GOC43 User Manual

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Version: 1.12

Revision:

Version	Date	Description
1.00	October 2020	Draft Release
1.01	November 2020	First Release
1.02	December 2020	Second Release
1.03	December 2020	Modifications done as per QA review. Updated 'General Specifications' for environmental related specifications. Added default IP setting details, under following sections, *10. Status and Diagnostics* *15. System Variables*
1.04	January 2021	Removed information of analog input extension units which are not supported in product version release.
1.05	March 2021	Added information of analog input extension units GC-4UAD-10 and GC-4UAD-10E. Added '*Appendix*' for information of updation time for Analog input.
1.06	April 2021	Updated specification "Channel updation time" for analog input extension units GC-4A-12 and GC-4UAD-16.
1.07	June 2021	Added specifications and the details of - Supported 19 default fonts. - Modbus TCP Master function. - CC-Link IE Field Basic Master function. - Appendix 18.2 Task Configuration.
1.08	April 2022	Added information for CE approval.
1.09	July 2022	Added information of analog output extension units GC-2DA-12 and GC-1DA-12.
1.10	March 2023	Added details of - Alarm Configuration - Recipe Management - Data Logging - FTP Server
1.11	August 2023	Added information of extension unit GC-MODEM-40. Added Appendix 18.3 Version Compatibility Added Appendix 18.4 Getting SD Memory Card Ready for Data Logging
1.12	January 2024	Updations related to compliance.

Intended audience of this manual

Thank you for choosing the Mitsubishi Electric India product.

Do not use this product until you have full knowledge of the equipment.

Please forward this manual to end user.

This manual is intended to the following personnel,

- Managing in charge.
- Designing or developing personnel.
- Commissioning and Maintaining personnel.
- Supervising personnel.
- Operating personnel.

Scope of manual

This user manual provides the following details of GOC43 product.

- List of Main units, Extension units, COM units.
- Guideline for installation and wiring.
- Features and specifications of all types of units.
- Configuration and programming details.
- Status and diagnostic information.
- Maintenance and troubleshooting

Important information for user

Read and understand the manual carefully before using GOC43 product, to avoid any damages to persons, properties or environment. Ensure safe and proper usage of this product.

Do not modify, dismantle, re-construct and repair the electronic modules. For repair, contact nearest authorized sales office or technical support team.

Qualified and properly trained personnel should only install the product. The personnel should be aware of all the safety aspects of automated products and completely familiar with all associated documentation for the said product.

Protect the product from conductive dust, corrosive gases, wire debris, flammable gases, rain and fluid entering into the product through ventilation slits, this may cause malfunctioning, damage, fire, electric shock and deterioration.

List of Symbols

	This symbol indicates that the specified operation/s is/are mandatory or must to do or the precautions are mandatory.
	This symbol indicates warnings, specifically related to the electric shocks and hazards.
	This symbol indicates cautions for critical situations, which may cause accidents or serious injury or may be severe property damage. This covers general warnings as well as cautions.
	This symbol indicates or covers operations that user must to avoid. This is specifically related to disassembly of product.
NOTE	This symbol indicates points to note or to consider during usage of said product. Also, indicates summary of individual sections covered in this manual.

Terms and Conditions

- Mitsubishi Electric India Pvt. Ltd. shall have no responsibility or liability for any personnel injury or death, or loss or damage to the property caused by said product, if used or operated in applications which are not intended or excluded by instructions, precautions or warnings provided in this document.
- Specifications are subject to change without prior notice.
- The reproduction or transmission of this document or its contents in full or part is not allowed without written permission from the authority.

Precautions for safe use of product

- Disconnect all power supplies before performing installation and wiring work.
- For Mains power supply connections, confirm suitable fuse is used.
- Do not touch the conductive part directly. This may cause malfunctioning of product or electric shock.
- Do not bundle IO wires, 24 Vdc wires with Main control panel wiring together.
- Consider maximum rated current and inrush current of power supply while selecting 24 Vdc power supply source. Ensure that external breaker or fuse is used in series with 24 Vdc.
- Confirm that the source of voltages and currents are within specified ranges.
- Connect functional earth terminal properly. If not, product may be susceptible to the noise.
- Connect protective earth terminal to a good quality earth. If not, it may result in electric shock or erroneous operation.
- If this product emits smoke or an unusual odor or unusual sound or unusual operation, immediately switch OFF the power to the product. This may result in fire and damage the product. In such cases, contact the nearest authorized sales or service support team.

Disposal precaution

- Treat the said product/s as an industrial E-waste.

  For environmentally compliant recycling and disposal of your electronic waste, please contact to certified agency.

Recommendations for safe use of product

- It is always recommended to route cables carrying low level signals e.g. analog IO signals, serial communication signals, Ethernet communication cables separately and away from cables carrying high voltage and large current signals.
- It is recommended to connect cable shield to the ground terminal at the IO module end and leave it unconnected at the device (sensor/actuator) end.

Replacement Cycle

- Although it depends on the status of use, 10 years is the guideline for renewal.

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Content

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1 Overview

Graphic Operation Controller (GOC43) is a micro range of controllers which consists of PLC function, HMI function, function keys and illuminated keys. It is designed to cater the automation requirements of any small size, standalone machine.

1.1 Highlighting Features

PLC Function	
Flexible Hardware Configuration	▪ Various options of main units and extension units depending upon number of I/Os and type of I/Os. ▪ Functionality can be extended with addition of up to 2 I/O extension units and 1 COM extension unit. ▪ Offers 16 digital I/Os minimum to 48 digital I/Os maximum. ▪ Supports 1 serial port by adding COM extension unit. ▪ 2 built-in analog V/I input channels. Can be extended by additional 8 analog V/I input channels using I/O extension units
Configurable Special Functionality to Digital Inputs in Main Unit	▪ 2 single phase counters (inputs I00 and I03) with software direction and start/ stop control. Maximum input frequency 20 KHz. ▪ 2 Quadrature ABZ encoder interfaces (inputs I00, I01, I02 and I03, I04, I05). Maximum input frequency10 KHz.
General Features	▪ Built-in Real Time Clock. ▪ Controller input power is 24 VDC. ▪ Front panel mount; IP65 protection from front side, IP20 protection from rare side.
Built-in Ethernet Port	▪ Up to 8 simultaneous connections. ▪ Protocols supported: - Modbus TCP master - Modbus TCP slave (can connect to 8 slave devices maximum*) - CC-Link IE Field Basic master** (can connect to 4 stations maximum*)
Programming Platform	▪ Programming via built-in Ethernet port. ▪ Windows® based IEC 61131-3 compatible programming software CoDeSys V3.5. ▪ Support of all the IEC languages (LD, FBD, ST, IL, SFC) and CFC. ▪ Single software for programming PLC and HMI functionality. ▪ Manage password protection for project

* Total no. of connections for all the protocols configured should not exceed 8 connections.

**FB library GOC43 CCB.lib supports CC-Link IE Field Basic Master functionality.
Refer “GOC43 CCB FB Library user manual” for more detail.

Highlighting Features…

HMI Function	
Built-in LCD Display	▪ 4.3” 480 x 272 pixels, TFT, 64K color, Touch graphics LCD View size: 95.04 x 53.86 mm ▪ 4 function keys (F1 to F4) ▪ 4 illuminated keys (K1 to K4) with dual color (Green, Red) LEDs
User Defined LCD Screens	▪ Up to 64 user definable screens ▪ 19 default fonts* ▪ Monitor/ modify PLC data with all supported data types and formats. ▪ Alpha-numeric data entry by embedded Keypad, Numpad or Extended Numpad ▪ Direct access of PLC variable with symbolic name.
Visualization Elements	▪ **Basic**: Rectangle, Round rectangle, Ellipse, Line, Polygon, Polyline, Pie, Image, Frame. ▪ **Common controls**: Label, Combo box integer, Combo box array, Tab control, Button, Group box, Table, Text field, Scrollbar, Slider, Spin Control, Invisible input, Progress bar, Checkbox, Radio button ▪ **Measurement controls**: Bar display, Meter 90°, Meter 180°, Meter, Potentiometer, Histogram. ▪ **Special controls**: Waiting symbol flower, Cartesian XY Chart ▪ **Date/time controls**: Analog clock, Date picker ▪ **Lamps/switches/bitmaps**: Image switcher, Lamps and Switches ▪ **Symbols**: Arrows, Symbols, Icons
Alarm Configurator	▪ Monitor up to 64 alarms ▪ Support for acknowledgeable and archivable alarms ▪ Alarm history with time stamp for up to 256 events ▪ Visualization objects for Alarm table and Alarm banner
Recipe	▪ Up to 4 recipe definitions with up to 32 variables (ingredients) each ▪ Up to 16 recipes (products) per recipe definition
Function Keys	▪ 4 keys F1 to F4 ▪ Quick access to IO status monitor and system menu
Illuminated Keys	▪ 4 Illuminated keys i.e. keys with dual color bright LEDs ▪ LED control Red/Green/Yellow ▪ Insertable slide-in label over illuminated keys
Built-in Status and Diagnostics	▪ Monitor status of all digital IOs in one screen. ▪ System Menu for - Monitoring system status - System diagnostics: CPU, IO and Ethernet - System settings: RTC, IP settings, display, buzzer - Touch calibration and check - Keys and LEDs check

* Standard Windows® fonts are not supported.

Highlighting Features…

MicroSD card support	
Backup and restore	▪ For application program and/ or source code ▪ With user configurable password protection
Data logging	▪ Up to 64 log variables with 2 groups ▪ Logging interval 500 ms/ 1 Sec minimum depending on record size ▪ Computer friendly .CSV file format of log file ▪ User controlled log trigger and file switching ▪ FTP access to retrieve log files
Customization and branding	
Easy Customization of Front Look	▪ Insertable slide-in label over illuminated keys ▪ Customizable for OEM branding.

1.2 Nomenclature

GOC43 consists of main unit with built-in I/Os, display, function keys and illuminated keys. User can attach I/O extension units (up to 2) and COM extension unit (1 no.) to add I/Os and enhance functionality.

This section provides nomenclature details as below.

- Main unit
- I/O extension unit
- COM extension unit
- Main unit with extension units

1.2.1 Main Unit

The figure below shows all the views of bare Main unit with part names.

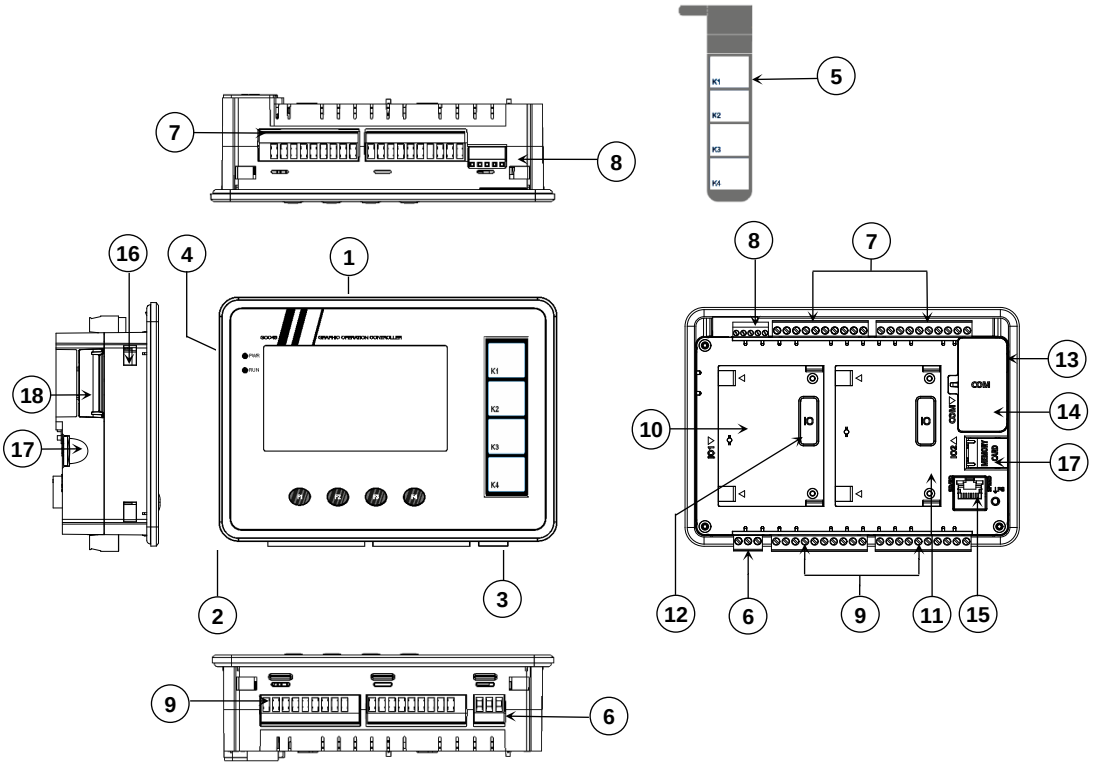


Figure 1: Main unit nomenclature

Parts Description
1. 4.3", 480 x 272 pixels, Touch graphics LCD
2. 4 Function keys [F1 to F4]
3. 4 Illuminated keys [K1 to K4]
4. LED indications [PWR, RUN]
5. Slide-in label
6. 3-pin terminal block [+24VDC, 0V, Earth]
7. 2 nos., 10-pins terminal block [Digital Inputs]
8. 1 no., 5-pin terminal block [Analog V/I Inputs]
9. 2 nos., 10-pins terminal block [Transistor/ Relay Outputs]

10. IO1 slot
11. IO2 slot
12. IO slot cover
13. COM slot
14. COM slot cover
15. Ethernet port
16. Cut-out for mounting clamp
17. MicroSD card slot with door
18. USB port with door

1.2.2 I/O Extension Unit

User can attach up to 2 I/O extension units on the back side of Main unit. The figure below shows all the views of I/O extension unit with part names.

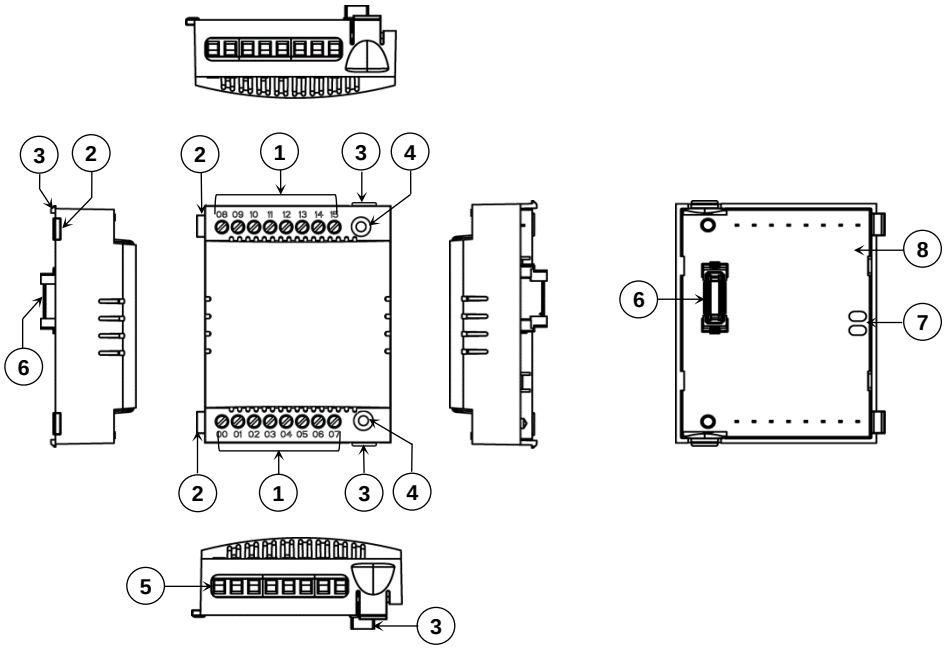


Figure 2: I/O extension unit nomenclature

Parts Description

1. I/O terminals
2. Latch
3. Clip
4. Unit fixing screw hole.
5. 8-pin fixed I/O terminal block
6. Interface connector
7. Slot position holes
8. Printed circuit board (PCB)

NOTE

Back side of I/O extension unit is open. Do not touch PCB and interface connector. It may cause damage to electronic hardware due to electrostatic discharge.

Height of extension unit GC-MODEM-40 is increased by 5 mm than other IO extension units due to SMA female connectors provided for antenna connections.

1.2.3 COM Extension Unit

User can attach 1 COM extension unit on the back side of Main unit. The figure below shows all the views of COM extension unit with part names.

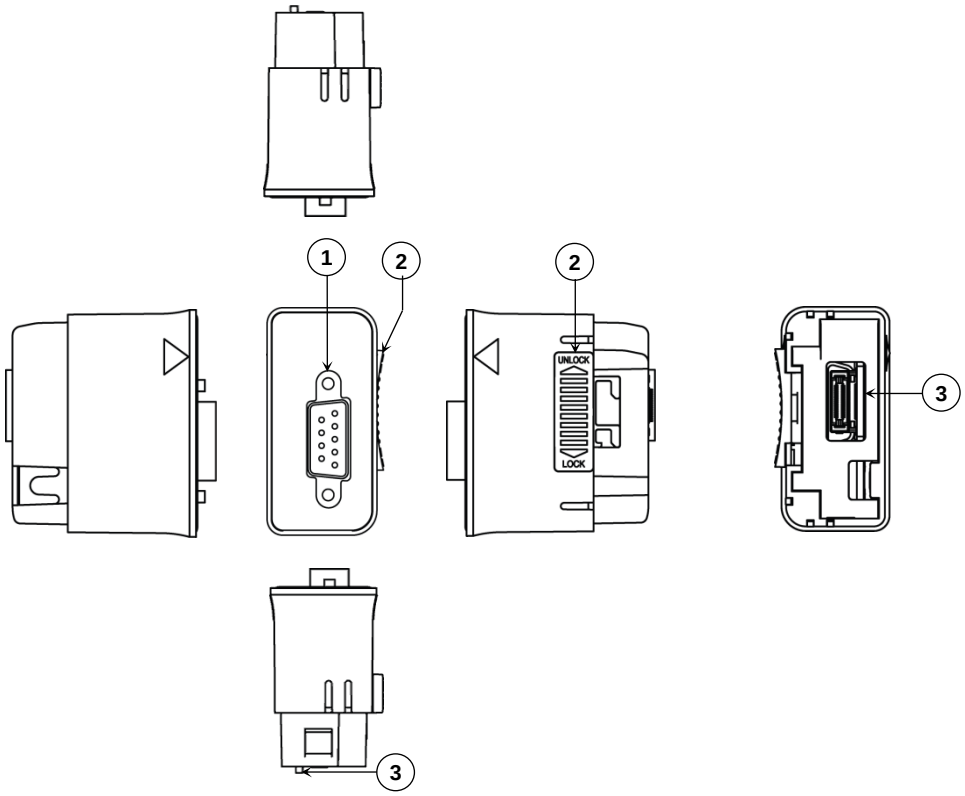


Figure 3: COM extension unit nomenclature

Parts Description

1. Connector for external communication interface
   - 9-pin D male connector for GC-232-COM
   - 5-pin removable terminal block for GC-422-COM
2. Locking clip
3. Interface connector

NOTE

Nomenclature details in Figure 3 show GC-RS232-COM extension unit. Similar plastic enclosure is used for other COM extension units like GC-RS422-COM, but with different external communication interface connector.

1.2.4 Main Unit with Extension Units

User can attach up to 2 I/O extension units and 1 COM extension unit on the back side of Main unit. The figure below shows all the views of Main unit attached with 2 I/O extension units and 1 COM extension unit with part names.

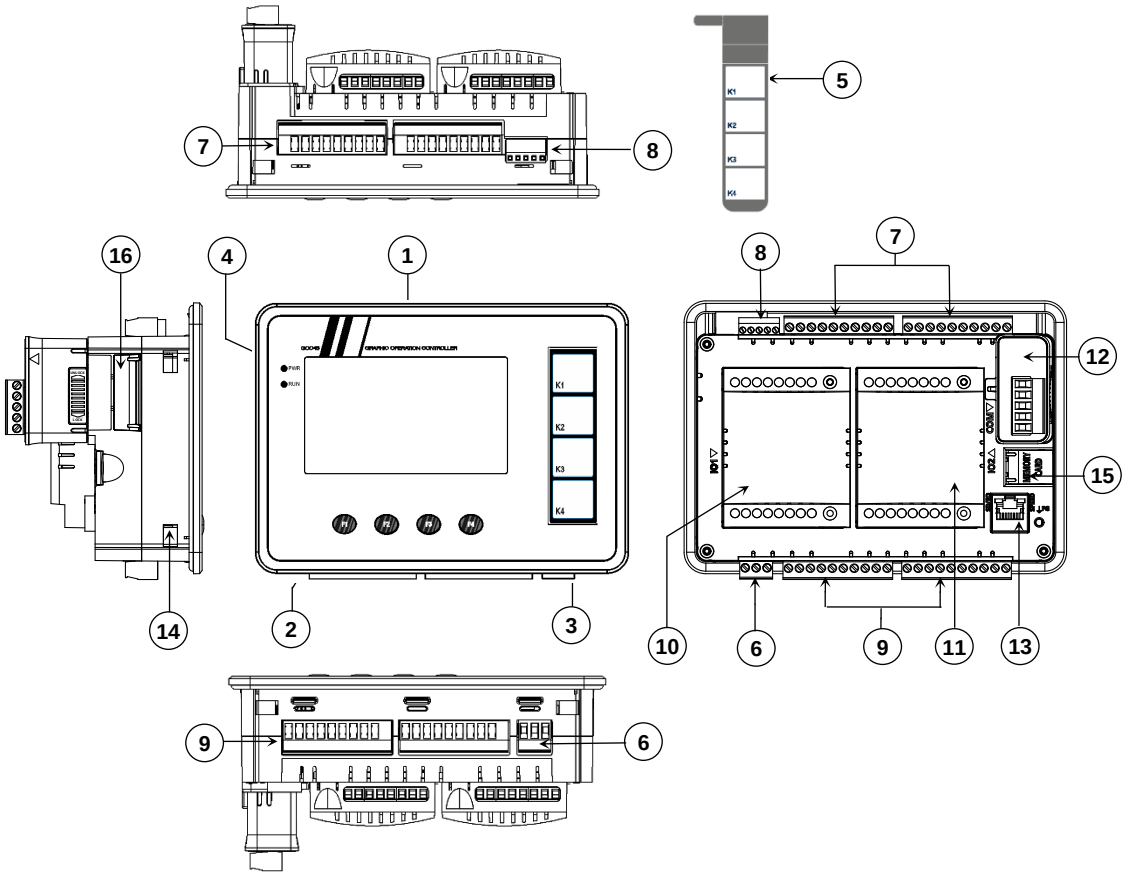


Figure 4: Main unit nomenclature with extension units

Parts Description

1. 4.3", 480 x 272 pixels, Touch graphics LCD
2. 4 Function keys [F1 to F4]
3. 4 Illuminated keys [K1 to K4]
4. LED indications [PWR, RUN]
5. Slide-in label
6. 3-pin terminal block [+24VDC, 0V, Earth]
7. 2 nos., 10-pins terminal block [Digital Inputs]
8. 1 no., 5-pin terminal block [Analog V/I Inputs]
9. 2 nos., 10-pins terminal block [Transistor/ Relay Outputs]
10. IO Extension 1
11. IO Extension 2
12. COM Extension
13. Ethernet port
14. Cut-out for mounting clamp
15. MicroSD card slot with door
16. USB port with door

Ensure that slot covers are fixed for unused slots of I/O extension/s as well as COM extension. Uncovered slots will expose interface connectors to external environment.

1.3 Ordering Information

Ordering Code	Ordering Description	Details
Main Units		
GC43MH-32MR-D	GOC- MAIN, 16DI+16RL, 500mA+2CH AI V/I	4.3” Touch Screen, 16 Pt. 24 VDC Digital Input, sink/source + 16 Pt. Relay Output, 500mA per output, 220 VAC/30 VDC + 2 Pt. Analog Input Voltage/ Current Horizontal model
GC43MH-32MT-DSS	GOC- MAIN, 16DI+16DO, SOURCE, 300mA+2CH AI V/I	4.3” Touch Screen, 16 Pt. 24 VDC Digital Input, sink/source + 16 Pt. 24 VDC Transistor Output, Source type, 300mA per output + 2 Pt. Analog Input Voltage/ Current Horizontal model
GC43MH-16MR-D	GOC- MAIN, 8DI+8RL, 500mA+2CH AI V/I	4.3” Touch Screen, 8 Pt. 24 VDC Digital Input, sink/source + 8 Pt. Relay Output, 500mA per output, 220 VAC/30 VDC + 2 Pt. Analog Input Voltage/ Current Horizontal model
GC43MH-16MT-DSS	GOC- MAIN, 8DI+8DO, SOURCE, 300mA+2CH AI V/I	4.3” Touch Screen, 8 Pt. 24 VDC Digital Input, sink/source + 8 Pt. 24 VDC Transistor Output, Source type, 300mA per output + 2 Pt. Analog Input Voltage/ Current Horizontal model
COM Extension Units		
GC-RS232-COM	GOC COM EXT PORT RS232 SERIAL	1 Port RS232 Serial
GC-RS422-COM	GOC COM EXT PORT RS422/485 SERIAL	1 Port RS422/485 Serial

Ordering Information…

Ordering Code	Ordering Description	Details
IO Extension Units		
GC-8EX-ES	GOC EXT DI 8DC IP, 24VDC	8 Pt. 24 VDC Digital Input, sink/source
GC-6EYR-ES	GOC EXT DO 6RL OP, 500mA, 30VDC/ 250VAC	6 Pt. Relay Output, 500mA per output, 30 VDC/ 250 VAC
GC-8ET-ESS	GOC EXT 4DC IP, 4DC OP SOURCE, 1.5A	4 Pt. 24 VDC Digital Input, sink/source + 4 Pt. 24 VDC Transistor Output, Source type, 1.5A per output
GC-4UAD-16	GOC EXT AI 4CH AIP, V/ I/ Tc/ PT, 16BITS	4 Ch. Universal Analog Voltage/Current/ Thermocouple/ PT100/ PT1000 Input, 16-bit
GC-4DA-12	GOC EXT AO 4CH AOP, V/I ,12BITS	4 Ch. Analog Voltage/Current Output, 12-bit
GC-2DA-12	GOC EXT AO 2CH AOP, V/I ,12BITS	2 Ch. Analog Voltage/Current Output, 12-bit
GC-1DA-12	GOC EXT AO 1CH AOP, V/I ,12BITS	1 Ch. Analog Voltage/Current Output, 12-bit
GC-4A-12	GOC EXT MIX 2CHAI 16BIT 2CHAO 12BIT V/I	2 Ch. Analog Voltage/ Current Input, 16-bit + 2 Ch. Analog Voltage/ Current Output, 12-bit
GC-4UAD-10*	GOC EXT AI 4CH AIP, V/I,10BITS, PT100	4 Ch. Universal Analog Voltage/Current/ PT100 (-50 to 150^{0}C) Input, 10-bit
GC-4UAD-10E*	GOC EXT AI 4CH AIP, V/ I/ PT, 10BITS	4 Ch. Universal Analog Voltage/Current/ PT100 (-50 to 450^{0}C) Input, 10-bit
GC-MODEM-40	GOC EXT GSM, GPRS, LTE, GPS 4G MODEM	4G LTE MODEM with GSM, GPRS, GPS enabled extension unit
Miscellaneous Items		
GC-10TB	TERMINAL BLOCK 10PIN I/O, FEMALE	10-pin female I/O Terminal Block
GC-3TB	TERMINAL BLOCK 3 PIN, PSU, FEMALE	3-pin female PSU Connector
GC-5ATB	TERMINAL BLOCK 5 PIN, ANALOG, FEMALE	5-pin female Analog Input Connector
GC-5TB	TERMINAL BLOCK 5 PIN, RS422/ RS485, FEMALE	5-pin female RS422/485 Connector

* GC-4UAD-10 and GC-4UAD-10E offers 12-bit resolution when used with GOC43 and offers 10-bit resolution when used with GOC35.

1.4 General Specifications

Item		Description
Power supply	Input voltage	24 VDC (18 to 30 VDC) 413 mA, 9.9 Watt.
	Inrush current	23 Amps maximum for 10 ms duration
	Fuse protection	Fuse protection T3.15A, 250V, Type 372
	Reverse polarity	Protected by series diode up to 40 V
Operating temperature		0 to 55 °C
Transport temperature		-40 to 70 °C
Storage temperature		-40 to 70 °C
Humidity		**Operating:** 10 to 95 % RH, No condensation | **Storage:** 10 to 95 % RH, No condensation
Altitude		2000 m or less
Operating atmosphere		Corrosive gases must not be present
Dimensions (W x H x D) in mm		**Main unit: Front panel:** 177.0 (W) x 127.8 (H) x 4 (D) **Rear side:** 164.6 (W) x 105.6 (H) x 49.2(D)
		I/O extension unit: 61.5 (W) x 75 (H) x 24.5 (D)
		COM extension unit : 26.0 (W) x 51.0 (H) x 42.2 (D)
10-pin and 3-pin terminal block	I/O wires	0.5 to 1 mm² copper, stranded (flexible) or solid wire
	Termination lugs	For 0.5 to 1 mm² wire, insertion length 6 mm
	Suggested tool	Flat blade screwdriver 3 mm wide, 0.4 mm thick
5-pin terminal block	I/O wires	0.5 to 1.5 mm² copper, stranded (flexible) or solid wire
	Termination lugs	For 0.5 to 1.5 mm² wire, insertion length 6 mm
	Suggested tool	Flat blade screwdriver 1.6 mm wide, 0.4 mm thick

1.5 Approvals: EU Directives and Standards

1.5.1 EMC Directives

Item		Description
Approvals		CE
EMC – Directives 2014/30/EU	EN 61131-2	Programmable logic controllers Part 2: Guidance for inspection and routine testing
	EN IEC 61000-6-2	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity standard for industrial environments
	EN IEC 61000-6-4	Electromagnetic compatibility (EMC) Part 6-4: Generic standards - Emissions standard for industrial environments

1.5.2 Requirements for Immunity to Disturbances

Immunity	Testing performed per standard:	Requirements per standard:	
		EN 61131-2 [1]	EN IEC 61000-6-2 [2]
Electrostatic discharge (ESD)	EN 61000-4-2	✓	✓
Radiated RF Electromagnetic Field Immunity	EN IEC 61000-4-3	✓	✓
Electric Fast transient/ Burst Immunity	EN 61000-4-4	✓	✓
Surge voltages (Surge)	EN 61000-4-5	✓	✓
Conducted Radio Frequency Immunity	EN 61000-4-6	✓	✓
Power Frequency Magnetic Fields Immunity	EN 61000-4-8	✓	✓
Voltage (Short) Interruptions	EN 61000-4-29	✓	--
Voltage Dips	EN 61000-4-29	--	--

1) EN 61131-2: Product standard - Programmable logic controllers
2) EN IEC 61000-6-2: Generic standard - Immunity for industrial environments

Criteria to prove the performance of a PLC system against EMC disturbances.

Criteria	During test	After test
A	The PLC system shall continue to operate as intended. No loss of function or performance.	The PLC system shall continue to operate as intended.
B	Degradation of performance accepted. The operating mode is not permitted to change. Irreversible loss of stored data is not permitted.	The PLC system shall continue to operate as intended. Temporary degradation of performance must be self-recoverable.
C	Loss of functions accepted, but no destruction of hardware or software (program or data)	The PLC system shall continue to operate as intended automatically, after manual restart or power off / power on.
D	Degradation or failure of functionality that can no longer be restored	PLC system permanently damaged or destroyed.

Electrostatic discharge (ESD)

Testing performed per standard: EN 61000-4-2	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Contact discharge (CD) to conductive accessible parts	±4 kV Criteria B	
Air discharge (AD) to insulating external parts	±8 kV Criteria B	

Radiated RF Electromagnetic Field Immunity

Testing performed per standard: EN IEC 61000-4-3	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Enclosure with wiring	80 MHz to 1000 MHz, 10 V/m 1400 MHz to 2000 MHz, 3 V/m 2000 MHz to 2700 MHz, 1 V/m Criteria A	

Electrical Fast Transient/ Burst (EFT/B) Immunity

Testing performed per standard: EN 61000-4-4	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Mains 24VDC	±2 kV / 5 kHz [1)] Criteria B	
Ethernet port, Serial port, Digital IOs, Analog IOs	±1 kV / 5 kHz [1)] Criteria A	

1) Only for connections with a permitted line length greater than 3 m.

Surge Immunity

Testing performed per standard: EN 61000-4-5	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Mains 24VDC	Differential Mode: ±0.5 kV [1)] Common Mode: ±1 kV Criteria B	Differential Mode: ±0.5 kV Common Mode: ±1 kV Criteria B
Shielded line of Ethernet port	±1 kV [1)] Criteria B	

1) Only for connections with a permitted line length greater than 30 m.

Conducted Radio Frequency Immunity

Testing performed per standard: EN 61000-4-6	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Mains 24VDC	10 V_{rms} 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	
Ethernet port, Serial port, Digital IOs, Analog IOs	10 V_{rms}[1)] 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	

1) Only for connections with a permitted line length greater than 3 m.

Power Frequency Magnetic Fields Immunity

Testing performed per standard: EN 61000-4-8	Requirements per standard: EN 61131-2 / Zone B	Requirements per standard: EN IEC 61000-6-2
Enclosure with wiring	30 A/m 3 axes (x, y, z) 50/60 Hz[1)] Criteria A	

1) Main frequency as per manufacturer data.

Voltage (Short) Interruptions

Testing performed per standard: EN 61000-4-29	Requirements per standard: EN 61131-2 / Zone B
Mains 24VDC	0% residual voltage ≥10 ms (PS2) Criteria C

Voltage Dips

Testing performed per standard: EN 61000-4-29	
Mains 24VDC	40% residual voltage Criteria B
	70% residual voltage Criteria B

1.5.3 Emission Requirements

Phenomenon	Testing performed per standard:	Requirements per standard:	
		EN 61131-2 [1]	EN IEC 61000-6-4 [2]
Conducted emission (Emissions related to lines)	CISPR 11:2015+A2:2019 Clause 7.3 of CISPR 16-2-3	✓	✓
Radiated emissions	CISPR 11:2015+A2:2019 Clause 7.3 of CISPR 16-2-3	✓	✓

1) EN 61131-2: Product standard - Programmable logic controllers

2) EN IEC 61000-6-4: Generic standards - Emission standard for industrial environments

Conducted Emission

Testing performed per standard: EN IEC 61000-6-4	Limit values per standard: EN 61131-2 / Zone B
Mains 24VDC	150 kHz to 5 MHz 89 to 83 dB (µV) quasi-peak value 76 to 70 dB (µV) average value
	5 MHz to 30 MHz 83 dB (µV) quasi-peak value 70 dB (µV) average value

Testing performed per standard: CISPR 11:2015+A2:2019	Limit values per standard: EN 61131-2 / Zone B	Limit values per standard: EN IEC 61000-6-4
Ethernet port	150 kHz to 500 kHz 97 to 87 dB (µV) quasi-peak value 84 to 74 dB (µV) average value	
	500 kHz to 30 MHz 87 dB (µV) quasi-peak value 74 dB (µV) average value	

Radiated emissions

Testing performed per standard: CISPR 11:2015+A2:2019	Limit values per standard: IEC 61131-2 / Zone B	Limit values per standard: EN IEC 61000-6-4
Electric field / Measured from 3 m 30 MHz to 1 GHz	30 to 230 MHz 50 dB (µV/m) quasi-peak value	
	230 MHz to 1 GHz 57 dB (µV/m) quasi-peak value	

1.5.4 Mechanical Conditions

Vibration test

Testing performed per standard: IEC 60068-2-6	Limit values per standard: EN 61131-2	
Vibration test	**Frequency**	**Amplitude**
	5 to 8.4 Hz[1)]	Constant displacement: 3.5 mm_{peak}[1)]
	8.4 to 150 Hz[1)]	Constant acceleration 10 m/s^2_{peak}[1)]

1) In all 3 axes (x, y, z); Sweeping rate of 1 octave per minute with ±10%.

Shock test

Testing performed per standard: IEC 60068-2-27	Requirements per standard: EN 61131-2
Shock test	Acceleration 150 m/s^2 peak[1)] Duration 11 ms, 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z).

Free fall withstand test

Testing performed per standard: IEC 60068-2-32	Requirements per standard: EN 61131-2 with product packaging	
Free fall withstand test	Weight	Height
	<10kg	0.3 m
	10 to 40 kg	0.3 m
	>40 kg	0.25 m
	5 attempts	

1.5.5 Electrical Safety

Over voltage category

Requirement per standard: EN 61131-2	
Overvoltage category	OVC II

Pollution degree

Requirement per standard: EN 61131-2	
Pollution degree	PD2 (only non-conductive pollution)

IP rating

Requirement per standard: EN 61131-2	
IP rating	IP65 from front
	IP20 from rear side

1.5.6 Overview of Standards

Standard	Description
EN 55011 (CISPR 11)	Industrial, scientific, and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement
IEC 60068-2-6	Environmental testing Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
IEC 60068-2-27	Environmental testing Part 2-27: Tests - Test Ea and guidance: Shock
IEC 60068-2-32	Environmental testing Part 2-32: Tests - Procedure 1: Free fall
EN 61000-4-2	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN IEC 61000-4-3	Electromagnetic compatibility (EMC) Part 4-3: Testing and measurement techniques - Radiated, radio frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5	Electromagnetic compatibility (EMC) Part 4-5: Testing and measuring techniques - Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8	Electromagnetic compatibility (EMC) Part 4-8: Testing and measuring techniques - Power frequency magnetic field immunity test
EN 61000-4-29	Electromagnetic compatibility (EMC) Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions, and voltage variations on DC input power port immunity tests
EN IEC 61000-6-2	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity standard for industrial environments
EN IEC 61000-6-4	Electromagnetic compatibility (EMC) Part 6-4: Generic standards - Emission standard for industrial environments
EN 61131-2	Programmable logic controllers Part 2: Guidance for inspection and routine testing

1.6 Technical Specifications

This section provides CPU specifications covering system specifications.

Item	Description
Execution time	**BOOL**: 0.9 µsec **BYTE/ WORD/ DWORD/ REAL Move**: 0.9 / 0.9 / 1.0 / 1.0 µsec
Number of I/O points	Main unit: up to 32 digital I/Os + 2 analog I/Os. Can be extended up to 48 digital I/Os using I/O extension units. Digital I/O status indication on graphical LCD.
Extensions units	Up to 2 I/O extension units and 1 COM extension unit
Marker memory	32 Kbytes
Data memory	2 Mbytes
Retain memory	4 Kbytes Stored in FRAM type of memory. **Battery free operation**.
Program memory	64 Mbytes flash includes - Application program code (8 Mbytes maximum), - Application program source code, - Application data (Visualization fonts, images, text lists, other system files, etc.)
Tasks supported	3 tasks 1. MainTask (Cyclic task) 2. Visu_Task (Freewheeling task) 3. User Defined (Cyclic)
Application program security	Password protection supported for - Project file - Source code upload
Timers	Number of instances (TON, TOFF, TP) can be called. Limited by available data memory only. *1
Counter	Number of instances (CTU, CTD, CTUD) can be called. (Limited by available data memory only) *1

Technical specifications…

Item		Description
Timers		Number of instances (TON, TOFF, TP) can be called. Limited by available data memory only. *1
Counter		Number of instances (CTU, CTD, CTUD) can be called. (Limited by available data memory only) *1
Real Time Clock		Onboard
		Super capacitor backup: 2 weeks duration nominal at 25°C ambient
		Max error: ± 2 Secs max per day
Special functionality for digital inputs on Main unit (User configurable)		Single phase counter: 20 KHz – Up to 2 Counter0: I00 Counter3: I03
		Encoder (A, B, Z) interfaces: 10 KHz – Up to 2 Encoder1: I00 (A), I01(B), I02(Z) Encoder3: I03 (A), I04(B), I05(Z)
Operating modes		RUN, STOP
HMI *2	Display	4.3", 480 x 272 pixels, TFT Touch graphics LCD, 64K Color View size: 95.04 x 53.86 in mm
	Keypad	4 Function keys (F1 to F4) for system settings, diagnostics, alarms and to monitor IOs
	Illuminated keys	4 illuminated keys, with dual colored LED (Red, Green)
	Slide-in label	Insertable label over illuminated keys
Alarm configuration		Refer to Alarm Configuration
Recipe		Refer to Recipe Management
Ethernet port		
Physical layer		10/100 Base-TX
Connector type		RJ45 female, shielded
Auto crossover		Yes
Cable type		Category 5e or higher STP (Shielded Twisted Pair)
Max. cable distance		100 meters
Diagnostics		Green and Yellow LEDs (On RJ45 connector)
Isolation		1500 Vac / 1 minute
Protocols supported		▪ Modbus TCP Slave ▪ Modbus TCP Master (can connect to 8 slave devices maximum*) ▪ CC-Link IE Field Basic master *3 (can connect to 4 occupied stations maximum*)
No. of simultaneous connections supported		8 maximum for all the protocols configured

*1 FB instance can be declared retentive and entire instance data is retained. (Limited by available retentive memory)

*2 Even though, maximum 64 user defined screens are allowed, it is limited by program memory.

*3 FB library GOC43 CCB.lib supports CC-Link IE Field Basic Master functionality. Refer “GOC43 CCB FB Library user manual” for more detail.

Technical specifications…

Item	Description
Programming	
Port	Built-in Ethernet port
Software	Windows® based GOC Toolkit V3 consisting of CoDeSys version 3.5
Standard	IEC 61131-3
Languages	IL, LD, FBD, SFC, ST, CFC
Debugging and Online Monitoring	Visualization, Forcing, Writing for PLC variables, Watch windows
Online change	Not supported
Offline simulation	Supported for PLC logic only. Not supported for visualization screens
Memory Card	
Type	Micro SD Card
SD Card standard	SDHC
Speed Class Supported	Class 4 (4MB/S), Class 6 (6MB/S), Class 10 (10MB/S)
Memory Capacity	2 to 32GB
File System	FAT32
SD Card Dimensions (D x H x W) in mm	11 x 15 x 1.0
Backup and Restore via SD memory Card	
Applicable for	Boot project and source code
Password protecion	User configurable
Data logging using SD memory Card	
Refer to Data logging	

NOTE

Firmware download is possible on the field by MEI authorized personnel only using PC based tool via USB port. Micro size slide switch is provided near USB port. When slide switch position is towards top side of unit and unit power is turned on, unit is put in firmware download mode. In such case, RUN LED indication is turned off.

NOTE

Before using SD memory card in GOC43, format SD card using ‘SD Memory Card Formatter’ by SD Association. Use format option as ‘FULL(Erase) FORMAT, FORMAT SIZE ADJUSTMENT OFF’.

NOTE

Refer document “N18006AAMH07 GOC43 Version Compatibility” for more details of version compatibility of firmware, hardware and GOC Toolkit V3.

2 Installation and Wiring

This chapter discusses about installation and wiring of Main unit, IO extension unit and COM extension unit. It also explains installation and removal of microSD card in the Main unit.

2.1 Dimensional Details

This section provides dimensional details of various parts of GOC43 such as Main unit, I/O extension unit and COM extension unit. These details help user during mounting of Main unit and extension units in the control panel.

2.1.1 Main Unit

The figure below shows all the views of Main unit with dimensional details. All dimensions are in mm.

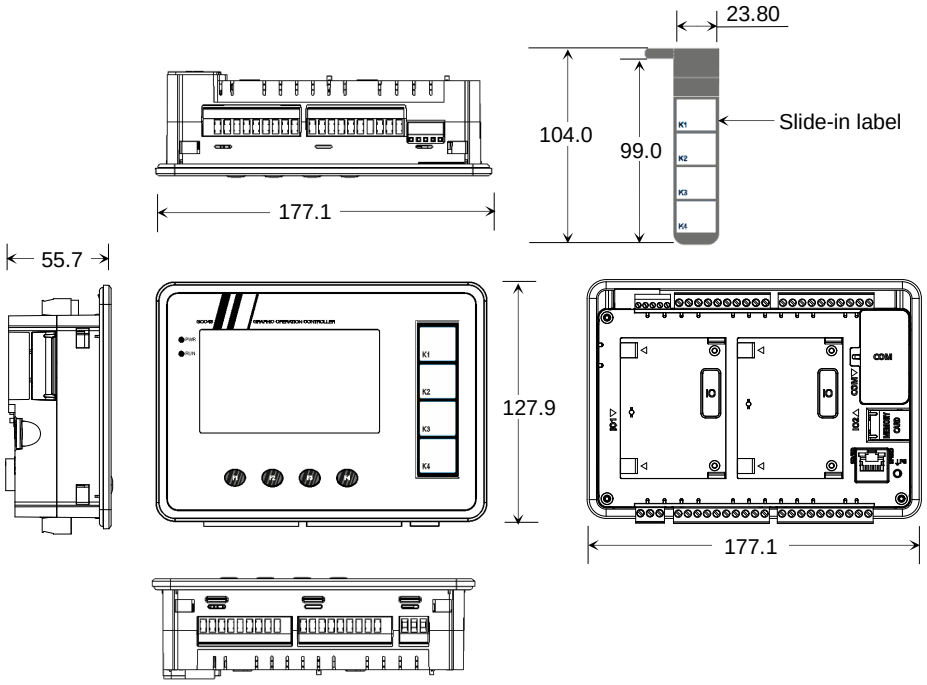


Figure 5: Main unit dimensions

2.1.2 I/O Extension Unit

User can attach up to 2 I/O extension units on the back side of Main unit. The figure below shows all the views of I/O extension unit with dimensional details. All the dimensions are in mm.

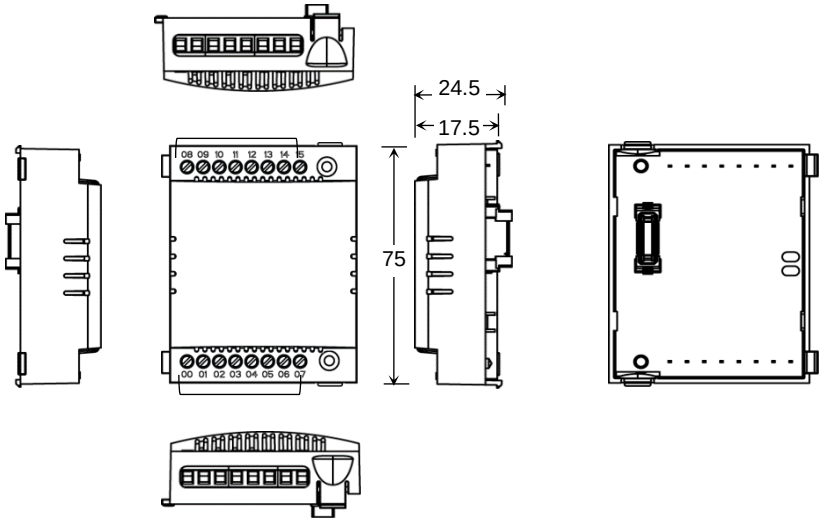


Figure 6: I/O extension unit dimensions

2.1.3 COM Extension Unit

User can attach 1 COM extension unit on the back side of Main unit. The figure below shows all the views of COM extension unit with dimensional details. All the dimensions are in mm.

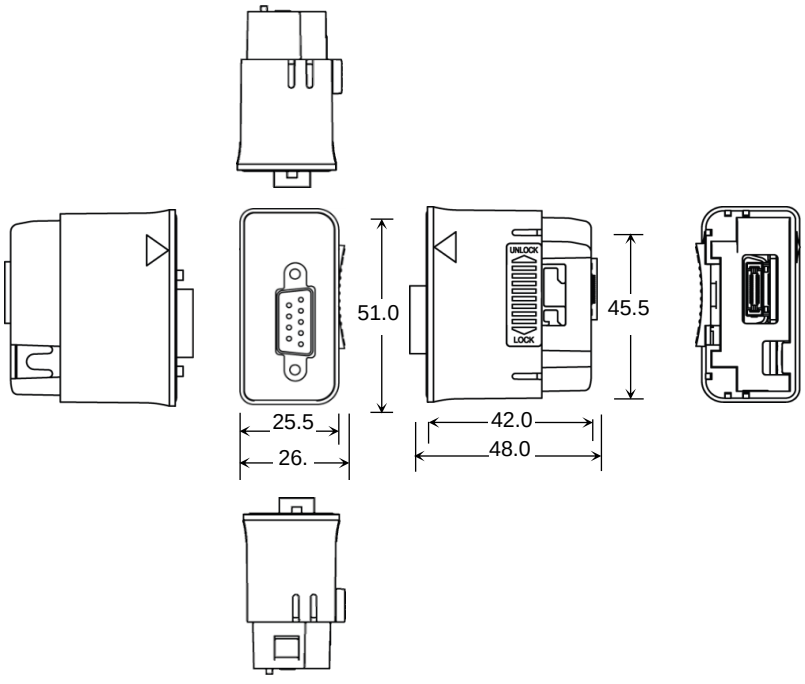


Figure 7: COM extension unit dimensions

NOTE

Dimensional details in Figure above shows GC-RS232-COM extension unit. Similar plastic enclosure is used for another COM extension unit GC-RS422-COM with different interface connector. So, there is minor change in dimensions due to connector used for communication interface.

2.1.4 Main Unit with Extension Units

User can attach up to 2 I/O extension units and 1 COM extension unit on the back side of Main unit. The figure below shows all the views of Main unit attached with 2 I/O extension units and 1 COM extension unit with dimensional details. All the dimensions are in mm.

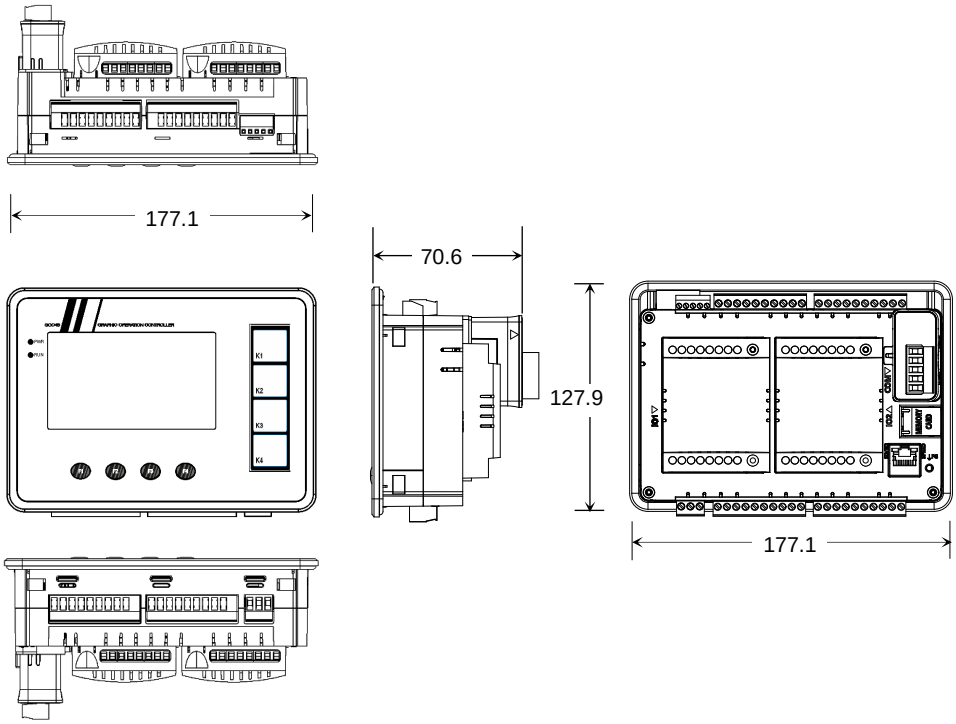


Figure 8: Main unit dimensions with extension units

2.2 Installation

This section provides recommendations and precautions to be observed during installation of various units of GOC43.

2.2.1 Installation Recommendations

GOC43 is a front panel mount controller. Install the controller in an environment conforming to the general specifications and installation recommendations and precautions.

The recommendations are as below.

1. Mount controller on a firm, plane and conducting surface. Installation in orientation other than recommended one (as shown in the adjescent figure below), may cause overheating, damage and malfunctioning of the controller.

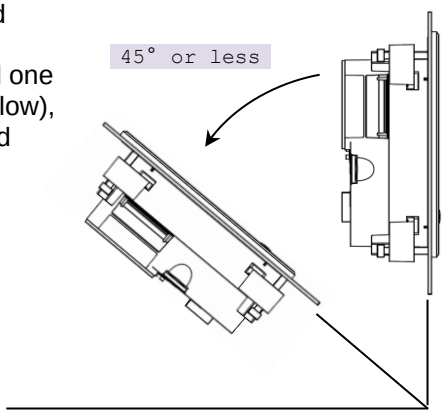


Figure 9: **Mounting orientation**

2. Mount controller on non-vibrating surfaces and should be protected if necessary by rubber pads so that the shock is not felt.
3. Mounting plate thickness should not exceed 4 mm.
4. Installation should take care of keeping free space considering depth of controller with COM extension unit installed on it i.e. 90 mm inclusive of additional space required for communication cable routing.

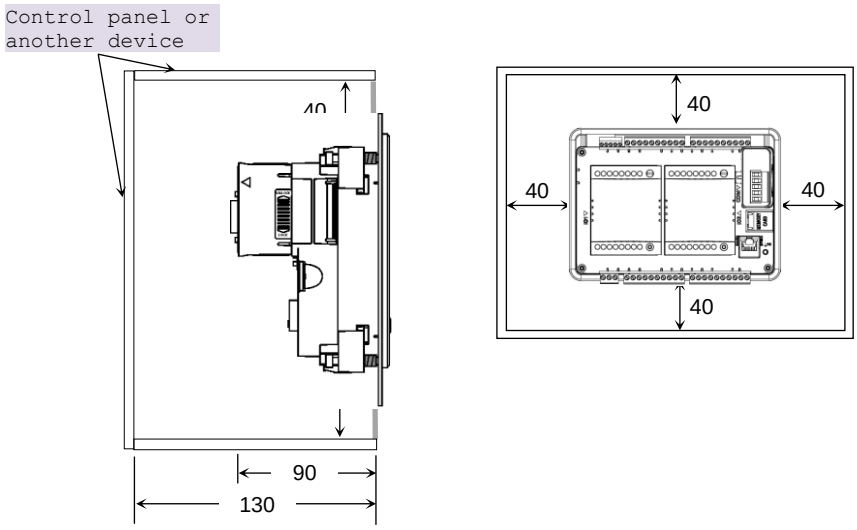


Figure 10: Mounting recommendations

5. Ensure the gap of 40 mm between controller and cabinet walls, other equipments and wiring duct.
6. Leave a minimum space of 40 mm around the Main unit to facilitate air circulation for heat transfer by natural convection and easy fixing and removal of unit.

2.2.2 Precautions to be Taken

This section lists out general precautions to be observed during installation.

1. Make sure to cut off all the phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product.
2. Back side of I/O extension unit is open. Do not remove I/O extension unit specially relay output extension unit with AC power connected. It may cause electric shock.
3. Maintain proper thermal distances between equipments producing heat (like heaters, transformers etc.) inside the control panel. Do not install controller immediately above such equipments.
4. Protect the controller from conductive dust, corrosive gases, wire debris, flammable gases, rain and fluid from entering into the controller through ventilation slits. This may cause malfunction, damage, fire, electrical shock and deterioration to the controller.

   Proper dust tight control panels, filters, rubber gaskets, etc. should be provided to minimize this problem.
5. The ambient temperature of the installation location should be between 0 to 55ºC. Cooling of the electrical and electronic components is accomplished by method of convection.
6. Exposure to humid environment for a long time can reduce component life. It may cause corrosion of electrical and electronic components, or may lead to shorts or malfunctions. Do not expose controller to humid atmosphere for an extended period.

7. Avoid controller exposure to excessive or continuous vibrations or shocks. Failure to do so may cause disengagement of PCB components, connectors, on-board soldered components, etc. from their counter positions.
8. Cover unused slots (IO and COM) by covers provided with Main unit to protect them against dust, moisture and ESD (Electric Static Discharge).
9. Use controller within the range of general and technical specifications.
10. Connect functional ground terminal properly. If not, product may susceptible to noise.
11. Connect protective earth to a good quality earth. If not, it may result in electric shock or errorneous operation.

2.2.3 Main Unit Installation

This section provides steps to mount Main unit on front panel as well as unmounting it.

Product packaging consists of

1. Main unit with all the terminal blocks attached

2. installation manual

3. mounting template

4. 4 mounting clamps

Before installation and removal, refer sections *Installation Recommendations and Precautions* to be observed. Failure to follow the recommendations and precautions to be observed may cause electric shock or damage to the product.

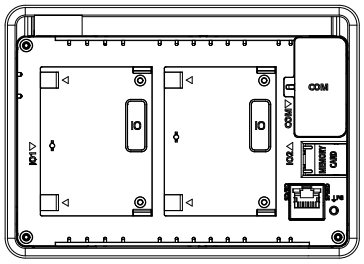
Mounting Main Unit

Follow the steps below to mount Main unit on front panel.

1. Prepare Main unit for mounting

   Detach all the terminal blocks (10-pin I/O terminal blocks, 3-pin power supply terminal block and 5-pin analog V/I input terminal block) from Main unit.

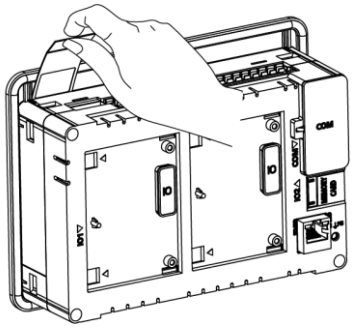
   Make sure that silicone rubber gasket on outer periphery of front panel backside is in place.



2. Insert slide-in label

   Main unit is provided with default slide-in label inserted. But user can remove it and insert customized label. Slit is provided to insert slide-in label. It is located at left top on the backside of Main unit.

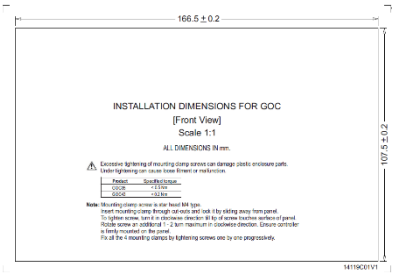
   See that top edge of slide-in label remains below groove of the gasket.



3. Make cut out in the control panel

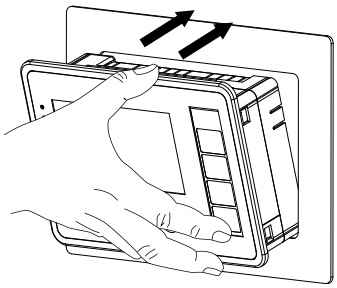
   Remove adhesive tapes provided at corners of backside of mounting template and stick the mounting template on front panel where Main unit is to be mounted. Mark 4 corners of the rectangular cut-out and make a cut out.

   Dimensions of cut out should be 166.5 X 107.5 mm minimum.



4. Insert Main unit through cut-out

   Insert Main unit from outside through cut out on panel. Hold Main unit by hand from outer side of the panel so that it will not fall during fitment of mounting clamps.

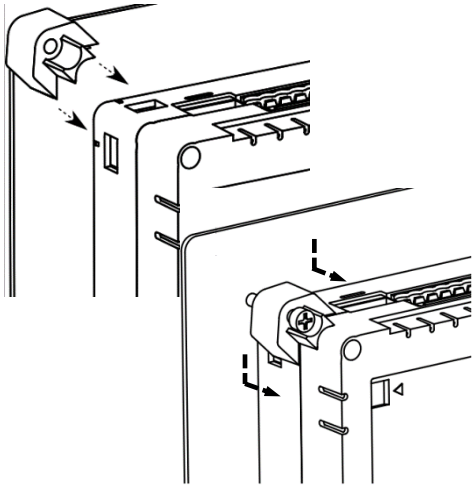


5. Attach mounting clamps

   Cut-outs are provided near each corner on back side of Main unit to insert mounting clamps.

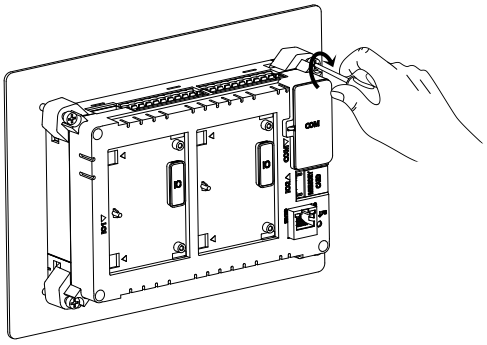
   Insert legs of clamp into matching cut-out.

   Then pull body of mounting clamp away from panel till it clicks and engage at corner of plastic enclosure as shown in adjacent figure.



6. Tighten mounting clamps

   Mounting clamp screw (M4 x 30 mm) head is of star type. Turn mounting clamp screw in clockwise direction till tip of screw slightly touches surface of panel. Rotate screw an additional 1 - 2 turns in clockwise direction and ensure controller is firmly mounted in the panel. Fix all the 4 mounting clamps by tightening screws one by one progressively.



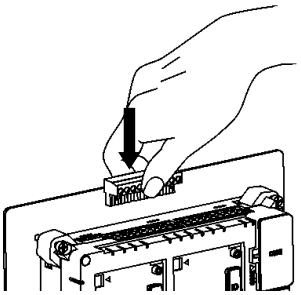
Tightening torque should not exceed 0.2 Nm.
Excessive tightening can damage plastic enclosure parts.
Under tightening can cause loose fitment or malfunction.

7. Insert terminal blocks

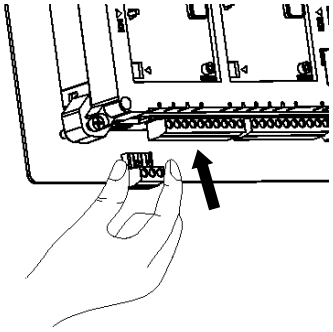
   Insert 10-pin input terminal blocks/s at upper side.

   Insert 5-pin analog V/I input terminal block at upper side.

   Insert 10-pin output terminal block/s at lower side.



8. Insert 3-pin power supply terminal block.



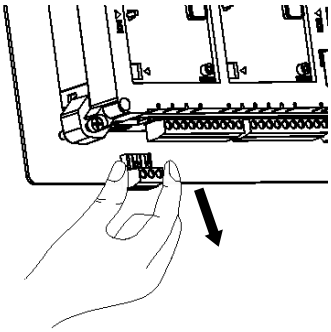
Unmounting of Main Unit

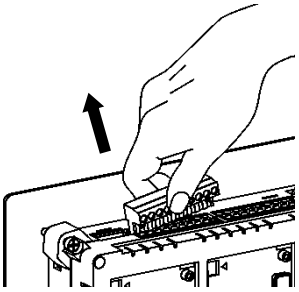
Follow the steps below to unmount Main unit from front panel. Preparation for unmounting of Main unit is as,

Donot forget Cut off all the phases of the power supply to the control panel.

1. Remove 3 pin power supply terminal block.

   Remove all the I/O terminal blocks. For removal, pull terminal block from one side first. Once this part is out, remaining part can be pulled out easily.



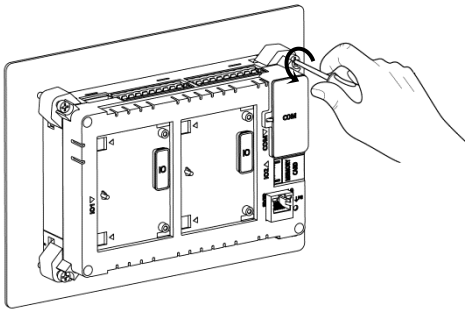


2. Turn mounting clamp screws in anti-clockwise direction to loosen it one by one.

   Push body of clamp towards panel to disengage it from the cut-outs on the Main unit.

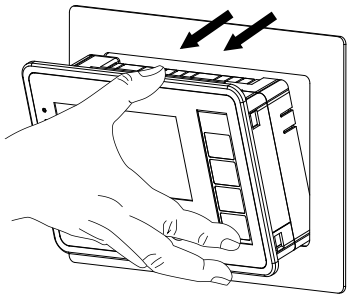
   Take moulting clamps off the Main unit.

   Hold Main unit from front side with one hand while untightening of the clamps.



3. Removal of Main unit

   After removing all mounting clamps, hold and pull-out unit from front side, through the cut out.



2.2.4 I/O Extension Unit Installation

User can attach up to 2 I/O extension units on the back side of Main unit and extend no. of I/Os as per application requirement. This unit is optional and should be procured separately. This section explains mounting and unmounting of I/O extension unit.

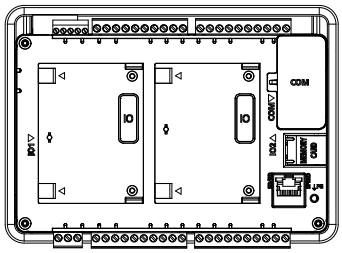
Product packaging consists of I/O extension unit, installation manual and 2 self-tapping screws (M3 x 10 mm) for fixing I/O extension unit on Main unit.

> Before installation and removal, refer sections *Installation Recommendations* and *Precautions to be observed*. Failure to follow recommendations and precautions to be observed may cause electric shock or damage to the product.

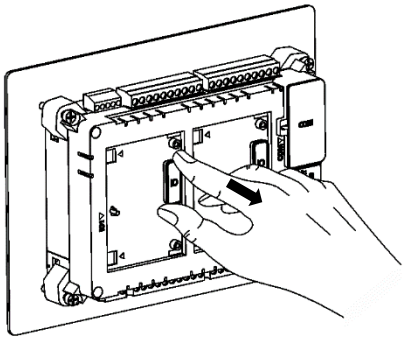
Mounting of I/O Extension Unit

1. Prepare Main unit for mounting I/O extension unit.

   Main unit is provided with slot covers fixed on IO interface connectors and COM interface connector.

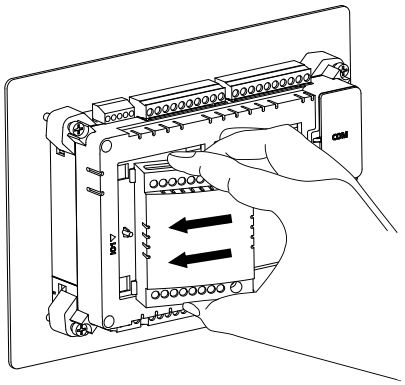


   Remove interface connector cover on IO slot interface connector on Main unit.

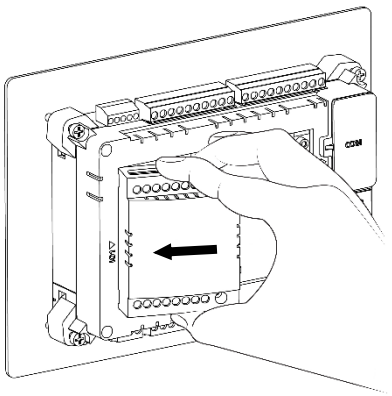


2. Fixing I/O extension unit

   Hold I/O extension unit between thumb and pointing finger with latches on left side. Ensure that left side part of unit is tilted towards Main unit by 30 degrees approximately. Otherwise, its backside will obstruct projection provided at left side of slot area.



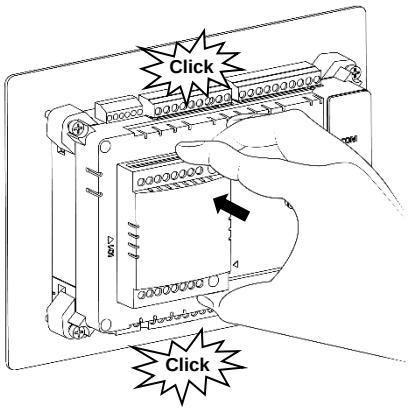
   Insert both latches in respective openings on left side of desired IO slot (IO1/IO2) on Main unit and slide unit to left to insert latches completely inside openings.



   Push right side part of I/O extension unit towards Main unit till unit interface connector gets engaged with its male counterpart on Main unit.

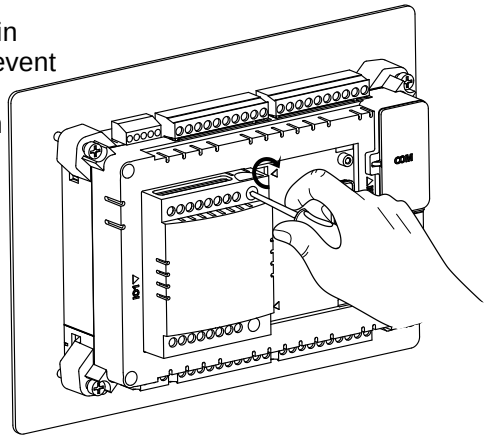
   Projection provided on slot area on Main unit is accommodated through the oval shaped hole on PCB.

   Then push right side further gently till both the unit clips are clicked.



3. Tighten self-tapping screws

   Insert self-tapping screws (M3 x 10 mm, dispatched along with I/O extension unit) in unit fixing screw holes and tighten it to prevent effect of vibrations. Main unit mounted on slanted front panel may require fitting with screws.



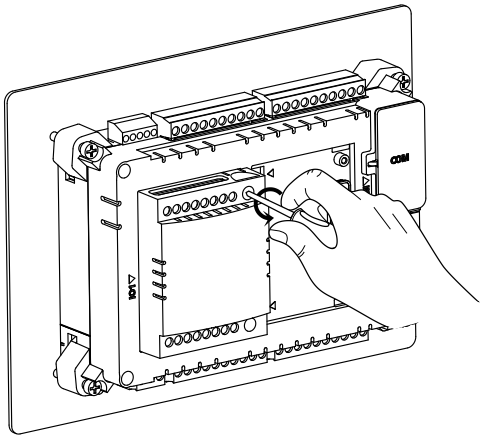
Do not use any other screw of different size to fix the I/O extension unit on Main unit. Incorrect handling and installation of I/O extension unit may cause malfunctioning and/or damage to the hardware.

Unmounting of I/O Extension Unit

Firstly, remove I/O wiring from I/O terminal blocks of Extension unit.

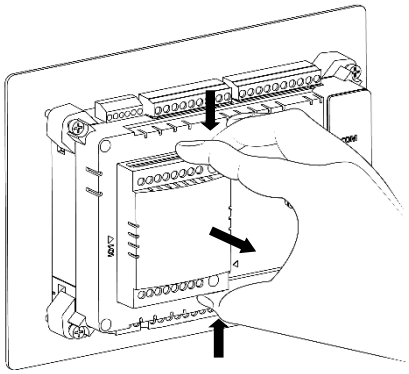
1. Un-tighten self-tapping screws.

   Untighten both mounting screws fully if already fitted. Do not try to pull out extension unit forcefully with tightened screws. It may cause damage to the hardware/ plastic enclosure.

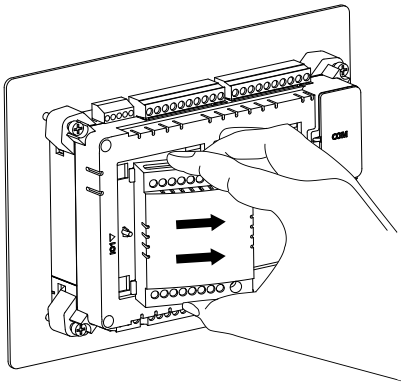


2. Removal of I/O extension unit

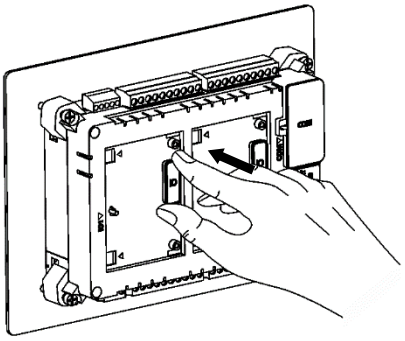
   Keep thumb on bottom clip and pointing finger on top clip. Push both I/O extension units clips inside so that they are unlocked from respective slot openings. Pull right side of I/O extension unit away from Main unit so that interface connector gets disengaged.



   Slide I/O extension unit towards right side such that both latches on left side come out of respective openings on left side of slot area. Lift I/O extension unit away from Main unit to take out from IO slot.



   Ensure that slot cover is fitted on interface connector of unused IO slot to protect it against dust, moisture and ESD (Electric Static Discharge).



2.2.5 COM Extension Unit Installation

User can attach 1 serial COM extension unit on the back side of Main unit and interface third party serial devices. This section explains mounting and unmounting of COM extension unit.

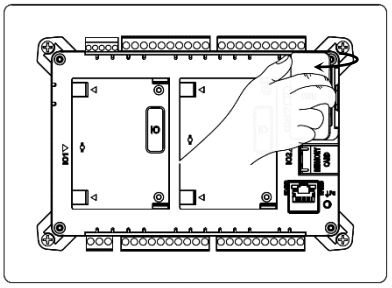
Product packaging consists of COM extension unit and installation manual. For GC-RS422-COM unit, 5-pin terminal block is attached to the unit.

> Before installation and removal, refer sections *Installation Recommendations* and *Precautions to be observed*. Failure to follow recommendations and precautions to be observed may cause electric shock or damage to the product.

Mounting of COM Extension Unit

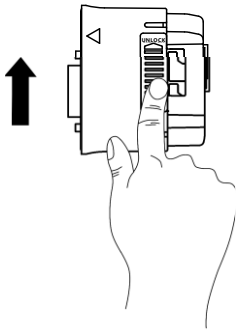
1. Prepare Main unit for fixing COM extension unit.

   Remove slot cover from Main unit. Cover remains attached on Main unit due to hinge on its left side.

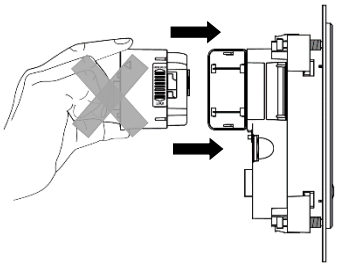


2. Prepare COM extension unit for fixing

   Make sure that locking clip on right side of COM extension unit is pushed upward completely before fixing it in the slot on Main unit.

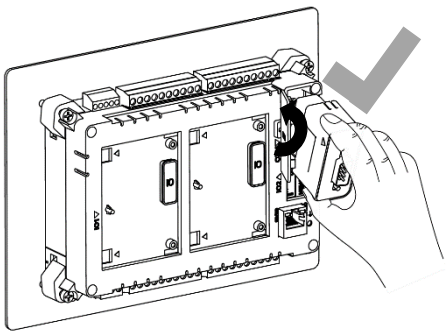


3. COM extension unit cannot be inserted in the COM slot with straight orientation.

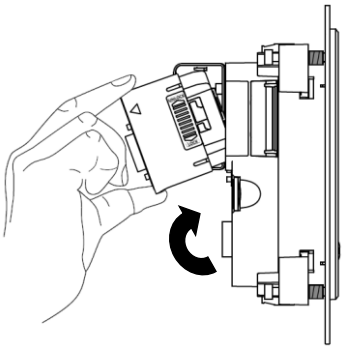


4. Insert COM extension unit in Main unit COM slot

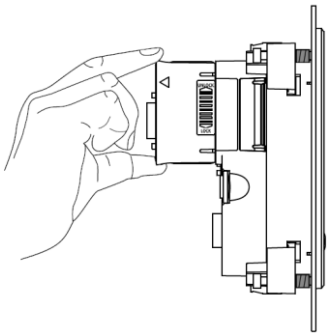
   Hold COM extension unit with thumb on bottom front edge and pointing finger on upper front edge with unit locking clip on right side. Hold it in tilted position such that bottom side gets inserted first.



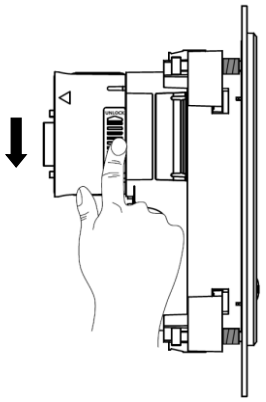
Firstly, insert bottom part of COM extension unit through slot



Then push upper part gently so that interface connector gets engaged with its male counterpart on Main unit.



Push unit locking clip downward fully so that COM extension unit is locked firmly on the Main unit. Failing to do so will cause loose connection and sudden removal of COM extension unit from the slot.



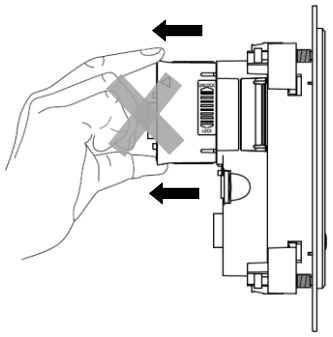
Incorrect handling and installation of COM extension unit may cause malfunctioning and/or damage to the hardware/plastic enclosure.

Unmounting of COM Extension Unit

5. Prepare COM extension unit for removal

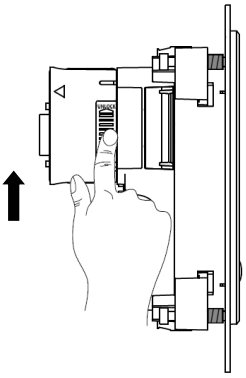
   Remove communication cable connected to COM extension unit.

   Do not try to pull COM extension unit with unit locking clip in downward position. It may cause damage to COM extension unit as well as Main unit

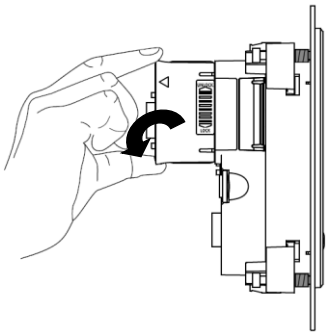


6. Unmounting of COM extension unit.

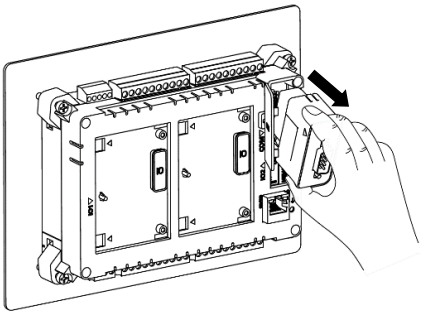
   Push unit locking clip upward fully first.



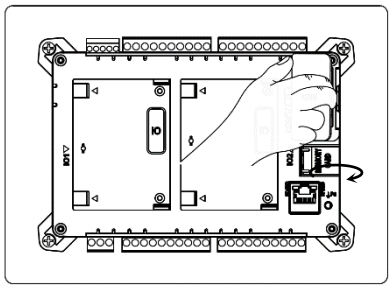
   Keep thumb on bottom edge of front and pointing finger on top edge of front. Pull upper part of unit, so that its interface connector gets disengaged from its counterpart on Main unit.



   Then take out unit out of the COM slot.



   Ensure that cover is fitted on interface connector of unused COM slot to protect it against dust, moisture and ESD (Electric Static Discharge).



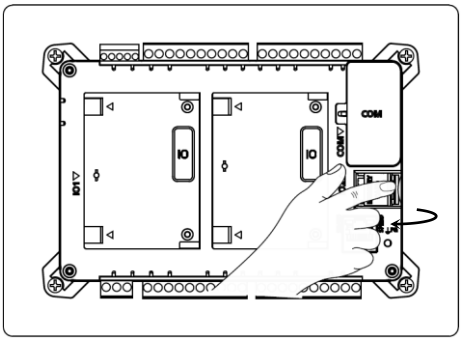
2.2.6 microSD Card Installation

All the Main units are equipped with a SD card slot located above RJ45 connector.

User can insert commercially available microSD card in this slot. Specifications of compatible microSD cards are mentioned in section *SD memory card* .

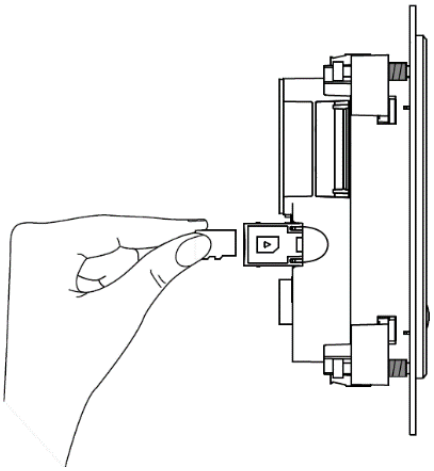
Insertion of microSD card

1. Open door marked as “MEMORY CARD” which covers microSD card slot on Main unit



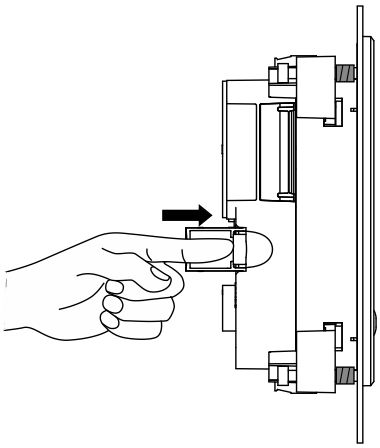
2. Inserting microSD card

   Insert microSD card in the slot and push inside. Ensure correct insertion direction of the card as shown in the adjacent figure and marked on door in open condition.



   The card makes a slight clicking sound when it is fully inserted

   After correct insertion, close the door. SD card is detected automatically.



Status can be monitored in system menu. Refer chapter *System menu*.

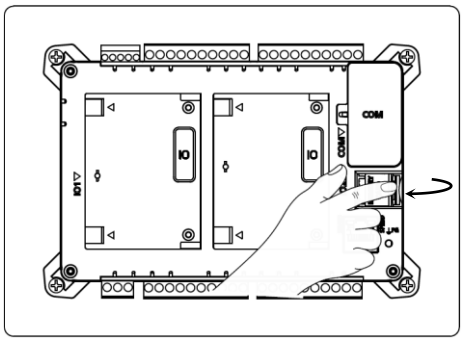
> Incorrect insertion of microSD card may cause malfunctioning and/or damage to the Main unit hardware or memory card itself.

Removal of microSD card

1. If you are removing SD card when Main unit is powered up, make sure that SD card is un-mounted first.

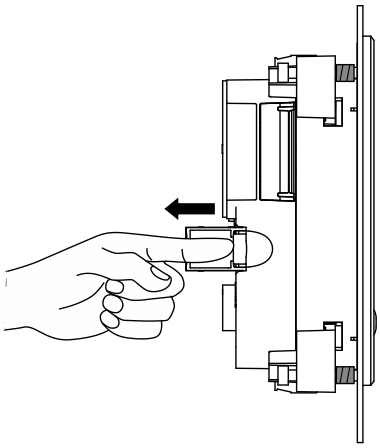
   Refer chapter '*System Menu*' for un-mounting procedure.

   Open door marked as "MEMORY CARD".



2. Gently push SD card inside till it makes clicking sound of unlock.

   Release finger after clicking sound.



3. microSD card comes out from card holder.

   Now microSD card can be pulled out easily.

Accidental removal of SD card before un-mounting may cause malfunctioning, loss of log data and/or damage to microSD card.

2.3 Wiring

This chapter provides recommendations and precautions to be observed during wiring of entire controller. GOC43 consists of Main unit, IO extension unit (optional) and COM extension unit (optional). For wiring of individual unit, refer subsequent chapters specific to individual unit type and model.

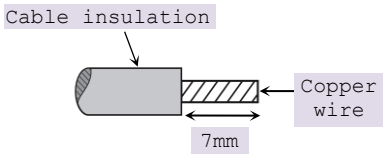
2.3.1 Recommendations

For 10-pin terminal block and 3-pin terminal block

Cable

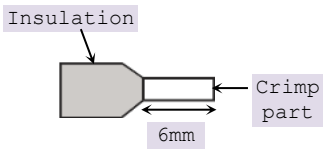
Terminal block pitch size is 5.08 mm.

Use stranded (flexible) or solid wire of size 0.5 to 1 mm² (AWG 22 to 18). Strip insulation of stranded wire and twist the strands to prevent it from spreading and crimp the lug.



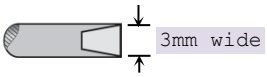
Lug

The adjacent figure shows recommended size of lug.

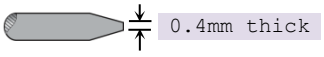


Screwdriver

Terminal block screw size is M3. For tightening terminal, use flat blade screwdriver. The figure shows desired size of screwdriver blade.



The tightening torque should not exceed 0.50 Nm.

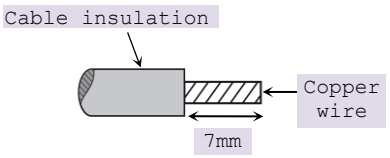


For 5-pin terminal block

Cable

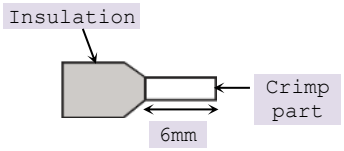
Terminal block pitch size is 3.81 mm.

Use stranded (flexible) or solid wire of size 0.5 to 1.5 mm² (AWG 28 to 16). Strip insulation of stranded wire and twist the strands to prevent it from spreading and crimp the lug.



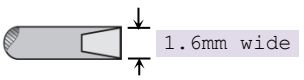
Lug

The adjacent figure shows recommended size of lug.

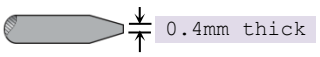


Screwdriver

Terminal block screw size is M2. For tightening terminal, use flat blade screwdriver. The figure shows desired size of screwdriver blade.



The tightening torque should not exceed 0.2 Nm.



2.3.2 Precautions to be Taken

1. Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product.
2. Do not use wire without lug. Do not solder-plate the wire ends.It may cause loose connection. Ensure that only one lug is connected to one terminal.
3. Ensure that size of wire and lug used are as per the specifications. Use screw driver with specified size of tip. Tightening torque should be as per the specifications.
4. Ensure the gap of 40 mm between controller and cabinet walls, other equipments and wiring duct This will help in natural cooling of controller and also easy mounting or unmounting of hardware.
5. Separate wiring by signal types. Bundle wiring with similar electrical characteristics together. Differnetiate wiring with different electrical characteristics by coloured insulations e.g. AC wiring and DC wiring
6. Make sure that there is a separate bundle and routing for input and output wires. Fix-up the wire bundle with support on panel so thatthere is no stress on wires and subsequently on unit. Ensure that bunch is routed properly and wires are not kept hanging.
7. Do not bundle 24 VDC I/O wires with main control panel wiring.
8. Do not bundle cable carrying low level signals like communication and analog signals with input output wiring and control panel wiring.
9. Generally, the I/O wiring length should not exceed 30 meters to ensure the safety. Route the input and output signal lines separately.
10. Ensure that length of wire that connects 24 VDC power supply to I/O unit is less than 3 meters. Locate 24 VDC power supply near to the controller.

It is recommended to twist power supply cable to minimize adverse effects of noise.

2.3.3 Guidelines for Earthing

1. Connect EARTH (Symbol) terminal directly to clean earth in the control panel avoiding ground loops.
2. Ensure Class D grounding. (Grounding resistance: 100 Ω or less)
3. Ground the controller independently. If it cannot be grounded independently, ground it jointly as shown below.

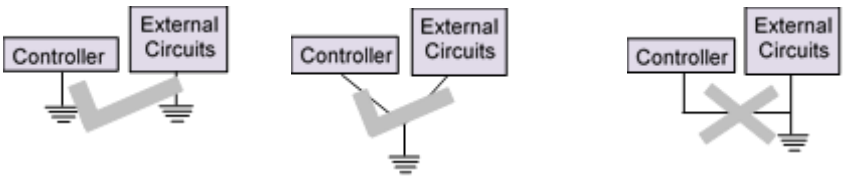


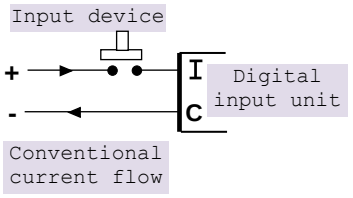
Figure 11: Unit Earthing

4. Ensure that EARTH cable is thick and short as far as possible to provide low impedance path.
5. If EARTH is not connected, it may result in electric shock or erroneous operation.

2.3.4 Digital Input Sink/Source Operation

The term sourcing and sinking applicable to digital input refers to the manner in which external input device is wired to digital input of unit.

Sink type of input connection (-ve common)

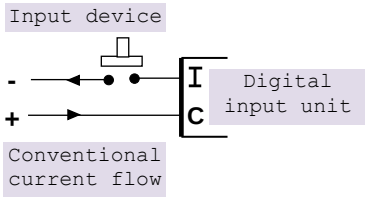


For this type of input connection, the ground of 24 Vdc supply is connected to common point on unit (C0, C1).

When external input device is active (push button pressed in adjacent figure), +24 Vdc is available at input terminal on unit.

External input device in active state supplies current to input circuit of unit. As unit is receiving current in this case, it is sink type.
Normally, PNP type of devices (e.g. proximity switches) are connected in this fashion.

Source type of input connection (+ve common)



For this type of input connection, the +24 Vdc supply is connected to common point on unit (C0, C1).

When external input device is active (push button pressed in adjacent figure), current flows through input circuit of unit and passes through external input device to ground of 24 Vdc supply. As unit is supplying current in this case, it is source type.

Normally, NPN type of devices (e.g. proximity switches) are connected in this fashion.

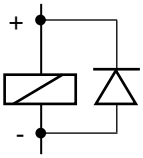
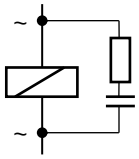
2.3.5 Guidelines for using Digital Outputs

Noise suppressors

It is extremely important to connect noise suppressors directly across any inductive load (relays, contactors, solenoid valves, etc.) irrespective of whether it is actuated by PLC output or actuated externally. The inductive load generates strong electrical noise that may affect PLC operation.

The noise suppressor should be mounted close to the load, as a rule, should not be away more than 0.5 meters. This helps in attenuating noise at the source it self.

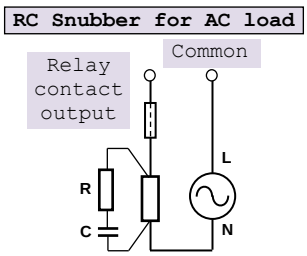
In case of resistive loads (incandescent lamps, LED lamps, heating resistors, etc.), It is not necessary to use noise suppressors.

Noise suppressor for DC devices	**Noise suppressor for AC devices**
DC operated devices are protected by diode connected a shown below 	AC operated devices are protected by RC snubber as shown below 

2.3.6 Guidelines for using Relay Outputs

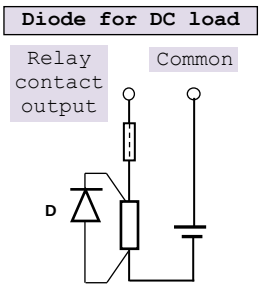
External fuse links or fused terminals are recommended for relay output wiring to avoid any burnout of internal copper tracks due to excessive current flow due to external short circuit, overload or inductive surges.

The life of relay contacts can be enhanced by the use of RC snubber (spark quenchers) across the AC load. A suggested combination for of the R and C could be R=220Ω/ Half watt and C=0.1 µF/1000 Volts.



For DC loads a free-wheeling diode such as 1N4007 should be used in reverse polarity to avoid effects of back EMFs generated by inductive load.

The diode and the snubber should be positioned and wired up as near as possible to the external load for maximum effect.



3 Main Unit

4 models of Main unit are available depending upon number of I/Os and type of outputs.

Main unit model	No. of inputs	No. of outputs	Type of output
GC43MH-32MT-DSS	16	16	Transistor (source)
GC43MH-32MR-D	16	16	Relay
GC43MH-16MT-DSS	8	8	Transistor (source)
GC43MH-16MR-D	8	8	Relay

3.1 I/O Specifications

This section provides specifications of digital inputs and outputs built in the Main unit.

3.1.1 Digital Input Specifications

Item	Description	
Number of inputs	16 for GC43MH-32MT-DSS, GC43MH-32MR-D 8 for GC43MH-16MT-DSS, GC43MH-16MR-D	
Voltage rating	24 VDC (18 to 30 VDC)	
Type	Sink or Source in group of 4, with one common per group	
ON voltage level	18 VDC minimum	
OFF voltage level	5 VDC maximum	
ON/ OFF Current	**ON current**: 6 mA at 24 VDC	**OFF current**: 2.5 mA maximum
Input impedance	5.1 KΩ Typically	
Transition delay	10 ms (Default filter time)	
Isolation between	Input and internal circuit	Optical 1.5 KV
	Groups	1.5 KV
	Individual input point	Nil
I/O terminal blocks [Removable, screw type]	Two 10-pin, GC43MH-32MT-DSS and GC43MH-32MR-D One 10-pin, GC43MH-16MT-DSS and GC43MH-16MR-D	

Digital input specifications…

Special functions of digital inputs (User configurable)				
Single phase counters (up to 2 nos.)	**Counter**	**Input**		
	Counter0	input I00		
	Counter3	input I03		
	Input frequency: 20 KHz maximum			
	Pulse ON/ OFF time: 20 µsec minimum			
Quadrature encoder (Up to 2 nos.)	**Encoder**	**A phase**	**B phase**	**Z marker**
	Encoder0	input I00	input I01	input I02
	Encoder3	input I03	input I04	input I05
	Input frequency: 10 KHz maximum (for individual phase)			
	Pulse ON / OFF time for A and B phase: 20 µsec minimum. **Pulse ON / OFF time for Z marker pulse:** 50 µsec minimum.			

3.1.2 Analog Input Specifications

Item	Description	
Number of input channels	2, non-isolated, 12 bits	
Input types and digital format	Voltage: 0 to 10VDC	Current: 0 to 20mA
	0 to 4000	0 to 4000
Resolution	2.5 mV	5 µA
Overall accuracy	± 0.4 at 25°C	± 1.5 at 25°C
	± 0.6 at 60°C	± 1.8 at 60°C
Input impedance	900 KΩ	260 Ω
Engineering scaling	Supported	
Absolute maximum input	± 30 VDC/ ± 30 mA	
Filter types	For **Digital filter**, Time constant: 50 ms (Default) Supported range: 10 to 5000 msec For **Averaging**, No. of averaging samples: 4(Default), 8, 16, 32	
Updation time	Refer section *Appendix → Updation Time for Analog Input*, in this manual	
Channel protection	PTC for over current up to 100 mA	
Isolation	No isolation.	
I/O terminal blocks [Removable, screw type]	One 5-pin, removable screw type	

3.1.3 Transistor Output (Source) Specifications

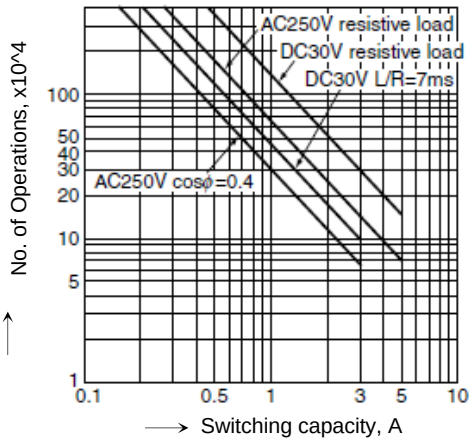
Item	Description	
Number of outputs	16 for GC43MH-32MT-DSS 8 for GC43MH-16MT-DSS	
Type of output	Transistor source type	
Voltage rating	24VDC (18 to 30 VDC)	
Current rating	0.3A per point 1 common per group of 8 outputs. Paralleling of outputs is possible in a group.	
On voltage drop	0.1 VDC maximum	
Off state leakage current	10 µA maximum	
Response time	**OFF to ON**	250 µs
	ON to OFF	300 µs
Isolation	Optical 1.5 KV between input and internal circuit	
Protection	Output short circuit protection	
	Fast demagnetization for inductive loads	
Load supply	24 VDC (18 to 30 VDC)	
	Reverse polarity protection	
I/O terminal blocks [Removable screw type]	Two 10-pin, GC43MH-32MT-DSS and GC43MH-32MR-D One 10-pin, GC43MH-16MT-DSS and GC43MH-16MR-D	

3.1.4 Relay Output Specifications

Item	Description	
Number of outputs	16 for GC43MH-32MR-D 8 for GC43MH-16MR-D	
Type of output	Non latching normally open (NO) contact Electro-mechanical relay	
Max. switching voltage	250 V (AC), 110 V (DC) (0.4 A)	
Max. switching current	5 A (AC, DC)	
Minimum load	1 mA	
Contact resistance	Max. 30 mΩ (By voltage drop 6 V DC, 1A)	
Contact life*	Electrical life	Min. 10^5 (3 A 250 V AC, 30 V DC, resistive load) Min. 5×10^4 (5 A 250 V AC, 30 V DC, resistive load) (at 20 times/min.)
	Mechanical life	min 20, 000, 000 (at 180 times/min.)
Response time	OFF to ON	Max. 10 ms (excluding contact bounce time)
	ON to OFF	Max. 5 ms (excluding contact bounce time and without diode)
Conditions (Operating/ Transport/ Storage)	Ambient temperature	–40°C to 90°C (–40°F to 194°F)
	Humidity	5 to 85% R.H. (Not freezing and condensing at low temperature)
	Maximum operating speed	20 times/min.
Initial breakdown voltage	Between open contacts	1,000 Vrms for 1min. (Detection current: 10mA.)
	Between contact and coil	3,000 Vrms for 1min. (Detection current: 10mA.)
Surge breakdown voltage	Between contacts and coil	6 KV
I/O terminal blocks [Removable, screw type]	Two 10-pin, GC43MH-32MR-D One 10-pin, GC43MH-16MR-D	

***Life curve of relay**

The graph shown is provided by relay manufacturer specification sheet. There may be some degree of variation in relay characteristics depending on ambient and type of load.
So this data should be used only for reference purpose.



3.2 Wiring

Wiring of Main unit comprises of 24 VDC input supply wiring and I/O wiring.

3.2.1 Wiring of Input Power Supply (24 VDC)

3-pin removable terminal block is provided to connect 24 VDC input supply to the controller Main unit. Connect 24 VDC supply between first 2 terminals. Connect last terminal to clean Earth directly as per the guidelines provided in section *Guidelines for Earthing*.

Ensure that EARTH cable is short as far as possible to provide low impedance path.

If EARTH is not connected, it may result in erroneous operation.

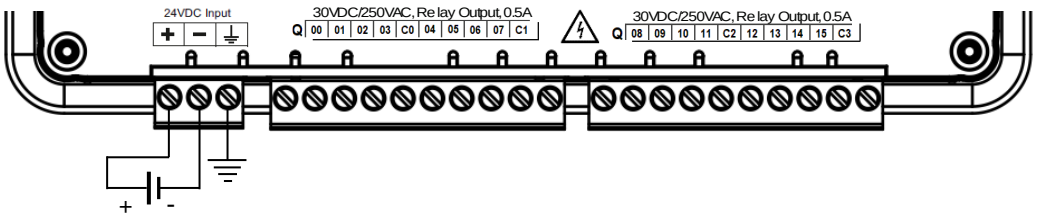


Figure 12: Main unit power supply wiring

Marked as PWR, power on LED glows when 24 VDC input power supply is connected and internal 5 VDC supply is generated. It is OFF if internal 5 VDC is not generated or input power 24 VDC not connected or incoming fuse blown off.

NOTE

Fuse protection T3.15A, 250V, Type 372, Littel fuse make) is provided onboard to protect incoming 24 VDC supply. This fuse is soldered on PCB internally and should not be replaced on the field. It is recommended to connect a Miniature Circuit Breaker (MCB) of proper rating in series with supply as additional protection and to serve as a manual isolator

3.2.2 Wiring of Digital Inputs

Main unit provides 16/8 points of 24 VDC digital inputs (sink/source type) as shown in the table below.

Main unit model	No. of inputs	No. of 10-pin terminal blocks for input connection
GC43MH-32MT-DSS	16	2
GC43MH-32MR-D	16	2
GC43MH-16MT-DSS	8	1
GC43MH-16MR-D	8	1

For Main unit, 8 input points are connected to one 10-pin terminal block. Input terminal block/s is/are provided at upper side.

Unit provides; 1 common each for a group of 4 inputs. Any group can be wired for sink or source operation independently.

Refer section *Digital Input Sink/Source Operation* to understand sink/ source operation.

The wiring diagram below shows how to connect field input devices like potential free push button contacts and limit switches for sink and source connection. The diagram shows connection of NPN type of switch connected for source type of connection and PNP type of switch connected for sink type of connection.

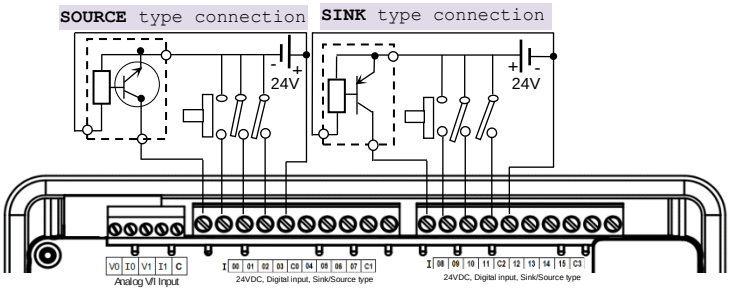


Figure 13: Main unit input connections

Here, input group **I00** to **I03** is connected for source type of operation and input group **I08** to **I11** is connected for sink type of operation.

NOTE

GOC43 Main unit models GC43MH-32MT-DSS and GC43MH-32MR-D provide 2 input terminal blocks. Models GC43MH-16MT-DSS and GC43MH-16MR-D provide 1 input terminal block.

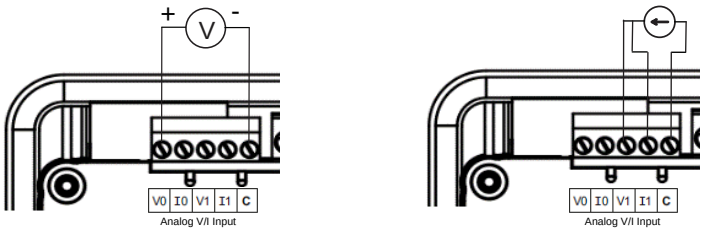
Some of the input devices like proximity switches may malfunction due to inherent off state leakage current. Ensure that proper bleeder resistor is connected as a load considering maximum OFF current specified.

3.2.3 Wiring of Analog Inputs

Main unit provides 2 Ch. Analog V/I input with 12-bit resolution.
It provides terminals V, I and C. C is common for both channels.

Connect voltage input signal between terminals V and C.

Connect current input signal between terminals I and C, with terminals V and I connected together.



Here, **channel0** is connected for voltage input and **channel1** is connected for current input .

Refer section *Precautions to be Taken*, covered in this manual.

3.2.4 Wiring of Transistor Source Outputs

Main unit provides 16/8 points of 24 VDC transistor output (source type) as shown in the table below.

Main unit model	No. of transistor outputs (source)	No. of 10-pin terminal blocks for output connection
GC43MH-32MT-DSS	16	2
GC43MH-16MT-DSS	8	1

For Main unit, 8 output points are connected to one 10-pin input terminal block. Output terminal block/s is/are provided at lower side. As transistor output is of source type, connect one end of output device to output point on terminal block and connect other end of output device to GND terminal of 24 VDC load supply.

It is mandatory to connect 24 VDC output load supply as shown below.

