

## markMX

## DDC controller



### Summary

DDC (Direct digital control) controller markMX is a free programmable process station with MPC5200 processor and Linux operating system. It is suitable for control of large installations (approximately 400...500 physical data points). MarkMX contains one Ethernet port, 2 × RS485 interface, and 2 × RS232 interface for expanding I/O modules. On the board there is an I/O mix of 16 AI, 32 DI, 8 AO, and 32 DO.

### Application

- Free programmable control units for HVAC systems and other applications with local HMI and web access
- Data acquisition, processing, and presentation systems with advanced networking features
- Controls of power systems, photovoltaic power plants etc.
- Protocol converters with web data presentation (must be programmed by user)

### Function

The controller hosts an embedded Linux operating system which boots up the Merbon runtime with the application. The board contains real time clock with battery backup, flash memory containing OS, runtime, application, and other data (time programs, setpoints etc.), and a watchdog. It is also possible to use NVRAM to backup parameters in case of unexpected system shutdown.

The application is created and uploaded in the Merbon IDE development environment. The maximum application program size depends on number of physical and software data points, amount of function blocks which require more memory (e.g. time schedulers), degree of code optimisation, and number of connections the PLC has to handle.

For communication with other devices, markMX contains 1 × Ethernet port, 2 × a RS485 interface and 2 × a RS232 interface. The I/O part (16 AI, 8 AO, 32 DI, 32 DO) communicates with the PLC over a RS485 data bus. This internal module communicates as a MXIO at **COM port 3, address 2**. There may be more modules using Modbus RTU at the same channel, connected over the COM3 port.

The process station contains a web server for remote connection and user intervention. The web pages are created in Merbon HMI editor, which is included in the package of development programs. The exported web definition is uploaded to the process station through Merbon IDE. From the security point of view, the website is not recommended for use in the public network, it is intended for operation in a local network., Therefore it is necessary to integrate the configured router or other element that ensures network security during the design of the network topology.

The PLC can be mounted on the base plate of the switchboard, or on another flat and smooth surface by two screws.

## Technical data

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Supply voltage	24 V ± 10 % DC/AC; max. 20 VA; fuse 2 A
<b>Communication</b>	
Ethernet	1 × Ethernet 10/100BaseT RJ45, 2 LED (link, data) integrated in the connector
RS232	COM1, COM2 2 × CANNON 9 male; pin 2 = TX, 3 = RX, 5 = GND 300...115 200 bit/s, parity and bits are set in software
RS485	COM3, COM4 RS485 (K+, K-) 2 separated buses galvanically insulated from each other, insulating voltage 1 kV 300...115 200 bit/s parity and bits are set in SW maximal bus length 1200 m maximum number of modules depends on requested response time – up to 255 addresses, for common HVAC applications use about 300...400 physical data points on the bus
LED	3 × system: PWR, RUN RT, RUN IO 8 × communication: COM1...4 Rx/D, Tx/D 32 × digital inputs: DI1...32 32 × digital outputs: DO1...32
<b>Analogue inputs</b>	
Number	8 × resistance measuring only 8 × resistance/voltage/current measuring selectable
Resistance measuring range	0...1600 Ω, 0...5000 Ω; sensor Pt1000 Characteristics Pt100, Pt500, Pt1000, Ni1000 - 5000, Ni1000 - 6180 can be transformed from resistance input by predefined transformation in the process station application.
Voltage measuring range	0...10 V DC (input settings is possible over Merbon IDE)

