

BRUSHLESS DC MOTOR DRIVE

BLDH1500RA
User manual

1. Brief introduction

BLDH1500RA is designed by ICAN-Tech with high-performance and low-cost which used for high voltage brushless DC motors less 1500W. It supports Modbus communication protocol, and also provides more flexible choices for users among actual practice.

1.1 Features

- Support Modbus communication protocol, can be controlled by touch screen or PC
- Built-in RV speed setting
- External potentiometer speed setting
- External analog signal speed setting
- Pulse frequency and PWM speed setting
- Support 100V~220VAC voltage range
- Support -25°C~+50°C temperature range of working environment
- Open / closed loop control
- Works for 1500W or lower power of BLDC motor
- 5 seconds waiting time for locked-rotor

2. Electrical performance and environment indicators

2.1 Electrical indicators

Driver parameter	Min.	Rated value	Max.
Input voltage AC (V)	100	220	250
Phase Current Peak (A)	-	-	13
Motor rotate speed (rpm)	100①	-	-

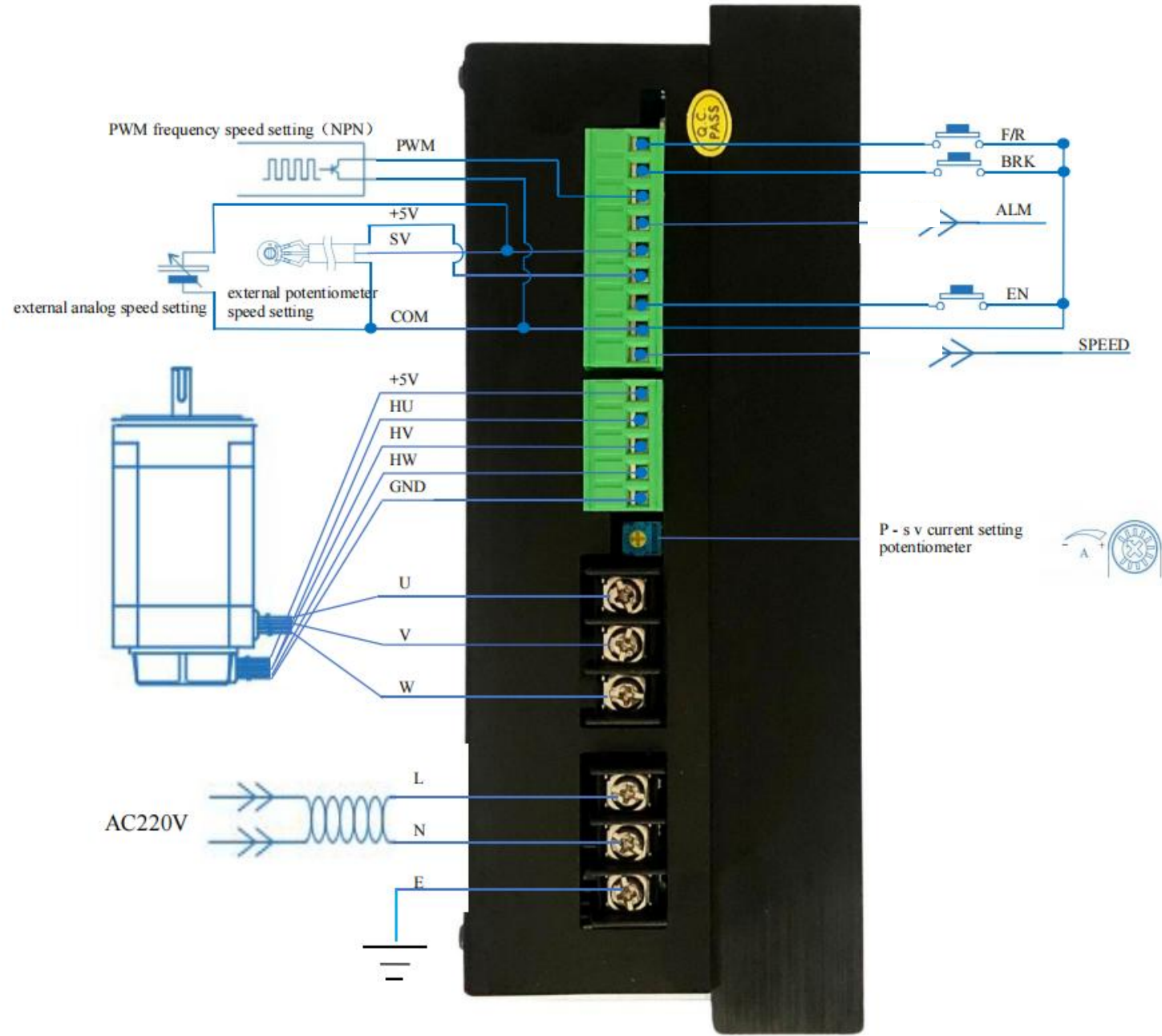
① Under closed loop, the minimum speed of the motor is 100 only if the pole number is set on the driver correctly.

