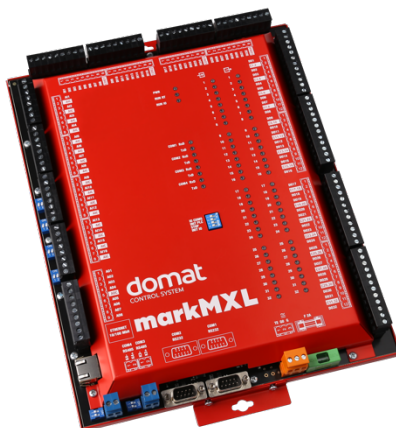# markMXL DDC controller

Summary

DDC (Direct digital control) controller markMXL is a free programmable process station with i.MX6 processor and Linux operating system. It is suitable for control of large installations (approximately 400…500 physical data points). MarkMXL contains two ethernet ports, 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. Compared to markMX.3 process station the markMXL has bigger memory (512 MB RAM, 256 MB FLASH) and support for .NET drivers.

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 Domat 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 Domat 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, markMXL contains 2 × 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 Domat HMI editor, which is included in the package of development programs. The exported web definition is uploaded to the process station through Domat 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		
	Supply voltage	24 V AC/DC ± 10 %; 20 W
	Communication	
	Ethernet	2 × Ethernet 10/100 BaseT,
		RJ45, 2 LED (link, data) integrated in the connector
	RS232	COM1, COM2
		2 × CANNON 9 male; pin TX, RX, GND; RTS, CTS
		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
		bus end
		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
		1 × LINK/DATA (ETHERNET)
		8 × communication: COM1…4 RxD, TxD
		32 × digital inputs: DI1…32
		32 × digital outputs: DO1…32
	Analogue inputs	
	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 Domat IDE)

12/2023 Subject to technical changes. domat markMXL

Current measuring range	0(4)...20 mA (for hardware input settings see section Terminals -> DIP switches; the range also must be set in Domat IDE)
Resolution	16 bits
Measuring error (from range)	0.25 %
Measuring frequency	1/s
Input impedance	> 10 MΩ
Galvanic insulation	insulating voltage 1 kV
Analogue outputs	
Number	8
Voltage range	0...10 V DC
Analogue outputs load	min. 10 kΩ, current 10 mA each output; outputs are short-circuit protected by current limitation to 20 mA
Resolution	10 bits
Galvanic insulation	insulating voltage 1 kV
Digital inputs	
Number	32
Voltage measuring range	24 V AC/DC – voltage must be applied (no dry contacts)
Max. switching frequency	10 Hz
Digital outputs	
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	CPU ARM i.MX6UL 528 MHz, 256 MB FLASH, 512 MB SRAM, 128 kB NVRAM FRAM, realtime clock 20 ppm, watchdog
SW	Domat 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	IP20 (EN 60529)
Terminals	Screw terminals M3, cross-section 0.35...1.5 mm^2
Ambient conditions	from -20...50 °C; 5...85% relative humidity; non-condensing gases, chemically non-aggressive conditions, fog, ice and frost (according EN IEC 60721-3-3 ed. 2:2019 climatic class 3K22, 1K21, 3M11) for installation at high altitude, it is necessary to consider the reduction of dielectric strength and a limited cooling air (EN IEC 60664-1 ed.3: 2020)

Standards of conformity	EMC EN IEC 61000-6-2 ed. 4:2019, EN IEC 61000-6-4 ed. 3:2019 (industrial environment) electrical safety EN IEC 62368-1 ed. 2:2020+A11:2020 hazardous substances reduction EN IEC 63000:2019

