5.1 RTU mode and format

When controller communicates via Modbus in RTU mode, each byte is divided into 2 hexadecimal characters of 4 bits. The main advantage of this mode is that it can transfer characters with higher density compared with ASCII mode given the condition of the same baud rate, and each information must be transported continuously.

1) each byte format in RTU mode

Encoding system： 8 bits binary, hexadecimal 0-9, A-F.

Data bits： 1 bit of start bit, 8 bits of data (send from the lower bit), 1 bit of stop bit, optional parity check bit (refer to bit sequence of RTU data frame).

Error check zone： cyclic redundancy check (CRC)。

2) Bit sequence of RTU data frame

With parity check

Start	1	2	3	4	5	6	7	8	Par	Stop

Without parity check

Start	1	2	3	4	5	6	7	8	Stop

5.2 Register Address and Function Code

1) supported function code

Function code	Function description
03	Read multiple registers
06	Write single register
10	Write multiple registers continuously
13	Read single parameter

2) register address

Register function	Address
Control command input	0x2000
Read monitor parameter	0xD000（0x1D00）～0xD039（0x1D39）

MODBUS frequency setting	0x2001
MODBUS torque setting	0x2002
MODBUS PID frequency given	0x2003
MODBUS PID feedback setting	0x2004
MODBUS analog output AO1 control	0x2005(0~7FFF means 0%~100%)
MODBUS analog output AO2 control	0x2006 (0~7FFF means 0%~100%)
MODBUS pusle output DO control	0x2007 (0~7FFF means 0%~100%)
MODBUS digital output terminal control	0x2008 (0~7FFF means 0%~100%)
Parameter setting	0x0000～0x0F15

3) 03H read multiple parameters（8 items continuously at most）

Inquiry information frame format（send frame）:

Address	01H
Function	03H
Starting data address	00H
	01H
Number of Data(Byte)	00H
	02H
CRC CHK High	95H
CRC CHK Low	CBH

Analysis of this segment data:

01H is the address of the driver
03H read function code
0001H is start address, equivalent to F0.01 of control panel
0002H is item count of menu, i.e. the two items of F0.01 and F0.02
95CBH is 16 bits of CRC check code

Response information frame format（return frame）:

Address	**01H**
Function	**03H**
DataNum*2	**04H**
Data1[2Byte]	**00H**
	64H
Data2[2Byte]	**00H**
	64H
CRC CHK High	**BAH**
CRC CHK Low	**07H**

Analysis of this segment data：

01H is the address of the driver
03H read function code
04H is the product of (read item)*2
0064H read the data of F0.01
0064H read the data of F0.02
BA07H is 16 bits of CRC check code

Example：

name	Frame format
Read data of F0.01 and F0.02	**Send frame： 01H 03H 0001H 0002H 95CBH**
	Return frame：01H 03H 04H 0064H 0064H BA07H
Read data of F2.01	**Send frame： 01H 03H 0201H 0001H D472H**
	Return frame：01H 03H 02H 000FH F840H
Read monitor parameter of d-00 (address D000H	**Send frame： 01H 03H D000H 0001H BCCAH**

and 1D00H interchangeable）	Return frame：01H 03H 02H 1388H B512H
	Send frame： 01H 03H 1D00H 0001H 8266H
	Return frame：01H 03H 02H 1388H B512H
Read the status when the driver stops（address A000H and 1A00H interchangeable, refer to the run status description of the driver）	Send frame： 01H 03H A000H 0001H A60AH
	Return frame：01H 03H 02H 0040H B9B4H
	Send frame： 01H 03H 1A00H 0001H 8312H
	Return frame：01H 03H 02H 0040H B9B4H
Read fault code E-19 （address E000H and 1E00H interchangeable, refer to the fault code table）	Send frame： 01H 03H E000H 0001H B3CAH
	Return frame：01H 03H 02H 0013H F989H
	Send frame： 01H 03H 1E00H 0001H 8222H
	Return frame：01H 03H 02H 0013H F989H
Read pre-alarm code A-18（address E001H and 1E01 interchangeable, refer to the pre-alarm code table）	Send frame： 01H 03H E001H 0001H E20AH
	Return frame：01H 03H 02H 0012H 3849H
	Send frame： 01H 03H 1E01H 0001H D3E2H
	Return frame：01H 03H 02H 0012H 3849H

4) 06H write single parameter

Inquiry information frame format（send frame）:

Address	01H
Function	06H
Starting data address	20H
	00H
Data(2Byte)	00H
	01H
CRC CHK Low	43H

CRC CHK High	**CAH**

Analysis of this segment data：

01H is the address of the driver
06H write function code
2000H is the address of control command
0001H is forward command
43A1H is 16 bits of CRC check code

Response information frame format（return frame）:

Address	**01H**
Function	**06H**
Starting data address	**20H**
	00H
Number of Data(Byte)	**00H**
	01H
CRC CHK High	**43H**
CRC CHK Low	**CAH**

Analysis of this segment data： if set right, return the same input data

Example：

	Frame format
forward	**Send frame： 01H 06H 2000H 0001H 43CAH**
	Return frame：01H 06H 2000H 0001H 43CAH
reverse	**Send frame： 01H 06H 2000H 0009H 420CH**
	Return frame：01H 06H 2000H 0009H 420CH

stop	**Send frame：　01H　06H　2000H　0003H　C20BH**
	Return frame：01H　06H　2000H　0003H　C20BH
Free stop	**Send frame：　01H　06H　2000H　0004H　83C9H**
	Return frame：01H　06H　2000H　0004H　83C9H
reset	**Send frame：　01H　06H　2000H　0010H　43CAH**
	Return frame：01H　06H　2000H　0010H　43CAH
Forward jog	**Send frame：　01H　06H　2000H　0002H　03CBH**
	Return frame：01H　06H　2000H　0002H　03CBH
Reverse jog	**Send frame：　01H　06H　2000H　000AH　020DH**
	Return frame：01H　06H　2000H　000AH　020DH
Set F8.00 parameter at 1	**Send frame：　01H　06H　0800H　0001H　4A6AH**
	Return frame：01H　06H　0800H　0001H　4A6AH
MODBUS reference frequency 40HZ	**Send frame：　01H　06H　2001H　0FA0H　D642H**
	Return frame：01H　06H　2001H　0FA0H　D642H
MODBUS PID reference 5V	**Send frame：　01H　06H　2003H　01F4H　721DH**
	Return frame：01H　06H　2003H　01F4H　721DH
MODBUS PID feedback 4V	**Send frame：　01H　06H　2004H　0190H　C237H**
	Return frame：01H　06H　2004H　0190H　C237H

MODBUS torque set at 80%	Send frame： 01H 06H 2002H 0320H 22E2H
	Return frame：01H 06H 2002H 0320H 22E2H
User password check （address AD00H and 1C00H interchangeable）	Send frame： 01H 06H AD00H 0001H 68A6H
	Return frame：01H 06H AD00H 0001H 68A6H
	Send frame： 01H 06H 1C00H 0001H 4F9AH
	Return frame：01H 06H 1C00H 0001H 4F9AH
Check operation limit password（address AD01H and 1C01H interchangeable）	Send frame： 01H 06H AD01H 0002H 7967H
	Return frame：01H 06H AD01H 0002H 7967H
	Send frame： 01H 06H 1C01H 0002H 5E5BH
	Return frame：01H 06H 1C01H 0002H 5E5BH
MODBUS analog output AO1 output control 5V	Send frame: 01H 06H 2005H 3FFFH C3BBH
	Return frame：01H 06H 2005H 3FFFH C3BBH
MODBUS analog output AO2 output control 10V	Send frame: 01H 06H 2006H 7FFFH 027BH
	Return frame：01H 06H 2006H 7FFFH 027BH
MODBUS pulse output DO output control 25KHz	Send frame: 01H 06H 2007H 3FFFH 627BH
	Return frame：01H 06H 2007H 3FFFH 627BH
MODBUS digital output terminal Y1 output control	Send frame: 01H 06H 2008H 0001H C208H
	Return frame：01H 06H 2008H 0001H C208H

5) 10H write multiple parameters continuously

Inquiry information frame format（send frame）:

Address	01H
Function	10H
Starting data address	01H

	00H
Number of Data(Byte)	00H
	02H
DataNum*2	04H
Data1(2Byte)	00H
	01H
Data2(2Byte)	00H
	02H
CRC CHK High	2EH
CRC CHK Low	3EH

Analysis of this segment data:

01H is the address of the driver
10H write function code
0100H start address, equivalent to F1.00 of control panel
0002H amount of registers
04H bytes sum（2*register amount）
0001H data of F1.00
0002H data of F1.01
2E3EH 16 bits of CRC check code

Response information frame format（return frame）:

Address	01H
Function	10H
Starting data address	01H
	00H
Number of Data(Byte)	00H

	02H
CRC CHK High	40H
CRC CHK Low	34H

Analysis of this segment data：

01H address of the driver
10H write function code
0100H write data of F1.00
0002H item count of write menu, i.e. two items of F1.00 and F1.01
4034H 16 bits of CRC check code

Example：

Name	Frame format
Set F1.00, F1.01 at 1 and 0.02 respectively	Send frame： 01H 10H 0100H 0002H 04H 0001H 0002H 2E3EH
	Return frame：01H 10H 0100H 0002H 4034H
Forward and communicate reference frequency at 50HZ	Send frame： 01H 10H 2000H 0002H 04H 0001H 1388H 36F8H
	Return frame：01H 10H 2000H 0002H 4A08H
Set F1.00 at 1	Send frame： 01H 10H 0100H 0001H 02H 0001H 7750H
	Return frame：01H 10H 0100H 0001H 0035H

