

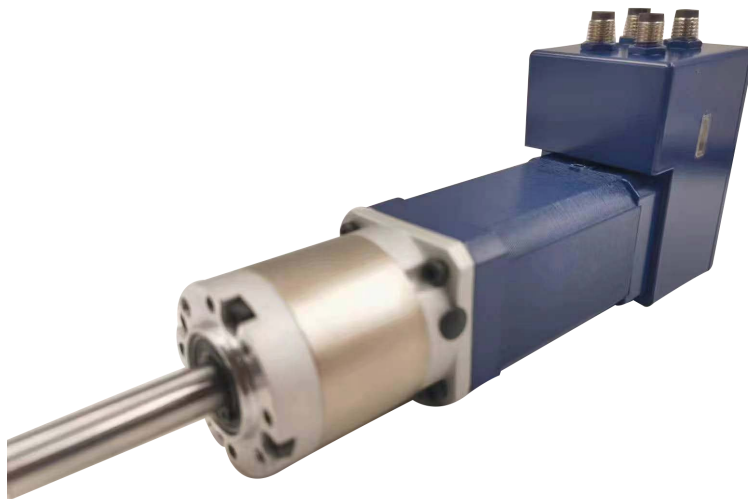
Hardware Technical Manual

PDEC40

Fieldbus: ModbusRTU

For use with the following variants:

PDEC40S PDEC40M PDEC40L



Valid with firmware version FIR-v2213
and since hardware version W002

Technical Manual Version: 1.6.0

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1 Introduction

The PDEC40 series integrated motor is an intelligent integrated drive control DC servo motor.

This manual describes the functions of the controller and the available operating modes. It also shows how you can address and program the controller via the communication interface.

You can find further information on the product on www.yanlanmc.com.

1.1 Version information

Manual version	Date	Changes	Firmware version	Hardware version
1.0.0	06/2018	First edition	FIR-v1748	W002
1.1.0	11/2018	Changes in <u>Limitation of the range of motion</u> and <u>Setting the motor data</u>	FIR-v1825	W002
1.2.0	08/2019	■ New chapter <u>Configuring the sensors</u> ■ Changes and additions in chapter <u>Closed-Loop</u> ■ New sections in chapter <i>Control modes</i>: <u>Controller structure</u>, <u>Feed forward</u>, <u>Assignment of the feedbacks to the control loops</u> and <u>Slow Speed</u> ■ Addition to the connection data for the connectors ■ Minor additions and error corrections in the object dictionary	FIR-v1926	W002
1.3.0	10/2019	Error corrections	FIR-v1939	W002
1.4.0	11/2020	■ New chapter <u>Analog inputs</u> ■ New objects <u>606F_h</u> and <u>6070_h</u> for monitoring the actual speed in <i>Profile Velocity</i> mode ■ New object <u>3250_h:09_h</u> for switching the LEDs on/off ■ New object <u>320E_h:0D_h</u> for setting a voltage feed forward (see <u>Feed forward</u>) ■ New objects <u>320E_h:0F_h</u> and <u>320F_h:05_h</u> for setting the maximum PWM voltage ■ New object <u>4021_h</u> for configuring the ballast circuit	FIR-v2039	W002
1.5.0	09/2021	Additions and error corrections	FIR-v2139	W002
1.6.0	07/2022	Changes in chapter <u>Controller structure</u>: New objects <u>321A_h</u>, <u>321B_h</u>, <u>321C_h</u>, <u>321D_h</u> and <u>321E_h</u> for the control parameters replace <u>320E_h</u>. The current controller in <i>open-loop</i> is now only parameterized in <u>3210_h</u>, object <u>320F_h</u> has been removed. New object <u>230E_h</u> <u>Timer</u>	FIR-v2213	W002

1.2 Copyright, marking and contact

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1.3 Intended use

The PDEC40 Motor is used as a component in drive systems in a wide range of industrial applications.

