
Communication Protocol

9

9.1 What this chapter contains

This chapter describes the communication protocol of Goodrive200A series inverters. The Goodrive200A series inverters provide RS485 communication interface. It adopts international standard MODBUS communication protocol to perform master-slave communication. The user can realize centralized control through PC/PLC, upper control PC, etc. (set the control command, running frequency of the inverter, modify relevant function codes, monitor and control the operating state and fault information of the inverter and so on) to adapt specific application requirements.

9.2 Brief instruction to MODBUS protocol

MODBUS protocol is a software protocol and common language which is applied in the electrical controller. With this protocol, the controller can communicate with other devices via network (the channel of signal transmission or the physical layer, such as RS485). And with this industrial standard, the controlling devices of different manufacturers can be connected to an industrial network for the convenient of being monitored.

There are two transmission modes for MODBUS protocol: ASCII mode and RTU (Remote Terminal Units) mode. On one MODBUS network, all devices should select same transmission mode and their basic parameters, such as baud rate, digital bit, check bit, and stopping bit should have no difference.

MODBUS network is a controlling network with single-master and multiple slaves, which means that there is only one device performs as the master and the others are the slaves on one MODBUS network. The master means the device which has active talking right to sent message to MODBUS network for the controlling and inquiring to other devices. The slave means the passive device which sends data message to the MODBUS network only after receiving the controlling or inquiring message (command) from the master (response). After the master sends message, there is a period of time left for the controlled or inquired slaves to response, which ensure there is only one slave sends message to the master at a time for the avoidance of singles impact.

Generally, the user can set PC, PLC, IPC and HMI as the masters to realize central control. Setting certain device as the master is a promise other than setting by a bottom or a switch or the device has a special message format. For example, when the upper monitor is running, if the operator clicks sending command bottom, the upper monitor can send command message actively even it can not receive the message from other devices. In this case, the upper monitor is the master. And if the designer makes the inverter send the data only after receiving the command, then the inverter is the slave.

The master can communicate with any single slave or with all slaves. For the single-visiting command, the slave should feedback a response message; for the broadcasting message from the master, the slave does not need to feedback the response message.

9.3 Application of the inverter

The MODBUS protocol of the inverter is RTU mode and the physical layer is 2-wire RS485.

9.3.1 RS485

The interface of 2-wire RS485 works on semiduplex and its data signal applies differential transmission which is called balance transmission, too. It uses twisted pairs, one of which is defined as A (+) and the other is defined as B (-). Generally, if the positive electrical level between sending drive A and B is among +2~+6V, it is logic“1”, if the electrical level is among -2V~-6V; it is logic“0”.

485+ on the terminal board corresponds to A and 485- to B.

Communication baud rate means the binary bit number in one second. The unit is bit/s (bps). The higher the baud rate is, the quicker the transmission speed is and the weaker the anti-interference is. If the twisted pairs of 0.56mm (24AWG) is applied as the communication cables, the Max. Transmission distance is as below:

| Baud rate | Max. transmission distance | Baud rate | Max. transmission distance |
|-----------|----------------------------|-----------|----------------------------|
| 2400BPS | 1800m | 9600BPS | 800m |
| 4800BPS | 1200m | 19200BPS | 600m |

It is recommended to use shield cables and make the shield layer as the grounding wires during RS485 remote communication.

In the cases with less devices and shorter distance, it is recommended to use 120Ω terminal resistor as the performance will be weakened if the distance increase even though the network can perform well without load resistor.

9.3.2 RTU mode

9.3.2.1 RTU communication frame format

If the controller is set to communicate by RTU mode in MODBUS network every 8bit byte in the message includes two 4Bit hex characters. Compared with ACSII mode, this mode can send more data at the same baud rate.

