AMPSTech | Shenzhen AMPS Intelligent Technology Co.,Ltd.

L2DB Series Servo Hub Driver User Manual V3.0

Content

1. Naming Rule

1.1 Drive Model Naming Rules

L2DB 48 30-CA FC-ASL3

① ② ③ ④ ⑤ ⑥

①series

LSDB: Single-drive servo hub drive

L2DB: One tow and two twin drive servo hub drives

②Voltage level

48:Input voltage range 20~56V

24:Input voltage range 18~30V

③Peak current

30:Peak current 30Ap, continuous current 10Arms

75:Peak current 75Ap, continuous current 15Arms

④Types of feedback supported on the hardware

CA: Communication magnetic encoders

⑤Communication bus

FR: RS485 + UART

FC: CAN + UART

⑥Factory functional formulation

This 4-digit code is used as the factory default function configuration code of the driver, including motor parameters, control ring parameters, I/O functions, communication function parameters and other configurations. Many of these formulations come from the customer's field application needs, in order to facilitate the customer's use, as much as possible so that the customer can meet their field use as soon as the driver is obtained, without the need to configure the relevant parameters.

1.2 Motor naming rules

WA	60	L	-	13A	280	D	-	M	U	H	B	05
①	②	③		④	⑤	⑥		⑦	⑧	⑨	⑩	⑪

①series

WA：Servo hub motor with reducer

WS：Direct drive servo hub motor

②size

55：5.5inch

65：6.5 inch

60：6 inch

80：8 inch

95：9.5 inch

A0：10 inch

C0：12 inch

③Motor type

L：Hub motor

④Rated torque

05A：5Nm

07A：7Nm

13A：13Nm

15A：15Nm

30A：30Nm

⑤Rated speed

170：170rpm

280：280rpm

480：480rpm

⑥Rated voltage

B：24V

C：36V

D：48V

⑦Encoder type

M：Hub Driver Communication Encoder (2*2 3.0 Plug)

⑧Tire type

U: Black rubber non-inflatable tires

G: Polyurethane-coated tires

A: Inflatable tires

R: Rubber-clad tires

S: Grey non-marking rubber non-inflatable tires

Z: Grey non-marking coated rubber tires

⑨Whether it is with a brake

A: No holding gate and no oil seal
B: With holding gate without oil seal
C: The shaft end is sealed without a brake
D: The end of the refueling sealing shaft with the brake is not beaten
F: No brake shaft end without brake
G: It does not come with a brake shaft end hit
H: With manual holding brake

⑩Shaft type

A: Standard flat shaft
B: 45mm double flat threaded single out shaft
E: 45mm threaded double outlet shaft

⑪Line length

03：0.3m
05：0.5m
10：1.0m

1.3 Drive basic properties

Driver model	L2DB4830-CAFX-XXXX	L2DB4875-CAFX-XXXX
Rated Input Voltage (V)	Support 20~56VDC	
Maximum Continuous Output Current (Arms)	10 (single axis).	15 (single axis).
Peak Current (Ap)	30 (single axis)	75（single axis）
Supported motor types	Servo hub motor (can drive 2 axes)	
Encoder types are supported	12-bit Communication Magnetoelectric Encoder (4096 Resolution)	
DIN quantity	DIN1、DIN2Not defined,DIN3 is an emergency stop	
DOUT1 function	Alarm output	
Types of communications	UART+RS485 （Supported by L2DB4830-CAFR-XXXX, L2DB4875-CAFR-XXXX） UART+CAN （Supported by L2DB4830-CAFC-XXXX, L2DB4875-CAFC-XXXX）	
UART Porter rate	115200bps，Support controller or computer control	
RS485 baud rate	38400bps/115200bps Select by switching SW2-8 L2DB4830-CAFR-XXXX、L2DB4875-CAFR-XXXX	
CAN Baud rate	500kbps/1Mbps 通过开关 SW2-8 选择 Supported by L2DB4830-CAF**C**-XXXX、 L2DB4875-CAF**C**-XXXX	
Protection function	Overvoltage protection, undervoltage protection, motor overheating (I^2T) protection, Short-circuit protection, drive overheating protection, etc	
Operating temperature	-10℃～40℃(No freezing)	
Operating humidity	5～95%RH(No condensation)	
Storage temperature	-10℃～70℃(No freezing)	

Storage humidity	Below 90% RH (no condensation)

1.4 WS series direct drive servo hub motor and drive configuration

Driver model	Types of communications	Hub motor model	Wheel diameter	Rated torque	Maximum torque
L2DB4830-CAFC-ASL3	CAN+UART	WS55L-07A250C-MUCA03 WS65L-07A250C-MUCA03 WS80L-07A250C-MUCA03	140mm 170mm 200mm	7Nm	18Nm
L2DB4830-CAFR-ASL3	RS485+UART				
L2DB4830-CAFC-ASM4	CAN+UART	WS80L-10A150C-MUCA03	200mm	10Nm	24Nm
L2DB4830-CAFR-ASM4	RS485+UART				
L2DB4830-CAFC-ASM5	CAN+UART	WS55L-15A110C-MUCA03 WS80L-15A110C-MUCA03	140mm 200mm	15Nm	24Nm
L2DB4830-CAFR-ASM5	RS485+UART				
L2DB4875-CAFC-ASH8	CAN+UART	WS80L-30A250D-MGGA10 WSA0L-30A250D-MFGA05 WSC0L-30A250D-MFGA05	200mm 243mm 315mm	30Nm	60Nm
L2DB4875-CAFR-ASH8	RS485+UART				

1.5 WA series with reducer servo hub motor and drive configuration

Driver model	Types of communications	Hub motor model	Wheel diameter	Rated torque	Maximum torque
L2DB4875-CAFC-AAC3	CAN+UART	WA60L-13A280D-MRAB05 WA80L-13A280D-MUAB05 WA80L-13A280D-MRAB05	160mm 203mm 200mm	13Nm	60Nm
L2DB4875-CAFR-AAC3	RS485+UART	WA80L-13A280D-MGAB05 WA95L-13A280D-MUAB05 WAC0L-13A280D-MUAB05 WAC0L-13A280D-MAAB05	198mm 238mm 300mm 320mm		
L2DB4875-CAFC-AAB3	CAN+UART	WA60L-13A280D-MRHB05 WA60L-13A280D-MGHB05 WA80L-13A280D-MUHB05	158mm 159mm 203mm	13Nm	60Nm

L2DB4875-CAFR-AAB3	RS485+UART	WA80L-13A280D-MGAB05 WA95L-13A280D-MUHB05 WAC0L-13A280D-MUHB05	198mm 238mm 300mm		
L2DB4875-CAFC-AAC5	CAN+UART	WA60L-15A170D-MRAB05 WA80L-15A170D-MUAB05 WA80L-15A170D-MRAB05 WA80L-15A170D-MGAB05 WA95L-15A170D-MUAB05 WAC0L-15A170D-MUAB05 WAC0L-15A170D-MAAB05	160mm 203mm 200mm 198mm 238mm 300mm 320mm	15Nm	60Nm
L2DB4830-CAFC-AAC5 (Peak torque40Nm)	CAN+UART				
L2DB4875-CAFR-AAC5	RS485+UART				
L2DB4875-CAFC-AAB5	CAN+UART	WA60L-15A170D-MRHB05 WA60L-15A170D-MGHB05 WA80L-15A170D-MUHB05 WA95L-15A170D-MUHB05 WAC0L-15A170D-MUHB05	158mm 159mm 203mm 238mm 300mm	15Nm	60Nm
L2DB4875-CAFR-AAB5	RS485+UART				

2. Motor characteristics

2.1 WS series direct drive servo hub motor characteristics

2.1.1 WS series direct drive servo hub motor parameter table

Category	5.5 inches 7 Nm	6.5 inches 7 Nm	8 inches 7 Nm	8-inch 7Nm omnidirectional wheels
Outside Diameter	140mm	170mm	200mm	213.8mm
Rated Voltage	DC 20-56V			
Rated Current	7Arms			
Maximum Speed	The maximum speed is 250rpm 5.5 inches maximum travel speed 1.8m/s 6.5 inches maximum travel speed 2.2m/s 8 inches maximum running speed 2.6m/s			
RatedTorque	7Nm			
Peak Torque	18Nm			
Insulation Resistance	≥200MΩ			
High voltage	600VDC 1SEC 10mA			
RoHS	RoHS			
Characteristic Curve	For details, please refer to "WS Series 7Nm Wheel Characteristic Curve"			
External Apperance	For details, see "5.5-inch hub motor installation size"	For details, see "6.5-inch hub motor installation dimensions"	For details, please refer to "8 inch 7Nm hub motor installation dimensions"	For details, please refer to "8-inch 7Nm hub motor (omnidirectional wheel) installation dimensions"
Operating Temperature	10℃～40℃(No freezing)			

Working Humidity	5～95%RH(No condensation)
Stored Temperature	-10℃～70℃(No freezing)
Storage Humidity	Below 90% RH (no condensation)
Protection level	IP67 (except shaft end)

Category	5.5 inches 15 Nm	5.5 inches 15 Nm (24V winding)	8 inches 15 Nm	8 inches 15 Nm (24V winding)
Outside Diameter	140mm		200mm	
RatedVoltage	DC 20-56V			
RatedCurrent	7.4Arms	12Arms	7.4Arms	12Arms
MaximumSpeed	The maximum speed at 36V is 110rpm, and the maximum walking speed is 0.8m/s	Maximum speed 150rpm, The maximum travel speed is 1.1m/s	The maximum speed is 110rpm, The maximum travel speed is 1.1m/s	Up to 150rpm, The maximum running speed is 1.6m/s
RatedTorque	15Nm	15Nm	15Nm	15Nm
Peak Torque	24Nm	20Nm	24Nm	20Nm
InsulationResistance	≥200MΩ			
High voltage	600VDC 1SEC 10mA			
RoHS	RoHS			
Characteristic Curve	For details, please refer to "WS Series 15Nm Wheel Characteristic Curve"	For details, see "WS Series 15Nm (24V Winding) Hub Characteristic Curve"	For details, please refer to "WS Series 15Nm Wheel Characteristic Curve"	For details, please refer to " WS Series 15Nm (24V Winding) Hub Characteristic Curve"
ExternalApperance	For details, please refer to "5.5-inch 15Nm hub motor installation size"		For details, please refer to "8 inch 15Nm hub motor installation size"	
Operating Temperature	10°C~40°C (non-freezing)			
Working Humidity	5~95%RH (no condensation.)			
Stored Temperature	-10°C~70°C (non-freezing)			
Storage Humidity	Below 90% RH (no condensation)			
Protection level	IP67 (except shaft end)			

Category	8 inches 30 Nm	10 inch 30 Nm	12 inches 30 Nm
RatedVoltage	48VDC		
RatedCurrent	15Arms		
MaximumSpeed	The maximum speed is 250rpm The maximum travel speed is 2.6m/s	The maximum speed is 250rpm The maximum travel speed is 3.1m/s	The maximum speed is 250rpm The maximum travel speed is 4.1m/s
RatedTorque	30Nm		
Peak Torque	60Nm		
InsulationResistance	≥200MΩ		
High voltage	600VDC 1SEC 10mA		
RoHS	RoHS		
Characteristic Curve	For details, please refer to the "8-inch 30Nm characteristic curve diagram"	For details, see "10-inch 30Nm characteristic curve"	For details, see "12-inch 30Nm characteristic curve"
ExternalApperance	For details, please refer to "8-inch 30Nm hub motor installation dimensions"	For details, please refer to "10-inch 30Nm hub motor installation size"	For details, please refer to "12-inch 30Nm hub motor installation dimensions"
Operating Temperature	10°C~40°C (non-freezing)		
Working Humidity	5~95%RH (no condensation)		
Stored Temperature	-10°C~70°C (non-freezing)		
Storage Humidity	Below 90% RH (no condensation)		
Protection level	IP67 (except shaft end)		

