15 of outdoor with direct line of sight.

TECHNICAL CHARACTERISTICS

Power circuit	
Input voltage	110 … 264 Vac
Frequency	47 … 63 Hz
Maximum consumption	2,5 …. 4,5 VA
Environmental conditions	
Temperature range	-10 …. +60ºC
Humidity range	5 …. 95%
Mechanical characteristics	
Enclosure material	Plastic UL94 – V0 Self-extinguishable
Protection grade	IP20
Unit dimensions (Width x Height x Length)	18 x 70 x 109 mm
Weight	70 g
Mounting	DIN Rail (1 module)
Maximum working altitude	2000 m
Serial interface	
Type	RS-485 three wires
Baud rate	9600 / 19200 / 38400 / 57600 / 115200 bps configurable
Data bits	8
Parity	Without parity / Even configurable
Stop bits	1 / 2 configurable
Characteristics and electrical security	
Security	CAT III 300 V under EN 61010
Electric shock protection	Double insulation class II
Standards	
Standards	UNE EN 61010-1:2010, UNE-EN 61000-6-2, UNE-EN 61000-6-4

INSTALLATION

**Bridge LR** has been designed for DIN rail mounting.

|	**IMPORTANT**
⚠	Take into account that when the device is connected, the terminals may be hazardous to the touch, and opening the covers or removing elements may provide access to parts that are dangerous to the touch. Do not use the device until it is fully installed

CONNECTIONS
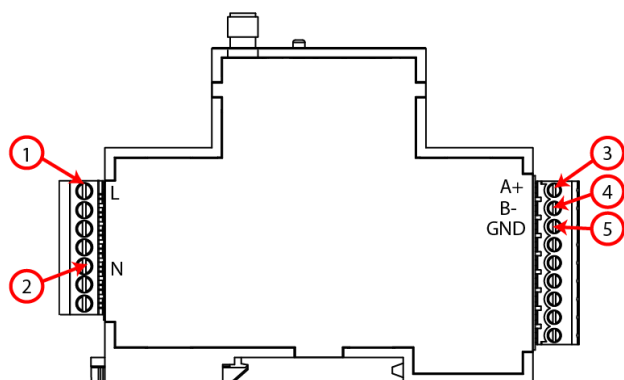
Mark	Description
1	**L,** Power supply
2	**N,** Power supply
3	**A+,** RS-485 port
4	**B-,** RS-485 port
5	**GND,** RS-485 port

LEDS
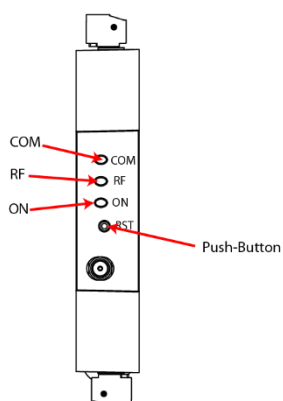
Led	Description
ON	**Power** - Activity: Green led on
RF	**LoRa™ radiofrequency** - Data transmission: Red slow blinking - Data reception: Green rapid blinking - Silence/waiting time: Blue led on (only on Master mode)
COM	**RS-485** - Data transmission: Red rapid blinking - Data reception: Green rapid blinking

DIMENSIONS
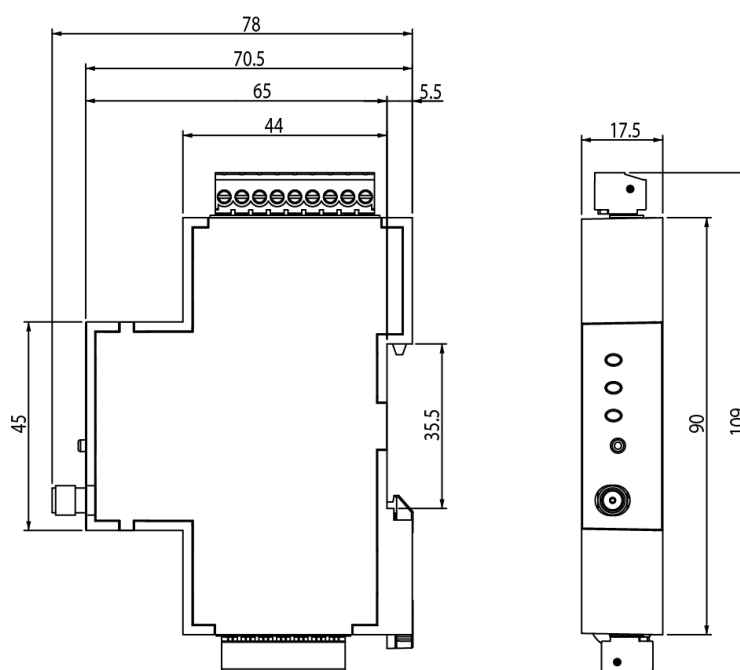
RS-485 COMMUNICATION

The device comes equipped with a RS-485 communication port to read and write the parameters of the device or other devices connected. The protocol used is Modbus RTU.