Code system

- 1 start bit
- 7 or 8 digital bit, the minimum valid bit can be sent firstly. Every 8 bit frame includes two hex characters (0...9, A...F)
- 1 even/odd check bit . If there is no checkout, the even/odd check bit is inexistent.
- 1 end bit (with checkout), 2 Bit(no checkout)

Error detection field

- CRC

The data format is illustrated as below:

11-bit character frame (BIT1~BIT8 are the digital bits)

| | | | | | | | | | | |
|-----------|------|------|------|------|------|------|------|------|-----------|---------|
| Start bit | BIT1 | BIT2 | BIT3 | BIT4 | BIT5 | BIT6 | BIT7 | BIT8 | Check bit | End bit |
|-----------|------|------|------|------|------|------|------|------|-----------|---------|

10-bit character frame (BIT1~BIT7 are the digital bits)

| | | | | | | | | | |
|-----------|------|------|------|------|------|------|------|-----------|---------|
| Start bit | BIT1 | BIT2 | BIT3 | BIT4 | BIT5 | BIT6 | BIT7 | Check bit | End bit |
|-----------|------|------|------|------|------|------|------|-----------|---------|

In one character frame, the digital bit takes effect. The start bit, check bit and end bit is used to send the digital bit right to the other device. The digital bit, even/odd checkout and end bit should be set as the same in real application.

The MODBUS minimum idle time between frames should be no less than 3.5 bytes. The network device is detecting, even during the interval time, the network bus. When the first field (the address field) is received, the corresponding device decodes next transmitting character. When the interval time is at least 3.5 byte, the message ends.

The whole message frame in RTU mode is a continuous transmitting flow. If there is an interval time (more than 1.5 bytes) before the completion of the frame, the receiving device will renew the uncompleted message and suppose the next byte as the address field of the new message. As such, if the new message follows the previous one within the interval time of 3.5 bytes, the receiving device will deal with it as the same with the previous message. If these two phenomena all happen during the transmission, the CRC will generate a fault message to respond to the sending devices.

The standard structure of RTU frame:

| | |
|-------------------------------|--|
| START | T1-T2-T3-T4(transmission time of 3.5 bytes) |
| ADDR | Communication address: 0~247(decimal system)(0 is the broadcast address) |
| CMD | 03H:read slave parameters 06H:write slave parameters |
| DATA (N-1) ... DATA (0) | The data of 2*N bytes are the main content of the communication as well as the core of data exchanging |
| CRC CHK low bit | Detection value:CRC (16BIT) |
| CRC CHK high bit | |
| END | T1-T2-T3-T4(transmission time of 3.5 bytes) |

9.3.2.2 RTU communication frame error checkout

Various factors (such as electromagnetic interference) may cause error in the data transmission. For example, if the sending message is a logic "1", A-B potential difference on RS485 should be 6V, but in reality, it may be -6V because of electromagnetic interference, and then the other devices take the sent message as logic "0". If there is no error checkout, the receiving devices will not find the message is wrong and they may give incorrect response which cause serious result. So the checkout is essential to the message.

The theme of checkout is that: the sender calculate the sending data according to a fixed formula, and then send the result with the message. When the receiver gets this message, they will calculate another result according to the same method and compare it with the sending one. If two results are the same, the message is correct. If not, the message is incorrect.

The error checkout of the frame can be divided into two parts: the bit checkout of the byte and the whole data checkout of the frame (CRC check).

Bit checkout of the byte

The user can select different bit checkouts or non-checkout, which impacts the check bit

setting of each byte.

The definition of even checkout: add an even check bit before the data transmission to illustrate the number of "1" in the data transmission is odd number or even number. When it is even, the check byte is "0", otherwise, the check byte is "1". This method is used to stabilize the parity of the data.

The definition of odd checkout: add an odd check bit before the data transmission to illustrate the number of "1" in the data transmission is odd number or even number. When it is odd, the check byte is "0", otherwise, the check byte is "1". This method is used to stabilize the parity of the data.

For example, when transmitting "11001110", there are five "1" in the data. If the even checkout is applied, the even check bit is "1"; if the odd checkout is applied; the odd check bit is "0". The even and odd check bit is calculated on the check bit position of the frame. And the receiving devices also carry out even and odd checkout. If the parity of the receiving data is different from the setting value, there is an error in the communication.

CRC check

The checkout uses RTU frame format. The frame includes the frame error detection field which is based on the CRC calculation method. The CRC field is two bytes, including 16 figure binary values. It is added into the frame after calculated by transmitting device. The receiving device recalculates the CRC of the received frame and compares them with the value in the received CRC field. If the two CRC values are different, there is an error in the communication.

During CRC, 0*FFFF will be stored. And then, deal with the continuous 6-above bytes in the frame and the value in the register. Only the 8Bit data in every character is effective to CRC, while the start bit, the end and the odd and even check bit is ineffective.

