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RX Horizontal Multi-Function Distributed I/O

CANOPEN protocol
Remote IO Module
Distributed IO Module

CATALOGUE

1.Preface

1.1 Document Usage Instructions

This document outlines the product's functional specifications, installation, operation, and settings, as well as information regarding network protocols. This document is intended for use by well-trained electrical automation engineers only.

(1) Disclaimer

The author has conducted the necessary review of the document. However, as the product progresses and evolves, the document may contain errors in technical parameters or editing. We reserve the right to make adjustments and modifications without prior notification to the users.

(1) Trademark

CANOPEN® is a registered trademark of the CIA Association.

(3) Patent Description

The designer of this product has obtained patent protection for both its appearance and the technical implementation method. Any attempt to copy, imitate or reverse engineer it could potentially violate the law.

(4) Copyright

Without the author's permission, it is strictly prohibited to copy, distribute or use this document.

1.2 Safety matters

This product is a professional equipment designed for industrial use and can only be operated by personnel with electrical operation experience. Before use, please carefully read this manual and follow the instructions to operate it properly to avoid causing personal injury or product damage.

This product is designed with an IP20 protection level. When using it, it needs to be installed in a distribution cabinet with dust-proof and moisture-proof functions.

1.3 Document History

Version	Date	Explanation
V1.12	2015.08.01	Modify the size parameters of the module.

1.4 Reference document

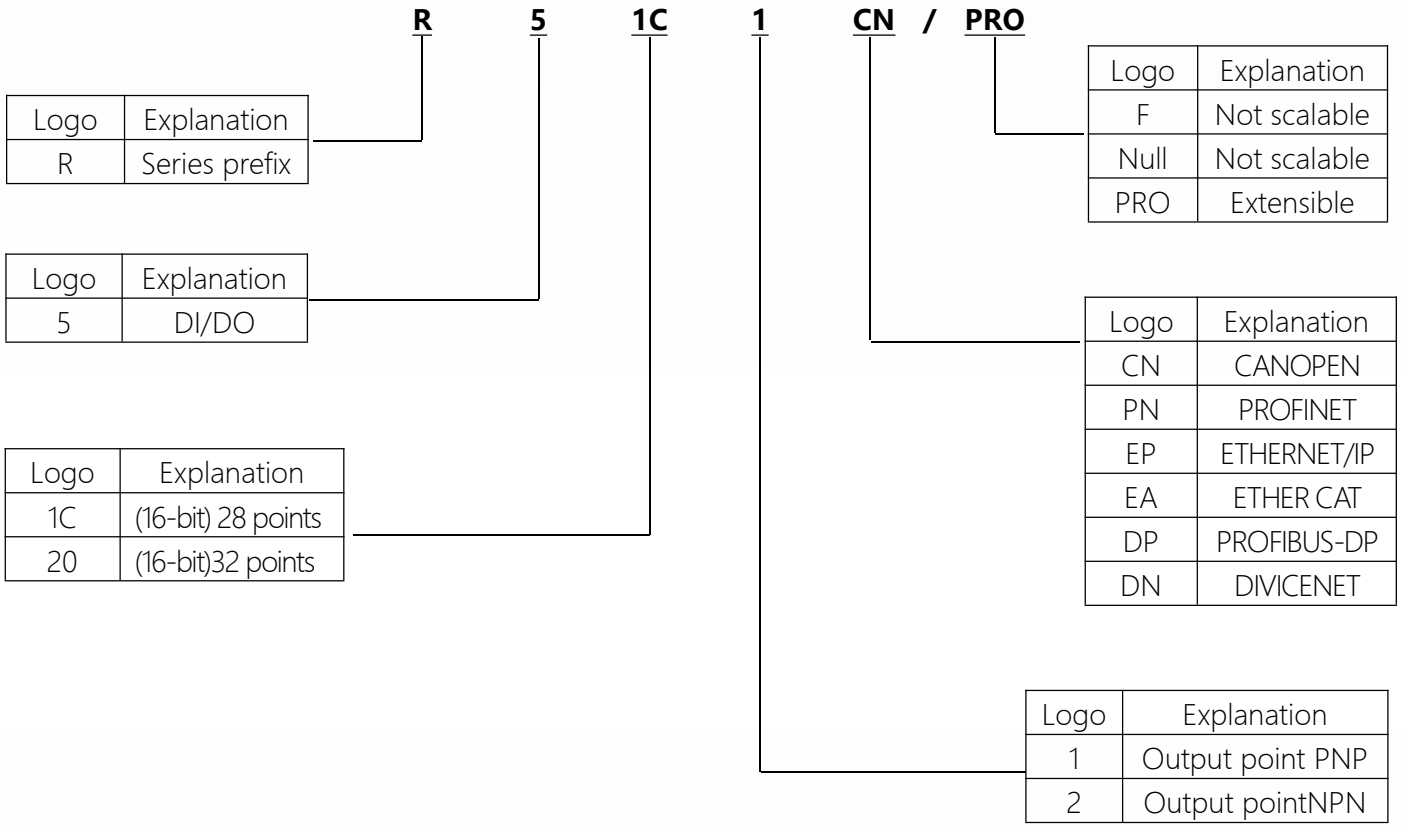
《IEC11631-22007 Programmable controllers –Part 2:Equipment requirements and tests》;