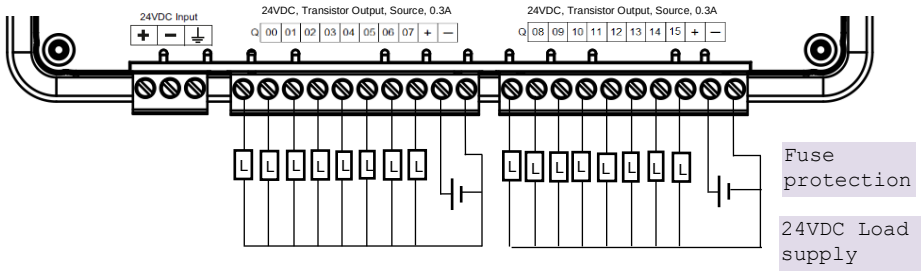


Figure 14: Main unit transistor source output connections

The ON voltage across the output transistor is 0.1V maximum. When driving a semiconductor element, check the voltage characteristics of the connected element.

NOTE

GOC43 Main unit model GC43MH-32MT-DSS provides 2 output terminal blocks. Model GC43MH-16MT-DSS provides 1 output terminal block.

3.2.5 Wiring of Relay Outputs

Main unit provides 16/8 points of relay outputs as shown in the table below.

Main unit model	No. of relay outputs	No. of 10-pin terminal blocks for outputs connection
GC43MH-32MR-D	16	2
GC43MH-16MR-D	8	1

Before wiring relay outputs, refer section *Guidelines for Using Relay Outputs*.

For Main unit, 8 outpoint points are connected to one 10-pin input terminal block. Output terminal block/s is/are provided at lower side. 2 common points are provided per 10-pin output terminal block i.e. 1 common point for 4 outputs.

The figure below shows how to connect output devices to terminal block.

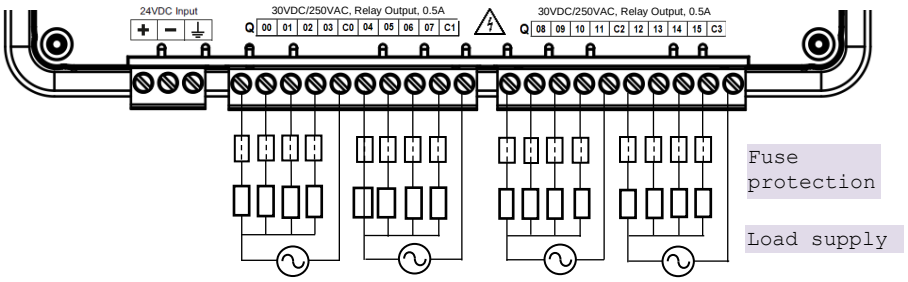


Figure 15: Main unit relay output connections

NOTE

GOC43 Main unit model GC43MH-32MR-D provides 2 output terminal blocks. Model GC43MH-16MR-D provides 1 output terminal block.

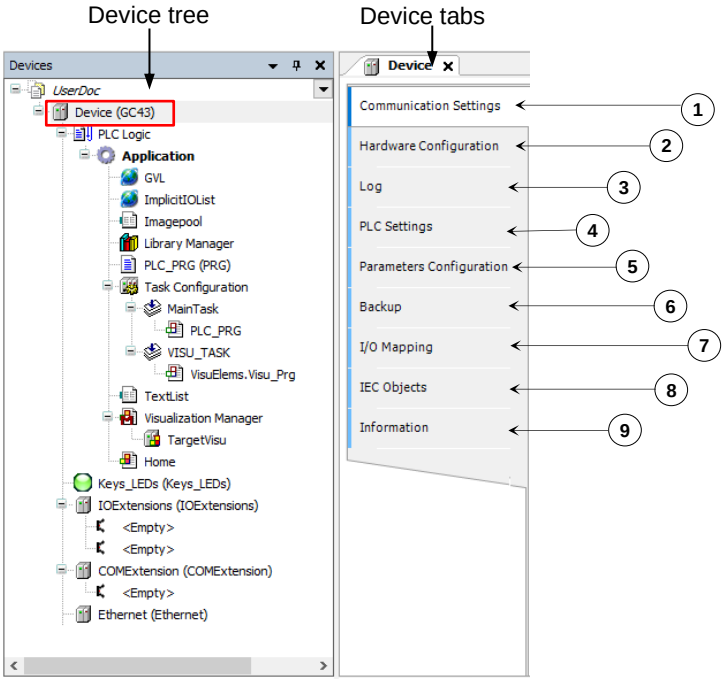
3.3 Configuration and Programming

Refer section *Programming* for installation of GOC ToolKit V3 and project creation.

User can configure and set parameters of connected Main unit using different Device (GC43) tabs as shown below.

After creating a new project, screen appears as shown below.

Click on "*Device (GC43)*" to open following device menu.

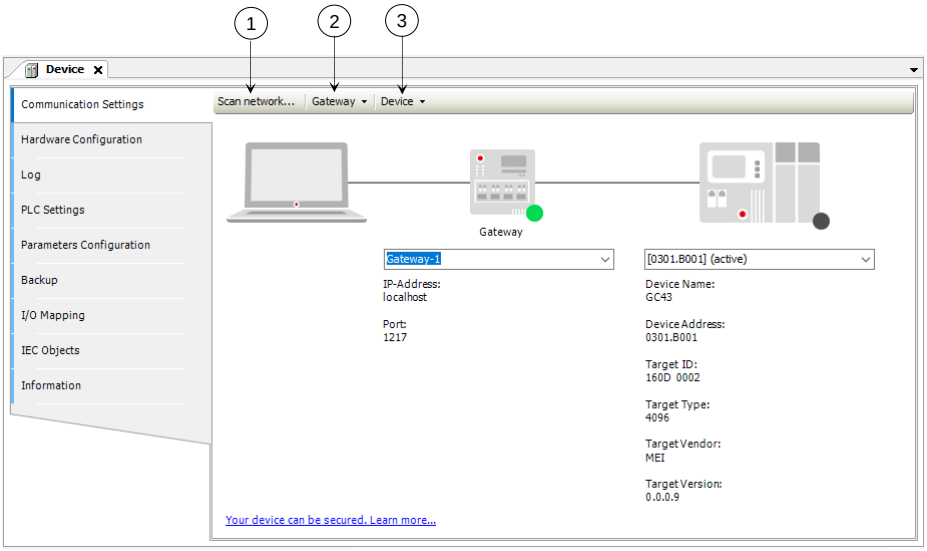


Sr. No.	Device menu	Description
1	Communication settings	User can define the connection path between CoDeSys V3.5 and the device where application should run. User can - scan network for connected device. - Add or manage Gateway
2	Hardware configuration	User can update device version i.e. Main unit version. User can plug IO Extension device in slot IO1 and IO2. and COM Extension device in COM slot. User can configure various functions supported.
3	Log	It lists the events that were recorded on the GOC43. This includes the following: • Events during the startup and shutdown of the system (components loaded, with version) • Application download and loading of the boot application • Log entries from I/O drivers etc.
4	PLC Settings	User can define I/O behavior in case of PLC STOP mode, along with additional settings such as, - bus cycle task - enable diagnostics for device - showing I/O warnings as errors.
5	Parameter Configuration	User can configure functionality of digital and analog inputs of Main unit.
6	Backup	User can allow transfer of application program and source code between CPU and SD memory card, User can set password protection for such transfer. User can also back up application program and source code from PC to SD memory card.
7	I/O Mapping	Lists of digital inputs and outputs of Main unit with pre-defined variable names. Also, shows on/off status in online mode. User can use these variable names directly in the application program. User can modify variable names if required.
8	IEC Objects	Shows variables related to functionality configured. Also, shows system variables with prefix as _SysVar. User can monitor values in online mode.
9	Information	Shows device description

Following are details of individual device menu,

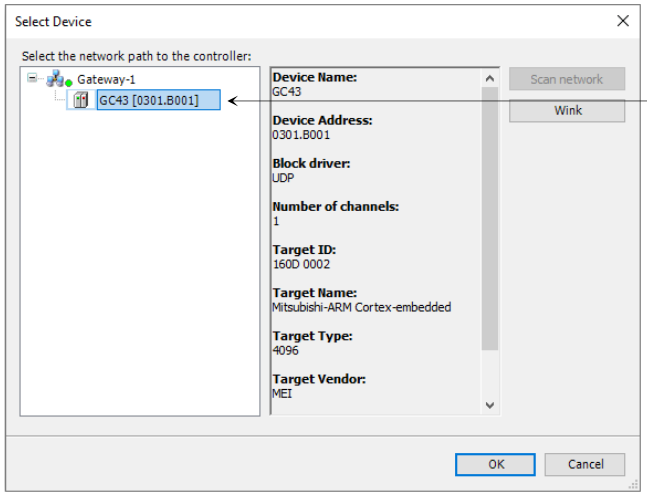
3.3.1 Communication settings

User can define the connection path between CoDeSys and the target device.



Sr. No.	Device menu	Description
1	Scan network	CoDeSys searches for the device in the network of the gateway and lists all configured gateways with the associated devices. User can select one target device from this list to login.
2	Gateway	The connection to the device is established via a gateway. This gateway can be a development computer, or another network computer connected to the device. User can add, manage and configure local gateway.
3	Device	User can manage devices. Wink active device: Helps in identifying connected device. GOC43 blinks LCD backlit.

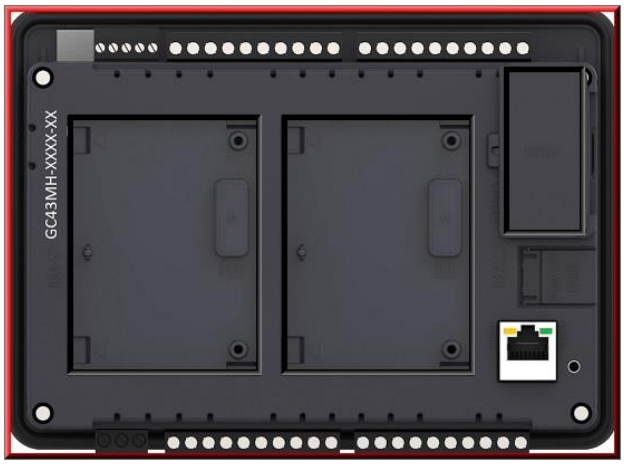
Select Device dialogue appear after clicking on *Scan network* tab.



Select device to be connected on go online from the list of connected devices generated after scan.

3.3.2 Hardware Configuration

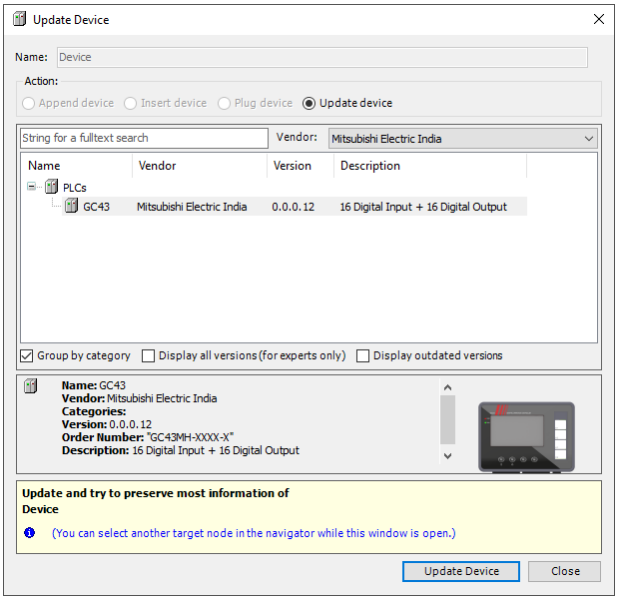
Hardware configuration tab shows back side view of Main unit as below. There is no differentiation for Main unit based on model.



Red highlighter shows unit/device. Currently, it shows that Main unit is selected.

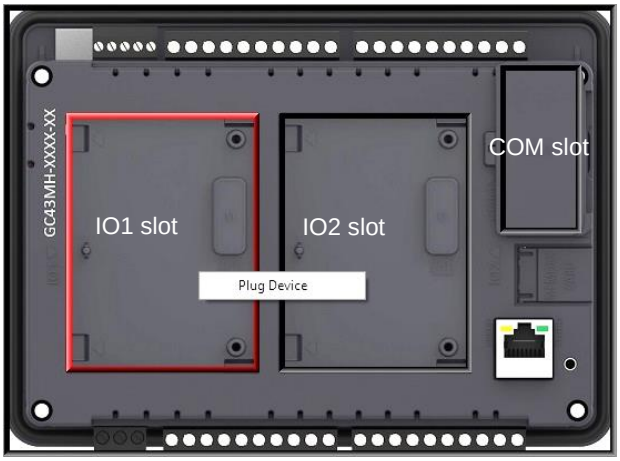
Right click on Main unit area to update device version if necessary.

After right click → Update Device window pops up.

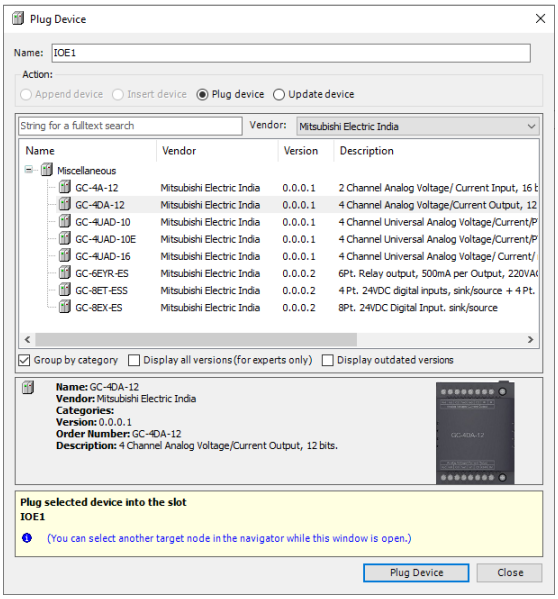


Select required device version and click on 'Update Device' button.
Adjacent dialog shows only one version. Device versions will get added in near future as new features will get added.

Back side view shows IO1 slot, IO2 slot and COM slot where use can plug extension unit. Click on slot area to highlight selected slot. Image below shows that IO1 slot is selected. Right click on selected slot to plug extension as shown below.

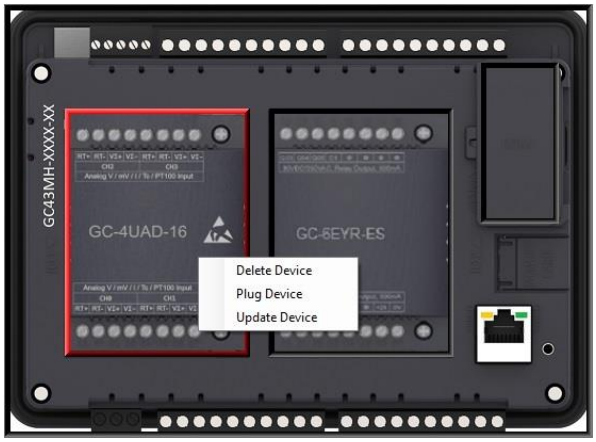


Click on context menu ‘Plug Device’ to pop up ‘Plug Device’ window as shown below.



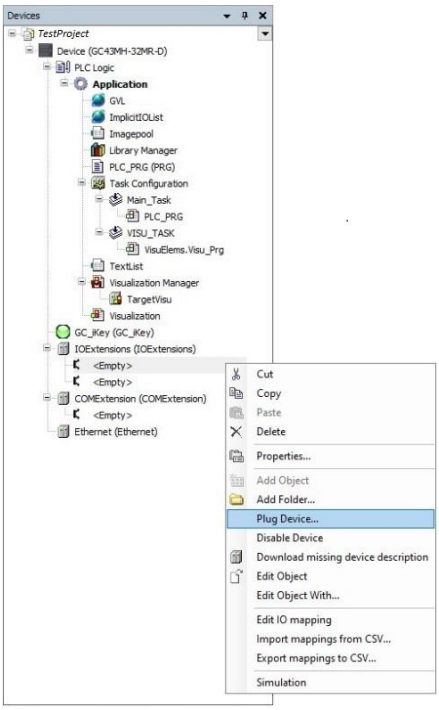
User can select IO extension device as per requirement and click on button ‘Plug Device’.

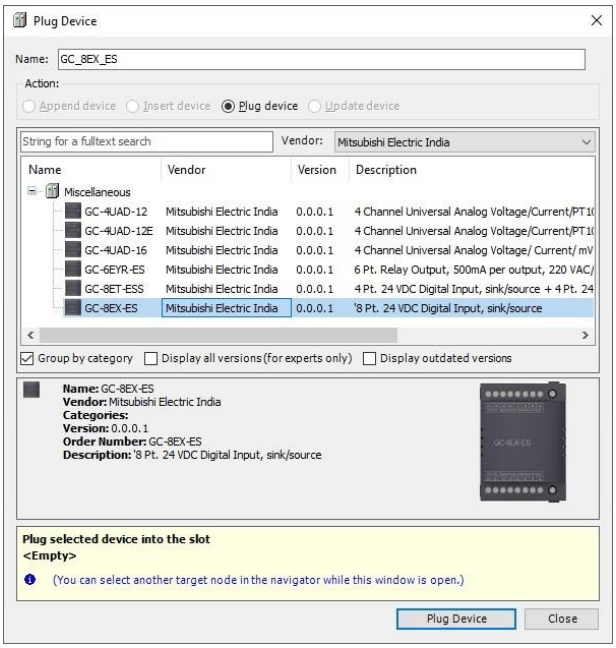
After plugging any device, one can right click on selected slot to plug/update or delete device as required.



Alternately, user can plug extension device in respective slot (*IOExtension* and *COMExtension*) in Device tree. Follow the steps below.

1. Right click on *<Empty>* slot to pop up context menu.
2. Click on *Plug Device*. *Plug Device* dialog shows the list of extension devices supported for the selected slot.
3. Select extension device and double click on it or click on button *Plug Device* to plug it into selected slot.





3.3.3 Log

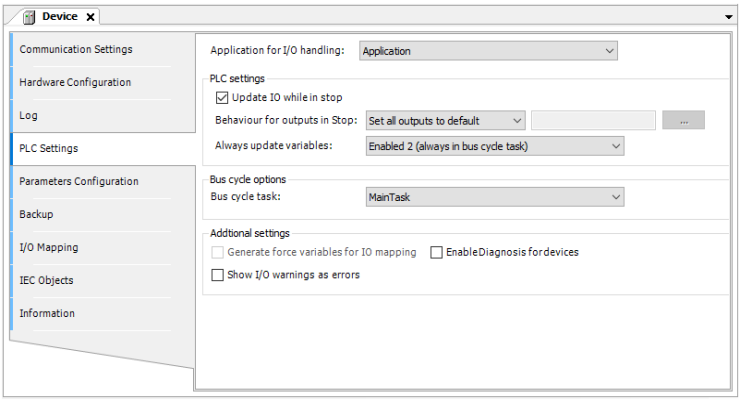
It lists the events that were recorded on the GOC43.

This includes the following:

- Events during the startup and shutdown of the system (components loaded, with version)
- Application download and loading of the boot application
- Log entries from I/O drivers etc

3.3.4 PLC Settings

User can make the basic settings like updation of inputs and outputs and its association with the bus cycle task.



For safe operation, select option Set all outputs to default for setting *Behaviour of outputs in Stop*.

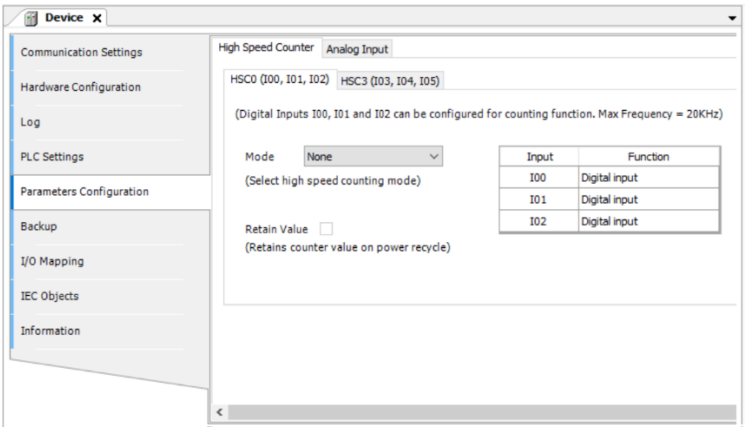
Ensure to choose option *Enabled 2 (always in bus cycle task'* for setting *Always update variables*.

Ensure to choose option *MainTask'* for setting *Bus cycle task*.

Any setting other than recommended above will cause malfunctioning and hence, should be avoided.

3.3.5 Parameter Configuration

User can configure special functionality of Main unit like, high speed counter and analog input.



Tabs available in *'Parameter Configuration'* dialogue

3.3.5.1 High Speed Counter

GOC43 Main unit provides high speed inputs. By default, these inputs function as general purpose digital inputs. These inputs can be configured for different modes of counter operations. Inputs and different modes of operation with maximum frequency allowed is explained in the table below.

Description \ Inputs	I00	I01	I02	I03	I04	I05
Single phase counter	Pulse input	Digital input	Digital input	Pulse input	Digital input	Digital input
	20 KHz	-	-	20 KHz	-	-
Encoder without Z	Encoder phase A	Encoder phase B	Digital input	Encoder phase A	Encoder phase B	Digital input
	10 KHz		-	10 KHz		-
Encoder with Z	Encoder phase A	Encoder phase B	Encoder phase Z	Encoder phase A	Encoder phase B	Encoder phase Z
	10 KHz			10 KHz		

Refer section *Built-in HSC* (*High Speed Counter)* for configuration and programming, IEC objects related to High-Speed Counter in Online mode.

3.3.5.2 Analog Input

Refer section *Built-in Analog V/I Input*, covered in this document.

3.3.6 Backup

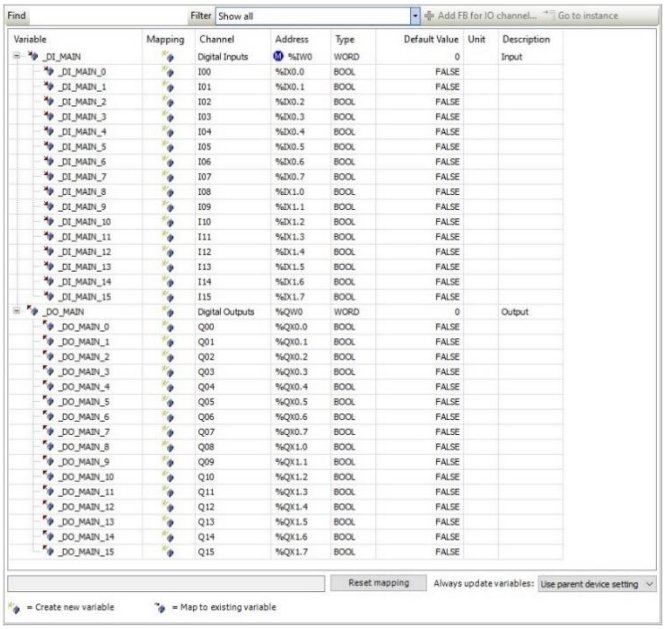
User can backup application program from CPU to SD card. Backed up project can be restored to other or same GOC43 device afterwards as required.

This function allows user to download application program to CPU without using CoDeSys application from PC.

Refer section '*SD card*' for more details

3.3.7 IO Mapping

For GOC43, I/O memory map is fixed. Main unit consumes input memory %IB0, %IB1 and output memory %QB0, %QB1. *I/O Mapping* dialogue shows digital Inputs and outputs as shown below.

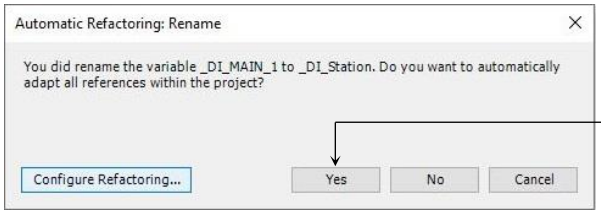


Predefined symbolic names (with prefix as '_') are global variables assigned for each input and output.

For input I00, symbolic name is `_DI_MAIN_0` and address is %IX0.0.

Prefix is `_DI_` and text `MAIN_0` indicates that it is input I00 of Main unit.

User can change the symbolic name after double click on name in Variable column. The dialog below pops up to confirm the change in name reflected throughout the Application.



Click Yes to accept change in variable name.

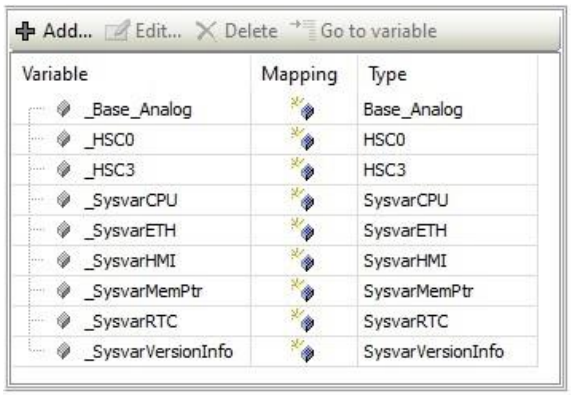
In Online mode,

- Column *Default Value* shows IO values.
- Debug → Write values (Ctrl + F7) allows user to write values to outputs by modifying values in *Prepared Value* column.

3.3.8 IEC Objects

IEC objects are pre-defined global variables ((with prefix as '_') which consists of system variables and variables related to various functions.

The dialog below shows offline view.



User can monitor and modify values of IEC objects (Read write type) in Online mode.

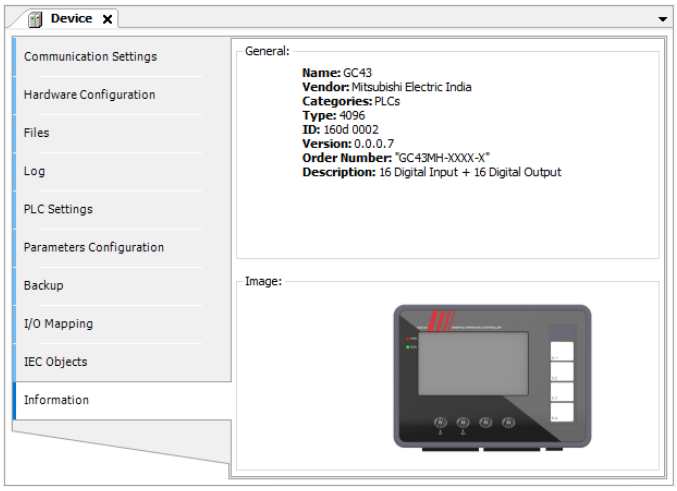
Refer section *Built-in Analog V/I Input* for more details on '_Base_Analog'.

Refer section *Built-in HSC (High Speed Counter)* for more details on '_HSC0' and '_HSC3'

Refer section *System Variables* for more details of system variables.

3.3.9 Information

Information tab provides general details of Main unit such as device name, vendor name, category, type, ID, version, ordering code and description etc. as shown below.



4 Digital I/O Extension Units

Digital input extension units accept 24 VDC inputs from various input devices like push buttons, limit switches and proximity switches. It can be used for sink or source type of interface.

Digital output extension units provide 24 VDC type of output through solid-state type of devices in order to switch on off various field elements like relays, contactors, lamps and solenoid valves, etc. Source type of digital output modules are available.

4.1 GC-8EX-ES

This is 8 Pt. 24 VDC Digital Input extension unit. User can attach up to 2 I/O extension units on the back side of Main unit.

4.1.1 Specifications

Item	Description
Number of Inputs	8, 2 groups of 4 inputs each
Mode of operation	Sink or source in group of 4 inputs; depends on connections
Voltage rating	24 VDC
ON / OFF voltage	**ON voltage:** 18 VDC minimum **OFF voltage:** 5 VDC maximum
Current rating	6 mA at 24 VDC
OFF Current	2.5 mA max
Input impedance	5.1 KΩ Typically
Transition delay	10 ms (Default filter time)
Isolation	Optical 1.5 KV between input and internal bus, 1.5 KV between groups, Nil between input points in a group.
Method of termination	2 nos. 8-pin terminal blocks, fixed, screw type
Status indication	On LCD screen on Main unit
Dimensions (in mm)	61.5 (W) x 75 (H) x 24.5 (D)
Weight (in grams)	60

NOTE

Typical digital input sensing time can be considered as summation of cyclic interval time of MainTask, scan time of MainTask and filter time (10 ms)

4.1.2 Wiring

I/O extension unit provides two 8-pin fixed terminal blocks for wiring I/O devices. One is located at lower side of unit and another is located at upper side of unit.

I/O extension unit provides 2 commons; 1 common each for a group of 4 inputs. Either group can be wired for sink or source operation independently. For an example, the wiring diagram shows input group I00 to I03 connected for sink type of operation and input group I04 to I07 connected for source type of operation.

Refer section *Digital input sink/source operation* to understand sink/ source operation.

Refer section *Wiring*, before wiring digital inputs to I/O extension unit.

The wiring diagram shows how to connect field input devices like potential free push buttons and limit switches for sink and source type of connections. The diagram shows connections of typical proximity switch. PNP switch is connected for sink type of connections and NPN switch is connected for source type of connection.

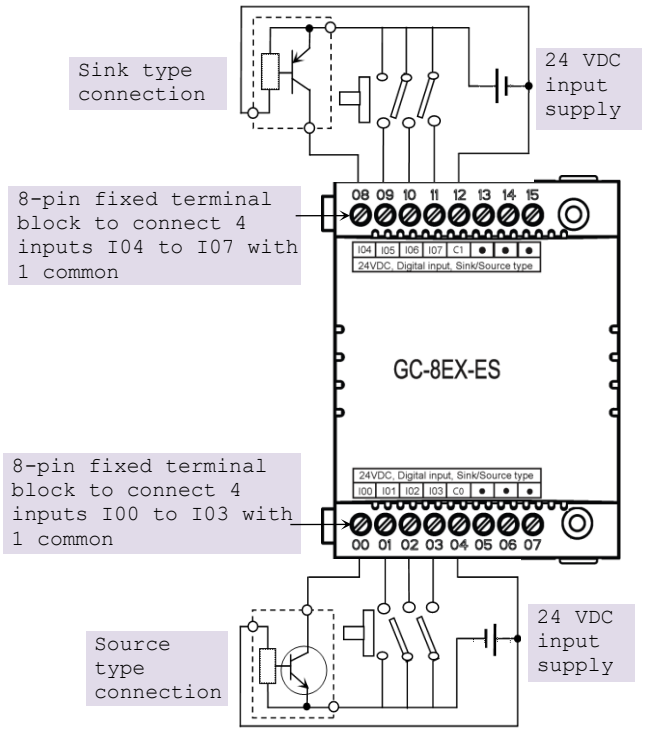


Figure 16: Wiring GC-8EX-ES

Some of the input devices like proximity switches may malfunction due to inherent off state leakage current. Ensure that proper bleeder resistor is connected as a load considering maximum OFF current specified.

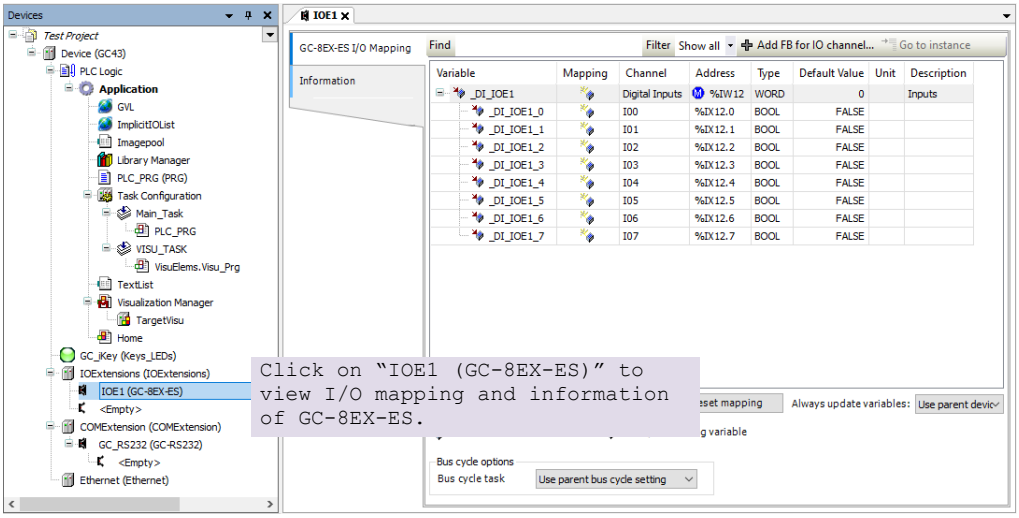
4.1.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-8EX-ES consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

Click on Device → Hardware configuration tab which shows back side view of Main unit.

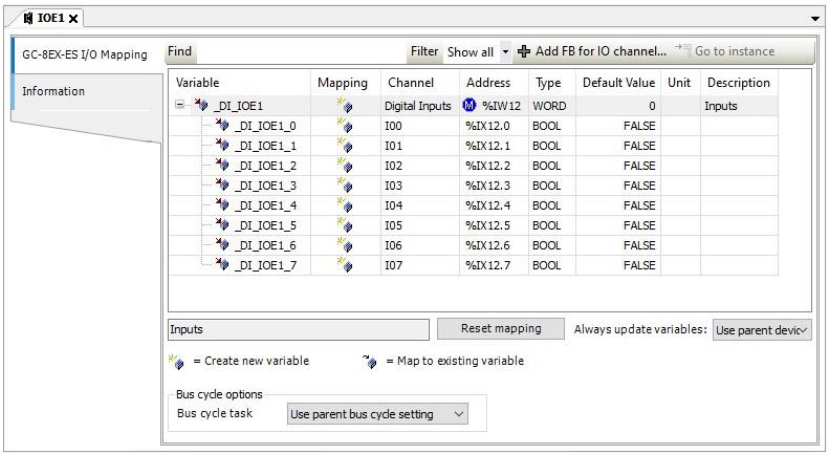
To plug extension device GC-8EX-ES in selected slot, refer section *Hardware Configuration*. After plugging GC-8EX-ES, <Empty> slot is replaced by IOE1 (GC-8EX-ES) as shown below.



Similarly, after plugging GC-8EX-ES in slot2, <Empty> slot is replaced by IOE2 (GC-8EX-ES).

4.1.4 I/O Mapping

Click on *GC-8EX-ES I/O Mapping* tab to view inputs as shown below.



It provides predefined symbolic naming for each input. There is no other configuration required.

For input I00, symbolic name is `_DI_IOE1_0` and address is %IX12.0. Prefix is `_DI_`. Text `IOE1_0` indicates that unit is fixed in IO1 slot and input is I00.

User can change the name e.g. `StartPushButton` after selecting input in Variable column and clicking on respective highlight.

The table below provides the details of I/O bits related to GC-8EX-ES.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot.

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
_DI_IOE☐_0	%IX12.0	%IX14.0	Holds ON/OFF status of extension unit input I00
_DI_IOE☐_1	%IX12.1	%IX14.1	Holds ON/OFF status of extension unit input I01
_DI_IOE☐_2	%IX12.2	%IX14.2	Holds ON/OFF status of extension unit input I02
_DI_IOE☐_3	%IX12.3	%IX14.3	Holds ON/OFF status of extension unit input I03
_DI_IOE☐_4	%IX12.4	%IX14.4	Holds ON/OFF status of extension unit input I04
_DI_IOE☐_5	%IX12.5	%IX14.5	Holds ON/OFF status of extension unit input I05
_DI_IOE☐_6	%IX12.6	%IX14.6	Holds ON/OFF status of extension unit input I06
_DI_IOE☐_7	%IX12.7	%IX14.7	Holds ON/OFF status of extension unit input I07

For GC-8EX-ES, input byte %IB13 and %IB15 and output bytes %QB13 to %QB15 are not used.

4.2 GC-6EYR-ES

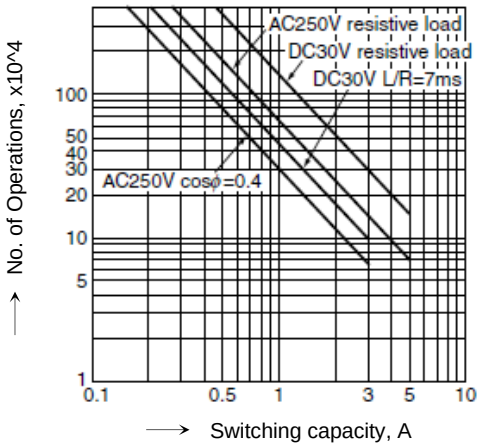
This is 6 Pt. Relay output extension unit. User can attach up to 2 I/O extension units on the back side of Main unit.

4.2.1 Specifications

Item	Description	
Number of outputs	6, 2 groups of 3 outputs each	
Type of output	Non latching normally open (NO) contact Electro-mechanical relay	
Max. switching voltage	250 V (AC), 110 V (DC) (0.4 A)	
Max. switching current	5 A (AC, DC)	
Minimum load	1 mA	
Contact resistance	Max. 30 mΩ (By voltage drop 6 V DC 1A)	
Contact life*	Electrical life	Min. 10^5 (3 A 250 V AC, 30 V DC, resistive load) Min. 5×10^4 (5 A 250 V AC, 30 V DC, resistive load) (at 20 times/min.)
	Mechanical life	min 20, 000, 000 (at 180 times/min.)
Response time	OFF to ON	Max. 10 ms (excluding contact bounce time)
	ON to OFF	Max. 5 ms (excluding contact bounce time and without diode)
Conditions (Operating/ Transport/ Storage)	Ambient temperature	–40°C to 90°C (–40°F to 194°F)
	Humidity	5 to 85% R.H. (Not freezing and condensing at low temperature)
	Maximum operating speed	20 times/min.
Initial breakdown voltage	Between open contacts	1,000 Vrms for 1min. (Detection current: 10mA.)
	Between contact and coil	3,000 Vrms for 1min. (Detection current: 10mA.)
Surge breakdown voltage	Between contacts and coil	6 KV
Method of termination	2 nos. 8-pin terminal blocks, fixed, screw type	
Status indication	On LCD screen on Main unit	
Dimensions (in mm)	61.5 (W) x 75 (H) x 24.5 (D)	
Weight (in grams)	60	

***Life curve of relay**

The graph shown is provided by relay manufacturer specification sheet. There may be some degree of variation in relay characteristics depending on ambient and type of load.
So this data should be used only for reference purpose.



4.2.2 Wiring

I/O extension unit provides two 8-pin fixed terminal blocks for wiring I/O devices. One is located at lower side of unit and another is located at upper side of unit.

Refer section *Guidelines for using relay output*, before wiring relay outputs,

Refer section *Wiring*, before wiring output devices to I/O extension unit.

I/O extension unit provides 2 common; 1 common each for a group of 3 relay outputs. Unit requires external 24 VDC supply for relay coil operation. The wiring diagram shows how to connect field output devices to the unit.

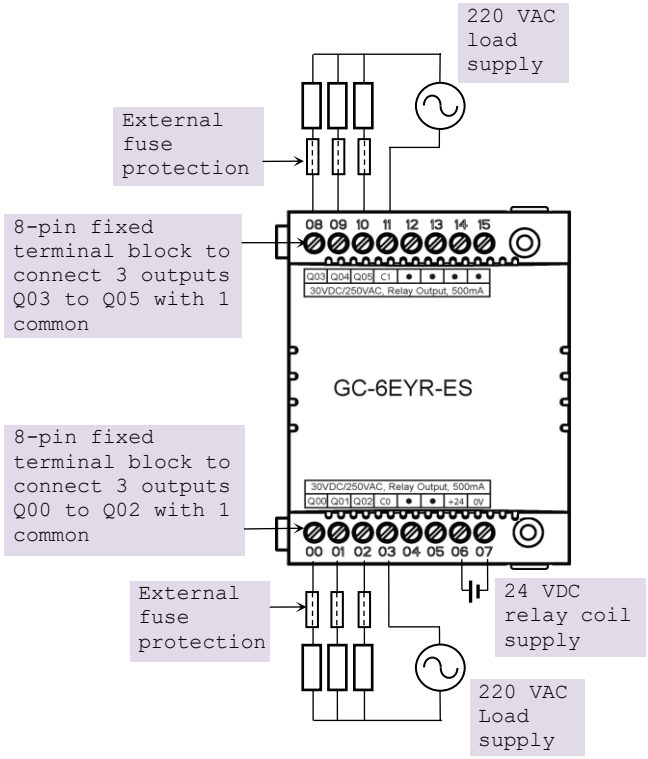


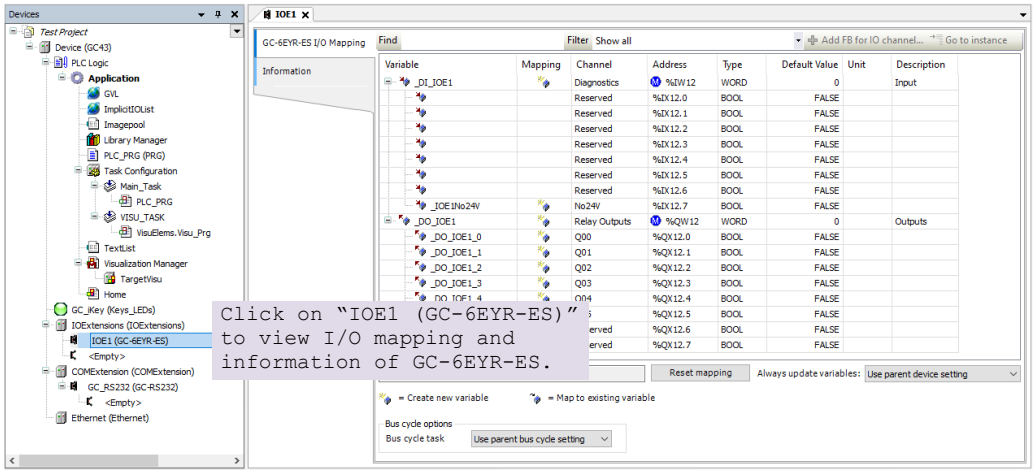
Figure 17: Wiring GC-6EYR-ES

4.2.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-6EYR-ES consumes %IB12 and %QB12 when fixed in IO1 slot and %IB14 and %QB14 when fixed in IO2 slot.

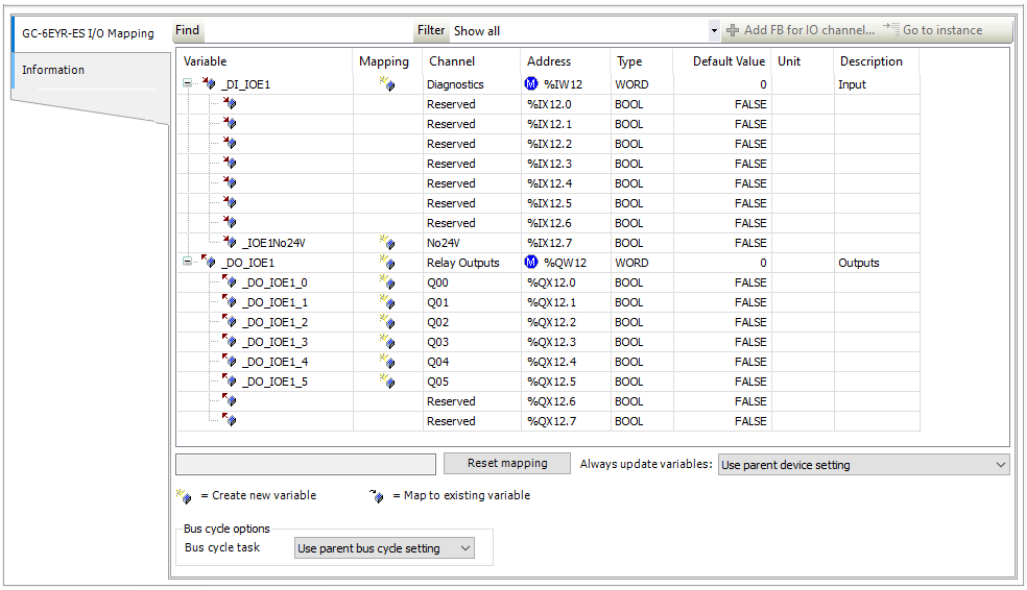
To plug extension device GC-6EYR-ES in selected slot, refer section *Hardware Configuration*. After plugging GC-6EYR-ES, <Empty> slot is replaced by IOE1 (GC-6EYR-ES) as shown below.



Similarly, after plugging GC-6EYR-ES in slot2, <Empty> slot is replaced by IOE2 (GC-6EYR-ES).

4.2.4 I/O Mapping

Click on *GC-6EYR-ES I/O Mapping* tab to view input as shown below.



It provides predefined symbolic naming for each output and input. There is no other configuration required.

For output Q00, symbolic name is `_DO_IOE1_0` and address is %QX12.0.

Prefix is `_DO_`. Text `IOE1_0` indicates that unit is fixed in IO1 slot and output is Q00.

User can change the name as e.g. `_MOTOR1`.after selecting output in Variable column and clicking on respective highlight.

The table below provides the details of I/O bits related to GC-6EYR-ES.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
_IOE☐_No24V	%IX12.7	%IX14.7	Holds 24 VDC supply status of extension unit
_DO_IOE☐_0	%QX12.0	%QX14.0	Holds ON/OFF status of extension unit output Q00
_DO_IOE☐_1	%QX12.1	%QIX14.1	Holds ON/OFF status of extension unit output Q01
_DO_IOE☐_2	%QX12.2	%QX14.2	Holds ON/OFF status of extension unit output Q02
_DO_IOE☐_3	%QX12.3	%QX14.3	Holds ON/OFF status of extension unit output Q03
_DO_IOE☐_4	%QX12.4	%QX14.4	Holds ON/OFF status of extension unit output Q04
_DO_IOE☐_5	%QX12.5	%QX14.5	Holds ON/OFF status of extension unit output Q05

For GC-6EYR-ES, input bytes %IB13 to %IB15 as well as output bytes %QB13 and %QB15 are not used.

4.3 GC-8ET-ESS

This I/O extension unit (GC-8ET-ESS) provides 4 point 24 VDC digital inputs and 4 point 24VDC transistor outputs. It allows sink or source type connections for 4 inputs and source type of connections for 4 outputs. It can be fixed in any IO slot on the back side of Main unit.

4.3.1 Specifications

Item	Description	
Digital Inputs (Sink/ Source type)		
Number of Inputs	04	
Mode of operation	Sink or source, depends on connections	
Voltage rating	24 VDC	
ON / OFF voltage	**ON voltage:** 18 VDC minimum **OFF voltage:** 5 VDC maximum	
Current rating	6 mA at 24 VDC	
OFF current	2.5 mA maximum	
Input impedance	5.1 KΩ Typically	
Transition delay	10ms (Default filter time)	
Digital Outputs (Source type)		
Number of Outputs	04	
Type of output	Transistor source type	
Voltage rating	24 VDC	
Current rating	1.5 A per output, 1 common point. Paralleling of outputs is possible	
ON voltage drop	0.27 VDC maximum	
OFF state leakage current	10 µA maximum	
Response Time	**OFF to ON:** 300 µs	**ON to OFF:** 300 µs
Isolation	1.5 KV optical from internal bus	
Detection	No 24 VDC supply	
Load supply	24 VDC	
	Reverse polarity protection	

NOTE

Typical digital input sensing time can be considered as summation of cyclic interval time of MainTask, scan time of MainTask and filter time (10 ms)

GC-8ET-ESS specifications continue…

Item	Description
General	
I/O status indication	On LCD screen on Main unit
Isolation	Optical 1.5 KV between input and internal circuit Optical 1.5 KV between output and internal circuit
Protection	Output Short circuit protection. Fast demagnetization for inductive loads
Method of termination	For inputs, 1 no., 8-pin terminal block (fixed, screw type) located at upper side of unit
	For outputs, 1 no., 8-pin terminal block (fixed, screw type) located at lower side of unit.
Dimensions (in mm	61.5 (W) x 75 (H) x 24.5 (D)
Weight (in grams)	60

4.3.2 Wiring

I/O extension unit provides two 8-pin fixed terminal blocks for wiring I/O devices. One is located at lower side of unit is for transistor (source type) outputs and another is located at upper side of unit is for digital (sink/ source type) inputs.

As 1 common is provided for a group of 4 inputs, all the inputs can be either connected for source type of input connection or sink type of input connection at a time as shown in figure below. Figure also shows connection of transistor outputs Q00 to Q03 as source type of outputs.

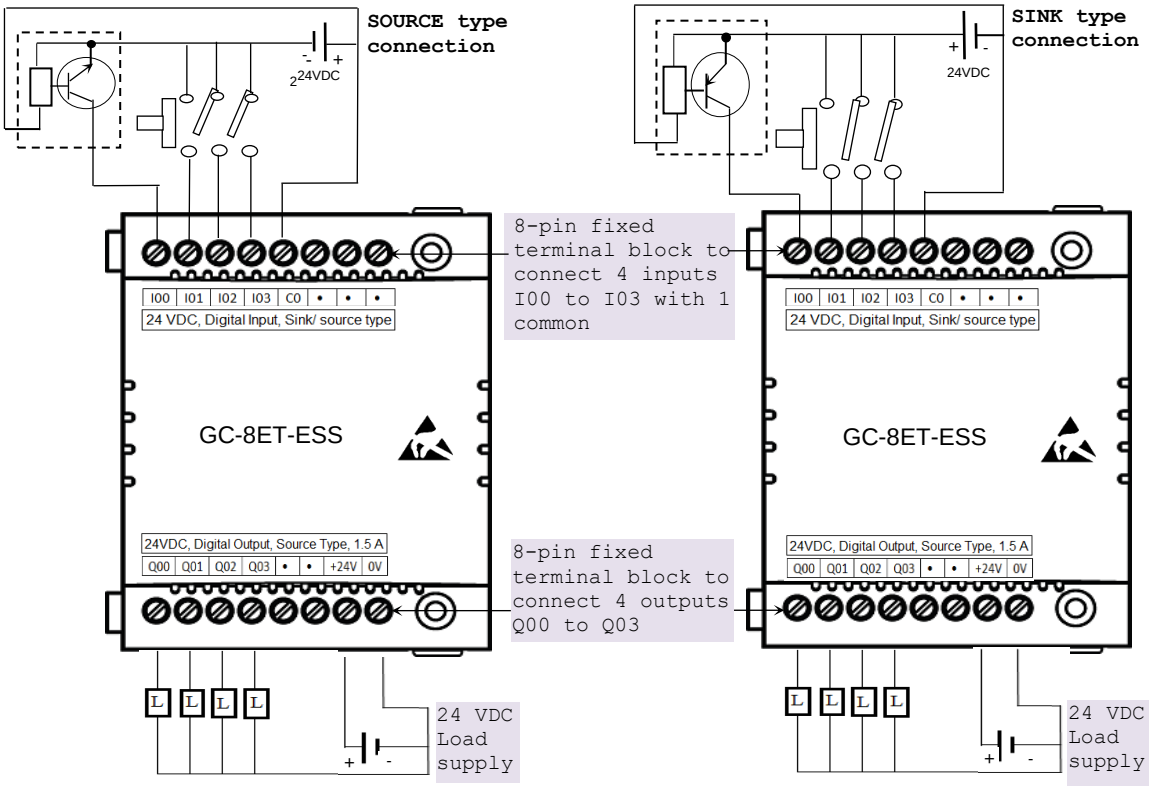


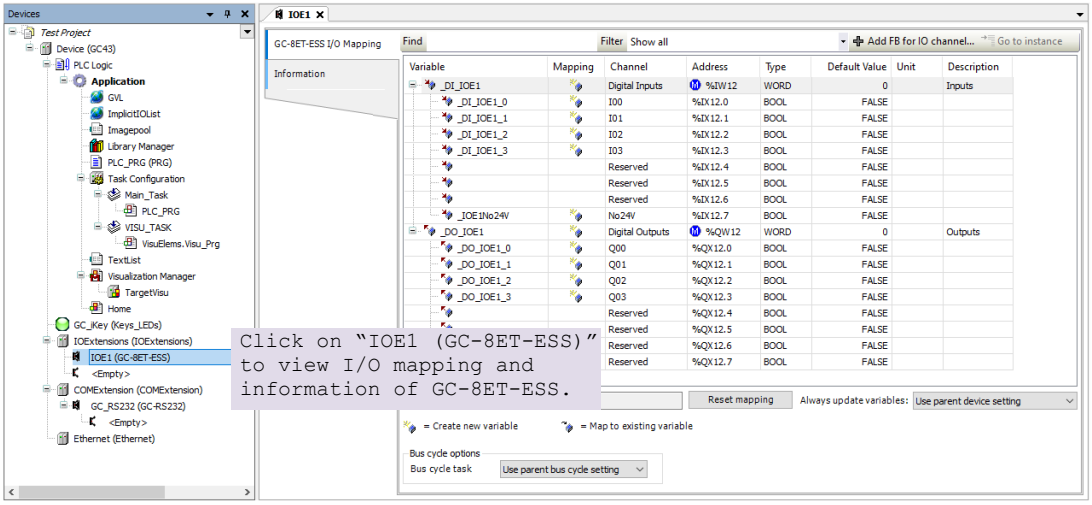
Figure 18: Wiring GC-8ET-ESS

4.3.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-8ET-ESS consumes %IB12 and %QB12 when fixed in IO1 slot and %IB14 and %QB14 when fixed in IO2 slot.

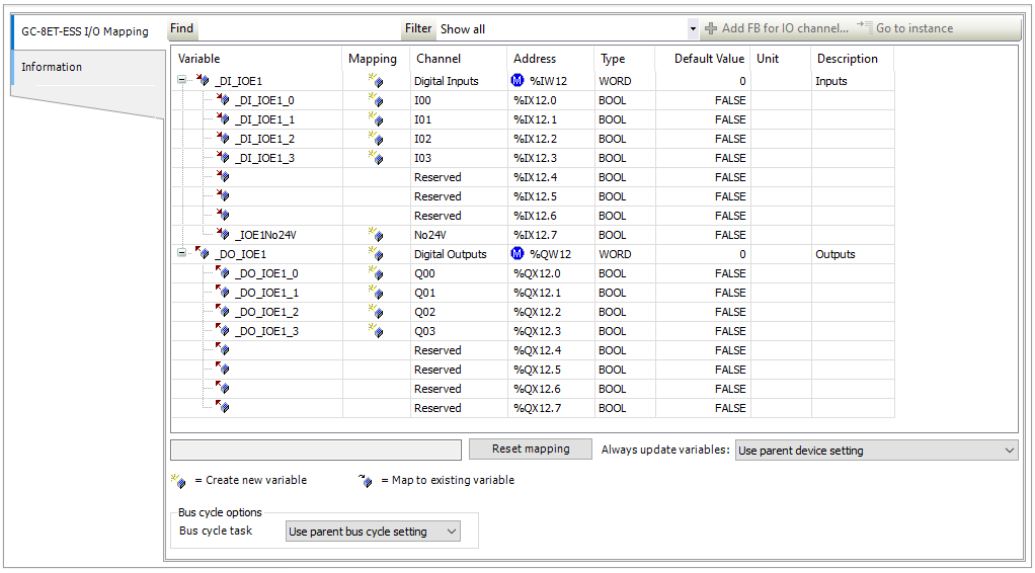
To plug extension device GC-8ET-ESS in selected slot, refer section *Hardware Configuration*. After plugging GC-8ET-ESS, <Empty> slot is replaced by IOE1 (GC-8ET-ESS) as shown below.



Similarly, after plugging GC-8ET-ESS in slot2, <Empty> slot is replaced by IOE2 (GC-8ET-ESS).

4.3.4 I/O Mapping

Click on *GC-8ET-ESS I/O Mapping* tab to view input as shown below.



It provides predefined symbolic naming of each input and output. There is no other configuration required.

For input I00, symbolic name is `_DI_IOE1_0` and address is %IX12.0.

Prefix is _DI_. Text `IOE1_0` indicates that unit is fixed in IO1 slot and input is I00.

Similarly, for output Q00, symbolic name is `_DO_IOE1_0` and address is %QX12.0.

Prefix is `_DO_`. Text `IOE1_0` indicates that unit is fixed in IO1 slot and output is Q00.

Users can change the name as e.g. `MOTOR1`.after selecting output and clicking on respective highlight.

The table below provides the details of I/O bits related to GC-8ET-ESS.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

Input Variables	Address		Description
	IO1 Slot	IO2 Slot	
_DI_IOE☐_0	%IX12.0	%IX14.0	Holds ON/OFF status of extension unit input I00
_DI_IOE☐_1	%IX12.1	%IX14.1	Holds ON/OFF status of extension unit input I01
_DI_IOE☐_2	%IX12.2	%IX14.2	Holds ON/OFF status of extension unit input I02
_DI_IOE☐_3	%IX12.3	%IX14.3	Holds ON/OFF status of extension unit input I03
_IOE☐_No24V	%IX12.7	%IX14.7	Holds 24 VDC supply status of extension unit
Output Variables	**Address**		**Description**
	IO1 Slot	IO2 Slot	
_DO_IOE☐_0	%QX12.0	%QX14.0	Holds ON/OFF status of extension unit output Q00
_DO_IOE☐_1	%QX12.1	%QIX14.1	Holds ON/OFF status of extension unit output Q01
_DO_IOE☐_2	%QX12.2	%QX14.2	Holds ON/OFF status of extension unit output Q02
_DO_IOE☐_3	%QX12.3	%QX14.3	Holds ON/OFF status of extension unit output Q03

5 Analog I/O Extension Units

Analog input extension units convert input voltage, current, RTD and thermocouple readings into equivalent binary values.

Analog output extension unit takes digital value data from processor and generates equivalent analog output voltage or current as per channel configuration.

5.1 GC-4DA-12

This is a 4 Channel analog voltage/current output extension unit that provides 12-bit resolution. Users can attach up to 2 I/O extension units on the back side of Main unit.

5.1.1 Specifications

Item		Description			
Number of outputs		4 channels voltage/current, non-isolated, 12-bit resolution			
Output types (individual channel is software configurable)		**Voltage**		**Current**	
		0 to 10 VDC	-10 to +10 VDC	0 to 20 mA	4 to 20 mA
Input data		0 to 4000	-2000 to 2000	0 to 4000	0 to 4000
1-bit resolution		2.5 mV	5 mV	5 µA	5 µA
Overall accuracy (% of full scale)	At 25°C	±0.3	±0.3	±0.3	±0.3
	At 55°C	±0.4	±0.4	±0.4	±0.4
Load		> 5 KΩ		0 to 500 Ω	
Unit updation time		In sync with output scan			
Output settling time		2 ms			
Isolation		No isolation			
Output protection		Short circuit protection for voltage output			
Unit supply		24 VDC (18 to 30 VDC)			
Method of termination		2 nos. 8-pin terminal blocks, fixed, screw type			
Status indication		On LCD screen on Main unit			
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)			
Weight (in grams)		60			

5.1.2 Wiring

I/O extension unit provides 3 terminals per channel **Vo**, **Io** and **C**. Voltage output is generated between terminals **Vo** and **C**. Whereas current output is generated between terminals **Io** and **C**.

Refer section *Wiring*, before wiring analog output devices to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- Connect cable shield at extension unit end directly to a good quality earth in the control panel. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

The wiring diagram shows how to connect field output devices to extension unit. For an example, channel 0 and 1 are configured for voltage output and channel 2 and 3 are configured for current output.

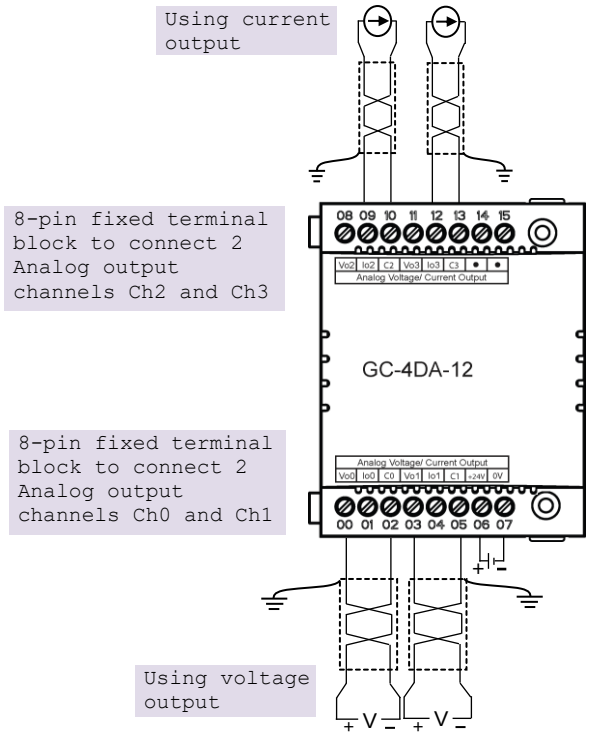


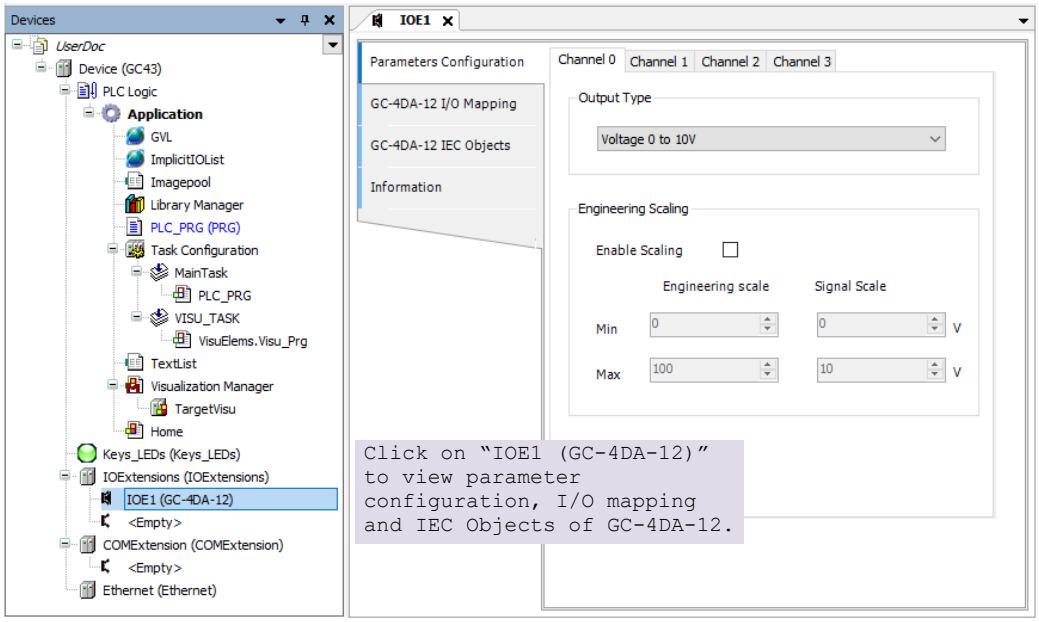
Figure 19: Wiring GC-4DA-12

5.1.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-4DA-12 consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-4DA-12 in selected slot, refer section *Hardware Configuration*. After plugging GC-4DA-12, <Empty> slot is replaced by IOE1 (GC-4DA-12) as shown below.



Similarly, after plugging GC-4DA-12 in slot2, <Empty> slot is replaced by IOE2 (GC-4DA-12).

5.1.3.1 Parameter Configuration

For parameters configuration of extension GC-4DA-12, click on device 'GC-4DA-12' → Parameters Configuration.

Set individual channel parameters using list of parameters provided under 'Channel 0' to 'Channel 3'.

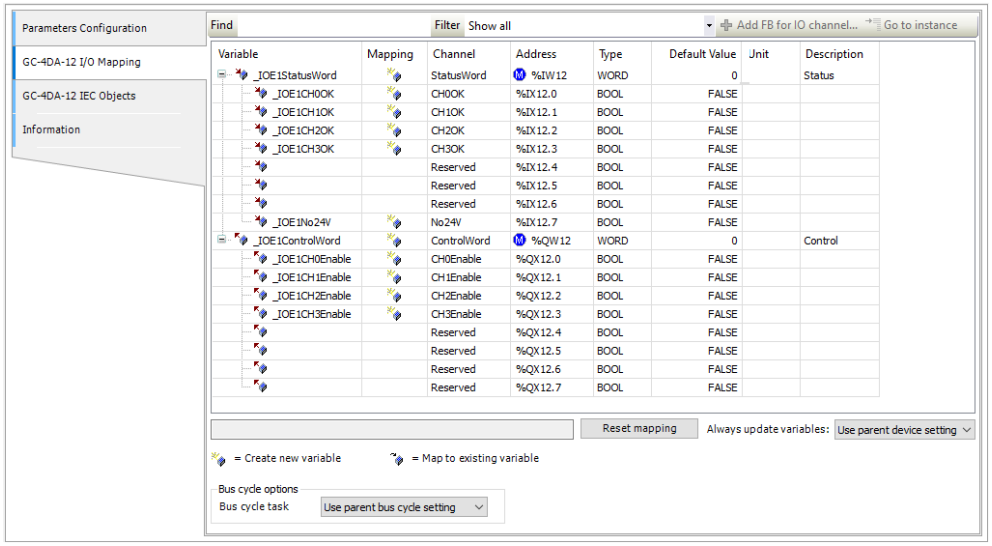
As shown below, parameters configuration is explained for Channel 0.

Sr. No.	Parameter	Options	Description
Analog Output configuration			
1	Output Type	Voltage 0 to 10V (Default) Voltage -10 to +10V Current 0 to 20mA Current 4 to 20mA	Selection for type of output as per application requirement.
Engineering scaling [Enable Scaling] applicable for all supported output types			
2	Enable Scaling	Enable/ Disable	Check 'Enable' to apply engineering scaling to Channel 0.
3	Engineering scale	For Voltage 0 to 10V output type, Min: 0 V and Max: 10 V. For Voltage -10 to +10V output type, Min: -10 V and Max: 10V. For Current 0 to 20mA output type, Min: 0 mA and Max: 20 mA For Current 4 to 20mA output type, Min : 4 mA and Max : 20 mA	This parameter holds minimum and -maximum values of output signal as per configured output type.
4	Signal scale	Default values: Min: 0 and Max: 100 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set minimum and maximum values of engineering scaling as per application requirement. This parameter in not editable

Similarly, user can configure parameters for Channel 1 to Channel 3 using tabs '*Channel 1*', '*Channel 2*' and '*Channel 3*' as shown above.

5.1.4 I/O Mapping

Click on *GC-4DA-12 I/O Mapping* tab to view input as shown below.



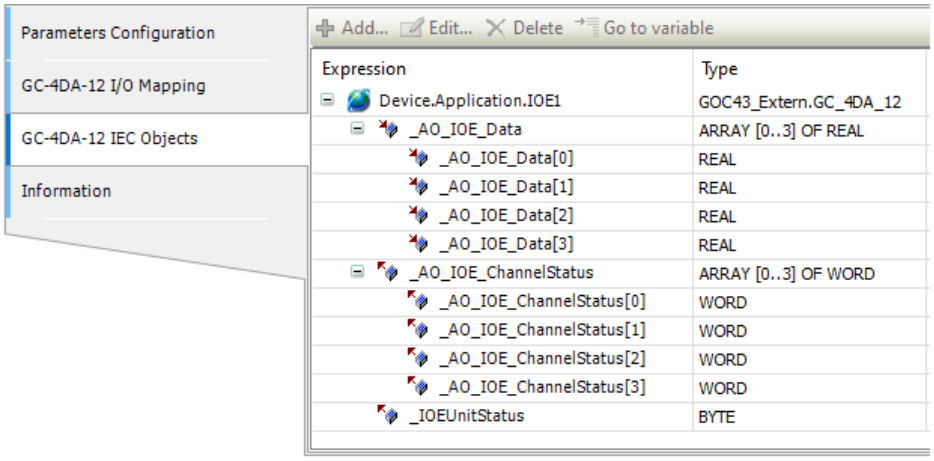
For individual output, symbolic name is `_IOE☐CH0OK` and address is %IX12.0. The table below provides the details of I/O bits related to GC-4DA-12.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
`_IOE☐StatusWord.`			
`_IOE☐CH0OK`	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit or short circuit detected at output
`_IOE☐CH1OK`	%IX12.1	%IX14.1	
`_IOE☐CH2OK`	%IX12.2	%IX14.2	
`_IOE☐CH3OK`	%IX12.3	%IX14.3	
`_IOE☐No24V`	%IX12.7	%IX14.7	**TRUE**: - Unit supply absent - Unit supply polarity reversed - Unit supply below specified 18 VDC
`_IOE☐ControlWord.`			
`_IOE☐CH0Enable`	%QX12.0	%QX14.0	**TRUE** - Enable individual output channel. **FALSE:** - Disable individual output channel
`_IOE☐CH1Enable`	%QX12.1	%QX14.1	
`_IOE☐CH2Enable`	%QX12.2	%QX14.2	
`_IOE☐CH3Enable`	%QX12.3	%QX14.3	

5.1.4.1 IEC Objects

In '*GC-4DA-12 IEC Objects*' tab, user can monitor variables related to GC-4DA-12 in online mode as shown below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td rowspan="7">IOE1._AO_IOE_Data[0]</td><td rowspan="7">REAL</td><td colspan="2">Holds analog output channel 0 data.
The table below provides channel data available when Engineering Scaling is not enabled.</td></tr>
<tr><td>Channel Data</td><td>Output Type</td></tr>
<tr><td>0 to 4000</td><td>0 to 10 VDC</td></tr>
<tr><td>-2000 to 2000</td><td>-10 to 10 VDC</td></tr>
<tr><td>0 to 4000</td><td>0 to 20 mA</td></tr>
<tr><td>0 to 4000</td><td>4 to 20 mA</td></tr>
<tr><td colspan="2">In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling to generate proportional output</td></tr>
<tr><td>IOE1._AO_IOE_Data[1]</td><td>REAL</td><td colspan="2">Holds analog output channel1 data.as explained for _AO_IOE_Data[0]</td></tr>
<tr><td>IOE1._AO_IOE_Data[2]</td><td>REAL</td><td colspan="2">Holds analog output channel2 data.as explained for _AO_IOE_Data[0]</td></tr>
<tr><td>IOE1._AO_IOE_Data[3]</td><td>REAL</td><td colspan="2">Holds analog output channel3 data.as explained for _AO_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._AO_IOE_ChannelStatus</td><td>ARRAY [0..3] OF WORD</td><td>Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0.
Details of bits of status word as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr><tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr><tr><td>2</td><td>Channel data (written at _AO_IOE_Data[n]) is out of range as defined by default resolution or engineering scaling.
0: Data count valid
1: Data count invalid</td></tr><tr><td>3</td><td>Open circuit or short circuit detected at output
0 - No open circuit
1 - Open circuit</td></tr><tr><td>4 - 15</td><td>Reserved</td></tr></table></td></tr>
<tr><td>IOE1._IOEUnitStatus</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr><tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr><tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr><tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr></table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with IOE2._<VariableName>.

5.2 GC-2DA-12

This is a 2 Channel analog voltage/current output extension unit that provides 12-bit resolution. Users can attach up to 2 I/O extension units on the back side of Main unit.

5.2.1 Specifications

Item		Description			
Number of outputs		2 channels voltage/current, non-isolated, 12-bit resolution			
Output types (individual channel is software configurable)		**Voltage**		**Current**	
		0 to 10 VDC	-10 to +10 VDC	0 to 20 mA	4 to 20 mA
Input data		0 to 4000	-2000 to 2000	0 to 4000	0 to 4000
1-bit resolution		2.5 mV	5 mV	5 µA	5 µA
Overall accuracy (% of full scale)	At 25°C	±0.3	±0.3	±0.3	±0.3
	At 55°C	±0.4	±0.4	±0.4	±0.4
Load		> 5 KΩ		0 to 500 Ω	
Unit updation time		In sync with output scan			
Output settling time		2 ms			
Isolation		No isolation			
Output protection		Short circuit protection for voltage output			
Unit supply		24 VDC (18 to 30 VDC)			
Method of termination *1		2 nos. 8-pin terminal blocks, fixed, screw type			
Status indication		On LCD screen on Main unit			
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)			
Weight (in grams)		60			

*1 There is no connection to 8-pin terminal block located at upper side of IO Extension Unit.

5.2.2 Wiring

I/O extension unit provides 3 terminals per channel **Vo**, **Io** and **C**. Voltage output is generated between terminals **Vo** and **C**. Whereas current output is generated between terminals **Io** and **C**.

Refer section *Wiring*, before wiring analog output devices to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- Connect cable shield at extension unit end directly to a good quality earth in the control panel. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

The wiring diagram shows how to connect field output devices to extension unit. For an example, channel 0 is configured for voltage output and channel 1 is configured for current output.

There is no connection to 8-pin terminal block located at upper side of IO Extension Unit.

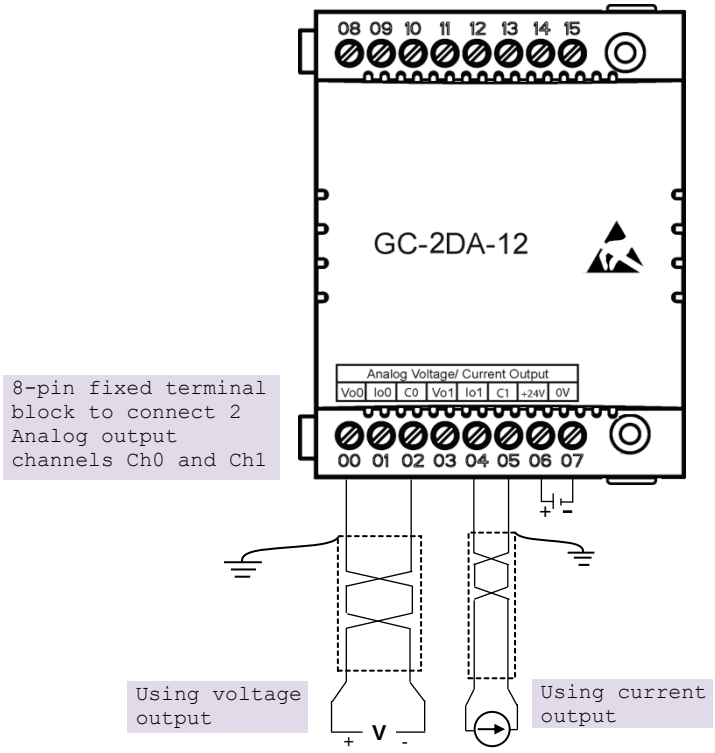


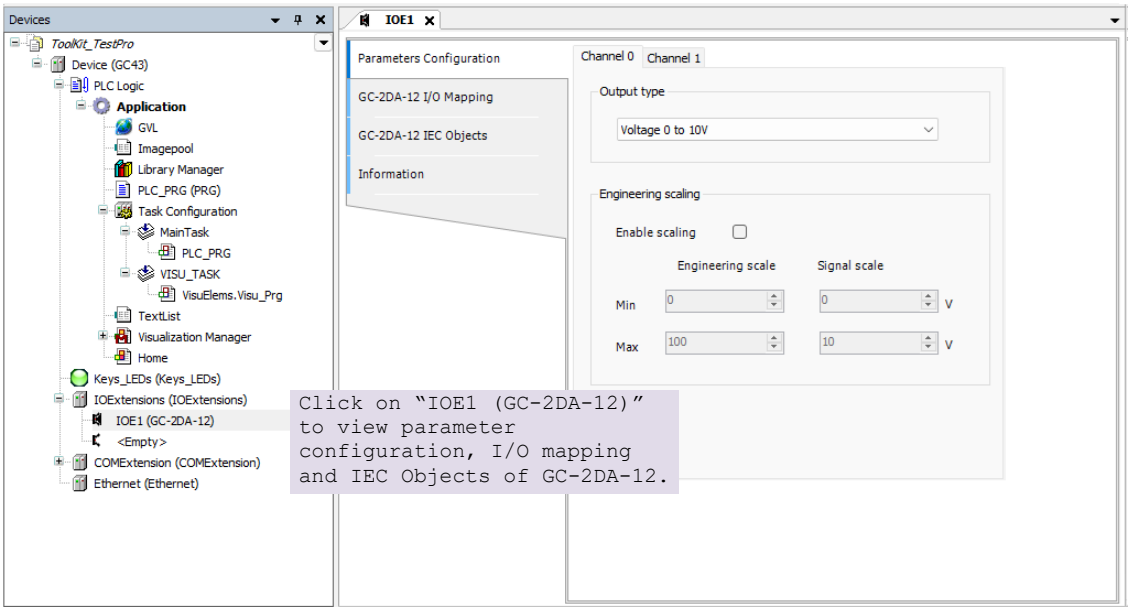
Figure 20: Wiring GC-2DA-12

5.2.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-2DA-12 consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-2DA-12 in selected slot, refer section *Hardware Configuration*. After plugging GC-2DA-12, <Empty> slot is replaced by IOE1 (GC-2DA-12) as shown below.



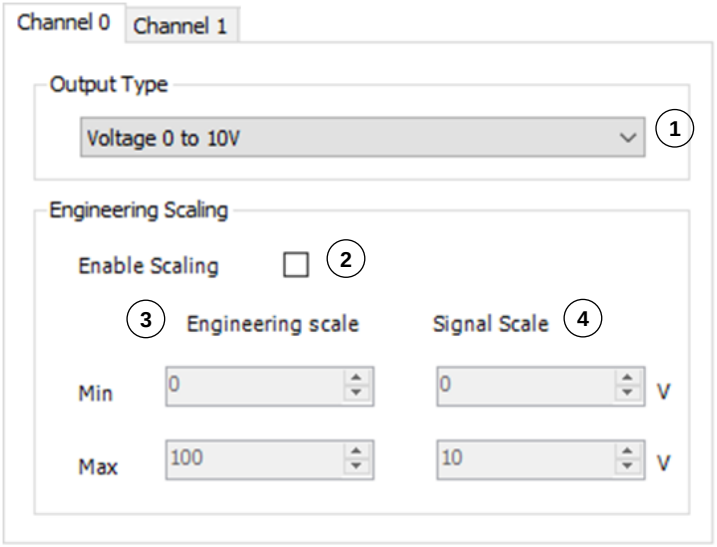
Similarly, after plugging GC-2DA-12 in slot2, <Empty> slot is replaced by IOE2 (GC-2DA-12).

5.2.3.1 Parameter Configuration

For parameters configuration of extension GC-2DA-12, click on device 'GC-2DA-12' → Parameters Configuration.

Set individual channel parameters using list of parameters provided under 'Channel 0' and 'Channel 1'.

As shown below, parameters configuration is explained for Channel 0.

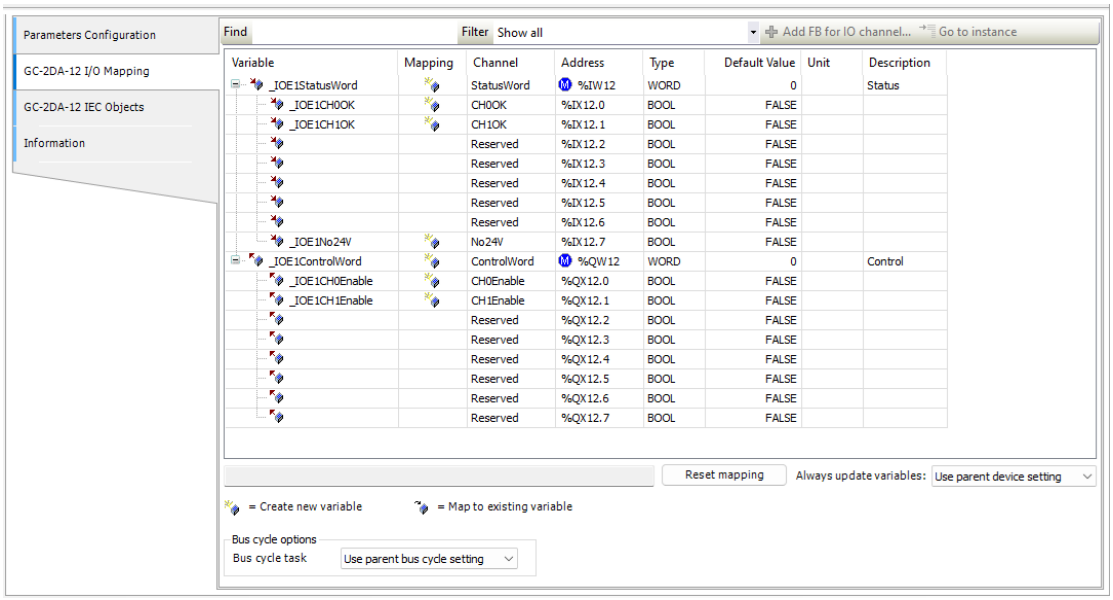


Sr. No.	Parameter	Options	Description
Analog Output configuration			
1	Output Type	Voltage 0 to 10V (Default) Voltage -10 to +10V Current 0 to 20mA Current 4 to 20mA	Selection for type of output as per application requirement.
Engineering scaling [Enable Scaling] applicable for all supported output types			
2	Enable Scaling	Enable/ Disable	Check 'Enable' to apply engineering scaling to Channel 0.
3	Engineering scale	For Voltage 0 to 10V output type, Min: 0 V and Max: 10 V. For Voltage -10 to +10V output type, Min: -10 V and Max: 10V. For Current 0 to 20mA output type, Min: 0 mA and Max: 20 mA For Current 4 to 20mA output type, Min : 4 mA and Max : 20 mA	This parameter holds minimum and -maximum values of output signal as per configured output type.
4	Signal scale	Default values: Min: 0 and Max: 100 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set minimum and maximum values of engineering scaling as per application requirement. This parameter in not editable

Similarly, user can configure parameters for Channel 1 using tab '*Channel 1*' as shown above.

5.2.4 I/O Mapping

Click on *GC-2DA-12 I/O Mapping* tab to view input as shown below.



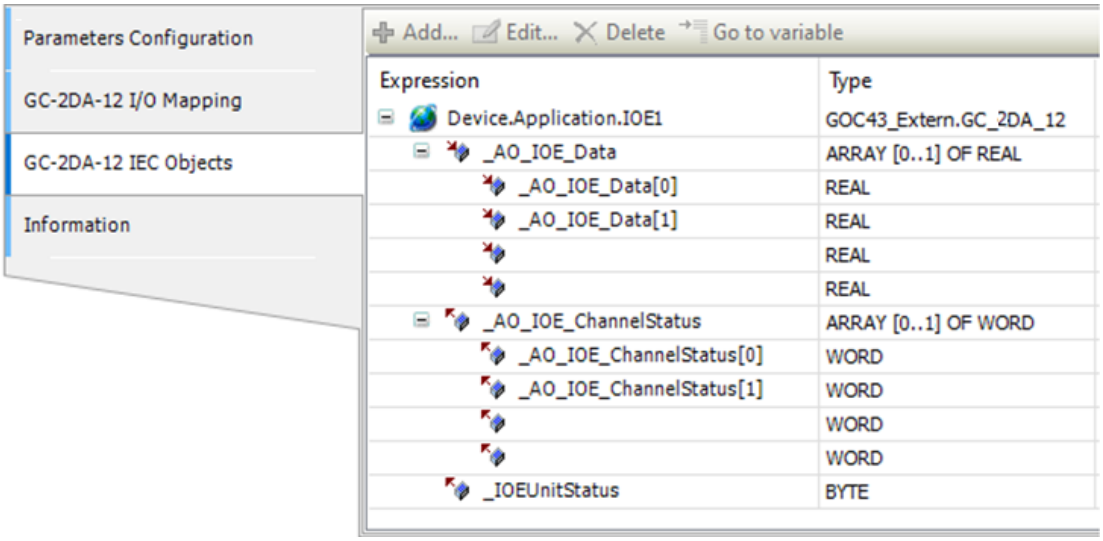
For individual output, symbolic name is `_IOE☐CH0OK` and address is %IX12.0. The table below provides the details of I/O bits related to GC-2DA-12.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
`_IOE☐StatusWord.`			
`_IOE☐CH0OK`	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit or short circuit detected at output
`_IOE☐CH1OK`	%IX12.1	%IX14.1	
`_IOE☐No24V`	%IX12.7	%IX14.7	**TRUE**: - Unit supply absent - Unit supply polarity reversed - Unit supply below specified 18 VDC
`_IOE☐ControlWord.`			
`_IOE☐CH0Enable`	%QX12.0	%QX14.0	**TRUE** - Enable individual output channel. **FALSE:** - Disable individual output channel
`_IOE☐CH1Enable`	%QX12.1	%QX14.1	

5.2.4.1 IEC Objects

In '*GC-2DA-12 IEC Objects*' tab, user can monitor variables related to GC-2DA-12 in online mode as shown below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td>IOE1._AO_IOE_Data[0]</td><td>REAL</td><td>Holds analog output channel 0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Channel Data</th><th>Output Type</th></tr>
<tr><td>0 to 4000</td><td>0 to 10 VDC</td></tr>
<tr><td>-2000 to 2000</td><td>-10 to 10 VDC</td></tr>
<tr><td>0 to 4000</td><td>0 to 20 mA</td></tr>
<tr><td>0 to 4000</td><td>4 to 20 mA</td></tr>
<tr><td colspan="2">In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling to generate proportional output</td></tr>
</table></td></tr>
<tr><td>IOE1._AO_IOE_Data[1]</td><td>REAL</td><td>Holds analog output channel1 data.as explained for _AO_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._AO_IOE_Channel Status</td><td>ARRAY [0..1] OF WORD</td><td>Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0.
Details of bits of status word as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr><tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr><tr><td>2</td><td>Channel data (written at _AO_IOE_Data[n]) is out of range as defined by default resolution or engineering scaling.
0: Data count valid
1: Data count invalid</td></tr><tr><td>3</td><td>Open circuit or short circuit detected at output
0 - No open circuit
1 - Open circuit</td></tr><tr><td>4 - 15</td><td>Reserved</td></tr></table></td></tr>
<tr><td>IOE1._IOEUnitStatus</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr><tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr><tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr><tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr></table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with IOE2._<VariableName>.

5.3 GC-1DA-12

This is a 1 Channel analog voltage/current output extension unit that provides 12-bit resolution. Users can attach up to 2 I/O extension units on the back side of Main unit.

5.3.1 Specifications

Item		Description			
Number of outputs		1 channel voltage/current, non-isolated, 12-bit resolution			
Output types (individual channel is software configurable)		**Voltage**		**Current**	
		0 to 10 VDC	-10 to +10 VDC	0 to 20 mA	4 to 20 mA
Input data		0 to 4000	-2000 to 2000	0 to 4000	0 to 4000
1-bit resolution		2.5 mV	5 mV	5 µA	5 µA
Overall accuracy (% of full scale)	At 25°C	±0.3	±0.3	±0.3	±0.3
	At 55°C	±0.4	±0.4	±0.4	±0.4
Load		> 5 KΩ		0 to 500 Ω	
Unit updation time		In sync with output scan			
Output settling time		2 ms			
Isolation		No isolation			
Output protection		Short circuit protection for voltage output			
Unit supply		24 VDC (18 to 30 VDC)			
Method of termination *1		2 nos. 8-pin terminal blocks, fixed, screw type			
Status indication		On LCD screen on Main unit			
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)			
Weight (in grams)		60			

*1 There is no connection to 8-pin terminal block located at upper side of IO Extension Unit.

5.3.2 Wiring

I/O extension unit provides 3 terminals per channel **Vo**, **Io** and **C**. Voltage output is generated between terminals **Vo** and **C**. Whereas current output is generated between terminals **Io** and **C**.

Refer section *Wiring*, before wiring analog output devices to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- Connect cable shield at extension unit end directly to a good quality earth in the control panel. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

The wiring diagram shows how to connect field output devices to extension unit. For an example, in figure 21, channel 0 is configured for voltage output and in figure 22, channel 0 is configured for current output.

There is no connection to 8-pin terminal block located at upper side of IO Extension Unit.

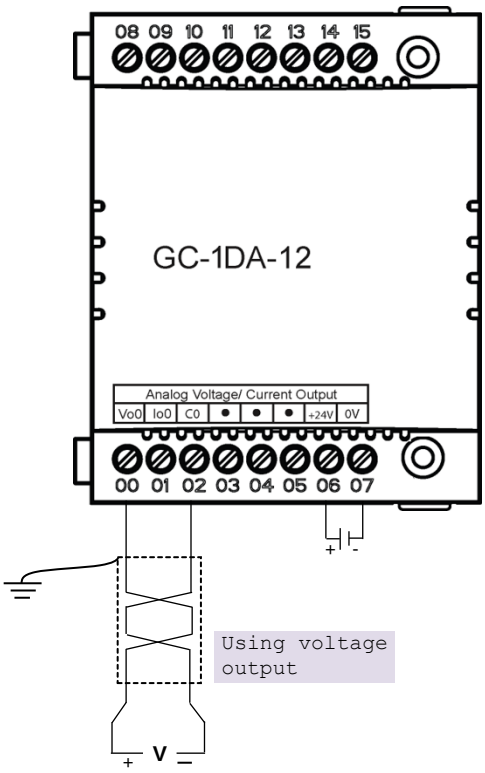


Figure 21: Wiring GC-1DA-12

8-pin fixed terminal block to connect Analog output channel Ch0

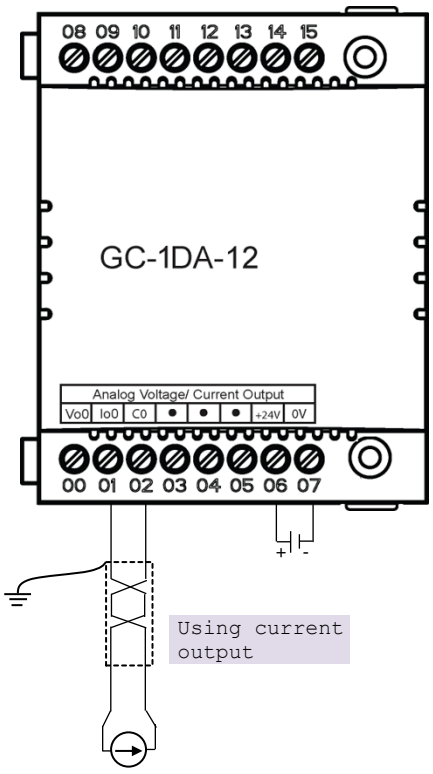


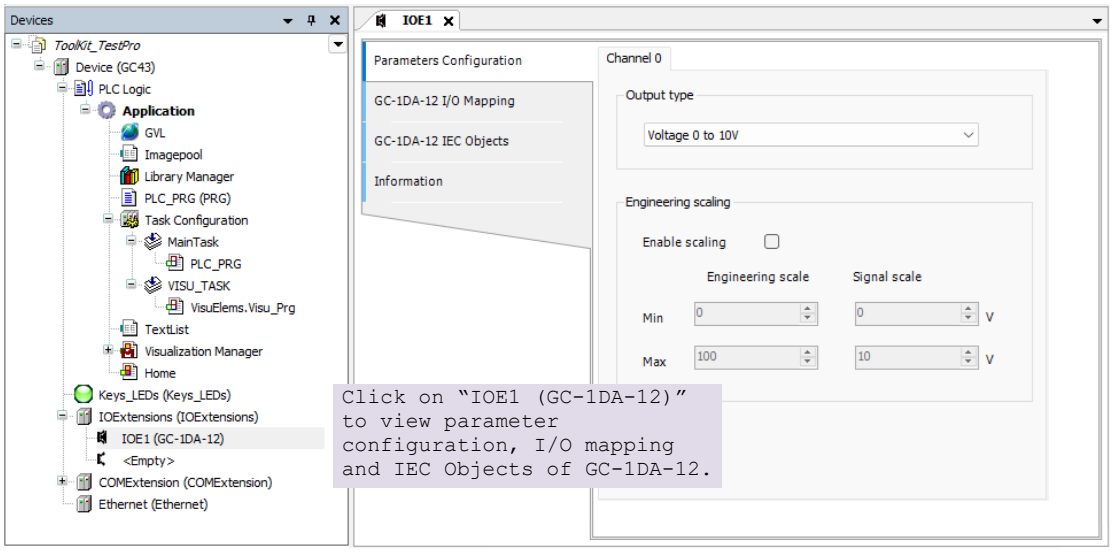
Figure 22: Wiring GC-1DA-12

5.3.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-1DA-12 consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-1DA-12 in selected slot, refer section *Hardware Configuration*. After plugging GC-1DA-12, <Empty> slot is replaced by IOE1 (GC-1DA-12) as shown below.



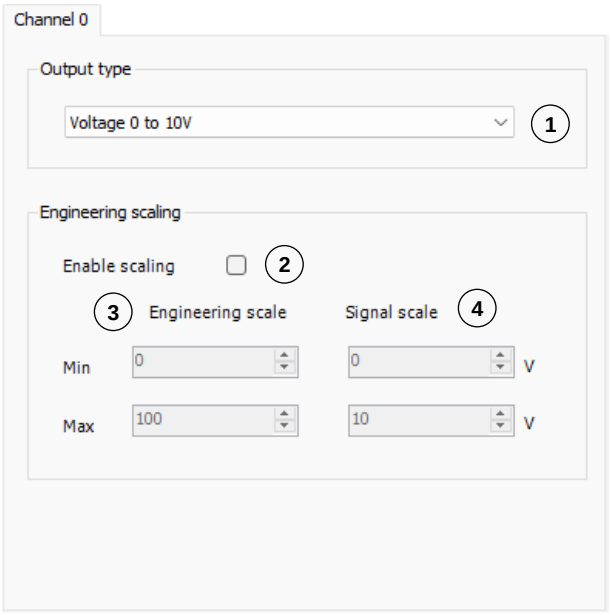
Similarly, after plugging GC-1DA-12 in slot2, <Empty> slot is replaced by IOE2 (GC-1DA-12).

5.3.3.1 Parameter Configuration

For parameters configuration of extension GC-1DA-12, click on device 'GC-1DA-12' → Parameters Configuration.

Set individual channel parameters using list of parameters provided under 'Channel 0'.

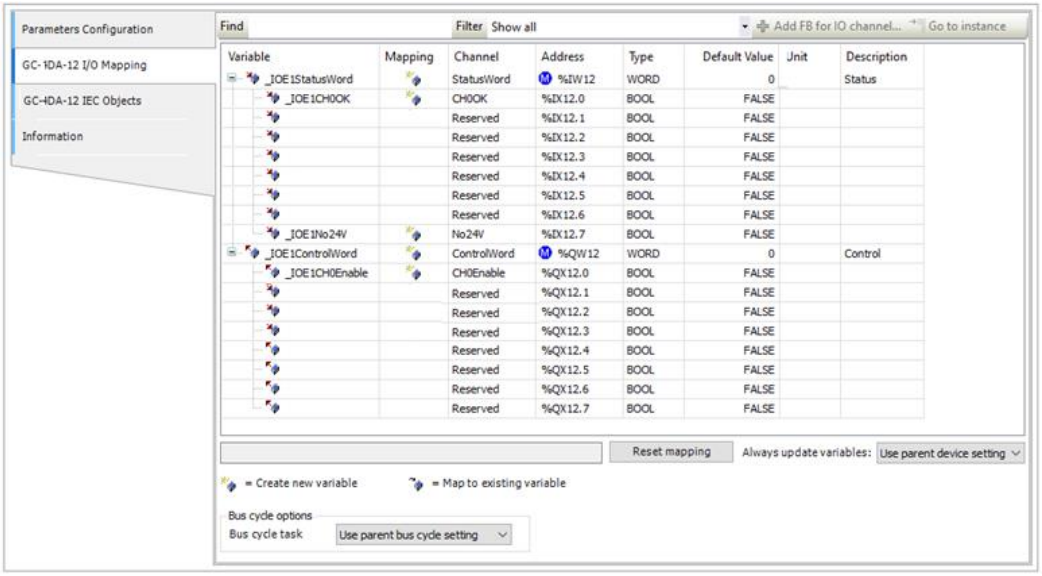
As shown below, parameters configuration is explained for Channel 0.



Sr. No.	Parameter	Options	Description
Analog Output configuration			
1	Output Type	Voltage 0 to 10V (Default) Voltage -10 to +10V Current 0 to 20mA Current 4 to 20mA	Selection for type of output as per application requirement.
Engineering scaling [Enable Scaling] applicable for all supported output types			
2	Enable Scaling	Enable/ Disable	Check 'Enable' to apply engineering scaling to Channel 0.
3	Engineering scale	For Voltage 0 to 10V output type, Min: 0 V and Max: 10 V. For Voltage -10 to +10V output type, Min: -10 V and Max: 10V. For Current 0 to 20mA output type, Min: 0 mA and Max: 20 mA For Current 4 to 20mA output type, Min : 4 mA and Max : 20 mA	This parameter holds minimum and -maximum values of output signal as per configured output type.
4	Signal scale	Default values: Min: 0 and Max: 100 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set minimum and maximum values of engineering scaling as per application requirement. This parameter in not editable

5.3.4 I/O Mapping

Click on *GC-1DA-12 I/O Mapping* tab to view input as shown below.



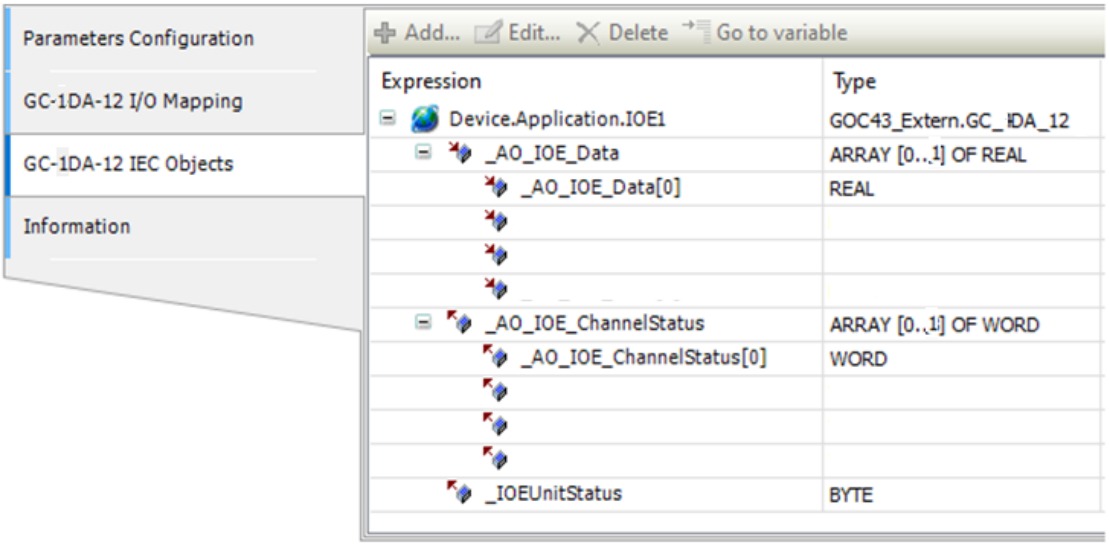
For individual output, symbolic name is `_IOE☐CH0OK` and address is %IX12.0. The table below provides the details of I/O bits related to GC-1DA-12.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
`_IOE☐StatusWord.`			
`_IOE☐CH0OK`	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit or short circuit detected at output
`_IOE☐No24V`	%IX12.7	%IX14.7	**TRUE**: - Unit supply absent - Unit supply polarity reversed - Unit supply below specified 18 VDC
`_IOE☐ControlWord.`			
`_IOE☐CH0Enable`	%QX12.0	%QX14.0	**TRUE** - Enable individual output channel. **FALSE:** - Disable individual output channel

5.3.4.1 IEC Objects

In '*GC-1DA-12 IEC Objects*' tab, user can monitor variables related to GC-1DA-12 in online mode as shown below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td rowspan="6">IOE1._AO_IOE_Data[0]</td><td rowspan="6">REAL</td><td>Holds analog output channel 0 data.
The table below provides channel data available when Engineering Scaling is not enabled.</td></tr>
<tr><td>
<table>
<tr><th>Channel Data</th><th>Output Type</th></tr>
<tr><td>0 to 4000</td><td>0 to 10 VDC</td></tr>
<tr><td>-2000 to 2000</td><td>-10 to 10 VDC</td></tr>
<tr><td>0 to 4000</td><td>0 to 20 mA</td></tr>
<tr><td>0 to 4000</td><td>4 to 20 mA</td></tr>
</table>
</td></tr>
<tr><td>In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling to generate proportional output</td></tr>
</table>

<table>
<tr><td>IOE1._AO_IOE_ChannelStatus</td><td>WORD</td><td>Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0.
Details of bits of status word as follows
<table>
<tr><th>Bit No</th><th>Details</th></tr>
<tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr>
<tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr>
<tr><td>2</td><td>Channel data (written at _AO_IOE_Data[n]) is out of range as defined by default resolution or engineering scaling.
0: Data count valid
1: Data count invalid</td></tr>
<tr><td>3</td><td>Open circuit or short circuit detected at output
0 - No open circuit
1 - Open circuit</td></tr>
<tr><td>4 - 15</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>IOE1._IOEUnitStatus</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table>
<tr><th>Bit No</th><th>Details</th></tr>
<tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr>
<tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr>
<tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr>
<tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr>
</table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with IOE2._<VariableName>.

5.4 GC-4A-12

This is mixed analog I/O extension unit that provides 2 Ch., 16-bit, analog voltage/ current input and 2 Ch., 12-bit, analog voltage/ current output. User can attach up to 2 I/O extension units that can be fixed in IO1 slot and IO2 slot to the Main unit.

5.4.1 Specifications

Item		Description			
Analog Input					
Number of input channels		2 channels voltage/current input, single ended/ differential, non-isolated, 16-bit resolution			
Input types (User configurable)		**Voltage**		**Current**	
		0 to 10 VDC	±10 VDC	0 to 20 mA	4 to 20 mA
Output data		0 to 64000	-32000 to 32000	0 to 64000	
1-bit Resolution		0.15 mV	0.3 mV	0.3 µA	0.3 µA
*Overall accuracy (% of full scale)	At 25°C	±0.1	±0.1	±0.2	±0.2
	At 55°C	±0.3	±0.3	±0.4	±0.4
Input impedance		1 MΩ		124 Ω	
**Channel updation time		[[(2 x Cyclic interval) + Channel Conversion Time] x Number of Channels Enabled] + (Time constant x 10) [[(2 x Cyclic interval) + Channel Conversion Time] x Number of Channels Enabled] x No. of averaging samples.			
Absolute maximum input		±30 VDC/ 30 mA			
Open circuit detection		For 4 to 20mA input type			
Channel Protection		PTC for over current protection for current input up to 100 mA.			
Isolation		No isolation from internal logic			
Method of termination		2 nos. 8-pin terminal blocks, fixed, screw type			
Connection terminals		Iin, Vin and Cn for each analog input channel			

* Overall accuracy mentioned is applicable for digital filter setting of 50 msec.

** Channel updation time depends on digital filter time constant setting and number of averaging samples.

Item		Description			
Analog Output					
Number of output channels		2 channels voltage/current output, non-isolated, 12-bit resolution			
Output types (User configurable)		**Voltage**		**Current**	
		0 to 10 VDC	±10 VDC	0 to 20 mA	4 to 20 mA
Input data		0 to 4000	-2000 to 2000	0 to 4000	
1-bit Resolution		2.5 mV	5 mV	5 µA	5 µA
Overall accuracy (% of full scale)	At 25°C	±0.05	±0.05	±0.05	±0.05
	At 55°C	±0.1	±0.1	±0.1	±0.1
Channel updation time		In sync with cyclic interval			
Output settling time		2 msec typically			
Output load		Voltage output: > 5 KΩ Current output: 0 to 500 Ω			
Open circuit detection		Supported			
Channel Protection		Short circuit protection for voltage output			
Connection terminals		Von, Ion and Cn for analog output channel			
Unit supply		18 to 30 VDC at terminals +24V and 0V			
Unit supply protection		No 24V detection Reverse polarity protection			
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)			
Weight (in grams)		60			

5.4.2 Wiring

I/O extension unit provides 3 terminals for individual input channel and output channel as below.

