Instruction Manual for the Product

Applicable series: RH series

Version: V1.4

Date: 2025.01

Preface

Thanks for choosing MYACTUATOR.

RH series joint module is a highly integrated joint module provided by the company under the premise of years of experience accumulation for customer service, which has a large transmission speed ratio, strong bearing capacity, precise control, easy to carry, and saves a lot of time for developers.

This manual introduces the parameters, usage methods, precautions and other information of the RH series integrated harmonic module, please read carefully before starting to operate.

If you need to know more about our company's other products, please contact us.

CN WEB

EN WEB

The name of the company: Suzhou Micro Actuator Technology Co., Ltd

Hotline: 400-998-9592

Address: Building 2, No. 599, Yuanchuang Road, Huaqiao Town,
Kunshan City, Jiangsu Province

Imprint Notice

 The product manual is only used as a reference for users and does not constitute the basis for meeting the user's overall usage requirements. Please be sure to evaluate it in combination with the user's overall system. The content of the manual strives to be detailed and accurate, but oversights are inevitable. If you find any errors, please provide your valuable feedback.

The company reserves the right to modify and improve this manual at any time without prior notice. For the latest version of the manual, please visit the official website (www.myactuator.com) to download it by yourself, or contact the company to obtain it.

Table I Version update instructions

Version	Update instructions
V1.0	First edition
V1.1	Update electrical interface content and pictures
V1.2	Update motor detailed parameters
V1.3	Product iteration
V1.4	Add stall torque data

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Catalog

1. Safety Precautions

This product is a high-precision product. Only professionals with corresponding qualifications can perform tasks such as installation, debugging, and maintenance. Corresponding personnel must understand and comply with IEC60364/IEC60664 and national accident prevention regulations. Please read the manual carefully before installing, operating, or repairing this product. Wrong operation may damage the module or even cause casualties. Be sure to follow the safety precautions in this manual.

This manual has the following safety symbols:

Warn! May endanger personal safety

Note! It is possible to damage the product or even the entire device

Be careful! Beware of surface temperatures

In this manual, we record hazardous situations as much as possible, and please see Table 1-1 for details. Relevant personnel are requested to understand and follow the following precautions. In addition, there are too many uncertain factors that cannot be considered and recorded. In actual application processes It is necessary to prevent and handle it according to the actual situation.

Table 1-1 Safety precautions

Unboxing	
	**Please check whether the outer packaging of the device is intact** Before unpacking, please check whether the outer packaging of the device is intact and whether it is damaged, damp, deformed, etc.
	**Please do not unbox violently** Please unpack in accordance with the hierarchical order, and violent knocking is strictly prohibited.

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	**Please check whether the module and its accessories are complete** Please refer to the list to check whether the module name is correct, whether the accessories are complete, whether there is any damage on the surface of the equipment and its accessories, etc. If there is any problem, please do not install it and contact our company in time.

Installation and maintenance phase	
	**Please assemble the module in place** When assembling the module, assemble it in place according to the screw torque standards to ensure that there will be no danger of accidental falling.
	**Do not plug or unplug the power cord while the power is on** Make sure the power indicator light goes out before wiring and maintaining the device.
	**Do not plug or unplug communication lines while the power is on** When the GND of the control terminal and the module are not connected, the voltage is inconsistent. The voltage difference between the two at the moment of connection may damage the communication interface.
	**Do not disassemble the module and its associated equipment while the power is on** It is strictly prohibited to disassemble any device or accessory of the equipment while the power is on, otherwise there is a risk of electric shock.
	**Please keep the module shell grounded and use shielding layer properly** If the module shell is not grounded, it may cause charge accumulation in the shell, affecting the normal operation of the motor, and even causing harm to the human body. The wiring cable must meet the

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	corresponding wire diameter and shielding requirements, and the shielding layer of the shielded cable must be reliably grounded.
	**Please use a multi-turn encoder power battery that meets the specifications** In order to prevent the multi-turn value from being lost due to power outage, the multi-turn encoder is powered by a specific battery with the required specification of 2.7~3.6V. Please do not use other types of batteries. If the module is damaged, our company will not provide technical support for it. .
	**It is strictly prohibited to connect the power supply to the output of the device** It is strictly prohibited to connect the power supply to the output terminal of the device to avoid damage to the device or even fire.
	**Please do a risk assessment** Please conduct a risk assessment before use and take appropriate measures to ensure personal safety and equipment safety.
	**Please observe the technical data and specifications** Please refer to the parameters of each model in the manual to set reasonable parameters to prevent damage to the module.
	**Please set appropriate protection limits** Set appropriate position limits, speed limits, current limits, etc. Exceeding the limits may damage the motor or even threaten personal safety.
	**Please perform a no-load test run before using the module** To prevent accidents, please perform a no-load test run on the module.
	**Do not disassemble or replace parts by yourself** Product failure due to abnormal use will void the warranty rights of the product.

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	**Do not hit or squeeze the module and its components with gravity** The module is a precision device. Do not use a hammer to hit the module hard. Please place it carefully to prevent the module from falling off the table and causing cracks and other damage.
	**The use environment complies with regulations** The working environment temperature of the module is 0~50℃. When the temperature is low, it is recommended to use low-temperature grease to improve the operating resistance of the module. Please keep the environment free of dust, corrosive gases, flammable gases, etc.
	**Be careful of high temperature burns** During the operation of the module, the surface may be very hot, please pay attention to protection. When the surface temperature exceeds 40℃, please avoid long-term contact, which may cause low-temperature burns. When the surface temperature exceeds 85℃, please avoid touching it, which may cause minor burns.

Storage	
	**Storage environment meets standards** Please refer to the manual to strictly require transportation and storage temperature and humidity, and avoid direct sunlight, strong magnetic fields, strong electric fields, strong vibrations and other places.
	**Storage time should not be too long** Avoid storing the module for more than 3 months. If the storage time is too long, please take more stringent protective measures and necessary inspection and maintenance.
	**Do not mix and transport equipment that may cause damage** Please pack the module strictly before transporting it. It is strictly prohibited to transport it mixed with equipment that may affect it.