Current measuring range	0(4)...20 mA (for hardware input settings see section Terminals -> Jumpers; the range also must be set in Merbon IDE)
Resolution	16 bit
Measuring error (from range)	0.25 %
Measuring frequency	1/s
Input impedance	> 10 MΩ
Galvanic insulation	insulating voltage 1 kV
<b>Analogue outputs</b>	
Number	8
Voltage range	0...10 V DC
Analogue outputs load	min. 10 kΩ outputs are protected against permanent short-circuit
Resolution	10 bit
Galvanic insulation	insulating voltage 1 kV
<b>Digital inputs</b>	
Number	32
Voltage measuring range	24 V AC/DC – voltage must be applied (no dry contacts)
Max. switching frequency	10 Hz
<b>Digital outputs</b>	
Number	32
Load	relay, normally open: 5 A/250 V AC, 5 A/30 V DC, 750 VA, 90 W (AC1, non-inductive load EN 60947-4-1)
HW	MPC5200, 400 MHz, 760 MIPS, 128 MB RAM, 64 MB flash, 128kB NVRAM FRAM
SW	Merbon IDE
Housing	Steel, powder coated surface
Dimensions	292.3 (h) × 237 (w) × 40 (d) mm (module) 324.3 (h) × 237 (w) × 40 (d) mm (incl. fixtures)
Protection degree	IP21 (EN 60529)
Terminals	Screw terminals M3, maximum wire cross-section 2,5 mm <sup>2</sup>
Ambient conditions	5...40 °C; 5...85 % relative humidity; non-condensing gases and chemically non-aggressive conditions (according EN 60721-3-3 climatic class 3K3)