2.1.2 WS series 7Nm wheel characteristic curve

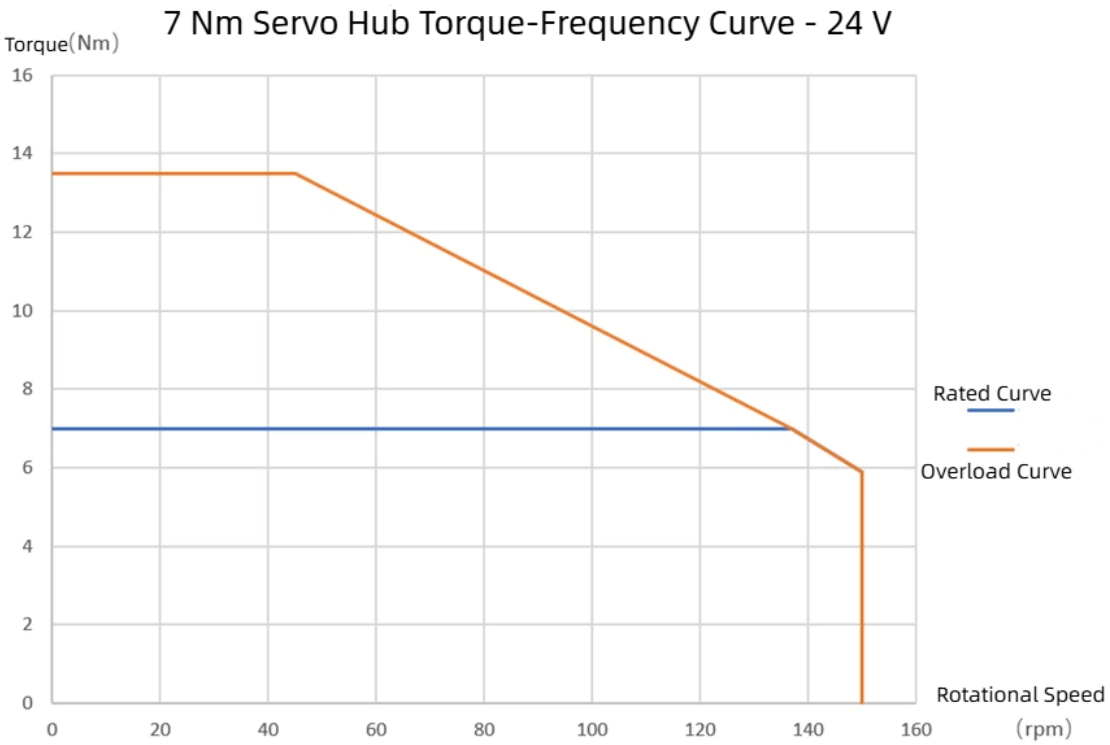


Fig. 2.1.2-1 24V characteristic curve of WS series 7Nm hub motor

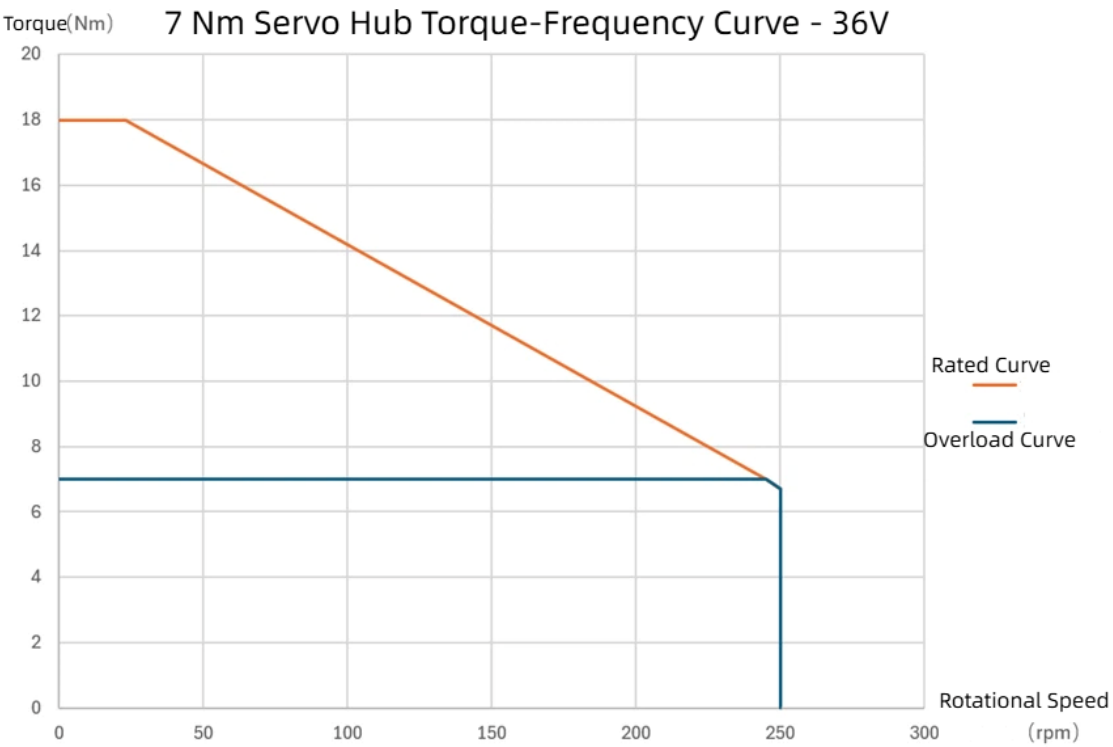


Fig. 2.1.2-2 36V characteristic curve of WS series 7Nm hub motor

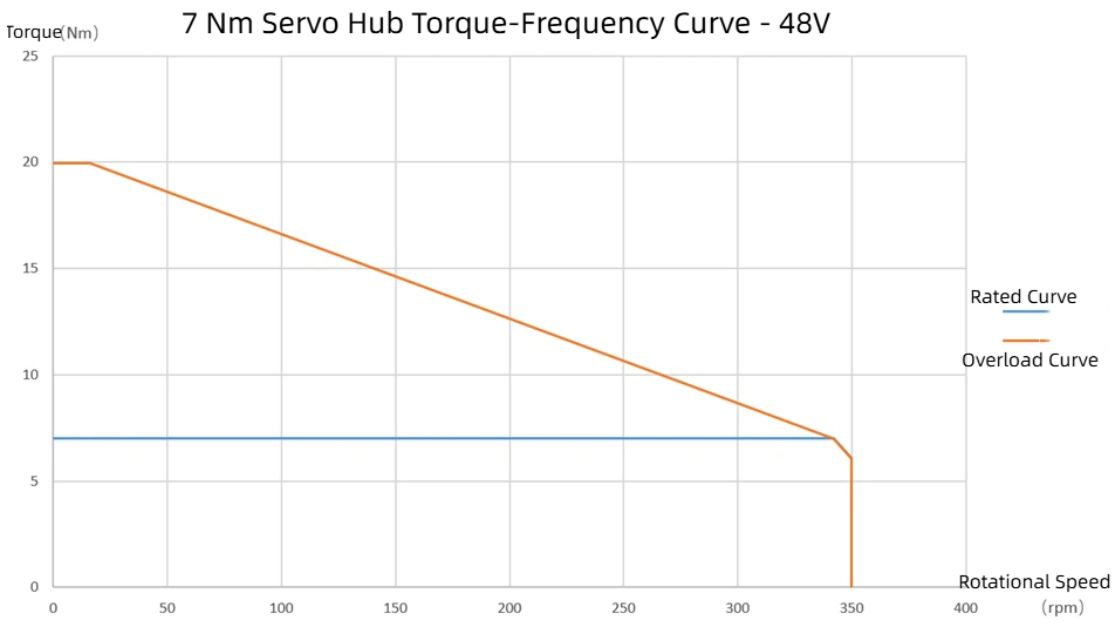


Fig. 2.1.2-3 Characteristic curve of 48V of WS series 7Nm hub motor

2.1.3 WS series 15Nm wheel characteristic curve

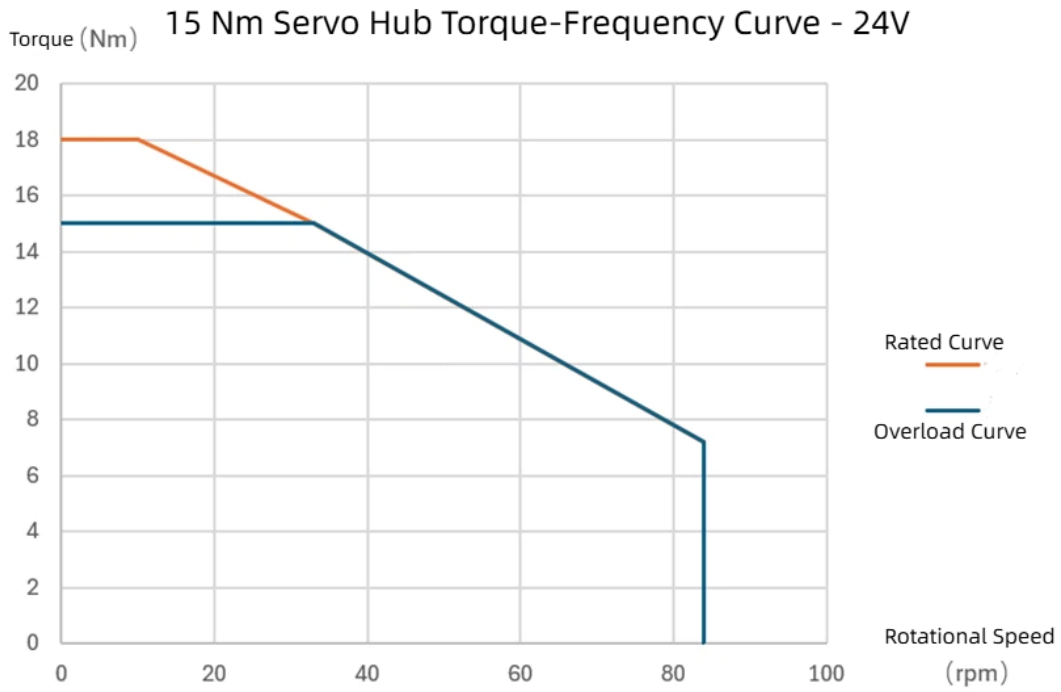


Fig. 2.1.3-1WS series 15Nm hub motor 24V characteristic curve

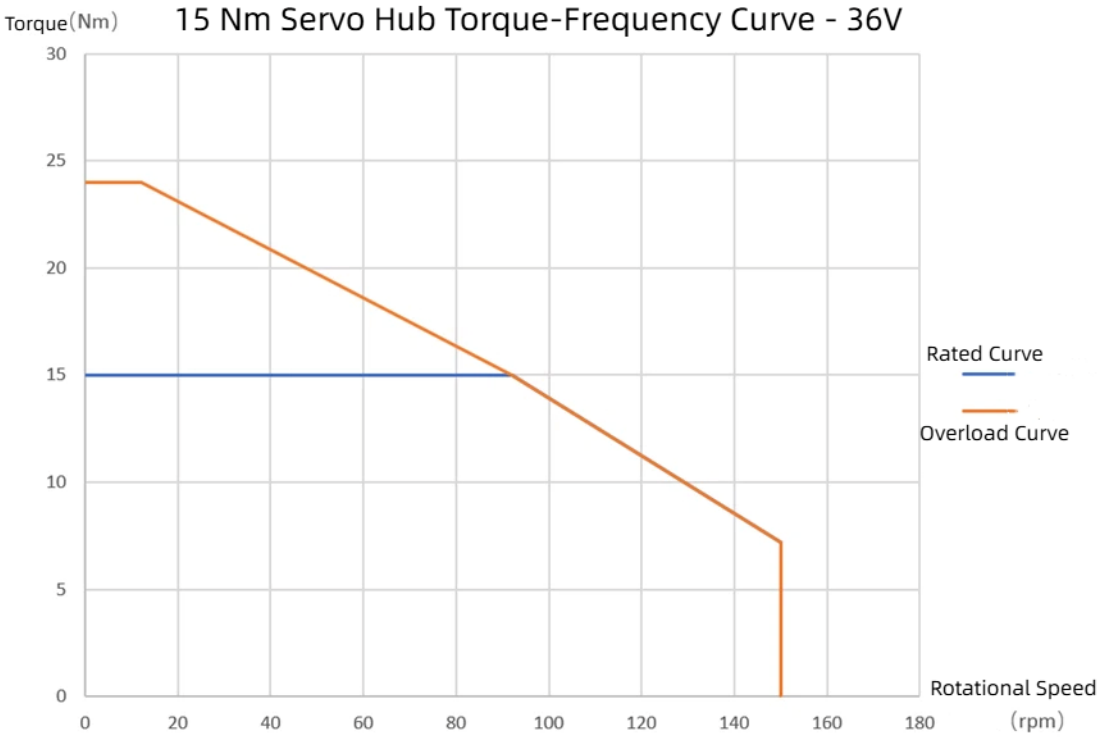


Fig. 2.1.3-2 36V characteristic curve of WS series 15Nm hub motor

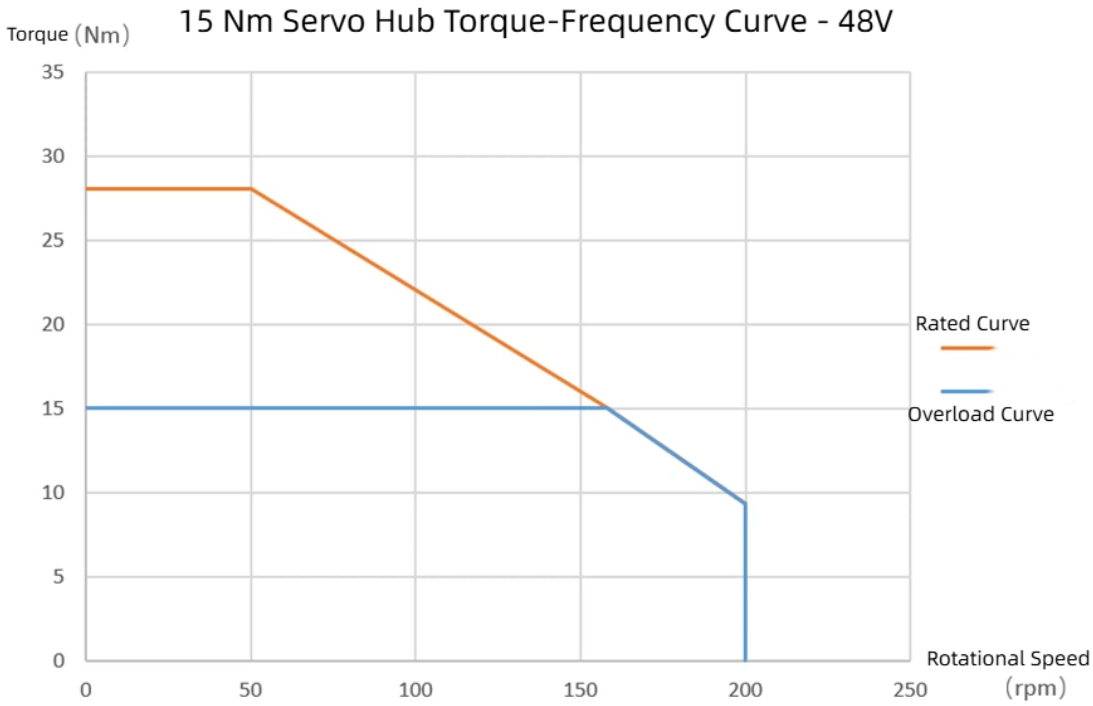


Fig. 2.1.3-3 48V characteristic curve of WS series 15Nm hub motor

2.1.4 WS series 15Nm (24V wound) hub characteristic curve

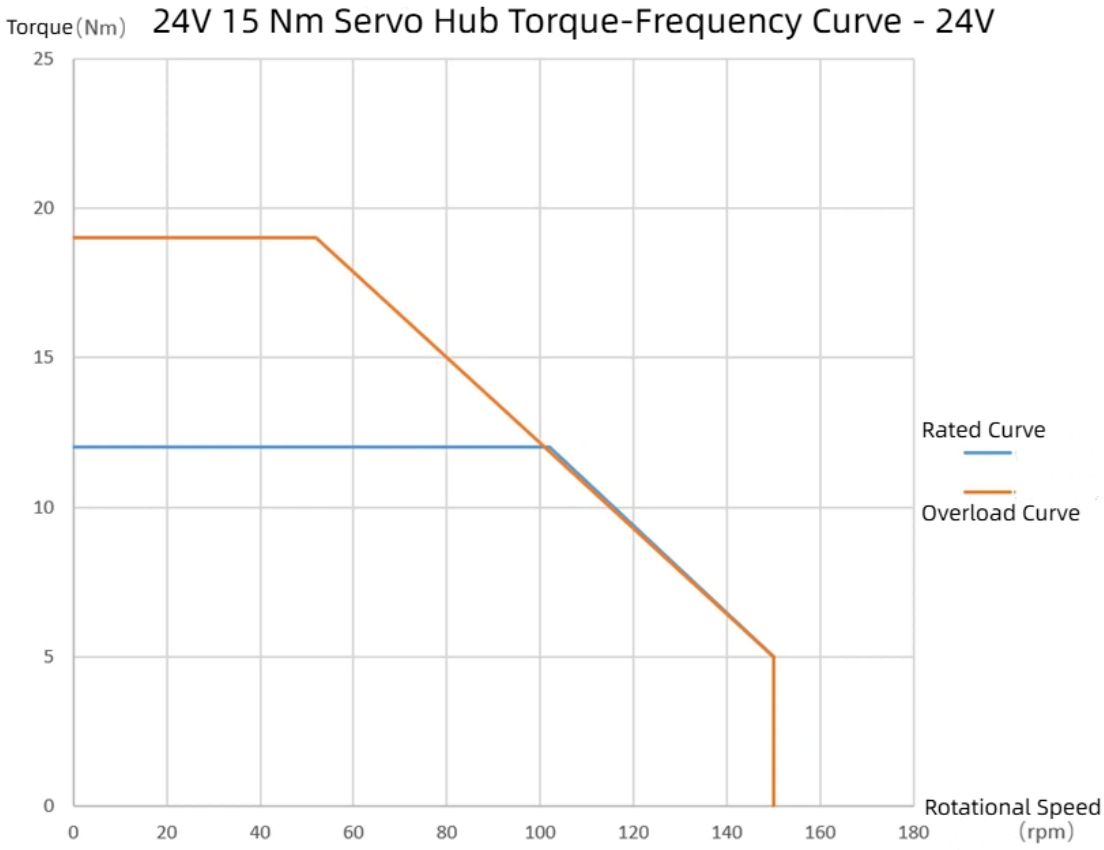


Fig. 2.1.4-1 24V characteristic curve of WS series 15Nm (24V wound) hub motor

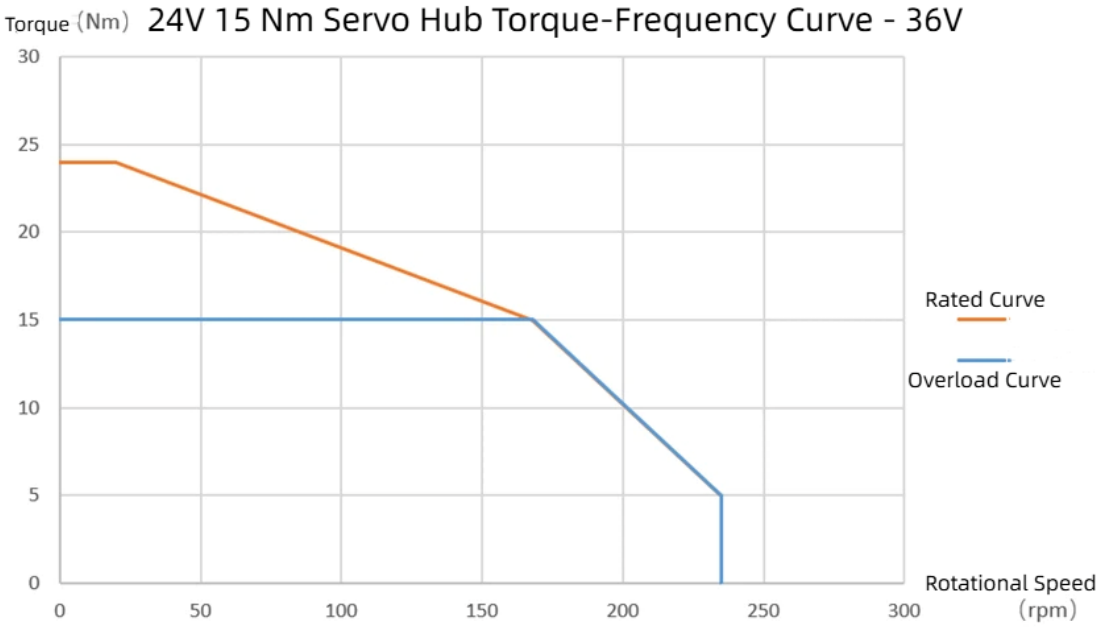


Fig. 2.1.4-2 36V characteristic curve of WS series 15Nm (24V wound) hub motor

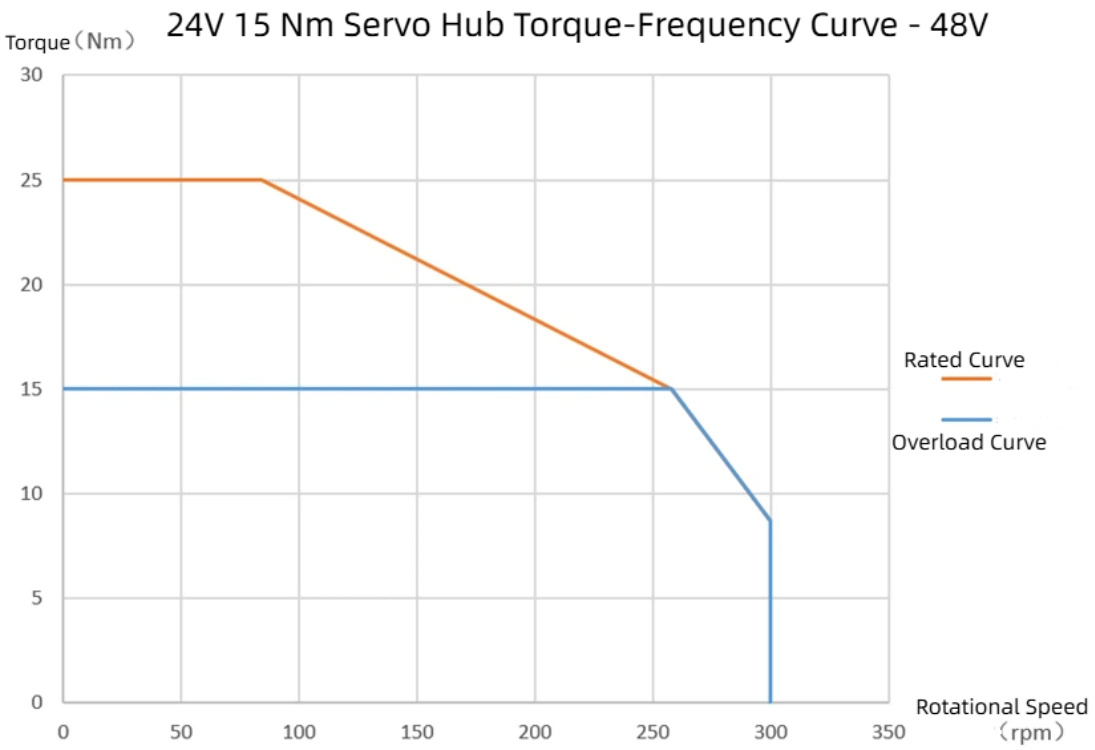


Figure 2.1.4-3 48V characteristic curve of WS series 15Nm (24V wound) hub motor

2.1.5 WS series 30Nm wheel characteristic curve

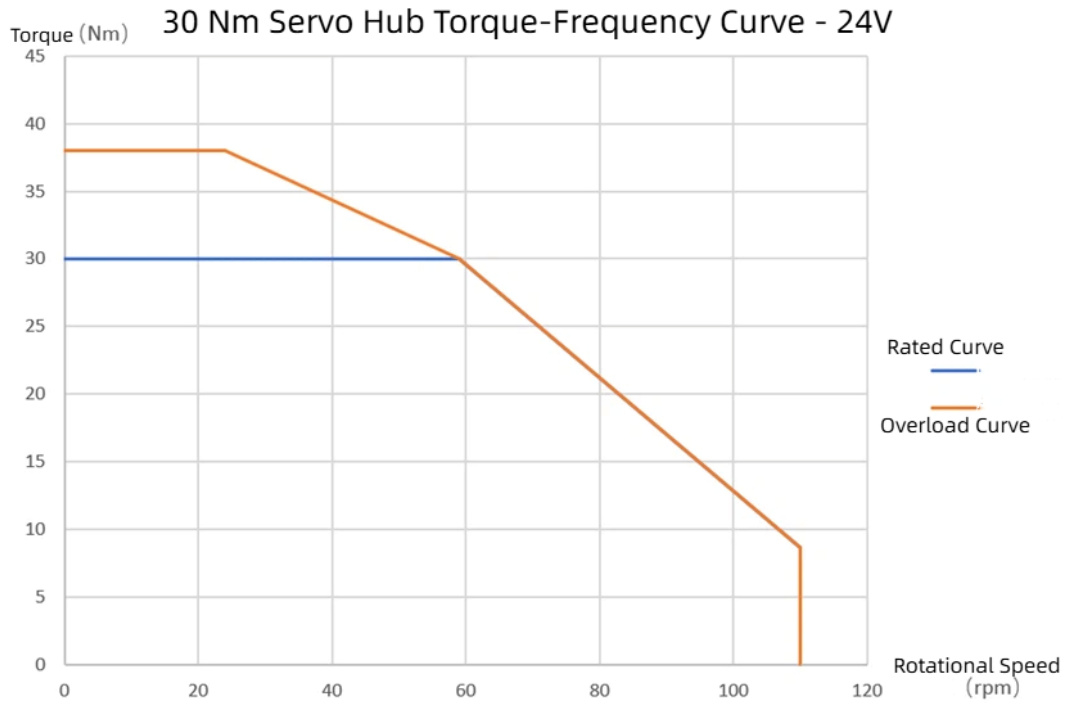


Figure 2.1.5-1WS series 30Nm hub motor 24V characteristic curve

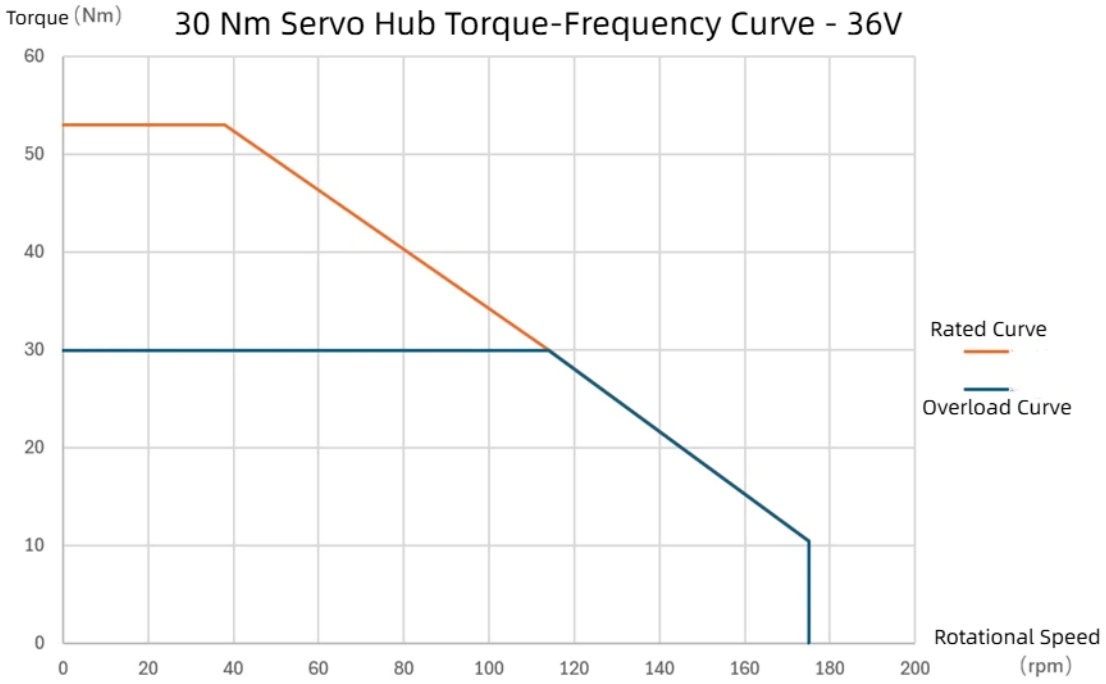


Figure 2.1.5-2 36V characteristic curve of WS series 30Nm hub motor

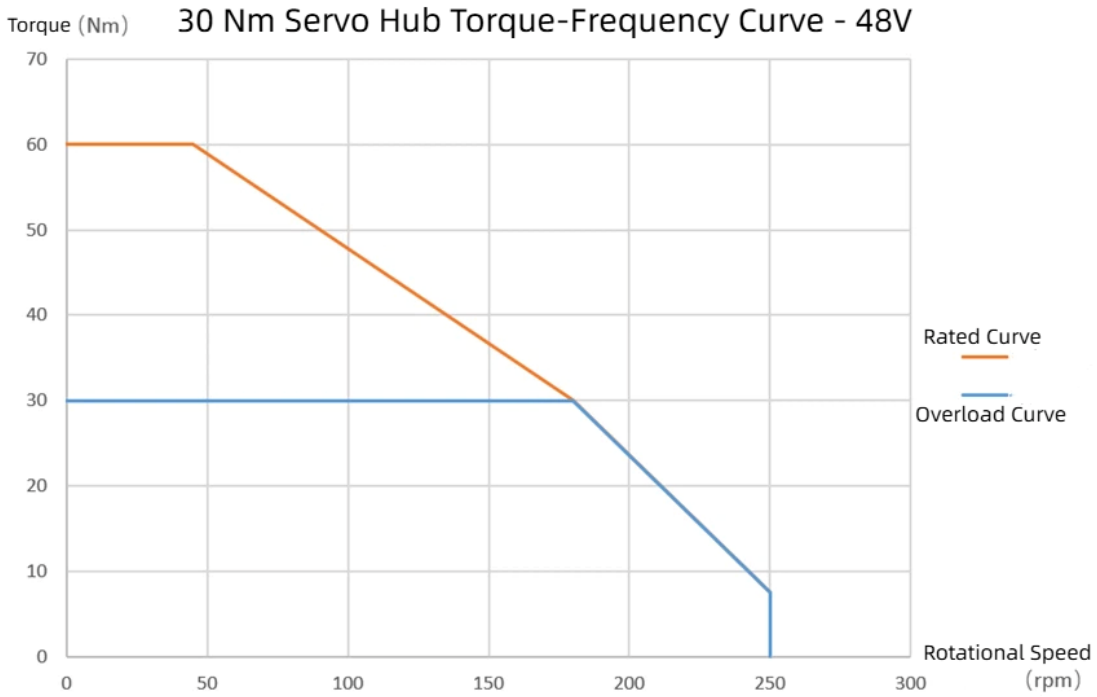


Fig. 2.1.5-3 48V characteristic curve of WS series 30Nm hub motor

2.2 WA series with reducer servo hub motor characteristics

2.2.1 WA series with reducer servo hub motor parameter table

Category	6 inches 13 Nm	8 inches 13 Nm	9.5 inch 13 Nm	12 inches 13 Nm
Rated Voltage	DC 48V			
Rated Current	10.2Arms			
Rateimum Speed	280rpm			
RatedTorque	13Nm			
Peak Torque	60Nm			
speed ratio	1:5.23			
pole pair	10			
Encoder resolution	12bit			
Characteristic Curve	For details, please refer to the "WA Series 13Nm Hub Motor Characteristic Curve"			
External Apperance	See "3.2.1-3.2.3" for details	See "3.2.4-3.2.7" for details	See "3.2.8-3.2.9" for details	See "3.2.10-3.2.12" for details
Operating Temperature	10°C~40°C (non-freezing)			
Working Humidity	5~95%RH (no condensation)			
Stored Temperature	-10°C~70°C (non-freezing)			
Storage Humidity	Below 90% RH (no condensation)			
Protection level	IP67 (except shaft end)			

Category	6 inches 15 Nm	8 inches 15 Nm	9.5 inch 15 Nm	12 inches 15 Nm
RatedVoltage	DC 48V			
RatedCurrent	7.5Arms			
RateimumSpeed	170rpm			
RatedTorque	15Nm			
Peak Torque	60Nm			
speed ratio	1:5.23			
pole pair	10			
Encoder resolution	12bit			
Characteristic Curve	For details, please refer to "WA Series 15Nm Hub Motor Characteristic Curve"			
ExternalApperance	See "3.2.1-3.2.3" for details	See "3.2.4-3.2.7" for details	See "3.2.8-3.2.9" for details	See "3.2.10-3.2.12" for details
Operating Temperature	10°C~40°C (non-freezing)			
Working Humidity	5~95%RH (no condensation)			
Stored Temperature	-10°C~70°C (non-freezing)			
Storage Humidity	Below 90% RH (no condensation)			
Protection level	IP67 (except shaft end)			

