

YKD2405PR

Bus Type Stepper Drive User Manual

Version: V1.3



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Foreword

Thank you for using our bus type stepper drive.

Before using this product, be sure to read this manual carefully for necessary safety information, precautions and operating instructions.

Wrong operation may have serious consequences.

Statement

The design and manufacture of this product do not have the ability to protect personal safety from mechanical systems. Please consider safety precautions in the design and manufacture of mechanical systems to prevent accidents due to improper operation or product abnormalities.

Due to product improvements, the contents of this manual may be changed without notice.

YAKO will not take any responsibility for user's any modification of the product.

Please note the following mark in the manual:



Note: to remind you to note the main points in the text.



Caution: Incorrect operation can result in personal injury and equipment damage.

1 Overview

1.1 Product introduction

YKD2405PR bus type stepper motor driver is a digital stepper drive based on the traditional open-loop stepper drive, but it added bus communication and single-axis controller function. Bus communication using RS-485 interface, supports the standard MODBUS-RTU protocol.

1.2 Features

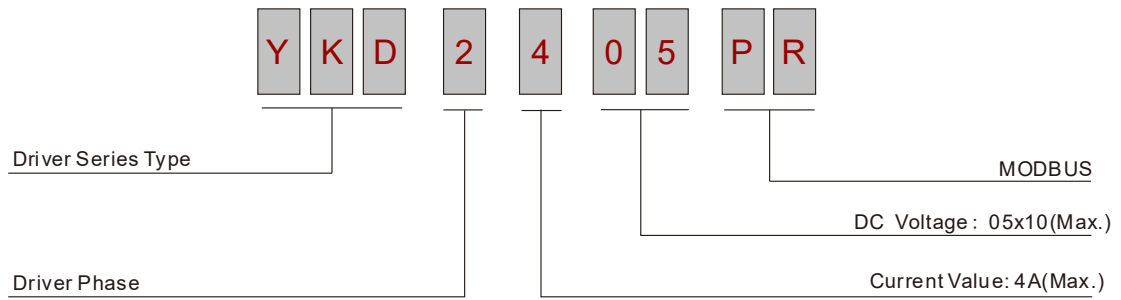
- New generation of 32-bit DSP technology, cost-effective, good stability, low noise, low vibration.
- RS-485 isolated bus, supports standard MODBUS-RTU protocol, mount up to 30 devices.
- Bus-type driver can achieve long-distance reliable control, which effectively solve the problem of pulse loss in interference environment.
- Users can set the current through the bus, subdivision, lock current, control motor start and stop and inquire real-time status of the motor.
- Built-in single-axis controller function: The user can set the start speed, acceleration time, deceleration time, maximum speed, the total number of pulses and other parameters through the bus to achieve trapezoidal acceleration and deceleration position control, with homing, multi-position mode and other functions.
- Support position control, speed control and multi-position mode.
- 2 photoelectric isolation programmable high-speed differential input interface, external signal can be used to control the motor start and stop
- 8 optical isolated programmable input interface, receiving external control signals to enable the drive, start & stop, emergency stop, position limit and other functions
- 4 photoelectric isolated programmable output interface, output driver status and control signals
- 16 constant torque microstep, 40000 microstep the highest
- Smooth and precise current control, small motor heat
- Motor current automatic halve when the step pulse stops more than 200ms
- Excellent smoothness in low frequency and small subdivision
- Driving current adjustable below 4.2 A
- Voltage: DC24-50V
- Over-voltage, under-voltage, over-current protection

1.3 Applications

Mainly used in textile machines, embroidery machines, security equipment, stage

lighting, robots, medical equipment, laser equipment, marking machines, plotters and other automation equipment.

1.4 Product naming rules



2 Performance indicators

2.1 Electrical features

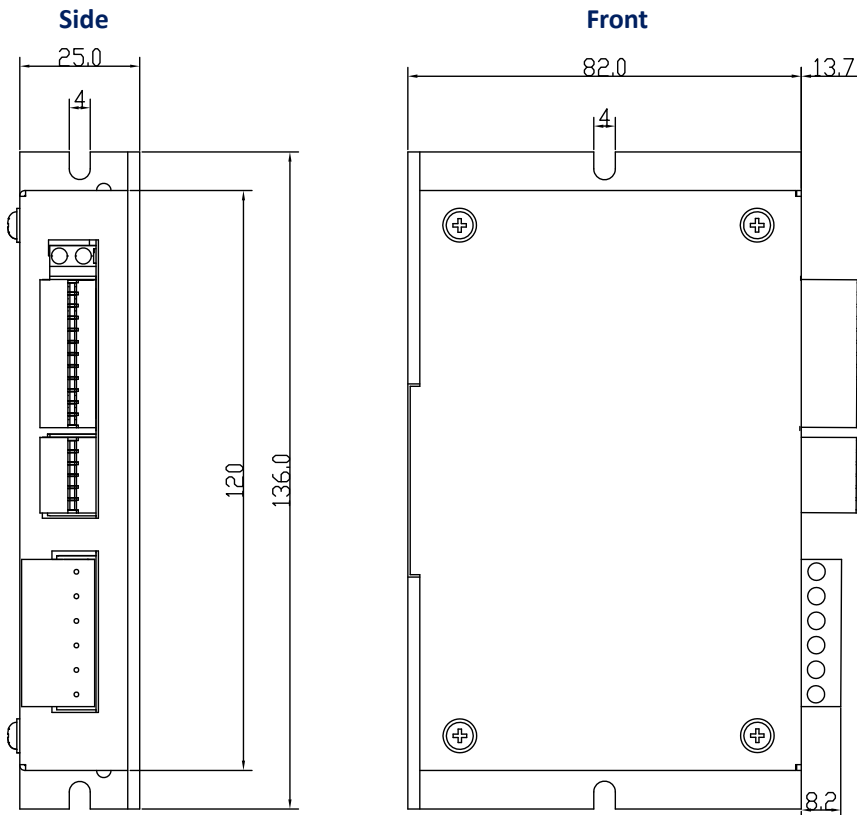
Spec.	YKD2405PR			
	Min value	Typical value	Max value	Unit
Output current	0.5	-	4.2	A
Input voltage	18	24	50	Vdc
Logic input current	7	10	16	mA
Logic input voltage	-	5	24	V
Pulse frequency	0	-	200	kHz
Insulation resistance	100	-	-	MΩ

2.2 Working environment

Cooling	Cooling fin	
Working environment	Environment	Keep away from other heating equipment as far as possible. Avoid dust, oil mist, corrosive gas, strong vibration, prohibit combustible gas and conductive dust
	Temperature	0°C~50°C
	Humidity	40—90%RH (No condensation)
	Vibration	10~55Hz/0.15mm
Storage temperature	-20°C~+80°C	

3 Installation

3.1 Installation dimensions



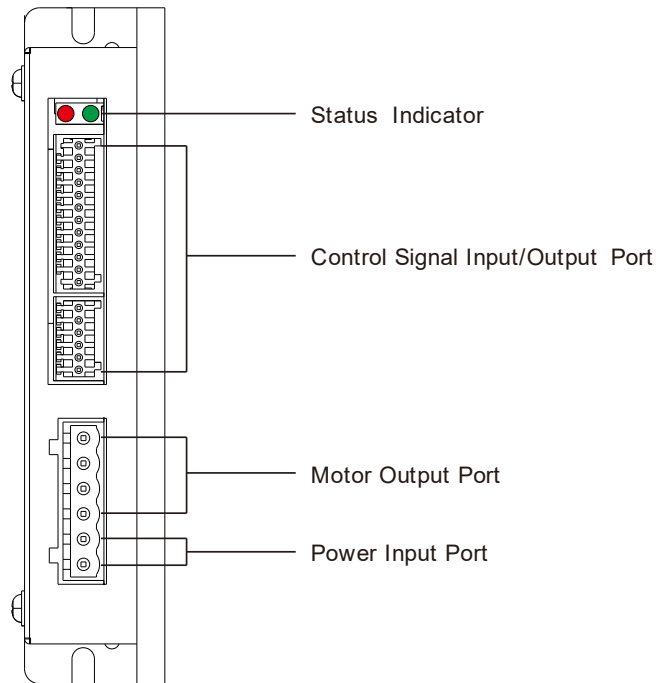
Installation dimensions (unit: mm)

3.2 Installation requirements

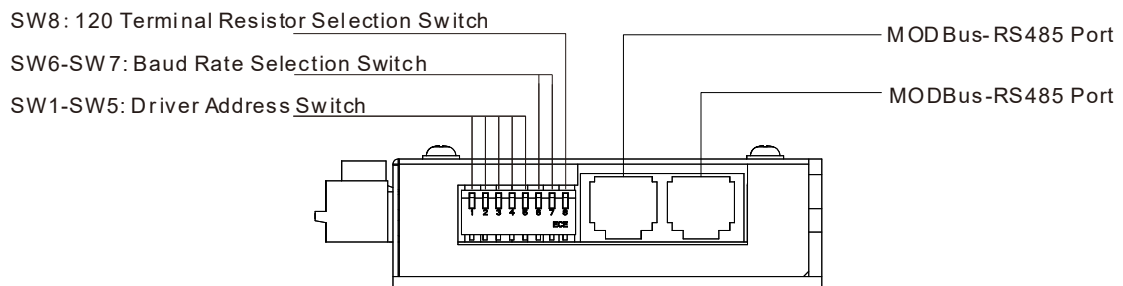
When installing the driver, please use upright side mounting to make the radiator surface have strong air convection; if necessary, install a fan near the driver to force the heat dissipation to ensure the driver work in a reliable working temperature (the reliable operating temperature of the driver is usually 60℃, the motor operating temperature is 80 ℃ or less).