Use the product as intended within the limits defined in the technical data (in particular, see Permissible operating voltage) and the approved Environmental conditions.

Under no circumstances may this YanLan product be integrated as a safety component in a product or system. All products containing a component manufactured by YanLan must, upon delivery to the end user, be provided with corresponding warning notices including instructions for safe use and safe operation. All warning notices provided by YanLan must be passed on directly to the end user.

1.4 Warranty and disclaimer

YanLan assumes no liability for damages and malfunctions resulting from installation errors, failure to observe this manual or improper repairs. The selection and use of YanLan products is the responsibility of the plant engineer or end user. YanLan accepts no responsibility for the integration of the product in the end system.

Our general terms and conditions at www.yanlan.net apply.



NOTICE

Changes or modifications to the product are not permitted.

1.5 Target group and qualification

The product and this documentation are directed towards technically trained specialists staff such as:

- Development engineers
- Plant engineers
- Installers/service personnel
- Application engineers

Only specialists may install, program and commission the product. Specialist staff are persons who

- have appropriate training and experience in working with motors and their control,
- are familiar with and understand the content of this technical manual,
- know the applicable regulations.

1.6 EU directives for product safety

The following EU directives were observed:

- RoHS directive (2011/65/EU, 2015/863/EU)
- EMC directive (2014/30/EU)

1.7 Other applicable regulations

In addition to this technical manual, the following regulations are to be observed:

- Accident-prevention regulations
- Local regulations on occupational safety

1.8 Used icons

All notices are in the same format. The degree of the hazard is divided into the following classes.

CAUTION	
	The CAUTION notice indicates a possibly dangerous situation. Failure to observe the notice may result in moderately severe injuries. ► Describes how you can avoid the dangerous situation.
NOTICE	
	Indicates a possible incorrect operation of the product. Failure to observe the notice may result in damage to this or other products. ► Describes how you can avoid the incorrect operation.
TIP	
	Shows a tip for the application or task.

1.9 Emphasis in the text

The following conventions are used in the document:

Underlined text indicates cross references and hyperlinks:

- The following bits in object 6041_n (statusword) have a special function:
- A list of available system calls can be found in chapter NanoJ functions in the NanoJ program.

Text set in *italics* marks named objects:

- Read the *installation manual*.
- Use the *Plug & Drive Studio* software to perform the auto setup.
- For software: You can find the corresponding information in the *Operation* tab.
- For hardware: Use the *ON/OFF* switch to switch the device on.

1 Introduction

A text set in `Courier` marks a code section or programming command:

- The line with the `od_write(0x6040, 0x00, 5 );` command has no effect.
- The NMT message is structured as follows: 000 | 81 2A

A text in "quotation marks" marks user input:

- Start the NanoJ program by writing object 2300_h, bit 0 = "1".
- If a holding torque is already needed in this state, the value "1" must be written in 3212_h:01_h.

1.10 Numerical values

Numerical values are generally specified in decimal notation. The use of hexadecimal notation is indicated by a subscript *h* at the end of the number.

The objects in the object dictionary are written with index and subindex as follows: <Index>:<Subindex>

Both the index as well as the subindex are specified in hexadecimal notation. If no subindex is listed, the subindex is 00_h.

Example: Subindex 5 of object 1003_h is addressed with 1003_h:05_h, subindex 00 of object 6040_h with 6040_h.

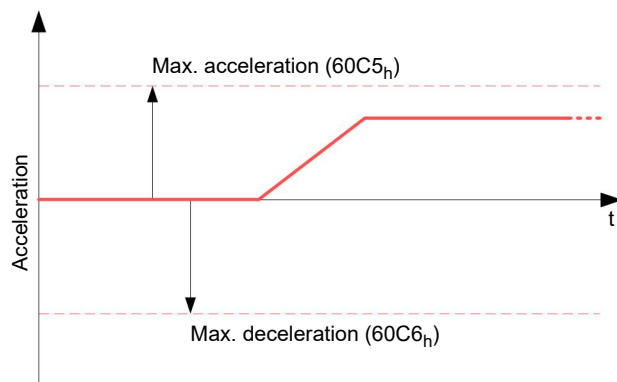
1.11 Bits

The numbering of individual bits in an object always begins with the LSB (bit number 0). See the following figure, which uses data type *UNSIGNED8* as an example.

