USER MANUAL

Longo programmable controller
LPC-2.A05
Analog Input Output module

Version 4

SMARTEH d.o.o. / Poljubinj 114 / 5220 Tolmin / Slovenia / Tel.: +386(0)5 388 44 00 / e-mail: info@smarteh.si / www.smarteh.si

Written by SMARTEH d.o.o.

User Manual

Document Version: 4
August, 2024

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 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-2.A05

1 ABBREVIATIONS

DC	Direct Current
RX	Receive
TX	Transmit
UART	Universal Asynchronous Receiver-Transmitter
PWM	Pulse Width Modulation
NTC	Negative Temperature Coeficient
I/O	Input/Output
AI	Analog Input
AO	Analog Output

2 DESCRIPTION

The LPC-2.A05 module is a universal analog module offering a variety of analog input and output options.

The module is equipped with 8 configurable analog inputs (I1 to I8) and 8 configurable analog inputs or outputs (IO1 to IO8). So all together LPC-2.A05 module can support up to 16 analog inputs and outputs.

Each I1 to I8 input channel can be individually configured for the following: analog voltage input, analog current input or thermistor input. Each IO1 to IO8 input/output channel can be individually configured for the following: thermistor input, analog voltage output, analog current output and PWM output.

Thermistor inputs are dedicated for temperature measurement using thermistors NTC, Pt100, Pt1000, etc.

PWM output generates a digital pulse signal with a variable duty cycle, e.g. for motor speed control or LED dimming.

Functionality for each channel is selected according physical jumper on the LPC-2.A05 module and by the configuration register.

The module is powered from the internal bus and can be controlled by the main module (e.g. LPC-2.MC9, LPC-2.MM1, ...).

3 FEATURES

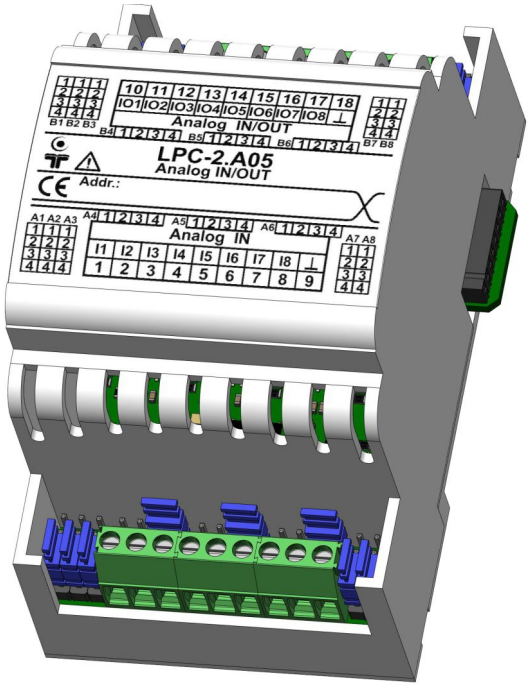


Figure 1: LPC-2.A05 module

Table 1: Technical data
8 analog inputs: voltage input, current input, thermistor
8 analog inputs/outputs: voltage output, current output, thermistor, PWM output
Jumper selectable type of input/output
Signal LED
Supplied from the main module
Small dimensions and standard DIN EN50022-35 rail mounting

4 OPERATION

LPC-2.A05 module can be controlled from the main PLC module (e.g. LPC-2.MC9). Module parameters can be read or written via Smarteh IDE software.
LPC-2.A05 module can also be controlled by the Modbus RTU Slave main module (e.g. LPC-2.MU1).

4.1 Operation description

Types of inputs I1..I8 according to the jumper position

Thermistor input – jumper position 1-2

To measure the thermistor's temperature, set the appropriate reference voltage for the analog output (V_{AO}) and measure the voltage at the input (V_{AI}), refer to Figure 2 for the module output schematic. The series resistance value (R_S) is 3950 ohms and maximum voltage analog input is 1,00 V. Based on these data, the connected thermistor's resistance (R_{TH}) can be calculated. The output reference voltage is set based on the selected thermistor type and desired temperature range. This ensures the input voltage stays below 1.0 V while maintaining sufficient resolution. The recommended reference voltage values for accurate measurement of the given thermistors across their entire temperature range are listed below.