4 Drive port and wiring

4.1 Wiring diagram



Drive side wiring diagram



Drive top wiring diagram



Caution:

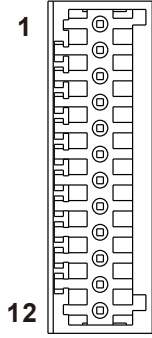
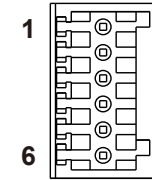
- The personnel involved in the wiring must have professional ability.
- No wiring with electricity power on.
- Wiring after the installation is firmly finished.
- Do not wrongly connect + and – of power, input voltage should not exceed 50V.

4.2 Port definition

4.2.1 Status Indicator

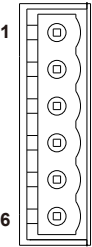
Colour	Name	Function
Green	Power Indicator	After powered on, the green light illuminate
Red	Alarm indicator	Overcurrent, the indicator flashing once for cycle; Over-voltage, the indicator flashing twice for cycle; Undervoltage, the indicator flashing three times for cycle; EEPROM error, the indicator flashing four times for cycle; When communication is wrong, the indicator flashing five times for cycle.

4.2.2 Control signal input / output port

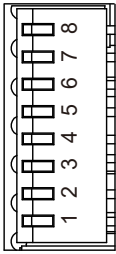
Port	PIN	Mark	Name	Function	
	1	X0	Single-ended input port	① (P/D mode) pulse signal (only for high-speed differential port PU); ② (P/D mode) direction signal (only for high speed differential port DR); ③ Home signal; ④ Forward limit signal; ⑤ Backward limit signal; ⑥ Motor MF signal; ⑦ Alarm clear signal; ; ⑧ PV enable signal; ⑨ PV direction signal; ⑩ Stop signal; ⑪ Emergency stop signal ⑫ Position mode movement; ⑬ Speed mode movement; ⑭ JOG+ point movement; ⑮ JOG- point movement; ⑯ Homing enable signal; ⑰ PT enable signal; ⑱ PIN0~4;	
	2	X1			
	3	X2			
	4	X3			
	5	X4			
	6	X5			
	7	X6			
	8	X7			
	9	DR-	Differential input port		
	10	DR+			
	11	PU-			
	12	PU+			
	1	XCOM	Single-ended input common	Common port: Compatible with common cathode and common anode wiring	
	2	YCOM	Single-ended output common		
	6	3	Y0	Single-ended output	① Alarm signal
		4	Y1		② Brake signal;

	5	Y2		③ Homing completion signal;
	6	Y3		④ Motor running status signal;
				⑤ Position ready signal;

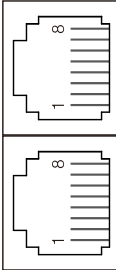
4.2.3 Power input / motor output port

Port	PIN	Mark	Name	Function
	1	B-	Motor power port	Two-phase stepper motor connection port
	2	B+		
	3	A-		
	4	A+		
	5	V+	Power input port	DC24-50V
	6	V-		

4.2.4 Switch

Port	PIN	Mark	Name	Function
	1	SW1	Switch	SW1-5: Drive address setting
	2	SW2		
	3	SW3		
	4	SW4		
	5	SW5		
	6	SW6		SW6-7 : Communication baud rate setting
	7	SW7		SW8 : 120 terminal resistor effective bit
	8	SW8		

4.2.5 MODBUS port

Port	PIN	Mark	Name	Function
	1	RS-485-A	Communication port	RS485 Communication line
	2	RS-485-B		
	3	NC	Reserve	Reserve
	4	NC		
	5	RS-485-GND	Common ground	Common ground
	6	NC	Reserve	Reserve
	7	NC		
	8	NC		

4.3 Input / output port operation

- Port hardware description

YKD2405PR drive provides 8 optical isolated programmable input interface, compatible with common cathode and common anode connection, 2 differential signal input.

2 differential internal high-speed optocoupler differential signal can be configured for pulse direction or double pulse control, and it can also be configured as a common differential input terminal. The input signal voltage is 5V, current limit resistor is needed when the voltage is higher than 5V (such as when the input signal is 24V, 2~3K resistor should be connected).

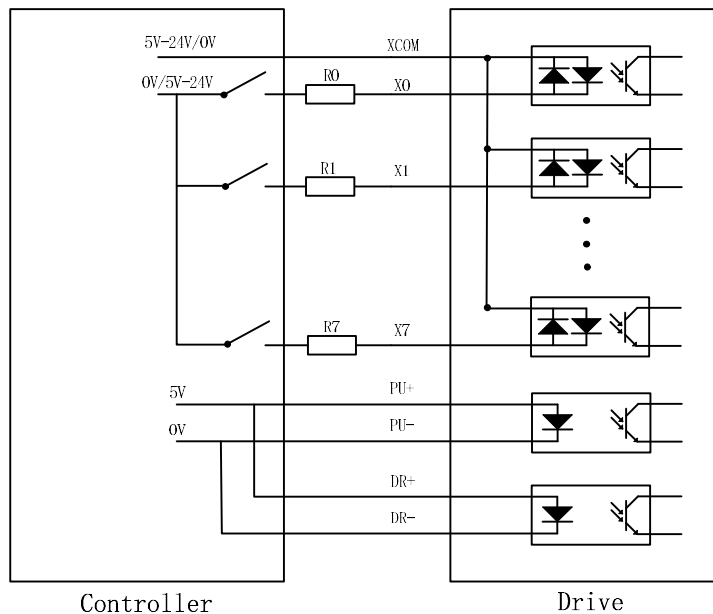
8 (X0-X7) programmable input signal and external control interface are isolated through optocoupler. The driver is compatible with common cathode and common anode connection, as shown below. In order to ensure that the drive optocoupler conduction is reliable, the controller requires to provide drive current at least 10mA. The driver has been inserted with optocoupler current limiting resistor, when the input signal voltage is higher than 5V, an external resistor can be added according to needs.

Current-limiting resistor selection: if voltage is +5V, R=0; if voltage is +12V, R=1KΩ; if voltage is +24V, R=2KΩ.



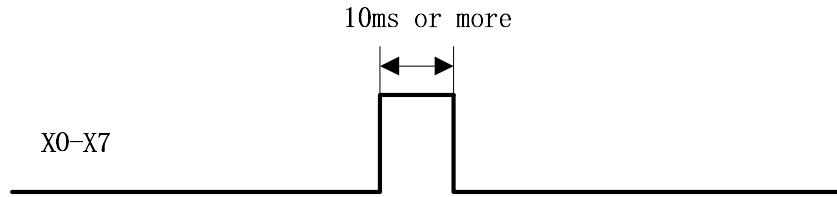
Note:

- If the controller outputs 24V control voltage by default, YKD2405PR-A1 can be selected to avoid trouble of adding resistance. The default input terminal control voltage of this sub-model is 24V.



Input terminal connection reference circuit

The level of X0-X7 input pulse width needs more than 10ms, otherwise the drive may not respond properly. X0-X7 timing diagram as shown below.



