Fully Digital Stepper Motor Driver

DM278M

User Manual

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●Important Notice●

Please make sure to read this user manual before operating this machine. Please do NOT use it unless you fully understand the correct operation, safety information and etc.

1. Electric Shock Prevention

! Danger
● If connect wire or repair, please make sure to cut off the power and confirm the voltage by using a circuit tester first. ● Stepper motor driver and stepper motor must be reliably grounded. ● The wire connection and repair work need to be operated by professional technician. ● The driver and stepper motor must be well installed before grounding. Otherwise it may le ad to electric shock.

2. Fire Prevention

! Caution
● Please do NOT use any inflammable substance to install the driver. Or it may lead to a fire. ● Please cut off the power if any error occurs. Heavy current can cause a fire.

3. Transportation & Installation

! Caution
● Please use appropriate way to transport the machine according to the weight. ● Please do NOT pile the drivers over specified quantity. ● Please do NOT pull motor wire/spindle to move the motor. ● Please install the machine according to the technical information. ● Please keep proper space between driver and other machines. ● Please do NOT mix any tiny screws, metal shavings and other combustible substance in driver internal. ● The driver is precision machine, please prevent it from falling or strongly impact.

Chapter One Function & Configuration

1.1 General Introduction

DM278M is 2-phase stepper motor driver based on 32-bit DSP control. It is fully digital new product configured by advanced DSP control chip and 2-phase IPM module. The adoption of this new idea together with integrated design makes great improvement of technology and integration level. And the volume and weight is reduced. What is more, it brings a qualitative leap of dynamic processing performance compared to traditional driver. The procedure of production and debug is greatly simplified too. Since DSP provides high processing speed and rich resources, the driver not only can replace traditional stepper motor driver which is based on single chip or CPLD, but also can satisfy the customers who have special requirements. (e.g., requirements about acceleration/deceleration)

Additionally, DM278M supports RS-485 port communication. The user can set the parameters, control internal pulse and program single-axis control mode in PC which is installed driving software.

1.2 Model Name Design

DM	Fully Digital Universal Driver
2	Mating 2-Phase Stepper Motor
7	Output Current: 1.2A-7.0A RMS
8	Input Voltage: DC24-80V
X	X＝M：Standard Driver with Basic Function
	X＝N：Can be customized

1.3 Driver Specifications

Power● Voltage、Frequency	Single-phase DC24-80V
Power● Allowable Fluctuation of Voltage	Within ±15%
Power● Allowable Fluctuation of Frequency	Within ±5%
Control Mode	Sine Wave PWM control，current control
Dynamic Brake	Built-in
Protection Function	Over current, overload, driver overheating, phase short circuit
Max Pulse Frequency Input	200Kpps
Micro Steps	Max 60000 pulse/R
Cooling Method	Air cooling
Temperature	0℃～+55℃ Storage：-20℃～+65℃
Humidity	Less than 90%RH
Surrounding Environment	Indoor, no corrosive gas, flammable gas, and dust
Above Sea Level	Less than 1000m
Vibration	5.0m/s²
Weight	0.75Kg

1.4 Function Table

The following is function table of stepping motor driver. Details please refer to each specific chapter.

Function	Note
Self-test function	Driver tests self status when powered up.
Micro steps change	High/low subdivision can be changed freely. (Refer to parameter BS02, BS03)
Command pulse choosing(single/double pulse mode)	Two pulse input modes for optional.
Smoothing speed	Guarantee motor run smoothly when external

	pulse changes dramatically.(Refer to BS05)
Phase Memory Function	Automatically memorized motor phase if pulse stops 3 seconds.
Internal pulse control	No need to input any signal but directly use driver to run stepper motor.
Overload capability	With overload capability when start/stop the driver.
Micro steps setting	Pulse input can be reduced or enlarged X times.
Status display	Driver status can be shown on the LED display.
Alarm function	Give the alarm if driver or motor works abnormally.
PC communication	485 COM to PC or other drivers
Speed mode	Set up any speed and enter start/stop switch value to control the motor.

1.5 Drivers & Mating Motors

The following chart is about driver and mating stepper motor model.

