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The M2M Enabler

RTCU LX5 pro

Advanced Industrial M2M/IoT Gateway

Technical Manual

Version 1.01

Introduction

The **RTCU LX5 pro** is a powerful M2M/IoT Gateway device that rests on an entirely new hardware and software architecture representing a significant leap in functionality, power, openness, and performance. The **RTCU LX5 pro** has been designed for the most demanding M2M and Industrial Internet of Things applications that dictate the most advanced product available on the market.

The device is based on the new **NX32L** (NX32 for Linux) architecture that embraces many new technologies and at the same time maintains full backward compatibility, which ensures already implemented and tested **NX32** applications can execute without changes.

The **RTCU LX5 pro** device has been designed to meet the ever-increasing security challenges. It offers full TLS on all major protocols and includes a hardened protected execution environment with dual-boot and automatic fallback and recovery.

The **RTCU LX5 pro** can also operate as a secure and intelligent industrial router/firewall for LAN/WLAN side clients connecting to the Internet over the cellular interface.

This manual contains technical documentation covering the installation and usage of the RTCU LX5 pro device. For detailed information on the product's programming and software configuration, please refer to the RTCU IDE documentation.

For detailed information on the powerful RTCU M2M Platform, please refer to the ***RTCU M2M Platform datasheet***.

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Important Information

Thank you very much for using a product from Logic IO Aps. Our products are designed for professional use, and therefore this manual assumes technical knowledge and practice working with such products.

This documentation does not entail any guarantee on the part of Logic IO Aps with respect to technical processes described in the manual or any product characteristics set out in the manual. We do not accept any liability for any printing errors or other inaccuracies in the manual, unless it can be proven, that we are aware of such errors or inaccuracies, or that we are unaware of these as a result of gross negligence and Logic IO Aps has failed to eliminate these errors or inaccuracies for this reason.

This product is a complex and sensitive electronic product. Please act carefully and ensure that only qualified personnel will handle and use the device. In the event of damage to the device caused by failure to observe the information in this manual and on the device, Logic IO Aps shall not be required to honor a warranty claim even during the warranty period and shall be exempted from the statutory accident liability obligation. Any attempts to repair or modify the product also voids all warranty claims. Do not open the product. There is no user-serviceable part inside.

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Technical Highlights

Platform:

- Based on the **RTCU M2M Platform**.
- **NX32L (NX32 for Linux)** execution architecture.
  - RTCU IDE development tool.
  - Operates under a full and highly optimized Linux variant.
  - Open and extendable with Platform SDK.

LX Hardware Core:

- Cortex-A7 32-bit ARM processor operating at up to 1 GHz.
- Cortex-M4 32-bit co-processor for advanced power-management.
- Hardware floating-point and DSP instructions.
- 128 MByte RAM.
- 512 MByte NAND Flash (system boot, persistent memory, and file-systems).
- Real-time clock with dedicated backup battery.

Security:

- Embedded firewall.
- Port forward and NAT services.
- TLS/SSL support with full certificate management.
- TLS/SSL supporting all significant TCP protocols, such as RCH, FTP, SMTP, MQTT, and sockets.
- Hardware assisted encryption/authentication: AES-128, AES-192, AES-256, DES, TripleDES, HASH, RND and RSA signature.

Wireless Communication:

- **LTE Cat. 4 Multi-Band Cellular Engine.**
- Internal SIM-card reader with support for eSIM.
- **Wireless LAN** (Wi-Fi).
- Medium range **ISM band RF transceiver** with an on-board antenna.
- Multi-constellation **GNSS** with GPS, GLONASS, and GALILEO.

Wired Communication:

- 100 Mbps Ethernet **LAN** interface.
- 1 x **Full CAN 2.0B** controller with hardware filtering and multi-speed support.
- **1-Wire bus** for accessories such as ID-button reader, temperature sensors, etc.
- 1 x **RS232** channel.
- 1 x **RS485** channel.

I/O Interfaces:

- 3 x **digital inputs**.
- 4 x **solid-state open-drain digital outputs**.
- 3 x **analog inputs with 0..10 volt / 0..20 mA** with 12 bit precision.
- **Expandable I/O** with standard Modbus modules.

Sensors:

- **3-axis Accelerometer** with 16g scale.
- Temperature sensor.

User Interaction:

- 3 x bi-color LED.
- High-speed Mini-USB service-port connector.

Audio:

- Fully digitized audio system.
- Transfer, store, and play audio.
- Digitized cellular audio.
- DTMF support for Interactive Voice Response applications.

Storage:

- **Internal flash drive** with up to 128 MByte capacity.
- **Persistent memory** and circular datalogger.
- **Micro SD-Card** reader.

Power and Battery:

- Operating voltage from 8 to 36VDC.
- On-board **2 Ah Li-Ion battery** with intelligent charging.

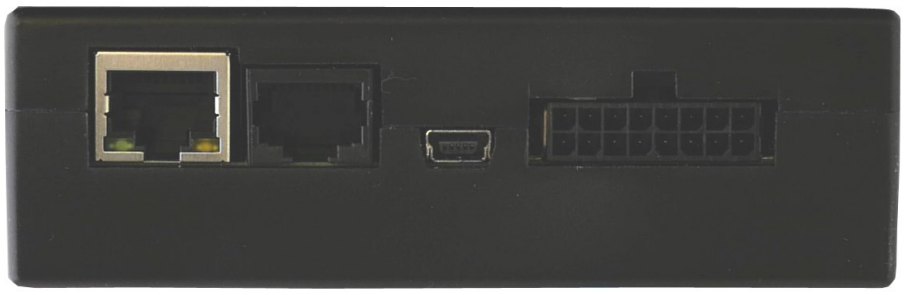
Encapsulation:

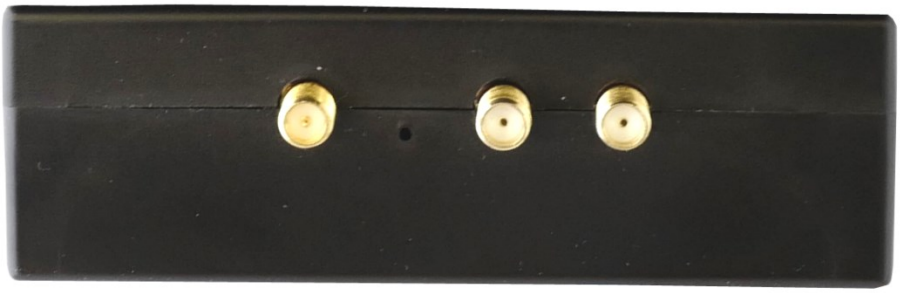
- Housed in a compact UL94 V0 grade PC fire-resistant plastic encapsulation.
- DIN rail mounting option.