X0-X7 timing diagram

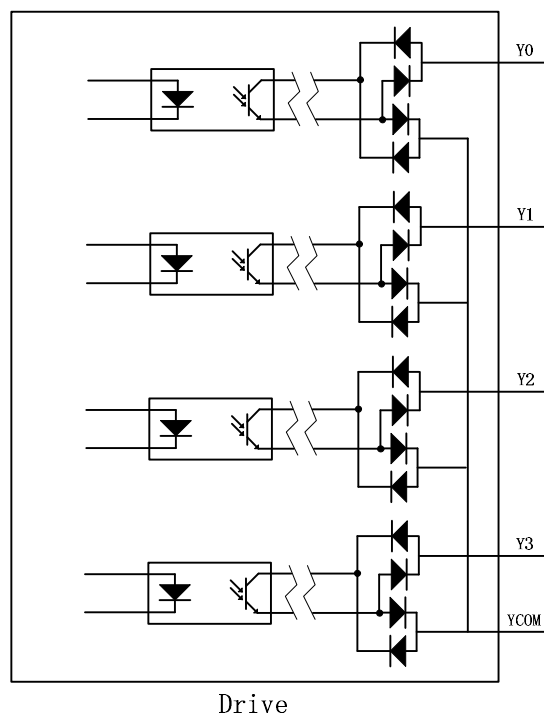
Each time the driver is powered on, X0-X7 are defaulted to be in unspecified state. In this condition, the input signal is invalid. The user can configure the X0-X7 input via the bus.

For example, to configure X0-X2 input signal as table ※ Terminal function setting content, host needs to send slave the following command: 01 06 00 43 00 01 B9 DE, 01 06 00 44 00 02 48 1E, 01 06 00 45 00 03 D8 1E.

※ Terminal function setting content

Input signal	Funtion
X0	Homing signal
X1	Forward limit signal
X2	Backward limit signal

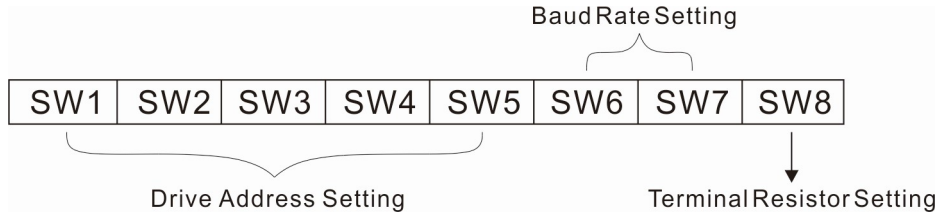
The driver provides 4 optocoupler isolated output terminals, supports NPN wiring and PNP wiring, support high or low level effective controller.



Y0-Y3 output terminal internal circuit

4.4 Switch setting

YKD2405PR bus type stepper motor drive use 8-bit DIP switch to set the drive address, communication baud rate and termination resistor, described in detail as follows:



DIP switch combination diagram

- **Drive address settings**

With RS-485 bus, up to 30 drives can be controlled simultaneously. Drive communication address setting using 5 DIP switches, address setting range is 0-31. 0 is reserved for the system. When the drive address is more than 31, you need to use the host debugging software to set and save it, in this condition, all the switch should be set to OFF. As shown in the following table:

SW5	SW4	SW3	SW2	SW1	Address
OFF	OFF	OFF	OFF	OFF	Customize
OFF	OFF	OFF	OFF	ON	1
OFF	OFF	OFF	ON	OFF	2
OFF	OFF	OFF	ON	ON	3
OFF	OFF	ON	OFF	OFF	4
OFF	OFF	ON	OFF	ON	5
OFF	OFF	ON	ON	OFF	6
OFF	OFF	ON	ON	ON	7
OFF	ON	OFF	OFF	OFF	8
OFF	ON	OFF	OFF	ON	9
OFF	ON	OFF	ON	OFF	10
OFF	ON	OFF	ON	ON	11
OFF	ON	ON	OFF	OFF	12
OFF	ON	ON	OFF	ON	13
OFF	ON	ON	ON	OFF	14
OFF	ON	ON	ON	ON	15
ON	OFF	OFF	OFF	OFF	16
ON	OFF	OFF	OFF	ON	17
ON	OFF	OFF	ON	OFF	18
ON	OFF	OFF	ON	ON	19
ON	OFF	ON	OFF	OFF	20
ON	OFF	ON	OFF	ON	21

ON	OFF	ON	ON	OFF	22
ON	OFF	ON	ON	ON	23
ON	ON	OFF	OFF	OFF	24
ON	ON	OFF	OFF	ON	25
ON	ON	OFF	ON	OFF	26
ON	ON	OFF	ON	ON	27
ON	ON	ON	OFF	OFF	28
ON	ON	ON	OFF	ON	29
ON	ON	ON	ON	OFF	30
ON	ON	ON	ON	ON	31



Note:

- One controller can control up to 30 drives simultaneously through RS-485 bus.
- Each drive's communication address settings must be unique, otherwise it will cause communication errors.

● **Communication baud rate setting**

※Communication baud rate setting

SW7	SW6	Baud rate
ON	ON	9600 (Note)
ON	OFF	19200
OFF	ON	38400
OFF	OFF	115200



Note:

- When the communication baud rate in the above table can not meet the usage requirements, the baud rate can be customized by the host computer. In this condition, SW6 and SW7 are all turned ON. The default baud rate is 9600 bits.

● **Terminal resistor setting**

This bit can be used to select whether the communication 120 termination resistor is effective, which is depended on the application. As shown in the following table:

SW8	120 termination resistor selection bit
OFF	Not effective
ON	Effective

4.5 RS485 communication port

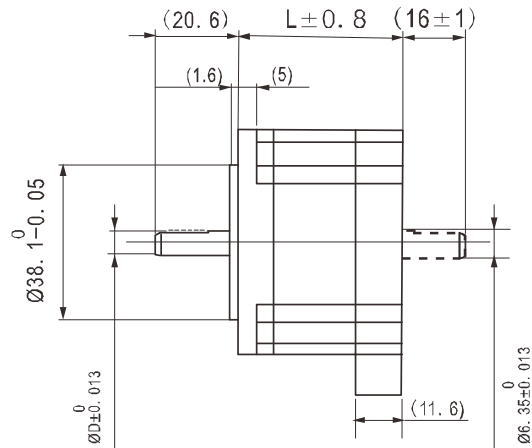
YKD2405PR drive provides two side by side RS-485 communication interface, communication interface using standard RJ45 socket. RJ45 socket has 8 pins, of which pin 1 and pin 2 are used for RS-485 half-duplex communication, pin 5 is RS-485 common ground. Other pins are not used. For details, see 4.2.5 MODBUS Bus Port.

5 Applied motor

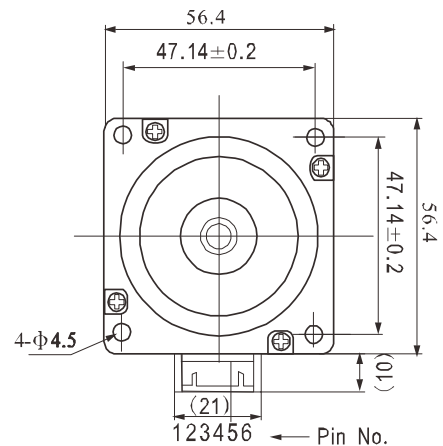
YKD2405PR standard stepper motor model are YK57XN55-3506A, YK57XN78-3506A, YK57XN78-4208A, YK57XQ56-833A, YK57XQ76-833A and YK57XQ76-4008A, all of them are 57mm(NEMA 23) 4 line motor.

