INSTRUCTION MANUAL

SIL 2 Switch / Proximity Detector Repeater, Open Collector Output DIN-Rail and Termination Board, Model D6231E

gmi

technology for safety

General Description:

The Switch/Proximity Detector Repeater type D6231E is a unit with eight independent channels suitable for applications requiring SIL 2 level (according to IEC 61508:2010) in safety related systems for high risk industries.

The unit can be configured for switch or proximity detector (EN60947-5-6 NAMUR), NO or NC input and for NO or NC floating solid-state relay (photo-MOS) isolated output compatible with logic circuits. Configuration is programmable from PC by the GM Pocket Portable Adapter PPC5092 via USB serial line and SWC5090 Configurator software.

Each channel enables a load to be controlled by a switch, or a proximity detector.

Fault detection circuit (configurable by PC) is available for all proximity sensors and switches equipped with end of line resistors. In case of fault, when enabled it de-energizes the corresponding solid-state relay (photo-MOS) and turns the fault red LED on; when disabled the corresponding solid-state relay (photo-MOS) repeats the input line open or closed status as configured.

D6231E has eight inputs and eight independent outputs. Modbus RTU RS-485 output is available on Bus connector.

Mounting on standard DIN-Rail, with or without Power Bus, or on customized Termination Boards.

Technical Data

Supply:

24 Vdc nom (18 to 30 Vdc) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp, 2 A time lag fuse internally protected.

Current consumption @ 24 V: 75 mA for 8 channels with short circuit input and solid-state relay (photo-MOS) closed, typical.

Power dissipation: 1.8 W with 24 V supply voltage, for 8 channels with short circuit input and solid-state relay (photo-MOS) closed, typical.

Isolation (Test Voltage):

In/Out 1.5 KV; In/Supply 1.5 KV; Out/Supply 500 V.

Input switching current levels:

ON ≥ 2.1 mA (1.9 to 6.2 mA range), OFF ≤ 1.2 mA (0.4 to 1.3 mA range),

switch current ≈ 1.65 mA ± 0.2 mA hysteresis.

Fault current levels: open fault ≤ 0.2 mA, short fault ≥ 6.8 mA.

Input equivalent source: 8 V 1 KΩ typical (8 V no load, 8 mA short circuit).

Output:

voltage free SPST optocoupled open-collector transistor (solid-state relay, photo-MOS).

Open-collector rating: 100 mA at 35 V (≤ 1.0 V voltage drop).

Leakage current: ≤ 10 µA at 35 V.

Response time: 500 µs.

Frequency response: 500 Hz maximum.

Modbus Output: Modbus RTU protocol up to 115.200 baud on Bus connector.

Compatibility:

CE CE mark compliant, conforms to Directive: 2014/30/EU EMC, 2014/35/EU LVD, 2011/65/EU RoHS.

Environmental conditions:

Operating: temperature limits – 40 to + 70 °C, relative humidity 95 %, up to 55 °C.

Storage: temperature limits – 45 to + 80 °C.

Max altitude: 2000 m a.s.l.

Approvals:

SIL 2 conforms to IEC61508:2010 Ed.2.

Mounting:

EN/IEC60715 TH 35 DIN-Rail, with or without Power Bus or on customized Termination Board.

Weight: about 175 g.

Connection: by polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.

Protection class: IP 20.

Dimensions: Width 22.5 mm, Depth 123 mm, Height 120 mm.

Programming

The module is fully programmable. Operating parameters can be changed from PC via PPC5092 adapter connected to USB serial line and SWC5090 software.

Measured values and diagnostic alarms can be read on both serial configuration or Modbus output line.
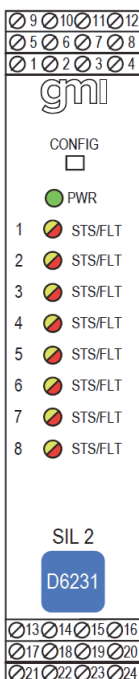
SWC5090 software also allows the Monitoring and Recording of values. For details please see SWC5090 manual ISM0154.