Regulatory Approvals:

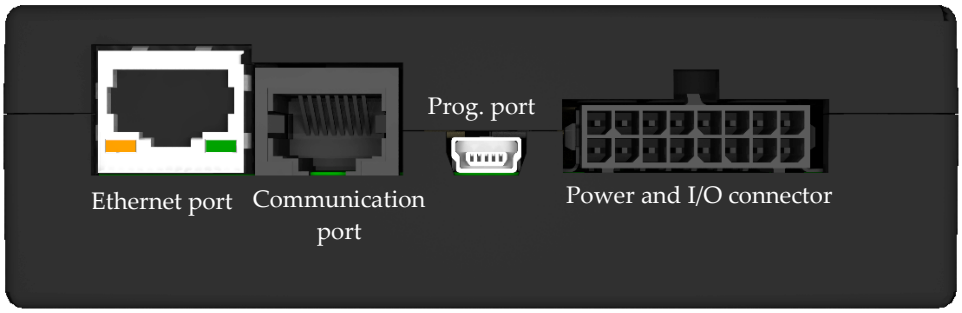
- Radio Equipment Directive, RED 2014/53/EU.
- EMC Directive, 2014/30/EU.
- 2011/65/EU RoHS Directive.

RTCU LX5 pro Overview



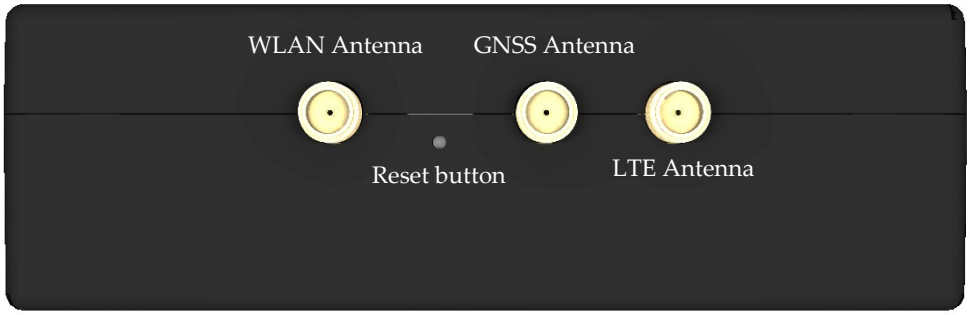


On the frontside of the device, the Ethernet, Communication, and Programming ports are found. Also located on the front side is the Power and I/O connector.



Frontside

On the backside of the device, the LTE, WLAN, and GNSS antenna connectors are found. Also located on this side is the small hole for the reset button.

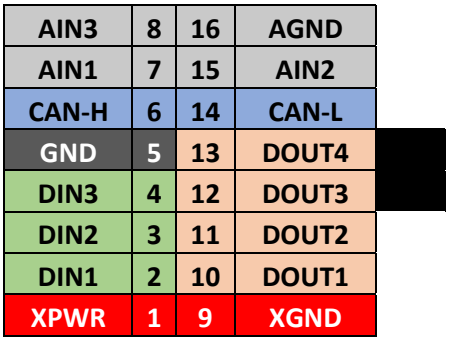


Backside

Inside the encapsulation, the SIM-card / Micro SD-card readers and various configuration/termination jumpers are located.

For convenience and easy installation, the front of the devices contains all connectors' documentation and includes several tables for its layout.

Power and I/O Connector

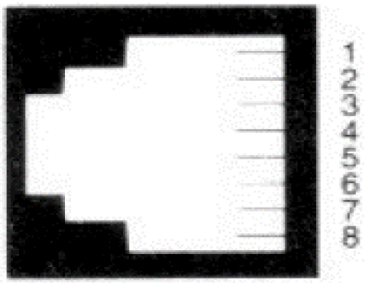


16 pin I/O connector overview

Pin	Name	Description
1	XPWR	Power supply, positive (+) connection
2	DIN1/IGN	Digital input 1 / Ignition input
3	DIN2	Digital input 2
4	DIN3	Digital input 3
5	GND	System ground
6	CAN-H	CAN bus H-signal
7	AIN1	Analog input 1
8	AIN3	Analog input 3
9	XGND	Power Ground
10	DOUT1	Digital output 1
11	DOUT2	Digital output 2
12	DOUT3	Digital output 3
13	DOUT4	Digital output 4
14	CAN-L	CAN bus L-signal
15	AIN2	Analog input 2
16	AGND	Analog Ground

Communication Connector

RS232 TXD	1
RS232 RXD	2
RS485 RSA	3
GND	4
1-Wire LED	5
RS485 RSB	6
1-Wire	7
GND	8



RJ45 communication connector

Pin	Name	Description
1	RS232 TXD	RS232 Transmit Data
2	RS232 RXD	RS232 Receive Data
3	RS485 RSA	RS485 non-inverting signal
4	GND	Signal input 3
5	1-Wire LED	1-Wire ID-Button LED
6	RS485 RBS	RS485 inverting signal
7	1-Wire	1-Wire bus
8	GND	Signal Ground

Mini USB-B Connector

This USB port is for programming and communication with the RTCU IDE (RACP compliant application). A standard USB cable can be used between the device and the PC.

