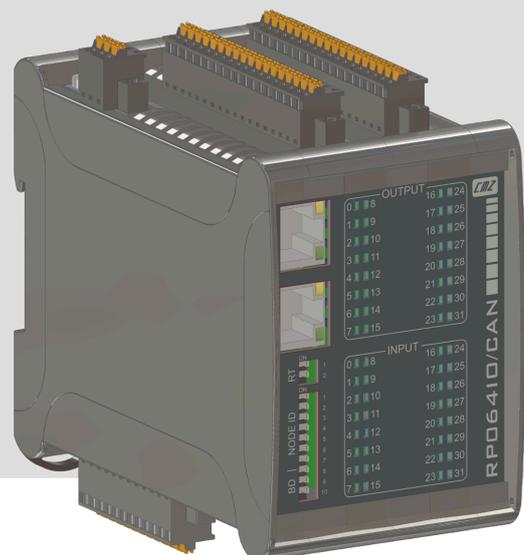


# RP064IO/CAN

*CANopen peripheral for digital and analog IOs*





User Guide

# RP064IO/CAN

CANopen peripheral for digital and analog IOs

*Doc. TR062311*

*Ed. 2.1 - English - 01 Mar 2023*



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# Chapter 1

## General information

### 1.1. Purpose

This manual is a complete guide for the installation, commissioning, operation and use of the RP064IO: It is a CANopen peripheral and it provides 32 digital inputs, 32 digital outputs, 2 analog inputs, 2 outputs analog. The board also manages 2 incremental encoders and 2 single-channel counters. The manual contents are about general informations and peripheral features, installation notes, warnings for people and product safe; moreover, for the technicians, the manual furnishes all the data and specifications for the connections and the commissioning.



#### **ATTENTION: Product version**

What is reported in this manual refers to the firmware version 1.0, unless otherwise specified. Previous versions could not implement all the functionalities described in this manual.



#### **Suggestion: CANopen notions.**

For a better understanding of this document, it is recommended to have a basic knowledge of CANopen fieldbus.

### 1.2. Recipients

Only specialized operators can wire and use the RP064IO. The specialized operators must read this document and all the documentations relating to the product and they must understand its content. The specialized staff also must have received adequate safety training, to recognize and avoid possible risk. The technical training, acquired knowledge and experience of the specialized operators must be such as to be able to foresee and recognize the dangers that may arise from the use of the product, from changing the settings and operation of mechanical, electrical and equipment electronics of the system as a whole. Specialists must be aware of all the current regu-

lations, as well as the accident prevention provisions and standards that must be observed when carrying out work on the product.

The following operations must be carried out by qualified personnel:

- Transport: only by personnel with knowledge of handling components sensitive to electrostatic charges.
- Unpacking: By qualified electricians only.
- Installation: By qualified electricians only..
- Use: only by qualified personnel with specific knowledge of electrotechnics and fieldbus.

The specialized staff must know and respect the following regulations:

- EN ISO 12100, EN 60364 ed EN 60664;
- National accident regulations .



### **WARNING: safety instructions**

During the product functioning, depending on the equipments connected to it, risk of death, serious injuries or material damage may happen. The security officer must check that the staff working with the drives read and understood this manual before using them.

## **1.3. Responsibility**

CMZ SISTEMI ELETTRONICI S.r.l. can modify the described products in this document in any time and without any notice.

This manual was written by CMZ SISTEMI ELETTRONICI S.r.l. only for their customers use providing the most updated version of the products, in relation of the issue data.

The responsibility to use this manual belongs to every user and the use of some functions described in this document must be done under strict care to avoid any danger for the staff and the equipment damage.

No other warranty is provided by CMZ SISTEMI ELETTRONICI S.r.l., in particular for possible imperfections, incompleteness, and/or any other difficulties.

## **1.4. Abbreviations and definitions**

*CANopen* it is a registered mark of CAN in Automation E.V.

<b>Abbreviations / Definitions</b>	<b>Meaning</b>
0x	hexadecimal number

Abbreviations / Definitions	Meaning
CAN	Controller Area Network, fieldbus
CiA-301	Specification that defines the communication protocols and the objects for the management of the CANopen network ( <i>Communication Profile DS301</i> ).
CE	Communauté Européenne
COB-ID	Communication object identifier
EMC	Electromagnetic compatibility
EMCY	Emergency: object of the CANopen protocol for reporting errors
HW	Hardware
ID	Identifier
Controller (Master)	Device which controls the communication bus and starts, as first, the interaction with the other connected nodes..
Node	Hardware device (peripheral, sensors, actuators) connected to the communication bus, able to communicate with the other devices.
NC	Not connected
NMT	Network management: object of CANopen protocol for network managing
PDO	Process data object: object of the CANopen protocol for writing/reading cyclic data (parameters mappable on PDO)
RMS	Root Mean Square
SDO	Service data object: object of the CANopen protocol for writing/reading peripheral parameters
Device (Slave)	Node receiving data or data requests from the Controller
a.s.l.	above sea level
SYNC	Synchronization: object of the CANopen protocol to synchroniz the nodes on the network
SW	Software
TBD	To be defined

## 1.5. Symbols



### Danger

It shows an imminent dangerous situation that, in case of failure to comply with safety rules, can lead to a serious or fatal accident or a damage to the equipment.



### Warning

It shows a potentially dangerous situation that, in case of failure to comply with safety rules, can lead to a serious or fatal accident or a damage to the equipment.



### Caution

It shows a potentially dangerous situation that, in case of failure to comply with safety rules, can lead to a minor or moderate accident or a damage to the equipment.



### Important

It shows some important information on the mentioned topic.



### Note

It shows some information which has to emerge from the text, related to the mentioned topic.



### Tip

It contains an useful particular advice related to the mentioned topic.

## 1.6. Revisions

Revision History		
Revision 1.0	13/09/2022	Autore: CMZ SISTEMI ELETTRONICI S.r.l.
<ul style="list-style-type: none"> <li>• First version</li> </ul>		
Revision 2.0	09/02/2023	Autore: CMZ SISTEMI ELETTRONICI S.r.l.
<ul style="list-style-type: none"> <li>• Added chapters related to software management</li> </ul>		
Revision 2.1	01/03/2023	Autore: CMZ SISTEMI ELETTRONICI S.r.l.
<ul style="list-style-type: none"> <li>• Correct the description of X3A-X3B and X4A-X4B connectors</li> </ul>		

# RP064IO device information and precautions

The RP064IO is a CANopen device to manage 32 digital inputs and 32 digital outputs (consisting respectively of 2 groups of 16 inputs and 2 groups of 16 outputs) and 2 analog inputs and 2 analog outputs. The board also manages 2 incremental encoders and 2 single-channel counters; it's provides LEDs and dip-switches.

