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MLIO Small distributed I/O module

Summary

Small I/O module MLIO is a microprocessor-controlled, communiccative module for installation outside the control panel. It is used for topologies with distributed inputs and outputs which save cabling costs and cabinet space. The module communicates over a RS485 bus with Modbus RTU (slave) protocol, and can be integrated in a variety of control systems easily

Application

- **Small I/O module for control of heating circuits, AHUs and zone controllers**
- **Estension and add-on module for larger systems, even 3rd party**
- **Data acquisition and process control**

Function

MLIO is a module containing inputs and output (4 universal AI, 1 AO, 2 DO). Communication follows over a galvanically separated RS485 bus. The Modbus RTU protocol enables seamless integration into many control systems ands PLCs, see the Modbus table below.

The Modbus RTU addressing may be selected as manual using a rotary switch and DIP switches in the range of 1...39, or as software (as with all other Domat I/O modules) in the range of 1...255. Manual (hardware) addressing is easy to perform even for the installers, on the other hand, software addressing offers larger address range.

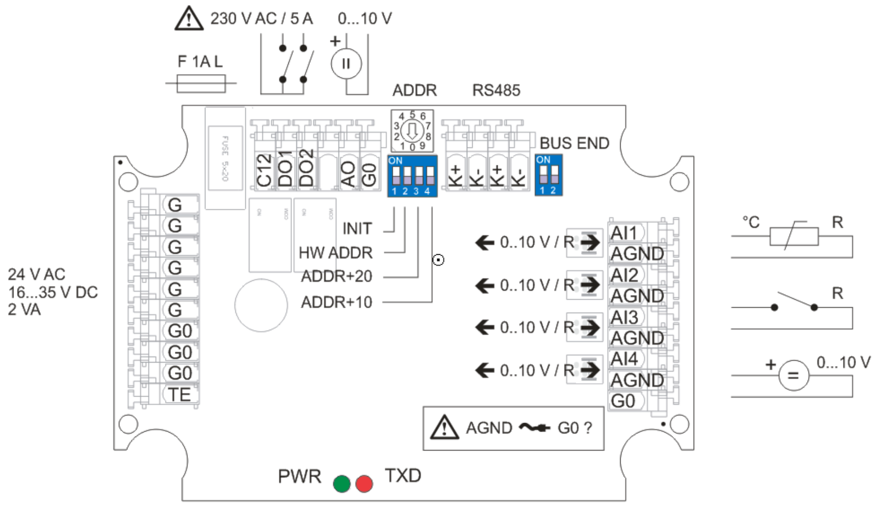
Analogue input measuring range (0...10 V or passive resistance / temperature) is also set manually by switches at the board.

The communication circuits are surge-protected. If the module is the first or the last on the bus, it must terminate the bus by setting the BUS END switches to ON. The module is supplied in a ABB installation box and has flexible cable glands for cables, so that it may be installed on a flat wall, air duct, or installation tray using four apertures in the box bottom.

Technical data

Power supply Protection	16...35 V DC (G...+, G0...-), 14...24 V AC glass fuse F 1A
Consumption	nominal 5 VA, maximal 7 VA (all relays on)
Working temperature of the module	0...70 °C
Communication	RS485, 1200 ... 19200 bit/s Modbus RTU slave
RS485 - terminals K+, K-	
Max. bus length	1200 m
Max. number of MLIOs on the bus	depends on maximum allowed response time, for HVAC application about 50 modules, data collection up to 100, physical addressing up to 250
Analogue inputs	4x Pt 1000, Pt100, Ni1000, resistance 20...5000 Ohm, configurable with DIP switches also as 0...10 V DC measuring current in the passive mode (0...1600 Ohm): 200 uA at 12.5 % of time inputs can be used as binary for potential-free contacts, too.
Analogue output	1 x 0...10 V DC
Analogue output load	typically 10 kΩ, max. current 10 mA, the output is resistant to permanent short-circuit with current limitation to 20 mA.
Digital outputs	2 x relay, normally open contact: 5 A/250 V AC 1250 VA, 5 A/30 V DC, 150 W
Protection	IP20 after the cable glands are perforated
Dimensions	162 (l) x 120 (w) x 72 (h) mm