Ordering Information

| Model:	D6231	
8 channels		E

Power Bus and DIN-Rail accessories:
Connector JDFT049 — Cover and fix MCHP196
Terminal block male MOR017 — Terminal block female MOR022
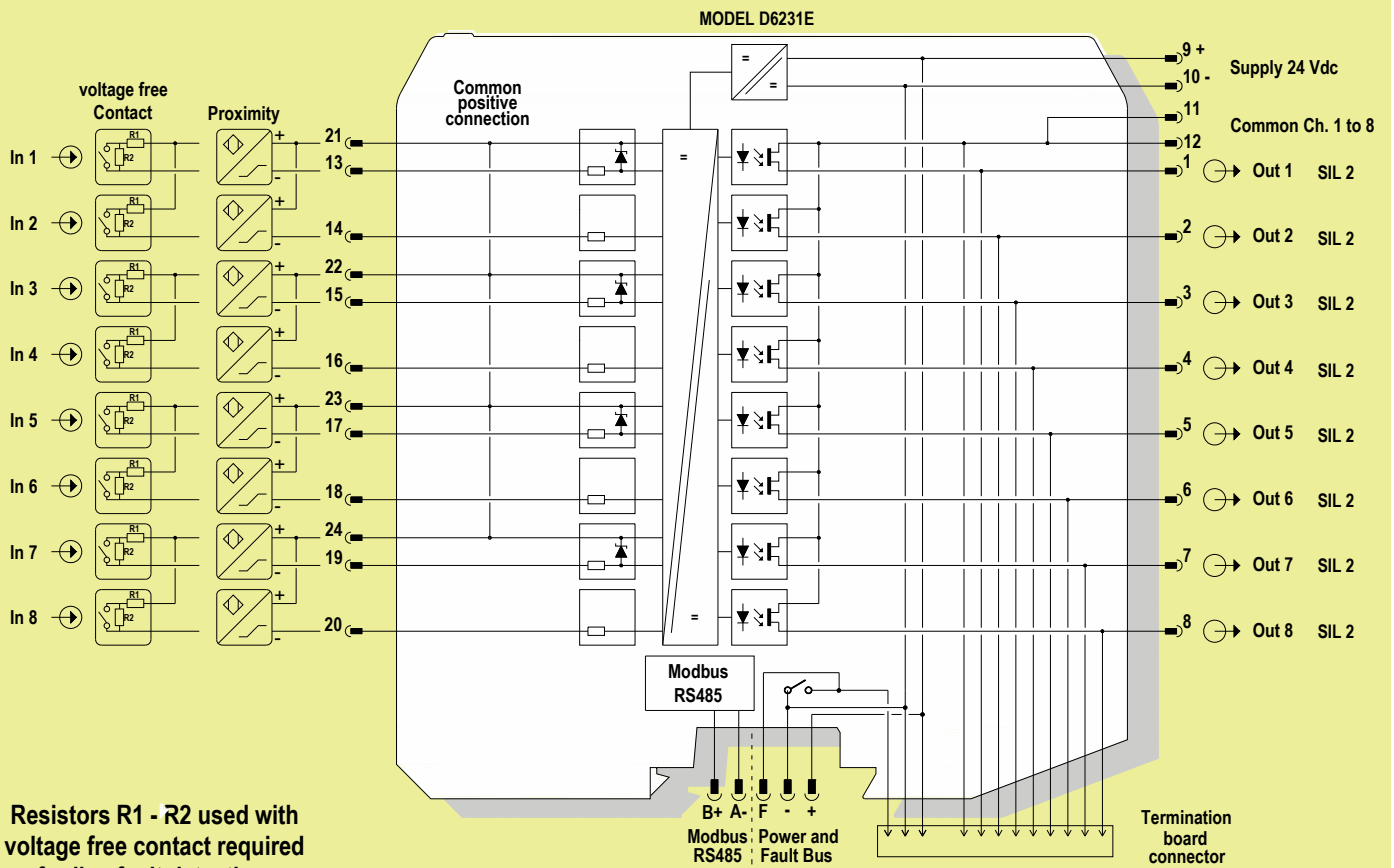
Front Panel and Features