1. For Analog inputs, unit provides 3 terminals per channel I*in*, V*in* and C*n*.
   - Voltage input is connected between terminals V*in* and C*n*.
   - Current input is connected between terminals I*in* and C*n* with and V*in* and I*in* connected together externally.
2. For Analog outputs, unit provides 3 terminals per channel Vo*n*, Io*n* and C*n*.
   - Voltage output is generated between terminals Vo*n* and C*n*.
   - Current output is generated between terminals Io*n* and C*n*.
3. External 24 VDC supply is required for analog output. It is connected between terminals +24V and 0V.

The wiring diagram shows how to connect field input devices to I/O extension unit. For an example, for analog inputs, channel 0 is connected to current input and channel 1 is connected to voltage input.

For analog outputs, channel 0 is connected for voltage output and channel 1 is connected for current output.

External unit supply is connected between terminals +24V and 0V.

Refer section *Wiring*, before wiring analog input sensors and actuators to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- Connect cable shield at I/O extension unit end directly to a good quality earth. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

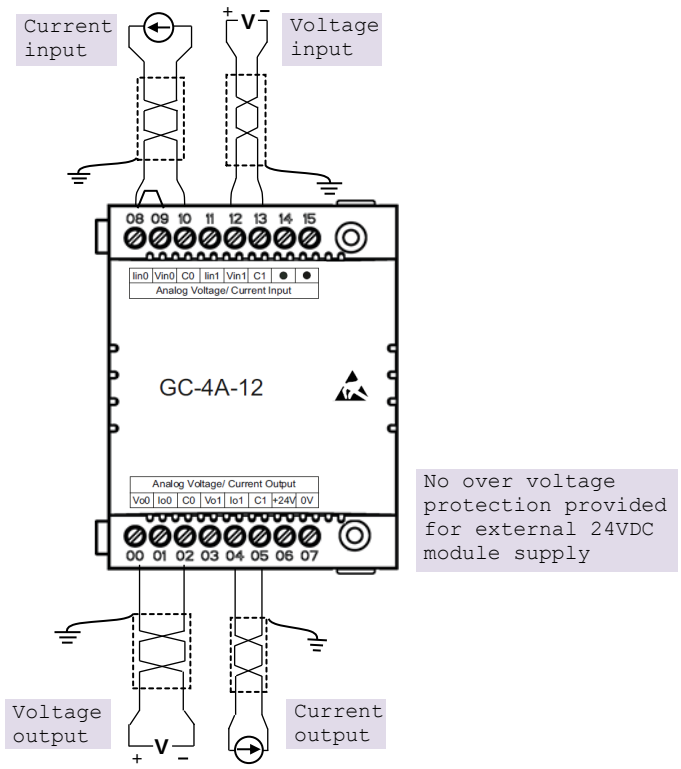


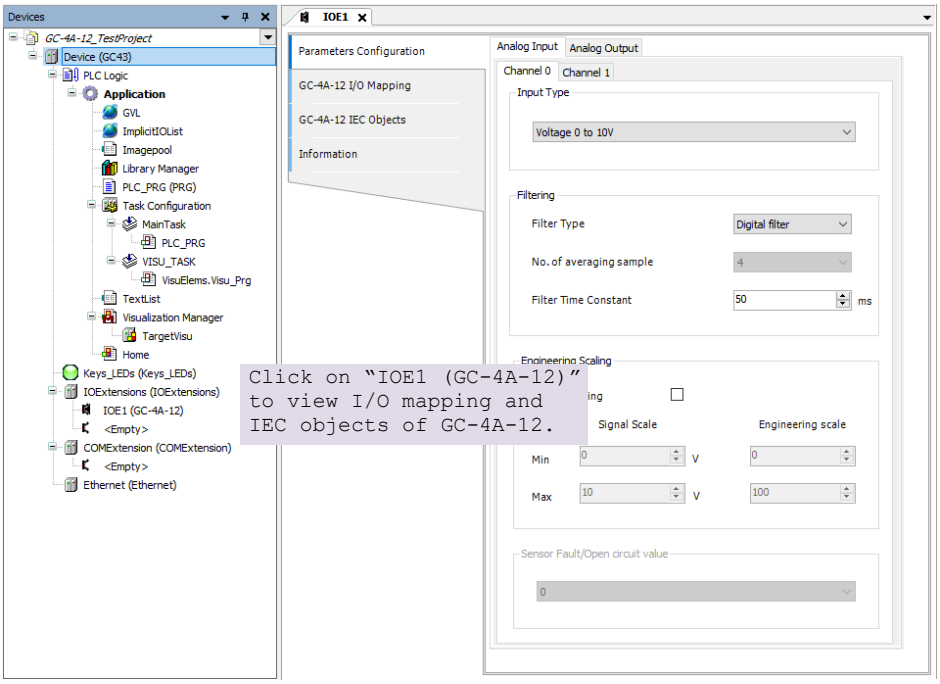
Figure 20: Wiring GC-4A-12

5.4.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-4A-12 consumes %IB12, %IB13, %QB12, %QB13 when fixed in IO1 slot and %IB14, %IB15, %QB14, %QB15 when fixed in IO2 slot.

To plug extension device GC-4A-12 in selected slot, refer section *Hardware Configuration*. After plugging device GC-4A-12, <Empty> slot is replaced by IOE1 (GC-4A-12) and as shown below.

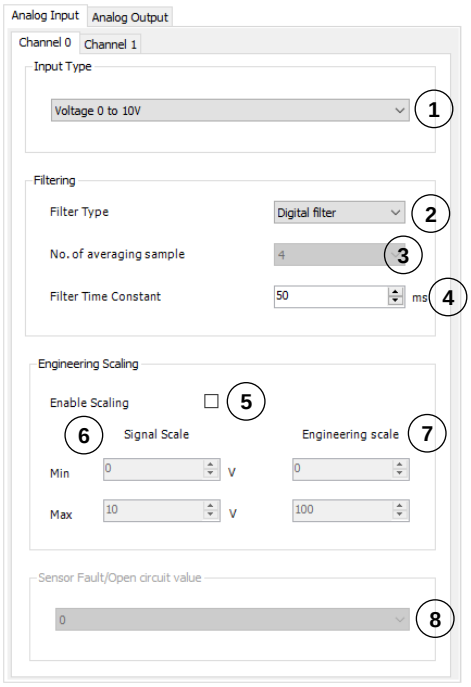


Similarly, for slot2, after plugging GC-4A-12, <Empty> slot is replaced by IOE2 (GC-4A-12).

5.4.3.1 Parameter Configuration

For parameters configuration of GC-4A-12, double click on device 'IOE1 (GC-4A-12) → Parameters Configuration.

For analog inputs, set individual channel parameters using tabs 'Analog Input → 'Channel 0' and 'Channel 1'. Parameters configuration is explained for 'Analog Input → 'Channel 0' as shown below.

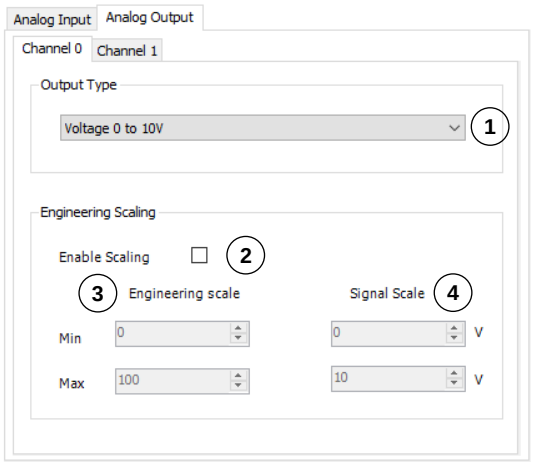


Sr. No.	Parameter	Options	Description
Analog Input configuration			
1	Input type	Voltage 0 to 10V (Default) Voltage -10 to +10V Current 0 to 20mA Current 4 to 20mA	Selection for type of input as per application requirement.
2	Filter type	No Filter Averaging Digital Filter (Default)	Selection for signal conditioning by software filtering
3	No. of averaging sample	4 (Default) 8 16 32	For filter type as 'Averaging', user can select number of averaging samples using drop-down.
4	Filter time constant	Default value: 50 ms Supported range: 10 to 5000 ms	For filter type as 'Digital Filter', user can set filter time constant in msec.

Engineering scaling [Enable Scaling] applicable for all supported input types			
5	Enable scaling	Enable/ Disable	Check 'Enable' to apply engineering scaling. to Channel 0.
6	Signal scale	For Voltage 0 to 10V input type, Min: 0 V and Max: 10 V. For Voltage -10 to +10V input type, Min: -10 V and Max: 10 V. For Current 0 to 20mA input type, Min: 0 mA and Max: 20 mA For Current 4 to 20mA input type, Min: 4 mA and Max: 20 mA	This parameter holds minimum and maximum values of input signal as per configured input type. This parameter in not editable
7	Engineering scale	Default values: Min: 0 and Max: 100 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set minimum and maximum value of engineering scaling as per application requirement.
Sensor Fault/ Open circuit value [applicable only for 4 to 20 mA input type]			
8	Sensor Fault/Open circuit value	0	Holds zero value
		Maximum Value	Holds maximum value of range
		Minimum Value	Holds minimum value of range
		Last Value	Holds valid count for the input channel before sensor fault or open circuit occurrence.

Similarly, user can configure parameters for Channel 1 using tab '*Channel 1*' under tab '*Analog Input*' as shown above.

For analog outputs, set individual channel parameters using tabs ‘Analog Output → ‘Channel 0’ and ‘Channel 1’. Parameters configuration is explained for ‘Analog Output → ‘Channel 0’ as shown below.



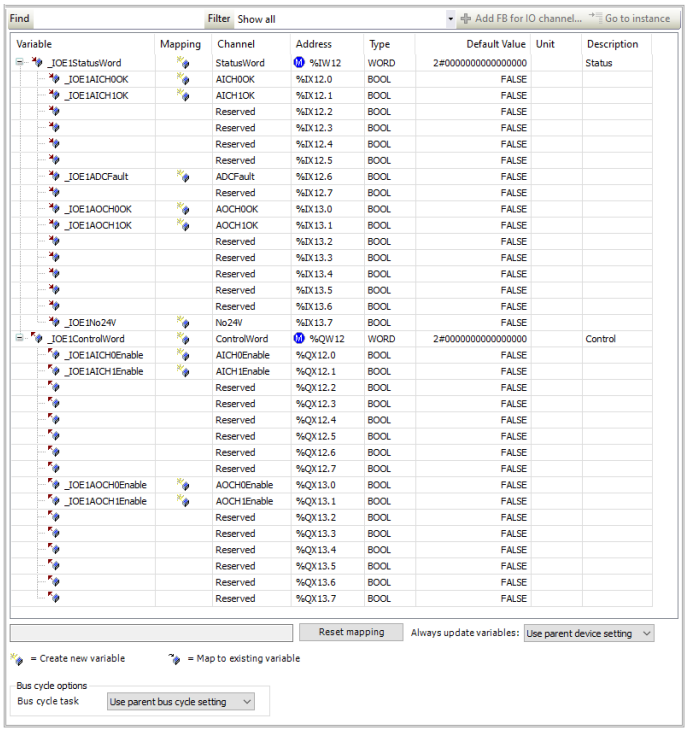
Sr. No.	Parameter	Options	Description
Analog Output configuration			
1	Output Type	Voltage 0 to 10V (Default) Voltage -10 to +10V Current 0 to 20mA Current 4 to 20mA	Selection for type of output as per application requirement.
Engineering scaling [Enable Scaling] applicable for all supported output types			
2	Enable Scaling	Enable/ Disable	Check ‘Enable’ to apply engineering scaling to Channel 0.
3	Engineering scale	For Voltage 0 to 10V output type, Min: 0 V and Max: 10 V. For Voltage -10 to +10V output type, Min: -10 V and Max: 10V. For Current 0 to 20mA output type, Min: 0 mA and Max: 20 mA For Current 4 to 20mA output type, Min : 4 mA and Max : 20 mA	This parameter holds minimum and - maximum values of output signal as per configured output type.
4	Signal scale	Default values: Min: 0 and Max: 100 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set minimum and maximum values of engineering scaling as per application requirement. This parameter in not editable

Similarly, user can configure parameters for Channel 1 using tab ‘*Channel 1*’ under tab ‘*Analog Output*’ as shown above.

5.4.4 I/O Mapping

On '*GC-4A-12 I/O mapping*' tab, list of I/O variables is available.

To view I/O mapping, double click on IOE1 (GC-4A-12) → *GC-4A-12 I/O Mapping* as shown below.



Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
_IOE1StatusWord		StatusWord	%IW12	WORD	2#0000000000000000		Status
_IOE1AICH0OK		AICH0OK	%IX12.0	BOOL	FALSE		
_IOE1AICH1OK		AICH1OK	%IX12.1	BOOL	FALSE		
		Reserved	%IX12.2	BOOL	FALSE		
		Reserved	%IX12.3	BOOL	FALSE		
		Reserved	%IX12.4	BOOL	FALSE		
		Reserved	%IX12.5	BOOL	FALSE		
_IOE1ADCFault		ADCFault	%IX12.6	BOOL	FALSE		
		Reserved	%IX12.7	BOOL	FALSE		
_IOE1AOCH0OK		AOCH0OK	%IX13.0	BOOL	FALSE		
_IOE1AOCH1OK		AOCH1OK	%IX13.1	BOOL	FALSE		
		Reserved	%IX13.2	BOOL	FALSE		
		Reserved	%IX13.3	BOOL	FALSE		
		Reserved	%IX13.4	BOOL	FALSE		
		Reserved	%IX13.5	BOOL	FALSE		
		Reserved	%IX13.6	BOOL	FALSE		
_IOE1No24V		No24V	%IX13.7	BOOL	FALSE		
_IOE1ControlWord		ControlWord	%QW12	WORD	2#0000000000000000		Control
_IOE1AICH0Enable		AICH0Enable	%QX12.0	BOOL	FALSE		
_IOE1AICH1Enable		AICH1Enable	%QX12.1	BOOL	FALSE		
		Reserved	%QX12.2	BOOL	FALSE		
		Reserved	%QX12.3	BOOL	FALSE		
		Reserved	%QX12.4	BOOL	FALSE		
		Reserved	%QX12.5	BOOL	FALSE		
		Reserved	%QX12.6	BOOL	FALSE		
		Reserved	%QX12.7	BOOL	FALSE		
_IOE1AOCH0Enable		AOCH0Enable	%QX13.0	BOOL	FALSE		
_IOE1AOCH1Enable		AOCH1Enable	%QX13.1	BOOL	FALSE		
		Reserved	%QX13.2	BOOL	FALSE		
		Reserved	%QX13.3	BOOL	FALSE		
		Reserved	%QX13.4	BOOL	FALSE		
		Reserved	%QX13.5	BOOL	FALSE		
		Reserved	%QX13.6	BOOL	FALSE		
		Reserved	%QX13.7	BOOL	FALSE		

Default configuration provides pre-defined symbolic naming for each input and output. There is no other configuration required.

For channel 0, symbolic name is `_IOE1AICH0Enable` and address is %IX12.0.
for output Q00, symbolic name is `_DO_IOE1_0` and address is %QX12.0.

Prefix is `_DO_`. Text `IOE1_0` indicates that unit is fixed in IO1 slot and output is Q00.

User can change the name as e.g. `MOTOR1`.after selecting output and clicking on respective highlight.

The table below provides the details of I/O bits related to GC-8ET-ESS.

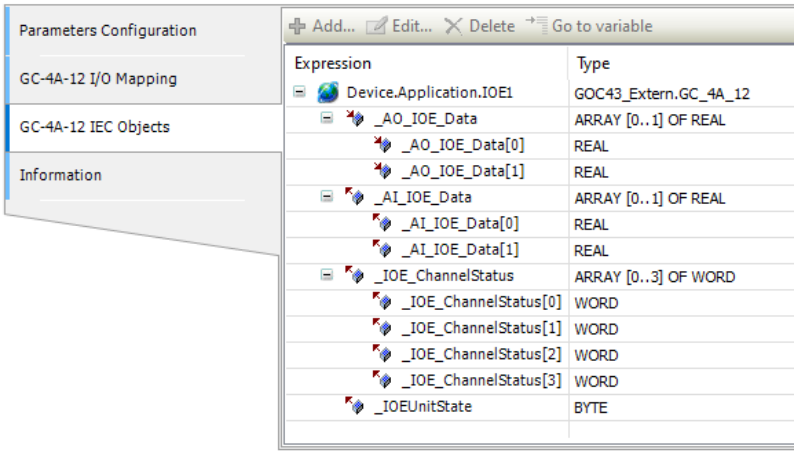
The table below provides the details of I/O bits related to GC-4A-12.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
_IOE☐StatusWord.			
_IOE☐AICH0OK	%IX12.0	%IX14.0	**TRUE**: - Respective input channel is enabled and healthy. **FALSE**: - Respective input channel is disabled. - Open circuit for 4 to 20 mA current input type
_IOE☐AICH1OK	%IX12.1	%IX14.1	
_IOE☐ADCFault	%IX12.6	%IX14.6	**TRUE:** On-board ADC is faulty. **FALSE:** On-board ADC is healthy.
_IOE☐AOCH0OK	%IX13.0	%IX15.0	**TRUE**: - Respective output channel is enabled and healthy. **FALSE**: - Respective output channel is disabled. - Open circuit for 4 to 20 mA current output type
_IOE☐AOCH1OK	%IX13.1	%IX15.1	
_IOE☐No24V	%IX13.7	%IX15.7	**TRUE**: - External 24Vdc supply is not connected to unit. - External 24Vdc supply is connected but in reverse polarity. - External DC supply connected is below 18Vdc. **FALSE**: - External 24Vdc supply connected to the unit is healthy
_IOE☐ControlWord.			
_IOE☐AICH0Enable	%QX12.0	%QX14.0	**TRUE** - Enable respective channel through *IO Mapping* tab. **FALSE:** Disable respective channel through *IO Mapping* tab.
_IOE☐AICH1Enable	%QX12.1	%QX14.1	
_IOE☐AOCH0Enable	%QX13.0	%QX15.0	
_IOE☐AOCH1Enable	%QX13.1	%QX15.1	

5.4.4.1 IEC Objects

On ‘GC-4A-12 IEC Objects’ tab, user can monitor variables related to GC-4A-12 in online mode as below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td>IOE1._AI_IOE_Data[0]</td><td>REAL</td><td>Holds analog input channel0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Input Type</th><th>Channel Data</th></tr>
<tr><td>0 to 10 VDC</td><td>0 to 64000</td></tr>
<tr><td>-10 to +10 VDC</td><td>-32000 to 32000</td></tr>
<tr><td>0 to 20 mA</td><td>0 to 64000</td></tr>
<tr><td>4 to 20 mA</td><td>0 to 64000</td></tr>
</table>
In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling.</td></tr>
<tr><td>IOE1._AI_IOE_Data[1]</td><td>REAL</td><td>Holds analog input channel1 data.as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AO_IOE_Data[0]</td><td>REAL</td><td>Holds analog output channel0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Channel Data</th><th>Output Type</th></tr>
<tr><td>0 to 4000</td><td>0 to 10 VDC</td></tr>
<tr><td>-2000 to 2000</td><td>-10 to +10 VDC</td></tr>
<tr><td>0 to 4000</td><td>0 to 20 mA</td></tr>
<tr><td>0 to 4000</td><td>4 to 20 mA</td></tr>
</table></td></tr>
<tr><td>IOE1._AO_IOE_Data[1]</td><td>REAL</td><td>Holds analog output channel1 data.as explained for _AO_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._IOE_ChannelStatus</td><td>ARRAY [0..3] OF WORD</td><td>Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0.
Array location 0 and 1 holds status of analog input channel 0 and channel 1.
Array location 2 and 3 holds status of analog output channel 0 and channel 1.
Details of bits of status word as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr><tr><td>1</td><td>Reserved</td></tr><tr><td>2</td><td>Open circuit or sensor fault status
0 - No open circuit / Sensor fault
1 - Open circuit detected at channel</td></tr><tr><td>3</td><td>If channel data is out of range, as defined by basic resolution or engineering scaling, then,
0: Data count valid
1: Data count invalid</td></tr><tr><td>4 - 15</td><td>Reserved</td></tr></table></td></tr>
<tr><td>IOE1._IOEUnitState</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr><tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr><tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr><tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr></table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with `IOE2.<VariableName>.`

5.5 GC-4UAD-10

This is 4 Ch. analog voltage/ current/ 3-wire PT100 input extension unit that provides 12-bit resolution. User can attach 2 I/O extension units on the back side of Main unit.

5.5.1 Specifications

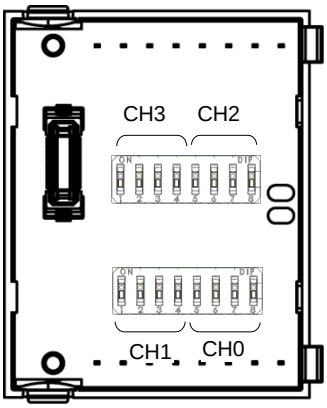
Item		Description		
Number of inputs		4 channels voltage/current/ 3-wire PT100 (385), single ended, non-isolated, 12-bit resolution		
Input types (Configurable through DIP switch setting on unit backside)		**Voltage**	**Current**	**3-Wire PT100**
		0 to 10 VDC	0 to 20 mA	-50 to 150°C
Output data		0 to 4000	0 to 4000	-50.0 to 150.0
1-bit Resolution		2.5 mV	5 µA	0.24°C
Overall accuracy (% of full scale) *1	At 25°C	±0.3	±0.3	±0.4
	At 55°C	±0.4	±0.4	±1.5
Input impedance		1 MΩ	135 Ω	Not applicable
Sensor excitation		Not applicable		1 mA
Lead wire resistance		Not applicable		20 Ω max. per wire
Unit updation time		Refer section 17.Appendix → 17.1 Updation time for Analog input, in this manual		
Absolute maximum input		±30 VDC/ 30 mA		
Isolation		No isolation		
Method of termination		2 nos. 8-pin terminal blocks, fixed, screw type		
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)		
Weight (in grams)		60		

*1 Accuracy is measured with default filter time of 50 msec.

NOTE

Unit offers 12-bit resolution when used with GOC whereas it offers 10-bit resolution when used with GOC35.

For each analog input channel, 4-DIP switch settings are provided for input type selection, which is placed on the back side of extension unit.



Input Type	DIP switch settings							
	1	2	3	4	5	6	7	8
	Ch1/ Ch3				Ch0/ Ch2			
3 wire PT100 (385)	ON	ON	OFF	OFF	ON	ON	OFF	OFF
Voltage	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
Current	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON

NOTE

For any other undefined settings of DIP switch, for all input types (3-wire PT100, voltage, current) channel data holds maximum count of respective configured input type.

User should ensure that DIP switch settings are set as per input type configuration through CoDeSys application i.e. using configuration parameters of GC-4UAD-10. In case of mismatch or invalid setting, channel data behavior will be as explained in the table below

Input Type configuration through Tool	DIP Switch setting	Behaviour of analog input channel
0 to 10V	Current [0 to 20 mA]	Channel data holds minimum count of configured input type
	PT 100 [-50° to 150°C]	Channel holds maximum count of configured input type
	Any other setting	
0 to 20mA	Voltage [0 to 10 VDC]	Channel holds minimum count of configured input type
	PT 100 [-50° to 150°C]	Channel holds maximum count of configured input type
	Any other setting	
3-wire PT 100 [-50° to 150°C]	Current [0 to 20 mA]	Channel holds minimum count of configured input type
	Voltage [0 to 10 VDC]	
	Any other setting	Channel holds maximum count of configured input type

5.5.2 Wiring

I/O extension unit provides 4 terminals per channel **CS**, **V**, **I** and **C**.

1. Voltage input is connected between **V** and **C**.
2. Current input is connected between **I** and **C**.
3. 3-wire PT100 sensor is connected between **V** and **C** with lead compensation cable connected to **CS**.

The wiring diagram shows how to connect field input devices to I/O extension unit. For an example, channel 0 is connected to voltage input, channel 2 is connected to current input and channel 3 is connected to 3-wire PT100 sensor.

Refer section *Wiring*, before wiring analog input sensors to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- For analog sensors, PT100 sensors, use cable provided/recommended by the sensor manufacturer. Follow the recommendations provided by sensor manufacturer.
- Connect cable shield at I/O extension unit end directly to a good quality earth. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

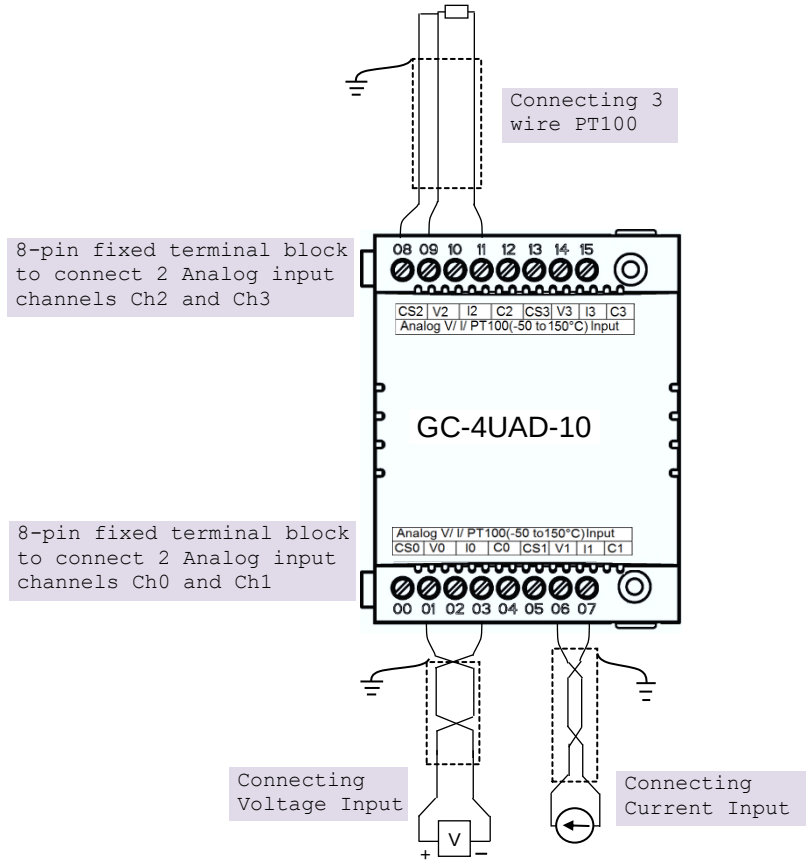


Figure 21: Wiring GC-4UAD-10

For PT100 [-50 to 150°C] type of input, sensor is connected between terminals **V** and **C** with lead compensation cable connected to **CS**.

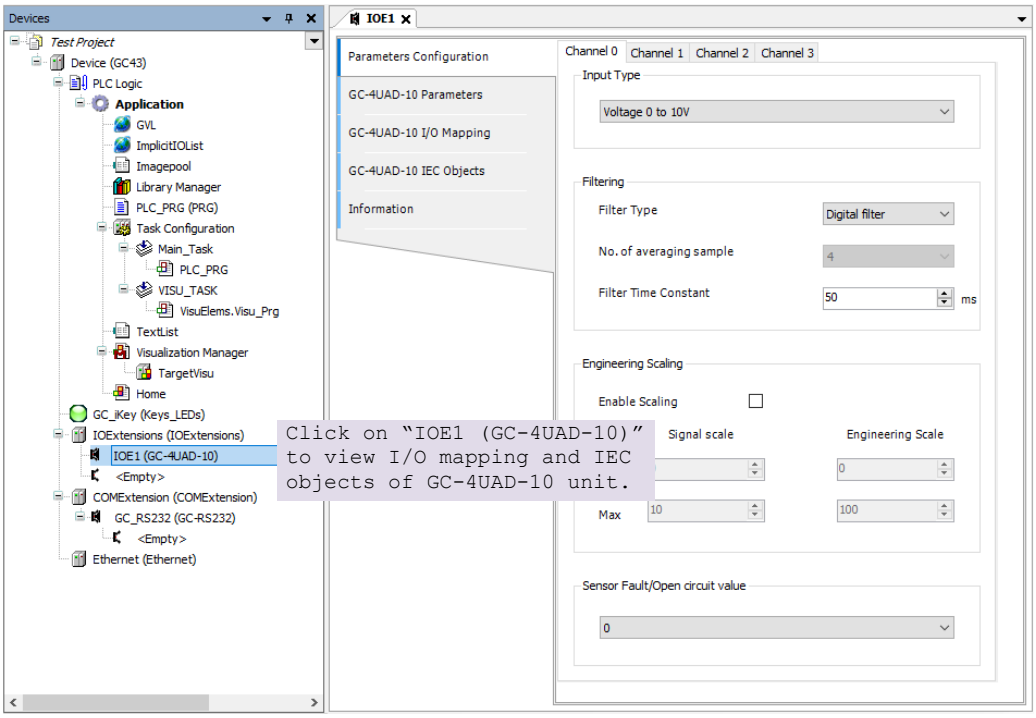
If user connects **voltage**/ **current** input to **CS** terminal, then it damages connected input channel.

5.5.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-4UAD-10 consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-4UAD-10 in selected slot, refer section *Hardware Configuration*. After plugging GC-4UAD-10, <Empty> slot is replaced by IOE1 (GC-4UAD-10) as shown below.

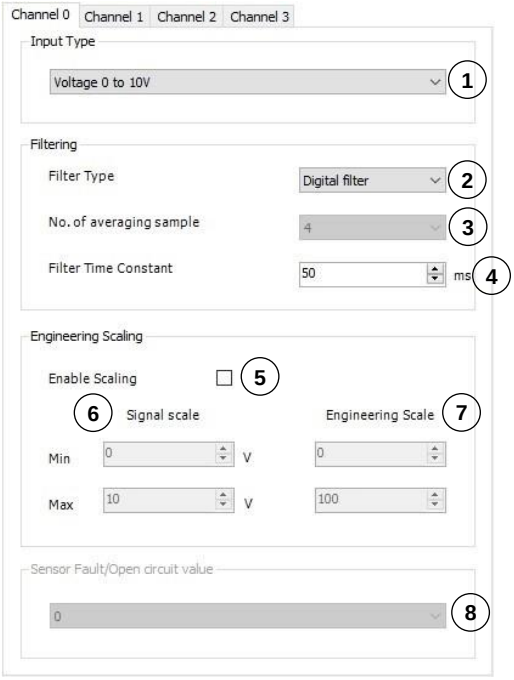


Similarly, after plugging GC-4UAD-10 in slot2, <Empty> slot is replaced by IOE2 (GC-4UAD-10).

5.5.3.1 Parameter Configuration

For parameters configuration of GC-4UAD-10, click on device 'GC-UAD-10' → Parameters Configuration.

Set individual channel parameters using tabs 'Channel 0' to 'Channel 3'. Parameters configuration is explained for Channel 0 as shown below.



Sr. No.	Parameter	Options	Description
Analog Input configuration			
1	Input Type	Voltage: 0 to 10Vdc (Default) Current: 0 to 20mA PT100: -50 to 150°C	Selection for type of input as per application requirement.
2	Filter type	No Filter Averaging Digital Filter (Default)	Selection for signal conditioning by software
3	No. of averaging sample	4 (Default) 8 16 32	For filter type as 'Averaging' user can select number of averaging samples using drop-down as either,
4	Filter time constant	Default value : 50 (msec). Supported range : 10 to 5000 msec	For filter type as 'Digital Filter' user can set filter time constant in msecs.

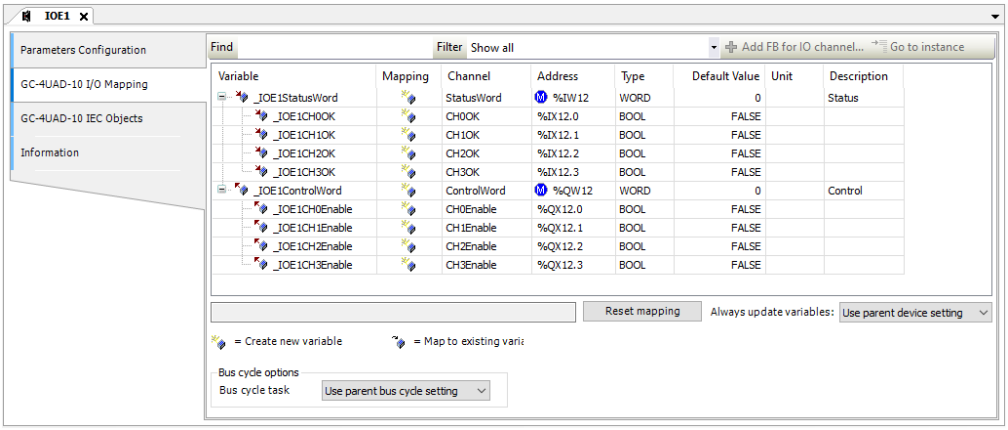
Engineering scaling [Enable Scaling] applicable for 0 to 10V and 0 to 20mA input types			
5	Enable	--	Check 'Enable' to apply engineering scaling to Channel 0.
6	Signal scale	For 0 to10V input type, Min : 0V and Max : 10V. For 0 to 20mA input type, Min : 0mA and Max : 20 mA	This parameter holds min-max values as per configured input type
7	Engineering scale	Supported range : -64000.0 to 64000.0 for both Min-Max settings	User can set min-max values of engineering scaling as per application requirement.
***Sensor Fault/ Open circuit value** [applicable only for PT100 input type]			
8	Sensor Fault/Open circuit value	0	Holds zero value at input channel
		Maximum Value	Holds maximum value of range [+150.0°C]
		Minimum Value	Holds minimum value of range [-50.0°C]
		Last Value	Holds valid count at channel before sensor fault or open circuit occurrence.

For PT100 input type, sensor fault/ open circuit is detected only if either of sensor input terminals (i.e. terminal V or C) becomes open or faulty.

5.5.4 I/O Mapping

On '*GC-4UAD-10 I/O mapping*' tab, list of I/O variables is available.

To view I/O mapping, click on Devices → IOE1 (GC-4UAD-10) → *GC-4UAD-10 I/O Mapping* as shown below.



Default configuration provides predefined symbolic naming for each input. There is no other configuration required.

For input I00, symbolic name is `_IOE☐CH0OK` and address is %IX12.0. The table below provides the details of I/O bits related to GC-4UAD-10.

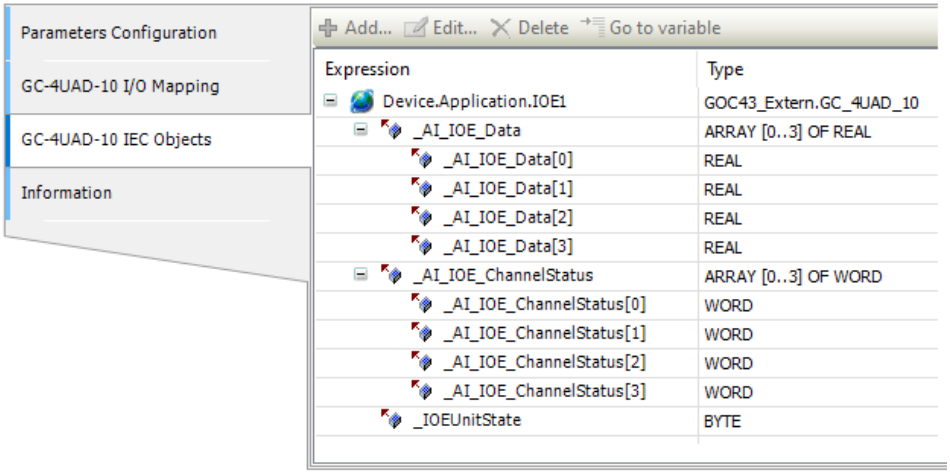
☐=0 for unit fixed in IO1 slot, ☐=1 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
`_IOE☐StatusWord.`			
`_IOE☐CH0OK`	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit for PT100 sensor
`_IOE☐CH1OK`	%IX12.1	%IX14.1	
`_IOE☐CH2OK`	%IX12.2	%IX14.2	
`_IOE☐CH3OK`	%IX12.3	%IX14.3	
`_IOE☐ControlWord.`			
`_IOE☐CH0Enable`	%QX12.0	%QX14.0	**TRUE** - Enable input channel. **FALSE:** - Disable input channel.
`_IOE☐CH1Enable`	%QX12.1	%QX14.1	
`_IOE☐CH2Enable`	%QX12.2	%QX14.2	
`_IOE☐CH3Enable`	%QX12.3	%QX14.3	

For GC-4UAD-10, input byte %IB13 and %IB15 as well as output bytes %QB13 to %QB15 are not used.

5.5.4.1 IEC Objects

On 'GC-4UAD-10 IEC Objects' tab, user can monitor variables related to GC-4UAD-10 in online mode as below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td>IOE1._AI_IOE_Data[0]</td><td>REAL</td><td>Holds analog input channel0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Input Type</th><th>Channel Data</th></tr>
<tr><td>0 to 10 VDC</td><td>0 to 4000</td></tr>
<tr><td>0 to 20 mA</td><td>0 to 4000</td></tr>
<tr><td>3-wire PT100 [-50 to 150ºC]</td><td>-50.0 to 150.0</td></tr>
</table>
In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling.
User defined Engineering Scaling is not applicable for input type 3-wire PT100 [-50 to 150ºC].</td></tr>
<tr><td>IOE1._AI_IOE_Data[1]</td><td>REAL</td><td>Holds analog input channel1 data.as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[2]</td><td>REAL</td><td>Holds analog input channel2 data.as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[3]</td><td>REAL</td><td>Holds analog input channel3 data.as explained for _AI_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._AI__IOE_Channel Status</td><td>ARRAY [0..3] OF WORD</td><td>Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0.
Details of bits of status word as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr><tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr><tr><td>2</td><td>PT100 sensor fault
0 - No open circuit
1 - Open circuit</td></tr><tr><td>3 - 15</td><td>Reserved</td></tr></table></td></tr>
<tr><td>IOE1._IOEUnitState</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr><tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr><tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr><tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr></table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with `IOE2.<VariableName>`.

5.6 GC-4UAD-10E

This is 4 Ch. analog voltage/ current/ 3-wire PT100 input extension unit that provides 12-bit resolution. User can attach up to 2 I/O extension units on the back side of Main unit.

5.6.1 Specifications

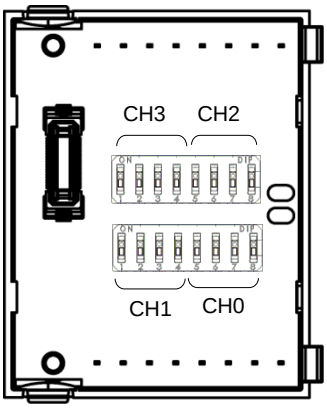
Item		Description		
Number of inputs		4 channels voltage/current/ 3-wire PT100 (385), single ended, non-isolated, 10-bit resolution		
Input types (Configurable through DIP switch setting on unit backside)		**Voltage**	**Current**	**3-Wire PT100**
		0 to 10 VDC	0 to 20 mA	-50 to 450°C
Output data		0 to 4000	0 to 4000	-50.0 to 450.0
1-bit Resolution		2.5 mV	5 µA	0.6°C
Overall accuracy (% of full scale) *1	At 25°C	±0.3	±0.3	±0.4
	At 55°C	±0.4	±0.4	±1.5
Input impedance		1 MΩ	135 Ω	Not applicable
Sensor excitation		Not applicable		1 mA
Lead wire resistance		Not applicable		20Ω max. per wire
Unit updation time		Refer section *17.Appendix → 17.1 Updation time for Analog input*, in this manual		
Absolute maximum input		±30 VDC/ 30 mA		
Isolation		No isolation		
Method of termination		2 nos. 8-pin terminal blocks, fixed, screw type		
Status indication		On LCD screen		
Dimensions (in mm)		61.5 (W) x 75 (H) x 24.5 (D)		
Weight (in grams)		60		

*1 Accuracy is measured with default filter time of 50 msecs.

NOTE

Unit offers 12-bit resolution when used with GOC whereas it offers 10-bit resolution when used with GOC35.

For each analog input channel, 4-DIP switch settings are provided for input type selection, which is placed on the back side of extension unit.



Input Type	DIP switch settings							
	1	2	3	4	5	6	7	8
	Ch1/ Ch3				Ch0/ Ch2			
3 wire PT100 (385)	ON	ON	OFF	OFF	ON	ON	OFF	OFF
Voltage	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
Current	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON

NOTE

For any other undefined settings of DIP switch, for all input types (3-wire PT100, voltage, current) channel data holds maximum count of respective configured input type.

User should ensure that DIP switch settings are set as per input type configuration through Hardware Configuration Tool. In case of mismatch or invalid setting, channel data behavior will be as explained in the table below

Input Type configuration through Tool	DIP Switch setting	Behaviour of analog input channel
0 to 10V	Current [0 to 20 mA]	Channel holds minimum count for configured input type
	PT 100 [-50° to 450°C]	Channel holds maximum count for configured input type
	Any other setting	
0 to 20mA	Voltage [0 to 10 VDC]	Channel holds minimum count for configured input type
	PT 100 [-50° to 450°C]	Channel holds maximum count for configured input type
	Any other setting	
3-wire PT 100 [-50° to 450°C]	Current [0 to 20 mA]	Channel holds minimum count for configured input type
	Voltage [0 to 10 VDC]	
	Any other setting	Channel holds maximum count for configured input type

5.6.2 Wiring

I/O extension unit provides 4 terminals per channel **CS**, **V**, **I** and **C**.

1. Voltage input is connected between **V** and **C**.
2. Current input is connected between **I** and **C**.
3. 3-wire PT100 sensor is connected between **V** and **C** with lead compensation cable connected to **CS**.

The wiring diagram shows how to connect field input devices to I/O extension unit. For an example, channel 0 is connected to voltage input, channel 2 is connected to current input and channel 3 is connected to 3-wire PT100 sensor.

Refer section *Wiring*, before wiring analog input sensors to I/O extension unit.

- It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.
- For analog sensors, PT100 sensors use cable provided/recommended by the sensor manufacturer. Follow the recommendations provided by sensor manufacturer.
- Connect cable shield at I/O extension unit end directly to a good quality earth. It is recommended to keep cable shield at sensor end unconnected.
- The Earthing resistance should be 100 Ω or less.

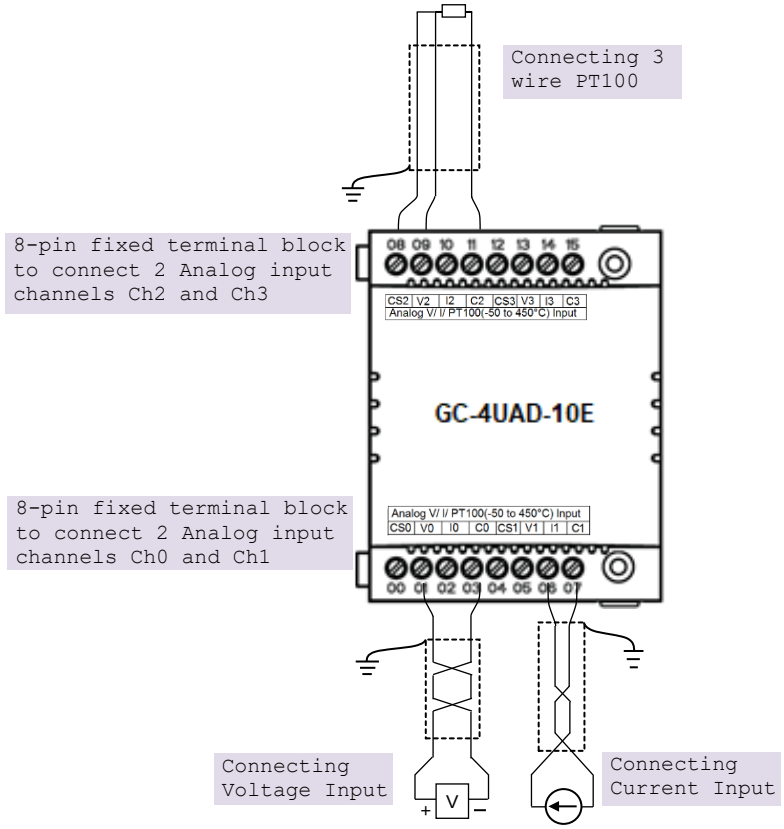


Figure 22: Wiring GC-4UAD-10E

For PT100 [-50 to 450°C] type of input, sensor is connected between terminals **V** and **C** with lead compensation cable connected to **CS.**

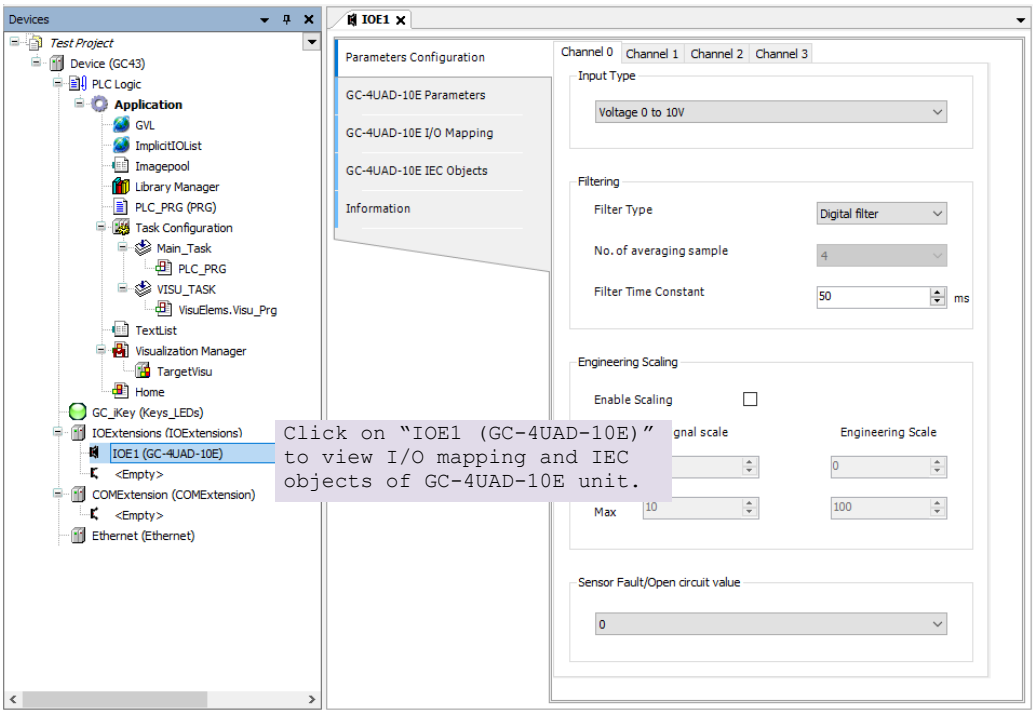
If user connects **voltage**/ **current** input to **CS** terminal, then it damages connected input channel.

5.6.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-4UAD-10E consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-4UAD-10E in selected slot, refer section *Hardware Configuration*. After plugging GC-4UAD-10E, <Empty> slot is replaced by IOE1 (GC-4UAD-10E) as shown below.



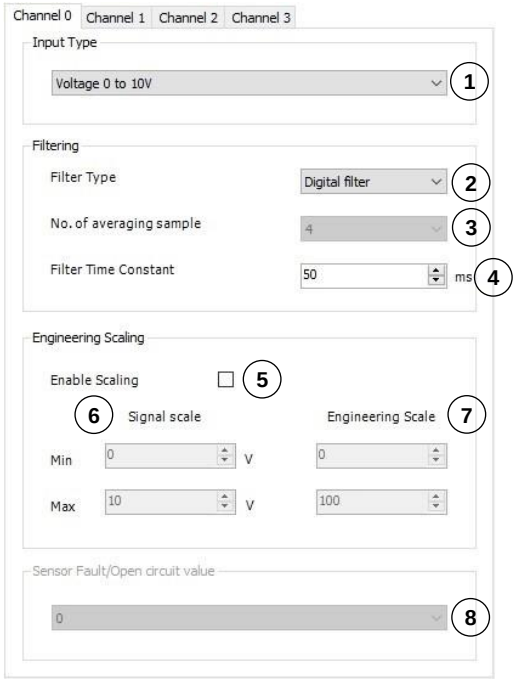
Similarly, after plugging GC-4UAD-10E in slot2, <Empty> slot is replaced by IOE2 (GC-4UAD-10E).

5.6.3.1 Parameter Configuration

For parameters configuration of GC-4UAD-10E, click on device 'GC-UAD-10E' → Parameters Configuration.

Set individual channel parameters using tabs 'Channel 0' to 'Channel 3'.

As shown below, parameters configuration is explained for Channel 0.



Sr. No.	Parameter	Options	Description
Analog Input configuration			
1	Input Type	Voltage: 0 to 10Vdc (Default) Current: 0 to 20mA PT100: -50 to 450°C	Selection for type of input as per application requirement.
2	Filter type	No Filter Averaging Digital Filter (Default)	Selection for signal conditioning by software
3	No. of averaging sample	4 (Default) 8 16 32	For filter type as 'Averaging' user can select number of averaging samples using drop-down as either,
4	Filter time constant	Default value : 50 (msec). Supported range : 10 to 5000 msec	For filter type as 'Digital Filter' user can set filter time constant in msecs.

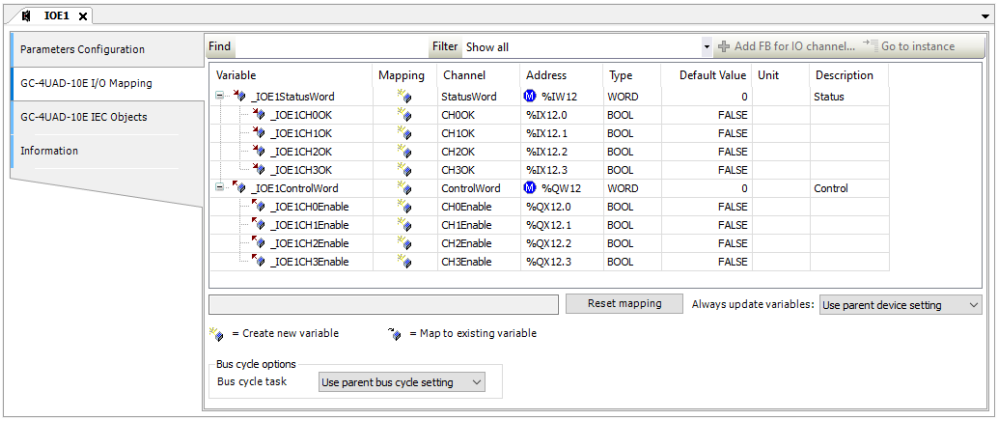
Engineering scaling [Enable Scaling] applicable for 0 to 10V and 0 to 20mA input types			
5	Enable	--	Check 'Enable' to apply engineering scaling to Channel 0.
6	Signal scale	For 0 to10V input type, Min : 0V and Max : 10V. For 0 to 20mA input type, Min : 0mA and Max : 20 mA	This parameter holds min-max values as per configured input type
7	Engineering scale	Supported range : -64000.0 to 64000.0 for both Min- Max settings	User can set min-max values of engineering scaling as per application requirement.
***Sensor Fault/ Open circuit value** [applicable only for PT100 input type]			
8	Sensor Fault/Open circuit value	0	Holds zero value at input channel
		Maximum Value	Holds maximum value of range [+450.0°C]
		Minimum Value	Holds minimum value of range [-50.0°C]
		Last Value	Holds valid count at channel before sensor fault or open circuit occurrence.

For PT100 input type, sensor fault/ open circuit is detected only if either of sensor input terminals (i.e. terminal V or C) becomes open or faulty.

5.6.4 I/O Mapping

On '*GC-4UAD-10E IO mapping*' tab, list of I/O variables is available.

To view I/O mapping, click on Devices → IOE1 (GC-4UAD-10E) → *GC-4UAD-10E I/O Mapping* as shown below.



Default configuration provides predefined symbolic naming for each input. There is no other configuration required.

For input I00, symbolic name is `_IOE☐CH0OK` and address is %IX12.0. The table below provides the details of I/O bits related to GC-4UAD-10E.

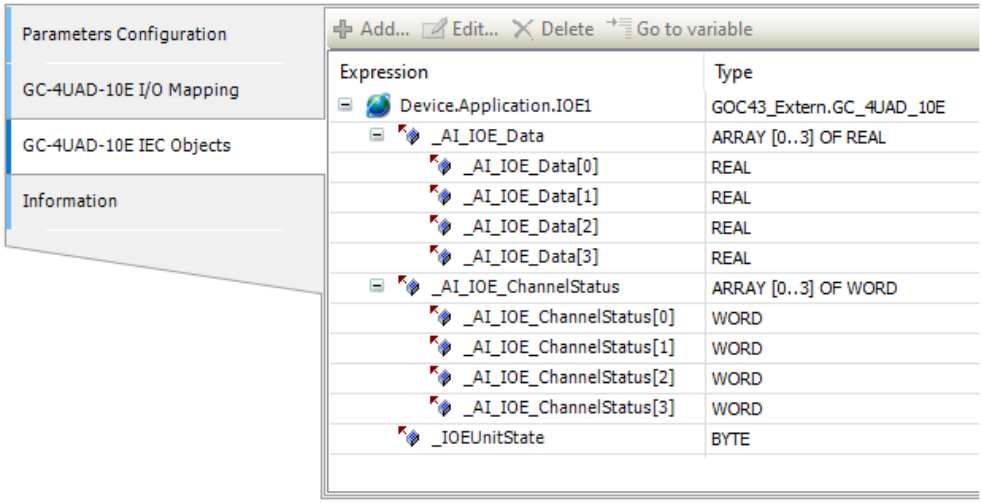
☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
`_IOE☐StatusWord.`			
`_IOE☐CH0OK`	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit for PT100 sensor
`_IOE☐CH1OK`	%IX12.1	%IX14.1	
`_IOE☐CH2OK`	%IX12.2	%IX14.2	
`_IOE☐CH3OK`	%IX12.3	%IX14.3	
`_IOE☐ControlWord.`			
`_IOE☐CH0Enable`	%QX12.0	%QX14.0	**TRUE** - Enable input channel. **FALSE:** - Disable input channel.
`_IOE☐CH1Enable`	%QX12.1	%QX14.1	
`_IOE☐CH2Enable`	%QX12.2	%QX14.2	
`_IOE☐CH3Enable`	%QX12.3	%QX14.3	

For GC-4UAD-10E, input byte %IB13 and %IB15 as well as output bytes %QB13 to %QB15 are not used.

5.6.4.1 IEC Objects

On 'GC-4UAD-10E IEC Objects' tab, user can monitor variables related to GC-4UAD-10E in online mode as below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td>IOE1._AI_IOE_Data[0]</td><td>REAL</td><td>Holds analog input channel0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Input Type</th><th>Channel Data</th></tr>
<tr><td>0 to 10 VDC</td><td>0 to 4000</td></tr>
<tr><td>0 to 20 mA</td><td>0 to 4000</td></tr>
<tr><td>3-wire PT100 [-50 to 450ºC]</td><td>-50.0 to 450.0</td></tr>
</table>
In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling.
User defined Engineering Scaling is not applicable for input type 3-wire PT100 [-50 to 450ºC].</td></tr>
<tr><td>IOE1._AI_IOE_Data[1]</td><td>REAL</td><td>Holds analog input channel1 data.as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[2]</td><td>REAL</td><td>Holds analog input channel2 data.as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[3]</td><td>REAL</td><td>Holds analog input channel3 data.as explained for _AI_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._AI__IOE_Channel Status</td><td>ARRAY [0..3] OF WORD</td><td>Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus[0] holds status of channel 0. Details of bits of status word as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr><tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr><tr><td>2</td><td>PT100 sensor fault
0 - No open circuit
1 - Open circuit</td></tr><tr><td>3 - 15</td><td>Reserved</td></tr></table></td></tr>
<tr><td>IOE1._IOEUnitState</td><td>BYTE</td><td>This variable holds I/O extension unit state as follows
<table><tr><th>Bit No</th><th>Details</th></tr><tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr><tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr><tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr><tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr></table></td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with `IOE2.<VariableName>`.

5.7 GC-4UAD-16

This is 4 Ch. universal analog voltage/ current/ thermocouple/ milli volt / 3-wire PT100/ P1000 input extension unit that provides 16-bit resolution. User can attach up to 2 I/O extension units on the back side of Main unit.

5.7.1 Specifications

<table>
<tr><th>Item</th><th colspan="5">Description</th></tr>
<tr><td>Number of inputs</td><td colspan="5">4 channel voltage/ current/ thermocouple/ milli volt/ 3-wire PT100 /PT1000,
Differential, non-isolated, 16-bit resolution</td></tr>
<tr><td rowspan="12">Input types</td><td rowspan="2">Input Type</td><td rowspan="2">Resolution</td><td rowspan="2">Output Data</td><td colspan="2">Overall Accuracy (% of FSD)</td></tr>
<tr><td>At 25°C</td><td>At 55°C</td></tr>
<tr><td>0 to 10 Vdc</td><td>0.15 mV</td><td>0 to 64000</td><td>±0.2</td><td>±0.3</td></tr>
<tr><td>±10 Vdc</td><td>0.3 mV</td><td>-32000 to 32000</td><td>±0.2</td><td>±0.3</td></tr>
<tr><td>±100 mV</td><td>3 µV</td><td>-32000 to 32000</td><td>±0.1</td><td>±0.2</td></tr>
<tr><td>0 to 20 mA</td><td>0.3 µA</td><td>0 to 64000</td><td>±0.2</td><td>±0.3</td></tr>
<tr><td>4 to 20 mA</td><td>0.3 µA</td><td>0 to 64000</td><td>±0.2</td><td>±0.3</td></tr>
<tr><td>PT100 (385)</td><td>0.1 °C</td><td>-200.0 to 850.0</td><td>±0.3</td><td>±0.6</td></tr>
<tr><td>PT100 (385)</td><td>0.01 °C</td><td>-50.00 to 250.00</td><td>±0.5</td><td>±1</td></tr>
<tr><td>PT1000 (385)</td><td>0.01 °C</td><td>-50.0 to 250.0</td><td>±0.4</td><td>±0.6</td></tr>
<tr><td>J Type Tc</td><td>0.1 °C</td><td>-100.0 to 1200.0</td><td>±0.5</td><td>±1</td></tr>
<tr><td>K Type Tc</td><td>0.1 °C</td><td>-100.0 to 1372.0</td><td>±0.5</td><td>±1</td></tr>
<tr><td>Scaling to engineering units</td><td colspan="5">For voltage, milli volt and current input types</td></tr>
<tr><td>Input impedance</td><td colspan="5">Voltage Input: > 1 MΩ,
Current Input: 124Ω,
Thermocouple/ mVolts input: > 100 KΩ</td></tr>
<tr><td>Sensor excitation</td><td colspan="5">For PT100, 1 mA
For PT1000, 0.1 mA</td></tr>
<tr><td>Lead wire resistance</td><td colspan="5">30Ω max. per wire [Applicable only for 3-wire PT100, PT1000 input types]</td></tr>
<tr><td>Cold junction compensation</td><td colspan="5">Range: From 0 to 100 °C for thermocouple input</td></tr>
<tr><td>Channel updation time</td><td colspan="5">[[(2 x Cyclic interval) + Channel Conversion Time] x No. of Channels Enabled] + (Time constant x 10)
[[(2 x Cyclic interval) + Channel Conversion Time] x No. of Channels Enabled] x No. of averaging samples.
Channel conversion time for individual input type is,
Voltage/ mV input : 50 ms
Current input : 25 ms
PT100/ PT1000 input/ CJC sensor : 100 ms
Thermocouple Input : 200 ms</td></tr>
<tr><td>Absolute maximum input</td><td colspan="5">±30 VDC/ ±30 mA</td></tr>
<tr><td>Method of termination</td><td colspan="5">2 nos. 8-pin terminal blocks, fixed, screw type</td></tr>
<tr><td>Status indication</td><td colspan="5">On LCD screen</td></tr>
<tr><td>Dimensions (in mm)</td><td colspan="5">61.5 (W) x 75 (H) x 24.5 (D)</td></tr>
<tr><td>Weight (in grams)</td><td colspan="5">60</td></tr>
</table>

5.7.2 Wiring

I/O extension unit provides 4 terminals per channel **RT+**, **RT-**, **VI+** and **VI-**.

1. Voltage input is connected between **VI+** and **VI-**.
2. Current input is connected between **VI-** and **RT-**, along with short link between terminals **VI+** and **RT-**.
3. 3-wire PT100/ PT1000 sensor is connected between **RT+** and **RT-** along with lead compensation wire connected to **VI-**.
4. Thermocouple/ mVolts input is connected between **RT+** and **RT-**.

The wiring diagram shows how to connect field input devices to I/O extension unit. For an example, channel 0 is connected to voltage input, channel 1 is connected to current input, channel 2 is connected to 3-wire PT100 sensor and channel 3 is connected to thermocouple input.

Refer section *Wiring*, before wiring analog input sensors to I/O extension unit.

It is recommended to use 2-core shielded twisted pair cable for carrying analog signal.

For sensors especially for thermocouple and PT100/ PT1000, use cable provided/ recommended by the sensor manufacturer. Follow the recommendations provided by sensor manufacturer.

For PT100/PT1000 input type, open circuit detection is supported for sensor connections. It is not supported for lead wire compensation input at terminal VI-.

Connect cable shield at I/O extension unit end directly to a good quality earth. It is recommended to keep cable shield at sensor end unconnected.

The Earthing resistance should be 100 Ω or less.

It is recommended to use thermocouple with isolated tip. Accuracy will be hampered, if non isolated type of thermocouple element is used and if it gets connected to improper earth.

Ensure that input signal is connected to relevant terminals as per configured input type. Unit may get damaged with wrong connections.

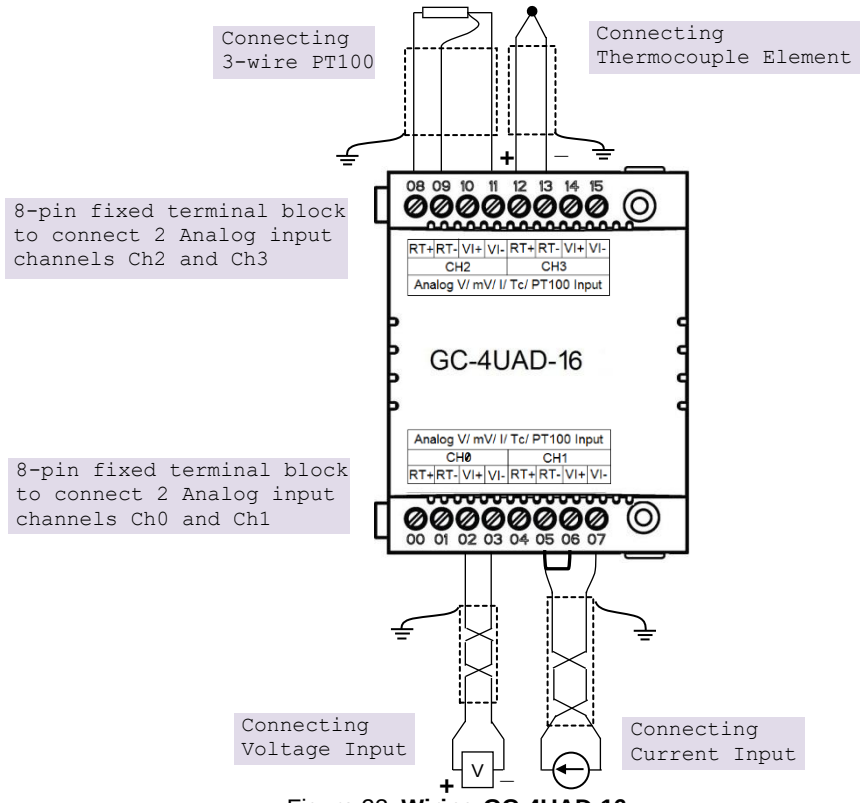


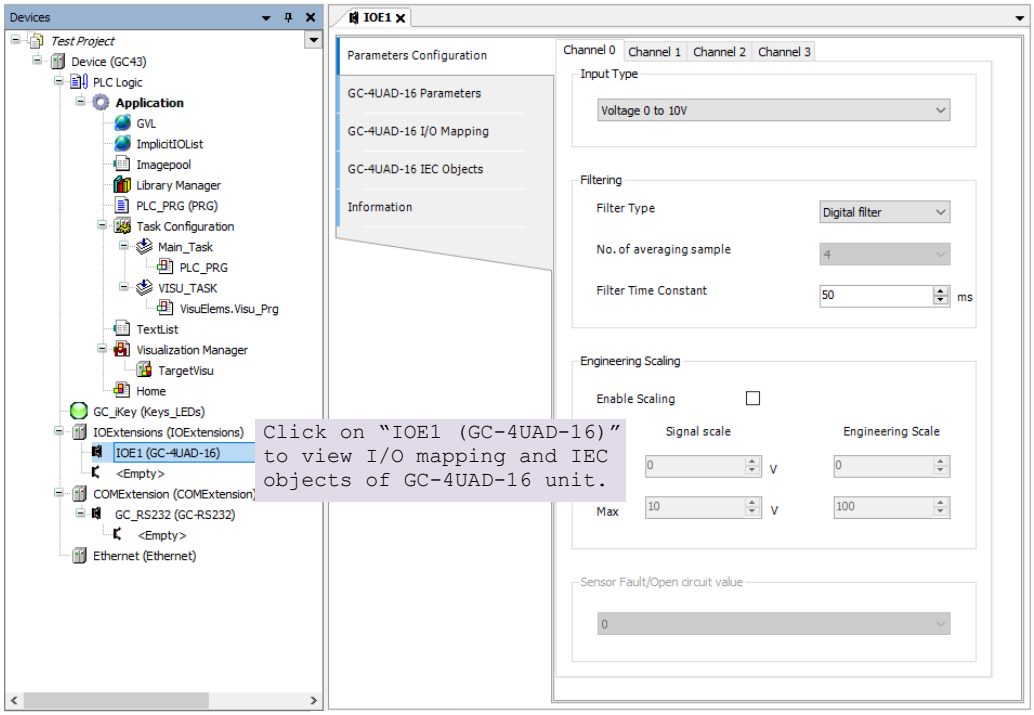
Figure 23: **Wiring GC-4UAD-16**

5.7.3 Configuration and Programming

For I/O Extension units, I/O memory map is fixed.

GC-4UAD-16 consumes %IB12 when fixed in IO1 slot and %IB14 when fixed in IO2 slot.

To plug extension device GC-4UAD-16 in selected slot, refer section *Hardware Configuration*. After plugging GC-4UAD-16, <Empty> slot is replaced by IOE1 (GC-4UAD-16) as shown below.



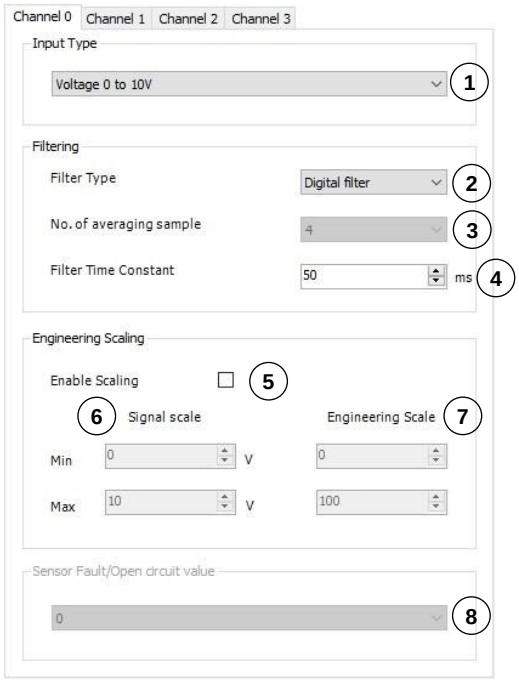
Similarly, after plugging GC-4UAD-16 in slot2, <Empty> slot is replaced by IOE2 (GC-4UAD-16).

5.7.3.1 Parameter Configuration

For parameters configuration of GC-4UAD-16, click on device 'GC-UAD-16' → Parameters Configuration.

Set individual channel parameters using tabs 'Channel 0' to 'Channel 3'.

As shown below, parameters configuration is explained for Channel 0.



The table below provides the details of configuration required for analog input channel.

Sr. No.	Parameter	Options	Description
Analog Input configuration			
1	Input Type	Voltage: 0 to 10Vdc (Default) -10 to +10Vdc -100 to +100mV Current: 0 to 20mA 4 to 20mA PT100: -200 to 850°C -50 to 250°C PT1000 : -50 to 250°C Thermocouple: J type K type	Selection for type of input as per application requirement.
2	Filter type	No Filter Averaging Digital Filter (Default)	Selection for signal conditioning by software
3	Number of Samples	4 (Default), 8, 16, 32	Selection for number of samples for moving average. Channel data updation = Controller scan time x Number of averaging samples.

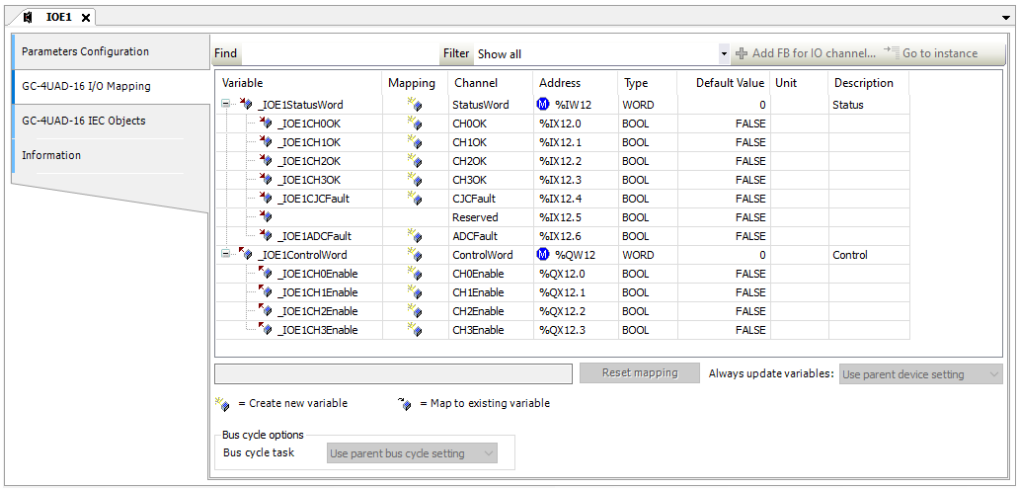
4	Time Constant	Default value 50 ms	Enter digital filer time constant value from 10 to 5000 ms Channel data updation = Controller scan time + (Time Constant*5). Apply digital filter for analog input signal with erroneous fast variations.
5	Enable Scaling	Checkbox unchecked	Channel data holds value as per basic resolution e.g. 0 to 64000 if input signal is 0 to 10 VDC for input type 0 to 10VDC.
		Checkbox checked	Channel data scaling to engineering units as per user defined values of Min and Max. User defined Engineering Scaling is not supported for thermocouple and 3-wire PT100/ PT1000 input types.
6	Signal Scale	For 0 to10V input type, Min : 0V and Max : 10V.	This parameter holds min-max values as per configured input type
		For -10 to +10V input type, Min : -10V and Max : +10V.	
		For 0 to 20mA input type, Min : 0mA and Max : 20 mA	
		For 4 to 20mA input type, Min : 4mA and Max : 20 mA	
7	Engineering Scale	Default value=0 Supported range : -64000.0 to 64000.0 for both Min setting	Enter channel data value as per the application requirement. - 0 for input type 0 to 10VDC - -100 for input type ±10VDC, ±100mV - 0 for input type 0 to 20mA, 4 to 20mA
		Default value=100 Supported range : -64000.0 to 64000.0 for Max setting	Enter channel data value as per the application requirement. 100: for input types 0 to 10VDC, ±10VDC, ±100mV, for input type 0 to 20mA, 4 to 20mA
8	Sensor Fault/ Open circuit Value	0 (Default) Minimum Value Maximum Value Last Value	Applicable for thermocouple, 4 to 20mA and 3-wire PT100/ 1000 input types. Defines value of channel data in case if sensor fault is detected at input channel *1 Minimum value and maximum value depend upon Engineering scaling selected.

*1 Sensor fault detection is provided for thermocouple, 4 to 20mA and 3-wire PT100/ 1000 input types Sensor fault is detected in case if sensor is open/ gets disconnected/ in case of malfunctioning.

Similarly, user can configure analog input Channel 1, Channel 2 and Channel 3,using respective channel tabs.

5.7.4 I/O Mapping

On '*GC-4UAD-16 IO mapping*' tab, list of I/O variables is available. To view I/O mapping, click on Devices → IOE1 (GC-4UAD-16) → *GC-4UAD-16 I/O Mapping* as shown below.



The table below provides the details of I/O bits related to GC-4UAD-16.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
_IOE☐StatusWord.			
_IOE☐CH0OK	%IX12.0	%IX14.0	**TRUE**: - Respective channel is enabled and healthy. **FALSE**: - Respective channel is disabled. - Open circuit for PT100/ PT1000 sensor, thermocouple and 4 to 20mA input types.
_IOE☐CH1OK	%IX12.1	%IX14.1	
_IOE☐CH2OK	%IX12.2	%IX14.2	
_IOE☐CH3OK	%IX12.3	%IX14.3	
_IOE☐CJCFault	%IX12.4	%IX14.4	**TRUE:** - CJC faulty - CJC Sensor Open or Short - CJC value below 0°C or beyond 100°C **FALSE:** CJC healthy
	%IX12.5	%IX14.5	Reserved
_IOE☐ADCFault	%IX12.6	%IX14.6	**TRUE:** - ADC faulty **FALSE:** - ADC healthy

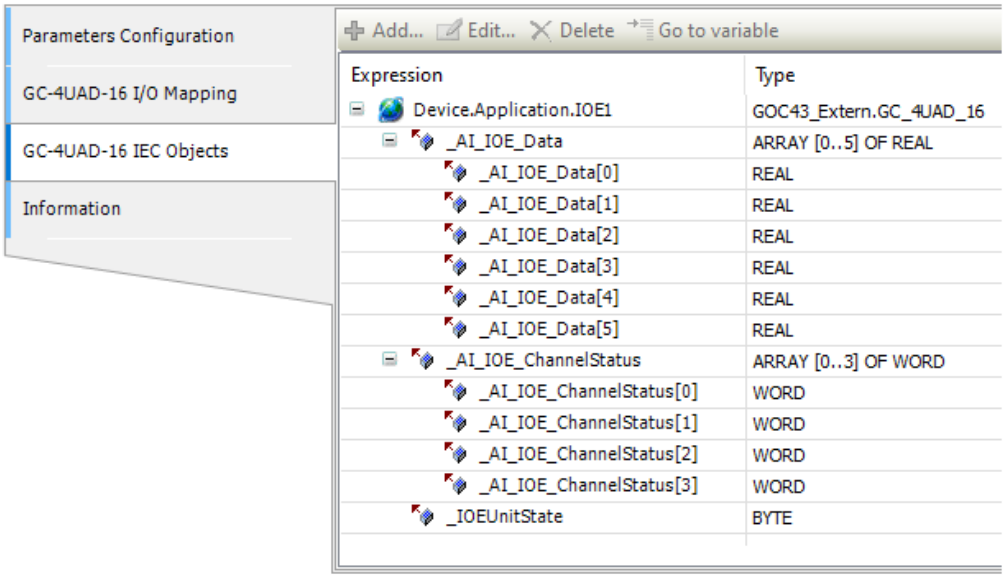
_IOE□ControlWord.			
_IOE□CH0Enable	%QX12.0	%QX14.0	**TRUE** - Enable respective channel through *Hardware Configuration Tool*. **FALSE:** - Disable respective channel through *Hardware Configuration Tool.*
_IOE□CH1Enable	%QX12.1	%QX14.1	
_IOE□CH2Enable	%QX12.2	%QX14.2	
_IOE□CH3Enable	%QX12.3	%QX14.3	

NOTE

In module memory, CJC data gets updated for any input channel irrespective of input type configuration. It is recommended to consider CJC count for thermocouple input type configuration only.
For PT100/PT1000 input type, open circuit detection is supported for sensor connections. It is not supported for lead wire compensation input at terminal VI-.

5.7.4.1 IEC Objects

On '*GC-4UAD-16 IEC Objects*' tab, user can monitor variables related to GC-4UAD-16 in online mode as below.



<table>
<tr><th>Variables</th><th>Data Type</th><th>Description</th></tr>
<tr><td>IOE1._AI_IOE_Data[0]</td><td>REAL</td><td>Holds analog input channel0 data.
The table below provides channel data available when Engineering Scaling is not enabled.
<table>
<tr><th>Input Type</th><th>Channel Data</th></tr>
<tr><td>0 to 10 Vdc</td><td>0 to 64000</td></tr>
<tr><td>±10 Vdc</td><td>-32000 to 32000</td></tr>
<tr><td>±100 mV</td><td>-32000 to 32000</td></tr>
<tr><td>0 to 20mA</td><td>0 to 64000</td></tr>
<tr><td>4 to 20mA</td><td>0 to 64000</td></tr>
<tr><td>PT100</td><td>-200.0 to 850.0</td></tr>
<tr><td>PT100</td><td>-50.00 to 250.00</td></tr>
<tr><td>PT1000</td><td>-50.0 to 250.0</td></tr>
<tr><td>J Type Tc</td><td>-100.0 to 1200.0</td></tr>
<tr><td>K Type Tc</td><td>-100.0 to 1372.0</td></tr>
</table>
In case if Engineering Scaling is enabled, channel data holds value as per Min and Max values defined for Engineering Scaling.
User defined Engineering Scaling is not supported for thermocouple and 3-wire (PT100, PT1000) input types.</td></tr>
<tr><td>IOE1._AI_IOE_Data[1]</td><td>REAL</td><td>Holds analog input channel1 data as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[2]</td><td>REAL</td><td>Holds analog input channel2 data as explained for _AI_IOE_Data[0]</td></tr>
<tr><td>IOE1._AI_IOE_Data[3]</td><td>REAL</td><td>Holds analog input channel3 data as explained for _AI_IOE_Data[0]</td></tr>
</table>

<table>
<tr><td>IOE1._AI_IOE_Data[4]</td><td>REAL</td><td colspan="2">Holds CJC1 data</td></tr>
<tr><td>IOE1._AI_IOE_Data[5]</td><td>REAL</td><td colspan="2">Holds CJC2 data</td></tr>
<tr><td rowspan="6">_IOE□ChannelStatus</td><td rowspan="6">ARRAY [0..3] OF WORD</td><td colspan="2">Holds status of channels if Extended Settings is enabled.
Each array element is assigned for individual channel e.g._IOE□ChannelStatus [0] holds status of channel 0.
Details of bits of status word as follows</td></tr>
<tr><td>Bit No</td><td>Details</td></tr>
<tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr>
<tr><td>1</td><td>Channel configuration
0 - Invalid
1 - Valid</td></tr>
<tr><td>2</td><td>Sensor fault
0 - No open circuit
1 - Open circuit for Thermocouple, PT100, PT1000 and 4 to 20mA input ranges and CJC sensor fault.</td></tr>
<tr><td>3</td><td>CJC Sensor fault
0 - CJC sensor is healthy
1 - CJC Sensor is faulty</td></tr>
<tr><td>4 - 15</td><td>Reserved</td></tr>
<tr><td rowspan="5">IOE1._IOEUnitState</td><td rowspan="5">BYTE</td><td colspan="2">This variable holds I/O extension unit state as follows</td></tr>
<tr><td>Bit No</td><td>Details</td></tr>
<tr><td>0</td><td>No unit is fixed in I/O slot or No unit is detected in I/O slot by CPU</td></tr>
<tr><td>1</td><td>Mismatch between configured unit and attached unit in I/O slot.</td></tr>
<tr><td>2</td><td>Configured unit is detected, and it is in configuration state.</td></tr>
<tr><td>100</td><td>Configured unit is detected, configured successfully and is in running condition.</td></tr>
</table>

Similarly, user can access IEC objects of I/O extension unit configured in I/O extension slot2 with IOE2.<VariableName>.

NOTE

CJC data i.e. terminal temperature is updated when any channel is configured for any input type.

User defined setting for “Engineering Scale” is applicable only for voltage and current input types (i.e. 0 to 10Vdc, ±10Vdc, ±100mV, 0 to 20mA and 4 to 20mA).

6 COM Extension Units

This section provides information related to serial communication extension units supported for GOC.

6.1 GC-RS232-COM

This is RS232 serial communication extension unit. User can attach only 1 COM extension unit on the back side of Main unit.

6.1.1 Specifications

Item		Description
No. of serial ports		1
Hardware interface		RS232C
Signals		TxD, RxD, GND, Carrier detect *1
Communication parameters	Baud rate (bps)	9600, 19200, 38400, 57600, 115200
	Data bits	7, 8
	Parity	Odd, Even, None
	Stop bits	1, 2
Communication type		Full duplex or half duplex
Connector type		9-pin D male
Isolation		No isolation from Main circuit
Dimensions (in mm)		26.0 (W) x 51.0 (H) x 48.0 (D)
Weight (in grams)		40

*1 RS/CS control is not supported.

6.1.2 Wiring

This is 1 port RS232 serial communication unit. It provides 9-pin D male connector on its front side.

The figure below shows front view of COM extension unit with connection details.

Tighten both screws on 9-pin D female connector to avoid malfunctioning due to loosen connections.

Do not try to pull out communication cable connector before un-tightening 2 screws. It may cause damage to the electronic hardware /plastic enclosure of COM extension unit.

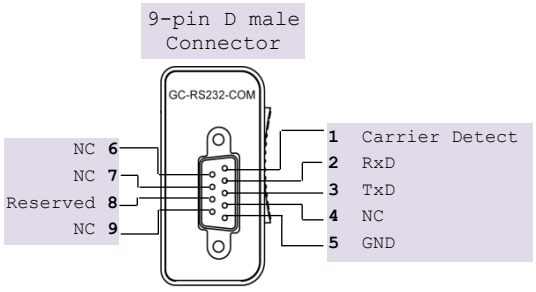


Figure: Connection details for GC-RS232-COM

Refer section *Wiring*, before wiring to COM extension unit.

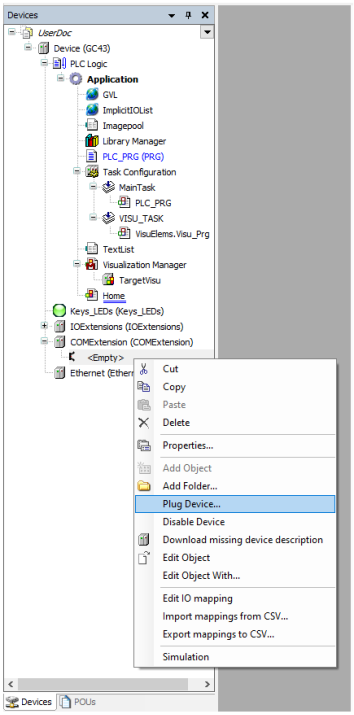
It is recommended to limit RS232 communication cable length to 10 meters maximum.

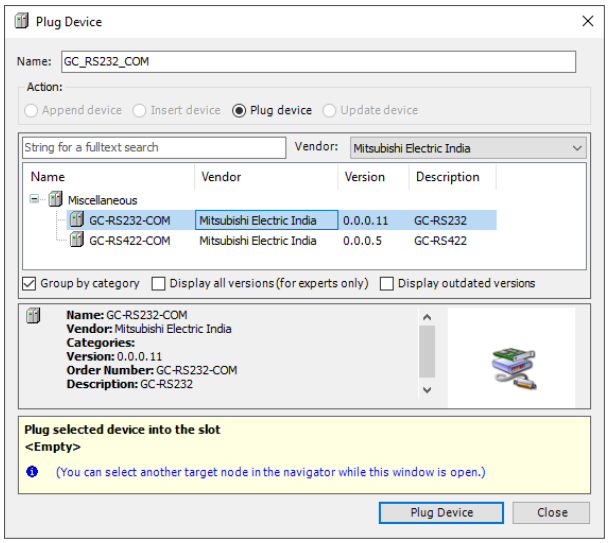
6.1.3 Configuration and Programming

For GOC COM Extension units, I/O memory map is fixed.

In CoDeSys project, plug COM extension unit GC-RS232-COM at <Empty> slot under COMExtension (COMExtension).

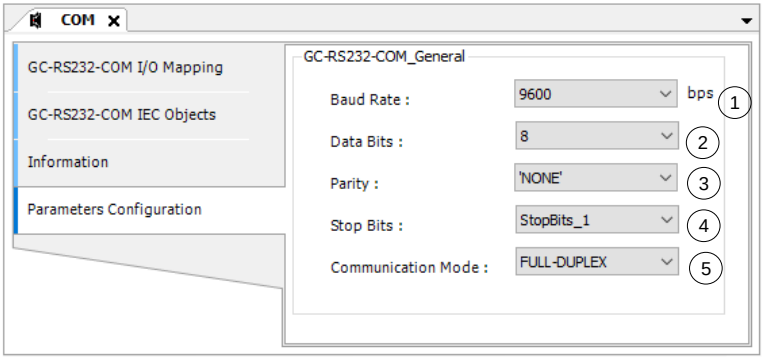
After plugging GC-RS232-COM, <Empty> slot is replaced by COM (GC-RS232-COM) as shown below.





6.1.3.1 Parameter Configuration

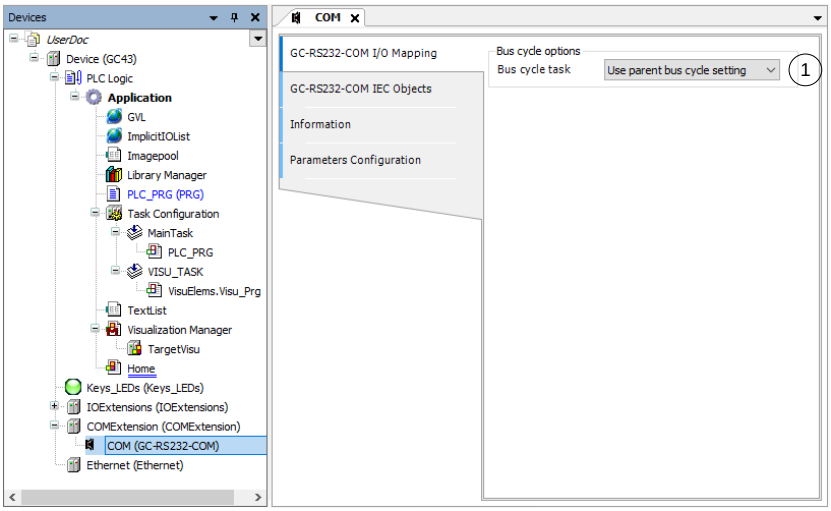
Click on tab '*Parameter Configuration*', to set communication settings available under 'GC-RS232-COM_General',



Sr. No.	Parameter	Option	Description
1	Baud Rate	1200, 2400, 4800, 9600 (Default), 19200, 38400, 57600, 115200	Baud rate in bps
2	Data Bits	8 (Default), 7	Number of data bits
3	Parity	EVEN, ODD, NONE (Default)	Parity
4	Stop Bits	StopBits_1 (Default), StopBits_2	Number of stop bits
5	Communication Mode	FULL-DUPLEX (Default) HALF-DUPLEX	Communication mode as half duplex or full duplex.

6.1.4 I/O Mapping

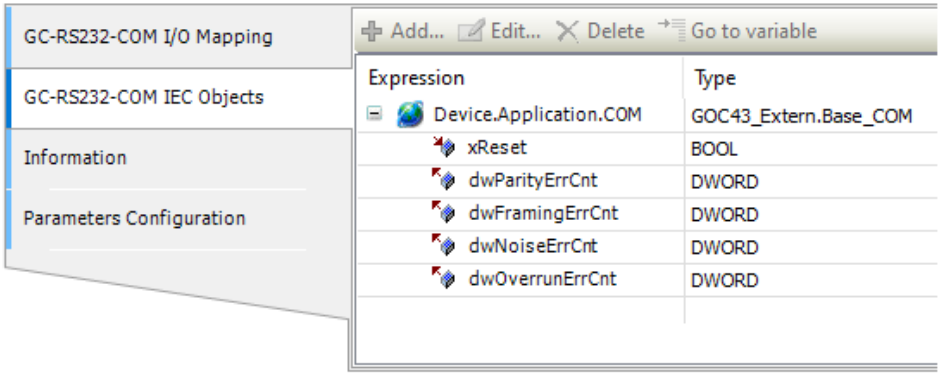
To view I/O mapping, click on Devices → COM (GC-RS232-COM) → *GC-RS232-COM I/O Mapping* as shown below.



Sr. No.	Parameter	Option	Description
1	Bus cycle task	Use parent bus cycle setting MainTask VISU_TASK	--

6.1.4.1 IEC Objects

On '*GC-RS232-COM IEC Objects*' tab, user can monitor variables related to *GC-RS232-COM* in online mode as below.



Variables	Data Type	Description
`xReset`	BOOL	If TRUE, initializes `dwParityErrCnt`, `dwFramingErrCnt`, `dwNoiseErrCnt` and `dwOverrunErrCnt` to 0.
`dwParityErrCnt`	DWORD	Holds count of parity error
`dwFramingErrCnt`	DWORD	Holds count of framing error
`dwNoiseErrCnt`	DWORD	Holds count of noise error
`dwOverrunErrCnt`	DWORD	Holds count of overrun error

6.2 GC-RS422-COM

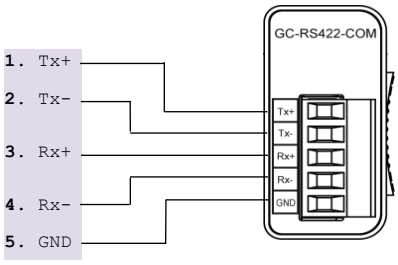
This is RS422/485 serial communication extension units. User can attach only 1 COM extension unit on the back side of Main unit.

6.2.1 Specifications

Item		Description
No. of serial ports		1
Hardware interface		RS422/ 485, depending upon external connections
Signals		Transmit+, Transmit-, Receive+, Receive-, Ground
		For RS485 interface, D+ → connect signals 'Transmit+' and 'Receive+' together on terminal block D - → connect signals 'Transmit+' and 'Receive+' together on terminal block User can connect terminating resistors externally as applicable.
Communication parameters	Baud rate (bps)	9600, 19200, 38400, 57600, 115200
	Data bits	7, 8
	Parity	Odd, Even, None
	Stop bits	1, 2
Communication type		Full duplex or half duplex
Connector type		5-pin removable terminal block
Isolation		No isolation from Main circuit
Dimensions (in mm)		26.0 (W) x 51.0 (H) x 51.2 (D)
Weight (in grams)		40

6.2.2 Wiring

COM extension unit provides 5-pin removable terminal block on its front side. The figure below shows front view of COM extension unit with connection details.



For RS485 interface,

D+: Connect terminal 1 (Tx+) and terminal 3 (Rx+) together.

D- : Connect terminal 2 (Tx-) and terminal 4 (Rx-) together.

Terminating resistor is not provided on board. Hence, whenever required, connect termination resistor on terminal block externally.

Figure 24: Connection details of GC-RS422-COM

Refer section *Wiring*, before wiring to COM extension unit.

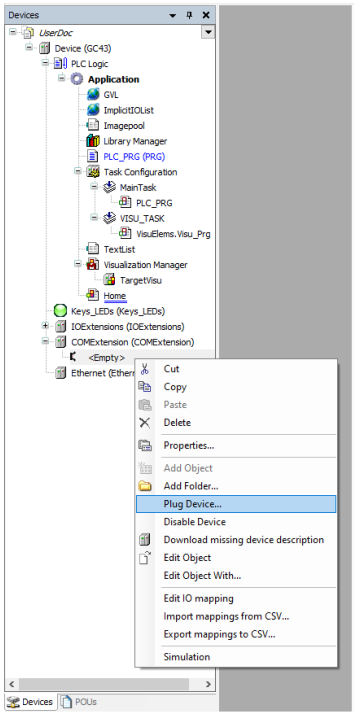
As RS422/485 communication signals are low level signals, it is recommended to limit communication cable length to 25 meters maximum. Install protection devices externally if cable length is greater than 25 meters for safety.

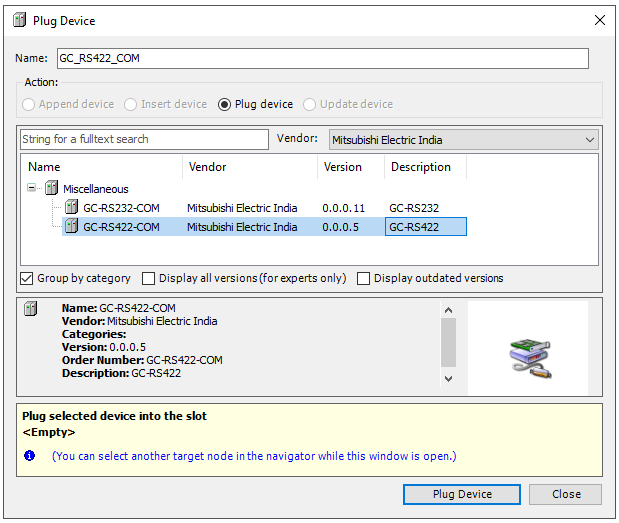
6.2.3 Configuration and Programming

For GOC COM Extension units, I/O memory map is fixed.

In CoDeSys project, plug COM extension unit GC-RS422-COM at <Empty> slot under COMExtension (COMExtension).

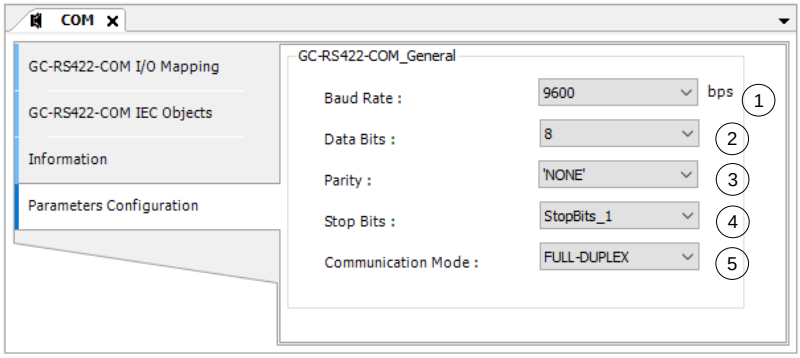
After plugging GC-RS422-COM, <Empty> slot is replaced by COM (GC-RS422-COM) as shown below.





6.2.3.1 Parameter Configuration

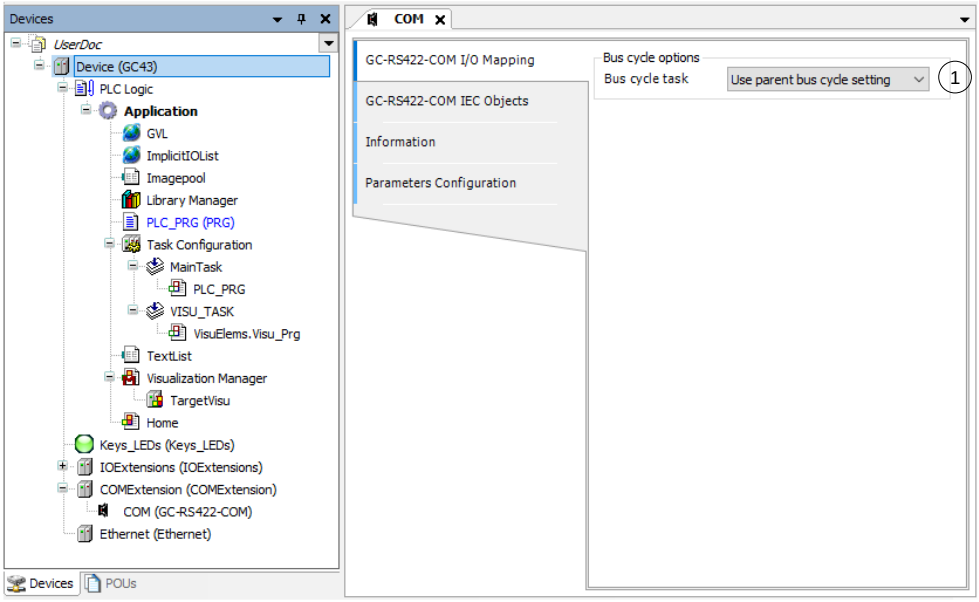
Click on tab '*Parameter Configuration*', to set communication settings available under 'GC-RS422-COM_General',



Sr. No.	Parameter	Option	Description
1	Baud Rate	1200, 2400, 4800, 9600 (Default), 19200, 38400, 57600, 115200	Baud rate in bps
2	Data Bits	8 (Default), 7	Number of data bits
3	Parity	EVEN, ODD, NONE (Default)	Parity
4	Stop Bits	StopBits_1 (Default), StopBits_2	Number of stop bits
5	Communication Mode	FULL-DUPLEX (Default) HALF-DUPLEX	Communication mode as half duplex or full duplex.

6.2.4 I/O Mapping

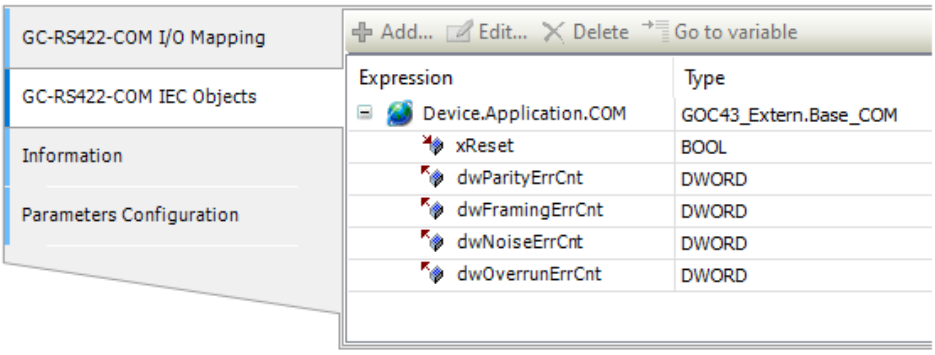
To view I/O mapping, click on Devices → COM (GC-RS422-COM) → *GC-RS422-COM I/O Mapping* as shown below.



Sr. No.	Parameter	Option	Description
1	Bus cycle task	Use parent bus cycle setting MainTask VISU_TASK	--

6.2.4.1 IEC Objects

On '*GC-RS422-COM IEC Objects*' tab, user can monitor variables related to *GC-RS422-COM* in online mode as below.



Variables	Data Type	Description
`xReset`	BOOL	If TRUE, initializes `dwParityErrCnt`, `dwFramingErrCnt`, `dwNoiseErrCnt` and `dwOverrunErrCnt` to 0.
`dwParityErrCnt`	DWORD	Holds count of parity error
`dwFramingErrCnt`	DWORD	Holds count of framing error
`dwNoiseErrCnt`	DWORD	Holds count of noise error
`dwOverrunErrCnt`	DWORD	Holds count of overrun error

7 Special Function Extension Units

This section provides information related to special function extension units supported.

1. GC-MODEM-40 : GOC EXT GSM, GPRS, LTE, GPS 4G MODEM)

7.1 GC-MODEM-40

This is 4G LTE MODEM with GSM, GPRS, GPS enabled extension unit.

The GC-MODEM-40 extension unit adds mobile wireless communication capabilities to GOC43. It supports functions such as sending and receiving SMS messages, tracking GPS position, and secure MQTT communication.

User can attach one GC-MODEM-40, in either I/O extension slot 1 or 2 at a time.

NOTE

GC-MODEM-40 extension is supported in GOC43 firmware versions 02.00.06.00 and GOC Toolkit V3 version 01.03.06.00 onwards.
Refer document “N18006AAMH07 GOC43 Version Compatibility” for more details of version compatibility of firmware, hardware and GOC Toolkit V3.

7.1.1 Specifications

7.1.1.1 General Specifications

Item	Description
Unit supply	24 VDC (18 to 30 VDC), 30 mA minimum. Typical current 130mA at the time of data sharing via LTE. Maximum current 400mA at the time of burst data sharing Reverse polarity protection is provided.
Frequency band	GSM band: 900/ 1800 MHz LTE bands: B1: 2100MHz-FDD, B3 : 1800MHz-FDD, B5: 850MHz-FDD, B7 : 2600MHz-FDD, B8: 900MHz-FDD, B20 : 800MHz-FDD, B38: 2600MHz-TDD, B40 : 2300MHz-TDD, B41: 2500MHz-TDD
Transmitter power	GSM850: 33dBm ±2dB (Class4, 2W) DCS1800, PCS1900: 30dBm ±2dB (Class1, 1W) LTE: 0.25dB (Class3)
Transmission speed	LTE CAT 1: 10 Mbps (DL), 5 Mbps (UL) LTE-FDD CAT4: 150 Mbps (DL), 50 Mbps (UL) LTE-TDD CAT4: 130 Mbps (DL), 35 Mbps (UL)
External interface	Nano SIM card
	SMA connector female (2 nos.)
GPS data	Location, Date and Time
GPS data update rate (User Configurable)	1/ 10/ 30 secs (Default), 1/ 10/ 30/ 60 Minutes.
Coverage	India
Dimensions (in mm)	61.5 (W) x 80 (H) x 24.5 (D)
Weight (in grams)	60

7.1.1.2 Antenna specifications

Item	Description
Network	2G/ 3G/ 4G (GSM, UMTS, LTE)
Type	Omnidirectional
Gain	- 6.46 dBi, - 4.93 dBi, - 1.42 dBi, - 1.07 dBi, - 0.61 dBi, - 0.02 dBi, 0.66 dBi, 0.33 dBi, 0.36 dBi
Impedance	50 Ohms
Polarization	Linear
Operating Frequency	698 MHz to 2.69 GHz
Centre Frequency	700 MHz, 800 MHz, 850 MHz, 900 MHz, 1800 MHz, 1900 MHz, 2100 MHz, 2600 MHz, 1561 MHz, 1575 MHz, 1602 MHz
Connector compatibility	SMA connector
Height (in mm)	72 ±1.6
Diameter (in mm)	10 ±1.1
Weight (in grams)	6

NOTE

Module GC-MODEM-40 is provided with SMA female connectors to connect GSM/GPRS antenna and GPS antenna.
Antenna (1 no.) for GSM/ GPRS and GPS communication will be provided along with the unit. User can procure GSM/GPRS antenna and GPS antenna separately.
Refer antenna specifications before procuring antenna.

7.1.1.3 SMS specifications

Item	Description
Number of users	32 max.
Number of user groups	16 max.
Number of users per group	10 max.
Number of send messages	32 max.
Size of send messages	160 characters max. *1
Number of receive messages	32 max.
Size of receive messages	50 characters max. *1

*1 Keyboard character '$' is not supported

7.1.2 Visual Indications

GC-MODEM-40 extension unit has two LED indications to show unit status as below,

LED	Color	Status	Description
READY	GREEN	ON	24 VDC supply to extension unit is connected.
		OFF	24 VDC supply to extension unit is disconnected.
N/W STATUS	RED	Blinking x3	GSM/ GPRS communication is established.
		Blinking x2	Device is not registered to mobile network
		Blinking x1	Device is registered to mobile network
		OFF	Extension unit is powered off.