《IEC/TR 61158 Industrial Communication Network - Fieldbus Specification》;

2.Product Overview

2.1Model list

The R51C1-CN series of remote I/O products support the high-performance CANOPEN V0 bus communication protocol. Through the digital or analog I/O interfaces integrated in the module body, they can directly provide high-performance input and output functions without the need for other CANOPEN bus couplers. The expandable version of the module can also increase the required IO points by selecting different expansion modules.



Number	Model number	Explanation
1	R51C1-CN	16DI, 12DQ (transistors), fixed I/O points, CANOPEN V0 remote I/O module

Table 1 CANOPEN Remote I/O Module

2.2 R51C1-CN Specifications and Parameters

This article only provides explanations for the product specification parameters of R51C1-CN. For the specification parameters of other models, please contact your supplier for information.

2.2.1 DI specification

The specifications for digital input (DI) are shown in Table 2.

Number	Project	Specification
1	Number of channels	16
2	Access Type Ton	2 bytes
3	Toff	Type. 18uS / Max. 35uS
4	Input type	Type. 135uS / Max. 250uS
5	Input connector	Source type or sink type
6	Rated input voltage	Plug-in connector
7	"0" signal level	24 V DC (-15 %/+20 %), (IEC 61131-2, type 1)
8	"1" signal level	-3...+5 V (IEC 61131-2, type 1)
9	Input current	15...30 V (IEC 61131-2, type 1)
10	Electrical isolation	Typ. 10mA/Ch(IEC 61131-2, type 1)
11	Number of channels	Input/Control Area: 500V DC

Table 2 Specifications for Digital Input

2.2.2 DQ Specification

The specifications for the digital output (DQ) of the MOSFET are shown in Table 3.。

Number	Project	Specification
1	Number of channels	12
2	Access Type Ton	2 bytes
3	Toff	Type. 12uS / Max. 25uS
4	Output type	Type. 10mS / Max. 20mS(Empty load)
5	Output connector	Source type
6	Load type	Plug-in connector
7	Rated output voltage	Pure resistive, inductive, bulb
8	Maximum output current	24 V DC (-15 %/+20 %), (IEC 61131-2, type 1)
9	Rated total output current	Max. 0.5 A /Ch,Independent short-circuit protection for each channel
10	Power connector	6A
11	Number of channels	Two sets of 2-pin spring connectors

Table 3 Output Specifications of MOSFET

2.2.3 CANOPEN Communication Specification

The parameters of the ANOPEN communication specification are shown in Table 4.