- 8 fully independent channels
- NO/NC switch/proximity Detector Input, NO/NC solid-state output relay .
- Field open and short circuit detection.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- Modbus RTU RS-485 Output.
- EMC Compatibility to EN61000-6-2, EN61000-6-4, EN61326-1, EN61326-3-1 for safety system.
- Fully programmable operating parameters.
- Any input can be assigned to any number of outputs. Logical output functions available.
- High Density, eight channels per unit.
- Simplified installation using standard DIN-Rail and plug-in terminal blocks, with or without power Bus, or customized Termination Boards.

Terminal block connections
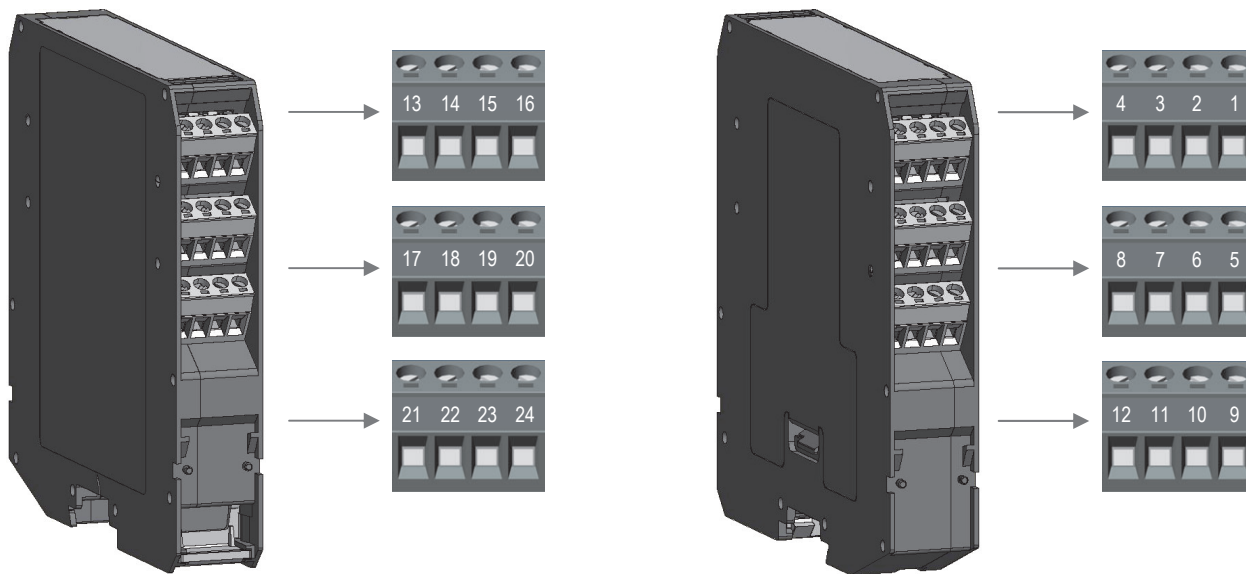
13	- Input Ch 1 for Proximity or Voltage free Contact		1	Output 1
14	- Input Ch 2 for Proximity or Voltage free Contact		2	Output 2
15	- Input Ch 3 for Proximity or Voltage free Contact		3	Output 3
16	- Input Ch 4 for Proximity or Voltage free Contact		4	Output 4
17	- Input Ch 5 for Proximity or Voltage free Contact		5	Output 5
18	- Input Ch 6 for Proximity or Voltage free Contact		6	Output 6
19	- Input Ch 7 for Proximity or Voltage free Contact		7	Output 7
20	- Input Ch 8 for Proximity or Voltage free Contact		8	Output 8
21	+ Common positive Input for Ch 1 to 8		9	+ Power Supply 24 Vdc
22	+ Common positive Input for Ch 1 to 8		10	- Power Supply 24 Vdc
23	+ Common positive Input for Ch 1 to 8		11	Common Output channel 1 to 8
24	+ Common positive Input for Ch 1 to 8		12	Common Output channel 1 to 8