Terminals



G power supply, +
G0 power supply, -, signal ground AO

C12 common relay contact
DO1 relay 1, NO contact
DO2 relay 2, NO contact
AO analogue output 0...10 V against G0
G0 power supply, -, signal ground AO

K- communication RS485, negative
K+ communication RS485, positive

AI1 analogue input 1
AGND analogue input ground
AI2 analogue input 2
AGND analogue input ground
AI3 analogue input 3
AGND analogue input ground
AI4 analogue input 4
AGND analogue input ground
G0 power supply, -, signal ground AO – the terminal is used for optional connection of AGND and G0 if active sensors are used

As default, **AGND and G0 are disconnected**, which means that the analogue inputs are galvanically separated from the power part and thus immune against EMC influences. This is useful if the module is used in a harsh environment, such as close to variable speed drives, at PV plants etc. If any of the analogue inputs is connected to an active 0..10 V sensor, the terminals AGND and G0 must be connected so as the inputs have their reference potential.

Control and indication elements

INIT if ON, sets address 1 and communication parameters 9600, N, 8, 1 after power-up
HW ADDR – **if ON, the module is addressed using rotary switch ADDR** and the switches ADDR+10, ADDR+20. If the address switch is set to 0, address 1 is used automatically. **If OFF, software addressing is used** (as at all other domat I/O modules), e.g. using the domat.exe configuration software.
ADDR+10 – if ON, the hardware address is increased by 10
ADDR+20 – if ON, the hardware address is increased by 20
ADDR sets the hardware address (if the HW ADDR is set to ON)

Examples – HW ADDR = ON:
ADDR = 8, ADDR+10 = OFF, ADDR+20 = OFF : the address is 8
ADDR = 5, ADDR+10 = ON, ADDR+20 = OFF : the address is 15
ADDR = 2, ADDR+10 = ON, ADDR+20 = ON : the address is 32

If the address switch is set to 0 with HW addressing, address 1 is used automatically.

BUS END – terminates the bus; set both switches to ON if the MLIO is the first or the last on the bus.
0..10 V/R – switches the corresponding input between active input for voltage measuring (if set to left) and resistance, or temperature (if set to right). Presence of voltage up to 24 V AC on the input at any position of the switch does not damage the input.
PWR green LED indicating power supply voltage presence (steady on)
TXD red LED indicating data transmission on the bus (flashing)

Communication cirtuits are optically separated from other parts of the module.

The switches are at the printed circuit board. They are accessible after removal of the plastic cover of the MLIO.

If the LED PWR is not on with power supply applied,
- check the polarity if MLIO is powered by DC power
- check and replace the fuse (with the same type only).

Installation

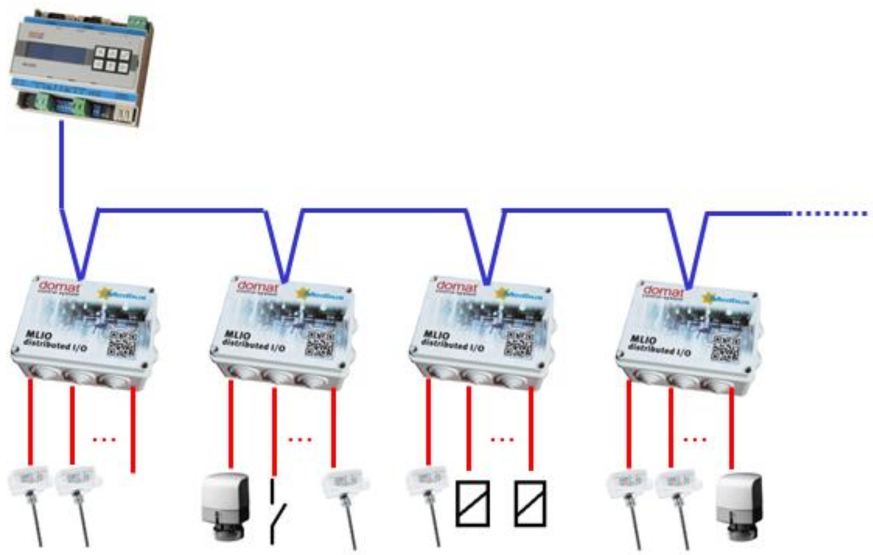
The MLIO is installed on a flat wall or any fixed plate (air handling unit, cable tray, etc.) using four screws. The holes are accessible after the cover is removed. Cut the tops of the cable glands to the diameter of the cables for power, communication, and peripherials.

