USER MANUAL

Longo programmable controller
LPC-2.MM1
Main module

Version 5

SMARTEH d.o.o. / Poljubinj 114 / 5220 Tolmin / Slovenia / Tel.: +386(0) 388 44 00 / e-mail: info@smarteh.si / www.smarteh.si

Written by SMARTEH d.o.o.

User Manual

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STANDARDS AND PROVISIONS: Standards, recommendations, regulations and provisions of the country in which the devices will operate, must be considered while planning and setting up electrical devices. Work on 100 .. 240 V AC network is allowed for authorized personnel only.

DANGER WARNINGS: Devices or modules must be protected from moisture, dirt and damage during transport, storing and operation.

WARRANTY CONDITIONS: For all modules LONGO LPC-2 – if no modifications are performed upon and are correctly connected by authorized personnel – in consideration of maximum allowed connecting power, warranty of 24 months is valid from the date of sale to the end buyer, but not more than 36 months after delivery from Smarteh. In case of claims within warranty time, which are based on material malfunctions the producer offers free replacement. The method of return of malfunctioned module, together with description, can be arranged with our authorized representative. Warranty does not include damage due to transport or because of unconsidered corresponding regulations of the country, where the module is installed.

This device must be connected properly by the provided connection scheme in this manual. Misconnections may result in device damage, fire or personal injury.
Hazardous voltage in the device can cause electric shock and may result in personal injury or death.
NEVER SERVICE THIS PRODUCT YOURSELF!
This device must not be installed in the systems critical for life (e.g. medical devices, aircrafts, etc.).

If the device is used in a manner not specified by the manufacturer, the degree of protection provided by the equipment may be impaired.

Waste electrical and electronic equipment (WEEE) must be collected separately!

LONGO LPC-2 complies to the following standards:

- EMC: EN 303 446-1 V1.2.1, EN 303 446-2 V1.2.1, EN 61131-2:2017, EN IEC 61000-6-3:2021, EN 301 489-1 V2.2.3, EN 301 489-17 V3.3.1

Smarteh d.o.o. operates a policy of continuous development. Therefore we reserve the right to make changes and improvements to any of the products described in this manual without any prior notice.

MANUFACTURER:
SMARTEH d.o.o.
Poljubinj 114
5220 Tolmin
Slovenia

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Longo programmable controller LPC-2.MM1

1 ABBREVIATIONS

SOM	System on module
ARM	Advanced RISC machines
OS	Operating system
TCP	Transmission control protocol
SSL	Secure sockets layer
IEC	International electrotechnical commission
CAN	Controller area network
COM	Communication
USB	Universal serial bus
USB OTG	Universal serial bus On the go
IP	Internet protocol
PLC	Programmable logic controller
LED	Light emitting diode
RAM	Random access memory
NV	Non volatile
PS	Power supply
RTU	Remote terminal unit
RTC	Real time clock
IDE	Integrated development environment
FBD	Function block diagram
LD	Ladder diagram
SFC	Sequential function chart
ST	Structured text
IL	Instruction list
GUI	Graphical User Interface
DHCP	Dynamic Host Configuration Protocol

2 DESCRIPTION

LPC-2.MM1 Smarteh flagship main module modular PLC offers improved performance, scalability and a wide range of new features within a single compact SOM based package. Simple and innovative concept, where most competitors require multiple products to deliver similar functionality. The main module based on ARM architecture processor running Linux based OS adds more computing power, more control and additional interface connection offering capability for future core SOM module upgrades without hardware changes.

In addition, LPC-2.MM1 is designed to connect additional input and output modules on the right side, to the connector K1.

LPC-2.MM1 has an integrated USB programming and debugging port, connection for Smarteh intelligent peripheral modules, three Ethernet ports and WiFi connectivity that all can be used as a programming and debugging port, as a Modbus TCP/IP Master and/or Slave device and as BACnet IP (B-ASC). Two Ethernet ports support Ethernet daisy chain fail-safe functionality by using integrated Ethernet switch. In the case of LPC-2.MM1 and/or local power supply failure, two Ethernet ports will be physically disconnected from the LPC-2.MM1 Ethernet driver and will connect to each other directly. LPC-2.MM1 is also equipped with RS-485 port for Modbus RTU Master or Slave communication with other Modbus RTU equipment.

Hardware configuration is done using Smarteh IDE programming software, used to design user configuration by selecting from a wide range of modules with up to 7 modules in a single configuration.

This software also provides you with a simple entry in the IEC programming languages such as:

- Instruction List (IL)
- Function Block Diagram (FBD)
- Ladder Diagram (LD)
- Structured Text (ST)
- Sequential Function Chart (SFC).

This provides a large number of operators such as:

- Logic operators such as AND, OR, ...
- Arithmetic operators such as ADD, MUL, ...
- Comparison operators such as <, =, >
- Other ...

Programming software is used to create, debug, test and document a project. Functions for analog processing, closed-loop control and function blocks such as timers and counters simplify programming.