By default the device is configured with **peripheral number 1** (decimal) and **communication mode 0** (9600 bps, 8, N, 1). Using the command for changing the device number it is possible to assign any other number (maximum FF in hexadecimal or 255 in decimal).
In case you don't remember the slave number, you can return to default number and communication mode following this steps:
- Press and hold for 10 seconds the reset button.
- Stop pressing the reset button (leds will blink several times) and the device will recover all factory default settings.

LORA™ COMMUNICATION PARAMETERS

The device comes equipped with LoRa™ radio technology wireless communication for private networks. These devices are only for private networks and can't be connected to LoRaWAN networks. By default, **Bridge LR** is configured in **slave mode**.

The frequency for Europe is free ISM band 868 MHz but the device incorporates 9 different channels between 865,1 MHz (channel 0) and 869,85 MHz (channel 9). **Default frequency is fixed to 869,525 MHz (channel 7)**. These channels have different settings of **working time and silence time** depending on restrictions of each frequency. The following table shows the **duty cycle** of each frequency channel which is the percentage of time that it's allowed to transmit in each channel. The smaller the duty cycle is, more restrictive the transmission period is. It's recommended to use channels with bigger duty cycle for applications that require a faster data refresh time.

Radio channel	Frequency	Duty cycle
0	865,1 MHz	1%
1	865,2 MHz	1%
2	865,6 MHz	1%
3	868,5 MHz	1%
4	868,3 MHz	1%
5	868,85 MHz	0,10%
6	868,95 MHz	0,10%
7	869,525 MHz	10%
8	869,85 MHz	1%

In reference to **transmission and reception mode**, the device includes 10 modes to choose between 300 bps and 21875 bps considering that increasing bitrate affects to signals coverage.
In order to comply the spectral limitation, depends on transmission mode configured in the master, a silence time will be established. During this time, the device won't be able to transmit and that will be displayed with RF led fixed on blue and returning "Busy" via serial port. The following table shows the properties of each mode:

LoRa™ mode	Bits per second	Comments and maximum distance
0	292,97 bps	Maximum distance. Minimum bitrate. Max. 15 km
1	585,94 bps	Max. 7,50 km
2	976,56 bps	Max. 4,50 km
3	1171,88 bps	Max. 3,75 km
4	1953,13 bps	Max. 2,25 km
5	2148,44 bps	Max. 2,05 km
6	3515,63 bps	Max. 1,25 km
7	7031,25 bps	Max. 0,63 km
8	12500 bps	Max. 0,35 km
9	21875 bps	Minimum distance. Maximum bitrate. Max. 0,20 km

LORA™ COMMUNICATION RULES

Below, we describe all the time parameters that you need to manage in order to install properly the wireless network:

- **Transmission time**: It's the time it takes for a data submission to go out of the Modbus Master, get the data from the Modbus slave and return to the Modbus Master (a complete communication cycle). On LoRa™ communications, it could take from 0,5 to 10 seconds, depending on Bridge LR configuration.
- **Silence time**: According on the configuration of LoRa™ mode, LoRa™ frequency and LoRa™ transmission time, Bridge LR Master fix a silence time. During this time, all RS-485 communication through the LoRa™ network are blocked. If the Modbus Master continues sending data requests, it will receive timeout answers.
- **Time between transmissions**: From the point of view of Modbus Master, it's the time between RS-485 requests. Basically, the sending cadence.