6) 13H read single parameter（including attribute, min.value, max.value）

Inquiry information frame format（send frame）:

Address	01H
Function	13H
Starting data address	00H
	0CH
Number of Data(Byte)	00H
	04H

CRC CHK High	45H
CRC CHK Low	CBH

Analysis of this segment data:

01H address of the driver
13H read function code
000CH start address, equivalent to F0.12 of control panel
0004H register amount
45CBH 16 bits of CRC check code

Inquiry information frame format（return frame）:

Address	01H
Function	13H
Starting data address	00H
	12H
Data1(2Byte)	13H
	88H
Data2(2Byte)	03H
	22H
Data3(2Byte)	00H
	00H
Data4(2Byte)	13H
	88H
CRC CHK High	28H
CRC CHK Low	31H

Analysis of this segment data:

01H address of the driver

13H write function code
000CH start address, equivalent to F0.12 of control panel
1388H parameter value
0322H attribute value
0000H min.value
1388H max.value
2831H 16 bits of CRC check code

Example：

Name	Frame format
Read parameter value of F0.12	Send frame： 01H 13H 000CH 0001H 85CAH
	Return frame：01H 13H 02H 1388H B1D2H
Read parameter value + attribute value of F0.12	Send frame： 01H 13H 000CH 0002H C5CBH
	Return frame：01H 13H 04H 1388H 0322H FCE4H
Read parameter value + attribute value + min.value of F0.12	Send frame： 01H 13H 000CH 0003H 040BH
	Return frame：01H 13H 06H 1388H 0322H 0000H 628BH
Read parameter value + min.value + max.value of F0.12	Send frame： 01H 13H 000CH 0004H 45CBH
	Return frame：01H 13H 08H 1388H 0322H 0000H 1388H 2831H

5.3 Functions of other Register Address:

function	address	description

		byte	bit	meaning
VFD operation status	A000H(1A00H)	Byte1	Bit7	0: no action 1: overload pre-alarm
			Bit6～Bit5	0:INV_220V 1:INV_380V 2:INV_660V 3:INV_1140V
			Bit4	0: no action 1: power off save
			Bit3	0: no action 1: reset
			Bit2～Bit1	0: no action 1: static tuning 2: dynamic tuning
			Bit0	0: control panel mode 1: terminal control mode 2: communication control mode 3: reserved

		Byte0	Bit7	
VFD operation status	A000H(1A00H)	Byte0	Bit6	0: no action 1: bus voltage is normal
			Bit5	0: no action 1: undervoltage
			Bit4	0: no action 1: jog run
			Bit3	0: forward 1: reverse
			Bit2～Bit1	1: Acc 2: Dec 3: constant speed
			Bit0	0: stop status 1: run status
Read VFD fault code	E000H(1E00H)	Address E000H and 1E00H interchangeable（refer to fault code table and example of read function code 03H）		
Read VFD fault pre-alarm code	E001H(1E01H)	Address E001H and 1E01H interchangeable（refer to example of pre-alarm code, read function code 03H）		
User password check	AD00H(1C00H)	Address AD00H and 1C00H interchangeable（refer to example of write function code 06H）		

Operation limit password check	**AD01H(1C01H)**	**Address AD00H and 1C00H interchangeable（refer to example of write function code 06H）**

5.4 Fault Code：

Fault code	Displayed code	Fault information
0000H	——	No fault
0001H	E-01	Overcurrent when accelerating
0002H	E-02	Overcurrent when decelerating
0003H	E-03	Overcurrent at constant speed
0004H	E-04	Overvoltage when accelerating
0005H	E-05	Overvoltage when decelerating
0006H	E-06	Overvoltage at constant speed
0007H	E-07	Bus undervoltage
0008H	E-08	Motor overload
0009H	E-09	Driver overload
000AH	E-10	Driver off load
000BH	E-11	Function module fault
000CH	E-12	Input phase loss
000DH	E-13	Output phase loss or current unbalance
000EH	E-14	Short circuit of output to earth
000FH	E-15	Heatsink overheat 1
0010H	E-16	Heatsink overheat 2
0011H	E-17	RS485 communication fault

0012H	E-18	Keypad communication fault
0013H	E-19	External device fault
0014H	E-20	Current detection fault
0015H	E-21	Motor tuning fault
0016H	E-22	EEPROM read-write fault
0017H	E-23	Parameters copy fault
0018H	E-24	PID feedback disconnection
0019H	E-25	Voltage feedback disconnection
001AH	E-26	Arrival of operation limit time
001BH	E-27	Coprocessor communication fault
001CH	E-28	Encoder disconnection fault
001DH	E-29	Speed deviation too much
001EH	E-30	Over-speed fault