	MSB				LSB				
Bit Nummer	7	6	5	4	3	2	1	0	
Bits	0	1	0	1	0	1	0	1	$\triangleq 55_{\text{hex}} \triangleq 85_{\text{dec}}$

1.12 Counting direction (arrows)

In figures, the counting direction is always in the direction of an arrow. Objects 60C5_h and 60C6_h depicted as examples in the following figure are both specified as positive.



2 Safety and warning notices

NOTICE



Damage to the controller!

Changing the wiring during operation may damage the controller.

- ▶ Only change the wiring in a de-energized state. After switching off, wait until the capacitors have discharged.

NOTICE



Damage to the controller due to excitation voltage of the motor!

Voltage peaks during operation may damage the controller.

- ▶ Install suitable circuits (e. g., charging capacitor) that reduce voltage peaks.

NOTICE



Damage to the electronics through improper handling of ESD-sensitive components!

The device contains components that are sensitive to electrostatic discharge. Improper handling can damage the device.

- ▶ Observe the basic principles of ESD protection when handling the device.

NOTICE



Damage to the electronics if the supply voltage is connected with reversed polarity!

Polarity reversal results in a short-circuit between supply voltage and GND (earth) via the power diode.

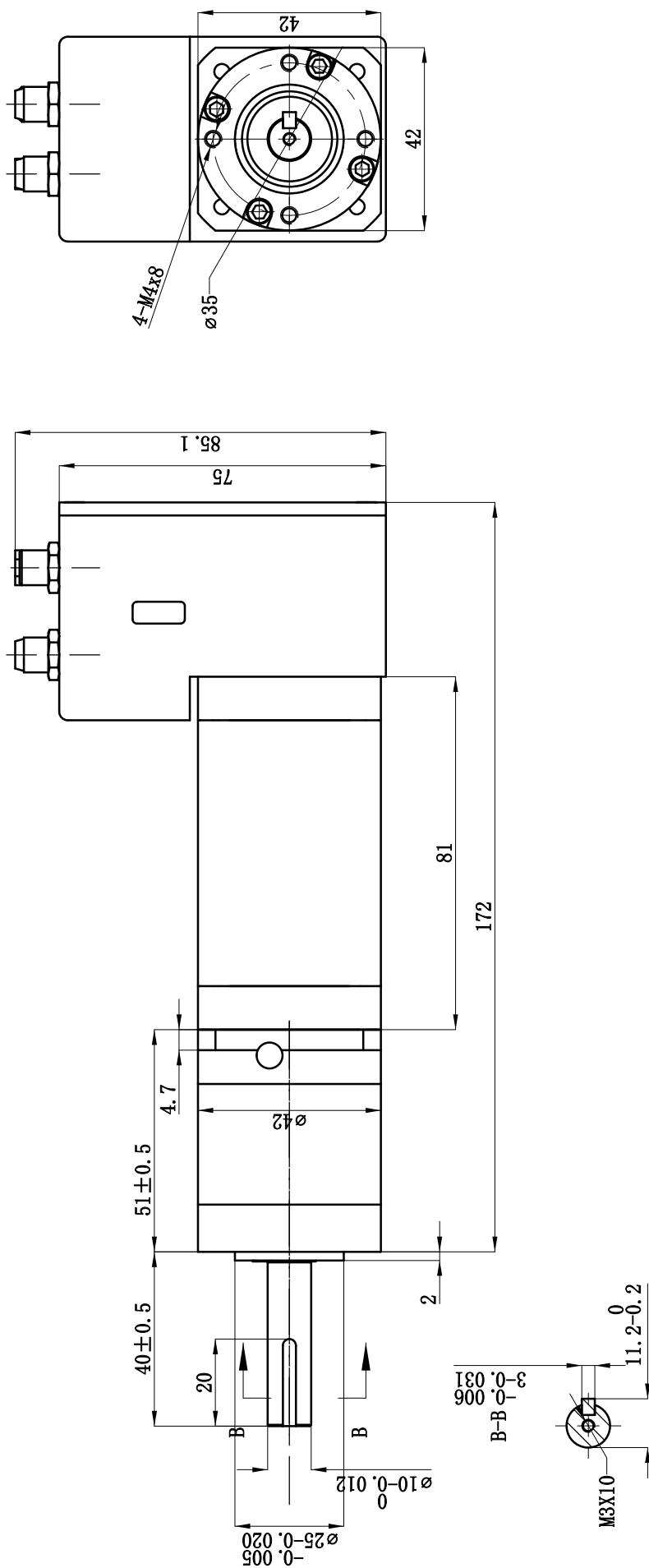
- ▶ Install a line protection device (fuse) in the supply line.