2.2 Environment indicators

Environment factors	Environment indicators
Heat Sinking Method	Natural cooling or fan-forced cooling
Atmosphere	Avoid dust, oily mist and corrosive air
Operating Temperature	-25°C~+50°C
Storage Temperature	-30°C~+70°C

3. Driver interface and wiring diagram

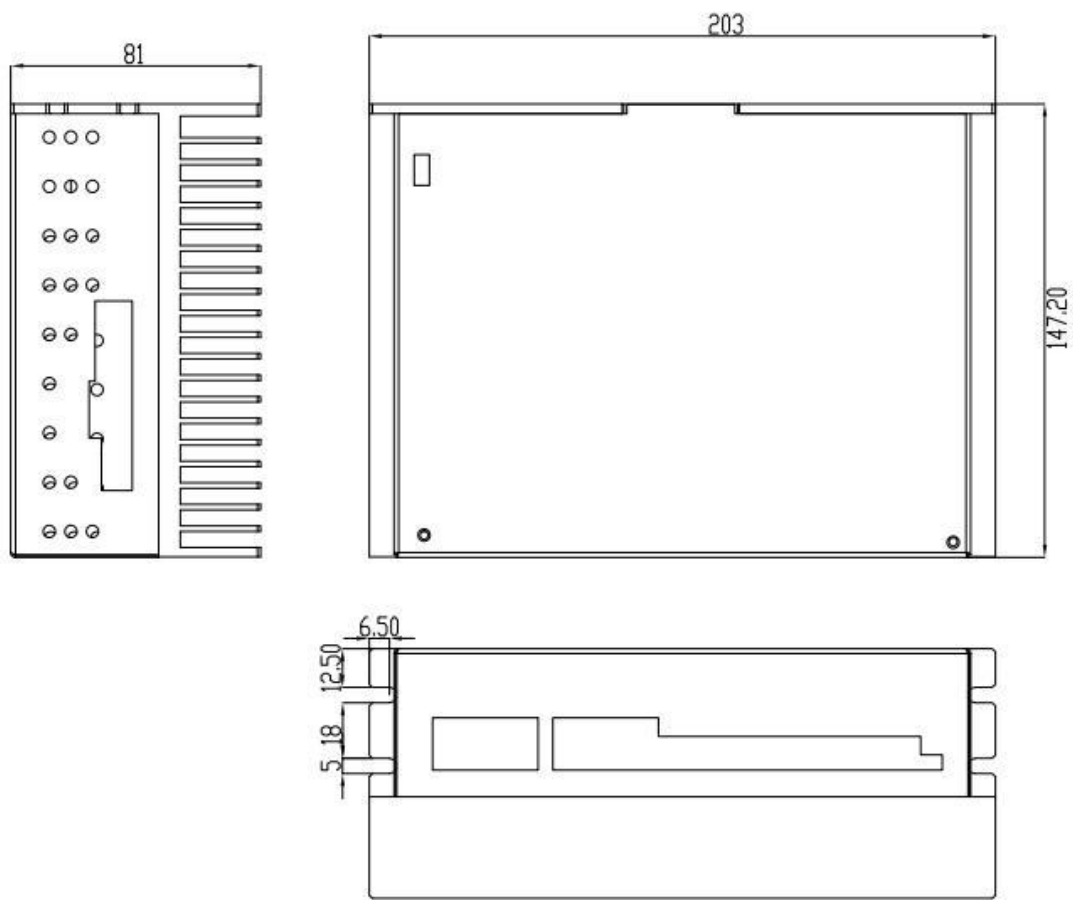
3.1 Driver interface



3.2 Signal port description

Signal category	Terminal	Functional Description
Power supply input	E	AC Power supply ground electrode
	L	AC Power supply input
	N	AC Power supply input
Motor connector	U	Motor line U phase
	V	Motor line V phase
	W	Motor line W phase
Hall signal connector	GND	Hall signal ground electrode
	HW	Hall sensor signal HW
	HV	Hall sensor signal HV
	HU	Hall sensor signal HU
	+5V	Hall sensor signal power supply+
Control signal connector	SPEED	Rotate speed output in form of frequency
	COM	Common port
	EN	Stop signal terminal; EN and COM connect, motor runs; EN and COM disconnect, motor stops.
	+5V	5V power supply
	SV	① External potentiometer speed setting input; ② External analog signal input, 0 ~ 5V input.
	ALM	Fault output, refer to 6.3 Normal : high level Fault : low level