Ethernet / LAN

This is a standard 10Base-T/100Base-TX IEEE 802.3 compliant RJ45 Ethernet connector.
Please use an appropriate connector and cable, such as a standard CAT-5 twisted pair patch cable
The connector has the following LED indicators shows the LINK status and communication activity.

DIN Rail Mounting

The RTCU LX5 pro can be delivered in a version suitable for mounting on a standard DIN rail according to IEC/EN 60715.

On the bottom side of the device the DIN rail clip allows attaching to the DIN rail.

Power Supply

The RTCU LX5 pro device must be supplied with 8..36 VDC from an external DC power source. Positive power is applied to the XPWR pin, and the ground to the XGND pin.

There are three different ground labels for ground connections: Supply ground (XGND), signal ground (GND), and analog ground (AGND).

The signal and the analog grounds are filtered from the power ground. Power ground must only be used as a power supply return path.

The RTCU LX5 pro contains an internal backup battery, which will supply the RTCU if the external power supply fails or is disconnected. By default, the RTCU is powered down when a power failure occurs. This setting, however, can be changed. Please consult the RTCU IDE on-line help for more information. When the wakeup/ignition inputs are activated with a logical high, the RTCU LX5 pro device will wake up in power-down mode.

Power supply pins

Pin	Name	Description
1	XPWR	Power supply, positive (+) connection
9	XGND	Power ground, negative (-) connection

Digital outputs

The digital outputs control four open-drain switches. They function like a contact, where one side is connected to the digital output, and the other side is to the ground internally in the RTCU unit. The switches are protected against short circuit and ESD.

The digital output control circuit is supplied from both the external power supply and the internal lithium-ion battery. Therefore, the digital outputs can be controlled even if the external power supply is not present.

The RTCU unit offers advanced power management that can have one or more outputs enabled while the RTCU is in low power mode. Please consult the RTCU IDE documentation for additional information.

16 pin I/O connector overview.

Pin	Name	Description
10	DOUT 1	Digital output 1
11	DOUT 2	Digital output 2
12	DOUT 3	Digital output 3
13	DOUT 4	Digital output 4

Specification for each digital output

Type	Min.	Max.	Unit	
Open-drain	0	36	VDC	Short-circuit, Overload, Overvoltage, and ESD protected
	-	1	A	
	-	600	mΩ	On-state resistor per channel

Digital Inputs / Ignition Input

The digital inputs are all low-pass filtered and transient protected. To activate the inputs, connect a positive voltage between the input and the GND connector.

Please note: The DIN 1/IGN input is unique as it also functions as the ignition input. If the ignition input is activated with a logically high or low (Wait For Event mode only), it will wake up the unit when the RTCU is in low power mode. A power apply will also wakeup the unit, if it is in power-down mode or WaitForEvent mode with power Apply and/or ignition selected for wakeup.

The power management allows the possibility to configure a wakeup on one or more digital inputs with individually configured falling- or rising edge detection. Please consult the RTCU IDE documentation for additional information.

16 pin I/O connector overview.

Pin	Name	Description
2	DIN 1/IGN	Digital input 1 / Ignition input.
3	DIN 2	Digital input 2
4	DIN 3	Digital input 3
5	GND	Signal Ground

Specification for each digital input:

	Min.	Typ.	Max.	Unit	
Logic "High"	8	12	40	VDC	Protected against transients and
Logic "Low"	-5	-	3	VDC	low-pass filtered
Bandwidth	-	7	-	kHz	
Input impedance	-	14	-	kΩ	

Analog Inputs

The RTCU LX5 pro has three analog inputs, which can be configured individually to work either as voltage or current measurement inputs by using the configuration jumpers. The range in voltage mode is 0.10 VDC, and in current mode 0-20mA.

The conversion resolution is 12 bit.

The input signal is connected between AINx and AGND. AGND must be connected to the reference of the connected equipment. Please be aware that deviations may occur, as the system is very noise-sensitive. Avoid long unshielded wires and significant fast-changing signals routed parallel to the analog signals.

The inputs are low-pass filtered, ESD- and transient protected.

By default, the inputs are configured as voltage inputs. For replacement and configuration of the hardware jumpers inside the device, please refer to the device configuration guide in Appendix D.

16 pin I/O connector overview.

Pin	Name	Description
7	AIN 1	Analog input 1
15	AIN 2	Analog input 2
8	AIN 3	Analog input 3
16	AGND	Analog Ground

Specification for each analog input (voltage mode):

	Min.	Typ.	Max.	Unit	
Voltage	0	-	10	VDC	Protected against transients and
Resolution	-	-	12	Bit	low-pass filtered
Precision	-	0.4	0.6	%FSR	
Cut-off frequency	-	4.5	-	kHz	
Input impedance	-	40	-	kΩ	

Specification for each analog input (current mode):

	Min.	Typ.	Max.	Unit	
Current	0	-	20	mA	Protected against transients and
Resolution	-	-	12	Bit	low-pass filtered
Precision	-	0.4	0.6	%FSR	
Cut-off frequency	-	4.5	-	kHz	
Input impedance	-	504	-	Ω	

CAN bus port

The RTCU provides the physical layer for the CAN (Controller Area Network) serial communication interface in accordance with the ISO 11898 standard. The CAN bus is designed for high-speed (up to 1Mbit) robust communication in especially harsh environments like those found in the automotive industry.

The CAN interface can be connected to an existing CAN network with a common protocol like the J1939 standard to retrieve information for surveillance or information purposes. The interface can also be used as a robust serial data link with a non-standard protocol. Please consult the RTCU IDE documentation for more information.

The physical layer consists of a two-wire (CAN-H and CAN-L) differential bus and a signal ground for reference.

If the RTCU is connected to a "non-existing" network, a 120 ohm resistor must be connected between CAN-H and CAN-L on each end of the transmission line in order to terminate it and avoid signal reflections. The termination can be enabled by the jumper internal in the device. Please refer to Appendix D for the configuration details.

Be aware that connecting the RTCU to a CAN network can be dangerous. If the RTCU is not configured with the correct network parameters, it will lead to network corruption and may interfere with other connected equipment on the bus. Especially in vehicles, great precautions must be observed to prevent communication interruptions.