The following diagram shows the described times in a graphical way:
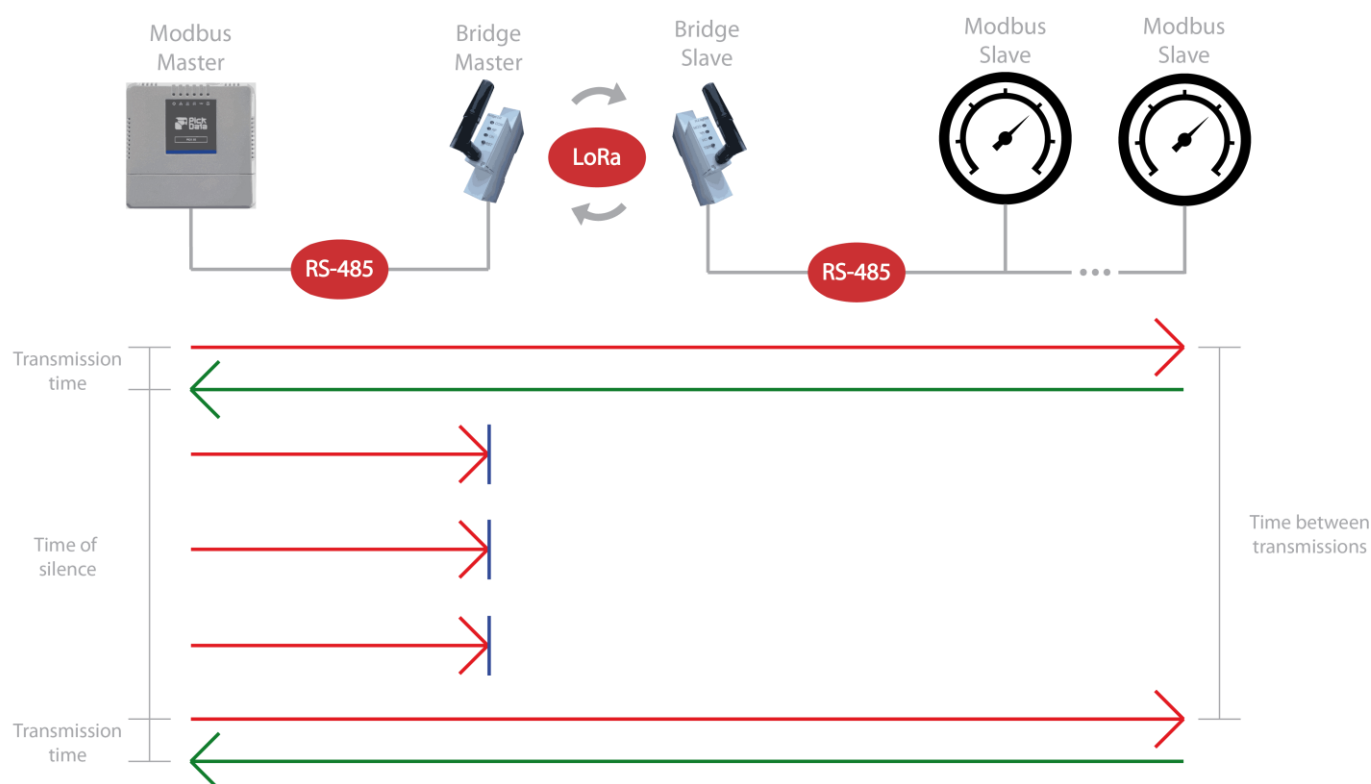
Based on these times, we establish 2 communication rules that must be applied at the Modbus Master. The first one is completely mandatory in order to establish communication with the Modbus slaves through a Bridge LR network:

> **Timeout RX Master Modbus > Transmission time**

The second rule allows you to avoid timeout errors at communication bus. It's not mandatory, but it's highly recommended to skip false errors and have a clean RS-485 communication log:

> **Time between transmissions = Transmission time + Silence time**

LORA™ TRANSMISSION CYCLE

As explained among the previous sections of the manual, in order to reach a wireless communication between the Modbus master and the Modbus slaves (via Bridge LR converters from Modbus to LoRa™), timing rules must be configured on the Modbus master responsible to communicate with the devices.

Below, we show a guide with information about the transmission and silence time generated in common scenarios like querying 1 or 2 Modbus registers from a Modbus master to an end slave. These times are just a reference and they could change depending on the communication area.

The transmission time must be configured as timeout; and the total time must be configured as time between transmissions in the Modbus master. The first rule is completely mandatory to ensure the wireless communication, and the second rule will allow you to control the cadence between queries. We highly recommend to apply both rules to your Modbus master to control the sequence and the petitions order, and to avoid Modbus communication errors between you master and slaves.