The calculation of CRC applies the international standard CRC checkout principles. When the user is editing CRC calculation, he can refer to the relative standard CRC calculation to write the required CRC calculation program.

Here provided a simple function of CRC calculation for the reference (programmed with C language):

```
unsigned int crc_cal_value(unsigned char *data_value,unsigned char data_length)
{
int i;
unsigned int crc_value=0xffff;
while(data_length--)
{
  crc_value^=*data_value++;
  for(i=0;i<8;i++)
  {
if(crc_value&0x0001)crc_value=(crc_value>>1)^0xa001;
else crc_value=crc_value>>1;
}
}
return(crc_value);
}
```

In ladder logic, CKSM calculated the CRC value according to the frame with the table inquiry.

The method is advanced with easy program and quick calculation speed. But the ROM space the program occupied is huge. So use it with caution according to the program required space.

9.4 RTU command code and communication data illustration

9.4.1 Command code: 03H

read N words (Word) (the Max. continuous reading is 16 words)

Command code 03H means that if the master read data form the inverter, the reading number depends on the “data number” in the command code. Max. continuous reading number is 16 and the parameter address should be continuous. The byte length of every data is 2 (one word). The following command format is illustrated by hex (a number with “H” means hex) and one hex occupies one byte.

The command code is used to read the working step of the inverter.

For example, read continuous 2 data content from 0004H from the inverter with the address of 01H (read the content of data address of 0004H and 0005H), the frame structure is as below:

RTU master command message (from the master to the inverter)

| | |
|-------------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 01H |
| CMD | 03H |
| High bit of the start address | 00H |
| Low bit of the start address | 04H |
| High bit of data number | 00H |
| Low bit of data number | 02H |
| CRC low bit | 85H |
| CRC high bit | CAH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

T1-T2-T3-T4 between START and END is to provide at least the time of 3.5 bytes as the leisure time and distinguish two messages for the avoidance of taking two messages as one message.

ADDR = 01H means the command message is sent to the inverter with the address of 01H and ADDR occupies one byte

CMD=03H means the command message is sent to read data form the inverter and CMD occupies one byte

“**Start address**” means reading data form the address and it occupies 2 bytes with the fact that the high bit is in the front and the low bit is in the behind.

“**Data number**” means the reading data number with the unit of word. If the “start address” is 0004H and the “data number” is 0002H, the data of 0004H and 0005H will be read.

CRC occupies 2 bytes with the fact that the high bit is in the front and the low bit is in the behind.

RTU slave response message (from the inverter to the master)

| | |
|-------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|-------|--|

| | |
|--------------------------------|--|
| ADDR | 01H |
| CMD | 03H |
| Byte number | 04H |
| Data high bit of address 0004H | 13H |
| Data low bit of address 0004H | 88H |
| Data high bit of address 0005H | 00H |
| Data low bit of address 0005H | 00H |
| CRC CHK low bit | 7EH |
| CRC CHK high bit | 9DH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

The meaning of the response is that:

ADDR = 01H means the command message is sent to the inverter with the address of 01H and ADDR occupies one byte

CMD=03H means the message is received from the inverter to the master for the response of reading command and CMD occupies one byte

“Byte number” means all byte number from the byte(excluding the byte) to CRC byte(excluding the byte). 04 means there are 4 byte of data from the “byte number” to “CRC CHK low bit”, which are “digital address 0004H high bit”, “digital address 0004H low bit”, “digital address 0005H high bit” and “digital address 0005H low bit”.

There are 2 bytes stored in one data with the fact that the high bit is in the front and the low bit is in the behind of the message, the data of data address 0004H is 1388H, and the data of data address 0005H is 0000H.

CRC occupies 2 bytes with the fact that the high bit is in the front and the low bit is in the behind.