3 Technical details and pin assignment

3.1 Environmental conditions

Environmental condition	Value
Protection class	IP54
Ambient temperature (operation)	-10 ... +40°C
Air humidity (non-condensing)	0 ... 95 %
Max. Altitude of site above sea level (without drop in performance)	1500 m
Ambient temperature (storage)	-20 ... +85°C

3.2 Dimensioned drawings and installation options



3.3 Electrical properties and technical data

Property	Description / value
Operating voltage	12 ... 48 V DC
Rated current	3 A _{rms}
Peak current	for 3 seconds 9 A _{rms}
Commutation	closed loop with encoder
Operating modes	<i>Profile Position Mode, Profile Velocity Mode, Profile Torque Mode, Velocity Mode, Homing Mode, Interpolated Position Mode, Cyclic Sync Position Mode, Cyclic Sync Velocity Mode, Cyclic Synchronous Torque Mode,</i>
Set value setting / programming	<i>IO, Analog</i>
Interfaces	RS485
Inputs	■ 4 inputs, 24 V (inputs 1 to 4) ■ 1 analog input, 10 bit, 0-10 V
Outputs	2 outputs Open drain electrode, (max. 24 V and 100 mA)
Protection circuit	Overvoltage and undervoltage protection Overtemperature protection (> 80° Celsius on the power board) Polarity reversal protection: In the event of a polarity reversal, a short-circuit will occur between supply voltage and GND over a power diode; a line protection device (fuse) is therefore necessary in the supply line. The values of the fuse are dependent on the application and must be dimensioned ■ greater than the maximum current consumption of the controller, ■ less than the maximum current of the voltage supply. If the fuse value is very close to the maximum current consumption of the controller, a medium / slow tripping characteristics should be used.