MODEL D6231E

voltage free Contact   Proximity

In 1

In 2

In 3

In 4

In 5

In 6

In 7

In 8

21
13

14

22
15

16

23
17

18

24
19

20

Common positive connection

Modbus RS485

B+ A- F - +

Modbus RS485   Power and Fault Bus

9 +
10 -   Supply 24 Vdc

11
12   Common Ch. 1 to 8

1   Out 1   SIL 2

2   Out 2   SIL 2

3   Out 3   SIL 2

4   Out 4   SIL 2

5   Out 5   SIL 2

6   Out 6   SIL 2

7   Out 7   SIL 2

8   Out 8   SIL 2

Termination board connector

Resistors R1 - R2 used with voltage free contact required for line fault detection.

Warning

D6231 series must be installed, operated and maintained only by qualified personnel, in accordance to the relevant national/international installation standards.
Warning: de-energize main power source (turn off power supply voltage) and disconnect plug-in terminal blocks before opening the enclosure to avoid electrical shock when connected to live hazardous potential.
Failure to properly installation or use of the equipment may risk to damage the unit or severe personal injury.
The unit cannot be repaired by the end user and must be returned to the manufacturer or his authorized representative.
Any unauthorized modification must be avoided.

Operation

The Switch/Proximity Detector Repeater type D6231E is a unit with eight independent channels suitable for applications requiring SIL 2 level (according to IEC 61508:2010) in safety related systems for high risk industries.
The unit can be configured for switch or proximity detector (EN60947-5-6 NAMUR), NO or NC input and for NO or NC floating solid-state relay (photo-MOS) isolated output compatible with logic circuits. Configuration is programmable from PC by the GM Pocket Portable Adapter PPC5092 via USB serial line and SWC5090 Configurator software. Each channel enables a load to be controlled by a switch, or a proximity detector.
Fault detection circuit (configurable by PC) is available for all proximity sensors and switches equipped with end of line resistors. In case of fault, when enabled it de-energizes the corresponding solid-state relay (photo-MOS) and turns the fault red LED on; when disabled the corresponding solid-state relay (photo-MOS) repeats the input line open or closed status as configured.
Note: use of voltage free electrical contacts with fault detection enabled (control equipment) requires, near the switch at the end of the line a R1=1 KΩ typical (470 Ω to 2 KΩ range) resistor in series and a R2=10 kΩ typical (5 KΩ to 15 KΩ range) resistor in parallel to the contacts in order to allow the fault detection circuit to distinguish between a condition of contact close/open and a line open/short circuit fault.

Installation

D6231 series modules are housed in a plastic enclosure suitable for installation on EN/IEC60715 TH 35 DIN-Rail, with or without Power Bus or on customized Termination Board.
D6231 unit can be mounted with any orientation over the entire ambient temperature range.
Electrical connections are accommodated by polarized plug-in removable screw terminal blocks which can be plugged in/out into a powered unit without suffering or causing any damage. Connect only one individual conductor per each clamping point, use conductors up to 2.5 mm² (13 AWG) and a torque value of 0.5-0.6 Nm. Use only cables that are suitable for a temperature of at least 85°C. The wiring cables have to be proportionate in base to the current and the length of the cable.
On the section "Function Diagram" and enclosure side a block diagram identifies all connections.
Identify the function and location of each connection terminal using the wiring diagram on the corresponding section.

The enclosure provides, according to EN60529, an IP20 minimum degree of protection (or similar to NEMA Standard 250 type 1). The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.
Units must be protected against dirt, dust, extreme mechanical (e.g. vibration, impact and shock) and thermal stress, and casual contacts.
If enclosure needs to be cleaned use only a cloth lightly moistened by a mixture of detergent in water.
Any penetration of cleaning liquid must be avoided to prevent damage to the unit.
Any unauthorized modification must be avoided.
D6231 series must be connected to SELV or PELV supplies.
All circuits connected to D6231 unit must comply with the overvoltage category II (or better) according to EN/IEC60664-1.
Warning: de-energize main power source (turn off power supply voltage) and disconnect plug-in terminal blocks before opening the enclosure to avoid electrical shock when connected to live hazardous potential.