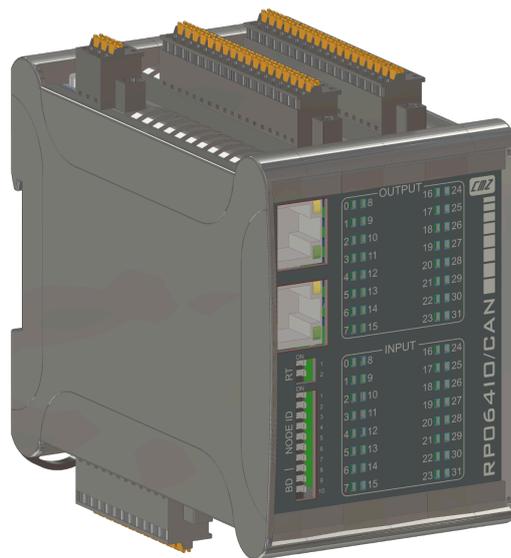


Figure 2.1. The peripheral RP064IO.

## 2.1. Peripheral equipment

The package includes::

- The RP064IO
- Cable side connectors

For any accessories, please contact the CMZ sales office.

Before beginning to work with the RP064IO, verify that there are not visible damages. Be sure that the peripheral in the package is the correct model for the application, that it corresponds

to what has been ordered. Be sure that it can be provided a voltage supply as prescribed for the peripheral.

## 2.2. Identifier label

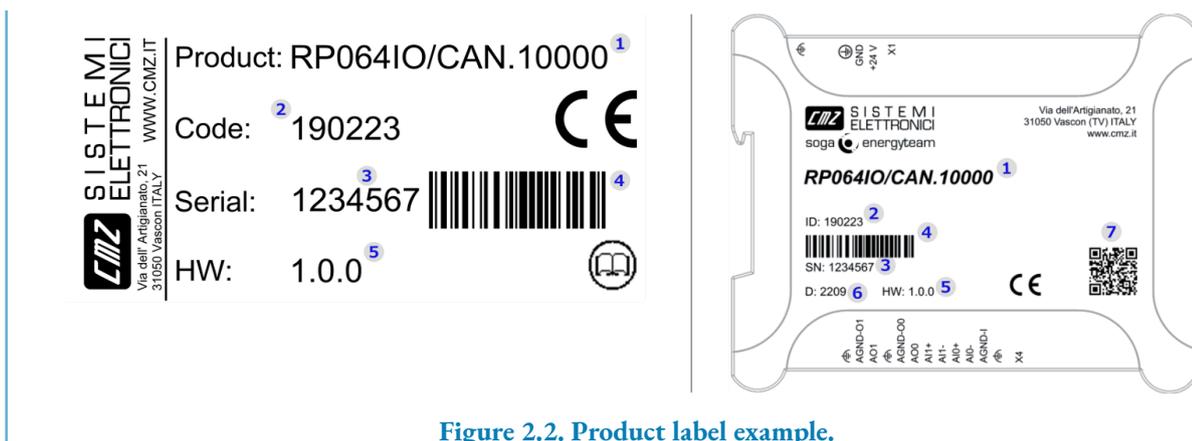


Figure 2.2. Product label example.

Reference	Meaning
1	Product name
2	Identifier code
3	Serial number
4	Serial number bar code
5	Hardware revision
6	Date of production (AAMM)
7	QR Code:documentation link

Table 2.1. Label fields

## 2.3. Regulations for European market

The RP064IO complies with the following directives:

- EN 61000-6-2:2005 relating to electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for the industrial environment;
- EN 61000-6-4:2007  
EN 61000-6-4:2007/A1:2011 relating to electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission for industrial environments;
- EN 63000:2018 relating to the technical documentation for the evaluation of electrical and electronic products in relation to the restriction of the use of dangerous substances;

The RP064IO is intended for installation in an industrial environment. Its use in domestic environments could result in the need for additional emission measures and the adoption of adequate precautions.

The RP064IO must be installed by trained personnel only that must have an in-depth knowledge about the safety requirements and the electromagnetic compatibility (EMC).

The system integrator has the responsibility to guarantee that the product or the final system comply to the pertinent regulations that are in force in the country in which the product (or the entire system) is used.



### Important

The user of the machine who uses the peripheral must carry out a risk analysis for the system and must implement appropriate measures to ensure that unexpected risks do not cause damage to people or to the system itself.

## 2.4. Safety precautions and use limits

The precautions described in this paragraph are designed to avoid dangerous situations for users through correct use of the product.

### 2.4.1. Precautions for the product handling



#### CAUTION: Electrostatic charges



The content includes parts that are sensitive to the electrostatic charges, under damage risk. Use suitable protections for the electrostatic charges before touching the product and avoid the contact with the materials that can have electrostatic charge (e.g. insulating materials or exposed conductive parts).



#### CAUTION: Environmental conditions

Pay attention to the environmental conditions required for the transport/storage as temperature, humidity and shock limits (see *Chapter 3, RP064IO technical data*).



#### Note: Safekeeping

Do not keep the product in the storage room without the original packaging. Open the packaging only immediately before the installation.

## 2.4.2. Installation and wiring precautions



### **DANGER: Risks of use**

The drive must not be used in an explosive or corrosive environment, in the presence of inflammables, water or fuels. There can be risk of fire, electrical shock or injuries.



### **WARNING: Grounding**

The connection of the protective ground conductor must be realized so that to guarantee its functionality of "grounding", even in case of a not appropriate use of the peripheral (for example a wrong electrical connection).



### **CAUTION: Secure installation**

The RP064IO is designed to be used exclusively in an adequate electrical panel.



### **Note: Installation responsibilities**

The RP064IO peripheral must be installed by trained personnel only that must have an in-depth knowledge about the safety requirements and the electromagnetic compatibility (EMC).

The system integrator has the responsibility to guarantee that the product or the final system comply to the pertinent regulations that are in force in the country in which the product (or the entire system) is used.

## 2.4.3. Maintenance and inspection



### **Note: Product tampering**

Do not open or modify the product: for the internal inspections or repairs refer to CMZ SISTEMI ELETTRONICI S.r.l.. In case of tampering the product the warranty expires.

## 2.4.4. Modality of waste disposal at life end of product

The device must be disposed as electric and electronic waste. For the recycling or the disposal of the product, CMZ invites to respect the local regulation in force and the most suitable procedures.