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	**Regular inspection and maintenance** Please perform daily and regular inspection and maintenance on the module, and keep maintenance records.

Others	
	**Do not remove the anti-tear warranty label** Do not remove the anti-tear warranty label, otherwise you will lose your warranty rights.
	**Please dispose of it as industrial waste** Please dispose of the module and its accessories as industrial waste.

2. Quality Assurance

2.1. After-sales Policy

This product strictly implements the following after-sales services in accordance with the “Law of the People's Republic of China on the Protection of Consumers' Rights and Interests” and the “Law of the People's Republic of China on Product Quality”.

①All users who purchase this product can enjoy the return and exchange service if there is a product quality problem within 7 days. When returning or exchanging, you should provide a valid proof of purchase and return invoice, and ensure that the returned product has intact functions, no damage to appearance, and complete accessories;

②Users who purchase this product will enjoy free warranty service within one year from the day after receipt. In the event of man-made damage, manual disassembly, etc., no warranty service will be provided; if after testing, it is confirmed that the motor needs to be replaced, the merchant will need to negotiate with customers whether to purchase additional repair parts;

③If there is a quality problem with the product within 7 to 15 days from the day after receipt, you can enjoy the exchange service after confirmation. When exchanging goods, you should provide a valid proof of purchase and return invoice, and ensure that

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the returned product has intact functions, no damage to appearance, and complete accessories;

④The following situations are found not to be covered by the warranty:

●Failure to install and connect other control equipment according to the requirements of the user manual may cause the motor to burn out;
●When used, the specifications or standards shown in the user manual are exceeded (such as wrong motor parameter settings);
●The storage method and working environment exceed the specified range in the user manual (such as pollution, salt damage, condensation, etc.);
●Product damage caused by abnormal working conditions (such as falling, impact, liquid intrusion, violent impact, etc.);
●Product damage caused by force majeure (natural disasters, fires, floods, etc.);
●Users dismantle the product by themselves, causing damage to the motor;
●Exceeds the warranty period provided by the post-sale policy;
●Unable to provide valid proof of purchase;
●Failures other than those mentioned above are not caused by Suzhou Micro Actuator Technology Co., Ltd.'s responsibility.

In the event of a joint module failure, you must contact Suzhou Micro Actuator Technology Co., Ltd as soon as possible to obtain a solution. Users are not allowed to disassemble and assemble the joint module for any reason, otherwise the warranty service will be terminated.

2.2. Disclaimer

Please read this statement carefully before use. Once used, it is deemed to be recognition and acceptance of the entire content of this statement. Please install and use this product in strict compliance with the manual, product instructions, and relevant laws, regulations, policies, and guidelines. In the process of using the product, users promise to be responsible for their own actions and all consequences arising therefrom. Myactuator will not be held legally responsible for any losses caused by improper use,

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installation, or modification by users. The final right to interpret the disclaimer belongs to Myactuator.

3. Basic Parameters of the Module

The RH series module integrates a frameless torque motor, absolute encoder, servo driver, harmonic reducer, and brake. It has a compact structure, strong integration, and is easy to install. RH series modules are currently available in RH-14, RH-17, RH-20, RH-25, RH-32, making robot development more convenient and flexible.

3.1. Module Nameplate and Model

Series		Reducer model		Ratio		Communication		Brake
RH	-	**20**	-	**100**	-	**E**	-	**B**

14	Model 14
17	Model 17
20	Model 20
25	Model 25
32	Model 32

100	100 Ratio
50	50 Ratio

C	CANBUS
E	EtherCAT

B	Brake
N	No brake

Taking RH-20-100-E-B as an example, the module product model parameters are explained in Table 3-1.

Table 3-1 Product Model Parameter Explanation

Parameter	Explanation
RH	Integrated RH series harmonic module.
20	There are five reducer models: 14, 17, 20, 25 and 32.
100	The reduction ratio is determined by the number of teeth on the flex spline and the circular spline.
E	Indicates the communication interface type of the module, including ETHERCAT and CANBUS.
B	B indicates that the module is equipped with a holding brake, and N indicates that the module is not equipped with a holding brake.

