

## BRUSHLESS MOTOR DRIVER BLDH-400R

BLDH-400R

Instruction BOOK

## 1 Brief Introduction

1.1 BLDH400R is a high-performance, low-cost brushless DC motor driver and mainly for BLDC motor below 400W, which is independently developed by ICAN-Tech. The BLDH400R supports Modbus communication protocol and provides more flexible choices for users in practical applications.

### 1.2 Features

- Support Modbus communication protocol which is suitable for users to use touch screen or PC control.
- Built-in RV speed setting, External analog signal speed setting, PWM speed setting, frequency speed setting
- Working voltage is ranged from 110V to 220VAC.
- Working temperature is ranged from -25℃~+50℃
- Open/closed loop control
- Drive BLDC motor of rated power 400W
- 3 seconds for motor locked time

## 2 Electrical properties and environmental indicators

### 2.1 Electrical properties

Driver Parameter	Min Value	Typical Value	Max Value
Voltage input AC(V)	110	220	250
Peak phase current(A)	-	-	5.5
Motor range speed (rpm)	60①	-	-

① Set the pole number right if speed 60rpm is needed.

### 2.2 Environmental indicators

Environmental factor	Environmental indicator
Cooling Method	Natural cooling or forced cooling
Use Occasion	Avoid dust, oily mist, and corrosive air
Operating Temperature	-25℃~+50℃
Storage Temperature	-30℃~+70℃

## 3 Driver interface and wiring diagram

### 3.2 Port signal description

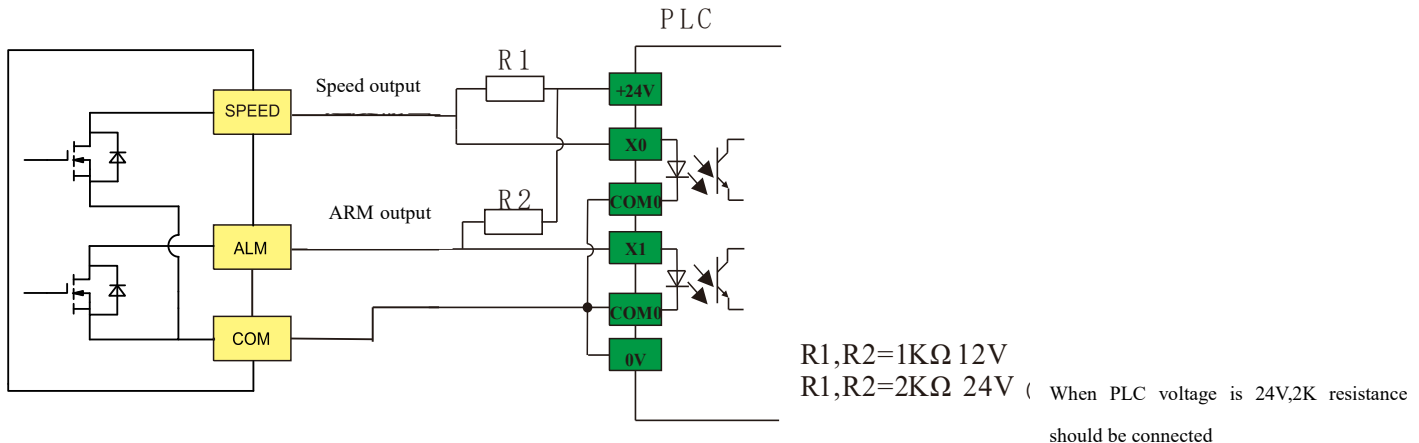
Signal category	Terminal	Description
Power input	E	AC power ground wire
	L	AC power input+
	N	AC power input-
Motor connection	U	Motor line U phase
	V	Motor line V phase
	W	Motor line W phase
Hall signal	GND	Hall sensor signal ground wire
	HW	Hall sensor signal HW

Control signal	HV	Hall sensor signal HV
	HU	Hall sensor signal HU
	+5V	Hall sensor signal power supply+
	SPEED	Speed signal output port. Pulse frequency is corresponding to the rotating speed.
	COM	Common port
	EN	EN connects COM, motor runs, otherwise motor stops
	+5V	5V power input+
	SV	①External speed setting potentiometer, ②External analog signal input
	ALM	Alarm signal output port's connection ref 4.3.it is high resistance output when no occur, when fault occurs, the voltage changes from high to low voltage
	PWM / F	PWM / F frequency port, 5V signal, selecting by SW4.
	BRK	BRK and COM disconnect motor will run, otherwise, motor will brake stops
	F/R	F/R and COM disconnect, motor will rotate clockwise and otherwise, motor will rotate anticlockwise.