3.4 Overtemperature protection

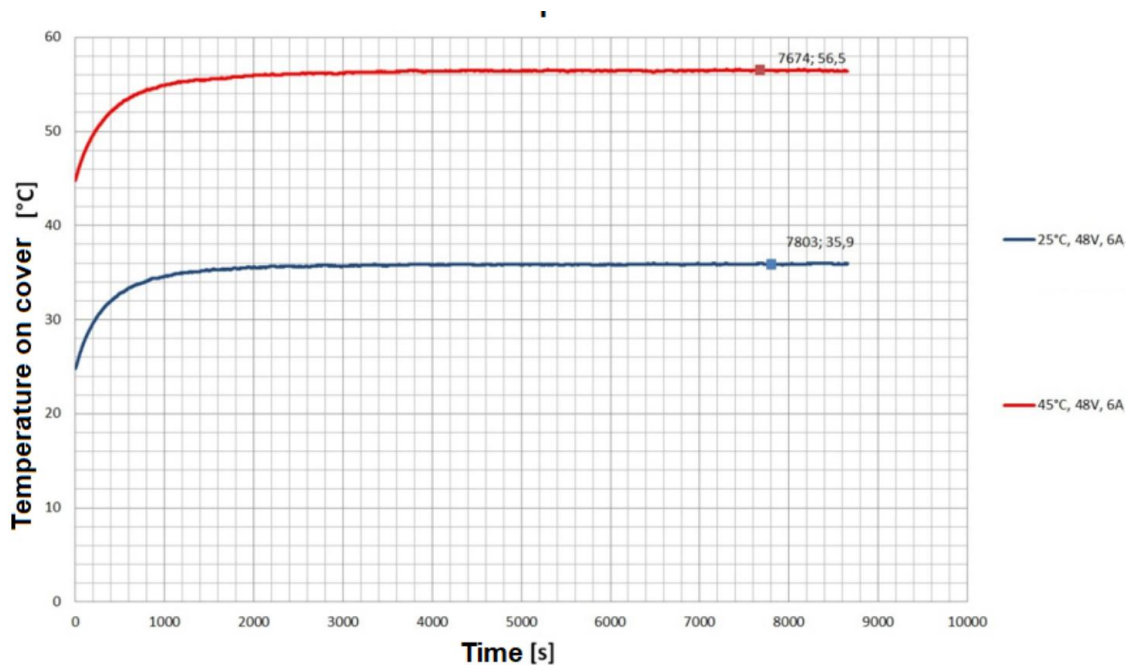
Above a temperature of approx. 80°C on the power board (corresponds to 65–72°C outside on the back cover), the power part of the controller switches off and the error bit is set (see objects 1001_h and 1003_h). After cooling down and confirming the error (see table for the controlword, "Fault reset"), the controller again functions normally.

The following temperature test results provide information on the temperature behavior of this controller.

Temperature tests are performed under the following conditions:

- Operating voltage: 48 V DC
- Motor current: 3 A
- Operation mode: Velocity Mode, full step, 30 rpm
- Ambient temperature: 25 °C / 45 °C
- Altitude of site: 500 m above sea level
- No external cooling in the climatic chamber, e. g., via fan

The following graphic shows the results of the temperature tests:



Summary:

At 25°C (+48 V, 3/3 A rms, Velocity Mode 30 rpm), the controller was in operation for longer than 2 hours without having been switched off. The temperature on the cover was stable at approx. 38°C.

At 45°C (+48 V, 3/9 A rms, Velocity Mode 30 rpm), the controller was in operation for longer than 3 hours without having been switched off. The temperature on the cover was stable at approx. 58°C.

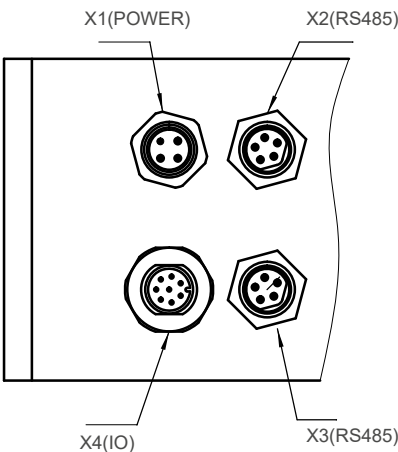
NOTICE



Aside from the motor, the exact temperature behavior is also dependent on the flange connection and the heat transfer there as well as on the convection in the application. For this reason, we recommend always performing an endurance test in the actual environment for applications in which current level and ambient temperature pose a problem.