Transmission of 1 Modbus register (16 bits)

LoRa™ mode	Transmission time	Silence time	Total time
0	4s	8s	12s
1	3s	3s	6s
2	2s	3s	5s
3	2s	2s	4s
4	1s	2s	3s
5	1s	1s	2s
6	1s	1s	2s
7	1s	1s	2s
8	0.402s	1s	1.402s
9	≈0	≈0	0.126s

Transmission of 2 Modbus registers (32 bits)

LoRa™ mode	Transmission time	Silence time	Total time
0	4s	14s	18s
1	3s	6s	9s
2	3s	3s	6s
3	2s	3s	5s
4	2s	2s	4s
5	1s	2s	3s
6	1s	1s	2s
7	1s	1s	2s
8	0.804s	1s	1.804s
9	≈0	≈0	0.196s

PC SOFTWARE
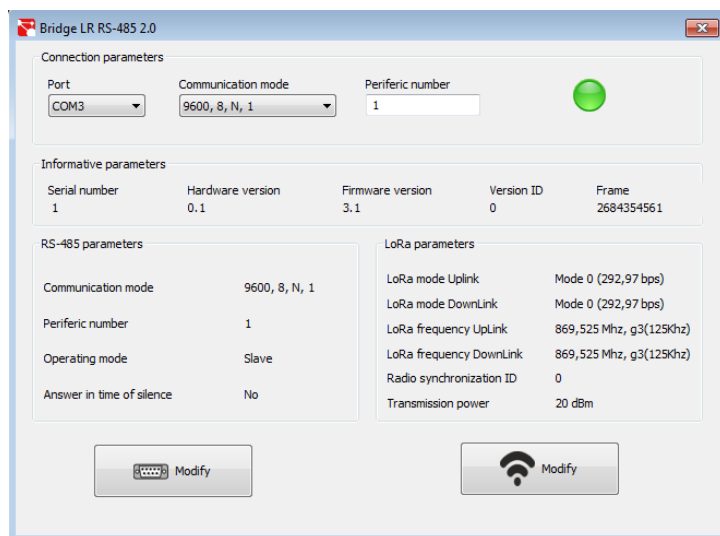
A PC software is used to easy configure the device. This software can be downloaded from the web site www.pickdata.net

To proceed with configuration, connect the device to the computer using a USB RS-485 converter/bridge and fill in the fields of *Connection parameters* section, choosing the communications port assigned by the PC (visible accessing to *Devices administrator/Ports (COM and LPT))*, the communication mode and the peripheral number of Bridge LR.

Once the device is communicating, you will be able to see the communication icon turning into green and you will be able to read informative parameters, RS-485 and LoRa™ parameters.

To configure RS-485 parameters you must click *Modify* button with serial port icon.

Accessing we will be able to configure the parameters *Communication mode, Peripheral number, Mode* and *Answer in time of silence.* Mode will allow us to choose if **Bridge LR** will be the *Master* of the installation or *Slave* (32 units - physical limit). Enabling the parameter of *Answer in time of silence* will force Bridge LR Master to answer "Busy" when the Modbus Master sends any transmission request during the Time of silence (blue led ON).

Once all changes are done, we must click *Accept* button to send it to the device. Changes done at RS-485 parameters section are applied automatically without need of update *Connections parameter* to recover serial communication.
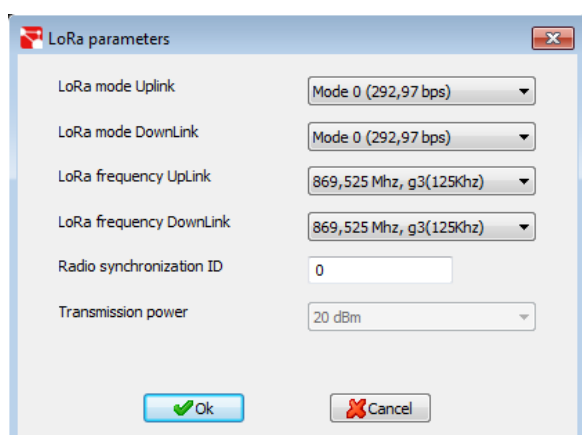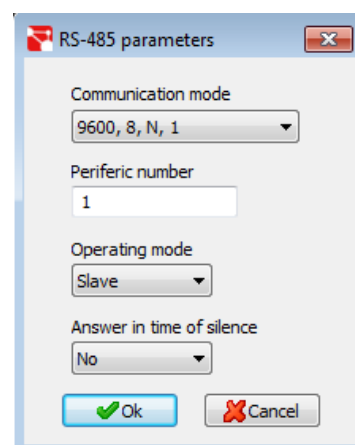
To configure LoRa™ parameters we must click *Modify* button with wireless network icon.