# RP064IO technical data

GENERAL FEATURES	
Quantity	Value
Control section voltage	+24 Vdc $\pm$ 20%
Typical absorbed current for the control section @24 Vdc	75 mA
Working environment temperature	from 0 to +40 °C
Storage environment temperature	from -20 to +70 °C
Storage and working relative humidity (without condensation)	from 5 to 95 %
Control section protection	short-circuit, with fuse <sup>a</sup> 2 A delay (NOT replaceable)
Weight	340 g
Maximum altitude	2000m [a.s.l.]
Protection class	IP20

<sup>a</sup>Breaking a fuse also causes damage to part of the electronics: in this case, contact CMZ SISTEMI ELETTRONICI S.r.l..

**Table 3.1. RP064IO features.**

DIGITAL INPUTS	
Quantity	Value
Digital inputs number	32 (16 for each group)
Input type	PNP
Galvanic insulation	YES, optoisolators
Input voltage	<ul style="list-style-type: none"> <li>Nominal: +24 Vdc</li> <li>LOW signal (physical status 0): from -30 to +3 Vdc</li> <li>HIGH signal (physical status 1): from +15 to +30 Vdc</li> </ul>
Input current (typical) with Vin= 24 Vdc	4,3 mA for all inputs excluded IN0, IN1 , IN2 e IN16, IN17, IN18 (fast inputs for encoder and counters) where it is 6,4 mA
Fast inputs max frequency <sub>i</sub>	100 kHz Duty Cycle 40-60%
DIGITAL OUTPUTS	
Quantity	Value
Digital outputs numbers	32 (16 for each group)

DIGITAL OUTPUTS	
Quantity	Value
Digital outputs power supply	24 Vdc $\pm$ 20%
Digital outputs power supply protection	Polarity inversion, overcurrent, short-circuit with 15A delay NOT replaceable fuse (one fuse for each group of 16 outputs)
Digital outputs protection	overcurrent, short-circuit
Typical current consumption for 24 vdc digital outputs (for every group of 16 outputs)	35 mA
Maximum output current (for every output)	200 mA (32 uscite) 500 mA (for max 16 of 32 outputs, independently from the digital outputs group)
Maximum current absorbed when loaded (for each group of 16 digital outputs)	$(500 \text{ mA} \times 16) + 35 \text{ mA} = 8,035 \text{ A}$
Maximum current absorbed when loaded (for two groups of digital outputs)	$(500 \text{ mA} \times 16) + (200 \text{ mA} \times 16) + (35 \text{ mA} \times 2) = 11,27 \text{ A}$

**Table 3.2. Digital inputs outputs features.**

ANALOG INPUTS	
Quantity	Value
Number of analog inputs	2 (not isolated)
Maximum functioning differential voltage	$\pm 10 \text{ V}$
Inputs impedance	66 K $\Omega$
ADC resolution	12 bits
ANALOG OUTPUTS	
Quantity	Value
Number of analog outputs	2 (galvanically isolated, not from each other)
Full scale voltage	$\pm 10 \text{ V}$
Max current	$\pm 10 \text{ mA}$
DAC resolution	12 bits

**Table 3.3. Analog inputs and outputs features.**

### 3.1. Dimensions and sizes

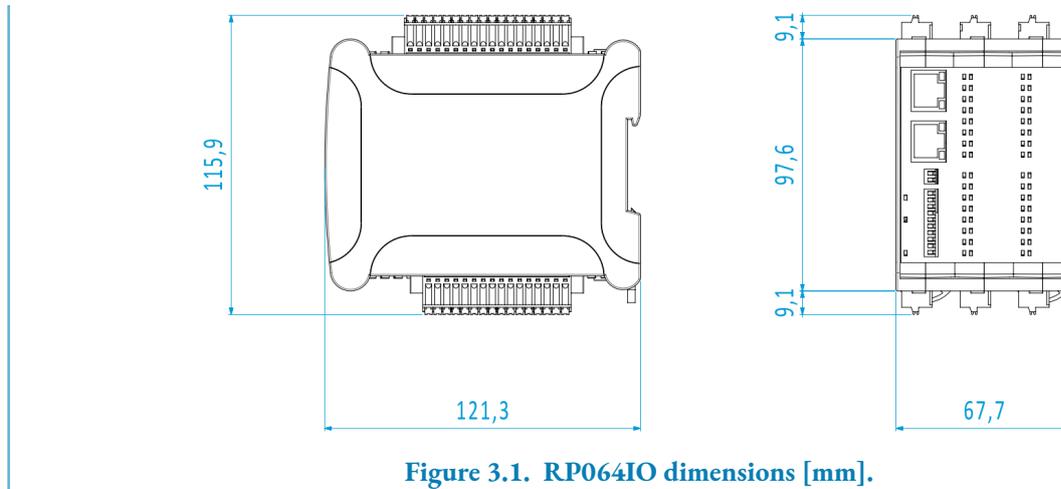


Figure 3.1. RP064IO dimensions [mm].

### 3.2. RP064IO Mechanical installation

The RP064IO is designed to be installed on the DIN rail using two special snap hooks.



# Electrical connections, LEDs and dip-switches

## 4.1. Electrical connections

### 4.1.1. RP064IO connectors

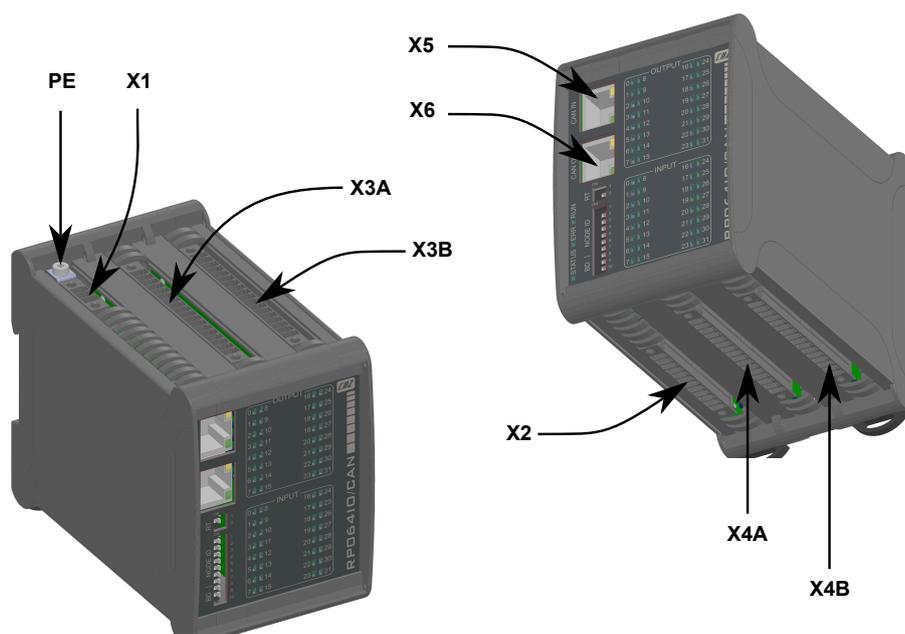


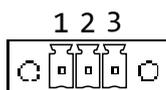
Figure 4.1. Connectors arrangement.