Driver Model	Stepper Motor Model	Note
DM278M	BS57HB51-03,BS57HB56-03, BS57HB76-03, BS86HB65-04,BS86HB80-04, BS86HB118-06	Standard Driver
DM278N	BS57HB51-03,BS57HB56-03, BS57HB76-03, BS86HB65-04,BS86HB80-04, BS86HB118-06	Customized Driver

Chapter Two Installation

! Caution
● Please do NOT pile the drivers over the specified quantity. ● Please do NOT use any inflammables to install the driver, otherwise it may cause a fire. ● Please properly storage and use the driver under specified surrounding conditions. ● Please keep proper space between driver and other machines. ● Please do NOT mix any screws, metal shavings and other combustible substance in driver internal. ● The driver is precision machine, please prevent it from falling or strongly impact.

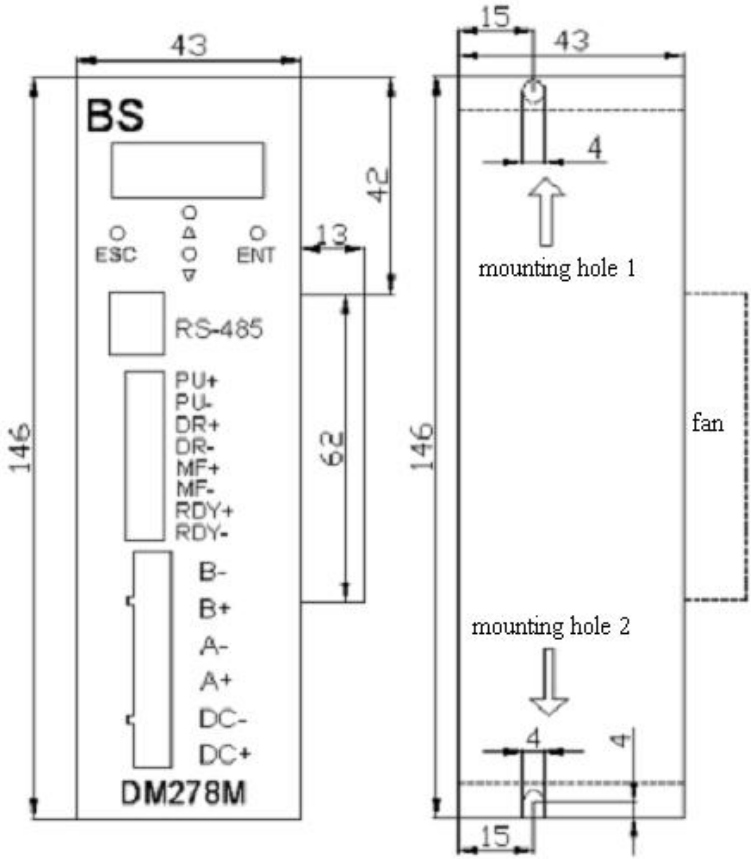
2.1 Environmental Condition

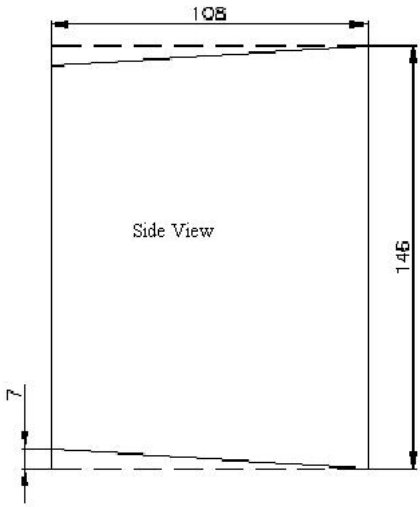
Environment	Condition
Temperature	0℃ ～ +55℃(not frozen) storage： -20℃ ～ +65℃(not frozen)
Humidity	Less than 90%RH(not coagulated)
Surrounding	Indoor (no sun) no corrosive gas, flammable gas, and dust
ASL	Above sea level less than1000m
Vibration	5.0m/ s²

2.2 Installing Space & Dimension

! Caution
● Please comply with the instructions of installing direction. Otherwise it may cause fault. ● Please keep proper space between the drivers and inner wall of control cabinet. Otherwise it may cause fault.