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3.2. Module Appearance Size

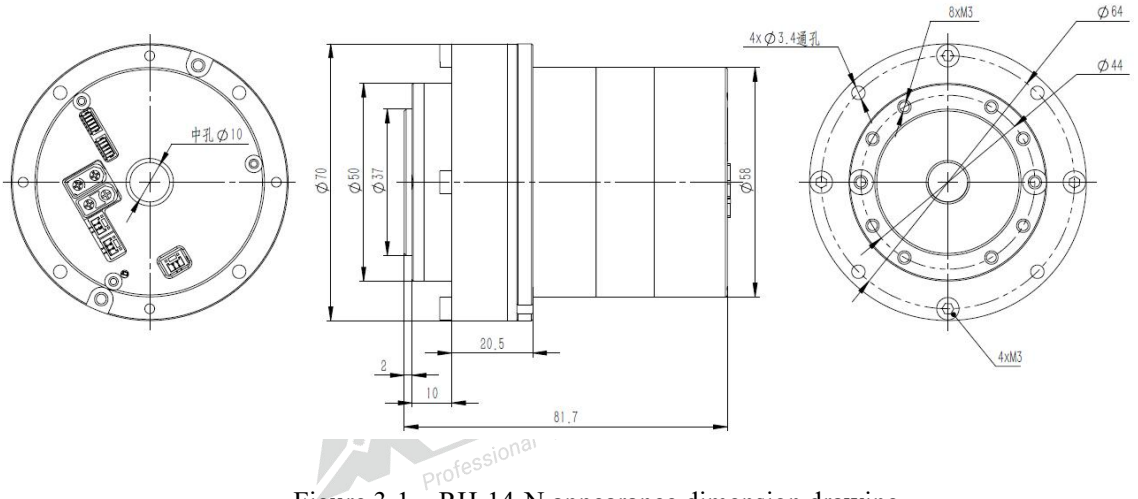

Figure 3-1 RH-14-N appearance dimension drawing

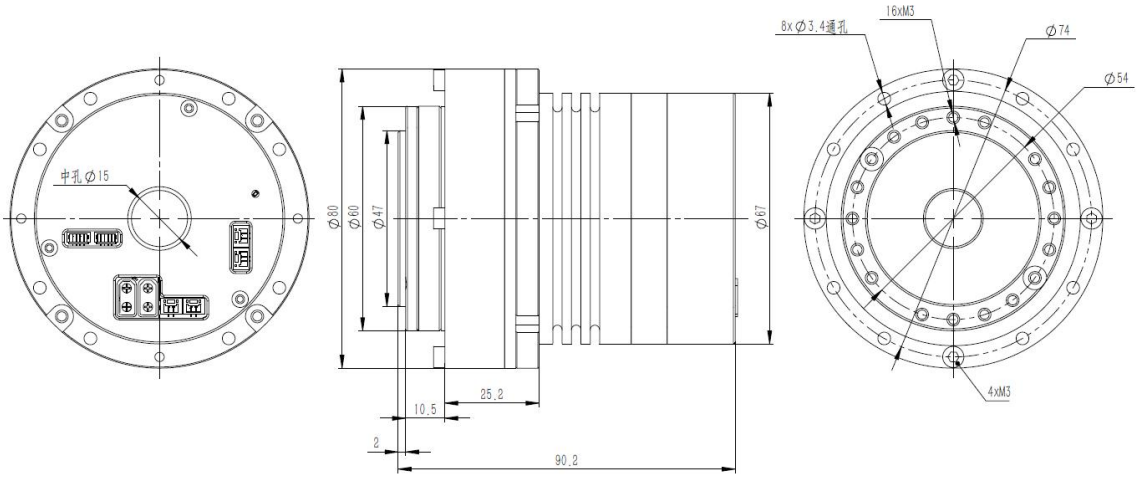

Figure 3-2 RH-17-N appearance dimension drawing

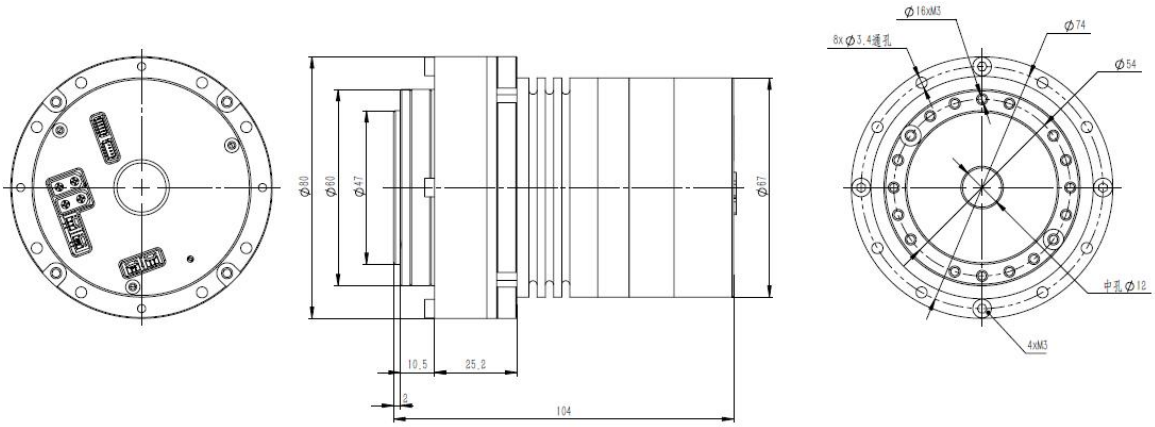

Figure 3-3 RH-17-B appearance dimension drawing

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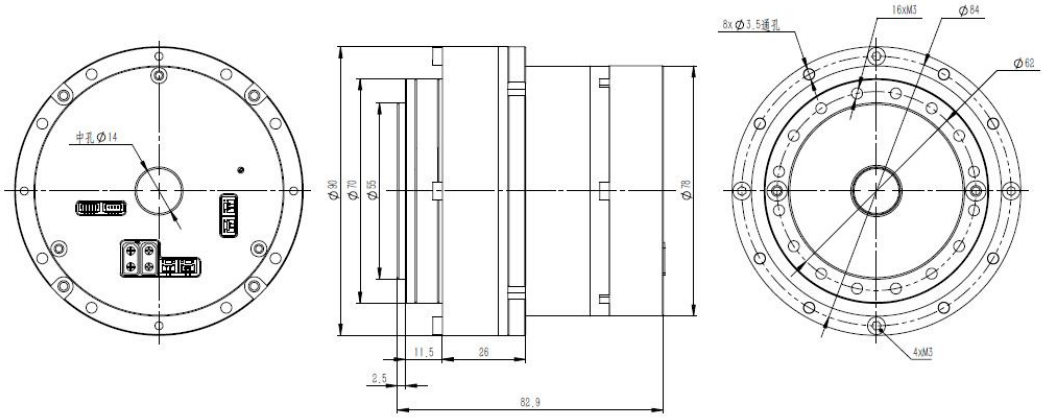