#### Screw for earth connection *PE*

M3 screw (maximum thread length = 12 mm), to be connected to the system earth (PE).

#### *X1* Control supply

Connector for control supply and grounding, Terminal block, pitch 3,5 mm, 3 poles.



PIN	Signal	Description
1	PE	Earth protection
2	GND	Reference for control section power supply
3	+24V	Positive for control section power supply

### Cable side connector *X1*

Terminal block, female, removable, Push-in with lateral screw	
Connector type	Female (removable)
Poles number	3
Section of the stranded copper wire	from 0,2 to 1,5 mm <sup>2</sup>

### *X2* Analog inputs outputs

Connector for analog inputs outputs, terminal block, pitch 3,5 mm, 12 poles.



PIN	Signal	Description
1	PE	Earth protection
2	GND_AI	Reference for analog inputs
3	AI0+	Analog input 0 (+)
4	AI0-	Analog input 0 (-)
5	AI1+	Analog input 1 (+)
6	AI1-	Analog input 1 (-)
7	AO0	Analog output 0
8	GND_A0	Reference for analog outputs
9	PE	Earth protection
10	AO1	Analog output 1
11	GND_A0	Reference for analog outputs
12	PE	Earth protection

## Cable side connector **X2**

Terminal block, female, removable, Push-in with lateral screw	
Connector type	Female (removable)
Poles number	12
Section of the stranded copper wire	from 0,2 to 1,5 mm <sup>2</sup>

## **X3A-X3B** Connection for each group of 16 digital outputs

Connector for a group of 16 digital outputs, terminal block, pitch 3,5 mm, 18 poles.



Connector	PIN	Signal	Description
X3A	1	GND24	GND 24V IO
	2	+24Vdc	24 Vdc power supply for digital outputs
	3	OUT15	Digital output 15
	4	OUT14	Digital output 14
	5	OUT13	Digital output 13
	6	OUT12	Digital output 12
	7	OUT11	Digital output 11
	8	OUT10	Digital output 10
	9	OUT9	Digital output 9
	10	OUT8	Digital output 8
	11	OUT7	Digital output 7
	12	OUT6	Digital output 6
	13	OUT5	Digital output 5
	14	OUT4	Digital output 4
	15	OUT3	Digital output 3
	16	OUT2	Digital output 2
	17	OUT1	Digital output 1
	18	OUT0	Digital output 0
Connector	PIN	Signal	Description
X3B	1	GND24	GND 24V IO
	2	+24Vdc	24 Vdc power supply for digital outputs
	3	OUT31	Digital output 31
	4	OUT30	Digital output 30
	5	OUT29	Digital output 29
	6	OUT28	Digital output 28
	7	OUT27	Digital output 27

Connector	PIN	Signal	Description
	8	OUT26	Digital output 26
	9	OUT25	Digital output 25
	10	OUT24	Digital output 24
	11	OUT23	Digital output 23
	12	OUT22	Digital output 22
	13	OUT21	Digital output 21
	14	OUT20	Digital output 20
	15	OUT19	Digital output 19
	16	OUT18	Digital output 18
	17	OUT17	Digital output 17
	18	OUT16	Digital output 16

### Cable side connector *X3A-X3B*

Terminal block, female, removable, Push-in with lateral screw	
Connector type	Female (removable)
Poles number	18
Section of the stranded copper wire	from 0,2 to 1,5 mm <sup>2</sup>

### *X4A-X4B* Connection for each group of 16 digital inputs

Connector for single group of 16 digital inputs, terminal block, pitch 3,5 mm, 16 poles.



Each group of 16 digital inputs includes 3 special inputs which, if necessary, can be dedicated to an incremental encoder and to a single-channel counter.

- X4A:
  - IN0 e IN1 → incremental encoder 1
  - IN2 → single-channel counter 1
- X4B:
  - IN16 e IN17 → incremental encoder 2
  - IN18 → single-channel counter 2



### Important: digital input ground reference

For the use of the respective digital inputs, the *X4A-X4B* connectors can be connected to two different power supplies since the ground references (ie pin 1 respectively of *X4A-X4B*) are galvanically isolated from each other.

Connector	PIN	Signal	Description
X4A	1	IN0	Digital input 0 - A phase of incremental encoder 1
	2	IN1	Digital input 1 - B phase of incremental encoder 1
	3	IN2	Digital input 1 - single-channel counter 1
	4	IN3	Digital input 3
	5	IN4	Digital input 4
	6	IN5	Digital input 5
	7	IN6	Digital input 6
	8	IN7	Digital input 7
	9	IN8	Digital input 8
	10	IN9	Digital input 9
	11	IN10	Digital input 10
	12	IN11	Digital input 11
	13	IN12	Digital input 12
	14	IN13	Digital input 13
	15	IN14	Digital input 14
	16	IN15	Digital input 15
Connector	PIN	Signal	Description
X4B	1	IN16	Digital input 16 - A phase of incremental encoder 2
	2	IN17	Digital input 17 - B phase of incremental encoder 2
	3	IN18	Digital input 18 - single-channel counter 2
	4	IN19	Digital input 19
	5	IN20	Digital input 20
	6	IN21	Digital input 21
	7	IN22	Digital input 22
	8	IN23	Digital input 23
	9	IN24	Digital input 24
	10	IN25	Digital input 25
	11	IN26	Digital input 26
	12	IN27	Digital input 27
	13	IN28	Digital input 28
	14	IN29	Digital input 29
	15	IN30	Digital input 30
	16	IN31	Digital input 31

**Cable side connector X4A-X4B**

Terminal block, female, removable, Push-in with lateral screw	
Connector type	Female (removable)
Poles number	16
Section of the stranded copper wire	from 0,2 to 1,5 mm <sup>2</sup>

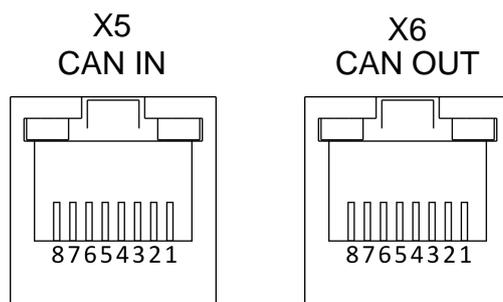
**X5-X6 Main bus (CAN)**

Connectors CAN IN e CAN OUT for CANopen fieldbus , RJ45 female, shielded.