	PWM / F	PWM or pulse frequency speed setting input terminal (chosen by SW4). The largest input voltage is 5VDC.
	BRK	Motor brake stop signal; BRK and COM disconnect, motor runs; BRK and COM connect, motor stops and then braking.
	F/R	Motor direction control terminal; F/R and COM disconnect, motor rotates clockwise; F/R and COM connect, motor rotates anticlockwise.

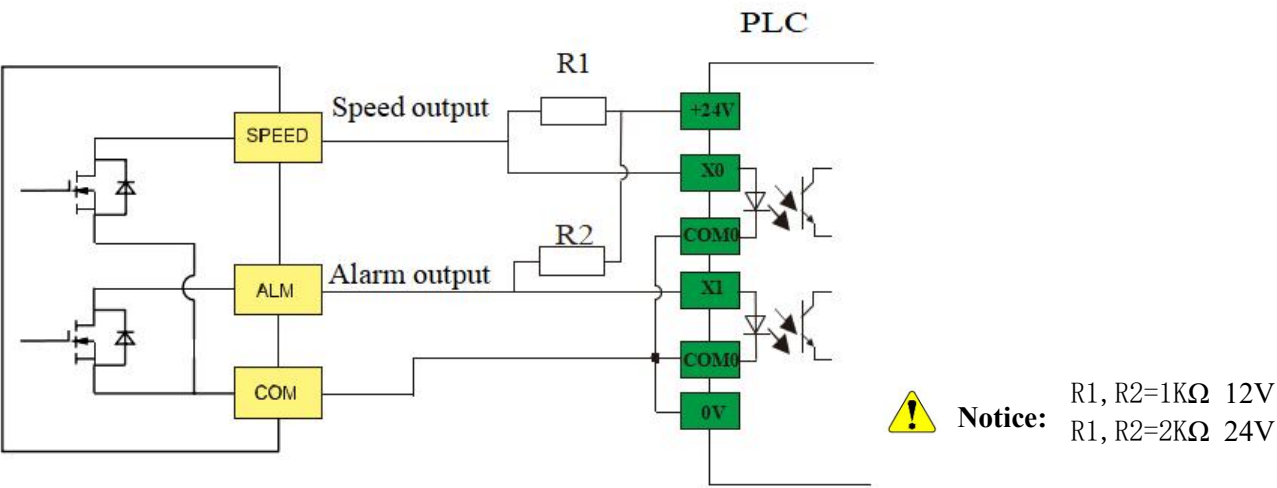
3.3 Dimension (Units : mm)



3.4 The connection of ALM 、 SPEED and PLC

The internal structure of ALM and SPEED ports is following as below, the connection with PLC depends on the input terminal type. For example, the PLC input module AX40/741/42/50/60 and QX40/41/42 of Mitsubishi only support Sourcing Input, users should connect according to the characteristics of this input type.

Output interface circuit of brushless driver



3.5 Speed port description

This port feeds motor rotate speed and outputs in form of frequency, 1000rpm=1000Hz, 500rpm=500Hz; Notice that the precision of feedback depends on correct poles setting :

- 1) Closed loop mode : accurate feedback;
- 2) Open loop mode : 4 poles motor rotate speed feedback in default which is underlying setting and cannot be modified by customer.