2.2.2 WA series 13Nm wheel characteristic curve

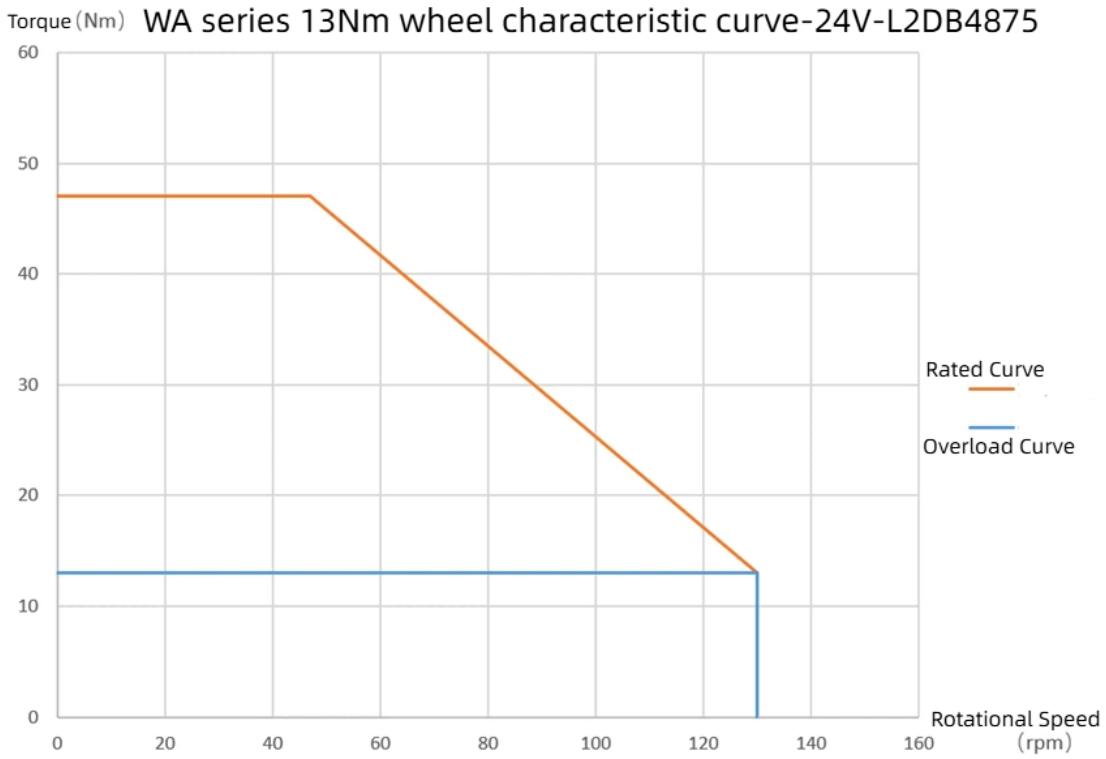


Figure 2.2.1-1 24V characteristic curve of WA series 13Nm hub motor

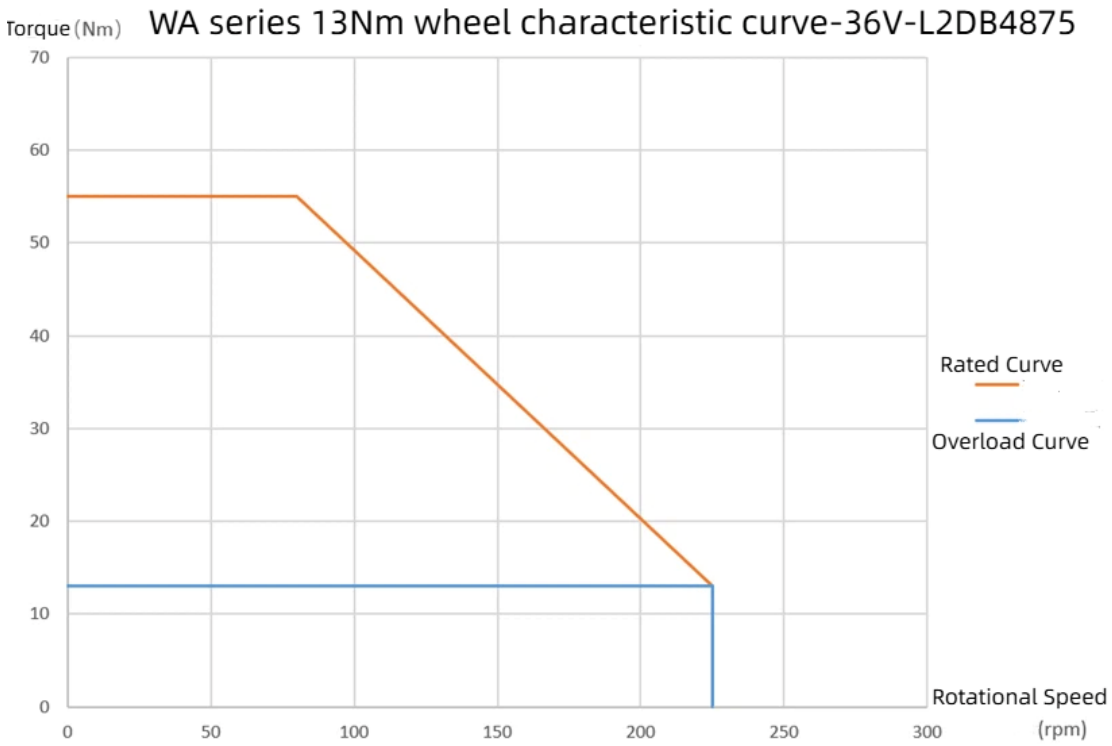


Figure 2.2.1-2 36V characteristic curve of WA series 13Nm hub motor

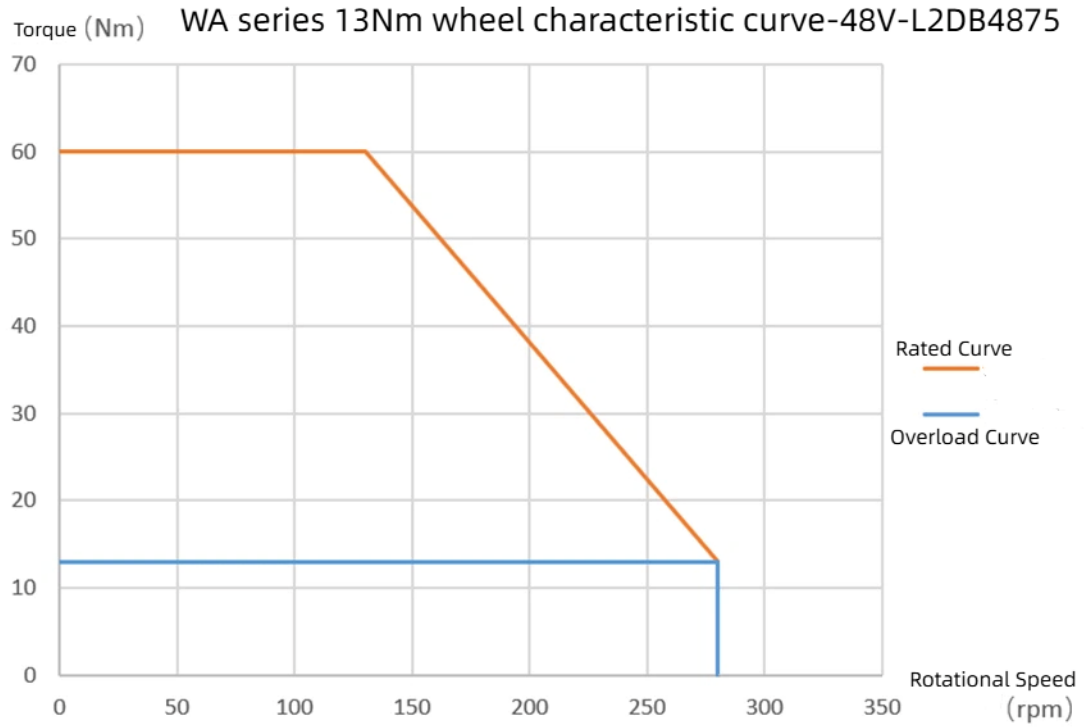


Figure 2.2.1-3 48V characteristic curve of WA series 13Nm hub motor

2.2.3 WA series 15Nm wheel characteristic curve

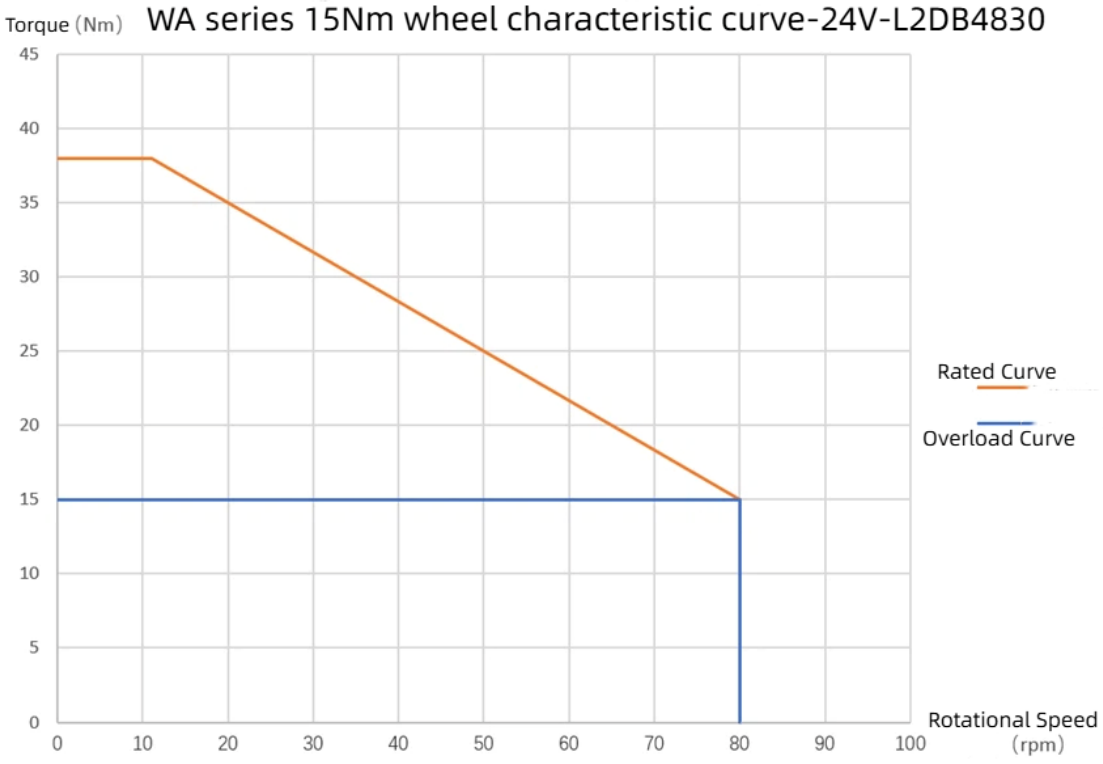


Figure 2.2.2-1 WA series L2DB4830 24V characteristic curve of 15Nm hub motor

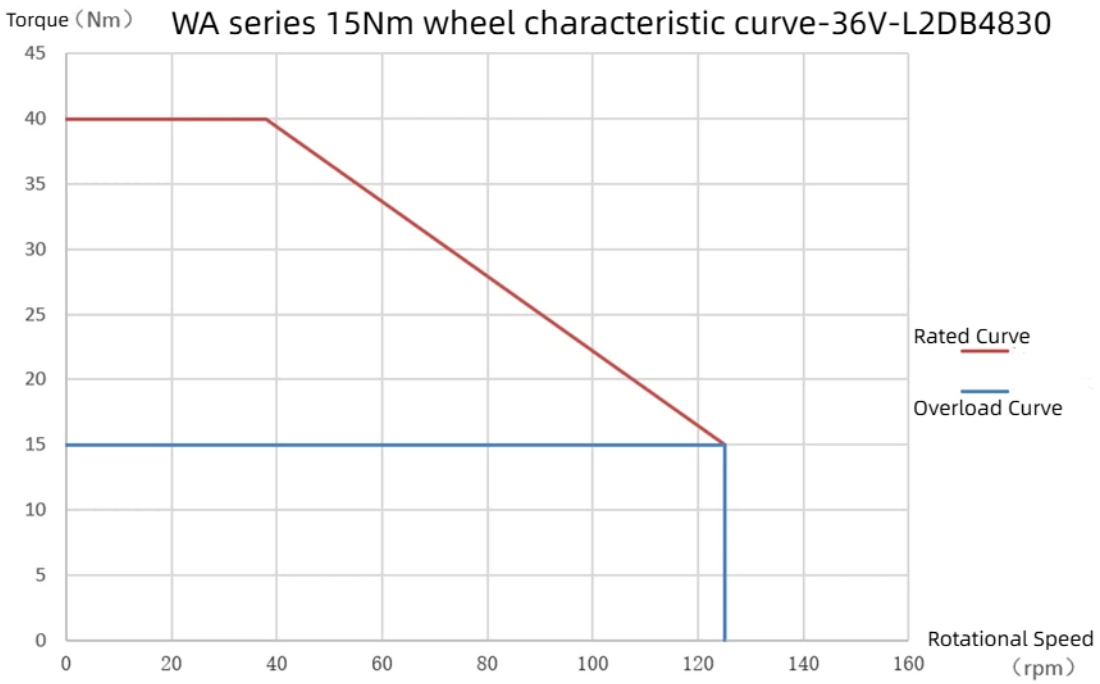


Figure 2.2.2-2 WA series L2DB4830 36V characteristic curve of 15Nm hub motor

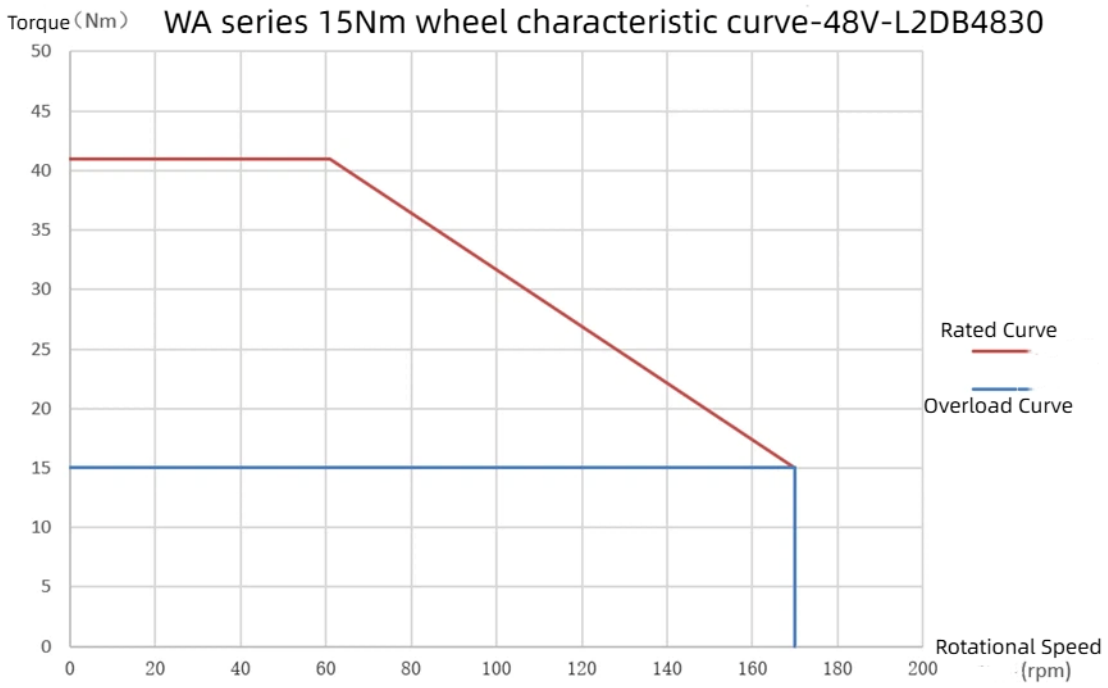


Figure 2.2.2-3 WA series L2DB4830 48V characteristic curve of 15Nm hub motor

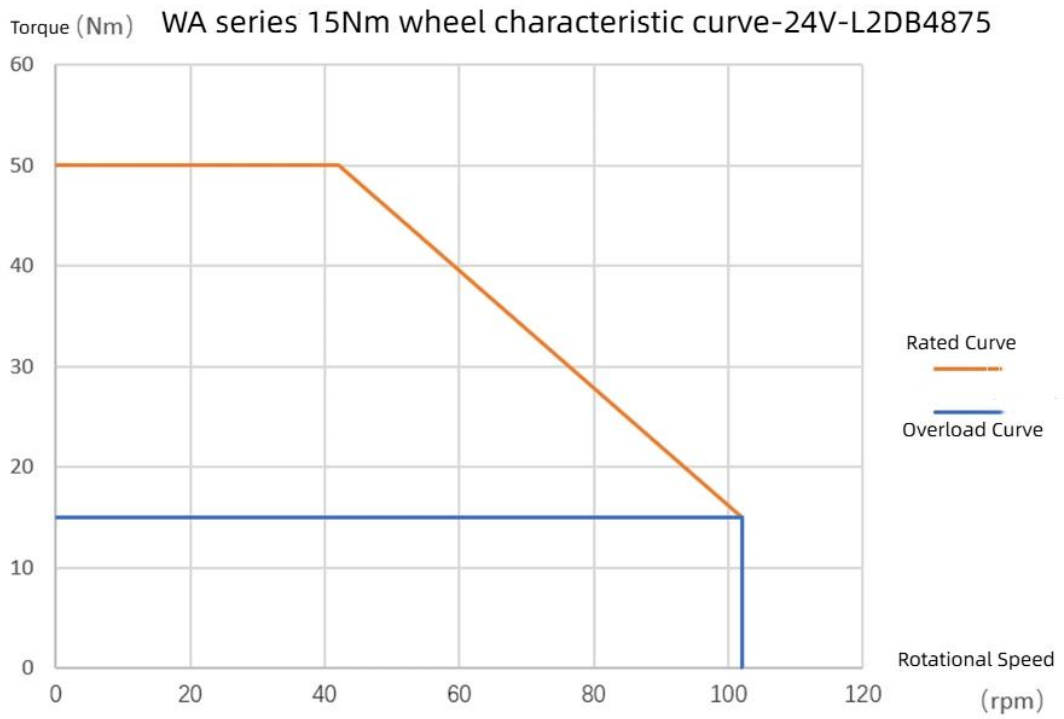


Figure 2.2.2-4 24V characteristic curve of the WA series L2DB4875 15Nm hub motor

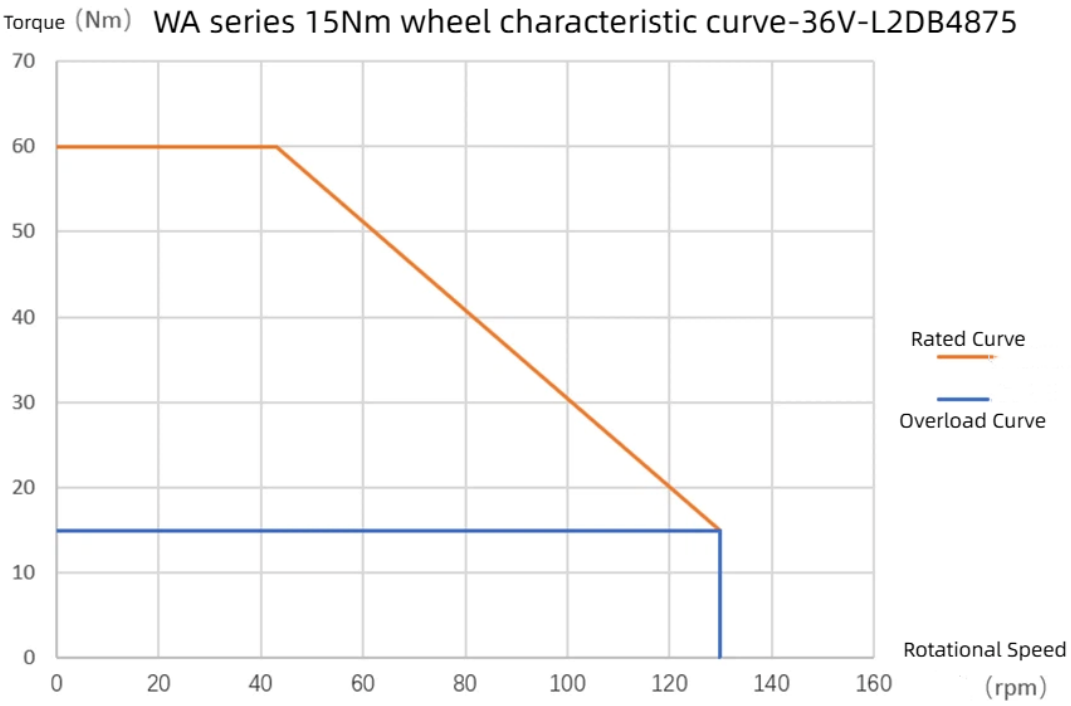


Figure 2.2.2-5 WA series L2DB4875 36V characteristic curve of 15Nm hub motor

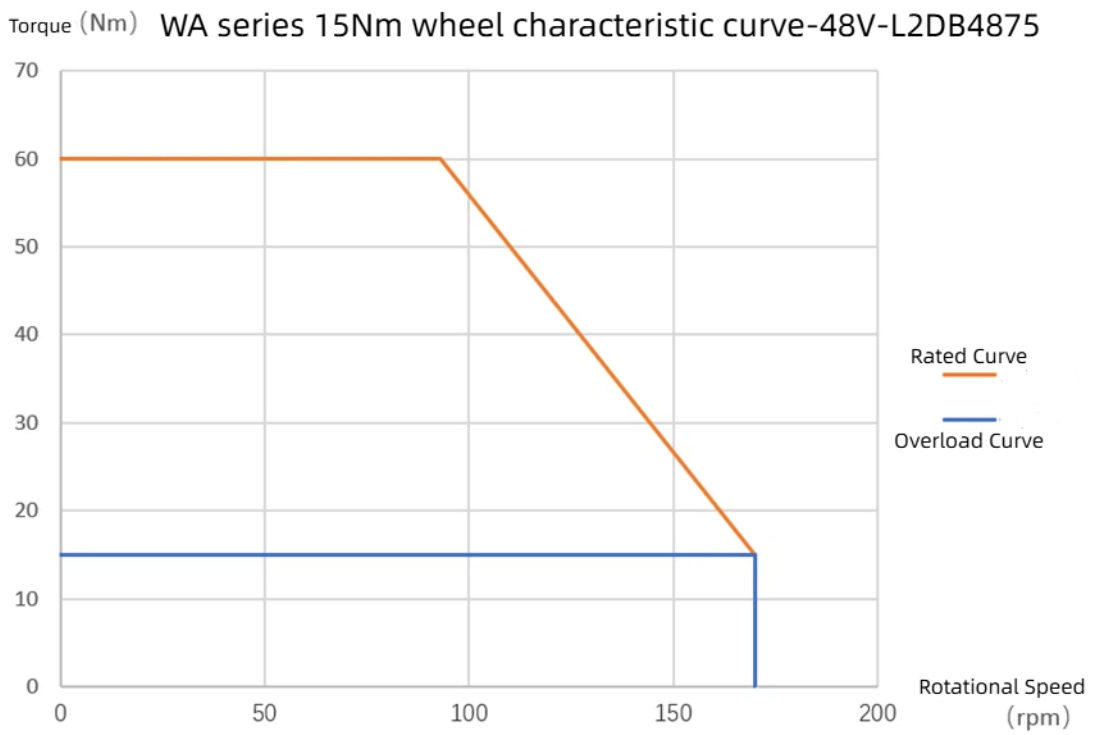


Fig. 2.2.2-6 WA series L2DB4875 48V characteristic curve of 15Nm hub motor

3. Installation size

3.1 WS series direct drive servo hub motor installation size diagram

3.1.1 L2DB4875 servo drive mounting size

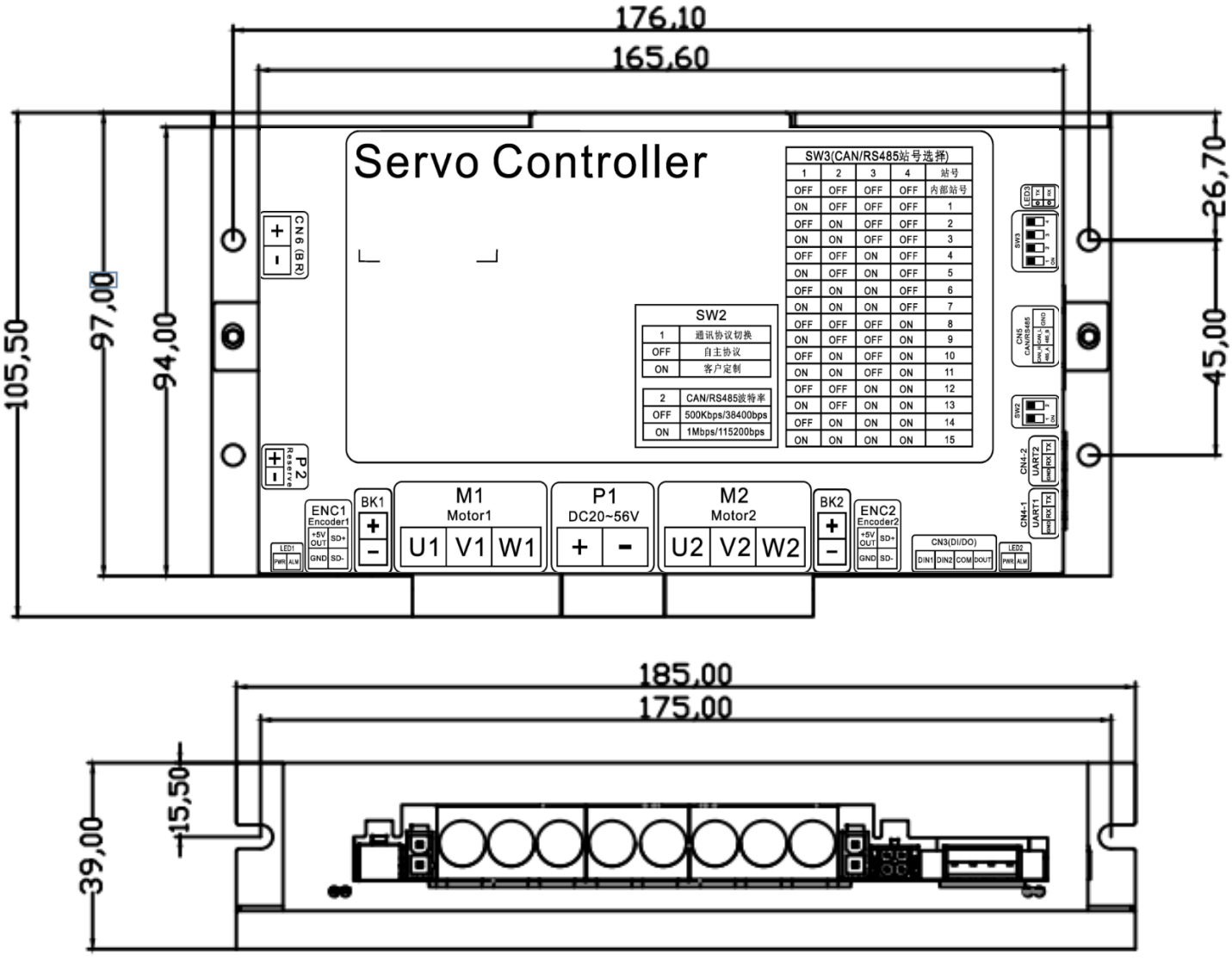


Figure 3.1.1 L2DB4875 the installation size of the servo drive

3.1.2 L2DB4830 servo drive mounting size

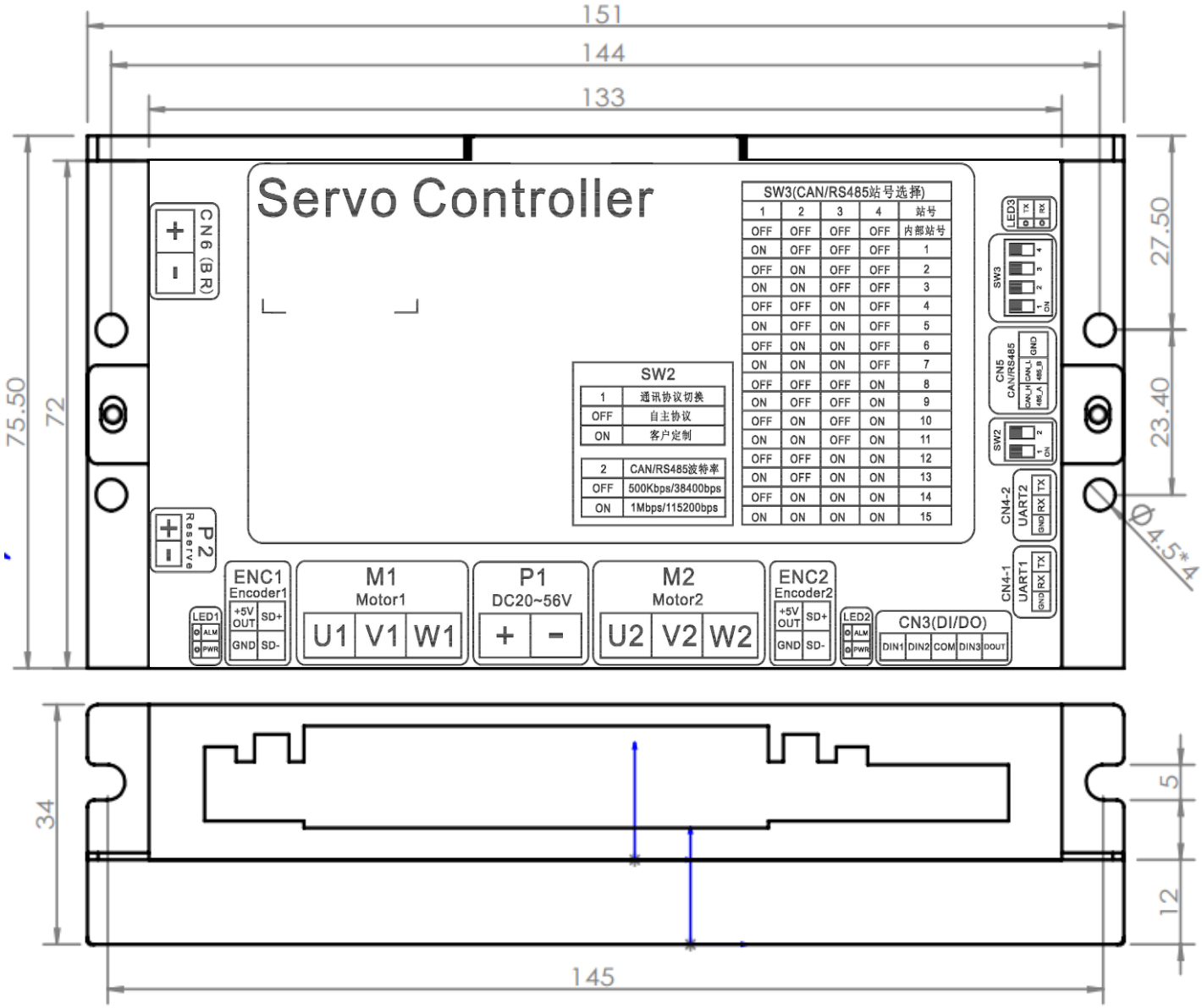


Figure 3.1.2 L2DB4830 servo drive mounting size

3.1.3 5.5 inch hub motor mounting size

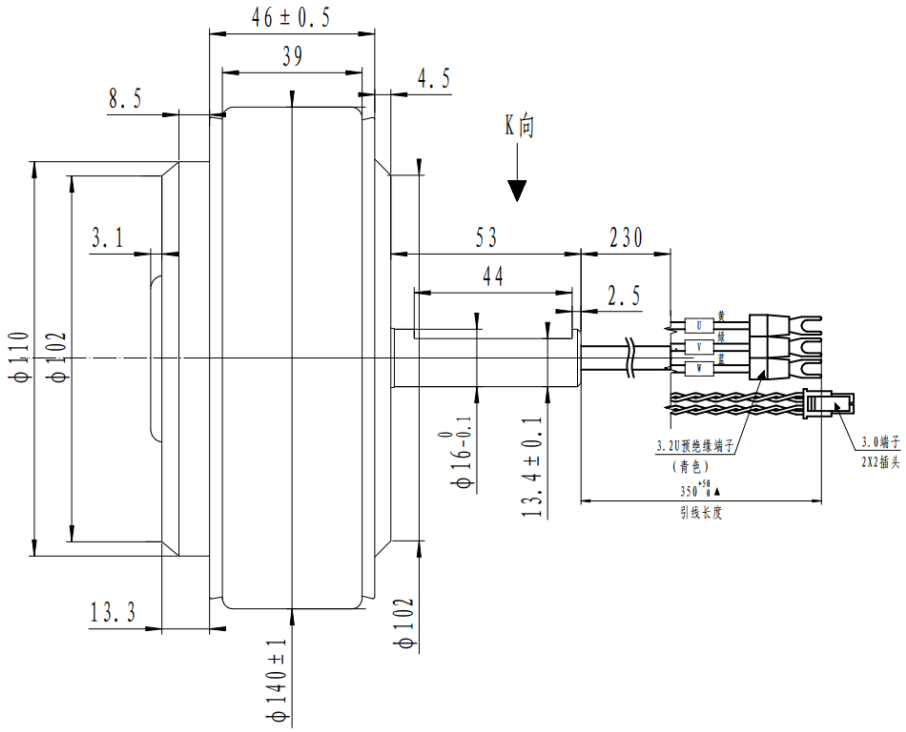


Figure 3.1.3 5.5 inch hub motor mounting size

3.1.4 6.5 inch hub motor mounting size

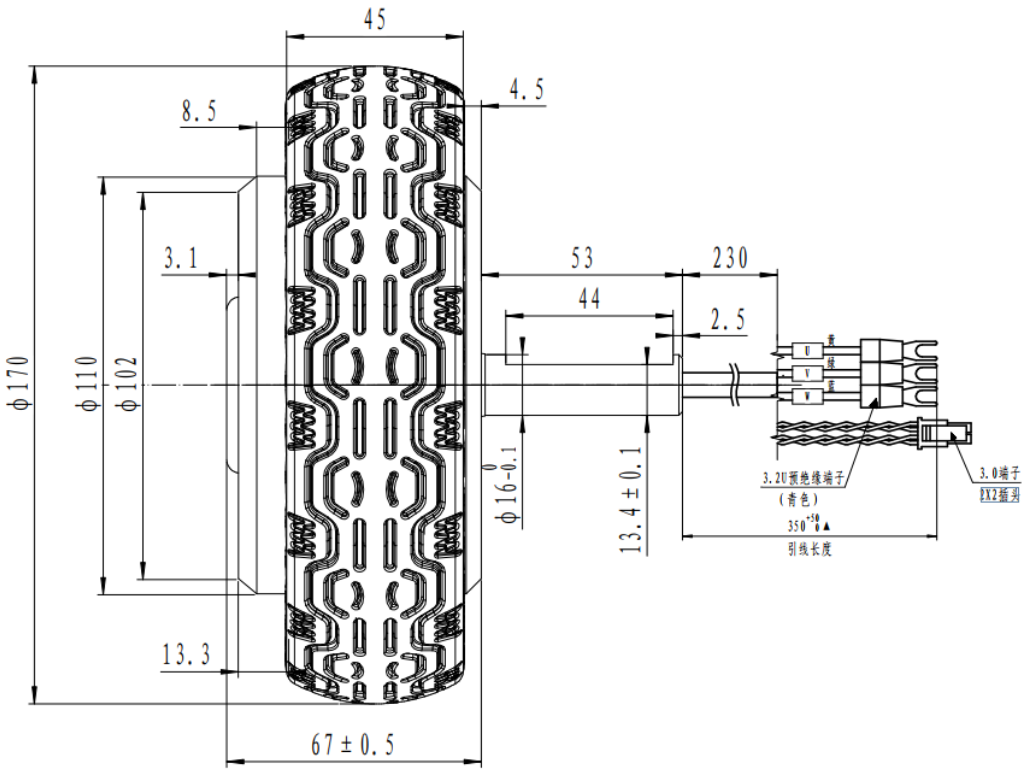


Figure 3.1.4 6.5 inch hub motor mounting size

3.1.5 8 inch 7Nm hub motor mounting size

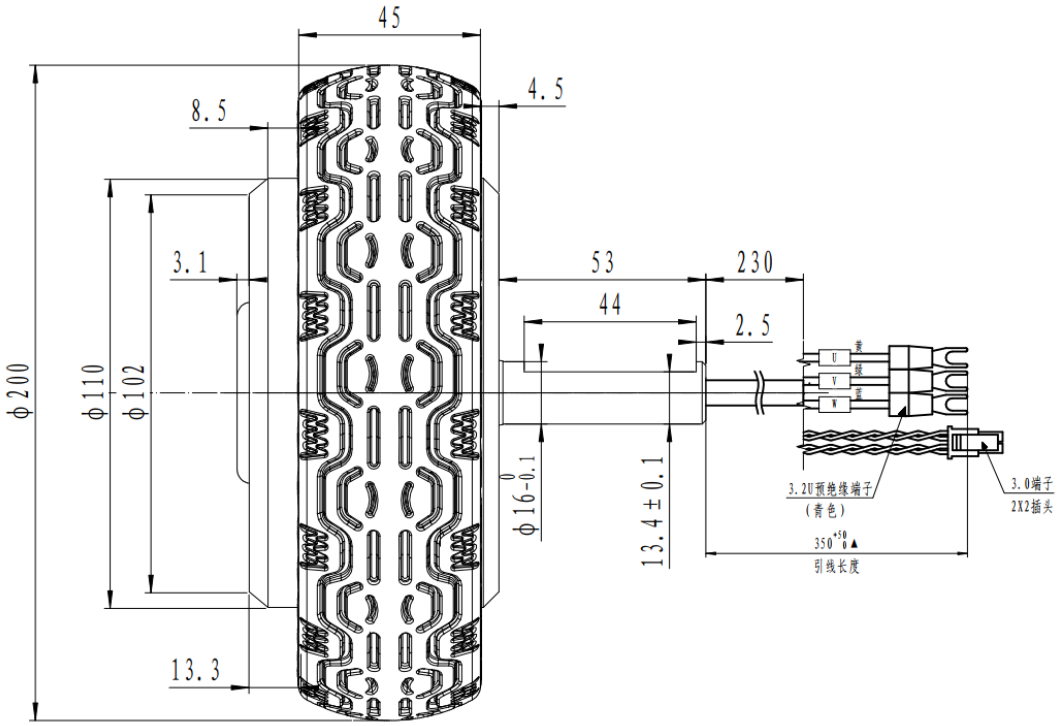


Figure 3.1.5 8 inch 7Nm hub motor mounting size

3.1.6 8 inch 7 Nm hub motor (omnidirectional wheel) mounting size

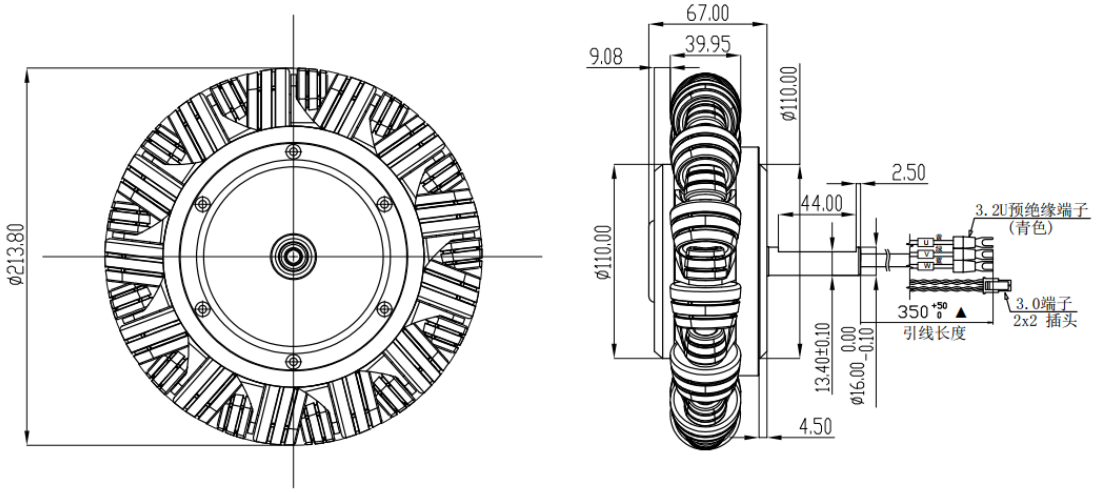


Figure 3.1.6 8 inch 7 Nm hub motor (omnidirectional wheel) mounting size

3.1.7 5.5 inch 15Nm hub motor mounting size

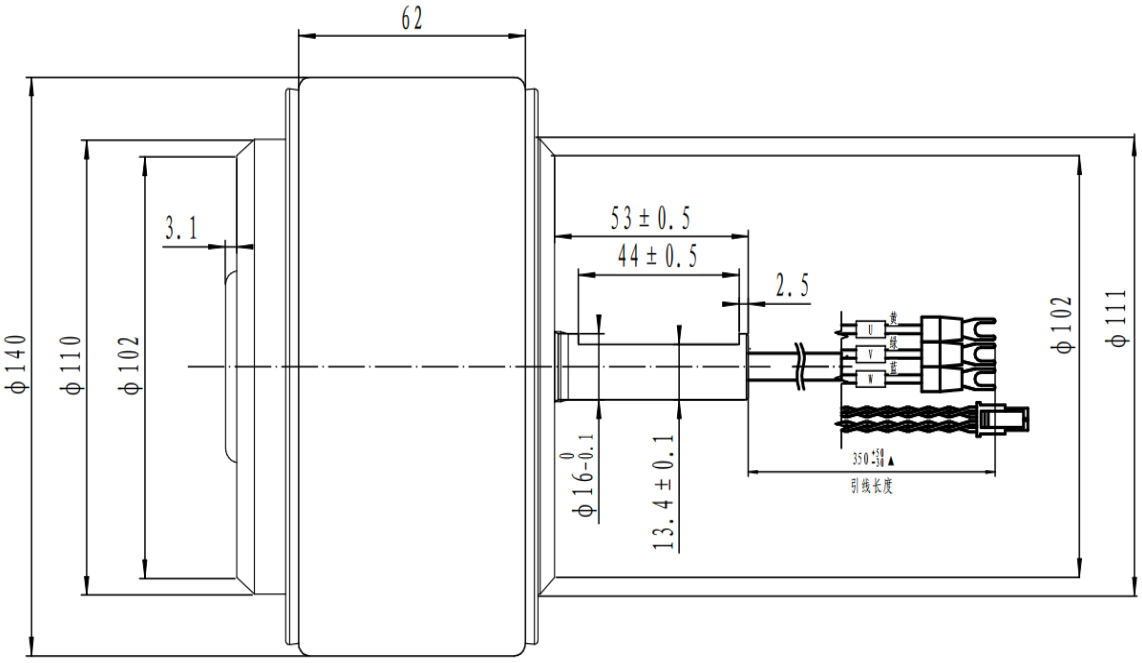


Figure 3.1.7 5.5 inch 15Nm hub motor mounting size

3.1.8 8 inch 15 Nm hub motor mounting size

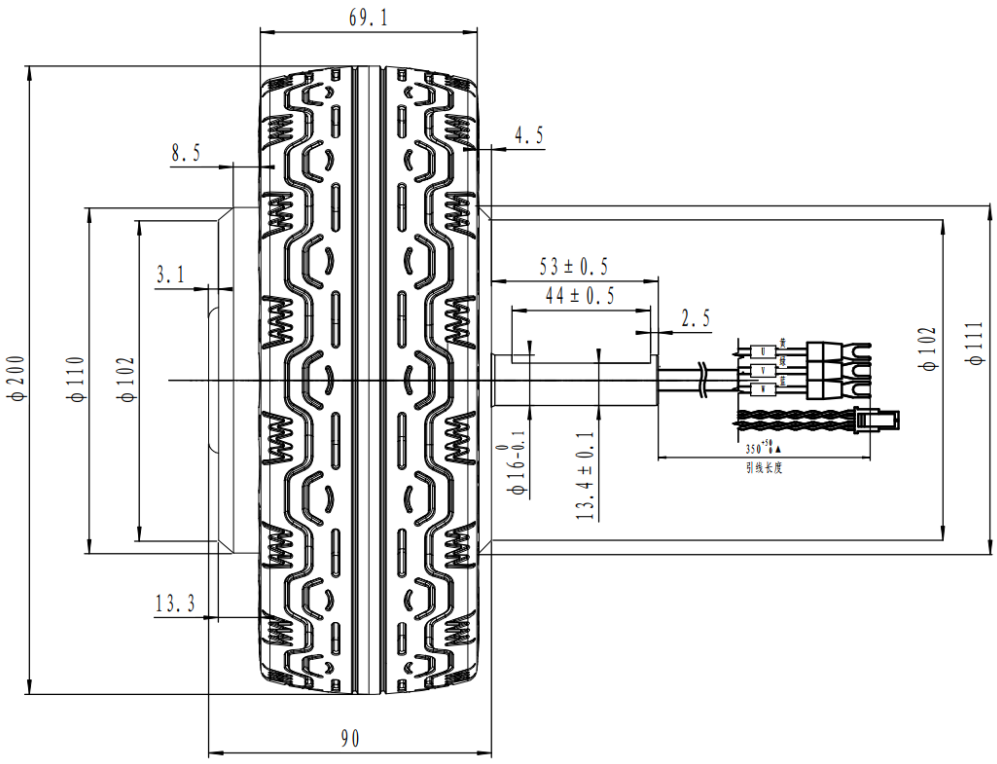


Figure 3.1.8 8 inch 15 Nm hub motor mounting size

3.1.9 8 inch 30Nm hub motor mounting size

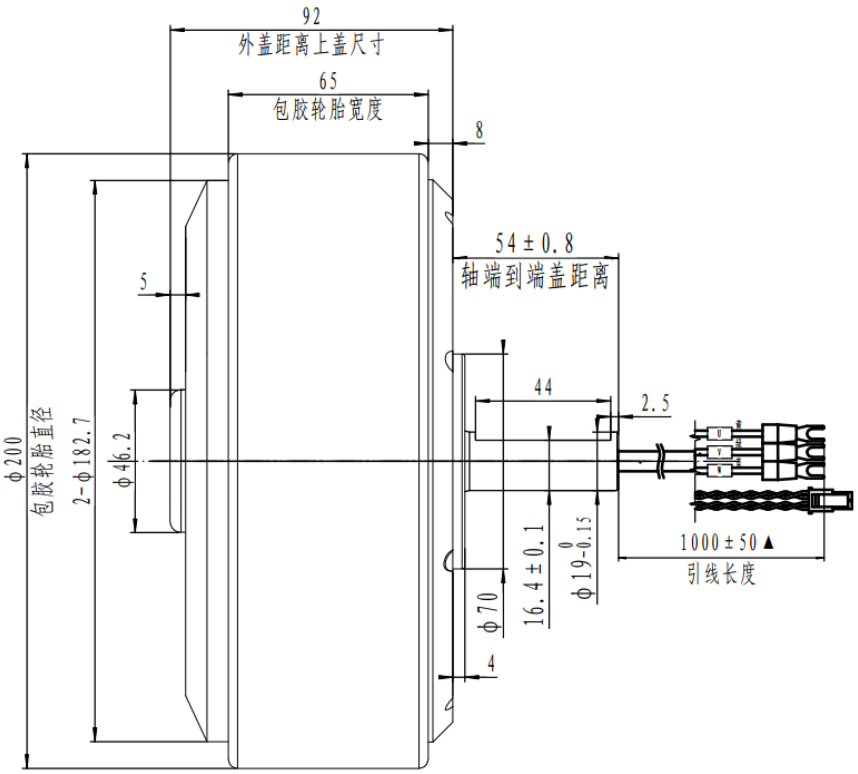


Figure 3.1.9 8 inch 30Nm hub motor mounting size

3.1.10 10 inch 30Nm hub motor mounting size

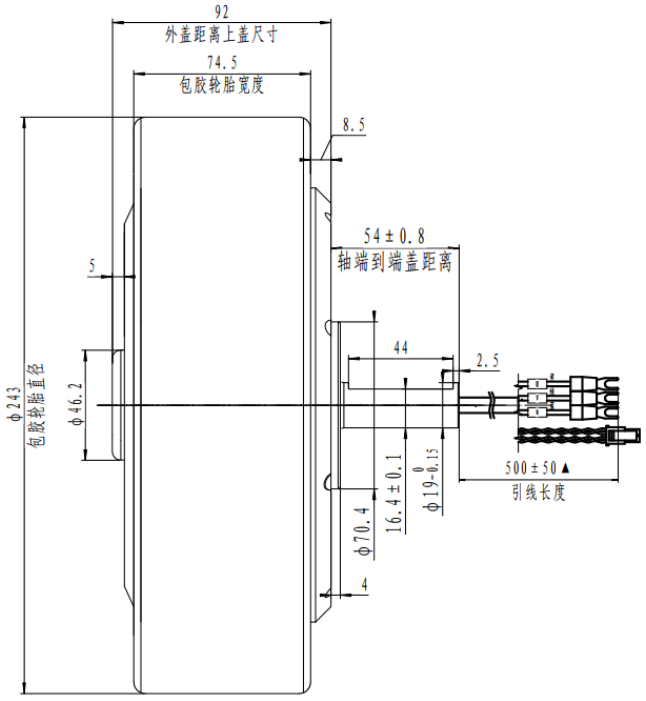


Figure 3.1.10 10 inch 30Nm hub motor mounting size

3.1.11 12 inch 30Nm hub motor mounting size

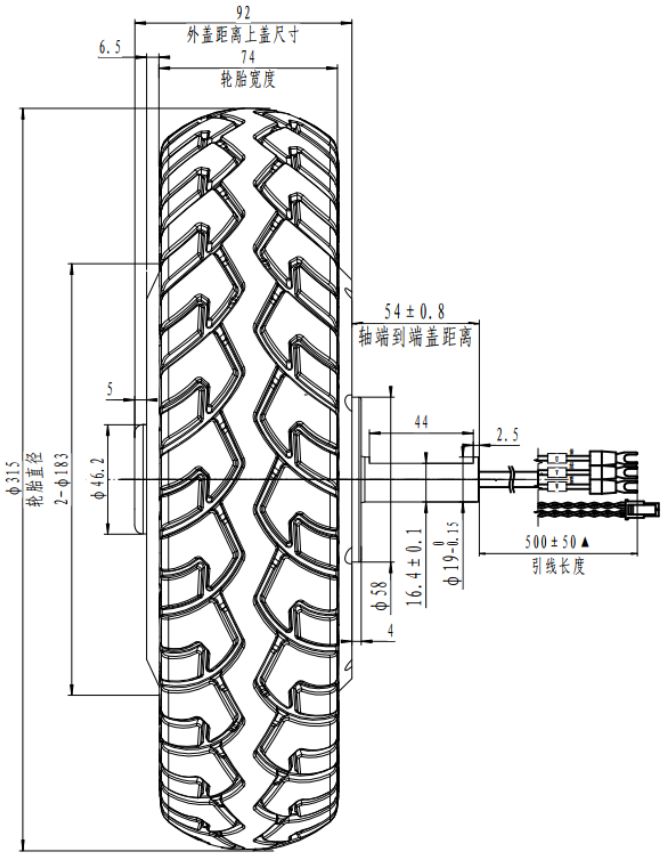


Figure 3.1.11 12 inch 30Nm hub motor mounting size

3.2 WA series servo hub motor with reducer installation dimension drawing

3.2.1 6 inch 13Nm/15Nm coated polyurethane tire hub motor mounting size

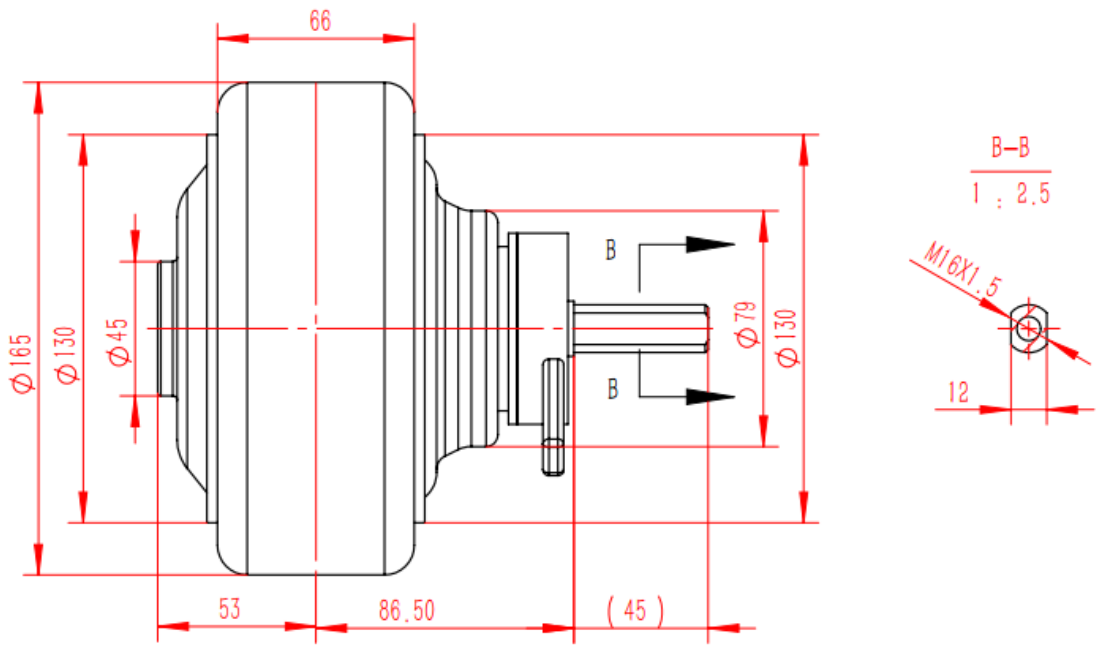


Figure 3.2.1 6 inch 13Nm/15Nm coated polyurethane tire hub motor mounting size

3.2.2 6 inch 13Nm/15Nm rubber-clad tires (without brakes) hub motor installation size

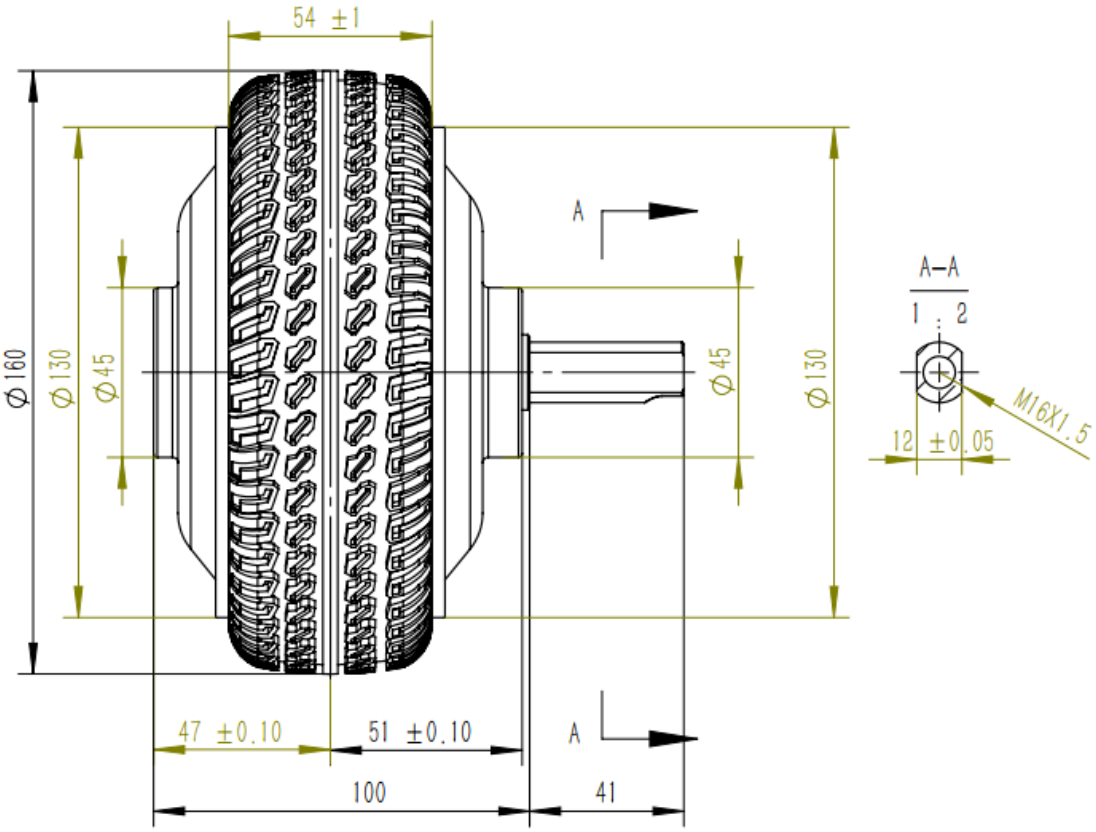


Figure 3.2.2 6 inch 13Nm/15Nm rubber-clad tires (without brakes) hub motor installation size

