LR210 LR260 LORA RELAY

INSTRUCTIONS MANUAL

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INTRODUCTION

This user manual helps you setup and use the LR210 and LR260 LoRa Relay controller, it contains both installation and protocol description for both versions of the product.

DISCLAIMER

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TECHNICAL SUPPORT

If you have problem using this product and can’t find the information in this manual, please contact us at any of the following addresses

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PRODUCT DESCRIPTION

OVERVIEW

Both LR210 and LR260 are DIN-mounted relay controllers allowing independent control of 2 relays channels over a LoRa network. Main difference between the LR210 and LR260 is the power supply side, LR210 is supplied directly from AC mains whereas LR260 is a 8 to 30V DC powered version. Both LR210 and LR260 by default features an always on LoRa Class C receiver for instant response to downlink commands. In addition the LR260 can be configured into a special low power mode where the receiver is setup as a Class A LoRa devices with downlink only available after each uplink data packet. This manual is common for both versions of the product, differences will be highlighted where applicable. Where both products are referenced, the designation “LR2x0” will be used which applies to both LR210 and LR260.

FEATURES

- 2 relay channels, each supporting up to 10A current
- LR210: AC mains powered
- LR260: DC 8-30V powered
- LoRa EU868 version 1.0.2 device
- LoRa Class C receiver
- LR260 in special low power mode: LoRa Class A receiver
- LED status indication for power, LoRa and relay states
- User buttons for manual relay control
- User button for LoRa activation and reset control
- Each relay channel fully isolated

TECHNICAL DATA

RELAY SPECIFICATION (EACH CHANNEL)

- Contact material: Ag-Alloy (Cd free)
- Rated carry current: 10A
- Max switching current: 10A AC
5A DC
- Max switching voltage: 277 VAC
30 VDC
- Contact resistance: 100mΩ max
- Durability: 100 000 operations 5A 30 VDC
25 000 operations 10A 250 VAC
- Isolation voltage: 4000 VAC

LORAWAN

- Frequency: 868MHz (EU868 region)
- Output power: 14dBm
- Antenna: Built-In
- Activation mode: OTAA (Over The Air Activation)

LR210 POWER SUPPLY

- Input voltage range: 85 to 250 VAC
- Input frequency: 47 to 63 Hz
- Input power: 1W (max)
- Isolation voltage: 4000 VAC

LR260 POWER SUPPLY

- Input voltage range: 8 to 30 VDC
over-voltage and reverse polarity protected
- Input power: 1W (max)

ENVIRONMENTAL

- Operating Temperature: -30C to +55C
- Storage Temperature: -40C to +85C
- Altitude: 0 to 2000m
- Operating humidity: max 85% RH (non-condensing)
- Usage: Indoor usage, pollution degree 2

INSTALLATION

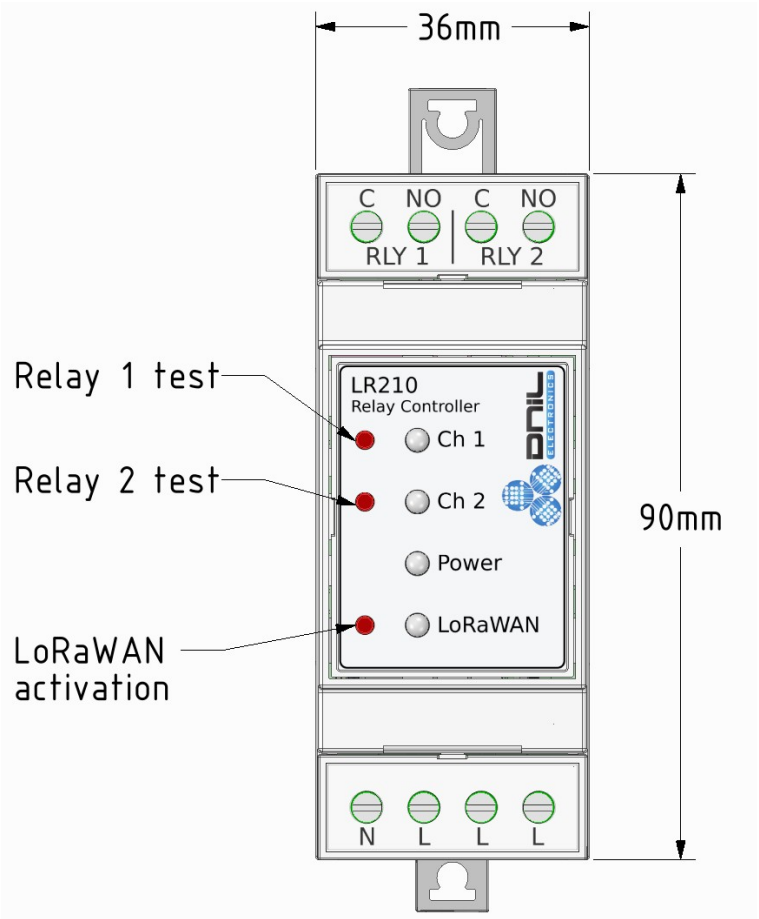
LR2x0 is installed on a standard 35mm DIN-rail using the built-in rail clips, the device is 36mm wide.