Figure 3-4 RH-20-N appearance dimension drawing

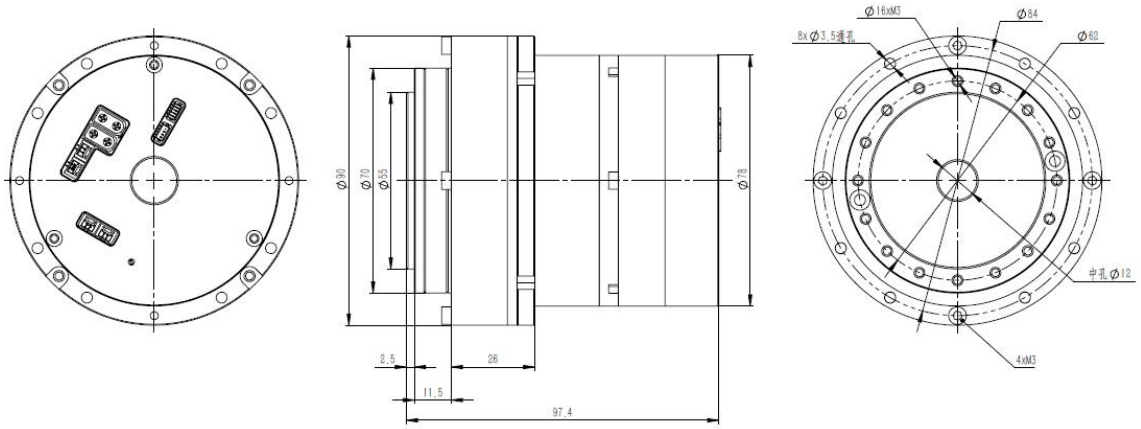

Figure 3-5 RH-20-B appearance dimension drawing

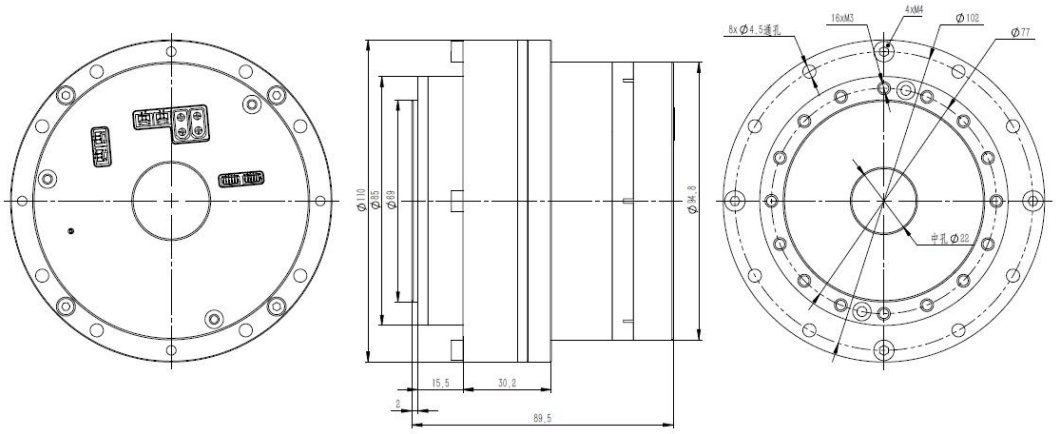

Figure 3-6 RH-25-N appearance dimension drawing

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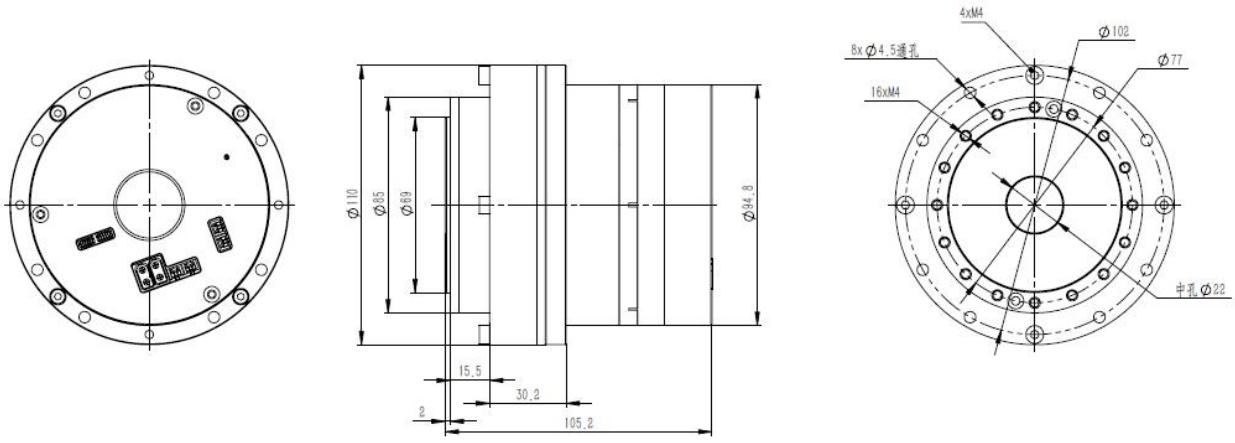