By default, the write capability on the CAN bus is disabled. This can be enabled by the jumper located internal in the device. Please refer to Appendix D for the configuration details.

16 pin I/O connector overview.

Pin	Name	Description
6	CAN-H	CAN-bus H-signal
14	CAN-L	CAN-bus L-signal
5	GND	Signal Ground

RS232 port

This port can be used as a general-purpose RS232 serial port with no hardware handshake signals.

RJ45 connector overview.

Pin	Name	Description
1	RS232 TXD	Transmit Data from serial port, RS232 compatible
2	RS232 RXD	Receive Data for serial port, RS232 compatible
4	GND	Signal Ground

RS485 Port

RS485 is a multi-drop network with a maximum of 32 nodes connected simultaneously to the bus. The RS485 bus contains an RSA and an RSB signal and a signal ground, which must always be connected to the common signal ground for all nodes connected to the RS485 bus!

The maximum cable length for the RS485 bus is according to the EIA/TIA-485-A standard (max. 1000m @ <100kbit); this limit is highly influenced by the quality of the cable, signaling rate, noise etc.

At longer cable lengths, noisy environments, or high communication speeds, it might be necessary to terminate the transmission line with a 120[1] ohm resistor at each end of the transmission line to terminate it and avoid signal reflections. If the RTCU LX5 pro is used as an endpoint node, the jumper for the RS485 port can be inserted in order to terminate the RS485 communication lines with 120Ω. By default, the RS485 communication lines are not terminated with 120 Ω.

Please note: For best performance, protection, and noise immunity, it is advised to use a shielded cable to connect the device to the RS485 communications bus.

RJ45 connector overview

Pin	Name	Description
3	RSA	RS485 non-inverting signal for RS485 port
6	RSB	RS485 inverting signal for RS485 port
8	GND	Signal ground

1 Assuming use of a CAT5 twisted pair cable

1-Wire bus

The 1-Wire bus is available on the RJ45 communication connector. All 1-Wire communication goes through a single connection, and all 1-Wire devices connected can retrieve power directly from the bus (called parasitic power). For this, only two wires are needed – the 1-wire signal and the ground reference – allowing minimal cable installations.

For 1-Wire ID-Button readers, which include a built-in LED, a dedicated output is available for this purpose. Please consult the RTCU IDE documentation for further information.

RJ45 connector overview.

Pin	Name	Description
7	1Wire	1-Wire bus for ID-Button / Temperature sensor
5	1W-LED	1-Wire ID-Button LED
8	GND	Signal Ground

Specification of the 1-Wire bus:

	Max.	Unit
Total weight[1]	65	m

1 The term of weight has been described in "Modular 1-wire concept – Technical Manual" document.

3D movement sensor

The RTCU LX5 pro device contains a 3-axis accelerometer to detect vibration and motion. It makes it possible to detect movement and position change in 3 directions, X-Y-Z with force as high as 16g in acceleration. The most straightforward use is with the power management detecting when the vehicle is moved and the most advanced analytical applications such as driving behavior/eco-driving.
Please consult the RTCU IDE documentation for more detailed information.

The positions of the 3-axis are as following:

Specification:

		Unit	
Resolution	±16	g	The acceleration can be set as relative to motion,
Precision	12	bit	or relative to earth gravity

LED Indicators

Three bi-colored (red and green) indicators are present on the device top.

One bi-colored LED (A and B) is available to the user, and the remaining two LEDs (S1 and S2) are signaling the status and possible errors of the RTCU device.

User LED A

LED A is composed of two individually controllable LEDs:

- LED named A on the front consists of LED 1 (green) and LED 2 (red).

The LEDs are easily accessed from within the application program, and it is possible to mix the LEDs to obtain a third color: yellow. Please consult the RTCU IDE documentation for more information.

System LED S1 and S2

The RTCU is equipped with two system LEDs, which show the status and possible errors of the RTCU device.

The different patterns are listed in the table below. If the color of the system LED S1 is yellow, the device actively communicates with the RTCU IDE (or another program supporting the RTCU RACP protocol).

The LED S2 signifies either the cellular engine activity or all other LEDs are off, that the RTCU is in the "wait for event" low power state.

S1: System LED1 pattern overview

Pattern	Description
Fastest blinking, green	The device is initializing, preparing to start the application.
Fast blinking, green S2 On, green	The device is installing an update. Depending on the kind of update, it may take some time. The progress can also be observed on the display.
Fast blinking, green[1]	The device has been forced into recovery mode with the use of the system switch. The application is not executing.
500ms On / 500ms Off green[3]	The device is executing the application program
1.5s On / 0.5s Off. green[3]	The device is executing the application program, while charging the internal backup battery.
Fast blinking, red[3]	A runtime error has been detected in the program. Use the RTCU IDE to obtain the fault log.
Alternating Fast/Slow, red[3]	The device has lost its firmware. This can only happen if, during a firmware upgrade, the RTCU device loses power or the communication is lost completely. In this case, simply upload the firmware to the device again.
75ms On / 925ms Off, green	Execution speed is different from full-speed.
On yellow (All other Leds OFF)	The device is booting, initializing the system

S2: System LED2 pattern overview (Cellular activity and "Wait For Event")

Pattern	Operating Status
Off	The cellular engine is turned off
600 ms On / 600 ms Off green	Missing SIM card or PIN code. Network search and logon in progress.
75 ms On / 3 s Off green	Logged on to the network.
75 ms On / 75 ms Off / 75 ms On / 3 s OFF green	A GPRS/data session is active.
Flashing green	Indicates data transfer.
On green	A voice session is active.
On green (and all other LEDs OFF)	The system is booting.
On yellow (and all other LEDs OFF)	The system is booting into recovery mode.
On red (and all other LEDs OFF)	The system is booting into monitor mode.
10 s OFF / 50 ms ON green (and all other LEDs OFF)	The RTCU device is in a low-power "Wait For Event" state.