4. Current limit adjustment P-sv

The current limit adjustment knob P-sv can limit the peak value of motor phase current, thereby limiting the calorific value of winding and protecting the motor.

Customers can use the current limit value between scale 3 and scale 10, when adjusting it to the maximum 10, the phase line limit current is 13A.



Notice: If P-sv is adjusted to 0, the motor will not rotate, and if there is a speed adjustment value at this time, it will alarm and be locked-rotor.

5. Speed setting via external signal

When switching to external analog control mode, the built-in potentiometer RV must be closed.(RV knob is rotated anticlockwise to the limit position)

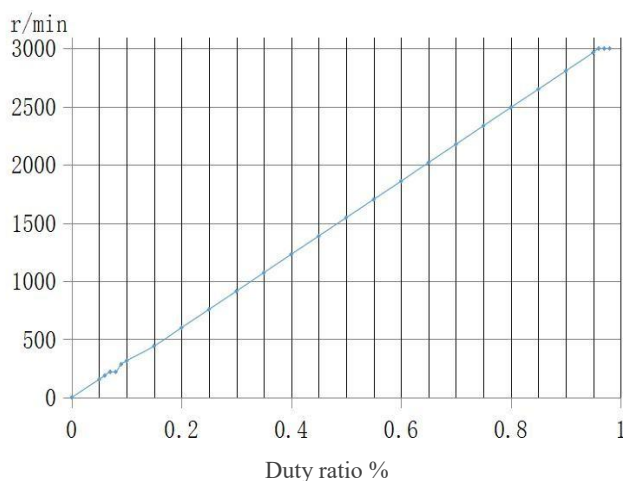
When multiple speed setting signal exist at the same time, the signal priority is as below :

Frequency > PWM > Internal Potentiometer > SV

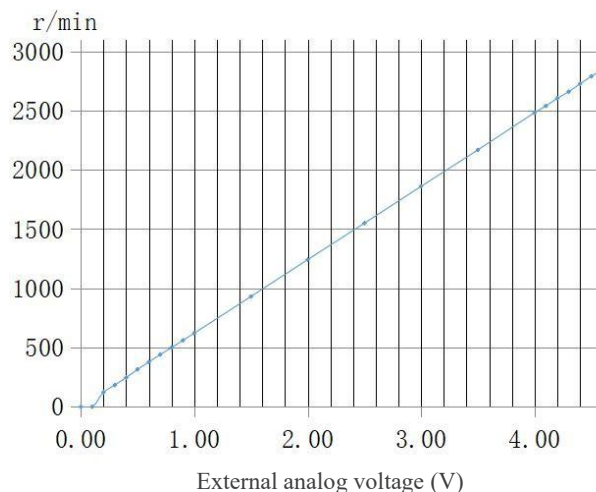
Below pictures are linearity test curve of external signal speed setting :

(1KHz) duty ratio value range: 2% ~ 95% ; (50%duty ratio) frequency speed setting: X Hz = X rpm

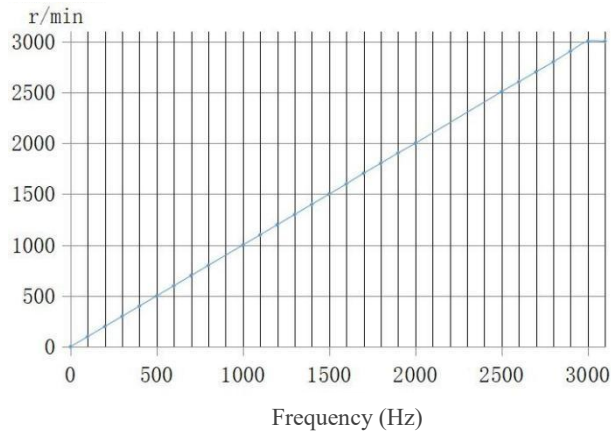
Rotating speed



Rotating speed



Rotating speed



6. Status indicator and trouble shooting

6.1 Status indicator

When appearing locked-rotor, Hall fault, over-temperature and over voltage, driver will give an alarm signal and stop working.