3 FEATURES

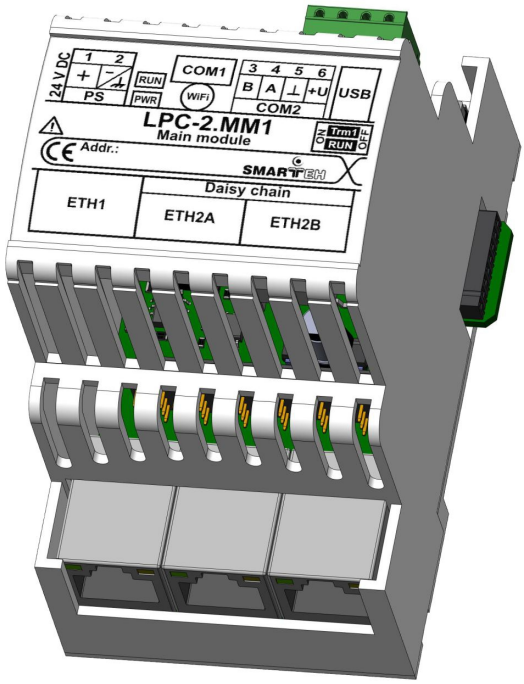


Figure 1: LPC-2.MM1 module

Table 1: Features
Real Time Linux OS ARM based main module
Three Ethernet ports. One with its own IP address and two of them with the same IP address, integrated Ethernet switch and fail-safe daisy chain functionality
WiFi connectivity
Ethernet & WiFi connectivity for debugging and application transfer, Modbus TCP/IP Slave (server) and/or Master (client) functionality, BACnet IP (B-ASC), web server and SSL certificate
Wi-Fi connector for external antenna
USB port for debugging and application transfer, USB OTG
Modbus RTU Master or Slave
Smarteh bus for connection with LPC-2 Smarteh intelligent peripheral modules
Remote access and application transfer
RTC and 512 kB non-volatile memory with super capacitor for needed energy storage
Status LEDs

