NXZ Series Automatic Transfer Switching Equipment
User Manual of the Communication Protocol

Product name: Automatic Transfer Switching Equipment

Model: NXZ series

Version: V1.0

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ZHEJIANG CHINT ELECTRICS CO., LTD.

Contents

1. Basic Rules of ModBus

All RS485 communication loops shall follow the master-slave communication mode. In such a way, data can be transferred between one master station (such as PC) and 32 sub-stations.

No communication can be started from a sub-station.

All communications in RS485 loop are transferred in the form of "information frame".

If the master station or sub-station receives the information frame containing unknown command, it will not respond.

2. Data Frame Format

The communication is transferred in an asynchronous mode with byte (data frame) as the unit. Each data frame transferred between the master station and sub-station is a 11-dit serial data stream.

Data Frame Format

Start bit	1 bit
Data bit	8 bits
Parity check bit	Odd parity check, even parity check or no parity check
Stop bit	No parity check 2 bits, parity check 1 bit
Baud rate	2400. 4800. 9600. 19200. 38400bps

3. Communication Agreement

When a communication command is sent to the module, the module with the relevant address code receives the communication command and removes the address code to read the information. If there are no errors, it executes relevant tasks and sends the execution result back to the sender. The information sent back includes the address code, function code for execution, data after execution, and Cyclic Redundancy Check (CRC). If there is an error, an error message will be sent back.

Information Frame Format

Initial structure	Address code	Function code	Data field	Error checking	End structure
Time delay (equivalent to the time of 3.5 bytes)	1 byte 8 bits	1 byte 8 bits	N bytes N * 8 bits	2 bytes 16 bits	Time delay (equivalent to the time of 3.5 bytes)

Address code: The range of address of an individual module is 1-247.

Function code: Function code is the second data transferred each time in the communication. If the highest bit of the function code returned by the sub-machine is 1 (function code >127), it shows the sub-machine has given a response or data are wrong. The following table lists the specific meanings and operations of the function code.

Function code	Definition	Operation
03H	Read the register	Read one or several registers
06H	Write one register	Write the data of one register
10H	Write several registers	Write the data of several registers

4. Calculation Procedures of CRC-16 Code

a) Place the 16-bit CRC register as hexadecimal FFFF;

b) Execute XOR of a 8-bit data and the low 8-bit of CRC register, and place the result in CRC register;

c) Move the content of CRC register rightward for one bit, and use 0 to fill up the highest bit; check the shift out bit;

d) If the least significant bit is 0, repeat step 3 (shift again);

e) If the least significant bit is 1, execute XOR between CRC register and hexadecimal A001;

f) Repeat procedures 3 and 4, till there are 8 right shifts; in this way, the 8-bit data are all processed;

g) Repeat procedures 2~5 for next data processing;

h) The CRC register value obtained finally is CRC code; during transmission, the low 8-bit data shall be sent first before the high 8-bit data.

Note: Calculation of CRC code starts from <sub-machine address>; all bytes of <CRC code> are excluded.

5. Examples of Information Frame Format

5.1. Function code 03H

Request message format of the master station:

Slave station address	Function code	Data initial address		Data volume		Redundancy check	
1 byte	03H	MSB	LSB	MSB	LSB	MSB	LSB

Response message format of the slave station:

Slave station address	Function code	Byte size	Data 1		…	Data n		Redundancy check	
1 byte	03H	1 byte	MSB	LSB	…	MSB	LSB	MSB	LSB

Note: MSB refers to the high byte of the double byte; LSB refers to the low byte of the double byte (hereinafter inclusive).

5.2. Function code 06H

Request message format of the master station:

Slave station address	Function code	Data storage address		Modified value		Redundancy check	
1 byte	06H	MSB	LSB	MSB	LSB	MSB	LSB

Response message format of the slave station:

Slave station address	Function code	Data storage address		Modified value		Redundancy check	
1 byte	06H	MSB	LSB	MSB	LSB	MSB	LSB

5.3. Function code 10H

Request message format of the master station:

Slave station address	Function code	Data initial address		Number of register		Byte size	Data 1		…	Data n		Redundancy check	
1 byte	10H	MSB	LSB	MSB	LSB	1 byte	MSB	LSB	…	MSB	LSB	MSB	LSB

Response message format of the slave station:

Slave station address	Function code	Data initial address		Number of register		Redundancy check	
1 byte	10H	MSB	LSB	MSB	LSB	MSB	LSB

6. Handling of Error Code

If the data address or data value sent by the master station is wrong, the slave station will send back an error message. The highest bit of the function code is 1, that's to say, the function code returned back to the host is the function code sent by the subordinate machine plus 128.