9.4.2 Command code: 06H

06H (correspond to binary 0000 0110), write one word(Word)

The command means that the master write data to the inverter and one command can write one data other than multiple dates. The effect is to change the working mode of the inverter. For example, write 5000 (1388H) to 0004H from the inverter with the address of 02H, the frame structure is as below:

RTU master command message (from the master to the inverter)

| | |
|--------------------------------|--|
| START | T1-T2-T3-T4(transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 06H |
| High bit of write data address | 00H |
| Low bit of write data address | 04H |
| High bit of data content | 13H |
| Low bit of data content | 88H |
| CRC CHK low bit | C5H |
| CRC CHK high bit | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

RTU slave response message (from the inverter to the master)

| | |
|----------------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 06H |
| High bit of writing data address | 00H |
| Low bit of writing data address | 04H |
| High bit of data content | 13H |
| Low bit of data content | 88H |
| CRC CHK low bit | C5H |
| CRC CHK high bit | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

Note: section 10.2 and 10.3 mainly describe the command format, and the detailed application will be mentioned in 10.8 with examples.

9.4.3 Command code 08H for diagnosis

Meaning of sub-function codes

| Sub-function Code | Description |
|-------------------|------------------------------------|
| 0000 | Return to inquire information data |

For example: The inquiry information string is same as the response information string when the loop detection to address 01H of driver is carried out.

The RTU request command is:

| | |
|-------------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 01H |
| CMD | 08H |
| High bit of sub-function code | 00H |
| Low bit of sub-function code | 00H |
| High bit of data content | 12H |
| Low bit of data content | ABH |
| Low bit of CRC | ADH |
| High bit of CRC | 14H |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

The RTU response command is:

| | |
|-------------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 01H |
| CMD | 08H |
| High bit of sub-function code | 00H |
| Low bit of sub-function code | 00H |
| High bit of data content | 12H |
| Low bit of data content | ABH |
| Low bit of CRC | ADH |
| High bit of CRC | 14H |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

9.4.4 Command code: 10H, continuous writing

Command code 10H means that if the master writes data to the inverter, the data number depends on the “data number” in the command code. The Max. continuous reading number is 16.

For example, write 5000(1388H) to 0004H of the inverter whose slave address is 02H and 50(0032H) to 0005H, the frame structure is as below:

The RTU request command is:

| | |
|-------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 10H |
| High bit of write data | 00H |
| Low bit of write data | 04H |
| High bit of data number | 00H |
| Low bit of data number | 02H |
| Byte number | 04H |
| High bit of data 0004H | 13H |
| Low bit of data 0004H | 88H |
| High bit of data 0005H | 00H |
| Low bit of data 0005H | 32H |
| Low bit of CRC | C5H |
| High bit of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

The RTU response command is:

| | |
|-------------------------|--|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 10H |
| High bit of write data | 00H |
| Low bit of write data | 04H |
| High bit of data number | 00H |
| Low bit of data number | 02H |
| Low bit of CRC | C5H |
| High bit of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

9.4.5 The definition of data address

The address definition of the communication data in this part is to control the running of the inverter and get the state information and relative function parameters of the inverter.

9.4.5.1 The rules of parameter address of the function codes

The parameter address occupies 2 bytes with the fact that the high bit is in the front and the low bit is in the behind. The range of high and low byte are: high byte—00~ffH; low byte—00~ffH. The high byte is the group number before the radix point of the function code and the low byte is the number after the radix point. But both the high byte and the low byte should

be changed into hex. For example P05.06, the group number before the radix point of the function code is 05, then the high bit of the parameter is 05, the number after the radix point 05, then the low bit of the parameter is 06, then the function code address is 0506H and the parameter address of P10.01 is 0A01H.

| Function code | Name | Detailed instruction of parameters | Setting range | Default value | Modification | Serial No. |
|---------------|-----------------------------|--|---------------|---------------|--------------|------------|
| P10.00 | Simple PLC means | 0: Stop after running once. 1: Run at the final value after running once. 2: Cycle running | 0-2 | 0 | ○ | 354 |
| P10.01 | Simple PLC memory selection | 0: power loss without memory. 1: power loss memory. | 0-1 | 0 | ○ | 355 |

Note: P29 group is the factory parameter which can not be read or changed. Some parameters can not be changed when the inverter is in the running state and some parameters can not be changed in any state. The setting range, unit and relative instructions should be paid attention to when modifying the function code parameters.

Besides, EEPROM is stocked frequently, which may shorten the usage time of EEPROM. For users, some functions are not necessary to be stocked on the communication mode. The needs can be met on by changing the value in RAM. Changing the high bit of the function code from 0 to 1 can also realize the function. For example, the function code P00.07 is not stocked into EEPROM. Only by changing the value in RAM can set the address to 8007H. This address can only be used in writing RAM other than reading. If it is used to read, it is an invalid address.