1 Or yellow when communicating with the RTCU IDE or another program, supporting the RTCU RACP protocol).

System Reset Switch

The RTCU LX5 pro device contains a combined reset/diagnostic switch. This switch is accessible on the backside of the unit. It is necessary to use a small thin object with a diameter of approx. 2 mm, for example, a straightened-out paper clip for this purpose.

By activating the switch shortly, the RTCU device will perform a full reset.

If the reset switch is held down for approx. 3 seconds[1], the device will instead enter recovery mode[2] , and the application will not be started. In recovery mode, the system will automatically turn on the cellular engine to connect to the network and RTCU Communication Hub (if configured).

Pressing reset will also activate the device when in power-down mode. If external power is removed and the backup battery is disabled, the reset switch can still be used to boot into recovery mode, as long as there is enough power left on the battery.

1 System LED S2 will flash green three times when this state is entered.

2 System LED S1 will indicates this state by fast blinking green or yellow.

Rechargeable Li-Ion Backup Battery

The RTCU contains an internal Li-Ion battery for operation even when the external power is absent, making it possible to report power loss etc. Please note, that when external power is removed, the device will be powered down by default. This setting can be changed as documented in the RTCU IDE documentation.

The battery charging is entirely automated and handled internally by the RTCU device – leaving no need for user interaction. Different kinds of functions (Battery low, Charger enable, charging status, etc.) are available to the user application.

The charge current is relatively high, for a shorter charge time, as specified in the technical specification. Make sure both the power supply and cables can handle the high current.

Whenever a power failure has occurred, the battery will be charged to establish the capacity, thus making the battery ready for the next power failure.

By default, the battery cannot be charged above 45°C or below 0°C. The RTCU offers to charge down to -10 ˚C using a specialized algorithm to protect the battery.

If the temperature is above 45°C, the charging will not start and will be postponed, until it is below this threshold.

The temperature has a strong influence on the battery capacity. At 0°C the capacity has dropped to 60% of the initial capacity, and it falls dramatically at lower temperatures.

The battery cycle (numbers of charges and discharges) also influences the capacity. After 300 cycles the capacity has dropped to approximately 80% of the initial capacity.

Warning
Misusing the RTCU device may cause the built-in battery security circuit to be damaged.

- *Do not place the RTCU device in high-temperature locations such as in direct sunlight or near engines. Using the RTCU device in this environment may result in loss of battery performance and a shortened life expectancy.*
- *Do not expose the device to water, saltwater or allow the battery to get wet.*
- *Avoid strong impacts and shocks.*

LTE Cat. 4 Cellular Engine

The RTCU LX5 pro uses an LTE/UMTS/HSPA engine with the following features:

- LTE Cat. 4 with a maximum of 150Mbps down / 50Mbps upload speed.
- LTE-FDD: B1 / B3 / B5 / B7 / B8 / B20.
- LTE-TDD: B38 / B40 / B41.
- WCDMA: B1 / B5 / B8.
- GSM: 900/1800 MHz
- SMS (Text and PDU)
- UMTS release 7, max. 42Mbps down / 5.76Mbps upload, (Cat 6)
- Digitized audio / DTMF capability.

The Cellular Engine is designed for EMEA, Korea, and Thailand.

SIM-Card

The RTCU LX5 pro device contains a standard Mini SIM card reader located inside the device. The SIM card reader is a lid-based reader with a mechanical lock system to secure the SIM card installation. Please refer to Appendix A for the SIM card installation guide.

If the SIM-card is removed during the cellular operation, the device will be rejected from the network shortly after.

WLAN

The RTCU LX5 pro device contains a radio for WLAN (Wi-Fi) communication.

WLAN Technical Data

- Wi-Fi at 2.4 GHz ISM band
- IEEE 801.11b/g/n/d/e/h/i
- WPA/WPA2 certification
- Up-to 150 Mbps

ISM RF

The RTCU LX5 is provided with an ISM band RF radio that gives the device the ability to communicate wirelessly with other certain types of equipment and devices. The radio communicates in the 868 MHz frequency band and complies with the European EN 300 220 requirements. The antenna for the ISM radio is internal to the device.
Please consult the RTCU IDE on-line help for more information on how to configure the RF interface.

In the table below, the specifications of the RF module is shown:

RF module specifications

Data	Min.	Typ.	Max.
Output Power	-30 dBm	+10 dBm	+12 dBm
Frequency	779 MHz	869,4 MHz	928 MHz
Modulation *	-	GFSK	-
Baud Rate	0.6 Kbaud	38,4 Kbaud	600 Kbaud

Please note: Listen **B**efore **T**alk (LBT)[1] functionality to comply with EN 300 220 is implemented in the RF module. If the device is installed in an environment with disturbances in the same frequency band, it can observe RF transmission difficulties.

- Supported modulations are 2-FSK, 4-FSK, GFSK, MSK, ASK, and OOK.

1 LBT is a term used in radio communication whereby a radio transmitter senses its radio environment before it starts a transmission

Antennas

Cellular Antenna

The RTCU LX5 pro device contains an SMA female connector for connecting a suitable LTE compliant antenna. When installing the antenna, please ensure that the antenna is not in close proximity to metallic parts or anything else, which can influence the antenna's efficiency. Please consult the installation guide that follows the antenna.

GNSS antenna

The RTCU LX5 pro supports GPS, GLONASS, GALILEO, and QZSS, so a suitable GNSS antenna must therefore be used. The connection is with an SMA female connector, and the antenna must be a 3V active antenna with an SMA male connector.

When installing the antenna, please make sure that the antenna has a good view of the sky to receive the satellites' weak signals. Please also consult the installation guide that follows the antenna.

WLAN Antenna

The RTCU LX5 pro device contains an RP-SMA female connector for connecting a suitable WLAN antenna.

When installing the antenna, please ensure that the antenna is not close to metallic parts or anything else, influencing its efficiency. Please consult the installation guide that follows the antenna.

RF Antenna

The RTCU LX5 pro device contains an internal chip antenna for the 868 MHz ISM band.