5.5 Pre-alarm Code of the Driver:

Alarm code	displayed	Fault information
0000H	——	No fault
0009H	A-09	Driver overload alarm
0011H	A-17	RS485 communication fault alarm
0012H	A-18	Keypad communication fault alarm
0015H	A-21	Motor tuning alarm
0016H	A-22	EEPROM read-write fault alarm
0018H	A-24	PID feedback disconnection alarm

5.6 Control Command Format (see function code 06H example)：

<table>
<tr><th>address</th><th>bit</th><th>meaning</th></tr>
<tr><td rowspan="4">2000H</td><td>Bit7～Bit5</td><td>reserved</td></tr>
<tr><td>Bit4</td><td>0： no action
1： reset</td></tr>
<tr><td>Bit3</td><td>0： forward
1： reverse</td></tr>
<tr><td>Bit2～Bit0</td><td>100： free stop
011： stop
010： jog run
001： run</td></tr>
<tr><td rowspan="5">2008H(Press to position 1 is output, press to position 1 is shut)</td><td>Bit7~Bit4</td><td>Reserved</td></tr>
<tr><td>Bit3</td><td>Prorammable relay output R2</td></tr>
<tr><td>Bit2</td><td>Prorammable relay output R1</td></tr>
<tr><td>Bit1</td><td>Collector open circuit output Y2</td></tr>
<tr><td>Bit0</td><td>Collector open circuit output Y1</td></tr>
</table>

5.7 Parameter Attribute：

bit	meaning

<table>
<tr><td>Bit15</td><td colspan="3">reserved</td></tr>
<tr><td>Bit14</td><td colspan="3">menu</td></tr>
<tr><td>Bit13</td><td colspan="3">system</td></tr>
<tr><td>Bit12</td><td colspan="3">reset to factory defaults</td></tr>
<tr><td>Bit11</td><td colspan="3">EEPROM</td></tr>
<tr><td>Bit10～Bit9</td><td colspan="3">"○":01
"×":10
"◆":11
"◇":00</td></tr>
<tr><td>Bit8</td><td colspan="3">sign</td></tr>
<tr><td>Bit7～Bit3</td><td>1:00000
V:00001
A:00010
rpm:00011
HZ:00100
%:00110
S:01000</td><td>KHZ:01100
KW:01010
om:01110
ms:01001
MA:01011
KM:01101
CM:01111</td><td>us:10001
HZ/S:10000
mh:10010
C:10011
m/s:10100
H:10101
KWH:10110</td></tr>
<tr><td>Bit2～Bit0</td><td colspan="3">Decimal point</td></tr>
</table>

5.8 Error Code from Slave Response of Abnormal Information：

Error code	description
01H	Invalid function code
02H	Invalid address
03H	Invalid data

04H	Invalid register length
05H	CRC validation error
06H	Parameters can’t be changed during running
07H	The changes of parameters are invalid
08H	Control command of host is invalid
09H	Parameter protected by password
0AH	Password error

5.9 Communication Address of all Parameters：

Function code	Communication address
F0.00～F0.22	0000H～0016H
F1.00～F1.36	0100H～0124H
F2.00～F2.17	0200H～0211H
F3.00～F3.08	0300H～0308H
F4.00～F4.24	0400H～0418H
F5.00～F5.24	0500H～0518H
F6.00～F6.35	0600H～0623H
F7.00～F7.36	0700H～0724H
F8.00～F8.20	0800H～0814H
F9.00～F9.73	0900H～0949H
FA.00～FA.35	0A00H～0A23H
FB.00～FB.06	0B00H～0B06H
FC.00～FC.25	0C00H～0C19H
FE.00～FE.15	0E00H～0E0FH
FF.00～FF.21	0F00H～0F15H
d-00～d-57	D000H（1D00H）～D039H（1D39H）

Notice：

1) in the above examples, the driver address is 01, which makes it better for illustration; when the driver is slave, the address setting range is 1～247, and if any data of frame format is changed, the check code needs to be recalculated. The calculating tools of 16bit CRC check code can be download from internet.

2) Initial address of monitor item is D000, each item offset corresponding hexadecimal value based on this address, then plus it with the initial address. For example: the monitor initial item is d—00, the corresponding initial address is D000H (1D00H), now read monitor item d—18, 18-00=18, the corresponding hexadecimal of 18 is 12H, then the read address of d—18 is D000H+12H = D012H (1D00H+12H = 1D12H). Address D000H and 1D00H are interchangeable.

3) Frame format when the slave response information is abnormal: driver address + (80H+function code) + 16bit CRC check code; if the salve return frame is 01H + 83H + 04H + 40F3H, then 01H is slave address, 83H is 80H+03H indicating read error, 04H is invalid data length, 40F3H is 16bit CRC check code.