ICIO205   DDC controller

Summary

DDC (Direct digital control) controller ICIO205 is free programmable process station with ARM Cortex M4 processor and OS FreeRTOS. It contains one Ethernet port, 8 AI, 8 DI, 6 AO, 8 DO and also a RS485 interface and 8 MB external RAM. ICIO205 which is suitable for control of larger installations (approximately 150 physical data points).

Application

- Free programmable control units for HVAC systems and other applications with web access
- Data acquisition, processing, and presentation systems with advanced networking features
- Protocol converters with web data presentation (must be programmed by user)

Function

The controller hosts an embedded FreeRTOS 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, ICIO205 contains 1x Ethernet port and 1x RS485 interface for I/O module extension. I/Os integrated on the board are 8 AI, 8 DI, 6 AO and 8 DO.

ICIO205 has sufficient computing power to control larger installation with external I/O modules and communication channels (for example Modbus TCP server, or SSCP client).

The process station contains a web server for remote connection and user intervention. The web pages are created in Merbon IDE which is also used for uploading the exported web definition to the process station. 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 module is 217 mm wide and mounts on a standard DIN rail.

Technical data		
	Power	24 V AC/DC ± 20 %; max 10 W
	Communication	
	Ethernet	1 × Ethernet 10/100BaseT
		RJ45, 2 LED (link, data) integrated in the connector
	RS485	COM1 RS485 (K+, K-)
		galvanically insulated, 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 with ICIO205 use about 150 physical data points on the bus
	19× LED	RUN, TxD, PWR, 8× DI state, 8× DO state
	Analogue inputs	
	Number	8
	Resistance measuring range	0...1600 Ohm, 0...5000 Ohm, Pt100, Pt500, Pt1000, Ni1000-5000, Ni1000-6180 sensors (type of measuring is set using the Merbon IDE, transformation is performed only at the application level in the PLC)
	Voltage measuring range	0...10 V DC (type of measuring is set using the Merbon IDE)
	Current measuring range	0...20 mA
		AI1...AI4: particular DIP switch must be in position ON
		(type of measuring is set using the Merbon IDE)
		AI5...AI8: with an external resistor of 125 Ohm (parallel connection; type of measuring is set using the Merbon IDE)
	Resolution	16 bit
	Galvanic insulation	optically insulated up to 1 kV

Analogue outputs

Number	6
Voltage range	0…10 V DC
Analogue outputs load	min. 10 kΩ
	outputs are protected against permanent short-circuit – 10 mA limitation
Galvanic insulation	optically insulated up to 1 kV

Digital inputs

Number	8
Voltage	24 V AC/DC – voltage must be applied (no dry contacts), e.g. from G and G0
Input current	4 mA
Maximum voltage	60 V DC, 40 V AC
Max. switching frequency	10 Hz
Galvanic insulation	optically insulated up to 1 kV

Digital outputs

Number	6 NO (normally open) relays (no voltage - open)
	2 changing relays
NO relay load	3 A at 250 V AC, 750 VA
	3 A at 30 V DC, 90 W
Changing relay load	8 A at 250 V AC, 2000 VA
	8 A at 24 V DC, 192 W
Galvanic insulation	optically insulated up to 1 kV
Standard type	AC1, non-inductive load EN 60947-4-1

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HW	ARM Cortex M4 168 MHz, 10 MB FLASH, 256 KB + 8 MB SRAM, 4 KB + 64 KB NVRAM
SW	Merbon IDE
Housing	steel, powder coated surface
Dimensions	217 × 115 × 40 mm (including terminals); See the schema below.
Protection degree	IP20 (EN 60529)
Terminals	screw terminals M3, maximum wire cross-section 2.5 mm^2
Ambient conditions	5…40 °C; 5…85 % relative humidity; non-condensing gases and chemically non-aggressive conditions (according to EN 60721-3-3 climatic class 3K3)

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
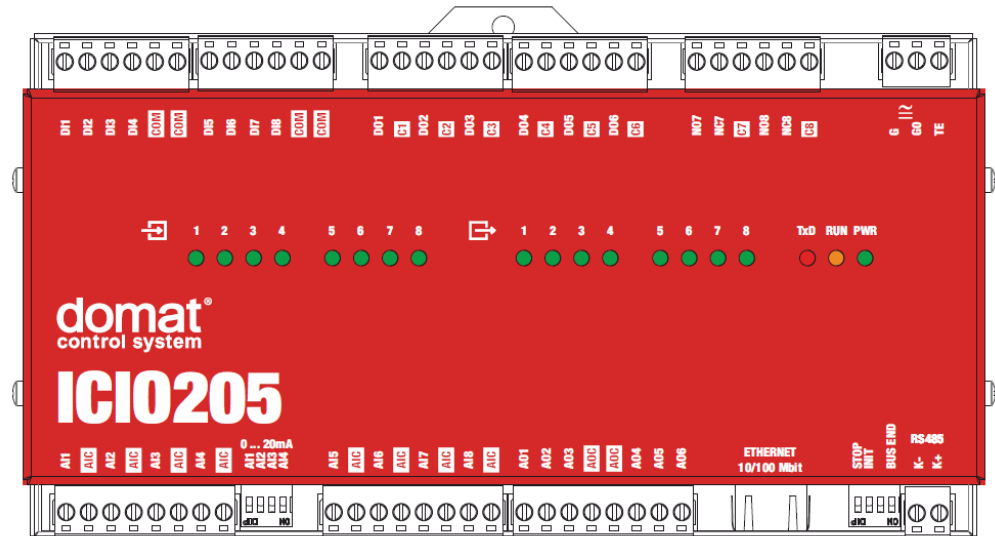
Terminals and connectors