### 3.3 The connection of ALM 、SPEED and PLC.

The internal structure of ALM and SPEED of the drive is as follows, the connection with PLC is 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 of brushless driver



### 3.4 SPEED port description

The speed port reflects the rotate speed of motor by frequency output, 1000rpm = 1000 Hz ,500rpm = 500 Hz.

Note that correct feedback of this port depends on the correct setting of pole numbers. It can be correctly reflecting the rotate speed of motor under close loop control; the default setting of open loop is 4 poles motor rotate speed feedback and bottom setting which can't be changed by customer.

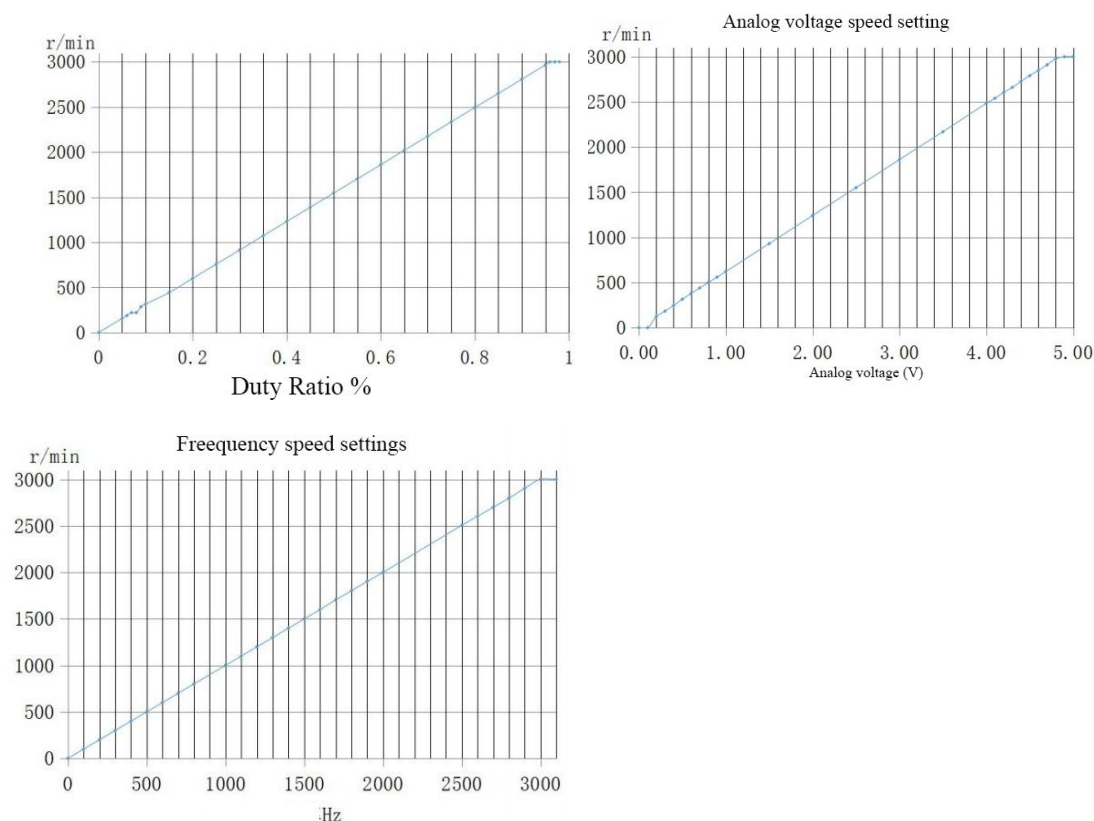
## 4 Current limit regulations

The function of Current limit regulation is to limit the peak value of motor phase current, to protect the motor. The principle of protection is that insulated paint will be apply on the surface of motor winding before inserting the core of motor stator, if the temperature of motor winding is too high, the insulated paint will be perished or dropped, then the winding will directly connect with core of the motor and lead to big current burn the motor(this also can be used in disassembling motor, the winding is heated by constant current to melt the insulated paint ), Current limit regulation is to limit the peak value of motor phase current, so as to protect the motor.