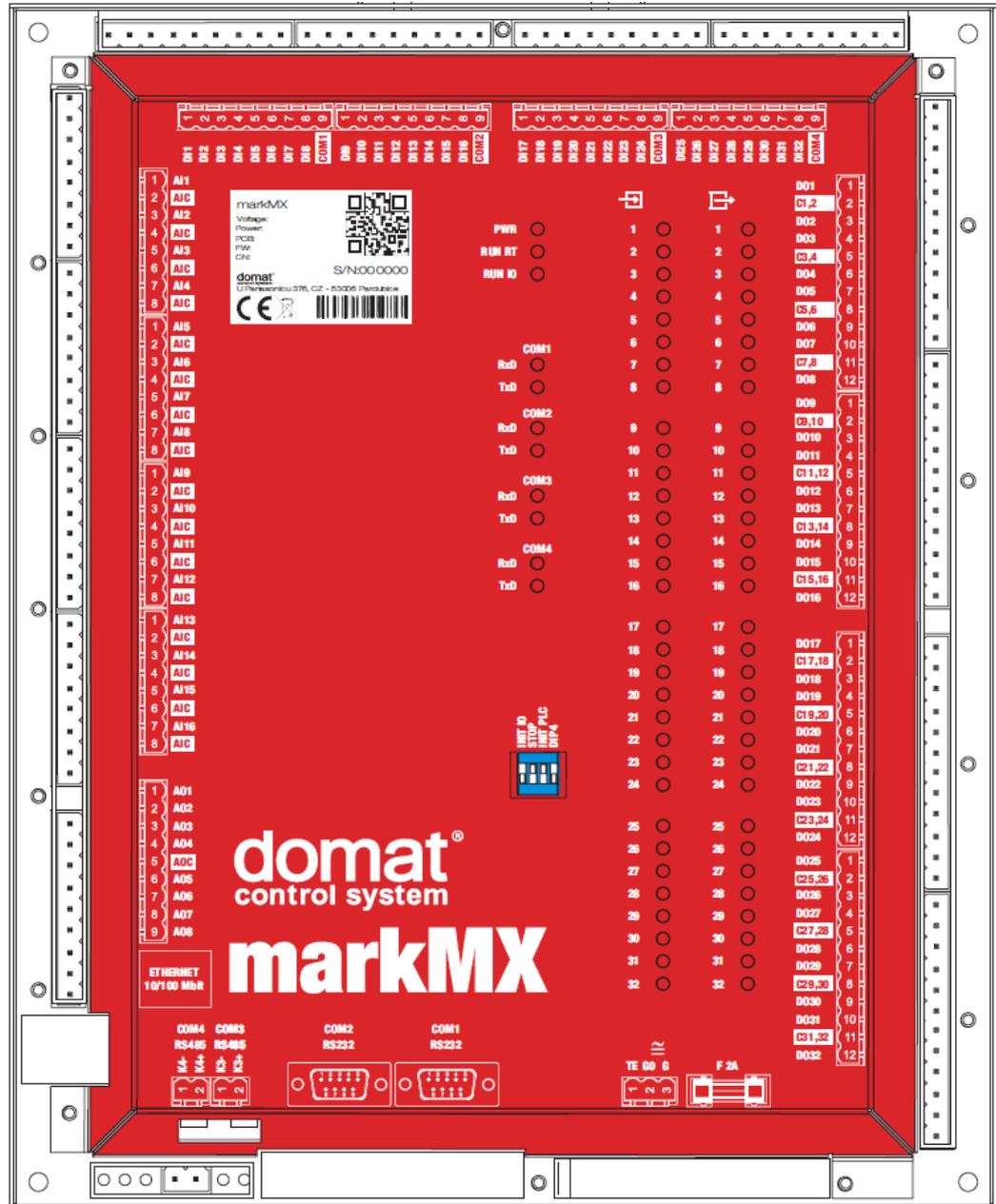
Conformity with standards

EMC EN 61000-6-2 ed.3:2005, EN 55022 ed.3:2010

EN 60950-1 ed.2:2006 + A11:2009 + A12:2011 + A1:2010 + A2:2014

EN 50581:2012

## Terminals



### Terminals and connectors:

**F 2 A**

Fuse F2A. Replace only with the same type if fuse broken.

**G**

power

**GO**

power

**TE**

optional connection for shielding

**COM1 RS232**

port COM1 - serial link RS232; CANNON 9 male

**COM2 RS232**

port COM2 - serial link RS232; CANNON 9 male

**COM3 RS485**

port COM3 - serial link RS485, terminals K+, K-

<b>COM4 RS485</b>	port COM4 - serial link RS485, terminals K+, K- Notice: Remember that <b>the internal I/O module is connected to COM3 on address 2</b> , and the COM3 port must be configured as Modbus RTU to reach the module.										
<b>Ethernet</b>	network interface										
<b>Analogue inputs</b>											
<b>AI1...8</b>	<b>analogue inputs 1... 8</b> are designed as <b>passive only</b> . The range (0...1600 Ω (default), 0...5000 Ω, Pt1000) can be set over Merbon IDE.										
<b>AI9...16</b>	<b>analogue inputs 9...16</b> can be set so as to measure <ul style="list-style-type: none"> <li>- <b>resistance</b> (same as AI1 to AI8),</li> <li>- <b>voltage</b> 0...10 V (default) or</li> <li>- <b>current</b> 0...20 mA.</li> </ul> The AI9 to AI16 0...20 mA ranges are set over a jumper <b>for each input independently</b> . The jumpers are accessible from outside of the module.										
<b>AIC</b>	<b>analogue inputs ground</b> (common for all AI) Notice: All analogue inputs AI1 to AI16 have common ground AIC. The inputs are optically separated from the other parts of the I/O module. For three-wire connection (active sensors, e.g. pressure, humidity), the analogue input ground AIC must be connected with the peripheral 24 V AC power ground (or 0 V terminal for DC peripheral). As all I/O types are mutually separated in the module, it is possible to use one common transformer to power both the active peripherals and the markMX module.										
<b>Jumpers</b>	The current range jumpers on the AI9 to AI16 set each input independently. They are accessible from the outside of the module. <table border="0" style="margin-left: 20px;"> <thead> <tr> <th style="text-align: left;"><b>Range</b></th> <th style="text-align: left;"><b>Jumper</b></th> </tr> </thead> <tbody> <tr> <td>resistance, passive</td> <td>OFF (default)</td> </tr> <tr> <td>temperature sensor</td> <td></td> </tr> <tr> <td>voltage 0...10 V</td> <td>OFF (default)</td> </tr> <tr> <td>current 0...20 mA</td> <td>ON</td> </tr> </tbody> </table>	<b>Range</b>	<b>Jumper</b>	resistance, passive	OFF (default)	temperature sensor		voltage 0...10 V	OFF (default)	current 0...20 mA	ON
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resistance, passive	OFF (default)										
temperature sensor											
voltage 0...10 V	OFF (default)										
current 0...20 mA	ON										
<b>Analogue outputs</b>											
<b>AO1...8</b>	<b>analogue outputs1...8</b> Notice: The outputs are short-circuit protected and optically separated from the other circuits in the module, and their ground (AOC) is not connected to the analogue inputs ground.										
<b>AOC</b>	<b>analogue outputs ground</b> Notice: The ground is optically separated from the other parts of the I/O module. For three-wire connection (active periphery, e.g. valves actuators, frequency changer), the analogue input										

ground AOC must be connected with the peripheral 24 V AC power ground (or 0 V terminal for DC peripheral). As all I/O types are mutually separated in the module, it is possible to use one common transformer to power both the active peripherals and the markMX module.