Accessing we will be able to configure *LoRa™ mode UpLink, LoRa™ mode Downlink, LoRa™ frequency UpLink, LoRa™ frequency DownLink, LoRa™ gateway ID, Transmission power* and *Radio synchronization ID.*

To perform a basic configuration we only need to ensure that *Mode* and *Frequency* parameters are identical at the *Master* and all *Slaves* on the same network. The parameter *ID synchronization* allows to create subnetwork between *Master* and *Slaves* with the same network ID.

For advanced configuration visit PickData website.

MODBUS RTU REGISTERS MAP

Magnitude	Holding registers	Unit	Function
Serial number	0x00-0x03		3
Software version	0x04-0x05		3
Device ID	0x06		3
Hardware version	0x07		3
Peripheral number	0x0E-0x0F	1 (Default)	3,16(0x10)
RS-485 communication	0x10-0x11	0: 9600, 8, N, 1 (Default) 1: 19200, 8, N, 1 2: 38400, 8, N, 1 3: 57600, 8, N, 1 4: 115200, 8, N, 1 5: 9600, 8, E, 1 6: 19200, 8, E, 1 7: 9600, 8, N, 2 8: 19200, 8, N, 2 13: 38400, 8, N, 2	3,16(0x10)
Operating mode	0x12-0x13	0: Slave (Default) 1: Master	3,16(0x10)
Silence time (only Master)	0x1E-0x1F	ms	3
LoRa™ reception mode	0x50-0x51	0: 292,97 bps (Default) 1: 585,94 bps 2: 976,56 bps 3: 1171,88 bps 4: 1953,13 bps 5: 2148,44 bps 6: 3515,63 bps 7: 7031,25 bps 8: 12500 bps 9: 21875 bps	3,16(0x10)
LoRa™ transmission mode	0x52-0x53	Same than reception mode	3,16(0x10)
LoRa™ reception frequency	0x54-0x55	0: 865,1 MHz 1: 865,2 MHz 2: 865,6 MHz 3: 868,5 MHz 4: 868,3 MHz 5: 868,85 MHz 6: 868,95 MHz 7: 869,525 MHz (Default) 8: 869,85 MHz	3,16(0x10)
LoRa™ transmission frequency	0x56-0x57	Same than reception mode	3,16(0x10)
Radio synchronization ID	0x58-0x59	0: No subnetworks Other: Subnetwork ID	3,16(0x10)
Radio signal strength (firmware version 11.0 or later)	0x1004	MSB: RSSI (negative dBm) LSB: SNR If 0 < SNR < 15, Positive If SNR > 15, Subtract 0xFF and process as Negative	4

MODEL REFERENCE

Model	Reference	Protocol	Communication
Bridge LR 230 VAC	P008	Modbus/RTU	RS-485

EXTERNAL ANTENNA REFERENCE

In case that an external antenna is needed:

Model	Reference	Cable length	Connector type
Antenna wall-mounted indoor	E001	2 meters	SMA Male
Antivandal antenna IP67 multi-band LORA/4G 1 mt	E032	1 meter	SMA Male

SAFETY PRECAUTIONS

	DANGER Warns of a risk, which could result in personal injury or material damage caused by an incorrect handling or installation of the unit. In particular, handling with voltages applied may result in electric shock, which may cause death or serious injury to personnel. Defective installation or maintenance may also lead to the risk of fi re. Read the manual carefully prior to connecting the unit. Follow all installation and maintenance instructions throughout the unit's working life. Pay special attention to the installation standards of the National Electrical Code.

DISCLAIMER

PickData, SL reserves the right to make modifications to the device or the unit specifications set out in this instruction manual without prior notice.

PickData, SL on its web site, supplies its customers with the latest versions of the device specifications and the most updated manuals.

MAINTENANCE AND TECHNICAL SERVICE

Device doesn't require maintenance.
In the case of any query in relation to unit operation or malfunction, please contact the PickData, SL technical support service.