It is recommended not to place the RTCU LX5 device inside a metal enclosure as this will degrade the ISM RF performance.

Micro SD-CARD reader

The RTCU LX5 pro device has a standard Micro SD card reader located inside the device (see graphical overview). The Micro SD card reader is a lid-based system with a mechanical lock for reliable insertion and operation. Please refer to Appendix C for the Micro SD card installation guide.

The RTCU LX5 pro supports a FAT file-system for standard PC-compatibility with up to 32 GB capacity support.

Both the card detect and the write protect[1] information is available to the user through the application. Please consult the RTCU IDE on-line help for more information. Avoid removing the Micro SD card during access to the card.

Approved SD-CARDs

To ensure the highest performance and compatibility, it is important to use SD-CARDs approved and tested by Logic IO.

Commercial grade SD-CARDs can be used in applications where the limited write endurance is acceptable - for example if the SD-CARD is often replaced. Commercial grade SD-CARDs should ***not*** be used in applications where the media's potential failure is considered mission-critical.

For applications that extensively use the SD-CARD media and where a failure is critical, it is recommended to use approved **Industrial Grade** SD-CARDs.

Logic IO has approved and recommends industrial-grade SD-CARDs from **ATP** available in capacities from 512 MB to 32 GB.

ATP Industrial Grade SD/SDHC Cards are optimized for demanding industrial applications with consistent performance in all conditions. ATP uses reliable SLC flash technology with a flash endurance more than 20 times higher than commercial grade products with MLC flash.

The differences in write endurance between commercial-grade MLC flash and ATP Industrial grade SLC flash is quite remarkable for write-intensive applications:

Product Line	Details	Total Writeable Data Prediction @ 1GB	Time Prediction @ 500 writes a day (1GB)
ATP Industrial Grade	SLC Flash + Advanced Wear Leveling	80,000GB or 2,800,000 writes	**5,740 days** or **15.7 years**
Commercial Grade	Grade A MLC (2 bits per cell) + Advanced Wear Leveling	4,000GB or 140,000 writes	**280 days**

1 This signal is not available, but for compatibility reason the software function will always return "not write protected"

Product Identification Label with Barcode

The RTCU LX5 pro product identification is found on the device's exterior and contains a unique serial-number in readable form and barcode.

The first three digits in the serial number identify the device type, and for the RTCU LX5 pro, this unique code is either **344** or **350**.

Barcode format used: 2/5 Interleaved with check-digit.

Power Consumption

The table below shows detailed information about the RTCU LX5 pro device's typical power consumption while it is running.

Typical power consumption: Device operating in normal mode

	12V	24V	BAT		
Device active	50	30	120	mA	
Device active with Cellular on*	55	32	125	mA	idle @ -51dBm* 42G)
Device active with GPRS session*	190	100	430	mA	@ -51dBm, Battery not charging*
Device active with GNSS on	70	35	160	mA	Mode 3
Device active with WLAN on	75	50	190	mA	Connected to AP, file transfer over the RCH
Device active with Ethernet on	110	55	250	mA	Connected to switch, file transfer over the RCH
Device active with RF sending	60	30	125	mA	
Device active while charging	400	200	-	mA	

Note: Values marked with (*) are averaged and should be considered guidelines as they may vary depending on the cellular signal strength.
Note: Power consumption from the battery @ 3.8V

The table below shows detailed information about the RTCU LX5 pro device's typical power consumption in power-saving modes.

The following power-saving modes are used:

➢ Mode 1: LED blinks every ~10 s, resumes the application when it is awoken.

➢ Power down: The device is powered down.

See the RTCU IDE on-line manual for information about how to use the power-saving modes.

	Mode 1			Power down			
Wake-up source	**12V**	**24V**	**BAT**	**12V**	**24V**	**BAT**	
Cellular	2	1.5	5	-	-	-	mA
CAN (Write enabled)	8.5	4.5	20	-	-	-	mA
CAN (Write disabled)	6.9	3.7	16.5	-	-	-	mA
RS232 Mode 1	1.1	0.7	2.2	-	-	-	mA
RS485 Mode 1	1.7	1	4	-	-	-	mA
RF	8.1	4.5	21	-	-	-	mA
Vibration	1.1	0.75	3	-	-	-	mA
Din 1/Ignition	1.1	0.7	3	0.5	0.3	0.7	mA
Din 2-3	1.1	0.7	3	-	-	-	mA
Power Failure	1.1	0.7	3	-	-	-	mA
Power Apply	1.1	0.7	3	0.5	0.3	0.7	mA
Time	1.1	0.7	3	0.5	0.3	0.7	mA

Note: Power consumption from the battery @ 3.8V

Note: Values marked with (*) are averaged and should be considered guidelines as they may vary depending on the signal strength.

Appendices

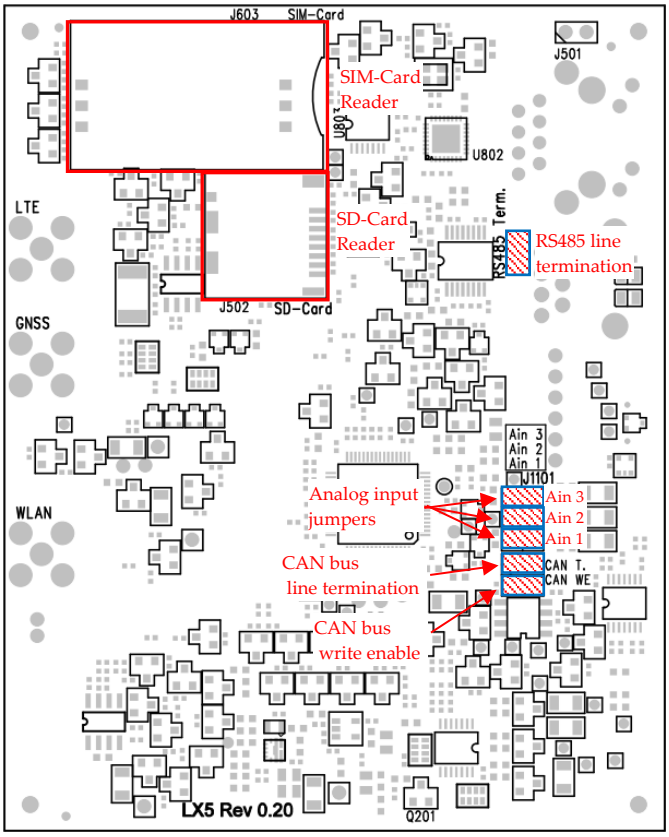
Appendix A – Assembling/disassembling the device

It is necessary to take the device apart to get access to the internal SIM-card reader, Micro SD-card reader, and the configuration jumpers. The bottom part of the encapsulation can be removed after removing the four Torx T7 screws found in each corner.