Start-up

Before powering the unit check that all wires are properly connected, particularly supply conductors and their polarity, input and output wires.
Check conductors for exposed wires that could touch each other causing dangerous unwanted shorts.
Turn on power, the "power on" green LED must be lit, output signal must be in accordance with the corresponding input signal value and input/output chosen transfer function,
Status/fault LED should reflect the input variable condition with respect to configured settings. If possible change the sensor condition and check the corresponding output.

Configurating and Monitoring via Software:

CONFIGURATION

Configuration parameters can be read and written from the module or from saved file.
It is also possible to reset the module configuration to factory default settings.
A report sheet containing complete configuration can be printed.

INPUTS 1 to 8:

Sensor Type:
☐ Proximity
☐ Voltage free contact
Note: To enable line diagnostic on Voltage free contacts, configure sensor as "Proximity" and follow instructions in Section "Operation".

TAGS 1 to 8:
16 alphanumerical characters.

OUTPUTS 1 to 8:

Source:
☐ Input 1   Output represents Input 1,
☐ Input 2   Output represents Input 2,
☐ Input 3   Output represents Input 3,
☐ Input 4   Output represents Input 4,
☐ Input 5   Output represents Input 5,
☐ Input 6   Output represents Input 6,
☐ Input 7   Output represents Input 7,
☐ Input 8   Output represents Input 8,
☐ Logical function Output represents AND/OR function of selected inputs,

Contact: normal condition of output contact when input is open
☐ Open
☐ Closed

In case of fault: Output behaviour when Input fault is detected.
☐ Ignore   Ignore,
☐ Open
☐ Closed

Fault repeater: Output represents Input Fault status

Logical Function: visible only when selected in "Output source".
Select 2 or more (up to 8) Inputs to connect logically.
☐ AND   Output represents AND logical function of selected Inputs,
                 - NO: On AND On = Close; On AND Off = Open; Off AND Off = Open
                 - NC: On AND On = Open; On AND Off = Close; Off AND Off = Close
☐ OR   Output represents OR logical function of selected Inputs
                 - NO: On OR On = Close; On OR Off = Close; Off OR Off = Open
                 - NC: On OR On = Open; On OR Off = Open; Off OR Off = Close

MONITOR

Allows the real-time monitoring of every Input and Output status.
Note that configuration is disabled when Monitoring is active.

INPUT STATUS: The status of each input is shown
☐ Open circuit   Open circuit fault (only for Proximity Inputs),
☐ Off   Off,
☐ On   On,
☐ Short circuit   Short circuit fault (only for Proximity Inputs).

OUTPUT STATUS: The status of each output contact is shown
☐ Open
☐ Closed

DATA LOGGER

The status of all Inputs and all Outputs is acquired at constant chosen intervals and saved to user selected file in Comma Separated Value format (.csv).
Note that configuration is disabled when Data Logger is active.

PARAMETERS SETUP:
Days: Number of days to acquire.
Hours: Number of hours to acquire.
Minutes: Number of minutes to acquire.
Scan rate: Frequency interval for acquisitions.

General Notes:

SWC5090 Software can be downloaded for free at www.gminternational.com
PPC5092 Adapter is needed to interface PC to D6231E module.
The PC supplies the module via USB, therefore operating power supply (24 Vdc) is not strictly needed when configuring the module.
Each channel has completely independent configurations.
See ISM0154 Manual for details on SWC5090 software.