3.5 Pin assignment

3.5.1 Overview



Connection	Function
X1	Voltage supply
X2	ModbusRTU IN
X3	ModbusRTU OUT
X4	Digital/analog inputs and outputs



NOTICE

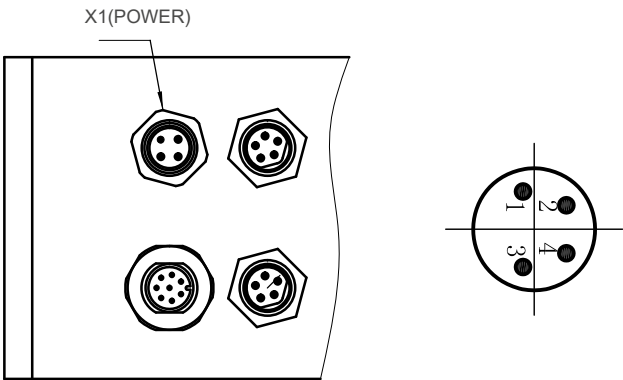
All pins with designation *GND* are internally connected.

3.5.2 X1 – voltage supply

- Type: M8*4 Male
- Mating connector (included in scope of delivery): ZK-M8-4-2M-S Female(or equivalent)

3.5.2.1 Voltage source

The operating or supply voltage supplies a battery, a transformer with rectification and filtering, or a switching power supply.

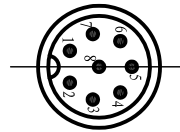
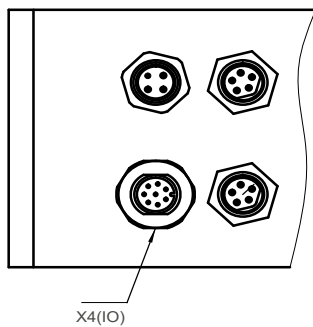


3 Technical details and pin assignment

Pin	Function	Note
1&2	+UB	12 V - 58 V DC, $\pm 5\%$ ZK-M8-4-2M-S BN & WH
3&4	GND	ZK-M8-4-2M-S BU & BK

3.5.3 X4 – inputs and outputs

- Type: M8*8 Male
- Mating connector (included in scope of delivery): ZK-M8-8-2M-S Female (or equivalent)



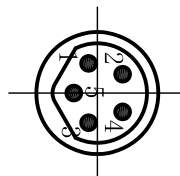
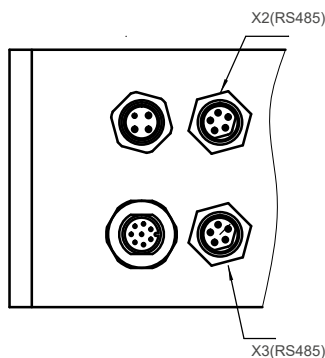
Pin 1 is standard

Pin	Function	Note
1	Digital input 1	24 V signal
2	Digital input 2	24 V signal
3	Digital input 3	24 V signal
4	Digital input 4	24 V signal
5	Analog input	10 bit, 0-10 V
6	Digital output 1	Open drain, maximum 24 V / 100 mA
7	Digital output 2	Open drain, maximum 24 V / 100 mA
8	GND	GND

3.5.4 X2/X3 – ModbusRTU IN and OUT

Type: M8*5 Male

- Mating connector (included in scope of delivery): ZK-M8-5-2M-S Female (or equivalent)



Pin	Function	Note
3	RS485-A	
4	RS485-B	
5	GND	

4 Commissioning

4.1 Configuring via Modbus RTU

Described in the following chapters is how you can establish the communication.

The controller is set to slave address 5ex works , baud rate 19200 baud, even parity, 1 stop bit. All changes take effect only after the controller is restarted.

4.1.1 Communication settings

If you have not connected any rotary switches, set object 2104_h:01_h to the value "0". You set the communication parameters in objects 2028_h, 202A_h and 202D_h.