Please ignore the scale 0、scale1、scale 2 of the C-sv potentiometer which is not consistent with the actual values, the scale 3 to scale 10 can be used by user, the max phase current is 5.5 A.

## 5 Speed setting via external potentiometer

When the external potentiometer speed setting mode is needed, the built-in potentiometer should be rotated anticlockwise to limit position. Below graphs are for external potentiometer speed setting.



Note: When multiplex modulation signal exists, the priority of speed regulation signal is: F>PWM>Built-in potentiometer (RV)>SV

## 6 Status indicator. Issue handling

### 6.1 Status indicator

When over-voltage, Hall fault, motor stall、over-temperature occurs, driver will send out alerting signal and stop working in the meantime. Please note that, there's possibility that the red light will always on when the motor working properly, this is normal because of the phase current is limited by the driver.

Led display	status statements
The red led flickers quickly and continuously, the motor don't stop	Indicate the current is limited
The red led flickers three times then the motor stop	The rectifier output voltage is more than 395V
The red led flickers four times then the motor stop	The rectifier output voltage is lower than 90V
The red led flickers five times then the motor stop	The driver cannot receive the Hall signal or receive wrong Hall signal
The red led flickers six times then the motor stop	Motor locked or drive circuit abnormal

The red led flickers seven times then the motor stop	The circuit on the PCB is abnormal
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## 6.2 Issue handling

When the issue appearing, please reset the driver to remove the ALM signal. If the ARM signal cannot be removed, please handling as below.

Reset the driver by one of below instructions.

- ◆ turn all speed signal to zero(including built-in potentiometer 、 external analog signal 、 PWM and frequency);
- ◆ Connecting the BRK Port and GNDE port on the driver ;
- ◆ Turn on the power again;

Led display	status statements
The red led flickers quickly and continuously, the motor doesn't stop.	No need to handle
The red led flickers three times then the motor stop	Please check the Power voltage
The red led flickers four times then the motor stop	Please check the Power voltage
The red led flickers five times then the motor stop	Please check whether the motor wiring is reliable and ensure that the motor is not damaged
The red led flickers six times then the motor stop	Please check whether the motor is overload or under good condition. If not, please try another driver to test
The red led flickers seven times then the motor stop	Please turn all speed to zero and pow up again. If there's still not work, please change to another driver.

## 6.3 ALM signal output

When the issues on the 6.2 list appearing, ALM will connect with the COM and output low voltage; when the driver is in good working status, the ALM will output high resistance.

## 7 ACC and DEC potentiometer

The potentiometer turns to the max value under accelerating condition, it takes about 15s for motor speed from 0 to the max speed.

The potentiometer turns to the max value under decelerating condition, it takes about 15s for motor speed from max speed to 0. (Note that it does not mean the actual speed of motor)

## 8 Switch Function (switch off=1,default setting=0)

### 8.1 Switch Function

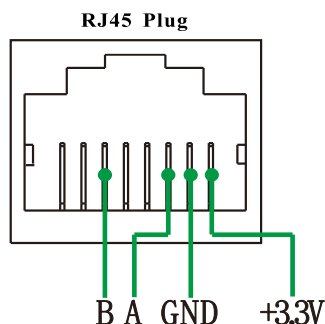
Switch		
SW1	0	The end resistance is not connected
	1	The end resistance is connected
SW2	SW3	
0	0	open loop

1	0	close loop, 4 poles
0	1	close loop, 8 poles
1	1	close loop, 10 poles
SW4	0	Frequency speed setting
	1	PWM speed setting

The switch SW5-SW8 is used for setting slave address, the setting way is as below. SW1 is used for 485bus terminal parallel terminal resistance 120  $\Omega$ , when in OFF status means disconnecting the end resistance.