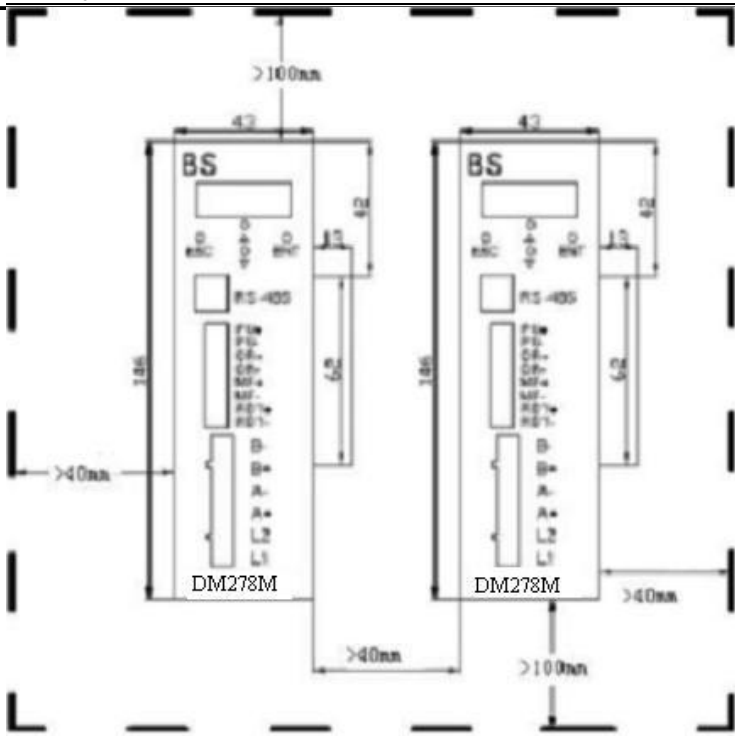
(1) Installing Dimension（unit：mm）





(2) Notes for Placing Two Drivers （Unit：mm）

The users need to keep enough spaces between the driver and internal wall of control cabinet. And please install a fan to control the cabinet temperature under surrounding temperature.



Chapter Three Signal & Wiring

3.1 I/O Signals

All input signals are optically isolated. To guarantee the reliable running of the built-in high-speed optocoupler, the driving current to control the signal is required to be 15mA at least. And the driver has been set in the optocoupler current limit resistor. When the input voltage is beyond 5V, please limit the current by connecting resistance R if necessary.

Current-limiting Resistance Value:

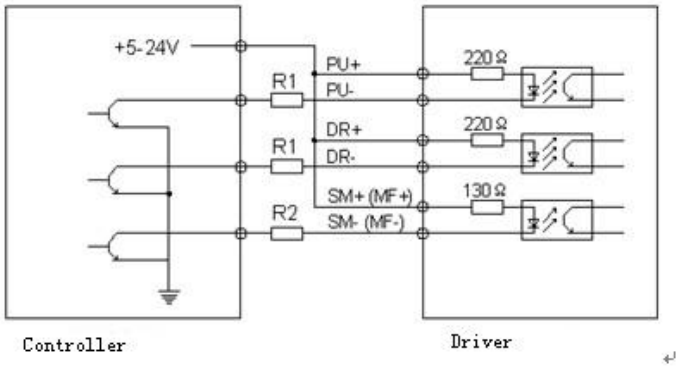
When controller/actuator signal outputs voltage:

+5V： R1=0, R2=0

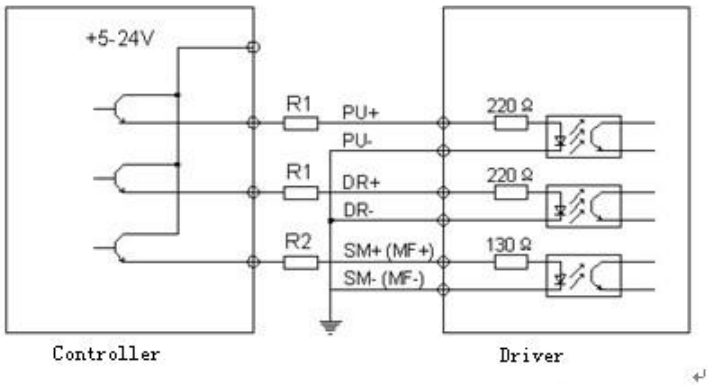
+12V： R1=510Ω，R2=820Ω；

+24V： R1=1.2KΩ，R2=1.8KΩ。

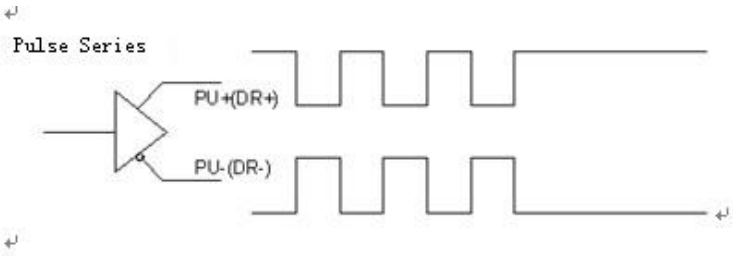
Common Anode Connection for Signal Input