### **Digital inputs**

#### **DI1...32**

#### **digital inputs 1...32**

Notice:

Digital inputs operate with 24 V AC/DC. Each set of eight digital inputs have their own common COM terminals. The inputs are optically separated from the other circuits in the module, and they may be linked to the same transformer or power supply which supplies the markMX module.

#### **COM1**

#### **digital inputs ground DI1...8**

Notice:

The ground is optically separated from the other parts of the I/O module.

#### **COM2**

#### **digital inputs ground DI9...16**

Notice:

The ground is optically separated from the other parts of the I/O module.

#### **COM3**

#### **digital inputs ground DI17...24**

Notice:

The ground is optically separated from the other parts of the I/O module.

#### **COM4**

#### **digital inputs ground DI25...32**

Notice:

The ground is optically separated from the other parts of the I/O module.

### **Digital outputs**

#### **DO1...32**

#### **digital outputs 1...32**

Notice:

Digital outputs are normally open relays with maximum voltage 250 V, 5 A. Each pair of outputs has one common terminal (CX, Y).

#### **CX,Y**

Common conductor for two neighbouring digital outputs with number X and Y.

### **LED indication**

#### **PWR**

green LED – power (ON: power OK; OFF: no power applied, weak or damaged power supply, ...)

#### **RUN RT**

yellow LED – system cycle (OK: LED flashes periodically 1 s ON, 1 s OFF; ERROR: LED flashes in other pattern, LED is permanently ON or OFF)

#### **RUN IO**

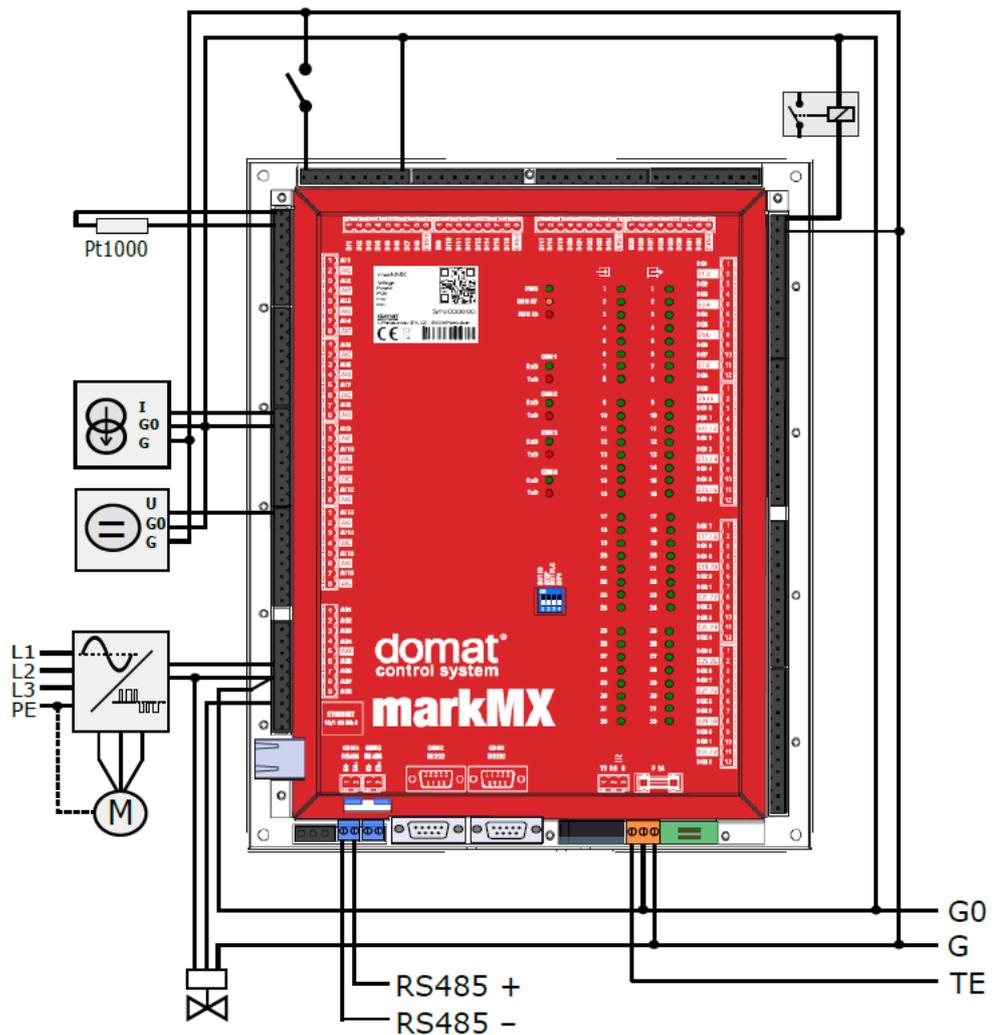
red LED - flashes: I/O module OK; OFF: error in the I/O module