Please follow the following steps to get inside the device:

1. Place the device upside-down on a plain surface. Please make sure that the surface is soft to avoid scratching the top of the encapsulation.
2. Remove the four screws located on the corners using a Torx T7 screwdriver.
3. Lift the bottom part of the encapsulation carefully upwards.

The SIM and Micro SD-Card readers and the jumpers are located as follows:



The assembly process of the encapsulation is in the reverse order of the above steps.

Please notice that the screws must be fastened with a **torque of max. 0.5 Nm** to avoid damaging the encapsulation.

Appendix B – Installing the SIM-Card

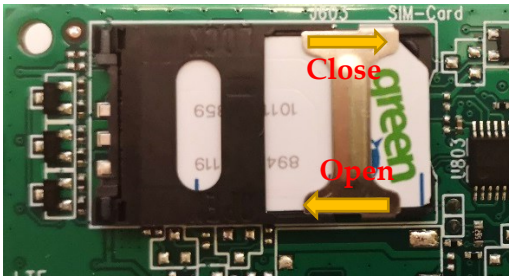
Please refer to Appendix A to get inside access to the device.

The SIM card reader is a lid-based type with a mechanical lock for insertion of a mini-SIM card.

Open the hinged lid on the SIM card reader, orientate the card as shown below, and insert it into the card reader's lid. Close the lid and slide the metal locking mechanism to the locked position, as shown with an arrow and text on the lid until a click is heard.

To remove the card, slide the metal locking mechanism to the unlocked position as shown with an arrow and test on the lid, and open the lid. The SIM card can now be removed.

SIM card orientation



SIM card inserted and locked

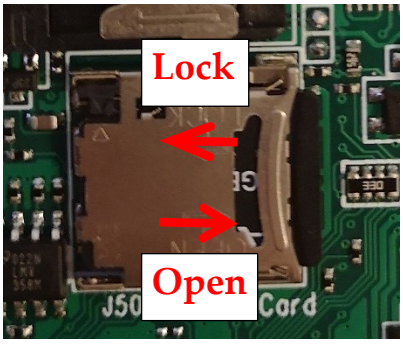
Appendix C – Installing the Micro SD card

Please refer to Appendix A to get inside access to the device.

In order to insert a Micro SD card into the reader, open the hinged lid of the card reader and then orientate the card as shown. Push the card into the reader and slide the metal lid in place as shown below.

Remove the card by sliding the lid in the direction shown with an arrow on the lid and then open the lid. Avoid removing the Micro SD card during software access to the card.

Micro SD card orientation

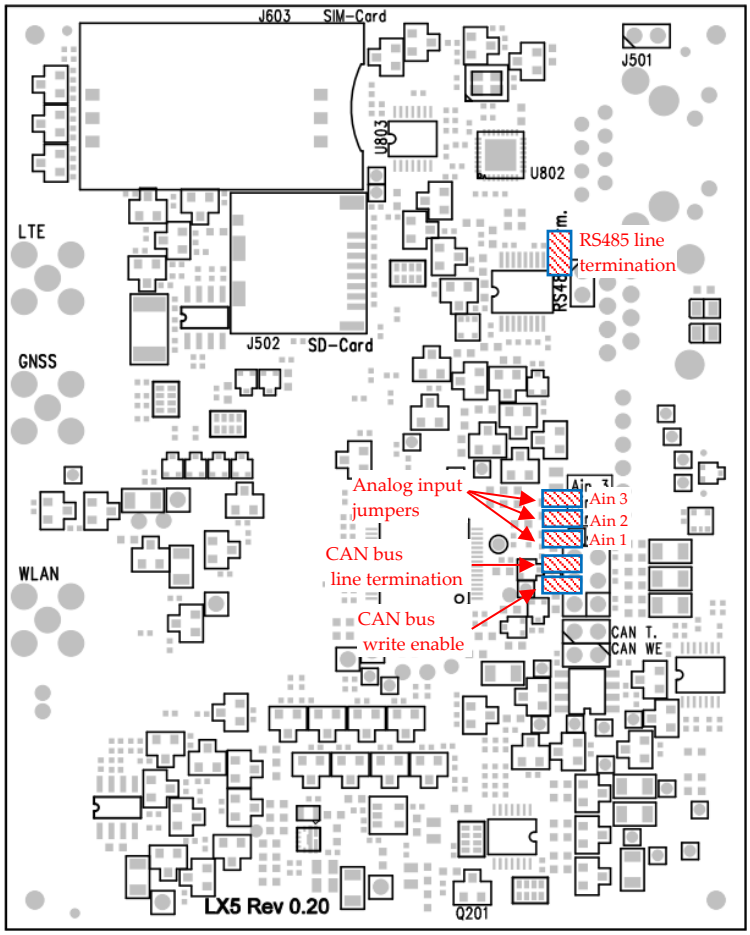


Micro SD card inserted and locked

Appendix D – Device Configuration Guide

Please refer to Appendix A to get inside access to the device.

