USER MANUAL

Longo programmable controller
LPC-3.IOT.001
Input Output Transistor PLC

Version 2

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 .. 230 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-3 – 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-3 complies to the following standards:
- EMC: EN 61000-6-3:2007 + A1:2011, EN 61000-6-1:2007, EN 61000-3-2:2006 + A1:2009 + A2: 2009, EN 61000-3-3:2013,
- LVD: IEC 61010-1:2010 (3rd Ed.), IEC 61010-2-201:2013 (1st Ed.)

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

Index

Longo programmable controller LPC-3.IOT.001

1 DESCRIPTION

Smarteh third generation of customizable PLC (Programmable Logic Controller) is ideal solution for the automation of machines and production lines where high number of various input, output and communication connections per single PLC is desirable. LPC-3 controllers offers through its innovative design a very attractive solution for a competitive price. The modules are designed with special attention to the machine building market.

LPC-3.IOT.001 (Input Output Transistor) is an innovative PLC with 16 galvanic isolated digital inputs supporting -12 .. 30 V input voltage range.

16 galvanic isolated transistor outputs (2 groups of 8 outputs) guarantee a current source up to 1.2 A. Outputs are current and thermal protected.

LPC-3.IOT.001 is equipped with Ethernet connection and can be used as a Modbus TCP Slave device, with an USB port, used for programming and debugging. It also includes 2 galvanic isolated CAN bus, used for local or remote connection to other LPC-3 PLC.

Integrated "Setting Storage FLASH", "RTC" and "NV RAM", doesn't need the battery for it's functioning.

Smarteh IDE (Integrated Development Environment) software tool is used with all the PLC from the LPC-3 family and it supports all five standard PLC programmable languages (FBD, LD, SFC, ST, IL). It also supports "off line", "on line" debugging and local program transferring. Distributed processing is supported, which makes it possible to handle fast operations.

Controller is powered from external power supply.

NOTE: For proper connection please refer to CONNECTION & CONFIGURATION GUIDE and for proper system configuration and data allocation please refer to PROGRAMMING GUIDE chapter of this user manual.
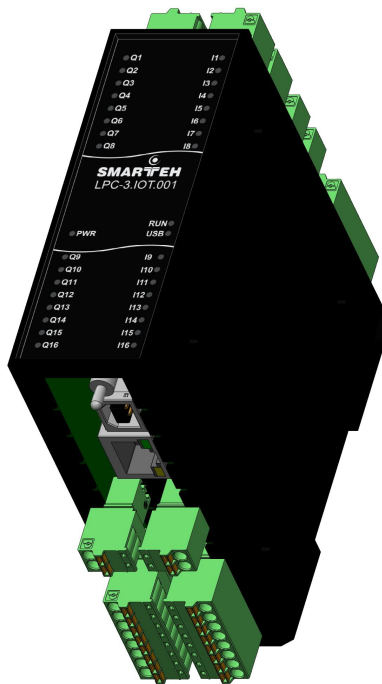
2 FEATURES

Figure 1: LPC-3.IOT.001 PLC

Table 1: Technical data
Ethernet connectivity with Modbus TCP slave (server) functionality
USB port for Debugging, Application and Default parameters transfer
2 galvanic isolated (2500 V DC) CAN ports
RTC and 32 kB non-volatile memory with super capacitor for needed energy storage
4 kb Flash memory available for parameter storage
16 galvanic isolated digital inputs -12 .. 30 V
16 digital transistor outputs 11 .. 30 V, 1.2 A galvanic isolated (500 V AC) outputs, over current and thermal protected
Disconnect-able spring type connectors
35 status LEDs
Quality design

3 INSTALLATION

3.1 Block diagram

Figure 2: PLC block diagram[1]

---
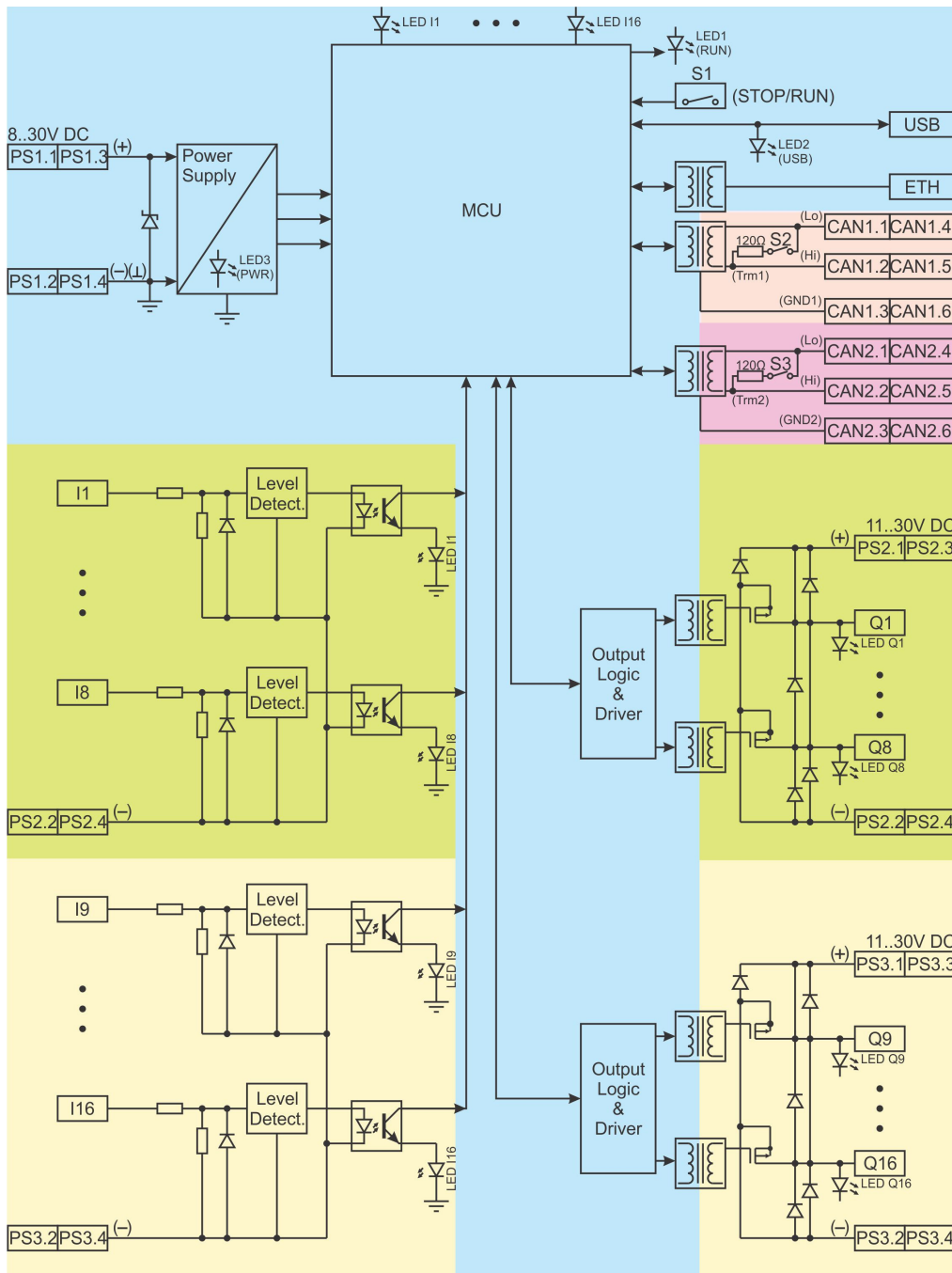
1 **Coloured areas** represents different voltage domains - galvanic isolated areas. **Please refer to** TECHNICAL SPECIFICATIONS for details.