Terminals
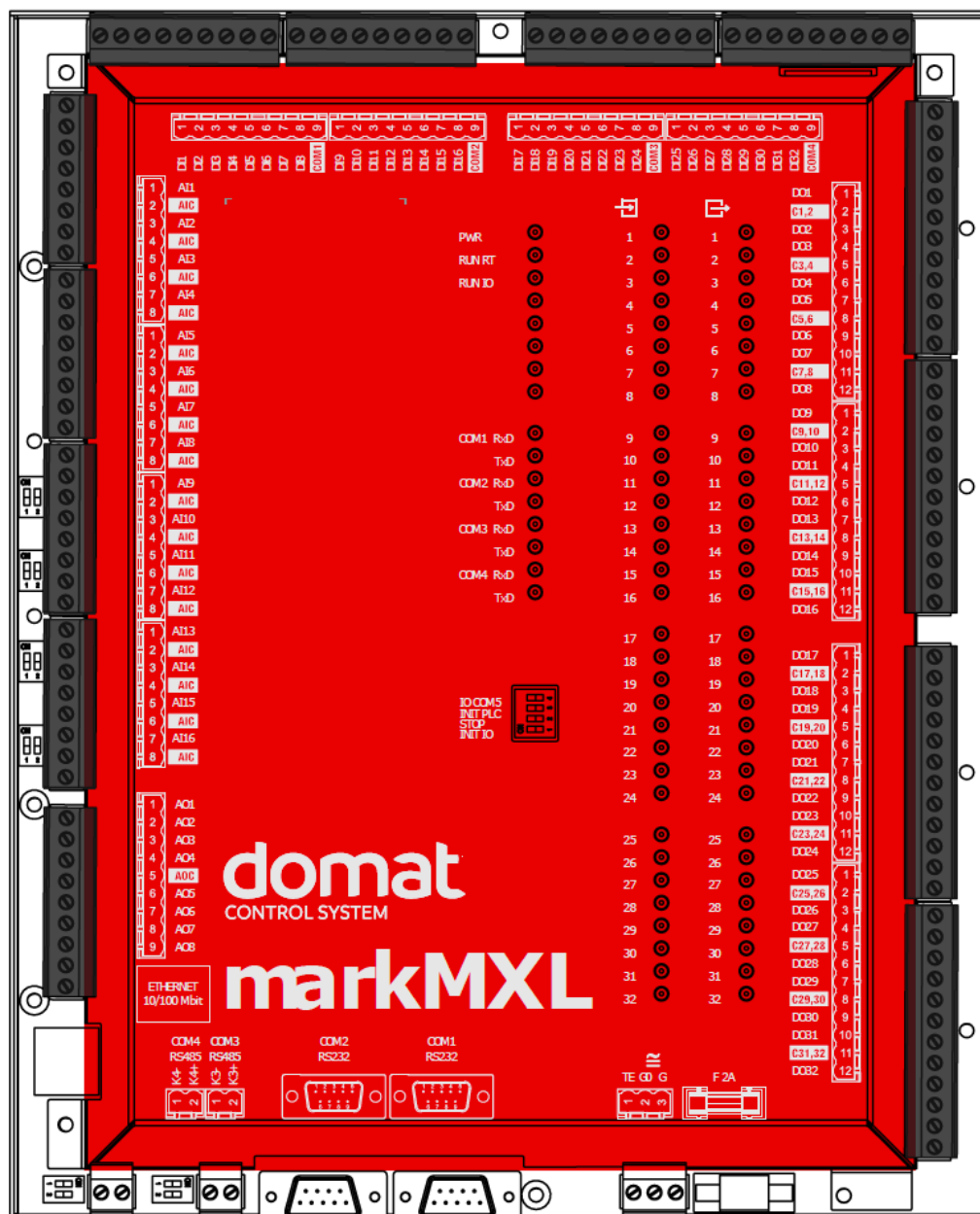
Terminals and connectors:

F2A	Fuse F2A. Replace only with the same type if fuse broken.
G	power
G0	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-
COM4 RS485	port COM4 - serial link RS485, terminals K+, K-

	Notice: Remember that **the internal I/O module is connected to COM3 on address 2**, and the COM3 port must be configured as Modbus RTU to reach the module.
Ethernet	network interface

Analogue inputs

AI1…8	**analogue inputs 1… 8** are designed as **passive only**. The range (0...1600 Ω (default), 0...5000 Ω, Pt1000) can be set over Domat IDE.
AI9…16	**analogue inputs 9…16** can be set so as to measure (when changing, it is necessary to write the settings to the RXIO module, solution tree on the left select the PLC -> channel -> RXIO right-click and choose Domat module configuration) **resistance** (same as AI1 to AI8), **voltage** 0...10 V (default) or **current** 0...20 mA. The AI9 to AI16 0...20 mA ranges are set using a DIP switch **for each input independently**. The jumpers are accessible from outside of the module.

Range	DIP switch
resistance, passive temperature sensors	OFF (default)
voltage 0...10 V	OFF (default)
current 0...20 mA	ON

AIC	**analogue inputs ground** (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 markMXL station.

Analogue outputs

AO1…8	**analogue outputs1…8** 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.
AOC	**analogue outputs ground** 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 markMXL station.