The format of the error code sent back by the subordinate machine is as follows:

Address code: 1 byte

Function code: 1 byte (the highest bit is 1)

Error code: 1 byte

CRC code: 2 bytes

The error code is as follows:

01: Illegal function code: the data received are not a valid function code.

02: Illegal data address: the data address received exceeds the address range in the table.

03: Illegal data value: the data value received exceeds the data range of relevant address.

7. Register Address and Description

Table 1: Working Position and Basic Measuring Data

Register	Number of register	Access rule	Unit	Format	Value range	Description
C00H	1	Read	V	UINT	0-500	Normal A phase voltage
C01H	1	Read	V	UINT	0-500	Normal B phase voltage
C02H	1	Read	V	UINT	0-500	Normal C phase voltage
C03H	1	Read	V	UINT	0-500	Alternative A phase voltage
C04H	1	Read	V	UINT	0-500	Alternative B phase voltage
C05H	1	Read	V	UINT	0-500	Alternative C phase voltage
C06H	1	Read	—	Bitmap 16		Overvoltage and undervoltage state of the power source: 0 = normal 1 = abnormal •bit 0: Normal A phase undervoltage •bit 1: Normal A phase overvoltage •bit 2: Normal B phase undervoltage •bit 3: Normal B phase overvoltage •bit 4: Normal C phase undervoltage •bit 5: Normal C phase overvoltage •bit 6: Alternative A phase undervoltage •bit 7: Alternative A phase overvoltage •bit 8: Alternative B phase undervoltage •bit 9: Alternative B phase overvoltage •bit 10: Alternative C phase undervoltage •bit 11: Alternative C phase overvoltage
C07H	1	Read	—	Bitmap 16		Switch position state: •bit 0: Normal switching-on •bit 1: Alternative switching-on •bit2: Off
C08H	1	Read	—	Bitmap16		Switch fault state information: •bit 0: Switch transfer fault •bit 1: Fire-fighting off

Table 2: Switch Transfer Control and Setting Parameter

Register	Number of register	Access rule	Unit	Format	Value range	Description
D00H	1	Read/ Write	V	UINT	160-200	Normal supply undervoltage setting value
D01H	1	Read/ Write	V	UINT	240-290	Normal supply overvoltage setting value
D02H	1	Read/ Write	S	UINT	0-180	Transfer delay time
D03H	1	Read/ Write	V	UINT	160-200	Alternative supply undervoltage setting value
D04H	1	Read/ Write	V	UINT	240-290	Alternative supply overvoltage setting value
D07H	1	Read/	S	UINT	0-180	Generator shutdown delay interval

Register	Number of register	Access rule	Unit	Format	Value range	Description
		Write				
D08H	1	Read/ Write	—	UINT	0-2	Operating mode 0: automatic switching, automatic recovery 1: automatic switching, nonautomatic recovery 2: power grid-generator
D09H	1	Read/ Write	—	UINT	0-2	Mode of operation: 0: automatic, 1: manual 2: remote

Table 3: Remote Control Register

Register	Number of register	Access rule	Unit	Format	Value range	Description
E00H	1	—	—	UINT	5A01H-5A04H	Remote control register

In remote control mode (when the value of E09H register unit is 2), the setup parameter can be written in the remote controller to control the switch transfer remotely.

● E00H unit read-in 5A01H means switch to the normal supply.

● E00H unit read-in 5A02H means switch to the alternative supply.

● E00H unit read-in 5A04H means switch to off position.

Note: When switching to the switching-on position, the voltage of the power supply shall be in a normal condition; in this way, the switch can execute relevant action; otherwise, the switch won't respond.

8. Setting of Communication Parameters

Double press the setup key in the parameter setting menu interface as shown in 2 of the LED display image when the controller is working, and press "◀" and "▶" for upturn/downturn of the setting. Press automatic/manual button to exit the setting menu. Press "▲" and "▼" to modify the parameter.