Number	Project	Specification
1	Communication Protocol PDO	CiA 301 V4.02, CiA 401 V2.1, CiA 303-3 V1.0
2	Node monitoring	Static TPDO1/RPDO1
3	Baud rate	Life protection, node protection, heartbeat producer/consumer
4	Communication address range	20k, 50K, 125K, 250K, 500K,1000K（kbps）
5	Physical interface	01~99
6	Number of stations	5-PIN socket
7	Port protection	Up to 99
8	Transmission cable	Air discharge 15kV, contact discharge 8kV (IEC 61000-4-2)
9	Protection level	2-core shielded twisted copper cable
10	Communication Protocol PDO	IP20

Table 4 CANOPEN Communication Specification

2.2.4 Power supply specifications

The module power supply is divided into three independent parts: the control part, the digital input part, and the MOSFET digital output part, which are isolated from each other. Therefore, three independent power supplies need to be provided for each part of the circuit or they can be directly connected in parallel.

① The control voltage uses 24V DC (-15% / +20%), with a maximum current consumption of 0.5A, and has polarity reverse protection; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.

② The digital input voltage uses 24V DC (-15% / +20%), with a maximum current consumption of 16*10mA; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.

③ The MOSFET digital output part uses 24V DC (-15% / +20%), with a maximum current consumption of 8*0.5A, and has channel-independent overcurrent protection; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.

3.Structure Explanation

3.1 Shell

The module adopts the standard enclosure design of the Rx series remote I/O module. Its dimensions are: 120.5 * 80 * 62 (W/H/D, mm). The height of the lower rail clip protrusion is h = 5.5 mm. It supports an IP20 protection level.

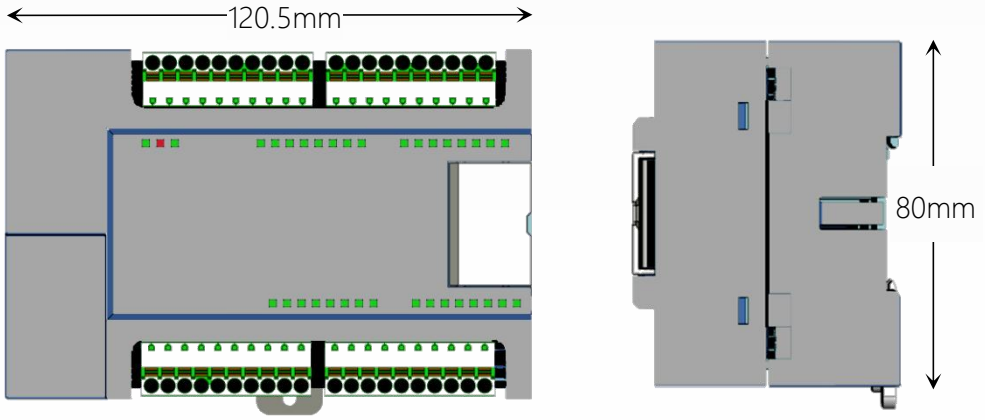


Figure 1 Module Dimension Diagram

3.2 Installation method

① The design of the module adopts natural convection cooling method. At least 25 mm of space must be left above and below the device to ensure normal heat dissipation. The distance between the front panel and the back panel should also be maintained at least 75 mm.

② The module can be easily installed on a standard DIN rail or the back panel of the control cabinet. The rail specification is TS35/7.5, as shown in Figure 2.