MLIO must be installed indoors. Choose the installation place so as the module is freely accessible and the cover can be removed. The point in using distributed I/Os is to reduce cable costs, this is why the module shall be installed close to the peripherials – valves, sensors, damper actuators and other controlled elements so that only bus and low voltage power wiring is connected between the modules and the cabinet. The cable lengths between the module and the peripherials are then reduced as much as possible.

Please check address settings and input range switch positions at all modules after installation. It will speed up the software commissioning and tests.

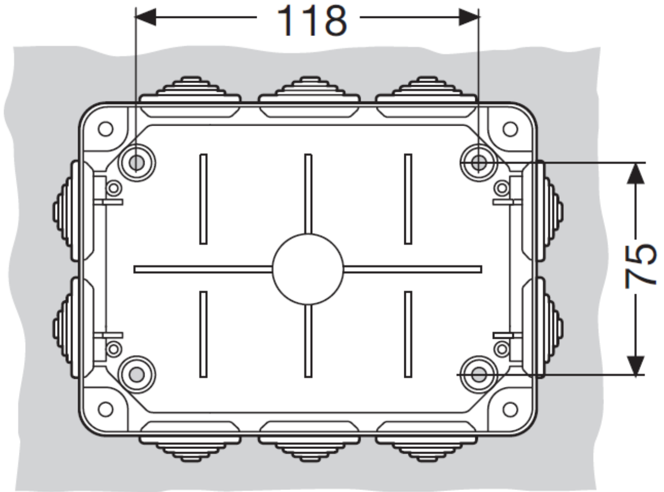
Topology

The bus topology must be linear. The first and the last device on the bus (MLIO, another I/O module, room unit, or a PLC) must terminate the bus by setting the BUS END switches to ON. Maximum possible distance between two modules is not limited. Maximum bus length must not exceed 1200 m. A pair of communication terminals on the module board makes the linear topology installation more convenient.

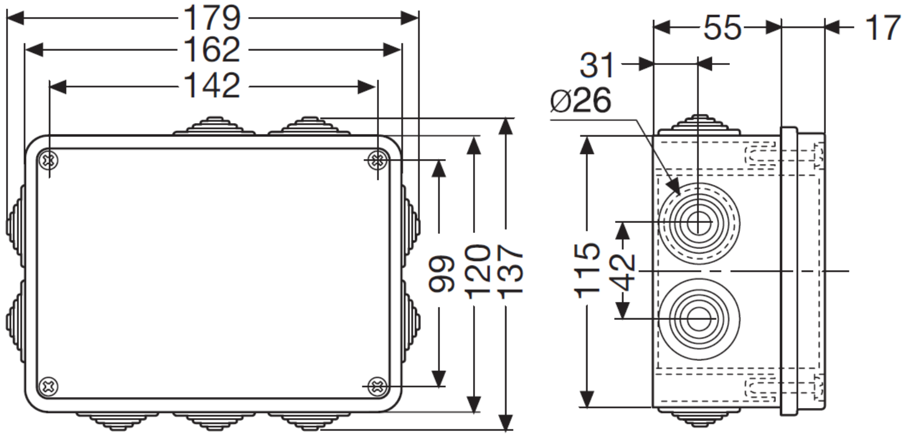


Together with the MLIO modules, there may be other module types on the bus, room units, variable speed drives etc., communicating Modbus RTU. However, separate buses for modules installed in the cabinet and outside the cabinet are recommended: with a common bus for all modules a and short-circuit of the bus in the field, the communication with the modules in the cabinet would be broken.

Installation apertures



Dimensions



Dimensions are in *mm*.

Safety notice

The device is designed for monitoring and control of heating, ventilation, and air conditioning systems. It must not be used for protection of persons against health risks or death, as a safety element, or in applications where its failure could lead to physical or property damage or environmental damage. All risks related to device operation must be considered together with design, installation, and operation of the entire control system which the device is part of.

Third party integration

Thanks to open Modbus communication, MLIO can be used in a variety of control and monitoring systems as a distributed input / output module. The Modbus table, see below, contains registers which provide the input values in several formats.