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DI1…8	digital inputs 1…8
COM	ground (common)
DO1…6	relay output 1…6, normally open against C1…C6
C1…6	relay output 1…6, ground
NO7	relay output 7, normally open against C7
NC7	relay output 7, normally closed against C7
C7	relay output 7, ground
NO8	relay output 8, normally open against C8
NC8	relay output 8, normally closed against C8
C8	relay output 8, ground
G	power
G0	power
TE	optional connection for shielding

AI1…8	analogue inputs 1…8
AIC	**analogue input ground** (common)

Notice:

All analogue inputs AI1 to AI8 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 ICIO module.

AO1…6	analogue outputs 1…6
AOC	**analogue output ground** (common)
	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 output 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 ICIO module.
Ethernet	network interface
RS485	port COM1 – serial line RS485, terminals K+, K-
LED indication	
LED DI1…8	indication the statuses of the inputs (ON: voltage 24 AC/DC ± 10 %; OFF: no or low voltage)
LED DO1…8	indication the statuses of the outputs (ON: relay closed; OFF: relay open)
TxD	red LED – M-bus transmitting data at COM1 (flashing: receiving data; still ON: shortcircuited bus or bus overload)
RUN	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)
PWR	green LED – power (ON: power OK; OFF: no power applied, weak or damaged power supply, …)
DIP switches	
STOP	if ON, the runtime is running, program execution is stopped
INIT	if ON at power-up, configuration parameters are brought to defaults (see Configuration parameters in Merbon IDE; e.g. IP address, user and password, database settings, proxy, …)
BUS END	if ON = bus end RS485; the first and last devices on bus should have bus end ON
AI1…4	if ON, the parallel resistance 125 Ohm is connected and input is ready for current measuring

Connection
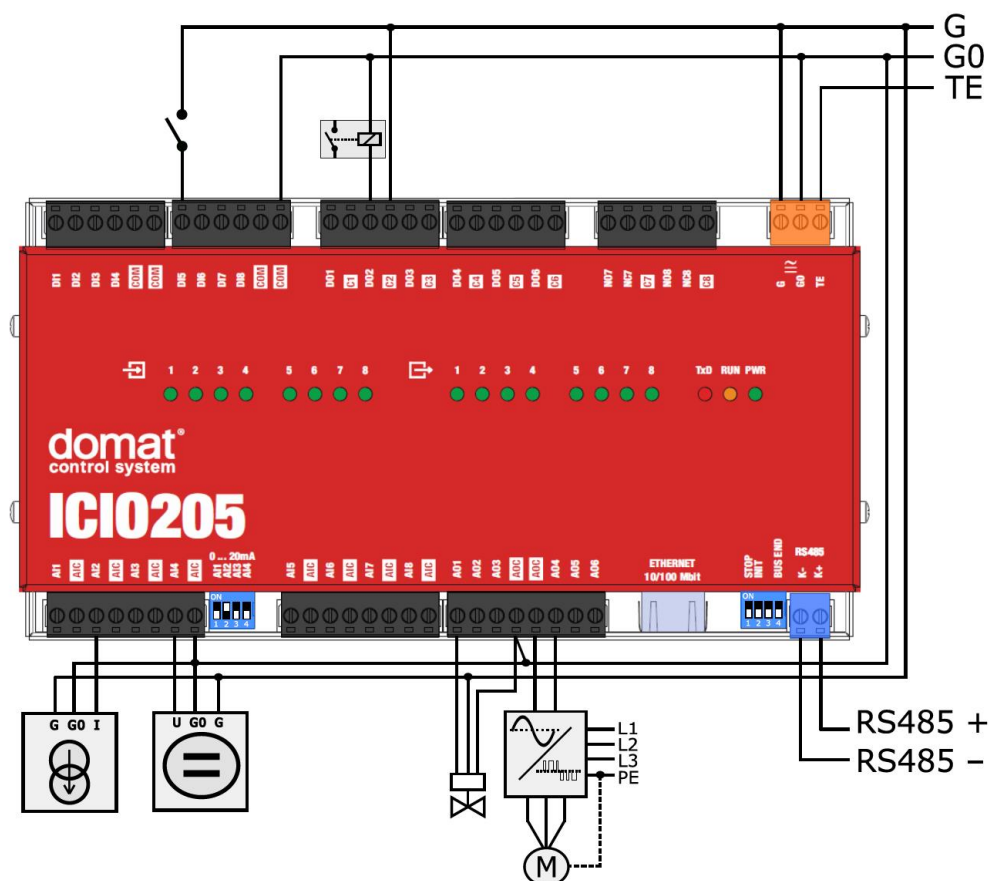
Resistive (passive) sensors are connected between AIx and AIC terminals, for the first 4 inputs must be DIP switch 0...20 mA in the off position. The resistance range is set in the software.