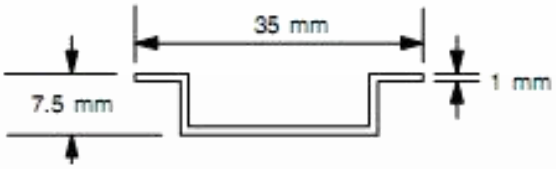
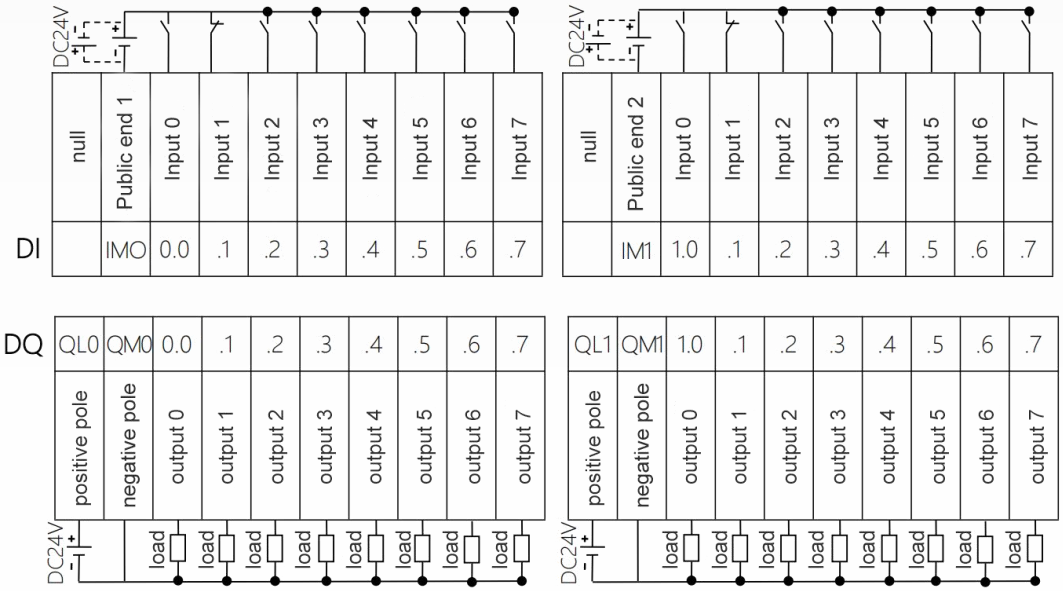


Figure 2 DIN rail

4. Hardware Description

4.1 R51C1-CN Circuit diagram



4.2 Communication interface

The module uses an open 5PIN socket as the physical interface for CANOPEN communication, and complies with the CiA 303_1 V1.8.0 CANopen recommendation - Part 1 Cabling and connector pin assignment specification.

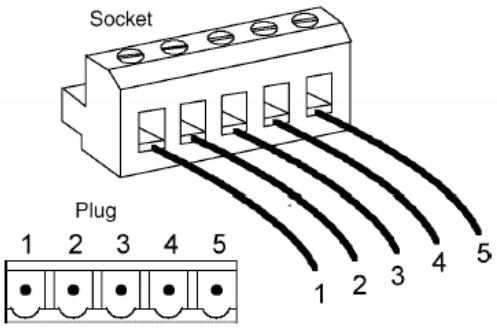
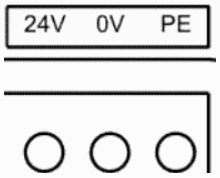


Figure 3 Module Wiring Diagram

Pin	Signal	Description
1	G	CAN bus ground
2	L	CAN bus L
3	SD	Shielding layer
4	H	CAN bus H
5	NC	NC

Table 5 CANOPEN Communication Interface

4.3 Communication power supply



24V	24V, positive terminal of the DC power supply
0V	0V, negative terminal of the DC power supply
PE	Connect to the ground

Table 6 Power Connection Terminal

4.4Node ID setting

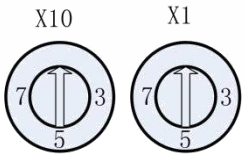


Figure 4 Node ID Setting Switch

The module sets the node ID through two-digit decimal encoding switches, as shown in the figure below. The range of node ID setting is from 01 to 99. The module program only reads the node ID setting at power-on and the modification during operation is invalid.