Alarm indicator	Status description
The green light flashes intermittently and rapidly, and the motor doesn't stop	Normal, driver is limiting current
The red light flashes twice, and the motor stops	Driver components over temperature (over 85°C)
The red light flashes 3 times, and the motor stops	Over voltage
The red light flashes 4 times, and the motor stops	Under voltage
The red light flashes 5 times, and the motor stops	Hall fault
The red light flashes 6 times, and the motor stops	Motor locked-rotor or driving circuit abnormal
The red light flashes 7 times, and the motor stops	Components on circuit board abnormal

6.2 Trouble shooting

When any of abnormal indicator in above table occurs, a reset command should be issued to driver to clear the alarm signal off. If the alarm signal still exists, then proceed as below table.

*The reset command refers to one of the following commands :

- Adjust all speed setting signals to 0, including built-in potentiometer, external analog signal, PWM and pulse frequency;
- BRK connects to GND again;
- Power-on again;

Alarm indicator	Exception handling
The green light flashes intermittently and rapidly, and the motor doesn't stop	No need to deal with
The red light flashes twice, and the motor stops	Reset the alarm or power on again after the driver cools down to below 60°C
The red light flashes 3 times, and the motor stops	Check to make sure power supply voltage is normal
The red light flashes 4 times, and the motor stops	Check to make sure power supply voltage is normal
The red light flashes 5 times, and the motor stops	Check motor connecting wire is stable and ensure motor is not damaged
The red light flashes 6 times, and the motor stops	Check if the load is too heavy and the motor is damaged, if not, please change another same type driver to test
The red light flashes 7 times, and the motor stops	Adjust all speed setting signals to 0, power-on again, if still any problem, please change another driver

6.3 Alarm signal output

If any of alarm in 6.2 table happens, ALM terminal would output low level; if driver is normal, ALM would output high level.

7. Acceleration and deceleration potentiometer

Acceleration and deceleration time refers to the time required for the motor from 0 to the set speed. (Notice : the motor rotate speed is not actual value)

8. Dial switch function (dial it down = 1, no dial by default = 0)

8.1 Dial switch function

SW1	0	Terminal resistance not connected
	1	Terminal resistance connected
SW4	0	Frequency speed setting
	1	PWM duty ratio speed setting

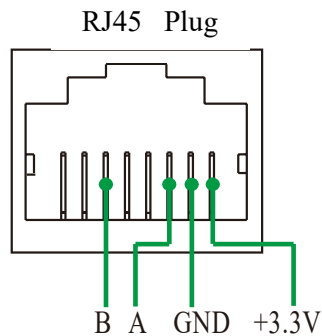
SW2	SW3	
0	0	Open loop
1	0	Closed loop 2 poles
0	1	Closed loop 4 poles
1	1	Closed loop 5 poles

The function of SW5~SW8 is setting slave address, the setting modes are listed as below table.

SW1 = OFF : disconnect the terminal resistance ($R=120\Omega$, paralleled to 485 bus)

SW5	SW6	SW7	SW8	Slave address
0	0	0	0	Broadcast communication
0	0	0	1	0x01
0	0	1	0	0x02
0	0	1	1	0x03
0	1	0	0	0x04
0	1	0	1	0x05
0	1	1	0	0x06
0	1	1	1	0x07
1	0	0	0	0x08
1	0	0	1	0x09
1	0	1	0	0x0A
1	0	1	1	0x0B
1	1	0	0	0x0C
1	1	0	1	0x0D
1	1	1	0	0x0E
1	1	1	1	0x0F

Motor driver BLDH1500R adopts two-wire electrical interface according to EIA/TIA-485 standard, three wires need to be connected for such interface : B,A and GND.RJ45 plug is equipped with these three wires, the detail wiring diagram can refer to 7.3.2 section of national standard GB/T 19582.2-2008. Concerning the industry practice, RJ45 plug also leads out 3.3V voltage, users can decide to connect it or not based on actual situation.