3.2 Inputs & outputs

Table 2: PLC digital input[2]		
	-12 .. 30 V[3] R_{in}=3.9 kΩ Max. input freq. = 50 Hz	-12 .. 30 V[4] R_{in}=3.9 kΩ Max. input freq. = 50 Hz
I1	Digital input 1	
I2	Digital input 2	
I3	Digital input 3	
I4	Digital input 4	
I5	Digital input 5	
I6	Digital input 6	
I7	Digital input 7	
I8	Digital input 8	
I9		Digital input 9
I10		Digital input 10
I11		Digital input 11
I12		Digital input 12
I13		Digital input 13
I14		Digital input 14
I15		Digital input 15
I16		Digital input 16

2 **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.
3 **Digital inputs I1..I8** are in reference to PS2.2 / PS2.4 negative (-) voltage.
4 **Digital inputs I9..I16** are in reference to PS3.2 / PS3.4 negative (-) voltage.

Table 3: PLC digital output[5]		
	Source 11 .. 30 V DC[6] Max. current per output = 1.2 A Max. output frequency = 50 Hz	Source 11 .. 30 V DC[7] Max. current per output = 1.2 A Max. output frequency = 50 Hz
Q1	Digital output 1	
Q2	Digital output 2	
Q3	Digital output 3	
Q4	Digital output 4	
Q5	Digital output 5	
Q6	Digital output 6	
Q7	Digital output 7	
Q8	Digital output 8	
Q9		Digital output 9
Q10		Digital output 10
Q11		Digital output 11
Q12		Digital output 12
Q13		Digital output 13
Q14		Digital output 14
Q15		Digital output 15
Q16		Digital output 16

---

5   **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.

6   **Digital outputs Q1..Q8** are source type of outputs in reference to PS2.1/PS2.3 negative (-) voltage. Positive power supply is provided from PS2.1(+)/PS2.3(+) connection. **Please refer to** CONNECTION & CONFIGURATION GUIDE for details.

7   **Digital outputs I9..I16** are source type of outputs in reference to PS2.1/PS2.3 negative (-) voltage. Positive power supply is provided from PS3.1(+)/PS3.3(+) connection. **Please refer to** CONNECTION & CONFIGURATION GUIDE for details.

Table 4: External Power Supply[8]		
PS1.1 (+)	PLC power supply	8 .. 30 V DC, 1 A
PS1.2 (-)	Reference point (⊥)	0 V
PS1.3 (+)	PLC power supply	8 .. 30 V DC, 1 A
PS1.4 (-)	Reference point (⊥)	0 V
PS2.1 (+)	Digital output Q1..Q8 power supply	11 .. 30 V DC, 8 A
PS2.2 (-)	Digital output Q1..Q8 reference point	0 V to PS2.1/PS2.3
PS2.3 (+)	Digital output Q1..Q8 power supply	11 .. 30 V DC, 8 A
PS2.4 (-)	Digital output Q1..Q8 reference point	0 V to PS2.3/PS2.1
PS3.1 (+)	Digital output I9..I16 power supply	11 .. 30 V DC, 8 A
PS3.2 (-)	Digital output I9..I16 reference point	0 V to PS3.1/PS3.3
PS3.3 (+)	Digital output I9..I16 power supply	11 .. 30 V DC, 8 A
PS3.4 (-)	Digital output I9..I16 reference point	0 V to PS3.3/PS3.1

Table 5: Switch		
S1	Operation mode (RUN/STOP)	*RUN*: PLC normal operational mode *STOP*: application not running, connected PLCs outputs in their off state
S2	CAN1 bus termination (Trm1)	*On*: corresponding channel is internally terminated with 120 Ω *Off*: no internal termination present
S3	CAN2 bus termination (Trm2)	*On*: corresponding channel is internally terminated with 120 Ω *Off*: no internal termination present

Table 6: LED		
LED1	Application running (RUN)	*On*: application is running *Off*: application is stopped or PLC in boot mode
LED2	USB connectivity (USB)	*On*: USB connection established *Off*: no USB connection
LED3	Power (PWR)	*On*: PLC is powered On *Off*: PLC has no power supply

Table 7: LED.I1 .. LED.I16	
Input status LED	*On*: Input is active, LED is switched On *Off*: Input is not active, LED is switched Off

---

8 **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.

Table 8: LED.Q1..LED.Q16

Output status LED	*On*: source voltage present, LED is switched On *Off*: output Off or over current / over temperature protection active, LED is switched Off

Table 9: CAN[9]

| Master CAN1 M	CAN1.1	CAN1 Low (Lo)	0 .. 5 V
	CAN1.2	CAN1 High (Hi)	
	CAN1.3	CAN1 reference point (Gnd1)	0 V to CAN1
Slave CAN2 S	CAN2.1	CAN2 Low (Lo)	0 .. 5 V
	CAN2.2	CAN2 High (Hi)	
	CAN2.3	CAN2 reference point (Gnd2)	0 V to CAN2
Master CAN1 M	CAN1.4	CAN1 Low (Lo)	0 .. 5 V
	CAN1.5	CAN1 High (Hi)	
	CAN1.6	CAN1 reference point (Gnd1)	0 V to CAN1
Slave CAN2 S	CAN2.4	CAN2 Low (Lo)	0 .. 5 V
	CAN2.5	CAN2 High (Hi)	
	CAN2.6	CAN2 reference point (Gnd2)	0 V to CAN2

---

9 **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. **Galvanic isolation** of 2500 V DC between CAN1, CAN2 and rest of the PLC circuit is provided.