**Important**

The cable shield must be continuative on the whole line and must be connected to the network Controller ground,while on theRP064IO it must be connected to the on the connector chassis X5-X6. Ensure equipotentiality called protective earth (PE - chassis) between the Controller and Device connectors of the network.



PIN	Signal	Description
1	CAN-H	CAN High
2	CAN-L	CAN Low
3	CAN_GND	Ground CAN
4 ÷ 6	-	Non connected
7	CAN_GND	Ground CAN
8	-	Non connected
Chassis	PE	Earth protection

## 4.2. LEDs

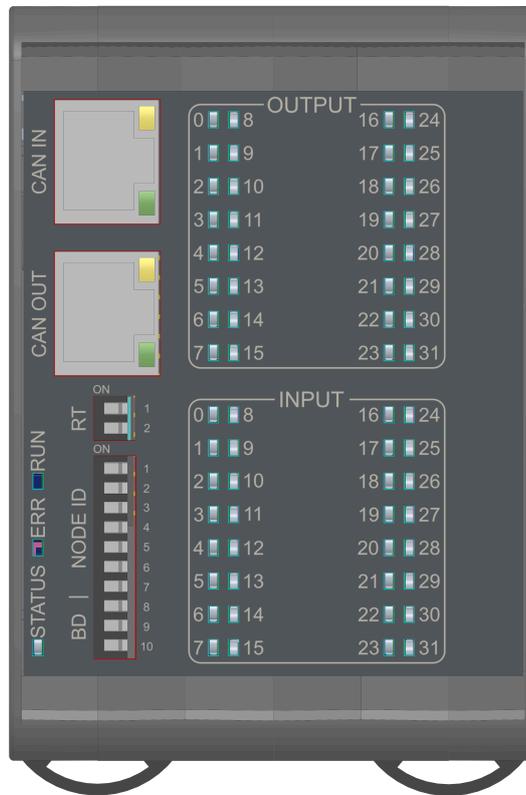


Figure 4.2. Leds and dip-switches arrangement.



### Note: LED on CAN connectors

The two LEDs that are part of the *X5-X6* connectors (CAN IN and CAN OUT), if present, are not used.

The RP064IO is equipped with 64 digital inputs and outputs status LEDs (32 for inputs and 32 for outputs) + 3 diagnostic LEDs and 2 dip switches.

The status LEDs, one for each digital input/output, represent the hardware status of relative input or output

A lit LED identifies the activation (logic level "1") of an input or an output.

The 3 diagnostic LEDs can assume the following states:

- *OFF*: led switched off;
- *ON*: led steady switched on;
- *1 FL* (1 flash): led 200 ms ON, 1 s OFF;
- *2 FL* (2 flash): led 200 ms ON, 200 ms OFF, 200 ms ON, 1 s OFF;
- *3 FL* (3 flash): led (200 ms ON, 200 ms OFF x 2) + 200 ms ON, 1 s OFF;

- 4 FL (4 flash): LED (200 ms ON, 200 ms OFF x 3) + 200 ms ON, 1 s OFF;
- 5 FL (5 flash): LED (200 ms ON, 200 ms OFF x 4) + (200 ms ON, 1 s OFF);
- BLK (blinking): led 200 ms ON, 200 ms OFF;
- FLK (flicker): led 50 ms ON, 50 ms OFF;

The meaning of the LED signals is shown in the following tables:

LED STATUS code	
Description	Colour
No error	green (ON)
Warning active	yellow (BLK)
Error active	red (BLK)
Firmware starting error	red (FLK)

LED ERR (ERROR) code		
Error on CANopen port	Description	LED (red)
No error	The CANopen port is working properly.	OFF
Warning limit reached	At least one of the error counters (TEC or REC) has reached or exceeded the notice level of 96.	1 FL
Error control event	The communication port is in Life Guard error.	2 FL
Sync error	SYNC controller error.	3 FL
Bus-off	The communication port is in Bus-off status.	ON

LED RUN code	
State machine status	LED (green)
PRE-OPERATIONAL	BLK
STOPPED	1 FL
OPERATIONAL	ON

### 4.3. Dip switches

The peripheral is provided with 2 dip switches (see *Figure 4.2, “Leds and dip-switches arrangement.”*), to configure:

- RT: Terminal resistor of CANopen port

Switch 2	Switch 1	Terminal resistor
OFF	OFF	Not connect
OFF	ON	Not permitted
ON	OFF	Not permitted
ON	ON	Connect

- NODE ID: ID CANopen addressing (switch 1 - switch 7)

Switch7	Switch6	Switch5	Switch4	Switch3	Switch2	Switch1	Node address
OFF	Not permitted						
OFF	OFF	OFF	OFF	OFF	OFF	ON	Node 1 (factory default)
OFF	OFF	OFF	OFF	OFF	ON	OFF	Node 2
OFF	OFF	OFF	OFF	OFF	ON	ON	Node 3
...	...	...	...	...	...	...	
ON	ON	ON	ON	ON	OFF	ON	Node 125
ON	ON	ON	ON	ON	ON	OFF	Node 126
ON	Node 127						

- DB: CANopen baud rate (switch 8,9,10)

Switch 10	Switch 9	Switch 8	Baud rate [bit/s]
OFF	OFF	OFF	1000000 (factory default)
OFF	OFF	ON	800000
OFF	ON	OFF	500000
OFF	ON	ON	250000
ON	OFF	OFF	125000
ON	OFF	ON	100000
ON	ON	OFF	50000
ON	ON	ON	20000



### Note

The setting of the dip-switches are applied only at the turn-on of the RP064IO and must be made with not supplied. Comply with the prescriptions on product handling.



# Communication protocol

## Bibliography

The list of official CiA documents to refer to regarding the implementation of the CANopen protocol is shown.

- For objects relating to the communication part: document CiA CANopen Application layer and communication profile - DS 301 v4.2.0
- For the objects relating to the standard I/O management functions: document CiA CANopen - Device Profile for Generic I/O Modules - DS 401 v3.0
- The parameters not included in the DS401 profile are accessible in the "manufacturer specific profile area" vocabulary area and are described in this document.
- The complete list of vocabulary objects is described in the "RP064IO\_ParameterReference\_en.pdf" file.