Digital inputs

DI1…32	**digital inputs DI1…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 markMXL station.
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). The statuses of the outputs are indicated by LEDs at the front panel of the module.
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)
TxD	red LED – transmitting data at the respective COM (flashing: transmitting data; OFF: no data traffic)
LED DI1…32	Indication the statuses of the inputs (ON: voltage 24 AC/DC ±10 %; OFF: no or low voltage)

LED DO1…32	Indication the statuses of the outputs (ON: relay closed; OFF: relay open)

DIP switches

| **IO COM5**	after switching DIP1 to the ON position, the internal I/O module communicates on the COM5 port at a speed of 9600 bit/s (you can set the speed up to 460800 bit/s). It is also necessary to change the settings of the given channel in the IDE and upload the project.
INIT PLC	if ON at power-up, configuration parameters are brought to defaults (see Configuration parameters in Domat IDE; for example IP address, user and password, database and proxy settings, etc.)
STOP	if ON runtime is running, program execution is stopped
INIT IO	if ON at power-up, communication parameters of the I/O module is set to 9600 bps, N, 8, 1
BUS END	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
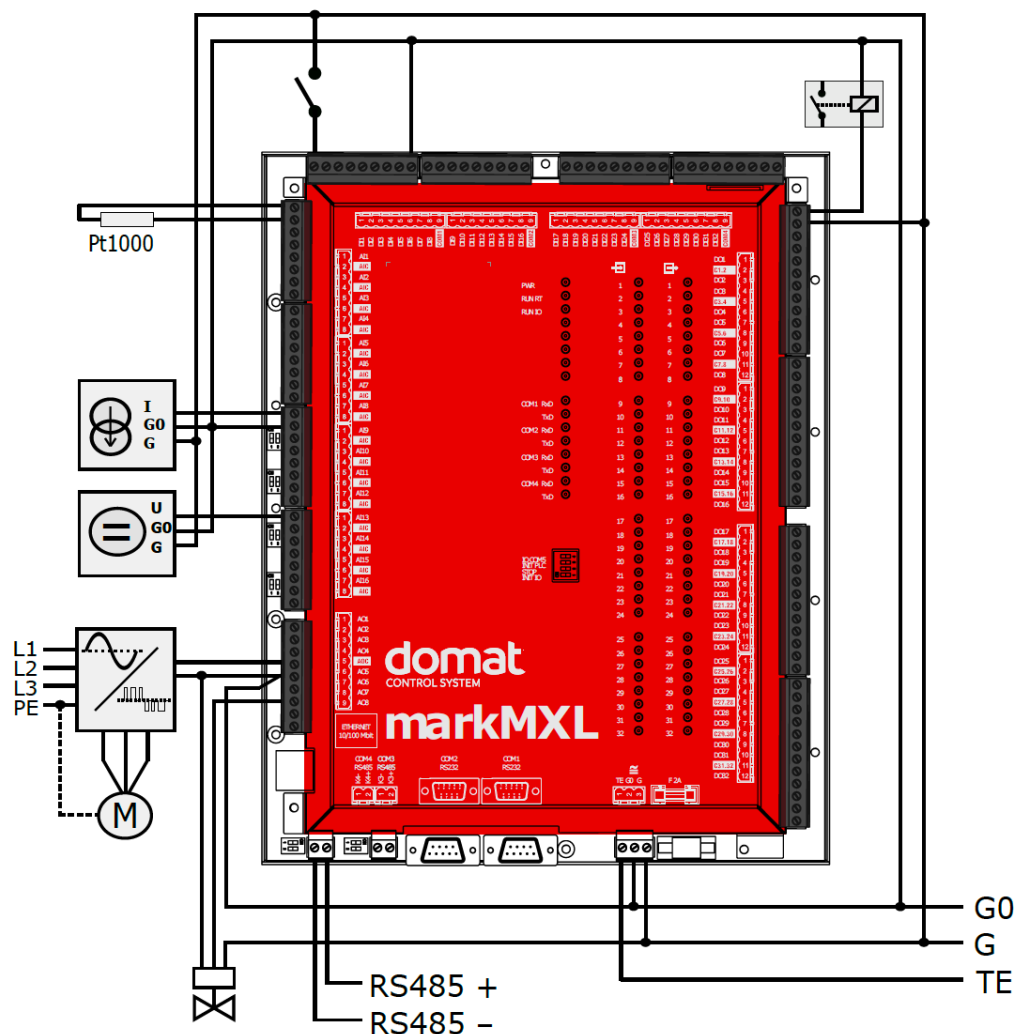
Others   **Ethernet**