Screenshots:

SWC5090 Software and PPC5092 USB Adapter
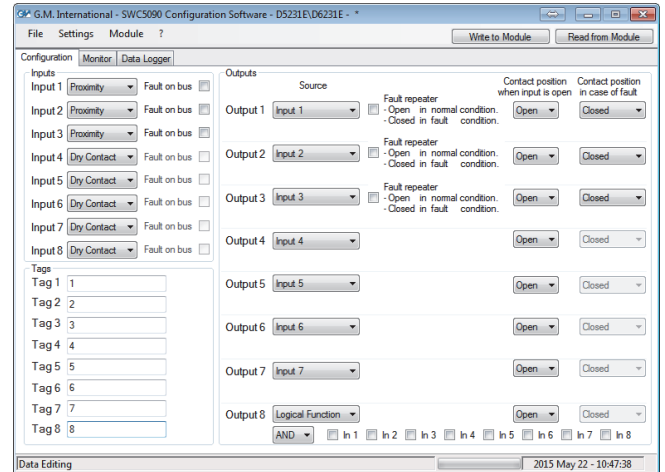
Input / Output configuration

Input / Output status real-time monitor

Real-time data logging to file

Supported Modbus parameters:

D6231E communicates via Modbus RTU RS-485 protocol. Below are all available registers.

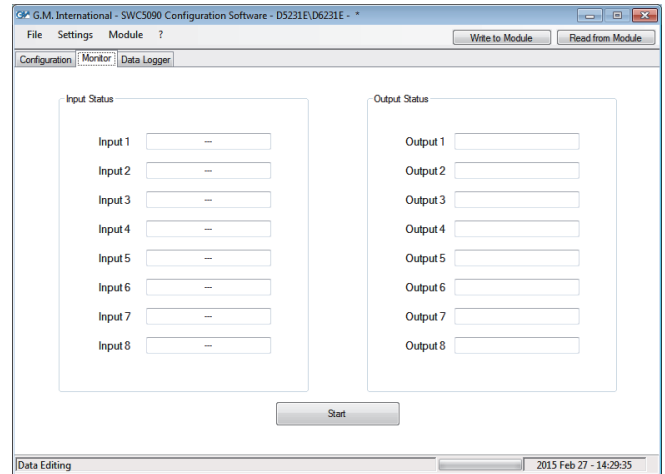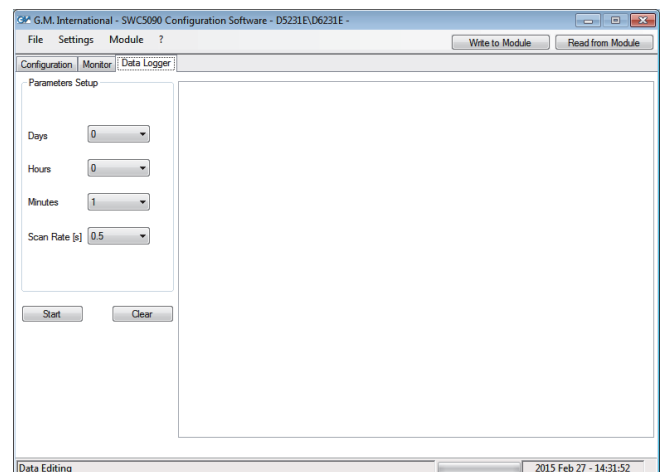| Addr.	Description	Notes	Type[5]
0	G.M. Factory Code		
1	Instrument Code		
2	Option Code	Identification Data	R
3	Hardware Release		
4	Software Release		
16	Modbus Address		
17	Modbus Baudrate [1]	Communication Data	R/W
18	Modbus Format [1]		
81	Input status of all channels [1]	Input Data	R
96-111	Output 1 Source [2]		
112-127	Output 2 Source [2]		
128-143	Output 3 Source [2]		
144-159	Output 4 Source [2]		
160-175	Output 5 Source [2]	Output Configuration	R/W
176-191	Output 6 Source [2]		
192-207	Output 7 Source [2]		
208-223	Output 8 Source [2]		
224	Output 1 Fault configuration [1]		
225	Output 2 Fault configuration [1]		
226	Output 3 Fault configuration [1]		
227	Output 4 Fault configuration [1]		
228	Output 5 Fault configuration [1]	Fault Configuration	R/W
229	Output 6 Fault configuration [1]		
230	Output 7 Fault configuration [1]		
231	Output 8 Fault configuration [1]		
232	Fault on Bus [1]		
233	Inputs configuration [1]	Input Configuration	R/W
464	Commands execution [4]	Command	W
520	Outputs Status	Output Data	R
548-555	Ch 1 [3]		
556-563	Ch 2 [3]		
564-571	Ch 3 [3]		
572-579	Ch 4 [3]		
580-587	Ch 5 [3]	Tags	R/W
588-595	Ch 6 [3]		
596-603	Ch 7 [3]		
604-611	Ch 8 [3]		