Figure 3-7 RH-25-B appearance dimension drawing

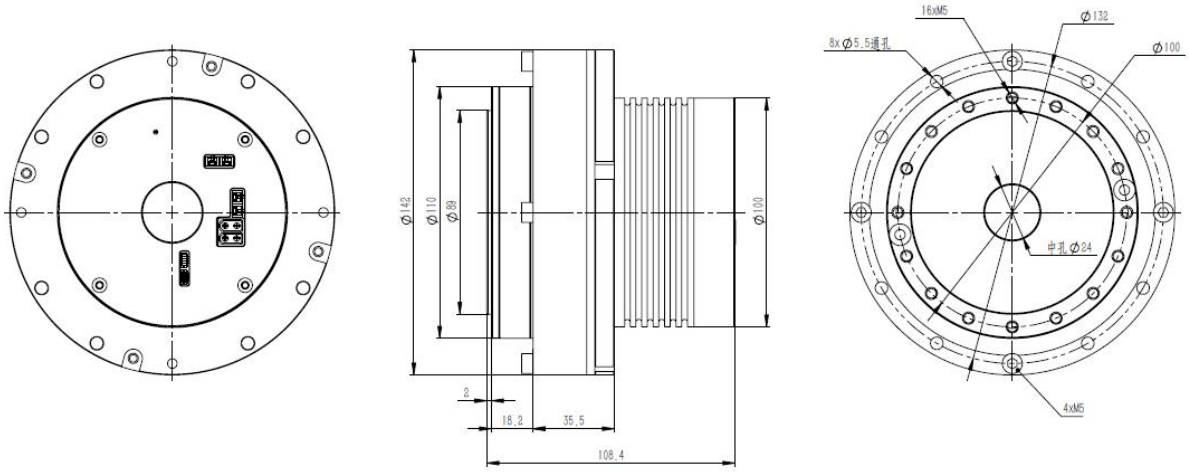

Figure 3-8 RH-32-N appearance dimension drawing

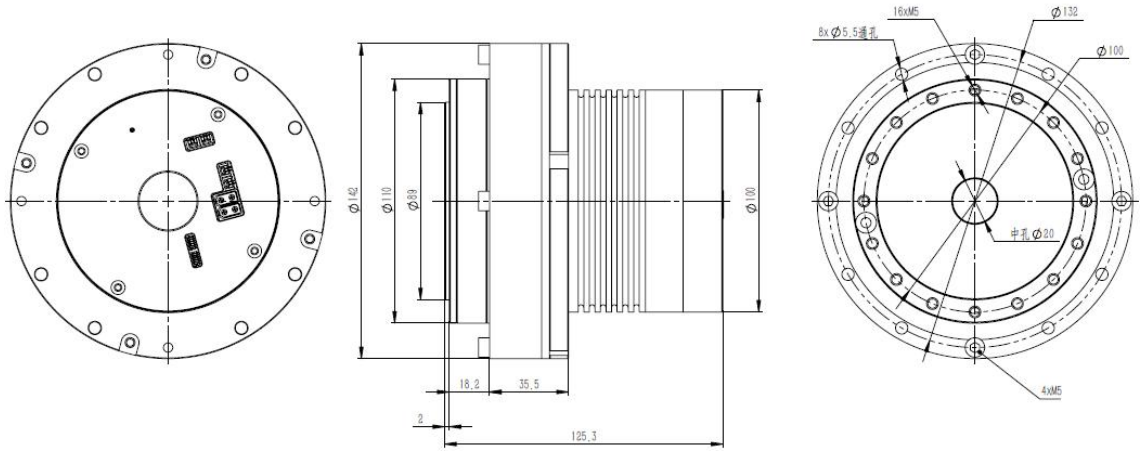

Figure 3-9 RH-32-B appearance dimension drawing

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3.3. Module Parameters

Table 3-2 Module parameter list 1

Parameter		RH-14		RH-17		RH-20	
Ratio		50	100	50	100	50	100
Input Voltage(V)		48		48		48	
Peak Speed (RPM)		60	30	60	30	60	30
No-load Current (A)		0.4	0.4	0.6	0.6	1.1	1.2
Rated Speed (RPM)		50	25	50	25	50	25
Rated Torque (N.m)		5.5	11	17.5	35	25	50
Rated Power (W)		28		91		130	
Rated Current (Arms)		2.8		4.7		6.8	
Peak Torque (N.m)		14	28	27	54	40	80
Peak Current (Arms)		5.7		7.4		10.6	
EMF Constant (Vdc/Krpm)		19.2		19.2		19.2	
Torque Constant (N.m/A)		2	4	3.7	7.4	3.65	7.3
Wire Resistance (Ω)		0.62		0.7		0.36	
Line Inductance (mH)		0.43		0.47		0.51	
Polar		10		10		10	
Wiring Method		Y		Y		Y	
Backlash（Arcsec）		< 40		< 40		< 40	
Radial Load (KN)	Static Load	8.6		16.3		22	
	Dynamic Load	5.8		10.4		14.6	
Axial Load (KN)	Static Load	58.7		78.2		132.7	
	Dynamic Load	16.2		20.8		34	
Moment of Inertia($Kg.m^2$)	N	0.11	0.29	0.16	0.52	0.21	0.87
	B	/	0.32	0.18	0.56	0.24	0.95
Encoder Type and Interface		Dual Encoder ABS-17BIT/ABS-17BIT					

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Repeatability(Degree)		< 0.01	< 0.01	< 0.01
Communication Method		EtherCAT/CAN	EtherCAT/CAN	EtherCAT/CAN
Length (mm)	N	81.7	90.2	82.9
	B	/	104	97.4
Outer Diameter (mm)		70	80	90
Wire Hole Diameter (mm)	N	10	15	14
	B	/	12	12
Weight (Kg)	N	0.78	1.11	1.45
	B	/	1.28	1.75
Insulation level		F		

Table 3-3 Module parameter list 2

Parameter	RH-25		RH-32	
Ratio	50	100	50	100
Input Voltage(V)	48		48	
Peak Speed (RPM)	60	30	40	20
No-load Current (A)	1.8	2.0	2.6	2.8
Rated Speed (RPM)	50	25	36	18
Rated Torque (N.m)	54	108	75	150
Rated Power (W)	282		282	
Rated Current (Arms)	10.6		21.8	
Peak Torque (N.m)	78.5	157	114.5	229
Peak Current (Arms)	14.1		32.1	
EMF constant (Vdc/Krpm)	19.2		26.7	
Torque constant (N.m/A)	5.05	10.1	3.45	6.9
Wire Resistance (Ω)	0.16		0.08	
Line Inductance (mH)	0.33		0.18	
Polar	10		10	

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Wiring Method		Y		Y	
Backlash（ Arcsec）		< 40		< 40	
Radial Load (KN)	Static Load	35.8		65.4	
	Dynamic Load	21.8		38.2	
Axial Load (KN)	Static Load	198.2		342.6	
	Dynamic Load	49.1		81.8	
Moment of Inertia(Kg.m²)	N	0.51	1.94	0.82	6.86
	B	0.59	2.32	2.05	8.32
Encoder type and interface		Dual Encoder ABS-17BIT/ABS-17BIT			
Repeatability(Degree)		< 0.01		< 0.01	
Communication method		EtherCAT/CAN		EtherCAT/CAN	
Length (mm)	N	89.5		108.4	
	B	105.2		125.3	
Outer diameter (mm)		110		142	
Wire hole diameter (mm)	N	22		24	
	B	22		20	
Weight (Kg)	N	2.42		4.32	
	B	2.74		4.74	
Insulation level		F			

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3.4. Motor Current-Output Torque-Speed Curve

Below are the test data and curves of motor current-output torque-speed for some model modules.

