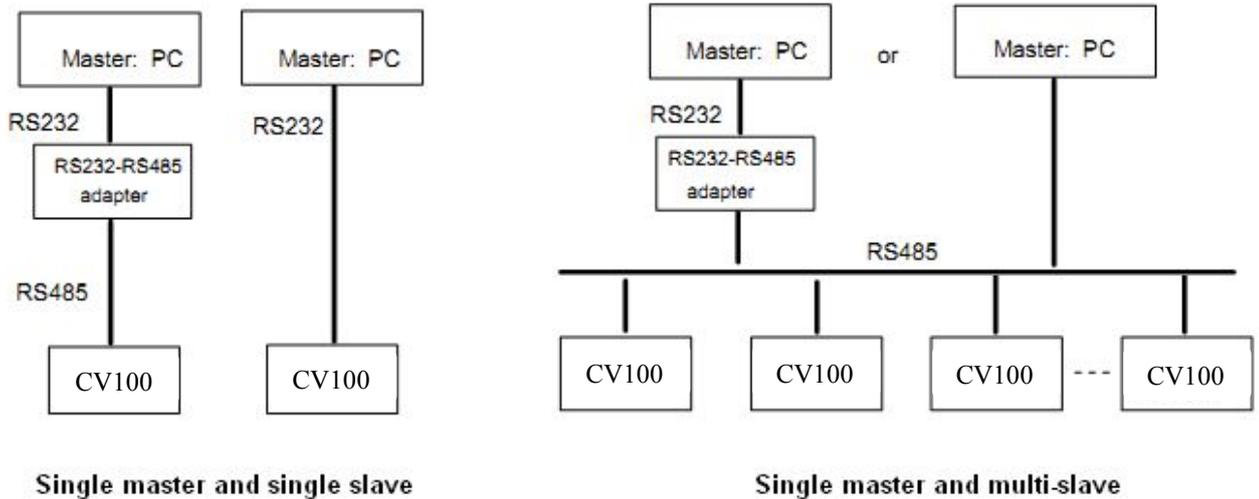

Communication Protocol

1. Networking Mode

According to the following pic 10-1, there are two networking modes: Single master and multi-slave, Single master and single slave.



Pic 10-1

2. Interfaces

RS485 or RS232: asynchronous, semi-duplex

Default: 8-N-1, 9600bps, RTU. Refer to Group b3 for parameter settings.

3. Communication Modes

1. The communication protocol for the drive is Modbus. It supports normal reading and writing of the registers, also supports managing the function code.
2. The drive is a slave in the network. It communicates in "point to point" mode.
3. When there is multi-station communication or the communication distance is long, please connect a 100~200 ohm resistance to the positive and minus terminal of the master's signal wire in parallel.
4. FV 100 normally provides RS485 interface, if you need RS232, please choose to add a RS232/RS485 conversion equipment.

4. Protocol Format

CV100 supports Modbus RTU and ASCII, its frame format is shown in Fig.10-2.

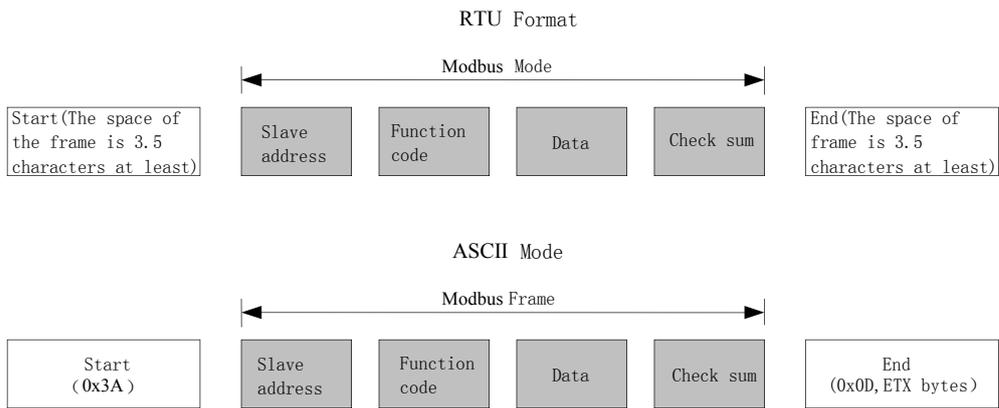


Fig.10-2 Modbus protocol format

Modbus use “Big Endian” of encoder mode, which means sending data with high byte in front and low byte behind.