SW5	SW6	SW7	SW8	Slave(server) 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

The driver BLDH400R adopts the "2-wire" electrical interface in EIA / TIA-485 standard, and RJ45 interface has three wires required by this interface: A, B and GND, for the connect detail, please refer to Section 7.3.2 in GB / T 19582.2-2008. Another connector (plug-in terminal) is only provided for users to debug. Considering industry practices, the 3.3V voltage wire is also added on the RJ45 connector and connected according to user actual situation.



## 8.2 Server all hold registers addresses

**The register address on the server read by client:**

Server address (1byte)	Function code (1byte)	Home address of keep register (2byte)	Access data size (2byte)	CRC check (2byte)	Function description
0xnn	0x03	0x0056	0x0001	CRC check	Read the set speed of the driver(unit:rpm)
0xnn	0x03	0x005F	0x0001	CRC check	Read motor feedback speed(unit:rpm)
0xnn	0x03	0x0066	0x0001	CRC check	Read whether the drive is enabled. If it is 0, it is enabled. If it is 1, it is disabled
0xnn	0x03	0x006A	0x0001	CRC check	Read whether the drive is braked. If it is 0, it is braked. If it is 1, it is not braked
0xnn	0x03	0x006D	0x0001	CRC check	Check the driver's direction. If it is 1, it is clockwise. If it is 0, it is in reverse rotation
0xnn	0x03	0x0076	0x0001	CRC check	Read the alarm code, For example, 5 represents hall fault
0xnn	0x03	0x0086	0x0001	CRC check	Read the set number of poles
0xnn	0x03	0x008A	0x0001	CRC check	Read acceleration and deceleration time setting value(unit:100ms)
0xnn	0x03	0x0092	0x0001	CRC check	Read the maximum speed of analog speed regulation(unit:rpm)
0xnn	0x03	0x00B6	0x0001	CRC check	Read RS-485 connection status
0xnn	0x03	0x00BB	0x0001	CRC check	The driver program version is not available to users

**The register address on the server written by client:**

Server address (1byte)	Function code (1byte)	Home address of keep register (2byte)	Access data size (2byte)	CRC check (2byte)	Function description
0xnn	0x06	0x0056	-	CRC check	Set the motor speed (unit: RPM), the value range of this register is 0-65535

0xnn	0x06	0x0066	-	CRC check	If write 0 is enabled, if write 1 is disabled,
0xnn	0x06	0x006A	-	CRC check	If 0 is written, it is braking state; if 1 is written, it is not braking state,
0xnn	0x06	0x006D	-	CRC check	If 1 is written, it is forward rotation, if 0 is written, it is reverse rotation
0xnn	0x06	0x0076	-	CRC check	If a value other than 0 is written, the register keeps the original value; If 0 is written, the value of the register can be changed to 0, that is the alarm is reset
0xnn	0x06	0x008A	-	CRC check	Acceleration time setting (unit: s), the value range of this parameter is 0-15, writing other values is invalid. The definition of this parameter refers to the completion time of acceleration from 0 to 3000 for a given speed. For example, the acceleration time is set to 12, which means that the time for the given speed of the driver to rise from 0 to 3000 is 12s. In addition, the given speed is not the actual speed, the actual speed will not be synchronized with the given speed
0xnn	0x06	0x0092	-	CRC check	The maximum speed of analog speed regulation (unit: RPM), the value range of this register is 0-20000, writing other values is invalid. This parameter is defined as the actual speed of the motor when SV pin inputs 5V. If SV pin inputs 1V, then the speed of the motor is the value of this parameter / 5. In addition, this parameter has no effect on the speed range of the client (touch screen and other devices)
0xnn	0x06	0x00B6	-	CRC check	Write RS-485 connection status (the setting function of this parameter is to decide which one to listen to when the driver receives the internal speed control signal and the speed control signal from the client at the same time) When write 0 = 485 Control disable, the client can only read the holding register, can not write other holding registers except for the address of 0x00b6 When write 1 = 485 Control enable, the client can read and write registers