Equation for resistance of thermistor on I1 .. I8: $$R_{TH} = \frac{V_{AI} \times R_S}{V_{AO} - V_{AI}} \ [\Omega]$$

Current analog input – jumper position 2-3

The input current value is calculated from the raw analog input voltage reading “Ix - Analog input”, using the following equation.

Current analog input on I1 .. I8: $$I_{IN} = \frac{V_{AI}}{50\ \Omega} \ [mA]$$

Voltage analog input – jumper position 3-4

The input voltage value is calculated from the raw analog input voltage reading “Ix - Analog input”, using the following equation.

Voltage analog input on I1 .. I8: $$V_{IN} = V_{AI} \times 11 \ [mV]$$

Types of inputs/outputs IO1..IO8 according to the jumper position

Current analog output or PWM signal output – jumper position 1-2

The type of output is selected by “Configuration register”. The output current value or PWM duty cycle value is set by specifying variables “IOx – Analog/PWM output”.

Voltage analog output - jumper position 2-3

The output voltage value is set by specifying variables “IOx - Analog/PWM output”.

Thermistor input - jumper position 3-4

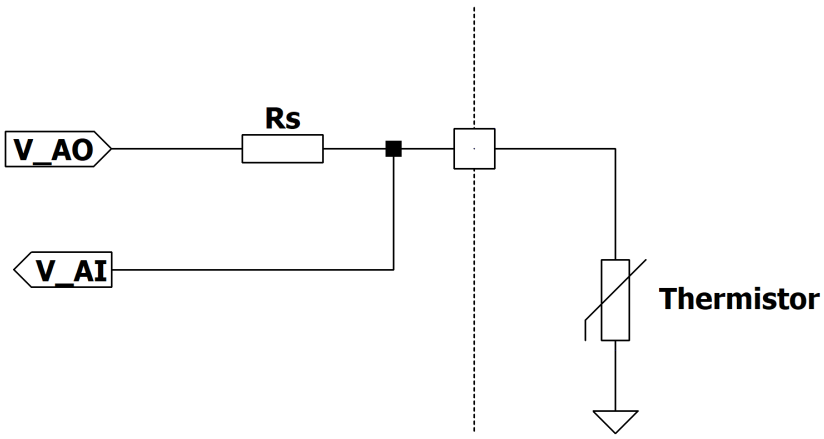
To measure the thermistor's temperature, set the appropriate reference voltage for the analog output (V_{AO}) and measure the voltage at the input (V_{AI}), refer to Figure 2 for the module output schematic. The series resistance value (R_S) is 3900 ohms and maximum voltage analog input is 1,00 V. Based on these data, the connected thermistor's resistance can be calculated. The output reference voltage is set based on the selected thermistor type and desired temperature range. This ensures the input voltage stays below 1.0 V while maintaining sufficient resolution. The recommended reference voltage values for accurate measurement of the given thermistors across their entire temperature range are listed below.

Equation for resistance of thermistor on IO1 .. IO8: $$R_{TH} = \frac{V_{AI} \times R_S}{V_{AO} - V_{AI}} \ [\Omega]$$

- **NTC 10k**
  Temperature range: -50°C .. 125°C
  Recommended set reference voltage = 1.00 V
- **Pt100**
  Temperature range: -200°C .. 800°C
  Recommended set reference voltage = 10.00 V
- **Pt1000**
  Temperature range: -50°C .. 250°C
  Recommended set reference voltage = 3.00 V

  Temperature range: -50°C .. 800°C
  Recommended set reference voltage = 2.00 V

Figure 2: Thermistor connection scheme



4.2 SmartehIDE Parameters

Input

I1 - Analog input [A05_x_ai_analog_input_1]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I2 - Analog input [A05_x_ai_analog_input_2]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I3 - Analog input [A05_x_ai_analog_input_3]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I4 - Analog input [A05_x_ai_analog_input_4]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I5 - Analog input [A05_x_ai_analog_input_5]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I6 - Analog input [A05_x_ai_analog_input_6]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I7 - Analog input [A05_x_ai_analog_input_7]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

I8 - Analog input [A05_x_ai_analog_input_8]: Analog input raw voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO1 - Analog input [A05_x_ai_analog_input_9]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO2 - Analog input [A05_x_ai_analog_input_10]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO3 - Analog input [A05_x_ai_analog_input_11]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO4 - Analog input [A05_x_ai_analog_input_12]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO5 - Analog input [A05_x_ai_analog_input_13]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO6 - Analog input [A05_x_ai_analog_input_14]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO7 - Analog input [A05_x_ai_analog_input_15]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