The following settings can be performed:

Configuration	Object	Value range	Factory settings
Slave address	<u>2028_h</u>	1 to 247	1 or 2
Baud rate	<u>202A_h</u>	7200 to 256000	115200
Parity	<u>202D_h</u>	■ None: 0x00 ■ Even: 0x04 ■ Odd: 0x06	0x00 (None)

The number of data bits is always "8" here. The number of stop bits is dependent on the parity setting:

- No parity: 2 stop bits
- "Even" or "Odd" parity: 1 stop bit

The following baud rates are supported:

- 7200
- 9600
- 14400
- 19200
- 38400
- 56000
- 57600
- 115200
- 128000
- 256000

You must save the changes by writing value "65766173_h" in object 1010_h:0B_h and :02_h. The changes are not taken over until after the controller has been restarted.

4 Commissioning

4.1.2 Preset Function

通过Modbus地址可以控制和读取我们的电机，我们预设的功能表如下：

控制指令表 (PLC-电机)

MODBUS地址	数据类型	功能
6000	UNSIGNED16	0x101: 速度模式 0x202: 绝对定位 0x04: 回零 0x08: 急停 0x10: 报警复位
6001+6002	INTEGER32	目标转速，单位转/分
6003	UNSIGNED16	回零模式 1: 堵转回零CW 2: 堵转回零CCW 3: 感应器找零CW 4: 感应器找零CCW
6004+6005	UNSIGNED32	加速度
6006+6007	UNSIGNED32	减速度
6008+6009	INTEGER32	目标位置
6010+6011	UNSIGNED32	定位模式速度
6012+6013	UNSIGNED32	回零速度
6014+6015	UNSIGNED32	调零速度
6016+6017	UNSIGNED32	堵转找零电流

注意: 32位数据, 6016 (高16位) +6017 (低16位)

状态指令表 (电机-PLC)

MODBUS地址	数据类型	功能
5000+5001	INTEGER32	实时速度
5002+5003	INTEGER32	实时位置
5004	UNSIGNED16	自定义状态: 1: 停止 2: 运行 3: 错误 4: 负极限 5: 正极限
5005	UNSIGNED16	错误代码
5006	UNSIGNED16	系统状态字
5007+5008	UNSIGNED32	数字输入

状态指令表 (电机-PLC)

MODBUS地址	数据类型	功能
5009+5010	INTEGER32	实时电流

5 Error Code**138Dh Error Code****Function**

This object returns the error code of the last error that occurred.

Error Code[16]

Refer to the following table for the meaning of the bytes.

Error Code	Description
1000 _h	General error
2300 _h	Current at the controller output too large
3100 _h	Overvoltage/undervoltage at controller input
4200 _h	Temperature error within the controller
5440 _h	Interlock error: Bit 3 in 60FD _h is set to "0", the motor may not start (see the section <i>Interlock function</i> in the chapter Digital inputs)
6010 _h	Software reset (watchdog)
6100 _h	Internal software error, generic
6320 _h	Rated current must be set (203B _h ;01 _h /6075 _h)
7110 _h	Error in the ballast configuration: Invalid/unrealistic parameters entered (see Ballast monitoring)
7113 _h	Warning: Ballast resistor thermally overloaded
7121 _h	Motor blocked
7200 _h	Internal error: Correction factor for reference voltage missing in the OTP
7305 _h	Sensor 1 (see 3204 _h) faulty
7306 _h	Sensor 2 (see 3204 _h) faulty
7307 _h	Sensor n (see 3204 _h), where n is greater than 2
Error Code	Description
7600 _h	Warning: Nonvolatile memory full or corrupt; restart the controller for cleanup work
8100 _h	Error during fieldbus monitoring
8130 _h	CANopen only: "Life Guard" error or "Heartbeat" error
8200 _h	CANopen only: Slave took too long to send PDO messages.
8210 _h	CANopen only: PDO was not processed due to a length error
8220 _h	CANopen only: PDO length exceeded
8240 _h	CANopen only: unexpected sync length
8400 _h	Error in speed monitoring: slippage error too large
8611 _h	Position monitoring error: Following error too large
8612 _h	Position monitoring error: Limit switch exceeded