1. RTU mode

In RTU mode,there must be a idle of at least 3.5 characters between two frames.It use CRC-16 for data check.

Following is an example for read the parameter of internal register 0101(A1.01) from No.5 slave.

Request frame:

Slave address	Function code	Data				Checksum	
		Register address		Length			
0x05	0x03	0x01	0x01	0x00	0x01	0xD5	0xB2

Response frame:

Slave address	Function code	Data			Checksum	
		Response length	Register content			
0x05	0x03	0x02	0x13	0x88	0x44	0xD2

Therein, checksum is CRC value.

2. ASCII mode

In ASCII *mode*, characters are used to start and end a frame. The colon “0x3A” is used to flag the start of a message and each message is ended with a “0x0D,0x0A” combination. Except frame header and end of frame,all other messages are coded in hexadecimal values, represented with readable ASCII characters. Only the characters 0...9 and A...F are used for coding. Herein the data use LRC as error checksum.

Following is an example for writing value 0003(0x0003) into the parameter of internal register 0201(A2.01) from No.5 slave.

Request frame:

	Frame header	Slave address		Function code		Data								Check code		Frame trail	
						Register address				Setting value							
Character	:	0	5	0	6	0	2	0	1	0	0	0	3	E	F	CR	LF
ASCII	3A	30	35	30	36	30	32	30	31	30	30	30	33	45	46	0D	0A

Therein,the check code is LRC checksum,which value is equal to the complement of (05+06+02+01+0x00+0x03) .

Response frame:

	Frame header	Slave address	Function code	Data								Check code	Frame trail
				Register address				Setting value					

Character	:	0	5	0	6	0	2	0	1	0	0	0	3	E	F	CR	LF
ASCII	3A	30	35	30	36	30	32	30	31	30	30	30	33	45	46	0D	0A

VFD can set different delay time for response according to different application. For RTU mode, the actual delay time for response is 3.5 characters interval at least. For ASCII mode, the actual delay time for response is 1 ms at least.

5. Protocol Function

The main functions of Modbus are read and write parameters. Different function codes need different operation request. The modbus protocol of VFD support the operations in the following table.

Function code	Meaning
0x03	Read parameters of VFD, including function code parameters, control parameters and status parameters.
0x06	Rewrite single function code or control parameter with 16bit length, the value of the parameter can't be saved after VFD power off.
0x08	Diagnosis.
0x10	Rewrite multiple function code or control parameters, the value of the parameters can't be saved after VFD power off.
0x41	Rewrite single function code or control parameter with 16bit length, the value can be saved after VFD power off.
0x42	Manage function code of VFD.
0x43	Rewrite multiple function code or control parameters, the value of the parameters can be saved after VFD power off.

All the function code, control parameters and status parameters of VFD are mapping to the read/write register of Modbus. The group number of function code is mapping to the high byte of register address and the index address in the group is mapping to the low byte of register address. The corresponding relationship between group number and register address is shown in following table.

Group No.	High byte of mapping address	Group No.	High byte of mapping address
Group A0	0x00	Group B2	0x0C
Group A1	0x01	Group B3	0x0D
Group A2	0x02	Group B4	0x0E
Group A3	0x03	Group C0	0x14
Group A4	0x04	Group C1	0x15
Group A5	0x05	Group D0	0x1E
Group A6	0x06	Group D1	0x1F
Group A7	0x07	Group D2	0x20
Group A8	0x08	Group U0	0x5A
Group B0	0x0A	Control parameter	0x32
Group B1	0x0B	Status parameter	0x33

For example, the register address of function code A3.02 is 0x0302, and the register address of the first control parameter (Control command 1) is 0x3200.

6.Control parameters and status parameters of VFD

The control parameters of VFD can achieve the function such as startup, stop,setting operating frequency and so on.Retrieving the status parameters of VFD can obtain the parameters such as operating frequency,output current,output torque and so on.

1. Control parameter

The control parameters of VFD are shown in following table.