3.2.3 6 inch 13Nm/15Nm rubber-coated rubber tires (manual brake) hub motor installation size

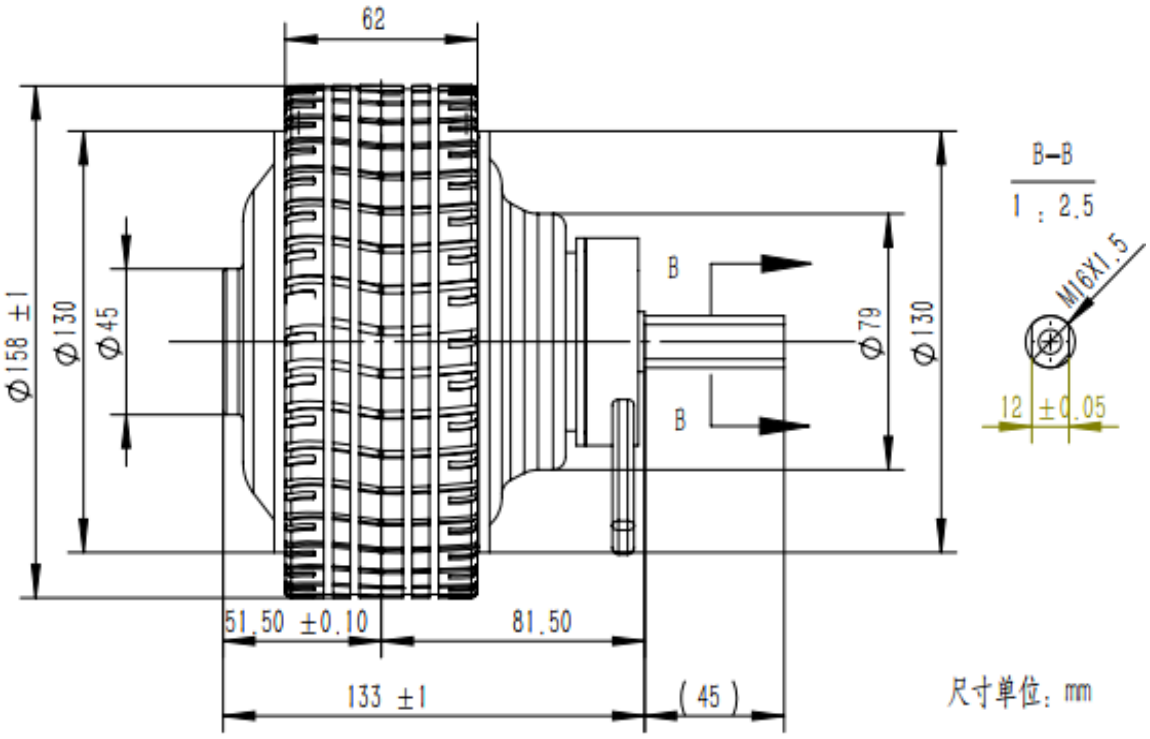


Figure 3.2.3 6 inch 13Nm/15Nm rubber-coated rubber tires (manual brake) hub motor installation size

3.2.4 8 inch 13Nm/15Nm coated polyurethane tire hub motor mounting size

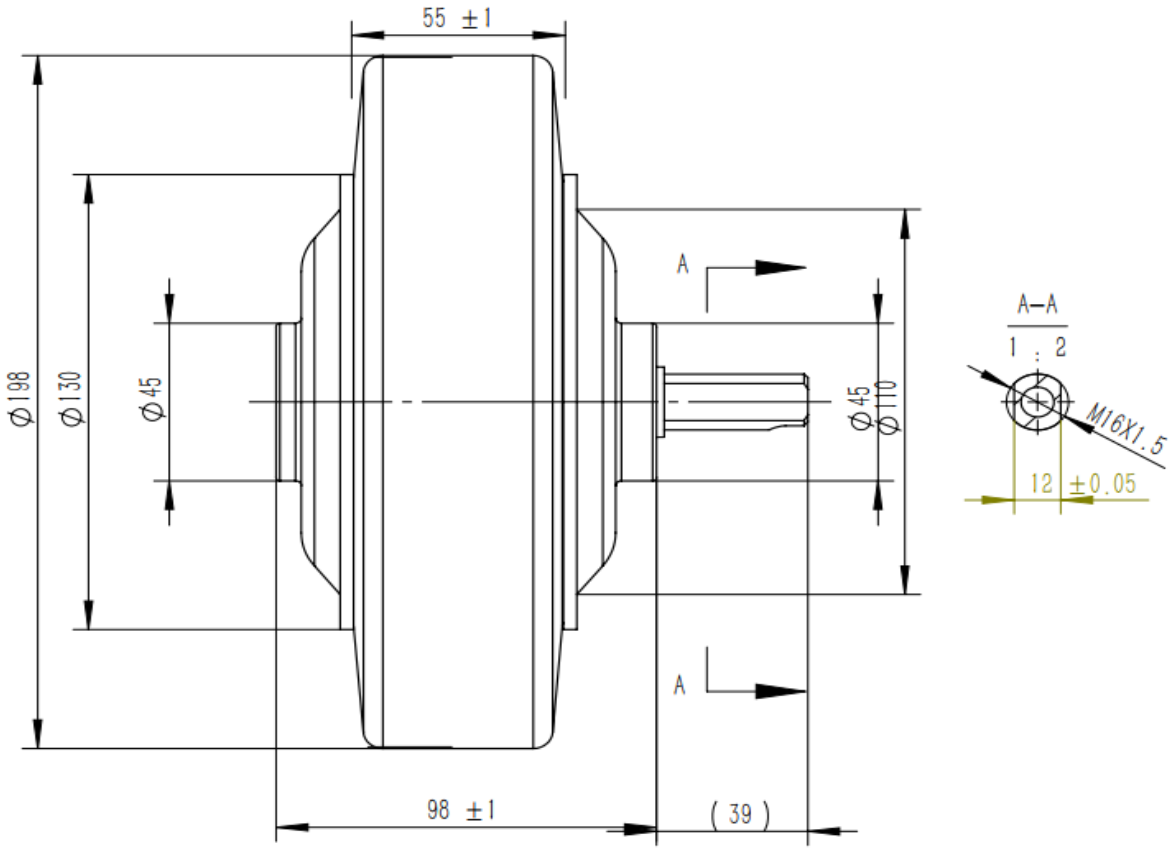


Figure 3.2.4 8 inch 13Nm/15Nm coated polyurethane tire hub motor mounting size

3.2.5 8-inch 13Nm/15Nm inflatable tires (without brakes) hub motor installation size

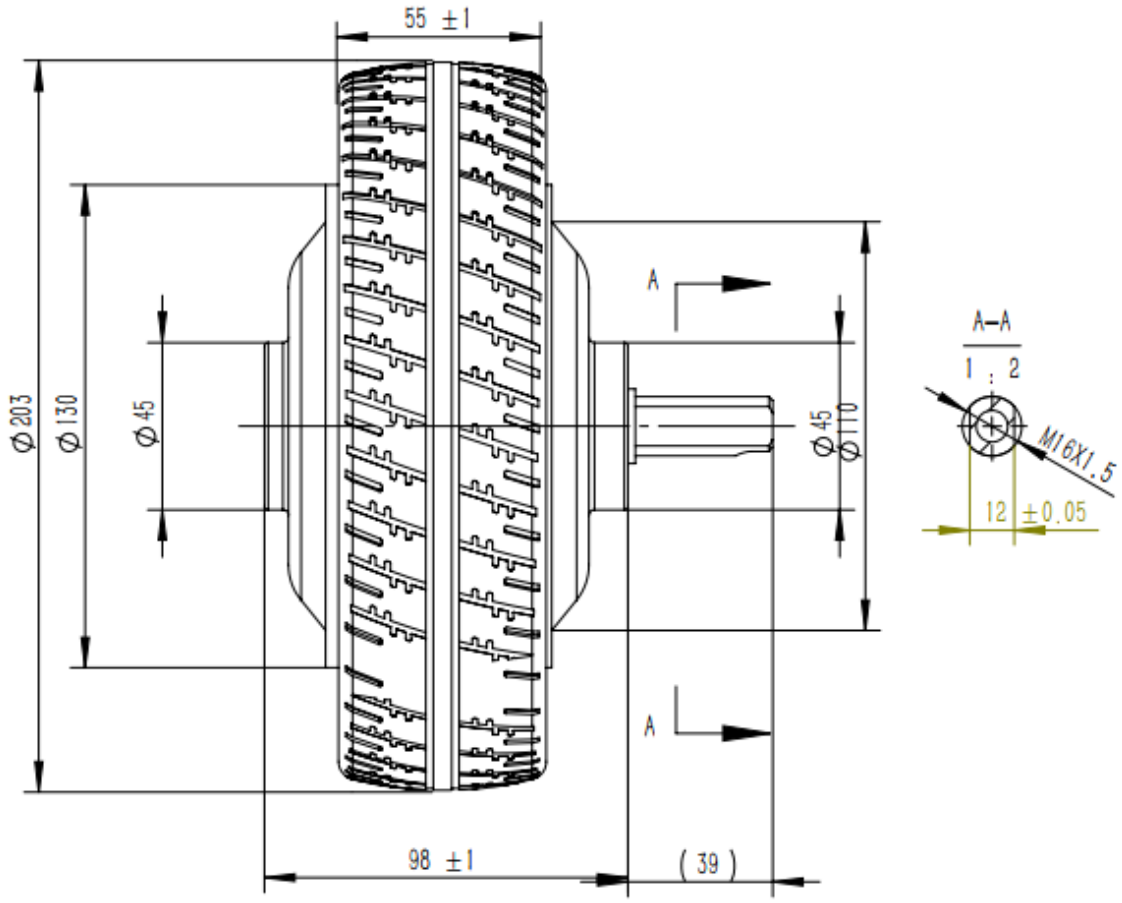


Figure 3.2.5 8-inch 13Nm/15Nm inflatable tires (without brakes) hub motor installation size

3.2.6 8-inch 13Nm/15Nm inflatable tire (manual brake) hub motor installation size

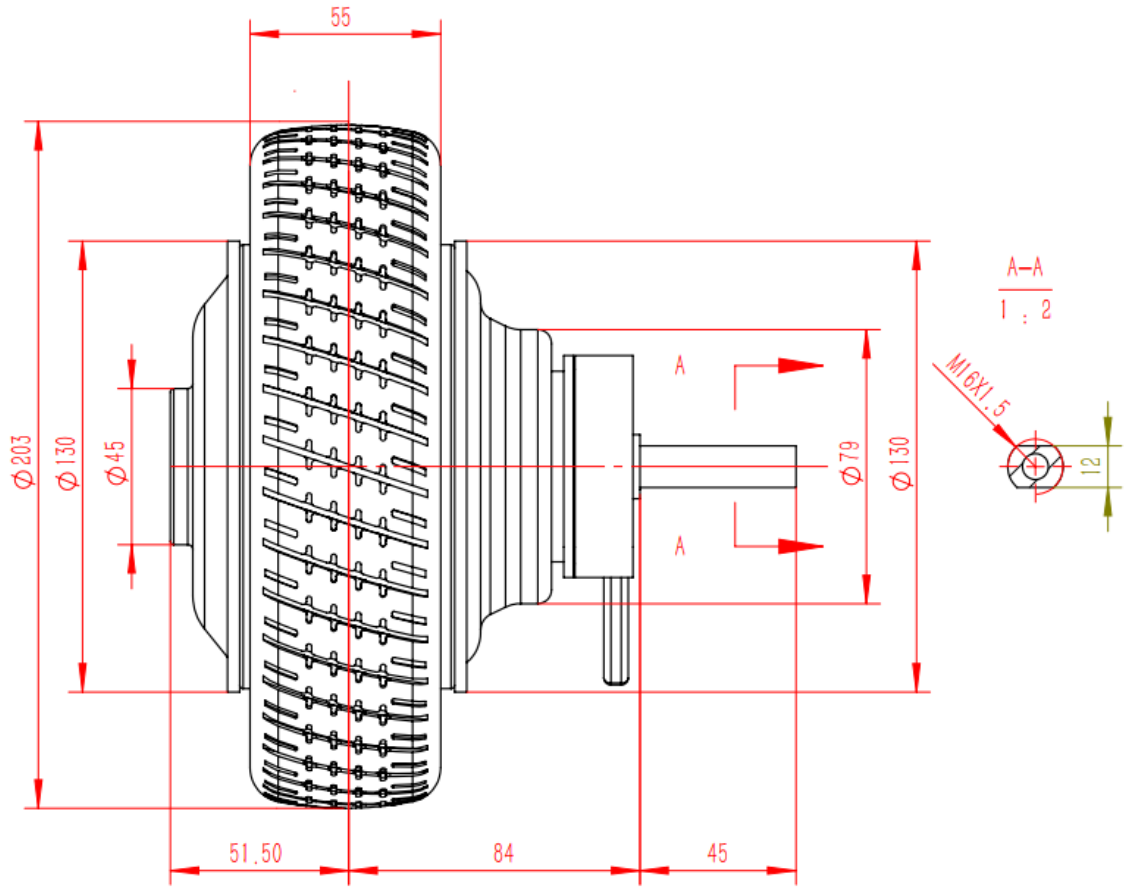


Figure 3.2.6 8-inch 13Nm/15Nm inflatable tire (manual brake) hub motor installation size

3.2.7 8 inch 13Nm/15Nm rubber-coated tire hub motor mounting size

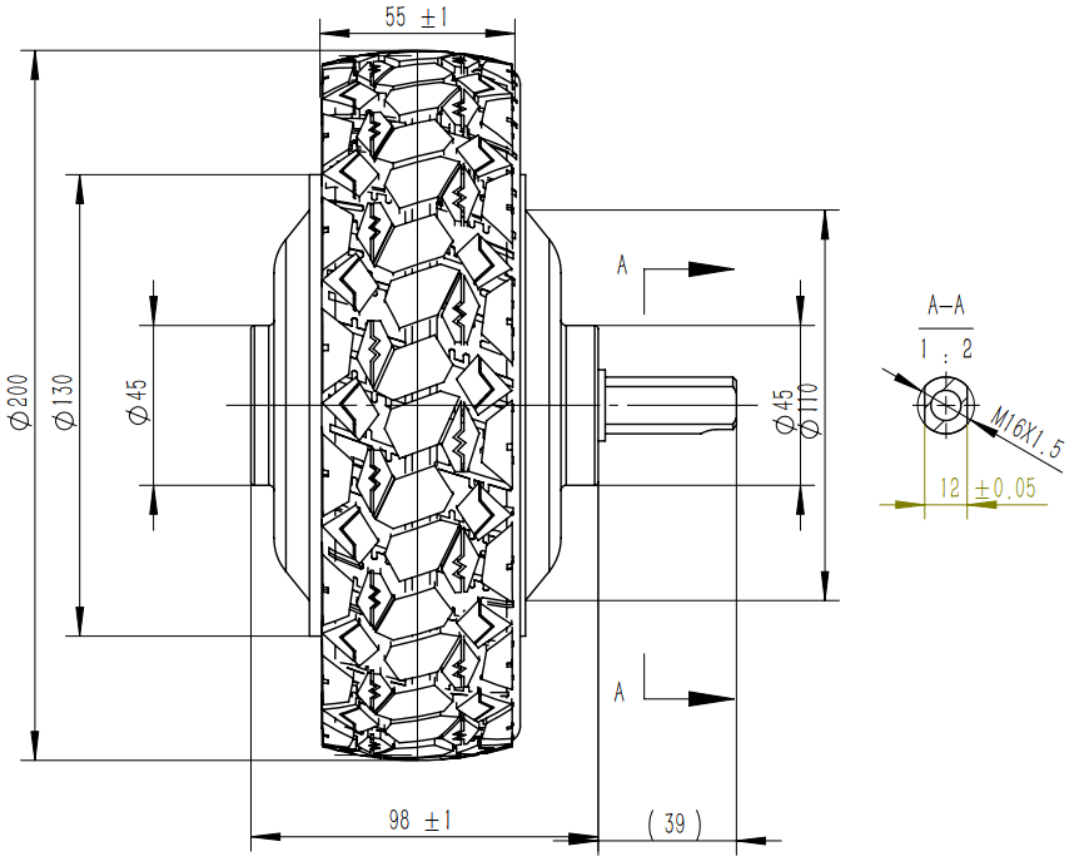


Figure 3.2.7 8 inch 13Nm/15Nm rubber-coated tire hub motor mounting size

3.2.8 9.5 inch 13Nm/15Nm inflatable tires (without brakes) hub motor installation size

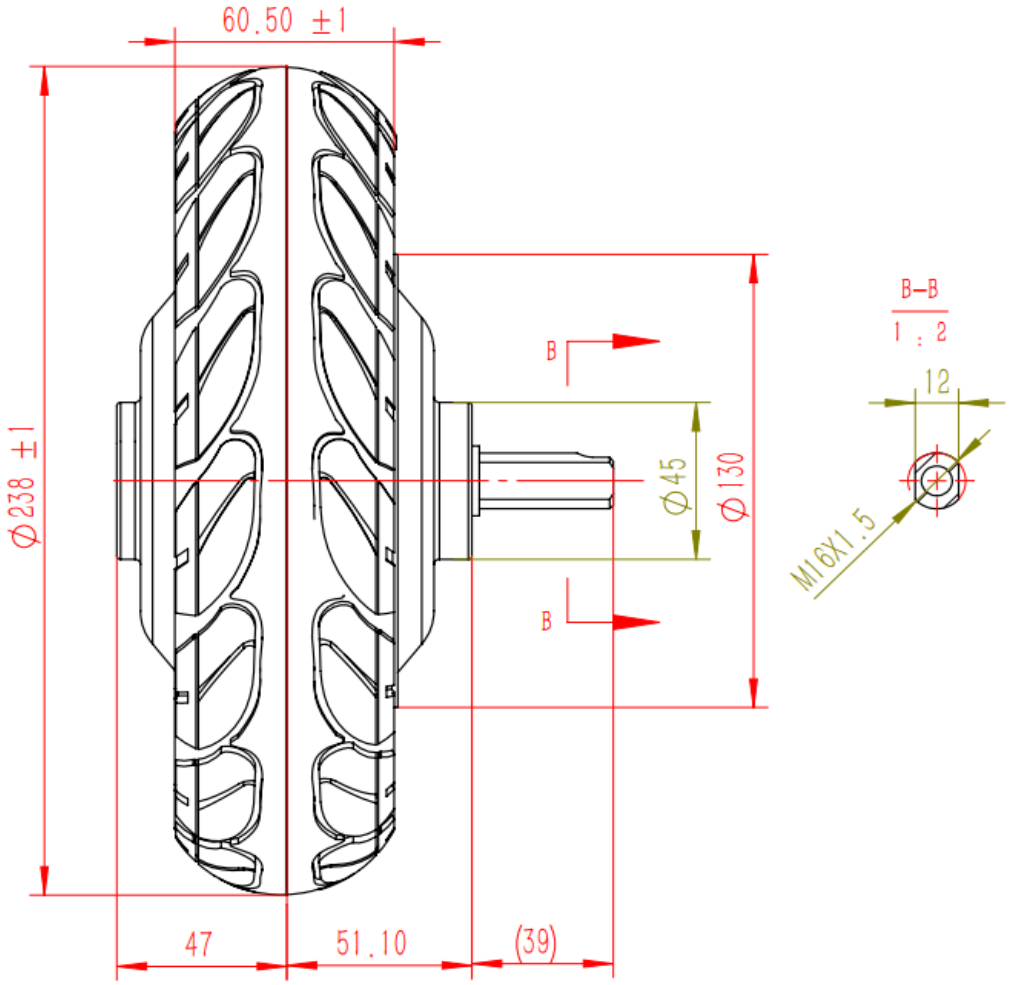


Figure 3.2.8 9.5 inch 13Nm/15Nm inflatable tires (without brakes) hub motor installation size

3.2.9 9.5 inch 13Nm/15Nm inflatable tire (manual brake) hub motor installation size

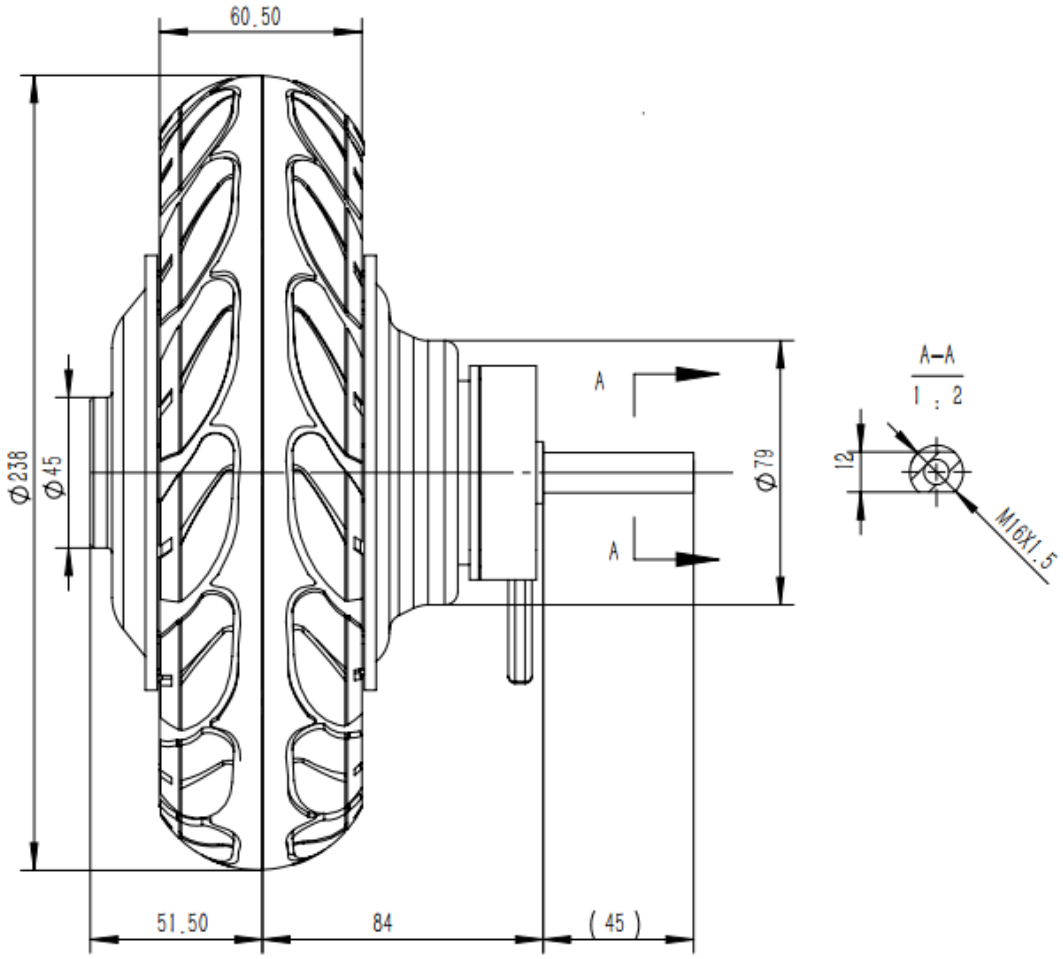


Figure 3.2.9 Installation size of 9.5-inch 13Nm/15Nm inflatable tire (manual brake) hub motor

3.2.10 12 inch 13Nm/15Nm pneumatic tire hub motor mounting size

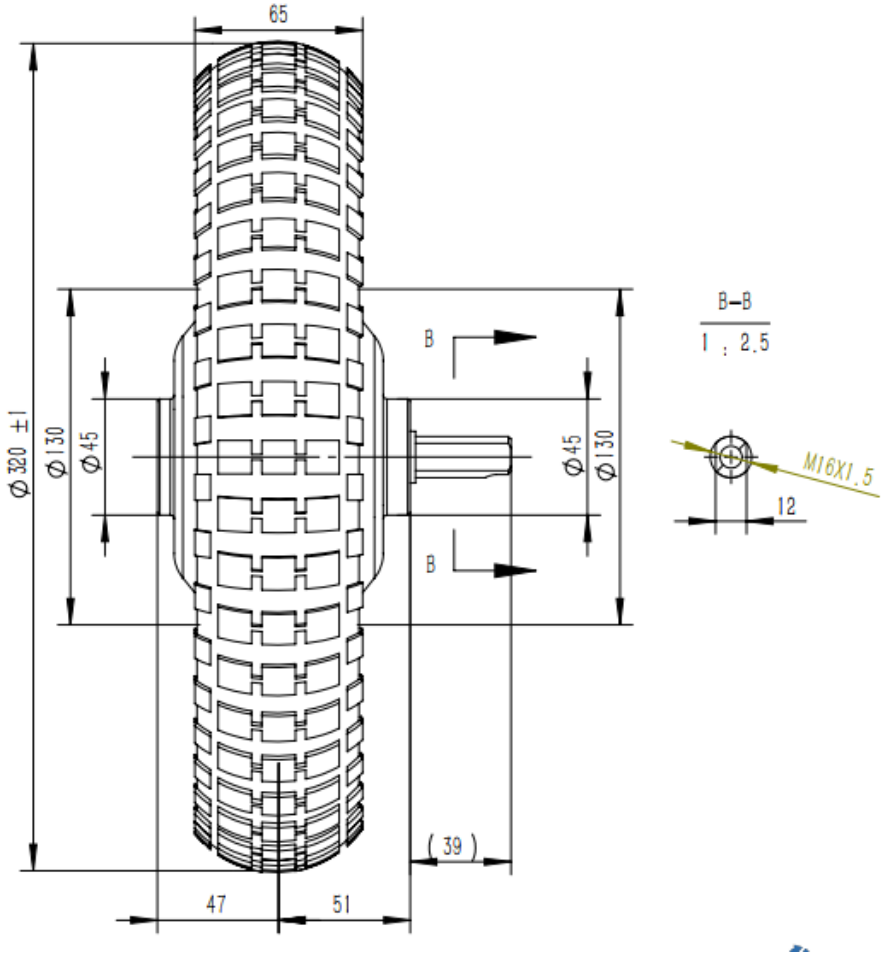


Figure 3.2.10 12 inch 13Nm/15Nm pneumatic tire hub motor mounting size

3.2.11 12-inch 13Nm/15Nm inflatable tires (without brakes) hub motor mounting size

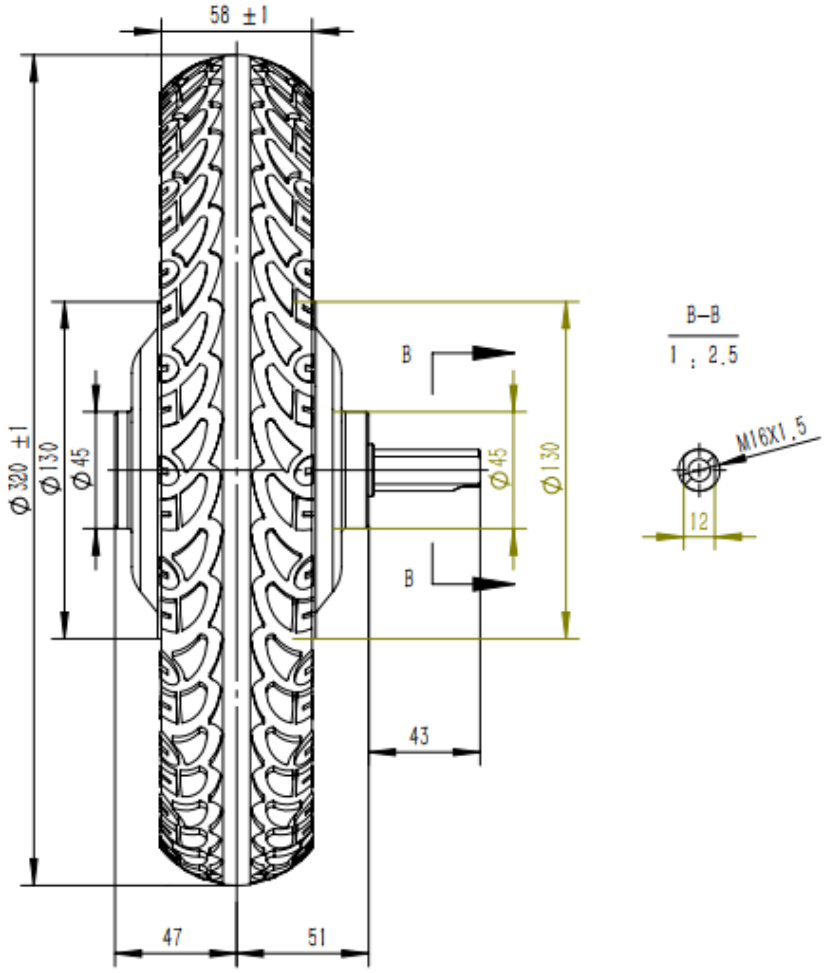


Figure 3.2.11 Installation dimensions of 12-inch 13Nm/15Nm inflatable tires (without brakes) hub motors

3.2.12 12-inch 13Nm/15Nm inflatable tire-free (manual brake) hub motor installation size

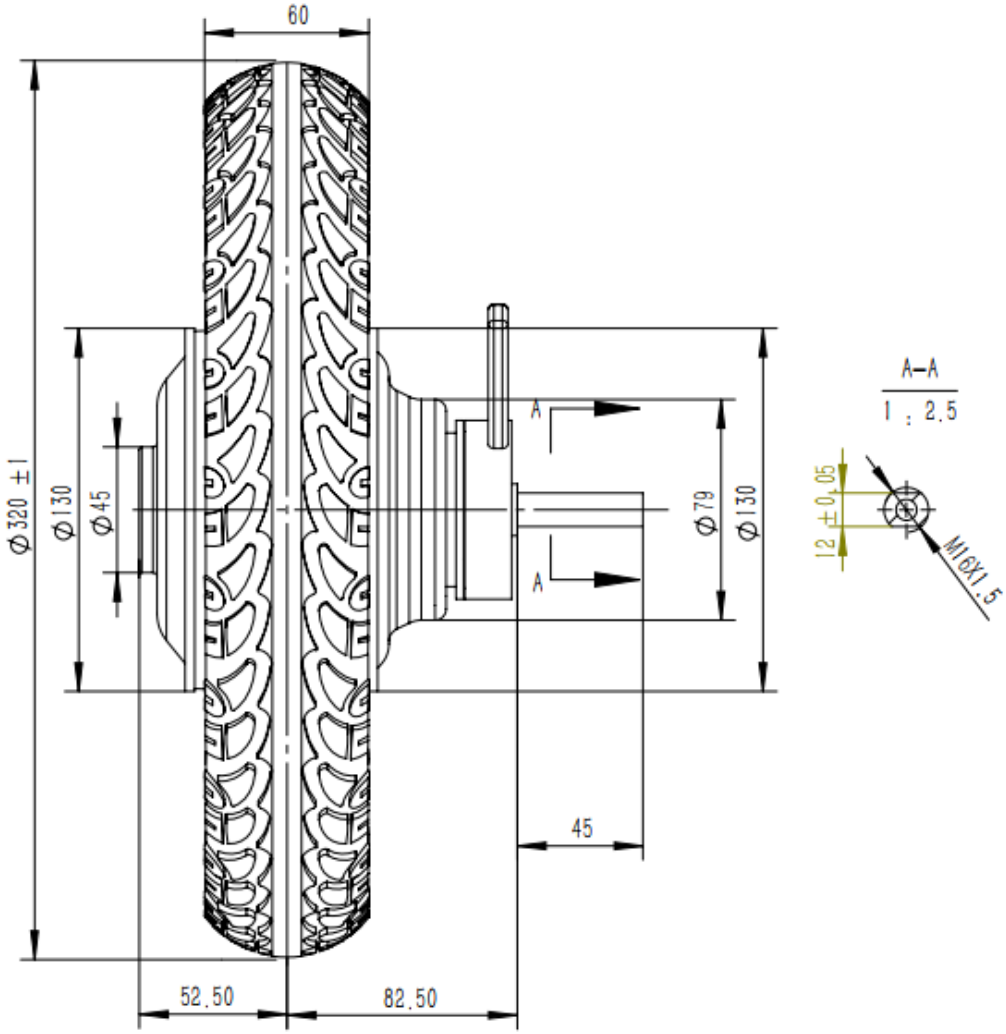
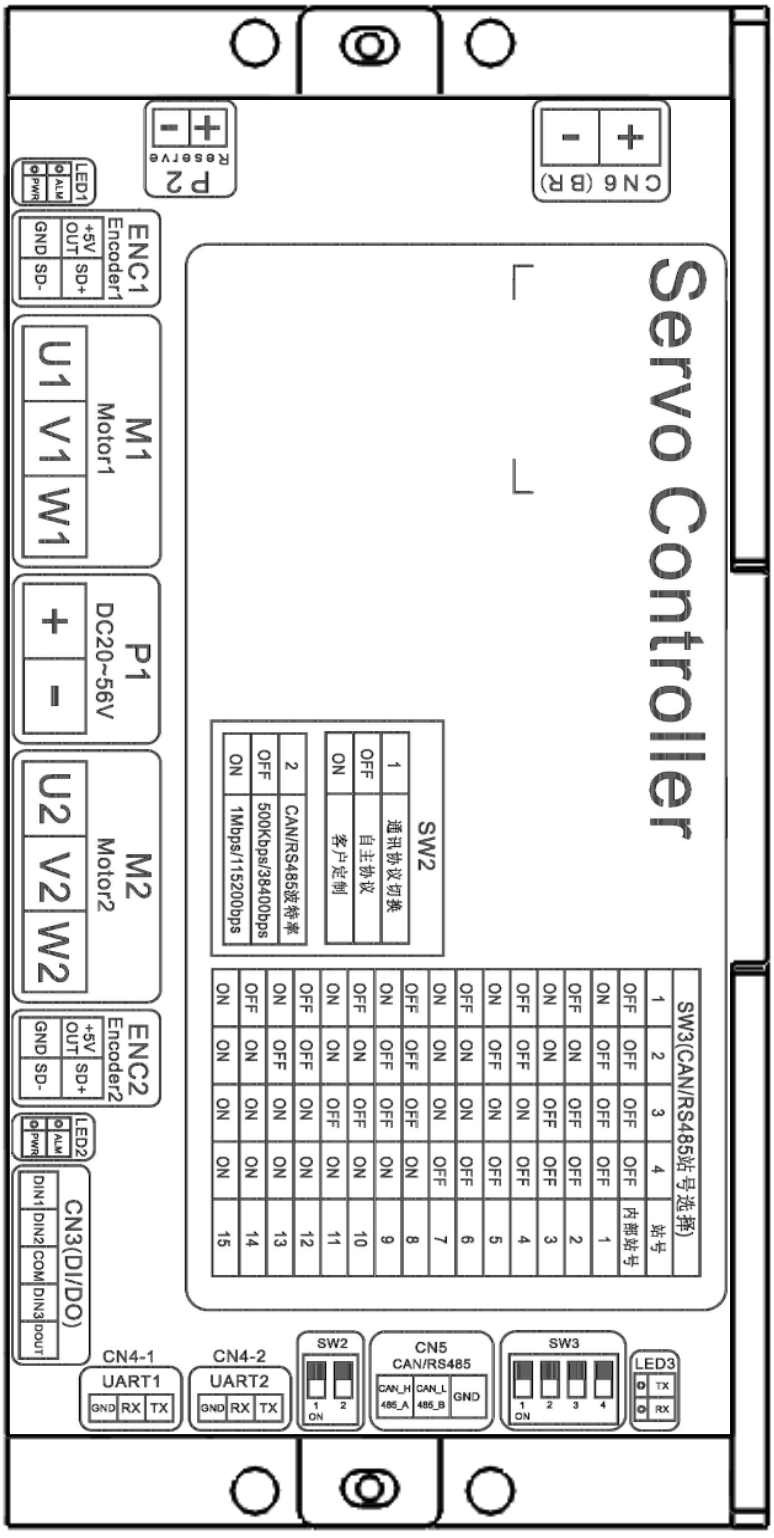