IO8 - Analog input [A05_x_ai_analog_input_16]: Analog input raw voltage value.
Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 1000.0 mV

Output

I1 - Reference output [A05_x_ao_reference_output_1]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I2 - Reference output [A05_x_ao_reference_output_2]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I3 - Reference output [A05_x_ao_reference_output_3]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I4 - Reference output [A05_x_ao_reference_output_4]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I5 - Reference output [A05_x_ao_reference_output_5]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I6 - Reference output [A05_x_ao_reference_output_6]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I7 - Reference output [A05_x_ao_reference_output_7]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

I8 - Reference output [A05_x_ao_reference_output_8]: Reference output voltage value.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV

IO1 - Analog/PWM output [A05_x_ao_reference_output_1]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO2 - Analog/PWM output [A05_x_ao_reference_output_2]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO3 - Analog/PWM output [A05_x_ao_reference_output_3]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO4 - Analog/PWM output [A05_x_ao_reference_output_4]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data: 0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO5 - Analog/PWM output [A05_x_ao_reference_output_5]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data:
0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO6 - Analog/PWM output [A05_x_ao_reference_output_6]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data:
0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO7 - Analog/PWM output [A05_x_ao_reference_output_7]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data:
0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

IO8 - Analog/PWM output [A05_x_ao_reference_output_8]: Analog output voltage or current value or PWM duty cycle.

Type: UINT

Raw to engineering data:
0 .. 10000 → 0 .. 10000 mV
0 .. 10000 → 0 .. 20.00 mA
0 .. 10000 → 0 .. 100.00 %

Configuration register [A05_x_ao_configuration_reg]: The output type of IOx is selectable through this register.

Type: UINT

Raw to engineering data:
xxxxxxx0 (bin) → IO1 set as analog output
xxxxxxx1 (bin) → IO1 set as PWM output
xxxxxx0x (bin) → IO2 set as analog output
xxxxxx1x (bin) → IO2 set as PWM output
xxxxx0xx (bin) → IO3 set as analog output
xxxxx1xx (bin) → IO3 set as PWM output
xxxx0xxx (bin) → IO4 set as analog output
xxxx1xxx (bin) → IO4 set as PWM output
xxx0xxxx (bin) → IO5 set as analog output
xxx1xxxx (bin) → IO5 set as PWM output
xx0xxxxx (bin) → IO6 set as analog output
xx1xxxxx (bin) → IO6 set as PWM output
x0xxxxxx (bin) → IO7 set as analog output
x1xxxxxx (bin) → IO7 set as PWM output
0xxxxxxx (bin) → IO8 set as analog output
1xxxxxxx (bin) → IO8 set as PWM output