Register	Parameter Name	Saved after powered off	Note
0X3200	Control word 1	No	
0x3201	Main setting	No	The main setting frequency: In the common operation mode, the channel of main setting is serial communication, it tack effects if the bit8 of control word 1 is set on. Wether it saves or not depends on the setting in A2.03
0x3202	Operation frequency setting	No	Same as above
0x3203	Digital closed loop setting	yes	Takes effects after the closed loop is enabled
0x3204	Pulse closed loop setting	/	Do not support
0x3205	Analog outprut AO1 setting	No	Enable when A6.28=15
0x3206	Reserved		
0x3207	Digital output DO setting	No	Enable when A6.25=65
0x3208	Frequency Proportion setting		Do not support
0x3209	Virtual terminal control setting	No	Bit0~bit4: X1~X5. Corresponding to on state of the bits in A6.24 Bit10~bit13: Y1 /RO1/RO2, They are enabled when A6.14~A6.17=17
0x320A	Set the acceleration time	Yes	
0x320B	Set the deceleration time	Yes	
Ox3212	Control command word 2	No	

Note:

- (1) When read control parameters,it will return the value which is rewrote in the previous communication.
- (2) In control parameters,the preset value,range of input/output setting value and decimal point scaling should refer to the corresponding function code.

The bits for the control command word 1 are defined as follows:

Bit	Value	Function	Note
bit2~bit0	111B	Running command	Start VFD (enable when jog is disable)
	110B	Stop mode 0	Stop according to the preset deceleration time(enable when jog is disable)
	101B	Stop mode 1	Coast to stop
	100B	Stop by external fault	Coast to stop and VFD display external
	011B	Stop mode 2	Not support
	Others	Reserved	
bit3	1	Reverse	Set the operating direction when run command is enable
	0	Forward	
bit4	1	Jog forward	No action when bits for jog forward and reverse are enable at the same time,and jog stop when both are disable at the same time.
	0	Jog forward disable	
bit5	1	Jog reverse	
	0	Jog reverse disable	
bit6	1	Enable Acc/Dec	The bit5~bit0 of control word 1 are enable when this bit is enable.
	0	Disable Acc/Dec	
bit7	1	Host computer control word 1 enable	Selection bit of host computer control word 1
	0	Host computer control word 1 disable	
bit8	1	Main reference enable	Selection bit of main reference
	0	Main reference disable	
bit9	1	Fault reset enable	Selection bit of fault reset
	0	Fault reset disable	
bit15~bit10	000000B	Reserved	

Note:

(1) The host computer control word(control word1 and control word 2) is enable when set “Methods of inputting operating commands” to “communication control”.The control word 1 is enabled when the bit7 of control word 1 is enable.And bit5~bit0 are enable when the bit6 of control word 1 is enable.

(2) Processing of fault and alarm in host computer:when VFD is failure,all the command of control word 1 and control word 2,except fault reset command,are disable,it need to reset fault firstly before sending other commands.When the alarm happens,the control words is still enable.

The bits definitions of control word 2 are shown as follows:

Bit	Value	Function	Note
-----	-------	----------	------

bit0	1	VFD operation disable	Selection bit for VFD operation enable/disable
	0	VFD operation enable	
bit1	1	Running(The direction refer to function code)	Running direction
	0	Other operation status(Refer to control word 1)	
bit2	1	Auxiliary reference enable	The selection bit for auxiliary reference frequency.
	0	Auxiliary reference disable	
bit3	1	The control word 2 enable	The selection bit for control word 2.
	0	The control word 2 disable	
bit15~bit4		Reserved	

Note: control word 2 is enabling when the bit3 of control word 2 is enable.

2. Status parameters

Register address	Parameters name	Note
0x3300	VFD operation status word 1	
0x3301	Current main reference value	Current operating frequency
0x3302	Slave model	
0x3303	VFD model	
0x3304	Software version	
0x3305	Current operating frequency	
0x3306	Output current	
0x3307	Output voltage	
0x3308	Output power	
0x3309	Operating rotary speed	
0x330A	Operating line speed	
0x330B	Analog close-loop feedback	
0x330C	Bus voltage	
0x330D	External counter	Not support
0x330E	Output torque	
0x330F	Digital input/output terminal status	bit0~bit4: X1~X5; bit10~bit12: Y1 /RO1。
0x3310	Actual length	Not support
0x3311	Operating frequency after compensation	Not support
0x3312	The first operating fault	
0x3313	The second operating fault	
0x3314	The latest operating fault	
0x3315	Operating frequency setting	
0x3316	Rotary speed setting	
0x3317	Analog close-loop setting	
0x3318	Line speed setting	