In addition to the address of the register, the user also needs to know how the drive stores data and calls data. The following table shows the relevant detail:

Keep register access start address (2byte)	Function description	Saving the value or not after writing	When B6 holding register=1, whether to call the value stored in the memory chip to set the server	When B6 holding register =0, whether to call the value stored in the memory chip to set the server	Default value
0x0056	Set the motor speed (unit: RPM), the value range of this register is 0-65535	Yes	Yes	No	0
0x0066	If write 1 is enabled, if write 0 is disabled	No	No	No	1
0x006A	If 1 is written, it is braking state; if 0 is written, it is not braking state	No	No	No	0
0x006D	If 1 is written, it is forward rotation, if 0 is written, it is reverse rotation	No	No	No	0
0x0076	If a value other than 0 is written, the register keeps the original value; If 0 is written, but the value of register become 1, which means the alarm is reset	No	No	No	1
0x008A	Acceleration time setting (unit: s), the value range is 0-15, writing other values is invalid. The definition of this parameter refers to the completion time of acceleration from 0 to 3000 for a given speed. For example, the	Yes	Yes	Yes	0

	acceleration time is set to 12, which means that the time for the given speed of the driver to rise from 0 to 3000 is 12s. In addition, the given speed is not the actual speed, the actual speed will not be synchronized with the given speed.				
0x0092	Maximum speed of analog speed regulation (unit: rpm),the value range of this register is 0-20000, this speed is defined by the voltage of the SV is 5V, if the voltage is 1V at the SV pin, the speed of the motor is given value/5. The setting is invalid when using customer controller(something like touch screen).	Yes	Yes	Yes	3000
0x00B6	Write RS-485 connection status (the setting function of this parameter is to decide which one to listen to when the driver receives the internal speed control signal and the speed control signal from the client at the same time) When write 0 = 485 Control disable, the client can only read the holding register and can not write other holding registers except for the address of 0x00B6	No	No	No	0

	When write 1 = 485 Control enable. the client can read and write registers				
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### 8.3 Communication steps when client is something like PC



This section is used for controller is something like PC, please skip this section when using touch screen.

Customer need to know something on the below 2 standard before using communication.

① GB/T 19582.1-2008 : 《 Industrial automation network specification based on Modbus Protocol Part 1: MODBUS Application Protocol》

② GB/T 19582.2-2008: 《Industrial automation network specification based on Modbus Protocol Part 2: Modbus Protocol Implementation Guide on serial link》

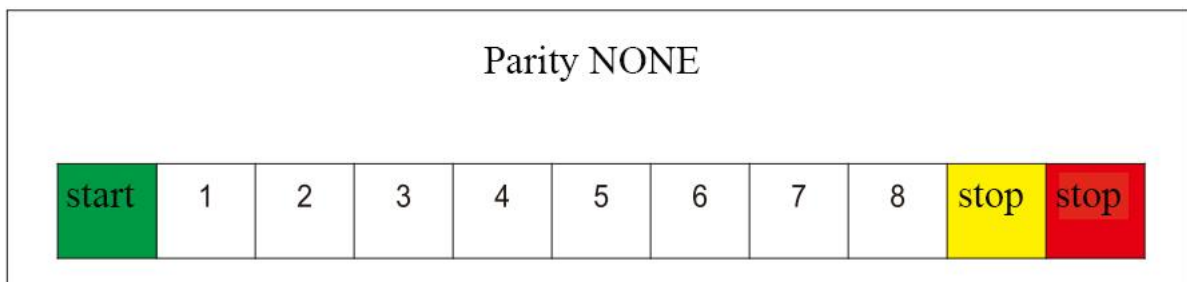
Customers need to program as below step when communicating

- ① Determine the address of the driver.
- ② According to the baud rate to send with a start bit, two stop bits of a single byte program.
- ③ Write CRC verification program.
- ④ The structure of ADU is determined according to the function and send the ADU.
- ⑤ Analyze the data according to the ADU returned by the drive.

For the address of driver, please refer to section 8.1, the below will introduce step2-step5.