7.1.3 Wiring

GC-MODEM-40 provides 3 terminals (+24V, 0V, EARTH) to connect external 24 VDC supply.

In addition, SMA connectors for GSM/ GPRS and GPS antennas are provided at upper side of unit.

Refer section *Wiring*, before wiring.

- Ensure that input supply is always within specified range of 18 to 30 Vdc, 30mA.
- Connect EARTH terminal directly to clean earth in the control panel and avoid ground loops.

The wiring diagram below shows various connections to the extension unit.

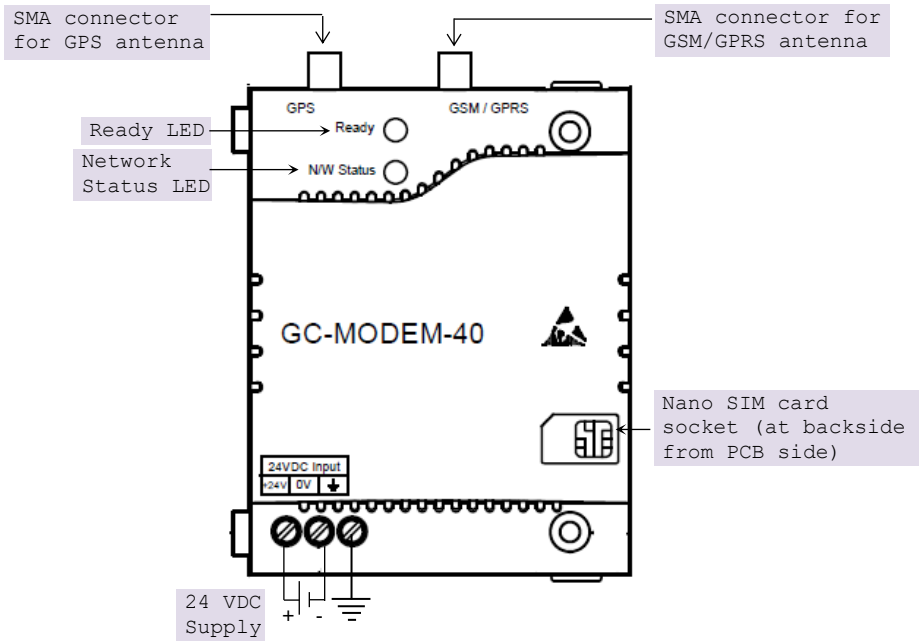


Figure 25: Wiring GC-MODEM-40

NOTE

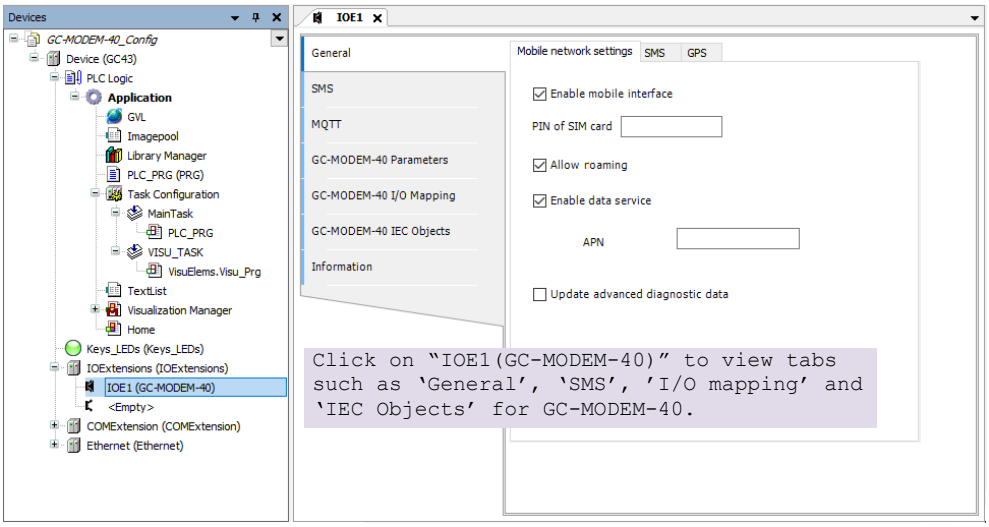
GC-MODEM-40 is provided with SMA female connectors for GSM/ GPRS and GPS antenna connections. Compatible antenna will be available with the unit.

7.1.4 Configuration and Programming

Plug extension device GC-MODEM-40 in IO extension slot. Refer section *Hardware Configuration* for procedure to plug IO extension unit.

Below image shows GC-MODEM-40 unit plugged in IO extension slot 1.

Note that only one GC-MODEM-40 unit can be configured in either slot.



After plugging GC-MODEM-40 in slot IOE1, double click on 'IOE1(GC-MODEM-40) in device tree. This opens IO Extension configuration.

Configuration of unit is divided in three tabs as

- General
  It includes mandatory configuration for the Mobile network settings, SMS, and GPS. These configurations must be completed before proceeding with further configuration.
  Refer to the section *General Configuration* for more details.
- SMS
  The configuration in this tab is necessary for sending and receiving SMS messages. This includes configuring Users, Groups, Send messages and Receive messages.
  Refer to the section *SMS Configuration* for more details.
- MQTT
  The configuration in this tab is necessary while using MQTT communication with the cloud. This includes configuration of Broker, Publish messages, and Subscribe messages.
  Refer to the section *MQTT Configuration* for more details.

NOTE

After a power cycle or application download, the GC-MODEM-40 takes up to 1 minute to initialize (detect SIM card, register on the network, etc.).
Use appropriate interlocks in the application program to start any actions related to SMS messaging and MQTT communication.

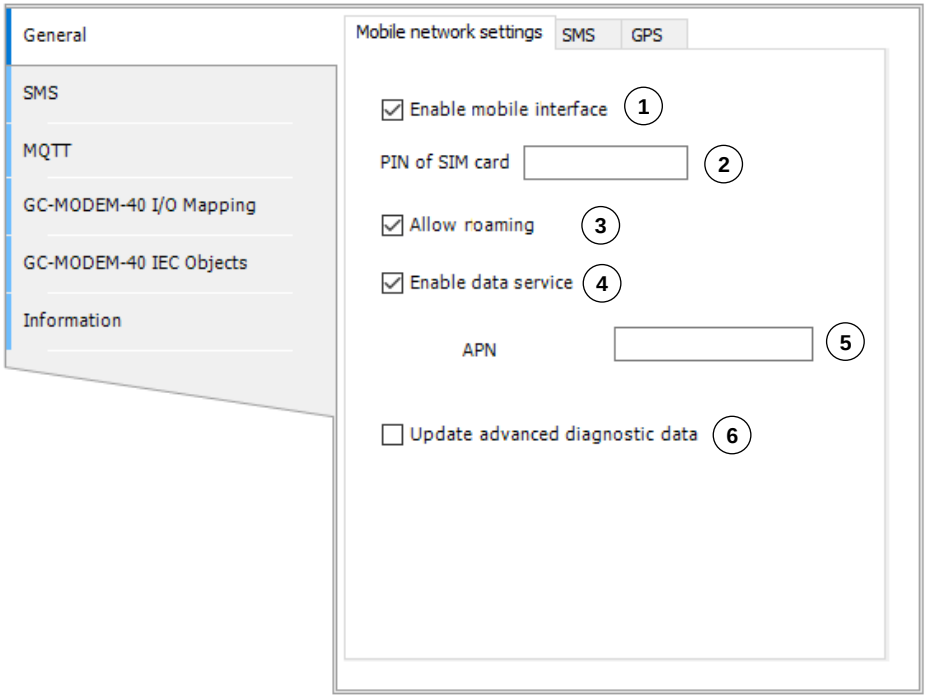
NOTE

The unit may take up to 3 minutes to complete a request, such as sending an SMS, connecting to an MQTT broker, or publishing a message.
Such delay is possible in following cases,
When mobile network is not available.
When mobile credit balance is insufficient.
Do not interrupt a request in progress, as doing so could cause the unit to malfunction.

7.1.4.1 General Configuration

'General' tab, covers Mobile network settings, SMS settings and GPS settings as shown below.

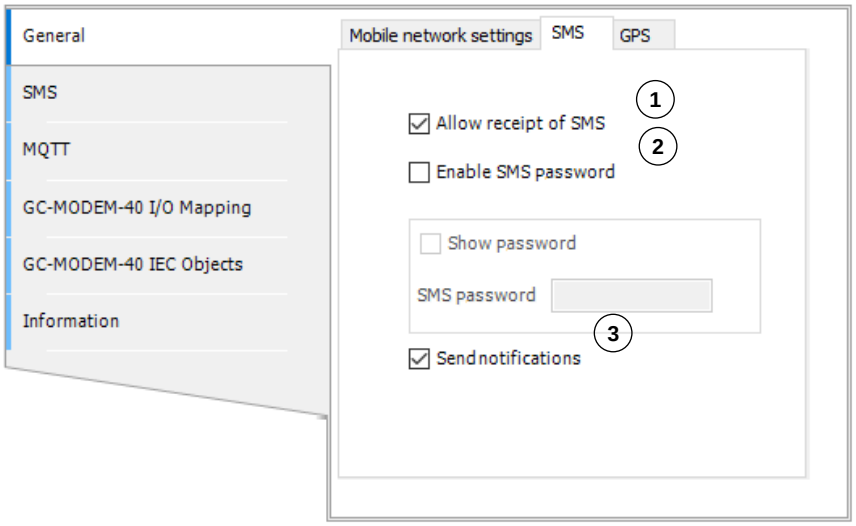
7.1.4.1.1 Mobile network settings



Sr. No.	Parameter	Default Value	Description
1	Enable mobile interface	Enabled	Enable: Enables mobile network interface. Disable: Disables mobile network interface. If mobile interface is disabled, SMS function is not enabled.
2	PIN of SIM card	Blank	This optional setting is required only if your SIM card is protected against unauthorized usage by setting a PIN. Enter the 4-digit PIN that you set for your SIM card. If your SIM card does not have a PIN, leave this field blank.
3	Allow roaming	Enabled	Checked: Allows roaming network connection. Unchecked: Does not connect to network while in roaming.
4	Enable data service	Disabled	Enables data service. If data service is disabled, mobile data service dependent function MQTT is not enabled.
5	APN	Blank	Setting is active if data service is enabled. Enter APN (Access Point Name) of service provider of SIM card. Contact service provider for the details.
6	Update advanced diagnostic data	Disabled	Enabled: Enables reading of advanced diagnostic data from extension. Advanced diagnostic data is available in IEC object '*IOEX_MOBILENETWORK* Refer section *IEC Objects* for more details. Disabled: Advanced diagnostic data is not updated.

If application program with incorrect PIN is downloaded to unit three times, SIM card may get locked. To reset PIN, contact SIM card service provider.

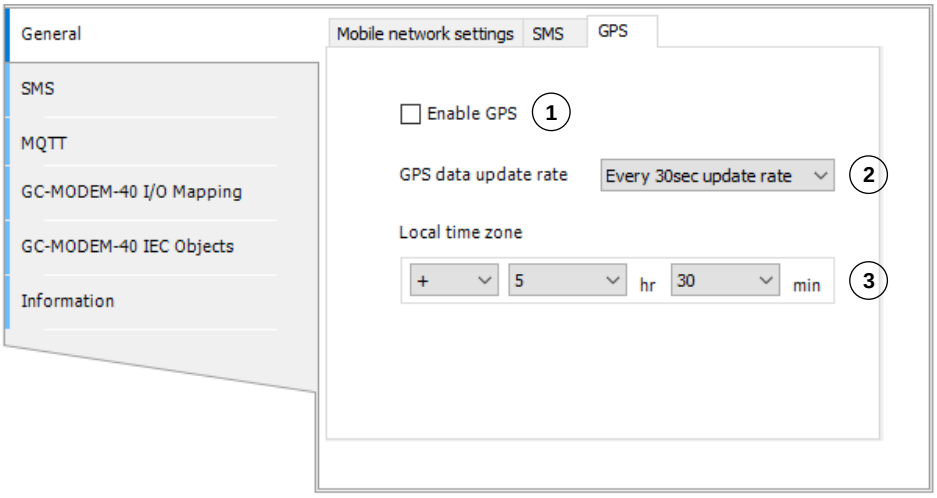
7.1.4.1.2 SMS settings



Sr. No.	Parameter	Default Value	Description
1	Allow receipt of SMS	Enabled	Select to allow receipt of messages. If disabled, unit will discard all SMS messages received. Enable this setting when receive messages are configured.
2	Enable SMS password	Disabled	Enables SMS password. With this option, the user can assign a password for commands / messages sent by configured user. If the option is enabled, the unit only evaluates received message that contains the password configured. Refer section *Receiving messages* for more details. Note that if this option is disabled, SMS messages sent to unit must not contain any password.
	Show password	Disabled	Show / hide SMS password.
	SMS password	Blank	The setting is active when the SMS password is enabled. The password must be 4 alphanumeric characters long maximum and can include special characters *1. Note that SMS password is case-sensitive.
3	Send notifications	Enabled	If enabled, the unit will send an SMS notification to configured/authorized users for each received SMS message. The notification will include the receipt of the SMS message and the result of the action requested by the received message. For more details, refer to the "Receive Messages" section. Notifications will not be sent to unauthorized users.

*1 Only keyboard character '$' is not supported.

7.1.4.1.3 GPS settings



Sr. No.	Parameter	Default Value	Description
1	Enable GPS	Disabled	If enabled, GPS tracking function is enabled. GPS data is updated periodically in IEC variable '`IOEX.GPS_Data`'. Refer section *IEC Objects* (`IOEX.GPS_Data`), which includes GPS data such as GPS position, GPS time etc.
2	GPS data update rate	30s	This setting defines GPS data update rate. Following options are available, 1 sec/ 10 sec/ 30 sec/ 1 minute/ 10 minute/ 30 minute/ 1 hour etc.
3	Local time zone	+ 5 h 30 min	Set UTC time zone value from drop-down to match with the unit location.

7.1.4.2 SMS Configuration

7.1.4.2.1 Overview

With the SMS feature of GC-MODEM-40, sending and receiving SMS messages is possible.

Users and groups

Before configuring send messages and receive messages, it is necessary to configure information about users and user groups.

In users configuration, you can configure information about users (up to 32) who can receive messages or send messages from or to the unit.

Two types of users can be configured:

- Users who can receive messages from the unit and also, send messages to the unit.
- Users who can only receive messages from the unit.

After configuring users, you need to configure user groups. User group configuration is mainly required when sending messages from the unit. Send messages can be configured to send to a particular group.

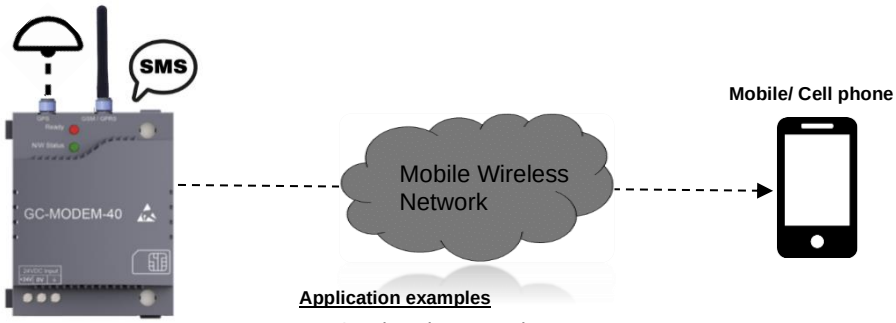
Up to 16 user groups can be configured.

A user can be a member of multiple groups. This way, you can send an SMS message to a specific group of users. For example, you could configure the unit to send machine failure alarms only to members of the "Maintenance team" group, and production data to members of the "All team" group.

For more details, refer to the section "Configuration > Users and Groups".

Sending messages

Unit can send an SMS message to a group of configured users.



Application examples

- Send static text – Alarms, Events etc.
- Send dynamic text – Production data, Machine status etc.
- Send message to a group of users configured.

Send message types

Unit can send two types of SMS messages.

- Static messages
  For static messages, text of messages is fixed at the time of configuration e.g. Alarm text like ‘Pump motor tripped!’ or ‘Chamber 1 temperature high’, etc.
- Dynamic messages
  For dynamic messages, text of messages can be changed at runtime. For example, a production data report with dynamic values can be sent every day, or an alarm message with dynamic value, such as "Chamber 1 temperature high. Current temperature is 40 degrees Celsius."

For dynamic messages, the message text is defined by an IEC object `IOEX.MSG_ArrDynamicMsg[YY]`. The `X` in the variable name represents the IO extension slot number, which can be 1 or 2. The `YY` represents the send message number, 0 to 31.
For example, the dynamic text for message number 5 of IO extension 1 can be defined in the variable '`IOE1.ArrDynamicMsg[5]`'. The user should write an application program to build a message string and move it to this variable before triggering the message.
Up to 32 send messages can be configured.

Send message trigger

Message sending can be triggered from an application program.

To trigger a send message, use the IEC object '`IOEX.MSG_Trigger`'. This variable is a DWORD type variable, and each bit of the variable is assigned to a send message number.

Bit number 0 (LSB) is assigned for message number 0 to bit number 31 (MSB) to message number 31. For example, to trigger message number 5 of IO extension 1, user would set the 5th bit of the '`IOE1.MSG_Trigger`' object to 1.

Note following points related to send message trigger.

- Action of sending SMS message is triggered on rising edge of the trigger bit.
- If multiple send message triggers are generated simultaneously, triggers will be processed sequentially starting from LSB.
- Also note that, sending SMS action may take multiple PLC scans, so new send message trigger will be processed only after completion of existing send tasks.
- If a send message trigger is received while another send message action is in processing, trigger and message text is stored in message buffer '`IOEX.MSG_ArrPendingSendEvent`' to process after completion of existing task.
- This buffer can hold up to 15 send triggers. Once this buffer is full, send message triggers will be lost.
- It is advised not to trigger a send message when this buffer is full. Buffer full can be checked using a bit in input image '`_IOEX_SendMessageBufferFull`'.

Send message status

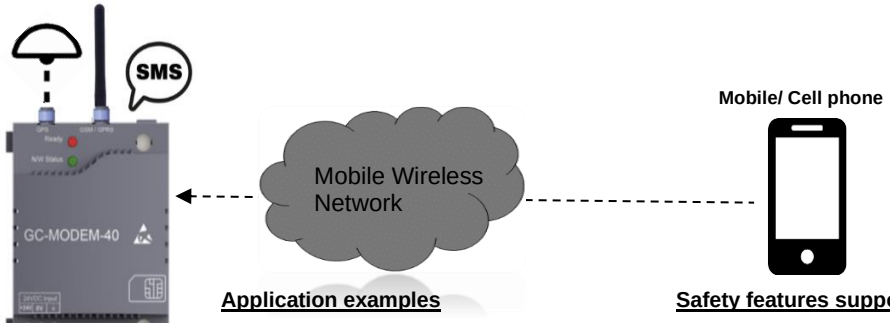
Status of last send message can be checked in IEC object '`IOEX.MSG_LastStatus`'.
Refer section *IEC Objects* for more details.

Send message statistics

Statistics of send messages can be checked in IEC object '`IOEX.MSG_Statistics`'.
It contains counts like total number of messages sent, number of times error occurred while sending messages, number of lost send message triggers, etc.
Refer section *IEC Objects* for more details.

Receiving Messages

Using receive messages it is possible to trigger different 'Receive actions' in GOC by sending a SMS message with predefined text (receive message text or command text) to unit.



Application examples

- Set / reset a Boolean variable.
- Set value of a variable
- Request GPS data (position and time)
- Request balance

Safety features supported.

- Enable receive SMS.
- Receive message from authorized mobile numbers only.
- Receive SMS with 4-character password.
- Send notification for received message.

NOTE

To use Receive messages function, setting 'General → SMS settings → Allow receipt of SMS' should be enabled.
Only authorized users are allowed to send SMS to unit. Refer configuration *User and groups* for more details.

Receive actions

The following receive actions are available for configuration.

- Send message
  This action can be used to request specific information from the device.
  To use this action, user first need to configure information to be send to user in reply using send message (static or dynamic).

  Example use cases:
  User wants to request machine information like serial number, type and other data of the machine on which GC43 device is installed by sending SMS with text 'Info?' to the device.
  For this use case, machine number and other required details of machine can be configured as static message in one of the send messages in send messages list. Configured message is sent as a reply to receive message from configured user.

- Set boolean variable and Reset boolean variable
  This action can be used to turn ON or OFF specific bit in marker memory of GC43 device by sending SMS.

  Example use case:
  User wants to turn on pump connected to GOC43 output by sending SMS to the device with text 'PUMP ON'.
  Direct access to digital output is not possible by sending SMS, hence a marker bit %MX100.0 is turned On by sending message and in turn pump output is switched on in the application program.

- Set value variable
  This action can be used to set value of a variable of data type BYTE/ WORD/ DWORD/ INT/ DINT in marker memory of GOC device by sending SMS. Value to be set is sent in text of the SMS.
  Minimum and maximum limits of value to be set can be defined in configuration of receive action.

Example use case:
Analog output from GOC is controlling speed of the motor. 0 to 10V analog output is applied to control speed between 0 to 1000 rpm. User wants to set speed of motor by sending SMS to the unit. SMS will be sent as 'SET PUMP SPEED 100' to set motor speed 100 rpm.

- Request GPS data
  This action can be used to get GPS data from device.
  On receiving command message text, device will send GPS data in reply.
  For example, "GPS Position: 18 27.53532, 073 50.83065, 651.6".

Receive message text

Receive message text is 'command text' send to unit in SMS message to trigger defined receive action in GOC.
The following rules must be considered for setting up command text.

- Receive message text must contain at least one character.
- First character of message text must be alpha numeric.
- Receive message text can contain up to 50 characters.
- Alpha numeric and special characters are allowed.
- # character is allowed only if receive action is selected as 'Set value of variable'.
- You can configure command text as case sensitive as well as non-case sensitive.
  If command text 'Info?' is configured with non-case sensitive, then unit will not check for case of received message text. i.e. Receive action configured with 'Info?' as receive message text will be performed on receiving command text as 'INFO?' or 'info' or InFo?' etc.
- If receive action is selected as 'Set value of variable',
  - '#' character is used as placeholder for numeric value of action.
  - Maximum number of # characters in receive message text depend on data type of set variable defined in action.
    3 for BYTE, 5 for WORD less than or equal to 5, 6 (including sign) for INT, 10 for DWORD, 11 (including sign) for DINT.
  - All # characters must be consecutive
    Example valid entries '#', '###', '#####'.
    Example invalid entries '##a##', '##.##' or '## ##.
  - # character must be last character of receive message text or must be followed by SPACE i.e.
    Example valid entries: 'Speed ###', 'Speed #### mps'
    Example invalid entries 'Speed ###mps'
  - Number of # characters in command text defines maximum number of digits (including sign) in command text.
    Example: If message text is set as 'Set zone 1 temperature ###',
    Valid command text - 'Set zone 1 temperature 5', 'Set zone 1 temperature 999', 'Set zone 1 temperature -10'.
    Invalid command text - 'Set zone 1 temperature 5555', 'Set zone 1 temperature -555'

SMS Password

You can set password authentication for receive messages.
Receive message password can be enabled in 'General→ SMS settings→Receive message password'.
If 'Receive message password' setting is enabled, command text must contain a SMS password before actual command text.

Password should be followed by ‘,’ (comma) or ‘;’ semicolon or ‘ ‘ (space) as a separator character between password and command text.

Example:

You want to receive GPS position data from device after sending SMS with text ‘LOCATION?’ to the device.
Password is enabled for receive message and password 1234 is set for receive messages.
In this case user must send SMS as
‘1234,LOCATION?’ or ‘1234;LOCATION?’ or ‘1234 LOCATION?’
If password is not included in SMS, error notification is sent to user.
Refer below section ‘Notifications and error messages’ for more details.

Notifications and error messages

After receiving message (command text) from authorised user, unit can be configured to send end result of execution of command to user as notification. Notification can be success report or error report of command execution.
SMS notifications are sent only if ‘Send notification’ setting is enabled in ‘General→SMS settings’.
If user is not configured to send messages to unit, notifications are not sent. Refer configuration of ‘Users and Groups’ for more details.
Following is the list of SMS notifications and their applicability for various receive actions.

No	Message	Possible cause	Applicable Receive actions				
			Send message	Set Boolean variable	Reset Boolean	Set value of a variable	Request GPS data
1	Success: <Command message text>	SMS command executed successfully	○	●	●	●	○
2	<Send message>	SMS command executed successfully	●	○	○	○	○
3	<GPS data>	SMS command executed successfully	○	○	○	○	●
4	Invalid command	SMS keyword could not be recognised. Check upper / lower case characters and syntax	●	●	●	●	●
5	No GPS signal	GPS data not available as there is no GPS signal	○	○	○	○	●
6	GPS not enabled	GPS is not enabled	○	○	○	○	●
7	Authentication failed, Password invalid.	SMS password is not available in received message or incorrect password found in received message.	●	●	●	●	●
8	No authorisation	User not configured in user list or user not authorised to send SMS to device	●	●	●	●	●
9	No success : Value not in range : <Command text>	Value mentioned in command SMS is not within defined range.	○	○	○	●	○

○ : Notification is not applicable for receive action.

● : Notification is applicable for receive action.

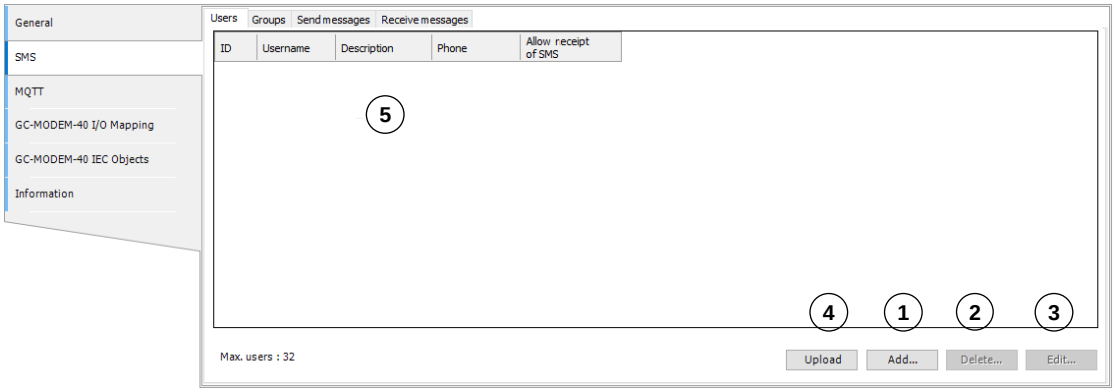
7.1.4.2.2 Configuration

NOTE

Before configuring the SMS function, complete the 'SMS' settings in the General configuration. Refer section *General configuration* for more details.

Users configuration

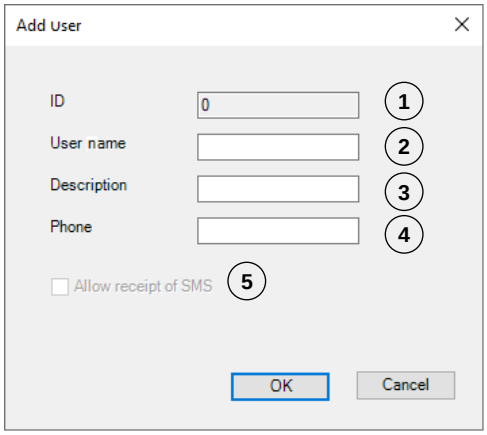
This tab allows to add, delete, and edit users. Maximum 32 users can be added.



Sr. No.	Item	Description
1	'Add' button	Button opens 'Add User' dialogue. Button gets disabled after addition of maximum (32) users in the list. Refer subsequent section for more details.
2	'Delete' button	Button deletes user from the user list. Refer subsequent section for more details.
3	'Edit' button	Button opens 'Edit User' dialogue for selected user. Refer subsequent section for more details.
4	Upload button	Button uploads users and groups configuration from device. This is useful when users and groups are changed in the device. This button is active in offline mode.
5	User list	Displays list of users.

Add User

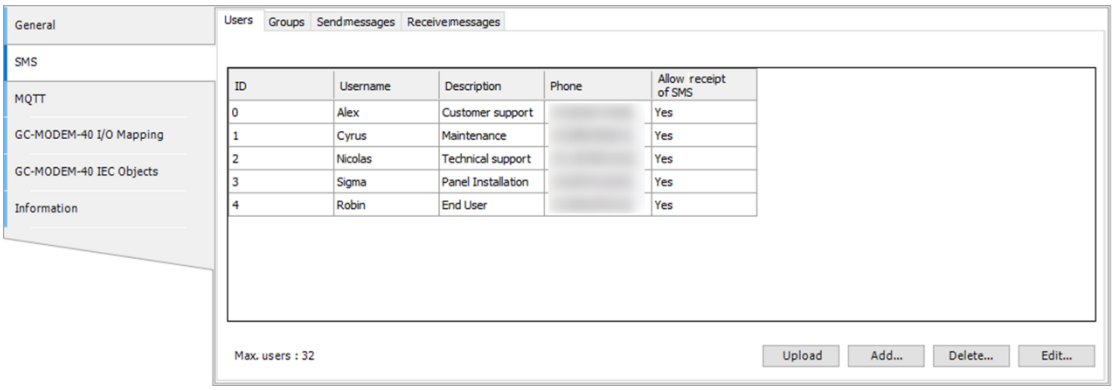
The "Add" button will open a dialog box to add a user.



Sr. No.	Item	Description
1	ID	User ID (0 to 31). Generated automatically.
2	User name	Enter user name. Maximum 20 alpha-numeric and special characters are allowed *1
3	Description	Enter the description of the user. Maximum 50 alpha-numeric and special characters are allowed *1
4	Phone	Enter Phone number of user. Add phone number along with country code prefix. For an example, add '+91' for India.
5	If checked, the user is authorized to send SMS message to unit to trigger receive action. If unchecked, SMS messages received from user are discarded without any action. No notification will be sent to user.	

*1 Special character '$' is not supported.

The following image shows the user list after adding users.



Delete User

To delete a user from the list, click on the row in the user list to select the user, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

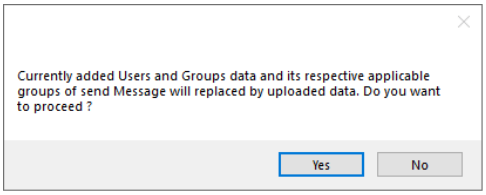
When a user is deleted, it will be automatically removed from the group.

Edit User Information

To modify user information, click on the row to select the user from the users list. Then, click on the "Edit" button and follow the instructions in the "Add User" section.

Upload users and groups

Click ‘Upload’ button to upload users and groups configuration from device.



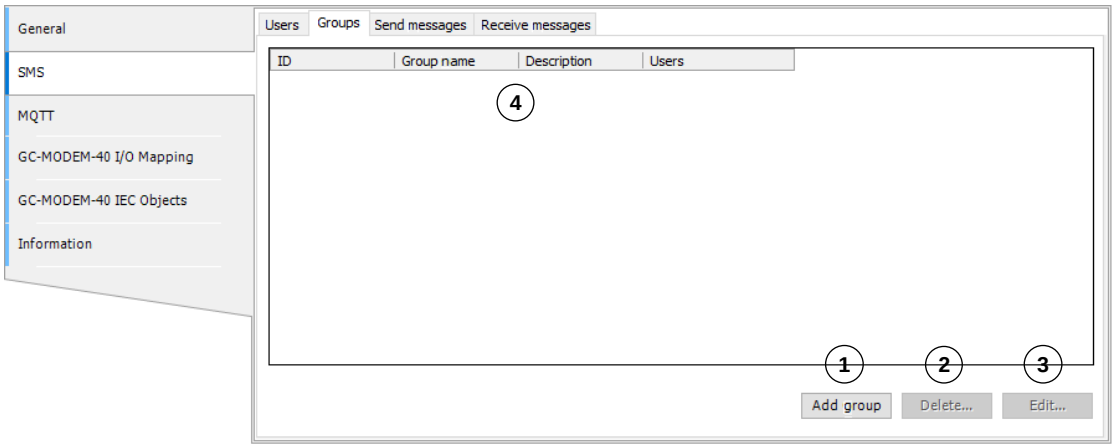
Feature is useful when users or groups are modified on device using visualization dialogues ‘GOC43_GSM.ChangeUserData’ and ‘GOC43_GSM.ChangeGroupData’.

Refer section *Visualization to edit user and group configuration* for more detail.

After upload, list of user and group in application program gets overwritten.

Groups configuration

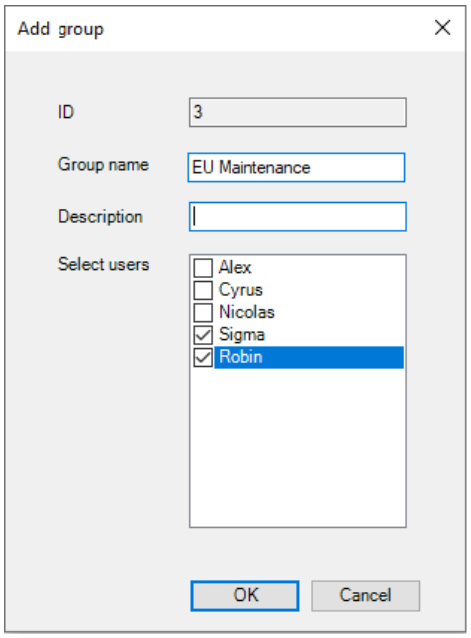
This tab allows to add, delete, and edit groups. Maximum 16 groups can be added.



Sr. No.	Item	Description
1	Add Group button	Button opens ‘Add Group’ dialogue. Button gets disabled after addition of maximum (16) groups in the list. Refer subsequent section for more details.
2	‘Delete’ button	Button deletes group from the group list. Refer subsequent section for more details.
3	‘Edit’ button	Button opens ‘Edit Group’ dialogue for selected group. Refer subsequent section for more details.
4	Group list	Displays list of groups.

Add Group

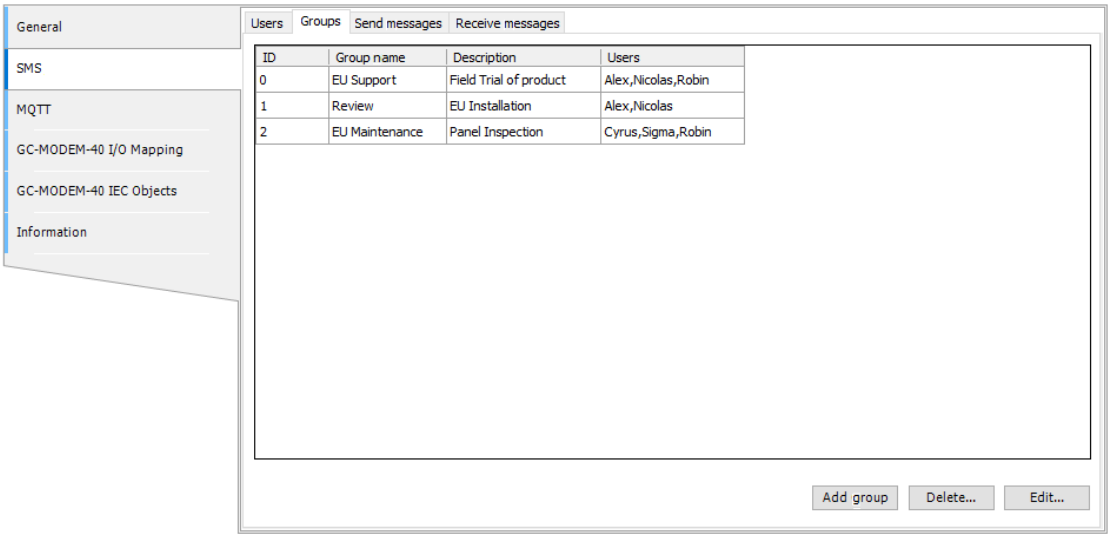
The "Add group" button will open a dialog box to add a group.



Sr.No.	Item	Description
1	ID	Group ID (0 to 15). Generated automatically.
2	Group Name	Enter group name. Maximum 20 alpha-numeric and special characters are allowed *1.
3	Description	Enter description for the group. Maximum 50 alpha-numeric and special characters are allowed *1.
4	Select users	Displays the list of users for selection. Maximum 10 users can be included in one group.

*1 Special character '$' is not supported.

The following image shows the group list after adding groups.



Delete Group

To delete a group from the list, click on the row in the group list to select the group, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

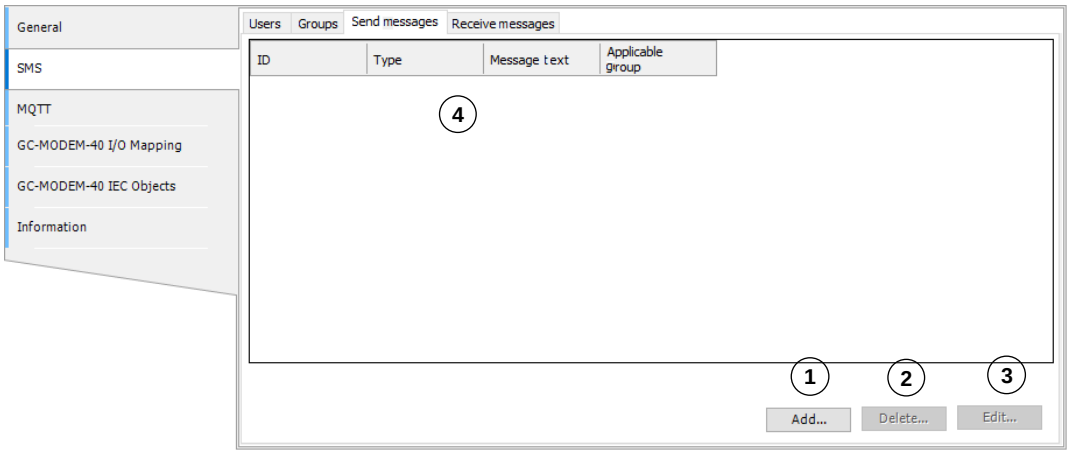
Edit Group

To modify group information, click on the row to select the group from the group list. Then, click on the "Edit" button and follow the instructions in the "Add group" section.

Send Messages

After completing 'Users and Groups' configuration, configuration for Send and Receive messages can be added. Send message configuration contains configuration of messages sent from unit to a group.

Maximum 32 send messages can be added.

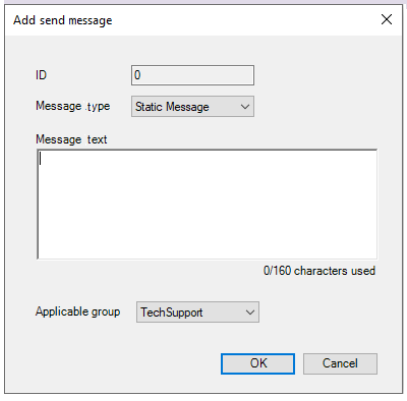


Sr. No.	Item	Description
1	'Add' button	Button opens 'Add Send Message' dialogue. Refer subsequent section for more details.
2	'Delete' button	Button deletes selected message from the send message list. Refer subsequent section for more details.
3	'Edit' button	Button opens 'Edit Send Message' dialogue. Refer subsequent section for more details.
4	Message list	Displays list of send messages.

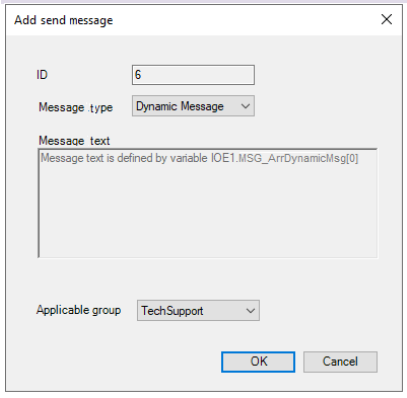
Add Send Message

The "Add…" button will open a dialog box to add a send message.

Message Type : Static message



Message Type : Dynamic message

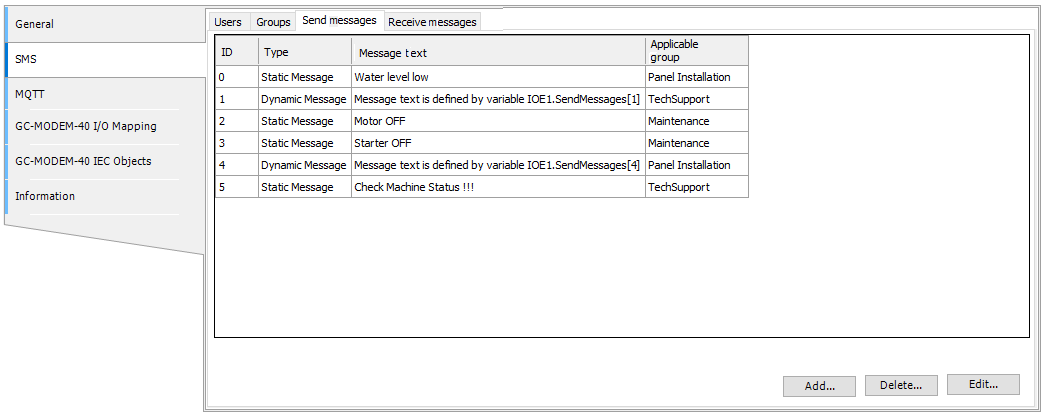


Sr. No.	Item	Description
1	ID	Message ID (0 to 31). Generated automatically.
2	Message type	Select message type 'Static Message' or 'Dynamic Message'. Refer section *Overview* for more details.
3	Message text	Set text of send message for static messages. For dynamic messages, displays STRING type variable to set text of the message e.g. `IOEX.MSG_ArrDynamicMsg[YY].`

Sr. No.	Item	Description
		The X is the IO extension slot number (1 or 2). The YY is the message ID (0 to 31). Up to 160 alpha-numeric and special characters are allowed. *1
4	Applicable group	Choose the group to send the message to.

*1 For static/ dynamic message, special character '$' is not supported.

The following image shows the message list after adding send messages.



'Delete Send Message'

To delete a message from the list, click on the row in the message list to select the message, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

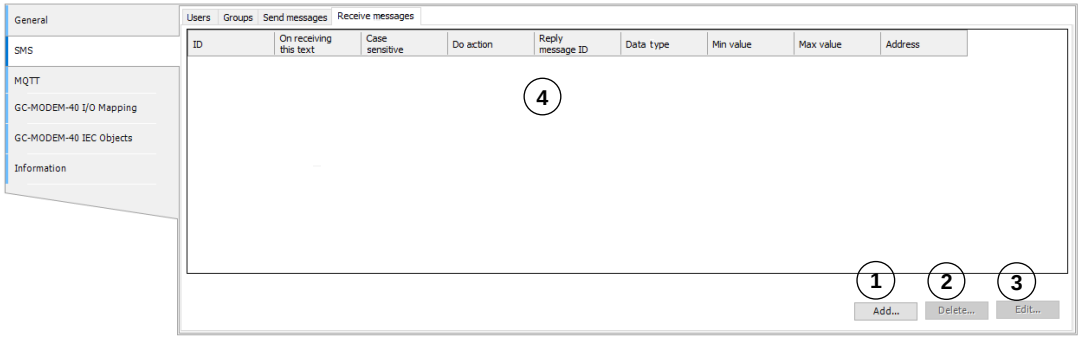
'Edit Send Message'

To modify message, click on the row to select the message from the message list. Then, click on the "Edit" button and follow the instructions in the "Add send message" section.

Receive Messages

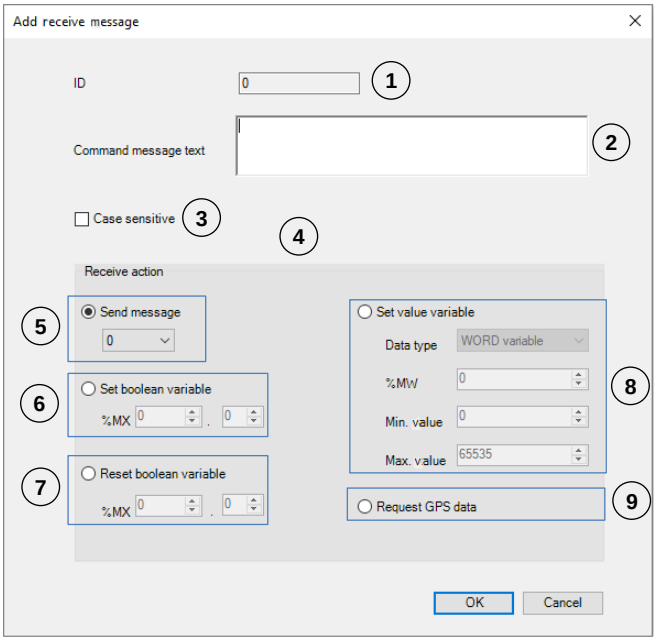
GC-MODEM-40 supports receiving SMS messages from the authorized users to trigger the action after reception of message.

Maximum 32 send messages can be added.



Sr. No.	Item	Description
1	'Add' button	Button opens 'Add Receive Message' dialogue. Refer subsequent section for more details.
2	'Delete' button	Button deletes selected message from the send message list. Refer subsequent section for more details.
3	'Edit' button	Button opens 'Edit Receive Message' dialogue. Refer subsequent section for more details.
4	Message List	Displays list of receive messages.

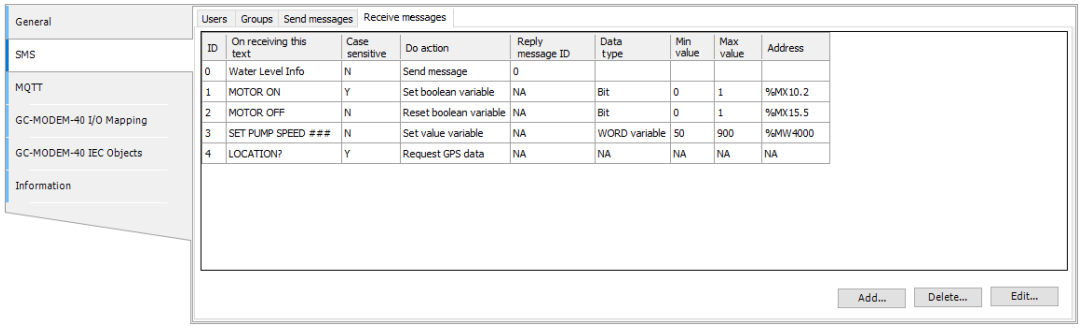
Add receive message



Sr. No.	Item	Description
1	ID	Message ID (0 to 31). Generated automatically.
2	Command message text	Set text of the command message sent by user. Refer section 'Overview' for validation rules of command text.
3	Case sensitive	Checked : Command message text is case sensitive

Sr. No.	Item	Description	
		Unchecked : Command message text is non case sensitive.	
4	Receive action selection	This defines action by GOC on receiving command message from user. The following actions can be selected.	
5	Send message	Message ID	Set ID of send message that is to be sent in response to received message.
6	Set boolean variable	%MX	Defines boolean marker address to be set to TRUE in response to received message. User can define a bit from marker memory %MX0.0 to %MX32767.7.
7	Reset boolean variable	%MX	Defines boolean marker address to be reset to FALSE in response to received message. User can define a bit from marker memory %MX0.0 to %MX32767.7.
8	Set value variable	Data type	Choose data type of marker memory to be set in response to received message. Default type is 'WORD'. It supports BYTE/ WORD/ DWORD/ INT/ DINT data types.
		%MW	Defines address of marker memory to set in response to received message. Supported range for setting Marker memory address is %MW0 to %MW32766.
		Min. value	Defines minimum setting of value variable.
		Max. value	Defines maximum setting of value variable.
9	Request GPS data		Sends GPS data (location and time) in response to received message.

The following image shows the message list after adding receive messages.



Delete receive message

To delete a message from the list, click on the row in the message list to select the message, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

Edit receive message

To modify message, click on the row to select the message from the message list. Then, click on the "Edit" button and follow the instructions in the "Add Receive Message" section.

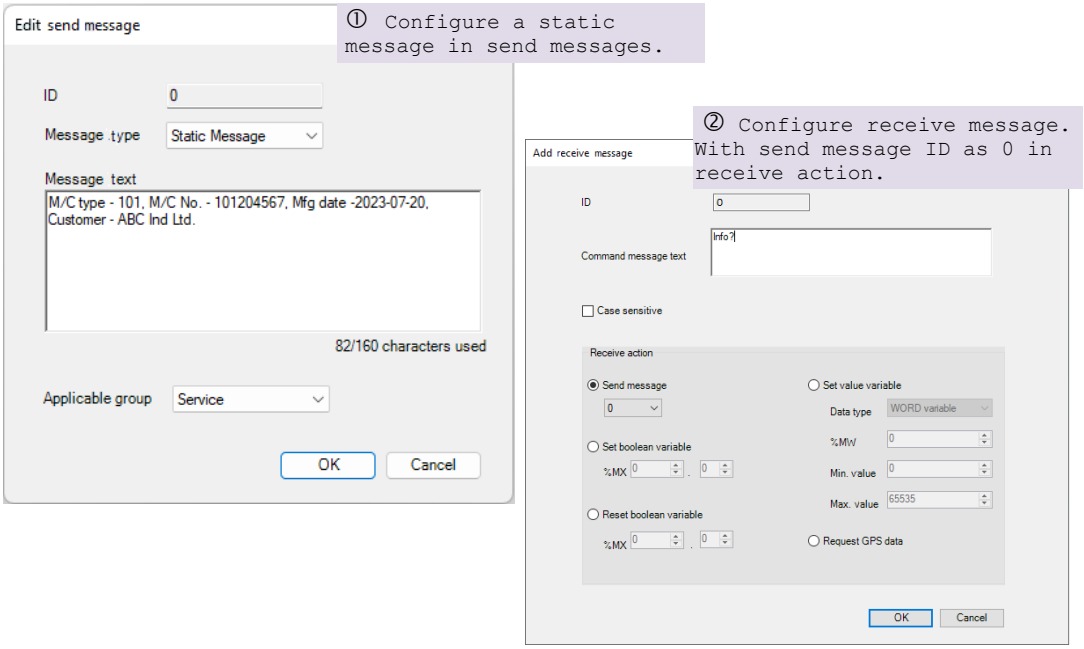
Receive message configuration examples

1. **Send message**:

Use case

User wants to request machine information by sending SMS message ‘Info?’ to unit installed on machine.

Configuration

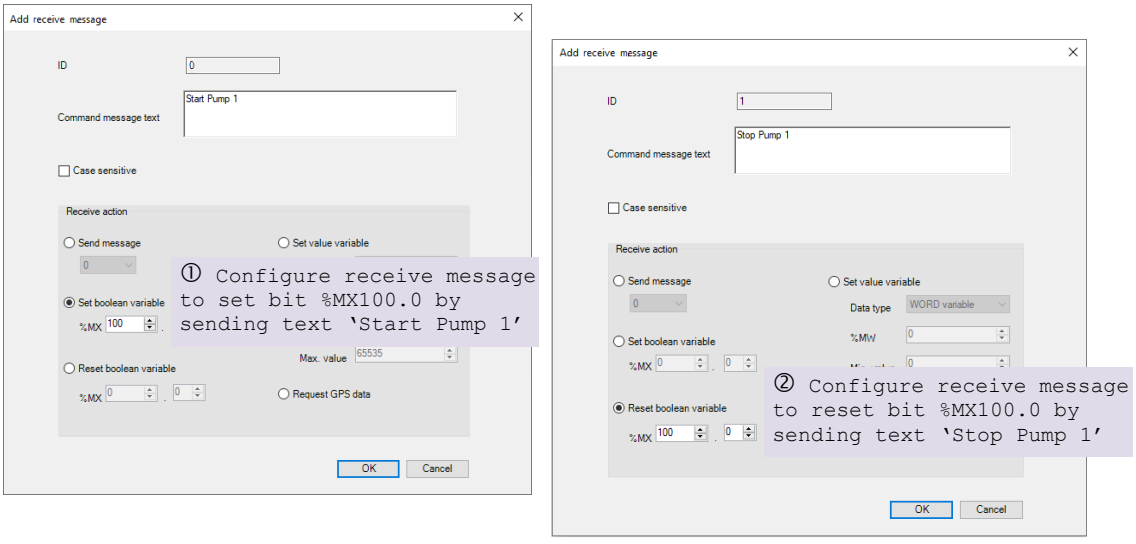


2. **Set boolean variable, Reset boolean variable:**

Use case

User wants to start pump 1 by sending a SMS message ‘Start Pump 1’ and stop pump 1 by sending SMS message as ‘Stop Pump 1’.

Configuration



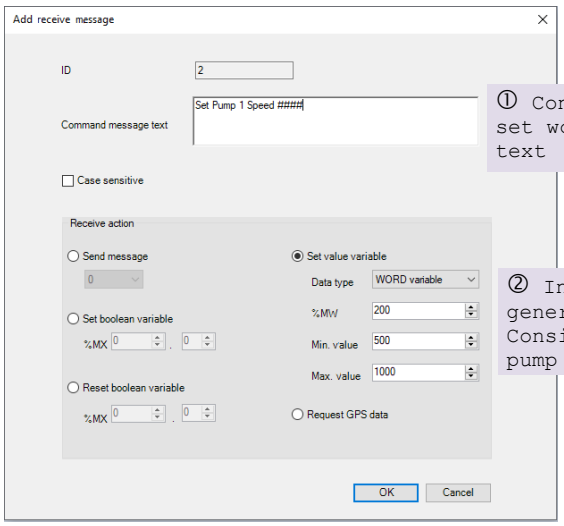
③ In PLC program, use %MX100.0 to turn ON/OFF GOC output that controls pump 1. Consider all safety interlocks for pump 1 control as required.

3. **Set value variable**:

Use case

User wants to set speed of pump between 500 to 1000 rpm by sending SMS message as ‘Set Pump 1 Speed 800’. Pump speed is controlled by analog output.

Configuration



① Configure receive message to set word value %MW200 by sending text ‘Set Pump 1 Speed ####’

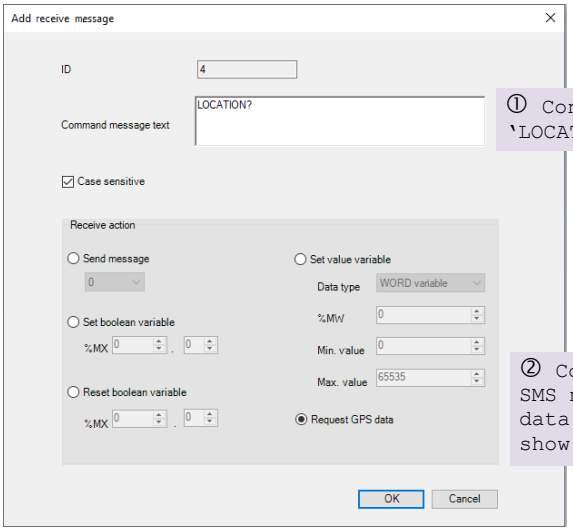
② In PLC program, use %MW200 to generate equivalent analog output. Consider all safety interlocks for pump 1 control as required.

4. **Request GPS data**:

Use case

SCADA system requests location of machine by sending SMS message ‘Location?’. Location shared by GOC is used to show machine location on map.

Configuration



① Configure receive message as ‘LOCATION?’ to ‘Request GPS Data’.

② Configure SCADA for sending SMS message to request location data from unit and process it to show location on map.

7.1.4.2.3 Visualization to edit user and group configuration

Users and groups configuration can be modified on device using visualization screens. This is useful in scenarios like change in group members, change in phone number of user at end user installation.

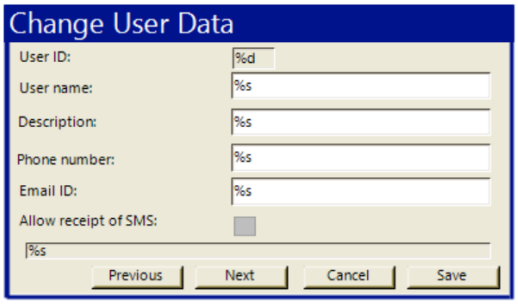
Following actions are possible with visualization.

- Change user configuration like user name, phone number, authorization for sending messages etc.
- Change in group configuration like name of group, adding new member to group, removing member from group etc.

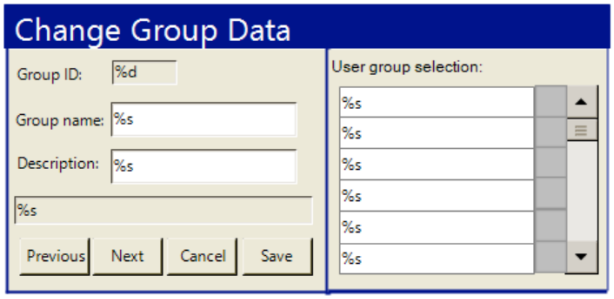
Note that adding and deleting user/group is not possible from visualization

Following ready to use dialogues are available for editing

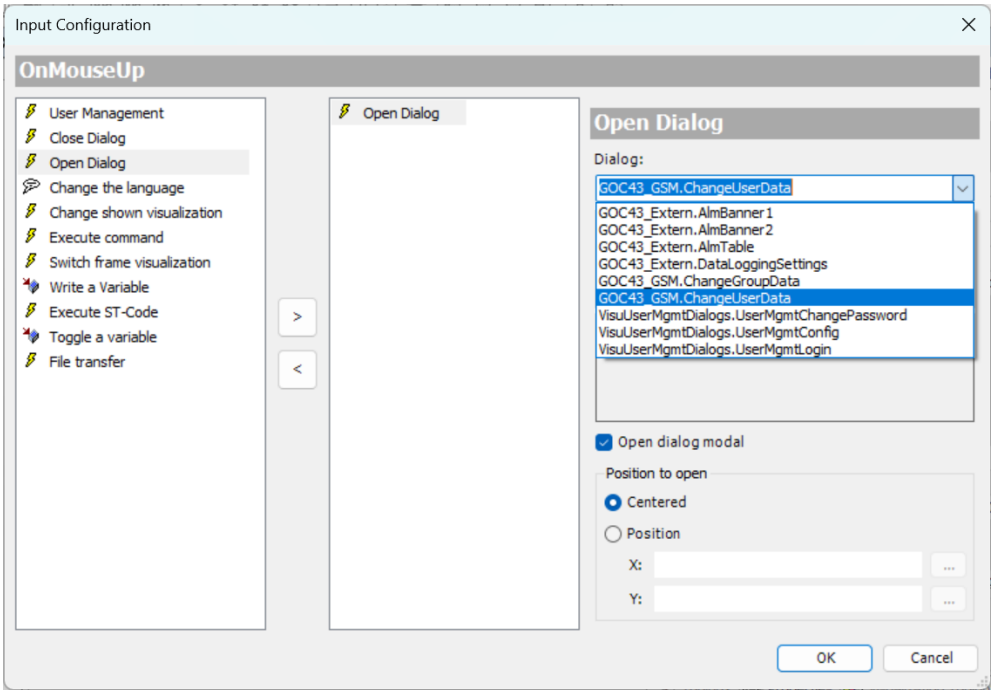
ChangeUserData



ChangeGroupData



These dialogues can be invoked by configurating ‘Open dialogue’ action in ‘Input configuration’ of a button in visualization as shown below



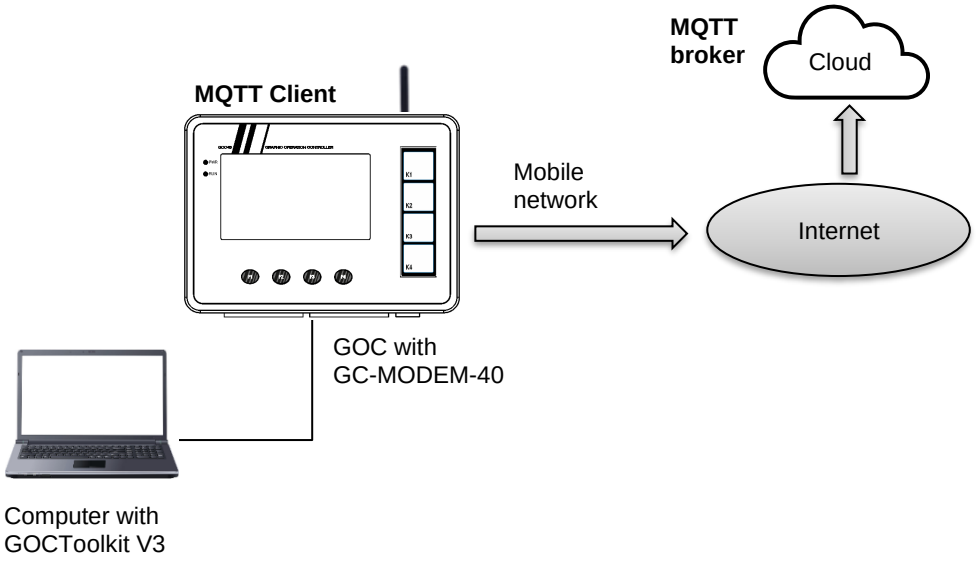
7.1.4.3 MQTT Configuration

7.1.4.3.1 Overview

MQTT is a lightweight messaging protocol designed for use with IoT devices. It is a publish/subscribe protocol that runs over TCP/IP and is used mainly for cloud connectivity. MQTT includes security features such as retransmission if a message is not received, TLS encryption, and client authentication. Data transmission and reception are only performed as needed, helping to reduce the load on communication network.

A broker is a server that receives messages on specified topics from publishers and sends them to subscribers of those topics.

GC-MODEM-40 functions as an MQTT client device. Subsequent sections explain broker configuration, publish message configuration, and subscribe message configuration.



The following are the key functions of the MQTT protocol:

- It works on the publish/subscribe model. It means that devices can publish messages to topics, and other devices can subscribe to those topics to receive the messages.
- Client devices publish data to the broker (i.e., cloud/local server). The broker is a central server that stores and routes messages.
- It transmits data received from publishers to subscribers via the broker. When a publisher publishes a message to a topic, the broker sends the message to all subscribers of that topic.
- The subscriber can decide whether to process the data or take some action based on the data.

7.1.4.3.2 Specifications

This section lists specifications of MQTT protocol supported in GC-MODEM-40.

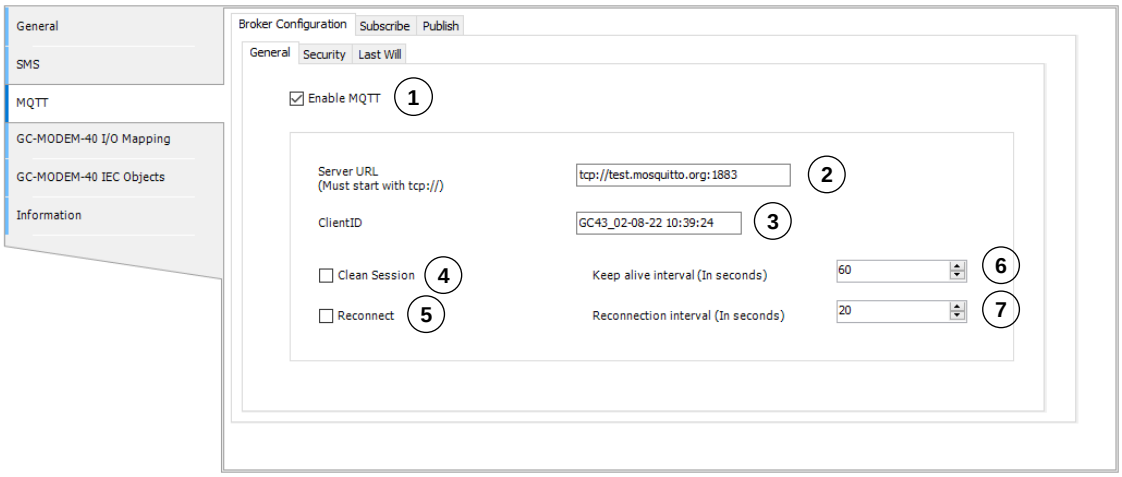
Item		Description
Versions		MQTT 3.1.1, TLS 1.2
Port number		1883, 8883
Broker connection		Via URL
Supported modes	Unsecured	Plain MQTT
	TLS (Transport Layer Security)	CA certificate only
		CA & client certificate
		Encryption only
Number of publish messages		64 (Transmission of only one message at a time)
Number of subscriptions		8 maximum
Size of topic name		128 characters maximum
Size of message		512 bytes maximum
Message format		Byte array, String
Quality of service for message delivery		Publish messages: QoS level 1 and 2. Subscribe messages: QoS level 0 and 1
Auto-reconnect		Supported
Auto subscription at power ON		Supported
Wildcard support (#, +) for subscription		Not supported
User Configuration		Clean session, Retain User name and Password Keep Alive, Last Will topic and message
Supported cloud services		AWS IoT core, Mosquito message broker

7.1.4.3.3 Configuration

This section provides instructions on how to configure the parameters for the MQTT client. The screenshot below shows the default settings for the MQTT broker configuration.

Broker Configuration → General

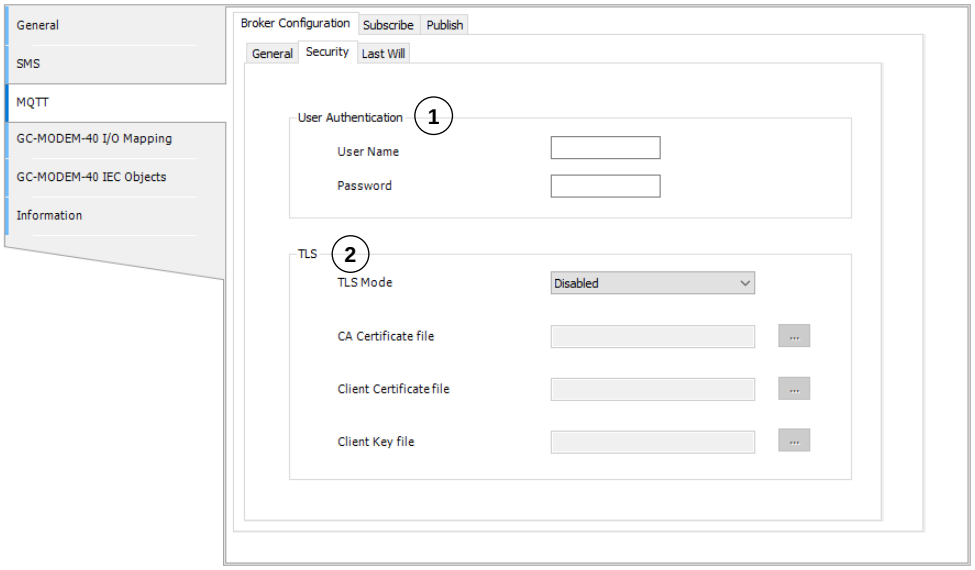
The broker configuration consists of three main sections: General settings, Security settings, and Last Will settings. The following sections explain the parameters for each setting.



Sr. No.	Parameter	Default Value	Description
1	Enable MQTT	Disable	Enables or disables MQTT client function.
2	Server URL	tcp://test.mosquitto.org:1883	Specify broker URL Following rules are applicable to define server URL, - String length is 9 to 255 characters. - Specify server URL as 'tcp://<URL>:<Port number>'. - Example: tcp://test.mosquitto.org:1883
3	ClientID	GC43_12-08-22 12:09:56	Specify client ID. It is UTF encoded string value. * Client IDs must be unique within the same MQTT broker. To ensure uniqueness, client ID is auto generated using device name, date, and time stamp. Client ID can be changed further as per requirement.
4	Clean Session	Enabled	Enable or disables clean session function. If enabled, the broker will discard any previously maintained information about the client, such as the client's subscriptions and the messages that were published to the client. If disabled, the broker will keep client information and buffer new messages for the client for later delivery. It is recommended to use default setting to avoid flooding of undelivered messages while client is disconnected.
5	Reconnect	Disable	If the reconnect option is enabled, the module will attempt to reconnect to the broker if the connection is lost.
6	Keep alive interval (In seconds)	60	Specify time that a client must send a message to the broker before the broker assumes that the client has disconnected. The keep alive interval is specified in seconds.
7	Reconnection interval (In seconds)	20	If client is disconnected, then this is the time after which the client will retry to connect to the broker.

Broker Configuration → Security

Security configuration allows user to select options for secured communication and upload necessary certificates.

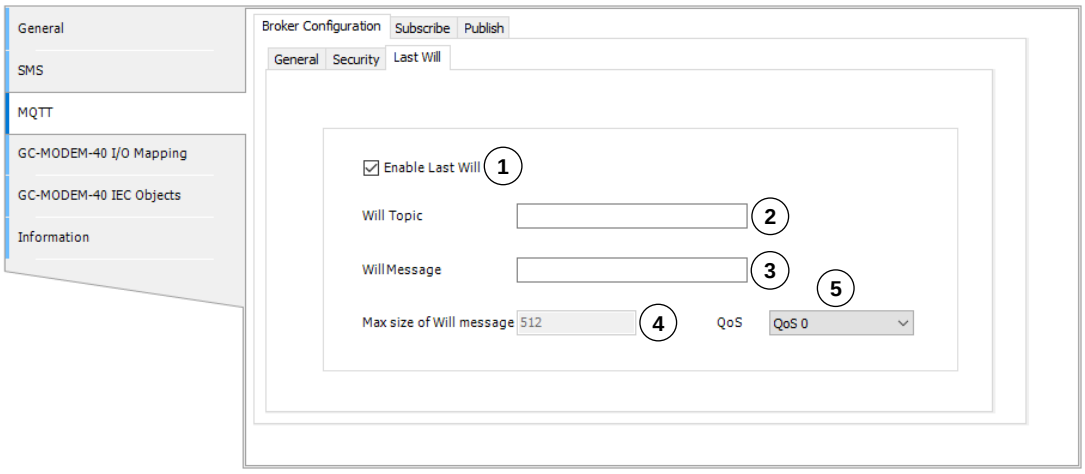


Sr. No.	Item		Default Value	Description
1	User Authentication	User Name	Blank	Specify user name for login with the broker.*1 Set username up to 256 characters.
		Password	Blank	Specify password for login with the broker.*1 Set password up to 256 characters.
2	TLS	TLS Mode	0	Check security requirements of broker and set TLS mode accordingly. Specify TLS modes as below 0: Disable: TCP/IP connection is setup with plain MQTT protocol without TLS. 1: With CA certificate: During establishing TLS communication, client has to provide a certificate matching the broker's certificate. GC43 device requires a valid certificate from broker 2: With CA certificate, Client Certificate/ Key 3: With encryption only: Secured encrypted connection is established without authentication for broker and client. Security certificates are not required in this mode.
		CA Certificate file *2	Blank	Specify CA certificate file. Applicable when TLS mode is set to "With CA Certificate" or "With CA certificate, Client Certificate/ Key". Supported certificate formats : .pem or .der.
		Client Certificate file *2	Blank	Specify client certificate file. Applicable only when TLS mode is set to "With CA certificate, Client Certificate/ Key". Supported certificate formats : .pem or .der.
		Client Key file *2	Blank	Specify client key file. User can upload client key file if TLS mode selected is 'With CA certificate, Client Certificate/ Key'.

*1 Special character'$' is not allowed. *2 Refer section, *Terminologies in MQTT* for more details.

Broker Configuration → Last Will

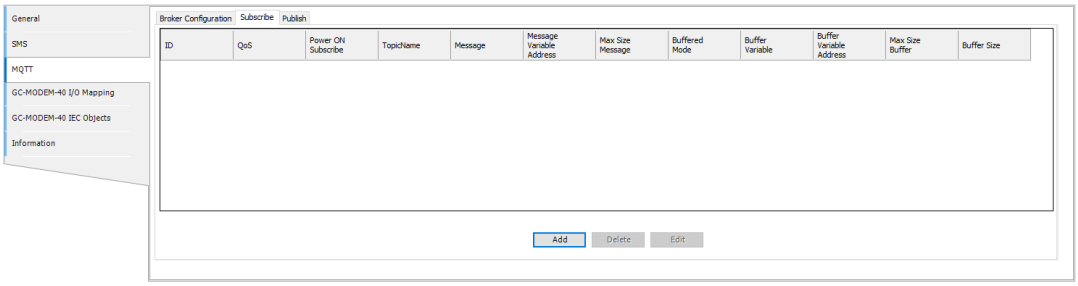
Will message in MQTT is a message that is published to when a client unexpectedly disconnects from the broker. The will message is used to notify other clients that the client has disconnected and to provide them with any relevant information.



Sr. No.	Item	Default Value	Description
1	Enable Last Will	Disabled	Enables/ disable last will function.
2	Will Topic	Blank	Specify will topic name. Set topic name up to 128 characters. Other clients interested in the client's status should subscribe to this topic.
3	Will Message	Blank	In case of disconnection with the client, broker will publish will message with will topic.
4	Max size of Will message	512	Specify maximum size of will message
5	QoS	QoS 0	Selects Quality of service for Will message as QoS 0 or QoS 1 or QoS 2.

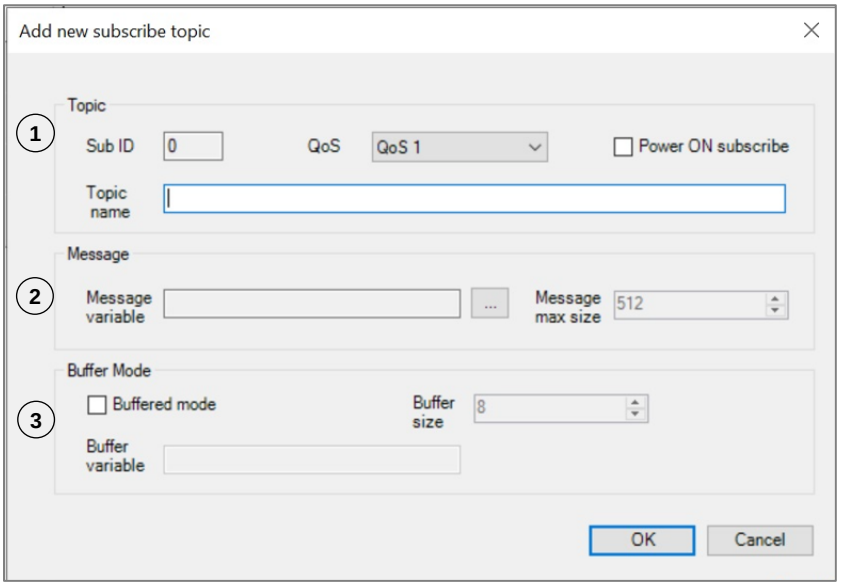
Subscribe

Up to 8 subscribe topics can be configured.



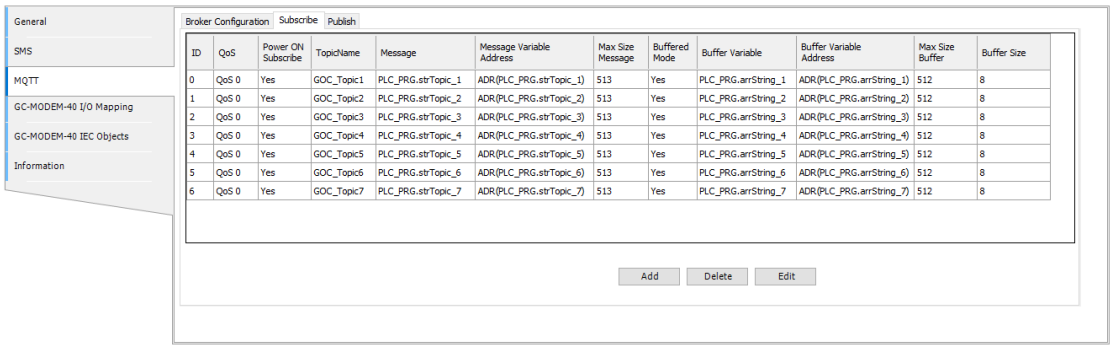
Add New Subscribe Topic

The "Add" button will open a dialog box to add a subscribe topic.



Sr. No.	Item		Default Value	Description
1	Topic	Sub ID	0	Subscribe topic ID (0 to 7). Generated automatically.
		QoS	QoS 0	Select Quality of Service for message as QoS 0 or QoS 1.
		Power ON Subscribe	Uncheck	Checked: Automatically subscribes to topic at power ON. Unchecked: Do not automatically subscribes to topic at power ON.
		Topic Name	Blank	Specify the name of the topic to subscribe. Set topic name up to 128 characters.
2	Message	Message variable	Blank	Specify variable to store receive message. After successful subscription, message received on subscribed topic will be store at this variable. Click the button to open input assistant dialogue and select a variable from the application program. Make sure that the message variable is large enough to store the received message.
		Message max size	512	Shows size of the 'Message variable'. The maximum size can be up to 512 bytes. If the size of the received message is larger than the specified maximum size, the excess message will be lost.
3	Buffer Mode	Buffered Mode	Disabled	If enabled, it allows to buffer up to 8 messages of a topic.
		Buffer variable	0	The buffer message variable name is displayed. This variable is automatically declared when buffer mode is enabled. The data type of the buffer variable is set as an array of the data type of the message variable. For example, if the message variable data type is STRING(250), the buffer variable is declared as `ARRAY [0…<Buffer size>] of STRING(250)`
		Buffer size	8	Specify maximum number of messages to be buffered for a topic.

The following image shows the message list after adding subscribe messages..



Delete Subscribe topic

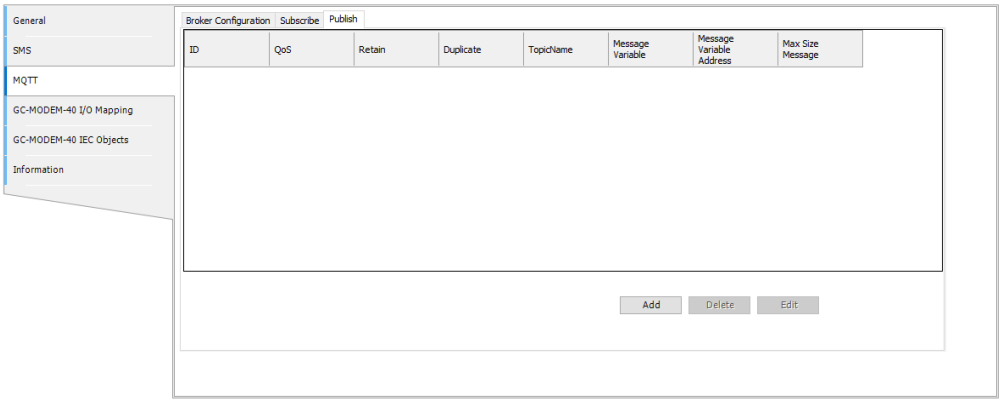
To delete a subscribe topic from the list, click on the row in the group list to select the subscribe topic, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

Edit Subscribe topic

To modify subscribe topic configuration, click on the row to select the topic from the list. Then, click on the "Edit" button and follow the instructions in the "Add new subscribe topic" section.

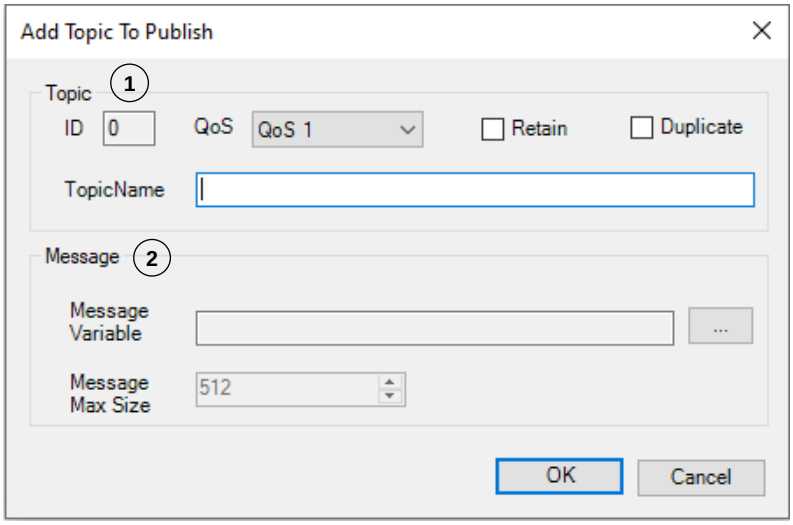
Publish

Up to 64 publish topics can be configured. However, publish on only one topic is allowed at a time. Messages can be published over multiple topics one after another.



Add Topic To Publish

The "Add" button will open a dialog box to add a publish topic.



Sr. No.	Item		Default Value	Description
1	Topic	ID	0	Subscribe topic ID (0 to 63). Generated automatically.
		QoS	QoS 0	Select Quality of Service for message as QoS 1 or QoS 2.
		Retain	Disabled	Enables / disables retain message function. When a message is published with the "retain" flag set to true, the broker stores that message and delivers it to any new subscribers who subscribe to that topic.
		Duplicate	Disabled	Enables / disables duplicate message function. It is recommended to keep this setting disabled.
		Topic Name	Blank	Name of the topic to be published.
2	Message	Message variable	Blank	Specify the variable that stores the publish data. The publish data is the message content that will be sent to a topic. You can select any PLC variable from the application project to store the publish data. To select a PLC variable, click the button. This will open the input assistant dialog, where you can select a variable from the application program.

Sr. No.	Item		Default Value	Description
		Message max size	512	Shows size of the ‘Message variable’. The maximum size can be up to 512 bytes

Delete Publish topic

To delete a publish topic from the list, click on the row in the topic list to select the publish topic, then click on the "Delete" button. A confirmation dialog will appear; click "Yes" to confirm the deletion.

Edit Publish topic

To modify publish topic configuration, click on the row to select the topic from the list. Then, click on the "Edit" button and follow the instructions in the "Add topic to publish" section.

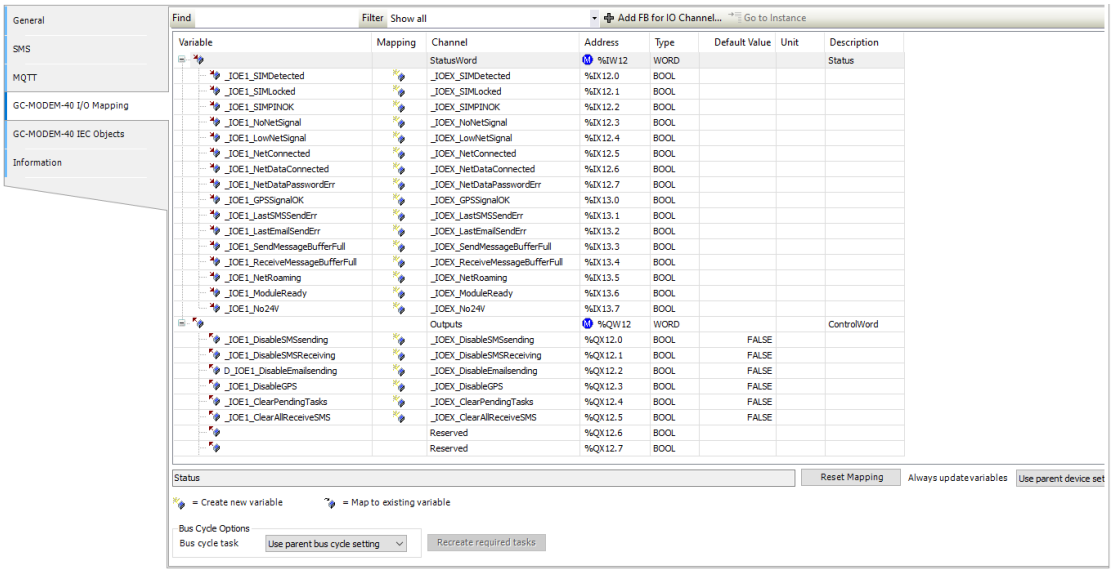
7.1.4.3.4 Terminologies in MQTT

Following are the frequently used terminologies in MQTT communication.

Sr. No.	Parameter	Description
1	MQTT	It is an abbreviation of 'Message Queue Telemetry Transport' communication protocol
2	Client ID	The client ID is used to identify the client at the MQTT broker
3	Clean Session	If clean session is enabled, the broker will discard any previously maintained information about the client, such as the client's subscriptions and the messages that were published to the client. If disabled, the broker will keep client information and buffer new messages for the client for later delivery.
4	Keep alive interval	The KeepAlive time determines the time interval in which the MQTT client is obligated to report to the MQTT broker.
5	CA certificate	This certificate is a public key signed by its owner which guarantees its authenticity and integrity. It is referred to authenticate the MQTT broker. The MQTT client requires the CA certificate of the broker.
6	Client certificate	This is a certificate which must be signed by the same CA as a server certificate.
7	TLS mode	'Transport layer security' mode. Specify TLS modes as below 0: Disable: TCP/IP connection is set up with plain MQTT protocol without TLS. 1: With CA certificate: During establishing TLS communication, the client has to provide a certificate matching the broker's certificate. GC43 device requires a valid certificate from broker 2: With CA certificate, Client Certificate/ Key 3: With encryption only: Secured encrypted connection is established without authentication for broker and client. Security certificates are not required in this mode.
8	Will topic/ Will message/	In MQTT protocol, pub/ sub mechanism is used. In pub/ sub mechanism, publishers do not know about subscribers' existence and vice versa. Then whenever broker notices disconnection with client, it publishes Will topic along with Will message to all subscribers.
9	QoS	It is an abbreviation of 'Quality Of Service'. MQTT protocol provides three service methods/ qualities to assure message transmission quality as below. 1. QoS 0: This is the lowest level in which no assurance is given that the message will arrive at all. 2. QoS 1: At this level 1, MQTT broker acknowledges receipt of message and it is ensured that, received message ends up in the topic queue. 3. QoS 2: At this level, the MQTT broker guarantees by multiple handshakes with the MQTT client that the message is exactly filed once.
10	Topic	Topic is a defined subject/ heading for messages to be transmit.
11	Subscribe	Subscribing in MQTT is the process of registering a client to receive messages published to a specific topic. When a client subscribes to a topic, the broker will deliver all messages published to that topic to the client.
12	Publish	Publishing in MQTT is the process of sending a message to a topic.

7.1.5 I/O Mapping

Click on *GC-MODEM-40 I/O Mapping* tab to view input and outputs as shown below.



Status and diagnostic information along with settings of SMS functionality is provided in I/O memory. The table below provides the details of I/O bits related to GC-MODEM-40.

☐=1 for unit fixed in IO1 slot, ☐=2 for unit fixed in IO2 slot,

I/O Variables	Address		Description
	IO1 Slot	IO2 Slot	
_IOE☐StatusWord.			
_IOE☐_SIMDetected	%IX12.0	%IX14.0	**TRUE**: SIM card is detected. **FALSE**: SIM card is not detected
_IOE☐_SIMLocked	%IX12.1	%IX14.1	**TRUE**: SIM card locked due to multiple entries of incorrect SIM. **FALSE**: SIM card is not present.
_IOE☐_SIMPINOK	%IX12.2	%IX14.2	**TRUE**: SIM PIN is Ok **FALSE**: SIM PIN is invalid/ error detected.
_IOE☐_NoNetSignal	%IX12.3	%IX14.3	**TRUE**: No network signal detected. **FALSE**: Network signal detected.
_IOE☐_LowNetSignal	%IX12.4	%IX14.4	**TRUE**: Network signal strength is weak **FALSE**: Network signal strength is good
_IOE☐_NetConnected	%IX12.5	%IX14.5	**TRUE**: Registered on network. **FALSE**: Not registered on network
_IOE☐_NetDataConnected	%IX12.6	%IX14.6	**TRUE**: Network data enabled and connection is established. **FALSE**: Network data disabled or connection is not established
Reserved	%IX12.7	%IX14.7	Reserved
_IOE☐_GPSSignalOK	%IX13.0	%IX15.0	**TRUE**: GPS signal is Ok **FALSE**: No GPS signal
_IOE☐_LastSMSSendErr	%IX13.1	%IX15.1	**TRUE**: Last SMS sending failed. **FALSE**: Last SMS sending is successful.

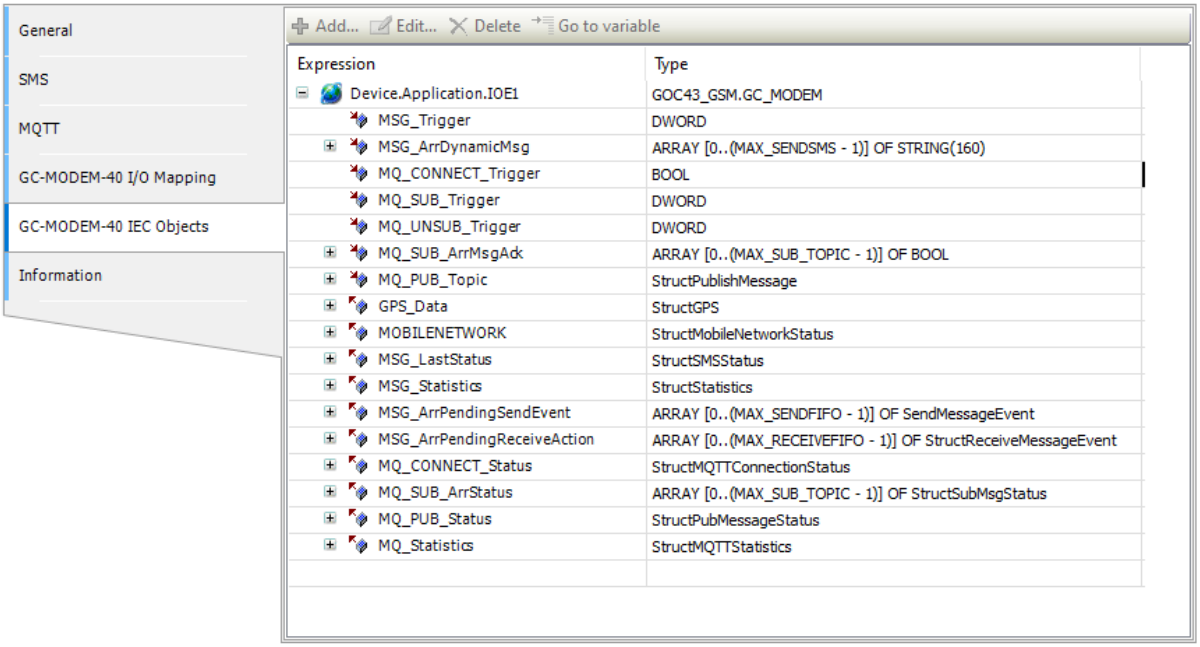
Reserved	%IX13.2	%IX15.2	Reserved
_IOE☐_SendMessageBufferFull	%IX13.3	%IX15.3	**TRUE**: Sent messages buffer is full. In such case, send message triggers are ignored. **FALSE**: Sent messages buffer is not full.
_IOE☐_ReceiveMessageBufferFull	%IX13.4	%IX15.4	**TRUE**: Receive message buffer is full. In such case, receive messages will get discarded without processing and notification. **FALSE**: Receive messages buffer is not full.
_IOE☐_NetRoaming	%IX13.5	%IX15.5	**TRUE**: Roaming is activated. Home network is not available. **FALSE**: Roaming is not activated.
_IOE☐_ModuleReady	%IX13.6	%IX15.6	**TRUE**: Module is ready for communication. **FALSE**: Module is not ready for communication.
_IOE☐_No24V	%IX13.7	%IX15.7	**TRUE**: 24VDC supply to module is absent. **FALSE**: 24VDC supply to module is Ok.
_IOE☐ControlWord.			
_IOE☐_DisableSMSsending	%QX12.0	%QX14.0	**TRUE**: Sending SMS is disabled. **FALSE**: Sending SMS is not disabled.
_IOE☐_DisableSMSReceiving	%QX12.1	%QX14.1	**TRUE**: Receiving SMS receiving is disabled. **FALSE**: Receiving SMS is not disabled.
Reserved	%QX12.2	%QX14.2	Reserved.
_IOE☐_DisableGPS	%QX12.3	%QX14.3	**TRUE**: GPS data updation periodically is stopped. **FALSE**: GPS data updation periodically is not stopped.
_IOE☐_ClearPendingTasks	%QX12.4	%QX14.4	**TRUE**: Pending list of send messages is cleared. **FALSE**: Pending list of send messages will not get cleared.
_IOE☐_ClearAllReceiveSMS	%QX12.5	%QX14.5	**TRUE**: Read all received SMS and discard them without action on it. **FALSE**: Reception of SMS is executed normally.
Reserved	%QX12.6 ⋮ %QX13.7	%QX14.6 ⋮ %QX15.7	Reserved.

7.1.6 IEC Objects

IEC objects are pre-defined variables, which exchange the information between I/O extension and the application program. Each IEC variable has a unique name and is categorized depending on functionality.

User can monitor IEC variables in online mode in CoDeSys project at

`IOE☐ (GC-MODEM-40)→GC-MODEM-40 IEC Objects`



Subsequent section explains the significance of IEC objects in details.

The table below explains the significance of IEC variables category wise –□

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MSG_Trigger	Read/Write	DWORD	This is SMS send trigger variable. Message with send message ID= n (0 to 31) is sent on rising edge of . IOE□.MSG_Trigger.n
IOE□.MSG_ArrDynamicMsg	Read/Write	ARRAY [0...31] of STRINGS(160)	Each element in the array holds a dynamic message text. The element with index 'n' holds the dynamic message text for message ID 'n'. For example, the element IOE□.MSG_ArrDynamicMsg[1] holds the dynamic message text for message ID 1. The application program must construct and store the message text in the array before generating a message trigger.
IOE□.GPS_Data			
.Status	Read only	ENUMGPSSTATUS	Holds GPS status as below, 0: GPS setting is not enabled. 1: GPS signal reception is bad because there is no line of sight to the GPS satellite. 2: GPS signal reception is good.
.VisibleSatelites	Read only	BYTE	Holds number of GPS satellites from which signals are being received.
.Position	Read only	StructGPSPosition	Holds GPS position data as below, Latitude: '18 27.53502',. Longitude: '073 50.8827743, Altitude: 648.7

Structure element	Data type	Description
.Lattitude	STRING(13)	Provides latitude in 'ddmm.mmmmmm' format
.NSIndicator	STRING(1)	Provides North/ South ('N'/'S') status
.Longitude	STRING(13)	Provides longitude in 'ddmm.mmmmmm' format
.EWIndicator	STRING(1)	Provides East/ West ('E'/'W') indication.
.Altitude	REAL	Provides altitude

.GPSTime	Read only	DATE_AND_TIME	Holds date and time received from GPS. For an example, DT#2023-06-24-17:56:41
.LastUpdateTime	Read only	DATE_AND_TIME	Holds date and time when GPS data i.e. .GPSPosition and .GPSTime was updated last time.

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MOBILENETWORK			
.Status	Read only	BYTE	Mobile wireless network status as below, 0: Network not registered. 1: Network registered, as home network 2: Searching network to get registered 3: Registration denied 4: Unknown network 5: Registered, as roaming network
.Name	Read only	STRING(15)	Name of mobile network service provider
.SignalStrengthCSQ	Read only	BYTE	These values represent strength indication <rssi> of received signal. Mobile network strength in CSQ 0 to 8: Signal reception not possible 9 to 16: Medium signal quality 17 to 31: Good signal quality 99: Signal not detected
.SignalStrengthdbm	Read only	INT	Mobile network strength in dbm -112 to -97: Signal reception not possible -95 to -81: Medium signal quality ≥ -79: Good signal quality ≤ -113: Signal not detected
.SignalQuality	Read only	BYTE	Signal quality in percentages (%)
.IMSI	Read only	STRING(15)	IMSI (**I**nternational **M**obile **S**ubscriber **I**dentity) number of device.
.IMEI	Read only	STRING(15)	IMEI (**I**nternational **M**obile **E**quipment **I**dentity) number of device.

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MSG_LastStatus			
.SendMsgID	Read only	BYTE	ID (0 to 31) of last SMS message sent.
.SentTime	Read only	DT	Date and time when last message was sent.
.SendTriggerType	Read only	BYTE	Type of trigger for last message sent, 0: Send message triggered via. IOE□.MSG_Trigger n 1: Send message triggered as an action for received message
.SendResult	Read only	BOOL	Status of last message sent. TRUE: SMS sent successfully. FALSE: SMS sent unsuccessful. Refer 'IOE□.MSG_LastStatus.SendErrorID' for cause of error.
.SendErrorID	Read only	BYTE	Error code observed while sending last message, 0: No error 1: SIM card not detected. 2: SIM card detected but not ready 3: Mobile network is not enabled 4: Mobile network is not available 5: Message is blank 6: Internal error
.SendMsg	Read only	STRING(160)	Text of last message sent successfully.
.SendUser	Read only	STRING(20)	Name of user to whom last message was sent successfully.
.SendGroup	Read only	STRING(20)	Name of user group to whom last message was sent successfully
.RecvMsgID	Read only	BYTE	ID of last message received
.RecvResult	Read only	BOOL	Status of last message received, TRUE: Message received successfully. FALSE: Error in message received. Refer 'IOE□.MSG_LastStatus.RecvErrorID' for cause of error.

Name of IEC Variable	Read/ Write Access	Data Type	Description
.RecvErrorID	Read only	BYTE	Holds error code observed while receiving last message as below, 0: No error observed 1: Received message text does not match with any configured receive messages. 2: No GPS signal 3: GPS signal is not enabled 4: Invalid password (Authentication failed) 5: Unauthorized user i.e. mobile number of message sender not configured 6: Invalid or out of range value received for receive action 'Set value variable'.
.RecvMsg	Read only	STRING(60)	Text of last message received.
.RecvUser	Read only	STRING(20)	Name of user from whom last message reception was attempted
IOE□.MSG_Statistics			
.SentCount	Read only	WORD	Number of messages sent
.SendFailCount	Read only	WORD	Number of times error was observed while sending message.
.RecvCount	Read only	WORD	Number of valid messages received.
.RecvDiscardCount	Read only	WORD	Number of received messages discarded.
.SentNotificationCount	Read only	WORD	Number of notifications sent.
.SendLostTriggerCount	Read only	WORD	Holds number of message triggers lost due to send message buffer full.
.RecvLostCount	Read only	WORD	Holds number of messages discarded due to receive message buffer full.

<table>
<tr><th>Name of IEC Variable</th><th>Read/ Write Access</th><th>Data Type</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">IOE□.ArrPendingSendEvent</td><td rowspan="5">Read only</td><td rowspan="5">ARRAY [0..15] OF SendMessageEvent</td><td colspan="3">Variable holds list of pending send message events. This is an array of ‘SendMessageEvent’ structure. Details of structure elements are as below</td></tr>
<tr><td>Structure element</td><td>Data type</td><td>Description</td></tr>
<tr><td>MsgID</td><td>BYTE</td><td>ID of send message triggered</td></tr>
<tr><td>TriggerTime</td><td>DATE_AND_TIME</td><td>Date and time when message were triggered.</td></tr>
<tr><td>Text</td><td>STRING(160)</td><td>Text of message to be sent.</td></tr>
<tr><td rowspan="5">IOE□.MSG_ArrPendingReceiveAction</td><td rowspan="5">Read only</td><td rowspan="5">ARRAY [0..7] OF StructReceiveMessageEvent</td><td colspan="3">Variable holds list of pending receive message events. This is an array of ‘RecvMessageEvent’ structure. Details of structure elements are as below</td></tr>
<tr><td>Structure element</td><td>Data type</td><td>Description</td></tr>
<tr><td>RecvFrom</td><td>STRING(50)</td><td>Mobile number of message sender</td></tr>
<tr><td>RecvTime</td><td>DATE_AND_TIME</td><td>Date and time when message was received.</td></tr>
<tr><td>Text</td><td>STRING(50)</td><td>Text of received message.</td></tr>
</table>

The table below explains the significance of IEC variables applicable for MQTT communication,

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MQ_CONNECT_Trigger	Read/Write	BOOL	If TRUE, initiates connection with broker. If FALSE, initiates disconnection with broker.
IOE□.MQ_SUB_Trigger	Read/Write	DWORD	Each bit in the variable represents a subscription topic. The bit at index 0 (the least significant bit, or LSB) is assigned to subscription topic ID 0, and the bit at index 7 is assigned to subscription topic ID 7. For example, to send a subscribe request for topic ID 5 of IO extension 1, set the 5th bit in the IOE1.MQ_SUB_Trigger object to TRUE.
IOE□.MQ_UNSUB_Trigger	Read/Write	DWORD	Each bit in the variable represents a subscription topic. The bit at index 0 (the least significant bit, or LSB) is assigned to subscription topic ID 0, and the bit at index 7 is assigned to subscription topic ID 7. For example, to send a unsubscribe request for topic ID 5 of IO extension 1, set the 5th bit in the IOE1.MQ_UNSUB_Trigger object to TRUE.
IOE□.MQ_SUB_ArrMsgAck	Read/Write	ARRAY [0..7] OF BOOL	Acknowledgement of new message reception. When a new message is received for a topic, the user should copy the message data and set boolean variable to acknowledge the reception of the message. It will allow unit to receive the next message. If boolean variable is not set after receiving a new message, all new messages received later will be discarded. Each boolean in the variable represents a subscription topic. The boolean at index 0 is assigned to subscription topic ID 0, and the boolean at index 7 is assigned to subscription topic ID 7.
IOE□.MQ_PUB_TOPIC	Read/Write	StructPublishMessage	Structure used to trigger publish message.

Structure element	Data type	Description
Trigger	BOOL	Message with ‘Publish_Msg_ID’ gets published.
Duplicate	BOOL	Not used
ID	BYTE	Hold topic ID of message to be published.
MsgLen	WORD	Holds publish message length

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MQ_CONNECT_Status			
.Connected	Read only	BOOL	This variable holds the status of connection. TRUE: Successful connection with broker. FALSE: Not connected with broker.
.Error	Read only	BOOL	This variable holds status of client connection. TRUE: Successful connection with broker. FALSE: Not connected with broker.
.State	Read only	ENUMCLIENT STATUS	This variable provides connection status as, 0: Connected. 1: Client initialization in progress. 2: Starting MQTT server. ?? 3: Acquiring client. 4: WILL topic initialization. 5: WILL message initialization. 6: Connection (certificate validation) in progress. 7: Not connected.
.ErrorID	Read only	MQ_ERRENUM	This variable holds received error code as, 0: Connected. 1: TBD (as per SIMCOM feedback) 2: TBD (as per SIMCOM feedback)

The table below explains object list of statistics of subscribed topic such as topic count, received messages count, published messages count etc.

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MQ_Statistics			
.ConnRetryCount	Read only	WORD	Holds count of number of times for which connection is attempted.
.PubMsgCount	Read only	WORD	Holds count of number of messages published by device.
.PubMsgFailCount	Read only	WORD	Holds count of number of times for which publish error is observed.
.SubMsgRecvCount	Read only	WORD	Holds count of number of valid messages received and processed by device.
.SubMsgDiscardCount	Read only	WORD	Holds count of number of messages discarded by device.
.SubMsgRecvLenErrCount	Read only	WORD	Holds count of number of subscribe messages received with length size. The unit will declare an error if a subscribe message is received with the size larger than maximum permissible message length.
.SubTopicCount	Read only	BYTE	Holds count of subscribed topics

The table below explains the significance of structure which stores subscribed topic status, received message details, buffer status, read message status etc.