5.1 Motor dimension

- 57mm 2 phase stepper motor (unit: mm)



Model	Shaft Diameter (mm)	Shaft Connect Type (mm)	Shaft Length L1(mm)
YK57XN55-3506A	6.35	Flat 0.5x15	20.6
YK57XN78-3506A	6.35	Flat 0.5x15	20.6
YK57XN78-4208A	8	Flat 0.5x15	20.6
YK57XQ56-833A	8	Flat 0.5x25	33.0
YK57XQ76-833A	8	Flat 0.5x25	33.0
YK57XQ76-4008A	8	Flat 0.5x15	20.6

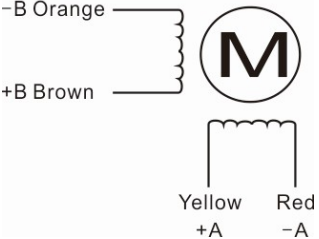
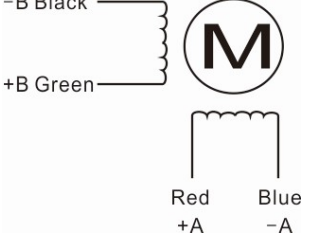


5.2 Technical Spec

Model	Step angle (°)	Voltage (v)	Motor length (mm)	Holding torque (N.m)	Rated current (A/phase)	Phase resistance (Ω)	Phase inductance (mH)	Rotor inertia (g.cm)	Motor weight (kg)	Motor line
YK57XN55-3506A	1.8	1.9	54.5	1.4	3.0	0.55	2.0	245	0.71	4
YK57XN78-3506A		3.0	77.5	2.2	3.0	0.85	3.3	470	1.11	4
YK57XN78-4208A		2.5	77.5	2.2	4.2	0.60	2.2	470	1.11	4
YK57XQ56-833A		1.6	55	1.2	4.0	0.40	1.6	280	0.7	4
YK57XQ76-833A		2.0	76	2.0	4.0	0.40	1.8	480	1.0	4
YK57XQ76-4008A		2.15	78	2.2	4.0	0.43	1.8	480	1.0	4

5.3 Motor wiring diagram

4 line motor (cable length 400mm)

YK57XN55-3506A YK57XN78-3506A	YK57XN78-4208A YK57XQ56-833A	YK57XQ76-4008A YK57XQ76-833A
<p>4 Leads</p> 	<p>4 Leads</p> 	



Note:

- The motor characteristic data and technical data are all measured with the drive. The test voltage is 24VDC.
- When installing the motor, be sure to use the flange of the motor to install and pay attention to the tolerance, strictly ensure the concentricity of the motor shaft and the load.
- When the motor and the drive are connected, please do not connect with wrong phase.

6 MODBUS communication protocol

6.1 MODBUS register address definition

※ Register address definition table

Register address	Item	Description	Setting range Note: Other values are invalid	Default
Status parameter group (read only)				
0x0000	Drive model	Drive model code	(RO)	0x0301/ 0x0302
0x0001	Drive version	Drive version	(RO)	V1.0
0x0002	Drive node number	MODBUS current communication slave node number	(RO)	-
0x0003	Drive working mode	0: position / speed mode; 1: Homing mode; 2: PT mode 3: PV mode;	(RO)	-
0x0004	Motor movement status	0: Static; 1: Moving;	(RO)	-
0x0005	Motor movement direction	0: counterclockwise (positive direction); 1: clockwise (negative direction);	(RO)	-
0x0006	Current error code	0: normal; 1 ~ 5: error;	(RO)	-
0x0007	Drive status bit	Bit0: In-position, 0: Not in-position, 1: In-position, Bit1: Homing completion bit, 0: Incomplete, 1: Completed; Bit2: Motor running bit, 0: Static, 1: running; Bit3: Alarm bit, 0: Normal, 1: Alarm; Bit4: Motor enable bit, 0: Enable, 1: Release; Bit5 ~ Bit15: Reserved;	(RO)	-
0x0008	Input terminal status bit	Bit0: PU terminal input status; Bit1: DR terminal input status; Bit2: X0 terminal input status; Bit3: X1 terminal input status; Bit4: X2 terminal input status; Bit5: X3 terminal input status;	(RO)	-

		<p>Bit6: X4 terminal input status; Bit7: X5 terminal input status; Bit8: X6 terminal input status; Bit9: X7 terminal input status; Bit10 ~ Bit15: Reserved;</p> <p>0: Input level is invalid 1: Input level is valid;</p>		
0x0009	Output terminal status bit	<p>Bit0: Y0 terminal output status; Bit1: Y1 terminal output status; Bit2: Y2 terminal output status; Bit3: Y3 terminal output status; Bit4 ~ Bit15: Reserved;</p> <p>0: Output level is invalid 1: Output level is valid;</p>	(RO)	-
0x000A	Current position high bit	Current position in absolute position (see 0x0026 function code)	(RO)	-
0x000B	Current position low bit	Current position in absolute position (see 0x0026 function code)	(RO)	-
0x000C	Current speed	Current motor speed	(RO)	-
Drive basic control parameter group 1				
0x0010	Current setting	<p>Value—RMS (Peak) Lock current 0—0.5A (0.7A); 1—0.8A (1.1A); 2—1.0A (1.4A); 3—1.2A (1.7A); 4—1.5A (2.1A); 5—1.9A (2.7A); 6—2.3 A (3.3A); 7—2.7A (3.8A); 8—3.1A (4.3A); 9—3.5A (4.9A); 10—4.0A (5.6A); 11—4.2A (5.9A);</p>	0~11 (RW/S)	6 (2.3A)
0x0011	Microstep setting	<p>Address—Microstep 0—200 (Pu/rev); 1—400 (Pu/rev); 2—800 (Pu/rev); 3—1600 (Pu/rev);</p>	0~15 (RW/S)	8 (1000P u/rev)

		4—3200 (Pu/rev); 5—6400 (Pu/rev); 6—12800 (Pu/rev); 7—25600 (Pu/rev); 8—1000 (Pu/rev); 9—2000 (Pu/rev); 10—4000 (Pu/rev); 11—5000 (Pu/rev); 12—8000 (Pu/rev); 13—10000 (Pu/rev); 14—20000 (Pu/rev); 15—40000 (Pu/rev);		
0x0012	Lock current	0: Half current; 1: Full current;	0~1 (RW/S)	0
0x0013	Custom drive node number	0~31: Undefined 32~127: Use it when node number is bigger than 31;	0~127 (RW/S)	0
0x0014	Custom communication baud rate	0: 9600 1: 14400 2: 128000 3: 256000 Note: After modifying, please re-power to make effect;	0~3 (RW/S)	0
0x0015	Serial data format	0: 8-bit data, no parity, 1 stop bit; 1: 8-bit data, no parity, 2 stop bits; 2: 8-bit data, even parity, 1 stop bit; 3: 8-bit data, odd parity, 1 stop bit; Note: After modifying, re-power to take effect;	0~3 (RW/S)	0
0x0016	Communication write function code value update to EEPROM	0: Parameters with attribute RW/S are updated to EEPROM synchronously. 1: Not updated;	0~1 (RW/S)	0
0x0017	Overtravel stop mode	0: Free stop; 1: Emergency stop; 2: Invalid	0~2 (RW/S)	0
0x0018	Bus control mode / pulse direction (P / D) control mode selection	0: Bus control; 1: External pulse / direction (P/D) control mode; 2: Double pulse control mode; Note: After the control mode is switched to external pulse control, the drive needs to be re-powered.	0~2 (RW/S)	0

Drive basic control parameter group 2				
0x0020	Start speed	The start speed of the movement;	2-300r/min (RW)	5 (5r/min)
0x0021	Acceleration time	Acceleration time;	0-2000ms (RW)	100 (100ms)
0x0022	Deceleration time	Deceleration time;	0-2000ms (RW)	100 (100ms)
0x0023	Maximum speed	In low microstep setting, the maximum speed is 3000r/min; In high microstep setting, the maximum output frequency is 200KHz	-3000~3000 r/min (RW)	60 (60r/min)
0x0024	Total pulse number high bit	Total number of pulses in position mode operation (including the total number of steps in the stages of acceleration, constant speed and deceleration) If you set 100000 pulses, the high bit is 0x0001 and the low bit is 0x86A0	-32767~32768 (RW)	0
0x0025	Total pulse number low bit		-32767~32768 (RW)	5000
0x0026	Relative position / absolute position	This bit is valid when use the external IO to trigger position/ multi-position operation: 0: Relative position: starting from the current point; 1: Absolute position: Starting position is the power-on position or the positon after homing;	0~1 (RW)	0
0x0027	Start command	Bit0-1: 1: Position mode; 2: Speed mode; Bit2: 0: Relative position; 1: Absolute position; this bit is valid only in position mode; Bit3 ~ Bit15: Reserved	0~6 (RW)	-
0x0028	Stop command	Bit0: 0: Normal stop; 1: Emergency stop;	0~2 (RW)	-
0x0029	Motor enable/release signal	0: Release; 1: Enable;	0~1 (RW)	-
0x002A	Alarm clear	0: Invalid; 1: Alarm clear;	0~1 (RW)	-