3.3 Mounting instructions

Figure 3: Housing dimensions

100mm
130mm
35mm

107mm
111mm
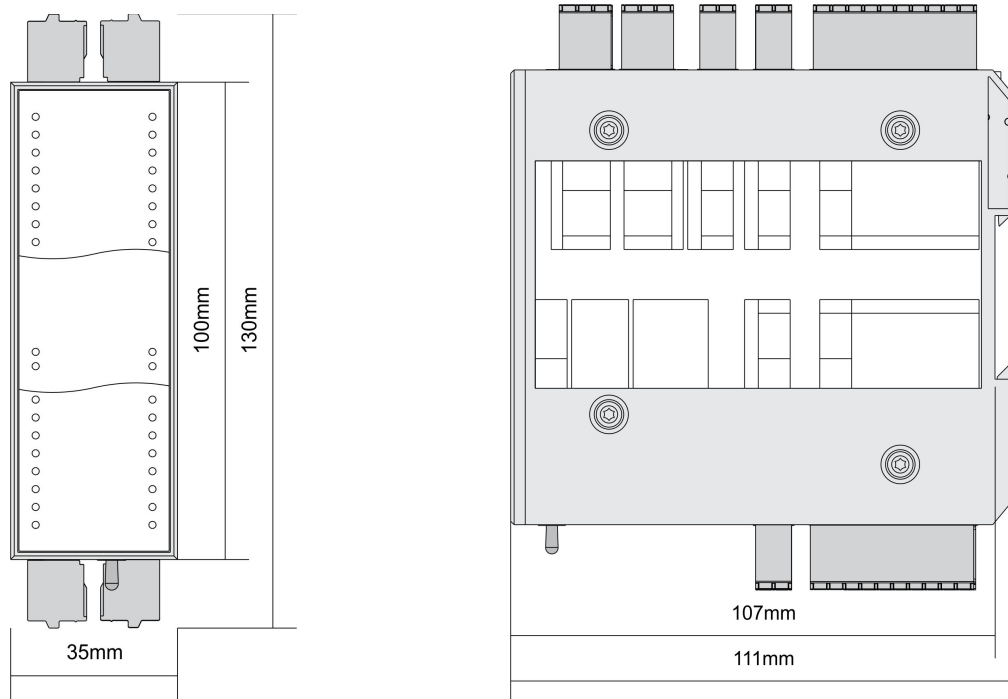
Module surrounding area must be free for optimal cooling.

EXTERNAL SWITCH OR CIRCUIT-BREAKER AND EXTERNAL OVERCURRENT PROTECTION: The unit is allowed to be connected to installation with over current protection that has nominal value of 6 A or less.

RECOMMENDATION ON SWITCH OR CIRCUIT-BREAKER PROTECTION: There should be two poles main switch in the installation in order to switch off the unit. The switch should meet the requirements of standard IEC60947 and have a nominal value at least 6 A. The switch or circuit-breaker should be within easy reach of the operator. It should be marked as the disconnecting device for the equipment. All connections, PLC attachments and assembling must be done while PLC is not connected to the external power supply.

Wires connected to the PLC must have cross sectional area at least 0.75 mm^2. Minimum temperature rating of wire insulation must be 85 °C.

1. Switch OFF external power supply PS1, PS2 and PS3.

2. Mount LPC-3 PLC to the provided place inside an electrical panel (DIN EN50022-35 rail mounting).

3. Mount other LPC-3 PLC (if required). Mount each PLC to the DIN rail first and then make required connections or connect disconnect-able connectors.

4. Connect needed input, output and communication wires.

5. Switch ON power supply PS1, PS2 and PS3.

4 TECHNICAL SPECIFICATIONS

Table 10: General technical specifications	
LPC-3.IOT.001 external power supply PS1	8 .. 30 V DC
LPC-3.IOT.001 external power consumption PS1	Max. 5 W
PS1 rated isolation voltage to PS2 and PS3	500 V AC
Digital output Q1..Q8 power supply PS2	11 .. 30 V DC
Maximum PS2 current	8 A
PS2 rated isolation voltage to PS1 and PS3	500 V AC
Digital output Q9..Q16 power supply PS3	11 .. 30 V DC
Maximum PS3 current	8 A
PS3 rated isolation voltage to PS1 and PS2	500 V AC
CAN1 isolation voltage to CAN2	2500 V DC
CAN1 or CAN2 isolation voltage to PS1, PS2, PS3	2500 V DC
Connection type	disconnect-able spring type connectors for stranded wire 0.14 to 2.5 mm^2
Ethernet	RJ45 10/100T IEEE802.3 standard
USB	B connector type, device mode, low speed, full speed
RTC and NVRAM	Capacitor backed up with retention of approximately 30 days.
Dimensions (L x W x H)	110 x 100 x 35 mm
Weight	350 g
Ambient temperature	0 to 50 °C
Ambient humidity	max. 95 %, no condensation
Maximum altitude	2000 m
Mounting position	vertical
Transport and storage temperature	-20 to 60 °C
Pollution degree	3
Over-voltage category	II
Electrical equipment	Class II (double insulation)
Protection class	IP 30

Table 11: Input technical specifications

	Input I1..I8[10]	Input I9..I16[11]
Digital input range	-12 .. 30 V	
Input resistance	3.9 kΩ	
Max. input frequency	50 Hz	
Input "Off" threshold voltage	5 V DC	
Input "On" threshold voltage	8 V DC	

Table 12: Transistor output technical specifications [12]

Digital output type	Source, P channel FET output
Rated source output voltage	11 .. 30 V DC
Max. source output current per channel[13]	1.2 A
Max, output switching frequency	50 Hz
Max. turn on time to 90 % of supply voltage	200 µs
Max. turn off time to 10 % of supply voltage	250 µs
Continuous output FET reverse drain current per channel, limited by total power dissipation	4 A
Continuous output sum reverse current through Q1..Q8 / Q9..Q16 corresponding reference point	-1.5 A
Inductive load switch-Off energy dissipation single pulse, only one channel active	10 J
Inductive load switch-Off energy dissipation single pulse, all channel simultaneously active	1 J
Capacitive load switch-On dissipation all channels	limited by digital outputs internal thermal protection
Output FET max. On resistance	350 mΩ
Max. output Off leakage current	50 µA
Over current protection	Yes
Thermal protection	Yes

---

10 **Digital inputs I1..I8** are in reference to PS2.2 / P23.4 negative (-) voltage.
11 **Digital inputs I9..I16** are in reference to PS3.2 / PS3.4 negative (-) voltage.
12 **Digital outputs Q1..Q8** voltages and currents are measured to digital outputs Q1..Q8 reference point PS2.1/PS2.3(-) voltage. **Digital outputs I9..I16** voltages and currents are measured to digital outputs I9..I16 reference point PS3.1/PS3.3(-) voltage. Please refer to CONNECTION & CONFIGURATION GUIDE for details.
13 **Sum current** on power supply pin for transistors outputs can not exceed 8 A. **Please refer to** INSTALLATION GUIDE for details.