## Services implemented in the protocol

- *NMT*
- *SYNC*
- *EMCY*
- NODEGUARD
- *SDO* and *PDO* (4 TPDO + 4 RPDO)

The I/Os peripherals are managed through the reading/writing of CANopen vocabulary objects, the term "*vocabulary parameters*" will be used throughout this document. The I/Os peripheral are:

- 32 Digital Inputs
- 32 Digital Outputs
- 2 Analog Inputs
- 2 Analog Outputs
- 2 Encoders

- 2 Counters (single channel high frequency counters)

## 5.1. Saving and restoring retentive parameters

The RP064IO has the possibility of saving some parameters retentively. The retentive parameters are divided into two groups:

### Communication parameters

These are the parameters that configure the 8 PDOs of the card. Each PDO will keep the following parameters retentive:

- *COB-ID*
- Transmission Type
- Inhibit Time
- Event Timer
- Number of mapping parameters
- Mapping Parameter (8 elements)

### Application parameters

This group contains the configuration of DS401 profile parameters of and the parameters the "manufacturer specific profile" section. Each I/O peripheral section will retain the following parameters:

Resource	parameter
Digital inputs	Polarity, FilterConstant, InterruptMaskAnyChange, InterruptMaskLowToHigh, InterruptMaskHighToLow, GlobalInterruptEnable
Digital outputs	Polarity, ErrorMode, ErrorValue, FilterMask
Analog inputs	InterruptTriggerSelect, InterruptUpperLimit, InterruptLowerLimit, InterruptDeltaUnsigned, InterruptNegativeDelta, InterruptPositiveDelta, Offset, GlobalInterruptEnable
Analog outputs	ErrorMode, ErrorValue, Offset
Encoders	Polarity, Preset
HW counters	Preset

The DS301 specification indicates in detail the procedure that the Controller must carry out to save and restore the default parameters; it also indicates some preliminary interrogation operations of the device to find out which groups of parameters can be saved or not.

All the commands that the Controller can make the RP064IO execute without having to execute the preliminary phase have been summarized in the following table. The commands are activated by writing a pre-set value in the specific parameter..

The "save commands" save the current configuration for the selected group of parameters into retentive memory .

The "restore-to-default" commands perform two distinct operations:

- setting of the default configuration for the selected parameter group
- saving the new configuration in retentive memory

CANopen parameter	Value to set	Description
CANopen.StoreParameters.SaveAll	0x65766173	Saves in retentively way all the parameters of the RP064IOs
CANopen.StoreParameters.SaveCommPar	0x65766173	Saves in retentively way all the Communication parameters
CANopen.StoreParameters.SaveAppl	0x65766173	Saves in retentively way all the Application parameters
CANopen.RestoreParameters.RestoreAll		Restores the default value of all the parameters of the RP064IO
CANopen.RestoreParameters.RestoreCommPar	0x64616F6C	Restores the default value of all the Communication parameters
CANopen.RestoreParameters.RestoreAppl	0x64616F6C	Restores the default value of all the Application parameters



# Encoders and counters management

## 6.1. Incremental single ended encoder management

The RP064IO is designed to acquire 2 incremental encoders (single ended) with 24 Volt signals. An incremental encoder is a linear or rotary displacement measurement device that has two digital output signals, phase A and phase B, that are 90 degrees out of phase with each other. Il primo ingresso encoder (Channel 1) utilizza i segnali degli ingressi digitali IN0 e IN1 del connettore [X4A](#).

Il secondo ingresso encoder (Channel 2) utilizza i segnali degli ingressi digitali IN16 e IN17 del connettore [X4B](#).

The decoding of the encoder phases is performed in parallel with the acquisition of the digital inputs, no software configuration is required to start reading the encoders, the function which is already active when the peripheral is switched on.

For the encoder phases decoding logic to function correctly, the input signals must have the following characteristics:

Counters supply	24 V $\pm$ 20%
Max frequency of encoder signals	$\leq$ 100 kHz
Duty-cycle of encoder signals	From 40% to 60%

The vocabulary parameters for managing the first encoder are described below, the second encoder has equivalent parameters to the first. The retentive parameters, after being permanently saved, are restored each time the peripheral is switched on

### Encoder.Channel1.Value

Value in counts of the encoder position: The hardware counter present in the system increases/decreases at each front of phases A-B. With this way, if a 1000 pulse/revolution encoder is acquired, 4000 edges/revolution are counted. When RP064IO switched on, the value of this parameter is zero. During operation it is possible to execute the commands set by the parameter [Encoder.Channel1.ControlWord](#) (position reset or preset to a predetermined value).

**Encoder.Channel1.Polarity**

With this parameter you set the counting direction of the encoder input, with the value 0 you get positive increments with first the positive front A and then the positive front B. If you set 1, positive increments are obtained with the positive edge B first and then the positive edge A. It is a retentive parameter.

**Encoder.Channel1.Preset**

This parameter sets the preset value that the *Encoder.Channel1.Value* parameter will assume each time the "Write Preset value into counter value" command is executed (*Encoder.Channel1.ControlWord* command). Just writing the *Encoder.Channel1.Preset* parameter does not alter the value of the *Encoder.Channel1.Value* parameter. It is a retentive parameter.

**Encoder.Channel1.ControlWord**

Writing this parameter it is possible to perform some operations on the value of the parameter *Encoder.Channel1.Value*. The table shows the values to write in the parameter to give the related command.

1	Sets encoder with 0 value
2	Sets encoder with Preset value

The correct execution of the command can be verified by reading the parameter *Encoder.Channel1.StatusWord*.

**Encoder.Channel1.StatusWord**

Reading this parameter returns the result of the last operation performed with the *Encoder.Channel1.ControlWord* parameter.

1	Reset of the encoder value done
2	Preset of the encoder value done
1000	Not valid command

**Encoder.Channel1.ErrorCode**

Reading this parameter returns any error code connected to the last operation performed with the *Encoder.Channel1.ControlWord* parameter, if the commands are successful or if there are no details to specify, this parameter remains zero.

## 6.2. Single channel counters management

The RP064IO is designed to acquire 2 high-frequency hardware counters (24 V single-channel counters). Il primo contatore (Channel 1) utilizza il segnale dell'ingresso digitale IN2 del connettore *X4A*.

Il secondo contatore (Channel 2) utilizza il segnale dell'ingresso digitale IN18 del connettore *X4B*.