4.5 Baud rate

Baudrate	1	2	3
20K	0	1	0
50K	0	1	1
125K	1	0	0
250K	1	0	1
500K	1	1	0
1M	1	1	1

Table 7 CANOPEN Baud Rate

4.6 LED indication

The LED indicators of the module are divided into two parts: system status indicator and I/O status indicator.

4.6.1 System status indication

The module uses three different colored LEDs to indicate the system status, as shown in Table 8.

Name	Colour	Description	
PWR	green	24V Power Indicator	
		ON	The power supply is working properly. Power failure
		OFF	The power supply is working properly. Power failure
ERR	red	Module failure	
		ON	The CAN bus has not entered the correct mode:
		Double flash	Heartbeat and node protection errors
		OFF	The CAN bus has entered a state where it can operate
RUN	orange	Operation indicator light	
		ON	The module enters the operation state and successfully establishes a cyclic data exchange with the main station.
		Single flash	The module enters the operation stop state.
		Flash burst	The module enters the pre-operation (PRE-OPERATIONAL) state.

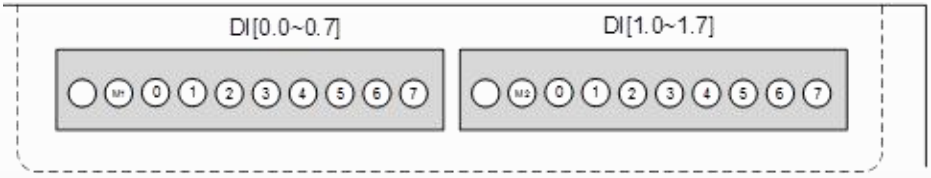
Table 8 System Status Indicator Lights

4.6.2 I/O status indicator

The digital input/output ports use green LEDs to indicate the status of the corresponding channels. When the light is on, it indicates that the logic state of the input/output port is "1", and when the light is off, it indicates that the logic state of the input/output port is "0".

4.7 Digital input interface

The digital quantity input interface is connected using two sets of 10P plug-in connectors, with a total of 16 input signals divided into DI-0 and DI-1 groups, as shown in the following figure.



Digital Input-0		Digital Input-1	
O	Null	O	Null
M1(*)	DI Public Port 1	M2(*)	DI Public Port 2
0	DI-0.0	0	DI-1.0
1	DI-0.1	1	DI-1.1
2	DI-0.2	2	DI-1.2
3	DI-0.3	3	DI-1.3
4	DI-0.4	4	DI-1.4
5	DI-0.5	5	DI-1.5
6	DI-0.6	6	DI-1.6
7	DI-0.7	7	DI-1.7

Table 9 Digital Input Terminals

Note: M1 and M2 are directly connected in parallel within the module.

4.8 Digital output interface

The digital output interface is connected using two sets of 10P plug-in connectors. The 12 output signals occupy the left 16P section of the connectors. Each digital output port is equipped with an independent 0.5A overcurrent protection.

Digital Output -0		Digital Output -1	
L3(*)	DQ Positive terminal of the power supply	L4(*)	DQ Positive terminal of the power supply
M3(*)	DQPower negative terminal	M4(*)	DQPower negative terminal
0	DQ-0.0	0	DQ-0.0
1	DQ -0.1	1	DQ -0.1
2	DQ -0.2	2	DQ -0.2
3	DQ -0.3	3	DQ -0.3
4	DQ -0.4	O	null
5	DQ -0.5	L0	Module power supply, refer to the description in Section 4.3
6	DQ -0.6	M0	
7	DQ -0.7	PE	

Table 10 Digital Output Terminals

Note*: L3/M3 and L4/M4 are directly connected in parallel within the module and are electrically isolated from the control circuit. When using, an external 24V DC power supply needs to be provided separately for the DQ circuit.

5.CANOPEN Bus

5.1 Bus transmission technology

The R51C1-CN series I/O modules are compatible with the CANOPEN bus, and the physical layer of transmission is based on CAN technology.