Register address	Parameters name	Note
0x3319	AI1	
0x331A	AI2	
0x331B	Length setting	Not support
0x331C	Acceleration time 1 setting	
0x331D	Deceleration time 1 setting	
0x331E	Methods of inputting operating commands 0: Panel control 1: Terminal control 2: Communication control	
0x331F	VFD operating status word 2	
0x3320	Main reference frequency selector 0:Digital setting 1(Keypad \wedge \vee setting) 1:Digital setting 2(Terminal UP/DN setting) 2:Digital setting 3 (Serial port) 3:AI analog setting 4:DI pulse setting 5:Expansion card.	
0x3321	Accumulated length	Not support

Note:

- (1) Status parameters don't support write operation.
- (2) The encoding rules of slave model is as follows:the range of slave model is 0~999.

The bit definitions of VFD operating status word 1 are shown in following table:

Bit	Value	Function	Note
bit0	1	VFD running	
	0	VFD stop	
bit1	1	VFD reverse rotation	
	0	VFD forward rotation	
bit2	1	Reach main reference	
	0	Not reach main reference	
bit3	1	Serial port control enable	
	0	Serial port control disable	
bit4	1	Serial port setting enable	
	0	Serial port setting disable	
bit5~bit6		Reserved	
bit7	1	Alarm	When this bit is 0,the bit15~8 of control word 1show the status.If bit15~8 are 0,means normal.If not,means failure.
	0	Fault or normal	
bit15~ bit8	0x00~0xFF	Fault/alarm code	0: normal. Not 0: fault/alarm.

The bit definitions of VFD operating status word 2 are shown in following table:

Bit	Value	Function	Note
bit0	1	Jog running	
	0	Non-jog running	
bit1	1	Close loop running	
	0	Non-close loop running	

bit2	1	PLC running	
	0	Non-PLC running	
bit3	1	Multi-section frequency operation	
	0	Non multi-section frequency operation.	
bit4	1	Common operation	
	0	Non-common operation	
bit5	1	Swing frequency	
	0	Non-swing frequency	
bit6	1	Under voltage	
	0	Normal voltage	
bit7		Reserved	
bit8		Servo operation	
bit9		Customized operation	
bit10		Synchronous speed operation	
Others		Reserved	

The bit definitions of VFD operating status word 3 are shown as following table:

Bit	Value	Function	Note
bit0~bit1		Reserved	
bit2		Zero speed operation	
bit3		Accelerating	
bit4		Decelerating	
bit5		Constant speed running	
bit6		Pre-excitation	
bit7		Tuning	
bit8		Over-current limiting	
bit9		DC over-voltage limiting	
bit10		Torque limiting	
bit11		Speed limiting	
bit12		VFD failure	
bit13		Speed control	
bit14		Torque control	
bit15		Position control	

1. Some instructions

1. For function code 0x10 and 0x43,when rewrite multiple continuous function codes,if any one of the function codes is invalid for write operation,then it will return error information and all of the parameters can't be rewritten.When rewrite multiple continuous control parameters,if any one of the parameters is invalid for write operation, then it will return error information and this parameter and others behind can't be rewritten,but other parameters before this parameter can be rewritten normally.

2. For some special function code,Using 0x06 and 0x41 or 0x10 and 0x43 are the same function,in write operation,the parameters can be saved after power failure.

Function code	Description
---------------	-------------

B4.02	Parameters protection setting
A6.00~A6.04	Selection of input terminal X1~X5
A2.03	Main reference frequency control
A2.03	Auxiliary reference frequency control
C2.00	PLC operation mode
C3.00	Swing frequency operation mode
B0.00	Motor rated power
U0.01	Machine model setting(Factory parameter)
U0.09	VFD series selection(Factory parameter)

3. Some control parameters can't save in EEPROM,so for these parameters,using function code 0x41 and 0x06 or 0x43and 0x10 are the same,mean parameters can be saved after power failure.