Supported Modbus functions are:

- **01 Read Coil Status** – read bits
- **03 Read Holding Registers** – read words
- **15 Force Multiple Coils** – write bits
- **16 Force Multiple Registers** – write words.

For a comfortable access to all registers, a free Modbus client domat.exe may be used. You can download it at www.rcware.eu. The Modbus register description is in the following table.

Name	Address	Type	Description	Note
module LSB	1 LSB	R	module ID lower byte	0x0104 hex
module MSB	1 MSB	R	module ID upper byte	
firmware LSB	2 LSB	R	firmware version, lower byte	
firmware MSB	2 MSB	R	firmware version, upper byte	
status LSB	3 LSB	R	module status, lower byte **bit 0** – EEPROM writing enabled **bit 4** – EEPROM init **bit 5** – calibration offset **bit 6** – calibration span **bit 7** – calibration enabled	**EEPROM init** is executed if the INIT was ON at the module power-up; when writing 1 to bit 4, the switch must be OFF (indicated by bit 2 of **status MSB**) **calibration enabled** is executed by writing a 1 into bit 7 (indicated by bit 3 in status MSB) **calibration offset** is executed by writing a 0 (must have been 1) to bit 7 and writing a 1 to bit 5. After calibration, the bit 5 goes to zero. **calibration span** is executed by writing a 0 (must have been 1) to bit 7 and writing a 1 to bit 6. After calibration, the bit 6 goes to zero.
status MSB	3 MSB	R	module status, upper byte **bit 0** 0... normal mode 1... init mode **bit 1** 1... at next write attempt to EEPROM the data will be written to EEPROM 0... at next write attempt to EEPROM the data will be written to RAM only **bit 2** – 1 – EEPROM initialized **bit 3 –** 1 – calibration enabled **bit 4** – 0 **bit 5** - 1 **bit 6** - 0 **bit 7** – 1	
address	4 LSB	R, W EEPROM (0x01)	module address **!!!** the change will be effective after restart only (however the register will be set immediately)	This is the actual module address configured by software or hardware switches.

baud rate	4 MSB	R,W EEPROM (9600 bps, 13dec)	communication, no parity 10_{dec} = 1200 bps 11_{dec} = 2400 bps 12_{dec} = 4800 bps 13_{dec} = 9600 bps 15_{dec} = 19200 bps 16_{dec} = 57600 bps 17_{dec} = 115200 bps	**!!!** the change will be effective after restart only (however the register will be set immediately)
input range for channels AI1, AI2	5 LSB	R (0x11)	2 … voltage 0 to 10 V 3 … resistance 0 to 1600 ohm	bit 0 – bit 3… channel 1 bit 4 – bit 7… channel 2
input range for channels AI3, AI4	5 MSB	R (0x12)	2 … voltage 0 to 10 V 3 … resistance 0 to 1600 ohm	bit 0 – bit 3… channel 3 bit 4 – bit 7… channel 4
SSR threshold value	6 LSB 6 MSB	R,W EEPROM (0x32)	**NOT USED - RESERVED**! There is a position for another output (SSR) on the board. The output is optionally linked with the analogue output. The value in this register specifies the switching threshold value. It is multiplied by 10, e.g. **50** (0x32) is for **5V**. With this setting the SSR will be off for 0...5V, and on for 5.1V to 10.0V.	If this register is set to 0, the SSR is controllerd separately over register **relay (9LSB)**
SSR hysteresis	7 LSB 7 MSB	R, W EEPROM (0x1)	Hysteresis for SSR relay switching. The hysteresis applies both above and below the setpoint. See register **6LSB, MSB**. The value is multiplied by 10. 1 = 0.1 V	Example: if the value is 2 dec and register 6 value is 50dec, the SSR switches on at 5.2 V, and off at 4.8 V
relay state	8 LSB	R, W EEPROM (0x0)	relays go on or off (according to corresponding bits) if there was no communication with module for a given time and in **relay com** the corresponding relay bit is set to 1	**bit 0** is relay 1 **bit 1** is relay 2
relay time	8 MSB	R, W EEPROM (0x0)	time in [s] of no communication which is considered as communication failure	if set to 0, the function is disabled
relay start enable	9 LSB	R, W EEPROM (0x0)	startup relay behaviour **0** – relays are not commanded **1** – the corresponding relay is set to its **relay start** value after module startup	**bit 0** is relay 1 **bit 1** is relay 2
relay start	9 MSB	R, W EEPROM (0x0)	relay status between power-up and first bus command	**bit 0** is relay 1 **bit 1** is relay 2