4 INSTALLATION

4.1 Connection scheme

Figure 2: Connection scheme

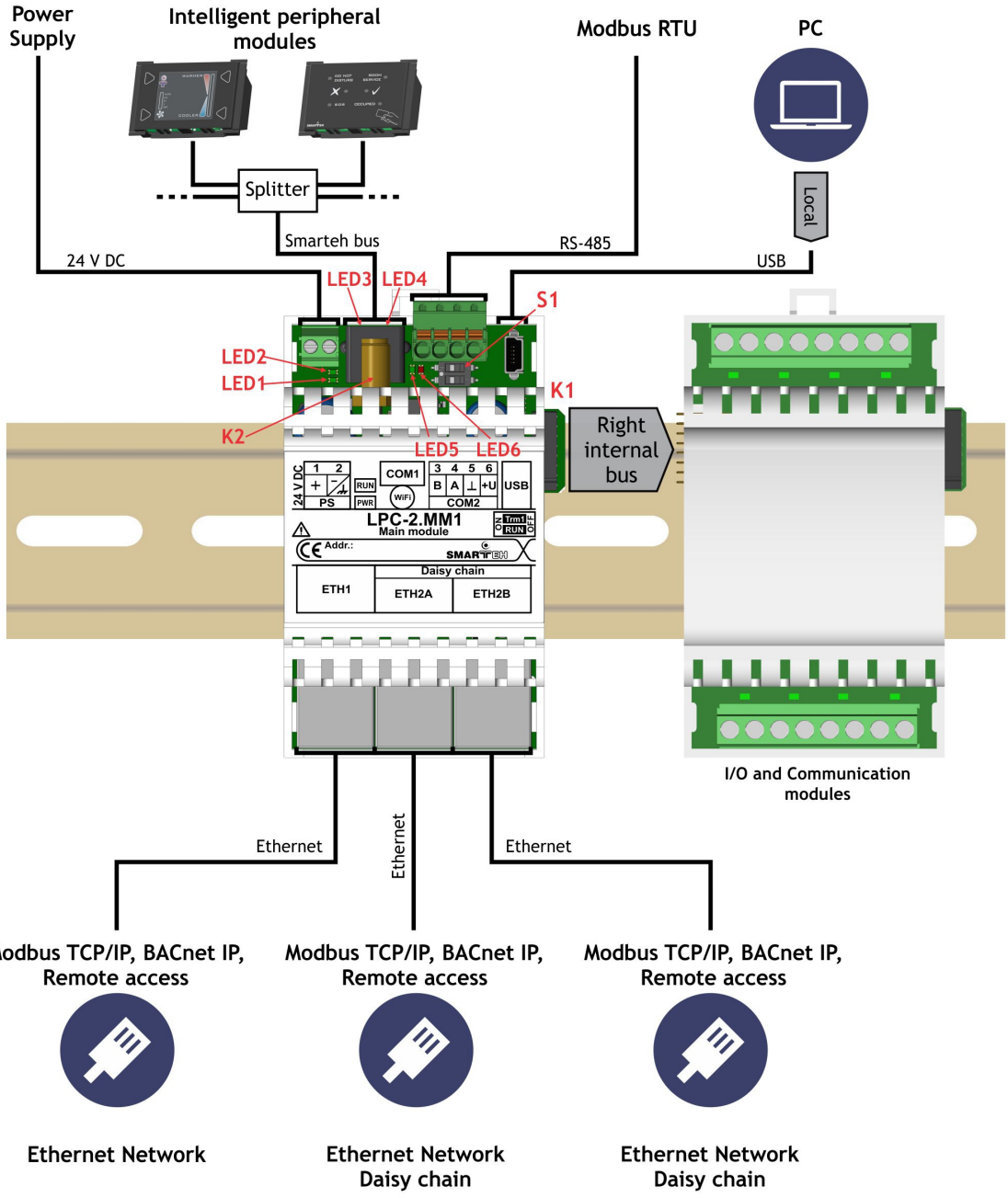


Figure 3: Connection scheme example

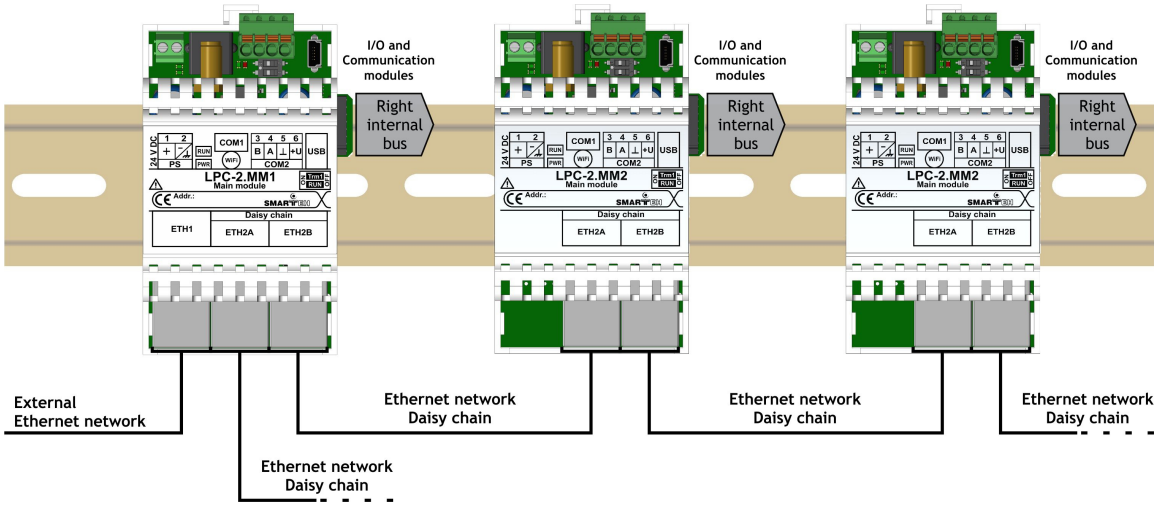


Table 2: Power supply

PS.1	+	Power supply, 20 .. 28 V DC, 2 A
PS.2	— / ⏚	EGND

Table 3: COM1 Smarteh bus

COM1.1	N.C.	
COM1.2	⊥	GND
COM1.3	+U	Power supply output, 15V
COM1.4	RS-485 (A) Smarteh bus	0 .. 3.3 V
COM1.5	RS-485 (B) Smarteh bus	
COM1.6	N.C.	

Table 4: COM2 RS-485[1]

COM2.3	RS-485 (B) Modbus RTU	0 .. 3.3 V
COM2.4	RS-485 (A) Modbus RTU	
COM2.5	⊥	GND
COM2.6	+U	Power supply output, 15V

1 **Different protocols** like Modbus RTU Master can be selected inside Smarteh IDE. **Wires** connected to the module must have cross sectional area at least 0.14 mm^2. Use twisted-pair cables of type CAT5+ or better, shielding is recommended. Minimum temperature rating of wire insulation must be 85 °C.

Table 5: Internal bus		
K1	Data & DC power supply	Connection to comm. modules

Table 6: WiFi		
K2	WiFi antenna connector	SMA

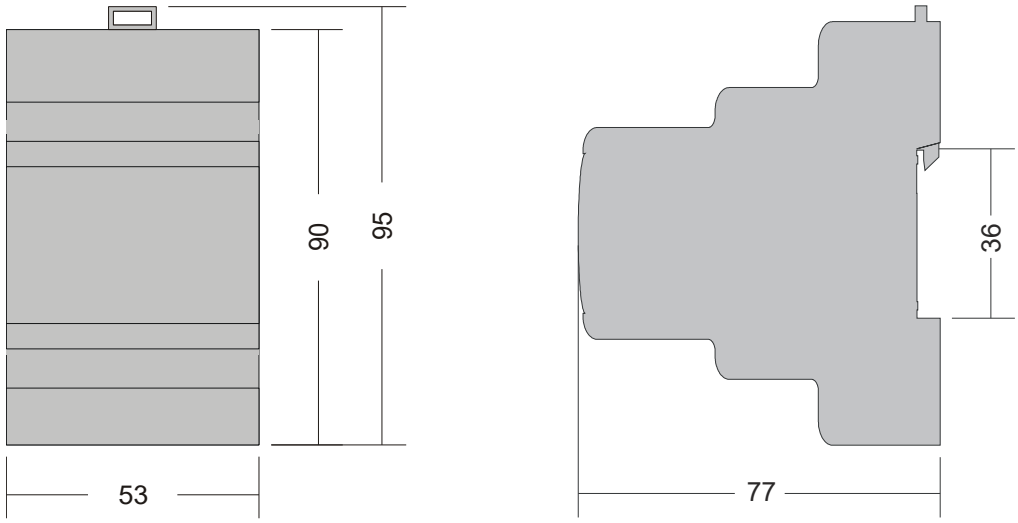
Table 7: USB and Ethernet		
USB	USB	mini B type, device mode or host mode, USB On-The-Go
Ethernet	ETH1	RJ-45 shielded
Ethernet	ETH2A	RJ-45 shielded, daisy chain functionality
Ethernet	ETH2B	RJ-45 shielded, daisy chain functionality