9.4.5.2 The address instruction of other function in MODBUS

The master can operate on the parameters of the inverter as well as control the inverter, such as running or stopping and monitoring the working state of the inverter.

Below is the parameter list of other functions

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|--|--------------------|--|---------------------|
| Communication control command | 2000H | 0001H:forward running | W/R |
| | | 0002H:reverse running | |
| | | 0003H:forward jogging | |
| | | 0004H:reverse jogging | |
| | | 0005H:stop | |
| | | 0006H:coast to stop (emergency stop) | |
| | | 0007H:fault reset | |
| | | 0008H:jogging stop | |
| The address of the communication n setting value | 2001H | Communication setting frequency(0~Fmax(unit: 0.01Hz)) | W/R |
| | 2002H | PID reference, range(0~1000, 1000 corresponds to100.0%) | |

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|----------------------|--------------------|--|---------------------|
| | 2003H | PID feedback, range(0~1000, 1000 corresponds to100.0%) | W/R |
| | 2004H | Torque setting value (-3000~3000, 1000 corresponds to the 100.0% of the rated current of the motor) | W/R |
| | 2005H | The upper limit frequency setting during forward rotation(0~Fmax(unit: 0.01Hz)) | W/R |
| | 2006H | The upper limit frequency setting during reverse rotation(0~Fmax(unit: 0.01Hz)) | W/R |
| | 2007H | The upper limit torque of electromotion torque (0~3000, 1000 corresponds to the 100.0% of the rated current of the motor) | W/R |
| | 2008H | The upper limit torque of braking torque (0~3000, 1000 corresponds to the 100.0% of the rated current of the motor) | W/R |
| | 2009H | Special control command word Bit0~1:=00:motor 1 =01:motor 2 =10:motor 3 =11:motor 4 Bit2:=1 torque control =0:speed control | W/R |
| | 200AH | Virtual input terminal command , range: 0x000~0x1FF | W/R |
| | 200BH | Virtual input terminal command , range: 0x00~0x0F | W/R |
| | 200CH | Voltage setting value(special for V/F separation) (0~ 1000, 1000 corresponds to the 100.0% of the rated voltage of the motor) | W/R |
| | 200DH | AO output setting 1(-1000~1000, 1000 corresponds to 100.0%) | W/R |
| | 200EH | AO output setting 2(-1000~1000, 1000 corresponds to 100.0%) | W/R |
| SW 1 of the inverter | 2100H | 0001H:forward running | R |
| | | 0002H:forward running | |
| | | 0003H:stop | |
| | | 0004H:fault | |
| | | 0005H: POFF state | |
| SW 2 of the inverter | 2101H | Bit0: =0:bus voltage is not established =1:bus voltage is established Bi1~2:=00:motor 1 =01:motor 2 =10:motor 3 =11:motor 4 | R |

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|---|--------------------|--|---------------------|
| | | Bit3: =0:asynchronous motor =1:synchronous motor Bit4:=0:pre-alarm without overload =1:overload pre-alarm Bit5~ Bit6:=00:keypad control =01:terminal control =10:commuincation control | |
| Fault code of the inverter | 2102H | See the fault type instruction | R |
| Identifying code of the inverter | 2103H | GD200A -----0x010C | R |
| Operation frequency | 3000H | Range: 0.00Hz~P00.03 | R |
| Setting frequency | 3001H | Range: 0.00Hz~P00.03 | R |
| Bus voltage | 3002H | Range: 0~1200V | R |
| Output voltage | 3003H | Range: 0~1200V | R |
| Output current | 3004H | Range: 0.0~5000.0A | R |
| Operation speed | 3005H | Range: 0~65535RPM | R |
| Output power | 3006H | Range: -300.0~300.0% | R |
| Output torque | 3007H | Range: 0~65535RPM | R |
| Close loop setting | 3008H | Range: -100.0%~100.0% | R |
| Close loop feedback | 3009H | Range: -100.0%~100.0% | R |
| Input IO state | 300AH | Range: 0000~00FF | R |
| Output IO state | 300BH | Range: 0000~00FF | R |
| AI 1 | 300CH | Range: 0.00~10.00V | R |
| AI 2 | 300DH | Range: 0.00~10.00V | R |
| AI 3 | 300EH | Range: 0.00~10.00V | R |
| AI 4 | 300FH | Reserved | R |
| Read high speed pulse 1 input | 3010H | Range: 0.00~50.00kHz | R |
| Read high speed pulse 2 input | 3011H | Reserved | R |
| Read current step of the multi-step speed | 3012H | Range: 0~15 | R |
| External length | 3013H | Range: 0~65535 | R |
| External | 3014H | Range: 0~65535 | R |