Table 3-4 RH-14-100Ratio - Joint Module Motor Current-Output Torque-Speed Data

Speed / Torque / Motor Current	0Nm	2N.m	5N.m	11Nm
1RPM	0.3A	0.7A	1.3A	2.3A
15RPM	0.6A	1.1A	1.5A	2.8A
25RPM	0.8A	1.2A	1.9A	3A
30RPM	0.9A	1.4A	2.1A	3.1A

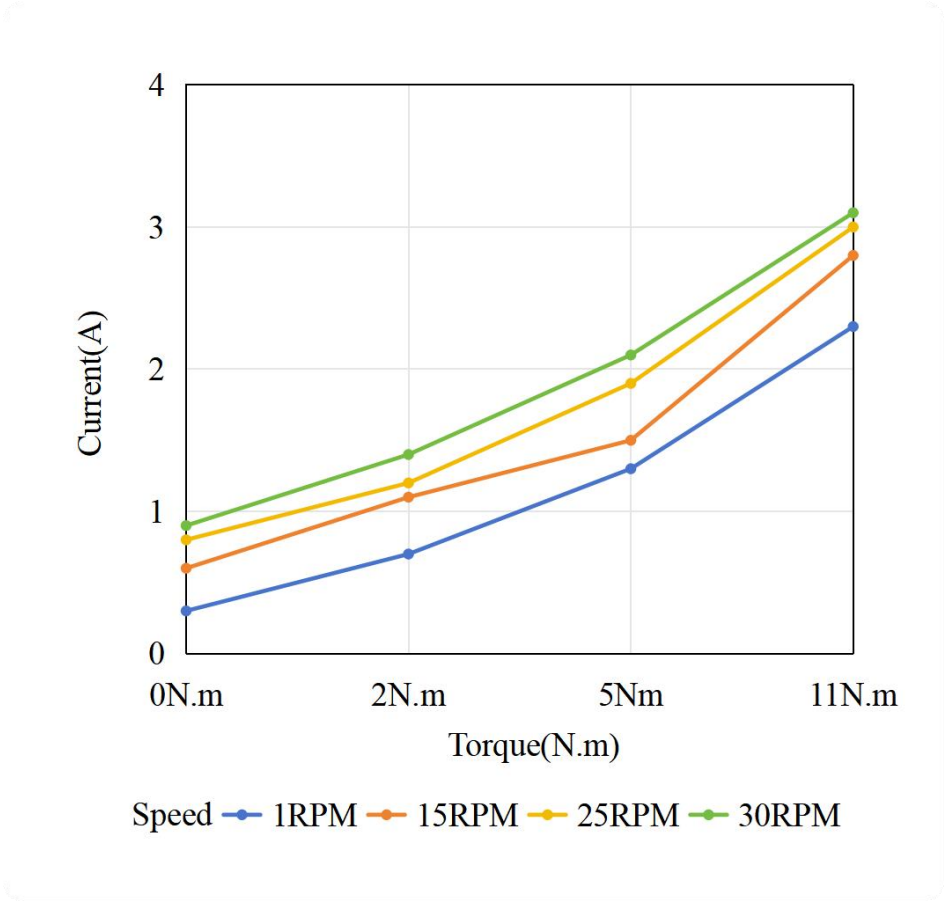

Figure 3-10 RH-14-100 Ratio - Module Motor Current-Output Torque-Speed Curve

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Table 3-5 RH-17-100Ratio - Joint Module Motor Current-Output Torque-Speed Data

Speed \ Torque / Motor Current	0Nm	5N.m	20N.m	35Nm
1RPM	0.5A	1.1A	3.2A	6.2A
15RPM	0.9A	1.5A	3.7A	6.7A
25RPM	1A	1.7A	3.9A	7.1A
30RPM	1.1A	1.9A	4.1A	7.3A

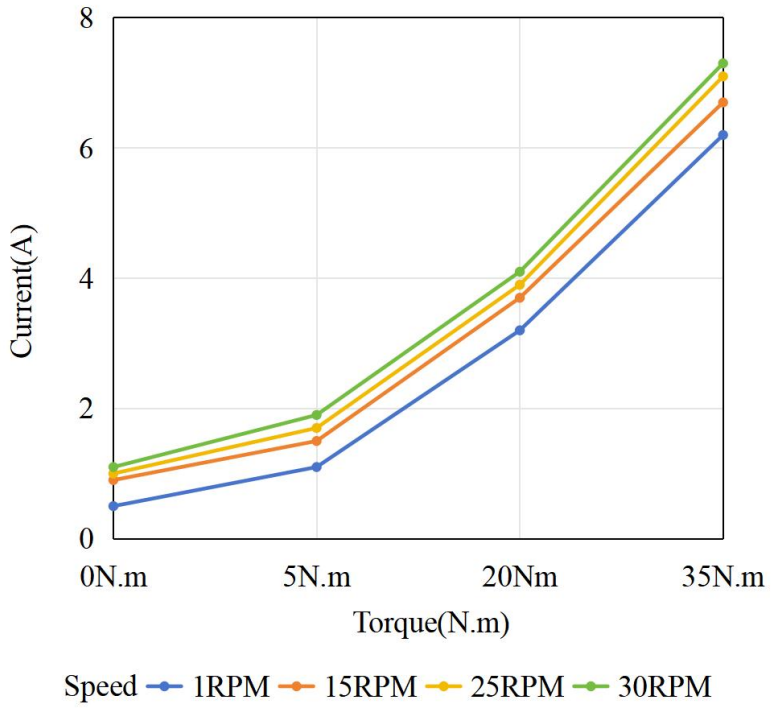

Figure 3-11 RH-17-100 Ratio - Module Motor Current-Output Torque-Speed Curve

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Table 3-6 RH-20-100Ratio - Joint Module Motor Current-Output Torque-Speed Data

Torque / Speed / Motor Current	0Nm	15N.m	35N.m	50Nm
1RPM	0.4A	2.5A	5.3A	7.5A
15RPM	1A	3.6A	6.3A	8.5A
25RPM	1.3A	4A	6.8A	8.9A
30RPM	1.5A	4.4A	7.1A	9.1A