Table 8: Switches		
S1.1	COM2 RS-485 termination (Trm)	ON: RS-485 channel is internally terminated with 1.2 kΩ OFF: no internal termination present
S1.2	Operation mode (RUN)	ON: PLC in normal operational mode (RUN) OFF: PLC application not running (STOP)

Table 9: LEDs		
LED1: green	RUN, Application running	ON: application is running OFF: application is stopped or PLC in boot mode
LED2: green	PWR, Power supply status	ON: PLC is powered on OFF: PLC has no power supply Blink: Short circuit
LED3: green	COM1 RS-485 Tx status	Blink: OK Off: no answer On: A and/or B line in shortcut
LED4: red	COM1 RS-485 Rx status	Blink: OK Off: no communication from Master On: A and/or B line in shortcut
LED5: green	COM2 RS-485 Tx status	Blink: OK Off: no answer On: A and/or B line in shortcut
LED6: red	COM2 RS-485 Rx status	Blink: OK Off: no communication from Master On: A and/or B line in shortcut

4.2 Mounting instructions

Figure 4: Housing dimensions



Dimensions in millimeters.

RECOMMENDATION ON SWITCH OR CIRCUIT-BREAKER PROTECTION: There should be two poles main switch in the installation in order to switch off the module. The switch must meet the requirements of standard IEC60947-1 and have a nominal value at least 6 A. The switch or circuit-breaker should be within easy reach of the operator. It must be used as the disconnected device for the equipment.

RATING AND CHARACTERISTICS OF FUSES: LPC-2.MM1 main module must be connected with 4 A circuit breaker in Live and Neutral conductor. It is class I unit and must be permanently connected to Protective Earth. The units are permanently connected to the Mains.

All connections, module attachments and assembling must be done while module is not connected to the main power supply. Wires connected to the module must have cross sectional area at least 0.75 mm^2. Minimum temperature rating of wire insulation must be 85 °C.

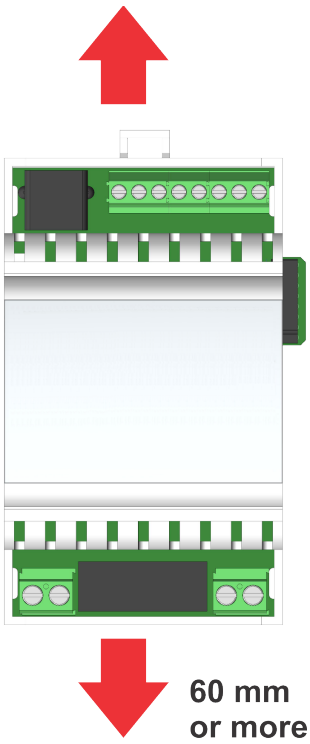
The modules must be installed in enclosure with no openings. Enclosure must provide electrical and fire protection which shall withstand dynamic test with 500 g steel sphere from distance is 1.3 m and also static test 30 N. When installed in enclosure, only authorized person can have a key to open it.

Operation in ambient temperatures above 40°C requires supplementary cooling, such as forced-air ventilation, to ensure optimal module performance.

Mounting instructions:

1. Switch OFF main power supply.
2. Mount module to the provided place inside an electrical panel (DIN EN50022-35 rail mounting).
3. Mount other IO modules (if required). Mount each module to the DIN rail first, then attach modules together through K1 connector.
4. Connect needed input, output and communication wires.
5. Switch ON main power supply.
6. Dismount in reverse order. For mounting/dismounting modules to/from DIN rail a free space of at least one module must be left on the DIN rail.

Figure 5: Minimum clearances

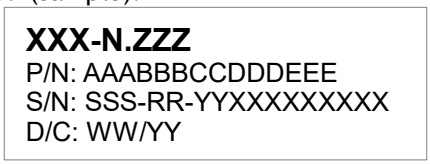


The clearances above must be considered before module mounting.

4.3 Module labeling

Figure 6: Label

Label (sample):



Label description:

1. **XXX-N.ZZZ** - full product name.
   - **XXX-N** - Product family
   - **ZZZ** - product
2. **P/N: AAABBBCCDDDEEE -** part number.
   - **AAA** - general code for product family,
   - **BBB** - short product name,
   - **CCDDD** - sequence code,
     - **CC** - year of code opening,
     - **DDD** - derivation code,
   - **EEE** – version code (reserved for future HW and/or SW firmware upgrades).
3. **S/N: SSS-RR-YYXXXXXXXXX -** serial number.
   - **SSS** – short product name,
   - **RR** – user code (test procedure, e.g. Smarteh person xxx),
   - **YY** – year,
   - **XXXXXXXXX**– current stack number.
4. **D/C: WW/YY -** date code.
   - **WW** – week and
   - **YY** – year of production.