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|----------------------|--------------------|--------------------------|---------------------|
| counting value | | | |
| Torque setting | 3015H | Range: 0-65535 | R |
| Inverter code | 3016H | | R |
| Fault code | 5000H | | R |

R/W characteristics means the function is with read and write characteristics. For example, “communication control command” is writing characteristics and control the inverter with writing command (06H). R characteristic can only read other than write and W characteristic can only write other than read.

Note: when operate on the inverter with the table above, it is necessary to enable some parameters. For example, the operation of running and stopping, it is necessary to set P00.01 to communication running command channel and set P00.02 to MODBUS communication channel. And when operate on “PID reference”, it is necessary to set P09.00 to “MODBUS communication setting”.

The encoding rules for device codes (corresponds to identifying code 2103H of the inverter)

| Code high 8 bit | Meaning | Code low 8 bit | Meaning |
|-----------------|---------|----------------|-------------------------------|
| 01 | GD | 0x08 | GD35 vector inverters |
| | | 0x09 | GD35-H1 vector inverters |
| | | 0x0a | GD300 vector inverters |
| | | 0x0b | GD100 simple vector inverters |
| | | 0x0c | GD200A general inverters |
| | | 0x0d | GD10 mini inverters |

Note: the code is consisted of 16 bit which is high 8 bits and low 8 bits. High 8 bits mean the motor type series and low 8 bits mean the derived motor types of the series. For example, 0110H means Goodrive200A vector inverters.

9.4.6 Fieldbus ratio values

The communication data is expressed by hex in actual application and there is no radix point in hex. For example, 50.12Hz can not be expressed by hex so 50.12 can be magnified by 100 times into 5012, so hex 1394H can be used to express 50.12.

A non-integer can be timed by a multiple to get an integer and the integer can be called fieldbus ratio values.

The fieldbus ratio values are referred to the radix point of the setting range or default value in the function parameter list. If there are figures behind the radix point ($n=1$), then the fieldbus ratio value m is 10^n . Take the table as the example:

| Function code | Name | Detailed instruction of parameters | Setting range | Default value | Modification | Serial No. |
|---------------|--------------------------------|--|---------------|---------------|-----------------------|------------|
| P01.20 | Hibernation restore delay time | Setting range: 0.0~3600.0s (valid when P01.19=2) | 0.0~3600.0 | 0.0s | <input type="radio"/> | 39 |
| P01.21 | Restart after power off | 0: disabling 1: enabling | 0~1 | 0 | <input type="radio"/> | 40 |

If there is one figure behind the radix point in the setting range or the default value, then the fieldbus ratio value is 10. if the data received by the upper monitor is 50, then the “hibernation restore delay time” is 5.0 (5.0=50÷10).

If MODBUS communication is used to control the hibernation restore delay time as 5.0s. Firstly, 5.0 can be magnified by 10 times to integer 50 (32H) and then this data can be sent.

01 06 01 14 00 32 49 E7
inverter address read command parameters address data number CRC check

After the inverter receives the command, it will change 50 into 5 according to the fieldbus ratio value and then set the hibernation restore delay time as 5s.

Another example, after the upper monitor sends the command of reading the parameter of hibernation restore delay time ,if the response message of the inverter is as following:

01 03 02 00 32 39 91
inverter address read command 2 bytes data parameter data CRC check

Because the parameter data is 0032H (50) and 50 divided by 10 is 5, then the hibernation restore delay time is 5s.

9.4.7 Fault message response

There may be fault in the communication control. For example, some parameter can only be read. If a writing message is sent, the inverter will return a fault response message.