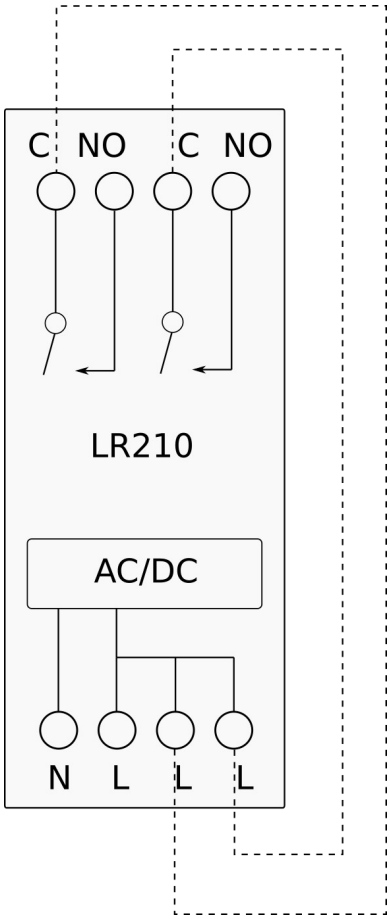
Wires are installed to terminal blocks at the top and bottom of the device, referring to the picture the relay connections are at the top and supply power at the bottom. The terminals each accept 0.05 to 4.0mm² (30-12 AWG) wires.

Each relay is connected using a common (“C”) and a normally open (“NO”) terminal, note that both relay channels are isolated both from each other as well as from the mains supply voltage.

LR210 AC MAINS CONNECTIONS

Supply voltage is connected between the neutral (“N”) and one of the line “L” terminals. There are a total of three line terminals marked ”L” which are all internally connected. The intention is to allow using the line terminals as a connection bar for example to run mains line voltage to either one of the relay terminals. Refer to the following connection diagram showing the internal functions of the LR210 as well as the optional (dashed) connections when the ”L” terminals are used as a connection bar.

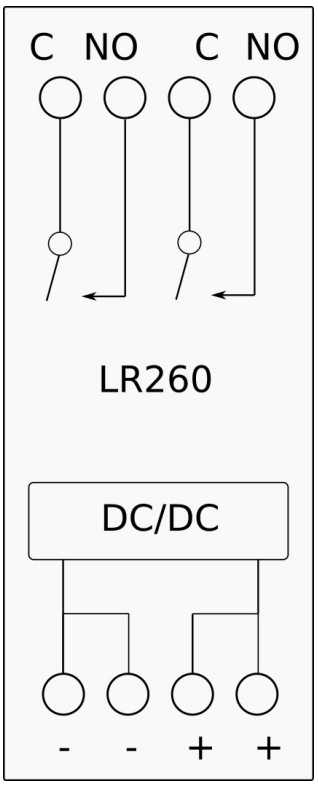




LR260 DC SUPPLY CONNECTIONS

A 8 to 30V DC power supply is connected to the terminals labeled ‘+’ and ‘-’ at the bottom of the DIN enclosure on the LR260. Similar to the LR210 there are dual terminals for both ‘+’ and ‘-’ which are internally connected, please reference picture on the right. The dual terminals are supplied with the intention to be usable as bus bars.

The LR260 is internally equipped with a 0.75A fuse, no additional fuse is required external to the device for protecting the LR260 itself however wiring to the LR260 should be protected. DC input is over-voltage protected capable of handling up to 120V transients, as well as reverse polarity protection.



OPERATION

POWER ON

When mains power is connected to the device the green LED labeled “Power” will be illuminated after 2-3 seconds. This indicates that the device is ready for LoRa activation and for manual relay operation.

RELAY OPERATION

On the front panel, each relay channel (“Ch 1” and “Ch 2”) has both an yellow LED indicator and a manual test button. The relay LED is illuminated when the corresponding relay channel is activated (closing the “C” and “NO” terminals). For installation test purposes it is possible to manually operate a relay by pressing the button next to the relay channel LED on the front panel, while the button is pressed the relay will invert its state (inactive relay becomes active and vice versa).