Figure 3.2.12 Installation size of 12-inch 13Nm/15Nm inflatable tire (manual brake) hub motor

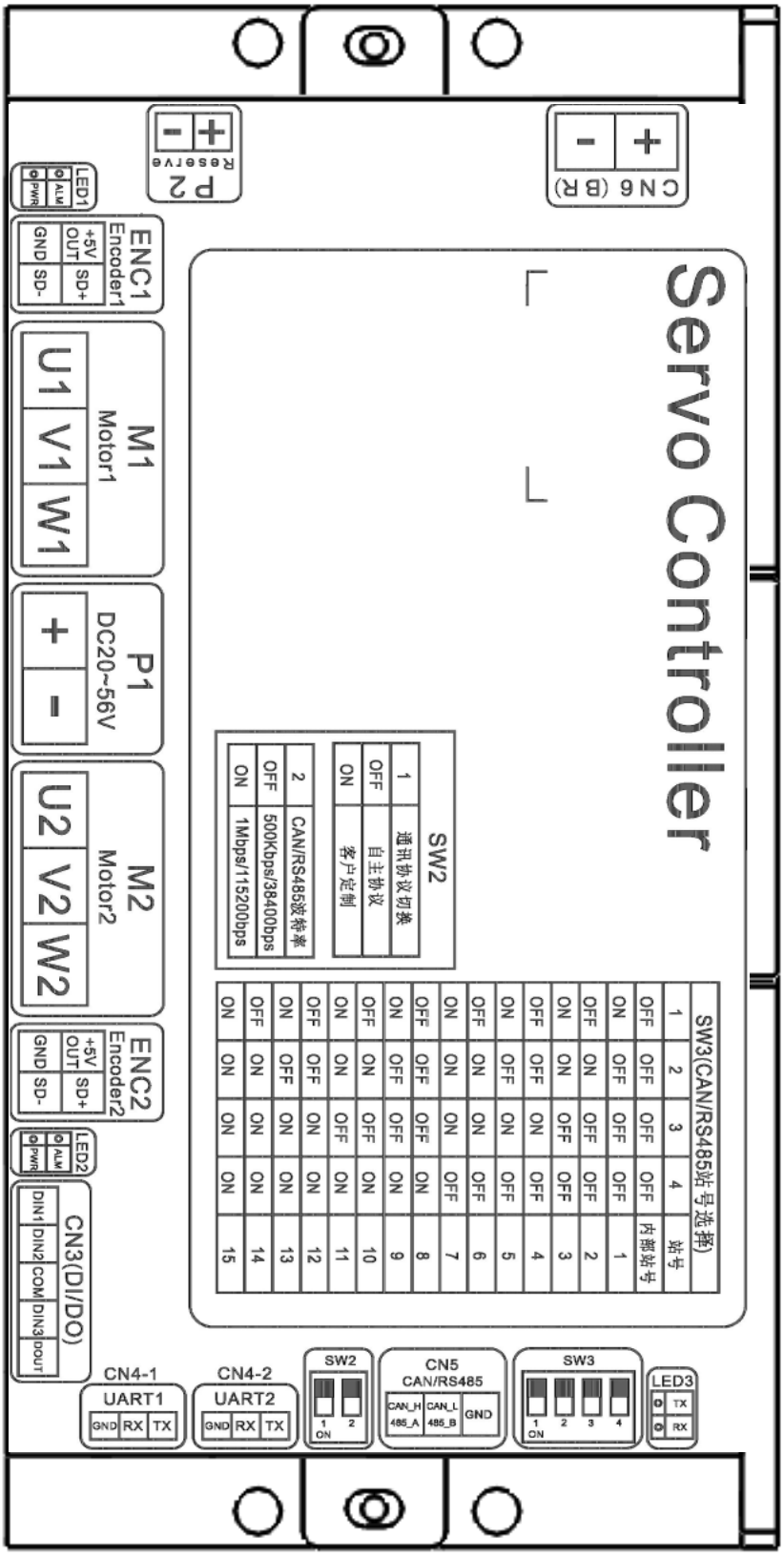
4. Description of interface functions

4.1 L2DB-4830 Housing Silk Screen



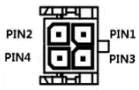
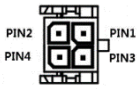
4.1.1 L2DB-4830 Housing Silk Screen

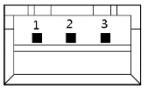
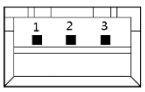
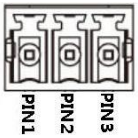
4.2 L2DB-4875 Housing Silk Screen

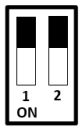
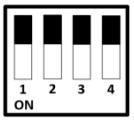


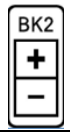
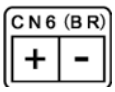
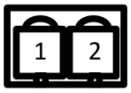
4.2.1 L2DB-4875 Housing Silk Screen

4.3 List of interface functions

serial number	name	definition	Function description
1	P1 	P1:Power interface	Drive input power
		PIN1: DC+	The power input is positive
		PIN2: DC-	The power input is negative
2	M1 	M1:Motor 1 interface	Motor 1 power line interface
		PIN1: U1	U phase of motor 1
		PIN2: V1	V phase of motor 1
		PIN3: W1	W phase of motor 1
3	M2 	M2: Motor 2 interface	Motor 2 power line interface
		PIN1: U2	U phase of motor 2
		PIN2: V2	V phase of motor 2
		PIN3: W2	W phase of motor 2
4	ENC1 	ENC1:Motor 1 encoder interface	Motor 1 encoder interface
		PIN1: +5Vout	+5V power supply output, maximum current 0.2A
		PIN2: GND	Power Ground
		PIN3: SD+	Serial data is positive
		PIN4: SD-	Serial data negative
5	ENC2 	ENC1:Motor 2 encoder interface	Motor 2 encoder interface
		PIN1: +5Vout	+5V power supply output, maximum current 0.2A
		PIN2: GND	Power Ground
		PIN3: SD+	Serial data is positive

		PIN4: SD-	Serial data negative
6	CN3 	CN3:Multi-function I/O ports	Multi-function digital inputs and outputs can be configured
		PIN1:DIN1	Multi-function digital input port DIN1: Connect with COM: Effective Disconnect from COM: Invalid Not configured by default
		PIN2:DIN2	Multifunction digital input DIN2: Connect with COM: Effective Disconnect from COM: Invalid Not configured by default
		PIN3:COM	The input and output ports are common
		PIN5:DOUT	Wrong output, NPN method (open collector): There is an error output of 0, and there is no error output of high resistance.
7	CN4-1 	CN4-1: UART1 interface	UART interface of motor 1
		PIN1:GND	UART1 bus public space
		PIN2:RX	UART1 native data receiver
		PIN3:TX	UART1 native data sender
8	CN4-2 	CN4-2: UART2 interface	UART interface of motor 2
		PIN1:GND	UART2 bus public space
		PIN2:RX	UART2 native data receiver
		PIN3:TX	UART2 native data sender
9	 CN5	CN5:RS485/CAN Bus interface	RS485/CAN bus interface
		PIN1:RS485_A/CAN_H	RS485 bus A-end/CAN bus H-end
		PIN2:RS485_B/CNA_L	RS485 bus B-end/CAN bus L-end
		PIN3:isoGND	RS485/CAN Bus Common Ground

<table>
<tr>
<td>10</td>
<td>SW2
 
</td>
<td>SW2: Parameter settings
BIT1: Protocol switching
BIT2: Baud rate selection, judgment of the state of the above power</td>
<td>BIT1:Communication protocol switching
<table>
<tr><td>OF</td><td>Autonomous agreements</td></tr>
<tr><td>ON</td><td>Customized by customers</td></tr>
</table>
BIT2:RS485/CAN Baud rate selection
<table>
<tr><td>OF</td><td>38400bps/500Kbps</td></tr>
<tr><td>ON</td><td>115200bps/1MKbps</td></tr>
</table></td>
</tr>
<tr>
<td>11</td>
<td>SW3
 
</td>
<td>SW3: RS485/CAN station number
Note 1: When the station number is greater than 15, please use the internal storage method to set the station number.
Note 2: This DIP switch status is only recognized once when powering up</td>
<td>Station Number Setting: (Only valid for CAN and RS485, not valid for UART)
<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>Station number</td></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Internal storage</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>1</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>2</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>3</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>4</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>5</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>6</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>7</td></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>8</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>9</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>10</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>ON</td><td>11</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>12</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>ON</td><td>13</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>14</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>15</td></tr>
</table>
The above is the station number of motor 1, and the station number of motor 2 is [motor station number 1] + 1 by default</td>
</tr>
<tr>
<td>12</td>
<td>LED1
 
</td>
<td>LED1: Motor 1 fault and operation indicator</td>
<td>The red LED flashes to indicate the alarm of the machine, and only the green LED light is on to indicate that the system is running normally. Please check it out "Chapter 8 Alarm and Elimination" chapter</td>
</tr>
<tr>
<td>13</td>
<td>LED2
 
</td>
<td>LED2: Motor 2 fault and operation indicator</td>
<td>The red LED flashes to indicate the alarm of the machine, and only the green LED light is on to indicate that the system is running normally. Please check it out</td>
</tr>
</table>

			"Chapter 8 Alarm and Elimination" chapter
14	LED3 	LED3: Bus communication indicator	A yellow light flashes to indicate that the drive is sending data, and a green light flashes to indicate that the drive is receiving data
15	BK1 	BK1: Brake Interface	BK1+: Brake Output Positive Terminal BK1-: Brake Output Negative Terminal
16	BK2 	BK2: Brake Interface	BK2+: Brake Output Positive Terminal BK2-: Brake Output Negative Terminal
17	CN6 	CN6: Brake Resistor	Brake Resistor
18	P2 	P2：Logic power supply PIN1:+ PIN2:-	Logic Power Supply Input Terminal Input Voltage: 24V Maximum Input Current: 1A

4.4 Multi-functional I/O port internal circuit structure

The multi-function I/O of the L2DB series driver adopts an active isolation design, which realizes the control of the driver with the input of dry contact signal, which is convenient for users. Its internal circuit diagram structure is shown in Fig. 4.4-1

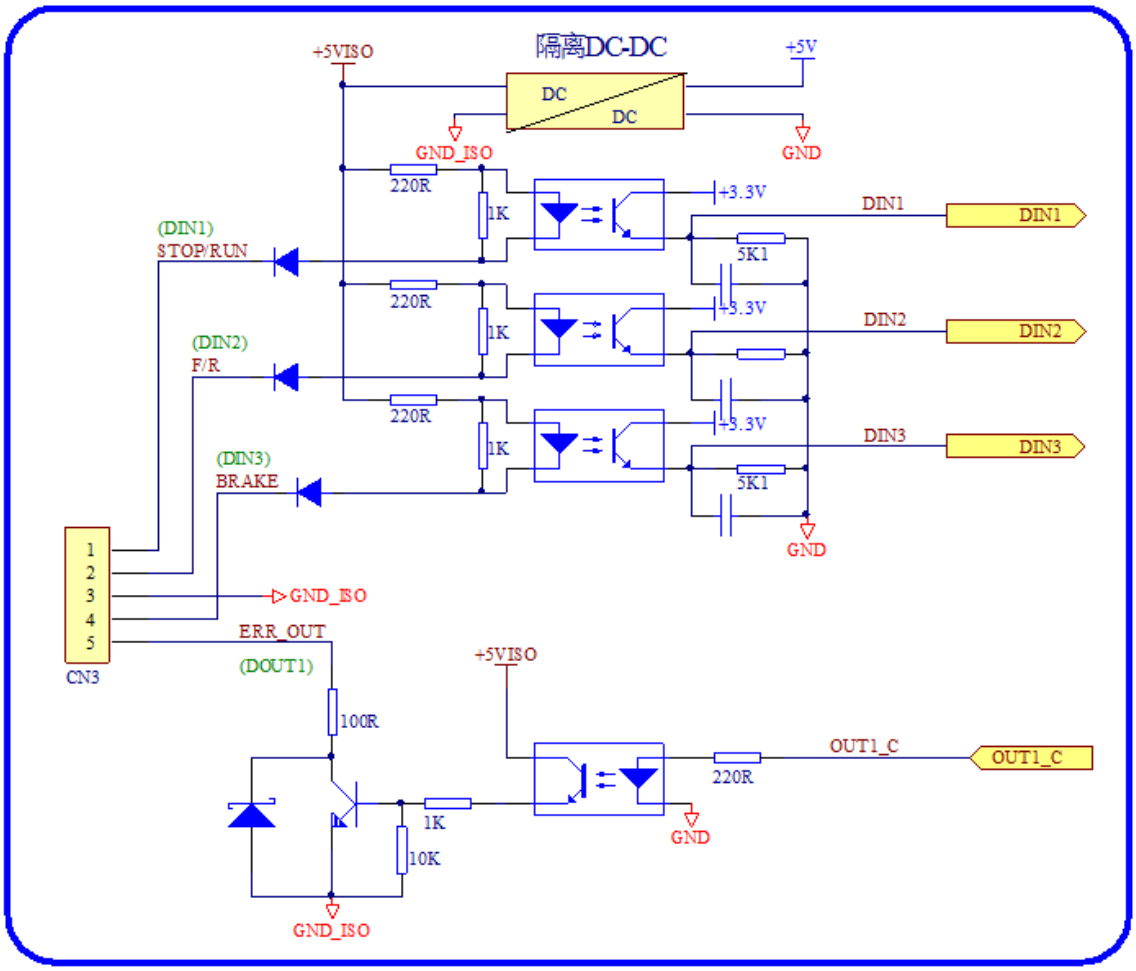


Figure 4.4-1

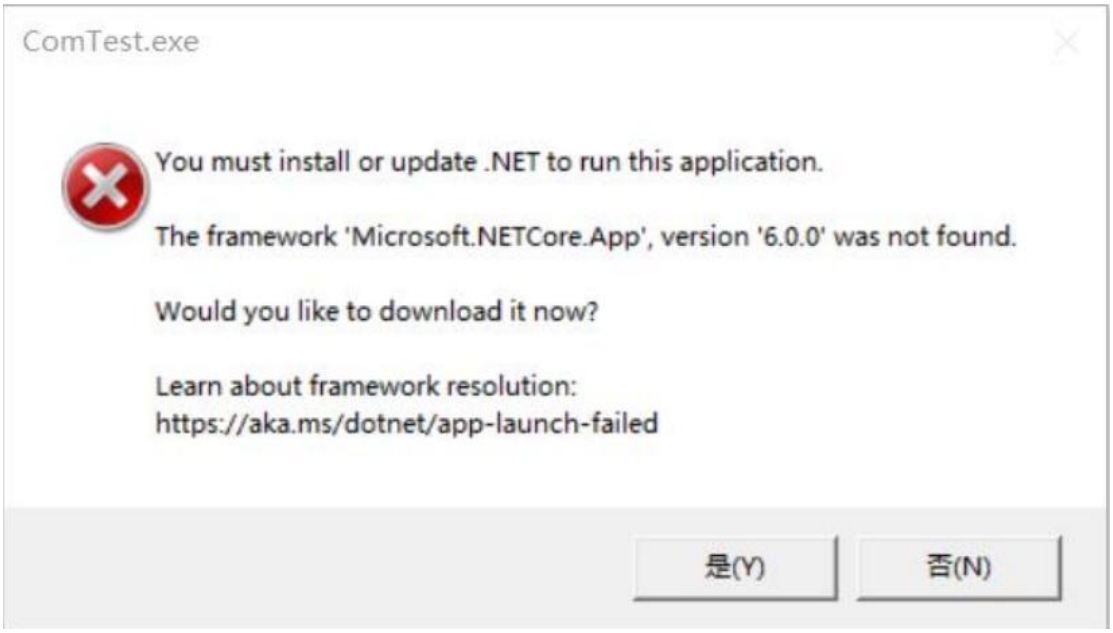
5. AMPS-tech host computer instructions

A must see before use

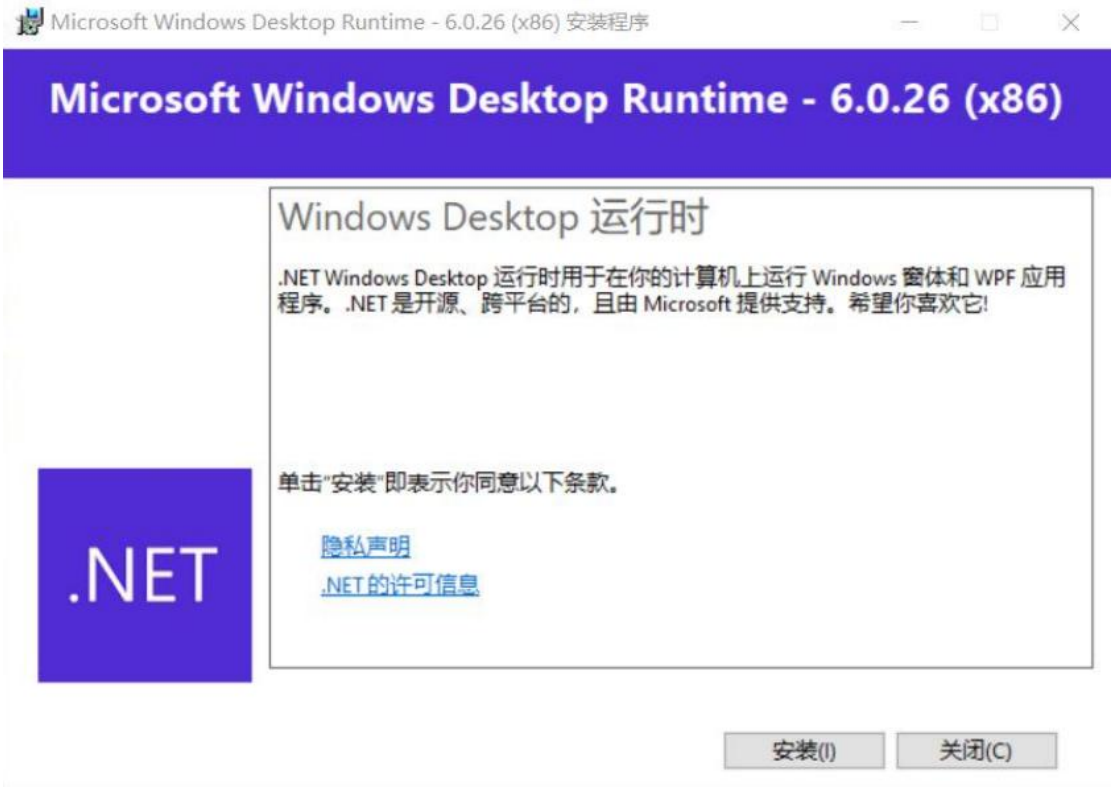
(The host computer is connected to the computer through the UART interface to USB).

1. Plugin issues

The following window will pop up when you open the AMPS host on some computers



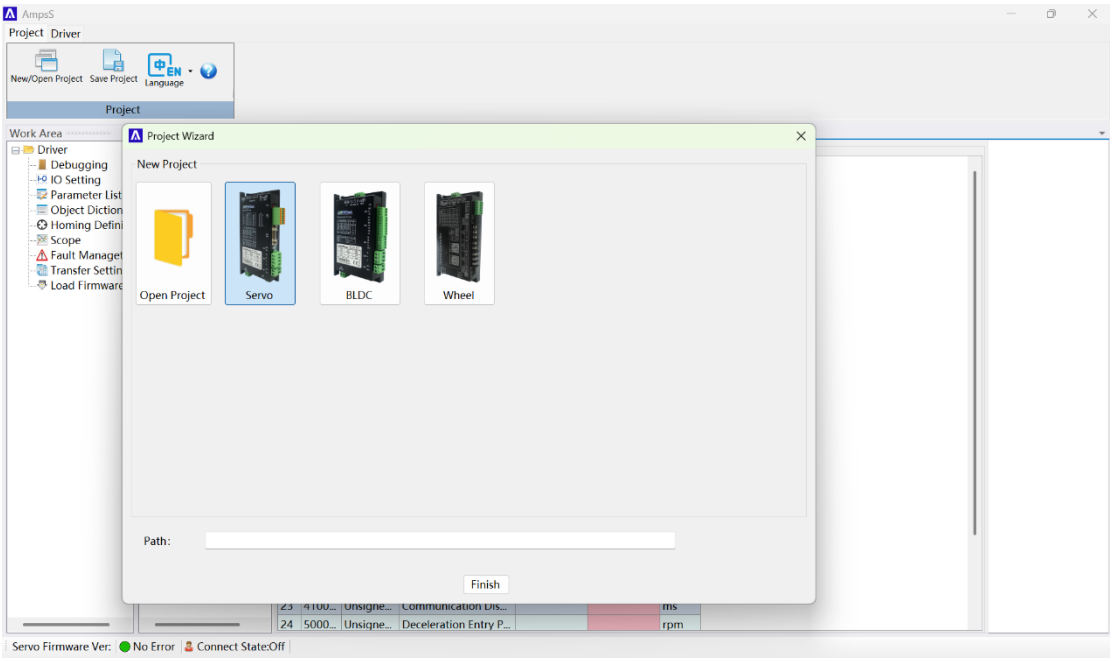
This is due to the computer missing the plug-ins required for software to run, here we click "Yes", the page will automatically jump to download the plug-in (network connection required) After the download is completed, open the installation package, click "Install", and click "Close" after the installation is completed



After that, the AMPS host software can be opened normally 。

2. Basic page introduction

After opening the host computer, the following page will pop up



Select the corresponding series according to the drive used to enter the software, here we choose the L2DB in-wheel motor series.
After entering, the interface is roughly divided into five areas

Serial port setting: Used to connect the computer to the drive
Motor control: used for motor related parameter management
Status: Displays the status of the drive and motor
Workspace: Users select different objects in the workspace to perform corresponding operations
Pop-up window: After clicking an object in the workspace, the corresponding window will pop up, and the parameter list in the workspace will default after logging in to the host computer.

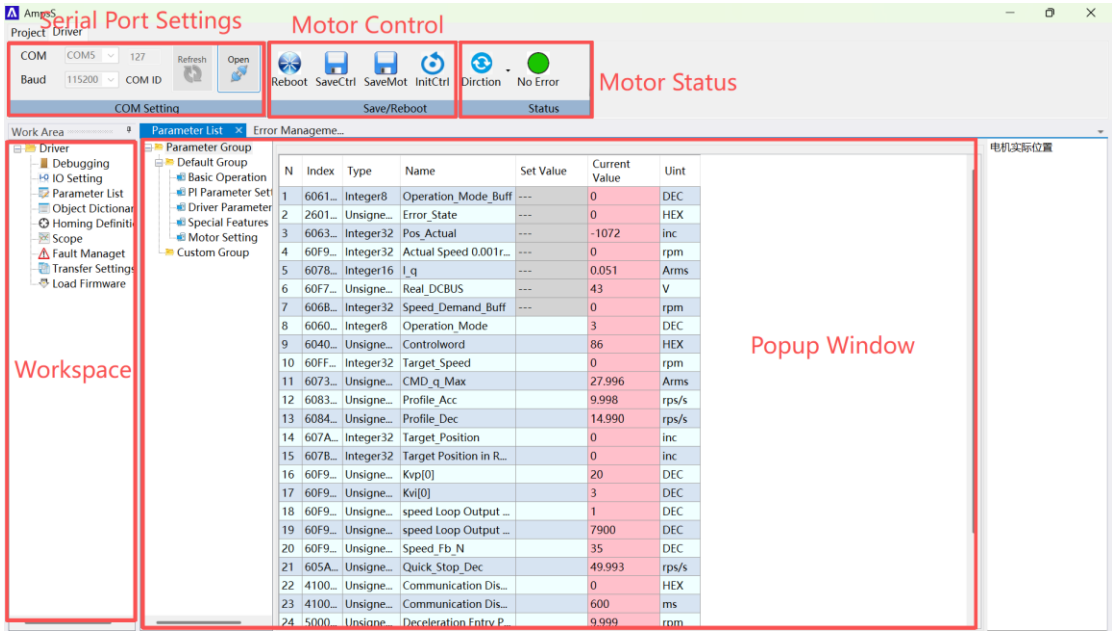


Figure 5-1 Basic page of the host computer

About adding rows in the pop-up window:

Click the pop-up window to have default parameters, if you need to add some more parameters, you can right-click in the pop-up window space, and then click "Add", the following page will appear

Enter a parameter name in the search box->Click Search-> Click >> ->Click “OK”

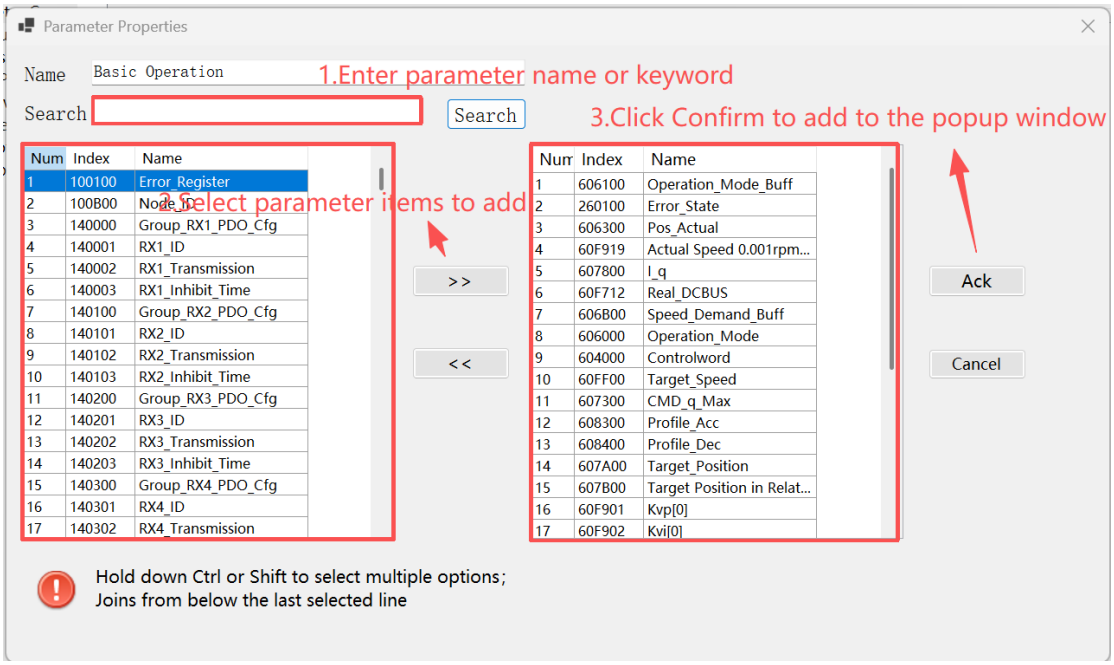


Figure 5-2 New parameters

3. Use of object dictionary

You can find "Object Dictionary" in the workspace, click "Object Dictionary", and the following pop-up window will appear

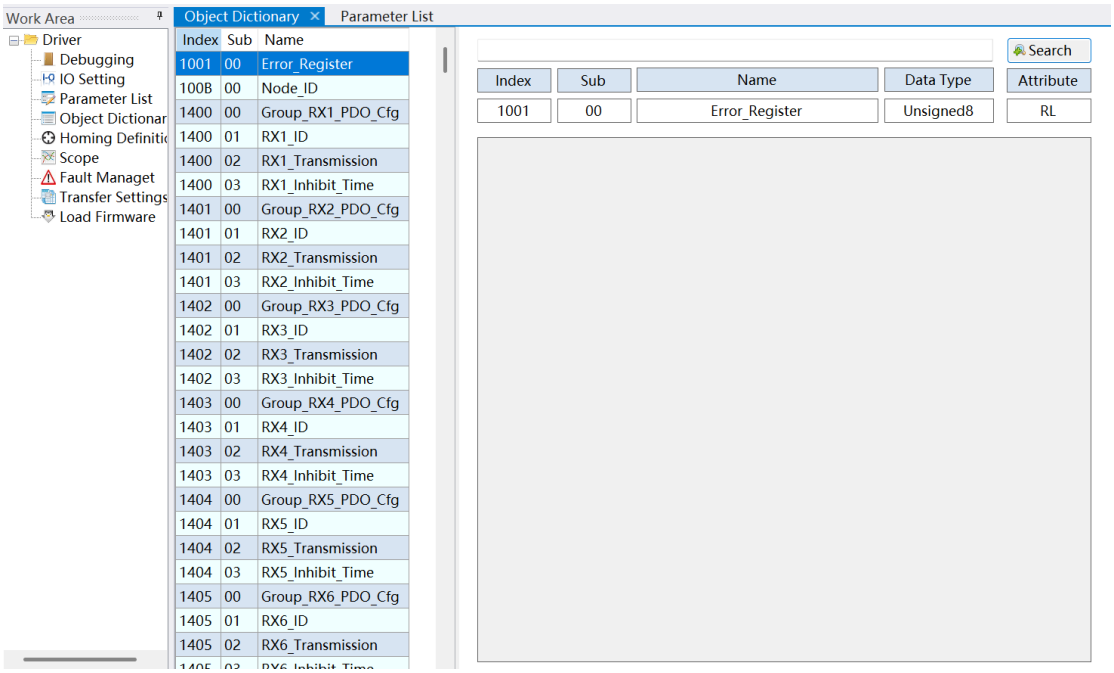


Figure 5-3 Object Dictionary Page

Through the search bar, we can quickly find information about relevant parameters, such as index number, data type, etc.

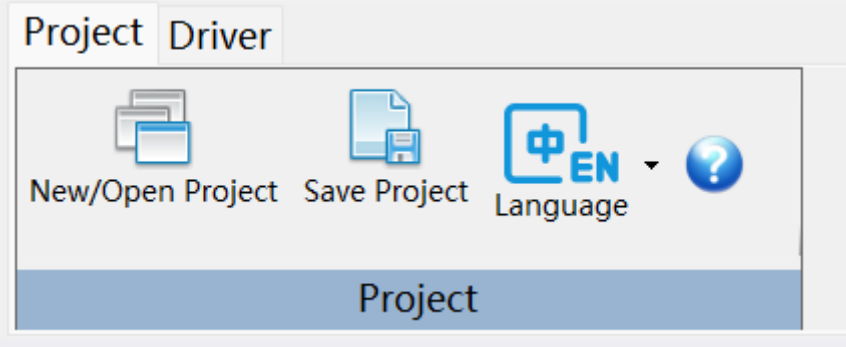
5.1 Connection of the driver to the host computer

5.1.1 Project document management

The project file is used to save the settings of configurations and parameters, and by saving the project, users can quickly load these settings in subsequent use, avoid duplicate settings, save time and labor, and can easily switch to different scenarios for experiments and tests in different working environments.