5 CONNECTION & CONFIGURATION GUIDE
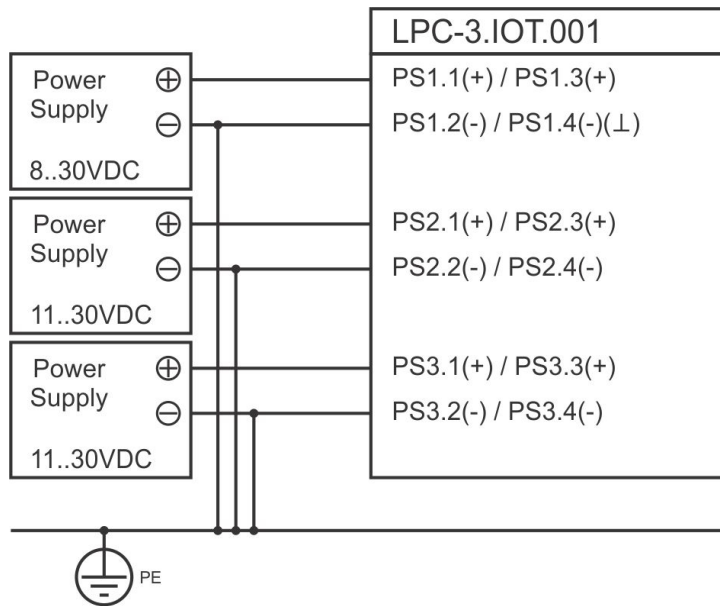
5.1 Main connection scheme & configuration
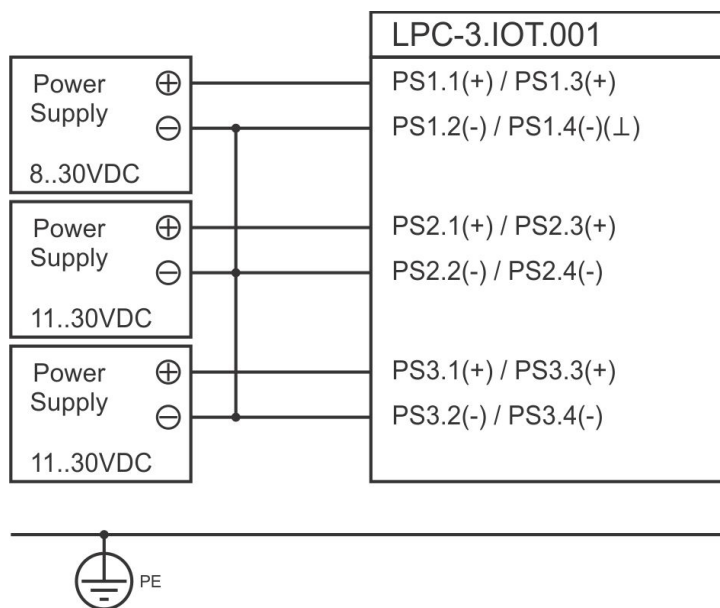
Figure 4: PLC main connection scheme[14]

---
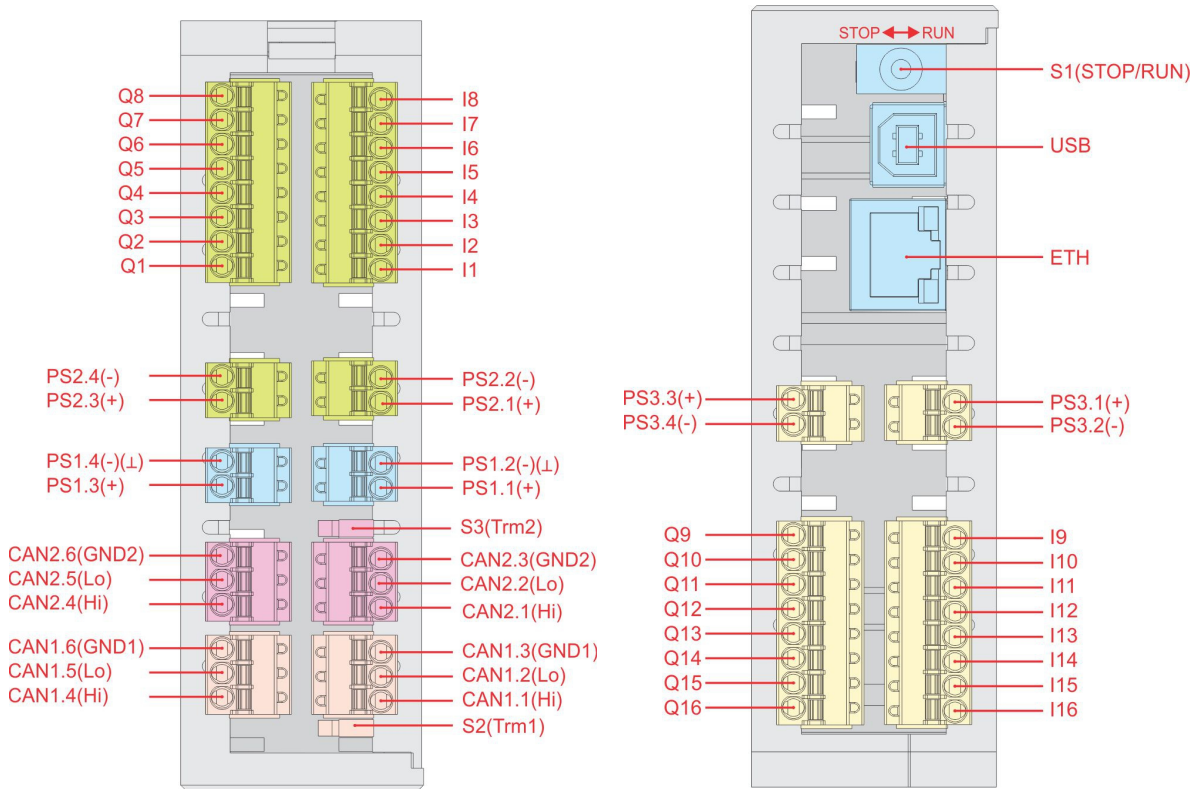
14 **Coloured areas** represents galvanic isolated areas. **Please refer to** TECHNICAL SPECIFICATIONS for details.