relay	10 LSB	R, W, RAM	value for commanding the digital outputs	**bit 0** is relay 1 **bit 1** is relay 2 bit 2 is SSR (reserved)
reserved	10 MSB			
AO value	11 LSB 11 MSB	R, W, RAM	analogue output value in %, or V * 10 maximum value is 100 dec	0 = 0 V 100 = 10 V
relay com	12 LSB 12 MSB	R, W EEPROM (0x0)	**0** – when no communication, relays stay in last state **1** – when no communication, relays are set to **relay state** values	**bit 0** is relay 1 **bit 1** is relay 2
reserved	13			
input AI1 voltage	14 LSB, 14 MSB	R, RAM	**0 to 10V** 0dec … 0.00V 9999dec … 10.00V	measured values at the inputs
input AI2 voltage	15 LSB, 15 MSB	R, RAM	**0 to 10V** 0dec … 0.00V 9999dec … 10.00V	measured values at the inputs
input AI3 voltage	16 LSB, 16 MSB	R, RAM	**0 to 10V** 0dec … 0.00V 9999dec … 10.00V	measured values at the inputs
input AI4 voltage	17 LSB, 17 MSB	R, RAM	**0 to 10V** 0dec … 0.00V 9999dec … 10.00V	measured values at the inputs
input AI1 resistance	18 LSB, 18 MSB	R, RAM	**0 to 5000 Ohm** 0dec … 0 Ohm 50 000dec … 5 000 Ohm	measured values at the inputs
input AI2 resistance	19 LSB, 19 MSB	R, RAM	**0 to 5000 Ohm** 0dec … 0 Ohm 50 000dec … 5 000 Ohm	measured values at the inputs
input AI3 resistance	20 LSB, 20 MSB	R, RAM	**0 to 5000 Ohm** 0dec … 0 Ohm 50 000dec … 5 000 Ohm	measured values at the inputs
input AI4 resistance	21 LSB, 21 MSB	R, RAM	**0 to 5000 Ohm** 0dec … 0 Ohm 50 000dec … 5 000 Ohm	measured values at the inputs

input AI1 temperature	22 LSB, 22 MSB	R, RAM	a **Pt 1000** must be connected 60536dec … -50.00 °C 0dec … 0.00 °C 15000dec … 150.00 °C	measured values at the inputs
input AI2 **temperature**	23 LSB, 23 MSB	R, RAM	a **Pt 1000** must be connected 60536dec … -50.00 °C 0dec … 0.00 °C 15000dec … 150.00 °C	measured values at the inputs
input AI3 temperature	24 LSB, 24 MSB	R, RAM	a **Pt 1000** must be connected 60536dec … -50.00 °C 0dec … 0.00 °C 15000dec … 150.00 °C	measured values at the inputs
input AI4 temperature	25 LSB, 25 MSB	R, RAM	a **Pt 1000** must be connected 60536dec … -50.00 °C 0dec … 0.00 °C 15000dec … 150.00 °C	measured values at the inputs
AI values as binary inputs	26 LSB, 26 MSB	R, RAM	AI values, if the inputs are used as potential-free on/off contacts. true ... contact closed false... contact open	bit 0 = AI1 bit 1 = AI2 bit 2 = AI3 bit 3 = AI4
input AI1 special	27 LSB, 27 MSB	R, RAM	AI1 value is changed according to the HW input range switch: VOLTAGE (0...10V) *100 0 = 0,00 V, 9999 = 10.00 V RESISTANCE (R) *10 0 = 0.0 Ohm 50000 = 5000.0 Ohm	measured values at the inputs
input AI2 special	28 LSB, 28 MSB	R, RAM	AI2 value, same as AI1	measured values at the inputs
input AI3 special	29 LSB, 29 MSB	R, RAM	AI3 value, same as AI1	measured values at the inputs
input AI4 special	30 LSB, 30 MSB	R, RAM	AI4 value, same as AI1	measured values at the inputs