Here's how to use it:

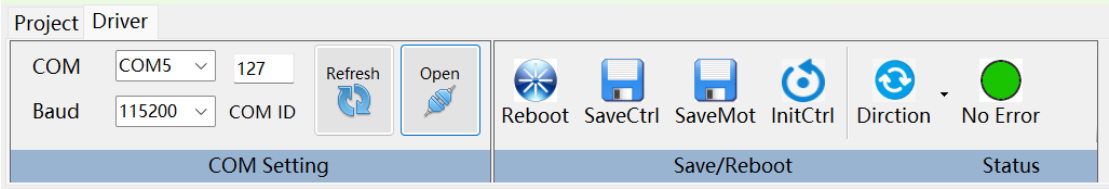
Open the host computer and click "Project" in the upper left corner, and the following menu bar will appear



- “New Project” is used to create a new project
- “Open Project”is used to open existing project files
- “Save Project”is used to save the current project in .kpjt format

5.1.2 Connection of the drive

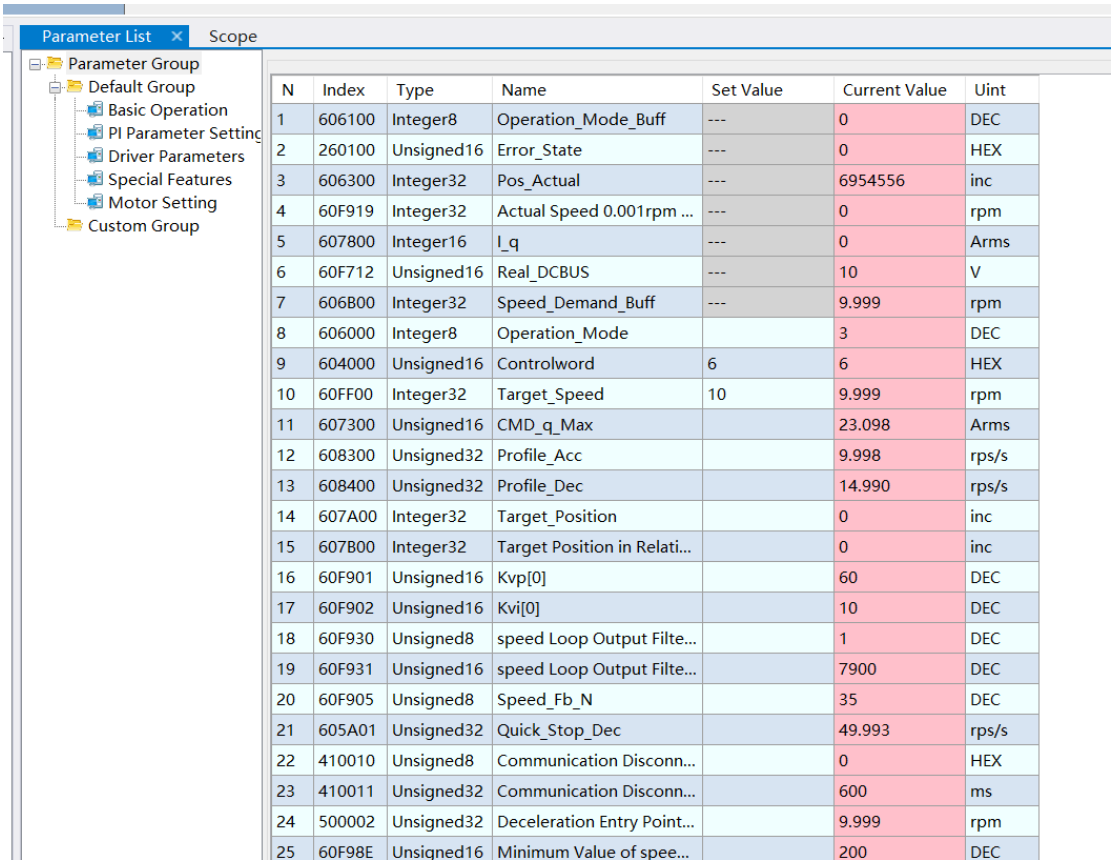
Click "Driver" in the upper left corner, and the following menu bar will appear



Select the corresponding port number, baud rate, and device ID, and click "Open"

- The device ID of any communication method is determined by the DIP switch, please refer to Chapter 4 for details. (The drive universal dial station is 127, i.e. any communication method can set the device ID to 127 to connect the drive)

Click on the parameter list - > basic parameters, and when the actual current, status words, etc. appear in it, it means that the connection is successful.



N	Index	Type	Name	Set Value	Current Value	Uint
1	606100	Integer8	Operation_Mode_Buff	---	0	DEC
2	260100	Unsigned16	Error_State	---	0	HEX
3	606300	Integer32	Pos_Actual	---	6954556	inc
4	60F919	Integer32	Actual Speed 0.001rpm ...	---	0	rpm
5	607800	Integer16	I_q	---	0	Arms
6	60F712	Unsigned16	Real_DCBUS	---	10	V
7	606B00	Integer32	Speed_Demand_Buff	---	9.999	rpm
8	606000	Integer8	Operation_Mode		3	DEC
9	604000	Unsigned16	Controlword	6	6	HEX
10	60FF00	Integer32	Target_Speed	10	9.999	rpm
11	607300	Unsigned16	CMD_q_Max		23.098	Arms
12	608300	Unsigned32	Profile_Acc		9.998	rps/s
13	608400	Unsigned32	Profile_Dec		14.990	rps/s
14	607A00	Integer32	Target_Position		0	inc
15	607B00	Integer32	Target Position in Relati...		0	inc
16	60F901	Unsigned16	Kvp[0]		60	DEC
17	60F902	Unsigned16	Kvi[0]		10	DEC
18	60F930	Unsigned8	speed Loop Output Filte...		1	DEC
19	60F931	Unsigned16	speed Loop Output Filte...		7900	DEC
20	60F905	Unsigned8	Speed_Fb_N		35	DEC
21	605A01	Unsigned32	Quick_Stop_Dec		49.993	rps/s
22	410010	Unsigned8	Communication Disconn...		0	HEX
23	410011	Unsigned32	Communication Disconn...		600	ms
24	500002	Unsigned32	Deceleration Entry Point...		9.999	rpm
25	60F98E	Unsigned16	Minimum Value of spee...		200	DEC

Figure 5.1.2-1 Basic Parameters

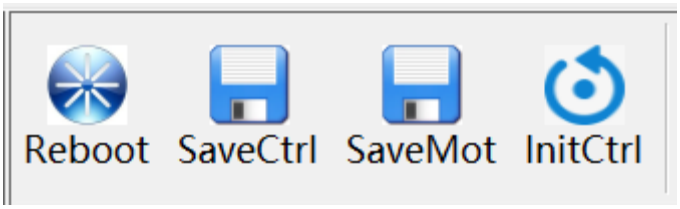
Note:

After setting the device ID and baud rate, you need to store the control parameters, and then restart the drive before it takes effect (if the storage control parameters are not effective, you can set the "storage motor parameters" to write the control parameters to the drive).

5.2 Motor parameters and control parameter management

5.2.1 Basic information of motor configuration

- Motor configuration: Go through the "Parameter List" - > "Motor Configuration"
- After the drive connection is completed, the motor parameters and control parameters can be managed through the four buttons in the figure below



- After completing the motor related parameters, click on it one after another SaveMot->Reboot->InitCtrl->SaveCtrl

note：

The motor only needs to be initialized once, and there is no need to configure it if there is no special reason such as replacing the motor or replacing the driver.

5.3 Debugging

Debugging refers to providing simple and easy-to-operate debugging functions in the host computer software to help users quickly check the working status and performance of equipment or systems. This debugging function usually does not require complex parameter settings or expertise, and is suitable for quick troubleshooting and basic performance testing.

The use of debugging is as follows：

Click " Debugging" in the workspace, and the following page will pop up

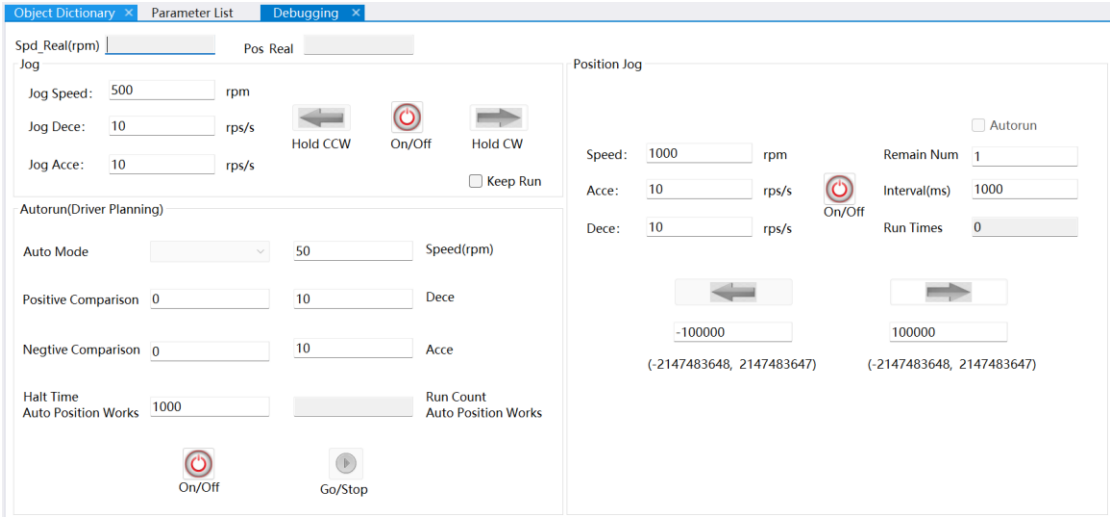


Figure 5.3-1 debugging page

The page is divided into three parts:

（1）jog： In speed jogging mode, the user can set the target speed and acceleration of the device, and the device will smoothly accelerate and decelerate according to these setpoints, and continue to move after reaching the target speed until the stop command is sent or the device stops.

- After setting the jog speed, jog Dece and jog Acce , click “on” ,When the icon corresponding to "on" changes from to indicating the drive is enabled ,motor lock shaft. After the motor locks the shaft, press and hold "Hold CW" or "Hold CCW" to rotate the motor， We can also click "Keep Run", check the option, and click " Hold CW " or " Hold CCW "to rotate the motor.

（2）Position jog： Users can input the coordinate information of the target location, and the device will move smoothly from the current position to the

target location according to the set speed and acceleration based on this coordinate information.

- After setting the corresponding speed, acceleration and deceleration, click "on" to set the corresponding position to rotate the motor， When the icon corresponding to "on" changes from to indicating the drive is enabled，motor lock shaft. Click to rotate the motor; After setting the remaining num of runs and the interval, check Autorun, and the motor will automatically move between the two positions set.

（3）**Autorun**：The automatic operation mode can be selected from no control, position control, speed control, time control and position control in oper. Speed control and position control are the same as the above concepts of jog and position jog, which are not explained. Below is an explanation of time control and position control in oper.

Time control：The forward and reverse times can be set, and the motor will continue to rotate forward and reverse.

As shown in the figure, through the time control, the forward transfer running time is **2000ms**, the reverse running time is **2000ms**, the running speed is **1000rpm**, and the acceleration and deceleration are **100rps/s**.

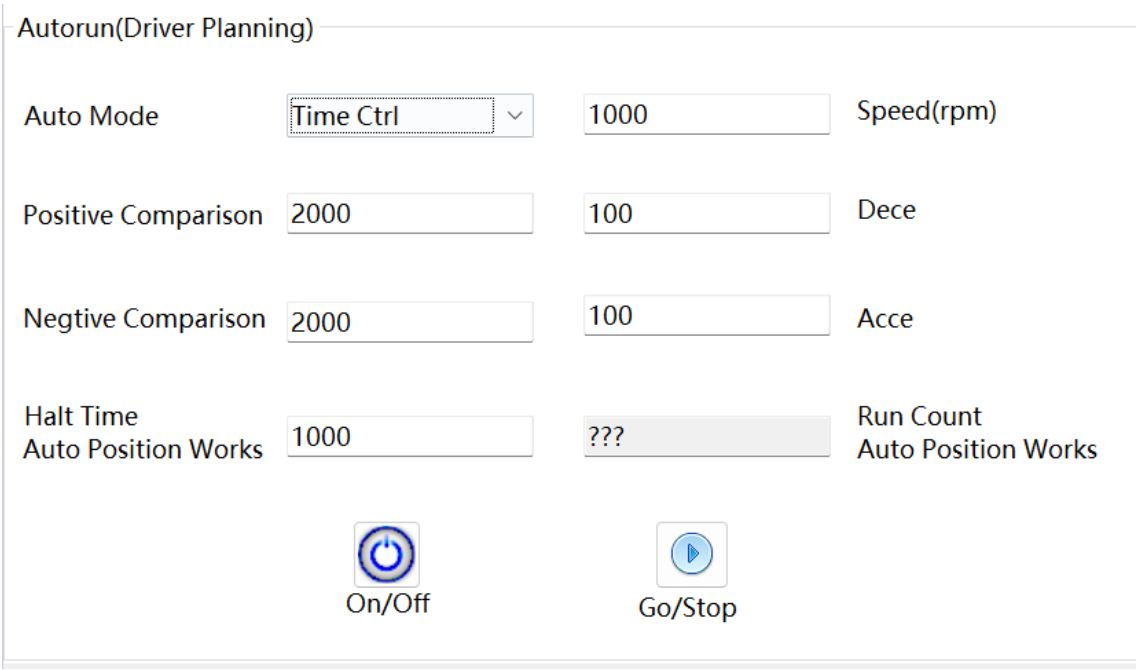


Figure 5.3-2 AutoRun

position control in oper.： By setting the positive comparison point and negative comparison point, the motor can run back and forth between the two positions, and set the Halt time to set the time to stay in a certain position. (This mode is similar to checking Auto Run in point position mode)

note：

If you need to switch modes or modify parameters, you need to click  Pause first, and click  Continue after modifying the parameters and modes.

5.4 IO setting

Click IO settings in the work area to enter the digital input and digital output modules.

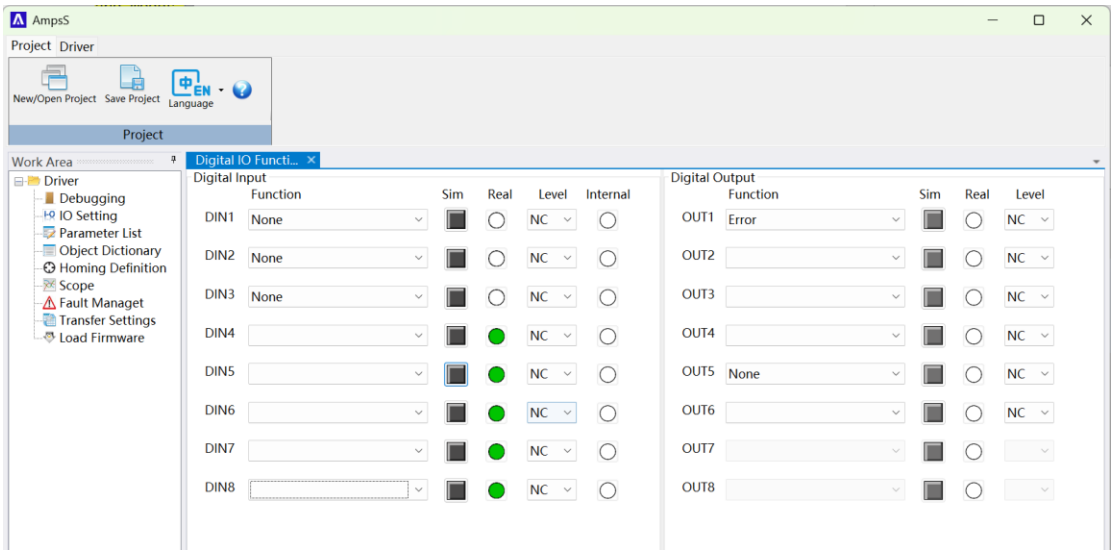


Figure 5.4-1 IO settings

5.4.1 Input mode

Function: Click  the area block to select the function

Simulation:  Indicates the simulation power-on. When the power is on  , when the power is off 

Actual Input: Indicates the actual number of inputs

Level: (1) Normally open mode - high level on, low level not on

(2) Normally closed mode - high level does not turn on, low level conduction is on

Valid input: Determined jointly by simulation (or actual input) and level attributes. It is represented by  when indicating digital logic 0, and by  when indicating digital logic 1.

Feature name	Function description
Quick Stop	For emergency situations, stop the system
Enable	For enabling drivers, if using the IO port Enable then the status word cannot be written
P Limit+	Use with hardware limit switches
P Limit-	
Invert Signal	In speed and moment mode, the speed command can be reversed

Table 5.4.1-1 List of input function modules and descriptions

5.4.2 Output mode

Function： Click 

to select the function.

Simulation：  Indicates the simulation power-on situation. Power-on is  ,

power-off is  .

Actual output: Indicates the actual digital output situation.
Electrical Level: (1) Normally open mode - High level is conductive, low level is disconnected.
(2) Normally closed mode - High level is disconnected, low level is conductive.
Effective output: Jointly determined by the simulation (or actual output) and electrical level property. Indicates the digital logic 0 is  , the digital logic 1 is

 .

Table 5-2 Output Function Module List and Description

Function name	Description
Drive error	The drive has an error
The motor brake takes effect	The order to hold the gate has taken effect

5.5 Trigger-based Oscilloscope

A trigger-based oscilloscope is a special type of oscilloscope used to capture and display specific events or signals in a waveform diagram. It controls the timing of the oscilloscope's data acquisition through a trigger signal to ensure that the waveform is only displayed under specific conditions, making it easier to observe and analyze.

Click on "Oscilloscope" in the work area to po up the following page.

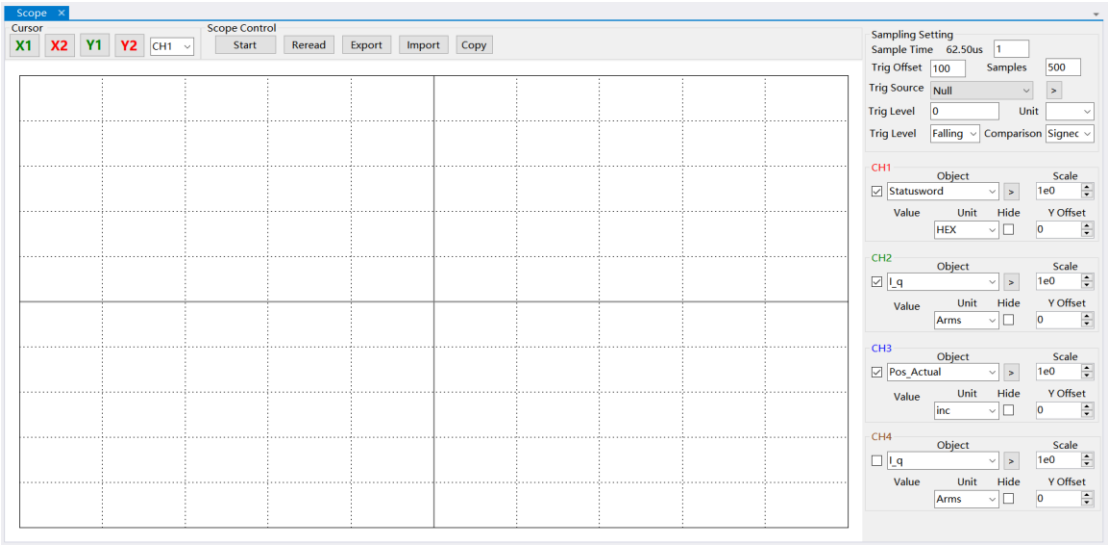


Figure 5.5-1 Oscilloscope Page

Below are some explanations of the oscilloscope-related parameters:

Sampling period: The period for collecting data, set to 1 indicates that data is collected every 62.5us.

Number of acquisitions: Indicates the total number of data collected in this sampling, set to 500 indicates that 500 pieces of data are collected.

Pre-trigger data points: The number of samples taken before the trigger source is triggered, set to 100 indicates that 100 samples are taken before the trigger.

Trigger source and trigger level: You can set when to start sampling through this setting, and the condition is set by yourself.

Trigger edge: Click to change to rising edge trigger, falling edge trigger, or edge trigger.

Object: The sum of the data lengths of the four objects being sampled at the same time is a maximum of 64 bits, for example, 2 32-bit objects, or 4 16-bit objects.

Cursor: By clicking the button, you can select the corresponding cursor, which will be displayed on the oscilloscope and select the channel you need to observe on the right side of the cursor.

Copy: Copy the sampled data to the clipboard.

Export: Export the sampled data to a .scope file.

Import: Import the .scope file and display the waveform.

Re-read data: Read out and display the waveform of the recently collected data from the driver.

If the required parameters are not in the default object list of the channel, you can click > to jump to the "Object Dictionary", enter the parameter name in the search box, and then double-click to add the parameter.

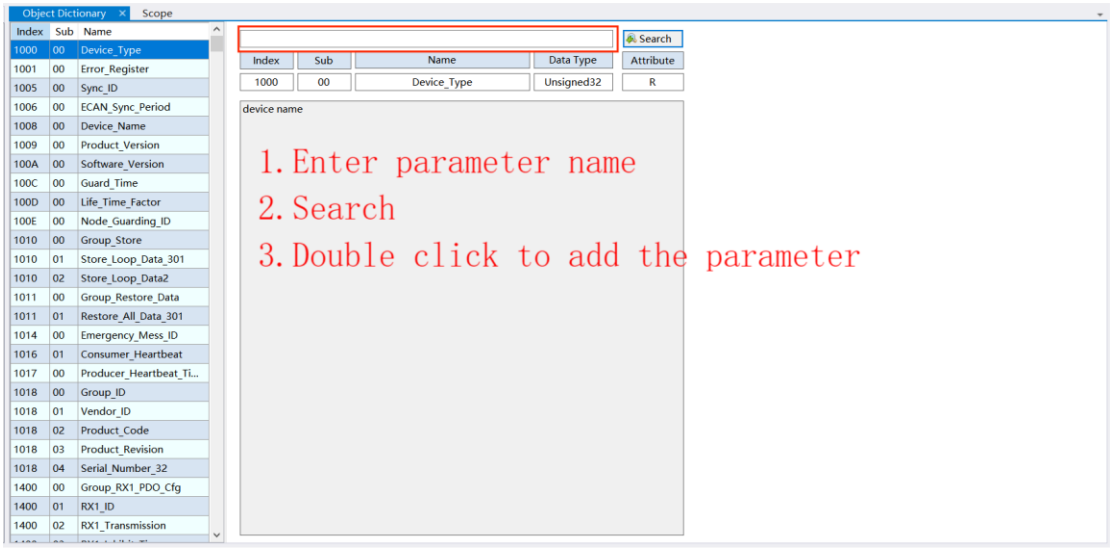


Figure 5.5-2 Adding Parameters

Here is an example of an oscilloscope reading the actual position versus the actual current:

(1) First, set the working mode to "3" mode, then set the contour acceleration and contour deceleration to 50, and the target speed to 300.

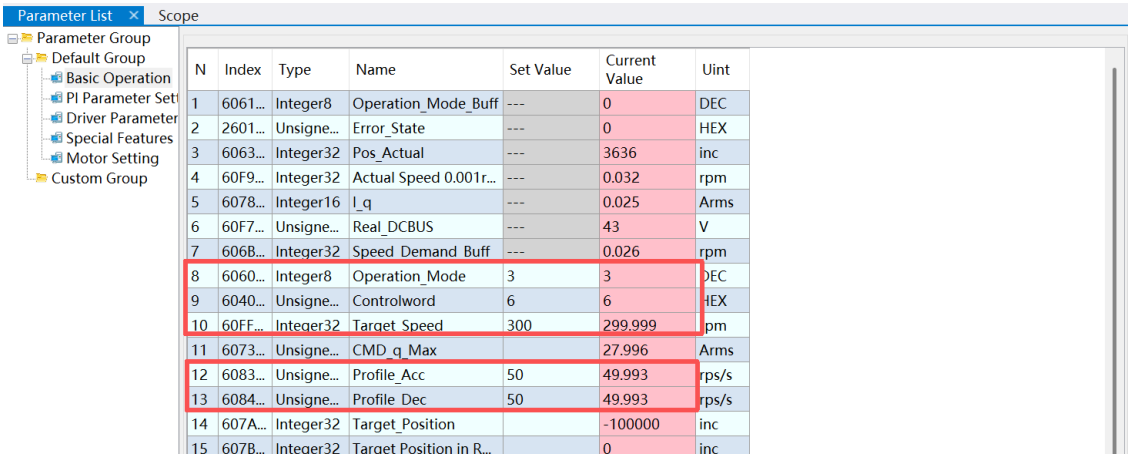


Figure 5.5-3 Modifying Parameters

(2) Open the oscilloscope and follow these steps:

First step: On the right CH1, set the object to the actual position.

Second step: Set the trigger source to NULL, that is, click "Start Acquisition" to start collecting data immediately.

Third step: Click "Start Acquisition" and wait for the progress bar to complete, which means the collection is successful.

Fourth step: Switch the "actual position" in the first step to "actual current" and click "Start Acquisition" again to switch the image from the actual position image to the actual current image.

Note：

If you want to set the sampling trigger condition, such as setting the trigger condition to the effective target speed reaches 500rpm, you need to confirm it by "Enter" on the keyboard, just like modifying the control word.

Every time you switch objects or channels, you need to click "Start Collection" once

We can zoom in on the image through the "scale" on the right side;

In addition, you can also zoom in on the waveform by pressing the middle mouse button for a long time.

Move the image up and down through "Y-axis offset";

Click "X1" and "Y1" near the cursor, and two vertical lines perpendicular to the X-axis and Y-axis will appear on the screen, and the coordinates of the intersection point of the two lines will be displayed in the upper right corner of the image. X2 and Y2 are used in the same way. dX and dY represent the difference between X1 and X2, Y1 and Y2.

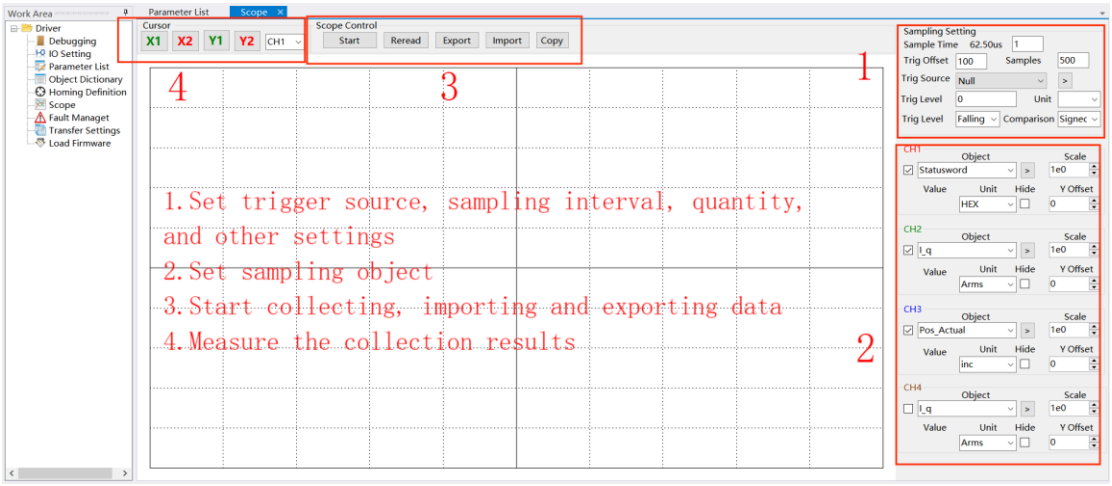


Figure 5.5-4 Steps to Read the Actual Position

The above lists the steps to read the actual position, and the method to read parameters such as actual speed is basically the same.

The above lists the steps to read the actual position, and the method to read parameters such as actual speed is basically the same.

Click "Export" to generate a .wave file 

at the specified path(customized),

Click "Import" again to display this waveform on the oscilloscope.

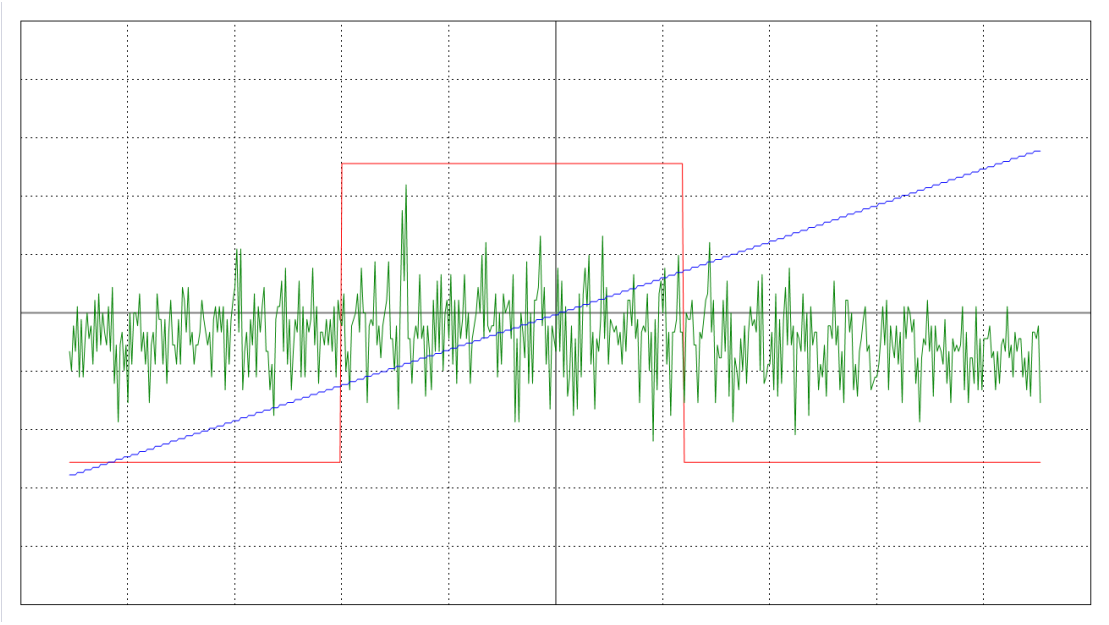


Figure 5.5-5 The waveform after importing the test.wave file

In addition, we can also click "Copy" to copy the data to the Excel table.

5.6 Historical Errors and Alarm

When the icon 

of the master station changes to 

, it indicates that a fault has occurred.

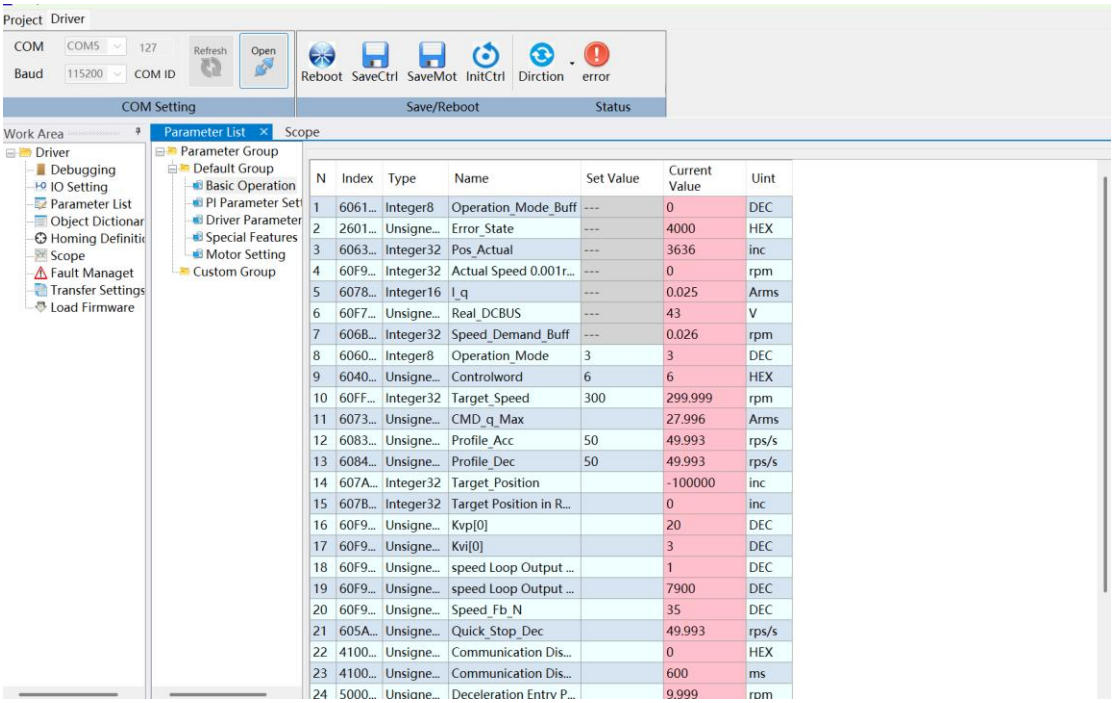


Figure 5.6-1 Fault Example

Click 

directly to jump to fault management, or click on fault management in the work area.

The fault management page is as follows:

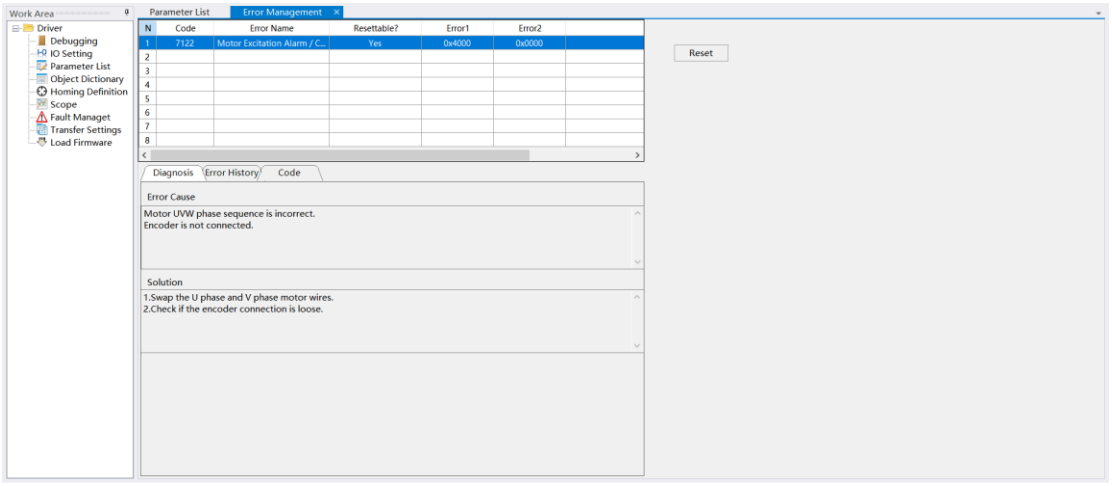


Figure 5.6-2 Fault Management

Through the host computer page, we can directly get the cause and solution of the failure

5.7 Driver Parameter Reading and Writing

Through driver parameter reading and writing, you can save the driver configuration in the master station or controller, which is convenient for subsequent device restoration and configuration. This is especially useful when replacing or maintaining equipment, as it allows you to quickly apply previous configurations to new equipment, saving debugging time and cost.