Optional

1. ***MAC***
2. ***Symbols***
3. ***WAMP***
4. ***Other***

5 TECHNICAL SPECIFICATIONS

Table 10: Technical specifications	
Rated power supply PS	24 V DC, 2A
Operational power supply PS	20 .. 28 V DC
Power consumption PS	up to 24 W depending on additional modules connected to main module
Connection type for PS	screw type connector for stranded wire 0.75 to 1.5 mm^2
Connection type for COM1	RJ-12 6/4
Connection type for COM2	disconnectable spring type connectors for stranded wire 0.14 to 1.5 mm^2
COM1 Smarteh bus	non isolated
COM2 RS-485 port	non isolated, 2 wire
Ethernet 1	RJ-45, 10/100/1000T IEEE 802.3
Ethernet 2A & Ethernet 2B	RJ-45, 10/100T IEEE 802.3 Daisy chain functionality, fail-safe operation. Integrated 10/100 Ethernet Switch
WiFi	IEEE 802.11 b/g/n, SMA female connector
USB	mini B type, device mode or host mode, USB On-The-Go, high-speed/full-speed
RTC	capacitor backed up with retention cca. 14 days
Operating system	Linux
CPU	i.MX6 Single (ARM® Cortex™-A9) @ 1GHz
RAM	1 GB DDR3
Flash	4 GB eMMC 8bits (MLC type)
NV RAM	512 kB, capacitor backed up with retention cca. 14 days
Dimensions (L x W x H)	90 x 53 x 77 mm
Weight	175 g
Ambient temperature	0 to 50°C[2]
Ambient humidity	max. 95 %, no condensation
Maximum altitude	2000 m
Mounting position	vertical
Transport and storage temperature	-20 to 60 °C
Pollution degree	2
Over-voltage category	II
Electrical equipment	class II (double insulation)
Protection class	IP 30

2 Operation in ambient temperatures above 40°C requires supplementary cooling, such as forced-air ventilation, to ensure optimal module performance. Fan ordering part number is listed in Chapter 7 “Spare parts”.

6 PROGRAMMING GUIDE

This chapter is intended to offer the programmer additional information about some of the functionalities and units integrated in this module.

6.1 Basic functionalities

RTC unit

For RTC back-up and for Retain variables there is Super Capacitor instead of battery integrated inside PLC. This way, replacement of the discharged battery is avoided. The Retention time is minimum 14 days from the power down. RTC time provides date and time information.

Ethernet

The LPC-2.MM1 features three Ethernet ports, each configurable for programming, debugging, Modbus TCP/IP (Master/Slave), and BACnet IP (B-ASC) functionality. Two of these ports, ETH2A and ETH2B, support Ethernet daisy-chain fail-safe operation through an integrated unmanaged switch. In the event of an LPC-2.MM1 or local power supply failure, these ports bypass the module's Ethernet driver, directly connecting to maintain network continuity.

For optimal daisy-chain performance, static IP addresses are strongly recommended for ETH2A and ETH2B ports, as DHCP usage can lead to communication disruptions, particularly during cable disconnections and reconnections. It is also advised to isolate the daisy-chain network from other Ethernet networks. A maximum of 32 LPC-2.MM1 devices can be reliably connected in a daisy-chain topology, with a maximum Ethernet cable length of 100 meters between active devices. Note that during a module or power supply failure, the direct connection between ETH2A and ETH2B effectively extends the cable path; this must be considered to ensure the total cable length remains within the 100-meter limit. The use of external Ethernet switches in a daisy-chain topology should have no significant impact on performance. Ring topology network configurations for LPC-2.MM1 modules are not supported.

WiFi

WiFi port can be used as a programming and debugging port, as a Modbus TCP/IP Master and/or Slave device and as BACnet IP (B-ASC).

Modbus TCP/IP master unit

When configured for Modbus TCP/IP Master / Client mode, the LPC-2.MM1 functions as a master device, controlling the communications with other slave devices such as sensors, inverters, other PLCs, etc. LPC-2.MM1 sends Modbus TCP/IP commands to and receives Modbus TCP/IP responses from the slave units.

Following commands are supported:

01 – Read Coil Status
02 – Read Input Status
03 – Read Holding Registers
04 – Read Input Registers
05 – Write Single Coil
06 – Write Single Register
15 – Write Multiple Coils
16 – Write Multiple Registers

Note: each of this command can read/write up to 10000 addresses.

Modbus TCP/IP slave unit

Modbus TCP slave has 10000 addresses in each memory section:

Coils:	00000 to 09999
Discrete inputs:	10000 to 19999
Input register:	30000 to 39999
Holding registers:	40000 to 49999

Supports up to 5 connections to the slave units (defined with MaxRemoteTCPClient parameter). Highest scan rate is 100 ms.

Modbus RTU master unit

When configured for Modbus RTU Master mode, the LPC-2.MM1 functions as a master device, controlling the communications with other slave devices such as sensors, inverters, other PLCs, etc. LPC-2.MM1 sends Modbus RTU commands to and receives Modbus RTU responses from the slave devices.