0x002B	MODBUS register parameter setting	0: Invalid 1: Restore factory settings 2: Save all parameters of RW attribute to EEPROM;	0~2 (RW)	-
0x002C	Current position clearance	Can be used to clear the current position when in absolute position mode: 0: Invalid 1: Clear current position;	0~1 (RW)	-
Homing function parameter group				
0x0030	Homing enable	0: Invalid; 1: Valid;	0~1 (RO)	-
0x0031	Homing mode	0: Positive position limit + home mode; 1: Negative position limit + home mode; 2: Positive position limit mode; 3: Negative position limit mode; Note: In mode 0 and 1, the limit signal can be omitted if it's not needed;	0~3 (RW/S)	0
0x0032	Homing speed	The speed of homing operation;	5-3000r/min (RW/S)	120 (60r/min)
0x0033	Homing query speed	Return speed after home is found;	5-300 r/min (RW/S)	60 (60r/min)
0x0034	Homing acceleration and deceleration time	Acceleration and deceleration time when querying home position;	30-2000ms (RW/S)	100 (100ms)
0x0035	Home positive compensation value	Counterclockwise compensation value;	0~65535 (RW/S)	0
0x0036	Home negative compensation value	Clockwise compensation value;	0~65535 (RW/S)	0
Input/output terminal parameter group				
0x0040	Input terminal active level	Bit0: PU terminal control bit; Bit1: DR terminal control bit; Bit2: input terminal X0 control bit; Bit3: input terminal X1 control bit; Bit4: input terminal X2 control bit; Bit5: input terminal X3 control bit;	0~65535 (RW/S)	0

		<p>Bit6: input terminal X4 control bit; Bit7: input terminal X5 control bit; Bit8: input terminal X6 control bit; Bit9: input terminal X7 control bit;</p> <p>Bit10 ~ Bit15: Reserved;</p> <p>0: default; 1: Level reversal; The driver input terminal level rising edge or high level is effective as default;</p>		
0x0041	Input terminal PU function selection	0: undefined	0~20 (RW/S)	0
0x0042	Input terminal DR function selection	1: origin signal; 2: positive position limit signal; 3: negative position limit signal;	0~20 (RW/S)	0
0x0043	Input terminal X0 function selection	4: motor MF signal;	0~20 (RW/S)	0
0x0044	Input terminal X1 function selection	5: Alarm clear signal; 6: PV enable signal;	0~20 (RW/S)	0
0x0045	Input terminal X2 function selection	7: PV direction signal;	0~20 (RW/S)	0
0x0046	Input terminal X3 function selection	8: Stop signal;	0~20 (RW/S)	0
0x0047	Input terminal X4 function selection	9: emergency stop signal; 10: position mode movement;	0~20 (RW/S)	0
0x0048	Input terminal X5 function selection	11: speed mode movement;	0~20 (RW/S)	0
0x0049	Input terminal X6 function selection	12: JOG+ point movement; 13: JOG- point movement;	0~20 (RW/S)	0
0x004A	Input terminal X7 function selection	14: homing enable signal; 15: PT enable signal;	0~20 (RW/S)	0
		16: PIN0; 17: PIN1; 18: PIN2;	0~20 (RW/S)	0
		19: PIN3; 20: PIN4;	0~20 (RW/S)	0
0x004B	Output terminal active level	Note: When using external pulse control mode, set the PU and DR functions to 0 to avoid unintended effects;	0~20 (RW/S)	0
0x004B	Output terminal active level	Bit0: output terminal Y0 control bit; Bit1: output terminal Y1 control bit; Bit2: output terminal Y2 control bit;	0~65535 (RW/S)	0

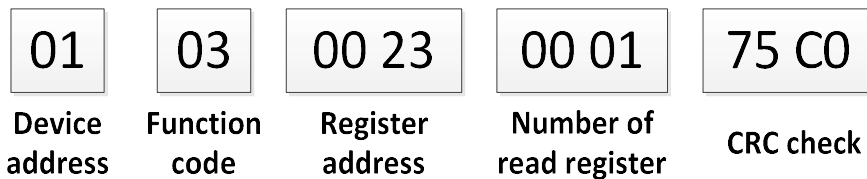
		Bit3: output terminal Y3 control bit; 0: default; 1: level reversal; The driver input terminal level rising edge or high level is effective as default;		
0x004C	Output terminal Y0 function selection	0. Undefined 1. Alarm signal 2. Brake signal 3. Drive status signal 4. Homing complete signal 5. Position ready signal 6. In PT mode	0~8 (RW/S)	0
0x004D	Output terminal Y1 function selection		0~8 (RW/S)	0
0x004E	Output terminal Y2 function selection		0~8 (RW/S)	0
0x004F	Output terminal Y3 function selection		0~8 (RW/S)	0
Multi-stage position parameter group				
0x0090~ 0x009F	Total pulse number high bit of PT position segment (seg. 1~ seg. 16)	Total number of pulses in position mode operation (including the total number of steps in the stages of acceleration, constant speed and deceleration) If you set 100000 pulses, the high bit is 0x0001 and the low bit is 0x86A0	0x00~ 0xFFFF (RW/S)	0
0x00A0~ 0x00AF	Total pulse number low bit of PT position segment (seg. 1~ seg. 16)		0x00~ 0xFFFF (RW/S)	0
0x00B0~ 0x00BF	Running speed of PT position segment (seg. 1~ seg. 16)	Running speed	0-3000r/min (RW/S)	0 (0/min)
0x00C0~ 0x00CF	Acceleration and deceleration time of PT position segment (seg. 1~ seg. 16)	Acceleration and deceleration time	30-2000ms (RW/S)	0 (0ms)
0x00E0~ 0x00EF	Maximum speed of PV speed segment (seg. 1~ seg. 16)	Motion speed of PV multi-segment speed mode	0-3000r/min (RW/S)	0 (0/min)
Performance parameter group				
0x0110	Current circle proportional	Factory default, normally do not need to adjust	0~65535 (RW/S)	-

	coefficient			
0x0111	Current circle integral coefficient	Factory default, normally do not need to adjust	0~65535 (RW/S)	-
0x0112	High speed proportionality coefficient	Factory default, normally do not need to adjust	0~65535 (RW/S)	-
0x0113	High speed integral coefficient	Factory default, normally do not need to adjust	0~65535 (RW/S)	-
0x0114	Proportionality coefficient of axial hold	Factory default, normally do not need to adjust	0~65535 (RW/S)	-
0x0115	Integral coefficient of axial hold	Factory default, normally do not need to adjust	0~65535 (RW/S)	-
0x0116	X0/X1 input filtering time	Factory default, normally do not need to adjust	0~65535 (RW/S)	10
0x0117	X2/X3 input filtering time	Factory default, normally do not need to adjust	0~65535 (RW/S)	10
0x0118	X4/X5 input filtering time	Factory default, normally do not need to adjust	0~65535 (RW/S)	10
0x0119	X6/X7 input filtering time	Factory default, normally do not need to adjust	0~65535 (RW/S)	10

6.2 MODBUS common function code

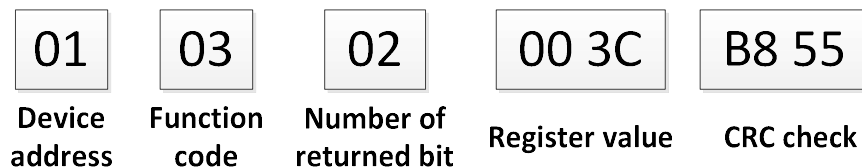
6.2.1 Read register command 03

➤ Master->Slave data



The host sends 11 to the slave to inquiry the maximum speed register.

Slave->Master data:



Slave return maximum speed register value is 60.

- Other examples of reading register commands are as follows:

Query start speed (0x0020), acceleration time (0x0021), deceleration time (0x0022), maximum speed (0x0023)

Master->Slave data: 01 03 00 20 00 04 45 C3

Slave->Master data: 01 03 08 00 05 00 64 00 64 00 3C F0 D1 (Start speed 5r/min, acceleration time 100ms, deceleration time 100ms, maximum speed 60r/min)



Note: The maximum number of register queries can not exceed 16.

6.2.2 Write a single register command 06

- Master->Slave data



The master writes a value of 60 to the slave maximum speed register. After receiving the command, the slave returns the same command to confirm.

Slave->Master data:



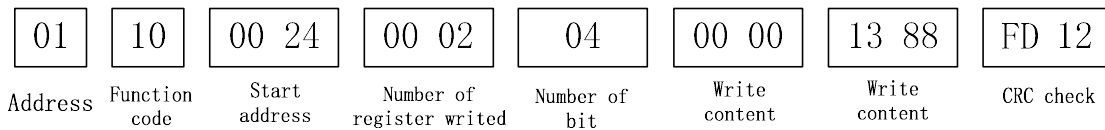
- Other examples of writing a single register command are:

Set the acceleration time register to 500ms:

Master->Slave data: 01 06 00 21 01 F4 D9 D7

Slave->Master data: 01 06 00 21 01 F4 D9 D7

6.2.3 Write multiple register command 10



An example of writing multiple register commands is as follows:

The master writes two registers to the slave, setting the high bit of pulse number register and the low bit of pulse number register respectively.