8.2 Address of all holding registers of the server

All server holding register addresses that can be read by client:

Server address (1byte)	Function code (1byte)	Holding register access initial address (2byte)	Access data size (2byte)	CRC check (2byte)	Function description
0xnn	0x03	0x0056	0x0001	CRC check	Read driver setting rotate speed(unit:rpm)
0xnn	0x03	0x005F	0x0001	CRC check	Read motor feeding back rotate speed(unit:rpm)
0xnn	0x03	0x0066	0x0001	CRC check	Read driver whether enable, 0=enable state 1=disable state
0xnn	0x03	0x006A	0x0001	CRC check	Read driver whether brake, 0=brake 1=not brake
0xnn	0x03	0x006D	0x0001	CRC check	Read driver rotate direction, 1=forward rotation 0=reverse rotation
0xnn	0x03	0x0076	0x0001	CRC check	Read alarm code, for an example: 5=Hall error
0xnn	0x03	0x0086	0x0001	CRC check	Read set value of poles
0xnn	0x03	0x008A	0x0001	CRC check	Read set value of ACC/DEC time (unit:s)
0xnn	0x03	0x0092	0x0001	CRC check	read the highest rotate speed of analog speed setting (unit:rpm)
0xnn	0x03	0x00B6	0x0001	CRC check	Read RS-485 connection state
0xnn	0x03	0x00BB	0x0001	CRC check	Driver program version

All server holding register addresses that can be written by client:

Server address (1byte)	Function code (1byte)	Holding register access initial address (2byte)	Register address (2byte)	CRC check (2byte)	Function description
0xnn	0x06	0x00B6	-	CRC check	Write RS-485 connected state (the function of setting this parameter is deciding to follow which one when the driver receives both speed setting signals : built-in signal and signal from client); Write 0=485 control disable, client can only read holding register, but cannot write other holding register except 0x00B6; Write 1=485 control enable, client can read and write register.
0xnn	0x06	0x0040	-	CRC check	Post-back function setting, which would affect communication rate, but be convenient to adjust machine. If write 0, then data would be post back. For an example: 0x0040 wrote 0, every time the PLC sending 06 function code command to driver, the driver would execute and post back data at once. 0x0040 write 1, driver would only execute but not post back.
0xnn	0x06	0x0056	-	CRC check	Set motor rotate speed(unit:rpm), the value range of register is 0-60000
0xnn	0x06	0x0066	-	CRC check	Write 0: enable state; write 1: disable state
0xnn	0x06	0x006A	-	CRC check	Write 0: brake state; write 1: not brake state
0xnn	0x06	0x006D	-	CRC check	Write 1: forward rotation; write 0: reverse rotation
0xnn	0x06	0x0076	-	CRC check	Write non-zero, register keep the original value; Write 0: reset alarm
0xnn	0x06	0x0086	-	CRC check	Motor poles setting , the largest writable value of this register is 255; Write 0: open loop 4 poles; write non-zero X: closed loop X poles
0xnn	0x06	0x008A	-	CRC check	Acceleration time setting(unit:s, range:0~15) For an example: the time is set as 12, the given rotate speed of driver accelerating from 0 to 3000 needs 12s. Notice : the actual rotate speed and given speed are out of sync.
0xnn	0x06	0x0092	-	CRC check	The highest rotate speed of analog speed setting(unit:rpm), the value range of this register is 0-60000 , writing other value is invalid 。 This parameter means the actual motor rotate speed when SV input 5V, if SV input 1V , then the speed should be parameter/5. Notice : this parameter is not useful for speed setting range of client.
0xnn	0x06	0x00BC	-	CRC check	Write 1: save each setting parameter once
0xnn	0x06	0x00CC	-	CRC check	Restore factory settings Write 1: Restore factory settings; Write 0: Do not restore factory settings or restore factory settings successfully

Except register address, users also need to know about the way to store data and call data of this driver, more details are listed as below:

Holding register access initial address (2byte)	Function description	Whether to save the value in memory chip after writing 1 to 0X00BC	when B6 holding register=1, whether to call the value saved in memory chip to set server	When B6 holding register=0, whether to call the value saved in memory chip to set server	Default value
0x0040	Set whether posting back data	Yes	No	No	0
0x0056	Set motor rotate speed(unit:rpm), value range: 0-60000	Yes	No	No	0
0x0066	Write 0: enable; write 1: disable	Yes	No	No	1
0x006A	Write 0: brake; write 1: not brake	Yes	No	No	1
0x006D	Write 1: forward rotation; write 0: reverse rotation	Yes	No	No	0
0x0076	Write non-zero, register keep the original value, don't clear alarm; Write 0: clear alarm	No	No	No	1
0x008A	Acceleration time setting(unit:s, range:0~15) For an example: the time is set as 12, the given rotate speed of driver accelerating from 0 to 3000 needs 12s. Notice : the actual rotate speed and given speed are out of sync.	Yes	Yes	Yes	0
0x0092	The highest rotate speed of analog speed setting(unit:rpm), the value range of this register is 0~20000, writing other value is invalid. This parameter means the actual motor rotate speed when SV input 5V, if SV input 1V, then the speed should be parameter/5. Notice : this parameter is not useful for speed setting range of client (touch screen etc).	Yes	Yes	Yes	3000
0x00B6	Write RS-485 connected state (the function of setting this parameter is deciding to follow which one when the driver receives both speed setting signals : built-in signal and signal from client); Write 0=485 control disable, client can only read holding register, but cannot write other holding register except 0x00B6; Write 1=485 control enable, client can read and write register.	No	No	No	0