Following commands are supported:

01 – Read Coil Status
02 – Read Input Status
03 – Read Holding Registers
04 – Read Input Registers
05 – Write Single Coil
06 – Write Single Register
15 – Write Multiple Coils
16 – Write Multiple Registers

Note: each of this commands can read/write up to 246 bytes of data. For analog (Input and Holding registers) this means 123 values, while for digital (Statuses and Coils) this means 1968 values. When higher quantity of data is required, LPC-2.MM1 can execute up to 32 same or different supported commands simultaneous.

Physical layer: RS-485

Supported baud rates: 9600, 19200, 38400, 57600 and 115200bps

Parity: None, Odd, Even.

Stop bit: 1

Modbus RTU slave unit

Modbus TCP slave has 1024 addresses in each memory section:

Coils:	00000 to 01023
Discrete inputs:	10000 to 11023
Input register:	30000 to 31023
Holding registers:	40000 to 41023

Highest scan rate is 100 ms.

Smarteh RS485 bus for connectivity with LPC-2 system

This port is used for communication with LPC-2 slave modules. All communication settings are

configured in SmartehIDE software program.

BACnet IP unit

When configured for BACnet IP (B-ACS), following commands are supported:

Data Sharing

ReadProperty-B (DS-RP-B)
WriteProperty-B (DS-WP-B)

Device and Network Management

Dynamic Device Binding-B (DM-DDB-B)
Dynamic Object Binding-B (DM-DOB-B)
Device Communication Control-B (DM-DCC-B)
Time Synchronization-B (DM-TS-B)
UTCTimeSynchronization-B (DM-UTC-B)

For more information, please contact the producer.

RUN Switch

Run: Status RUN status LED “on” indicate that the user graphical application is up and user program is running.

Stop: When the switch is turn to STOP state, the RUN status LED is “off” and application is stopped.

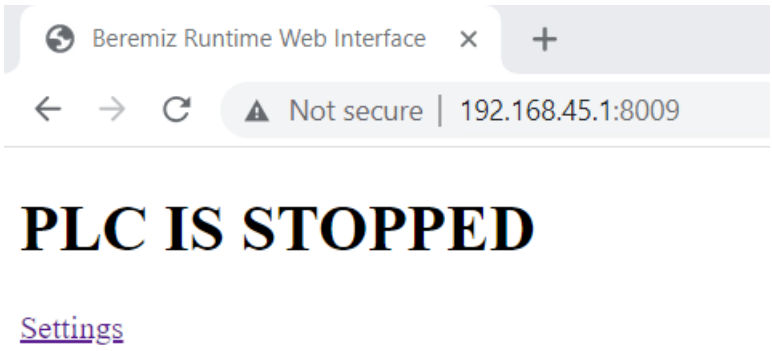
PLC task cycle time

Main PLC task interval (under Project tab -> Resource → Tasks → Interval) time is not recommended to be set lower than 50 ms.

6.2 WiFi configuration

1. Connect module to the PC via USB connector and switch ON power supply.
2. In the address bar, type the module's default IP address: 192.168.45.1 followed by the port number: 8009 (e.g., http://192.168.45.1:8009). Refer to Figure 7: Web interface.
3. Click on “Settings” button on the web interface.

Figure 7: Web interface



4. The Settings page opens. In the “Network Settings for wlan0 interface (wireless)” section set the parameters of the wireless network to which you want to connect: “Configuration type”, “Authentication type”, “Network name” and “Password”. Refer to Figure 8: Web interface settings.
5. Click the "Set" button at the bottom of the section to apply the changes.

Recommended parameters for Wi-Fi connection:

Master device program task cycle: 800 ms

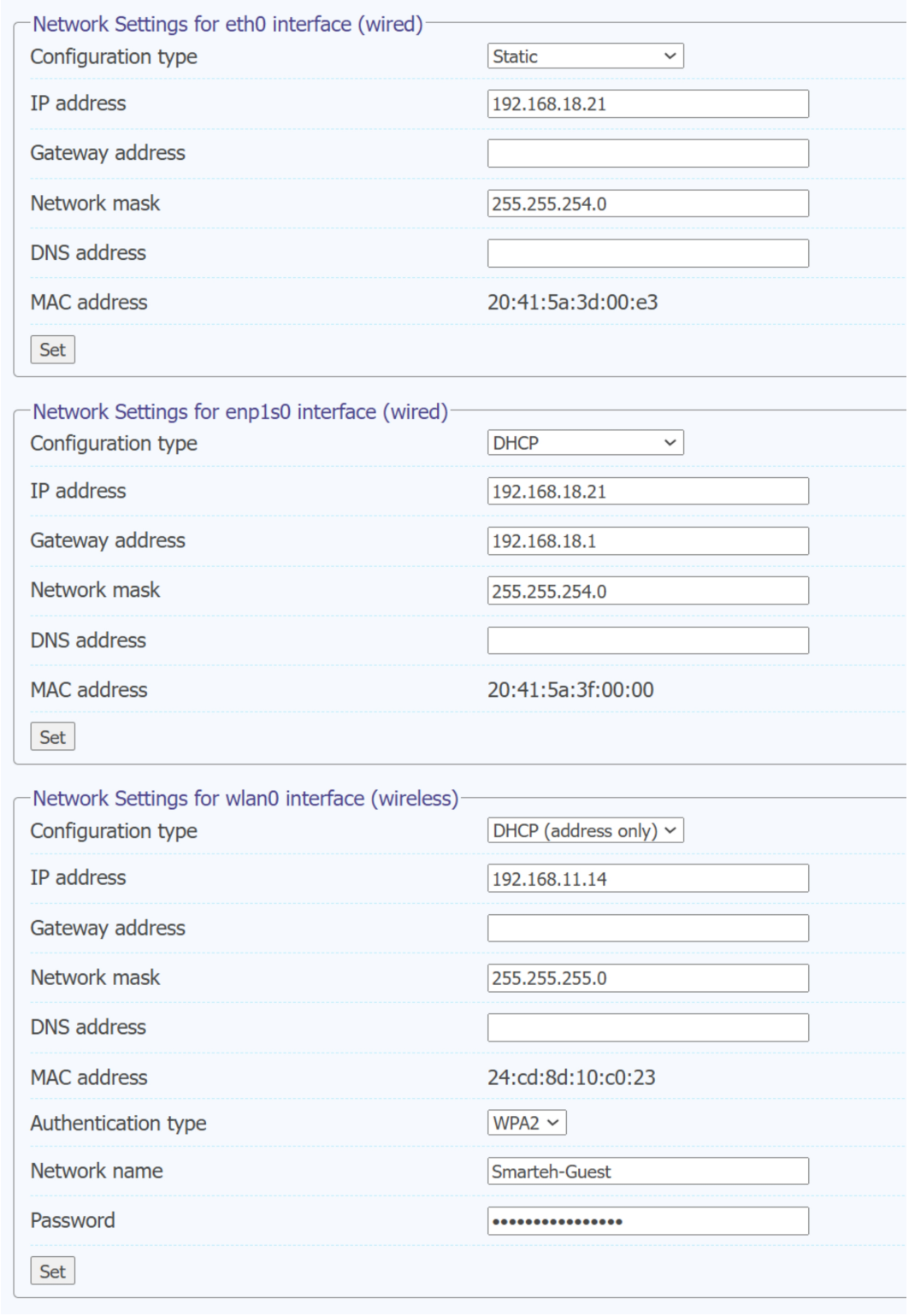
Slave device program task cycle: 180 ms

Read & write timeout: 600 ms

Request delay: 300 ms

Invocation rate: 180 ms

Figure 8: Web interface settings



6.3 Ethernet configuration

1. Connect module to the PC via USB connector and switch ON power supply.
2. Open a web browser on your PC.
3. In the address bar, type the module's default IP address: 192.168.45.1 followed by the port number: 8009 (e.g., http://192.168.45.1:8009). Press Enter. Refer to Figure 7: Web interface.
4. Click on “Settings” button on the web interface.
5. The Settings page will display three sections for configuring network connections (Ethernet and Wi-Fi). The “Network Settings for eth0 interface (wired)” section allows you to set parameters for the module's two RJ45 Ethernet ports ETH2A and ETH2B. These ports function as an integrated unmanaged Ethernet switch, enabling daisy-chain network connections. It is recommended to set a static IP address for the ETH2A and ETH2B ports. Using DHCP might cause communication issues, Ethernet communication will possibly not recover after the Ethernet cable is disconnected and again connected to the ETH2A or ETH2B port. Enter the desired network parameters for your specific network configuration. Refer to Figure 8: Web interface settings.
6. The “Network Settings for enp1s0 interface (wired)” section allows you to set parameters for the module's RJ45 Ethernet port ETH1. Enter the desired network parameters for your specific network configuration. Ethernet port and WiFi must use the same Gateway. So if we select the first port on DHCP, we must set the second one to DHCP (address only). Refer to Figure 8: Web interface settings.
7. Once you have configured the settings, connect a UTP cable to the desired port.
8. Click the "Set" button at the bottom of the section to apply the changes.

Table 11: Network ports and its corresponding title on the Web interface

ETH2A	eth0 interface (wired)
ETH2B	eth0 interface (wired)
ETH1	enp1s0 interface (wired)
WiFi	wlan0 interface (wireless)

Recommended parameters for Ethernet daisy-chain connection:

Master device program task cycle: 50 ms

Slave device program task cycle: 10 ms

Read & write timeout: 20 ms

Request delay: 0 ms

Invocation rate: 10 ms

6.4 GUI design and programming

Graphical interface is freely designed by the user with GUI editor in SmartehIDE (Inkscape 0.92).