- **Network topology**

The CANOPEN network supports linear topologies with terminal units. All devices are connected in a bus structure, and a single bus segment can connect up to 32 stations (master or slave).If the network has more than 32 stations, repeaters must be used to connect the various bus segments.At the beginning and end of each bus segment, an active bus terminator is required, as shown in Figure 6. This structure is usually designed inside the bus connector.

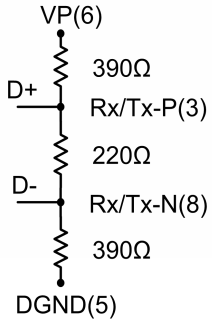


Figure 5 Bus Terminator

5.1.2 Transmission rate and cable length

The relationship between the transmission rate of the module and the length of the cable is shown in Table 11.

Transmission rate (kbps)	The range (m) of a single bus segment
1 M	25
800	50
500	100
250	250
125	500
50	1000
20	2500
10	5000

Table 11 Transmission Rate and Range of Cables

5.2 Communication Protocol CANOPEN

The Rx-CAN series I/O modules support CANOPEN version communication. The master/slave stations achieve the read/write functions of the I/O ports through cyclic data exchange.

5.2.1 Module configuration and address allocation

The DI/DQ data of R51C1-CAN-F is mapped to the main station's memory space through the configuration profile, as shown in Figure 7.

- The 16 digital inputs are mapped to TxPDO1;
- The 12 digital outputs are mapped to RxPDO1;

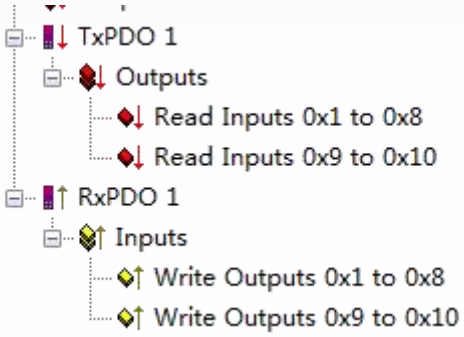


Figure 6 Module (R51C1-CAN) Address Mapping

5.2.2 User Parameters

The R51C1-CAN -F module is a digital module. The configuration of user parameters can be found in the detailed description of Section 6.1.

5.2.3 Diagnostic Function

The module has no diagnostic parameters.

5.2.4 System Behavior Characteristics

The behavior characteristics of the module follow the standard CiA301 protocol. There are mainly the following 5 states:

- Reset (Reset Node)

All module information is reset. It returns to the state of being powered on again.

- Reset Communication (Reset Communication)

The module only resets the communication parameters.

- Pre-operational (Pre-operational)

In this state, the master station and the slave station are in the configuration transmission stage, and the RUN indicator flashes rapidly. TPDO transmission cannot be carried out.

- Operation (operate)

The module information is in the process data transmission stage with the master station. The RUN indicator is constantly on.

- Stop State

The module information stops exchanging data with the host, and enters the safe mode.

5.2.5 Protection mechanism

① The module can use the node protection and heartbeat packet checks to detect faults in the main station or transmission. If there is no data communication with the main station within the set time interval (for example, if the communication cable is accidentally cut), the module will automatically switch the output to the safe state. At this time, the ER light will flash twice. The module enters the safe state.

② The values of the output terminals in the safe state are determined based on the actual settings of 6206h and 6207h, as shown in Figure 7.