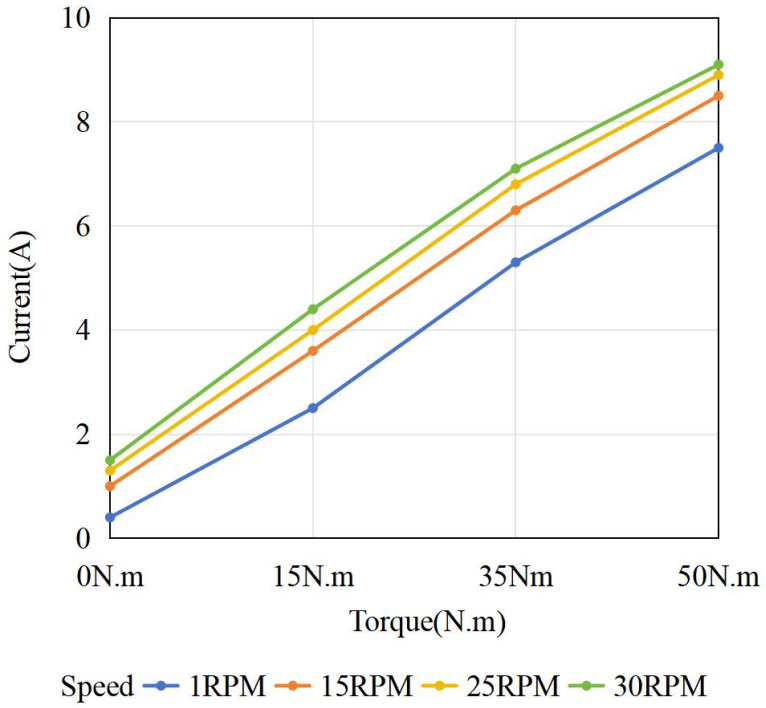

Figure 3-12 RH-20-100 Ratio - Module Motor Current-Output Torque-Speed Curve

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Table 3-7 RH-25-100Ratio - Joint Module Motor Current-Output Torque-Speed Data

Speed \ Torque / Motor Current	0Nm	50N.m	80N.m	108Nm
1RPM	0.8A	6A	9.2A	13A
15RPM	1.8A	7.5A	10.1A	14.5A
25RPM	2.1A	7.9A	11A	15A
30RPM	2.5A	8.1A	11.5A	14.7A

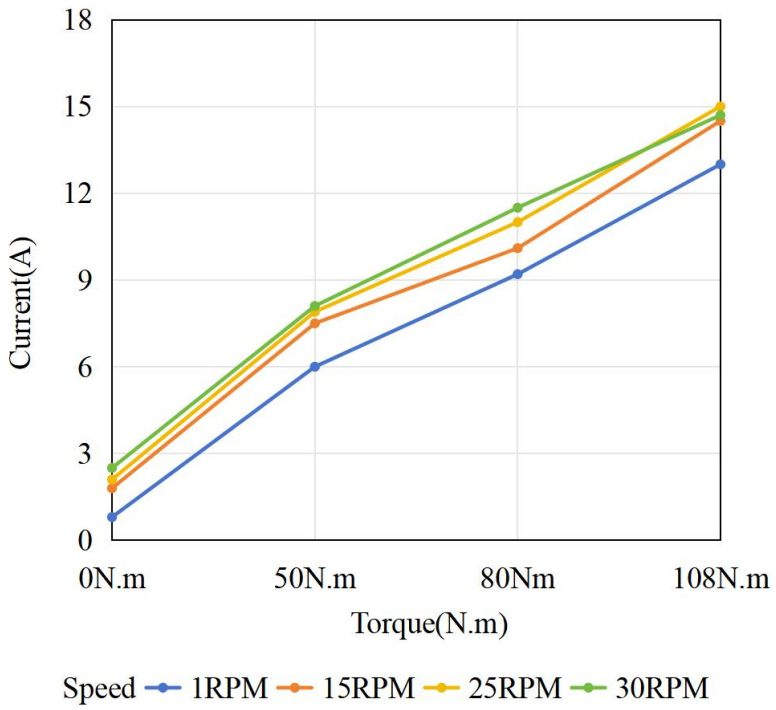

Figure 3-13 RH-25-100 Ratio - Module Motor Current-Output Torque-Speed Curve

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Table 3-8 RH-32-100Ratio - Joint Module Motor Current-Output Torque-Speed Data

Torque / Speed / Motor Current	0Nm	50N.m	100N.m	150Nm
1RPM	3A	10.1A	17.5A	25.6A
10RPM	5.2A	13.5A	19.6A	27.6A
15RPM	6.1A	14.2A	20.8A	28.2A
18RPM	6.7A	15A	21.9A	29.1A

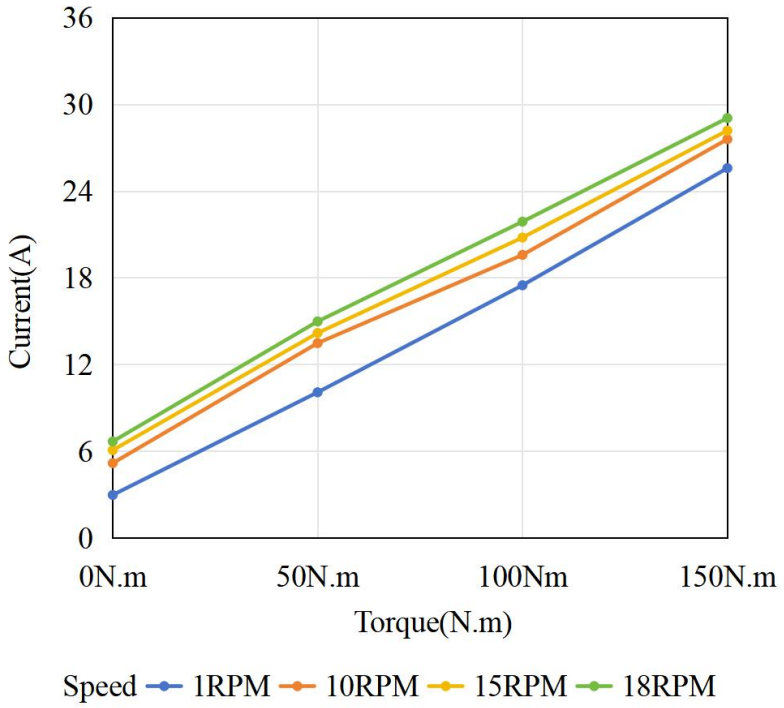

Figure 3-14 RH-32-100 Ratio - Module Motor Current-Output Torque-Speed Curve

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4. Mechanical Installation Requirements

Please carry out structural design and assembly based on the drawings of each model module provided by our company. Please refer to this chapter for details of the screw types and techniques required for assembly. During the assembly process, all fixed screws must be threaded with thread glue, and the position of thread glue must be consistent, and the amount of thread glue must be consistent. Use the diagonal method to tighten the screws. The specific tightening steps are as follows:

1. Tighten the screw to the end but do not tighten it;
2. Slightly tighten the screws in diagonal steps;
3. Tighten the screws using a torque wrench in diagonal steps.