Common Cathode Connection for Signal Input



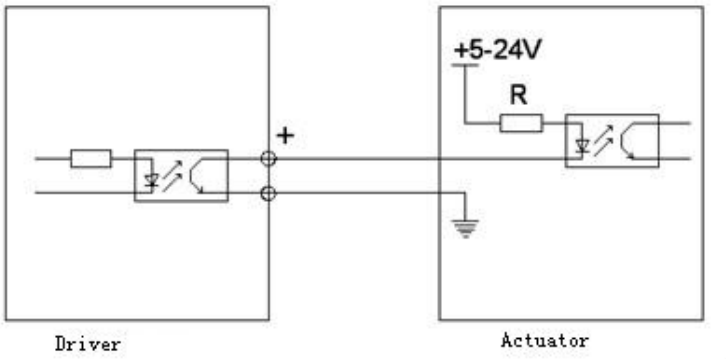
Connection for Differential Signal Input



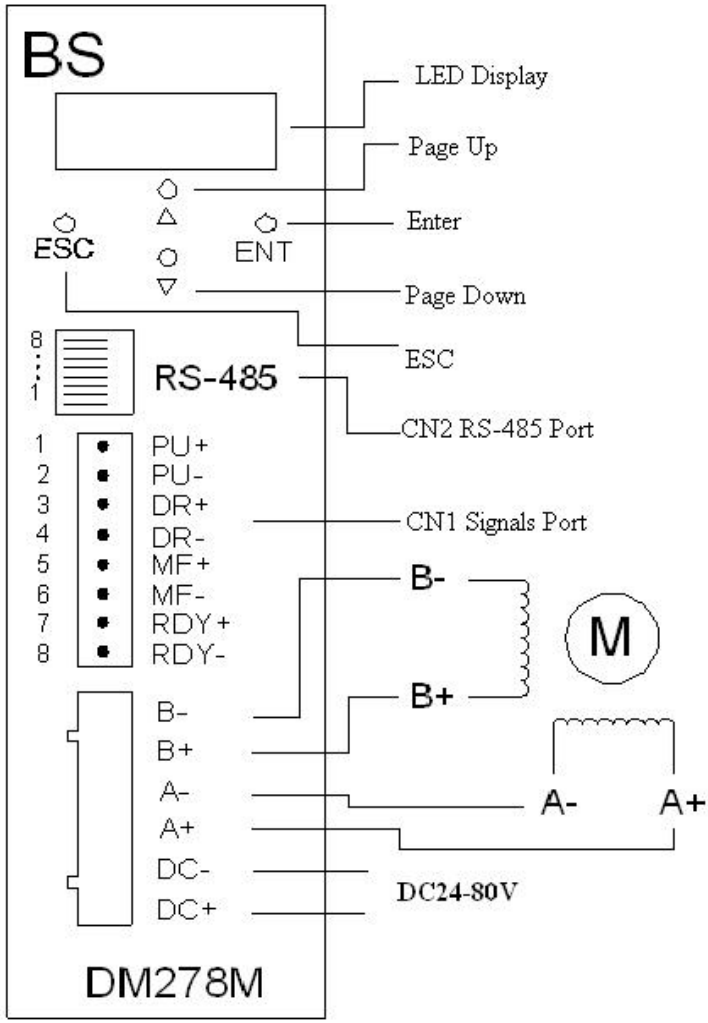
Signal Output

The driver outputs the signals through optocoupler. The max driving current can be 50mA.