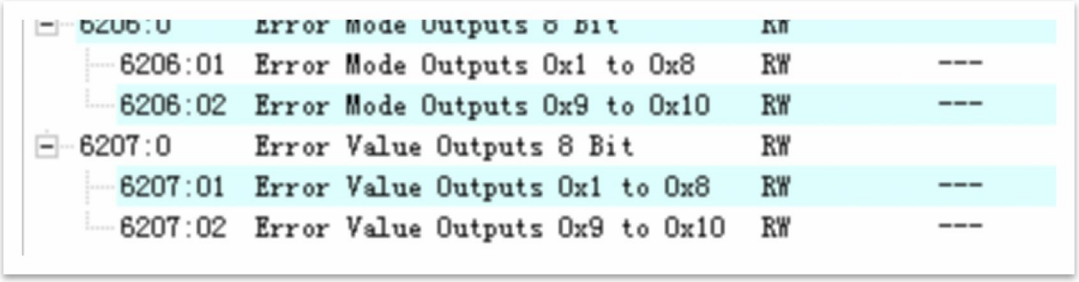


Figure 7 Module Safety Status Register

5.3 Equipment Database File (EDS)

CANOPEN uses device database files (EDS) to describe the communication characteristics of devices. The EDS files are readable ASCII text documents that contain general and specific specifications for communication.

5.3.1 Filename

The latest version of the EDS file for R51C1-CN is: R51C1_CANV1.eds.

"R51C1" represents the product number, corresponding to R51C1-CN, a 16DI/12DQ (MOSFET) remote IO module;

"V1" represents the version number, specifically version 1 (applicable only to R51C1-CN).

5.3.2 Register Overview

Register address	Register type	Name	Data type
1000	VAR	Device type	UNSIGNED32
1001	VAR	Error register	UNSIGNED8
1003	ARRAY	Pre-defined error field	UNSIGNED32
1005	VAR	COB-ID SYNC	UNSIGNED32
1006	VAR	Communication cycle period	UNSIGNED32
1007	VAR	Synchronous window length	UNSIGNED32
1008	VAR	Manufacturer device name	VIS-STRING
1009	VAR	Manufacturer hardware version	VIS-STRING
100A	VAR	Manufacturer software version	VIS-STRING
100C	VAR	Guard time	UNSIGNED16
100D	VAR	Life time factor	UNSIGNED8
1014	VAR	COB-ID EMCY	UNSIGNED32
1015	VAR	Inhibit time EMCY	UNSIGNED16
1016	ARRAY	Consumer heartbeat time	UNSIGNED32
1017	VAR	Produce heartbeat time	UNSIGNED16
1018	RECORD	Identity object	Identity
1029	ARRAY	Error behavior	UNSIGNED8
1200	RECORD	1st server SDO Parameter	SDO Parameter
1400	RECORD	1st receive PDO Parameter	PDO Parameter
1600	RECORD	1st receive PDO mapping	PDO Parameter
1800	RECORD	1st transmit PDO Parameter	PDO Parameter
1A00	RECORD	1st transmit PDO mapping	PDO Parameter
6000	ARRAY	Read input 8-bit	UNSIGNED8
6002	ARRAY	Polarity input 8-bit	UNSIGNED8
6003	ARRAY	Filter constant input 8-bit	UNSIGNED8
6005	VARIABLE	Global interrupt enable digital 8-bit	UNSIGNED8
6006	ARRAY	Interrupt mask any change 8-bit	UNSIGNED8
6007	ARRAY	Interrupt mask low–to-high 8-bit	UNSIGNED8
6008	ARRAY	Interrupt mask high-to-low 8-bit	UNSIGNED8
6200	ARRAY	Write output 8-bit	UNSIGNED8
6202	ARRAY	Change polarity output 8-bit	UNSIGNED8
6206	ARRAY	Error mode output 8-bit	UNSIGNED8
6207	ARRAY	Error value output 8-bit	UNSIGNED8
6208	ARRAY	Filter mask output 8-bit	UNSIGNED8

Table 12: R51C1-CN Register

6.I/O Process data

6.1 Module parameter configuration

The following is an explanation of the configuration parameters for the modules based on the Beihuo TwinCAT software.

6.1.1Digital Input (DI)

As shown in Figure 8, the digital quantity input consists of 3 parameters.