The 10/100 Mbit/s Ethernet RJ45 connector links the markMXL to
- engineering notebook with Domat 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
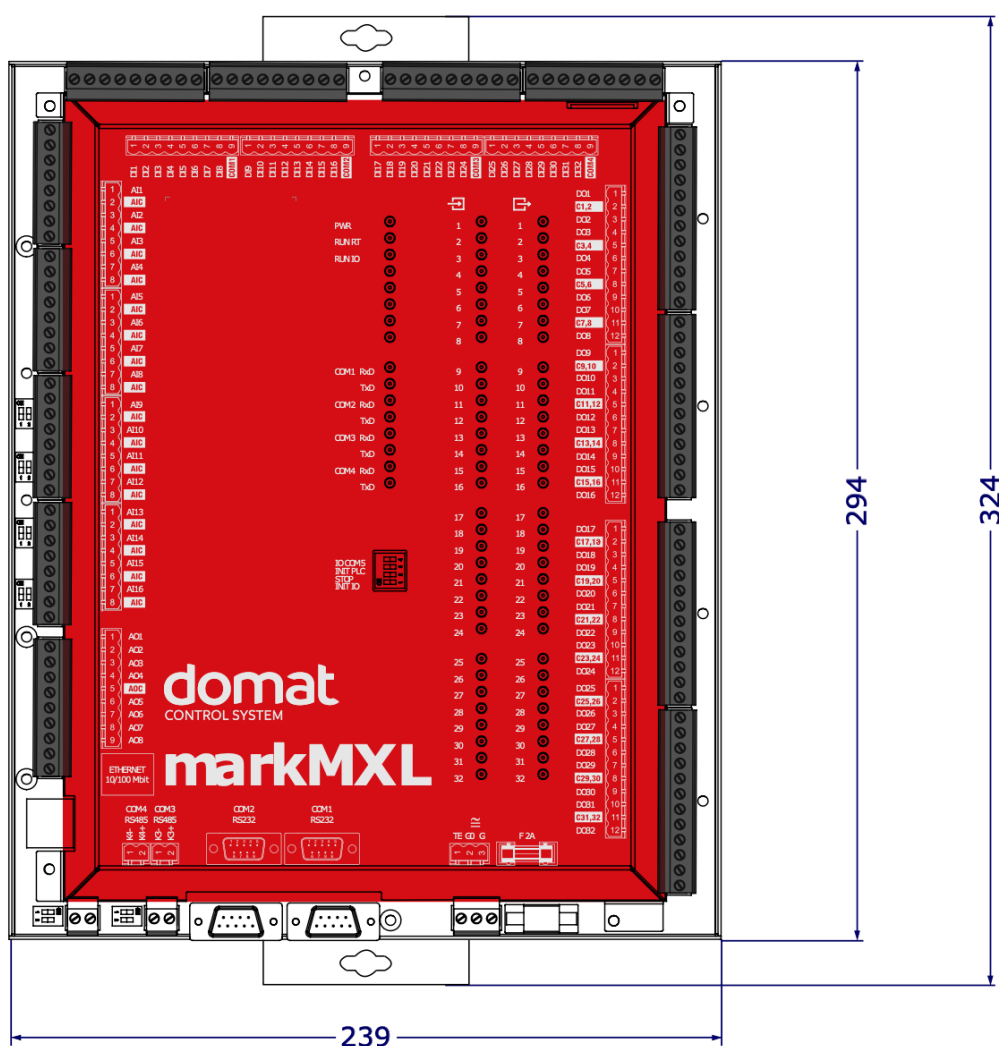
Dimensions are in *mm.*

Programming   **Domat IDE**

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

In case of implementation of your own ST driver, there is limitation of max. 10 clients connected simultaneously.

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 Domat 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 Domat 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 Domat release. Please check the required protocol features and functions with the list of implemented features in the Domat 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 Domat IDE, Domat SCADA, HT200, mobile application Domat Visual, connection from other PLCs over SSCP etc.

Uploading a project from the Domat IDE reserves two SSCP TCP connections.

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.

Cyber security note
The product may influence the information and cyber security (ICS) of the control system. It is supplied in default settings. Implementation and continuous compliance with the ICS rules (e.g. creating and upload of certificates and keys, their updates and management, protection against misuse, etc.) are fully the responsibility of the control system operator. The manufacturer is not responsible for damages which originated or may originate due of wrong or insufficient implementation of ICS rules when using the device. In case of questions, please contact Domat Control System technical support.

Changes in versions

12/2023 – New datasheet version.