RDY/ALM signals output



3.2 Names of the Parts



3.3 Ports Description

(1) CN1- Signals Port

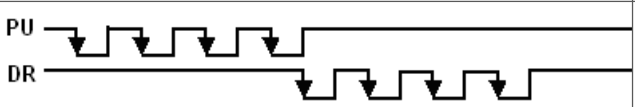
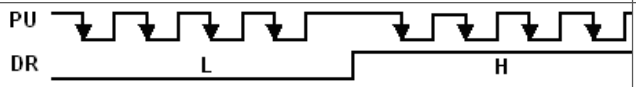
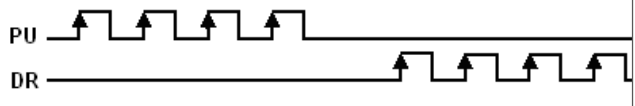
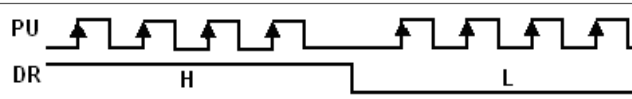
Signal Name	Symbol	Pin No.	Function & Application
Pulse Input	PU+ PU-	CN1 1 CN1 2	For pulse train input. When BS04 chooses “pulse+direction” mode, it is for stepper pulse signal. If “CW/CCW rotating pulse” mode, it is for pulse signal of CW rotating. (The driving current is requested to be above 15mA.)
Direction Signal Input	DR+ DR-	CN1 3 CN1 4	When BS04 chooses “pulse+direction” mode, it is for direction signal. If “CW/CCW rotating pulse” mode, it is for pulse signal of CCW rotating. (The driving current is requested to be above 15mA.)
Signal of Motor Free	MF+ MF-	CN1 5 CN1 6	It is valid when input low level. The driver cut off motor current and motor is in free state.
Ready Signal Output	RDY+ RDY-	CN1 7 CN1 8	After driver is powered up, it will finish self-test. RDY signal is valid when input low input and the driver works normally and able to receive external signals. The max output current is 50mA.

(2) CN 2-RS-485 Port

Signal Name	Symbol	Pin No.	Applications
Internal ground	GND	CN2 1	Internal power ground. To guarantee the reliable communication of port, the users can connect the port together with that of other drivers to the ground.
Internal power 5V	5V	CN2 2	Internal working power, please do NOT connect it in other ways.
485 Port	485+	CN2 7	A signal input
485 Port	485-	CN2 8	B signal input
NC	N		3、4、5、6 are special leads. NC.

3.4 Pulse Train Input

There are two ways to input pulse train. Command pulse train can be set by parameter BS04.

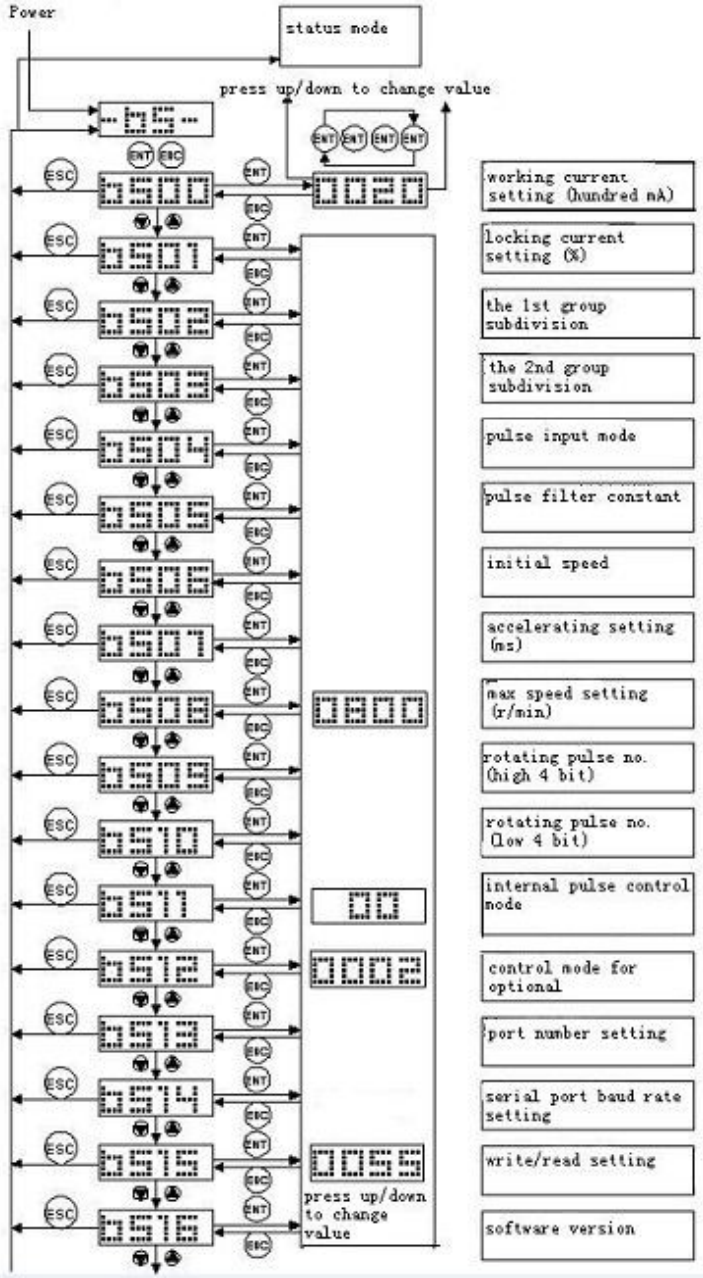
Pulse Train Type			BS 04
Negative Logic	CW/ CCW Rotating Pulse		0000
	Pulse+ Direction		0001
Positive Logic	CW/ CCW Rotating Pulse		0002
	Pulse+ Direction		0003

Chapter Four Display & Operation

4.1 Display Flow & Operation

Status and parameters can be set via the LED display and four buttons. (Note: Please long press “ENT” for 3 seconds after entering parameter setting menu.)