Master->Slave data: 01 10 00 24 00 02 04 00 00 13 88 FD 12

Slave->Master data: 01 10 00 24 00 02 01 C3

6.2.4 Communication error code

➤ CRC check error

If an error occurs during the data transmission, the slave device calculates a CRC value of the frame of data. If it is not 85 C0, then the slave discards this frame data and does not return any data.

Master->Slave data: 01 03 00 20 00 01 85 C1

Slave->Master data: 01 83 01 80 F0

➤ Function code error

If the function code requested by master is not 03 or 06, the device returns an exception code 01. Refer to Table 3 for details of exception code 01.

Master->Slave data: 01 02 00 00 00 04 79 C9

Slave->Master data: 01 82 02 61 C1

➤ Illegal data address

If the master requests an invalid data address, the device returns an exception code 03.

Master->Slave data: 01 03 00 19 00 01 55 CD

Slave->Master data: 01 83 03 01 31

Register address 0x0019 is empty, the device returns an exception code 03.

➤ Read address overflowed

If the master requests more data than read limit, the device returns an exception code 05. For details of exception code 05, please refer to the table **※ MODBUS exception code**.

Master->Slave data: 01 03 00 20 00 20 45 D8

Slave->Master data: 01 83 05 81 33

Read 32 data in one time is out of range, return exception code 05

➤ Illegal read and write

Function code read-write properties are divided into read-only, write-only, read and write three kinds, report exception code 06 for operations that do not meet the function code attribute.

Master->Slave data: 01 03 00 27 00 01 34 01

Slave->Master data: 01 83 06 C1 32

Function code 0x27 is write-only function code, reported exception code 06 for read operation.

➤ Write error

Write function code content beyond the range of its provisions.

Master->Slave data: 01 06 00 26 00 08 69 C7

Slave->Master data: 01 86 07 03 A2

Write function code out of range and return exception code 07.

※ **MODBUS exception code**

Code	Name	Meaning
01	CRC check error	CRC check error
02	Command code error	The slave receives the function codes other than 03 and 06.
03	Function code address error	Received data address that is not allowed by slave.
04	Exceeded function code address	The received data address is beyond the function code range.
05	Read function code number overflow	Read 16 function codes the maximum at one time.
06	Function code reading and writing illegal error	Function code read-write properties are divided into read-only, write-only, read and write three kinds, report exception code 06 for operations that do not meet the function code attribute.
07	Function code written wrong	Write function code content beyond the range of its provisions.

6.2.5 Application examples

➤ Example of position mode operation:

For example, the motor is driven forward by the parameter (current 2.3A, lock current is the half of running current, microstep is 1000 pulses/round, initial speed 10r/min, acceleration time 100ms, deceleration time 100ms, maximum speed 500r/min) to rotate one round.

Before starting this example, be sure to set the drive device address to 1, that is, DIP switches SW5-SW2 are set to OFF and SW1 is set to ON.

The following steps 1-3 must be set before step 4 (that is, set the parameters first, and then start to run), but there is no specific order for setting steps 1-3.

Step 1: Set the current (RMS 2.3A, lock current half)

Master—>Slave: 01 06 00 10 00 06 08 0D

Slave—>Master: 01 06 00 10 00 06 08 0D

Step 2: Set subdivision (1000 pulses/rev)

Master—>Slave: 01 06 00 11 00 08 D8 09

Slave—>Master: 01 06 00 11 00 08 D8 09

Step 3: Set the initial speed, acceleration and deceleration time, maximum speed and pulse value

Master—>Slave: 01 10 00 20 00 06 0C 00 0A 00 64 00 64 01 F4 00 00 03 E8 3D 69

Slave—>Master: 01 10 00 20 00 06 41 C1

Step 4: Relative position mode start command

Master—>Slave: 01 06 00 27 00 01 F8 01

Slave—>Master: 01 06 00 27 00 01 F8 01

➤ **Speed mode operation example:**

For example, the motor accelerates backwards to 500r/min and runs at a constant speed according to the parameter (current 2.3A, locking current is half of the operating current, microstep 1000Pu/rev, initial speed 10r/min, acceleration time 100ms).

Before starting this example, be sure to set the drive device address to 1, that is, DIP switches SW5-SW2 are set to OFF and SW1 is set to ON.

Step 1: Set the current (RMS 2.3A, lock current half), microstep

Master—>Slave: 01 10 00 10 00 02 04 00 06 00 08 13 64

Slave—>Master: 01 10 00 10 00 02 40 0D

Step 2: Set the initial speed, acceleration and deceleration time, the maximum speed

Master—>Slave: 01 10 00 20 00 04 08 00 0A 00 64 00 64 01 F4 AD C5

Slave—>Master: 01 10 00 20 00 04 C0 00

Step 3: Speed mode start command

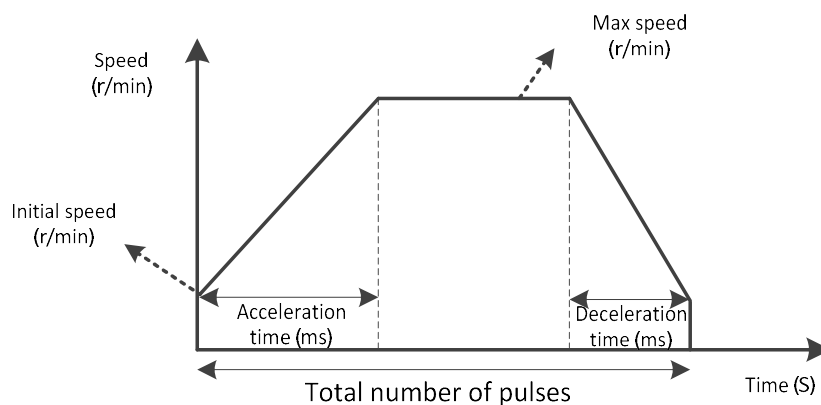
Master—>Slave: 01 06 00 27 00 02 B8 00

Slave—>Master: 01 06 00 27 00 02 B8 00

7 Motion control function introduction

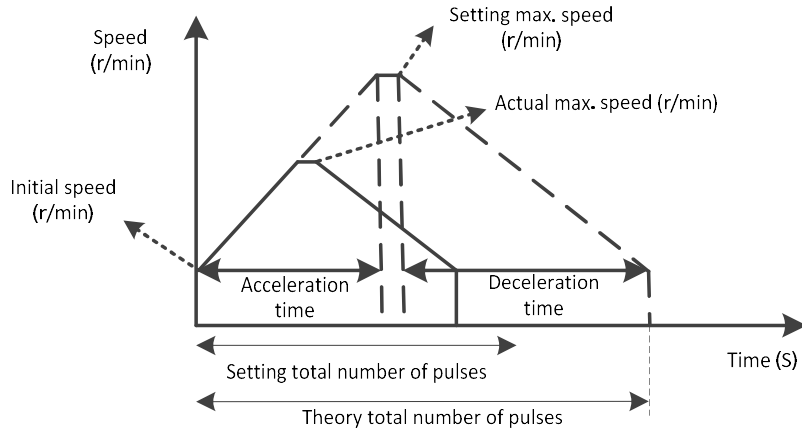
7.1 Position mode

The position mode is realized by trapezoidal acceleration and deceleration curve. Users can set the initial speed (address 0x0020), maximum speed (address 0x0023), acceleration time (address 0x0021), deceleration time (address 0x0022), the total number of pulses (address 0x0024, 0x0025) to achieve precise position control. By controlling the positive and negative of the total number of pulses to change motor rotation direction. Usually when the total number of pulses is positive, the motor is defined as forward. When the total number of pulses is negative, the motor is defined as backward. Trapezoidal acceleration and deceleration curve as shown below.



Position mode acceleration and deceleration curve

When users set a small number of total impulse, motor deceleration may be required before accelerate to maximum speed (that is, in the actual operation of the motor, the motor does not accelerate to user-defined maximum speed). Velocity curve is shown as follow. In the figure, solid lines shown the actual run curves, dotted lines shown the curves needed for speed up to the set maximum speed. Theoretical total number of minimum pulses is calculated in accordance with user-defined parameters (start speed, maximum speed, acceleration time, deceleration time). When a user sets the total number of pulses is less than total number of theory pulse, motor will run in according with the solid line in the following figure.