The single-channel counters increase with each positive edge detected on the connected digital input. The counting of the edges is performed in parallel with the acquisition of the digital input, it is possible to read both the logic status of the digital input and the number of edges detected at the same time.



### Activation of the counter mode

No software configuration is required to start reading the counters: the function is already active when the peripheral is switched on.

For the counters to function correctly, the input signals must have the following characteristics:

Counters supply	24 V $\pm$ 20%
Max frequency of encoder signals	$\leq$ 100 kHz
Duty-cycle of encoder signals	From 40% to 60%

The vocabulary parameters for managing the first counter are described below, the second counter has equivalent parameters to the first. The retentive parameters, after being permanently saved, are restored each time the peripheral is switched on

### Counter.Channel1.Value

Value in counts of the number of edges detected: The hardware counter present in the system increases with each positive edge of the digital input. When RP064IO switched on, the value of this parameter is zero. During operation it is possible to execute the commands set by the parameter *Counter.Channel1.ControlWord* (counter reset or preset to a predetermined value).

### Counter.Channel1.Preset

This parameter sets the preset value that the *Counter.Channel1.Value* parameter will assume each time the "Write Preset value into counter value" command is executed *Counter.Channel1.ControlWord*. Just writing the *Counter.Channel1.Preset* parameter does not alter the value of the *Counter.Channel1.Value* parameter.

It is a retentive parameter.

### Counter.Channel1.ControlWord

Writing this parameter it is possible to perform some operations on the value of the parameter *Counter.Channel1.Value*.

1	Sets counter with 0 value
2	Sets counter with Preset value

The correct execution of the command can be verified by reading the parameter *Counter.Channel1.StatusWord*.

### Counter.Channel1.StatusWord

Reading this parameter returns the result of the last operation performed with the *Counter.Channel1.ControlWord* parameter.

1	Reset of the counter value done
2	Preset of the encoder value done
1000	Not valid command

### Counter.Channel1.ErrorCode

Reading this parameter returns any error code connected to the last operation performed with the *Counter.Channel1.ControlWord* parameter, if the commands are successful or if there are no details to specify, this parameter remains zero.

# System diagnostic

The RP064IO peripheral includes in its vocabulary some parameters that display diagnostic information on the state of the system. The complete list of vocabulary objects is described in the “RP064IO\_ParameterReference\_en.pdf” file.

The most significant parameters are listed below:

## **System.Info.Version**

It is the firmware version running. It is a 32 bits value composed by 2 parts, the 16 most significant bits indicate the Major version, the 16 low significant bits indicate the Minor version.

For example: The firmware version 3.5 is the value 196613 (0x00030005).

## **System.Info.SerialNumber**

It is the system serial number. It is a 32-bit value, it is used to identify the production lot and the hardware revision of the system.

## **System.Info.HwFullVersionText**

It is System hardware versione (alphanumeric string).

Example: “HW 183 v.0.1.2”.

## **System.Info.SwFullVersionText**

It is the system software version (alphanumeric string); in comparison to the parameter *System.Info.Version* it also allows to identify preliminary versions of the software.

Example: “SW 2178 v.3.6.0-rc2”.

## **CanPort.RxErrorCounter**

Rx error counter of the CAN . It is used to evaluate the reliability of communication on the CAN network.

**CanPort.TxErrorCounter**

Tx error counter of the CAN It is used to evaluate the reliability of communication on the CAN network.

**System.Info.CpuTemp**

CPU temperature in 0.1°C.

## 7.1. Faults and warnings classification

The RP064IO includes in its vocabulary some parameters that display the faults and warnings status.

When the firmware detects operating anomalies or errors in parameter setting, it communicates error signals. Errors are divided into two categories, based on their level of severity:

- **Warning:** error indicating a non-critical system condition, the devices continue to function properly.
- **Fault:** error that causes a malfunction in the peripherals.

Furthermore, errors can be of the type:

- **Dynamic:** if the error condition is still present in the system (otherwise the signal disappears automatically).
- **Retentive:** if the fault is stored by the system, until it is reset via the Alarm.ResetFaultWarning parameter.

### 7.1.1. Generic alarm signalling

This chapter describes the structure of parameters with *Fault* of type *Dynamic*, the same structure is repeated also for those *Retentive*, and to parameters with *Warning* both *Dynamic* and *Retentive*.

The *Alarm.DynamicFault* parameter summarizes all the active fault groups in a bit mask. If a bit of this mask is active, you must read the details of the alarms in the group of connected parameters.

Alarm.DynamicFault	Group	Allarms detail
Bit 0	Control section	Alarm.Group.Control
Bit 1	In/Out section	Alarm.Group.IO Alarm.Group.Overload
Bit 2	Fieldbus communication	Alarm.Group.CANopen Alarm.Group.CANopen2
Bit 3	System commands	Alarm.Group.Info Alarm.Group.Firmware Alarm.Group.SystemManager

For example: bit 2 of *Alarm.DynamicFault* is active, this indicates that it is an alarm of the *Field-bus communication* group, the parameters that fall into this group are *Alarm.Group.CANopen*, the detail of the active fault will be read in these last parameters.

### Alarm.Group.Control

This alarm group belongs to the *Control section*. Alarms related to the system control section (CPU and memory status) are indicated.

Alarm.Group.Control	Value	Description
Bit 0	1	Control section over temperature
Bit 1	1	Control section undervoltage
Bit 30	1	Permanent memory data not valid
Bit 31	1	Internal software reset

### Alarm.Group.IO

This alarm group belongs to the *In/Out section*. The alarms connected to the management of the digital and analog outputs are shown.

Alarm.Group.IO	Value	Description
Bit 0	1	Digital Outputs 0-15 under voltage
Bit 1	1	Digital Outputs 16-31 under voltage
Bit 2	1	Digital Outputs 0-15 over temperature
Bit 3	1	Digital Outputs 16-31 over temperature
Bit 4	1	Analog outputs section overtemperature

### Alarm.Group.Overload

This alarm group belongs to the *In/Out section*. The alarms connected to the overload signaling of each digital output are shown.