5 INSTALLATION

5.1 Connection scheme

Figure 3: Connection scheme example

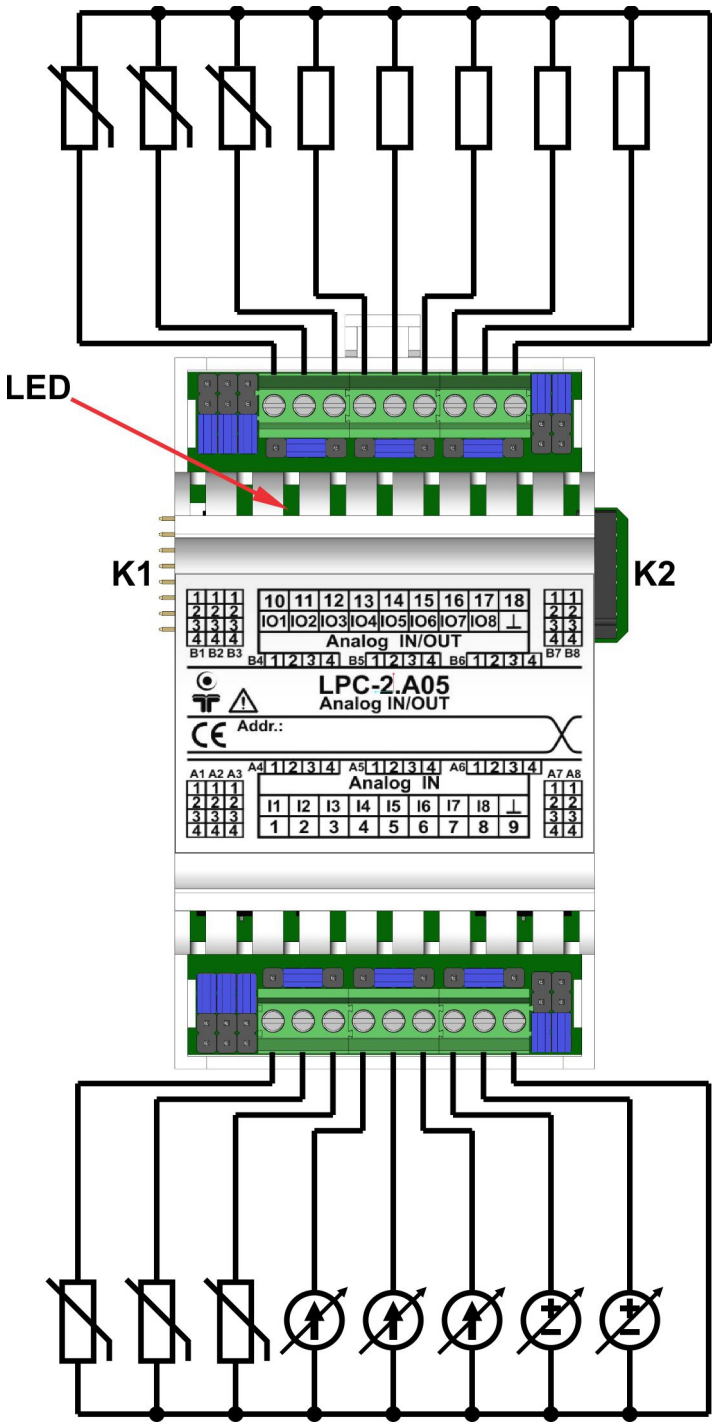


Table 2: Analog IN				
		Input type according to jumper position		
	Corresponding jumper	jumper pos. 1-2	jumper pos. 2-3	jumper pos. 3-4
I1	Jumper A1	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I2	Jumper A2	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I3	Jumper A3	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I4	Jumper A4	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I5	Jumper A5	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I6	Jumper A6	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I7	Jumper A7	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ
I8	Jumper A8	Pt100, Pt1000, NTC	Current analog input 0 .. 20 mA R_{in} = 50 Ω	Voltage analog input 0 .. 10 V R_{in} = 110 kΩ

Table 3: Analog IN/OUT				
		Input/output type according to jumper position		
	Corresponding jumper	jumper pos. 1-2	jumper pos. 2-3	jumper pos. 3-4
IO1	Jumper B1	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO2	Jumper B2	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO3	Jumper B3	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO4	Jumper B4	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC

Table 3: Analog IN/OUT				
IO5	Jumper B5	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO6	Jumper B6	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO7	Jumper B7	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC
IO8	Jumper B8	Current analog output 0 .. 20 mA, PWM output 200 Hz	Voltage analog output 0 .. 10 V	Pt100, Pt1000, NTC

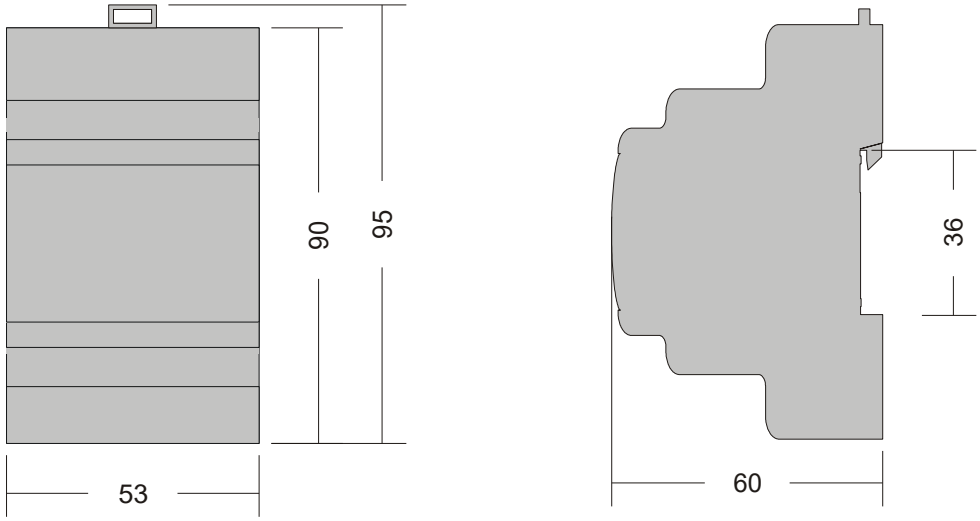
Table 4: K2		
Internal BUS	Data & DC power supply	Connection to I/O module

Table 5: K3		
Internal BUS	Data & DC power supply	Connection to I/O module

Table 6: LED		
LED	Communication and power supply status	ON: Power on and communication OK Blink: Communication error OFF: Power off

5.2 Mounting instructions

Figure 4: Housing dimensions



Dimensions in millimeters.