Name of IEC Variable	Read/ Write Access	Data Type	Description		
IOE□.MQ_SUB_ArrStatus	Read only	ARRAY [0..7] OF StructSubMsgStatus	This variable holds status of subscribed messages.		
			Structure element	Data type	Description
			Subscribed	BOOL	This variable holds status of topic subscription
			ErrorID	MQ_ERRENUM	This variable holds error ID received, if subscription is done successfully.
			NewMsg	BOOL	This variable holds message read status
			MsgLen	WORD	This variable holds received message length.
			BufferFull	BOOL	This variable is applicable only when buffered mode is activated.
			BufferEmpty	BOOL	This variable is applicable only when buffered mode is activated.

The table below explains objects applicable during message publishing to the device.

Name of IEC Variable	Read/ Write Access	Data Type	Description
IOE□.MQ_PUB_Status			
.Done	Read only	BOOL	TRUE: If message is published successfully. FALSE: If message publishing is in progress.
.Busy	Read only	BOOL	This variable holds status of message publishing as, TRUE: Message publishing is in progress. FALSE: Either when message publishing is done successfully or error is occurred during publishing.
.Error	Read only	BOOL	This variable holds message publishing status as, TRUE: Error occurred during message publishing. FALSE: If message is published successfully.
.ErrorID	Read only	MQ_ERRENUM	This variable holds error code observed during message publishing as below, 0: No Error 1: No sim card detected 2: SIM not ready 3: Mobile wireless network not enabled. 4: No mobile network 5: Publish message is blank 6: Other internal error 7: MQTT connection is in process 8: MQTT connection error 9: MQTT Connection lost 10: Topic ID not configured

8 Modbus RTU Configuration

User can configure Modbus RTU slave or master protocol for serial com extension unit (GC-RS232-COM, GC-RS422-COM) fixed in COM slot.

8.1 Modbus RTU Slave

8.1.1 Overview

GOC43 with serial com extension unit (GC-232-COM, GC-422-COM) can be configured as Modbus RTU slave device in Modbus network.

Memory mapping

Following table shows GOC43 memory mapping for Modbus memory.

Modbus Memory Area	GOC43 Memory	Details
Coils	Input bits (%IX)	Modbus master writes coils will be available as input bit
Holding registers	Input words (%IW)	Modbus master writes holding registers will be available as input words
Discrete inputs	Output bits (%QX)	Modbus master reads output bits as discrete inputs.
Input words	Output words (%QW)	Modbus master reads output words as input registers.

IO memory for Modbus RTU communication starts from %IW32 and %QW32. Size of input and output memory area shared over Modbus can be changed with configuration. Maximum size of input and output data is 500 words each. That means GOC43 can share 500 words of input data and 500 words of output data with Modbus RTU master device.

NOTE

Coils and Holding registers are mapped to same memory area in Input image of slave device. That means input memory of slave can be accessed as holding register or coil.

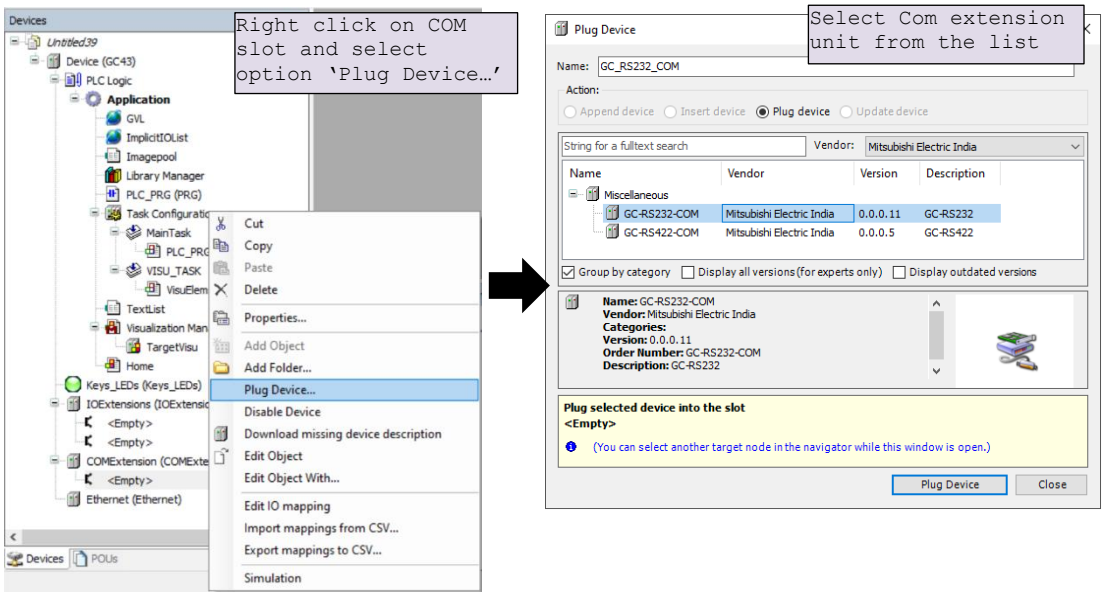
Supported function codes

Function Code	Description
01	Read coils
02	Read discrete inputs
03	Read holding registers
04	Read input registers
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
23	Read write multiple registers

8.1.2 Configuration

Plug COM extension device

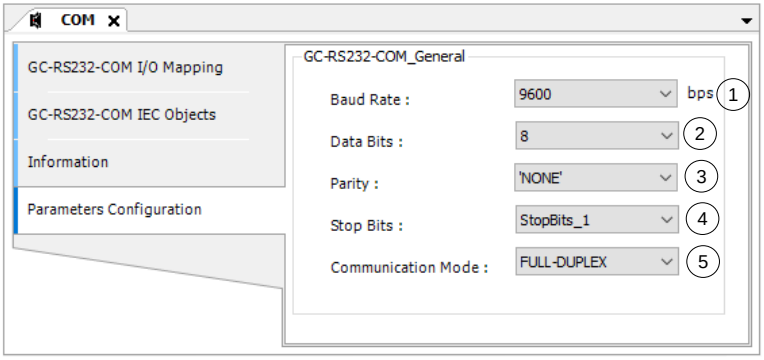
In CoDeSys project, plug COM extension unit GC-RS232-COM at <Empty> slot under COMExtension (COMExtension).



Set serial communication parameters

Double click on newly added COM extensions to open its device editor.

Click on tab 'Parameter Configuration' and set communication parameters



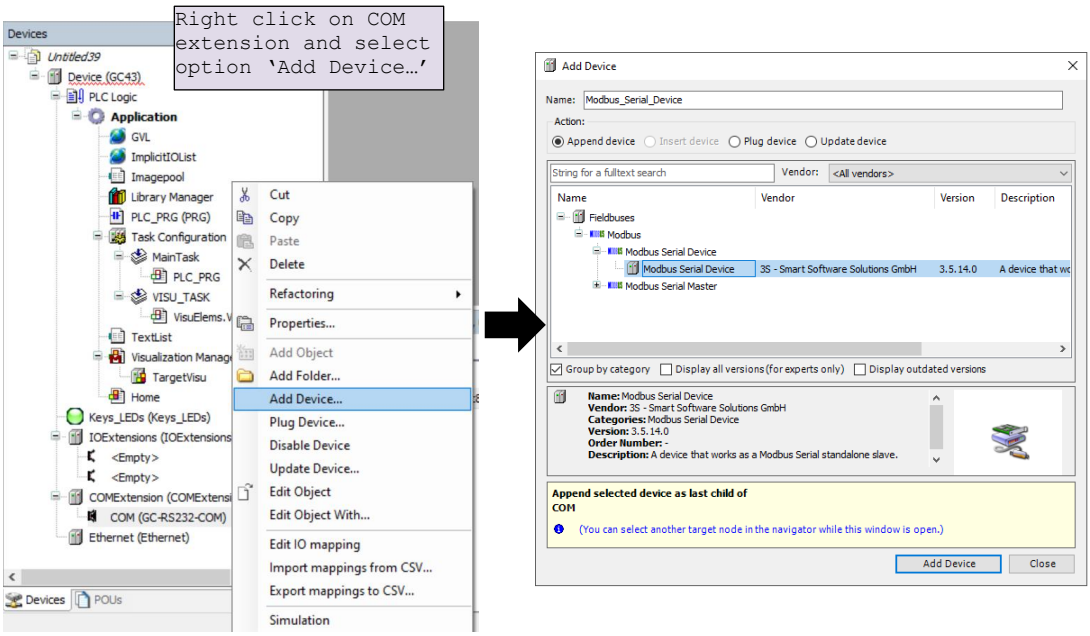
Sr. No.	Parameter	Option	Description
1	Baud Rate	1200, 2400, 4800, 9600 (Default), 19200, 38400, 57600, 115200	Baud rate in bps
2	Data Bits	8 (Default), 7	Number of data bits
3	Parity	EVEN, ODD, NONE (Default)	Parity
4	Stop Bits	StopBits_1 (Default), StopBits_2	Number of stop bits
5	Communication Mode	FULL-DUPLEX (Default), HALF-DUPLEX	Communication mode as half duplex or full duplex.

NOTE

While using GC-422-COM unit in RS485 communication mode, it is mandatory to set parameter 'Communication Mode' as 'HALF-DUPLEX'.

Add 'Modbus Serial Device'

To configure Modbus RTU slave function, do right click on COM extension unit in device tree and select 'Add Device' as shown.

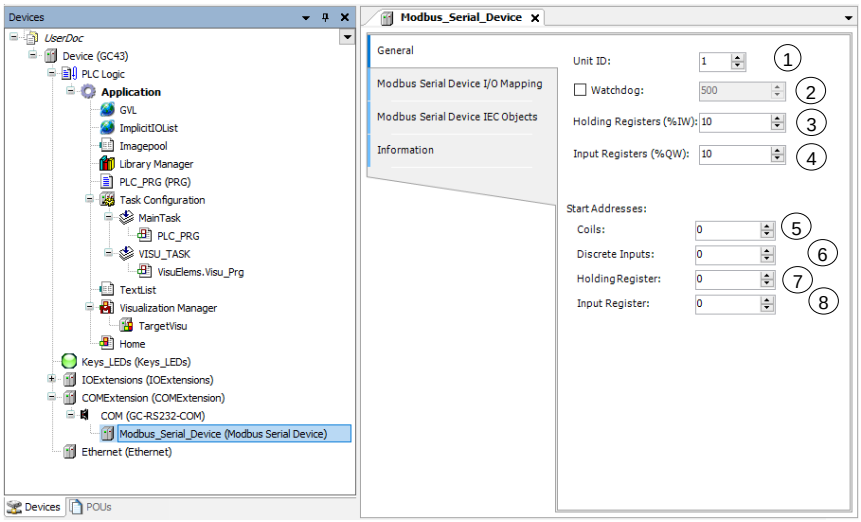


Set 'Modbus Serial Device' parameters.

Double click on Modbus Serial Device in device tree to open its device editor.

Click on 'General' Tab to set parameters.

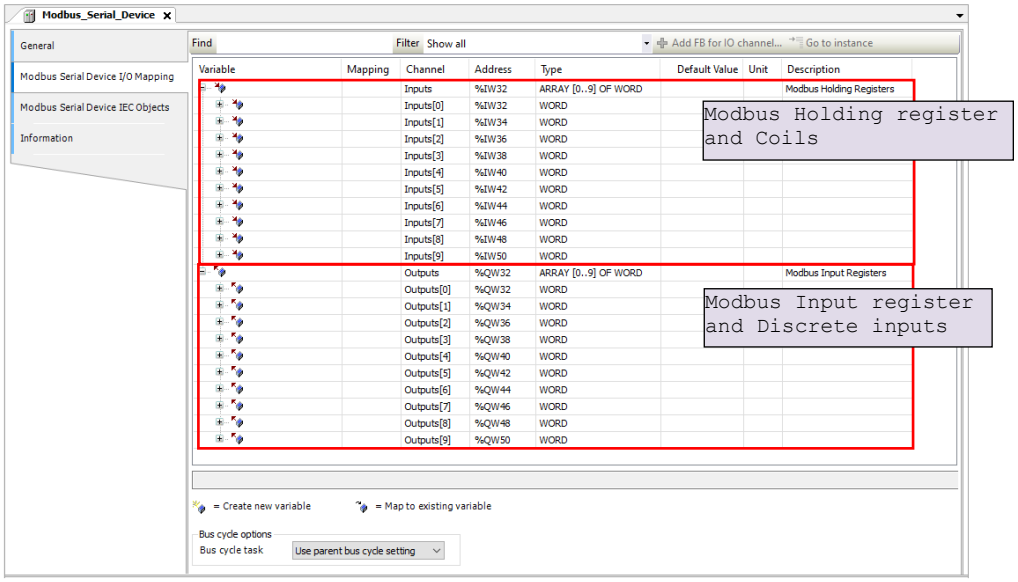
Set parameters as per the details mentioned below,



Sr. No.	Parameter		Default Value	Description
1	Unit ID		1	Set slave address within range of 1 to 247
2	Watchdog		500 ms	Enable and set watchdog time in msec. The incoming data (Holding Registers and coils / %I) is set to zero when Modbus slave device does not receive any valid query from the master for time defined by Watchdog. When disabled, watchdog action is never performed.
3	Holding Registers (%IW)		10	Set size of data at Holding registers (%IW) Maximum value =500
4	Input Registers (%QW)		10	Set size of data at Input registers (%QW) Maximum value =500
5	Start Addresses	Coils	0	Set starting offset addresses for Modbus. Logical start address of each Modbus data area can be set here. This means Modbus address with which Modbus Master addresses IO data can be set as per the application requirement. **Example:** If holding register start address set to 10 in slave device configuration, Modbus master should set offset =10 to access first holding register of device. Can be set to 0 if no special requirement of setting start address is identified.
		Discrete Inputs	0	
		Holding Registers	0	
		Input Registers	0	

IO mapping of 'Modbus Serial Device

'Modbus Serial Device I/O Mapping' shows list of Modbus holding registers and Modbus input registers as below.



8.2 Modbus RTU Master

8.2.1 Overview

GOC43 with serial com extension unit (GC-232-COM and GC-422-COM) can be configured as Modbus RTU Master in Modbus network.

When configured as Master, GOC43 allows to configure communication with 16 slave devices.

Data read from slave devices is mapped in to input memory.

Data to be write to slave devices is mapped to output memory.

Modbus master can use IO memory starting from %IW32 and %QW32.

Out of 2048 bytes first 32 bytes of IO memory is reserved for Local IOs from Main unit and IO extension units, remaining memory can be used by Modbus master. That means total memory available for Modbus master is 2048-32 =2016 BYTEs or 1008 WORDs.

Note that same IO memory area is also used by other communication protocols like Modbus RTU slave, Modbus TCP Master, Modbus TCP slave etc.

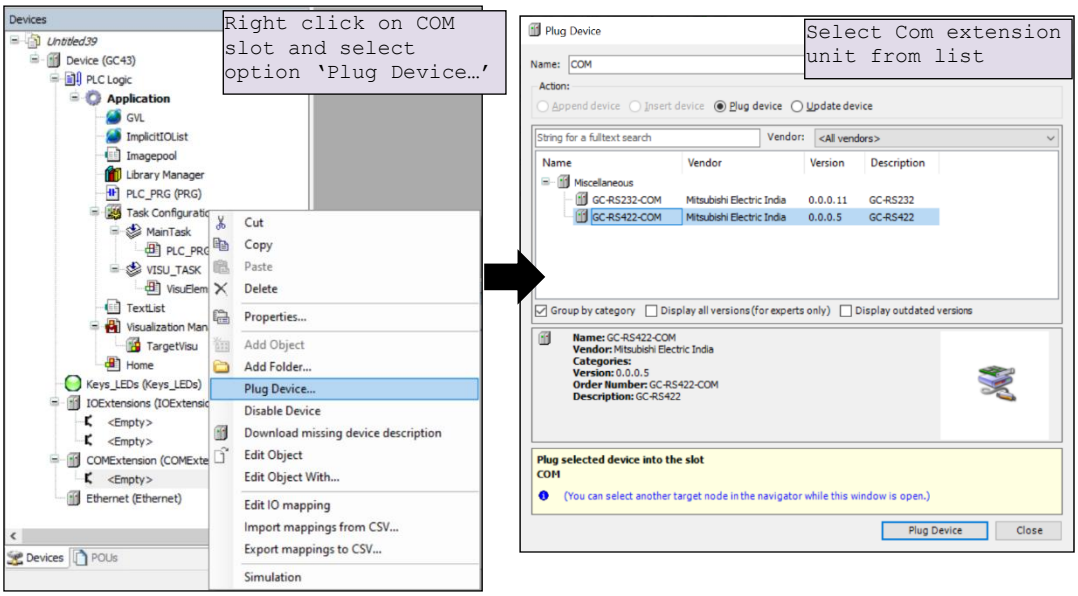
Supported function codes

Function Code	Description
01	Read coils
02	Read discrete inputs
03	Read holding registers
04	Read input registers
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
23	Read write multiple registers

8.2.2 Configuration

Add COM extension unit in configuration

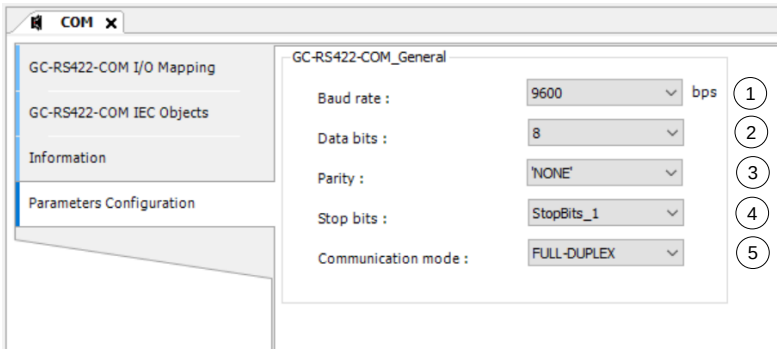
In CoDeSys project, plug COM extension unit GC-RS232-COM at <Empty> slot under COMExtension (COMExtension).



Set serial communication parameters

Double click on newly added COM extensions to open its device editor.

Click on tab 'Parameter Configuration' and set communication parameters



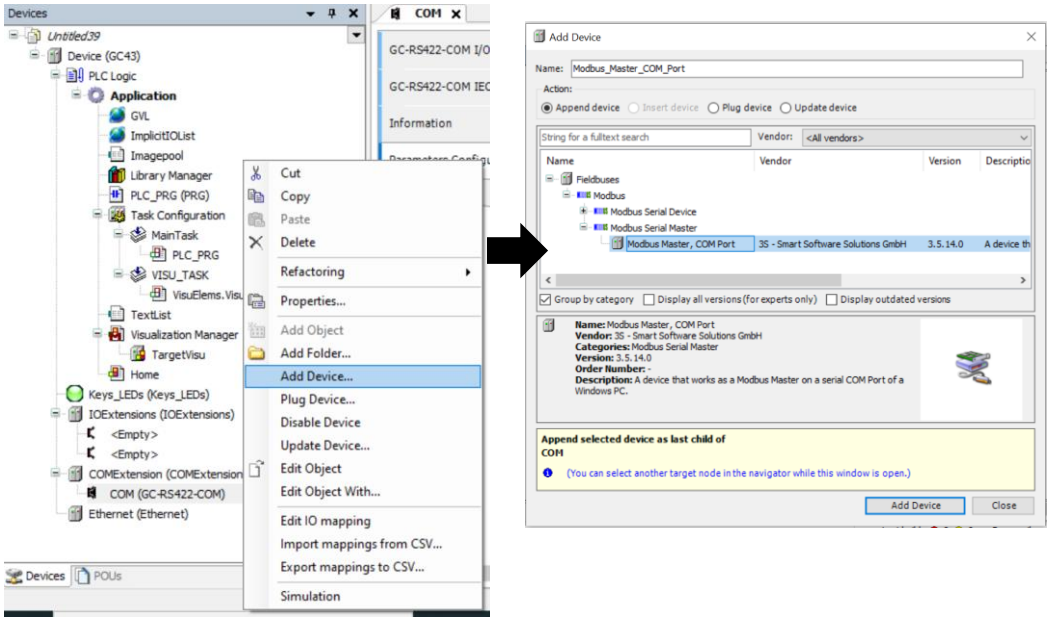
Sr. No.	Parameter	Option	Description
1	Baud Rate	1200, 2400, 4800, 9600 (Default), 19200, 38400, 57600, 115200	Baud rate in bps
2	Data Bits	8 (Default), 7	Number of data bits
3	Parity	EVEN, ODD, NONE (Default)	Parity
4	Stop Bits	StopBits_1 (Default), StopBits_2	Number of stop bits
5	Communication Mode	FULL-DUPLEX (Default), HALF-DUPLEX	Communication mode as half duplex or full duplex.

NOTE

While using GC-422-COM unit in RS485 communication mode, it is mandatory to set parameter 'Communication Mode' as 'HALF-DUPLEX'.

Add 'Modbus Serial Master'

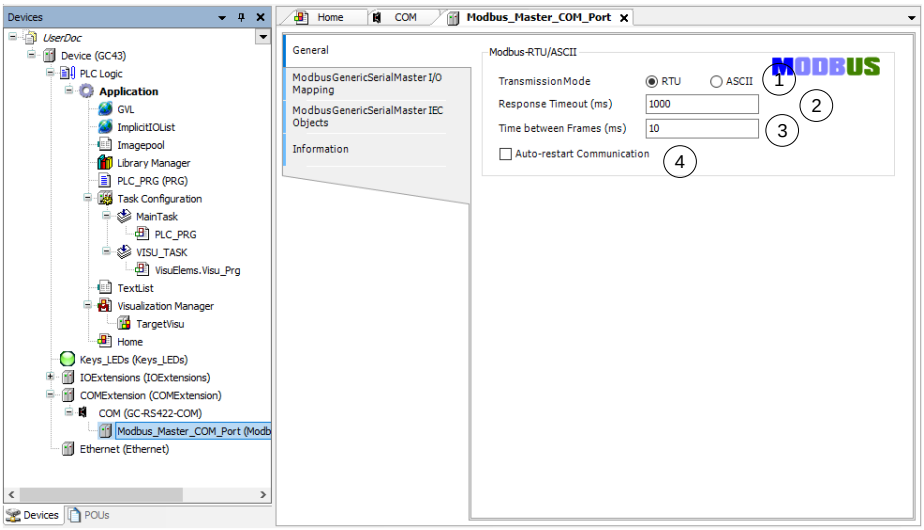
Right click on COM extension unit in device tree and select 'Add Device' as shown.



Setting Modbus Master parameters

Double click on Modbus Master Device in device tree to open its device editor.

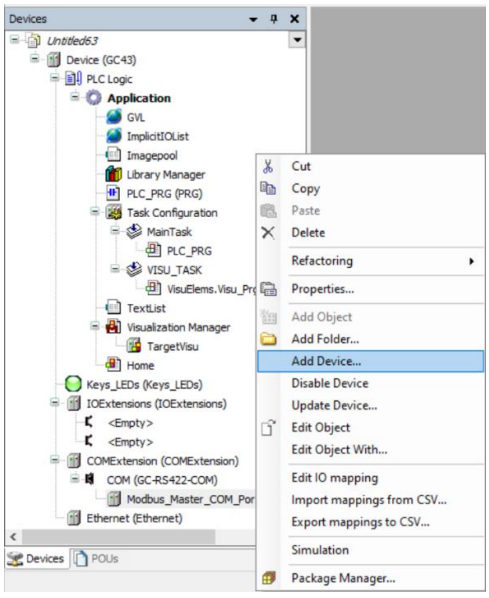
Click on ‘General’ Tab to set parameters. Set parameters as per the details mentioned below

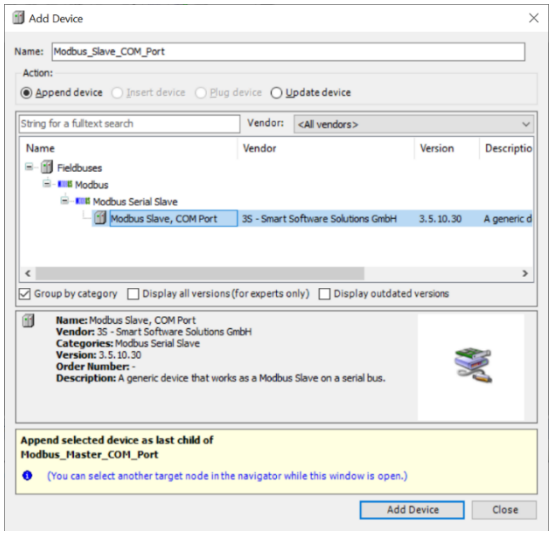


Sr. No.	Parameter	Default Value	Description
1	Transmission Mode	RTU	Set transmission mode as RTU. GOC43 supports only Modbus RTU transmission mode.
2	Response Timeout (ms)	1000	This is response timeout setting. It is recommended to set timeout for slave device in slave parameters. Once timeout is detected error is declared for slave, communication with device is stopped or continued as per setting 'Auto restart communication'
3	Time between Frames (ms)	10	This defines time duration between last response and next request.
4	Auto-restart Communication	Uncheck	This parameter defines master behavior in case of error. **Checked:** RTU Master keep on trying to communicate with a slave after response timeout. **Unchecked:** Master stops communication with slave until explicit confirmation by user. In this case, user has to reset or acknowledge error using IEC variables xReset or xAcknowledge. Refer section *IEC Objects* for more details.

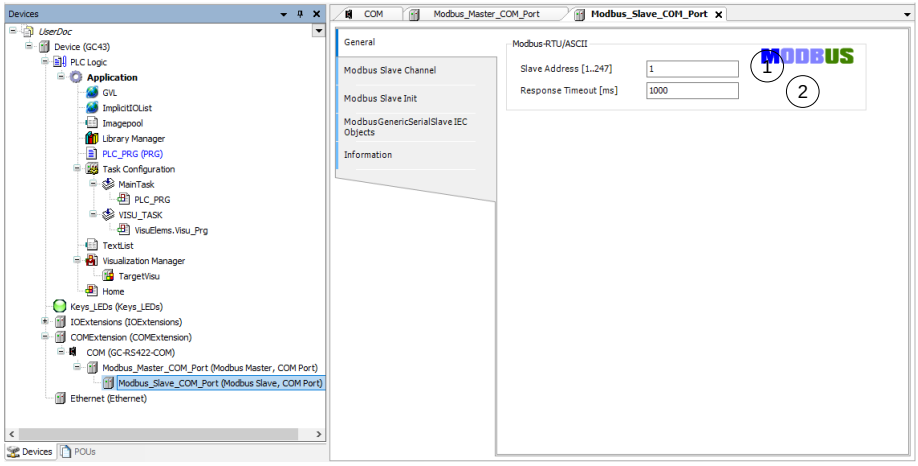
Add and configure Modbus RTU slave device.

Right click on 'Modbus_Master_COM_Port (Modbus Master, COM Port)' and select 'Add Device…' and select slave device.





After adding ‘Modbus Slave, COM port’ device, click on ‘Modbus Slave, COM Port in device tree to set ‘Slave Address’, ‘Response Timeout’ as shown below.



Sr. No.	Parameter	Default Value	Description
1	Slave address	1	Set slave address within range 1 to 247
2	Response Timeout (ms)	1000	This is response timeout setting. Once timeout is detected error is declared for slave, communication with device is stopped or continued as per setting ‘Auto restart communication’ in master configuration. It is recommended to set timeout for slave device in slave parameters.

NOTE

Up to 16 slave devices can be added to Modbus Master.

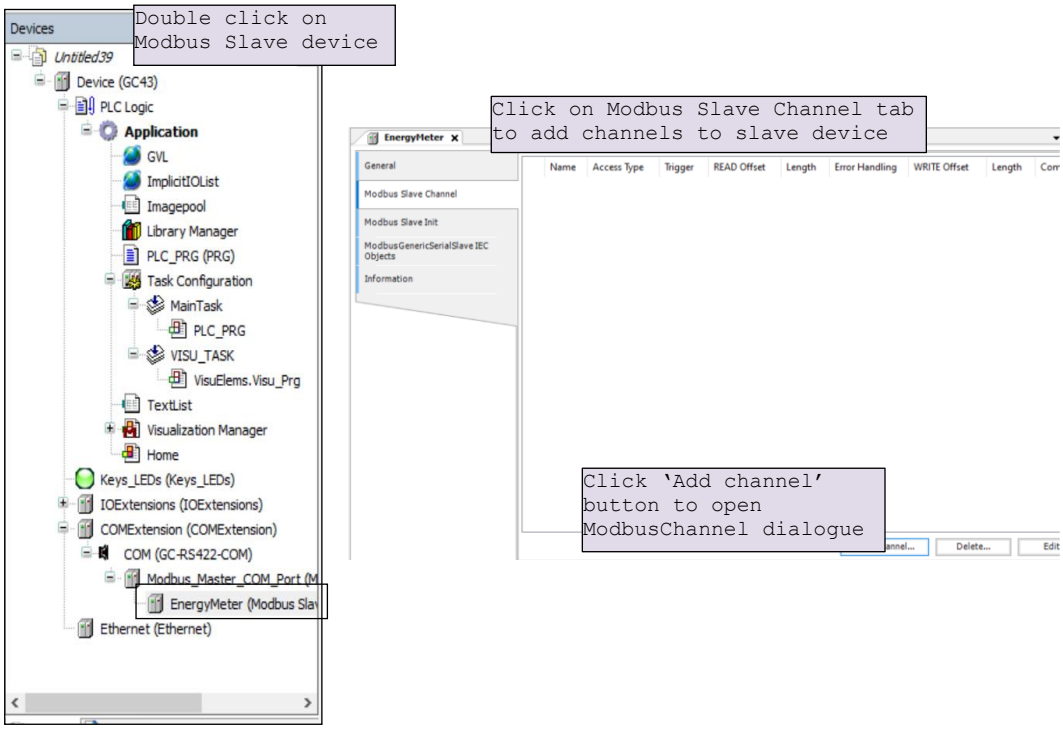
Add channels to slave device

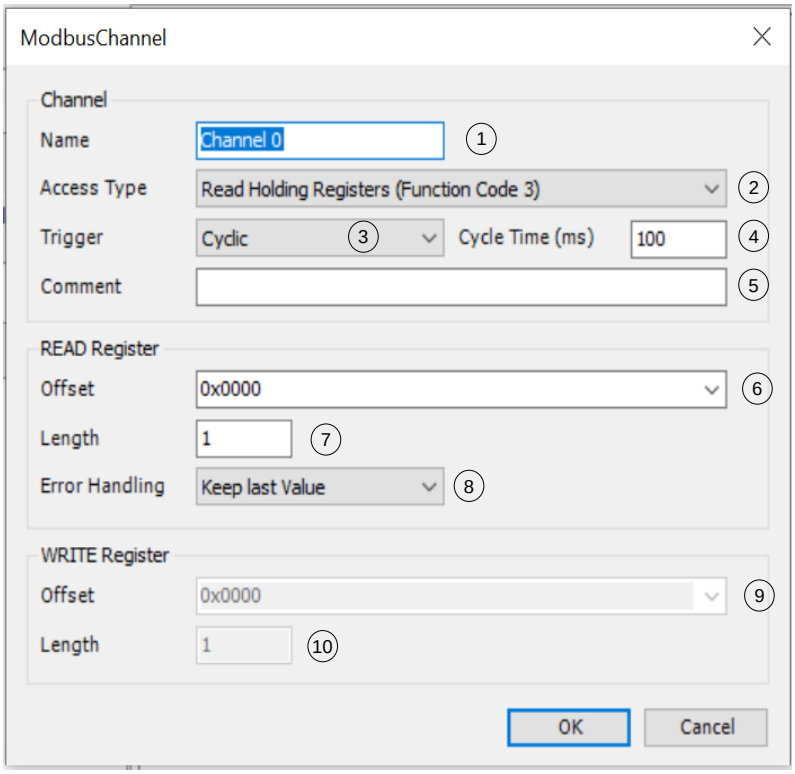
After adding slave device, next step is to add communication channels to slave device.

Each communication channel added to slave device forms a Modbus request to be sent to slave device. Each Modbus query is sent separately to slave device as per trigger type set in channel configuration.

Try to keep minimum Modbus requests per slave device for optimum communication cycle time. This can be achieved by include consecutive Modbus addresses of slave device in single Modbus query.
Example : If you want to read holding registers with offset 1 to 5 from slave device, it is better to add single Modbus request with read length 5 and starting address 1 instead of creating individual Modbus request for each channel.

Follow the procedure explained below to add channels





Sr. No.	Parameter	Default Value	Description
1	Channel Name	Channel_0	Set channel name. This is for identification purpose and will be displayed in IO mapping tab.
2	Channel Access Type	Function Code 03	Select Modbus function code to be used in Modbus request
3	Channel Trigger	Cyclic	**Cyclic:** The request occurs periodically. **Rising edge:** The request occurs as a reaction to a rising edge of the Boolean trigger variables. The trigger variable is defined in the tab I/O Mapping. **Application:** Modbus request is triggered by PLC application. Use Modbus channel FB to trigger request
4	Channel Cycle Time	100ms	Set cycle interval when Channel Trigger is Cyclic.
5	Comment	--	Description of channel
6	Read Offset	0x0000	Start Modbus offset where reading should start (value range 0-65535)
7	Read Length	1	Number of registers or coils to be read
8	Read Error Handling	Keep Last Value	Defines what should happen to the data in case of a communication error Keep last Value : Keeps last value updated Set to ZERO : Clears all values to zero
9	Write offset	0x0000	Start Modbus offset where writing starts in slave device (value range 0-65535)
10	Write Length	1	Number of registers to be written to

Follow the same procedure to add other channels of the slave.

You can add up to 99 channels for each slave device.

Add Modbus Slave Init Channels

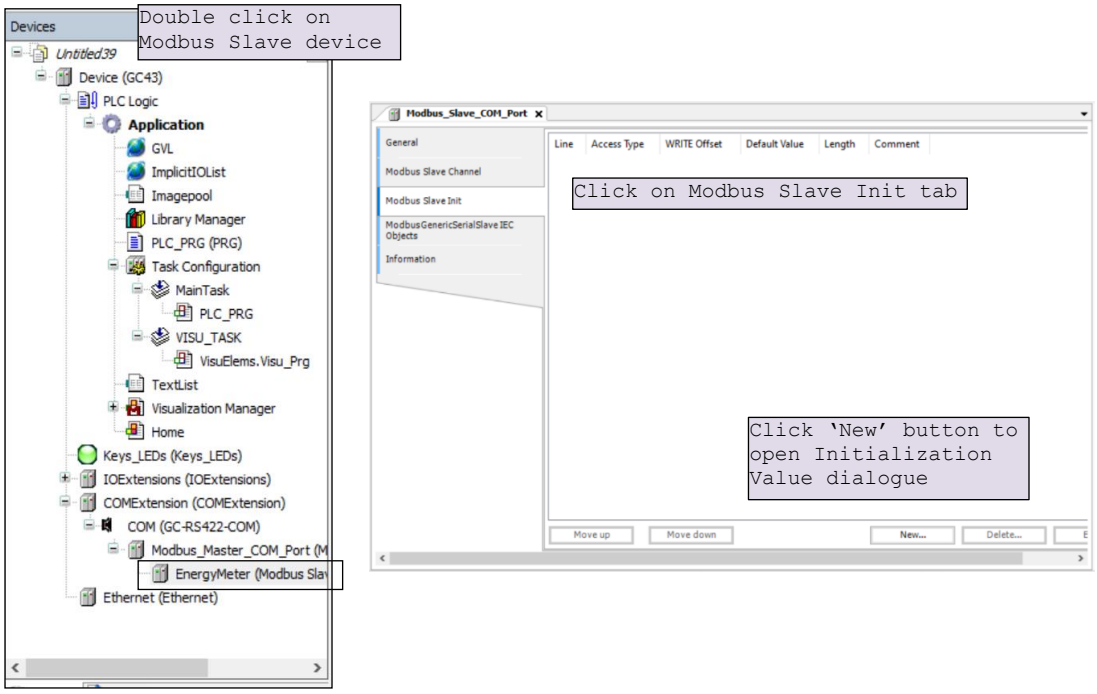
Apart from communication channels explained before, Modbus master allows to add 'Init' channels.

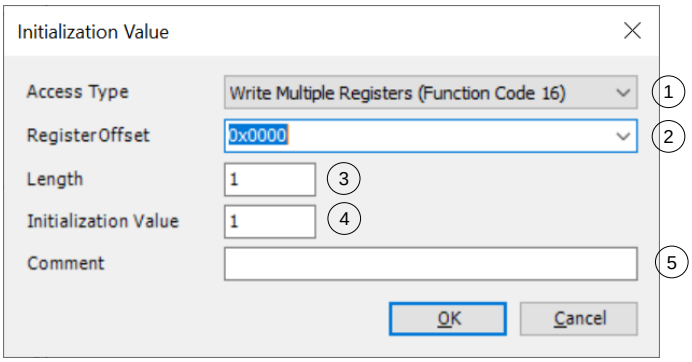
Init channels allows to send initialization commands to slave device. Initialization commands are executed one time when starting the slave device or after slave device recovered from error.

Initialization commands are sent to slave device in following cases

- Start of communication
- Reset of PLC (Reset warm or cold)
- Recovery of communication after error

Follow the procedure explained below to add 'Init channels'





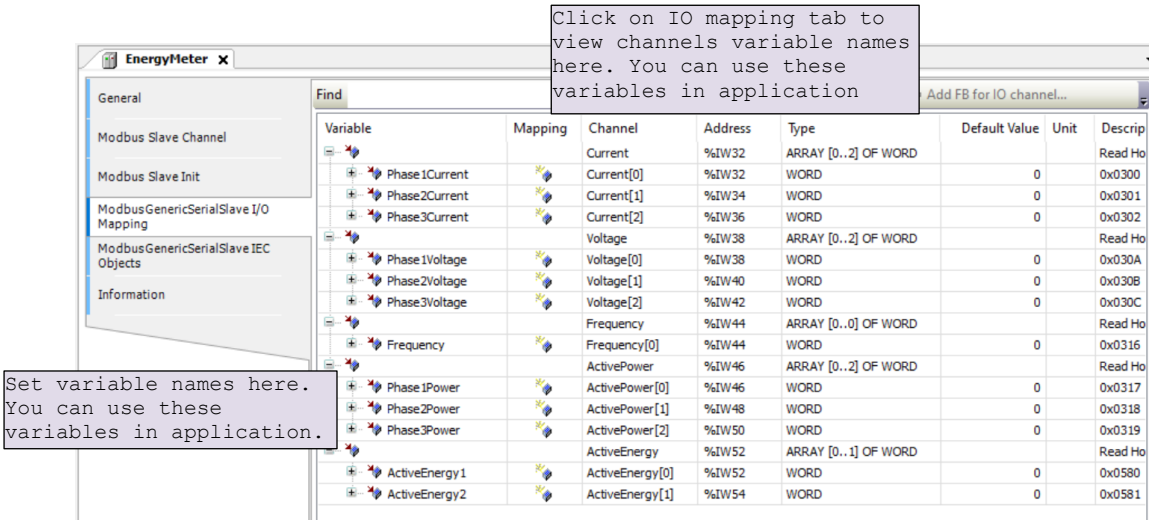
Sr. No.	Parameter	Default Value	Description
1	Access Type	Function Code 16	Select Modbus function code to Write initialization value.
2	Read Offset	0x0000	Start address where write should start (value range 0-65535)
3	Read Length	1	Number of registers to be read
4	Initialization value	1	Initialization value for the registers or coils
5	Comment	--	Description of channel

You can add up to 20 initialization channels for a slave.

IO mapping

After adding communication channels, IO mapping is updated accordingly in IO mapping tab of slave devices.

Below is an example of IO mapping



Follow the procedures explained to add Slave device, Modbus channel and Init channels for other slave devices, you can add up to 16 slave devices in the network.

Using Channel data in application program

Channels read from slave device are displayed as BOOL or WORD data type in IO mapping irrespective of their native data type in slave device.

If you want to use them in PLC code with their actual data types, declare a variable of required data type in the application program with IO address mentioned in IO mapping.

For example, Active energy value in above IO mapping image is a DWORD value in slave device and is mapped to two consecutive Modbus registers.

In IO mapping, value displayed as two WORDs, to use active energy value in PLC application as DWORD declare a variable as below

```
ActiveEnergy AT %IW52: DWORD;
```

Same method should be used for other data types like INT, DINT, REAL etc.

8.2.3 IEC Objects

Modbus master provides information related to status and diagnostics in IEC objects of Master device as well as configured slave device/s.

For Modbus master, IEC object instance is created with name of Modbus master device by default it is 'Modbus_Master_COM_Port'. Table shows details of individual variable in IEC object

Variable Name (Instance.XXX)	Data Type	Access	Description
xStop	BOOL	RW	If TRUE, then each new request to all the slaves is stopped. If FALSE, the communication process continues.
xResetComPort	BOOL	RW	Immediately closes and opens the COM port at a rising edge.
uiNumberOfCommunicatingSlaves	UINT	RO	Displays the number of communicating slaves
xAllSlavesOk	BOOL	RO	TRUE if all slaves are communicating. FALSE if one or more slaves have error.

For Modbus slave, IEC object instance is created with name of Modbus slave device. Table shows details of individual variable in IEC object

Variable Name (Instance.XXX)	Data Type	Access	Description
xTrigger	BOOL	RW	Triggers the transmission of all configured Modbus channels for a rising edge
xReset	BOOL	RW	Restarts communication and resets xError and byModbusError
xAcknowledge	BOOL	RW	Restarts communication and does not reset xError and byModbusError
xDoInit	BOOL	RW	TRUE execute Initialisation.
xInitDone	BOOL	RO	All initialization commands execution completed.
xBusy	BOOL	RO	Execution under process.
xDone	BOOL	RO	Execution completed for current channel.
xError	BOOL	RO	TRUE if any error occurs. Communication to the slave is interrupted.

Variable Name (Instance.XXX)	Data Type	Access	Description
byModbusError	MB_ ErrorCodes	RO	Current errors defined in the enumeration MB_ErrorCodes
iChannelIndex	INT	RO	Channel index of channel currently executing.

Enumeration: MB_ErrorCodes

Name	Value	Comment
RESPONSE_SUCCESS	16#00	Slave is communicating with master without any error
ILLEGAL_FUNCTION	16#01	Slave does not support the function code
ILLEGAL_DATA_ADDRESS	16#02	Slave does not support this register offset
ILLEGAL_DATA_VALUE	16#03	Not applicable
SLAVE_DEVICE_FAILURE	16#04	Not applicable
ACKNOWLEDGE	16#05	Not applicable.
SLAVE_DEVICE_BUSY	16#06	Not applicable.
MEMORY_PARITY_ERROR	16#08	Not applicable
GATEWAY_PATH_ UNAVAILABLE	16#0A	Not applicable.
GATEWAY_DEVICE_ FAILED_TO_RESPOND	16#0B	Not applicable.
RESPONSE_TIMEOUT	16#A1	There was no response in time
RESPONSE_CRC_FAIL	16#A2	The checksum of the response is not correct
RESPONSE_WRONG_ SLAVE	16#A3	The response is not from the expected slave
RESPONSE_WRONG_ FUNCTIONCODE	16#A4	The response is not the expected function code
REQUEST_FAILED_TO_ SEND	16#A5	Local COM Port error. Request was not sent
RESPONSE_INVALID_ DATA	16#A6	The response contains invalid data
RESPONSE_INVALID_ PROTOCOL	16#A7	The response is not modbus protocol
RESPONSE_INVALID_ HEADER	16#A8	Not applicable
UNDEFINED	16#FF	The request's result is undefined or not yet known, e.g. initial state

9 Modbus TCP Configuration

User can configure GOC43 as Modbus TCP Slave device or Modbus TCP Master for Ethernet communication.

9.1 Modbus TCP Slave

9.1.1 Overview

GOC43 with built-in Ethernet port can be configured as Modbus TCP Slave device in Modbus network. Up to 8 simultaneous masters can be connected to Modbus TCP slave.

NOTE

GOC43 support simultaneous 8 connections on Ethernet port. Number of simultaneous Modbus TCP master connections depend on use of Ethernet connections by other protocols.

Memory mapping

Following table shows GOC43 memory mapping for Modbus memory.

Modbus Memory Area	GOC43 Memory	Details
Coils	Input bits (%IX)	Modbus TCP master writes coils will be available as input bit
Holding registers	Input words (%IW)	Modbus TCP master writes holding registers will be available as input words
Discrete Inputs	Output bits (%QX)	Modbus TCP master reads output bits as discrete inputs.
Input registers	Output words (%QW)	Modbus TCP master reads output words as input registers.

IO memory for Modbus TCP communication starts from %IW32 and %QW32. Size of input and output memory area shared over Modbus can be changed with configuration. Maximum size of input and output data is 500 words each. That means GOC43 can share 500 words of input data and 500 words of output data with Modbus TCP master device.

NOTE

Coils and Holding registers are mapped to same memory area in Input image of slave device. That means input memory of slave can be accessed as holding register or coil. Coils and Holding registers are mapped to same memory area in Input image of slave device. That means input memory of slave can be accessed as holding register or coil.

NOTE

Ethernet port can be configured for multiple communication protocols simultaneously. Modbus TCP Slave, Modbus TCP Master and CC-Link IEF Basic protocols can be configured simultaneously, keeping maximum number of simultaneous connection up to 8.

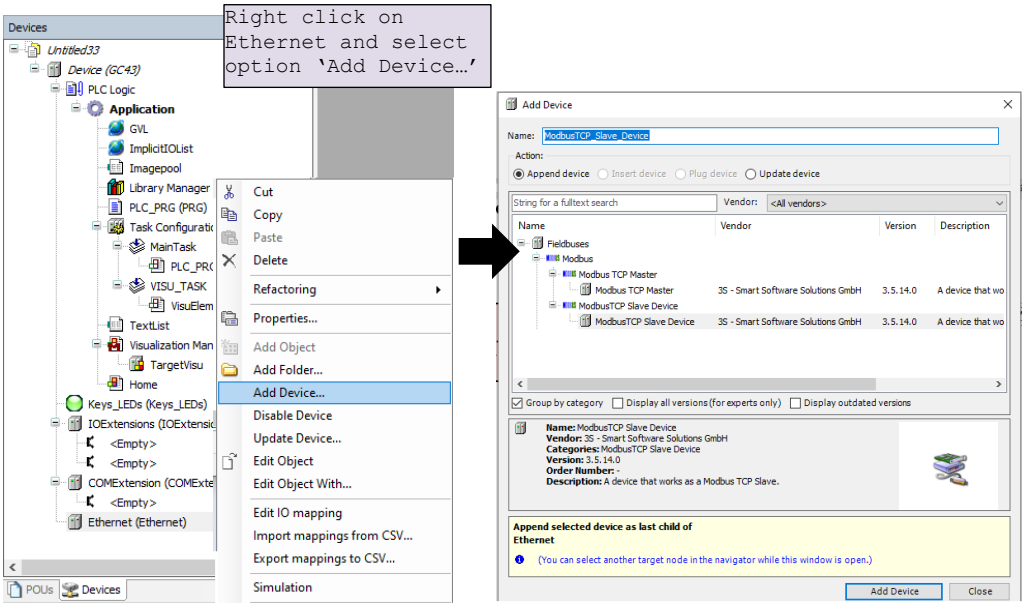
Supported function codes

Function Code	Description
01	Read coils
02	Read discrete inputs
03	Read holding registers
04	Read input registers
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
23	Read write multiple registers

9.1.2 Configuration

Add ‘Modbus TCP Slave Device’

To use GOC43 as Modbus TCP Slave device, right click on Ethernet (Ethernet) in device tree and select ‘Add Device’ as shown.

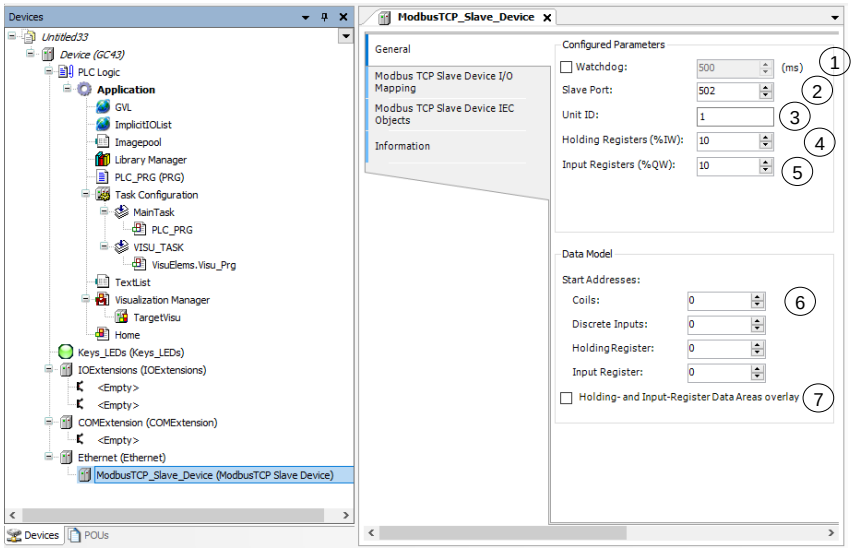


Set ‘Modbus TCP Slave Device’ parameters

Double click on Modbus TCP Slave Device in device tree to open its device editor.

Click on ‘General’ Tab to set parameters.

Set parameters as per the details mentioned below

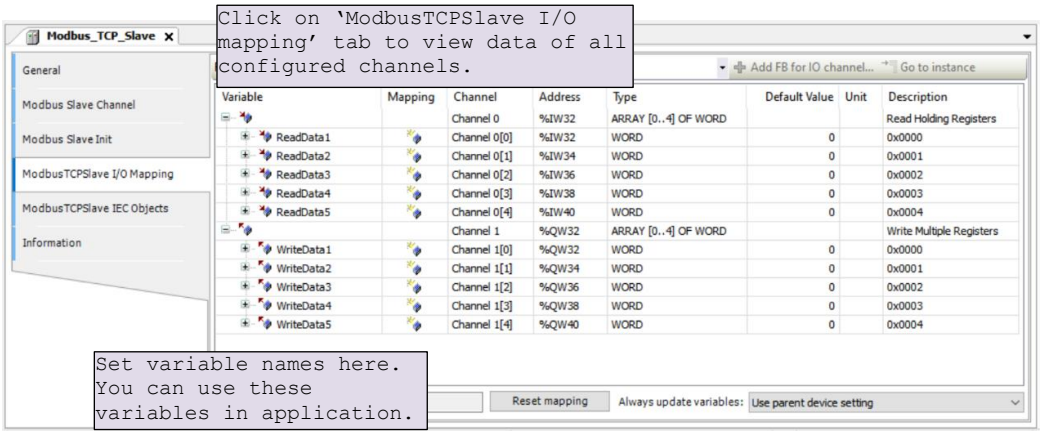


Sr. No.	Parameter		Default Value	Description
1	Watchdog		500 ms	Enable and set watchdog time in msec. The incoming data (Holding Registers, coils / %I range) is set to zero when the Modbus device does not receive any valid query from the Master for time defined by Watchdog. When disabled, watchdog action is never performed. Set watchdog time according to communication cycle time of master.
2	Slave Port		502	Port number of the slave.
3	Unit ID		1	Set station address within range 1 to 247
4	Holding Registers (%IW)		10	Set size of data at Holding registers (%IW) Maximum value =500
5	Input Registers (%QW)		10	Set size of data at Input registers (%QW) Maximum value =500
6	Start Addresses	Coils	0	Set starting offset addresses for Modbus. Logical start address of each Modbus data area can be set. This means Modbus address with which Modbus Master addresses IO data can be set as per requirement **Example:** If holding register start address set to 10, Modbus master should set offset =10 to access first holding register of device. Can be set to 0 if no special requirement of setting start address is identified.
		Discrete Inputs	0	
		Holding Registers	0	
		Input Registers	0	
7	Holding- and Input-Register-Data Areas overlay		☐	☑: Overlay of the process image by the holding and input register. This is required, for example, when the slave application is used to write to the holding register.

IO mapping of 'Modbus Serial Device

After adding communication channels, IO mapping is updated accordingly in IO mapping tab of slave devices.

Below is an example of IO mapping



Using Channel data in application program

Channels read from slave device are displayed as BOOL or WORD data type in IO mapping irrespective of their native data type in slave device.

If you want to use them in PLC code with their actual data types, declare a variable of required data type in the application program with IO address mentioned in IO mapping.

For example, if ReadData1 and ReadData2 value in above IO mapping image is a DWORD value in slave device and is mapped to two consecutive Modbus registers.

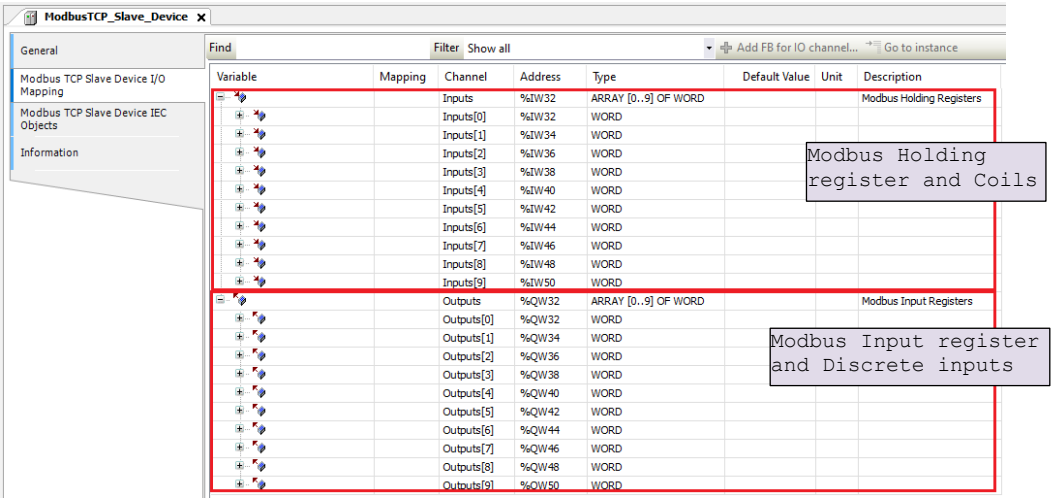
In IO mapping, value displayed as two WORDs, to use DWORD value in PLC application as DWORD declare a variable as below

```
ReadData12 AT %IW32: DWORD;
```

Same method should be used for other data types like INT, DINT, REAL etc.

IO mapping of 'Modbus TCP Slave Device

'Modbus TCP Slave Device I/O Mapping' shows list of Modbus holding registers and Modbus input registers as below.



9.1.3 IEC Objects

GOC43 Modbus TCP Slave device provides information related to status and diagnostics in IEC object of configured slave devices. Table below shows details of individual variable in IEC object.

Variable Name (Instance.XXX)	Data Type	Access	Description
xInternalError	BOOL	RW	Unrecoverable internal error
uiClientConnections	UINT	RO	Number of currently established client (master) connections (TCP/IP)

9.2 Modbus TCP Master

9.2.1 Overview

GOC43 with built-in Ethernet port can be configured as Modbus TCP Master in Modbus network. Up to 8 slave devices can be connected over Modbus network.

NOTE

GOC43 support simultaneous 8 connections on Ethernet port.
Number of simultaneous Modbus TCP slave connections depend on use of Ethernet connections by other protocols.

Memory mapping

Following table shows GOC43 memory mapping for Modbus memory.

Modbus Memory Area	GOC43 Memory	Details
Read Coils Read Discrete Inputs	Input bits (%IX)	Coils and Discrete input bits status read from slave devices are mapped in Input bits (%IX) memory of GOC43.
Read Holding registers Read Input registers	Input words (%IW)	Holding registers and Input registers status read from slave devices are mapped in Input words (%IW) memory of GOC43.
Write Coils	Output bits (%QX)	Coils of slave devices which are written by GOC43 Modbus TCP master are mapped as Output bits (%QX) memory of GOC43.
Write Holding registers Read/Write Holding registers	Output words (%QW)	Holding registers of slave devices which are written by GOC43 Modbus TCP master are mapped as Output words (%QW) memory of GOC43.

IO memory for Modbus TCP communication starts from %IW32 and %QW32.
Size of input and output memory area used by Modbus TCP master depends on amount of data read/write from slave devices.
Maximum size of input and output data is 1008 words each. That means GOC43 can share 1008 words of input data and 1008 words of output data with all the connected Modbus TCP slave devices.

NOTE

Input and output memory of GOC43 is shared by other protocol devices like Modbus RTU Master, Modbus RTU slave and Modbus TCP Slave etc.
Maximum Input and Output memory available for Modbus TCP Master depends on configurations of other protocol devices.

NOTE

Ethernet port can be configured for multiple communication protocols simultaneously. Modbus TCP Slave, Modbus TCP Master communication protocols and CC-Link IEF Basic protocols can be configured simultaneously, keeping maximum number of simultaneous connections up to 8.

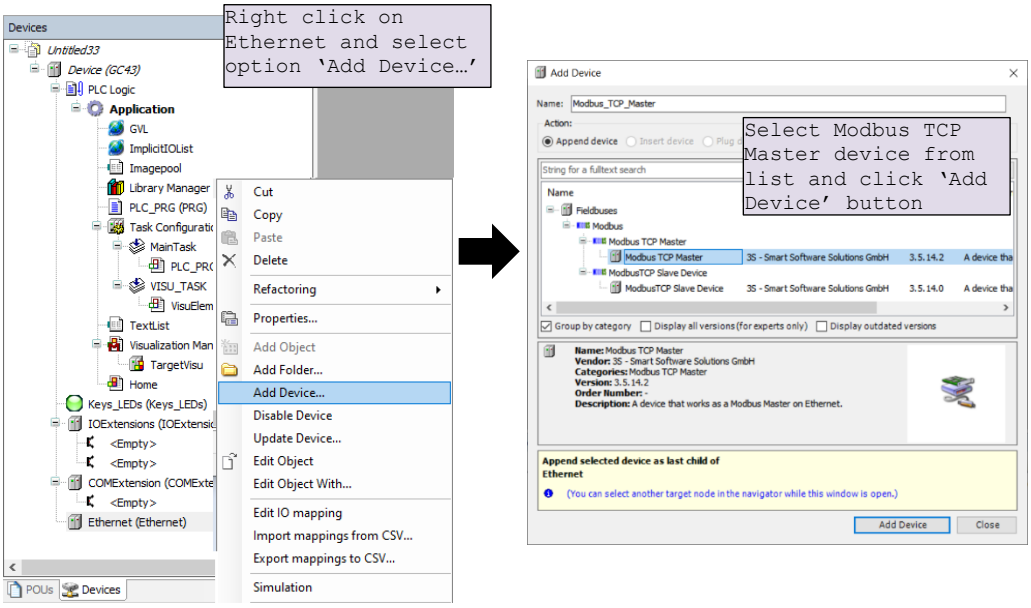
Supported function codes

Function Code	Description
01	Read coils
02	Read discrete inputs
03	Read holding registers
04	Read input registers
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
23	Read write multiple registers

9.2.2 Configuration

Add 'Modbus TCP Master Device'

To use GOC43 as Modbus TCP Master, right click on Ethernet (Ethernet) in device tree and select 'Add Device' as shown.

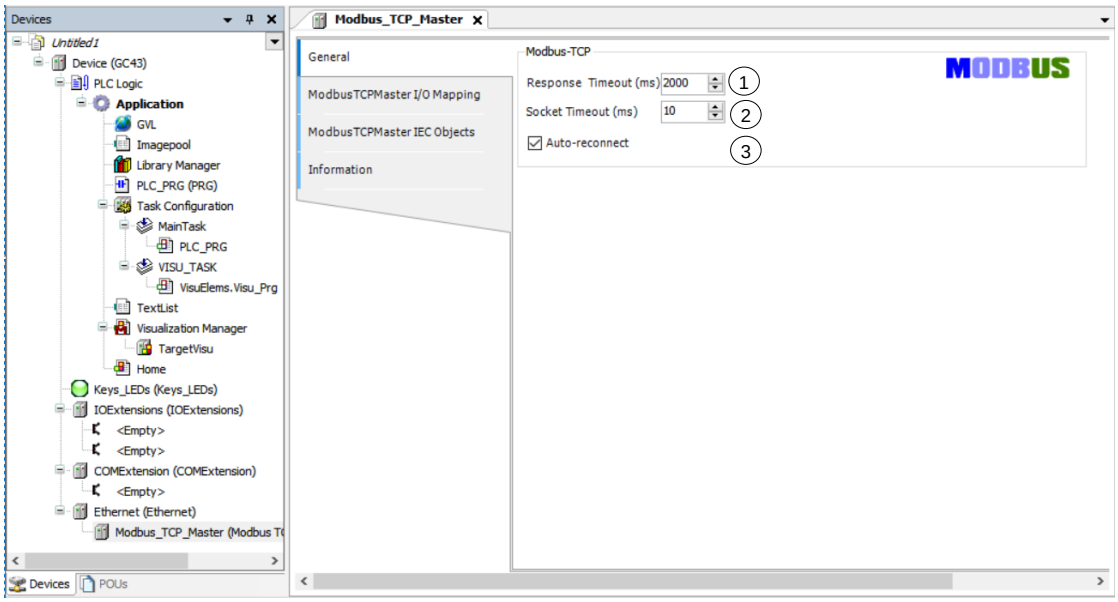


Set ‘Modbus TCP Master’ parameters

Double click on Modbus TCP Master Device in device tree to open its device editor.

Click on ‘General’ Tab to set parameters.

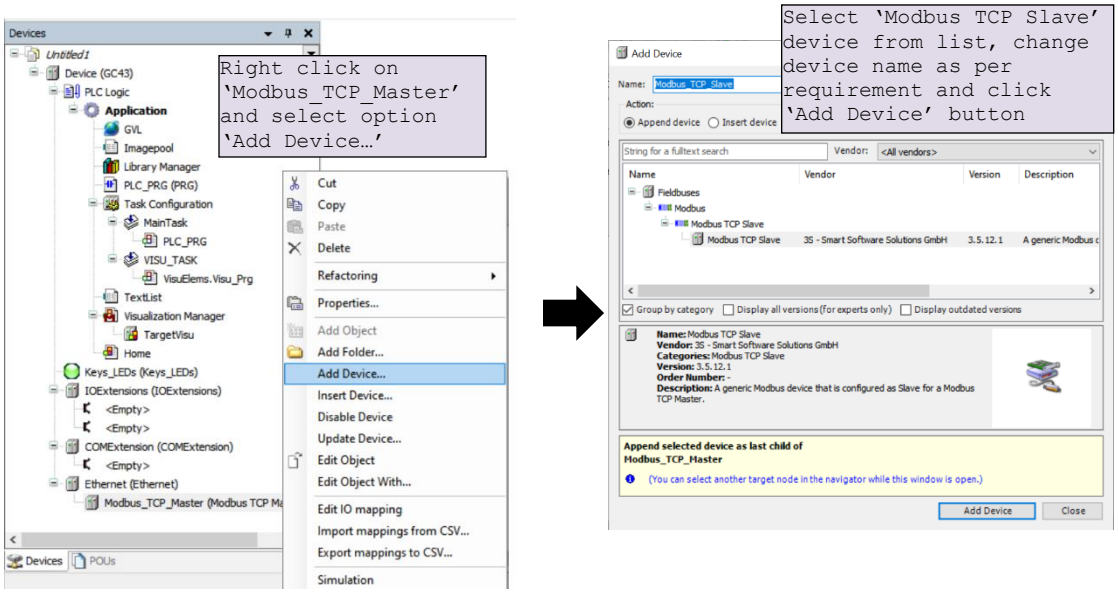
Set parameters as per the details mentioned below.



Sr. No.	Parameter	Default Value	Description
1	Response Timeout (ms)	2000 ms	This is response timeout setting. It is recommended to set timeout for slave device in slave parameters. It is recommended to set this timeout value to minimum 2000 ms. Once timeout is detected, error is declared for slave, communication with device is stopped or continued as per setting ‘Auto restart communication’
2	Socket Timeout (ms)	10	This setting has no effect.
3	Auto reconnect	1	This parameter defines master behavior in case of error. **Checked:** Master keep on trying to communicate with a slave after response timeout. **Unchecked:** Master stops communication with slave until explicit confirmation by user. In this case, user has to reset or acknowledge error using IEC variables xConfirmError.. Refer section *IEC Objects* for more details.

Add and configure Modbus TCP slave.

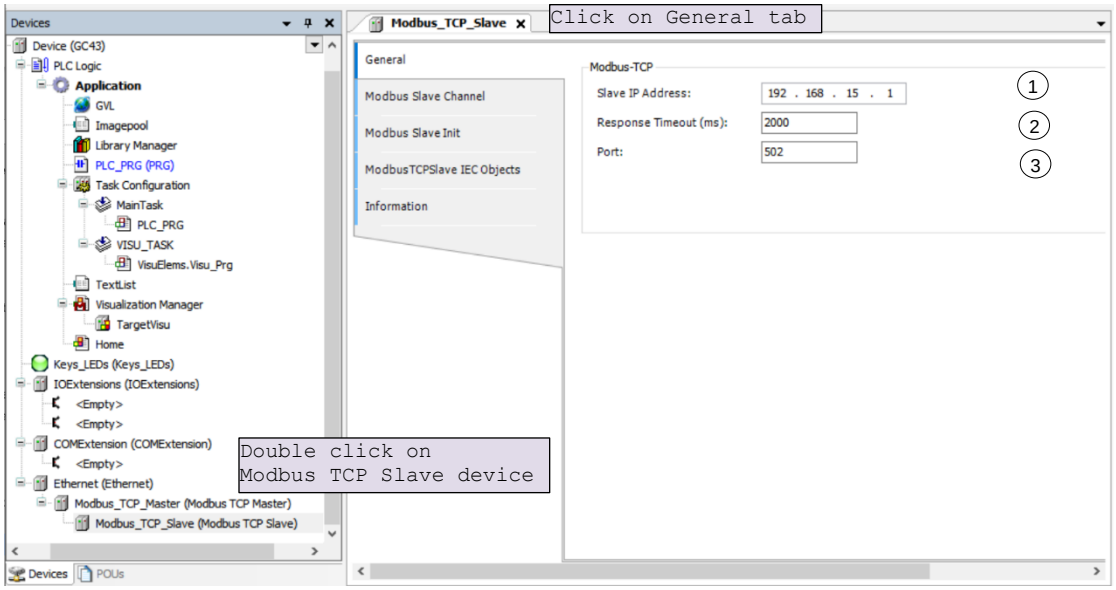
Right click on ‘Modbus_TCP_Master (Modbus TCP Master)’ and select ‘Add Device…’ and select ‘Modbus_TCP_Slave’ device.



NOTE

Up to 8 slave devices can be added to Modbus Master. However, number of simultaneous Modbus TCP slave connections depend on use of Ethernet connections by other protocols.

After adding ‘Modbus TCP Slave’ device, click on newly added Modbus_TCP_Slave in device tree to set ‘IP address’, ‘Response Timeout’ and ‘Port number’ as shown below.



Sr. No.	Parameter	Default Value	Description
1	Slave IP address	192.168.15.1	IP address of slave device. Make sure that Slave device IP address and master device IP address falls in the same subnet.
2	Response Timeout(ms)	2000	Time interval for the master to wait for the response from this slave. This is configured especially for this slave node and overwrites the general response timeout setting of the respective master. It is recommended to keep this timeout value minimum 2000 ms for uninterrupted connection with slave.
3	Port	502	Port number (TCP/IP) of the slave.

Add channels to slave device

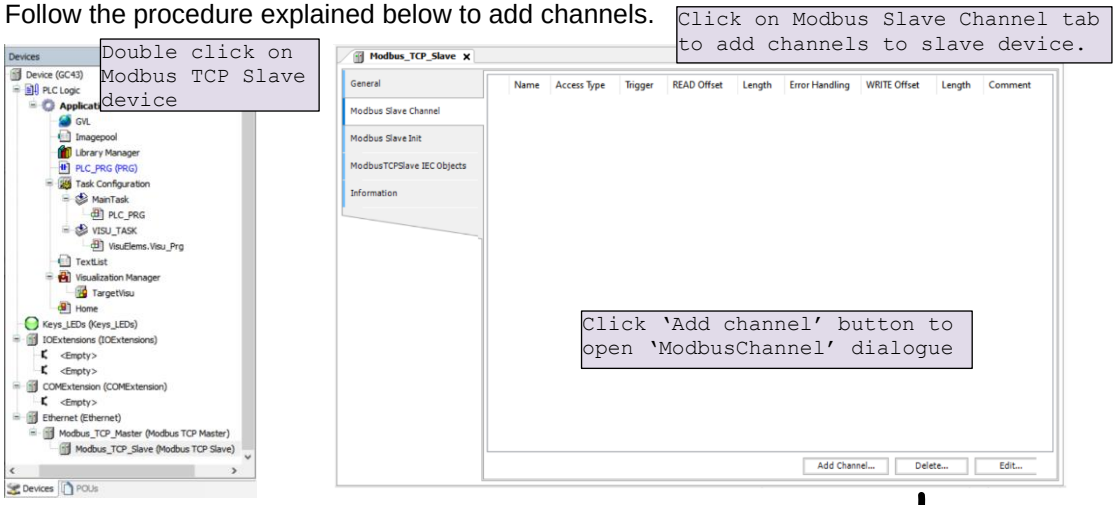
After adding slave device, next step is to add communication channels to the slave device.

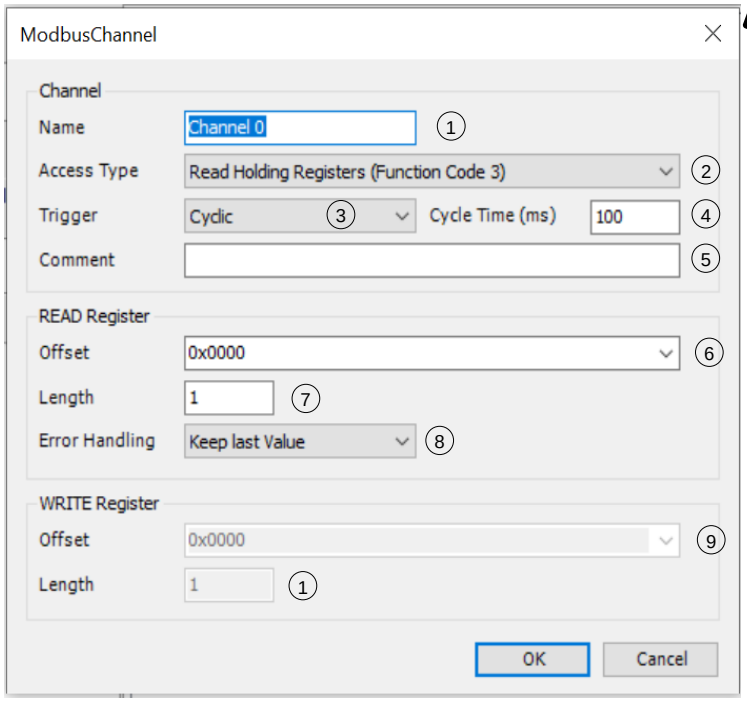
Each communication channel added to slave device forms a Modbus query to be sent to slave device. Each Modbus query is sent separately to slave device as per trigger type set in channel configuration.

Try to keep minimum Modbus requests per slave device for optimum communication cycle time. This can be achieved by include consecutive Modbus addresses of slave device in single Modbus query.

Example: If you want to read holding registers with offset 1 to 5 from slave device, it is better to add single Modbus request with read length 5 and starting address 1 instead of creating individual Modbus request for each channel.

Follow the procedure explained below to add channels.





Sr. No.	Parameter	Default Value	Description
1	Channel Name	Channel_0	Set channel name. This is for identification purpose and will be displayed in IO mapping tab.
2	Channel Access Type	Function Code 03	Select Modbus function code to be used in Modbus request
3	Channel Trigger	Cyclic	**Cyclic:** The request occurs periodically. **Rising edge:** The request occurs as a reaction to a rising edge of the Boolean trigger variables. The trigger variable is defined in the tab I/O Mapping. **Application:** Modbus request is triggered by PLC application. Use Modbus channel FB to trigger request
4	Channel Cycle Time	100ms	Set cycle interval when Channel Trigger is Cyclic. Minimum cycle time depend on communication cycle time between Master and slave device and also other factors like response time of slave device, Scan time of master etc.
5	Comment	--	Description of channel
6	Read Offset	0x0000	Start Modbus offset of slave device where reading should start (value range 0-65535)
7	Read Length	1	Number of registers or coils to be read
8	Read Error Handling	Keep Last Value	Defines what should happen to the data in case of a communication error Keep last Value: Keeps last value updated Set to ZERO: Clears all values to zero
9	Write offset	0x0000	Start Modbus offset of slave device where writing starts in slave device (value range 0-65535)
10	Write Length	1	Number of registers to be written to

Follow the same procedure to add other channels of the slave.

You can add up to 99 channels for each slave device.

Add Modbus Slave Init Channels

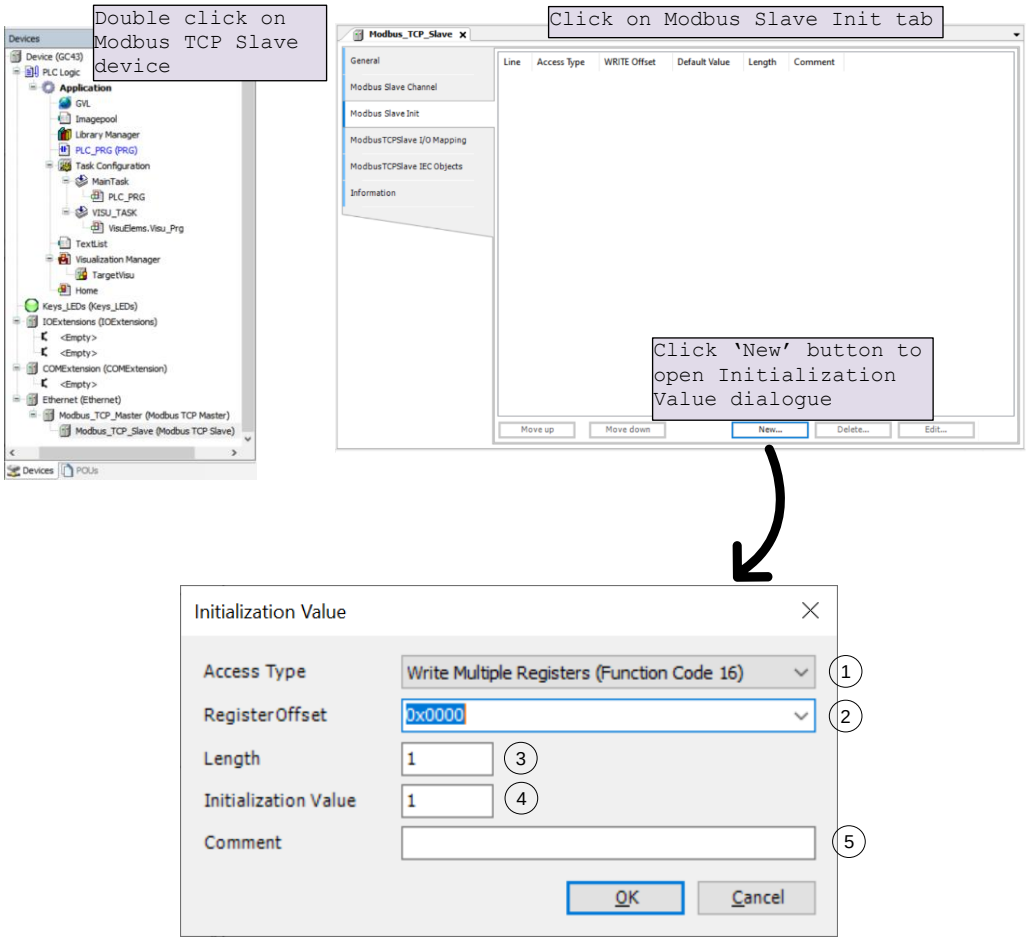
Apart from communication channels explained before, Modbus master allows to add ‘Init’ channels.

Init channels allows to send initialization commands to slave device. Initialization commands are executed one time when starting the slave device or after slave device recovered from error.

Initialization commands are sent to slave device in following cases

- Start of communication
- Reset warm or cold
- Recovery of communication after error

Follow the procedure explained below to add ‘Init channels’



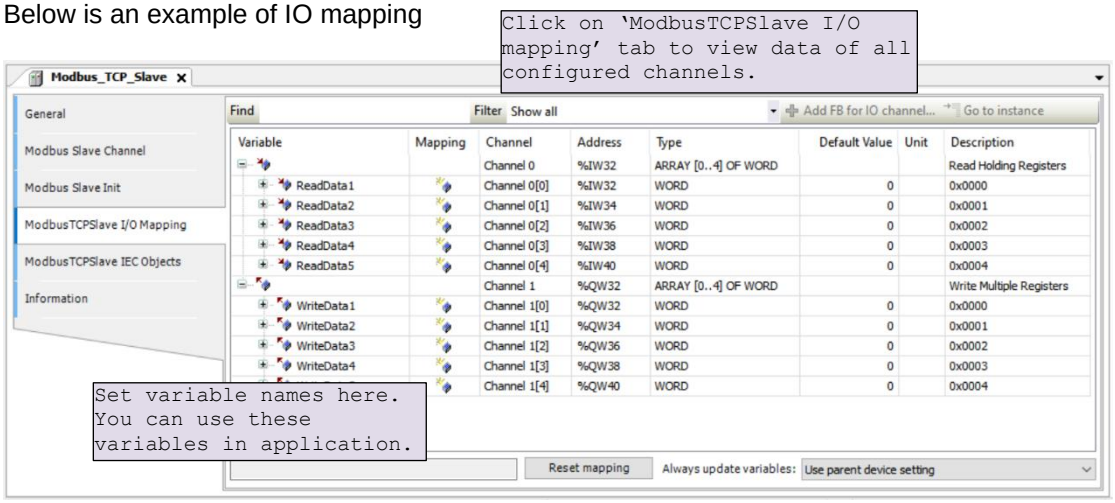
Sr. No.	Parameter	Default Value	Description
1	Access Type	Function Code 16	Select Modbus function code to Write initialization value.
2	Read Offset	0x0000	Start address where write should start (value range 0-65535)
3	Read Length	1	Number of registers to be read
4	Initialization value	1	Initialization value for the registers or coils
5	Comment	--	Description of channel

You can add up to 20 initialization channels for a slave.

IO mapping of 'Modbus TCP Device

After adding communication channels, IO mapping is updated accordingly in IO mapping tab of slave devices.

Below is an example of IO mapping



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Using Channel data in application program

Channels read from slave device are displayed as BOOL or WORD data type in IO mapping irrespective of their native data type in slave device.

If you want to use them in PLC code with their actual data types, declare a variable of required data type in the application program with IO address mentioned in IO mapping.

For example, if ReadData1 and ReadData2 value in above IO mapping image is a DWORD value in slave device and is mapped to two consecutive Modbus registers.

In IO mapping, value displayed as two WORDs, to use DWORD value in PLC application as DWORD declare a variable as below.

```
ReadData12 AT %IW32: DWORD;
```

Same method should be used for other data types like INT, DINT, REAL etc.

9.2.3 IEC Objects

Modbus TCP master provides information related to status and diagnostics in IEC objects of Master device as well as configured slave device/s.

For Modbus TCP master, IEC object instance is created with name of Modbus master device by default it is 'Modbus_TCP_Master'. Table shows details of individual variable in IEC object

Variable Name (Instance.XXX)	Data Type	Access	Description
xStop	BOOL	RW	If TRUE, then each new request to all the slaves is stopped. If FALSE, the communication process continues.
xSlaveError	BOOL	RO	If TRUE, indicates that there is a slave device with an error.
uiConnectedSlaves	UINT	RO	Number of slaves connected by TCP/IP

For Modbus TCP slave, IEC object instance is created with name of device. Table shows details of individual variable in IEC object.

Variable Name (Instance.XXX)	Data Type	Access	Description
xInitDone	BOOL	RO	All initialization commands execution completed.
xBusy	BOOL	RO	TRUE while a request is in process
xDone	BOOL	RO	TRUE if a request was ended successfully
xError	BOOL	RO	TRUE if a request was ended with errors
byModbusError	MB_ ErrorCodes	RO	Specifies the current errors as defined in the enumeration MB_ErrorCodes *Modbus RTU Master > IEC Objects* for details
ComSettings	ModbusTCP-Comsettings	RO	Currently configured communication settings.
ComState	MODBUSTCP-COMSTATE	RO	Indicates Modbus TCP Slave device communication state as OFF: No action performed on socket. Device is disabled. CONNECTING: TCP connect request is currently in progress. CONNECTED: TCP connection is established. DISCONNECTING: TCP connection is aborted. SOCKET_ERROR: TCP socket error occurred. Read/Write failure due to disconnected cable etc.
iChannelIndex	INT	RO	Channel index of channel currently executing.
xConfirmError	BOOL	RW	Acknowledges the error and restarts communication.
xDoInit	BOOL	RW	TRUE execute Initialisation.

10 Status and Diagnostics

Main unit provides 2 LED indications and LCD display on front panel to provide status and diagnostic information useful for troubleshooting. GOC43 provides system menu screen that provides more information.

10.1 LED Indications

Main unit provides 2 LED indications on front panel. The table below explains the significance of CPU diagnostics related LEDs

Status	Power	Run	Relevant System Variables
	Red	Green	
OFF	• No power	• User stop. • Stop due to system error. *1 • New firmware download,	_SysvarCPU.WSTATUS _SysvarCPU.BCPUSTOPCAUSE
ON	• Power ON	• Run mode	_SysvarCPU.WSTATUS _SysvarCPU.BINITSTATUS
Blinking 1x	• Not applicable	• IO Error	_SysvarCPU.WSTATUS
Blinking 2x		• Power fail error *2	NA
Blinking 3x		• Watchdog fault	_SysvarCPU.WSTATUS _SysvarCPU.BCPUSTOPCAUSE
Flashing		• Memory error • Application download in progress • Key error - If any of Illuminated key, function key, touch screen is detected as pressed, at power on due to actual pressing or hardware fault.	_SysvarCPU.WSTATUS _SysvarCPU.BCPUSTOPCAUSE

*1 When CPU is in STOP mode, LCD screen shows system menu SYSTEM INFO. For more details, refer section *System Info*

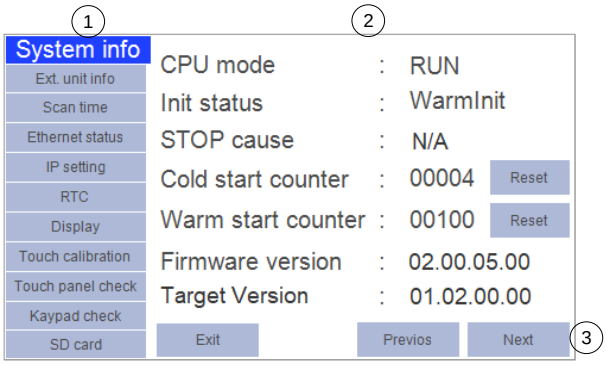
*2 CPU goes in Stop mode permanently, when input supply falls below 18 VDC (but remains above 10 VDC). It continues in Stop mode even though input supply is recovered above 18 VDC for safety purpose. To recover the system, it is necessary to power cycle the Main unit.

Refer section *System Variables*, for more details of system variables.

10.2 System Menu

System Menu screens are predefined screens useful to monitor system status and diagnostics. It also allows user to modify system settings.

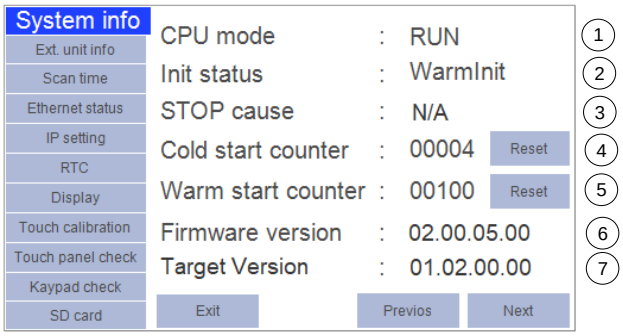
Below image shows system menu screen layout.



Sr. No.	Item	Description
1	System menu direct access button array.	This button array displays all the available system menus. These buttons can be used to jump to respective system menu directly. In case if any system menu is not accessible due to current state of product / application, then respective system menu is shown disabled.
2	Display area	Display area shows content of system menu like system status or system settings.
3	Navigation buttons	Next/ Previous buttons are used to switch to next/ previous system menu. Exit button is used to exit the system menu. Then, display shows user defined visualization screens.

10.2.1 System Info

System info menu shows CPU status, useful for diagnostics and troubleshooting.



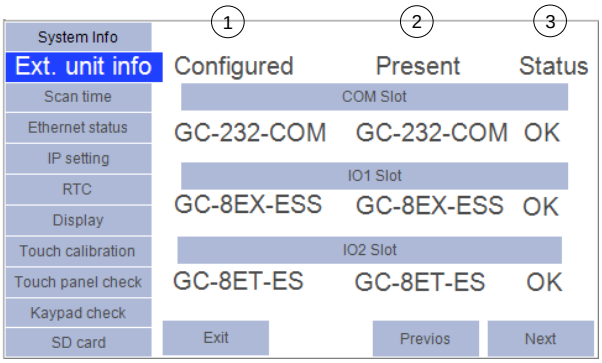
Sr. No.	Item	Details	Applicable system variable
1	CPU mode	Shows CPU mode as RUN or STOP. RUN: Application program executing STOP: Application program not executing	_SysvarCPU.WSTATUS.0
2	Init status	Displays CPU initialization status. Hot Init- If power fail has occurred for short duration. CPU continues to function normally as if there is no power fail Warm Init- If power fail has occurred normally or if CoDeSys menu command Online → Reset warm is issued. This is healthy initialization. Non retained data is reset to 0 or user defined initial value. Retained data holds last value before power off. Cold Init- This is faulty initialization or if CoDeSys menu command Online → Reset cold is issued or if program is downloaded. All the data is reset to 0 or user defined initial value. Cause may be hardware fault or external EMI issue.	_SysvarCPU.BINITSTATUS
3	Stop cause	User- If programmer puts CPU in STOP mode intentionally through programming software CoDeSys. Mem Err – If application program code is invalid. Wd Err_<Name of Task> – If CPU is in STOP mode due to watchdog error i.e. if scan time of respective task exceeds watchdog time set.	_SysvarCPU.BCPUSTOPCAUSE
4	Cold start counter	Number of occurrences of cold start initialization till date or last reset. Increment in count indicates recent occurrence. User can reset counter to 0 by Reset button.	_SysvarCPU.WCOLDSTARTCOUNTER

System info continues..

Sr. No.	Item	Details	Applicable system variable
5	Warm start counter	Number of occurrences of warm start initialization till date or last reset. Increment in count indicates recent occurrence. User can reset counter to 0 by Reset button.	_SysvarCPU.WWARMSTARTCOUNTER
6	Firmware version	Shows firmware version running in the device	_SysvarVersionInfo.SRTSVERSION
7	Target Version	Shows target version downloaded in the device	--

10.2.2 Ext. unit info

Ext. unit info menu shows extension related information such as extension unit configured, actual present, status (Ok or Not ok) along with extension unit ordering code.

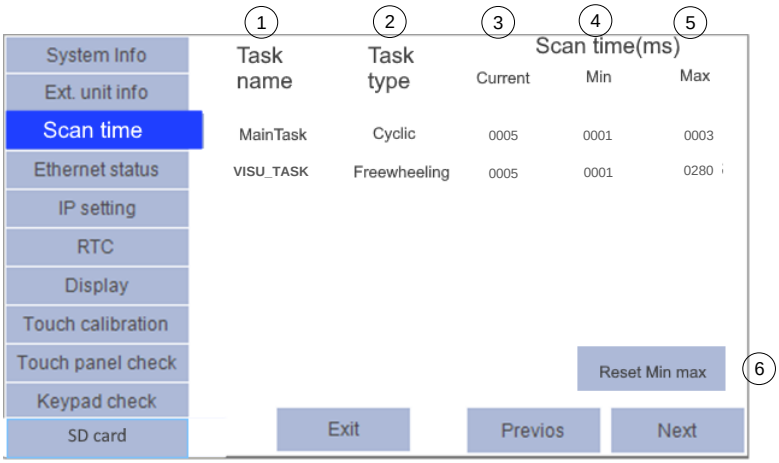


Sr. No.	Item	Details	Applicable system variable
1	Configured unit	Shows ordering code of extension unit configured in COM / IO extension slot. Shows 'Empty' if not configured.	_SysvarCPU.CONFIGMODULES
2	Present unit	Shows ordering code of extension unit actually present in COM / IO extension slot. Shows 'Empty' if not configured.	_SysvarCPU.AMODULEORDERINGCODE
3	Status	Shows IO error status of extension unit [Ok/ Not ok]	_SysvarCPU.W_IOERR

10.2.3 Scan time

'Scan Time' menu shows Task related information.
List of Tasks configured in application is displayed with task type, and scan times.

Maximum, minimum and current scan time of each task configured in application are displayed.



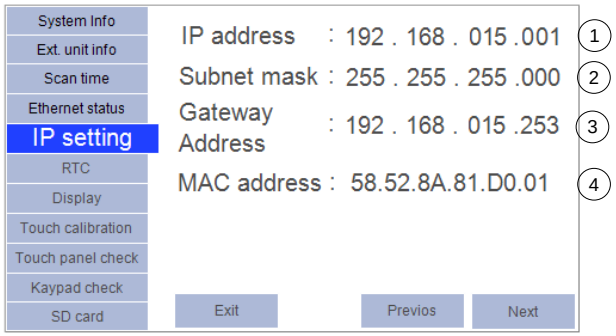
Sr. No	Item	Details	Applicable system variable
1	Task name	Name of the tasks	_SysvarCPU.ATASKNAME[0..4]
2	Task type	Task type: Cyclic or Freewheeling	Not applicable.
3	Current scan time (ms)	Current scan time in milliseconds	_SysvarCPU.WCURSCANTIME[0..4]
4	Min scan time (ms)	Minimum scan time in milliseconds	_SysvarCPU.WMINSCANTIME[0..4]
5	Max scan time (ms)	Maximum scan time in milliseconds	_SysvarCPU.WMAXSCANTIME[0..4]
6	Reset min max	Button to reset minimum and maximum scan times to current scan time	Not applicable.

10.2.4 Ethernet status

Will be supported in future.

10.2.5 IP setting

IP setting menu allows user to set IP address, subnet mask and gateway address. It also shows MAC address of the device.



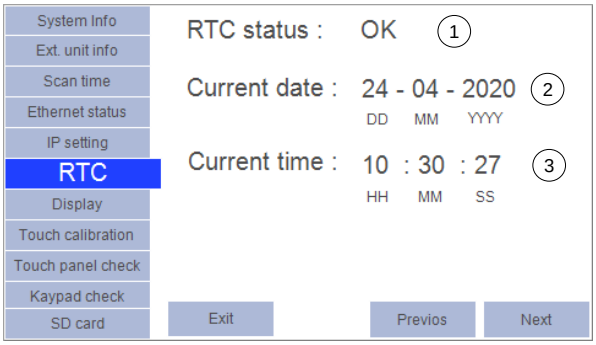
Sr. No.	Item	Details	Applicable system variable
1	IP address	IP address setting of the device `Default : 192.168.015.001`	`_SysvarETH.IPADR`
2	Subnet mask	Subnet mask setting `Default : 255.255.255.000`	`_SysvarETH.SUBNETMASK`
3	Gateway Address	Default gateway address setting `Default : 192.168.015.253`	`_SysvarETH.GATEWAYADR`
4	MAC address	MAC address of the device.	`_SysvarETH.MACADR`

NOTE

For modification in any IP setting, user should set individual octet of each setting independently.
User must do power cycle the device to make modifications in IP setting effective.

10.2.6 RTC

RTC (Real Time Clock) menu allows user to set real time clock. User can monitor RTC status, current date in (DD : MM : YYYY) format and current time.in (HH : MM : SS) format.



Sr. No.	Item	Details	Applicable system variable
1	RTC status	Shows RTC status as OK or Invalid. Invalid: RTC fault due to discharge of backup super capacitor or hardware fault. So current date is set to 01:01:1971 and current time to 00:00:00. In such case, user should ensure that backup supper capacitor is fully charged and set RTC value again. OK: RTC value is valid.	`_SysvarCPU. WSTATUS.4`

2	Current Date	Current date.	`_SysvarRTC. BREADDATE`
			`_SysvarRTC. BREADMONTH`
			`_SysvarRTC. BREADYEARL`
			`_SysvarRTC. BREADYEARH`

3	Current Time	Current time.	`_SysvarRTC. BREADHRS`
			`_SysvarRTC. BREADMINS`
			`_SysvarRTC. BREADSECS`

NOTE

For modification in RTC, user should set date, month, year, hour, minute and second independently.

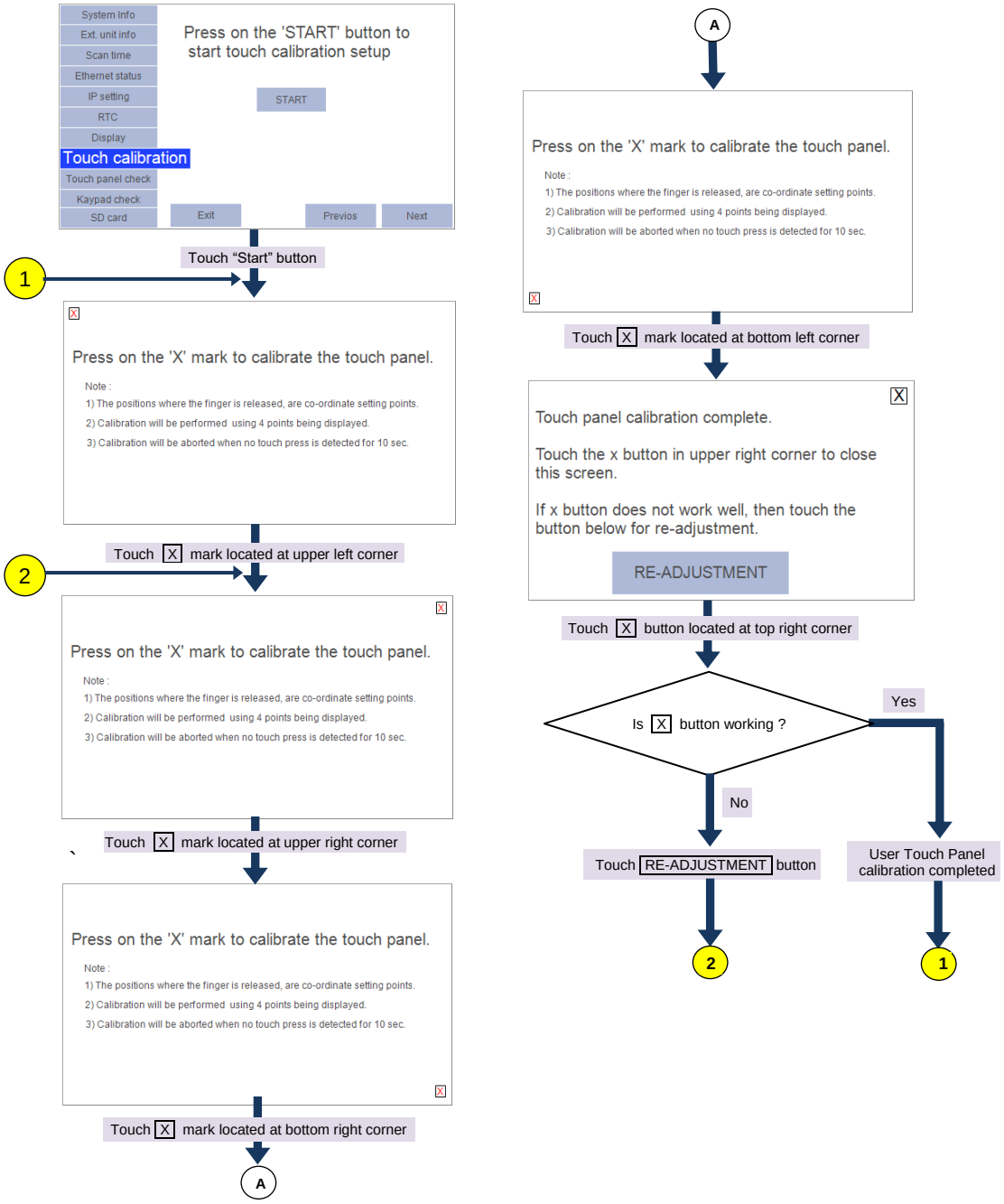
10.2.7 Display

Display menu provides display related settings such as backlit timeout, display brightness, buzzer volume and buzzer pitch.

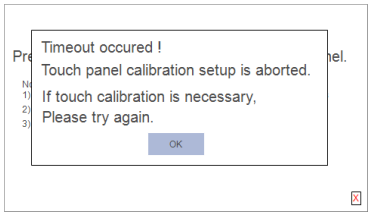
Sr. No.	Item	Details	Applicable system variable
1	Backlit timeout	Backlit timeout can be set from 0 to 99 minutes Default setting is 05 minutes. Setting 00 means that backlit is continuously ON. Note that backlit life is 20,000 hours at ambient temperature.	_SysvarHMI.BACKLITTIMEOUT
2	Display brightness	Display brightness can be set from 0 to 100%. Default setting is 50 %. i.e. minimum brightness.	_SysvarHMI.LCDBRIGHTNESS
3	Buzzer volume	Buzzer volume can be set as Short, Long, OFF. Default: Short	_SysvarHMI.BUZZERVOLUME
4	Buzzer pitch	Buzzer pitch can be set in 5 levels from 1 to 5. Default setting is 4	_SysvarHMI.BUZZERPITCH
5	Buzzer on	User can select buzzer to sound on pressing of Only touch Only keys Touch & key Default setting is Touch & key	_SysvarHMI.BUZZERONOPTION

10.2.8 Touch calibration

Touch calibration menu provides user calibration setup for touch panel. The section below shows sequnec of operation.

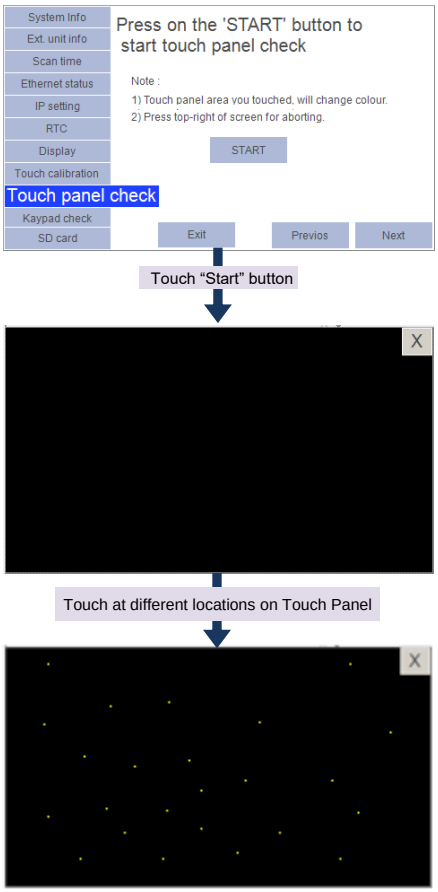


At any screen, if user does not press on X mark within 10 secs, then timeout window gets popped up and terminates touch panel calibration process.



10.2.9 Touch panel check

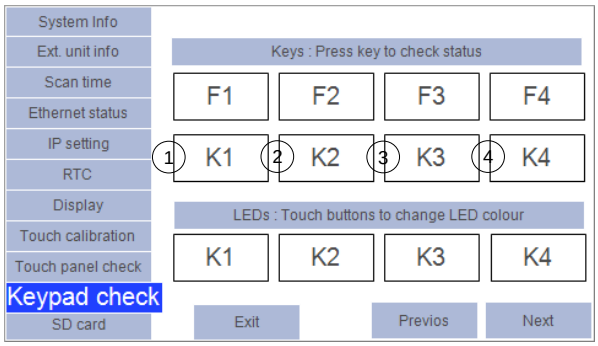
Touch panel check menu provides touch panel function and calibration check.



When touch is sensed, colour of respective 2 x 2 pixel area changes to yellow colour.
Touch [X] button to exit Touch panel check.

10.2.10 Keypad check

Keypad check menu helps user to check function keys (F1 to F4), illuminated keys (K1 to K4) and LEDs (K1 to K4). This check can be performed when CPU is put is stop mode using CoDeSys command Debug → Stop to avoid malfunctioning on running system.



For keys check, press any key on GOC43 front panel, respective key (i.e. F1 to F4, K1 to K4) square gets filled with RED colour.

For LED check, touch button (K1 to K4) on display. The table below provides behaviour of LEDs during LED check.

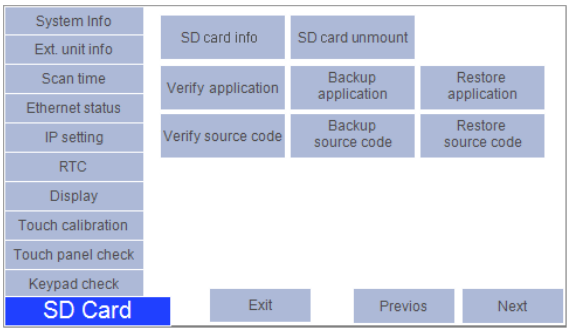
Sr. No.	Button pressing action		Description
1	K1	Once	K1 key illuminates with Red color
		Twice	K1 key illuminates with Green color
		Three times	K1 key illuminates with Yellow color
2	K2	Once	K2 key illuminates with Red color
		Twice	K2 key illuminates with Green color
		Three times	K2 key illuminates with Yellow color
3	K3	Once	K3 key illuminates with Red color
		Twice	K3 key illuminates with Green color
		Three times	K3 key illuminates with Yellow color
4	K4	Once	K4 key illuminates with Red color
		Twice	K4 key illuminates with Green color
		Three times	K4 key illuminates with Yellow color

NOTE

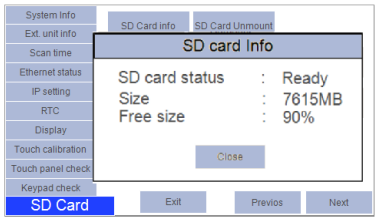
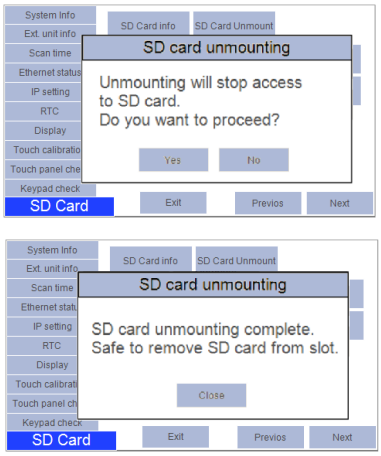
Keypad check is possible only when PLC is in STOP mode.

10.2.11 SD card

System menu tab ‘SD card’ provides access to brief status of SD card and various SD card operations.