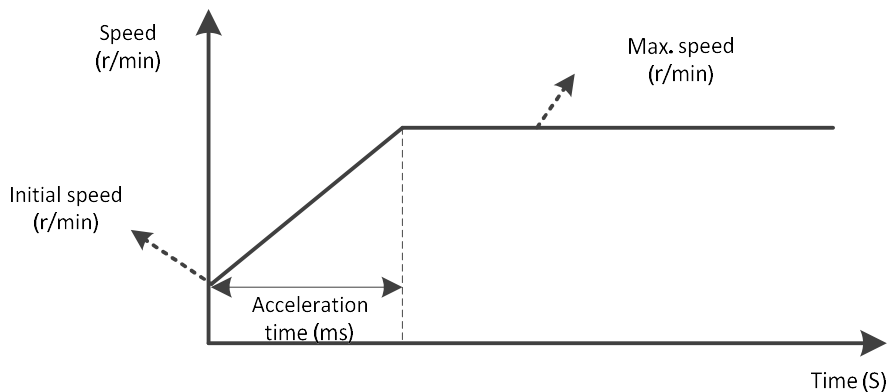


Position model acceleration and deceleration curve (max. speed not reached)

In addition, use the 0027 start command register to control whether to select relative position or absolute position in position mode. For details, please see the description in chapter 7.6.1 Start command.

7.2 Speed mode

The acceleration curve of Speed mode is shown as follow. Different with position mode, in speed mode, you only need to set the start speed (Address 0x0020), acceleration time (Address 0x0021) and maximum speed (Address 0x0023) parameters. Motor will accelerate to maximum speed according to three parameters, then run at a constant speed when it reaches maximum speed. Among them, the positive and negative of maximum speed registers determined motor direction. Usually maximum speed registers is positive, the motor is defined as forward rotate; maximum speed register is negative, the motor is defined as backward rotate.

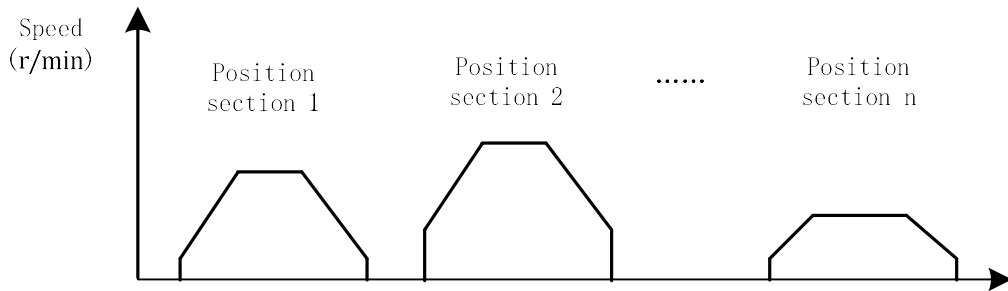


Speed mode accelerate curve

7.3 Multi-position mode

Multi-position mode function is to combine multiple position section in a certain order, trigger movement through external signal, it's a way of work through a series of actions. The function also can treat as a combination of position mode movements in chapter 7.1. The difference is user can save several position parameters (such as deceleration time,

total pulse number) in EEPROM in advance, users only need to set a trigger to complete the motion process. Its work process description is shown as follow.



Multi-position working mode

7.3.1 Position section parameters introduction

As described in the previous section, the user can save the parameters describing a position section in the EEPROM, up to 16 segment positions can be saved now. This section describes the required parameter sets for a position section.

※ Parameter sets for a position section

Parameter name	Function description
Total number of pulses high bit (0x0090~0x009F)	Total number of pulses high bit
Total number of pulses low bit (0x00A0~0x00AF)	Total number of pulses low bit
Run speed (0x00B0~0x00BF)	Run speed of position section
Acceleration and deceleration time (0x00C0~0x00CF)	Acceleration and deceleration time of position section

The above parameters' corresponding MODBUS-RTU communication addresses are listed in 6.1 MODBUS register address definition.

7.3.2 Multi-position control method

Start command and segment selection for multi-position functions can be set via external IO. When using external IO as start command and segment selection, the input terminal function needs to be set. The external terminal start function needs to configure the terminal function as "PT enable signal", and the external terminal segment selection function needs to configure the terminal function as "PIN0 ~ 4", the input terminal can be any choice from X0 ~ X7:

※ Multi-position mode IO configuration

Input terminal	Functional description
X0~X7	PT enable signal
X0~X7	PIN0~PIN4

Select position section according to the binary number composed by PIN0 ~ PIN4, the

corresponding relation is as the following table:

※ **Input terminal position section correspondence**

PIN4	PIN3	PIN2	PIN1	PIN0	Position section
0	0	0	0	0	No selection
0	0	0	0	1	1
0	0	0	1	0	2
0	0	0	1	1	3
0	0	1	0	0	4
0	0	1	0	1	5
0	0	1	1	0	6
0	0	1	1	1	7
0	1	0	0	0	8
0	1	0	0	1	9
0	1	0	1	0	10
0	1	0	1	1	11
0	1	1	0	0	12
0	1	1	0	1	13
0	1	1	1	0	14
0	1	1	1	1	15
1	0	0	0	0	16

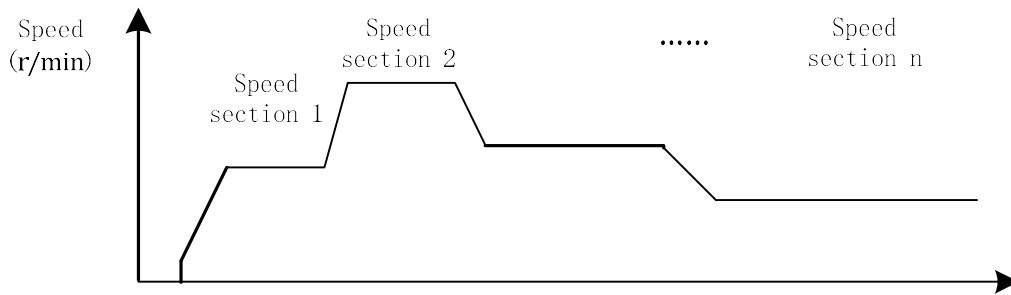


Note:

- When using the PIN terminal to choose position section, the PIN signal should be valid for 5ms before and after "PT (Multi-position) enable signal".
- In multi-position mode, the relative/absolute position register 0x0026 controls whether the position section is relative position or absolute position. The default is relative position.

7.4 Multi-speed mode

Multi-speed mode function is pre-save multiple speed segments, trigger movement by external IO signal, to complete a series of different speed movements. In multi-speed mode, each acceleration / deceleration time is the same as the acceleration/deceleration time parameter (0x00C0 ~ 0x00CF) of multi-position. The value of different segment speeds is set by PV speed segment max speed parameter group (0x00E0~0x00EF). After the parameter modification is completed, it will be automatically saved into EEPROM.



Multi-speed working mode

7.4.1 Speed segment parameter introduction

As mentioned in the previous section, the user can save the parameters describing a speed segment in EEPROM, currently YKD2405PR supports up to 16 speed segments. This chapter describes the required parameter set for speed segment.

※ Parameter group describing speed segment

Parameter name	Function description
Acceleration and deceleration time (0x00C0~0x00CF)	Acceleration and deceleration time between the switch of different speeds
PV mode maximum speed (0x00E0~0x00EF)	The speed of different speed segments

7.4.2 Multi-speed control mode

The start command, direction and segment selection of multi-speed function are completed by external IO trigger. Before using the external IO, you need to set the input terminal function. The external terminal start function needs to configure the terminal function as "PV enable signal", and the external terminal segment select function needs to configure the terminal function as "PIN0 ~ 4", those terminal can be any choice of X0 ~ X7:

※ Multi-speed mode IO configuration

Input terminal	Function description
X0~X7	PV enable signal
X0~X7	PV direction signal
X0~X7	PIN0~PIN4

External terminal segment selection: select the speed segment according to the binary number composed by PIN0 ~ PIN4. The corresponding relationship is as follows:

※ Input terminal of selecting speed segment

PIN4	PIN3	PIN2	PIN1	PIN0	speed segment
0	0	0	0	0	No choice
0	0	0	0	1	1

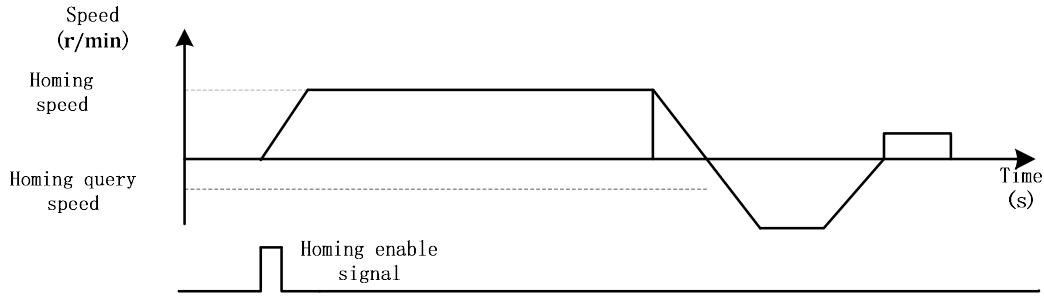
0	0	0	1	0	2
0	0	0	1	1	3
0	0	1	0	0	4
0	0	1	0	1	5
0	0	1	1	0	6
0	0	1	1	1	7
0	1	0	0	0	8
0	1	0	0	1	9
0	1	0	1	0	10
0	1	0	1	1	11
0	1	1	0	0	12
0	1	1	0	1	13
0	1	1	1	0	14
0	1	1	1	1	15
1	0	0	0	0	16

7.5 Homing function

YKD2405PR currently supports two kinds of homing mode, and it need to use the limit signal or the origin signal in the homing process. When using the homing function, user needs to choose input terminal as limit signal or origin signal according to the homing mode selection. At the same time, the homing function can be triggered by external I/O or by MODBUS command. When using external I/O trigger, please enable any input terminal function as "Homing Enable".

- **Position limit + home mode**

The driver starts the motion with "Homing speed (0x0032)" and "Homing acceleration/deceleration time (0x0034)" after receiving the "Homing Enable (0x0030)" command. When it encounters the rising edge of the homing signal, it will decelerate to stop according to the speed of "Homing acceleration/deceleration time (0x0034)", and reverse after stopping. Then the drive stops again when encountering the falling edge of the origin signal. After that, the drive will seek for home at the speed of "Homing query speed (0x0033)". When receiving the rising edge of the origin signal, the drive stops the movement and finishes the process of homing. If the "Homing compensation value (0x0035, 0x0036)" in the function code is not zero, the drive will rotate the motor according to the compensation value. In the process of returning to the origin, if the limit signal is encountered, the motor will reverse according to the upper and lower limit signals. If there is no limit requirement, the limit signal can not be connected.



Position limit + home workflow

- **Position limit mode**

The driver starts the motion with "Homing speed (0x0032)" and "Homing acceleration/deceleration time (0x0034)" after receiving the "Homing Enable (0x0030)" command. When it encounters the rising edge of the position limit signal, it will decelerate to stop according to the speed of "Homing acceleration/ deceleration time (0x0034)", and reverse after stopping. Then the drive stops again when encountering the falling edge of the position limit signal. After that, the drive will seek for home at the speed of "Homing query speed (0x0033)" slowly. When receiving the rising edge of the position limit signal, the drive stops the movement and finishes the process of homing. If the "Homing compensation value (0x0035, 0x0036)" in the function code is not zero, the drive will rotate the motor according to the compensation value.

7.6 Motion control command

7.6.1 Start command (0x0027)

Refer chapter 6.1 MODBUS Register Address Definition Table for the description of 0x0027 register:

Bit0~1: 1: Position mode; 2: Speed mode;

Bit2: 0: Relative position; 1: Absolute position; This bit is valid in position mode.

Bit3~Bit15: Reserved

This register is used to trigger the position and speed movements as well as the control of direction. Which is as follows:

Relative position movement: 01 06 00 27 00 01 F8 01

Absolute position movement: 01 06 00 27 00 05 F9 C2

Speed movement: 01 06 00 27 00 02 B8 00

7.6.2 Stop command (0x0028)

Refer to 6.1 MODBUS Register Address DefinitionTable for description of register 0x0028:

Bit0: 0: Normal stop; 1: Emergency stop;

This register stops the moving motor, stop mode is divided into normal stop and

emergency stop.

Normal stop: 01 06 00 28 00 00 09 C2

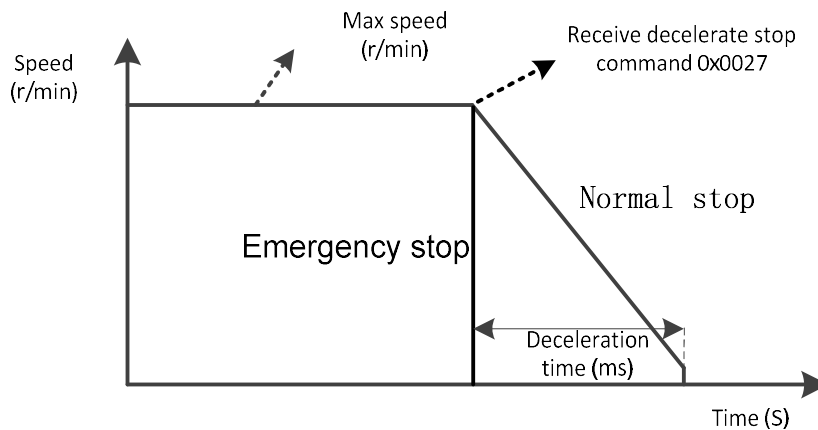
Emergency stop: 01 06 00 28 00 01 C8 02

While the motor is operating in position mode and speed mode, the motor will decelerate and stop according to the set deceleration time (address 0x0022) after it receives the normal stop command (00 28 00 00). After the drive receives emergency stop command (00 28 00 01), it will stop directly without deceleration.



Note:

- The deceleration time parameter needs to be set before the motor runs. If the drive receives the command after the motor starts running, the deceleration time parameter will be executed according to the previous one.



Normal stop and emergency stop

7.6.3 Homing command (0x0030)

Refer to chapter 6.1 MODBUS Register Address Definition Table for the description of register 0x0030:

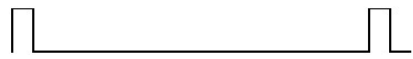
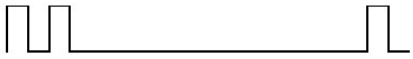
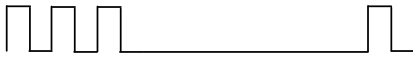
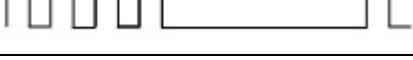

0: Invalid; 1: Valid;

This register is used to trigger the homing function.

Homing command: 01 06 00 30 00 01 48 05

8 Alarm diagnosis

YKD2405PR drive has 5 kinds of alarm information, the alarm indicator flashing several times according to the alarm code, the specific alarm code and treatment as shown in the following table.

Alarm code	Alarm message	Indicator	Reset
Err1: 0x01	Overcurrent or short circuit between phases		Lock motor / re-power to reset
Err2: 0x02	Power supply voltage high		Lock motor / reset automatically
Err3: 0x03	Power supply voltage low		Lock motor / reset automatically
Err4: 0x04	EEPROM read/write error		Can be reset
Err5: 0x05	Position deviation		Repower to reset

9 Version history

Version	Description	Time	Remark
V1.0	First edition	2015.11.12	
V1.1	Revise register table	2016.2.15	
V1.2	Revise typo	2016.8.23	
V1.3	Add the size of the motor, specifications and parameters.	2017/07/07	

10 Warranty and after-sales service

10.1 Warranty

Please keep the box for transportation, storage or return of the product to YAKO for maintenance purposes.

One year warranty:

The warranty is for damage caused by the product within one year of purchasing.

Inapplicability of warranty:

- Improper wiring, power supply voltage and damage caused by user peripheral configuration.
- User changed the drive without written authorization from YAKO.
- Use beyond the electrical and environmental requirements.
- Drive serial number is missing or unreadable.
- Obviously damage of the shell.
- Irresistible disaster.

10.2 After-sales service

When you need product after-sales service support, please call the company's national toll-free service hotline (only Chinese): 400-033-0069

Monday to Friday (except for national holidays) 8: 30-17: 30

YAKO headquarters address : 6B, building B3, Guangming Science and Technology Park, Guangming District, Shenzhen City, P.R. China.

YAKO R&D center : 802A, Languang Building, Nanshan District, Shenzhen City, P.R. China.

Tel : (86) 755-86142288 86142255

Fax : (86) 755-86142266

Web : www.yankong.com

Before you make a call, please record the following information:

- Fault phenomenon
- Product model and serial number
- Installation date or production date