Figure 5: Grounding possibilities[15]

a) All PLC negative power supply poles connected together on to the Protective Earth (PE) ⏚ functional earthing.
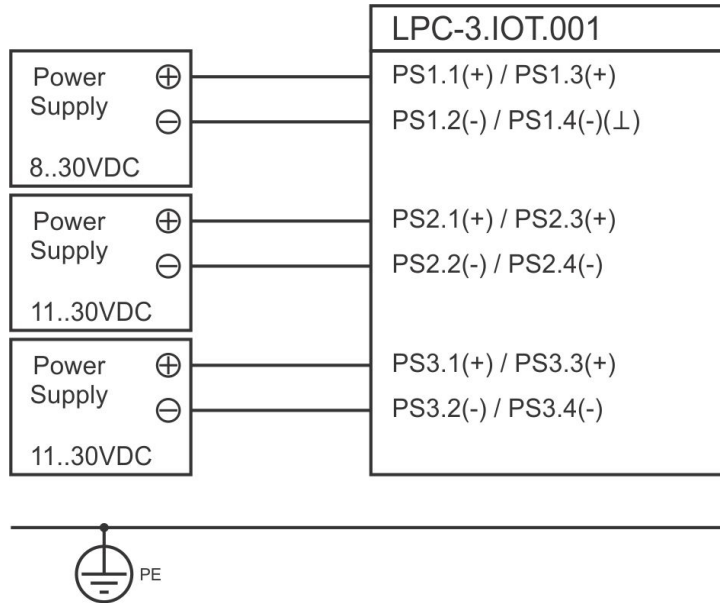

b) All PLC negative power supply poles connected together but not to the Protective Earth (PE) ⏚ functional earthing.

---

15 **Potential differences** between any two negative power supply poles could not exceed prescribed values. **Please refer to** TECHNICAL SPECIFICATIONS for details.

Figure 5: Grounding possibilities (continue)

c) Not any PLC negative power supply poles connected together or to the Protective Earth (PE) ⏚ functional earthing.
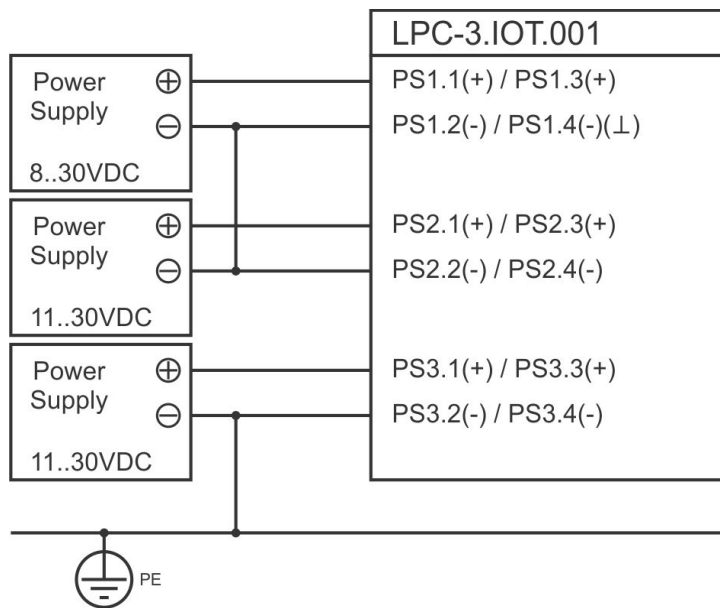
d) Mixed connection where required, selected PLC negative power supply poles connected together and /or to the Protective Earth (PE) ⏚ functional earthing.

Figure 6: Main configuration of the PLC[16]
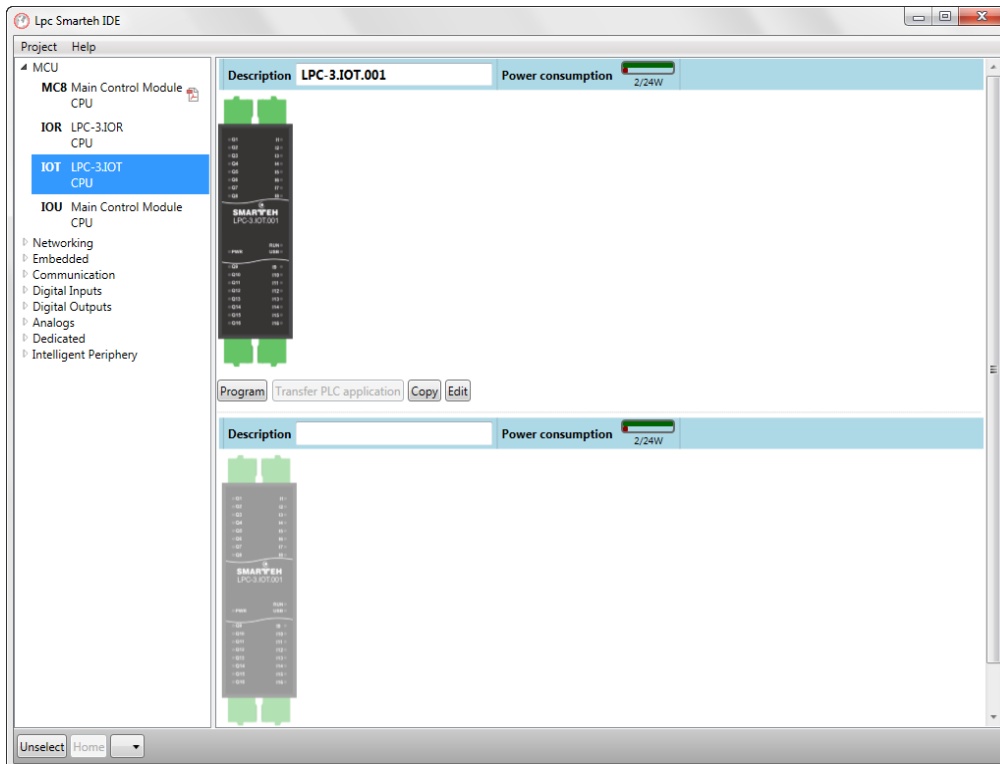
Smarteh IDE configuration interface.
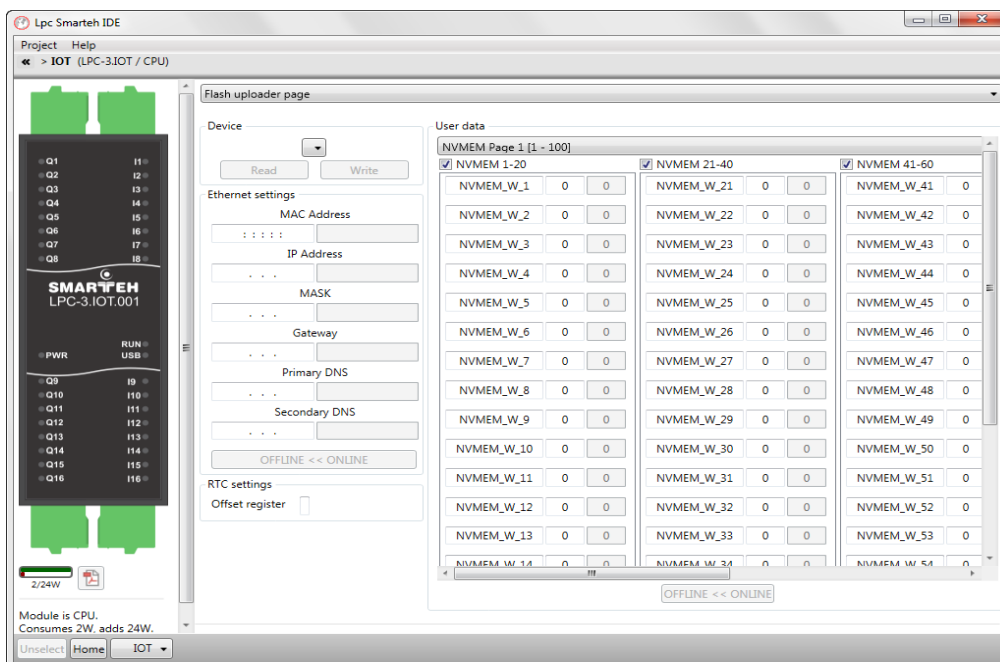
Smarteh IDE flash uploader page.