Below table provides functional details of individual button

Sr. No.	Button	Details	
1	SD card info		Touch on button ‘SD card info’ displays a dialogue showing SD card status information as below **SD card status** Ready: SD card is mounted and ready Invalid format: SD card format is other than FAT32. Mounting : Card mounting in progress Unmounting: Card unmounting in progress Unmounted: Card unmounted. **Total memory size** of SD card in Mbytes. **Available/ free memory** size in percentage.
2	SD card unmount		Touch on ‘SD card unmount’ button to unmount SD card. It pops up dialogue to confirm the action. - click ‘Yes’ to unmount SD card - click ‘No’ to continue SD card access. Unmounting is completed and completion message is displayed if clicked ‘Yes’ button. In such case, SD card info shows SD card status as ‘Unmounted’, Size as ‘0000 MB’ and Free size as ‘00%’. **Warning**: When user wants to remove SD memory card, it is mandatory to unmount it first. Failing to do so may lose data, damage/ corrupt SD memory card.

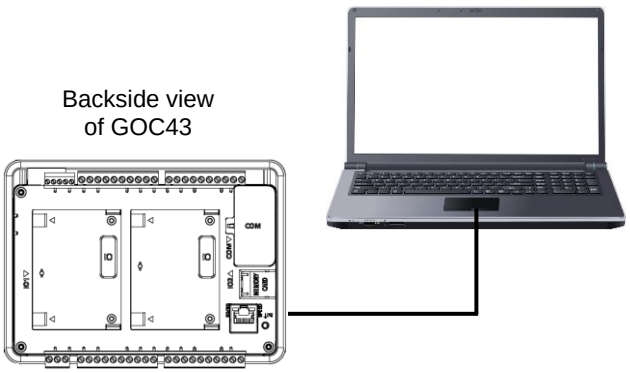
Backup application, Backup source code	Buttons initiate backup function to copy application program and source code from device to SD card. Refer section *Backup* for more details.
Restore application, Restore source code	Buttons initiate restore function to copy application program and source code from SD card to device. Refer section *Restore* for more details.
Verify application, Verify source code	Buttons initiate verify function to compare application program and source code from device and SD card. Refer section *Verify* for more details.

11 Programming

11.1 Setup Requirements

Hardware setup requirement:

Programming of GOC43 is possible through built-in Ethernet port interface provided on its backside as shown below.



Software setup requirement:

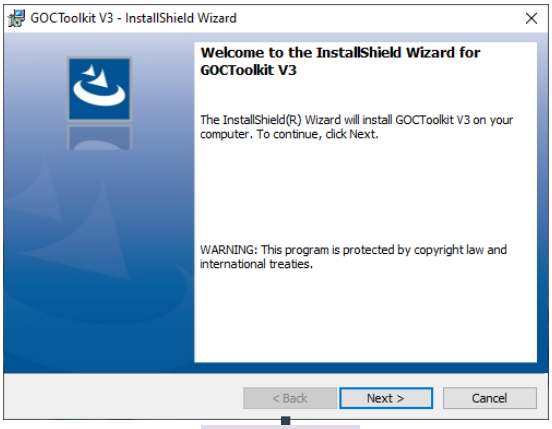
Before installing the toolkit, ensure that the following requirements of computer are satisfied.

Processor	Dual Core or higher
Disk space	2 GB
RAM memory	4GB
Screen resolution	800 x 600 or Higher
Platform	Windows® 10/ 11 (32/64 bit)
Ethernet interface	RJ45

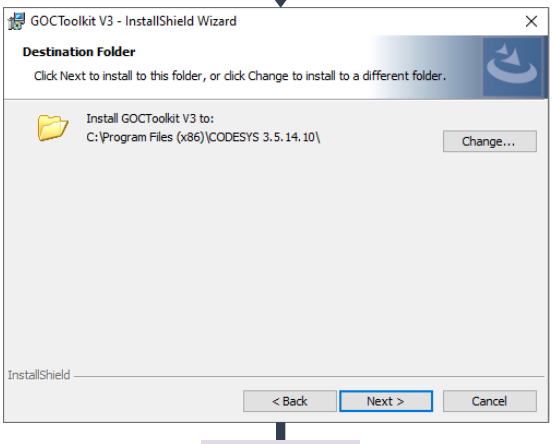
11.2 GOCToolkit V3 Installation

For installation of GOCToolKit V3, follow the steps as provided below.

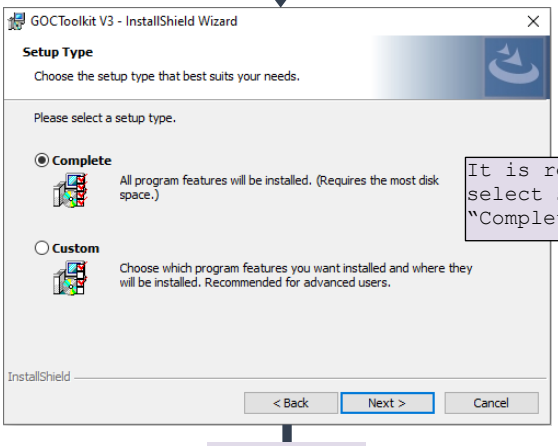
1. Confirm the requirement covered under *Software setup requirement* section.
2. Download ‘GOCToolkit V3.exe’ GOCToolkit V3.exe setup from MEI website.
3. Run ‘GOCToolkit V3.exe’ on your PC. During execution of .exe file,



Click “Next” button



Click “Next” button



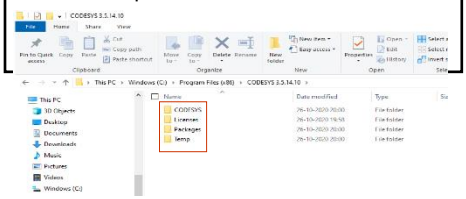
Click “Next” button

1

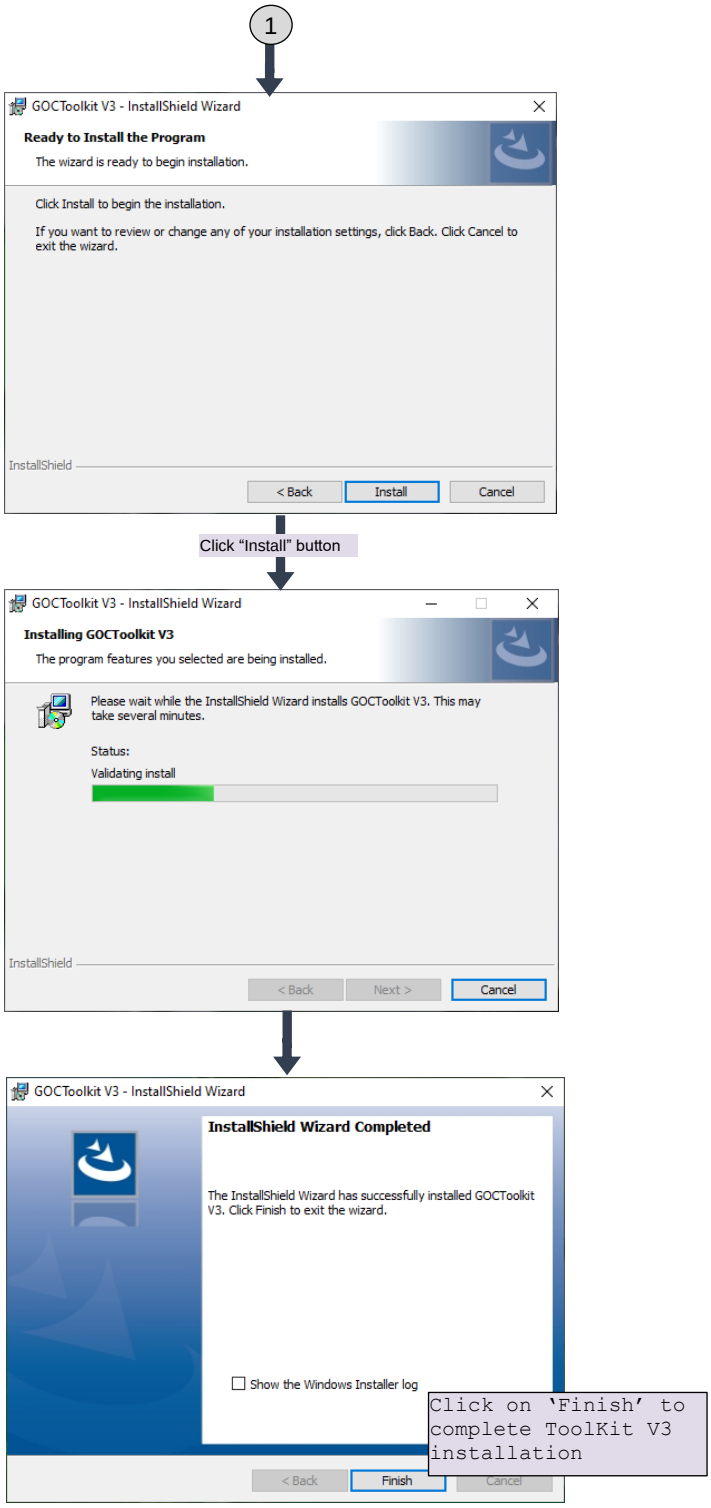
In case if user, uninstalls previous ToolKit versions from PC and updates system with latest ToolKit setup, then before running ‘GOCToolkit V3.exe’. It is mandatory to uninstall CODESYS 3.5.14.10 from PC and delete all files/ folders from path *C:\Program Files (x86)\CODESYS 3.5.14.10*.

Folder “CODESYS 3.5.14.10” should be empty before latest ToolKit installation.

Refer below screenshot as an example….

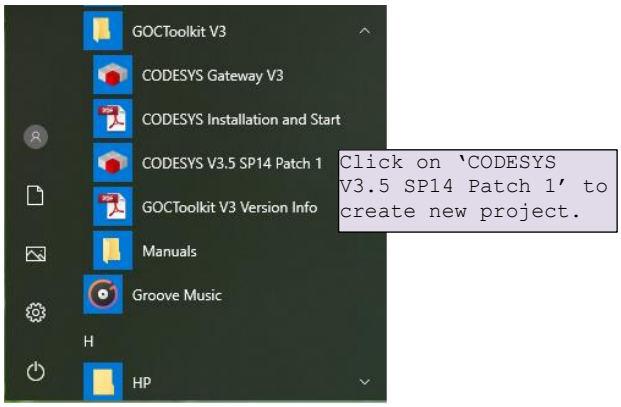


It is recommended to select setup type as “Complete”



This completes GOCToolKit V3 installation on PC/ laptop.

After successful installation, ‘GOCToolKit V3’ menu gets added under start menu as shown below.



NOTE

Refer document “N18006AAMH07 GOC43 Version Compatibility” for more details of version compatibility of firmware, hardware and GOC Toolkit V3.

11.3 Quick start CoDeSys

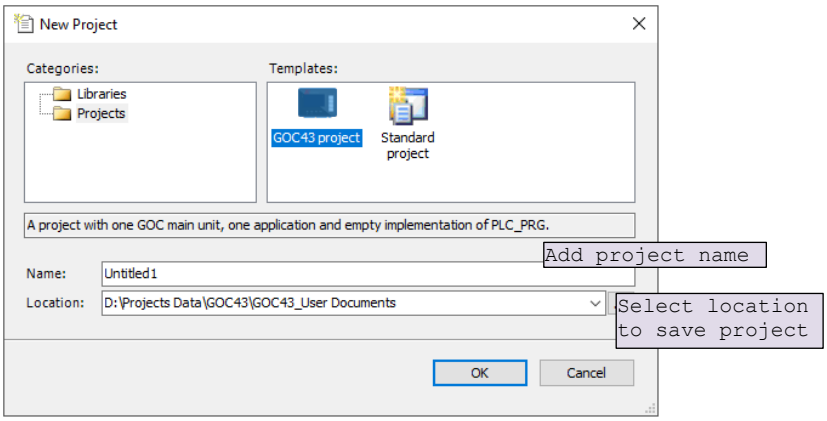
This section explains

1. Creation of a new project using GOC43 project template
2. Hardware configuration
3. Create a simple ladder program
4. Create a simple HMI program
5. Download and online operations

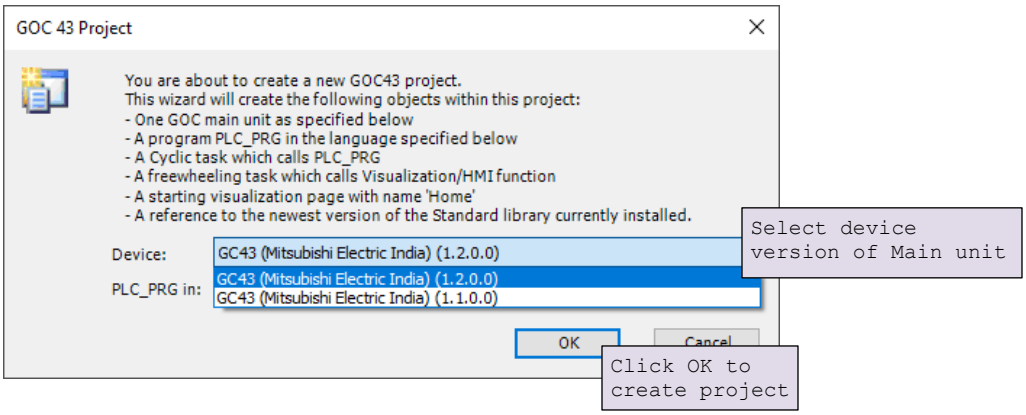
11.3.1 Creation of a New Project using GOC43 Project Template

Open CoDeSys 3.5. Click on menu ‘File’ → New Project, following window gets pop up.

Select category ‘Projects’ and click on template ‘GOC43 project’. Click OK to save project.

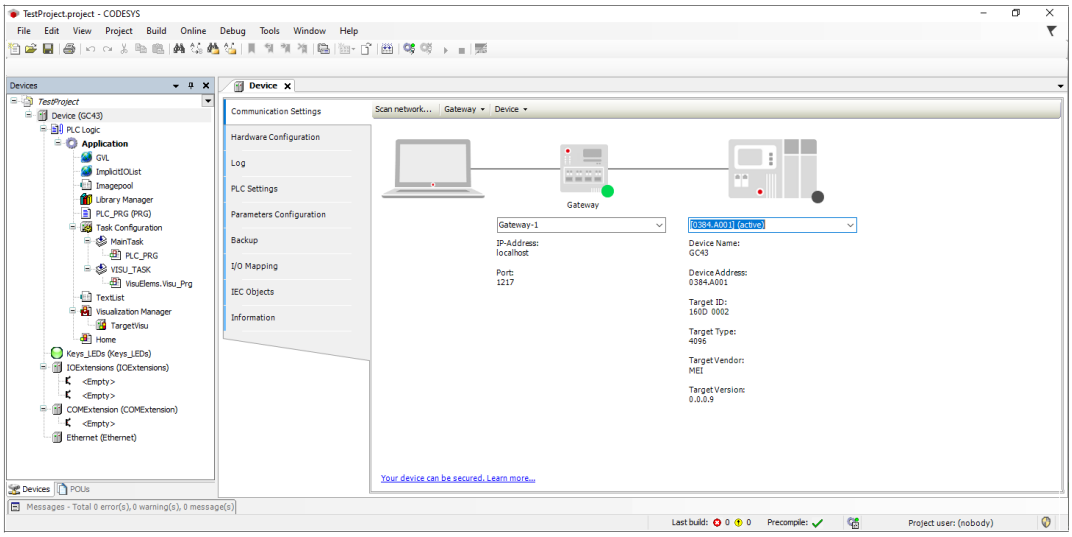


After saving project below ‘GOC 43 Project’ window gets pop up.



Refer document ‘N18006AAMH07 GOC43 Version Compatibility’ (Version: 2.0) for more details.

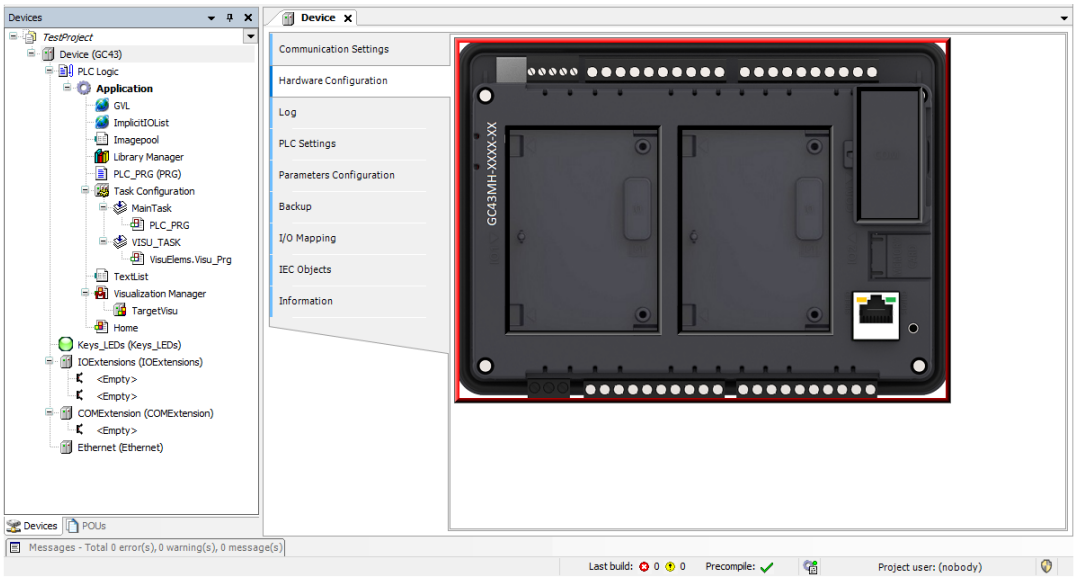
After clicking OK, following ‘Devices’ tab gets open as shown below.



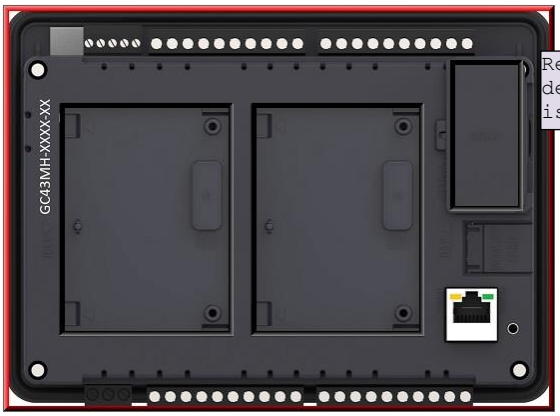
This completes project creation and device (Main unit) selection.

11.3.2 Hardware Configuration

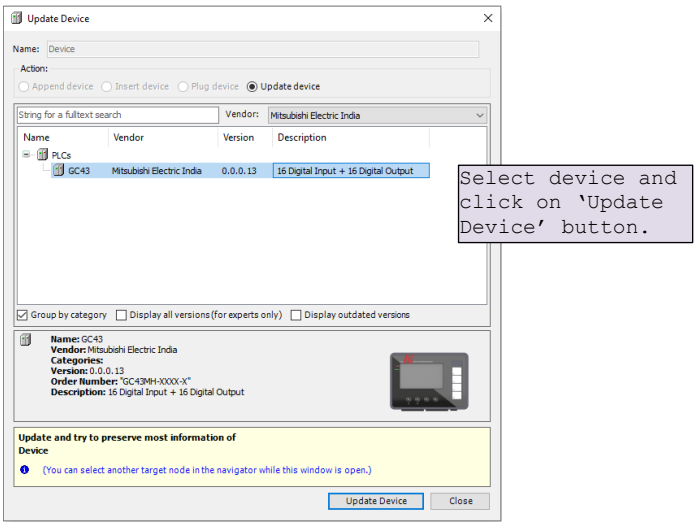
1. For Hardware configuration, click on device *Device(GC43)* as shown below.



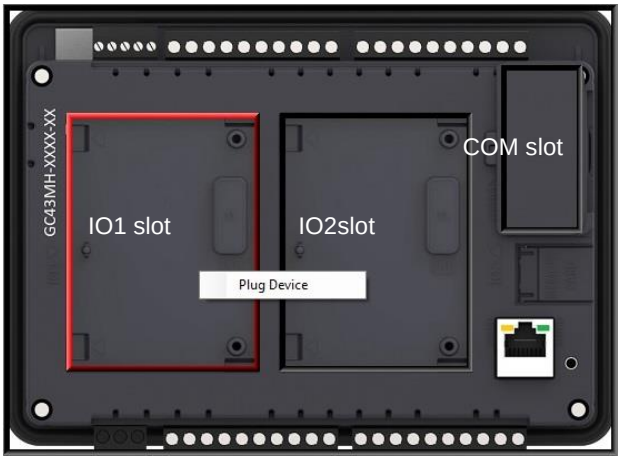
2. On Hardware configuration tab back side view of Main unit is shown as below.



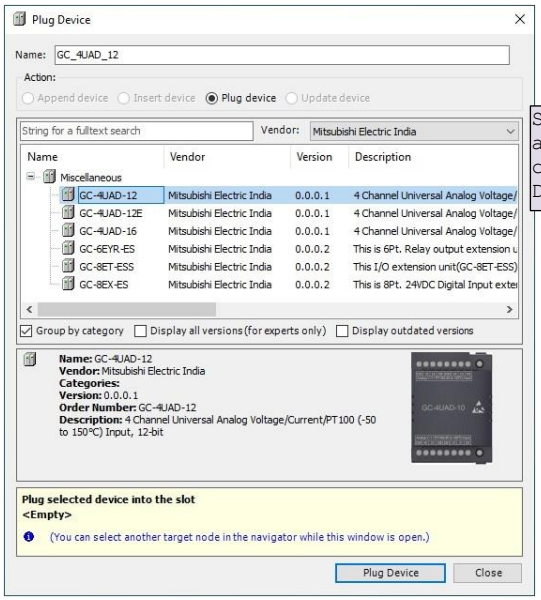
3. Right click on Main unit area opens, *Update Device* window.



4. For IO extension unit addition and selection, below steps are provided.
   a. Back side view shows IO1 slot, IO2 slot and COM slot where use can plug extension unit.
   b. Click on slot area to highlight selected slot.
   c. Do right click on selected slot, to plug extension as shown below.



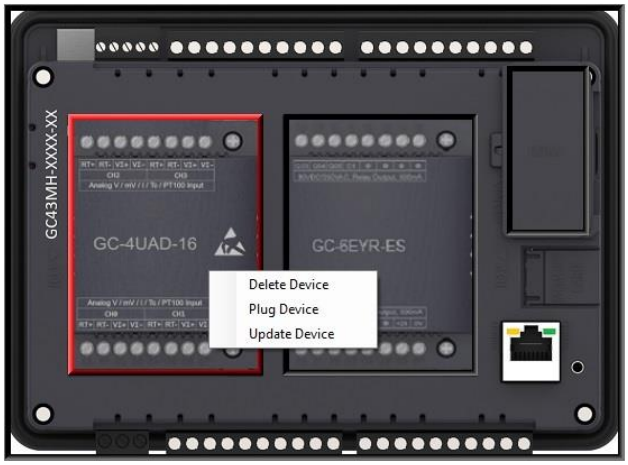
5. Click on context menu ‘Plug Device’ to pop up ‘Plug Device’ window as shown below.



Select IO extension device as per requirement and click on button ‘Plug Device’.

6. After plugging IO extensions, if user requires to plug/update or delete device as per application requirement, right click on extension unit.

For example, IO1 slot extension unit is selected and right clicked as shown below.

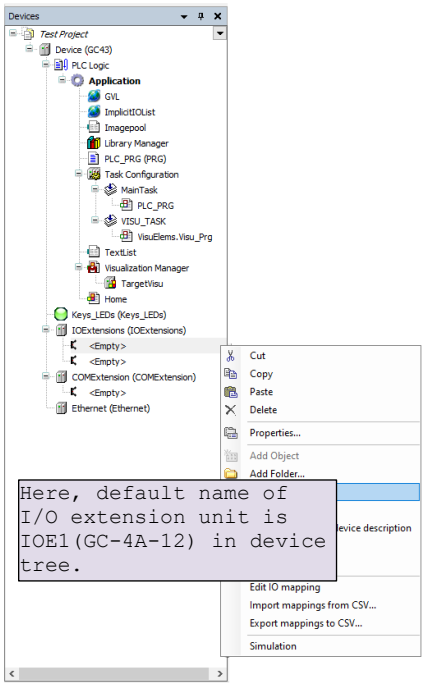


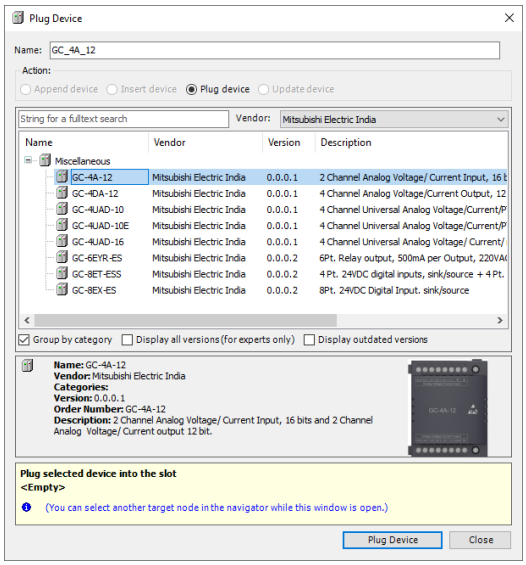
This completes one method for plugging IO extensions and COM extensions.

Alternately, user can plug extension devices in respective slots (*IOExtensions* and *COMExtension*) in Device tree. Follow the steps below.

1. Right click on *<Empty>* slot to pop up context menu.
2. Click on *Plug Device*. *Plug Device* dialog shows list of extension devices supported for the selected slot.
3. Select extension device and double click on it or click on button *Plug Device* to attach it to selected slot.

   After plugging, default name of I/O extension unit as IOE1<UnitOrderingCode> and IOE2<UnitOrderingCode>.

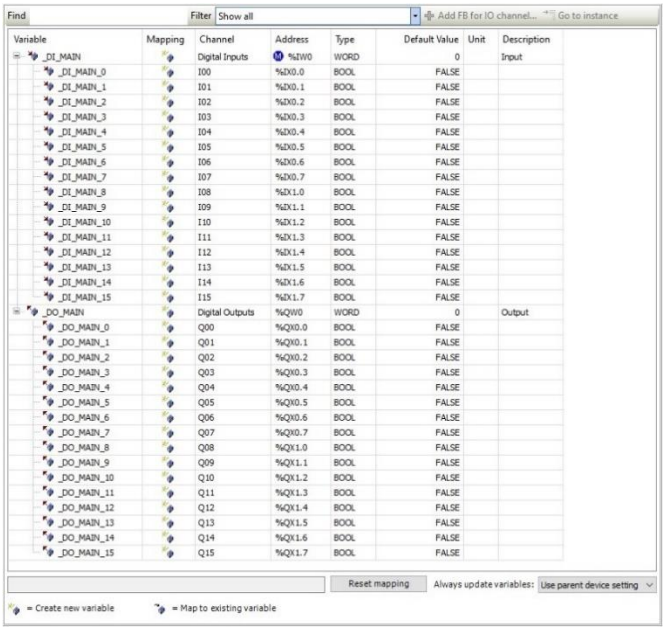




This completes hardware configuration selection.

11.3.3 IO Mapping

For GOC43, I/O memory map is fixed. Main unit consumes input memory %IB0, %IB1 and output memory %QB0, %QB1. *I/O Mapping* dialogue shows digital Inputs and outputs as shown below.

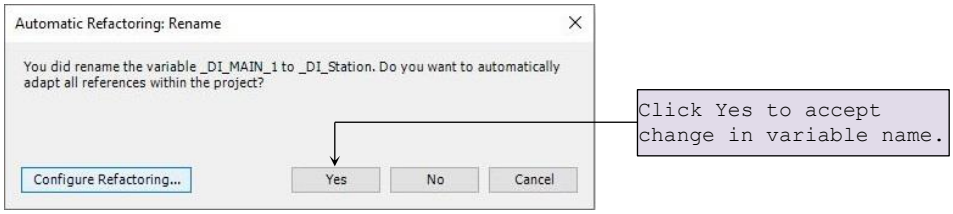


Predefined symbolic names (with prefix as '_') are global variables assigned for each input and output.

For input I00, symbolic name is `_DI_MAIN_0` and address is %IX0.0.

Prefix is `_DI_` and text `MAIN_0` indicates that it is input I00 of Main unit.

Change the symbolic name after double click on name in Variable column. The dialog below pops up to confirm the change in name throughout the Application .



In Online mode,

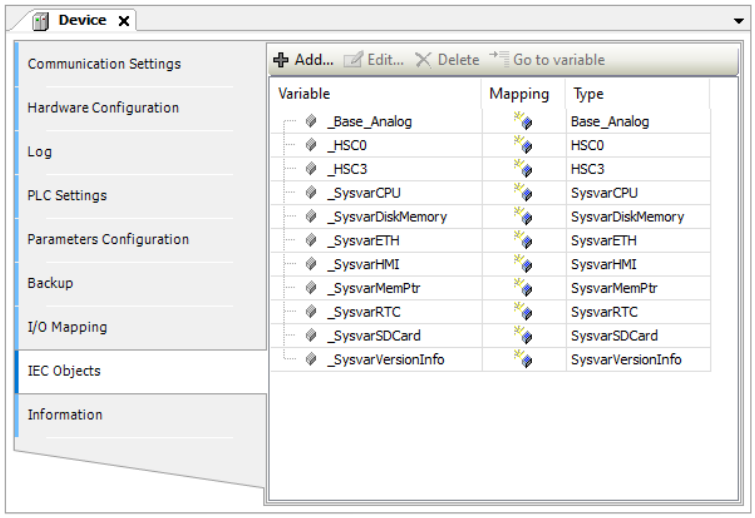
Column *Default Value* shows IO values.

Debug → Write values (Ctrl + F7) allows user to write values to outputs by modifying values in *Prepared Value* column.

11.3.4 IEC Objects

IEC objects are pre-defined global variables ((with prefix as '_') which consists of system variables and variables related to various functions.

The dialog below shows offline view.

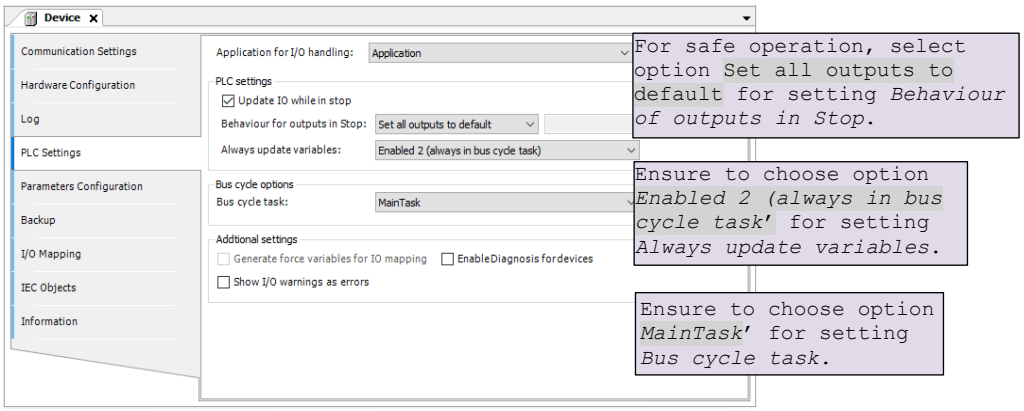


User can monitor and modify values of IEC objects in Online mode.

Using tab "IEC Objects", user can monitor and set system variables in CoDeSys online mode.

11.3.5 PLC Settings

User can make the basic settings like handling of inputs and outputs and the bus cycle task.

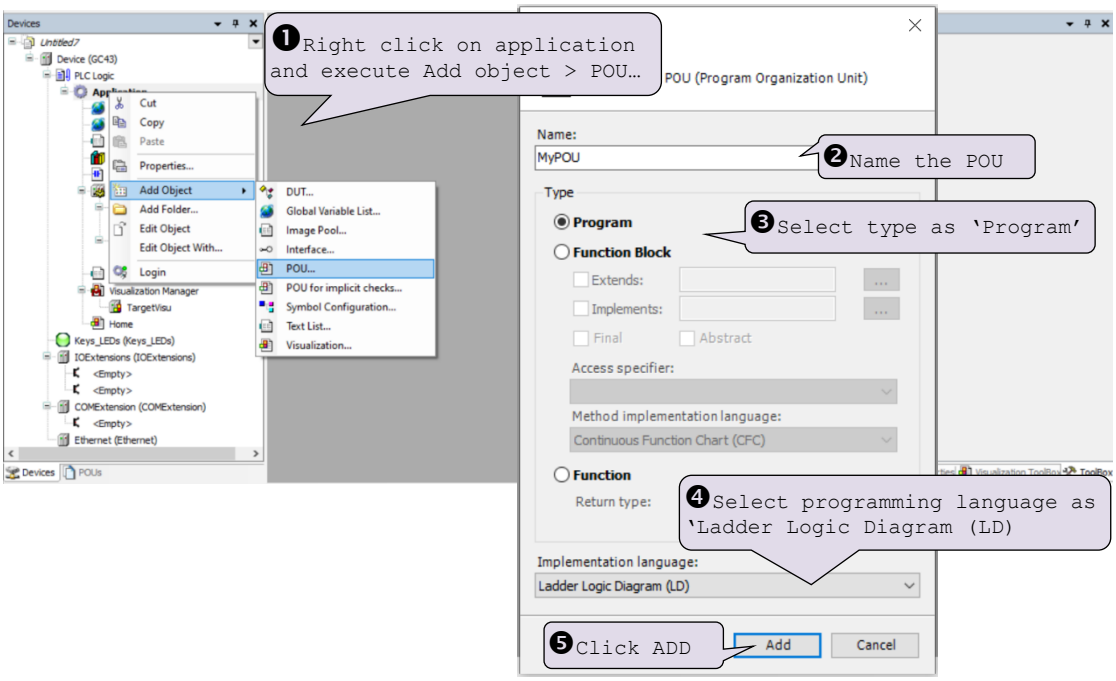


11.3.6 To Create Simple Ladder Program

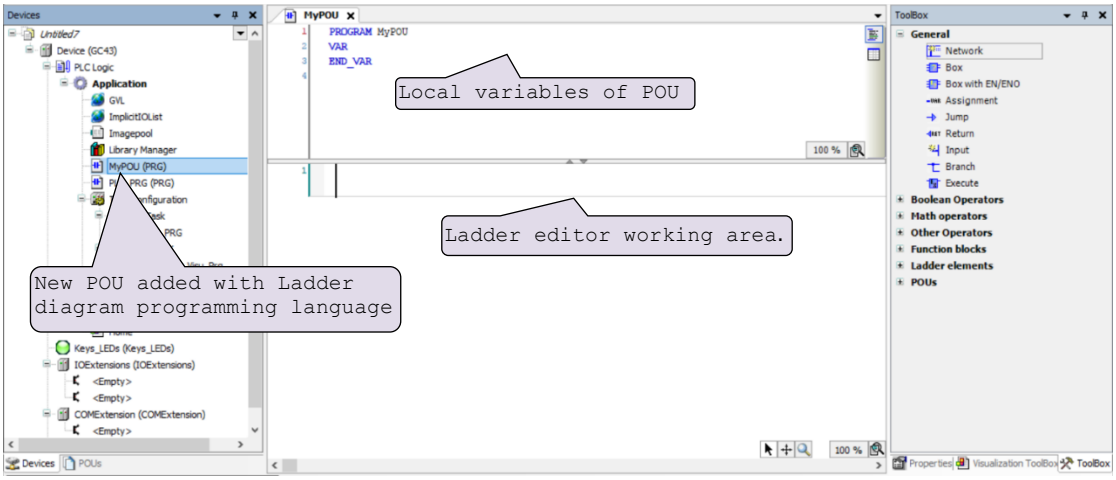
In this section, we can write a PLC code using ladder editor as an exercise.

- Add new POU with ladder language
- Add a variable ‘Start’ and ‘Motor’
- Switch ON ‘Motor’ if ‘Start’ is ON for 1 sec or more.
- Call POU in PLC_PRG

Adding new POU with ladder language

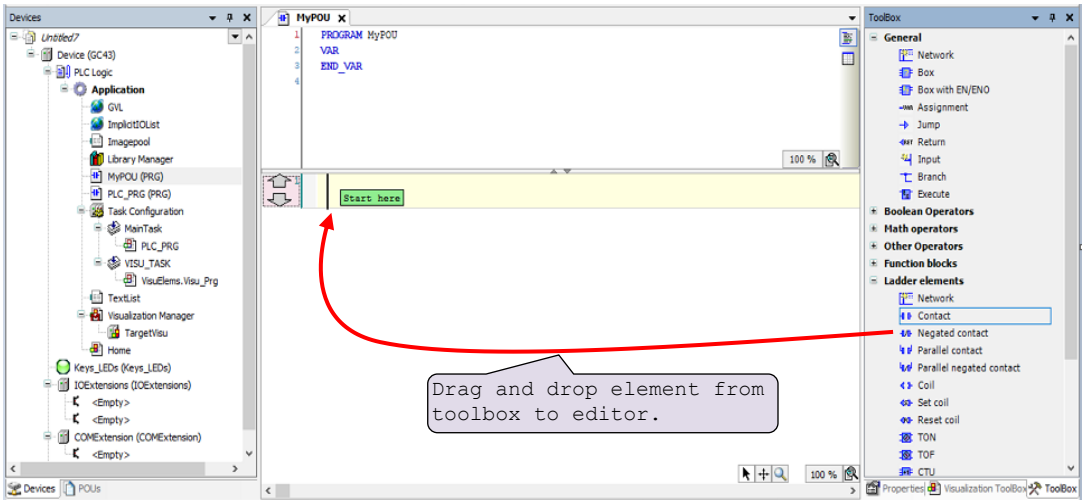


Click on “MyPOU (PRG)” to open as below.



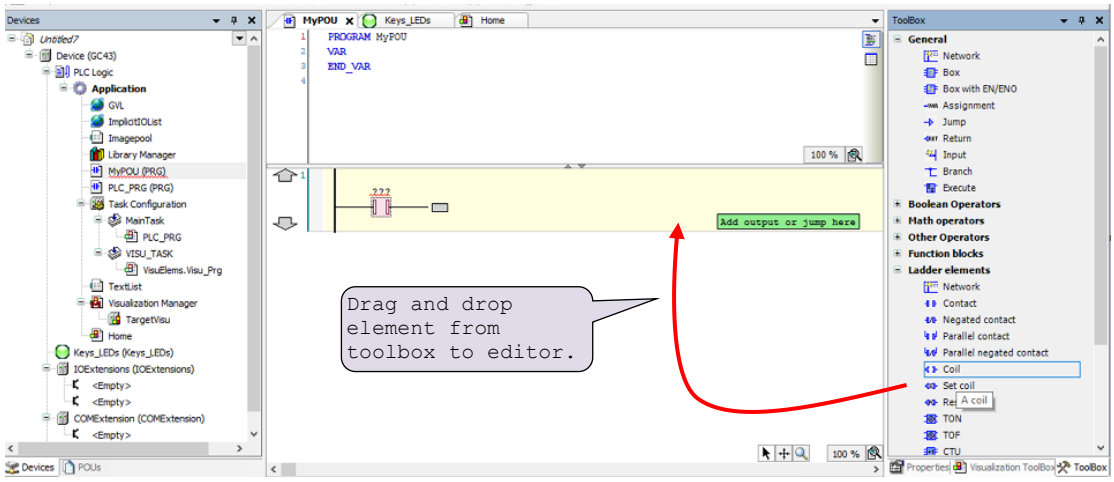
Add variable ‘Start’ and ‘Motor’

For adding new element (here, contact) in ladder network, drag and drop respective element from toolbox to editor as shown below.



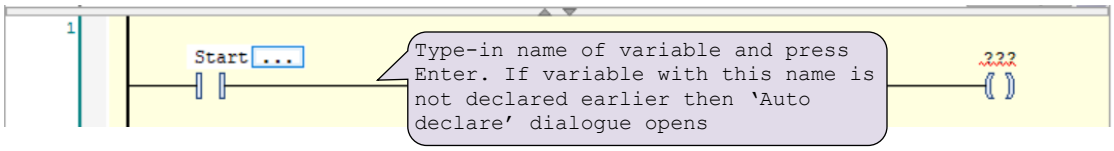
A view after adding new contact element in editor is as below,

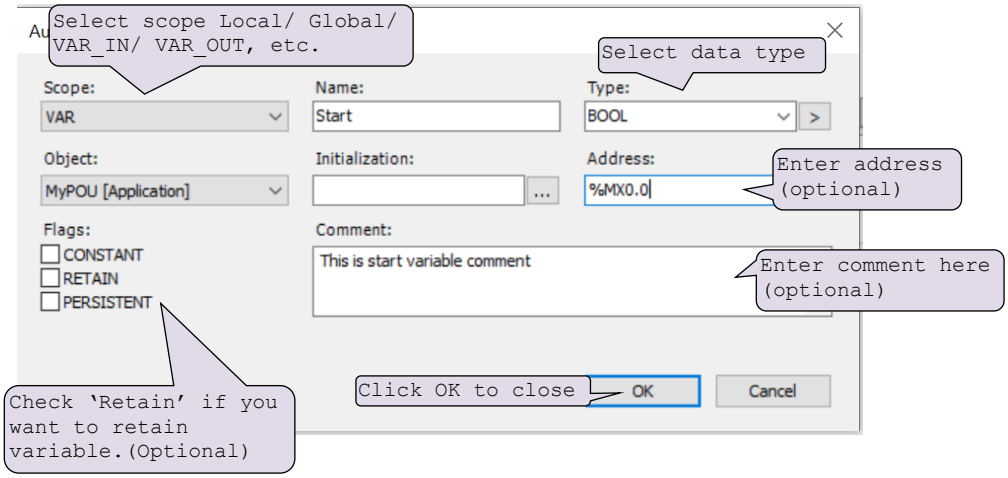
Similarly, user can add coil element to ladder network.



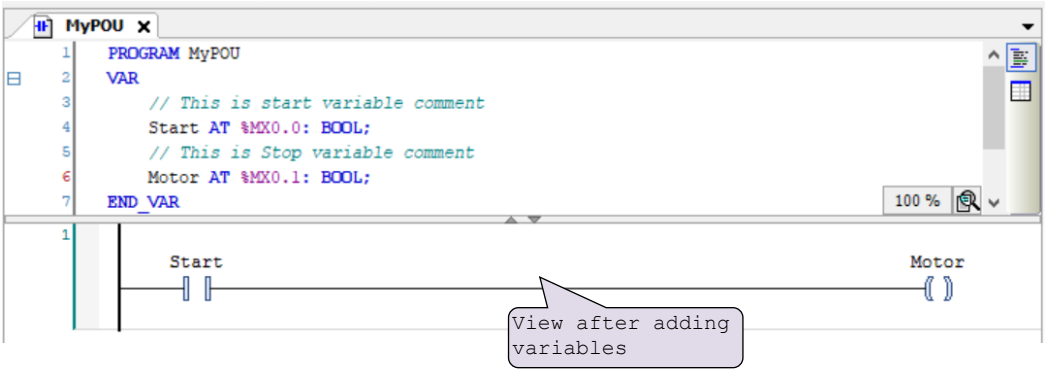
A view after adding new coil element in editor is as below,

After adding elements to ladder network , user can assign variable to element as shown below.



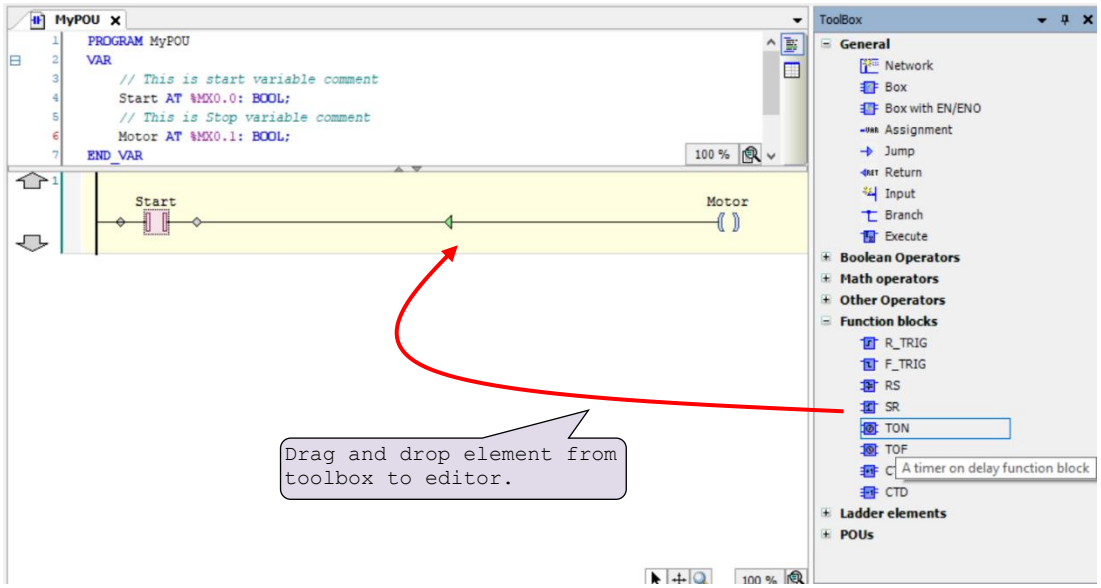


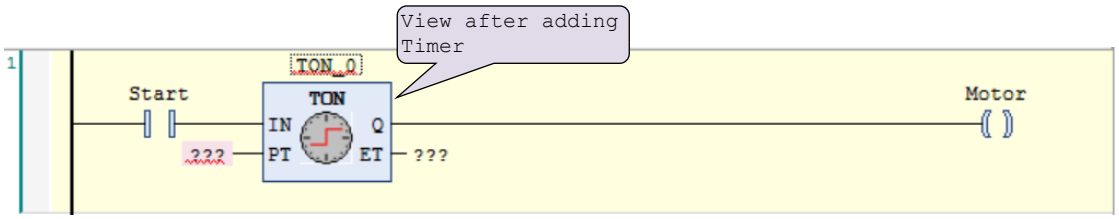
Similarly, assign variable to coil element as 'Motor'.



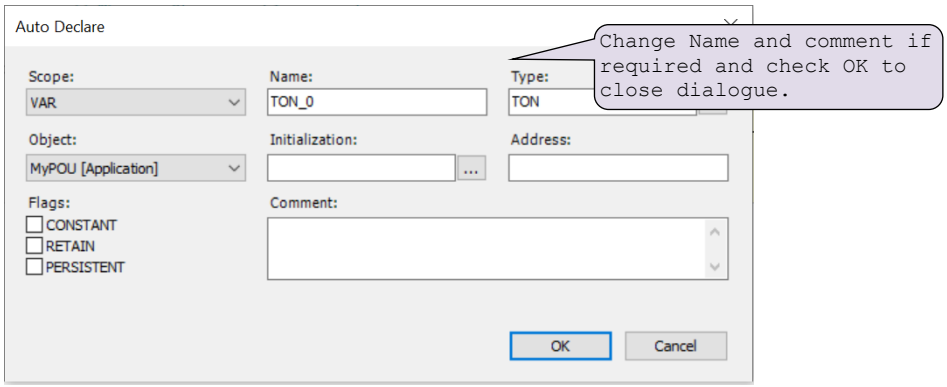
Switch ON 'Motor', if 'Start' is ON for 1 sec.

To turn 'Motor' ON when 'Start' is ON for 1 sec, it is required to add timer function block in ladder network as shown below.



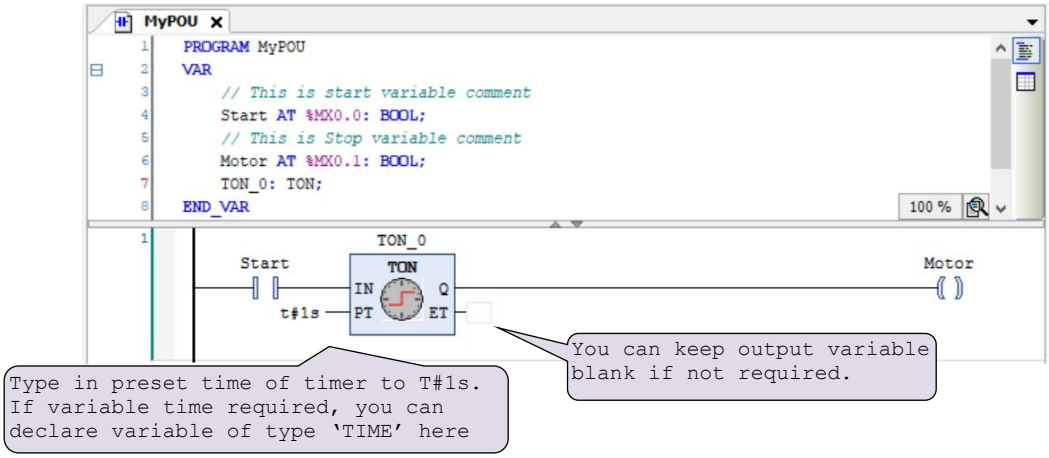


After pressing enter, auto-declare dialogue opens to declare timer FB instance.



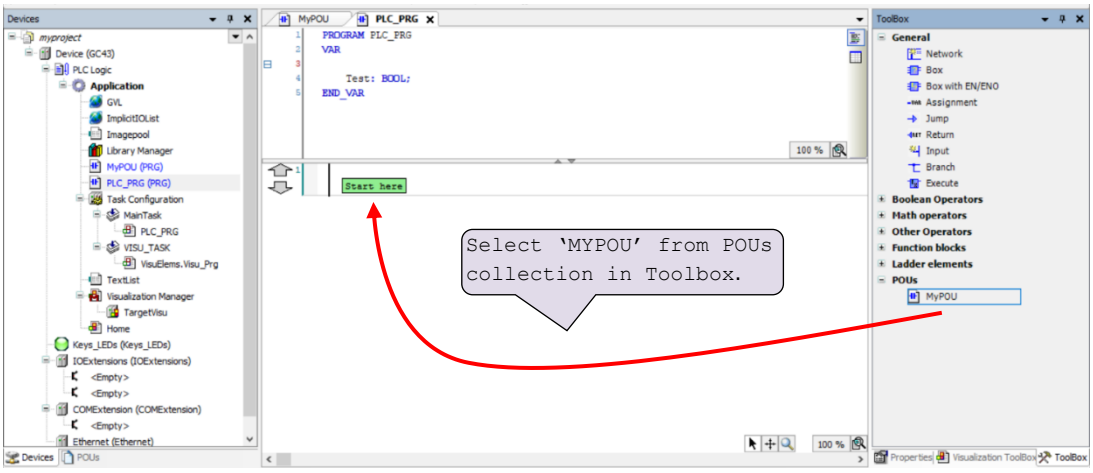
This completes assigning names and variables to added elements.

Assign variables to function block instance ‘TON_0’ as shown below.



Now call POU named as “MyPOU” in PLC_PRG.

Do double click on PROGRAM type of POU PLC_PRG to open it in editor.

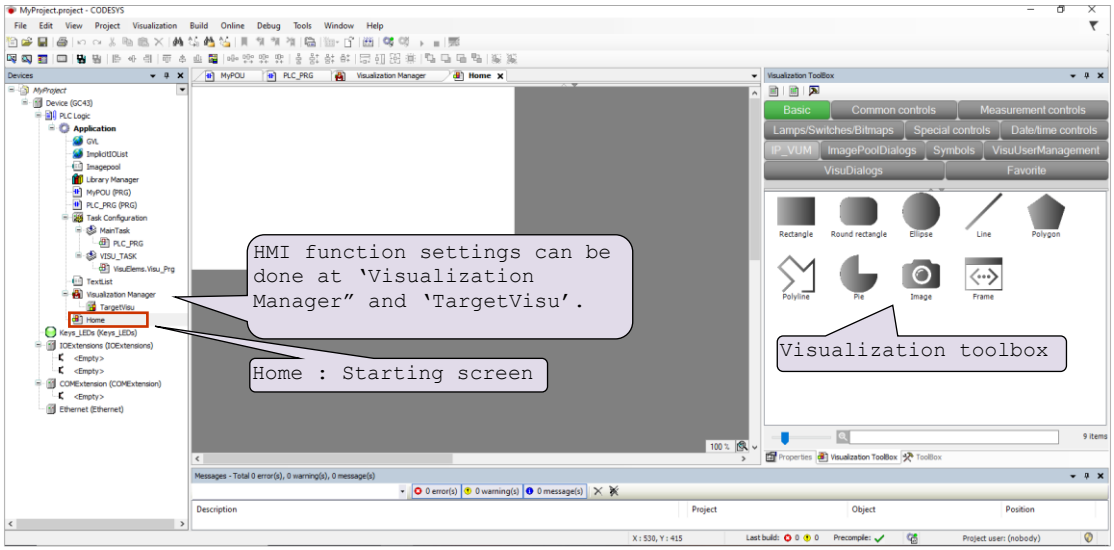


Drag and drop “MyPOU” to PLC code and the view after adding “MyPOU” in PLC_PRG is as below.

11.3.7 To Create Simple HMI Program

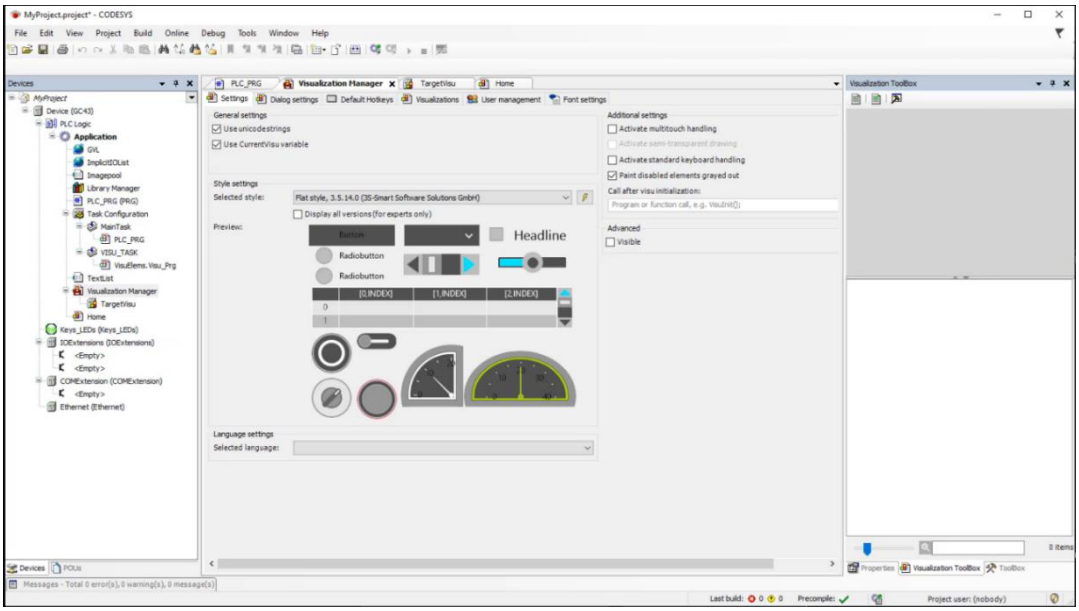
In this section, we can see how to do HMI programming in CoDeSys 3.5.

Execute Device (GC43) >> Application >> Visualization Manager, for HMI function settings and to drag and drop HMI objects from visualization toolbox.



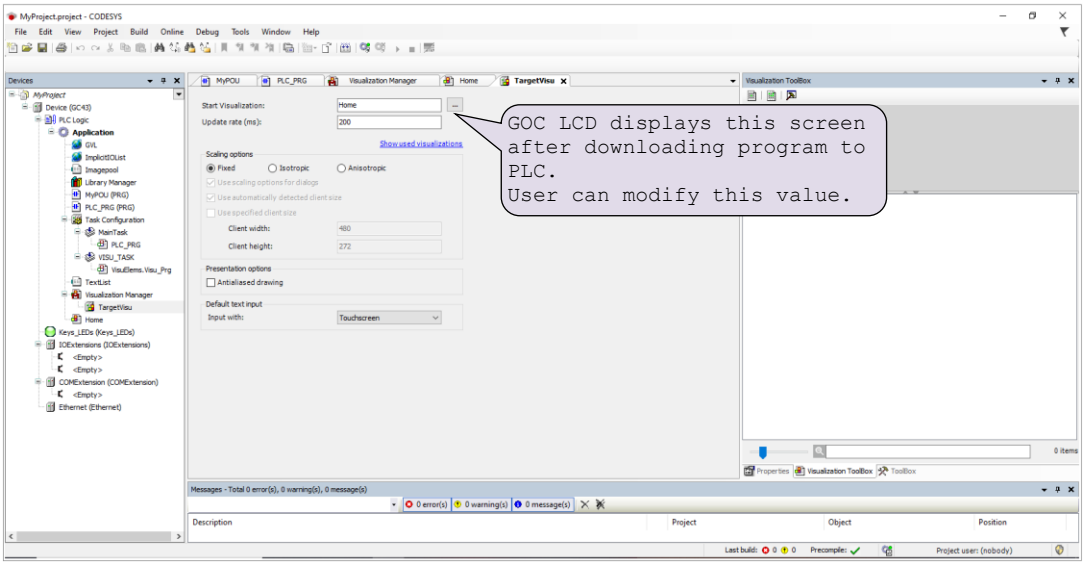
For setting HMI functions, click on "Visualization Manager",

Do not modify default settings available on "Visualization Manager" tab as below. It may cause malfunction of HMI functionality.

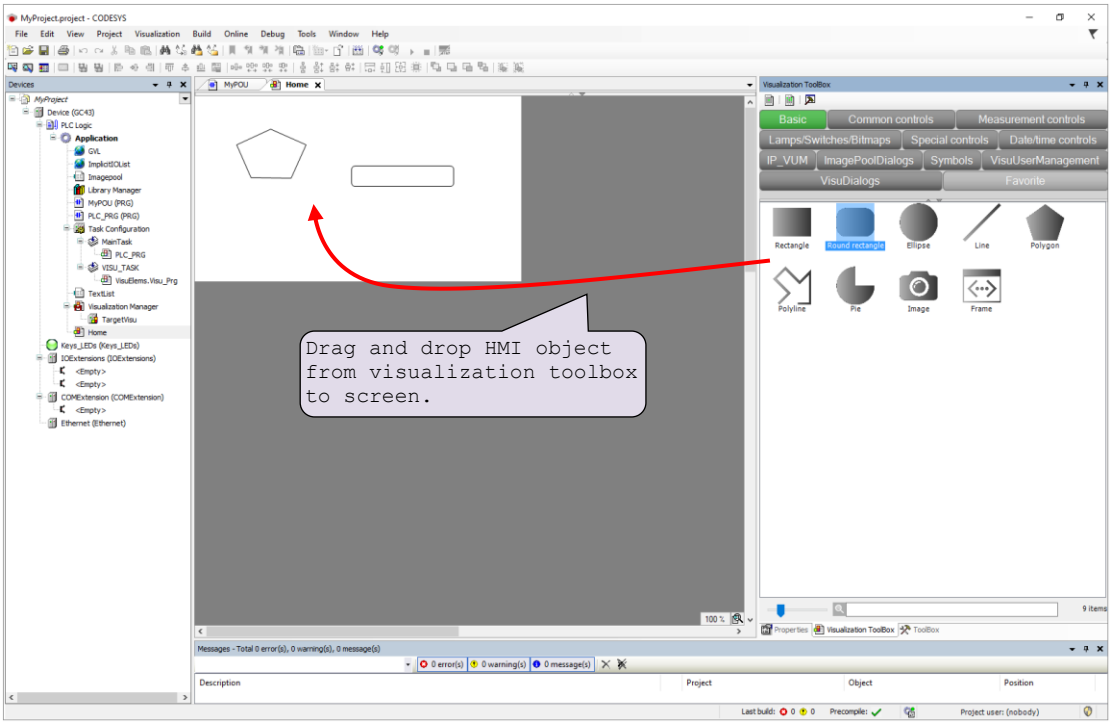


Do not modify default settings provided on "Visualization Manager" tab and "TargetVisu" tab.

Click on “TargetVisu” tab, to view further visualization settings such as start visualization, update rate, scaling options, default text input etc.

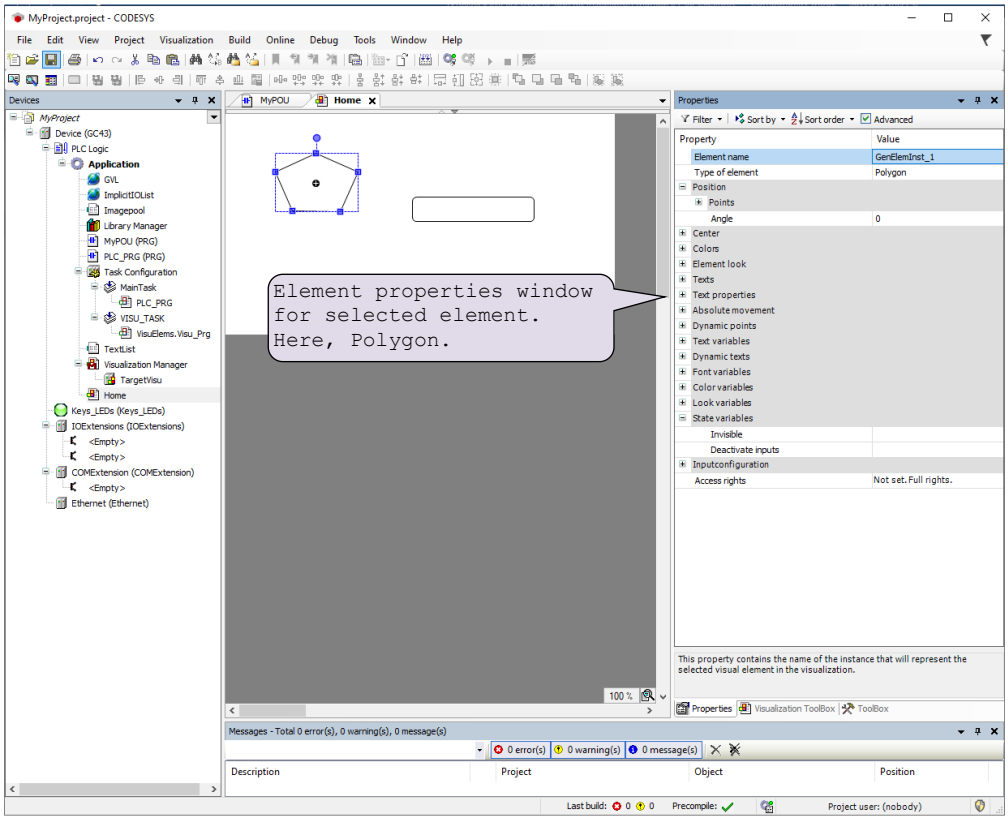


Click on ‘Home’ screen and add HMI elements by drag and drop as shown below.

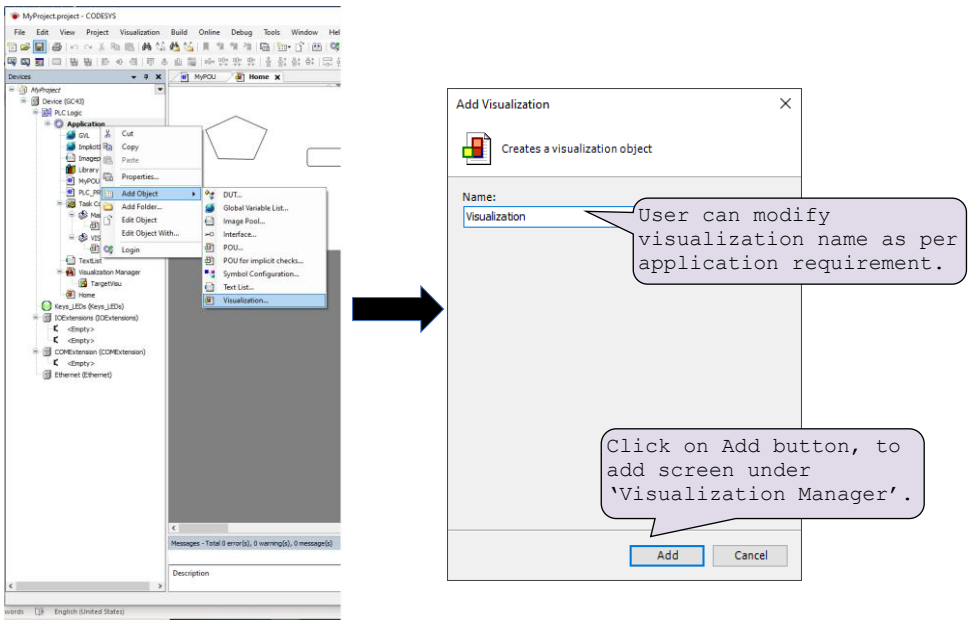


Similarly, user can drag and add elements covered in other groups such as Common controls, Measurement controls, Lamps/Switches/Bitmaps, Special controls, Date/time controls etc.

For setting properties of individual element, select element on screen so that element ‘Properties’ window gets open in toolbox as shown.



Also, user can add multiple screens up to 64 screens by executing Device (GC 43) >> Application [do right click] >> Add Object >> Visualization.



11.3.8 To Download Project and Online Operations

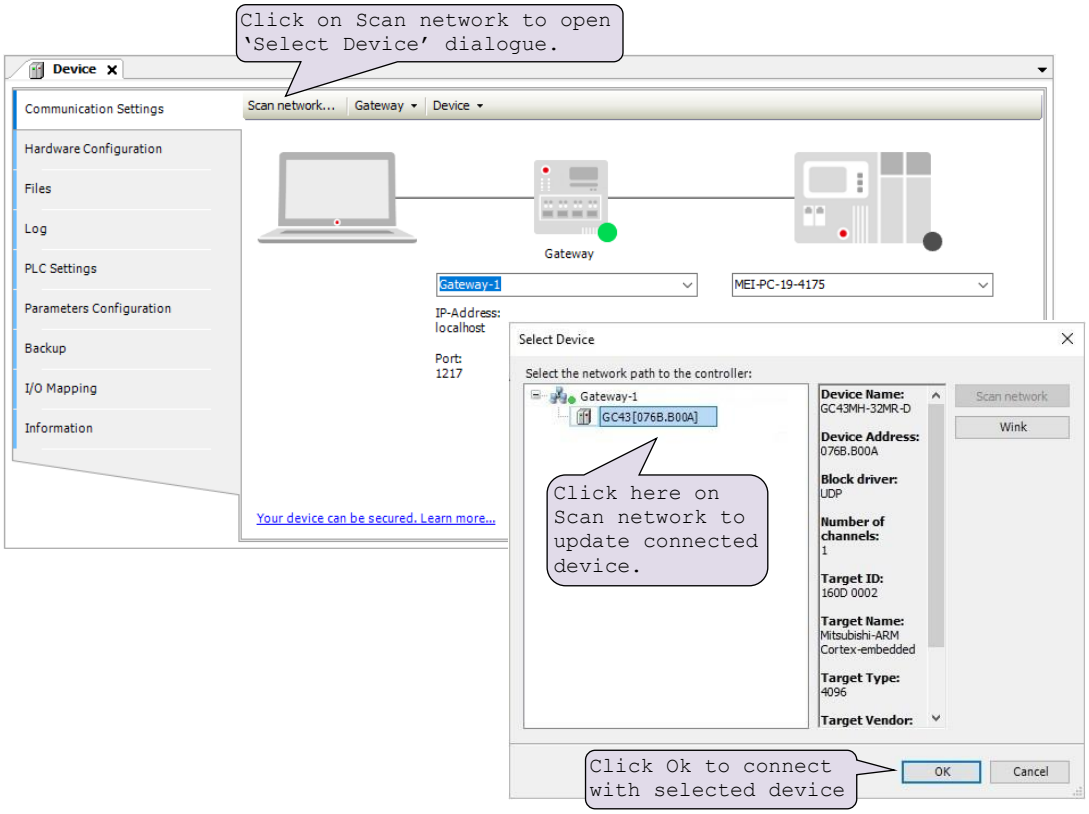
For downloading project to PLC, it should be error free.

Compile project by executing menu Build >> Clean all, Build >> Rebuild. This provides user list of errors (if any), warnings and information messages under “Messages” window.

After successful compilation of project, follow below steps,

1. Power ON and connect GOC43 device to PC via Ethernet.

2. Click on Device (GC 43) >> Communication settings as shown below.



3. Execute menu Online >> Login (Alt + F8), this opens confirmation dialogue to start project downloading.

4. After successful downloading, execute menu Debug >> Start (F5) to put device in RUN mode.

12 Controller Memory

During development of PLC logic and visualization screens, it is important to understand the different types of memory available and how to access it. In GOC43, three types of memory is used.

1. RAM (volatile memory): holds PLC variable data (input, output, marker and data)
2. Flash (permanent memory): holds application program code and source code.
3. FRAM (permanent memory): holds retain data and settings like (IP settings, display settings, calibration data)

The table below shows utilization of RAM and Flash memory.

Memory	Description	Addressing	Size
RAM	Input process image (Main unit and Extension units)	Addressable as %I	32 Bytes
	Input process image (Communication protocol interface)		2016 Bytes
	Output process image (Main unit and Extension units)	Addressable as %Q	32 Bytes
	Output process image (Communication protocol interface)		2016 Bytes
	Marker *	Addressable as %M	32 Kbytes
	Data *	Addressable by user defined symbolic names	2 Mbytes
Flash	Application program code, Application program source code, Application data (Other files, visualization fonts and images etc.)	Not addressable	64 Mbytes
FRAM	Marker *	Addressable as %M	1 Kbytes
	Data *	Addressable by user defined symbolic names	3 Kbytes

* User can declare part of marker memory and data memory as retentive as per application need. Retentive data is stored in FRAM.

12.1 Input Process Image

The processor scans the input points from Main unit and extension units in input scan prior to Main_Task and stores the status in input process image after filtering.

It also copies input data updated by communication protocol interface (e.g. Modbus TCP, Modbus RTU, etc.) to input process image.

The application program attached to Main_Task, then refers this status in the logic scan.

Input memory size for Main and Extension units is 32 bytes and is addressed from %IB0 to %IB31.

Input memory size for communication protocol interface is 2016 bytes and is addressed from %IB32 to %IB2047.

The input process image is not retained.

12.2 Output Process Image

The processor updates the status of output points as per the application program attached to Main_Task and stores the updated status in the output process image. It also copies output data updated by communication protocol interface (e.g. Modbus TCP, Modbus RTU, etc) to output process image.

The processor executes output scan after Main_Task. The output scan activates the actual outputs on Main unit and extension units as per the output process image.

Output memory size for Main and Extension units is 32 bytes and is addressed from %QB0 to %QB31.

Output memory size for communication protocol interface is 2016 bytes and is addressed from %QB32 to %QB2047.

The output process image is not retained.

12.3 Marker Memory

Marker memory holds the intermediate results in the application program. Marker memory size is 32767 bytes and is addressed from %MB0 to %MB32767.

1000 bytes of marker memory from %MB31744 to %MB32767 can be retained.

12.4 Data Memory

Data memory holds the intermediate results and Function Block instance data. This memory is addressed by user defined symbolic name only. The programming software ‘CoDeSys’ assigns the address to such PLC variable during compilation of the application program. This address is for internal purpose and may change during number of compilations at the time of application program development. So, the address of such variable is not fixed and external devices like HMI and SCADA cannot access it via protocols like Modbus TCP, Modbus RTU protocol.

3000 bytes of data memory can be retained.

12.5 I/O Memory Mapping

Digital I/O memory mapping is fixed with respect to Main unit and extension units.

I/O memory mapping is fixed irrespective of type of Main and extension unit. If any I/O points are not used, respective I/O memory is redundant. If any extension is not used, respective input/output memory is redundant and input byte holds 0 permanently whereas if output byte is modified in application program there is no action.

Unit	Slot number	Digital input address	Digital output address
Main	0	%IB00 to %IB01	%QB00 to %QB01
Function keys and illuminated keys	Not applicable	%IB02	%QB02
Reserved	--	%IB03 to %IB11	%QB03 to %QB11
IO1 Extension	5	%IB12 to %IB13	%QB12 to %QB13
IO2 Extension	6	%IB14 to %IB15	%QB14 to %QB15
Communication protocol interface	Not applicable	%IB32 to %IB2047	%QB32 to %QB2047

Input image of digital inputs in Main unit is updated even if inputs are configured for special functionality like high speed counter but it may not be useful in the application.

For IO extension units like analog I/Os, input memory provides status of analog channels and output memory is used for commands and settings.

Addressing I/Q/M memory

The figure below shows the addressing of input, output and marker memory.

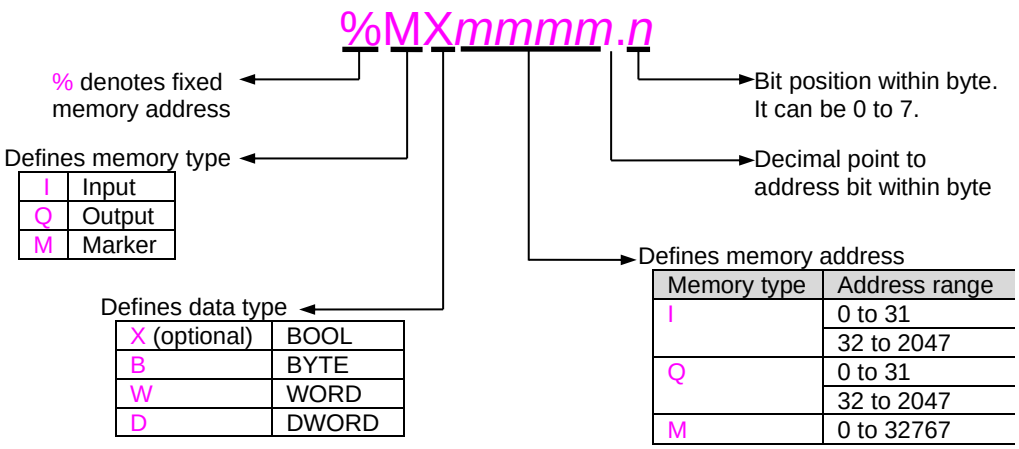


Figure 26: Addressing of PLC variables

The figure below shows memory mapping and significance of BOOL, BYTE, WORD and DWORD data type for marker memory as an example.

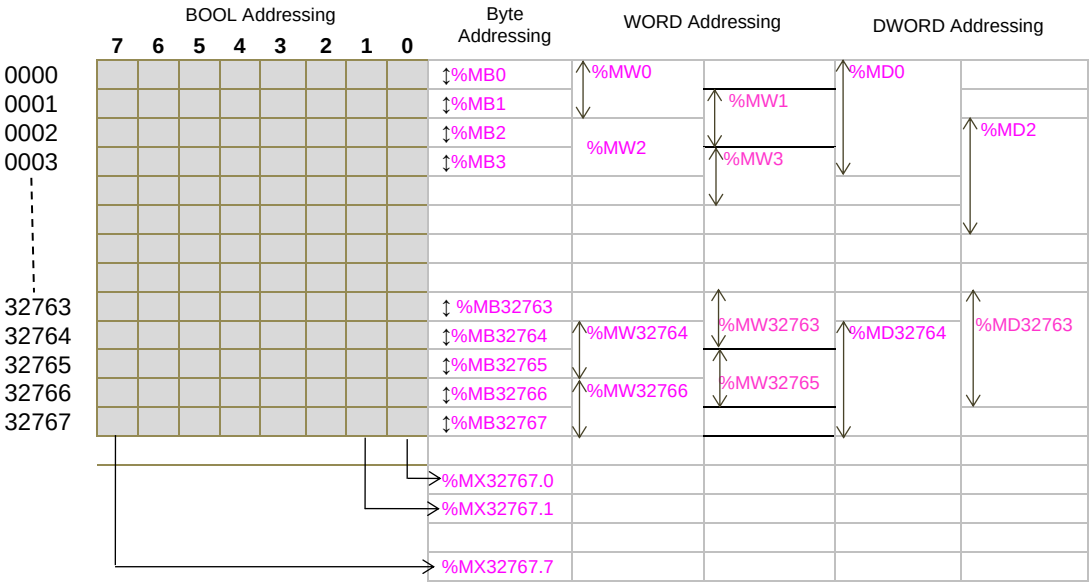


Figure 27: Memory mapping

Points to remember

1. Memory is arranged byte wise. All the 8 bits (0 to 7) within a byte can be addressed individually.
2. When memory is addressed as WORD, then two consecutive bytes are accessed. Byte at start address is lower byte and next byte is higher byte.
3. When memory is addressed as DWORD, then two consecutive words (i.e. four consecutive bytes) are accessed. Word at start address is lower word and next word is higher word.
4. Addressing of WORD and DWORD as %MW0, %MW1, %MW2, %MD0, %MD1, %MD2, %MD3 is allowed.
5. Addressing words like %MD0, %MD1 in same application program will overlap 2 bytes (%MB1 in this case) and should be avoided.
6. Addressing double words like %MD0, %MD1 and like %MD2, %MD4 in same application program will certainly overlap 3 bytes (%MB1, %MB2 and %MB3 in first case) and 2 bytes (%MB4 and %MB5 in second case) and should be avoided.

12.6 Addressing Range

The following table shows addressing range supported by GOC43.

PLC Memory	Type	Data Type	Range
Input BOOL	I	X	%IX0.0 to %IX0.7 %IX1.0 to %IX1.7 ⋮ %IX2047.0 to %IX2047.7
Input BYTE	I	B	%IB0, %IB1, %IB2 to %IB2047
Input WORD	I	W	%IW0, %IW1, %IW2, %IW3, %IW4 to %IW2046
Input DWORD	I	D	%ID0, %ID1, %ID2, %ID3, %ID4 to %ID2044
Output BOOL	Q	X	%QX0.0 to %QX0.7 %QX1.0 to %QX1.7 ⋮ %QX2047.0 to %QX2047.7
Output BYTE	Q	B	%QB0, %QB1, %QB2 to %QB2047
Output WORD	I	W	%QW0, %QW1, %QW2, %QW3, %QW4 to %QW2046
Output DWORD	I	D	%QD0, %QD1, %QD2, %QD3, %QD4 to %QD2044
Marker BOOL	M	X	%MX0.0 to %MX0.7 %MX1.0 to %MX1.7 ⋮ %MX32767.0 to %MX32767.7
Marker BYTE	M	B	%MB0, %MB1, %MB2 to %MB32767
Marker WORD	M	W	%MW0, %MW1, %MW2, %MW3, %MW4 to %MW32766
Marker DWORD	M	D	%MD0, %MD1, %MD2, %MD3, %MD4 to %MD32764

12.7 Retained Memory

Retentive memory is a memory that is declared by the user to maintain values through a power cycle or warm initialization. GOC43 allows 4000 bytes of memory to retain. The table below shows memory type and maximum size of memory that can be retained

Data memory	3 Kbytes
Marker memory	1 Kbytes (from %MB31744 to %MB32767)

Retained data is stored in FRAM type of memory. Cold initialization resets entire memory (including retentive memory) to 0 or user defined initial value.

Points to remember

1. User can define PLC variable as retentive using keyword VAR RETAIN. Local as well as global variable can be declared as retentive.

   e.g.

   ```
   VAR RETAIN
       Data1: WORD;
   END_VAR
   ```

   Here, variable declared with symbolic name Data1 is retained.

2. Marker memory form %MB31744 to %MB32767 is retained by default if user accesses it directly by marker memory address (and not declared with some symbolic name). Whereas remaining marker memory from %MB0 to %MB31743 is cleared at warm initialization.

3. If any variable with symbolic name is mapped at marker memory address from %MB31744 to %MB32767, it is cleared at warm initialization if declared as shown below

```
VAR
    Data1 AT%MW32000: WORD;
END_VAR
```

To retain this variable, user has to declare it as retentive as below

```
VAR RETAIN
        Data1 AT%MW32000: WORD;
END_VAR
```

4. Any variable mapped outside specified marker memory is not retained even though declared as retentive.

e.g.

```
VAR RETAIN
        Data10 AT%MW1000: WORD;
        Op2 AT%QB2: BYTE;
END_VAR
```

Here, variables Data10 and Op2 will not be retained.

5. If user declares function block instance as retentive, then the complete instance of the function block (all the data of function block instance) is retained.

   e.g.

```
VAR RETAIN
    T1: TON;
END_VAR
```

   If instance T1 of ON delay timer TON is declared as retentive, then 28 bytes of data memory is retained.

6. During application program compilation, programming software 'CoDeSys' checks PLC variables declared by symbolic name (and not mapped at I/Q/M memory) for retained size limit of 3 Kbytes. If retained size exceeds 3 Kbytes, it displays compilation error as

   `C0103: Out of retain memory: Variable '<name>', <number> bytes`

   But for PLC variables mapped at marker memory (as well as for input and output memory), it does not check for retained size limit of 1 Kbytes. It does not display any compilation error for user mistake.

12.8 System Variables

The system variables are pre-defined global variables. These variables exchange the information between CPU and application program. Each system variable has a unique name which starts with underscore '`_Sysvar`'. These system variables are useful to know the system status and diagnostics.

For more details, refer chapter *System Variables*.

12.9 Application Program Memory

GOC43 stores application program in flash memory in form of code and source code.

Application Program Code (Boot Project)

The programming software 'CoDeSys V3.5' downloads complied project when

1. Menu command Online→ Download is executed or
2. Menu command Online → Login Alt+F8 is executed and there is mismatch between complied project and existing project in GOC43

This complied project is called the application program code or boot project which is executed by the processor.

Maximum application program code size is 8 Mbytes.

Points to remember

1. Application program code (boot project) is not retrievable i.e. cannot be uploaded as a project file.
2. CoDeSys downloads application program code in flash memory. In case of unresolved external POUs (POUs in external library those are not supported by CPU firmware), CoDeSys prompts programmer at the end of download and PLC remains in STOP mode indicating memory error. At this point, programmer must download a valid application program code and put PLC in RUN mode.
   Instead if programmer recycles PLC power, PLC may start executing application code containing unresolved external POUs and may malfunction.

Application Data

This memory consists of visualization fonts, images, text lists, other system files, etc. It gets downloaded along with application program code. This is not a part of 8 Mbytes of application program code memory size.

Note that application data once downloaded to the device is stored in the flash memory. On further downloads, only additional application data is downloaded. If user deletes some of the previously downloaded application data (e.g. image, fonts) from visualization, it will not be deleted from flash memory on the device. So, there are chances of consuming 64 Mbytes of flash memory. In such case, CoDeSys declare disk full error and downloading is aborted.

To delete unused application data, user can erase application data along with application program code by executing command Online → Reset origin and download application program again. This ensures that only used application data is stored in the device.

Application Program Source Code

The programming software 'CoDeSys' enables user to develop the application program using various IEC languages. This application program is saved as <Project_Name>.pro file on computer hard disk. The project file contains all project related information e.g. POUs in various IEC languages, program comments, variable declarations with symbolic name and comments, password, visualization screens with images and fonts, libraries (optional), system files, etc. It is necessary to store all this information called as Source code in GOC43 in the format defined by user.

Menu command Online→ Sourcecode download to connected device or Menu → Source download.. downloads application program source code to flash memory. Source code download is possible when CoDeSys is in Online monitoring mode.

Menu command File→ Source upload uploads project file from GOC43 and present it in **.pro** file format.

Points to remember

1. Download source code is mandatory so that entire application project remains with GOC43 Main unit and can be retrieved later on whenever required.
2. Programmer can restrict unauthorized uploading of source code by programming read protection password.
3. During source code download / upload, PLC function and visualization continues to function normally.
4. Command Online → Reset origin deletes application program and application data.

13 Built-in HSC (High Speed Counter)

GOC43 Main unit provides high speed inputs. By default, these inputs function as general purpose digital inputs. These inputs can be configured for different modes of counter operations.

13.1 Specifications

<table>
<tr><th>Item</th><th colspan="4">Description</th></tr>
<tr><td colspan="5">Special functions of digital inputs (User configurable)</td></tr>
<tr><td rowspan="4">Single phase counters
(up to 2 nos.)</td><td>Counter</td><td colspan="3">Input</td></tr>
<tr><td>Counter0</td><td colspan="3">input I00</td></tr>
<tr><td>Counter3</td><td colspan="3">input I03</td></tr>
<tr><td colspan="4">Input frequency: 20 KHz maximum</td></tr>
<tr><td></td><td colspan="4">Pulse ON/ OFF time: 20 µsec minimum</td></tr>
<tr><td rowspan="5">Quadrature
encoder
(Up to 2 nos.)</td><td>Encoder</td><td>A phase</td><td>B phase</td><td>Z marker</td></tr>
<tr><td>Encoder0</td><td>input I00</td><td>input I01</td><td>input I02</td></tr>
<tr><td>Encoder3</td><td>input I03</td><td>input I04</td><td>input I05</td></tr>
<tr><td colspan="4">Input frequency: 10 KHz maximum (for individual phase)</td></tr>
<tr><td colspan="4">Pulse ON / OFF time for A and B phase: 20 µsec minimum.
Pulse ON / OFF time for Z marker pulse: 50 µsec minimum.</td></tr>
</table>

NOTE

All the counters are 32-bit bi-directional counters.

13.2 Single Phase Counter with Software Direction

Main unit provides up to 2 high speed inputs which can be configured for single phase counter operation (32-bit bi-directional) and counting direction can be changed through the application program.

Inputs I00 (HSC0) and I03 (HSC3) are single phase counters.

The figure below shows action of Reset and Direction control on single phase counter.

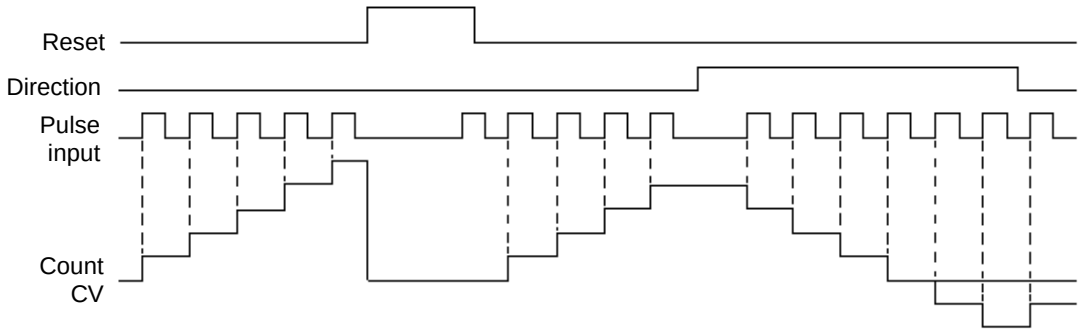


Figure 28: Functioning of single-phase counter with software direction

At rising edge (OFF to ON) at input, count increments by 1 if counting direction set is FALSE. At rising edge (OFF to ON) at input, count decrements by 1 if counting direction set is TRUE.

Counter current value is reset to 0 as long as Reset is TRUE.

13.3 Encoder A B Phase

Main unit provides up to 2 encoder interfaces. Counter provides 32 bit bi-directional count.

Two inputs I00 (phase A) and I01 (phase B) along with common terminal C0 provide one encoder interface as HSC0.

Two inputs I03 (phase A) and I04 (phase B) along with common terminals C0 and C1 provide another encoder interface as HSC3.

The figure below shows action of Reset and direction control depending upon phase shift beteen A phase and B phase.

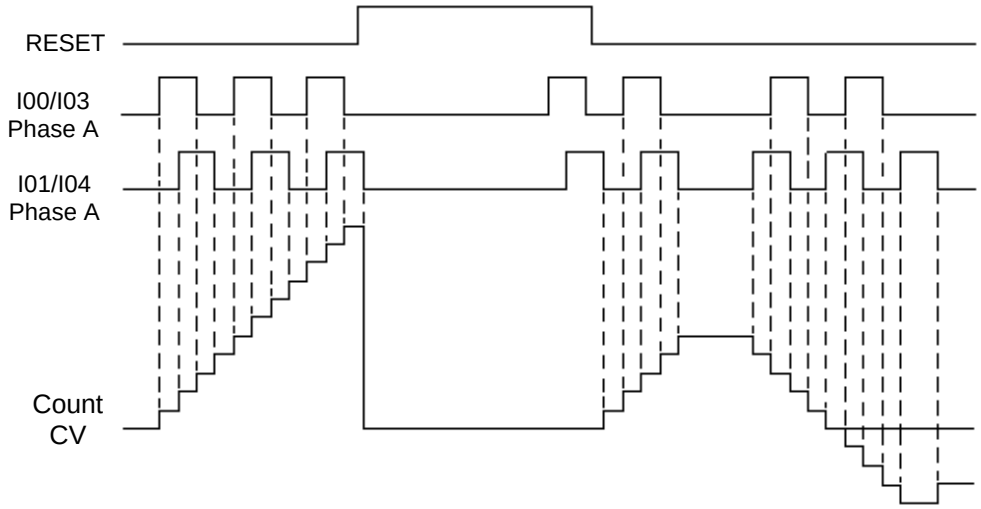


Figure 29: Functioning of AB encoder

At rising edge (OFF to ON) as well as falling edge (ON to OFF) at A phase and at rising edge (OFF to ON) as well as falling edge (ON to OFF) at B phase, count increments by 1 if A phase is leading B phase.

At rising edge (OFF to ON) as well as falling edge (ON to OFF) at A phase and at rising edge (OFF to ON) as well as falling edge (ON to OFF) at B phase,count decrements by 1 if A phase is lagging B phase.

Counter current value is reset to 0 as long as Reset is TRUE.

13.4 Encoder A B Phase with Z Pulse

Main unit provides up to 2 encoder interfaces. Counter provides 32-bit bi-directional count.

Three inputs I00 (A phase), I01 (B phase), I02 (Z marker pulse) along with common terminal C0 provide one encoder interface as HSC0.

Three inputs I03 (A phase), I04 (B phase), I05 (Z marker pulse) along with common terminals C0 and C1 provide one encoder interface as HSC3.

User can program Z input to reset counter current value on occurance.The figure below shows action of Reset and Z input on encoder count.

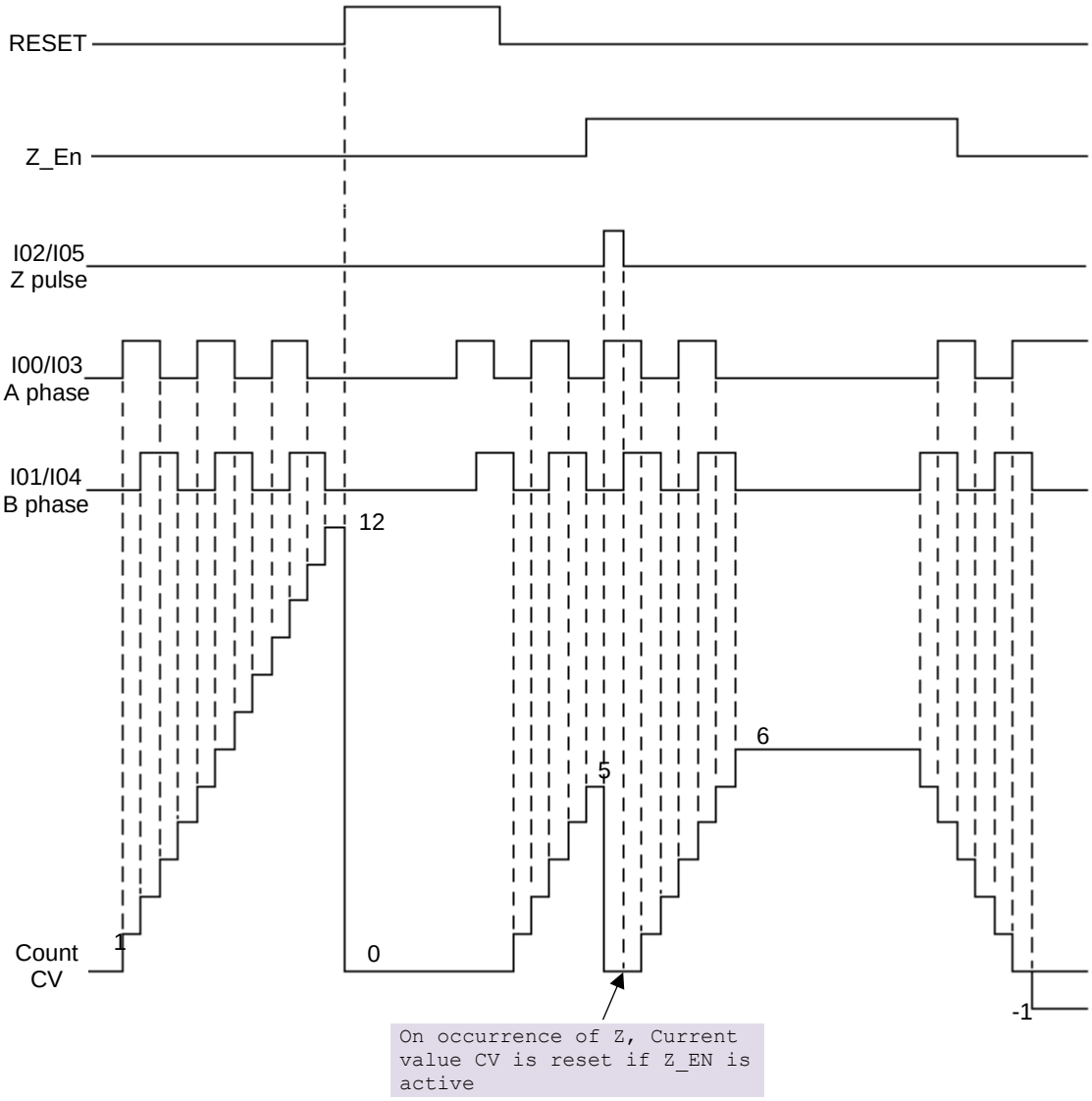


Figure 30: Functioning of ABZ encoder

If RUN is TRUE, counter starts counting. If RUN is FALSE, counter does not count and counter current value CV holds last value.

At rising edge (OFF to ON) as well as falling edge (ON to OFF) at A phase and at rising edge (OFF to ON) as well as falling edge (ON to OFF) at iB phase, count increments by1 if A phase is leading B phase.At rising edge (OFF to ON) as well as falling edge (ON to OFF) at A phase and at rising edge (OFF to ON) as well as falling edge (ON to OFF) at B phase,count decrements by 1 if A phase is lagging B phase.Counter current value is reset to 0 as long as Reset is TRUE.

If user enables Z action then counter current value gets reset to 0 on occurrence of Z pulse. It reMains 0 as long as Z marker pulse in ON.

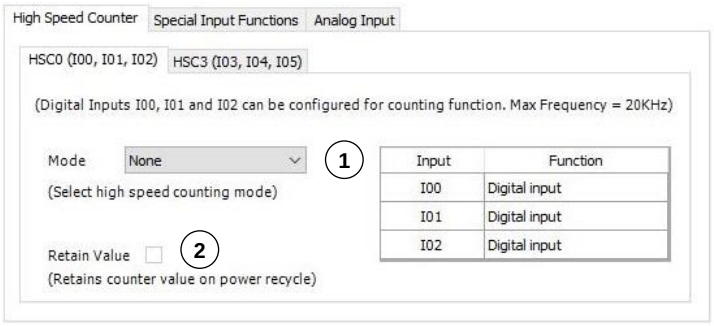
User can modify counter current value at any time and counter starts counting from modified value afterwards.

13.5 Configuration and Programming

This section provides information to understand configuration and programming of High speed counter functionality from Main unit.

13.5.1 Parameter Configuration

User can configure HSC0 and HSC3 as shown below.

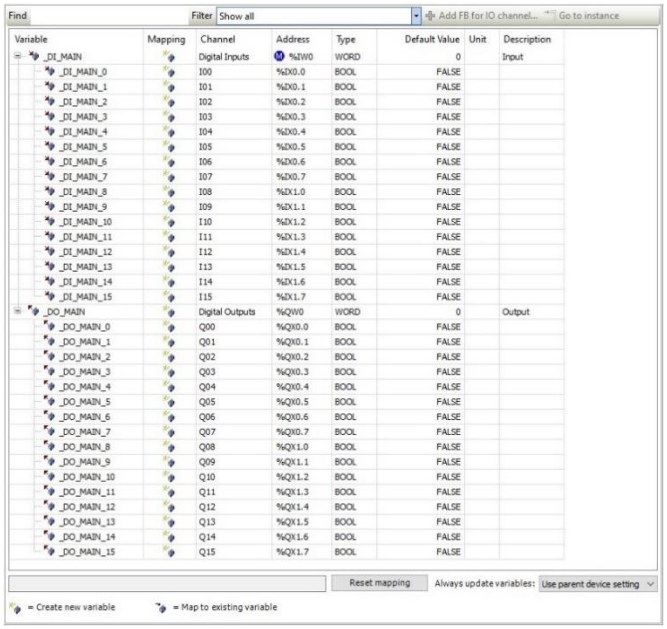


Sr. No.	Parameter	Options	Description		
High Speed Counter (I00, I01, I02)					
1	Mode	None (Default) Single phase counter Encoder without Z Encoder with Z	Select High Speed Counter modes from drop down. *As per mode selection, functions of individual input get changed* as shown in below table.		
			Mode	**Input**	**Function**
			None	I00	Digital input
				I01	Digital input
				I02	Digital input
			Single phase counter	I00	Pulse input for counter
				I01	Digital input
				I02	Digital input
			Encoder without Z	I00	Encoder phase A
				I01	Encoder phase B
				I02	Digital input
			Encoder with Z	I00	Encoder phase A
				I01	Encoder phase B
				I02	Encoder phase Z
2	Retain Value	--	This parameter holds counter current value after PLC power cycle.		

Similarly, user can configure HSC modes for inputs I03, I04 and I05 using tab '*HSC3 (I03, I04, I05)*'.

13.5.2 I/O Mapping

I/O Mapping dialogue shows digital Inputs and outputs as shown below.



As per mode selection, functions of individual input get changed as shown in below table.

HSC Mode	Input	Function
None	I00	Digital input
	I01	Digital input
	I02	Digital input
Single phase counter	I00	Pulse input for counter
	I01	Digital input
	I02	Digital input
Encoder without Z	I00	Encoder phase A
	I01	Encoder phase B
	I02	Digital input
Encoder with Z	I00	Encoder phase A
	I01	Encoder phase B
	I02	Encoder phase Z

13.5.3 IEC Objects

The table below provides IEC objects related to Main unit high speed counter inputs.

IEC Variables	Data Type	Description
Device.Application._HSC0		
_HSC0_En	BOOL	Enable counting for HSC0
_HSC0_Dir	BOOL	If True, counting direction for HSC0 is upward. If False, counting direction for HSC0 is downward.
_HSC0_Reset	BOOL	If True, resets HSC0 count
_HSC0_Load	BOOL	If True, loads Preset value (PV)to HSC0
_HSC0_PV	DINT	Holds preset value (PV)for HSC0
_HSC0_CV	DINT	Holds current value (CV)for HSC0
Device.Application._HSC3		
_HSC3_En	BOOL	Enable counting for HSC3
_HSC3_Dir	BOOL	If True, counting direction for HSC3 is upward. If False, counting direction for HSC3 is downward.
_HSC3_Reset	BOOL	If True, resets HSC3 count
_HSC3_Load	BOOL	If True, loads Preset value (PV)to HSC3
_HSC3_PV	DINT	Holds preset value (PV)for HSC3
_HSC3_CV	DINT	Holds current value (CV)for HSC3

Using tab “IEC Objects”, user can also monitor and set system variables in CoDeSys online mode.

14 Built-in Analog V/I Input

Main unit provides 2 channels analog V/I input with 12-bits resolution. It supports 0 to 10VDCand 0 to 20mA input ranges. Equivalent count is generated from 0 to 4000.

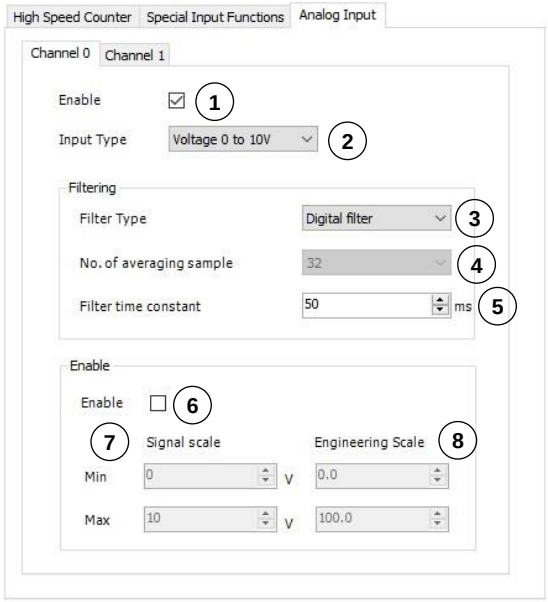
14.1 Analog Input Specifications

Item	Description	
Number of input channels	2, Non-isolated, 12 bits	
Input types and digital format	Voltage: 0 to 10VDC	Current: 0 to 20mA
	0 to 4000	0 to 4000
Resolution	2.5 mV	5 µA
Overall accuracy	± 0.4 at 25°C	± 1.5 at 25°C
	± 0.6 at 60°C	± 1.8 at 60°C
Input impedance	900 KΩ	260 Ω
Engineering scaling	Supported	
Absolute maximum input	± 30 VDC/ ± 30 mA	
Filter types	For **Digital filter**, Time constant: 50 ms (Default) Supported range: 10 to 5000 ms For **Averaging**, No. of averaging samples: 4(Default), 8, 16, 32	
Updation time	Refer section *Appendix → Updation Time for Analog Input*, in this manual	
Channel protection	PTC for over current up to 100 mA	
Isolation	No isolation.	
I/O terminal blocks [Removable, screw type]	One 5-pin	

14.2 Configuration and Programming

14.2.1 Parameter Configuration

User can configure Channel 0 and Channel 1 as shown below.



Sr. No.	Parameter	Options	Description
Filtering			
1	Enable	--	Check to enable the channel 0.
2	Input Type	Voltage 0 to 10V (Default) Current 0 to 20mA	Selection for type of input as per application requirement.
3	Filter Type	- No Filter - Digital Filter - Averaging	User can select filter type for input channel 0
4	No. of averaging sample	4, 8, 16, 32 (Default)	For filter type as 'Averaging', user can select number of averaging samples using drop-down as either,
5	Filter time constant	Default value: 50 (ms). Supported range: 10 to 5000 ms	For filter type as 'Digital Filter', user can set filter time constant in msec.
Enable [Engineering scaling]			
6	Enable	--	Check 'Enable' to apply engineering scaling to Channel 0.
7	Signal scale	For 0 to10V input type, Min: 0V and Max: 10V. For 0 to 20mA input type, Min: 0mA and Max: 20 mA	This parameter holds min-max values as per configured input type. *User cannot modify this parameter*
8	Engineering scale	Default values, Min: 0.0 and Max: 100.0 Supported range: -64000.0 to 64000.0 for both Min- Max settings	User can set min-max values of engineering scaling as per application requirement.

Similarly, user can configure analog input Channel 1, using 'Channel 1' tab.

14.2.2 I/O Mapping

Not applicable

14.2.3 IEC Objects

The table below provides IEC objects related to the analog inputs of Main unit.