The fault message is from the inverter to the master, its code and meaning is as below:

| Code | Name | Meaning |
|------|-----------------------|--|
| 01H | Illegal command | The command from master can not be executed. The reason maybe: 1. This command is only for new version and this version can not realize. 2. Slave is in fault state and can not execute it. |
| 02H | Illegal data address. | Some of the operation addresses are invalid or not allowed to access. Especially the combination of the register and the transmitting bytes are invalid. |
| 03H | Illegal value | When there are invalid data in the message framed received by slave. Note: This error code does not indicate the data value to write exceed the range, but indicate the message frame is an illegal frame. |
| 04H | Operation | The parameter setting in parameter writing is invalid. For example, |

| Code | Name | Meaning |
|------|---|--|
| | failed | the function input terminal can not be set repeatedly. |
| 05H | Password error | The password written to the password check address is not same as the password set by P7.00. |
| 06H | Data frame error | In the frame message sent by the upper monitor, the length of the digital frame is incorrect or the counting of CRC check bit in RTU is different from the lower monitor. |
| 07H | Written not allowed. | It only happen in write command, the reason maybe: 1. The written data exceeds the parameter range. 2. The parameter should not be modified now. 3. The terminal has already been used. |
| 08H | The parameter can not be changed during running | The modified parameter in the writing of the upper monitor can not be modified during running. |
| 09H | Password protection | When the upper monitor is writing or reading and the user password is set without password unlocking, it will report that the system is locked. |

The slave uses functional code fields and fault addresses to indicate it is a normal response or some error occurs (named as objection response). For normal responses, the slave shows corresponding function codes, digital address or sub-function codes as the response. For objection responses, the slave returns a code which equals the normal code, but the first byte is logic 1.

For example: when the master sends a message to the slave, requiring it to read a group of address data of the inverter function codes, there will be following function codes:

0 0 0 0 0 1 1 (Hex 03H)

For normal responses, the slave responds the same codes, while for objection responses, it will return:

1 0 0 0 0 1 1 (Hex 83H)

Besides the function codes modification for the objection fault, the slave will respond a byte of abnormal code which defines the error reason.

When the master receives the response for the objection, in a typical processing, it will send the message again or modify the corresponding order.

For example, set the “running command channel” of the inverter (P00.01, parameter address is 0001H) with the address of 01H to 03, the command is as following:

01 06 00 01 00 03 98 0B
inverter address read command parameter address parameter data CRC check

But the setting range of “running command channel” is 0~2, if it is set to 3, because the number is beyond the range, the inverter will return fault response message as below:

01 86 04 43 A3
inverter address abnormal response code fault code CRC check

Abnormal response code 86H means the abnormal response to writing command 06H; the fault code is 04H. In the table above, its name is operation failed and its meaning is that the parameter setting in parameter writing is invalid. For example, the function input terminal can not be set repeatedly.

9.4.8 Example of writing and reading

Refer to 10.4.1 and 10.4.2 for the command format.

9.4.8.1 Example of reading command 03H

Read the state word 1 of the inverter with the address of 01H (refer to table 1). From the table 1, the parameter address of the state word 1 of the inverter is 2100H.

The command sent to the inverter:



If the response message is as below:



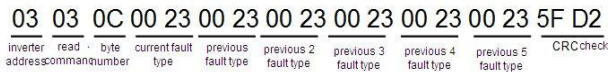
The data content is 0003H. From the table 1, the inverter stops.

Watch “the current fault type” to “the previous 5 times fault type” of the inverter through commands, the corresponding function code is P07.27~P07.32 and corresponding parameter address is 071BH~0720H(there are 6 from 071BH).

The command sent to the inverter:



If the response message is as below:



See from the returned data, all fault types are 0023H (decimal 35) with the meaning of maladjustment (STo).

9.4.8.2 Example of writing command 06H

Make the inverter with the address of 03H to run forward. See table 1, the address of “communication control command” is 2000H and forward running is 0001. See the table below.