---

16 **Configuration** of the PLC is done using Smarteh IDE software tool. **Please refer to** PROGRAMMING GUIDE for details.

5.2 Digital input connection scheme & configuration guide

Figure 7: Digital input I1..I16 connection scheme
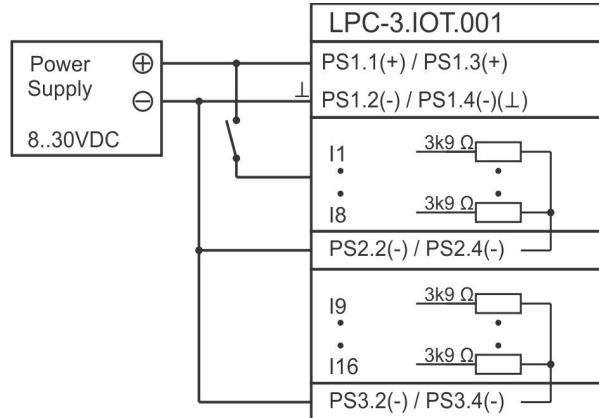
a) Voltage free contact connection to PLC input.
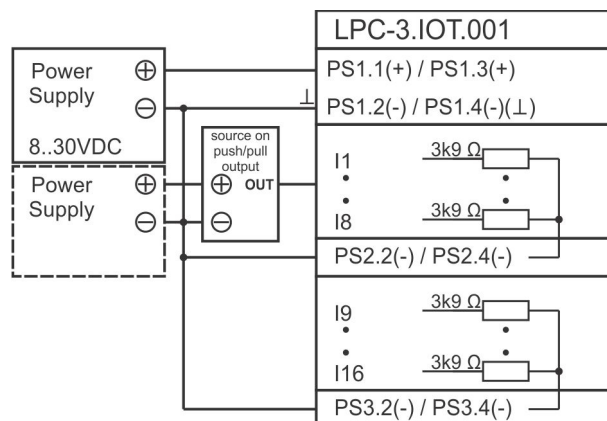
b) Active voltage source or push/pull output connection to PLC input.
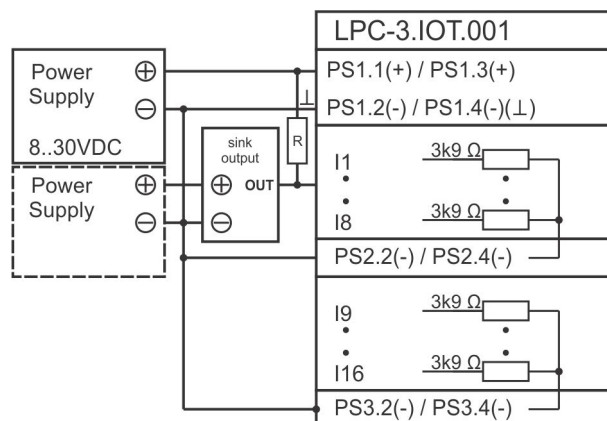
c) Active voltage sink output connection to PLC input.