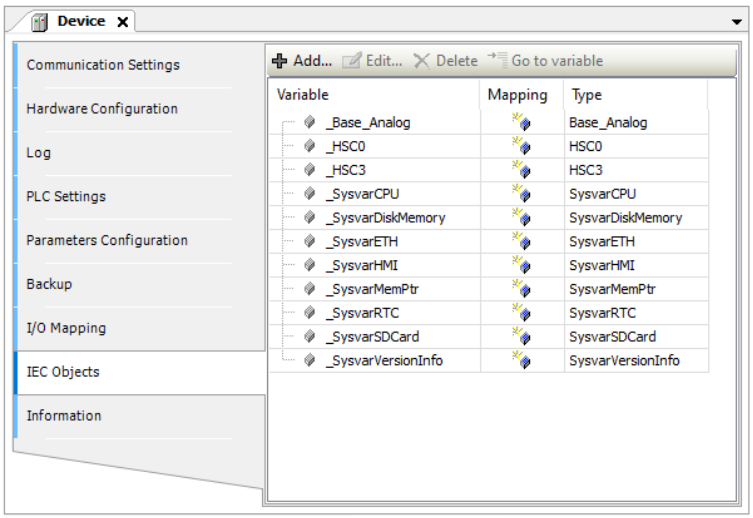
<table>
<tr><th>IEC Variables</th><th>Data Type</th><th colspan="2">Description</th></tr>
<tr><td colspan="4">Device.Application._Base_Analog</td></tr>
<tr><td>_AI_Data_00</td><td>REAL</td><td colspan="2">Holds analog input data for Channel 0</td></tr>
<tr><td>_AI_Data_01</td><td>REAL</td><td colspan="2">Holds analog input data for Channel 1</td></tr>
<tr><td rowspan="6">_AI_ChannelStatus</td><td rowspan="6">ARRAY [0..1]OF WORD</td><td colspan="2">Holds status of channels 0 and 1.
Each array element is assigned for individual channel e.g._AI_ChannelStatus[0] holds status of channel 0.
Details of bits of status word as follows</td></tr>
<tr><th>Bit No</th><th>Details</th></tr>
<tr><td>0</td><td>Channel enable status
0 - Disabled
1 - Enabled</td></tr>
<tr><td>1</td><td>Channel configuration
0 - Valid
1 - Invalid</td></tr>
<tr><td>2</td><td>Channel input data is out of range,
0: Data count valid
1: Data count invalid</td></tr>
<tr><td>3</td><td>Open circuit or short circuit detected,
0 - No open circuit
1 - Open circuit</td></tr>
<tr><td></td><td></td><td>4 - 15</td><td>Reserved</td></tr>
</table>

15 System Variables

The system variables are predefined IEC objects, which exchange the information between the CPU and the application program. Each system variable has a unique Name, which starts with '_Sysvar'. System variables are categorized depending on functionality.

User can monitor system variables in online mode in CoDeSys project at

Device(GC43)→IEC Objects



Below explained the significance of system variable structures based on functionality–

_SysvarCPU

- Provides CPU specific status and diagnostic information.

_SysvarDiskMemory

- Provides Q-flash memory size, application code size, source code size etc.

_SysvarETH

- Provides Ethernet port specific system variables.

_SysvarHMI

- Provides HMI function specific system variables.

_SysvarMemPtr

- Provides start address and size of different types of memory blocks in the controller.

_SysvarRTC

- Provides RTC data and status.

_SysvarSDCard

- Provides system variables specific to SD card configuration and status.

_SysvarVersionInfo

- Provides version of firmware and hardware of CPU.

_SysvarDataLog

- Provides system variables specific to Data logging configuration and status.

_SysvarAlarm

- Provides system variables specific to alarm configuration and status.

Individual system variable can be accessed using dot (.) operator e.g. `_SysvarVersionInfo.SRTSVERSION` which holds firmware version.

Most of the system variable information is displayed in the system menu on display.

The table below explains the significance of system variables category wise –

Name of System Variable	Data Type	Access	Description	
_SysvarCPU				
.WCOLDSTARTCOUNTER	WORD	Read Only	Holds number of cold start initialization occurrences. This variable is persistent.	
.WWARMSTARTCOUNTER	WORD	Read Only	Holds number of warm start initialization occurrences. This variable is persistent.	
.SYSTEMBITS	WORD	Read only	These are special bits useful for the application program. Bit number and details are provided as below.	
			Bit	**Details**
			0	Bit remains ON always.
			1	Bit is on for the first scan cycle. This bit can be used to call an initialization subroutine.
			2	Bit is ON in case of warm start initialization. It becomes ON in first scan only.
			3	Bit is ON in case of cold start initialization. It becomes ON in first scan only.
			4	Reserved
			5	Reserved
			6	Bit provides a clock pulse with ON OFF duration of 500 ms, when PLC is in RUN mode.
			7	Bit provides a clock pulse with ON OFF duration of 30 sec, when PLC is in RUN mode.
			8	Bit provides scan cycle clock.
			9 - 15	Reserved

System variables…

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th colspan="3">Description</th></tr>
<tr><td colspan="6">_SysvarCPU</td></tr>
<tr><td rowspan="11">.WSTATUS</td><td rowspan="11">WORD</td><td rowspan="11">Read only</td><td colspan="3">Holds system status and the significance of individual bit is as explained below.</td></tr>
<tr><td>Bit</td><td>Status</td><td>Significance</td></tr>
<tr><td rowspan="2">0</td><td>TRUE</td><td>CPU in RUN mode</td></tr>
<tr><td>FALSE</td><td>CPU in STOP mode</td></tr>
<tr><td>1</td><td>--</td><td>Reserved</td></tr>
<tr><td>2</td><td>--</td><td>Reserved</td></tr>
<tr><td rowspan="2">3</td><td>TRUE</td><td>This bit becomes TRUE, if I/O error occurs in following cases,
- If configured I/O extension unit is absent or removed after registration at power ON.
- If configured I/O extension unit is inserted after power ON.
- Hardware fault of extension unit
- Configured I/O extension and present I/O extension unit is mismatched.
- If non-configured or unsupported I/O extension unit is present in slot.</td></tr>
<tr><td>FALSE</td><td>This bit remains FALSE, if no I/O error observed in case,
- When no I/O extension is configured in slots.
- When I/O extension is configured and present at power ON</td></tr>
<tr><td rowspan="2">4</td><td>TRUE</td><td>RTC Error: Cause of RTC error is the loss of RTC back-up.
User should ensure super capacitor back-up to RTC circuit and set RTC again.</td></tr>
<tr><td>FALSE</td><td>RTC value is valid as RTC back-up is healthy</td></tr>
<tr><td rowspan="2">5</td><td>TRUE</td><td>Touch error is detected at PLC power ON.</td></tr>
<tr><td>FALSE</td><td>No touch error is detected at PLC power ON.</td></tr>
</table>

System variables…

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th colspan="4">Description</th></tr>
<tr><td colspan="7">_SysvarCPU</td></tr>
<tr><td>.WSTATUS</td><td>WORD</td><td>Read only</td><td>6</td><td>TRUE</td><td colspan="2">One or more illuminated keys (K1 to K4) found pressed at power ON.
It may indicate fault in illuminated key hardware section.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>FALSE</td><td colspan="2">No illuminated key/s found pressed at power ON.</td></tr>
<tr><td></td><td></td><td></td><td>7</td><td>TRUE</td><td colspan="2">One or more function keys (F1 to F4) found pressed at power ON.
It may indicate fault in illuminated key hardware section.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>FALSE</td><td colspan="2">No function key/s found pressed at power ON.</td></tr>
<tr><td></td><td></td><td></td><td>8 - 15</td><td>--</td><td colspan="2">Reserved</td></tr>
<tr><td>.BCPUSTOPCAUSE</td><td>BYTE</td><td>Read only</td><td colspan="4">Indicates the reason for CPU to go in STOP mode. It is cleared when CPU goes to 'RUN' mode.</td></tr>
<tr><td></td><td></td><td></td><td>Bit</td><td>Significance</td><td>Details</td><td>Corrective Action</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>CPU RUN</td><td>PLC in RUN mode</td><td>--</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>Scan Error</td><td>Scan time of POU PLC_PRG exceeds Watchdog time set for Main_Task.</td><td>Find out cause of scan error (e.g. infinite loop) in application program and download a valid and</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>User Stop</td><td>User initiated STOP mode command through programming software CoDeSys menu Debug.
It is also indicated by RUN LED indication.
Refer section LED Indications for more details.</td><td>User should put CPU in RUN mode through programming software</td></tr>
<tr><td></td><td></td><td></td><td>3</td><td>Memory Error</td><td>Invalid application program.
It is also indicated by RUN LED indication.</td><td>Download a valid application program.</td></tr>
<tr><td></td><td></td><td></td><td>4</td><td>PFNMI Error</td><td>Low input power (< 18 VDC) to the controller Main unit.
It is also indicated by RUN LED indication.
In this case, controller doesn’t communicate with programming software CoDeSys</td><td>Switch off the controller power and restore it again such that input power is > 18 VDC.</td></tr>
</table>

System variables…

Name of System Variable	Data Type	Access	Description
_SysvarCPU			
.BINITSTATUS	BYTE	Read only	Holds the status of CPU initialization. This byte is updated whenever related action is executed.
			Hot Initialization _SysvarCPU.BINITSTATUS holds 1, if system detects a power break for 20 to 200 ms. In this case controller functioning is normal as if there is no power disturbance.
			Warm Initialization _SysvarCPU.BINITSTATUS holds 2 on healthy power ON, if system detects a power break for more than 200 ms. It results resetting of data, which is not retained. CoDeSys menu command Online → Reset warm causes warm initialization
			Cold Initialization/ application download _SysvarCPU.BINITSTATUS holds 3, - If system detects any change in the application program. If a new application program is download is in progress or cold start is observed. - Retentive data is destroyed because of hardware fault. - CoDeSys menu command Online →Reset cold is executed.
.ATASKNAME	ARRAY [0..4] OF STRING(15)	Read Only	This variable holds task configuration available in CoDeSys application such as “MainTask”, “VISU_TASK” etc.
.WCURSCANTIME	ARRAY [0..4] OF WORD	Read Only	Holds scan time of last scan (in ms) of POU PLC_PRG attached to Main_Task. The value is updated at the end of each scan. If current scan exceeds Watchdog time set, CPU is put in STOP mode by declaring ‘scan error’.
.WMINSCANTIME		Read Only	Holds minimum scan time (in ms) in all previous PLC scans after power ON or warm or cold initialization. The value is updated at the end of each scan.
.WMAXSCANTIME		Read Only	Holds maximum scan time (in ms) in all previous PLC scans after power ON or warm or cold initialization with 1ms resolution.

System variables…

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th colspan="2">Description</th></tr>
<tr><td colspan="5">_SysvarCPU</td></tr>
<tr><td>.W_REG_STATUS</td><td>WORD</td><td>Read only</td><td colspan="2">Holds extension unit registration status as per the slots. The table below explains significance of bit depending upon hardware units and slot numbers.</td></tr>
<tr><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10"></td><td>Bit</td><td>Details</td></tr>
<tr><td>0</td><td>Bit becomes TRUE, if CPU detects presence of Main unit</td></tr>
<tr><td rowspan="2">1</td><td>Bit becomes TRUE, if CPU detects configured and fixed COM extension unit is identical.</td></tr>
<tr><td>Bit remains FALSE, in case if CPU detects,
- Configured and fixed COM extension unit is mismatched.
- Presence of unsupported COM extension unit.
- COM extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed COM extension unit.
- COM extension unit is configured but absent at power ON.</td></tr>
<tr><td>2, 3,4</td><td>Reserved</td></tr>
<tr><td rowspan="2">5</td><td>Bit becomes TRUE, if CPU detects configured and fixed IOE1 extension unit is identical.</td></tr>
<tr><td>Bit remains FALSE, in case if CPU detects,
- Configured and fixed IOE1 extension unit is mismatched.
- Presence of unsupported IOE1 extension unit.
- IOE1 extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed IOE1 extension unit.
- IOE1 extension unit is configured but absent at power ON.</td></tr>
<tr><td rowspan="2">6</td><td>Bit becomes TRUE, if CPU detects configured and fixed IOE2 extension unit is identical.</td></tr>
<tr><td>Bit remains FALSE, in case if CPU detects,
- Configured and fixed IOE2 extension unit is mismatched.
- Presence of unsupported IOE2 extension unit.
- IOE2 extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed IOE2 extension unit.
- IOE2 extension unit is configured but absent at power ON.</td></tr>
<tr><td>7 to 15</td><td>Reserved</td></tr>
</table>

System variables…

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th colspan="2">Description</th></tr>
<tr><td colspan="5">_SysvarCPU</td></tr>
<tr><td>.W_IOERR</td><td>WORD</td><td>Read only</td><td colspan="2">Holds hardware units error status as per the slots. Probable cause for this error is
- Configured extension unit is absent or removed after registration at power ON.
- Hardware fault of extension unit is detected.
- Configured and fixed extension unit is mismatched.
It takes 3 sec time duration to detect such error. Once IO error is declared it will not be cleared even if hardware is restored. I/O error is declared only for the hardware unit which is registered during controller power ON.
IO Error is also indicated by RUN LED indication.</td></tr>
<tr><td rowspan="9"></td><td rowspan="9"></td><td rowspan="9"></td><td>Bit</td><td>Details</td></tr>
<tr><td>0</td><td>Reserved</td></tr>
<tr><td rowspan="2">1</td><td>Bit becomes TRUE, if CPU detects IO error for COM extension slot such as,
- Configured and fixed COM extension unit is mismatched.
- Presence of unsupported COM extension unit.
- COM extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed COM extension unit.
- COM extension unit is configured but absent at power ON.</td></tr>
<tr><td>Bit remains FALSE, if configured and fixed COM extension unit is identical.</td></tr>
<tr><td>2, 3,4</td><td>Reserved</td></tr>
<tr><td rowspan="2">5</td><td>Bit becomes TRUE, if CPU detects IO error for IO extension slot IOE1 such as,
- Configured and fixed IOE1 extension unit is mismatched.
- Presence of unsupported IOE1 extension unit.
- IOE1 extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed IOE1 extension unit.
- IOE1 extension unit is configured but absent at power ON.</td></tr>
<tr><td>Bit remains FALSE, if configured and fixed IOE1 extension unit is identical.</td></tr>
<tr><td rowspan="2">6</td><td>Bit becomes TRUE, if CPU detects IO error for IO extension slot IOE1 such as,
- Configured and fixed IOE2 extension unit is mismatched.
- Presence of unsupported IOE2 extension unit.
- IOE2 extension unit is present at power ON but not configured in application.
- Hot plugin, hot plug out of Configured and fixed IOE2 extension unit.
- IOE2 extension unit is configured but absent at power ON.</td></tr>
<tr><td>Bit remains FALSE, if configured and fixed IOE2 extension unit is identical.</td></tr>
<tr><td>7 to 15</td><td>Reserved</td></tr>
</table>

System variables…

Name of System Variable	Data Type	Access	Description
_SysvarCPU			
.AMODULEORDERINGCODE	ARRAY [0..15] OF STRING	Read Only	This array holds ordering code of hardware units detected. _SysvarCPU.AMODULEORDERINGCODE[0]:Ordering code of Main unit _SysvarCPU.AMODULEORDERINGCODE[1]:Ordering code of COM Extension unit fixed in COM slot _SysvarCPU.AMODULEORDERINGCODE[2]:Reserved _SysvarCPU.AMODULEORDERINGCODE[3]:Reserved _SysvarCPU.AMODULEORDERINGCODE[4]:Reserved _SysvarCPU.AMODULEORDERINGCODE[5]:Ordering code of IO Extension unit fixed in IOE1 slot _SysvarCPU.AMODULEORDERINGCODE[6]:Ordering code of IO Extension unit fixed in IOE2 slot _SysvarCPU.AMODULEORDERINGCODE[7]to _AMODULEORDERINGCODE[15]: Reserved
_SysvarDiskMemory			
.DWTOTALSIZEKB	DWORD	Read only	This variable holds Q-Flash total memory size of connected device
.DWFREESIZEKB		Read only	This variable holds Q-Flash free memory size of connected device
.DWAPPSIZEKB		Read only	This variable holds application code size in Kbytes.
.DWAPPOBJECTDATASIZEKB		Read only	This variable holds object data files size in Kbytes.
.DWSOURCECODESIZEKB		Read only	This variable holds source code size in Kbytes.
_SysvarETH			
.IPADR	ARRAY [0..3] OF BYTE	Read write	This variable is used to set octets of IP address for connected device. Default IP address : 192.168.015.001
.SUBNETMASK		Read write	This variable is used to set subnet mask for connected device. Default Subnet mask : 255.255.255.000
.GATEWAYADR		Read write	This variable is used to set gateway address for connected device. Default Gateway Address : 192.168.015.253
.MACID		Read write	This variable is used to monitor and set MAC ID of connected device.

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th>Description</th></tr>
<tr><td colspan="4">_SysvarHMI</td></tr>
<tr><td>.BACKLITTIMEOUT</td><td>BYTE</td><td>Read write</td><td>Defines LCD backlit timeout in minutes. Default value is 5 minutes
User can change value either between 1 to 99 or 0. If timeout set is 0, LCD backlit is on permanently.</td></tr>
<tr><td>.LCDBRIGHTNESS</td><td>BYTE</td><td>Read write</td><td>Display brightness can be set from 0 to 100%.
Default setting is 50 %. i.e. minimum brightness.</td></tr>
<tr><td>.BUZZERVOLUME</td><td>BYTE</td><td>Read write</td><td>This variable is used for setting buzzer volume 0:Short (Default), 1:Long, 2:OFF</td></tr>
<tr><td>.BUZZERPITCH</td><td>BYTE</td><td>Read write</td><td>This variable is used for setting buzzer pitch value from 1 to 5.
Default setting is 4.</td></tr>
<tr><td>.BUZZERONOPTION</td><td>BYTE</td><td>Read write</td><td>This variable sets buzzer ON options as
0: Only touch – Buzzer sound will be ON only for touch press. Keys press will not make buzzer ON.
1: Only keys – Buzzer sound will be ON only for key press. Touch press will not make buzzer ON.
2 (Default) : Touch & key– Buzzer sound will be ON for touch input as well as key press..</td></tr>
<tr><td>.WKEYSSIMULATED</td><td>WORD</td><td>Read write</td><td>This variable is used to simulate the function keys and illuminated keys through application program. User can modify status of key to ON/OFF through application program without actually pressing it.
Refer SysvarHMI.WKEYSTATUS description for bit to HMI key relation.</td></tr>
<tr><td>.WIKEYLEDGREEN</td><td>WORD</td><td>Read only</td><td>Variable holds status of green LEDs provided in illuminated keys. Respective bit is TRUE when green LED glows and it becomes OFF when LED is off.
<table>
<tr><th>Bit</th><th>Green LED</th></tr>
<tr><td>0</td><td>K1</td></tr>
<tr><td>1</td><td>K2</td></tr>
<tr><td>2</td><td>K3</td></tr>
<tr><td>3</td><td>K4</td></tr>
<tr><td>4 to 15</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>.WIKEYLEDRED</td><td>WORD</td><td>Read only</td><td>Variable holds status of red LEDs provided in illuminated keys. Respective bit is TRUE when red LED glows and it becomes OFF when LED is off.
<table>
<tr><th>Bit</th><th>Red LED</th></tr>
<tr><td>0</td><td>K1</td></tr>
<tr><td>1</td><td>K2</td></tr>
<tr><td>2</td><td>K3</td></tr>
<tr><td>3</td><td>K4</td></tr>
<tr><td>4 to 15</td><td>Reserved</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Name of System Variable</th><th>Data Type</th><th>Access</th><th>Description</th></tr>
<tr><td colspan="4">_SysvarHMI</td></tr>
<tr><td>.WKEYSTATUS</td><td>WORD</td><td>Read only</td><td>This variable holds status of function keys. Bit becomes TRUE is respective key is pressed. It becomes FALSE if key is not pressed or key is released. Function key status is updated in every input scan.
<table>
<tr><th>Bit</th><th>Function Key</th></tr>
<tr><td>0</td><td>F1</td></tr>
<tr><td>1</td><td>F2</td></tr>
<tr><td>2</td><td>F3</td></tr>
<tr><td>3</td><td>F4</td></tr>
<tr><td>4 to 15</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>.WCALIBRATEDTOUCHX</td><td>WORD</td><td>Read only</td><td>This variable holds X co-ordinates of calibrated touch</td></tr>
<tr><td>.WCALIBRATEDTOUCHY</td><td>WORD</td><td>Read only</td><td>This variable holds Y co-ordinates of calibrated touch</td></tr>
<tr><td>.WIKEYSTATUS</td><td>WORD</td><td>Read only</td><td>This variable holds status of illuminated keys. Bit becomes TRUE is respective illuminated key is pressed. It becomes FALSE if key is not pressed or key is released. Illuminated key status is updated in every input scan.
<table>
<tr><th>Bit</th><th>Illuminated Key</th></tr>
<tr><td>0</td><td>K1</td></tr>
<tr><td>1</td><td>K2</td></tr>
<tr><td>2</td><td>K3</td></tr>
<tr><td>3</td><td>K4</td></tr>
<tr><td>4 to 15</td><td>Reserved</td></tr>
</table></td></tr>
</table>

NOTE

GOC43 front panel provided 4 keys with dual LEDs (Green and Red) behind it. When both LEDs glow, key is illuminated with yellow coloured light.

System variables…

Name of System Variable	Data Type	Access	Description
_SysvarMemPtr			
.ASEGMENTPTR	ARRAY [0..5] OF DWORD	Read only	Holds start address of various memory blocks – _SysvarMemPtr.ASEGMENTPTR[0]: Start address of input memory _SysvarMemPtr.ASEGMENTPTR[1]: Start address of output memory _SysvarMemPtr.ASEGMENTPTR[2]: Start address of marker memory _SysvarMemPtr.ASEGMENTPTR[3]: Start address of data memory _SysvarMemPtr.ASEGMENTPTR[4]: Reserved _SysvarMemPtr.ASEGMENTPTR[5]: Start address of LCD data buffer
.ASEGMENTLEN	ARRAY [0..5] OF WORD	Read only	Holds size of memory blocks – _SysvarMemPtr.ASEGMENTLEN[0]: Size of input memory _SysvarMemPtr.ASEGMENTLEN[1]: Size of output memory _SysvarMemPtr.ASEGMENTLEN[2]: Size of marker memory _SysvarMemPtr.ASEGMENTLEN[3]: Size of data memory _SysvarMemPtr.ASEGMENTLEN[4]: Reserved _SysvarMemPtr.ASEGMENTLEN[5]: Size of LCD data buffer
.ADRRXPORT1	DWORD	Read only	This variable holds start address of receive buffer of COM slot.
.ADRTXPORT1	DWORD	Read only	This variable holds start address of transmit buffer of COM slot.
_SysvarRTC			
.BRTCINVALID	BYTE	Read only	RTC is backed up by super capacitor and back up time is 2 weeks nominal. This bit is TRUE if RTC is corrupted due to loss of back up due to any reason. RTC is then initialized to date of January 1, 1970 and time of 00H:00M:00S:00MS. In such case user has to ensure that super capacitor back up is restored and set proper value of RTC again. If user wants to use RTC data in application, programmer should consider this bit to check validity of RTC and inform user to take necessary action.
.BREADSECS	BYTE	Read only	Holds current “Seconds” value of RTC
.BREADMINS	BYTE	Read only	Holds current “Minutes” value of RTC
.BREADHRS	BYTE	Read only	Holds current “Hours” value of RTC
.BREADDATE	BYTE	Read only	Holds current “Date” value of RTC
.BREADMONTH	BYTE	Read only	Holds current “Month” value of RTC
.BREADYEARL	BYTE	Read only	Holds current “Year” value (lower byte)
.BREADYEARH	BYTE	Read only	Holds current “Year” value (higher byte)

System variables…

Name of System Variable	Data Type	Access	Description
_SysvarSDCard			
.BUNMOUNT	BOOL	Read only	On rising edge of this variable SD card gets unmount from tool.
.BCARDREADY	BOOL	Read only	This bit provides card healthy status.
.BCARDFULL	BOOL	Read only	This bit becomes TRUE if SD card memory is 90% full.
.BCARDSTATUS	BYTE	Read only	Holds bitwise SD card status information.
			Bit / **Details**
			0 — SD card detected. This bit is TRUE, when microSD card is detected.
			1 — Card mount / unmount status This bit becomes TRUE, when microSD card is mounted successfully. This bit becomes FALSE, when microSD card is removed without unmount.
			2 — **Invalid format** This bit becomes TRUE, when format of microSD card is unknown. (other than FAT32 file system). This bit remains FALSE, inserted microSD card is formatted with FAT32 file system.
			3 to 6 — Not supported
			7 — **SD card is 80% full** This bit is TRUE, when microSD card memory is 80% full. This bit can be used in application program to generate prior intimation for operator before card is 100% full.
.WSIZE	WORD	Read only	Holds microSD card memory size in Mbytes. For e.g. for 4GB card, it displays 4096.
.BFREESIZE	BYTE	Read only	Holds percentages (%) of free memory on microSD card.
_SysvarVersionInfo			
.SRTSVERSION	STRING	Read only	String holds CPU firmware version.
.SHWVERSION	STRING	Read only	String holds CPU hardware version.

System variables…

<table>
<tr><th>Name of System Variables</th><th>Data Type</th><th>Access</th><th>Description</th></tr>
<tr><td colspan="4">_SysvarDatalogging.Setting1/_SysvarDatalogging.Setting2</td></tr>
<tr><td>.bLogStatus</td><td>BYTE</td><td>Read only</td><td>Byte variable displays status of data logging as
<table>
<tr><th>Value</th><th>Details</th></tr>
<tr><td>0</td><td>Data logging not configured by user.</td></tr>
<tr><td>1</td><td>SD card not detected/SD card not formatted.</td></tr>
<tr><td>2</td><td>Invalid data logging configuration found. Data logging will not start in this case.</td></tr>
<tr><td>3</td><td>SD card full.</td></tr>
<tr><td>4</td><td>File operation error.</td></tr>
<tr><td>5</td><td>Maximum file count reached. Logging stopped.</td></tr>
<tr><td>6</td><td>Logging buffer full. Logging data will be lost.</td></tr>
<tr><td>7</td><td>Folder structure required for data logging not found on SD card</td></tr>
<tr><td>100</td><td>Logging is in progress without any error.</td></tr>
</table></td></tr>
<tr><td>.bEnableLogging</td><td>BOOL</td><td>Read write</td><td>This BOOL variable allows enabling of data logging from application program.
User must set this to TRUE to enable data logging.</td></tr>
<tr><td>.bLogTrigger</td><td>BOOL</td><td>Read write</td><td>This BOOL variable accepts logging trigger from application program.
On the rising edge of this variable, data record is logged in SD card. Logging trigger is accepted only if ‘Condition Trigger Sampling’ is enabled.</td></tr>
<tr><td>.bCreateNewFile</td><td>BOOL</td><td>Read write</td><td>This BOOL variable accepts file switching trigger from application program.
If file switching from application is enabled from configuration, then on rising edge of this variable, new log file is created in SD card. Name of new file depends on file name format selected by user. Refer section Data Logging – Configuration for file name format details.</td></tr>
<tr><td>.wLogFileNumber</td><td>WORD</td><td>Read write</td><td>This word variable accepts file numbering from 1 to 1000. File numbers are increased by 1 every time when new file is created. File numbers are mentioned in logged file name. Refer section Data Logging – Configuration for file name format details.</td></tr>
<tr><td>.wLogRecNo</td><td>WORD</td><td>Read only</td><td>This word variable holds the count of number of records written in current file.</td></tr>
</table>

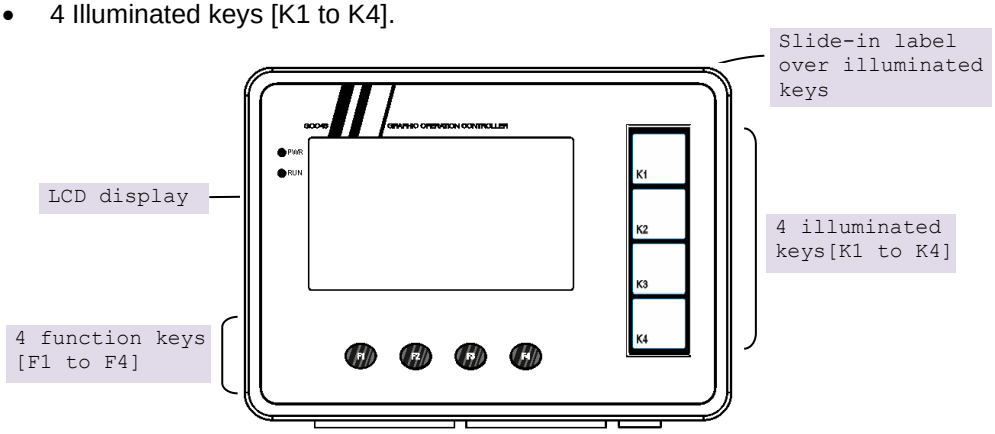
System variables…

Name of System Variable	Data type	Access	Description	
_SysvarAlarm				
.Trigger	LWORD	Read write	This LWORD variable is used to activate or deactivate configured alarms. 0^{th} bit of this LWORD represents Alarm no. 0 63^{rd} bit of this LWORD represents Alarm no. 63 Alarms are activated or deactivated if respective bit of this LWORD variable is made true or false.	
.AlmBannerDispPriority	BOOL	Read write	TRUE	High priority alarms are displayed on alarm banner. Alarm No. 0 has highest priority whereas Alarm No. 63 has lowest priority.
			FALSE	Alarms are displayed on alarm banner as per the occurrence.
.AlmActive	BOOL	Read only	TRUE	If any of the 64 alarms is/are in Active state.
			FALSE	If all the alarms are either in WaitAck state or in Normal state.
.AlmActiveAck	BOOL	Read only	TRUE	If any of the 64 alarms is/are in Active or WaitAck state.
			FALSE	If all the alarms are in Normal state.

16 HMI Function

GOC43 provides built-in HMI functionality. Front panel consists of 3 components.

- 4.3" 480 x 272 pixels, TFT, 64K color, Touch graphics LCD
- 4 Function keys [F1 to F4].
- 4 Illuminated keys [K1 to K4].



GOC43 offers enhanced HMI features.

There are 4 Function keys as F1 to F4 provided at bottom side of display. Function key provides default system functionality and user can provide functionality such as momentary, toggle, etc. by developing suitable application program.

There are 4 Illuminated keys (K1 to K4) provided at the right side of display. Each illuminated key consists of a key with dual color (red, green) LEDs. Dual color LEDs offer tri-color effect with colors as red, green, and yellow (red + green). Keys can be configured for operation like momentary, toggle, etc. by developing suitable application program. LEDs can be switched on/off through application program.

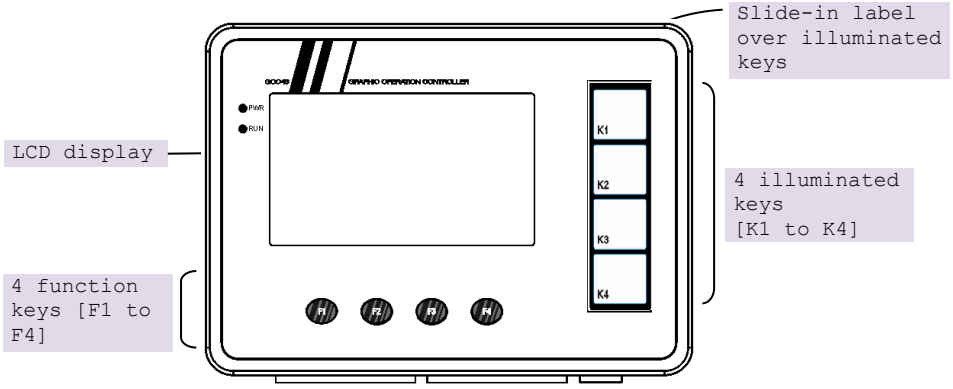
Slide-in label is inserted over illuminated keys. Unit is dispatched with default label with key nomenclature as K1 to K4. Label can be designed and printed by customers especially OEMs. Label combined with illuminated keys helps in customizing controller to suit application.

16.1 Highlighting Features

HMI Function	
Built-in LCD	▪ 4.3" Touch graphics LCD, 480 x 272 pixels, 64K color, View size: 95.04 x 53.86 mm ▪ 4 function keys (F1 to F4) ▪ 4 illuminated keys (K1 to K4) with dual color (Green, Red) LEDs
User Defined LCD Screens	▪ 5 fonts (Default, Headline, Large Headline, Title, Annotation). Standard Windows® fonts supported. ▪ Monitor/ modify PLC data with all supported data types and formats. ▪ Alpha-numeric data entry by Embedded keypad, Numpad or Extended Numpad ▪ Direct access of PLC variable with symbolic name.
Visualization Elements	▪ **Basic**: Rectangle, Round rectangle, Ellipse, Line, Polygon, Polyline, Pie, Image, Frame. ▪ **Common controls**: Label, Combo box integer, Combo box array, Tab control, Button, Group box, Table, Text field, Scrollbar, Slider, Spin Control, Invisible input, Progress bar, Checkbox, Radio button ▪ **Measurement controls**: Bar display, Meter 90°, Meter 180°, Meter, Potentiometer, Histogram. ▪ **Special controls**: Waiting symbol flower, Cartesian XY Chart ▪ **Date/time controls**: Analog clock, Date picker ▪ **Lamps/switches/bitmaps**: Image switcher, Lamps and switches ▪ **Symbols:** Arrows, Symbols, Icons
Function Keys	▪ 4 keys F1 to F4 ▪ Quick access to IO status monitor (F1 key) and system menu (F2 key)
Illuminated Keys	▪ 4 Illuminated keys i.e. keys with dual color bright LEDs ▪ LED control Red/Green/Yellow
Built-in Status and Diagnostics	▪ Monitor all IOs on one display screen. ▪ System Menu for - Monitoring system status - System diagnostics: CPU, IO and Ethernet - System settings: RTC, IP settings, display, buzzer - Touch calibration and check - Keys and LEDs check

16.2 Keys and LEDs

GOC43 provides 4 function keys (**F1** to **F4**) located at bottom side of display and 4 illuminated keys (**K1** to **K4**). located on right side of display as shown below.



Out of 8 keys, two function keys F1 and F2 has default system functionality assigned to them as explained in section *System action with keys*, remaining keys can be used for other application specific functionality.

There are two methods, you can configure function keys and illuminated keys for application specific requirements.

- **As digital IOs**
  Use keys as digital inputs and LEDs as digital outputs in application program.
  Refer section *Using Keys and LEDs as Digital IOs*.
- **As Hotkeys**
  Configure key functionality in synchronization with HMI program. With this method you can configure functions like change screen, user login, toggle bit etc.
  Refer section *Configuring Keys as Hotkeys.*

Mix of both methods can be used simultaneously while configuring user functionality. But it is strongly recommended to use only one method per Key to configure the user function.

16.2.1 System Action with Keys

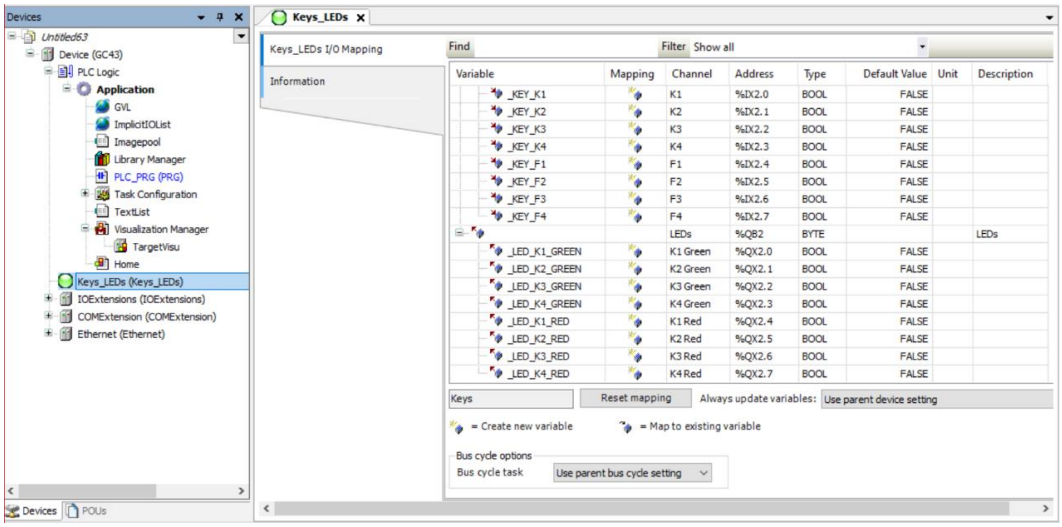
By default, function keys F1 and F2 are assigned with system functions as mentioned below

Function key	Description
F1	Long press to switch to IO Monitor screen on display.
F2	Long press to switch to system menu screen on display Refer section *System Menu* for more details.

System actions of keys F1 and F2 should be taken care while using keys for user actions.

16.2.2 Using Keys and LEDs as Digital IOs

Status of function keys and illuminated keys is available in input image at address %IB2. In programming software CoDeSys V3.5, click on Devices (GC43) → Keys_LEDs→tab I/O Mapping to view status of all the keys as shown below.



The table below provides address mapping for keys.

Address	Function key	Description
%IX2.0	K1	0 – LED off.
%IX2.1	K2	1 – LED on
%IX2.2	K3	
%IX2.3	K4	
%IX2.4	F1	
%IX2.5	F2	
%IX2.6	F3	
%IX2.7	F4	

In every input scan, key status is read and updated to input image.

Similarly, LEDs in illuminated keys are mapped to output address %QB2 as below.

Address	LED	Description
%QX2.0	K1 GREEN LED	0 – LED off.
%QX2.1	K2 GREEN LED	1 – LED on
%QX2.2	K3 GREEN LED	
%QX2.3	K4 GREEN LED	
%QX2.4-	K1 RED LED	
%QX2.5	K2 RED LED	
%QX2.6	K3 RED LED	
%QX2.7-	K4 RED LED	

In every output scan, LED illuminated is turned on/off according to output image %QB2. User should write application program to change tatus of output image as per requirement.

NOTE

Status of function keys (F1 to K4) is also updated in system variable '_SysvarHMI.WKEYSTATUS' and status of illuminated keys is updated in system variable '_SysvarHMI.WIKEYSTATUS'.

Similarly, Status of LEDs in illuminated keys (K1 to K4) is updated in system variables '_SysvarHMI.WIKEYLEDGREEN' and '_SysvarHMI.WIKEYLEDGRE'.

A key / LED is assigned to a specific bit in these variables.

Refer section *System Variables* for more details.

16.2.3 Configuring Keys as Hotkeys

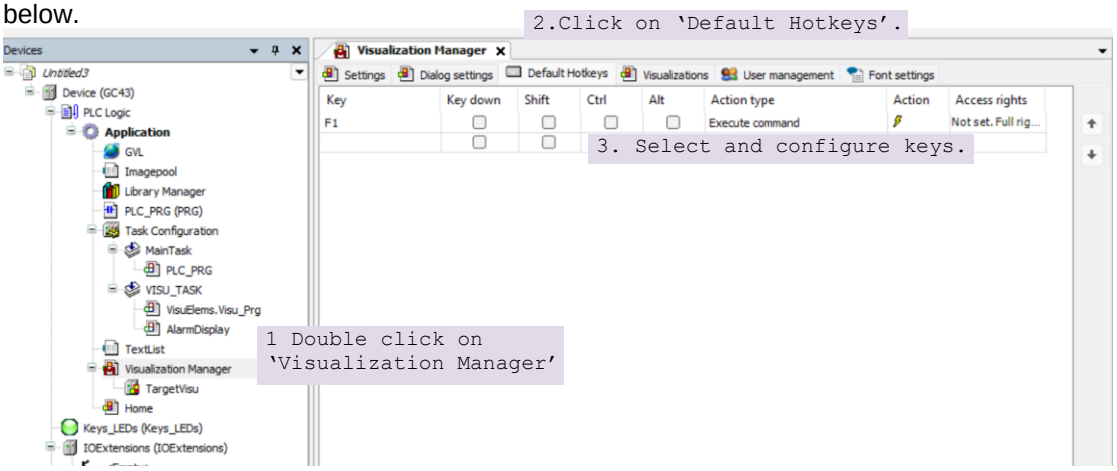
You can configure keys in Visualization Manager and assign specific actions to them. During normal operation, a visualization detects the key input event and executes the action. This method of configuration of keys is termed as 'Hotkey configuration'. There are different locations where you can configure hotkeys.

The options include the following:

- Configure key input that is valid for all visualizations.
  Refer section 'Accessing default hotkeys configuration' for more information.
- Configure key input for a specific visualization.
  Refer section 'Accessing visualization specific hotkeys configuration'

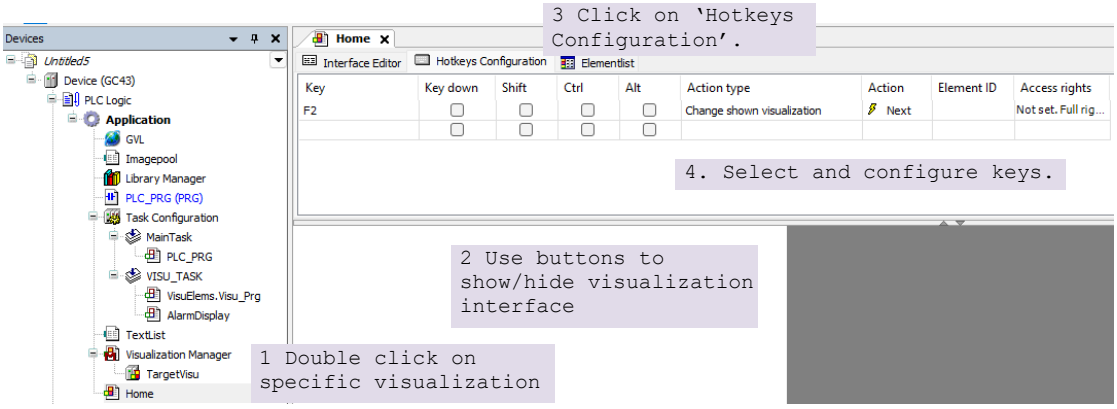
Accessing default hotkeys configuration

Default hotkeys configuration is available under 'Visualization manager' as shown below.



Accessing visualization specific hotkeys configuration

Visualization specific hotkey configuration is available under specific visualization e.g. ‘Home” as shown below.



Following actions can be configured for a key.

Action	Description	Supported for GOC43
Change shown visualization	Change visualization that is displayed on screen.	Yes
Change the language	Change visualization language.	No
Close dialogue	Close dialogue.	Yes
Execute command	Execute command like Read recipe, Write recipe, etc.	Yes
Execute ST-code	Execute PLC code written in ST language.	Yes
File transfer	Transfer file from PLC to visualization	No
Open dialogue	Open the dialogue	Yes
Toggle variable	Toggle boolean variable.	Yes
User management	Execute user management actions like Login, Logout etc.	Yes[*1]
Write a variable	Set value of variable	Yes[*2]

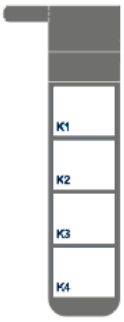
[*1] – Only supported as ‘Default Hotkey’. Not available in visualization specific hotkey configuration.

[*2] – Only supported as visualization specific hotkey configuration. Not available in ‘Default Hotkey’.

Refer CoDeSys help for more details on configuration of each input action.

16.2.4 Slide-in Label

Main unit is dispatched with default slide-in label with key nomenclature as K1 to K4. Label can be designed and printed by customers especially OEMs as per the design template provided by Mitsubishi Electric India. Label combined with illuminated keys helps in customizing controller to suit application. It can be used as push buttons and lamps and alarm annunciation.



Slide-in label with default printing.

Slide-in label can be inserted from backside of controller front surface when unit is not mounted. The insertion slit is located at left top on the backside of front panel.

Refer section *Main Unit Installation* to know how to insert and remove slide-in label.

Guidelines for customizing slide-in label

1. Use ***14137C02V3_I-KEY SLIDE LABEL GOC43.cdr*** file for dimensional details and sample label design.
2. Use material PVC with thickness 150 microns with glossy/mat finish.
   a. If failing to do so, may reduce pressing experience for individual key as well as disturbs smooth insertion of slide in label via insertion slit.
3. Process should be screen printing rather than digital printing which provides better quality and repeatability.
4. Printing should be carried out on the back side of slide-in label.
   a. Ensure that part excluding illuminated key parts (4 nos.) is completely opaque.
   b. User can get letters or any objects in white colour on opaque part of the slide-in label.
5. LED light can be transmitted through rectangular illuminated key part. For the same, ensure that required portion of label should be translucent white.
   a. Translucent effect is mandatory to ensure uniform illumination.
   b. Illuminated key part should not be transparent completely as it will show key part with cuts on it.

16.3 Visualization screens

For the configuration and development of screens and design of user interface, CoDeSys 3.5 project provides visualization editor.

In CoDeSys project, *Application → Visualization Manager and TargetVisu contains various setting related to* HMI.

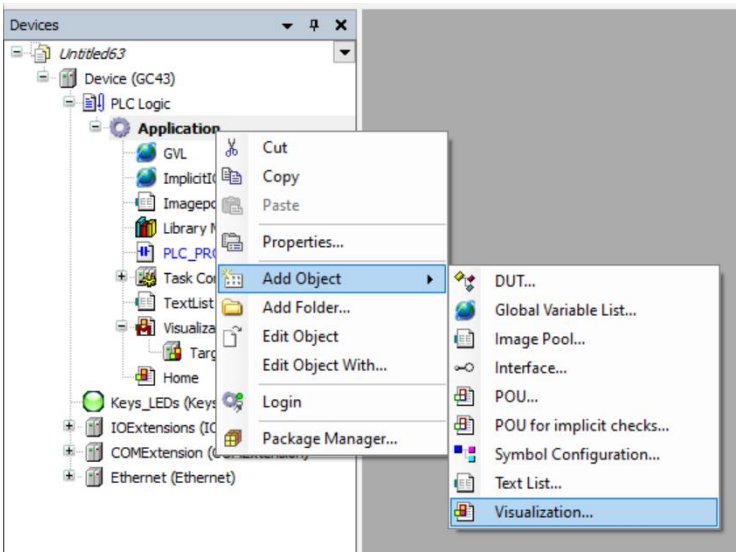
NOTE

Do not make changes to default settings of Visualization Manger and TargetVisu after creating project with GOC43 template.

Change in default settings may lead to unpredictable behavior.

By default, blank screen '*Home'* gets added after project creation.

Additional HMI screens can be added by right click on 'Application' node and select 'Add Object' → Visualization.

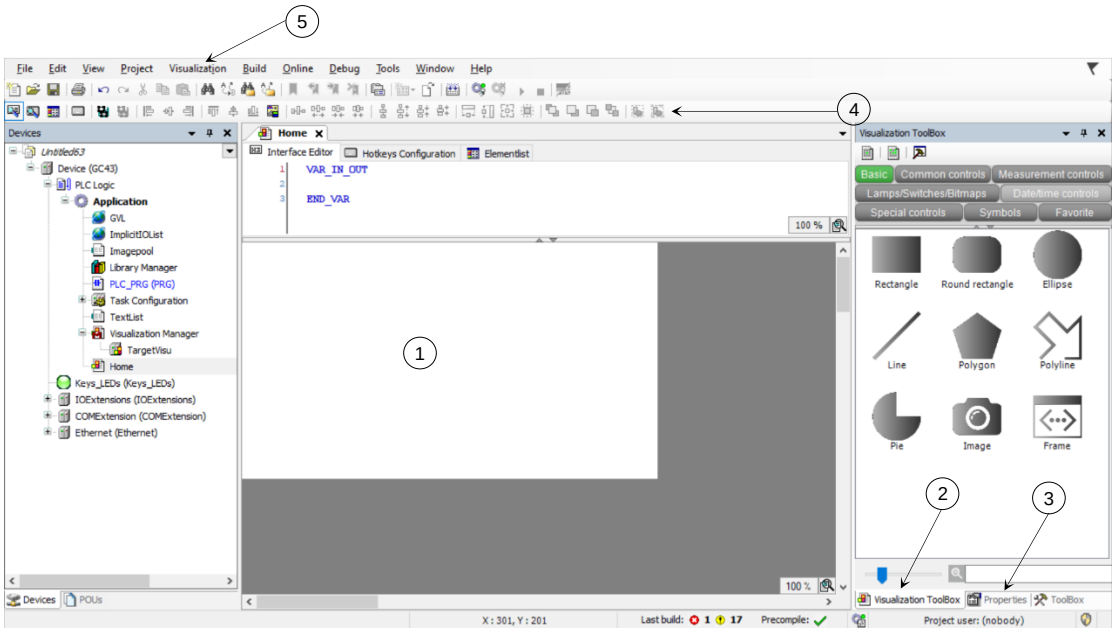


NOTE

Maximum 64 visualization screens can be added in GOC43 project.

16.3.1 Visualization Editor

To edit HMI screen design, Click on *Visualization* screen, this opens visualization editor as shown below.

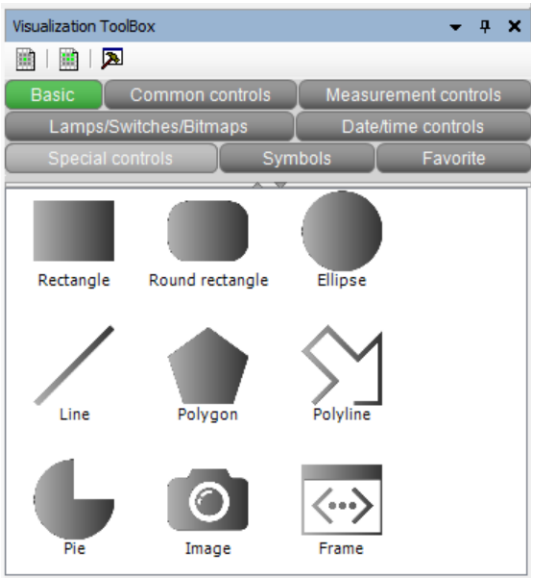


Sr. No.	Parameter	Description
1	Working area	Screen design area. White square shows display boundaries. Anything placed out of white color area is not displayed on LCD.
2	Visualization Toolbox	Contains various visualization elements which can be utilized to design HMI screen as per requirement. Elements are grouped as per the type. Section ‘Visualization elements’ contains list of visualization elements in all the groups.
3	Properties	Tab shows properties of visualization element on screen. Click on visualization element to view object properties.
4	Visualization Toolbar	Contains different commands useful for editing, alignment, spacing, size of visualization elements. Refer CoDeSys help for more details.
5	Visualization Menu	Visualization menu on Menu bar provides various commands useful for editing screen design. Refer CoDeSys help for more details.

16.3.2 Visualization Elements

For easy access, visualization elements in toolbox are grouped in categories such as '*Basic*', '*Common controls*', '*Measurement controls*', *Lamps/Switches/Bitmaps*', '*Special controls*', '*Date/time controls*', '*Symbols*' etc.

Below image provides visualization toolbox overview in CoDeSys application and table provides list of supported visualization categories/ groups.



Visualization Categories
1. Basic
2. Common controls
3. Measurement controls
4. Lamps/Switches/Bitmaps
5. Special controls
6. Date/time controls
7. Symbols

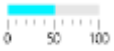
NOTE

User can utilize custom category 'Favorite' for frequently used visualization elements. To add element in favorite category. right click on element in toolbox and select 'Add item to category favorite' from context menu.

The table below provides information about each visualization category along with elements supported in it.

Name of element	Symbol	Description
Basic		
Rectangle		These elements can be used to display data by linking with application variables. User can set background color as per linked variable state. Also, user can convert element type within Rectangle, Round rectangle and Ellipse, only by changing 'Element type' property.
Round rectangle		
Ellipse		
Line		This element draws a single line. User can animate line object by linking with application variables.
Polygon		
Polyline		
Pie		This element draws a pie of any angle by referring start (begin) and end angles.
Image		This element adds an image to the visualization. The displayed image is managed in the image pool and referenced.
Frame		This element allows user to display one or more already existing visualizations. The display area of the referenced visualization then adapts itself to the frame size.
Common controls		
Label		This element is used to label the visualizations.
Combo box integer		This element shows values as a drop-down list. When the user clicks on an entry, the ID of the entry is written to an integer variable. The entries in the drop-down list can be from a list and contain images from an image pool.
Combo box array		This element shows values of an array as a drop-down list. When the visualization user clicks an entry, the array index of the entry is written to an integer variable.
Tab control		This element displays selected visualizations in tabs. The tabs can be used by means of the tab header without any input configuration. A visualization user can switch between visualizations by clicking the tab header.
Button		This element triggers an action, such as setting a variable.

Visualization elements continues…

Common controls		
Group box		This element provides visual grouping of visualization elements.
Table		This element displays data that can be represented as an array in a table. Therefore, the data type of the visualizing variable can be 1) a one-dimensional array, 2) a maximum two-dimensional array, 3) an array of an array, 4) an array of structures, or 5) an array of a function block.
Text field		This element can be used for, 1) Static output of text, 2) Showing a tooltip, 3) Dynamic output of text, 4) Input of text
Scrollbar		This element sets the value of a variable, depending on the position of the scrollbar.
Slider		This element adjusts the value of a variable, depending on the position of the slider within the slider bar. User can define the value range of the slider bar by means of the scale start and scale end.
SpinControl		This element increments or decrements the value of a variable in defined intervals.
Invisible input		This element is displayed in the editor with a dashed line and is not visible in online mode. User can define the behavior of the element using application variable or using *Input configuration* element property.
Progress bar		This element represents the value of a variable as a progress bar.
Checkbox		This element is used for setting and resetting a Boolean variable. The set state is represented by a check mark.
Radio button		This element provides a field with any number of options.
Measurement controls		
Bar display		This element displays the value of a variable.
Meter 90°		This element displays the value of a variable. The needle is positioned according to the value of the assigned variables.

Visualization elements continues…

Measurement controls		
Meter 180°		This element displays the value of a variable. The meter is positioned according to the value of the assigned variables on the scale.
Meter		This element displays the value of a variable. The needle is positioned according to the value of the assigned variables.
potentiometer		This element displays the value of a variable as a setting on the potentiometer. User can modify the value by dragging the pointer to another position.
Histogram		This element displays the data of a one-dimensional array as a histogram. User can assign specific colors for certain value ranges.
Lamps/Switches/Bitmaps		
Image switcher		This element displays one of three referenced images. Mouse actions can change the displayed image. The images can be defined in the *Image settings* element properties.
Lamp		This element shows the value of a variable, and the element is displayed as illumination.
Dip switch		This element assigns a value to a Boolean variable. The switch position "ON" assigns value TRUE to the variable, and the switch position "OFF" assigns the value FALSE to the variable. User can change the switch position using mouse actions.
Power switch		
Push switch		
Push switch LED		
Rocker switch		
Rotary switch		

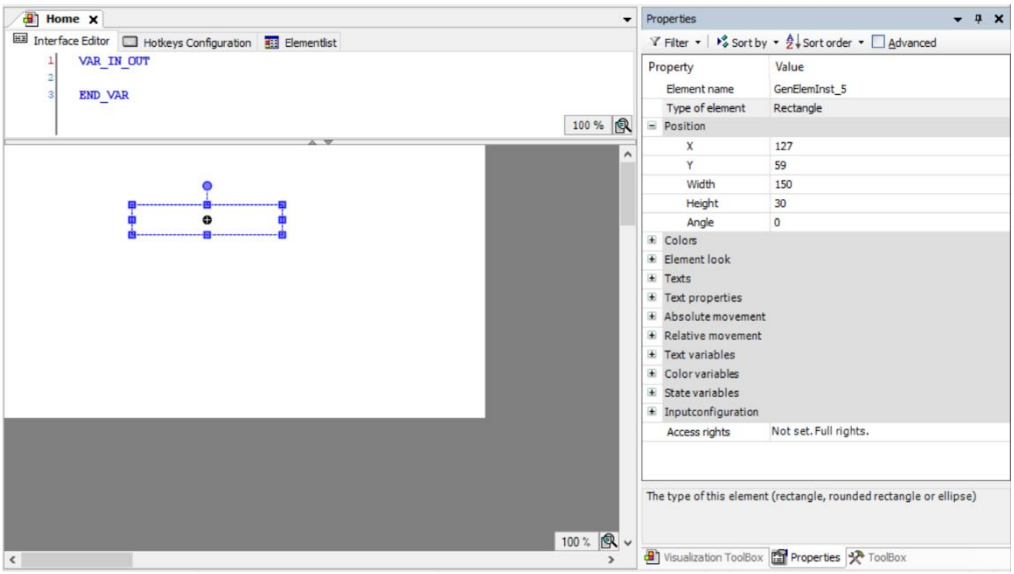
Visualization elements continues…

Special controls		
Waiting symbol flower		This element indicates that the system is busy or waiting for data.
Cartesian XY Chart		This element displays the curve of array values graphically as a line or bar chart in the Cartesian coordinate system. The chart can display multiple curves at one time.
Date/time controls		
Analog clock		This element is a clock that displays the current time of day. The clock can also display any time.
Date picker		This element is a calendar that displays the current date. User can, - Click on tag to select date which can be saved to a variable. - customize the time interval which is displayed by calendar. - Click on calendar head to change the year. - Click on arrow in calendar head to change the month.
Symbols		
Symbols		Number of arrows and other symbols are provided

16.3.3 Visualization Element Properties

Appearance and runtime behavior of visualization element can be changed with help of object properties.

To view properties of visualization element, click on element in working area. Element properties will be displayed as shown below.



Depending on visualization element type, properties of element will be displayed in properties tab.

Refer CoDeSys help for more details on properties of visualization elements.

16.3.4 Performance of HMI Function

Number of objects on a visualization screen

Visualization editor does not restrict on number of visualization elements on a screen, however for optimum performance of HMI function and overall product functioning, it is advised to use information mentioned below to calculate number of objects on a screen.

Use factor 'Visualization Screen Weightage' to judge impact of HMI function on overall performance. Visualization screen weightage is addition of individual weightages of all visualization elements on a screen.
For optimum performance, visualization screen weightage should not exceed 32 for any given screen.

Table below mentions visualization elements and their weightage on visualization screen.

Sr. No.	Visualization elements	Weightage
Basic		
1	Rectangle, Rounded rectangle, Ellipse, Line	1
2	Polygon, Polyline, Pie	2
3	Image, frame	8
Common controls		
5	Label	1
6	Combo box integer, Combo box array	2
7	Tab control	4
8	group box	4
9	Table	16
10	Text field	4
11	Scrollbar	8
12	Slider	8
13	Spin control	4
14	Invisible input	4
15	Progress bar	8
16	Checkbox	2
17	Radio button	2

Measurements controls		
18	Bar display, meter 90, meter 180, meter, Potentiometer,	4
19	Histogram	16
Lamps/switches/Bitmaps		
20	Image switcher, Lamp, Dip switch, Power switch, Push switch, Push switch LED, Rocker switch, Rotary switch	4
Date/time controls		
21	Analog clock, Date picker	4
Special controls		
22	Wait symbol	16
23	Cartesian XY chart	16
Symbols		
24	All symbols	4

HMI design with higher visualization screen weightage may impact performance of HMI function which may lead to slower screen updation, delay in screen changeover, delayed start after power on and higher touch sensing time.

16.4 Alarm Configuration

Alarm configurator allows user to monitor the critical conditions of the machine and the process, to trigger alarm and to log abnormality with time stamp. Up to 64 alarms can be configured. Alarm configurator offers visualization objects; alarm table (to list the active alarms), alarm banner (to display the latest or high priority alarm) and history table (to check the alarm history of last 256 alarms).

16.4.1 Specifications

The following table lists the functional specifications.

Item	Description
Number of alarm configurator	1
Number of alarms	64 maximum
Alarm states	1. Active 2. WaitAck 3. Normal
Types of alarms	1. Acknowledgeable 2. Archivable 3. Both acknowledgeable and archivable
Number of alarm tables	1
Number of history tables	1
Maximum alarms in history table	256 maximum
Alarm banners	1. Alarm banner with state 2. Alarm banner without state

NOTE

Alarm configuration is supported in GOC Toolkit V3 version v1.03.05.00.
Refer document 'N18006AAMH07 GOC43 Version Compatibility' for suitable firmware version.
Do not refer CoDeSys help of Alarm Manager. Alarm Manager provided by CoDeSys is different than Alarm Configuration supported by GOC43.

NOTE

Alarms which are not archived, will not be displayed in history table.

Prerequisites:

1. Before creating application, go to 'Device (GC43) → PLC Settings →Always updatevariables →set to 'Enabled 2 (always in bus cycle task)'.
2. Make sure that RTC status of GOC43 device is OK and, date and time are set to current date and time.

16.4.2 Before Configuration

This section contains information that should be known before configuring alarm function.

- Alarm types
- Alarm states

Alarm Types

3 types of alarms can be added in alarm configurator:

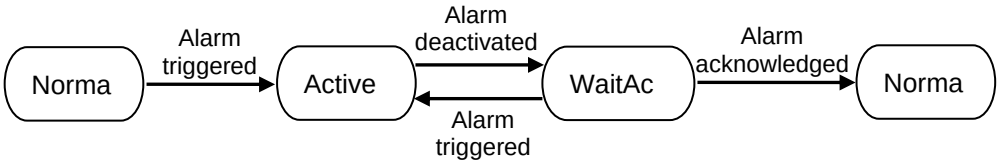
- **Acknowledgeable**:
  These alarms need to be acknowledged to move to normal state when deactivated.
- **Report only:**
  These alarms are unacknowledged and directly moves to normal state when deactivated.
- **Archivable:**
  These alarms are stored in history table. Both acknowledgeable and report only alarms can be archived. All the states of alarm are archived in history table.

Alarm States

Configured alarms goes through 3 states in its cycle as explained below:

- **Active state:**
  When any alarm is triggered, its state is changed from Normal state to Active state.
- **WaitAck state:**
  When active alarm is deactivated and is of type acknowledgeable, state is changed from Active state to WaitAck state. Alarms in this state are waiting for acknowledgement. If an alarm is in WaitAck state and is triggered again, its state is changed back to Active state.
- **Normal state:**
  When alarm is not triggered initially, it is in Normal state. When triggered alarm is deactivated (for report only type of alarms) and acknowledged (for acknowledgeable type of alarms), its state is changed back to Normal state.

Transition of states for acknowledgeable type of alarms:



Transition of states for report only type of alarms:

Active status and Acknowledge status of one or more alarms is indicated by system bit `_SysvarAlarm.AlmActive` and `_SysvarAlarm.AlmActiveAck`, respectively.

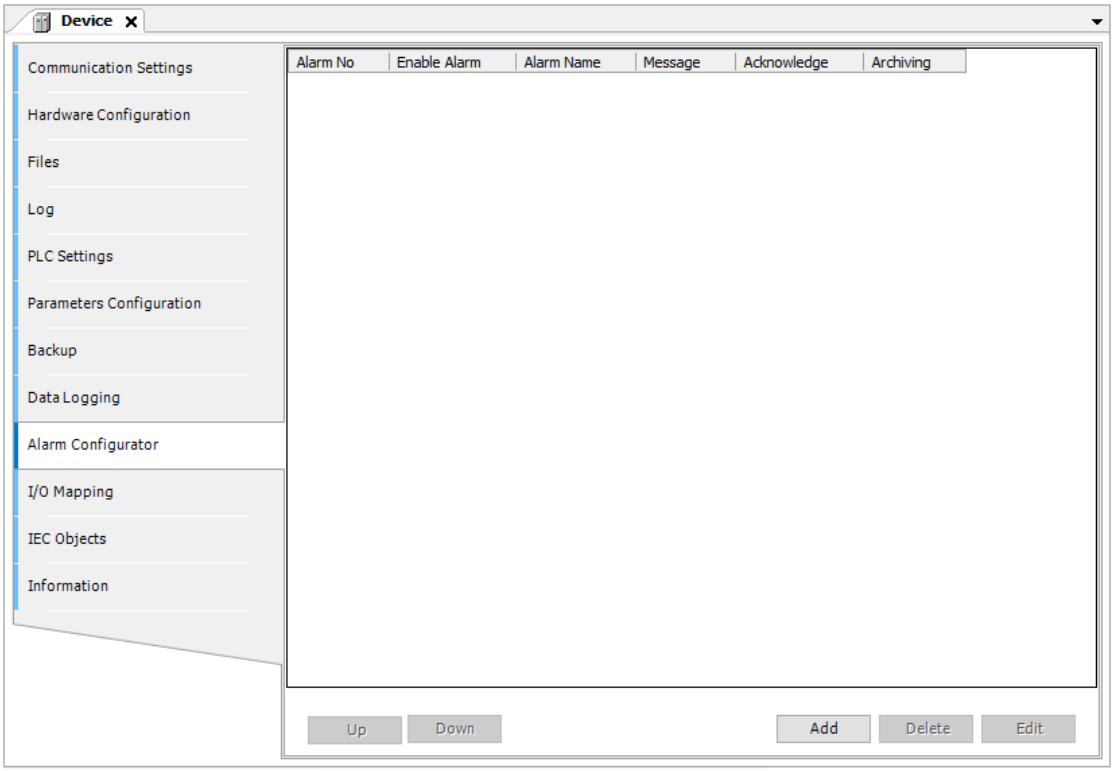
16.4.3 Configuration

This section contains information related to adding,

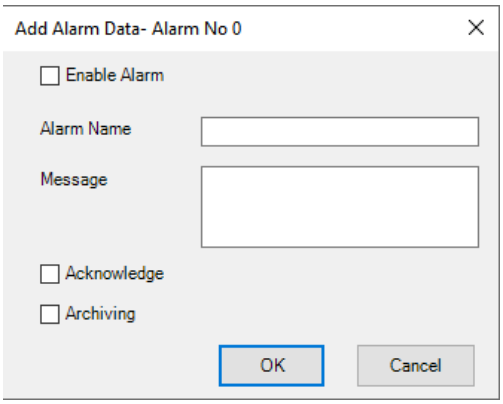
- Alarms in alarm configurator
- Alarm table visualization
- History table visualization
- Alarm banner visualization

Adding alarms in alarm configurator

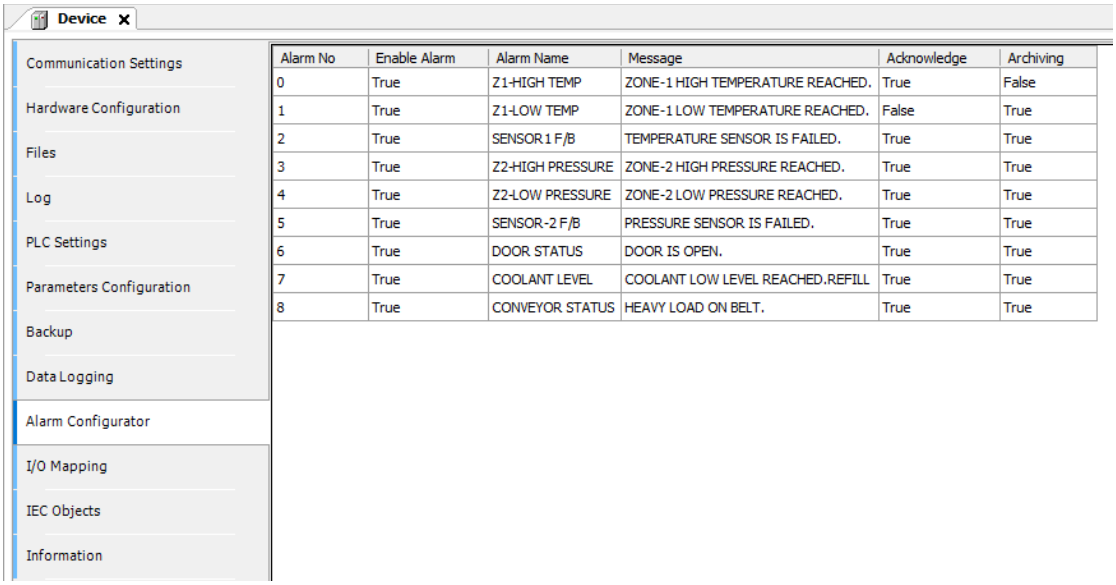
'Device (GC43) → Alarm Configurator' allows user to configure alarms as per the application requirement.



The following buttons are available to configure alarms.

Button Name	Details
Add	Opens 'Add Alarm Data- Alarm No 0' dialogue to add 1st alarm in alarm configurator. 'Alarm No' ranges from 0 to 63 and it indicates the bit position of 64-bit long word variable `'_SysvarAlarm.Trigger'`. Here 'Alarm No 0' belongs to 0th bit of 64-bit long word variable i.e. `'_SysvarAlarm.Trigger.n'` should be made high or low to trigger or deactivate alarm no. ***n***. Where ***n*** = 0 to 63. For example: `'_SysvarAlarm.Trigger.0'` should be made high or low to trigger or deactivate alarm no. 0. Refer section '*System Variables*' for more details.  • **Enable Alarm:** If checked, alarm configuration is enabled. Uncheck this option to disable the alarm event. • **Alarm Name:** 16 characters (alphanumeric and special characters) can be assigned as alarm name. It should be unique name and space is not allowed as a first character. Alarm name is used for the identification purpose only. It is not displayed in alarm table, history table and alarm banner. • **Message:** 32 characters (alphanumeric and special characters) can be assigned as message. Space is not allowed as a first character. • **Acknowledge:** If checked, deactivated alarm should be acknowledged to change its state to Normal state. • **Archiving:** If checked, alarm is saved in history table.
Delete	Deletes selected alarm entry from list.
Edit	Opens 'Edit Alarm Data- Alarm No (***n***)' dialogue for modification in configured alarm. Where ***n***= 0 to 63.
Up	Moves up selected alarm entry in the list.
Down	Moves down selected alarm entry in the list.

The screenshot below shows a list of configured alarms.



Alarm No	Enable Alarm	Alarm Name	Message	Acknowledge	Archiving
0	True	Z1-HIGH TEMP	ZONE-1 HIGH TEMPERATURE REACHED.	True	False
1	True	Z1-LOW TEMP	ZONE-1 LOW TEMPERATURE REACHED.	False	True
2	True	SENSOR 1 F/B	TEMPERATURE SENSOR IS FAILED.	True	True
3	True	Z2-HIGH PRESSURE	ZONE-2 HIGH PRESSURE REACHED.	True	True
4	True	Z2-LOW PRESSURE	ZONE-2 LOW PRESSURE REACHED.	True	True
5	True	SENSOR-2 F/B	PRESSURE SENSOR IS FAILED.	True	True
6	True	DOOR STATUS	DOOR IS OPEN.	True	True
7	True	COOLANT LEVEL	COOLANT LOW LEVEL REACHED.REFILL	True	True
8	True	CONVEYOR STATUS	HEAVY LOAD ON BELT.	True	True

Here, Alarm No 0 is Z1-HIGH TEMP alarm and it is acknowledgeable but not archived.
Alarm No 1 is Z1-LOW TEMP alarm and it is not acknowledged but archived.

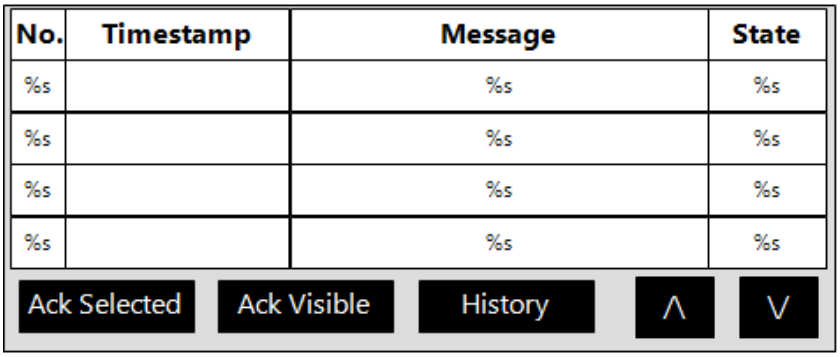
This completes alarm configuration using ‘Alarm Configurator’ tab on Device window.

Following section explains ‘How to configure/ add alarms’ using visualization.

Adding Alarm table (AlmTable) visualization

Object AlmTable shows alarms in a list with timestamp, message, and its state. If the state of alarm is changed recently, it is displayed on the top of the alarm table. Alarms in Active state, WaitAck state are displayed in alarm table. Once state is changed to Normal state, it is removed from alarm table.

The image below shows the contents of alarm table.



NOTE

GOC43_Extern library from visualization toolbox provides object AlmTable.
Device(GC43) → Application(right click) → Visualization → Visualization Toolbox → GOC43_Extern allows user to add AlmTable in the project.

Adding History table visualization

All the archived alarms are shown in the history table with time stamp, alarm message and state. If the state of archived alarm is changed, a new entry for the alarm is made again on the top of history table. Maximum 256 alarm events can be displayed in history table. Once, 256 count is reached, oldest alarm event is removed from history table and recent alarm is added at the top of the table.

Alarm table and History table contents are as follows:

Items	Details
No.	It displays the serial number of alarm event. For Alarm table, numbers are from 1 to 64. For History table, numbers are from 1 to 256. Latest alarm event has number 1 always.
Timestamp	It displays the time stamp of alarms event. Supported time stamp format: DD:MM:YYYY HH:MM:SS
Message	It displays the alarm message associated with respective alarm.
State	It displays the state of alarms shown. Active and WaitAck states are shown in Alarm table. Active, WaitAck and Normal states are shown in History table.
Ack Selected	Selected alarms in WaitAck state can be acknowledged by using Ack Selected button. Selected alarms are highlighted.
Ack Visible	All the visible alarms in WaitAck state in Alarm table can be acknowledged simultaneously by using Ack Visible button. Maximum 4 alarms are visible in alarm table at a time.
History	Opens history table visualization to view the alarm history. Button is highlighted when table shows alarm history.
	Alarm table and History table can be scrolled up by 4 alarms by using Up button.
	Alarm table and History table can be scrolled down by 4 alarms by using Down button.

NOTE

If two or more alarms are triggered at the same time, alarm with lower number has higher priority i.e. it will be displayed in table before alarm with lower priority. Alarm No. 0 has highest priority, whereas Alarm No. 63 has lowest priority.

Alarm banner (AlmBanner)

Alarm banner visualizes a single alarm only. Alarm in active state, WaitAck state is displayed. Once alarm state changes to Normal state, it is removed from Alarm banner and alarm in Active or WaitAck state as per occurrence of event or priority configured will be displayed back.

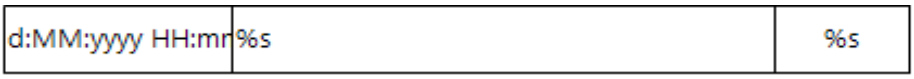
Alarms displayed in alarm banner can be controlled based on the priority or the occurrence of alarm. If IEC variable `'_SysvarAlarm.AlmBannerDispPriority'` is set to low, then latest alarm event is displayed. If state of any alarm is changed recently, it is displayed.

When `'_SysvarAlarm.AlmBannerDispPriority'` is set to high, only high priority alarm is displayed irrespective of change in state of low priority alarms.

Two types of alarm banners can be configured in application:

AlmBanner1:

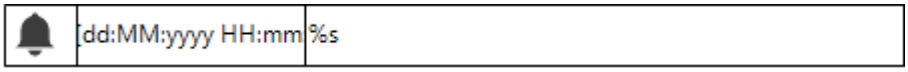
Alarm is displayed with state.



[Timestamp] [Alarm Message] [State]

AlmBanner2:

Alarm is displayed without state and with blinking alarm symbol.



[Symbol] [Timestamp] [Alarm Message]

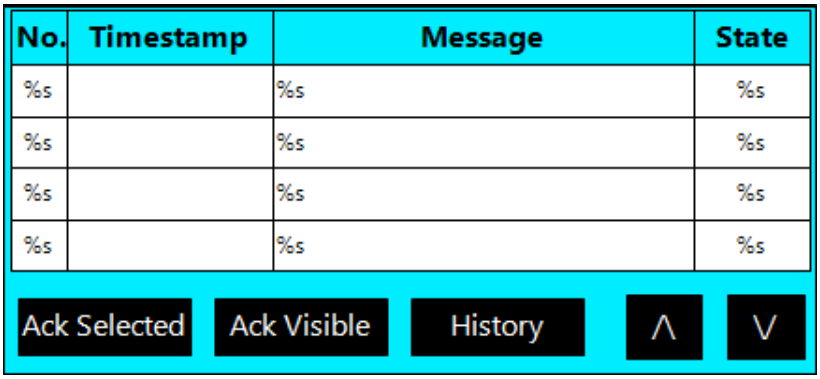
GOC43_Extern library from visualization toolbox provides object AlmBanner.

Device(GC43) → Application(right click) → Visualization → Visualization Toolbox → GOC43_Extern allows user to add AlmBanner1 and AlmBanner2 objects in the project.

Alarm table and alarm banner are transparent objects. User selected images, colors can be set as a background to these objects. Below is the procedure to set user defined colors as a background to these objects:

1. Go to Visualization Toolbox and insert rectangle objects of size of alarm table and alarm banners in application program.
2. Select rectangle object and go to Properties → Colours to fill the normal state colour. This colour acts as a background to alarm table and alarm banner.
3. Right click on rectangle objects → Order →select 'Send to back' option to set these objects as background to alarm table and alarm banner.
4. Go to Visualization Toolbox → GOC43_Extern → Drag alarm table and alarm banner object to place over these rectangle objects designed for alarm table and banner respectively.

Alarm table with user defined background color can be seen as below:



Alarm banners with user defined background color can be seen as below:

16.4.4 Effect of Power Cycle on Alarms Logged

When device is power cycled, alarms displayed in alarm table and on alarm banner will be cleared. If any alarm remains active after power on, it will be logged again with latest timestamp.

Alarms displayed in history table will be retained after power cycle.

Alarm history can be cleared by executing function `'ClearAlarmLog(TRUE)'` in the application.

16.5 Recipe Management

Recipes are sets of parameters that are stored in controller memory and can be transferred directly to PLC variables to enable fast, error-free product changeovers.

Each recipe includes a set of parameters important for the production process.

For example, a beverage vending machine, for instance, can dispense five different beverages. Different combinations of the same ingredients, such as water, milk, sugar, tea powder, and coffee powder, will be used in each product. A recipe is loaded when user chooses a product like tea, cappuccino, black coffee, etc. from the machine. Here, recipe contains quantity of each ingredient required to make selected beverages.

In GOC43, recipes are created and managed in 'Recipe manager'. Note following terms used in this section while configuring recipe function,

- **Recipe Variables**: Parameters or ingredients of a recipe.
  In above example, water, milk, sugar coffee etc. are ingredients of recipe.
- **Recipe**: Set of values of ingredients is called a recipe.
  In above example of vending machine, tea, cappuccino, black coffee etc. are recipes.
- **Recipe definition**: Set of Recipe Variable and no. of Recipes is called a Recipe definition.

16.5.1 Specifications

The following table lists the functional specifications.

Item	Description
Number of recipe definitions	4 max.
Number of recipes per recipe definition	16 max.
Number of recipe variables per recipe definition	32 max.
Recipe file storage type	Textual (Default) Binary
File extension	.txtrecipe
SD card backup of recipe files	Yes (With application program)
Upload recipe files from controller to PC	Yes (With source code)
Recipe management (create, edit, delete etc.) on controller in runtime	Yes [*1]

[*1] Recipe management on controller is supported via HMI operations only. Refer section *Create Visualization for Runtime Recipe Management* for more details.

Recipe management via PLC application program is not supported.

NOTE

Recipe manager is supported in GOC Toolkit V3 version v1.03.05.00 onwards.
Refer document 'N18006AAMH07 GOC43 Version Compatibility' for suitable firmware version.
Before creating application, go to 'Device (GC43) → PLC Settings → Always update variables →set to 'Enabled 2 (always in bus cycle task)'.

NOTE

Data types such as STRING, WSTRING, LTIME are not supported in CoDeSys Recipe manager.

16.5.2 Configuration of Recipe Manager

The following section explains how to add/ create recipe manager.

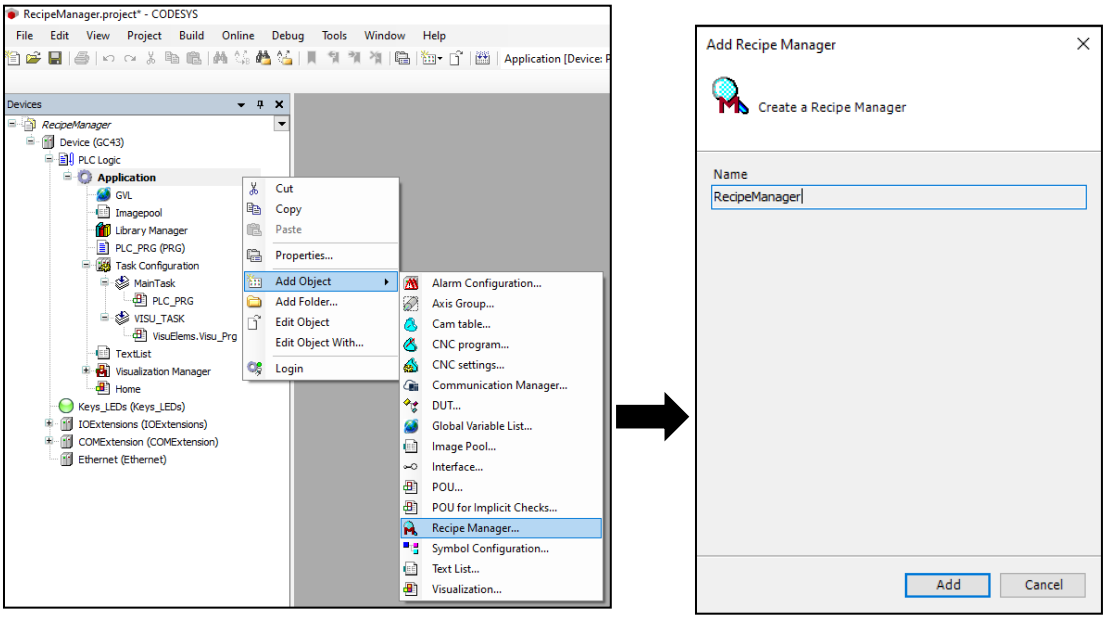
Prerequisite: New project is created. Variables (ingredients of recipe) are declared in the application.

1. Add recipe manager to application.
2. Set Recipe manager parameters.
3. Add recipe definition.
4. Add recipe variables.
5. Add recipes.
6. Create visualisation for runtime recipe management.
7. Download application to controller.

Adding recipe manager

Recipe manager is added in q application using method as below:

- Right click on ‘Application’ tab then select ‘Add object’ menu.
- A new sub tab gets open then select ‘Recipe Manager…’ menu.
- This opens ‘Add Recipe Manager’ window and allows to add recipe manager in the application.

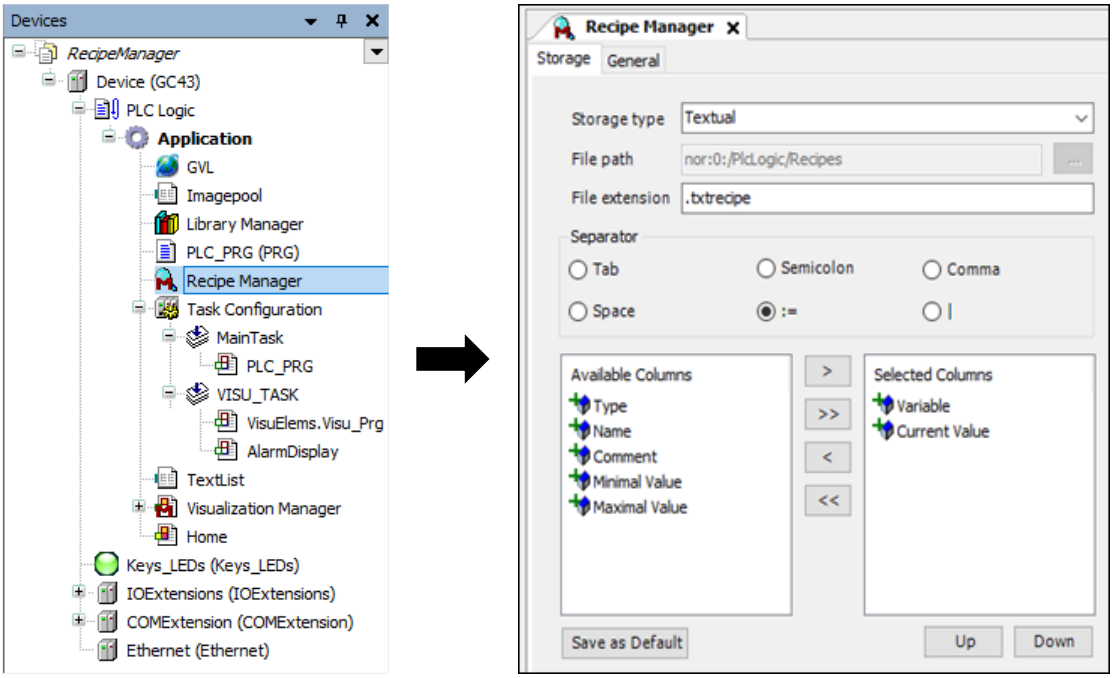


Setting recipe manager parameters

Double click on ‘Recipe Manager’ tab to open configuration window as shown below.

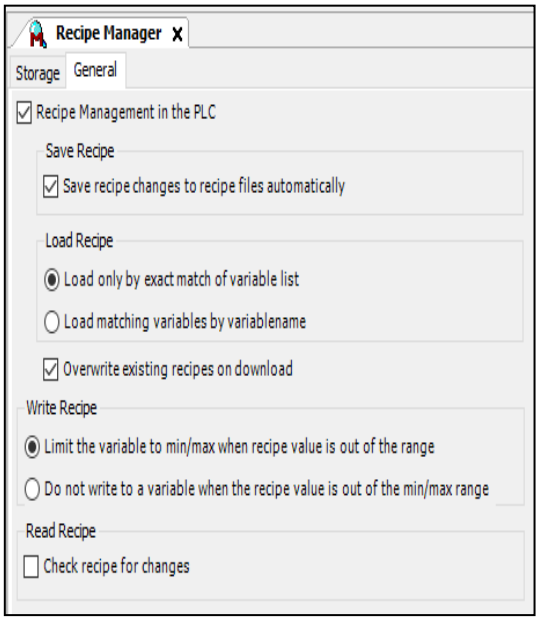
‘Recipe Manager’ window has 2 sections as Storage and General; as shown below.

Storage tab



Parameter Name	Details
Storage type	Defines storage type for recipe files. • Textual (Default) • Binary
File path	Default file path is ‘\PlcLogic\Recipes’ to store recipe files in the controller and is non editable.
File extension	Defines file extension for recipe files. Default file extension is .txtrecipe. ***Note***: Recipe file name format: <recipe_name>.<recipe_definition_name>.txtrecipe
Separators	Defines delimiters between the individual values in a recipe file if Storage type is Textual. Choose delimiter character from the options like Tab, Semicolon, Comma, Space, etc.
Available Columns	Defines the information and the order of information saved in recipe files. Following columns are available for selection: • Variable: Name of recipe variable (as declared in application). • Type: Data type of recipe variable. • Name: User defined name for recipe variable. • Comment: User defined comment for recipe variable. • Minimal value: Minimum value that can be set to a variable. • Maximal value: Maximum value that can be set to a variable. • Current value: Value of recipe variable.

General tab

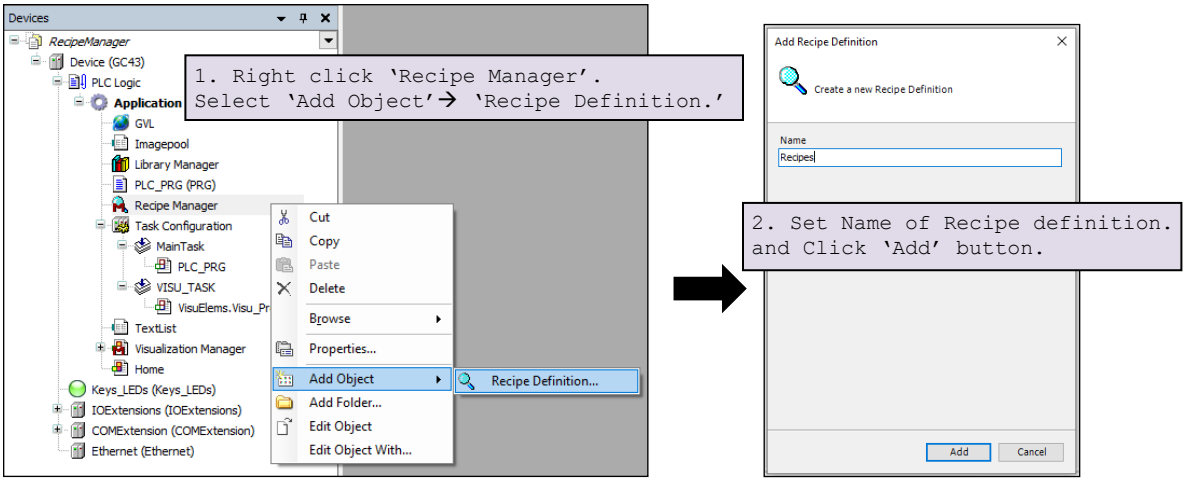


Parameter Name	Details
Recipe Management in the PLC	Check this option to enable recipe management in controller. Do not Uncheck this option. If unchecked, Recipe management function will not work on device.
Save Recipe	**Save recipe changes to recipe files automatically:** Recipe files on the controller are updated automatically at runtime whenever a recipe is changed i.e., when recipe is newly created or modified. Do not Uncheck this option.
Load Recipe	**Load only by exact match of variable list (default):** Recipe is loaded only if the file on the controller contains all variables from the variable list of the recipe definition of the application and these are sorted in the same order. Additional entries at the end are ignored. If the recipe file does not match with recipe definition, then the recipe values are not loaded in PLC variables. **Load matching variables by variable name:** Values of recipe variables in recipe file are loaded for matching variables defined in the recipe definition of the application. If the variable list of controller recipe differs in composition and sorting of recipe definition, then also the recipe values are loaded in current PLC variables. Normally it is recommended to select option ‘Load only by exact match of variable list’.

Load Recipe	Example: 1. Initially user created a recipe definition with 5 variables A, B, C, D and E. 2. User created recipe file 'Recipe 1' with values as A=10, B=20, C=30, D=40 and E=50. 3. During development of application program, user deleted variables 'D' and E. and also added new variables F, G, H and Z in recipe definition. Now, recipe definition contains 7 variables A, B, C, F, G, H, Z. 4. User try to load old recipe file 'Recipe1'. Here variables in recipe file does not match with recipe definition. If option 'Load only by exact match of variable list' is selected, recipe file values will not be loaded to PLC variables. 5. If option 'Load matching variables by variable name' is selected, values of matching variables i.e. A, B, and C are loaded from file to PLC variables. Other variables will retain previous values.
Write Recipe	**Limit the variable to min/max when recipe value is out of the range:** If recipe value is not within the set limit, then this value is limited to min/max set value respectively when a recipe is loaded. **Do not write to a variable when the recipe value is out of the min/max range:** If recipe value is not within the set limit, then this value is not written to recipe variable when a recipe is loaded and recipe variable retains the previously loaded value in runtime.
Read Recipe	**Check recipe for changes:** This setting does not have any effect while using with GOC43.

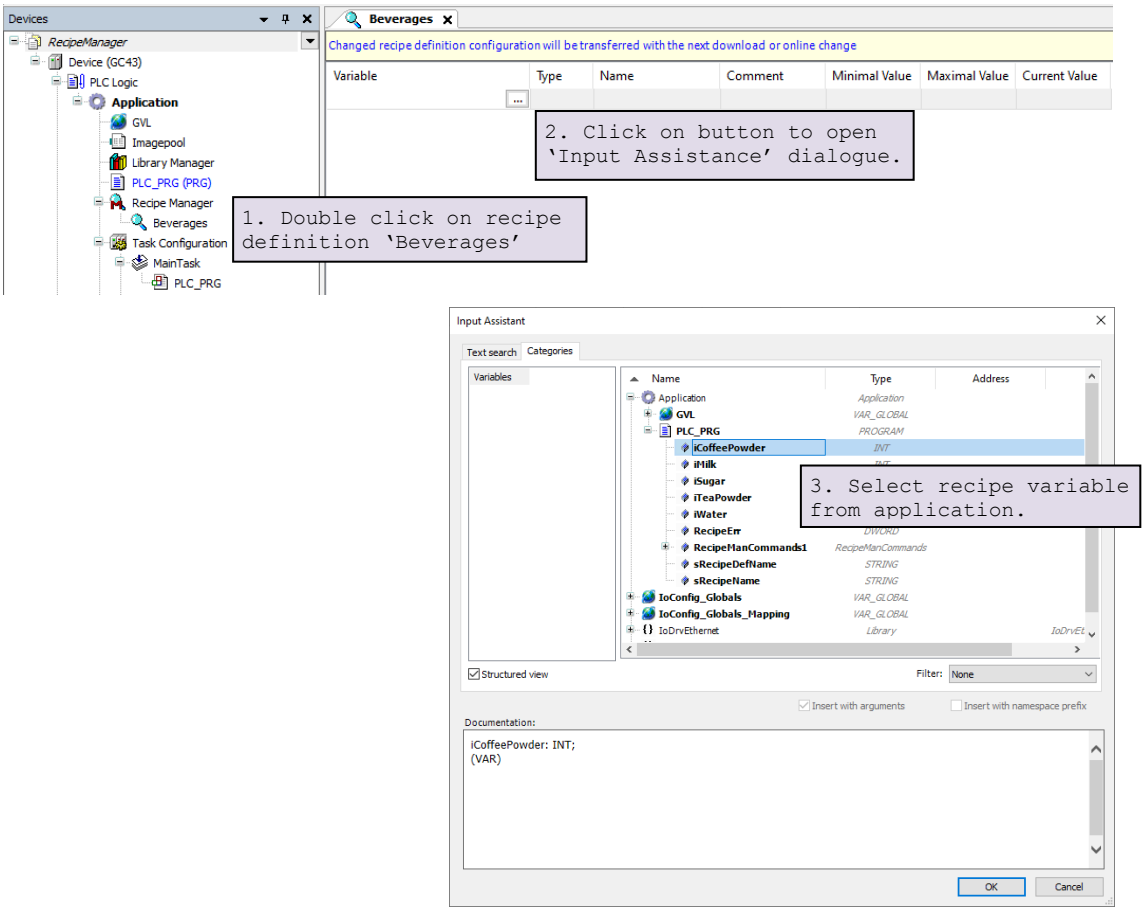
Add recipe definition

Up to 4 recipe definitions can be added as shown below.

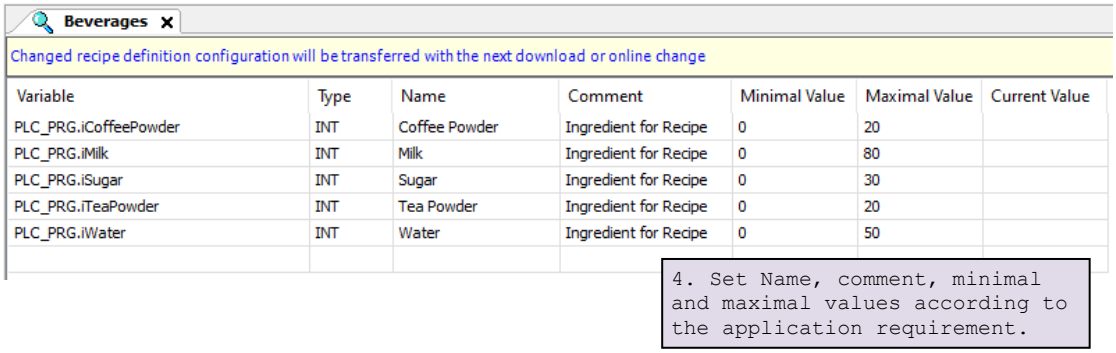


Add recipe variables

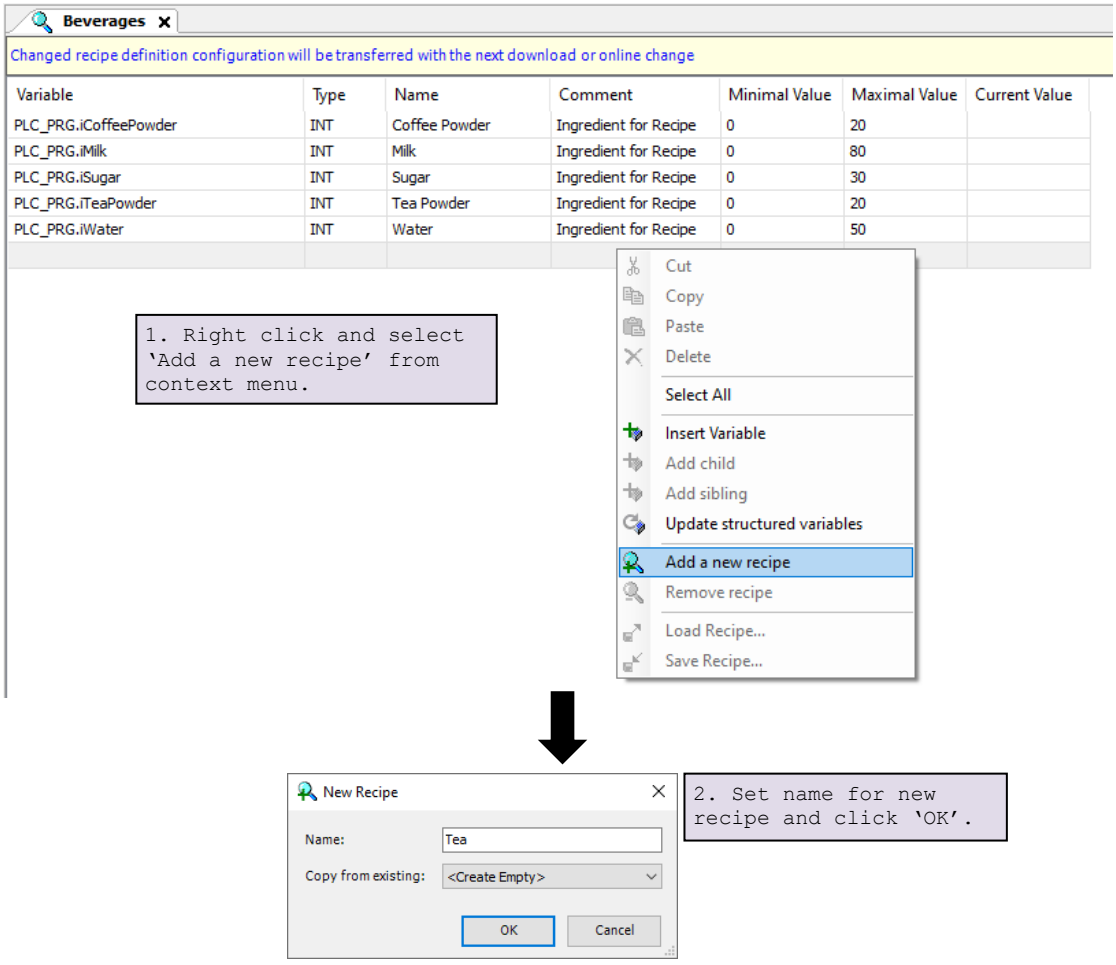
Open the newly added recipe definition and double click in variable column to add a recipe variable from application using input assistance tab. Make sure that variables to be added in recipe definition are already declared in application.



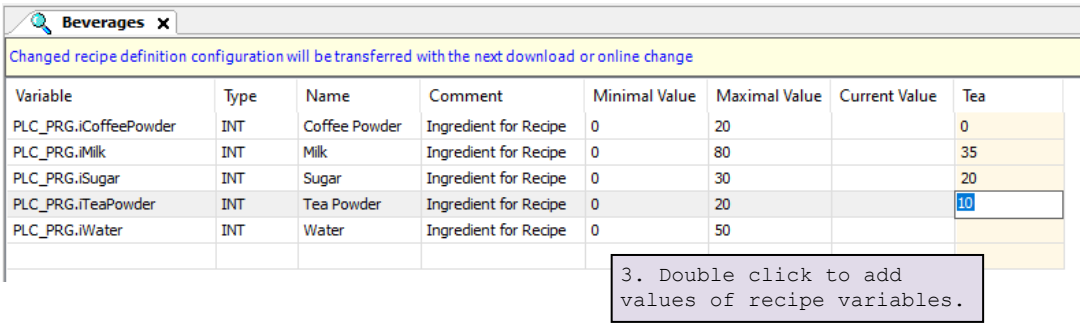
The recipe definition ‘Beverages’ after adding recipe variables is as shown below.



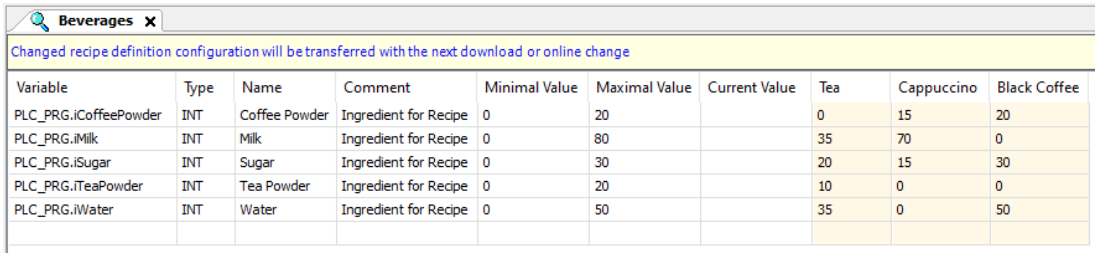
Add recipe



Assign the values to recipe variables as per the recipe requirement.



The recipe definition ‘Beverages’ after adding recipes like Tea, Cappuccino and Black Coffee is as shown below:



16.5.3 Create Visualization for Runtime Recipe Management

Two types of visualization schemes can be used for management of recipes during runtime.

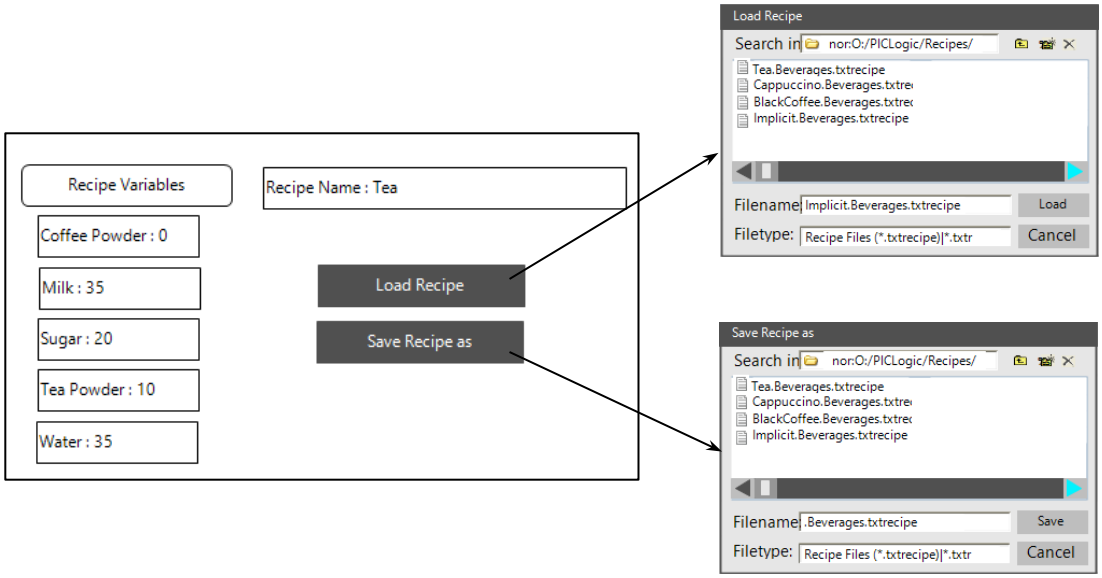
1. Load and Save recipes.
2. Read and Write recipes.