#### **RxD**

green LED – receiving data at the respective COM (flashing: receiving data; OFF: no data traffic)

<b>TxD</b>	red LED – transmitting data at the respective COM (flashing: transmitting data; OFF: no data traffic)
<b>LED DI1...32</b>	Indication the statuses of the inputs (ON: voltage 24 AC/DC $\pm 10\%$ ; OFF: no or low voltage)
<b>LED DO1...32</b>	Indication the statuses of the outputs (ON: relay closed; OFF: relay open)
<b>DIP switches</b>	
<b>INIT IO</b>	if ON at power-up, communication parameters of the I/O module is set to 9600 bps, N, 8, 1
<b>STOP</b>	if ON runtime is running, program execution is stopped
<b>INIT PLC</b>	if ON at power-up, configuration parameters are brought to defaults (see Configuration parameters in Merbon IDE; for example IP address, user and password, database and proxy settings, etc. )
<b>DIP4</b>	not used
<b>BUS END</b>	DIP1 and DIP2 both set to ON = the respective RS485 bus is terminated, in the OFF position the terminating resistors are disconnected. The first and the last module on the bus should have the BUS END on. The DIP switch is accessible through a small aperture close to the K+, K- terminals.

### Connection



## Others

### Ethernet

The 10/100 Mbit/s Ethernet RJ45 connector links the markMX to

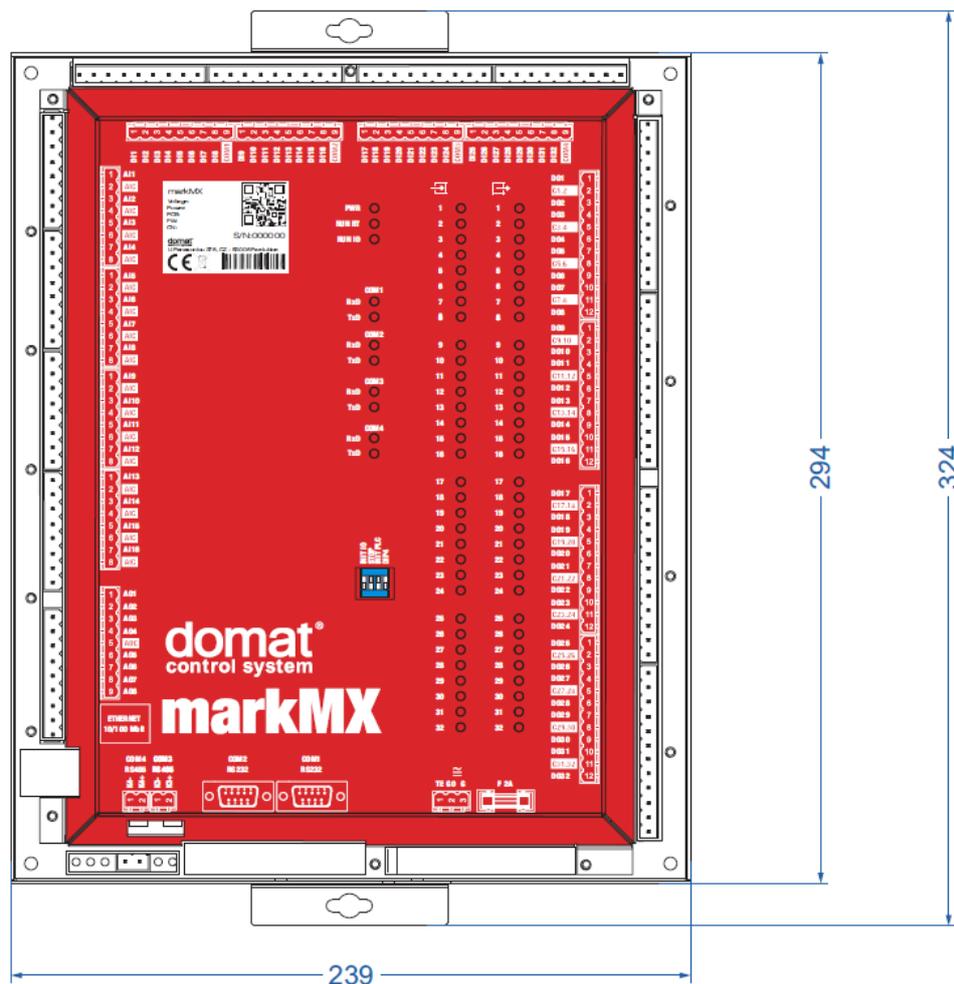
- engineering notebook with Merbon IDE
- web client (if web access is configured)
- RcWare Vision – SCADA
- other process stations for data exchange
- other clients
- the Internet for e-mail alarming.