8.2 Communication steps for PC



This portion is applicable for PC client and other device, but not for touch screen.

Before communication, users need to know about below two standards firstly:

- GB/T 19582.1-2008: 《Industrial automation network specification based on Modbus protocol part 1 : Modbus application protocol》
- GB/T 19582.2-2008: 《Industrial automation network specification based on Modbus protocol part 2 : Implementation Guide of Modbus Protocol on Serial Link》

When communicating, users need to write program following below steps:

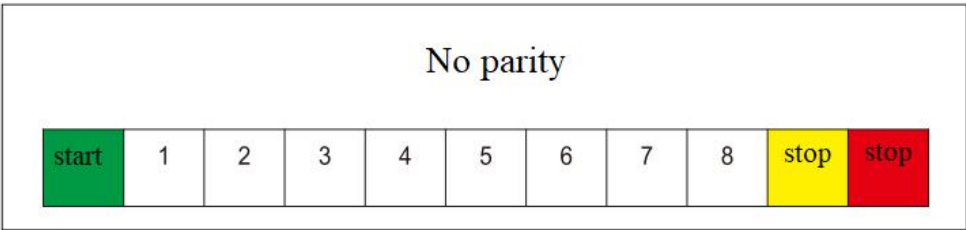
- ① Confirm the address of driver
- ② Write a single byte program with 1 start bit and 2 stop bits according to the baud rate
- ③ Write CRC calibration program
- ④ Determine the structure of ADU according to function and send the ADU
- ⑤ Parse data according to the ADU returned by driver

The address of driver could refer to part 8.1 of this manual, the detailed description for ②~⑤ is followed as below:

Write a single byte program with 1 start bit and 2 stop bits according to the baud rate

About the details of this portion, users can refer to part 6.5.1 of national standard GB/T 19582.2-2008.

*Notice: each character or byte is sent from left to right: (LSB) ... (MSB)



In above picture, the starting signal of a single data packet for serial communication is represented by logical 0 data bit, and the two stopping signals of data packet are represented by logical 1 data bit.

Write CRC verification program

The driver adopts CRC-16/Modbus algorithm model. Users can refer to Appendix B.2 of GB/T 19582.2-2008 for more details about this calibration method. Below is C source program for generating verified code which is for user's reference.

```
typedef unsigned char u8;
typedef unsigned int u16;
/**
 * @brief    generating check code
 * @param *ptr    array for storing information code, the first address of array is placed the first byte of ADU
 * @param length    bytes of check code removed by ADU
 * @retval u16    check code
 */
u16 getCRC16(u8 *ptr, u8 length)
{
    u8 i;
    u16 crc = 0xFFFF;

    if(length == 0)
        length = 1;
    while(length--) {
        crc ^= *ptr;
        for(i = 0; i < 8; i++)
        { if(crc & 1) {
            crc >>= 1;
            crc ^= 0xA001;
        }
        else
            crc >>= 1;
        }
        ptr++;
    }
    return(crc);
}
```

Determine the structure of ADU according to function and send the ADU

This drive uses two function codes: 03 and 06, so users need to be familiar with two formats of ADU only. Request ADU and response ADU of 03 function code can refer to section 7.3 of GB/T 19582.1-2008. Request ADU and response ADU of 06 function code can refer to section 7.6 of GB/T 19582.1-2008. The common ADU is listed in below table for user's reference.

In below example, the slave address is 1(dial code 8), the serial port assistant debugging is listed when 0X40 register value is 0, parameters would be returned. Users can determine whether return parameters or not based on the actual situation, write 1 if not need to return.