You can use any one or both visualization schemes in the project.

Example use of both visualization schemes is explained below. Detailed configuration of visualization is added in Sub sequent sections.

Load and Save recipe

With the visualization scheme, user can select a recipe file to load from / save to controller memory. Below is example screen.



Load Recipe

To load recipe (load recipe values from file on controller to PLC variables), press ‘Load recipe’ button on example screen. File selection dialogue will pop up showing recipe files on controller. User can select recipe file to load and press ‘Load’ button.

Save Recipe

To save recipe (save recipe values from PLC variables to recipe file), press ‘Save Recipe as’ button on example screen. File selection dialogue will pop up showing recipe files on controller. User can select recipe file to overwrite or enter new name to create new recipe and press ‘Save’ button.

NOTE

Recipe file should be saved/created in the format shown below:
<Recipe_name>.<Recipe_definition_name>.<File_extension>
If total length of file name exceeds 20 characters, file selection dialogue for ‘Load Recipe’ and ‘Save Recipe as’ will show first 20 characters maximum depending on alphabets used.

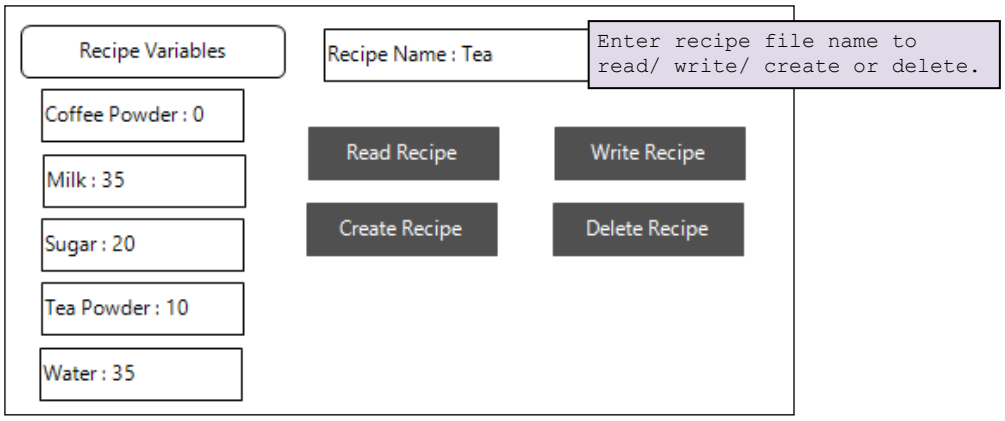
Delete Recipe

Recipe files can be deleted by using delete file button (✕) in top right corner of 'Load Recipe' or 'Save Recipe as' dialogues.

Read and Write recipe

With the visualization scheme, user can enter name of recipe file to read from / write to PLC variables. Contrary to load and save scheme where the user chooses a recipe from a list of available recipes, here the user must input the name of the recipe to read or write.

Below is example screen for Read and write recipes scheme.



Above screen is example screen where recipe variables and other visualization elements for management of recipes are added. Recipe name is showing string type variable where user can input recipe name. Button 'Read Recipe' is configured to execute read operation (PLC variable to recipe file) and Button 'Write recipe' is configured to execute write operation (recipe file to PLC variable). User can also create new recipe or delete existing recipe by using 'Create Recipe' and 'Delete recipe' buttons.

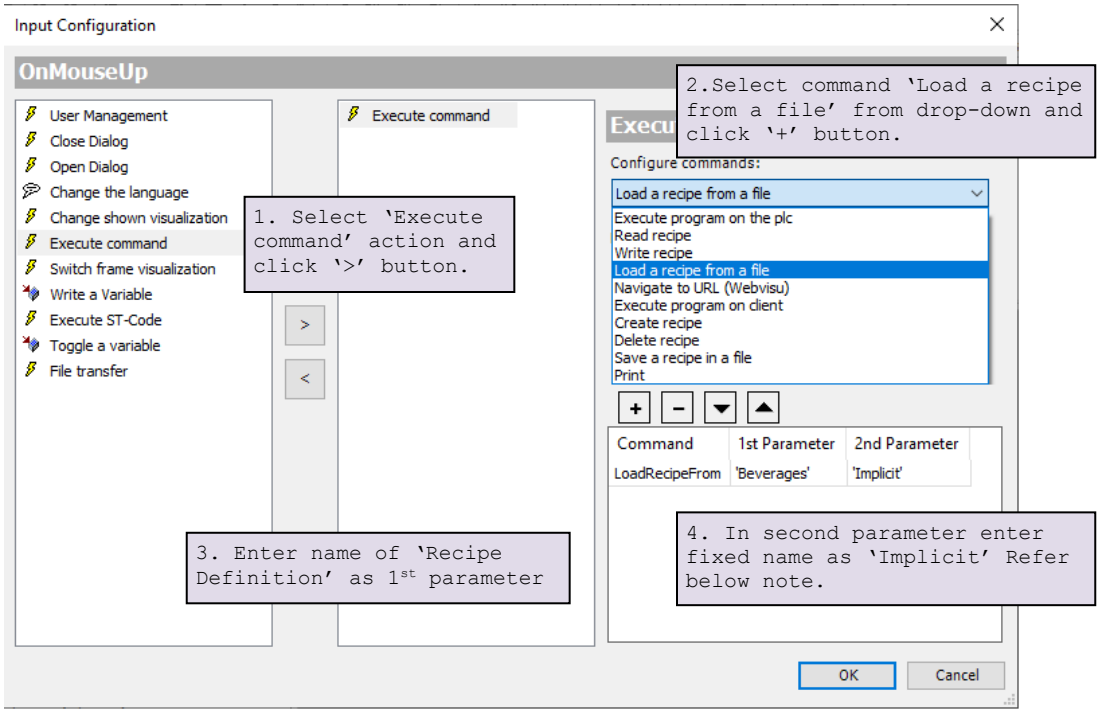
Configuration of Load and Save recipe visualization scheme:

Configure “Load Recipe” button in visualization:

- Add button to screen: Add a button from Visualization toolbox and set button name.
- Set input configuration of button as shown below:

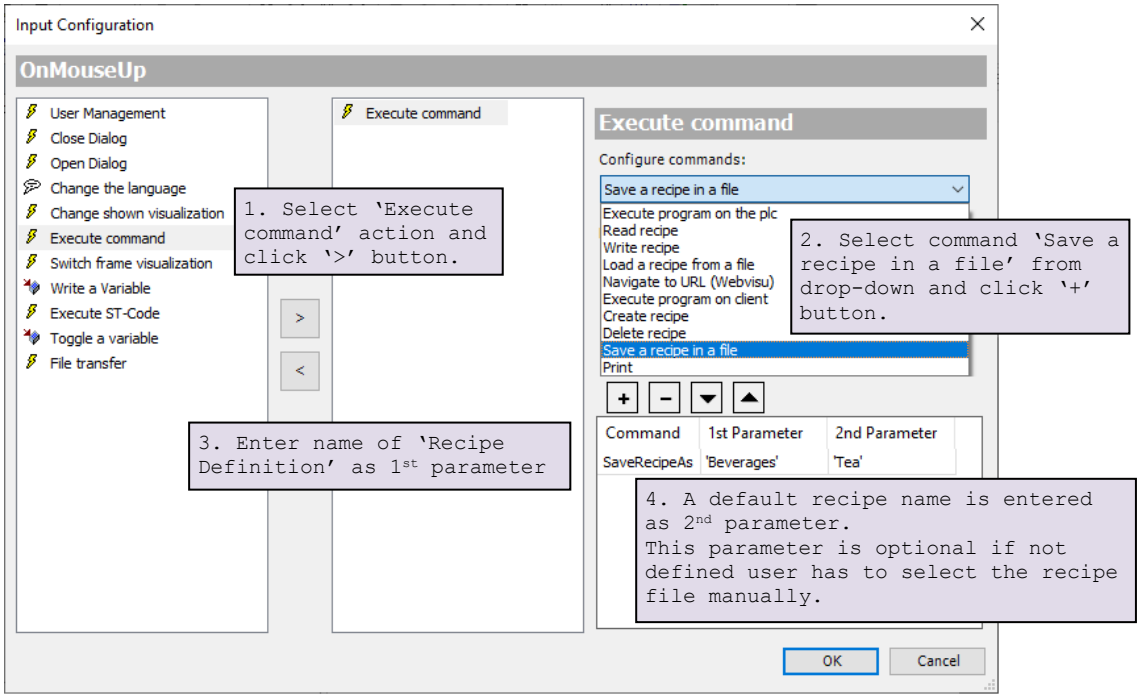
NOTE

Keep 2nd Parameter of ‘Load a recipe from file’ action as ‘Implicit’ as shown below.
During runtime, when user selects a recipe file to load, the recipes from the file are written to the ‘Implicit’ file and then recipe values are loaded to recipe variables.



Configure “Save Recipe” button in visualization:

- Add button to screen: Add a button from Visualization toolbox and set button name.
- Set input configuration of button as shown below:

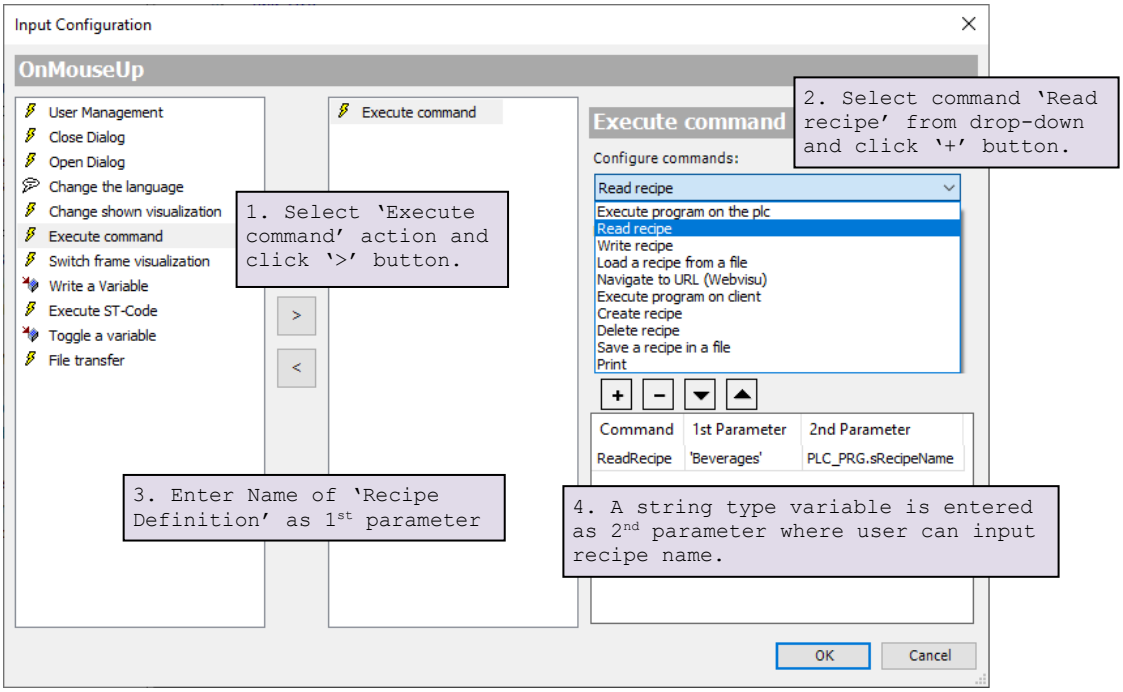


- Recipe values can be saved into a default recipe file defined in 2nd parameter or values can be saved in new file or one can overwrite the existing file.

Configuration of Read and Write recipe scheme

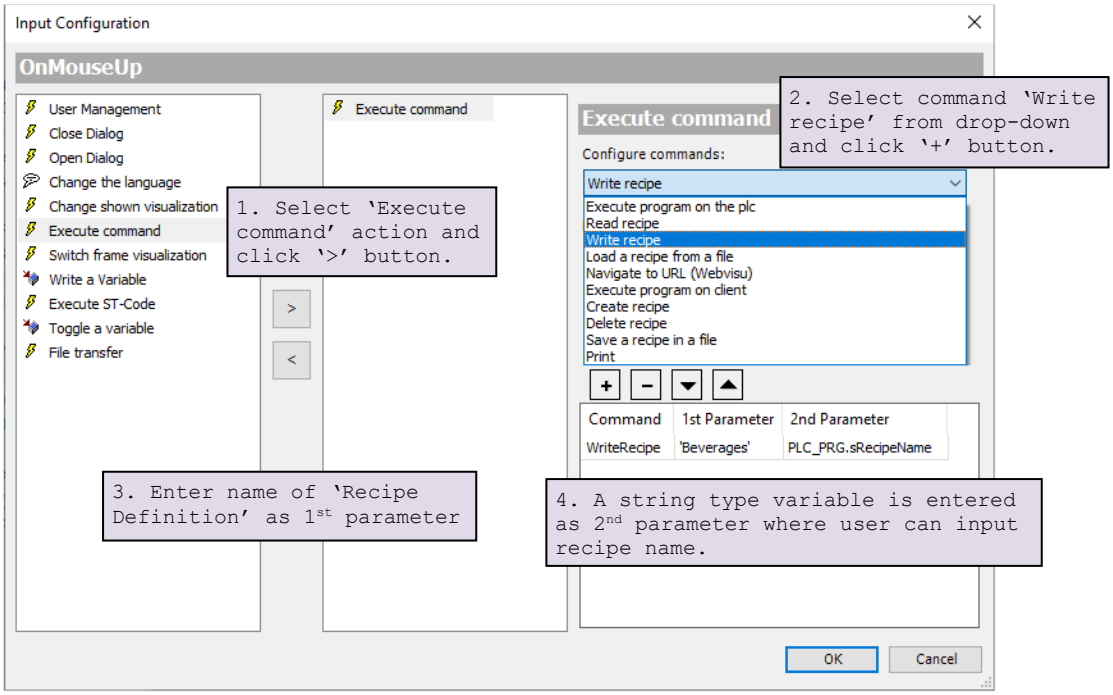
Configure “Read Recipe” button in visualization:

- Add button to screen: Add a button from Visualization toolbox and set button name.
- Set input configuration of button as shown below:



Configure “Write Recipe” button in visualization:

- Add button to screen: Add a button from Visualization toolbox and set button name.
- Set input configuration of button as shown below:



Similarly, Create Recipe, Delete Recipe commands can be configured.

16.5.4 Copying Recipe Files on Controller

Back up of recipe files can be taken on SD card by using ‘Backup application’ function available in ‘SD card’ menu of ‘System menu’. Recipes created from the application and from device in runtime are stored on SD card along with application. These recipes can be restored on device by using ‘Restore application’ function.

Refer section *SD Card* for more details of ‘Backup application’ and ‘Restore application’ functions.

16.5.5 User Cases

- Recipes created on controller memory in runtime cannot be uploaded in CoDeSys recipe definition by using ‘Upload Recipes from Device’ option. Instead, user can take backup of controller’s recipe on SD card and transfer these recipes to local PC storage independently.
- Data types such as STRING, WSTRING, LTIME are not supported in CoDeSys Recipe manager.
- Recipes (which are not a part of current recipe definition) from controller memory cannot be loaded in current PLC variables, if data type of recipe variable is changed from CoDeSys application in next downloading.
- All recipes available on controller can only be deleted by using ‘Reset origin’ command. User can delete individual recipe files by using ‘Delete’ button configured on controller’s screen or by using delete file button (✕) in top right corner of ‘Load Recipe’ or ‘Save Recipe as’ dialogues.

17 SD Card

GOC43 is equipped with microSD card slot. microSD card slot is located on the back side of Main unit. Slot is covered by door marked as MEMORY CARD. Below are the specifications of SD cards which can be used with GOC43.

Specification	Description
Type	Micro SD
SD Card Standard	SDHC
Speed Class Supported	Class 4 (4MB/S), Class 10 (10MB/S)
Supported Memory Capacity	4GB to 32GB
File System	FAT32
SD card Dimensions	11 x 15 x 1.0 mm
Recommendations	Transcend, Scandisk, Samsung

Refer section *microSD card Installation* for the procedure of insertion or removal of SD card from the slot.

NOTE

- For optimum performance, make sure that SD card is not more than 80% full. Regularly check free space on SD card to avoid data loss. Make sure that entire SD card memory is available for usage and no other unnecessary files are present on the card. In power on condition, do not remove the microSD card before un-mounting SD card. Accidental removal of SD card may lead to corruption of files. Refer section *System Menu* for un-mounting procedure.
- In few situations, after accessing SD card from PC, card may take few minutes time for mounting after first insertion.
- Though GOC43 should support all microSD cards with specifications mentioned in table above, it is observed that few SD cards are not functioning properly. Use SD cards only with recommended brands and specifications.

In GOC43, SD card can be used for program backup and restore function.

System menu button ‘SD card’ provides access to the operations related to SD card and status information of SD card.

Detailed diagnostic information of related to SD card can be obtained from system variable *_SysvarSDCard*.

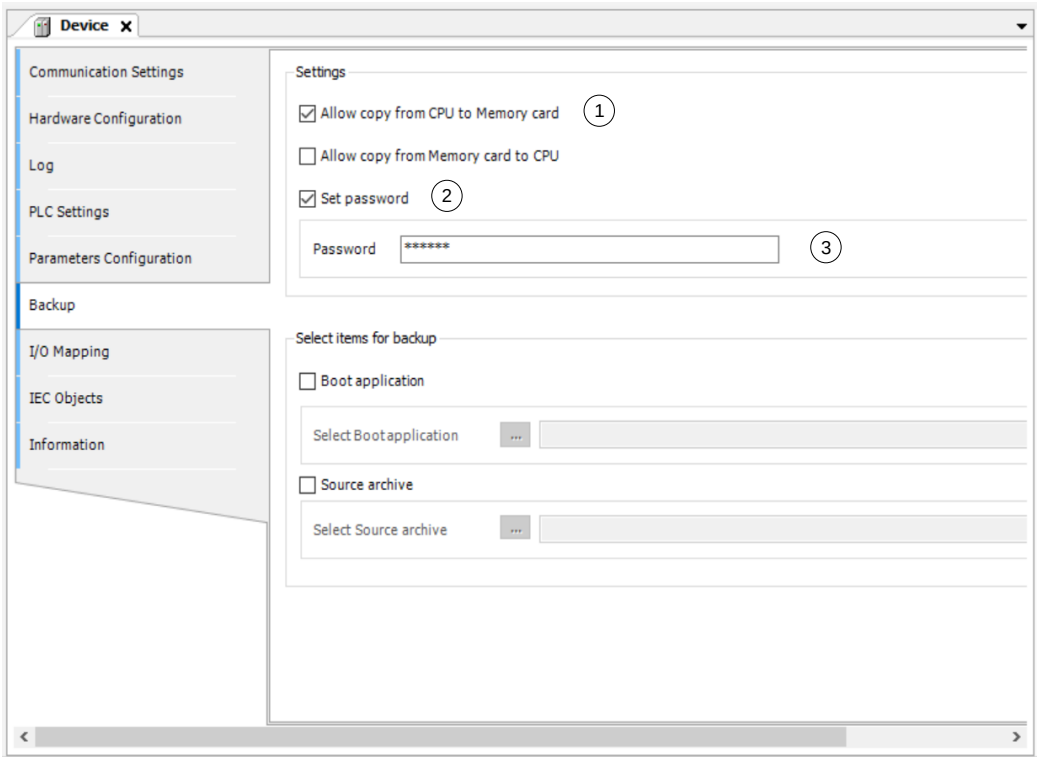
17.1 Backup and Restore

17.1.1 Backup

"Backup" function allows saving application program and / or source code from CPU to SD card.

Enabling backup function and setting password

To use backup function, setting ‘Allow copy from CPU to Memory card’ should be enabled in the device setting. Also, passwords can be set in application program to allow backup/ restore operations.



Sr. No.	Settings	Description
1	Allow copy from CPU to Memory card	Select to allow copy application and /or source code from CPU to Memory Card’. If disabled, backup function will not be allowed from device.
2	Set password	If selected, backup /restore will be allowed only after entering valid password.
3	Password	User can set 6 digits numeric security password to project backup.

Executing backup

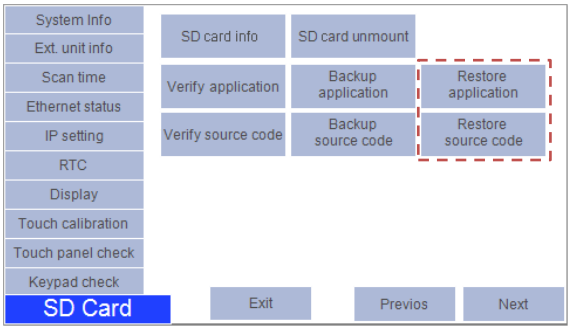
To execute backup operation, follow sequence mentioned below.

This section explains application program backup process only. Follow the same procedure for source code backup by selecting ‘Backup source code’ option in the sequence.

1. Insert SD card in SD card slot.
   Ensure card is formatted with FAT32 and having enough free memory (at least 20%).
2. Enter ‘System menu’
   Press F2 key on device for 3 sec duration to enter into System Menu.
3. Navigate to ‘SD Card’ menu as shown.

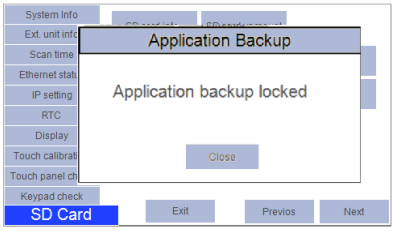
   Open ‘SD card info’ and confirm SD card is ready.

   Touch on ‘Backup application’ or ‘Backup source code’ button to start copy operation.



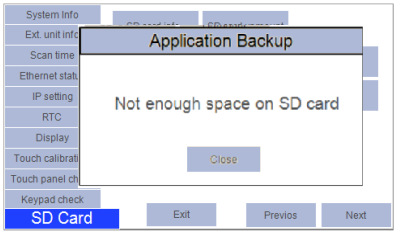
4. If application backup is not enabled in the application program running on device, adjacent message is displayed.

   Application or source code backup is not possible in this case and backup process is aborted.



5. If free size on SD card is not sufficient to copy application program, then device will block backup process with error message as shown below.

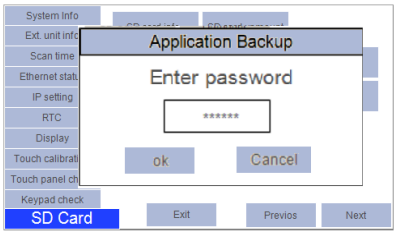
   Make enough (at least 20%) free space on SD card and try again.



6. Device will check if password is set for application backup / restore.

   If password is set, then message will be displayed for user to enter the password.

   Enter valid 6 digits numeric password to proceed with backup.



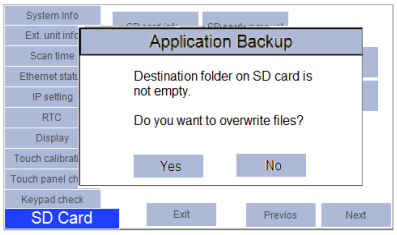
NOTE

During backup action, GOC compares password entered by user with password in application program stored on the device and allows backup only if password matches.

7. If SD card already contains application backup, then warning message is displayed as shown.

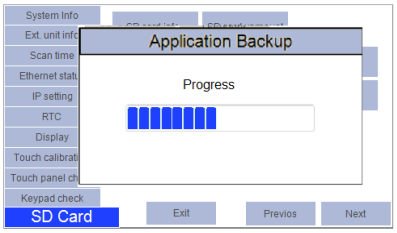
   Selecting ‘No’ will abort backup operation.

   Selecting ‘Yes’ will overwrite application program files on SD card.



8. Once backup process is started, progress of file copying is displayed as shown below

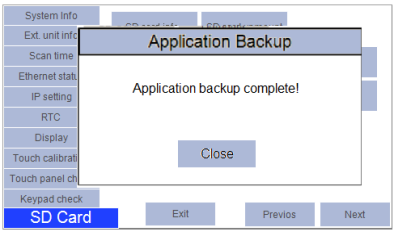
   Wait till CPU copies files to SD card.



9. Once application backup is completed successfully, message is displayed as shown.

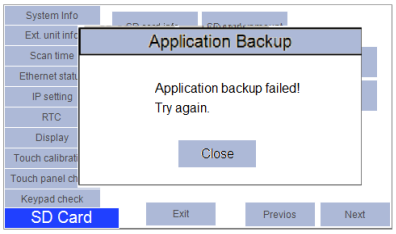
   Touch on ‘Close’ button to complete the process.

   You can unmount SD card and either copy files on SD card to PC or use this SD card to restore application to another GOC43.



10. During application backup, if backup process gets failed due to any reason, then error message is displayed.

    In this case, it is recommended to format SD card before retrying backup process again.

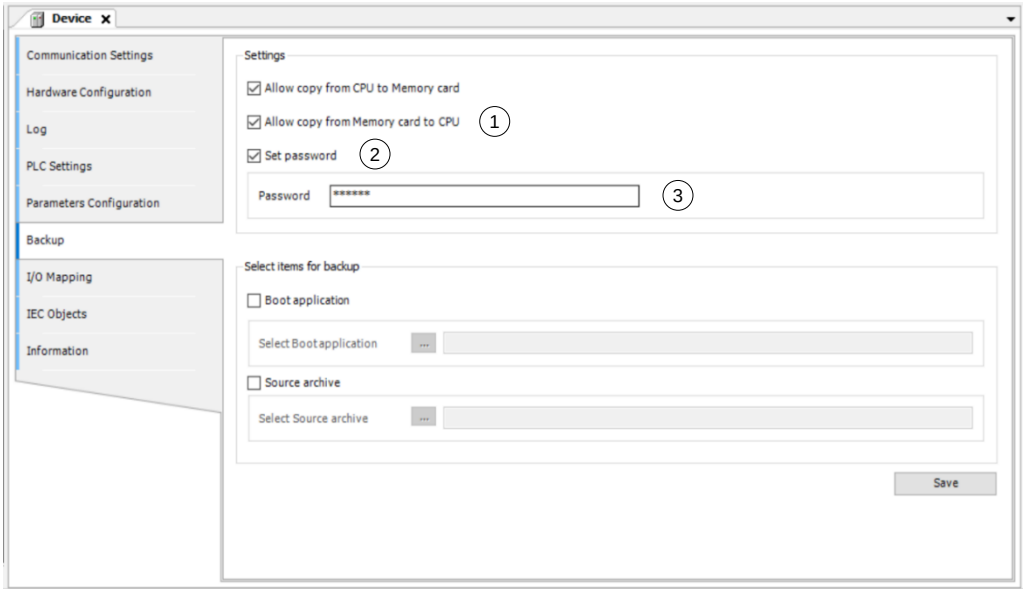


17.1.2 Restore

"Restore" function allows copying the application program and source code from SD card to CPU.

Enabling restore function on device and setting password

To use restore function, setting ‘Allow copy from Memory card to CPU’ should be enabled in device setting. Also, password can be set in application program for backup / restore operations.



Sr. No.	Settings	Description
1	Allow copy from Memory card to CPU	Select to allow copy application and /or source code copy from Memory Card to CPU. If disabled restore function will be locked from device.
2	Set password	If selected, backup/restore will be allowed only after entering valid password.
3	Password	User can set 6 digits numeric security password to project backup.

Copying application program and / or source code to SD card

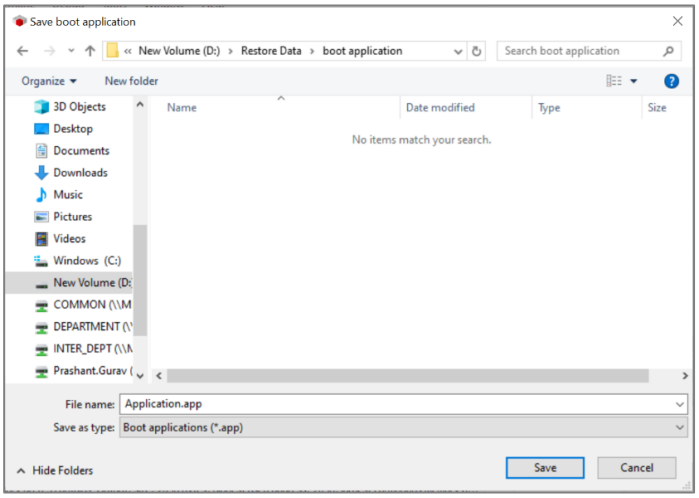
Let's first understand how to make SD card ready for restore, that means how to copy application and source code from PC to SD card. Once copied to SD card, application program and / or source can be copied to multiple GOC43 devices using restore function.

Method 1: Using 'Backup' tab in device properties.

Follow below steps to copy application program and /or source code to SD card

1. **Create boot application**

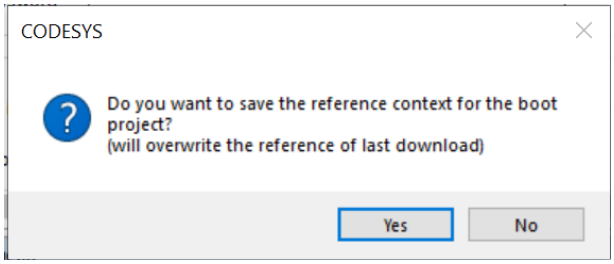
   This step is required if you want to restore application program. If you want to restore source code only then this step can be skipped.
   Open application program to be copied to SD card. Compile application and ensure that there are no errors.
   Execute command 'Online'→'Create boot application'. 'Save boot application' dialogue will appear as shown below.



   Select path on local drive of PC and click button save.

   Do not change file name from 'Application.app'

   Below message will be displayed

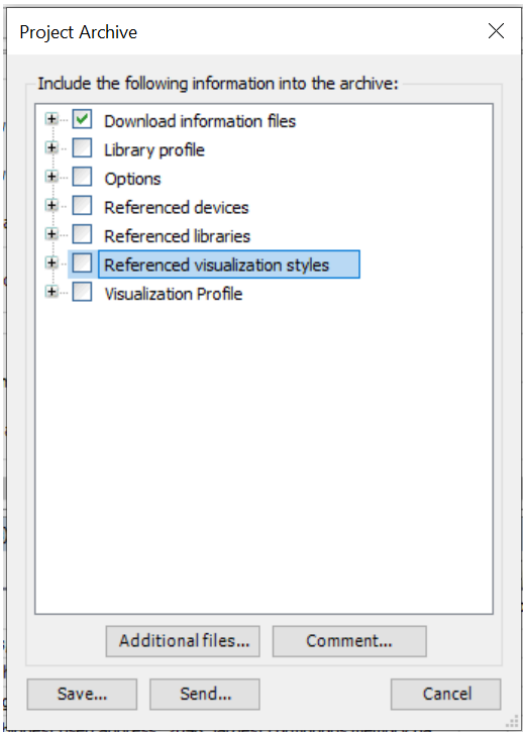


   Check 'Yes' to save application. Folder 'PlcLogic' and file 'Application.app' will be saved at selected path.

   Do not make any changes to the contents of folder and file.

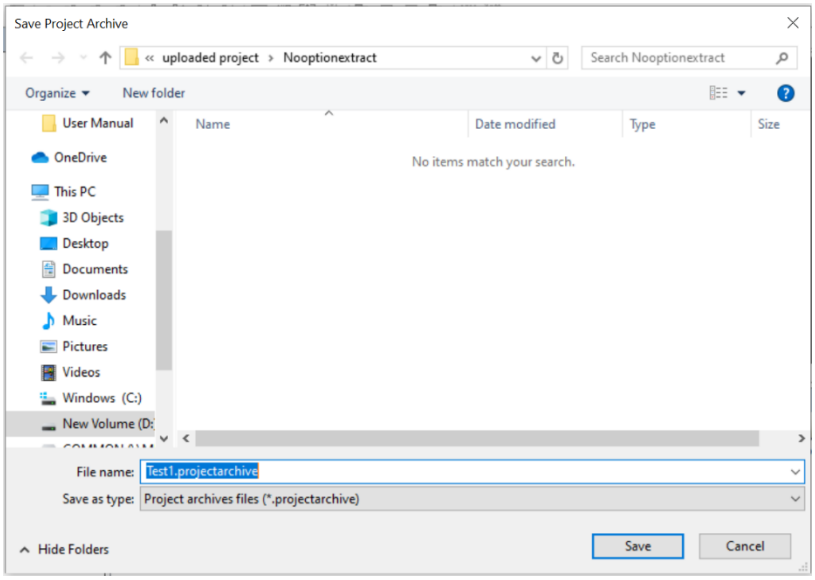
2. Create project archive

This step is required if you want to restore source code. If you want to restore application program only then this step can be skipped.
Open application program whose source code to be copied to SD card. Compile application and ensure that there are no errors.
Execute command 'File' → 'Project Archive' →'Save/Send Archive…'. This will open 'Project Archive' dialogue as shown below,



Select options as shown in above picture and click on 'Save…' button.

Save Project Archive dialogue will appear as shown below,



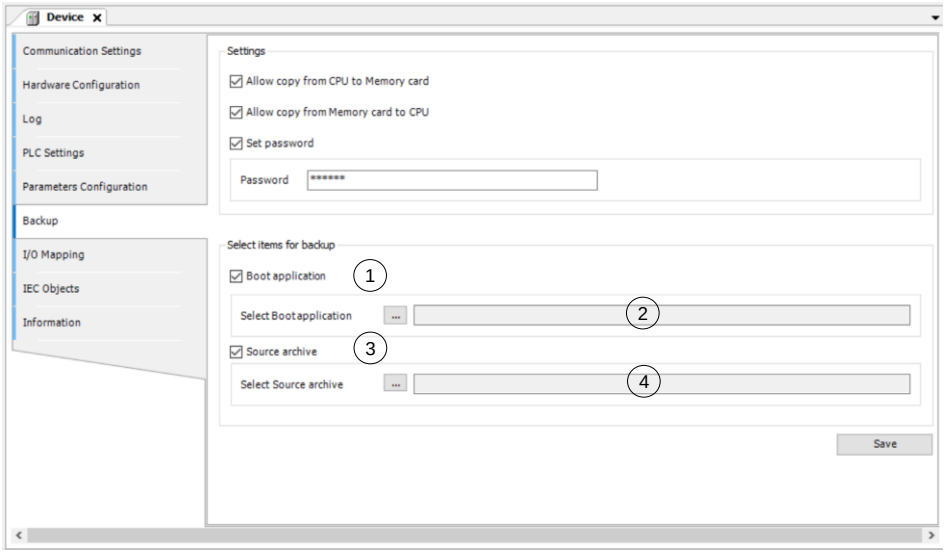
Select path on local drive of PC and click button save.

3. Create Package

This step creates package using boot application created in step 1 and project archive created in step 2.

To create package, go to ‘Backup’ tab in device editor.

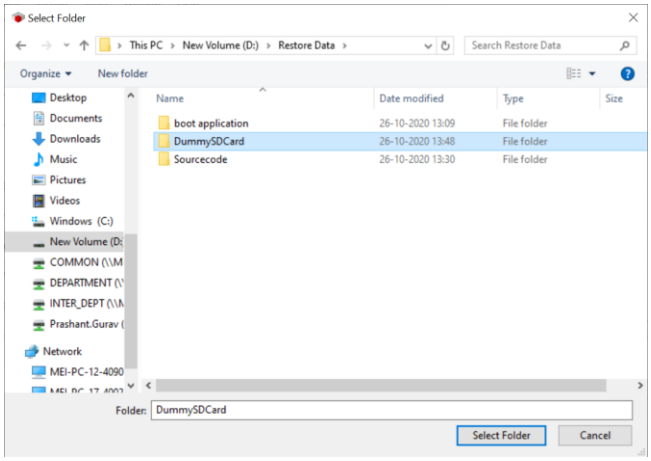
In ‘Select items for backup’, enable ‘Boot application’ and / or ‘Source archive’.



Sr. No.	Settings	Description
1	Select ‘Boot application’	Select to include boot application in the package. If unchecked, the package will not contain boot application and application restore cannot be executed.
2	Select boot application to include in the package.	Select boot application created in step 1.
3	Select Source archive to include in the package.	Select to include ‘Source archive’ in the package. If unchecked, the package will not contain source archive and source code restore cannot be executed.
4	Select Source archive path	Select source code archive created in step 2.

Select items to be included in the package and click Save button.

Select folder to save the package and click ‘Select folder’,



‘GOC43’ folder containing the package will be created at selected folder.

You should copy ‘GOC43’ folder to root directory of SD card to execute restore function.

Method 2: Using ‘Backup’ function of CPU

This method uses ‘Backup application program and source code’ function to copy files to SD card. Refer section ‘*Backup*’ for more details.

Once application and source code are copied to memory card using backup function, card can be used to restore application program and / or source code restore on multiple GOC43 devices using restore function.

Executing restore

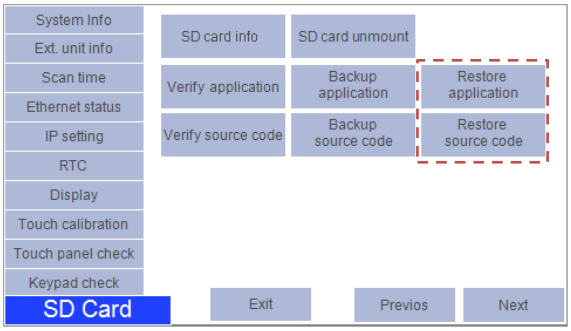
To execute restore operation on device, follow sequence as mentioned below. This section explains application program restore process only. Follow the same procedure by selecting 'Restore source code' option in the sequence.

1. Insert SD card in SD card slot on GOC43 device.
   Ensure card is formatted with FAT32 and having package saved in the SD card.
2. Enter 'System menu'
   Press F2 key on device for 3 sec duration to enter into System Menu.
3. Navigate to 'SD Card' menu as shown.

   Open 'SD card info' and confirm SD card is ready.

   'Restore application' or 'Restore source code' buttons allow user to copy application and source code file from SD card to GOC43 respectively.

   Touch on 'Restore application' or 'Restore source code' button to start copy operation.



4. If application restore is not enabled in application program running on device, message is displayed as shown in adjacent screen.

   Application or source code restore is not possible in this case. Restore process will be aborted.

   Enable setting 'Allow copy from Memory card to CPU' in application program and try again.

5. Device will check if password is set for application backup /restore.

   If password is set, then message will be displayed for user to enter the password.

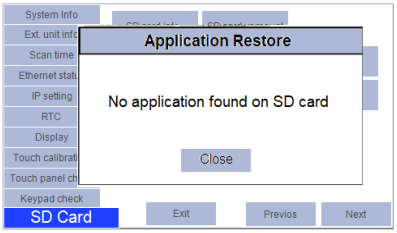
   Enter valid 6 digit numeric password to proceed with restore.

NOTE

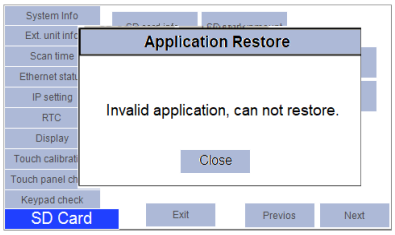
During restore action, CPU compares password entered by user with password of application program stored on SD card and allows restore only on matching entry done by user.

6. After receiving correct password, device checks for application program in 'Restore package' on SD card.

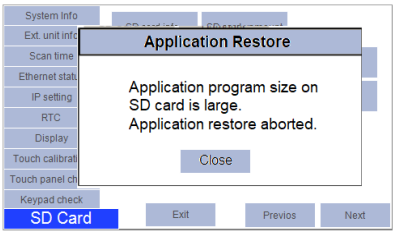
   Error message is displayed if device does not find valid application on SD card.



Message is displayed in case of invalid application.



Message is displayed if size of application program is exceeding device memory.

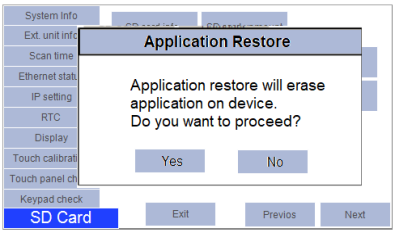


In such cases, copy ‘package’ with valid application program and try again.

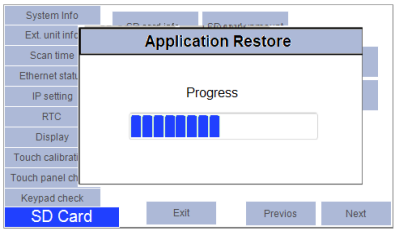
7. Once confirmation of validity of application is done, then message is displayed as

   Select ‘Yes’ to start restores action.

   Selecting ‘No’ to abort restore action.



8. During restore action, progress is displayed. Wait till files CPU copies files from SD card.



9. Once application restore is completed successfully, message is displayed as shown.

   Power cycle GOC to start restored application.

10. During application restore, if restore process gets failed due to any reason then error message is displayed.

    In this case, it is recommended to start restore process again.

17.1.3 Verify

"Verify" function compares application program and / or source code on SD card with that of the device.

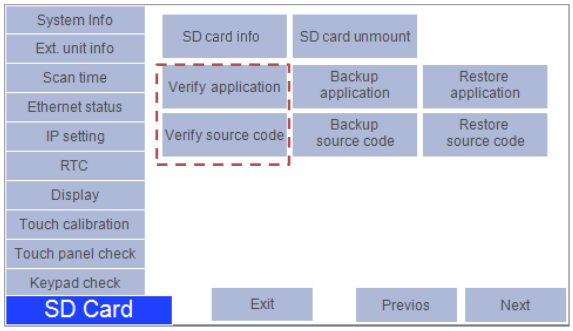
Executing Verify

To execute verify operation on device follow sequence as mentioned below, here only application program verification process is explained. Follow the same procedure with selecting 'Verify source code' option in the sequence.

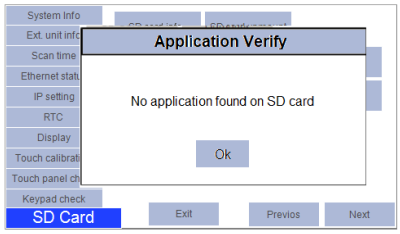
1. Insert SD card in SD card slot on GOC43 device.
   Ensure card is formatted with FAT32 and having restore package saved in the SD card.
2. Enter 'System menu'
   Press F2 key on device for 3 sec to enter in System Menu.
3. Navigate to 'SD Card' menu as shown in the screen below.

   Open 'SD card info' and confirm SD card is ready.

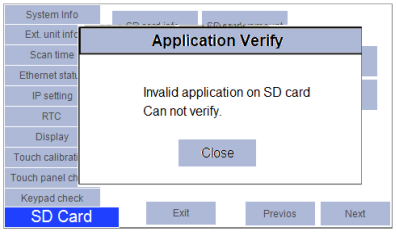
   'Verify application' or 'Verify source code' buttons allow user to compare application and source code file from SD card to GOC43 respectively.



4. Touch on 'Verify application' or 'Verify source code' button to start copy operation.
5. After starting verification, device checks for application program in 'Restore package' on SD card.
6. If device does not find valid application on SD card, then it displays error message as

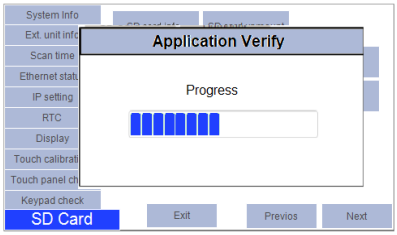


   Error message is displayed in case of invalid application.

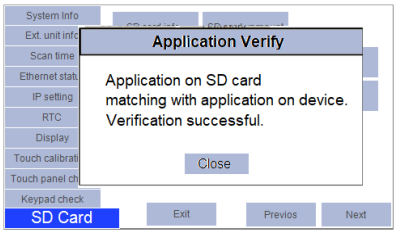


7. During verification, device checks application program and all supporting files on device and SD card.

   For its progress, progress bar is displayed.



8. Once verification process is completed successfully and application program on device and SD card are matching then message is displayed.



If application program on device and SD card are not matching, then message is displayed as

'Application on SD card not Matching with application on device. Verification failed'

17.2 Data Logging

Data logging feature allows user to log PLC variable values with timestamp into micro SDHC memory card in csv file format. Users can retrieve these logged records by reading .csv files using FTP client over Ethernet port. The logged data from csv files can be further used for analysis, records, and diagnostic purposes.

NOTE

Data logging function is supported in GOC Toolkit V3 version v1.03.05.00.
Refer document 'N18006AAMH07 GOC43 Version Compatibility' for suitable firmware version.

17.2.1 Specifications

Item	Description
Number of data log settings	2
Number of data elements	32 per setting
Data Types	BIT, WORD, DWORD, INT, DINT, REAL, STRING (up to 80 characters)
Maximum size of log record	512 Bytes per setting
Sampling method	• **Time Based Sampling:** Periodic time sampling at duration 500ms to 86400s. • **Condition Trigger Sampling:** Application trigger-based sampling
Minimum sample Interval *1	• 500ms for log record size less than 256 bytes • 1 sec for log record size more than 256 bytes and less than 512 bytes
File format	.csv
File switching	• Based on day change (New file every day) • Based on condition trigger from application • Based on number of records
Maximum number of files	2000 (1000 files per setting)
Maximum number of records	32000 per file
File access	• Using FTP client over Ethernet. Connection of 1 client at a time is allowed. • By removing card from GOC and reading .csv files directly in PC.

*1 Though user can generate condition trigger in alternate scan, practically minimum sample interval depends on number of data log elements, size of log record and scan time. Writing to card is relatively slow process compared to application program execution.

For data logging, an internal buffer of 8 KB (per setting) is reserved. Log records are stored in this buffer before writing to the card. Once the buffer reaches 4 KB size, data records are written to the card. This helps in reducing the number of write cycles to the card.

If the internal buffer is filled with log records faster than card writing time, data loss may occur. This situation is indicated by system variable '`_SysvarDatalogging.SettingN.bLogStatus`' = 6 here N = 1 and 2.

Refer section *System Variables → SysvarDataLog* for more details.

Always make sure that the user should not trigger data log records too frequently i.e. faster than minimum sampling interval.

17.2.2 Before Configuration

This section contains information related to data logging which should be known before configuring the data logging function.

1. Folder structure
2. Format of data log file
3. Log records
4. Data log elements
5. Data log trigger sources
6. Naming format for data log file
7. File switching conditions

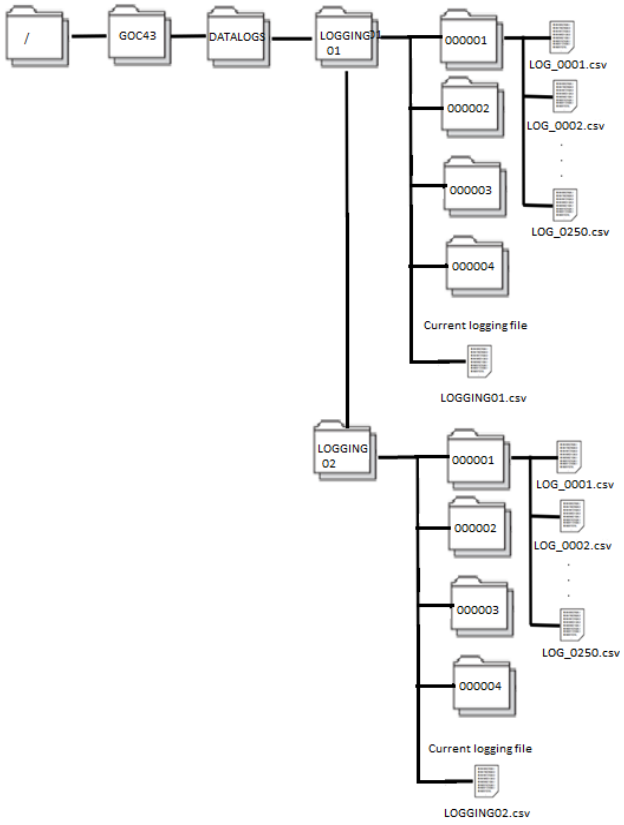
NOTE

It is mandatory to format SD memory card using “SD Card Formatter” utility to use it for data logging function in GOC43.

Refer section *Appendix → Getting SD Memory Card Ready for Data Logging* for more details.

Folder structure

A folder named "DATALOGS" is created at the path "root/GOC43" on the card when data logging is enabled. The image below shows the organization of the data logging folder on a card.



There are two subfolders called "LOGGING01" and "LOGGING02" in the "DATALOGS" folder that hold the log files for Setting1 and Setting2, respectively.

Log folders LOGGING01 and LOGGING02 further contain 4 subfolders namely 000001,000002,000003,000004. Each subfolder stores 250 of total 1000 log files of setting.

Files from 1 to 250 are kept in 000001, 251 to 500 are kept in 000002, 501 to 750 files are kept in 000003 and 751 to 1000 are kept in 000004 sub folder. Log files are divided in four sub folders for faster access.

Current log files "LOGGING01.csv" and "LOGGING02.csv" can also be found in the log folders "LOGGING01" and "LOGGING02," respectively. These are the data logging files that are currently being updated with data records. When the file switching condition is met, the current logging file is saves in subfolders depending on its file number. Further, fresh logging is continued in current file.

Format of data log file

Example of logged file LOG_0001.csv is as shown below:

	A	B	C	D	E	F	G	H	I	J	K
1	Data Logging	GOC43_1	3	4	5	2					
2	Setting1_Boiler Data										
3	DATETIME[YYYY/MM/DD HH:MM:SS]	INTERVAL	INDEX	BOOL[DEC	WORD[DEC:	DWORD[D	INT[DEC: 0]	DINT[DEC: 0]	REAL[DEC: 0]	REAL[DEC: 0]	STRING[DEC: 0]
4	TIME	INTERVAL [ms]	INDEX	BOILER FEEDBACK	LOW PRESSURE SETTING	HIGH PRESSURE SETTING	LOW TEMPERATURE SETTING	HIGH TEMPERATURE SETTING	CURRENT PRESSURE VALUE	CURRENT TEMPERATURE VALUE	BOILER STATUS
5	29-08-2022 16:26	0	1	0	0	200	-100	100	0	0	Boiler Status is Healthy
6	29-08-2022 16:36	600000	2	1	0	200	-100	100	100.5	50.549999	Boiler Status is Healthy

Content of log record file are explained below.

Row No	Content	Description
1	Header row	It contains following information, Fixed text (Data logging), Fixed text (GOC43_1), Data type information row number, Data name information row number, logged data start row number, File comment row number
2	File comment row	It contains a file comment. File comments can be defined in configuration of each setting. Refer section *Configuration* for more details.
3	Data type row	It mentions data type of data log elements. Refer section *Data log elements* for more details.
4	Data header row	It contains user defined names (data header) of data log elements.
5 and onwards	Log records	It contains values of data log elements (PLC variables) at the time of log. Refer section *Data log elements* for more details.
	CR LF	Return code at the end of each line.

Log records

A single row of logged data with set of time stamp, interval, index, values of data log elements and separator characters “,” is referred to as a log record.

The size of single log record is limited to 512 bytes maximum.

Data log elements

Users can select a PLC variable of supported data type from application program as data log element.

Maximum 32 data log elements can be selected per setting for a log record.

Users can select variables declared by symbolic name as data log element.

The table below shows supported data types, their display formats and maximum number of characters consumed.

No.	Data Type	Available Characters	Display Format	Max. Number of Characters
1	BOOL	0,1	#	1
2	WORD	0 to 9	#####	5
3	DWORD	0 to 9	##########	10
4	INT	-, 0 to 9	##### -#####	6
5	DINT	-, 0 to 9	########## -##########	11
6	REAL	0 to 9, +, -	-######.### ######.### (32-bit single-precision floating point (IEE754)	14
7	STRING	ASCII characters	ASCII string	1-80

NOTE

→ Leading 0s are not included for numerals.

→ '+' Sign not included for positive integer value.

→ String is not added with null character.

Data log trigger sources

Two log trigger options are supported.

- **Time Based Sampling**
  - Triggers data log sampling at specified time interval.
  - Sampling time can be set between 500 to 86400000 msec in steps of 50 msec or 1 to 86400 sec in steps of 1sec.
- **Condition Trigger Sampling**
  - Triggers data log sampling if specific condition is met in user application.
  - User can trigger sampling of log data through system variable `'_SysvarDatalogging.SettingN.bLogTrigger'` here N = 1 and 2.

User can enable both log trigger sources at a time. i.e., data is logged after specified time regularly and occasionally when specific condition is met.

Note that data logging functionality is executed at the end of every PLC scan i.e. at the end of execution of POU PLC_PRG. Hence, delay of one scan time is possible in processing of log trigger.

Writing to card is relatively slow process compared to application program execution.

Always make sure that you are not triggering data log records too fast i.e. faster than minimum sampling interval specified. Triggering faster data logs may lead to data loss.

Naming format for data log file

For both tabs ‘Setting1’ and ‘Setting2’, data log files can be created as per configured ‘file name’ format.

Below are the supported ‘file name’ formats,

1. `<File Name Prefix>_<File Number>.csv.`
2. `<File Name Prefix>_<File creation Date and Time>_<File Number>.csv`
3. `<File Name Prefix>_<File creation Date>_<File Number>.csv`

Here, `<File Name Prefix>` is user defined. File name prefix can be defined in configuration of each setting. Refer section *Configuration* for more details.

`<File number>` is defined by `'_SysvarDatalogging.SettingN.wLogFileNumber'` system variable. here N = 1 and 2.

When the condition for creating new log file is detected, file number is incremented by 1 and file is generated with incremented file number value. After reaching 1000, file number is reset to 1.

System variables for log file number are of read/write type. If required, user can modify file number by directly writing to the system variable from the application program.

File switching conditions

User can configure the condition for switching of log file as per the application requirement. User can enable one or more conditions from following 3 options:

- **Day Change File Switching:**
  Creates a new file every day. i.e. at 00:00 AM.
- **Condition Trigger File Switching:**
  Switches file at rising edge of system variable `'_SysvarDatalogging.Setting`**`N`**`.bCreateNewFile'` here N = 1 and 2.
- **No of Records File Switching:**
  Switches file when number of records in a file reaches to user defined ‘File Records Count’ setting. By default, this file switching condition is enabled with ‘File records count’ equal to 32000. User cannot disable this file switching condition. However, users can reduce ‘File Records Count’ from maximum 32000 to minimum 1000.

After detecting file switching condition, new file is generated with incremented file number. If file with same name is already available on card, it gets overwritten.

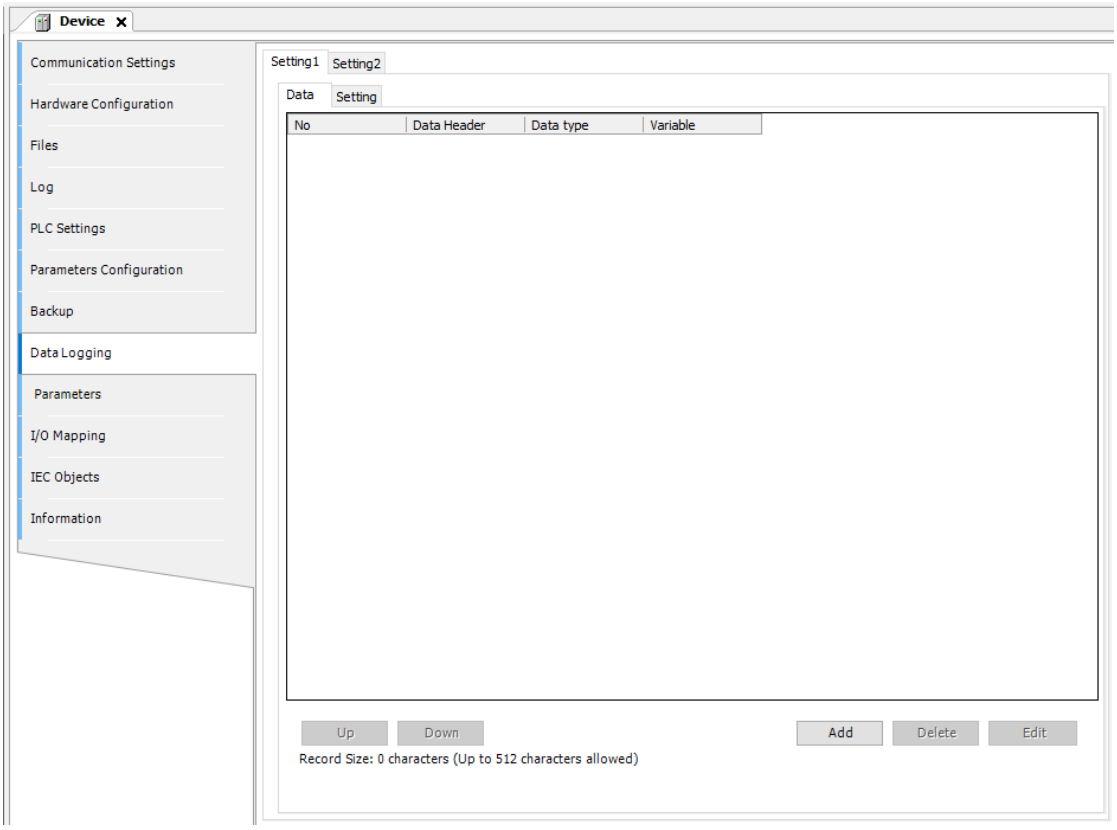
17.2.3 Configuration

Device (GC43) → Data Logging allows user to configure data logging functionality as per the application requirement.

NOTE

- Before configuration of data logging function, go to 'Device (GC43) → PLC Settings →Always update variables →set to 'Enabled 2 (always in bus cycle task)'.
  If application is downloaded without this setting, data logging may not start even after enabling data logging.
- Make sure that RTC status is healthy, date and time are set to current date and time. In case of RTC error, data get logged with incorrect time stamp.

Tab 'Device (GC43) → Data Logging →Setting1/Setting2' facilitates user configuration for data logging. The following dialogue appears for data logging configuration in 'Setting1' and 'Setting2'.



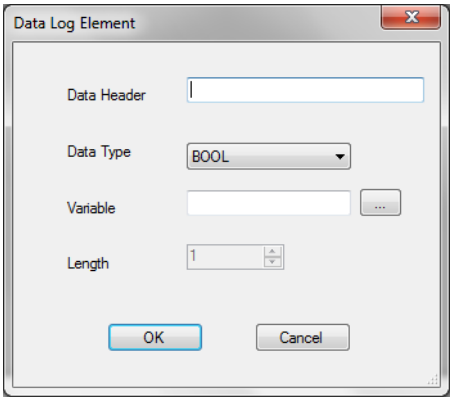
Two tabs are available under Setting1 and Setting2 as; '*Data*' and '*Setting*'.

'*Data*' tab is used to manage data log elements and

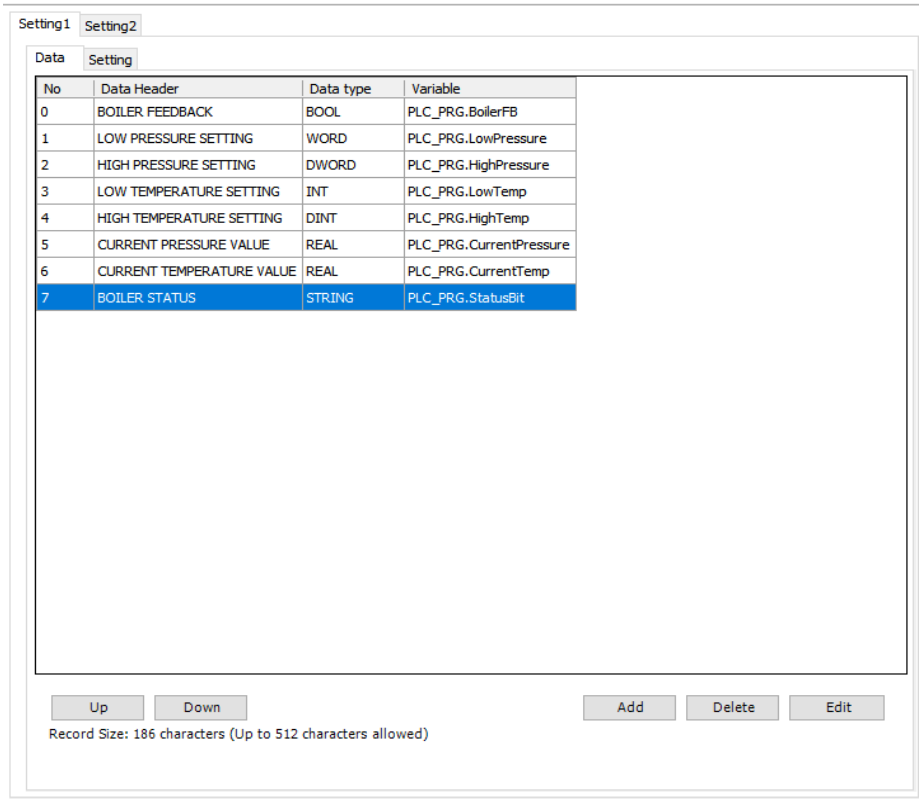
'*Setting'* tab allows user to set various configuration parameters related to log file content, log trigger source and file switching.

Data tab

The following buttons are provided to manage a list of log elements.

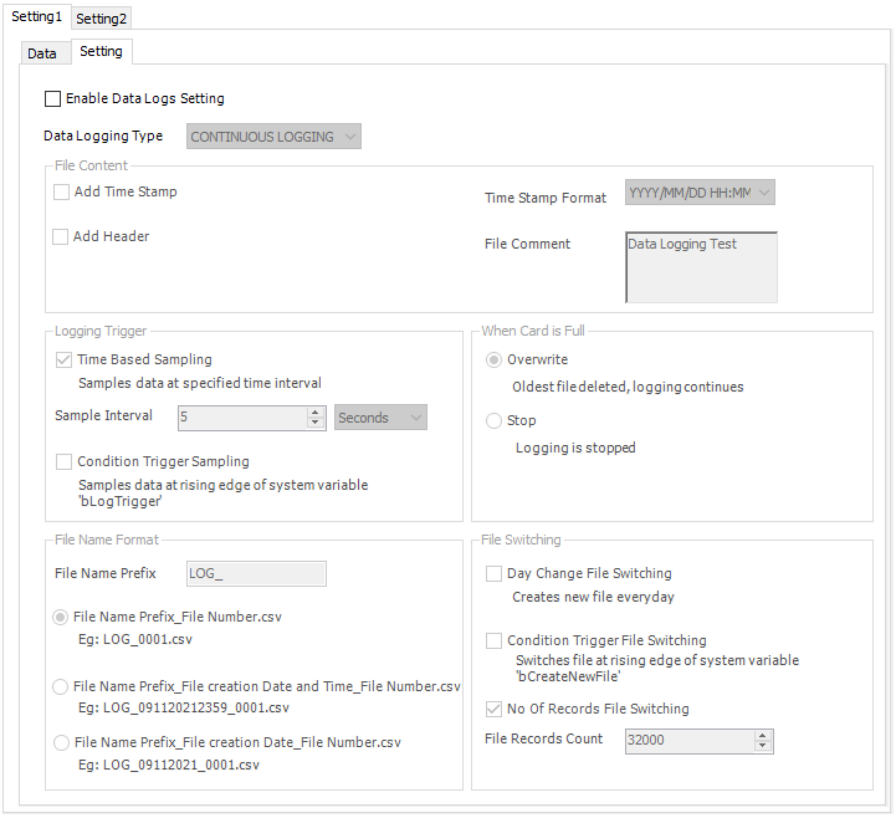
Button Name	Details
Add	Opens 'Data Log Element' dialogue to add new data log element.  Define data header up to 32-character size. Select data type of variable from BOOL, WORD, DWORD, INT, DINT, REAL and STRING. Select associated PLC variable. Users can select variables declared by symbolic name. **Important:** • Entry to direct address (%IW / %QW / %MW / %MD etc.) are not allowed. To select direct address as data log element, declare a variable with symbolic name and set required direct address in variable declaration. • Direct boolean address (%IX, %QX, %MX) or symbolic boolean variable with direct address is not allowed. For logging of boolean variables, use symbolic variables declared as boolean without direct address. Length defines the number of characters consumed by log element. For the data types other than STRING, length is automatically set to maximum characters consumed by selected data type. For STRING data type, user can set length from 1 to 80 characters. Maximum 32 entries are allowed in the list for each setting i.e. 'Setting1' and 'Setting2'.
Delete	Deletes selected entry from list.
Edit	Opens 'Edit Data Log Element' dialogue for modification.
Up	Moves up selected entry in the list.
Down	Moves down selected entry in the list.

Following is the '*Data*' tab view after adding data log elements under Setting1:



Setting tab

Following is the default view of '*Setting'* tab of both 'Setting1' and 'Setting2':



Group Name	Setting	Details
-	Enable Data Logs Setting	Allows to enable/disable of data logging setting configuration.
	Data Logging Type	It is fixed to Continuous logging.
File Contents	Group defines contents of file.	
	Add Time Stamp	Allows enabling / disabling inclusion of time stamp for a log record/
	Time Stamp Format	Allows selection of time stamp in following formats: YYYY/MM/DD HH:MM:SS DD/MM/YYYY HH:MM:SS HH:MM:SS
	Add Header	Allows enabling / disabling inclusion of file header which includes Header row, File comment row, Data type row and Data header row in log file. If disabled, log file will contain log records only.
	File Comment	Allows to add file comment for a log file. This comment will appear as file comment in data log file. Refer section 'Format of log file'. Maximum length: 50 Characters.

Group Name	Setting	Details
Logging Trigger	Group allows selection of logging triggers. At least one logging trigger must be selected.	
	Time Based Sampling	Enables periodic logging after a predefined Sample Interval. Sample Interval can be set as 500ms to 86400000 msec in steps of 50 msec. OR 1 to 86400 sec. in steps of 1 sec. Data Logging will not allow setting of Sample Interval less than 1 sec for Record Size greater than 256 characters.
	Condition Trigger Sampling	Enables accepting data log trigger from application program. For 'Setting1': data is sampled at rising edge of system variable '`_SysvarDatalogging.Setting1.bLogTrigger`'. For 'Setting2': data is sampled at rising edge of system variable '`_SysvarDatalogging.Setting2.bLogTrigger`'.
File Name Format	Group defines file name format of log files.	
	File Name Prefix	File name prefix can be defined by user. Default prefix is 'LOG_'. Maximum length: 4 characters.
	Format	User can select file name format from 3 options: 1.`<File Name Prefix>_<File Number>.csv` For example: LOG_0001.csv Here, 'LOG_' is prefix and '0001' is file number. 2.`<File Name Prefix>_<File creation Date and Time>_<File Number>.csv` For example: LOG_160520221735_0002.csv Here, 'LOG_' is prefix. '160520221735' is date 16-05-2022 (DD-MM-YYYY) and time 17:35 (HH:MM) when file is created. '0002' is file number. 3.`<File Name Prefix>_<File creation Date>_<File Number.csv` For example: LOG_16052022_0003.csv Here, 'LOG_' is prefix. 16052022' is date 16-05-2022 (DD-MM-YYYY) when file is created. '0003' is file number.

Group Name	Setting	Details
When Card is Full	Defines action when Number of files count reached to maximum i.e.1000.	
	Overwrite	File with file number defined by system variable . `'_SysvarDatalogging.SettingN.wLogFileNumber'` will be overwritten. e.g. after reaching file count 1000, new file is created by overwriting file number 1.
	Stop	Data logging is stopped when number of files count for setting reached to maximum i.e.1000 .
File Switching	Defines file switching conditions. Multiple file switching conditions can be selected at a time.	
	Day Change File Switching	New file is created when day changes.
	Condition Trigger File Switching	'Setting1': New file is created on rising edge of a system variable `'_SysvarDatalogging.Setting`**`N`**`.bCreateNewFile'`. `here N = 1 and 2.`: New file is created on rising edge of a system variable `'_SysvarDatalogging.Setting2.bCreateNewFile'`
	Number Of Records File Switching	New file is created if number of log records in a file exceeds defined 'File Records Count'. Value of 'File Records Count' can be defined between 1000 to 32000.

To start data logging, system bit `SysvarDatalogging.SettingN.bEnableLogging` should be set in the application program. N is 1 and 2 for setting 1 and 2, respectively.

17.2.4 Conditions of Loss of Data Records

This section explains situations when there is the possibility of loss of data records.

Power off

When data logging is in progress, file save operation is performed periodically after every 1 min. In case of power fail, data log records of last 1 minute before power fail may get lost.

Log file is also saved when data logging is disabled by user. If required, data log files of 'Setting1' and 'Setting2' can be saved forcefully by disabling data logging system variables `'_SysvarDatalogging.SettingN.bEnableLogging'`

Here, N = 1 and 2. from application program.

Buffer full condition

Though user can generate condition trigger in alternate scan, practically minimum sample interval depends on number of data log elements, size of log record and scan time. Writing to the card is a relatively slow process compared to application program execution.

For data logging, an internal buffer of 8 KB (per setting) is reserved. Log records are stored in this buffer before writing to the card. Once buffer reaches 4 KB size or 1 min duration is elapsed, data records are written to card. This helps in reducing the number of write cycles to cards.

If the internal buffer is filled with log records faster than card writing time, data loss may occur. This situation is indicated by system variable `'_SysvarDatalogging.SettingN.bLogStatus' = 6` here N = 1 and 2.

If card is corrupted

The following conditions may cause SD card failures or malfunctions.

- In power ON condition, SD card is removed without unmounting.
- Power is switched OFF. (Specifically, while writing data to file system) without disabling data logging.

In such conditions, the file system on SD card may get corrupt and which may lead to permanent data loss.

17.2.5 Effect on Scan Time

Use of Data logging function may increase execution time (scan time) of 'Main task'. Increase in scan time due to use of data logging function depends on the data logging configuration settings by user.

Typical increase in scan time due to data logging configuration, is as below.

Record size of Setting1	Record size of Setting2	Scan time increment (ms)
128	0	4-5
256	0	6-7
512	0	6-7
128	128	4-5
256	256	7-8
512	512	7-8

17.3 FTP Server

GOC43 can be configured as FTP server. File Transfer Protocol (FTP) is a protocol used to transfer a file over the internet from one host to another.

Users can access data log files using FTP client. Users can only read (from device to FTP client) or delete data log files. Writing (from FTP client to device) is not allowed.

Connection of 1 client at a time is allowed.

NOTE

FTP server function is supported in GOC Toolkit V3 version v1.03.05.00.
Refer document 'N18006AAMH07 GOC43 Version Compatibility' for suitable firmware version.

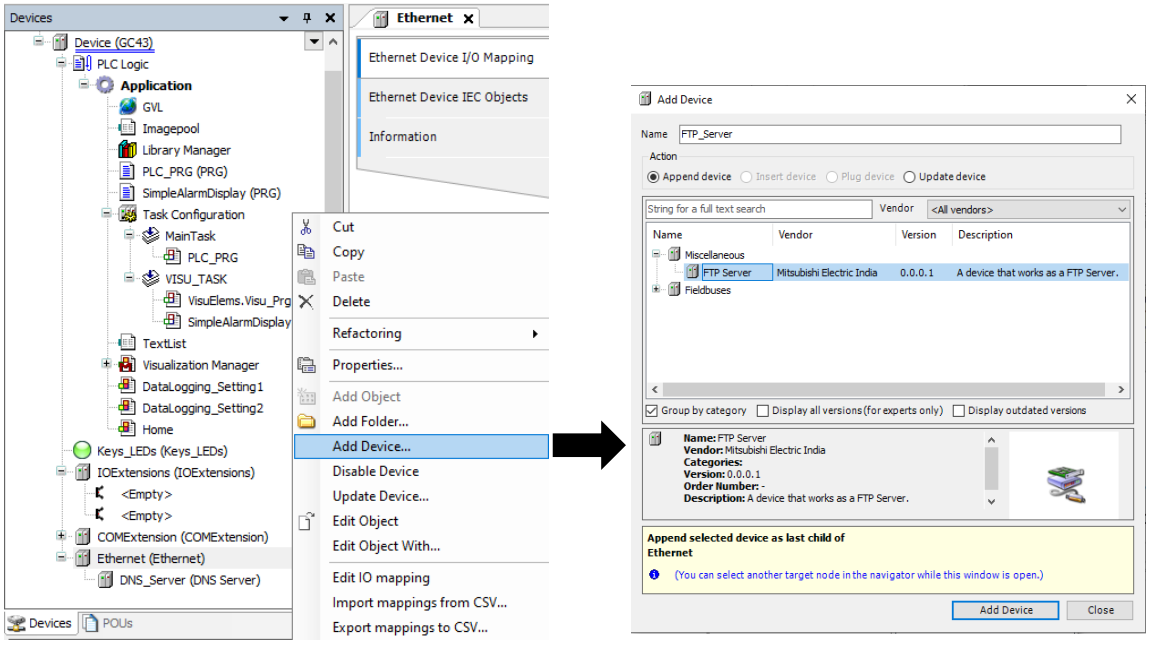
NOTE

Use of FTP function consumes 4 ethernet connections. If you want to use FTP server function of GOC, make sure at least 4 out of 8 ethernet connections are free or not used.

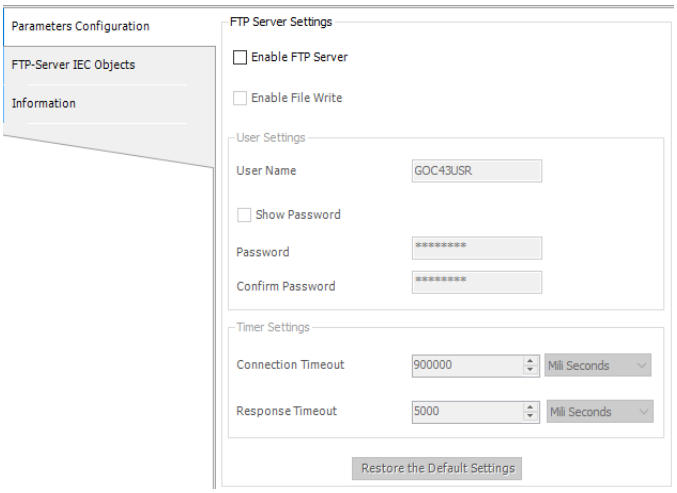
17.3.1 Configuration of FTP Server

Follow the steps below to configure GOC43 as a FTP server.

1. In Device (GC43), right click on Ethernet (Ethernet) slot and add device FTP_Server as shown below.



2. Double click on FTP Server device to enable it and configure parameters.

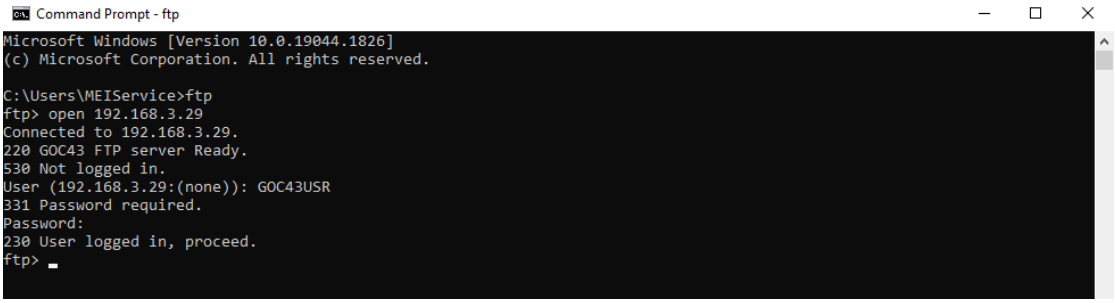


3. FTP Server Settings:

No.	Parameter	Default Value	Description
1	Enable FTP Server	Unchecked	If checked, FTP server function is enabled. It allows user to configure FTP server settings.
2	Enable File Write	Unchecked	User cannot change this setting. User can only read (from device to FTP client) or delete data log files. Writing (from FTP client to device) is not allowed.
3	User Name	GOC43USR	Username to be set in remote FTP client while requesting for file transfer. - Username field length is 12 characters max. - Numbers, alphabets can be used.
4	Show Password	Unchecked	Password field will be visible if checked.
5	Password	GOC43USR	Password to be set in remote FTP client while requesting for file transfer. - Password field length is 32 characters. - Numbers, alphabets, special characters can be used except $.
6	Confirm Password	GOC43USR	Set same password which is set in Password field. Confirm Password field remains hidden.
7	Connection Timeout	900000 msec	Connections will be closed after set timeout if there is no file transfer request from FTP client. Range of setting • 1 to 16383 sec • 1000 to 16383000 msec
8	Response Timeout	5000 msec	Connection will be closed if GOC could not respond to transfer request from FTP client within specified time. Range of setting • 1 to 16383 sec • 1000 to 16383000 msec

17.3.2 Logging into FTP Server

This section describes the steps from starting FTP and logging into the CPU module.Start FTP from Microsoft windows command prompt.



Use the login name and password that are set in "FTP Server Settings" under “Parameters Configuration".

Connection gets established when the FTP server receives correct login name and password from the external device (FTP client).

17.3.3 FTP Server Supported Commands

No.	Command name	Description	
1	ftp	Function	It starts FTP in command prompt.
2	open	Function	Specifies the IP address and port number on the FTP server side. Assign user name and password and connect with the FTP server.
		Format	open < IP address > <port>
		Example	Open 192.168.3.29 21
3	dir	Function	Displays the detailed information (name, date of creation, volume) of the files and subdirectories of specified directory from the device. The specified directory should be present in current directory of the device. This information can be stored on local device by specifying local file name in command.
		Format	dir <remote directory> <local file> <remote directory> : Assign directory from the device for which you want to see a listing. If directory is not specified, the current working directory listing is shown. <local file>: Specify the local file name where the directory listing is to be stored. If a local file name is not given, results are displayed on the screen of windows command prompt.
		Example	dir DATALOGS FILEINFO.txt
		Similar command	ls

No.	Command name	Description	
4	ls (LS)	Function	Displays only name of the files and subdirectories of specified directory from the device. This information can be stored on local device by specifying local file name in command.
		Format	ls <remote directory> <local file>
		example	ls DATALOGS FILEINFO.txt
5	mdir	Function	Stores the detailed information (name, date of creation, volume) of files and subdirectories of specified multiple directories from the device to local storage. The specified directories should be present in current directory of the device. Unlike 'dir' command, directory information is not shown on command prompt screen.
		Format	mdir < remote file1> <remote file2>…<local file>
		Example	mdir LOGGING01 LOGGING02 FILEINFO.txt
		Similar command	mls
6	mls	Function	Stores name of files and subdirectories of specified multiple directories from the device to local storage.
		Format	mdir < remote file1> <remote file2>…<local file>
		Example	mls LOGGING01 LOGGING02 FILEINFO.txt
7	cd	Function	Changes the working directory on the device. cd / : This command redirects to root directory.
		Format	cd /
		Example	cd /DATALOGS/LOGGING01/000001
8	lcd	Function	Changes the working directory on the FTP client. By default, the working directory is the directory in which the ftp command was started (C:/Users/Admin)
		Format	lcd < new local directory path>
		Example	lcd D:\FTP_Logs
9	pwd	Function	Displays current directory name of the device.
		Format	pwd
10	get	Function	Copies file from device to FTP client.
		Format	get <remote file> <local file> <remote file> : Specify the file name to be copied from device. <local file> : Specify the name with which you want to save the file on local storage. If the name is not specified, file is saved on local storage with remote file name.
		Example	get <S1_0001.csv> <LogFile1>
		Similar command	recv

No.	Command name	Description	
11	mget	Function	Copies multiple files from device to FTP client.
		Format	mget <remote file1> < remote file2>… Unlike get command, renaming of file is not allowed and file is copied to local storage with same name. mget * <.file format>: Copies all the files of given file format.
		Example	mget * .csv
12	delete	Function	Deletes the file from device.
		Format	delete <remote file>
		Example	delete <S1_0001.csv>
13	mdelete	Function	Deletes multiple files from device.
		Format	mdelete < remote file1> < remote file2>… mdelete * <.file format>: Deletes all the files of given file format.
		Example	mdelete * .csv
14	quit	Function	Ends the connection with the device (FTP server) and quits the FTP.
		Similar command	bye
15	close	Function	Ends the connection with the device (FTP server).
		Similar command	disconnect
16	prompt	Function	If Prompt mode is turned on, the ftp client prompts during multiple file transfers so that files can be transferred selectively.
		Format	prompt
17	verbose	Function	If verbose mode is on, all ftp command responses including file transfer rate are displayed on screen.
		Format	verbose
18	user	Function	Inputs the user name and password for the connected FTP server.
19	Status	Function	Shows the FTP connection status and settings
20	Help	Function	Displays help for commands used to interact with device.

17.3.4 Precautions

Precautions on FTP client side

- Specify the IP address for the FTP command without zero fill.
  Do: 192.168.3.3
  Don't: 192.168.003.003
- The FTP command specifications may differ from this manual depending on the FTP client. In this case, refer to the manual of the selected FTP client to check the functions and operation methods.
- Writing to FTP server (transferring files from FTP client to device, renaming files stored on device) is not supported. Write commands such as append, put, send, rename are not supported in GOC43 FTP server.
- If the FTP communication is blocked by a firewall on the FTP client side, data cannot be transferred from the FTP server.

Precautions on FTP server side

- You can only access the files of GOC43 root folder present in the SD card installed on a device.
- Do not power off the device or eject the SD card during file access. The file could be damaged if these are attempted.
- Only one FTP client can log into the device (FTP server) at a time.
- The file transfer processing time will differ according to the Ethernet line's load rate (line congestion), processing burden of device (FTP server) and system configuration (i.e. distance between FTP server and FTP client)

18 Appendix

18.1 Updation Time for Analog Input

This section is applicable for calculating updation time for,

- Build-in analog V/I input on Main unit.
- I/O extension unit GC-4UAD-10.
- I/O extension unit GC-4UAD-10E.

NOTE

Updation time explained in this section is strictly applicable for build-in V/I analog inputs on Main unit and I/O extension units GC-4UAD-10/10E.
Please refer respective section for analog input variants *GC-4A-12*, *GC-4UAD-16* covered on this manual.

Updation time is dependent on the following parameters.

- Cyclic interval of PLC_PRG.
- Number of input channels enabled.
- Number of PT100 input channels with open circuit.
- Filter type selection as,
  i. Time constant, if 'Digital filter' is selected.

Updation time = [Cyclic interval X (No. of input channels enabled + No. of channels with open circuit)] + (Time constant X 10)

  ii. No. of averaging samples, if 'Averaging' is selected.

Updation time = Cyclic interval X (No. of input channels enabled + No. of channel open circuit) X (No. of averaging samples)

  iii. If 'No filter', is selected.

Updation time = Cyclic interval X (No. of input channels enabled + No. of channel open circuit)

NOTE

If analog input channels on Main unit are disabled, delay of one cyclic interval will get added in updation time for first scan only. After first scan, updation time will be as mentioned in above formulae.

Table below shows list of applicable parameters.

Sr. No.	Parameter	Default Value	Supported range	Remark
1	Cyclic interval of MainTask	50 msecs	--	Cyclic interval of MainTask (PLC task).
2	Number of input channels enabled	Not applicable	0 to 10	Number of analog input channels calculated as; Up to 2 channels on Main unit + up to 4 channels from GC-4UAD-10/10E, configured in IOE1 + up to 4 channels from GC-4UAD-10/10E, configured in IOE2.
3	Number of PT100 channels open circuit	Not applicable	0 to 8	Number of PT100 channels open circuit from GC-4UAD-10/10E in IOE1 and GC-4UAD-10/10E in IOE2.
4	Time constant in msecs	50	10 to 5000	Digital filter time constant set for channel.
5	No. of averaging samples	4	4/ 8/ 16/ 32	Number of averaging samples set for channel.

The following table explains examples for updation time calculations.

Sr. No.	No. of input channels enabled	Input channel configuration	Channel Parameters	Updation time (in msecs)
1	1	0 to 10 VDC	Default	550
2	1	0 to 20 mA		550
3	1	-50 to 150°C		600
4	10	0 to 10 VDC		1000
5	10	0 to 20 mA		1000
6	8	-50 to 150°C		1300

18.2 Task Configuration

18.2.1 Overview

Tasks are defined in GOC43 project for controlling and executing the application program in the controller. A task is a time-based flow unit of an IEC program. A task definition includes a name, a priority, and a type that determines the condition which triggers the start of the task.

GOC43 supports 2 types of tasks, cyclic and freewheeling. There is one more type of task which is event-based task. Event based task is executed on occurrence of specific event. Examples of an event are the rising edge of a global variable or an interrupt event of the controller etc. GOC43 does not support event-based tasks.

A task calls one or more program organization units (POUs) from the application program. The combination of priority and condition defines the order in which the tasks are executed.

Rules for the processing order of the defined tasks:

- If the task condition is satisfied, then controller processes the task.
- If several tasks satisfy the condition for processing at the same time, then controller processes the tasks with the highest priority (low priority number) first.
- If several tasks with the same priority level satisfy the condition for processing at the same time, then controller processes the longest waiting task first.
- The program calls are processed in the order they appear in the configuration dialog of the task.
- Freewheeling tasks are executed with lower priority than Cyclic tasks irrespective of priority definition.

User can configure a watchdog for each task. In case task execution time exceeds watchdog time, ‘WD Error’ (Watchdog error) is declared for the task. Watchdog error status is displayed in system menu page ‘System Info’. STOP cause is displayed as WDErr_<Task Name>. Status of watchdog is also updated in system variable ‘_SysvarCPU.BCPUSTOPCAUSE’. In case of WD error, this variable holds 1.

GOC43 supports up to 3 tasks. Out of 3, 2 tasks are cyclic tasks, and one task is freewheeling task. Details of the tasks are described in the table,

Task Name	Priority	Type	Description
MainTask	1	Cyclic Cycle time = 50ms Watchdog time = 35ms	This task executes main POU of PLC application i.e. PLC_PRG. User can call all other application POUs and FBs from PLC_PRG. By default, IO processing is linked with this task. Inputs are updated before execution of this task and outputs are activated after execution of this task. This task gets added in the project automatically after creating project using GOC43 project template.

Task Name	Priority	Type	Description
VISU_TASK	31	Freewheeling	This task executes Visualization part of application. This task is executed with lower priority than other two tasks in the project. This task gets added in the project automatically after creating project using GOC43 project template.
<User defined>	0-31	Cyclic User configurable cycle time 5 to 65535ms	This task can be used to execute periodic actions which have different cycle time than MainTask. Use of this task is optional. User can add this task in the project as per the application requirement.

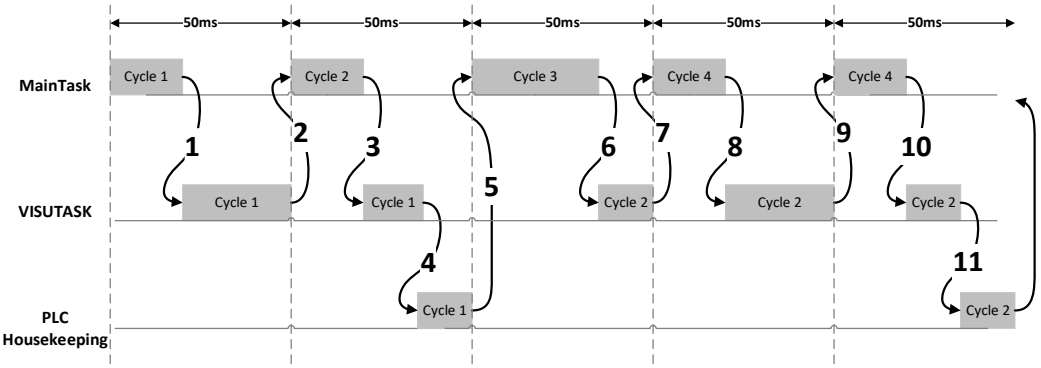
NOTE

It is recommended not to change default properties of 'MainTask' and 'VISU_TASK'. Changing task properties without understanding the method and rules of task execution may lead to unexpected behaviour.

18.2.2 Execution of Tasks without Addition of User Defined Task

Timing diagram below explains execution of 2 default tasks; MainTask and VISU_TASK and explains housekeeping activities. Housekeeping activities are carried out at the end of VISU_TASK and mainly contains following.

- Communication with external devices connected to serial and Ethernet port
- IO Extension unit and COM extension unit management
- Communication with programming software



After power ON initialisation, execution of MainTask is started.

1. After completion of execution of MainTask (Cycle1), VISU_TASK(Cycle1) execution is started.
2. As MainTask is cyclic task and VISU_TASK is freewheeling task, MainTask is executed with higher priority than VISU_TASK.
   Execution of VISU_TASK(Cycle1) is interrupted by MainTask(Cycle2).
3. After execution of MainTask(Cycle2), remaining execution of VISU_TASK(Cycle1) is completed.

4. After completion of execution of VISU_TASK(Cycle1), housekeeping activity is initiated if no other task is pending for execution.
5. Once housekeeping execution is complete, next task for execution is selected whose task condition is satisfied and priority of task.

Steps 6 to 11 shows repetition of task execution for VISU_TASK(Cycle2). Note that as shown for VISU_TASK(Cycle2), MainTask can interrupt execution of VISU_TASK multiple times based on its cycle time and execution time. This may delay execution of VISU_TASK and housekeeping tasks which includes communication with external devices. This delay can be reflected as updation time of Visualization displayed.

To avoid delay in visualization updation time, following precautions should be considered.

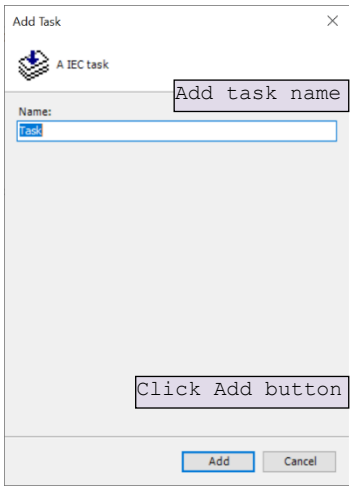
- Keep MainTask cycle time to default value of 50ms or higher. Do not reduce Main task cycle time.
  If you want to execute specific logic faster than 50ms, it is advised to use additional user configurable task as explained in next section.
- Keep MainTask cycle time (scan time) within limit (35ms or lower)
- Optimize visualization screen design with number of objects not exceeding 32 objects.
- Reduce number of visualization objects on screen (16 or less) while using advanced visualization objects from visualization groups Common controls, Measurement controls, Special controls etc.

18.2.3 Execution of Tasks with Addition of User Defined Task

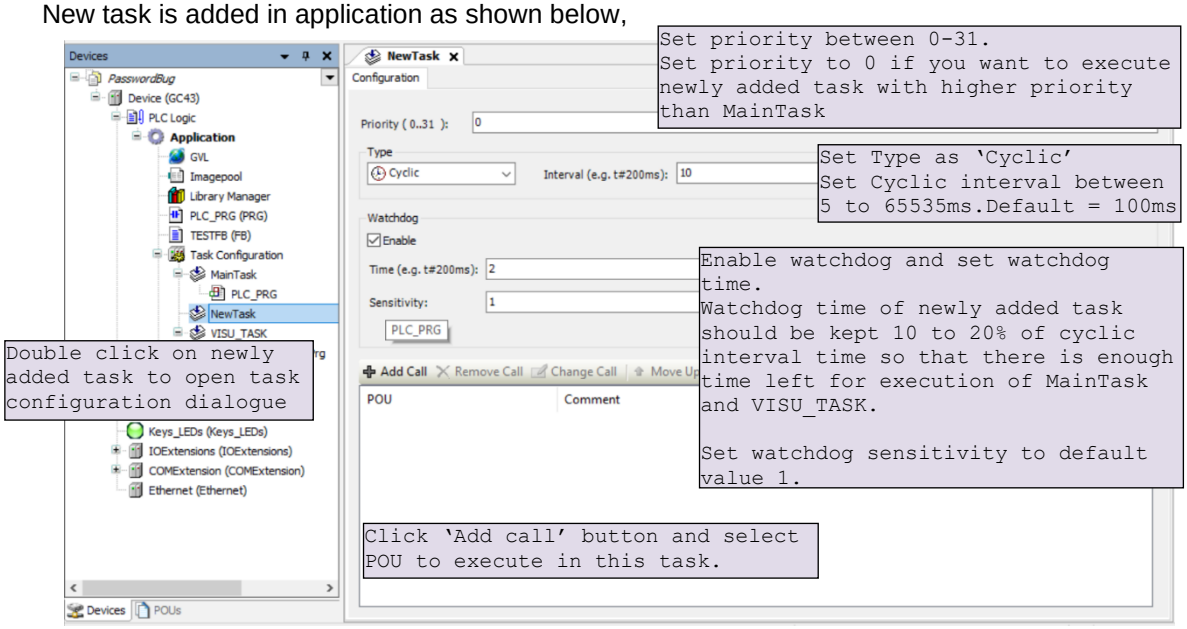
User can add one more task for execution of user logic. Cycle time of user defined task can be set between 5 to 65535ms as per the application requirement.

To add user configurable task, right click on 'Task Configuration' in project tree and select command 'Add Object' →'Task…'.

After executing command 'Add Task' dialogue will be displayed as follows

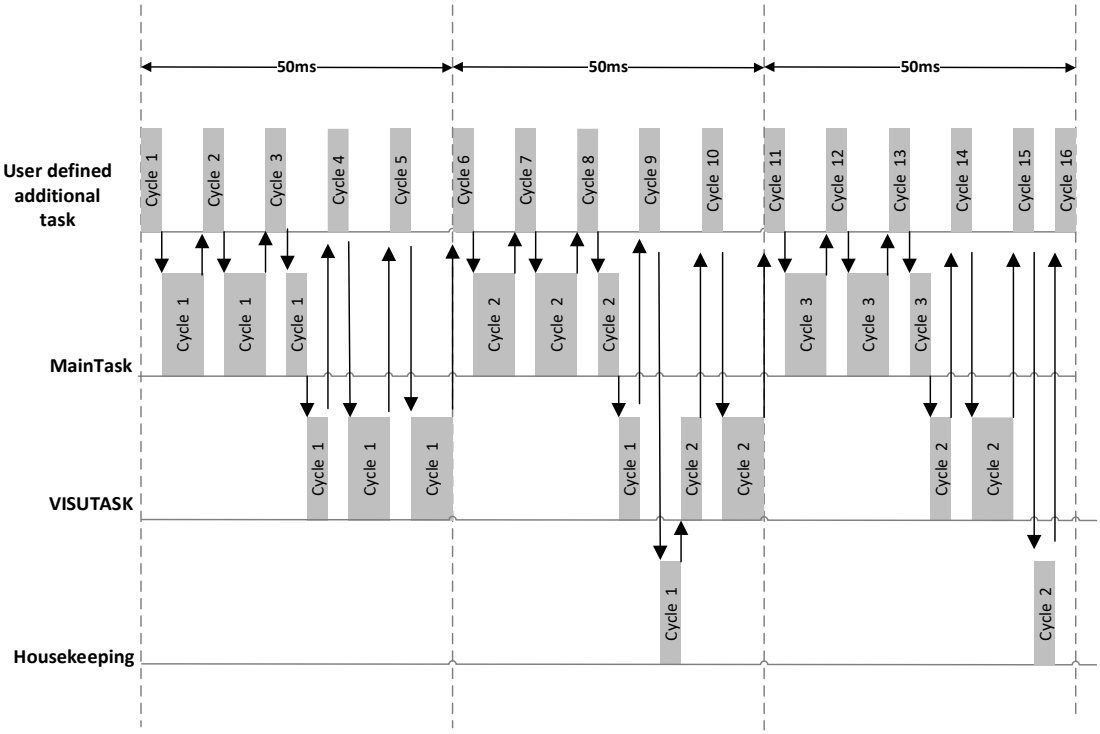


New task is added in application as shown below,



Timing diagram below shows execution of additional user defined task with following task configurations.

1. Task name: MainTask
   Task type: Cyclic, Cyclic interval time = 50ms and priority =1
2. Task name: VISU_TASK
   Task type: Freewheeling, priority =31
3. Task name: <User defined>
   Task type: Cyclic, Cyclic interval time = 10ms and priority =0 i.e. higher than MainTask.



After power ON initialisation, execution of highest priority task i.e. 'User defined additional task' is started. Once execution of user defined task is completed, execution of MainTask is started. As shown in the diagram, additional task interrupts execution of MainTask multiple times which may delay execution of MainTask.

Similarly high priority tasks (user defined task and Main task) interrupt execution of Visualization task multiple times which may delay execution of VISU_TASK and housekeeping activities.

Following points to be noted while configuring and using user defined task.

- IO updation is linked with MainTask. If it is necessary to update IOs in user defined task, functions 'Refresh_In' and 'Refresh_Out' should be called to update input and outputs on respectively on demand.
- Use of additional task will increase execution time of MainTask as well as VISU_TASK and subsequently housekeeping activities. Set watchdog time of Main task accordingly.
- It is recommended to configure user defined task only when it is necessary to execute particular part of logic with different cyclic interval than Main task.
  If cyclic interval time of user defined task is set below 10ms, it is recommended to write optimized logic in POU attached to user defined task to avoid delays in overall execution of entire application.

18.3 Version Compatibility

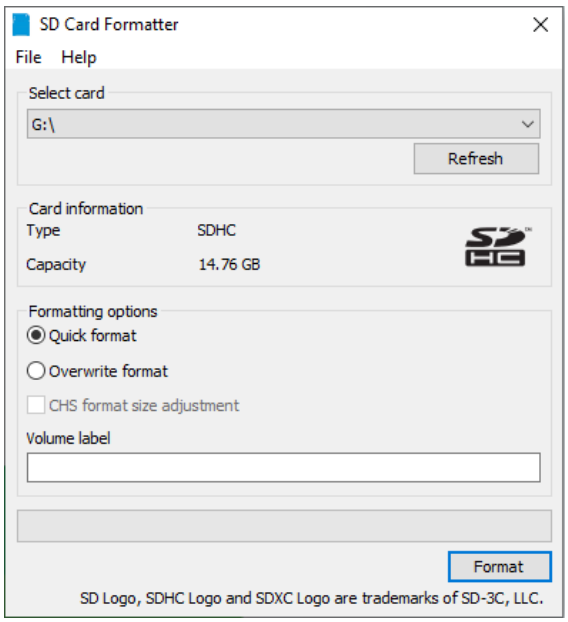
Refer document “N18006AAMH07 GOC43 Version Compatibility (Version: 2.00)” for more details of version compatibility of firmware, hardware, and GOC Toolkit V3.

18.4 Getting SD Memory Card Ready for Data Logging

This section explains mandatory procedure to make SD memory card ready to use for data logging. It must first be formatted, and a predefined folder structure must be created on it.

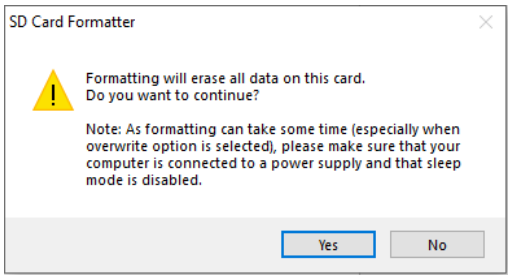
Follow the procedure as below,

1. Connect SD card interface device to your PC with SD Memory card inserted.
2. Download and install ‘SD Memory Card Formatter’ utility on your PC.
3. Run utility. SD Card Formatter window will be displayed as shown below.

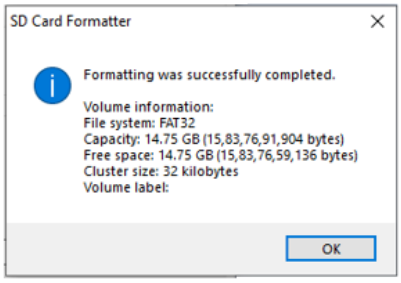


Select SD card drive and confirm card information.

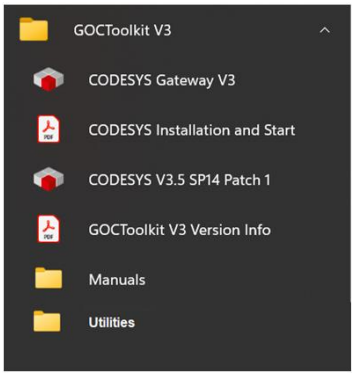
To format the SD card, click the "Format" button. Confirmation message window will pop up as shown.



Click the ‘Yes’ button to format the card. Once the formatting is complete, a confirmation window will appear. Click OK to close the window.

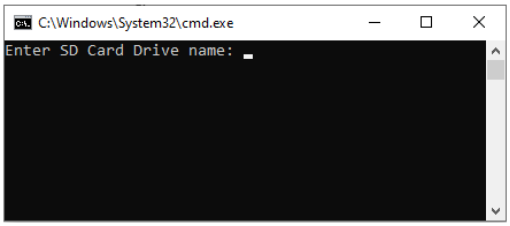


To create a folder structure on the SD memory card for data logging, open GOCToolkit V3 in Start menu as shown.

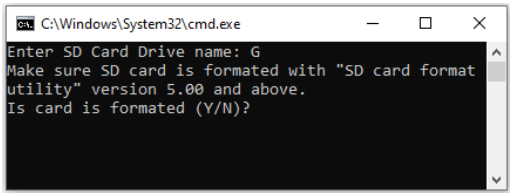


User can access batch file after opening folder 'Utilities →'SD Card folder structure creation'.

Run 'CreateFolderStructureForGOC43.bat' file.

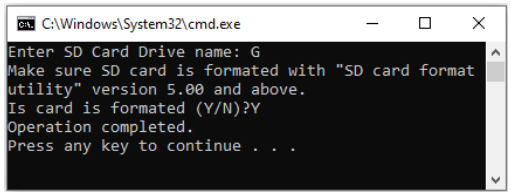


Enter SD Card drive name, for example, 'G' and press Enter key.

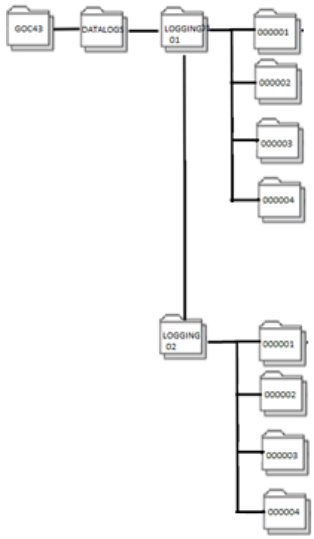


Enter 'Y' and press Enter.

The batch file creates necessary folder structure in SD card. Press any key to continue.



Open the SD card drive to confirm that the folder structure has been created.



NOTE

If folder structure on SD card is not as per requirement then, error will be updated in `.bLogStatus`. Refer section *System Variables → _SysvarDataLog* for more details.

Mitsubishi Electric India Pvt. Ltd.

Factory Automation and Industrial Division

ICC-Devi Gaurav Technology Park, Unit No. 402,

Opp. Vallabh Nagar Bus Depot,

Pune-411018, Maharashtra, India.

Email – MEI-FAID-INFO@asia.meap.com

Web – http://in.mitsubishielectric.com