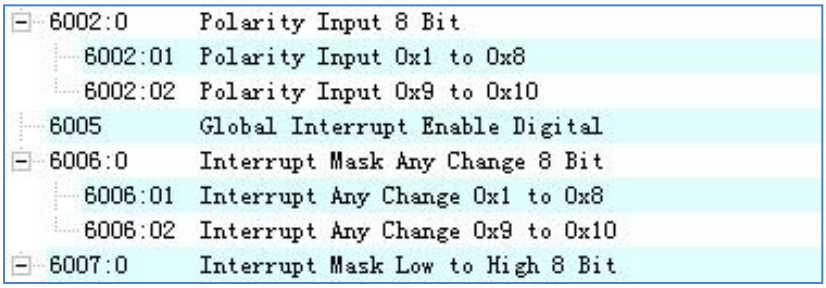


Figure 8 Digital Input Parameters

Parameter Explanation

Parameter	Name	Register	Input Range	Description
Polarity	Polarity inversion	6002:01H 6002:02H	0~255	The binary bits of this parameter correspond to the digital input channels (Bit 0 corresponds to DI-0.0, and so on). If the corresponding bit is set to "0", it means that the input value of the port is not processed; if it is set to "1", it means that the input value of the corresponding port is inverted (default is 0). Example: When Polarity[7..0] is set to "4" (binary 0000 0100B), the configuration reads the input value of the "DI-0.2" port as the inverted value.
Global Interrupt	Overall input switch	6005H	0-1	This value is 0. If the input data is all invalid, the data changes will not trigger PDO (the default value is 1).
Interrupt Mask	Input shielding bit	6006:01 6006:02	0-255	Each corresponding input point is denoted by Bit0, followed by Bit1, and so on. If the corresponding bit is set to "0", it indicates that the input value of the port is masked (default is 0).

6.1.2 Digital output (DQ)

As shown in Figure 9, digital output includes three parameters.

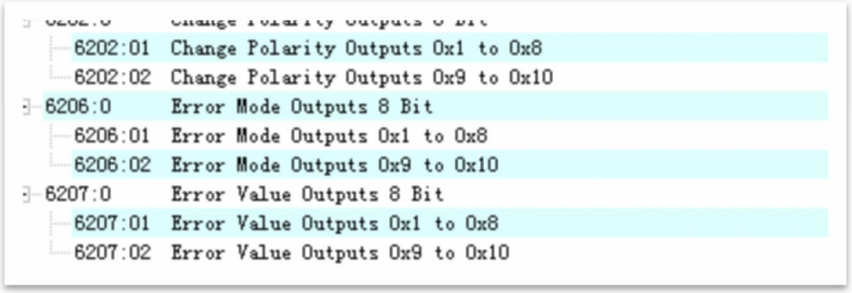


Figure 9 Digital output parameters

Parameter Explanation

Parameter	Name	Register	Input Range	Description
Polarity	polarity inversion	6202:01h 6202:02h	0~255	The binary bit of this parameter corresponds to the DQ0.x port (Bit0 corresponds to DQ-0.0, and so on). If the corresponding bit is set to "0", it indicates that the port output value will not be processed; if set to "1", it indicates that the corresponding port output value will be inverted. Example: When the Polarity[7..0] parameter is set to "4" (binary: 0000 0100B), the output value of the "DQ-0.2" port will be the negation of the actual configuration write value.
Error Mode	Enable Fault Safety Mode	6206:01h 6206:02h	0~255	The fault safety status value of the DQ0.x port is enabled, and the binary bit of this parameter corresponds to the DQ0.x port (Bit0 corresponds to DQ-0.0, and so on). When the module enters a fail-safe state, if the "Error Mode" corresponding bit is "1", the value of the "Error Value[7..0]" corresponding bit is output to the corresponding DQ0.x port.
Error Value	Fault safety status value	6207:01h 6207:02h	0~255	If the binary bit corresponding to the "Error Mode [7.. 0]" parameter is set to enable, then when the system enters a fail safe state, the value of this parameter is output to the DQ port.

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