Read register	
Read motor feedback speed	Send: 01 03 00 5F 00 01 B4 18 Receive: 01 03 02 02 48 B9 12 (motor rotate speed : 584rpm)
Read alarm code	Send: 01 03 00 76 00 01 65 D0 Receive: 01 03 02 00 00 B8 44 (alarm code : 0)
Read poles	Send: 01 03 00 86 00 01 65 E3 Receive: 01 03 02 00 04 B9 87 (poles : 4)
Read ACC/DEC time	Send: 01 03 00 8A 00 01 A5 E0 Receive: 01 03 02 00 00 B8 44 (acceleration time : 0)
Read the highest rotate speed of analog speed setting	Send: 01 03 00 92 00 01 25 E7 Receive: 01 03 02 0B B8 BF 06 (the highest rotate speed : 3000rpm)
Unicast mode write to register	
Write 485 control enable	Send: 01 06 00 B6 00 01 A9 EC Receive: 01 06 00 B6 00 01 A9 EC
Write the set speed 1100rpm	Send: 01 06 00 56 04 4C 6A EF (when 485 control enable)Receive: 01 06 00 56 04 4C 6A EF (when 485 control disable)Receive: 01 86 FF 02 20
Write enable	Send: 01 06 00 66 00 01 A8 15 (when 485 control enable)Receive: 01 06 00 66 00 01 A8 15 (when 485 control disable)Receive: 01 86 FF 02 20
Write forward rotation	Send: 01 06 00 6D 00 01 D9 D7 (when 485 control enable)Receive: 01 06 00 6D 00 01 D9 D7 (when 485 control disable)Receive: 01 86 FF 02 20
Write poles 2	Send: 01 06 00 86 00 02 E9 E2 (when 485 control enable)Receive: 01 06 00 86 00 02 E9 E2 (when 485 control disable)Receive: 01 86 FF 02 20
Write acceleration time 9s	Send: 01 06 00 8A 00 5A 28 1B (when 485 control enable)Receive: 01 06 00 8A 00 5A 28 1B (when 485 control disable)Receive: 01 86 FF 02 20
Write the highest rotate speed of analog speed setting 500rpm	Send: 01 06 00 92 01 F4 28 30 (when 485 control enable)Receive: 01 06 00 92 01 F4 28 30 (when 485 control disable)Receive: 01 86 FF 02 20
Broadcast mode write to register (Ignore address dialing status, no returned value)	
Write poles 2	Send: 00 06 00 86 00 02 E8 33 Receive: No response
Write the set speed 1100rpm	Send: 00 06 00 56 04 4C 6B 3E Receive: No response
Write 485 control enable	Send: 00 06 00 B6 00 01 A8 3D Receive: No response

Parse data according to the ADU returned by driver

Users should perform CRC verification on the returned ADU firstly, then parse the data. Data in ADU can be stored in two ways: one is stored in 16 bits register (the data is a 16 bit short integer at this time), the other is to put data in two registers with consecutive addresses (the data is a 32-bit single precision floating point number at this time). Due to limited space, this manual only gives the C source program for reading data in the second case as follows :

```
/**
 * @brief    Get floating point number
 * @param Address    8-bit character array address, the first byte of ADU put in the first address
 * @retval float    floating point number which can be read
 */
float getFloat(unsigned char *Address)
{
    unsigned char *floatAddress=Address+3;
    int temp=0;
    temp+=(int) (*(floatAddress))<<24;
    temp+=(int) (*(floatAddress+1))<<16;
    temp+=(int) (*(floatAddress+2))<<8;
    temp+=(int) (*(floatAddress+3));
    return *(float *)&temp;
}
```


After sale service

Warranty period

Dongguan ICAN Technology provides warranty for 1 year from the date of shipping.

Maintenance process

- ① Get the maintenance permission
- ② Ship the package to the following address: 4/F, Block B, RuiLian Zhenxing Industrial Park,
Wanjiang District, Dongguan City, Guangdong Province
Tel: 86-0769-22327568

Return policy

- ① After use or man-made damage condition (etc, wrong wiring), no return
- ② ICAN Technology guarantees the product quality, but product incompatibility is not in the return or maintain condition.
- ③ Customers don't use the products under the specified electrical performance and environment indicators, no maintain condition.



Automation

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