5.7.1 Read Setting

Click on "Transfer Setting" in the work area -> "Read Setting" -> "Open List" (select a file with a .oparam suffix) -> "Read" -> "Save to File".

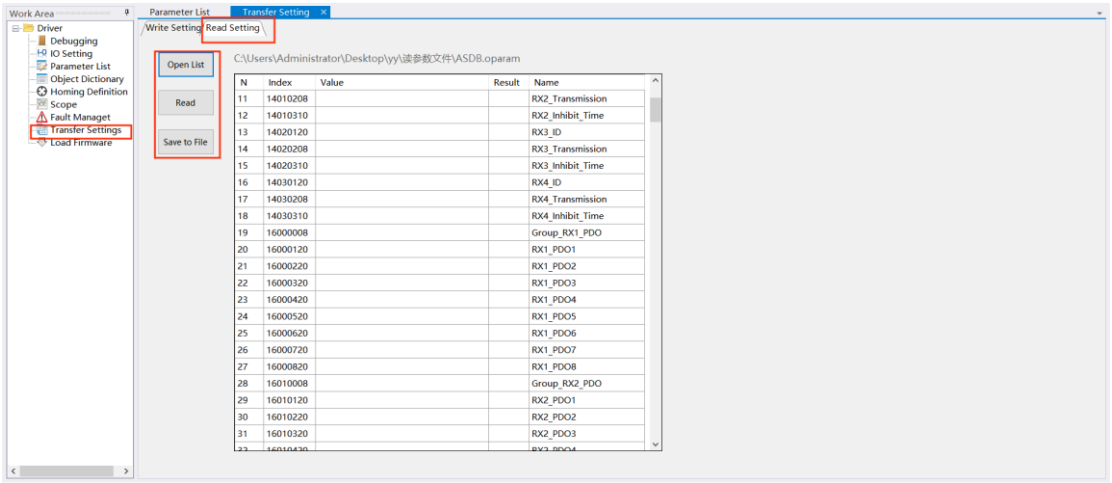


Figure 5.7.1-1 Read Driver Configuration

5.7.2 Write Driver Configuration

Click on "Transfer Setting" in the work area -> "Write Setting" -> "Open File" (select a file with a .iparam suffix) -> "Write" -> "Save in EEPROM"

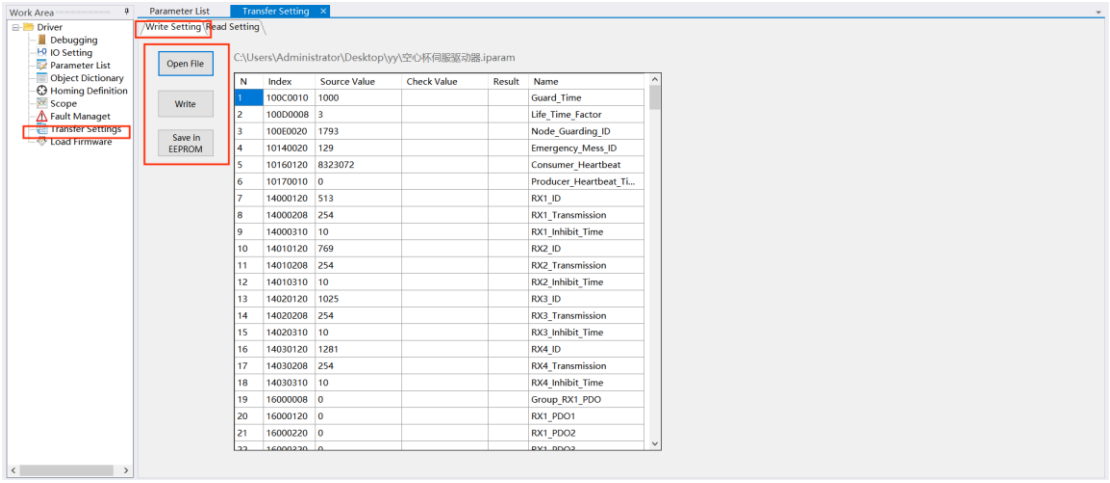


Figure 5.7.2-1 Write Driver Configuration

5.8 Load Firmware

If for some special reasons, you need to re-flash the firmware, you can follow these steps:
Click on "Load Firmware" → select the file → click on "Download"

Figure 5.8-1 Firmware Download

6. Bus communication function

In this machine, the communication interface is divided into UART interface, RS485/CAN bus interface, and the bus interface hardware adopts an active isolation design.

6.1 UART communication function

UART Communication Format

The UART communication format of this device is: 115200,8,N,1

Which means the baud rate is fixed at 115200 bps, 8 data bits, no parity check, and 1 stop bit.

UART Communication Protocol (Custom Protocol)

The UART communication of this device follows a strict master-slave protocol. The host computer/main controller sends one or multiple consecutive data frames to this device, and upon receiving correct data, this device will respond with one or multiple corresponding consecutive data frames.

The UART communication protocol uses a fixed 10-byte format:

Device Address	**Command Word**	**Object Address**		**Error/ Clear**	**Data Area**				**Check**
Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10
ID	CMD	AddrH	AddrL	ErrR	Data (MSB)	Data (N-1)	Data (N-2)	Data (LSB)	Check

ID: The UART address of the local machine, UART1 supports both 0x01 and 0x02 (when using 0x01, it corresponds to motor 1, 0x02 corresponds to motor 2), UART2 is fixed as 0x01 (corresponding to motor 2). Then the machine will not respond

CMD: Command word, divided into reading command 0xA0 and writing command 0x51, 0x52, 0x54

The specific definition of the command word is as follows:

1) Read command, the host reads the data of the relevant object address of the machine

The host sends the CMD	**The machine replied to CMD**	**Corresponding meaning**
0xA0	0xA1	The object data is 8 bits:[Data(LSB)]
0xA0	0xA2	The object data is 16 bits:[Data(N-2)~Data(LSB)]
0xA0	0xA4	The object data is 32 bits:[Data(MSB)~Data(LSB)]
0xA0	0x5F	The object address does not exist and the data area

		is invalid
0xA0	0x80	If the verification error occurs, the data area is invalid

2) Write commands, and the host writes data to the address of the relevant object on the machine

The host sends the CMD	The machine replied to CMD	Corresponding meaning
0x51	0x61	Object data is 8-bit: [Data4], write successful
	0x50	Data type mismatch, write failed
	0x58	Object address is not writable, write failed
	0x5F	Object address does not exist, write failed
0x52	0x62	Object data is 16-bit: [Data3^Data4], write successful
	0x50	Data type mismatch, write failed
	0x58	Object address is not writable, write failed
	0x5F	Object address does not exist, write failed
0x54	0x64	Object data is 32-bit: [Data1^Data4], write successful
	0x50	Data type mismatch, write failed
	0x58	Object address is not writable, write failed
	0x5F	Object address does not exist, write failed

AddrH, AddrL: 8 bits higher and 8 bits low for the object address

ErrR: Error Reporting and Clearing.

If ErrR is 0xCE in any valid read/write frame of the host, the local error will be cleared.

The data in the ErrR returned by the machine represents the native error message, and the 8-bit represents 8 kinds of errors, 0 has no error, and 1 has an error. The error breakdown is as follows:

ErrR that the machine responds to	Misdescription
bit0: [LSB]	Reserved
bit1:	Follow error exceeds allowable value
bit2:	Encoder error
bit3:	Motor overload
bit4:	Driver temperature too high
bit5:	DC bus voltage too high
bit6:	DC bus voltage too low
bit7: [MSB]	Driver output short circuit

Data(MSB)~Data(LSB): Data area, with the most significant byte (MSB) first and the least significant byte (LSB) last.

Check: Checksum，`Check=[Byte1~Byte9]` take the lower 8 bits.

UART Communication Protocol 2 (Custom Protocol)

Because different customers need different agreements for customization, please contact the manufacturer if you have customization requirements.

UART communication examples

Example 1: Read the actual DC bus voltage of the drive

By referring to the "Table F1-3 Measurement Data" in "Appendix 1 Common Object List", the object address of "Actual DC Bus Voltage" is 0x5001, and it is a 16-bit signed number.

Host should send: 01 A0 50 01 00 00 00 00 00 F2

Assume the current actual DC bus voltage is 36V (the underlined part in the response frame is valid data

Device will respond: 01 A2 50 01 00 00 00 00 24 18

Example 2: Read the actual position of the motor encoder

By referring to the "Table F1-3 Measurement Data" in "Appendix 1 Common Object List", the object address of "Actual Position Value" is 0x7071, and it is a 32-bit signed number.

Host should send: 01 A0 70 71 00 00 00 00 00 82

Assume the current actual motor encoder position is -8237 (its hexadecimal value is 0xFFFFDFD3, the underlined part in the response frame is valid data.

Device will respond: 01 A4 70 71 00 FF FF DF D3 74

If an error occurs in the driver (e.g., "Follow error exceeds allowable value", meaning bit1 in ErrR is 1, so ErrR=0x02)

Device will respond: 01 A4 70 71 02 FF FF DF D3 76

Example 3: Writing Target Speed (rpm)

By referring to "Table F1-1 Basic Mode and Control" in "Appendix 1 Common Object List", the object address of "Target Speed (rpm)" is 0x70B1, and it is a 16-bit signed number.

Assume the data to be written is 100 (hexadecimal: 0x0064)

Host should send: 01 52 70 B1 00 00 00 00 64 D8

Device will respond: 01 62 70 B1 00 00 00 00 64 E8

Example 4: Writing Target Speed (Fine Speed Command)

To achieve a more precise speed command, refer to "Table F1-1 Basic Mode and Control" in "Appendix 1 Common Object List": the object address of "Target Speed" is 0x70B2, and it is a 32-bit signed number.

Assume the target speed is 3.21 rpm. Calculate the corresponding DEC value using the formula:

U[y,x]: [DEC] = ([rpm] * 512 * [Feedback Precision]) / 1875

(Here, [Feedback Precision] = 4096)

[DEC] = (3.21 * 512 * 4096) / 1875 = 3590 (hexadecimal: 0x0E06)

Host should send: 01 54 70 B2 00 00 00 0E 06 8B

Device will respond: 01 64 70 B2 00 00 00 0E 06 9B

6.2 RS485 Communication

RS485communication parameters

RS485communication parameters are two types:

A)38400,8,N,1 B)115200,8,N,1

The baud rate is fixed at 38400/115200bps, the number of data bits is 8 bits, there is no parity, and there is 1 stop bit.

The baud rate is determined by the BIT2 of the DIP switch SW2. When BIT8 is "OFF", the baud rate is 38400bps, and when BIT2 is "ON", the baud rate is 115200bps.

RS485 Communication Protocol (Autonomous Protocol)

The native RS485 communication follows the strict master-slave station protocol, which can realize the control of multiple slaves by one hostThe host computer/master controller sends one frame or multiple consecutive frames of data to the machine, and the machine will respond to the corresponding data of one frame or multiple consecutive frames when it receives the correct data The difference between UART communication and RS485 communication is that RS485 will not reply if there is any error in check byte.

RS485 communication protocol format:

Device ID	**Function code**	**Object address**		**Error/ Clear**	**Data**				**Check**
Byte1	Byte2	Byte3	Byte4	Byte5	Byte 6	Byte7	Byte8	Byte9	Byte10
ID	CMD	AddrH	AddrL	ErrR	Data (MSB)	Data (N-1)	Data (N-2)	Data (LSB)	Check

ID: It is the address of RS485 communication,set by DIP switch SW3.

(Motor 1 is the station number corresponding to DIP switch SW3, motor 2 is the station number +1 corresponding to DIP switch SW3)

If ID is not exsit,driver willnot reply.

CMD: Command word, divided into read command 0xA0 and download 0x51, 0x52, 0x54

The details of function is as follows:

1)Read ,hostreads data from the object address of driver

Host sendingCMD	**Driver replyCMD**	**Description**
0xA0	0xA1	Driver reply 8bits data:[Data(LSB)]
0xA0	0xA2	Driver reply16bits data:[Data(N-2)~Data(LSB)]
0xA0	0xA4	Driver reply32bits data:[Data(MSB)~Data(LSB)]
0xAO	0x5F	Error:object is not exist.

2)Write ,host writes data into object address of driver

Host sending CMD	Driver reply CMD	Description
0x51	0x61	Writing 8bits data[Data4]successfully
	0x50	Error: data length is wrong.
	0x58	Error: object address is not writable
	0x5F	Error: object address is not exsit
0x52	0x62	Writing 16bits data[Data3~Data4]successfully
	0x50	Error: data length is wrong.
	0x58	Error: object address is not writable
	0x5F	Error: object address is not exsit
0x54	0x64	Writing 32bits data[Data1~Data4]successfully
	0x50	Error: data length is wrong.
	0x58	Error: object address is not writable
	0x5F	Error: object address is not exsit

AddrH,AddrL:Higher 8bits and lower 8bits of object address

ErrR:Error code and clear command

During host sending strings,if ErrR is 0xCE,it will clear error in driver..

The data in the ErrR returned by the machine represents the native error message, which is represented in 8bit 8 types of errors, 0 have no errors, and 1 has errors. The error breakdown is as follows:

ErrR	Decriptions
bit0: [LSB]	Reserved
bit1:	Following error
bit2:	Encoder error
bit3:	Motor overload
bit4:	Driver over-temperature
bit5:	Bus voltage too high
bit6:	Bus voltage too low
bit7: [MSB]	Driver output short-circuit

Data(MSB)~Data(LSB): Data area, high in front, low in back.

Check: Checksum,Check=Sum[Byte1~Byte9],then only check the lower byte.

RS485 Protocol 2 (Custom Protocol)

Because different customers need different customized agreements, please contact the manufacturer if you have customization requirements.

RS485 communication example

Example 1: Read “Actual bus voltage” in driver

By consulting the list of "Table F1-3 Measurement Data" in "Appendix 1 List of Common Objects", it can be seen that the address of the "Actual DC Bus Voltage" object is 0x5001, and it is a 16-bit signed number.

Host send: 01 A0 50 01 00 00 00 00 00 F2

If the actual bus voltage is 36V,then the driver will reply:

01 A2 50 01 00 00 00 00 24 18

Example 2: Read “Actual position” in driver

By consulting the list of "Table F1-3 Measurement Data" in "Appendix 1 List of Common Objects", the "actual position value" can be known The object address is 0x7071 and is a 32-bit signed number

Host send: 01 A0 70 71 00 00 00 00 00 82

If the actual position is-8237,convert to HEX 0xFFFFDFD3

Then the driver will reply:

01 A4 70 71 00 FF FF FD D3 74

If there is “Following error” alarm in driver at the same time ,then the driver will reply:

01 A4 70 71 02 FF FF FD D3 76

Example 3: Write “Target velocity_rpm” in driver

By consulting the list of "Table F1-1 Basic Modes and Controls" in "Appendix 1 List of Common Objects", the "target speed rpm" can be knownThe object address is 0x70B1 and is a 16-bit signed number

Suppose the data to be written is 500, i.e. hexadecimal is 0x01F4

Host send: 01 52 70 B1 00 00 00 01 F4 69

Driver reply: 01 62 70 B1 00 00 00 01 F4 79

Example 4: Write target speed (finer speed command).

In order to achieve more refined speed commands, the "target speed" can be found by consulting the "Table F1-1 Basic Modes and Controls" list in "Appendix 1 List of Common Objects"The object address is 0x70B2 and is a 32-bit signed number

If we want to write 3.21rpm,according to conversion formula([DEC]=([rpm]*512*4096)/1875,we can calculate the DEC value: [DEC]=(3.21*512*4096)/1875=3590,convert to HEX 0E06,

Host send: 01 54 70 B2 00 00 00 0E 06 8B

Driver reply: 01 64 70 B2 00 00 00 0E 06 9B

6.3 CAN Communication

The native CAN interface supports the Canopen SDO data transmission protocol, which is mainly used to transmit low-priority objects between devices, which is similar to the way of MODBUS, that is, after the master is issued, the data response needs to be returned from the slave: Client→Server/Server→
The basic structure of Client.SDO is shown in Table 6.3.1-1:
Table 6.3.1-1 Basic structure of SDO

Byte0	Byte1-2	Byte3	Byte4-7
SDO Command specifier	Object Index(LSB…MSB)	Object SubIndex	Maximum 4 bytes ofdata

Object index is 2 bytes ,lowest byte is in the front and highest byte is in the back.For example,if the index is 0x606C,then Byte1is 6C,Byte2 is 60.

Read

When reading parameters, the format of sending and receiving SDO packets is shown in Tables 4.3.2-1 and 4.3.2-2.
Table 6.3.2-1 Sending SDO packets when reading parameters

Identifier	DLC	Data							
		0	1	2	3	4	5	6	7
0x600+Node_ID	8	Sending CMD	Index		Subindex	00			

Table 5.3.2-2 SDO packets are received when reading parameters

Identifier	DLC	Data							
		0	1	2	3	4	5	6	7
0x580+Node_ID	8	Receiving CMD	Index		Subindex	Data			

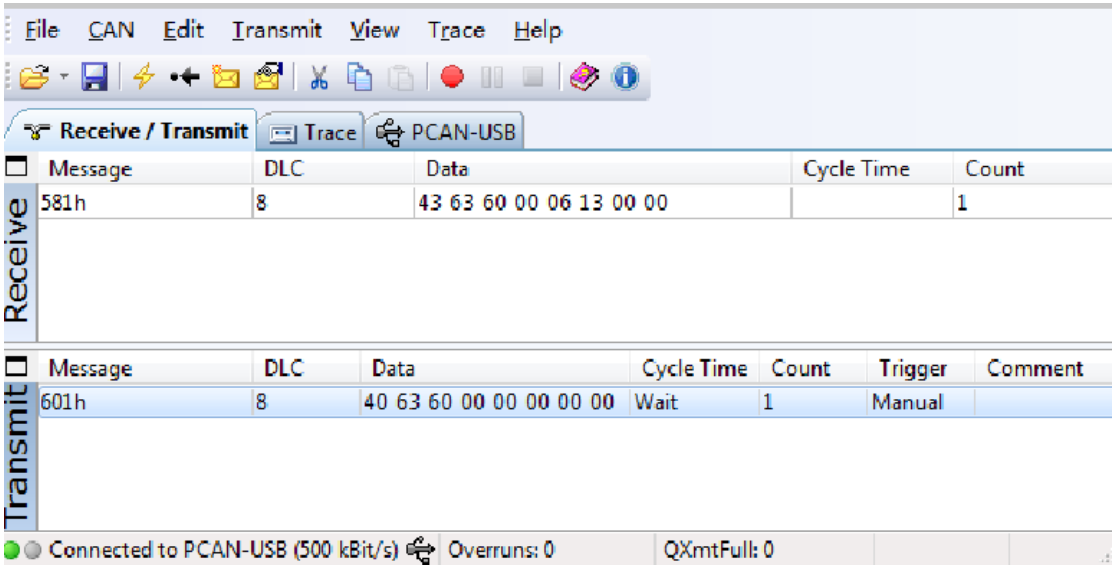
Note: The sending command is 0x40.
If receiving 1 byte, the receiving CMD is 0x4F.
If receiving 2 bytes, the receiving CMD is 0x4B.
If receiving 4 bytes, the receivingCMD is 0x43.
If receiving data failed, the receiving CMD is 0x80.

Example: Using Peak-CAN card to send command for reading"Actual position"(Obejcet address is0x606300),then it needs to send SDO string as follows:

601	40	63 60	00	00 00 00 00
(0x600+Node-ID)	(CMD)	(Index)	(Subindex)	(Data)

If the —Actual positionǁ is 4870(HEX is 1306),then it will reply:

581	43	63 60	00	00 00 00 00
(0x580+Node-ID)(CMD)	(Index)	（Subindex）		（Data）



Write

The formats of SDO packets sent and received when changing parameters are shown in Tables 6.3.3-1 and 6.3.3-2.

Table 6.3.3-1 Sending SDO packets when parameters are modified

Identifier	DLC	Date							
		0	1	2	3	4	5	6	7
0x600 +Node_ID	8	Sending CMD	Index		Subindex	Data			

Table 6.3.3-2 Receiving SDO Messages When Modifying Parameters

Identifier	DLC	Date							
		0	1	2	3	4	5	6	7
0x580 +Node_ID	8	Receiving CMD	Index		Subindex	Data			

Note: The sending command is as follows:

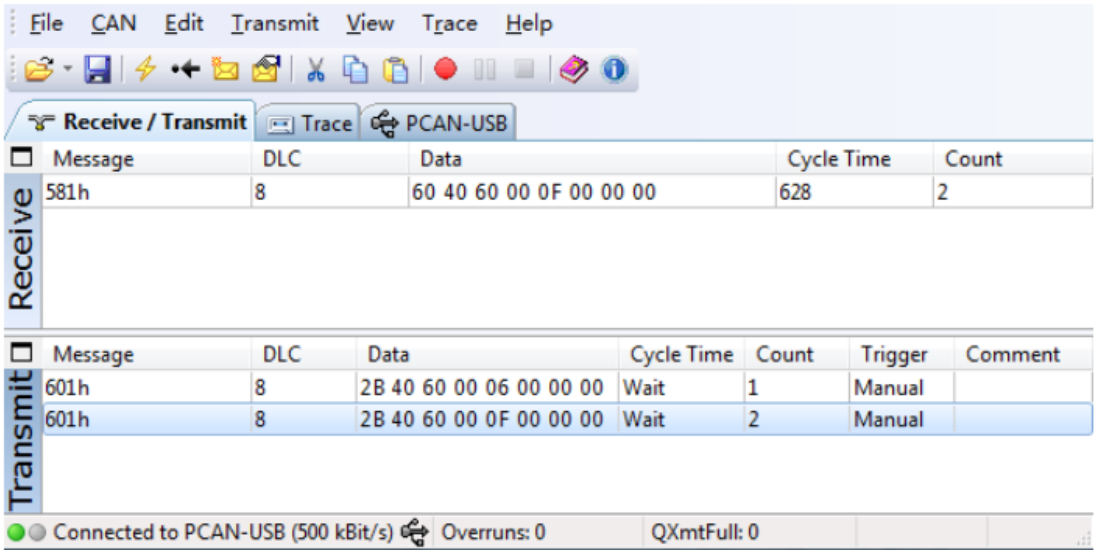
If writing data is 1 byte, the sending CMD is 0x2F.

If writing data is 2 bytes, the sending CMD is 0x2B.

If writing data is 4 bytes, the sending CMD is 0x23.

If writing data is successful, the receiving CMD is 0x60,if writing data failed, the receiving CMD is 0x80.

Example: Write data “6”and “F” to object address “Control word” （0x604000）.The strings areas following picture.



Simple PDO Function

Driver support simple PDO function, it doesn't need to configure in host

UART/RS485Objectaddress[16bit]	CAN Object address[16bit][8bit]Index SubIndex	Attribute	Unit	Description
	0x470001	08U, RW	DEC	Simple PDO function 1.EnableTXPDO1 0.Disable Default：0
	0x180003	16U, RW	mS	TX-PDO1prohibit time Default10ms
	0x470002	08U， RW	DEC	Simple TXPD0 Function (2 Options) 1.Enable TXPD02 (automatically reports status word, actual current, bus voltage, and driver temperature) 0.Disable Default value：0 Status Word： bit0：Driver ready (set to 1 by default after power-on) bit1、2:0（during shaft release） 1（during enable） bit3: 0（no alarm）1（alarm exists） bit5:0（emergency stop not triggered） 1（emergency stop triggered）
	0x180103	16U, RW	mS	TX-PDO2 prohibit time

				Default100ms

PDO1 format：

Identifier	DLC	Date							
		0	1	2	3	4	5	6	7
0x180+Node_ID	8	Mapping to object address0x60F919（ActualVelocity_0.001rpm）				Mapping to object address0x606300（Actual position）			

PDO1 format

Identifier	DLC	Date							
		0	1	2	3	4	5	6	7
0x280+Node_ID	8	0x604100（Status word）		0x607800（Actual current）		0x60f712（Bus voltage）		60f70b（Drive temperature）	

CAN SDO Example (Set ID as 1)

Example1: Read “Actual position”.

The object address of “Actual position” is 0x606300, and it is 32bits signed (Refer to table F1-3)

Host send: 601 40 63 60 00 00 00 00 00

If “actual position” is 4870,convert to HEX 1306

Then driver reply: 581 43 63 60 00 06 13 00 00

Example 2: Read “Actual position”.

The object address of “Actual current_Iq” is 0x607800,and it is 16bits signed(Refer to table F1-3)

Host send: 601 40 78 60 00 00 00 00 00

If “Actual current_Iq” is 1 Arms, calculated by conversion formula—[DEC]=[Arms]*1.414*2048/Peak current（L2DB4830’s peak current is30A）,1Arms=97（DEC）=61（HEX）

Driver reply: 581 4B 78 60 00 61 00 00 00

Example3: Write “Target Velocity_DEC”

The object address of “Target Velocity_DEC” is 0x60FF00, and it is 32bits signed (Refer to tableF1-2)

If we want to set speed as 150rpm, calculated by conversion formula U[y,x]:[DEC]=([rpm]*512*4096)/1875,

[DEC]=(150*512*4096)/1875= 167772,convert to HEX28F5C,

Host send: 601 23 FF 60 00 5C 8F 02 00

Driver reply: 581 60 FF 60 00 5C 8F 02 00

Example4: Write “Control word” as 0x0F

The object address of “Control Word” is 0x604000,and it is 16bits signed(Refer to table F1-2)

Host send: 601 2B 40 60 00 0F 00 00 00

Driver reply: 581 60 40 60 00 0F 00 00 00

CAN PDO Example (Set ID as 1)

1.EnablePDO

The object address of “Simple PDO function” is 0x470001,and it is 8bits unsigned(Refer to tableF1-5)

Host send: 601 2F 00 47 01 01 00 00 00

Driver reply: 581 60 00 47 01 01 00 00 00

2.Driver upload “Actual Velocity_0.0001rpm” and “Actual Position”

If the actual velocity is 10rpm(0x2710),and actual position is 1000 DEC(0x3E8),then driver will send following data every 10ms:181 10 27 00 00 E8 03 00 00

7. Control Mode

The driver supports position mode and speed mode.

7.1 Position Mode

Position mode supports absolute positioning and relative positioning.

The control word of absolute positioning and relative positioning is 1F and F.

For example, current position is 1000, we set target position 9000 and-1000 for relative positioning, and same target position for absolute positioning..

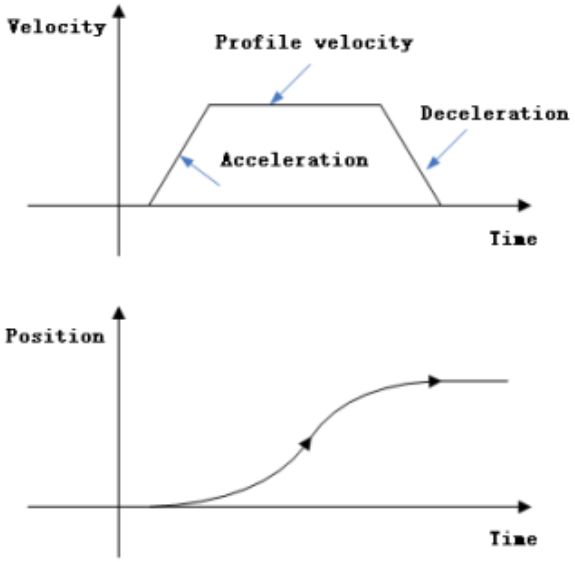


Figure 7.1-1 Velocity and position curves in position mode

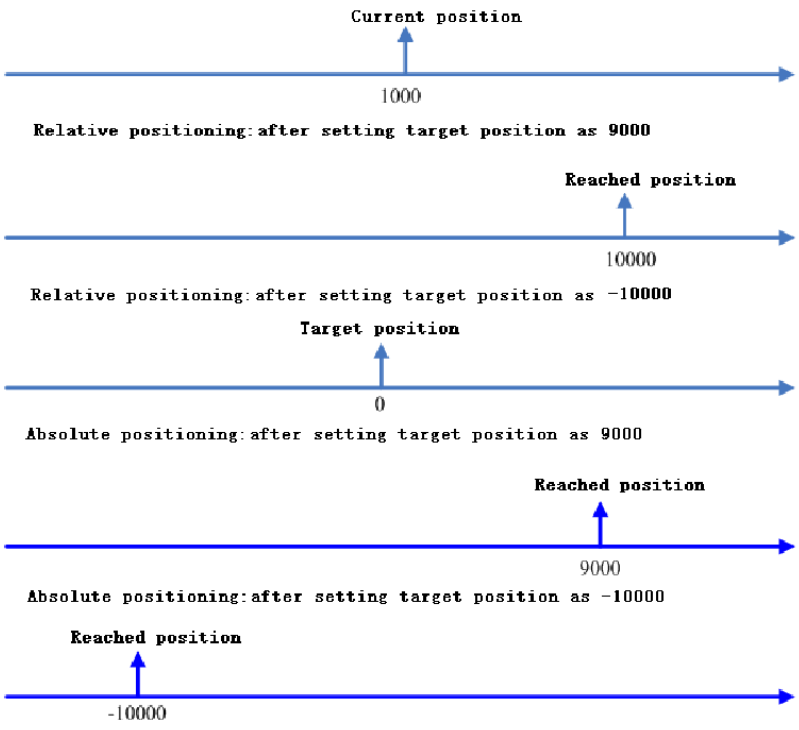


Figure 7.1-2 Schematic diagram of the position pattern

Common objects for position mode

UART /RS485 Object Address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Description
0x7017	0x606000	08S,RW	DEC	Operation mode 3 Speed mode with Acc/Dec -3 Speed mode without Acc/Dec 4 Torque mode 1 Position mode
0x7019	0x604000	16S,RW	HEX	Control word 0x06 Disable 0x0F Enable 0x86 Clear error
0x7018	0x606100	08S,RO	DEC	Current operation mode
0x7001	0x604100	16U,RO	HEX	Driver status word 0x0000:Driver normal 0x0008:Driver error Details of error information refer to object address[0x7011]
0x701F	0x605A11	08U,RW	DEC	Emergency stop 1: Enable 0: Disable
0x7091	0x607A00	32S,RW	DEC	Target position in absolute positioning （Valid in operation mode 1）
0x709F	0x607B00	32S,RW	DEC	Target position in relative positioning （Valid in operation mode 1）
0x709D	0x608200	16U,RW,S5	rpm	Profile velocity_rpm （Target speed in operation mode 1） Note: This object will affect the value of object[0x7098]
0x7099	0x608300	32U,RW,S5	DEC	Acceleration U[y,x]:[DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x709A	0x608400	32U,RW,S5	DEC	Deceleration U[y,x]:

				[DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x709B	0x605A01	32U,RW,S5	DEC	Deceleration in emergency stop Valid in operation mode 3 and 1 U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x7093	0x606500	32U,RW,S5	DEC	Following error window (Only valid in mode 1 when K pp0 is not 0)
0x709C	0x60FB02	16S,RW,S5	DEC	Position loop speed feedforward (Valid in mode 1) Range:0~256,corresponding to 0~100%
0x7094	0x60FB01	16S,RW,S5	DEC	Kpp0, propotion gain 0 in position loop
0x70B3	0x60F901	16U,RW,S5	DEC	Kvp0, propotion gain 0 in speed loop
0x70B4	0x60F902	16U,RW,S5	DEC	Kvi0, integrator gain 0 in speed loop

Operating procedure in relative position mode:

Step1：Set “Acceleration”, “Deceleration” and “Profile velocity_rpm” if it needs to be change.

Setp2 :Set “Operation mode” as 1.

Step3：Set “Control word” as F ,after this step ,the motor will enable.

Step4：Set “Relative target position”,after set this parameter ,motor will run the relative position.

Step5：Anytime it can change “Relative target position” and “Profile velocity_rpm”

Step6：Set “Control word” as 6 to disable motor (Loose the shaft) . During Step4~Step5,if “Emergency stop” enable ,motor will decelerate to stop(Use “Deceleration in emergency stop”).If “Emergency stop” disable and “Control word” is still F ,then motor will continue running to target position.

Example 1: Use UART port to control relative position mode.

Step1： Set “Acceleration” and “Deceleration” if it needs to be change.

Assume we need to set “Acceleration” as 2 rps/s, according to the formular

[DEC]=[rps/s]*256*[Resolution]/15625,
Writing value(DEC)= 2*256*4096/15625= 134,convert to HEX86
Host send: 01 54 70 99 00 00 00 00 86 E4
Driver reply:01 64 70 99 00 00 00 00 86 F4

Assuming that the "trapezoidal acceleration" is 5rps/s, if the feedback accuracy is 4096, according to the formula

[DEC]=[rps/s]*256*[Feedback Accuracy]/15625, which gives the "trapezoidal acceleration."

Value that should be written = 5*256*4096/15625 = 335,hexadecimal is 14F[H]

Host send: 01 54 70 9A 00 00 00 01 4F AF
Driver reply: 01 64 70 9A 00 00 00 02 4F BF

Step2：Set “Operation mode” as 1
Host send: 01 51 70 17 00 00 00 00 01 DA
Driver reply: 01 61 70 17 00 00 00 00 01 EA

Step3：Set “Control word” as F
Host send: 01 52 70 19 00 00 00 00 0F EB
Driver reply:01 52 70 19 00 00 00 00 0F FB

Step4：Set “Relative target position”as-3000(0xFFFFF448)
Host send: 01 54 70 9F 00 FF FF F4 48 9E
Driver reply: 01 64 70 9F 00 FF FF F4 48 AE

Step5：If we want to loose motor ,then set “Control word” as 6.
Host send: 01 52 70 19 00 00 00 00 06 E2
Driver reply: 01 62 70 19 00 00 00 00 06 F2

Operating procedure in absolute position mode

The control process for achieving the relative position mode via UART, RS485, or CAN bus is as follows:

Step1：Set “Acceleration”, “Deceleration” and “Profile velocity_rpm” if it needs to be change.

Step2：Set “Operation mode” as 1.

Step3：Set “Absolute target position”

Step4：Set “Control word” as 1F ,after this step, motor will run the target position.