Dimensions
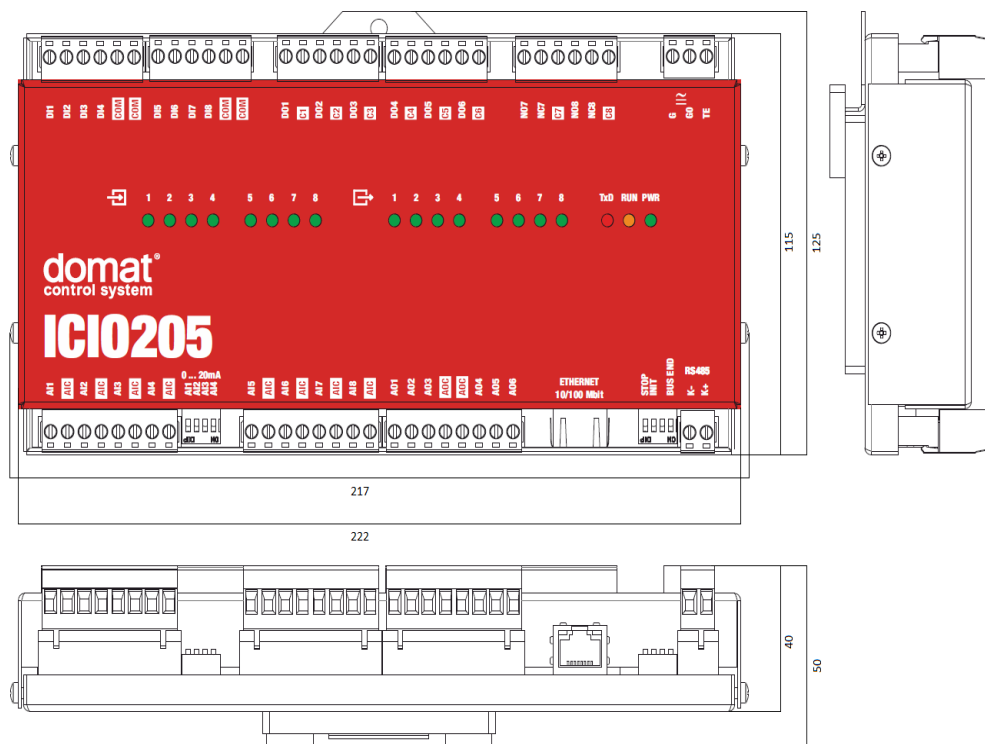
Dimensions are in *mm*.

| **Programming** | **Merbon IDE** |

Programming tool Merbon IDE contains I/O editor, graphical editor of the function plan (FBD), structure text editor, web page editor and LCD menu editor (HMI) for PLC and compiler.

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.). In addition to function blocks, the application program can also be compiled from structured text, or a combination of both languages can be used.

The minimum guaranteed number of records for history on the PLC is 79 000, but the actual number of stored samples may be larger depending on the data types that are stored in the history.

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 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 which communicates e.g. through Modbus TCP/RTU (server/client), M-Bus, IEC62056-21, SSCP, SoftPLC link and BACnet IP server/client (see 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 Merbon IDE, Merbon SCADA, HT104/200, mobile application Merbon Visual, connection from other PLCs over SSCP etc.

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

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

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

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	07/2016 – First version.
	07/2017 – Added terminals connection scheme.
	11/2017 – Added safety note, passive sensor connection information and power tolerance.
	12/2019 – ICIO200 removed.
	01/2020 – Photo changed.
	07/2020 – Added information about min. number of records in history.
	10/2020 – Added max. switching frequency, ground connections.
	08/2021 – Logo change, stylistic adjustments, sw names update.
	12/2021 – Stylistic Adjustments, added information about limiting the number of connected clients.
	03/2022 - Modified paragraph on the number of simultaneously connected clients using the SSCP protocol.