Figure 8: Digital input I1..I16 configuration[17]
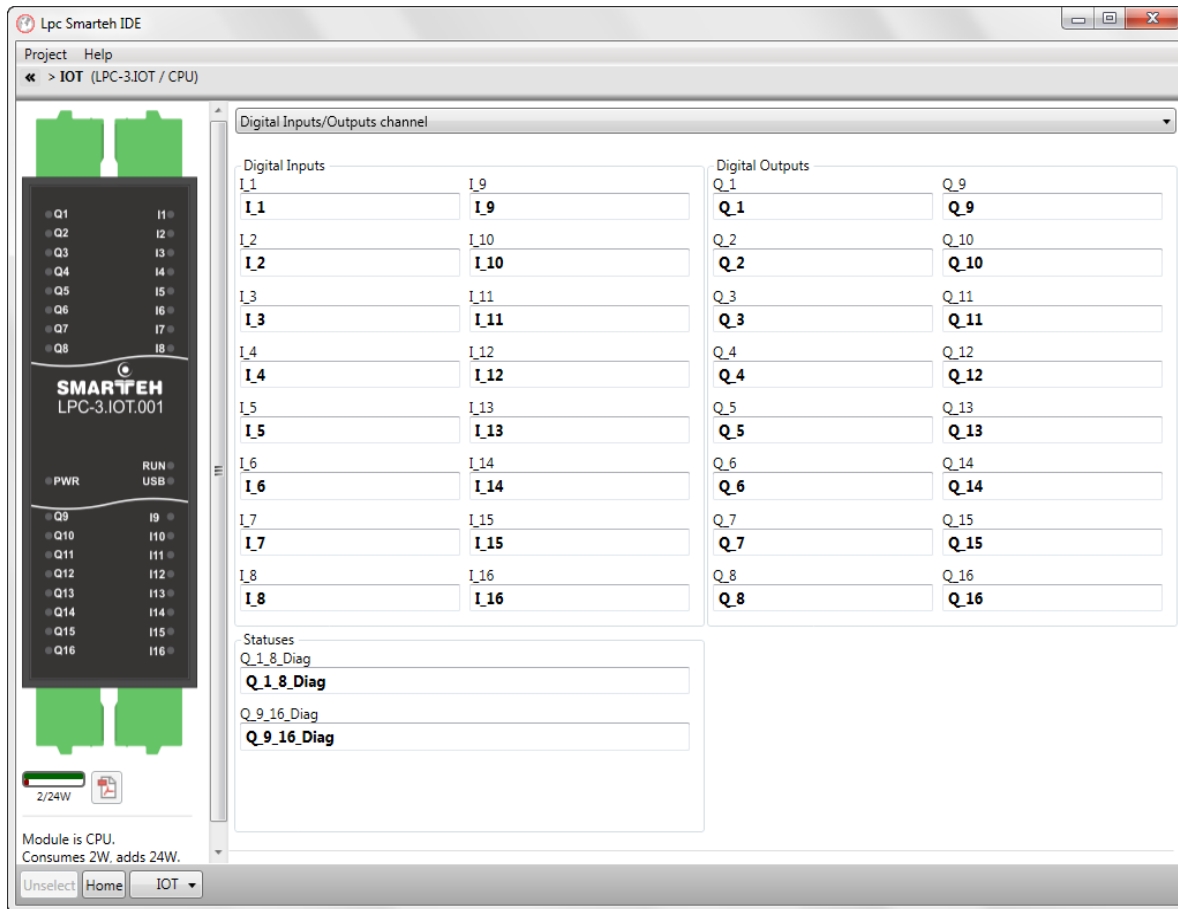
Smarteh IDE input setting interface.

5.3 Digital output connection scheme & configuration guide

Figure 9: Digital output I1..I16 connection scheme[18]
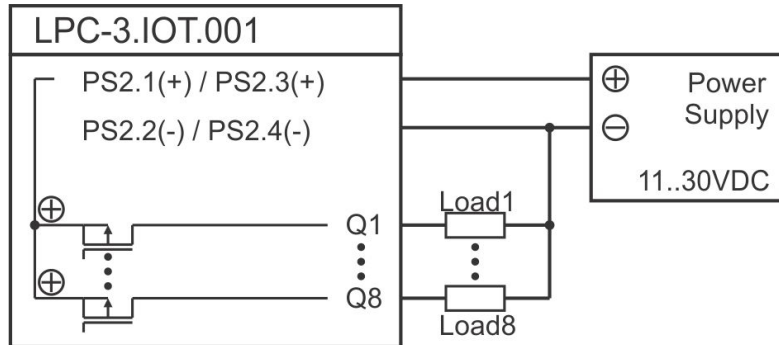
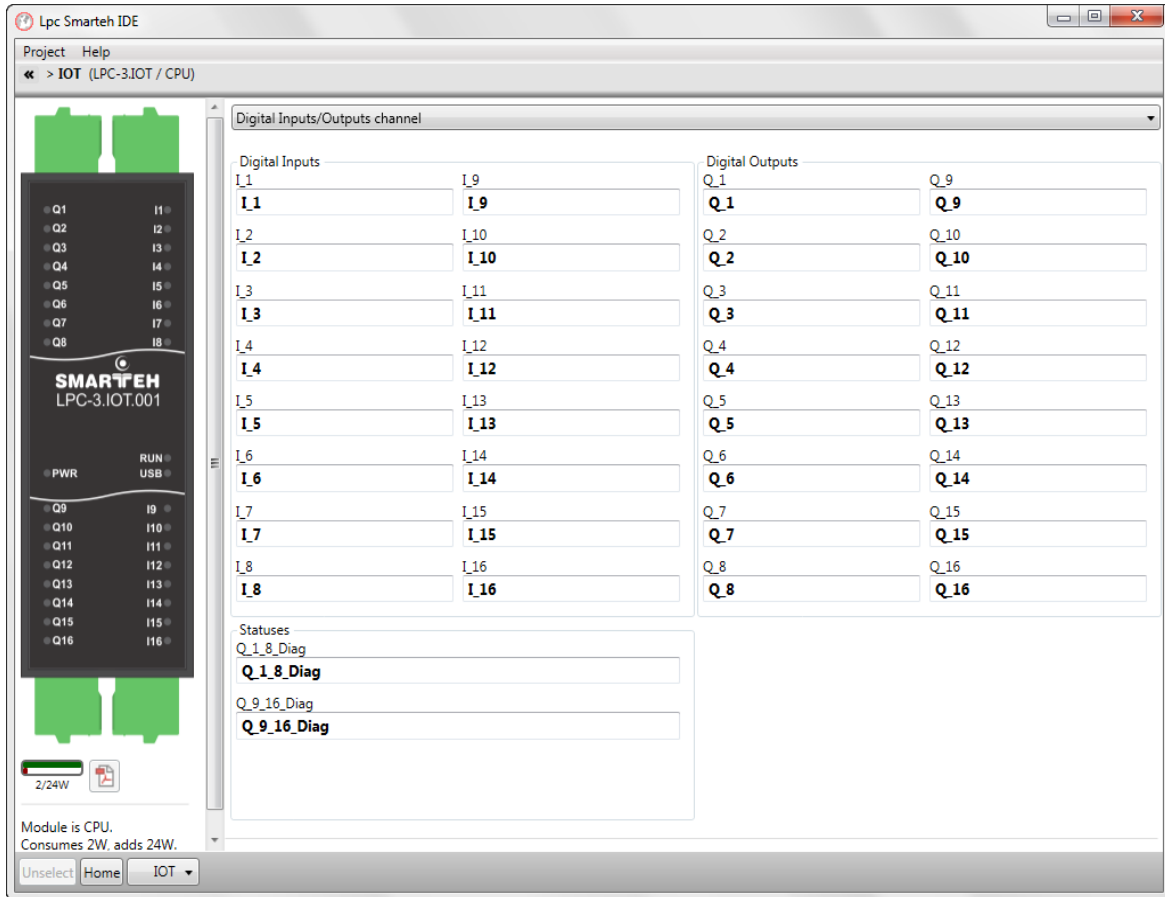a) PLC digital output Q1..Q8 connection to loads.
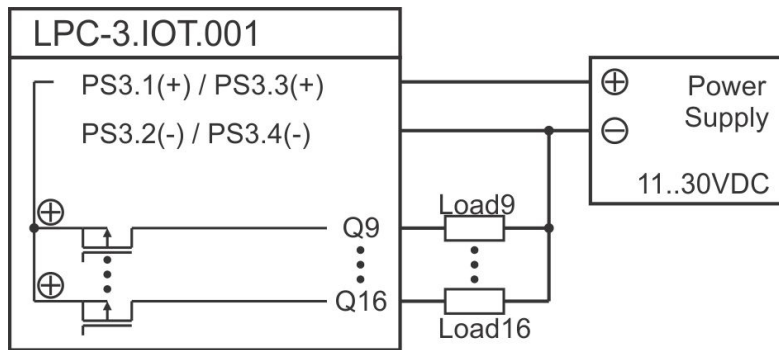
b) PLC digital output I9..I16 connection to loads.