Figure 9: SmartehIDE software tool[3]

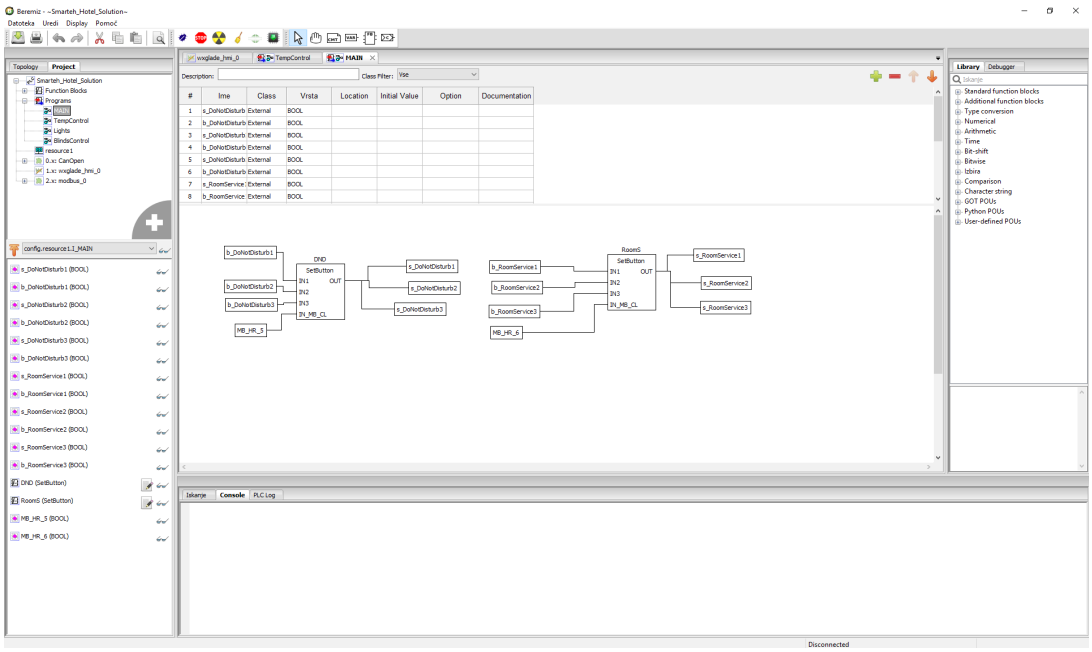
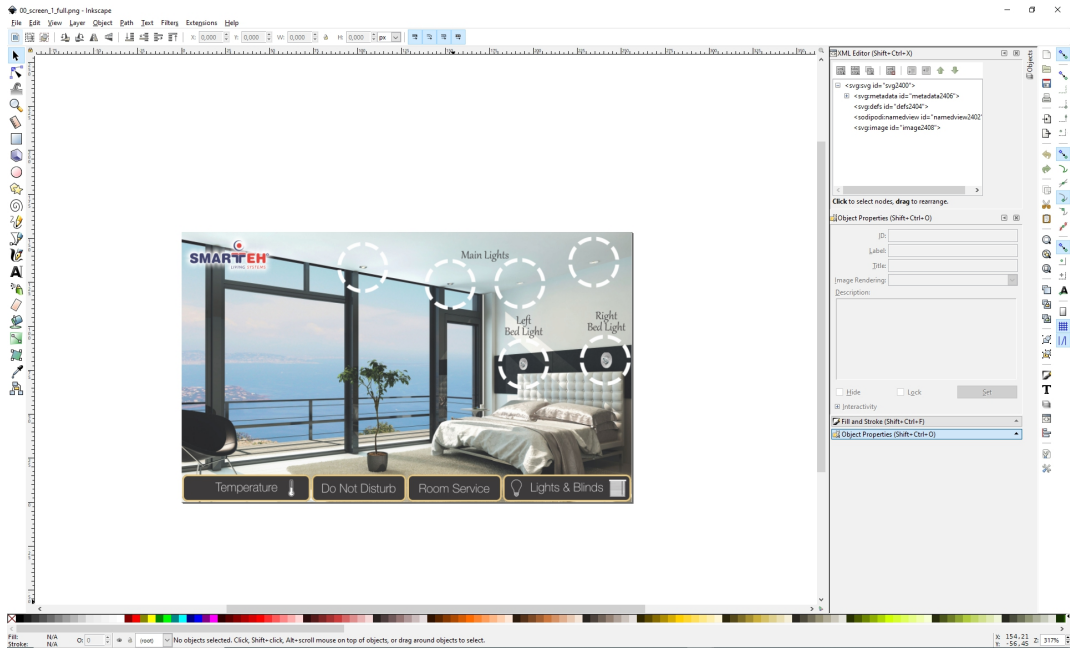


Figure 10: Inkscape open source tool[4]



3 **Configuration** of the PLC is done using Smarteh IDE software tool. **Please refer to SmartehIDE and LPC Manager user manual** for details.

4 **Configuration** of the GUI is done using Inkscape 0.92 open source tool.

NOTE: It is recommended that only one Ethernet or Wifi connection to the Smarteh PLC GUI by using an internet browser, is established and used at a time. Exceptionally up to three Ethernet or Wifi connections could be established at the same time.

7 SPARE PARTS

For ordering spare parts following Part Numbers should be used:

LPC-2.MM1 Main module	P/N: 225MM123001001
LCF-1 Longo Cooling Fan 1	P/N: 206LCF24001001

8 CHANGES

The following table describes all the changes to the document.

Date	V.	Description
15.05.25	5	Fan part number added in Chapter 7.
02.04.25	4	Chapter 6 updated.
13.06.24	3	Chapter 6 updated.
20.05.24	2	Chapter 6.3 added and chapter 6.1 updated.
19.12.23	1	The initial version, issued as *LPC-2.MM1 User Manual*.

9 NOTES