4. Some internal parameters of VFD are reserved and can't be changed via communication, refer to following table:

Function code	Description
B4.04	Parameters copy
B0.11	Motor parameters auto-tuning

5. The operation of user password and factory password in host computer

(1) User password

1) Protection of user password:Read/write function code, function code management (except “read address of displaydata” and”switch display data”)

2) If you set user password (A0.00!=0) ,then you must enter the right password to A0.00 when you want to visit function code,but control parameters and status parameters are not protected by user password.

3) User password can't be set,change or cancel by host computer,it can only operated by keypad. To A0.00 of write operation, only effective in two situations: one is in the password decryption; Second,write 0 is in the situation of no password.It will return invalid operation information in other situations.

4) The operation of host computer and keypad to user password is independent. Even if the keyboard completes decryption, but host computer still need to decrypt when it want to access function codes, and vice versa.

5) After host computer acquire the access right of parameters,when reading user password,it will return “0000” instead of actual user password.

6) The host computer will acquire the access right of function code after decryption,if there is no communication for 5minutes,then the access right will disable.And if it want to access function code,it need to enter user password again.

7) When host computer has acquired access right(no user password or has decryption),if the user password is rewritten by keypad at this moment,the host computer has still the current access right and no need to decryption again.

(2) Factory password

1) Protection range of factory password:Read/write parameters of Group U0, function code management of Group U0.

2) Host computer can only access function code of Group U0 after decryption(write correct factory password into U0.00).If there is no communication for 5 minutes after acquiring access right,the right will disable automatically,and it need to enter password again to access Group U0.

3) After acquiring the access right of Group U0,if host computer read U0.00,it will return 0000 instead of actual factory password.

4) The operation of host computer and keypad to user password is independent. They need to enter the correct password separately to acquire the access right.

5) Host computer has no right to modify factory password.When host computer write data into U0.00, it will return invalid operation unless the data is correct password.

2. Application example

CV100 only support 16bit access.

Start No.5 VFD to perform forward rotation.

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x3200	0x00C7	0xC764
Response	0x05	0x06	0x3200	0x00C7	0xC764

No.5 VFD stops in mode 0.

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x3200	0x00C6	0x06A4
Response	0x05	0x06	0x3200	0x00C6	0x06A4

No.5 VFD jogs forward.

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x3200	0x00D0	0x876A
Response	0x05	0x06	0x3200	0x00D0	0x876A

No.5 VFD stop jogging.

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x3200	0x00C0	0x86A6
Response	0x05	0x06	0x3200	0x00C0	0x86A6

No.5 VFD reset fault:

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x3200	0x0280	0x8636
Response	0x05	0x06	0x3200	0x0280	0x8636

Read the operating frequency of No.5 VFD and the response operating frequency of the VFD is 50.00Hz:

Data frame	Address	Function code	Register address	Number of registers or bytes	Register content	Checksum
Request	0x05	0x03	0x3301	0x0001	None	0xDB0A
Response	0x05	0x03	None	0x02	0x1388	0x44D2

Rewrite the acceleration time 1(Function code A0.06) of No.5 VFD to 10.0s and can't save after power failure.

Data frame	Address	Function code	Register address	Register content	Checksum
Request	0x05	0x06	0x0006	0x0064	0x69A4
Response	0x05	0x06	0x0006	0x0064	0x69A4

Read the output current of No.5 VFD and the response output current of the VFD is 30.0A.

Data frame	Address	Function code	Register address	Number of registers or bytes	Register content	Checksum
Request	0x05	0x03	0x3306	0x0001	None	0x6ACB
Response	0x05	0x03	None	0x02	0x012C	0x49C9

Read the deceleration time 1(Function code A0.07) of No.5 VFD and the response deceleration time of the VFD is 6.0s.

Data frame	Address	Function code	Register address	Number of registers or bytes	Register content	Checksum
Request	0x05	0x03	0x0007	0x0001	None	0x344F
Response	0x05	0x03	None	0x02	0x003C	0x344F

Scaling relationship of VFD:

A) Scaling of frequency C is 1: 100.

If you want to make the VFD run at 50Hz,then the main reference should be set as 0x1388(5000).

B) Scaling of time is 1: 10

If you want to set the acceleration time of the VFD as 30s,then the function code should be set as 0x012C(300).

C) Scaling of current is 1: 10

If the response current of VFD is 0x012C(300),then current of the VFD is 30A.

D) Output power is the absolute value.

E) Other (such as the input and output terminals, etc.) please reference inverter user manual