ACTIVATION

The LR2x0 is delivered in a deactivated state where no radio communication in either direction is possible, before LoRaWAN operation is possible to device needs to be activated and successfully joined on a LoRaWAN network. A deactivated state is indicated by the LoRaWAN LED being constantly off.

Ensure that the device is provisioned as a LoRa Class C device on the network server with the correct credentials, each device has a unique activation key which is provided at the time of delivery. The DevEUI is printed on the device label, and is also available in a machine readable data matrix format. For the special LR260 low power mode configuration the device shall be provisioned as a LoRa Class A device.

Press and hold the red button to the left of the LoRaWAN LED for around 3 seconds, then release the button. The green LoRaWAN LED will start blinking which indicates that the LR2x0 is attempting to join the LoRaWAN network, when the join procedure is completed successfully the green LoRaWAN LED will be lit constantly.

DEACTIVATION

If the LR2x0 needs to be returned back to the deactivated state (“factory reset”) for any reason this if performed by pressing and holding the “LoRaWAN” button for more than 10 seconds. The reset is indicated by the yellow “Power” LED being shut off for about 2 seconds, when this occurs the “LoRaWAN” button can be released.

OVER-TEMPERATURE DETECTION

LR2x0 is monitoring the internal circuit board temperature to detect abnormal internal device temperatures which can result from relay overloading for example. The temperature threshold is currently fixed at 60C +/- 5C hysteresis. If the internal circuit board temperature rises above 65C both relay channels will be shut off immediately regardless of what relay state the LoRaWAN server has requested, when the temperature has fallen below 55C the relay channels will be restored to the currently requested state. Any relay state changes requested by the LoRaWAN server during the over-temperature state will be stored internal to the LR2x0 and be used as the requested state when normal temperature condition is restored. When the LR2x0 transitions into or out of over-temperature state and additional uplink is sent (normal periodic data on port 2, see protocol description) where the relay state reflects the actual relay states.

LR260 LOW-POWER MODE

This feature is still under development, please contact support in case this feature is of special interest. The current state of development is a LoRa Class A device which draws around 120uA of current (with relay outputs turned off). Periodic uplinks are sent more frequent (by default at a 5 minutes interval) which allows a max latency of 5 minutes when controlling relay outputs. In addition to sending relay states and internal temperature in the periodic data also the supply voltage is included, periodic data is sent on a dedicated port 3 to separate this periodic data from the normal mode periodic data on port 2. Primary target for this mode is battery powered vehicles such as mobile homes, boats, cabins with solar panels etc.

LORAWAN PROTOCOL

OVERVIEW

In this section, uplink refers to all communication from the LR2x0 device to the network server and downlink to all communication from network server to the device.

The LR2x0 relay controller has a LoRa class C receiver by default, which means that the downlink channel is always available. This is in contrast to many battery powered LoRa devices where the downlink channel is only available in a short window after each uplink.

Downlink communication can be used to perform either a “set command”, “query command” or an “action” on the LR2x0. A “set command” is used to change a setting or state on the LR2x0, for example to change relay channel activation. Using “queries” it is possible to retrieve parameter settings or additional status information from the LR2x0 which will be sent on the uplink channel. “Actions” are used to perform operations such as a device reset. Only one command or action is allowed per downlink, all downlink communication is performed on LoRaWAN port 1.

Uplink communication is divided into two different groups, “protocol data” and “periodic data”. Protocol data is sent from the LR2x0 in response the queries performed using the downlink channel or for certain status messages, protocol data is always sent on LoRaWAN port 1. Periodic data is sent on a schedule and contains the current relay activation status and internal temperature sensor reading on the LR2x0, periodic data is always sent on LoRaWAN port 2.

All data is sent in binary form using network byte order (“big endian” or “most significant byte first”).

DOWNLINK DATA

Table 1 shows the structure of a downlink packet sent to LR2x0, a packet consists of at least 2 bytes of data (packet type and index). Only “set packets” have data bytes after the index byte, data bytes are not present for action and query packets.

Byte 0 **Packet Type**	**Byte 1** **Index**	**Byte 2-5** **Data**
0x01 : Set Packet 0x02 : Query Packet 0x03 : Action Packet	See Table 2 for valid indexes	See Table 2, only present for some indexes

Table 1: Downlink packet

Table 2 shows valid combinations of packet types and index bytes, and also the data encoding for the defined set packets. When valid query packets are received by the LR2x0 a response will be sent on the uplink channel after roughly 10 seconds.