#### ● Analyze the data according to the ADU returned by the drive.

For more detail, please refer to the section 6.5.1 of the GB/T 19582.2-2008, please note that the order is from left to right, least significant bit (LSB)... Most significant bit (MSB)



In the figure above, the start signal of a single data packet of serial communication is represented by a data bit of logic 0, while the two stop signals of data packet are represented by a data bit of logic 1.

#### ● Program the CRC check code

The driver adopts CRC-16 / MODBUS algorithm model. For more details, please refer to appendix B.2 of GB / T

19582.2-2008. The C source program of generating check code is given below for users' reference.

```
typedef unsigned char u8;
```

```
typedef unsigned int u16;
/**
 * @brief Create check out code
 * @param *ptr Saving inform code in the Number group which first address put in the ADU first byte
 * @param length The Number of ADU exclude check out code
 * @retval u16 Checkout 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);
}
```

### • The structure of ADU is determined according to the function and send the ADU.

There are only two structure code using by driver:03 and 06. About the 03 structure code, please refer to section 7.3 of the GB/T 19582.1-2008. For the 06 structure, please refer to section 7.6 of the GB/T 19582.1-2008. The most frequently used ADU is list in below for customer reference.

Read register	
Read motor feedback speed	send: 01 03 00 5F 00 01 B4 18 receive: 01 03 02 02 48 B9 12 (The motor speed is 584rpm)
Read alarm code	send: : 01 03 00 76 00 01 65 D0 receive: 01 03 02 00 00 B8 44 (The alarm code is 0)
Read pole pairs	send: 01 03 00 86 00 01 65 E3 Receive: 01 03 02 00 04 B9 87 (The pole pairs is 4)
Read Acceleration and deceleration	send: 01 03 00 8A 00 01 A5 E0 receive: 01 03 02 00 00 B8 44 (The acceleration time is 0)
Read the maximum speed	send: 01 03 00 92 00 01 25 E7

of analog speed regulation	receive: <b>01 03 02 0B B8 BF 06</b> (The maximum speed of analog speed regulation is 3000rpm)
<b>Unicast mode write register</b>	
Write set speed 1100rpm	send: <b>01 06 00 56 04 4C 6A EF</b> (when 485 control is enabled) receive: <b>01 06 00 56 04 4C 6A EF</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write enable	send: <b>01 06 00 66 00 01 A8 15</b> (when 485 control is enabled) receive: <b>01 06 00 66 00 01 A8 15</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write forward	send: <b>01 06 00 6D 00 01 D9 D7</b> (when 485 control is enabled) receive: <b>01 06 00 6D 00 01 D9 D7</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write pole pair 2	send: <b>01 06 00 86 00 02 E9 E2</b> (when 485 control is enabled) receive: <b>01 06 00 86 00 02 E9 E2</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write acceleration time is 9 seconds	send: <b>01 06 00 8A 00 5A 28 1B</b> (when 485 control is enabled) receive: <b>01 06 00 8A 00 5A 28 1B</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write the maximum speed of analog speed regulation 500rpm	send: <b>01 06 00 92 01 F4 28 30</b> (when 485 control is enabled) receive: <b>01 06 00 92 01 F4 28 30</b> (when 485 control is disabled) receive: <b>01 86 FF 02 20</b>
Write 485 Control enable	send: <b>01 06 00 B6 00 01 A9 EC</b> receive: <b>01 06 00 B6 00 01 A9 EC</b>
<b>Broadcast mode write register</b>	
Write pole pair 2	send: <b>00 06 00 86 00 02 E8 33</b> receive: No response
Write set speed 1100rpm	send: <b>00 06 00 56 04 4C 6B 3E</b> receive: No response
Write 485 Control enable	send: <b>00 06 00 B6 00 01 A8 3D</b> receive: No response

### ●Analyze the data according to the ADU returned by the drive

Customer should do CRC check to the returned ADU and then analyze the data in the ADU. There're 2 conditions of the data in the ADU, one is in the 16bit register and other is in the 2 registers of continuous address(when the data is 32bit single precision floating point number). There is only C source program for the second condition in the manual,please see below.

```
/**
 * @brief    get the floating number
 * @param    Address 8bits character address,head address in the first byte of ADU
 * @retval    float    Read the floating number
 */
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;  
}
```

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