Alarm.Group.Overload	Value	Description
Bit 0	1	Digital output 0 overload
Bit 1	1	Digital output 1 overload
Bit 2	1	Digital output 2 overload
Bit 3	1	Digital output 3 overload
Bit 4	1	Digital output 4 overload
Bit 5	1	Digital output 5 overload
Bit 6	1	Digital output 6 overload
Bit 7	1	Digital output 7 overload
Bit 8	1	Digital output 8 overload

Alarm.Group.Overload	Value	Description
Bit 9	1	Digital output 9 overload
Bit 10	1	Digital output 10 overload
Bit 11	1	Digital output 11 overload
Bit 12	1	Digital output 12 overload
Bit 13	1	Digital output 13 overload
Bit 14	1	Digital output 14 overload
Bit 15	1	Digital output 15 overload
Bit 16	1	Digital output 16 overload
Bit 17	1	Digital output 17 overload
Bit 18	1	Digital output 18 overload
Bit 19	1	Digital output 19 overload
Bit 20	1	Digital output 20 overload
Bit 21	1	Digital output 21 overload
Bit 22	1	Digital output 22 overload
Bit 23	1	Digital output 23 overload
Bit 24	1	Digital output 24 overload
Bit 25	1	Digital output 25 overload
Bit 26	1	Digital output 26 overload
Bit 27	1	Digital output 27 overload
Bit 28	1	Digital output 28 overload
Bit 29	1	Digital output 29 overload
Bit 30	1	Digital output 30 overload
Bit 31	1	Digital output 31 overload

### Alarm.Group.CANopen

This alarm group belongs to the *Fieldbus communication*. The alarms connected to the management of the CAN serial port and the alarms of the CANopen communication protocol are shown.

Alarm.Group.CANopen	Value	Description
Bit 1	1	CAN in error passive state
Bit 2	1	Life guard error
Bit 3	1	Recovered from bus-off
Bit 4	1	Sync controller error
Bit 5	1	Peripheral initialization error
Bit 25	1	Message overrun: Node guard (RX)
Bit 26	1	Message overrun: Node guard (TX)
Bit 27	1	Message overrun: SDO (RX)
Bit 28	1	Message overrun: SDO (TX)

Alarm.Group.CANopen	Value	Description
Bit 29	1	Message overrun: EMCY
Bit 30	1	Message overrun: SYNC
Bit 31	1	Message overrun: NMT

### Alarm.Group.CANopen2

This alarm group belongs to the *Fieldbus communication*. The alarms connected to the management of the CAN serial port and the alarms of the CANopen communication protocol are shown.

Alarm.Group.CANopen2	Value	Description
Bit 0	1	Message overrun: PDO TX 1
Bit 1	1	Message overrun: PDO TX 2
Bit 2	1	Message overrun: PDO TX 3
Bit 3	1	Message overrun: PDO TX 4
Bit 8	1	Message overrun: PDO RX 1
Bit 9	1	Message overrun: PDO RX 2
Bit 10	1	Message overrun: PDO RX 3
Bit 11	1	Message overrun: PDO RX 4
Bit 16	1	PDO RX 1 too short
Bit 17	1	PDO RX 2 too short
Bit 18	1	PDO RX 3 too short
Bit 19	1	PDO RX 4 too short
Bit 24	1	PDO RX 1 too long
Bit 25	1	PDO RX 2 too long
Bit 26	1	PDO RX 3 too long
Bit 27	1	PDO RX 4 too long

### Alarm.Group.Info

This alarm group belongs to the *System commands*. The alarms related to the operating incompatibility between hardware, bootloader and firmware are indicated; they can occur after the download of an incompatible firmware or as a consequence of the loss of the system production data.

Alarm.Group.Info	Value	Description
Bit 0	1	Versioning error: no memory available
Bit 4	1	Versioning error: hardware info of board are invalid
Bit 5	1	Versioning error: bootloader info of board are invalid
Bit 6	1	Versioning error: firmware info of board are invalid
Bit 12	1	Versioning error: hardware info of board not found

Alarm.Group.Info	Value	Description
Bit 15	1	Versioning error: hardware is not compatible with firmware of board
Bit 18	1	Versioning error: bootloader is not compatible with firmware of board
Bit 21	1	Versioning error: firmware of board is not compatible with hardware
Bit 24	1	Versioning error: firmware of board is not compatible with bootloader

### Alarm.Group.Firmware

This alarm group belongs to the *System commands*. The alarms connected to the firmware update procedure are indicated (reserved use). The detailed description of the error codes is described in the document “RP064IO\_ParameterReference\_en.pdf”.

Alarm.Group.Firmware	Value	Description
Bit 0...8	-	Firmware update: Specific error codes

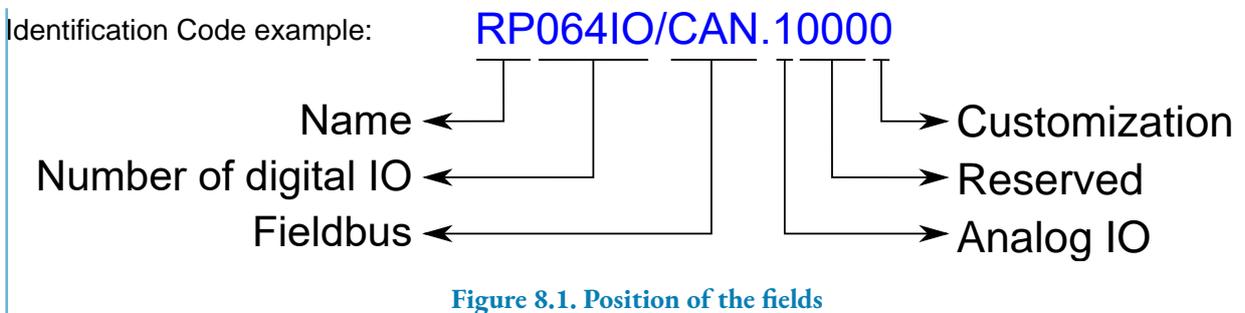
### Alarm.Group.SystemManager

This alarm group belongs to the *System commands*. The alarms connected to the SystemManager command are indicated (reserved use). The detailed description of the error codes is described in the document “RP064IO\_ParameterReference\_en.pdf”.

Alarm.Group.SystemManager	Value	Description
Bit 15...0	-	SystemManager: Specific error codes

# Identifier code (RP064IO)

The fields that make up the identification code of the RP064IO device are as follows.



Filed	Description	X	X	/X	.X	X	X	X	X
Name	Remote Peripheral	RP							
Number of digital IO	32 DI + 32 DO		064						
Fieldbus	CANopen			CAN					
Analog IO	Analog IOs not present				0				
	Analog IOs present				1				
Reserved	-					0	0	0	
Customization	CMZ code								0

**Table 8.1. Fields that make up the name of the RP064IO.**







CMZ reserves the right to change the data in order to update or improve its products without prior notice  
CMZ si riserva il diritto di modificare i dati per aggiornare o migliorare i propri prodotti senza alcun preavviso

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