Packet type	Index	Data Bytes	Data encoding
Set Packet	0x22: Relay State	4	32-bit data Bits 31:16 : Relay ctrl mask. Bit 16 : '1' Relay 1 state controlled by bit 0 Bit 16 : '0' Relay 1 state not controlled by bit 0 Bit 17 : '1' Relay 2 state controlled by bit 1 Bit 17 : '0' Relay 2 state not controlled by bit 1 Bits 15:0 : Relay state Bit 0 : '1' Relay 1 activated Bit 0 : '0' Relay 1 deactivated Bit 1 : '1' Relay 2 activated Bit 1 : '0' Relay 2 deactivated
Set Packet	0x23: Periodic Interval	2	16-bit unsigned data big endian 1 to 65535 minutes
Query Packet	0x03: FW git SHA	None	
Query Packet	0x06: CPU Voltage	None	
Query Packet	0x0A: CPU Temperature	None	
Query Packet	0x20: Status	None	
Query Packet	0x22: Relay State	None	
Query Packet	0x23: Periodic Interval	None	
Action Packet	0x05: Device Reset	None	

Table 2: Downlink index and data encoding

Table 3 contains example frames showing valid downlink packets.

Example Packet data	Packet Action
0x01 0x23 0x00 0xB4	Packet type 0x01 (set), index 0x23, data 0x00B4 Set periodic interval to 0x00B3 (180) minutes
0x01 0x22 0x00 0x03 0x00 0x03	Packet type 0x01 (set), index 0x22, data 0x00030003 Set both relay channels to active state
0x01 0x22 0x00 0x03 0x00 0x00	Packet type 0x01 (set), index 0x22, data 0x00030000 Set both relay channels to deactive state
0x01 0x22 0x00 0x02 0x00 0x02	Packet type 0x01 (set), index 0x22, data 0x00020002 Set relay channel 2 to active state, do not change channel 1
0x02 0x22	Packet type 0x02 (query), index 0x22 Query current relay state
0x02 0x0A	Packet type 0x02 (query), index 0x0A Query CPU temperature
0x03 0x05	Packet type 0x03 (action), index 0x05 Request LR2x0 device reset

Table 3: Example downlink packets

UPLINK DATA

Table 4 shows the structure of a uplink packet sent by to LR2x0, packet structure is similar to downlink packets with packet type and index bytes followed by data.

Byte 0 Packet Type	Byte 1 Index	Byte 2-3 Data
0x01 : Data Packet 0x02 : NACK Packet	See Table 5	See Table 5

Table 4: Uplink packet

Normally uplinks packets are sent with packet type set to 0x01 (data packet), in case a downlink query was sent with an invalid index the uplink packet type will be set to 0x02 (NACK) and the index byte will be the same invalid index.

Table 5 contains valid index bytes and data encoding for uplink data packets. Only periodic data is sent on LoRaWAN port 2, all protocol data is sent on port 1. For periodic data sent on port 2 the packet type and index byte are omitted.

Index	Data Bytes	LoRa Port	Data encoding
0x03: FW git SHA	6	1	6 ASCII characters showing FW revision
0x06: CPU Voltage	2	1	16-bit unsigned data big endian Supply voltage encoded in mV. Note that LR210 will always respond with 0mV, this function is reserved for the DC powered LR260 version.
0x0A: CPU Temperature	2	1	16-bit unsigned data big endian Temperature (celsius) encoded: (data / 100) – 50.0
0x20: Status	1	1	Bit 0: Watchdog reset occurred Bit 1: LR2x0 startup error occurred
0x22: Relay State	2	1	16-bit data Bits 15:0 : Relay state Bit 0 : ‘1’ Relay 1 activated Bit 0 : ‘0’ Relay 1 deactivated Bit 1 : ‘1’ Relay 2 activated Bit 1 : ‘0’ Relay 2 deactivated
0x23: Periodic Interval	2	1	16-bit unsigned data big endian Periodic interval encoded in minutes
Periodic data, index byte not present	4	2	32-bit data big endian Bits 31:16 : 16-bit relay state data Encoding: Identical to index 0x22 Bits 15:0 : 16-bit temperature data big endian Encoding: (data / 10) – 80.0

Table 5: Uplink index and data encoding

Table 6 contains example uplink frames and data decoding.

Example Packet data	Packet Action
0x00 0x01 0x04 0x4c on port 2	Periodic data 0x0001044c on port 2 Relay 1 activated, Relay 2 deactived. Temperature: (0x44c / 10) – 80.0 = 30.0 Celsius
0x01 0x20 0x00 on port 1	Packet type 0x01 (Data), index 0x20 (Status) Status = 0x0, ”no errors”
0x01 0x22 0x00 0x03 on port 1	Packet type 0x01 (Data), index 0x22 (Relay state) Relay 1 activated Relay 2 activated.
0x02 0xAA on port 1	Packet type 0x02 (NACK), index 0xAA LR2x0 was unable to respond to a query on index 0xAA

Table 6: Example downlink packets