---

18 **Outputs Q1..Q8** are galvanic isolated to outputs I9..I16, to inputs I1..I16 and to the rest of the PLC circuit on the same reference potential ($\perp$).

Figure 10: Digital output I1..I16 configuration[19]

Smarteh IDE output setting interface.

---

6 PROGRAMMING GUIDE

6.1 Basic programming

There are several logical units attached with this module. They can be accessed from the Smarteh IDE application. Some units are enabled by default, others can be enabled through Smarteh IDE. Unit is enabled when any of its variables is used.

PLC has 32 kB of non-volatile memory, which is available to any variable used inside application simply by setting the variable *Option* to *Retain*.

PLC also provides 4 kB of ROM (flash) memory area to the user who would like to use some initialization data or some fixed parameters. This area can be accessed from application only for reading. Setting the values of variables in Flash can be issued with Flash uploader page. In Flash memory area there are some preloaded data stored:

> **MAC:** is unique for every unit produced. This value can be also found on the label attached on the housing of the unit.

> **IP:** default value is 192.168.19.223

> **MASK:** default value is 255.255.255.0

> **Gateway, Primary DNS, Secondary DNS:** default 0.0.0.0

RTC and NVRAM unit

For RTC back-up and for Retain variables stored in NVRAM there is Super Capacitor instead of battery integrated inside PLC. This way replacement of the discharged battery is avoided. The Retention time is minimum 30 days from the power down.

RTC time provides date and time information. Along, alarming function is also supported.

Modbus slave unit

Modbus TCP/IP slave has 512 addresses in each memory section.

Coils:	00000 to 00511
Discrete Inputs:	10000 to 10511
Input Register:	30000 to 30511
Holding Registers:	40000 to 40511

Supports up to 3 connections to the slave unit. Scan rate is 500 ms or greater.

CANopen unit

CANopen unit consists of Master (CAN1) and Slave (CAN2) communication ports. They are independent, thus can be connected to two different CAN network at the same time.

The ports can operate at baud rates 50 kbps, 125 kbps or 250 kbps.

It follows the internationally standardized (EN 50325-4) CAN-based higher-layer protocol for embedded control systems. Advised rules and concepts by this standard must be followed to fulfill the conditions and so achieving normal operation and results.

The structure of the network as cable type and lengths, baud rates, number of the nodes and termination must be taken into account within the recommendations and requirements, when designing the network.

The bus network can consist of at least one Master and at least one Slave node by the standard, but it is advised that with increased number of nodes, the Master node fastest interval is reduced. Below are two examples:

Example 1: network with 1 master and 9 slaves, every slave have defined 32 (4x8) byte of data and baud rate 125 Kbps. Fastest Cycle time for this configuration is 50 ms.

Example 2: network with 1 master and 4 slaves, every slave have defined 4 byte of data and baud rate 250 Kbps. Fastest Cycle time for this configuration is 5 ms.

5 millisecond is the fastest recommended cycle time.

It is recommended to power-up all the nodes on the same network at the same time, if some or all nodes had been reprogrammed (to reinitialize the communication properly).

Additional operational information

After the installation of the PLC it must be at least 20 minutes external power supply, before the internal super capacitor is charged and the retain memory is ready to save variables, without loosing them switching power supply off.

RUN / STOP Switch

Run: Status (RUN) LED on indicate that the PLC program is up and user program is running.

Stop: When the switch is turn to STOP state, the status (RUN) LED is Off. The application switch to the boot loader, this fact allow users to program LPC-3.IOT.001.

When the user is done programming, the PLC via USB, the switch must be turned ON and the LPC-3.IOT.001 starts the application.

PLC task cycle time

Main PLC task interval (under Project tab → Resource → Tasks → Interval) time is not recommended to be set lower than 5 ms.

6.2 Digital input programming

Figure 11: Digital Input I1..I16 LD language example[20]

6.3 Digital output programming

Figure 12: Digital output I1..I16 LD language example[21]

7 MODULE LABELING

Figure 13: Labels on housing

Label 1 (sample):

> **LPC-3.IOT.001**
> P/N:226IOT14001001
> D/C: 05/15

Label 2 (sample):

> S/N: IOT-S9-1500000190

Label 1 descriptions:

1. **LPC-3.IOT.001** is the full product name.
2. **P/N: 226IOT14001001** is the part number.

   - **226** – general code for product family,

   - **IOT** – short product name,

   - **14001** – sequence code,

      - 14 – year of code opening,

      - 001 – derivation code,

   - **001** – version code (reserved for future HW and/or SW firmware upgrades).

3. **D/C: 05/15** is the date code.

   - **05** – week and

   - **15** – year of production.

Label 2 descriptions:

1. **S/N:IOT-S9-1500000190** is the serial number.

   - **IOT** – short product name,

   - **S9** – user code (test procedure, e.g. Smarteh person xxx),

   - **1500000190** – year and current stack code.

      - 15 – year (last two cyphers),

      - 00000190 – current stack number; previous module would have the stack number 00000189 and the next one 00000191.

8 CHANGES

The following table describes all the changes to the document.

Date	V.	Description
01.03.15	001	The initial version, issued as *LPC-3.IOT.001 UserManual*.
01.09.15	002	Technical update.

9 NOTES