Notes:

Each Modbus parameter is described by one 16-bit word.

(1) See command details on the right.
(2) Each Output can reflect the status of any Input.
   In order to change Output Source fill Output Address range as shown below:
   Input 1: All addresses contain value 43690.
   Input 2: All addresses contain value 52428.
   Input 3: All addresses contain value 61680.
   Input 4: All addresses contain value 65280.
   Input 5: Addresses contain:
       0,65535,0,65535,0,65535,0,65535,0,65535,0,65535,0,65535,0,65535.
   Input 6: Addresses contain:
       0,0,65535,65535,0,0,65535,65535,0,0,65535,65535,0,0,65535,65535.
   Input 7: Addresses contain:
       0,0,0,0,65535,65535,65535,65535,0,0,0,0,65535,65535,65535,65535.
   Input 8: Addresses contain:
       0,0,0,0,0,0,0,0, 65535,65535,65535,65535,65535,65535,65535,65535.
(3) Tags are composed of 16 characters.
   Each address contains 2 chars, starting from left.
(4) All configurations must be confirmed via Addr. 464, see details on the right.
(5) Parameter Type:
       R = read only,
       W = write only,
       R/W = read and write.

Supported modbus functions:

Code	Name	Notes
03	read holding registers	reads a stream of words from memory
04	read input registers	reads a stream of words from memory
08	diagnostics: subcode 0	returns query data
06	write single register	writes a word in memory
16	write multiple registers	writes a stream of words in memory

Parameters details:

Address 17: Supported ModBus Baudrates

Index	Baudrate
0	4800
1	9600
2	19200
3	38400
4	57600
5	115200

Address 18: Supported ModBus Formats

Endianness 32 bit Data (0 = Little; 1 = Big)
Termination resistance (1 = enabled)
Supported Modbus Parity:
0 8 data bit, no parity, 1 stop bit
1 8 data bit, even parity, 1 stop bit
2 8 data bit, odd parity, 1 stop bit

Address 81: Input status

In 8 In 7 In 6 In 5 In 4 In 3 In 2 In 1   In 8 In 7 In 6 In 5 In 4 In 3 In 2 In 1

(0 = Ok; 1 = Fault)   (0 = Off; 1 = On)

Address 224 to 231: Output Fault Configuration

Contact status:
(0 = Out closed; 1 = Out open)

In case of Fault:
(0 = Open; 1 = Closed)

In 8 In 7 In 6 In 5 In 4 In 3 In 2 In 1
(0 = None; 1 = Fault on Output)
Reflect status of Input Fault on Output

Address 232: Output Fault on Bus Configuration

In 8 In 7 In 6 In 5 In 4 In 3 In 2 In 1

(0 = None; 1 = Fault on BUS)
Reflect status of Input Fault on BUS

Address 233: Inputs Configuration

In 8 In 7 In 6 In 5 In 4 In 3 In 2 In 1

(0 = Proximity; 1 = Dry contact)

Address 464: Commands

1 Save Input/Output Configuration
2 Save Modbus configuration
8 Save Tags

Address 520: Outputs Data

Out 8 Out 7 Out 6 Out 5 Out 4 Out 3 Out 2 Out 1

(0 = Open; 1 = Close)