Other topologies on request, contact Domat Control System technical support please.

### Addressing

The Modbus address of the internal I/O module is set to 2, default communication parameters are 9600, 8, N, 1.

## Dimensions



Dimensions are in *mm*.

## Programming

### Merbon IDE

The main programming tool is the Merbon package which contains I/O editor, graphical editor of the function plan (FBD), structure text editor and compiler (Merbon IDE). The Merbon package also contains LCD menu editor as well as web editor (Merbon HMI).

The application program consists of function blocks which are stored in libraries. Those contain analogue and digital functions, mathematical blocks including goniometric functions, time schedulers, alarm blocks, and HVAC specific blocks (heat recovery, dewpoint calculation, enthalpy, pump switch etc.).

The minimum guaranteed number of records for history on the PLC is 37 000, but the actual number of stored samples may be larger depending on the data types that are stored in the history. The program can be set up also as structure text (ST) or with combination of both types of programming languages.

**Communication** Default network settings are:

IP address	192.168.1.10
subnet mask	255.255.255.0
default gateway	192.168.1.1

SSCP user: admin  
Password: rw

Notice: Do not forget to record the new network settings after change!

After these values have been changed, it is possible to bring the process station into default settings by the INIT PLC DIP switch: set INIT to ON and restart the station. All values in the PLC configuration are set to defaults. The PLC will respond at the default IP address and it is possible to change the old address through Merbon IDE.

The controllers can share variables over the Ethernet network (outside temperature, heat demands etc.) together with other PLC platforms.

The runtime provides drivers for communication with I/O modules and other subsystems. For example Merbon runtime contains: Modbus TCP / RTU (server/client), M-Bus, IEC62056-21, SSCP, SoftPLC link and BACnet IP server/client (viz PICS). The complete list of drivers can be found in the Channel configuration dialogue in the most recent Merbon release. Please check the required protocol features and functions with the list of implemented features in the Merbon IDE help. It is also possible to program own communication drivers using the I/O library functions in structure text language.

**Number of communication channels** (on the serial lines and Ethernet) to I/O modules and subsystems is not directly restricted. It depends on available RAM PLC memory.

**Number of connections from SSCP clients is max. 20.** This includes connections from RcWare Vision, Merbon IDE, HT102/200, mobile application Merbon Menu Reader, connection from other PLCs over SSCP etc.

**Number of connections from Modbus TCP clients on Modbus TCP server is max. 5.**

Other clients channels (web, ...) are not directly restricted.

**WEEE notice**

The device contains a non-rechargeable battery which backups the real-time clock and part of the memory. After the device is not operable, please return it to the manufacturer or dispose of it in compliance with local regulations.

**Safety note**

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.

**Changes in  
versions**

11/2015 –New data sheet version.

07/2016 –Added information about new communication drivers and communication limits. Corrected information about function of STOP DIP switch. Add information about COM3 maximum baud rate.

07/2017 – Added terminals connection scheme.

02/2018 – Added Safety note, change image.

07/2020 – Added information about min. number of records in history.

10/2020 — Added max. switching frequency, modified description of ground connection AIC and AOC, updated information about web usage, modified description of communication protocols.

08/2021 – Stylistic adjustments, change of logo.