After the driver is power up, please long press “ENT” for 3 seconds first, and then press ⊙|⊙ to display the next. Details as below:


Power
status mode
press up/down to change value
working current setting (hundred mA)
locking current setting (%)
the 1st group subdivision
the 2nd group subdivision
pulse input mode
pulse filter constant
initial speed
accelerating setting (ms)
max speed setting (r/min)
rotating pulse no. (high 4 bit)
rotating pulse no. (low 4 bit)
internal pulse control mode
control mode for optional
port number setting
serial port baud rate setting
write/read setting
press up/down to change value
software version

4.2 Display Example

Here is an example for reference.

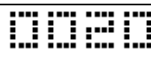
Items	Status	Example
Motor running current	2.0A	
Subdivision Setting	10000 pulse/R	

4.3 Setting Mode

When the driver is in standby state, please press “ENT” to set driver parameters.

(1) Operation Method

Take the following as example, after the driver is powered up, the current is adjusted from 2A to 2.8A via BS00. Display the parameter setting menu by pressing ENT button.

Steps	Operation	Display	Note
1	Power up the driver		Driver is in standby status.
2	Long press ENT for 3secs to display parameter no.		Press ▼/▲ to change parameter no.
3	Press ENT again and display parameter content.		The specified value will be flashing.
4	Press ▲ button to increase the value until 0028		Keep pressing ENT until all values stop flash and the parameter will be saved then.
5	Press ESC to exit the setting mode.		Driver is in standby state again.

4.4 Alarm Mode

The fault signal is sent via LED indicator. If any error occurs, the LED indicator will display alarm information. And it will not disappear even after repowered up. The motor is in power-off state and driver will not accept any command.

Display	Content	Solution
AL01	No motor connected or motor fault occurs.	To check motor connection and see if motor works normally.
AL02	Driver is over heating (above 75 degrees)	Cut off the power to help driver down to ordinary temperature.
AL03	Over current	Cut off the power and check if motor is short-circuited.
AL04	Module protection	Cut off the power and check if motor is short-circuited.

Chapter Five Parameters

5.1 Specifications

(1) Basic Parameter Table

NO.	Symbolic NO.	Name & Function	Initial value setting	unit	Set range
0	BS00	To set motor running current	0030	hundred mA	0010-0070
1	BS01	To set motor locking current.	50% of the working current	%	0%-100%
2	BS02	Micro steps . 20E3 means $20\times10^3=20000$ pulse/R	2000	Pulse/R	400-60E3
3	BS03	NC			

4	BS04	Pulse input mode. To choose waveform of pulse train input. 0000: cw/ccw rotating pulse control mode, it is valid on the trailing edge.. 0001: pulse and direction control mode, it is valid on the trailing edge.. 0002: cw/ccw rotating pulse control mode, it is valid on the rising edge. 0003: pulse and direction control mode, it is valid on the rising edge.	0001		0000-0003
5	**BS05**	**Driver pulse filter constant. The smoothing effect upon external pulse is stronger if the value is set bigger. And the high-speed function is also better. However, the driver response time is longer too. If PC gives opposite direction with previous instruction, please delay BS05 setting time and then give opposite direction instruction. When the value is 0,**	**3**		**0-6 (0/0.5/1/2/4/8/16ms)**

		there is no smoothing function.			
6	BS06	The initial speed of internal pulse control/serial ports control/speed control mode. The value must be less or equal to the value of BS08.	50	R/min	10-200
7	BS07	The accelerating speed of internal pulse control/serial control/speed control mode.	150	ms	20-2000
8	BS08	The max speed of internal pulse control/serial control/speed control mode	100	R/min	10-3000
9	BS09	The rotating pulse count of internal pulse control mode. Please set the four high bit,	2000		1-9999
10	BS10	The rotating pulse count of internal pulse control. Please set low four bit.	0000		1-9999
11	BS11	Internal pulse control status,. Using up and down to cw/ccw rotate.	00		
12	BS12	Parameter range reference: 0000：External pulse input mode 0001：Internal pulse control mode 0002：serial port control mode 0003：speed control mode	0000		0000-0003