All connections, module attachments and assembling must be done while module is not connected to the main power supply.

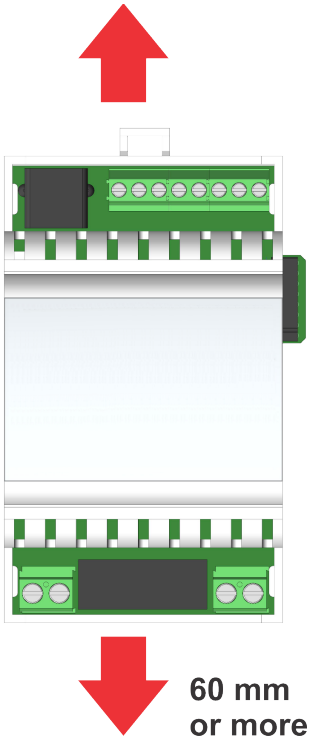
Mounting instructions:

1. Switch OFF main power supply.
2. Mount LPC-2.A05 module to the provided place inside an electrical panel (DIN EN50022-35 rail mounting).
3. Mount other LPC-2 modules (if required). Mount each module to the DIN rail first, then attach modules together through K1 and K2 connectors.
4. Connect input and output wires according to the connection scheme in Figure 2.
5. Switch ON main power supply.

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.

NOTE: LPC-2 main module should be powered separately from other electrical appliances connected to LPC-2 system. Signal wires must be installed separately from power and high voltage wires in accordance with general industry electrical installation standard.

Figure 5: Minimum clearances



The clearances above must be considered before module mounting.

6 TECHNICAL SPECIFICATIONS

Table 7: Technical specifications		
Power supply	From the main module via internal bus	
Max. power consumption	5 W	
Connection type	screw type connector for stranded wire 0.75 to 1.5 mm^2	
	analog input / output type	
	voltage	current
Max. input current	1 mA per input	20 mA per input
Max. output current	20 mA per output	20 mA per output
Analog input measuring error of the full scale value	< ± 1 %	< ± 2 %
Analog output accuracy of the full scale value	± 2 %	± 2 %
Load resistance for analog outputs	R > 500 Ω	R < 500 Ω
Analog input range	0 .. 10 V	0 .. 20 mA
Analog output range	0 .. 10 V	0 .. 20 mA
Max. transition time per channel	1 s	
ADC resolution	12 bit	
Resistance of resistor Rs for I1..I8	3950 Ω	
Resistance of resistor Rs for IO1..IO8	3900 Ω	
Maximum analog input voltage for thermistor measurement	1,00 V	
Pt100, Pt1000 temperature measurement accuracy -20..250°C	± 1 °C	
Pt100, Pt1000 temperature measurement accuracy on full range	± 2°C	
NTC 10k temperature measurement accuracy -40..125°C	± 1 °C	
PWM output	according to VDMA 24224, wet runner circulation pumps	
PWM output frequency	200 Hz	
PWM output accuracy	±3 %	
Dimensions (L x W x H)	90 x 53 x 60 mm	
Weight	100 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	2	
Overvoltage category	II	
Electrical equipment	Class II (double insulation)	
Protection class	IP 30	

7 MODULE LABELING

Figure 6: Label

Label (sample):

XXX-N.ZZZ
P/N: AAABBBCCDDDEEE
S/N: SSS-RR-YYXXXXXXXXX
D/C: WW/YY

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***

8 CHANGES

The following table describes all the changes to the document.

Date	V.	Description
22.08.24	4	Updated chapter *4.2 SmartehIDE Parameters*.
11.07.24	3	Update due to minor changes.
17.06.24	2	Figures 1 and 3 updated.
30.05.24	1	The initial version, issued as *LPC-2.A05 module UserManual*.

9 NOTES