Step5：Anytime it can change “Absolute target position” and “Profile velocity_rpm.”

Step6：Set “Control word” as 6 to disable motor (Loose the shaft) .

During Step4~Step5,if “Emergency stop” enable ,motor will decelerate to stop(Use “Decelerationin emergency stop”) .If “Emergency stop” disable and “Control word” is still 1F,then motor will continue running to target position.

Example1: Use UART port to control absolute position mode.

Step1：Set “Acceleration” and “Deceleration” if it needs to be change.

Assume we need to set “Acceleration” as 2 rps/s, according to the formular [DEC]=[rps/s]*256*[Resolution]/15625,

Writing value(DEC) = 2*256*4096/15625= 134,convert to HEX 86

Host send: 01 54 70 99 00 00 00 00 86 E4

Driver reply: 01 64 70 99 00 00 00 00 86 F4

Step2：Set “Operation mode” as 1

Host send: 01 51 70 17 00 00 00 00 01 DA

Driver reply: 01 61 70 17 00 00 00 00 01 EA

Step3：Set “Absolute target position” as-3000 (0xFFFFF448)

Host send: 01 54 70 91 00 FF FF F4 48 90

Driver reply: 01 64 70 91 00 FF FF F4 48 A0

Step4：Set “Control word” as 1F

Host send: 01 52 70 19 00 00 00 00 1F FB

Driver reply: 01 62 70 19 00 00 00 00 1F 0B

Step5：If we want to loose motor ,then set “Control word” as 6.

Host send: 01 52 70 19 00 00 00 00 06 E2

Driver reply: 01 62 70 19 00 00 00 00 06 F2

7.2 Speed Mode

This drive provides a speed control mode with acceleration and deceleration. The actual speed will gradually accelerate to the target speed. The speed command can be given to the internal potentiometer and the target speed given of the bus communication function. The actual speed characteristics of the speed mode are shown in Figure 7.2-1:

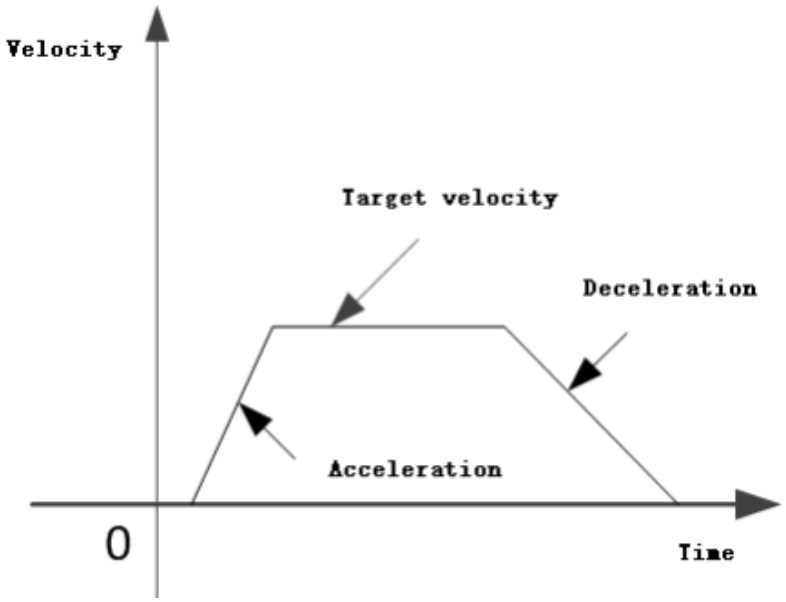


Fig.7.2-1 Speed mode with Acc/Dec

Common object for speed mode

UART/RS485object address[16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Description
0x7017	0x606000	08S, RW, S5	DEC	Operation mode 3 Speed mode with Acc/Dec -3 Speed mode without Acc/Dec 4 Torque mode 1 Position mode
0x7019	0x604000	16S, RW	HEX	Control word 0x06 Disable 0x0F Enable 0x86 Clear error
0x7018	0x606100	08S, RO	DEC	Current operation mode
0x7001	0x604100	16U, RO	HEX	Driver status word 0x0000:Driver normal 0x0008:Driver error Details of error information refer to objectaddress[0x7011]
0x701F	0x605A11	08U, RW	DEC	Emergency stop 1:Enable 0:Disable
0x7099	0x608300	32U, RW, S5	DEC	Acceleration U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x709A	0x608400	32U, RW, S5	DEC	Deceleration U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x709B	0x605A01	32U, RW, S5	DEC	Deceleration in emergency stop Valid in operation mode 3 and 1 U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x70B1	0x2FF009	16S, RW	rpm	Target Velocity_rpm （Valid in operation mode3,-3） Note: It will affect the value of object address[0x70B2]
0x70B2	0x60FF00	32S, RW	DEC	Target Velocity_DEC

				（Valid in operation mode3,-3） U[y,x]: [DEC]=([rpm]*512*[Resolution])/1875; [Resolution]Default:4096
0x7093	0x606500	32U, RW, S5	DEC	Max. following error (Only valid in mode 1 when K pp0 is not 0)
0x709C	0x60FB02	16S, RW, S5	DEC	Position loop speed feedforward (Valid in mode 1) Range:0~256,corresponding to 0~100%
0x7094	0x60FB01	16S, RW, S5	DEC	K pp0 ,propotion gain 0 in position loop
0x70B3	0x60F901	16U, RW, S5	DEC	K vp0,propotion gain 0 in speed loop
0x70B4	0x60F902	16U, RW, S5	DEC	K vi0,integrator gain 0 in speed loop

Operating procedure in speed mode:

The speed mode control process via UART, RS485 or CAN bus is as follows:

Step1：Set “Acceleration” and “Deceleration” if it needs to change.

Step2：Set “Control word” as F to enable motor.

Step3：Set “Target velocity_rpm” or “Target velocity_DEC”, then motor will accelerate to this velocity to run.

Step4：Anytime it can change “Target velocity_rpm” or “Target velocity_DEC”.

Step5：Set “Control word” as 6 to disable motor (Loose the shaft) .

During Step3~Step4,if “Emergency stop” enable, motor will decelerate to stop(Use “Deceleration in emergency stop”). If “Emergency stop” disable and “Control word” is still F,t hen motor will continue running at setting target velocity.

Example1:User UART communication to control speed mode

Step1：Set “Acceleration” and “Deceleration” if it needs to be change.

Assume we need to set “Acceleration”as 2 rps/s, according to the formular

[DEC]=[rps/s]*256*[Resolution]/15625,

Writing value(DEC) = 2*256*4096/15625= 134,convert to HEX 86

Host send: 01 54 70 99 00 00 00 00 86 E4

Driver reply: 01 64 70 99 00 00 00 00 86 F4

Step2：Set “Operation mode” as 3

Host send: 01 51 70 17 00 00 00 00 03 DC

Driver reply: 01 61 70 17 00 00 00 00 03 EC

Step3：Set “Control word” as F

Host send:01 52 70 19 00 00 00 00 0F EB

Driver reply: 01 52 70 19 00 00 00 00 0F FB

Step4： Set “Target velocity_rpm” as 100 (0x64)

Host send: 01 52 70 B1 00 00 00 00 64 D8

Driver reply: 01 62 70 B1 00 00 00 00 64 E8

Step5： If we want to loose motor, then set “Control word” as “6”.

Host send: 01 52 70 19 00 00 00 00 06 E2

Driver reply: 01 62 70 19 00 00 00 00 06 F2

8.Alarm and Troubleshooting

There are two LED in the driver used to indicate the alarm states, one is green(PWR) and the other one is red(ALM).The different blinking times of red LED indicate different alarm information as follows:

LED state 1: “PWR” ON, “ALM” blinking 1 times

LED States	PWR	ALM
	ON●	Blinking 1 times:●○. . . . . ●○. . . . .
Descriptions	Communication failed or Internal error	
Troubleshooting	Check whether the “Communication protection function” is on and host didn’t send command in cycle time，or contact manufacturer.	

LED state 2: “PWR” ON, “ALM” blinking 2 times

LED States	PWR	ALM
	ON●	Blinking 2 times:●○●○. . . . . ●○●○. . . . .
Descriptions	Actual following error exceed the Max_following error	
Troubleshooting	1.Check whether the installation mechanical is stuck. 2.It is overload, the output current of driver or torque of motor is not enough. 3.Setting target velocity is too high. 4.Power supply’s voltage is too low for high speed.	

LED state 3: “PWR” ON, “ALM” blinking 3 times

LED States	PWR	ALM
	ON●	Blinking 3 times: ●○●○●○. . . . . ●○●○●○. . . . .
Descriptions	Encoder signal error	
Troubleshooting	1.The feedback signal is not connected. 2.The wiring sequence of the feedback signal is incorrect or a signal wire is disconnected. 3.The motor feedback signal is mismatched with the driver.	

LED state 4: “PWR” ON, “ALM” blinking 4 times

LED States	PWR	ALM
	ON●	Blinking 4 times: ●○●○●○●○. . . . . ●○●○●○●○. . . . .
Descriptions	Overload	
Troubleshooting	1.Load is too big for motor. 2.The mechanical is stuck or not smooth.	

LED state 5: “PWR” ON, “ALM” blinking 5 times

LED States	PWR	ALM
	ON●	Blinking 5 times: ●○●○●○●○●○. . . . . ●○●○●○●○●○ ●○. . . . .

Descriptions	Driver temperature is too high(Higher than 80℃)
Troubleshooting	1.Overload too many times 2.The mechanical is stuck or not smooth. 3.Environment temperature is too high.

LED state 6: “PWR” ON, “ALM” blinking 6 times

LED States	PWR	ALM
	ON●	Blinking 6 times: ●○●○●○●○●○●○. . . . . ●○●○●○ ●○●○●○. . . . .
Descriptions	Driver voltage is too high.	
Troubleshooting	1.Condition with the dynamic braking resistor connected 1)The resistance value of the braking resistor is too high to absorb all the energy. 2) The braking resistor is damaged; return it to the manufacturer for repair. 2. Condition without the dynamic braking resistor connected 1) The input voltage of the bus power supply is too high, exceeding the overvoltage set point. 2) The deceleration rate is too high (i.e., the braking time is too short); the braking time can be adjusted appropriately.	

LED state 7: “PWR” ON, “ALM” blinking 7 times

LED States	PWR	ALM
	ON●	Blinking 7 times: ●○●○●○●○●○●○●○. . . . . ●○●○ ●○●○●○●○●○. . . . .
Descriptions	Driver voltage is too low.	
Troubleshooting	1.Input voltage of driver is too low. 2.Power of power supply is not big enough,its voltage is pulled down when motor is running.	

LED state 8: “PWR” ON, “ALM” blinking 8 times

LED States	PWR	ALM
	ON●	Blinking 8 times: ●○●○●○●○●○●○●○●○. . . . . ●○ ●○●○●○●○●○●○●○. . . . .
Descriptions	Driver output shortcircuit.	
Troubleshooting	1.UVW is shortcircuit or motor is burned. 2.MOSFET inside driver is burned.	

LED state 9: “PWR” ON, “ALM” blinking in combination

LED States	PWR	ALM
	ON●	Blinking in different times combination circularly.
Descriptions	Multiple types of error,refer to state 1-8.	
Troubleshooting	Refer to state 1-8.	

Appendix 1 Common Object List

Attribute descriptions:

RW—Readable and writable, RO—Read only, WO—Writ only.
DEC—Internal unit, it has different convertion formula with different unit.
Data Type：
08U—Unsigned byte,08S—Signed byte
16U—Unsigned 16bits integer,16S—Signed 16bits integer
32U—Unsigned 32bits integer,32S—Signed 32bits integer
S1,S2,… ,S8 : Sign for group of parameters for storage
S1—Communication parameters
S2—IO configuration parameters
S3—Adjusted parameters
S4—Motor parameters
S5—Control loop parameters
U[y,x]—Convertion formula for different unit.

Table F1-1 Motor Parameters

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x7046	0x641016	16U,RO	HEX	Current motor code
0x7031	0x641001	16U,RW,S4	HEX	Motor code setting
0x7032	0x641002	08U,RW,S4	HEX	Feedback type
0x7033	0x641003	32U,RW,S4	DEC	Encoder resolution
0x7035	0x641005	08U,RW,S4	DEC	Default:4096
0x7036	0x641006	08U,RW,S4	DEC	Motor pole pair
0x7037	0x641007	16S,RW,S4	DEC	Exciting mode
0x7038	0x641008	16U,RW,S4	ms	Exciting current
0x7039	0x641009	16U,RW,S4	0.1A	Exciting time
0x703A	0x64100A	16U,RW,S4	S	Motor Ilt current
0x703B	0x64100B	16U,RW,S4	0.1A	Motor Ilt time
0x7043	0x641013	08U,RW,S4	DEC	Motor max. current
0x704A	0x64101A	16U,RW,S4	rpm	Motor rotation direction
0x704B	0x64101B	16U,RW,S4	W	Motor rated speed
0x704F	0x64101F	16S,RW,S4	Degree	Motor rated power

Table F1-2 Basic Mode and Control

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x7017	0x606000	08S,RW,S5	DEC	Operation mode 3 Speed mode with Acc/Dec -3 Speed mode without Acc/Dec 4 Torque mode 1 Position mode
0x7019	0x604000	16S,RW	HEX	Control word 0x06 Disable 0x0F Enable 0x86 Clear error
0x7018	0x606100	08S,RO	DEC	Current operation mode
0x7011	0x260100	16U,RO	HEX	Driver error code 1 *Each bit indicates one error as shown in follows: BIT[0]:Internal error BIT[1]:Encoder ABZ signal error BIT[2]: Encoder UVW signal error BIT[3]:Encoder counting error BIT[4]:Driver temperature too high BIT[5]:Driver bus voltage too high BIT[6]:Driver bus voltage too low BIT[7]:Driver output short-circuit BIT[8]:Braking resistor temperature too high BIT[9]:Following error over-range BIT[10]:Reserved BIT[11]:I²*T error(Overload) BIT[12]:Speed following error over-

				range BIT[13]:Motor temperature too high BIT[14]:Searching motor failed (Communication encoder) BIT[15]:Communication failed
0x701F	0x605A11	08U,RW	DEC	Emergency stop 1:Enable 0:Disable
0x7091	0x607A00	32S,RW	DEC	Target position in absolute positioning （Valid in operation mode 1）
0x709F	0x607B00	32S,RW	DEC	Target position in relative positioning （Valid in operation mode 1）
0x7098	0x608100	32U,RW,S5	DEC	Profile Velocity_DEC （Valid in operation mode 1） U[y,x]: [DEC]=([rpm]*512*[Resolution])/1875; [Resolution]Default:4096
0x709D	0x608200	16U,RW,S5	rpm	Profile velocity_rpm （Target speed in operation mode 1） Note:This object will affect the value of object[0x7098]
0x7099	0x608300	32U,RW,S5	DEC	Acceleration U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x709A	0x608400	32U,RW,S5	DEC	Deceleration U[y,x]: [DEC]=[rps/s]*256*[Resol
0x709B	0x605A01	32U,RW,S5	DEC	Deceleration in emergency stop Valid in operation mode 3 and 1 U[y,x]: [DEC]=[rps/s]*256*[Resolution]/15625; [Resolution]Default:4096
0x70B1	0x2FF009	16S,RW	rpm	Target Velocity_rpm

				（Valid in operation mode 3,-3） Note:It will affect the value of object address [0x70B2]
0x70B2	0x60FF00	32S,RW	DEC	Target Velocity_DEC （Valid in operation mode 3,-3） U[y,x]: [DEC]=([rpm]*512*[Resolution])/1875; [Resolution]Default:4096
0x70E1	0x60F608	16S,RW	DEC	Output current （Setting output current for operation mode 4） U[y,x]:[DEC]=[Arms]*1.414*2048/Driver max. output current L2DB4830 max. output current is 33Ap
0x70E2	0x607300	16U,RW	DEC	Output current limit （Valid in all operation mode） U[y,x]:[DEC]=[Arms]*1.414*2048/ Driver max. output current L2DB4830 max. output current is 33Ap
0x70B8	0x608000	16U,RW,S5	rpm	Max. speed_rpm Setting maximum speed in all operation mode
0x7093	0x606500	32U,RW,S5	DEC	Max. position following error (Valid in operation mode 1 when “Kpp” is not 0)
0x8088	0x60FB88	08U,RW,S5	DEC	Position compensation for operation mode 3: 0:Disable, 1:Enable Default:0
0x709C	0x60FB02	16S,RW,S5	DEC	Position loop speed feedforward (Valid in mode 1) Range:0~256,corresponding to 0~100%
0x7094	0x60FB01	16S,RW,S5	DEC	Kpp0, propotion gain 0 in position loop

0x70B3	0x60F901	16U,RW,S5	DEC	Kvp0,propotion gain 0 in speed loop
0x70B4	0x60F902	16U,RW,S5	DEC	Kvi0,integrator gain 0 in speed loop
0x70AC	0x607C02	08U,RW	DEC	Clear actual position Set 1 to clear “Actual position” when motor is disable
0x701C	0x500050	08U,RW,S5	DEC	Noise reduction at zero speed Default：0 0：Disable 1：Enable
0x701D	0x500051	16U,RW,S5	mS	Noise reduction delay time for enable Default：500
0x80BC	0x60F98C	16U,RW,S5	DEC	Spring Compensation Coefficient Default Value: 10
0x80BE	0x60F98E	16U,RW,S5	DEC	Spring Compensation Base Point Default Value: 2
0x7004	0x300015	16U,RW,S3	℃	Max. temperature for driver overtemperature protection

Table F1-3 Measurement Data

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x7071	0x606300	32S,RO	DEC	Actual position
0x7075	0x60F918	16S,RO	rpm	Actual speed_rpm Sampling cycle can be changed in object 0x7079 Resolution:1rpm
0x7076	0x60F919	32S,RO	0.001rpm	Actual speed_0.001rpm Sampling cycle can be changed in object 0x7079 Resolution:0.001rpm
0x7079	0x60F91A	16U,RW,S5	ms	Sampling cycle for actual speed Default:30
0x7077	0x606C00	32S,RO	DEC	Actual speed_DEC Sampling cycle is 250uS [DEC]=([rpm]*512*[Resolution])/1875; [Resolution]Default:4096 Note:the value vibration is big because sampling cycle is too short.
0x7072	0x607800	16S,RO	DEC	Actual current_Iq [DEC]=[Arms]*1.414*2048/I_MAX Note: For L2DB4830 series，I_MAX=33；
0x7007	0x60F632	16U,RO	mA	Motor actual IIt current
0x5001	0x60F712	16S,RO	V	Actual DC bus voltage Resolution:1V
0x7002	0x60F70B	16S,RO	℃	Driver actual temperature
0x7092	0x60F400	32S，RO	DEC	Actual position following error

Table F1-4 IO Port Setting

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x5100	0x20100A	16U,RO	BIT	Actual states of digital input(Hardware states) BIT[0]—DIN1_State BIT[1]—DIN2_State … BIT[7]—DIN8_State The corresponding bit will be set 1 when DINx is valid, or it will be set 0
0x5102	0x201001	16U,RW,S2	BIT	Digital input polarity setting BIT[0]—DIN1_Polarity BIT[1]—DIN2_Polarity … BIT[7]—DIN8_Polarity DIN[x+1] polarity is negation when BIT[x] is set as 0 Default：0x00ff
0x5101	0x201002	16U,RW	BIT	Digital input simulate BIT[0]—DIN1_Simulate BIT[1]—DIN2_Simulate … BIT[7]—DIN8_Simulate DIN[x+1] is valid when BIT[x] as 1
0x5103	0x20100B	16U,RO	BIT	Digital Input Port Virtual State BIT[0]—DIN1_Virtual BIT[1]—DIN2_Virtual … BIT[7]—DIN8_Virtual This value is derived from the objects: Digital Input Port Actual Input State (Hardware Input) [0x20100A] Digital Input Port Polarity Setting [0x201001]

				Digital Input Port Simulation Input [0x201002] via the combined logic, with the logical relationship: ([0x20100A] XNOR [0x201001]) | [0x201002] When BIT[x] is 1, the corresponding DIN1_Virtual[x+1] is valid; When BIT[x] is 0, the corresponding DIN1_Virtual[x+1] is invalid. If the corresponding "Input [x+1] Function Definition" is configured, the corresponding function will be executed when DIN1_Virtual[x+1] is valid.

Table F1-5 Communication Parameters

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x1005	0x2FE001	08U,RW,S1	DEC	UART baudrate setting Setting value baudrate 3: 19200 4: 38400 5: 56000 6: 57600 7: 115200 It must save and reboot driver. Default:7
0x100F	0x2FE00F	08U,RW,S1	DEC	UART Protocol Selection 0: Proprietary Protocol 1: Custom Protocol 1 2: Custom Protocol 2 Save is required after configuration. Factory Default Value: Determined by the factory recipe

0x100C	0x65100F	08U,RW,S1	DEC	RS485/CAN ID Activate when DIP switch SW3 set as OFF Default:17
0x3010	0x410010	08U,RW,S1	DEC	Communication loss protection 0:Disable 1:Enable Default: depend on different model
0x3011	0x410011	32U,RW,S1	mS	Communication loss delay time Default:600 When the bus disconnection detection enable bit of object "0x3010" is set to 1, the motor will release the shaft if the bus disconnection duration exceeds the set time.
	0x470001	08U,RW	DEC	Simple PDO function 0：Disable 1：Enable TXPDO1（Auto-upload “Actual Position” and “Actual velocity_0.001rpm”） Default：0
	0x180003	16U,RW	mS	TX-PDO1 prohibit time Default:10ms
	0x470002	08U,RW	DEC	Simple PDO Function 2 1: Enable TXPDO2 (Automatically reports status word, actual current, DC bus voltage, and driver temperature) 0: DisableDefault value: 0 Status Word: Bit 0: Driver Ready (Set to 1 by default after power-on) Bits 1-2: 0 (When axis is disabled) 1 (When enabled) Bit 3: 0 (No alarm) 1 (Alarm triggered) Bit 5: 0 (Emergency stop not triggered)

				1 (Emergency stop triggered)
	0x180103	16U,RW	mS	TX-PDO2 prohibit time Default:100ms

Table F1-6 Parameters Storage

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x3061	0x2FE501	08U,RW	DEC	Save group S1 parameters 1:Save
0x3062	0x2FE502	08U,RW	DEC	Save group S2 parameters 1:Save
0x3063	0x2FE503	08U,RW	DEC	Save group S3 parameters 1:Save
0x3064	0x2FE504	08U,RW	DEC	Save group S4 parameters 1:Save
0x3065	0x2FE505	08U,RW	DEC	Save group S5 parameters 1:Save

Table F1-7 Driver Attribut

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x103A	0x30003A	32U,RO	ASCII	Driver mode 1 - series Default:L2DB
0x103B	0x30003B	32U,RO	ASCII	Driver mode 2 – voltage and current Default:4830
0x103C	0x30003C	32U,RO	ASCII	Driver mode 3 - communication Default(485): L2DB4830-CAFR-XXXX L2DB4875-CAFR-XXXX Default(CAN): L2DB4830-CAFC-XXXX L2DB4875-CAFC-XXXXX
0x103D	0x30003D	32U,RO	ASCII	Driver mode 4 – software version Default(7Nm Motor):ASL3 = 0x41534C33 Default(10Nm Motor): ASM4 = 0x41536D34 Default(15Nm Motor): ASM5 = 0x41536D35 Default(30Nm Motor):ASH8= 0x41534838 Default（WA Series 13Nm Motor）: AAB3= 0x41414233、AAC3= 0x41414333 Default（WA Series 15Nm Motor）: AAB5= 0x41414235、AAC5= 0x41414335
0x1007	0x2500F1	32U,RO	DEC	Firmware date Format:20190114 Year: 2019 Month: 01 Day: 14

0x1009	0x2500F3	32U,RO	ASCII	Hardware version

Table F1-8 Additional Functions

UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x802F	0x500020	08U,RW,S5	DEC	Sstop function 0:Disable 1:Enable Default:0 It is used to limit driver output current when motor is in zero speed.
0x8028	0x500028	32U,RW,S5	DEC	Sstop current limit U[y，x]： [DEC]=[Arms]*1.414*2048*256/I_MAX Note:L2DB4830 series,I_MAX=33； Default： L2DB4830 series：10485 (0.467Arms)
0x8002	0x500002	32U,RW,S5	DEC	S curve start point at decelerating U[y,x]: [DEC]=([rpm]*512*[Resolution])/1875; [Resolution]Default:4096 Default:5rpm
0x8004	0x500004	16U,RW,S5	DEC	Time for S curve Default:64
0x5F10	0x270F10	08U,RW	DEC	Error Stop Mode Usage 0: Not used 1: Used Default value: 0
0x5F11	0x270F11	32U,RW	HEX	Lower 8 Bits of Error Stop Mode: BIT[0~3]: Internal Error; BIT[4~7]: Encoder ABZ Signal Error;

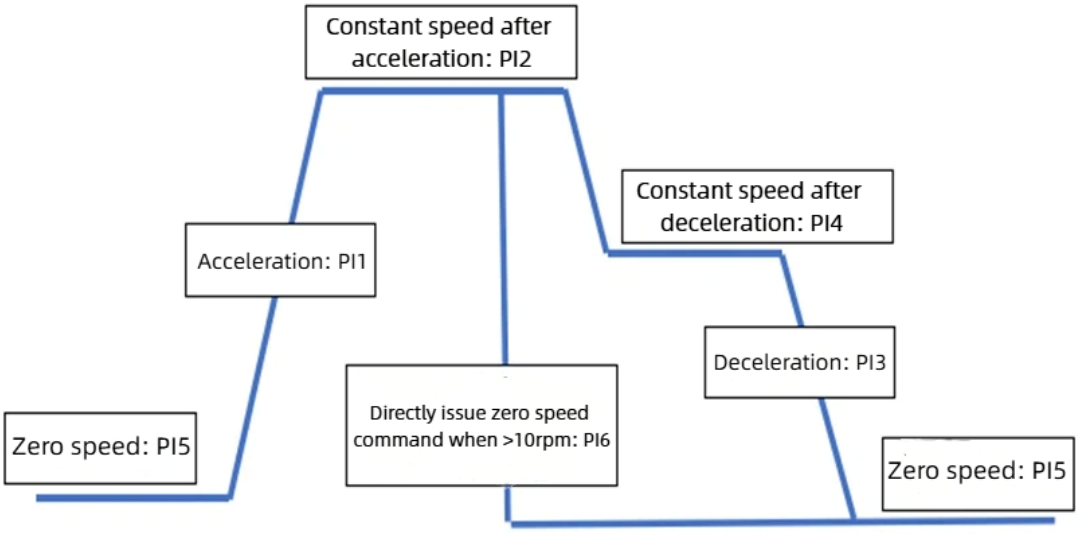
				BIT[8~11]: Encoder UVW Signal Error; BIT[12~15]: Encoder Count Error; BIT[16~19]: Driver Over-temperature; BIT[20~23]: Driver DCB us Over-voltage; BIT[24~27]: Driver DC Bus Under-voltage; BIT[28~31]: Driver Output Short Circuit. For each 4-bit group: Upper 2 bits = Select error stop mode during motion; Lower 2 bits = Select error stop mode after stopping. Execution Status After Corresponding Error During Motion: 00:Axis disabled (free run); 01: Motor three-phase short-circuited operation; 10: Driver actively controls motor to decelerate to 0 speed; 11: Reserved (not available temporarily); Default value=01. After Stopping: 00:Axis disabled; 01: Motor three-phase short-circuited; 10: Axis locked; 11: Reserved (not available temporarily); Default value=01
0x5F12	0x270F12	32URW	HEX	BIT[0~3]: Driver Brake Resistor

				Over-temperature Alarm BIT[4~7]: Actual Following Error Exceeds Allowable Value BIT[8~11]: Reserved for Future Use BIT[12~15]: I²T Fault (Driver or Motor Overload) BIT[16~19]: Speed Following Error Exceeds Allowable Value BIT[20~23]: Motor Over-temperature Alarm BIT[24~27]: Motor Detection Error (Communication Encoder) BIT[28~31]: Communication Loss Alarm For each 4-bit group: Upper 2 bits = Select error stop mode during motion; Lower 2 bits = Select error stop mode after stopping. Execution Status After Corresponding Error During Motion: 00:Axis disabled (free run); 01: Motor three-phase short-circuited operation; 10: Driver actively controls motor to decelerate to 0 speed; 11: Reserved (not available temporarily); Default value=01. After Stopping: 00:Axis disabled; 01: Motor three-phase short-circuited;

				10: Axis locked; 11: Reserved (not available temporarily); Default value=01

Multi-segment PID description

Multi-stage PI refers to the performance adjustment of the motor in different motion states using different PI parameters, which is divided into 6 groups, as follows:



UART /RS485 Object address [16bit]	CAN Object address [16bit][8bit] Index SubIndex	Attribute	Unit	Descriptions
0x8731	0x50F731	08U,RW,S1	DEC	PI mode selection Mode 0: No multi-segment PI is used Mode 1: PI1, 3, and 5 are modified synchronously; PI2,4are modified simultaneously; PI6 is modified separately. Mode 2: Synchronous modification of PI1 and 3; PI2,4are modified simultaneously;

				PI5 is modified separately; PI6 is modified separately. Mode 3: PI1, 2, 3, 4, 5, and 6 are all modified separately Mode 4: PI1, 2, 3, 4, 6 are modified simultaneously; PI5 is modified separately
0x8702	0x50F702	16S,RW	DEC	PI1, 2 speed switching points: When the motor accelerates to the target speed, the PI parameters are switched from PI1 to PI2's speed window
0x8704	0x50F704	16S,RW	DEC	PI3 and 4 speed switching points" When the motor decelerates to the target speed, the PI parameters are switched from PI3 to PI4's speed window When entering data, the conversion unit needs to be: [DEC]=([rpm]*512*[Feedback accuracy])/1875; [Feedback Accuracy] Default: 4096
0x8714	0x50F714	16U,RW	ms	PI5 cut-in time
0x8706	0x50F706	16S,RW	DEC	PI6 cutting speed After the motor accelerates to more than 10rpm, the PI parameter switches to the speed window of PI6 and directly gives the zero speed command When entering data, the conversion unit needs to be: [DEC]=([rpm]*512*[Feedback accuracy])/1875; [Feedback Accuracy] Default: 4096
0x8721	0x50F721	08U,RW	DEC	PI6 flag bit
0x8801	0x50F801	16U,RW	DEC	KVP1
0x8802	0x50F802	16U,RW	DEC	KVP2

0x8803	0x50F803	16U,RW	DEC	KVP3
0x8804	0x50F804	16U,RW	DEC	KVP4
0x8805	0x50F805	16U,RW	DEC	KVP5
0x8806	0x50F806	16U,RW	DEC	KVP6
0x8901	0x50F901	16U,RW	DEC	KVI1
0x8902	0x50F902	16U,RW	DEC	KVI2
0x8903	0x50F903	16U,RW	DEC	KVI3
0x8904	0x50F904	16U,RW	DEC	KVI4
0x8905	0x50F905	16U,RW	DEC	KVI5
0x8906	0x50F906	16U,RW	DEC	KVI6

Appendix 2 Error Code

For UART/RS485 communication,there is one byte(ErrR) in reply string used to indicate error code.Every bit in this byte indicate different error.When the bit is 0,it means no error,when the bit is 1,it means this error activates

ErrR	Descriptions	Behavior of driver and motor
bit0: [LSB]	Communication loss (Note:this alarm is only valid when enable “Communication loss function”)	Driver cut off output current,motor shaft released
bit1:	Following error over-range	Driver cut off output current,motor shaft released
bit2:	Encoder error	Driver cut off output current,motor shaft released
bit3:	Motor overload	Driver cut off output current,motor shaft released
bit4:	Driver temperature too high	Driver cut off output current,motor shaft released
bit5:	DC bus voltage too high	Driver cut off output current,motor shaft released
bit6:	DC bus voltage too low	Driver cut off output current,motor shaft released
bit7: [MSB]	Driver output shor-circuit	Driver cut off output current,motor shaft released

Appendix 3 Use of brake resistors

The brake resistor inside the drive is an element used to consume the regenerative energy generated by the motor braking, which can protect the drive from being damaged by overvoltage and achieve the effect of rapid shutdown or deceleration. The principle of brake resistance is to convert the kinetic energy and magnetic energy of the motor into heat energy, which is dissipated by the resistor heat, thereby reducing the voltage on the DC bus. This model of driver connects the brake resistor through the RB+ and RB- of CN6, and at the same time sets the correct brake resistance value and brake resistance power through the software. The selection of brake resistance is related to the motor model, and the specific selection can refer to the table below

Driver model	Brake Resistance Value[Ω]	Brake Resistance Power [W]	Brake Resistance Voltage [VDC]
L2DB-4830	8	50	100
L2DB-4875	4	100	100

Parameter Name	UART Correspondence address	Object properties	unit	Parameter description
Brake resistance value	60F701	Unsigned16（RW）	Ω	Configure the resistance value of the brake resistor
Brake resistance power	60F702	Unsigned16（RW）	W	Configure the nominal power of the brake resistor
Brake resistance time constant	60F703	Unsigned16（RW）	S	Time constant for configuring brake resistance (calculation method: N*256/1000)
Chopper voltage point	651006	Unsigned16（RW）	V	Configure the chopper voltage threshold for the driver

Version revision history

version	Revision date	Firmware date	Revision Notes
1.0	2020-11-25		Version 1.0 released
1.1	2021-06-25		Error status word description has been updated to improve and update
1.2	2021-11-03		New description of the 5.5-inch 7Nm and 5.5-inch 15Nm motors
1.3	2022-03-25		Correct DIN input description
2.1	2022-06-17		L2DB4875 high-power dual drive and 30Nm motor have been added
2.2	2024-10-25		Update 4.1 Shell Silk Screen Diagram; Added an alarm shutdown mode description
2.3	2024-10-31		Added a description of TXPDO2 related parameters
2.4	2024-11-15		Modified the TPDO2 status word description
3.0	2025-11-14		Added product parameters of each motor of the WA series, updated the schematic diagram of the drive housing, and added brake resistance interface and instructions