13	BS13	Port setting 0001：No.1 port	1		1-32
14	BS14	Serial port baud rate setting 48: 4800 96:9600 192:19200 384:38400 560:56000 576:57600 1152:115200 2304:230400	192	Hundred b/s	48 96 192 384 560 576 1152 2304
15	BS15	read/write setting 0055：BS00-BS15 readable, writable； Other value：BS00-BS14only readable，BS15 writable	55		0-90
16	BS16	Microsoft version 2C00			

Chapter Six Control Mode

6.1 External Pulse Control Mode

When parameter (BS12) is set 0000, the driver is in the state of receiving external pulse mode. The users need to pay attention to the following parameters setting under this mode.

1. BS02：Micro steps. 10E3 means $10\times10^3=10000$ pulse/R.

2. BS03：NC

3. BS04： To choose the waveform of pulse train input.

0000: cw/ccw rotating pulse control mode, it is valid on the trailing edge of the pulse.

0001: Pulse+direction control mode, it is valid on the trailing edge of the pulse.

0002: cw/ccw rotating pulse control mode, it is valid on the rising edge of

pulse.

0003: Pulse+direction control mode, it is valid on the rising edge of the pulse.

4. BS05: Driver filter constant. If the value is larger, the smoothing function upon external pulse will be the stronger. And the high speed performance will be better as well. However, the response time of driver will be longer. When PC sends out the command of opposite rotating direction with previous one, the users need to delay the time set via BS05 and then give opposite motion command.

6.2 Internal Pulse Control Mode

When parameter (BS12) is set 0001, the driver is in the state of internal pulse control mode. Please pay attention to the following parameter setting under this state.

1. BS02：Micro steps. 10E3 means $10\times10^3=10000$ pulse/R.
2. BS03：NC
3. BS06：The initial speed of internal pulse control, which must be less or equal to the value set via BS08.
4. BS07：The accelerating time (ms) of internal pulse control
5. BS08：The max speed of internal pulse control.
6. BS09：The rotating pulse number of internal pulse control (high 4 bit)
7. BS10：The rotating pulse number of internal pulse control (low 4 bit)
8. BS11：The status of internal pulse control. Press UP/DOWN to do positive/negative rotation.

6.3 Serial Port Command Control Mode

The driver supports RS485 COM port. (RTU Protocol) All basic and extended parameters can be directly written or read through the port. All information transmitted or received must be in the unit of 8 bytes. After each write operation, the driver will return the data sent by the master if they are received normally. Likewise, after each read operation, data will be sent back also.

Communication Rules: When communication command is transmitted to the driver, the matching port number will receive the command, read the information, run the task and finally send back the result. The returning information includes port number, function code, result data and error code. If any error occurs, there is no information.

The format of information frame comes as below:

Port No.	Function Code	Write/ Read Add.	Write/ Read Add.	Data	Data	Error Code	Error Code
8 bit (1 byte)	8 bit(1 byte)	High 8 bit Add.(1byte)	Low 8 bit Add.(1byte)	High 8 bit data(1 byte)	Low 8 bit data(1 byte)	High 8 bit check code(1 byte)	Low 8 bit check code(1 byte)

Port No.： Port number is the 1st byte of information frame, from 0-255. This byte indicates that the slave set by the user can receive information sent from master. Each slave has only one port number. And only the slave which matches the port number can response and return the information. When the information is sent back, the port number will state from which slave it comes.

Function Code： The function code sent by master is to instruct what task the slave needs to run.

Code	Content & Operation
03	Read data, to read the value under the appointed address.
06	Write data, to write the data to the appointed address.

Write/Read Add： The master writes/reads the driver address. Details are as the addresses listed in 6.2.

Data (read parameter data):

Function code 03: Master reads the data from driver.

Function code 06: Master writes the data to driver.