The RTCU LX5 pro has many features, and some of them require configuration by using hardware jumpers located inside the device. The placement of the jumpers are as follows:



Feature	Jumper	State	Default state
Communication	RS485 T.	Installed Not installed	RS485 line 120 Ω resistor enabled RS485 line 120 Ω resistor disabled
	CAN T.	Installed Not installed	CAN bus line 120 Ω resistor enabled CAN bus line 120 Ω resistor disabled
	CAN WE	Installed Not installed	CAN bus write-enabled CAN bus write disabled
Analog input	Ain 1	Installed Not installed	Ain 1 current mode selected Ain 1 voltage mode selected
	Ain 2	Installed Not installed	Ain 2 current mode selected Ain 2 voltage mode selected
	Ain 3	Installed Not installed	Ain 3 current mode selected Ain 3 voltage mode selected

RS485 T / CAN T
Enables/disables the on-board 120 Ω line termination resistors according to the standards; RS485 and CAN bus communication require a proper line termination value (*120 Ω assuming a CAT5 twisted pair cable is used*) resistors in both ends of the bus. If the RTCU LX5 pro device is used as an endpoint, the relevant jumper can be installed.

CAN WE
Connecting the RTCU to a CAN network can be dangerous. If the RTCU is not configured with the correct network parameters, it can lead to network corruption and may interfere with other connected equipment on the bus. Especially in vehicles, precautions must be taken in order to prevent interruption of communication.

By default, reading from the CAN bus is enabled, and writing to the CAN bus is disabled. To enable the CAN bus write capability, the CAN WE jumper must be installed.

Installing this jumper, thereby enabling the unit's CAN-bus writing capability, is done on the user's sole responsibility. Logic IO cannot be held responsible for any problems, or damage due to the decision to enable the CAN-bus writing capability

Ain 1 – Ain 3
These jumpers are used to select between current and voltage input measurement. With a jumper installed on the relevant analog input, it will measure current between 0-20mA

Appendix E - Open Source Disclaimer

The RTCU LX5 pro products include several open-source software tools. This open-source software is governed by the terms and conditions of the applicable open source license. You are bound by the terms and conditions of the appropriate open source license in connection with your use and distribution of the open-source software in this product.

Please refer to the separate document "**RTCU Open Source Licenses.pdf**" for detailed information about the packages used.

RTCU LX5 pro Specifications

RTCU M2M Platform
- NX32 for Linux - NX32L.
- Fully NX32 compatible.
- Hardened execution environment.
- Full TLS/SSL support.

LX Hardware Core
- Powerful 32-bit ARM processor.
- Hardware floating point and DSP.
- 128 Mbyte RAM.
- 512 Mbyte NAND flash.
- Real-time clock with battery-backup.

Storage
- Internal flash drive (Up to 128 MByte).
- Persistent data flash.
- Multiple circular dataloggers.
- Micro SD-card.

Cellular Engine
- LTE Cat.4 Engine (EMEA).
  Max 150 Mbps(DL)/Max 50 Mbps(UL).
  LTE FDD: B1/B3/B5/B7/B8/B20
  LTE-TDD: B38/B40/B41
  WCDMA: B1/B5/B8
  GSM: B3/B8.
- DTMF decoding / transmission.
- Digitized voice playback / IVR.
- Internal mini SIM-card reader.
- Optional eSIM.

Wireless LAN
- WiFi at 2,4 GHz ISM bands.
- IEEE 801.11b/g/n/d/e/h/i.
- WPA/WPA2 certification.
- Up-to 150 Mbps.

Sensors
- Temperature sensor.
- 3-axis accelerometer. 12 bit @ ±16g.

ISM RF
- 868 Mhz ISM RF.
- Multiple protocol support.
- Range (depending on environment / antenna):
  Up to 50 meter indoor.
  Up to 300 meter outdoor.
- Can be disabled for worldwide compliance.

GNSS
- GPS, GLONASS, GALILEO and QZSS.
- Active 3 volt GNSS antenna.
- Antenna and short-circuit detection.

Wired Communication
- 100BASE-T Ethernet interface.
- 1 x Full CAN2.0B with hardware filtering and multi-speed support.
- 1 x RS232.
- 1 x RS485.
- 1-Wire bus with LED support
- USB service/programming port.

Audio
- Fully digitized audio system.
- Transfer, store and play audio.
- Digitized cellular audio.

Digital I/O Interface
- 4 x open-drain digital outputs (max 1A).
- 3 x digital inputs.
  Logic high: 8 to 40 VDC.
  Logic low: -5 to 3 VDC.
- I/O expansion Modbus modules.

Analog Inputs
- 3 x analog inputs.
  Range is 0..10 VDC or 0..20 mA.
  Resolution: 12 bit
  Accuracy: Typ. ±0.4% FSR.
  Impedance: 40 kohm (V)/504 ohm (C).
- Protected against transients and low-pass filtered.

User Interaction
- 3 x bi-colour LED.
- Jumpers for CAN/RS485 termination
- Reset / recovery switch.

Electrical
- Supply operating range: 8 to 36 VDC.
- Short and reverse power protected.

Battery and Charger
- On-board 2 Ah (nominal) Li-Ion battery.
- Intelligent charger with temperature throttle and sub-zero degrees support.

Physical Characteristics
- Encapsulation: Black colour.
  UL94 V0 fire-resistant PC plastic.
- Approx. 200 gram without accessories.
- W 105 x H 85 x D 35 mm.
  (wihout external connectors.
- DIN rail mounting clip version.

Environmental Specification
- Operating temperature: -40 to 60°C.
- Battery charge temperature:
  -10 to 45 °C
- Recommended storage temperature:
  0 to 45°C.
- Humidity: 5..90% (non condensing).

Approvals
- 2014/53/EU Radio Equipment Directive.
- 2014/30/EU EMC Directive
- 2011/65/EU RoHS Directive.
- Cellular:
  GCF/CE/FCC/PTCRB/IC/Anatel/SRRC/NAL/CCC/KC/NCC/JATE/TELEC/RCM/IFETEL/FAC/NBTC/ICASA.

Warranty
- Two-years return to factory parts and labor.
- Optional warranty up to 5 years. (restrictions apply).

* * * * END OF DOCUMENT * * * *