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|-------------------------------|--------------------|---------------------------------------|---------------------|
| Communication control command | | 0001H: forward running | W- |
| | | 0002H: reverse running | |
| | | 0003H: forward jogging | |
| | | 0004H: reverse jogging | |
| | | 0005H: stop | |
| | | 0006H: coast to stop (emergency stop) | |
| | | 0007H: fault reset | |
| | | 0008H: jogging stop | |
| | | 0009H: pre-exciting | |
| | | 2000H: | |

The command sent by the master:

03 06 20 00 00 01 42 28
inverter address write command parameter address forward running CRC check

If the operation is success, the response may be as below (the same with the command sent by the master):

03 06 20 00 00 01 42 28
inverter address write command parameter address forward running CRC check

Set the Max. Output frequency of the inverter with the address of 03H as 100Hz.

| | | | | | | |
|--------|-----------------------|--|--------------|---------|---|----|
| P00.03 | Max. output frequency | Setting range : P00.04~600.00Hz(400.00 Hz) | 10.00~600.00 | 50.00Hz | ⊙ | 3. |
|--------|-----------------------|--|--------------|---------|---|----|

See the figures behind the radix point, the fieldbus ratio value of the Max. output frequency (P00.03) is 100. 100Hz timed by 100 is 10000 and the corresponding hex is 2710H.

The command sent by the master:

03 06 00 03 27 10 62 14
inverter address write command parameter address forward running CRC check

If the operation is successful, the response may be as below (the same with the command sent by the master):

03 06 00 03 27 10 62 14
inverter address write command parameter address forward running CRC check

Note: the blank in the above command is for illustration. The blank can not be added in the actual application unless the upper monitor can remove the blank by themselves.

Common communication fault

Common communication faults are: no response to the communication or the inverter returns abnormal fault.

The possible reason for no response to the communication:

Selecting wrong serial interface, for example, if the converter is COM1, selecting COM2 during the communication

The baud rate, digital bit, end bit and check bit are not the same with the inverter + and - of RS485 are connected in reverse.

The 485 wire cap on the terminal board of the inverter is not plug in. the wire cap in behind the terminal arrangement.

9.4.8.3 Example of continous writing command10H

Example 1: make the inverter whose address is 01H run forward at 10Hz. Refer to the instruction of 2000H and 0001. Set the address of “communication setting frequency” is 2001H and 10Hz corresponds to 03E8H. See the table below.

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|----------------------|--------------------|--------------------------|---------------------|
| Communication | 2000H | 0001H:forward running | W/R |

| Function instruction | Address definition | Data meaning instruction | R/W characteristics |
|--------------------------------------|--------------------|---|---------------------|
| control command | | 0002H:reverse running | |
| | | 0003H:forward jogging | |
| | | 0004H:reverse jogging | |
| | | 0005H:stop | |
| | | 0006H:coast to stop (emergency stop) | |
| | | 0007H:fault reset | |
| | | 0008H:jogging stop | |
| The address of communication setting | 2001H | Communication setting frequency(0~Fmax(unit: 0.01Hz)) | W/R |
| | 2002H | PID given, range(0~1000, 1000 corresponds to100.0%) | |

Set P00.01 to 2 and P00.06 to 8.

The command sent to the inverter:

01 10 20 00 00 02 04 00 01 03 E8 3B 10
Inverter address Continuous writing command Parameters address Data number Byte number Forward running 10Hz CRC check

If the response message is as below:

01 10 20 00 00 02 4A 08
Inverter address Continuous writing command Parameters address Data number CRC check

Example 2: set the ACC time of 01H inverter as 10s and the DEC time as 20s

| | | | | |
|--------|------------|--|-----------------|---|
| P00.11 | ACC time 1 | ACC time means the time needed if the inverter speeds up from 0Hz to the Max. One (P00.03). DEC time means the time needed if the inverter speeds down from the Max. Output frequency to 0Hz (P00.03). | Depend on model | ○ |
| P00.12 | DEC time 1 | Goodrive300 series inverters define four groups of ACC/DEC time which can be selected by P05. The factory default ACC/DEC time of the inverter is the first group. Setting range of P00.11 and P00.12:0.0~3600.0s | Depend on model | ○ |

The corresponding address of P00.11 is 000B, the ACC time of 10s corresponds to 0064H, and the DEC time of 20s corresponds to 00C8H.

The command sent to the inverter:

01 10 00 0B 00 02 04 00 64 00 C8 F2 55
Inverter address Continuous writing command Parameters address Data number Byte number 10s 20s CRC check

If the response message is as below:

01 10 00 0B 00 02 30 0A
Inverter address Continuous writing command Parameters address Data number CRC check

Note: The space between above commands is for instruction and there is no space between the commands during actual applications.