6.3.1 Basic Parameters (Writable/Readable)

NO.	Add. (1 byte)	Unit	Note(3 byte data)	Setting Range (decimal) Other value is invalid.
0	0x00	100mA	Current setting (unit: mA). Example: 2.3A, the written value is 0x17.	0x0-0x50 (0-80)
1	0x01	%	Set locking current.	0x0-0x64 (0-100)
2	0x02	Pulse/ R	Micro steps: 0x0—400 pulse/R；0x1--500 pulse/R 0x2--600 pulse/R；0x3--800 pulse/R 0x4—1000 pulse/R；0x5--1200 pulse/R 0x6--2000 pulse/R；0x7--3000 pulse/R 0x8--4000 pulse/R；0x9--5000 pulse/R 0x10--6000 pulse/R；0x11--10000 pulse/R 0x12--12000 pulse/R；0x13--20000 pulse/R 0x14--30000 pulse/R；0x15--60000 pulse/R	0x0-0x15
3	0x04		Pulse input mode. Used to choose waveform of pulse train input signal. 0000：positive/negative rotating pulse control mode, valid on the trailing edge.	0x0000-0x0001

			0001：pulse+direction control mode, valid on the trailing edge. 0002：positive/negative rotating pulse control mode, valid on the raising edge. 0003：pulse+direction control mode, valid on the raising edge.	
4	0x06	R/Min	Initial speed	0x00-0XC8 (0-200)
5	0x07	ms	Accelerating time	0x14-0x7D0 (20-2000)
6	0x08	R/Min	Max speed	0x10-0xBB8 (10-3000)
7	0x09	Pulse	High 4 bit pulse count	0x1-0xFFFF (1-65536)
8	0x0A	Pulse	Low 4 bit pulse count	0x1-0xFFFF (1-65536)
9	0x50		Star/stop command written into the address. If written into 0x055, motor runs in positive direction according to the parameter set by 0x6-0xA. If 0x155, motor will run in opposite direction according to the parameter set by 0x5-0x7. When written into 0xAA, motor gradually slows down and finally stops. If 0xCC, motor stops immediately.	0x55 0xAA 0xCC
10	0x23		Read 0x23, when the return value is 0x55, the motor is working, but if 0xAA, the motor stops working.	

6.3.2 Program Example

The driver can only be applied as slave. Before communication, the driver is set in serial port mode. The baud rate of host and slave needs to be set the same. When program, please make sure that port parameter of master complies with the requirements of MODBUS protocol.

Note：All following examples are based on port no. 1.

1) Set the driver current to be 2.3A by serial port communication.

Master->Slave data：01 06 0000 0017 C9C4

Slave->Master data：01 06 0000 0017 C9C4

The final two bytes are CRC code which is calculated by MODBUS protocol.

2) Start-up the Motor

Master->Slave data：01 06 0050 0055 49E4

Slave->Master data：01 06 0050 0055 49E4

After the command is sent successfully, driver will work according to the parameter set by 0x0-0xA.

3) Check Motor Status

Master->Slave data：01 03 0023 0002 35C1

Slave->Master data：01 03 0323 00AA 343B (Motor is under stop status)

If motor stops working, the return value of the 6th byte will be AA. If motor is rotating, the value will be 55.

6.4 Speed Control Mode

When parameter BS12 is set 0003, the driver is under the mode of speed control. LED displays motor rotating speed. When PU+, PU- input low level, motor starts to work at pre-set speed. The direction is determined by DR+ and DR-. If PU+ and PU- is disconnected, motor gradually low down the speed and finally stops. But if receives the signal of SM and MF, motor will stop immediately.

The users need to pay attention to the following parameters.

1. BS05：Startup speed under speed control mode.
2. BS06：Accelerating speed (ms) under speed control mode.
3. BS07：Max speed under speed control mode.

Appendix

Possible Problems & Solutions Table

Problems	Possible Cause	Solution
Motor stopped	LED indicator does not light	Check power supply
	LED indicates alarm information.	Refer to “Alarm Mode” at Chapter Four.
	Driver control mode does not match.	Choose matching control mode.
	Motor spindle is locked and motor does not work.	Check external control signal.
	LED displays normally, motor spindle is not locked.	Check if MF signal is valid.
Motor Screechy	Running current of the driver does not match motor rated current.	Set running current to be rated current.
	Accelerating time is too short.	Lengthen the accelerating time or increase the constant value of pulse wave filtering.
	The max speed is over-set.	Reduce Max speed.
Inaccurate Position	The Micro steps set incorrectly.	Choose correct micro steps.
	The motor load is too heavy.	Change the motor or appropriately increase driver running current.
Invalid Button	Button does not give response when driver is running.	Cut off external pulse signal and press the button again.
Electric Leakage	Not reliably grounded.	Make the driver/motor reliably grounded.
Driver/Motor Over-heat	Heavy running current or terrible external heat sinking condition	Appropriately reduce running current or improve the ventilation and heat dissipation.