For screw tightening force, refer to Table 4-1.

Table 4-1 Screw tightening torque table

Screw specifications (mm)	Tightening torque (kgf.cm)	Screw specifications (mm)	Tightening torque (kgf.cm)
M3 × 0.5	17	M14 × 2.0	1840
M4 × 0.7	40	M16 × 2.0	2870
M5 × 0.8	81	M18 × 2.5	3950
M6 × 1.0	138	M20 × 2.5	5600
M8 × 1.25	334	M22 × 2.5	7620
M10 × 1.25	663	M24 × 3.0	9680

Foreign matter such as metal shavings, dust particles, various types of sealant, etc. may be stuck to the installation surface, which will prevent reliable cooperation between the installation surfaces and further cause jitter and noise of the module. Therefore, please clean the installation surface carefully before installation.

5. Electrical Installation Requirements

5.1. About the Input Power Supply

The power supply uses 48VDC power supply, and the maximum withstand voltage

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of the module power interface is DC55V, and the input voltage exceeds 55V, which can easily lead to driver failure. When a switch is used to control the joint for power, there may be an over voltage at the moment of power-up shock, this power supply mode needs to connect an electrolytic capacitor in parallel after the switch and before the joint power input (Reference specification:1000uF, 100V), as shown in Figure 5-1, to suppress overshoot of the input voltage at the moment of power-up phenomenon.

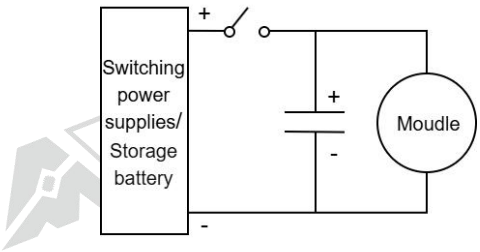

Figure 5-1 Protection circuits in the case of switching power supplies

There is no need to consider the effect of back EMF when using battery power, because the back EMF of the module directly charges the battery. In order to make the system more safe and reliable, the over voltage/under voltage protection voltage of the module can be modified according to the actual test situation, and the modification method is as follows: debugging the host computer - advanced parameters - protection parameters - over voltage/under voltage protection voltage, as shown in Figure 5-2.

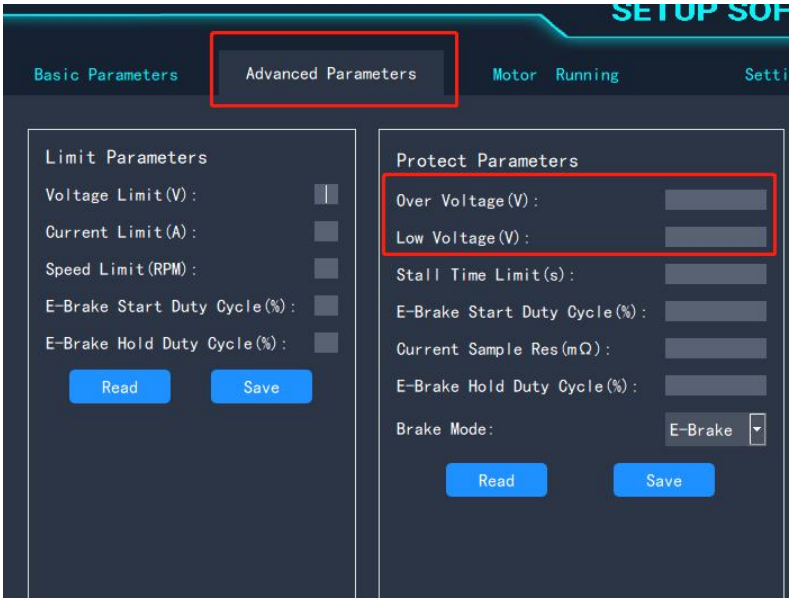

Figure 5-2 Schematic diagram of over voltage/under voltage protection voltage modification

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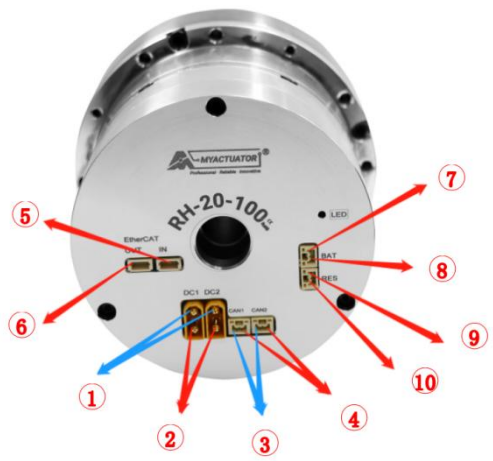
5.2. Interface Description

The interface is described as follows.

Table 5-1 Interface description



Number	Port	Port description
①	DC-	The negative pole of the power
②	DC+	The positive pole of the power
③	CAN_L	CAN_L network signal interface
④	CAN_H	CAN_H network signal interface
⑤	EtherCAT_IN	EtherCAT input port
⑥	EtherCAT_OUT	EtherCAT output port
⑦	BAT-	The negative pole of a multiturn
⑧	BAT+	The positive pole of a multiturn
⑨	RES-	Bleeder resistor interface
⑩	RES+	Bleeder resistor interface

Note: RH-14 model module has no bleeder resistance interface, please pay attention to the following points when using:

1) If used with other models, there is no need to add bleeder resistance when other modules have been added;

2) If you use it alone, you need to find a way to add bleeder resistance;

3) The EtherCAT interface definitions can be found on the motor label.

5.3. Indicator Description

Table 5-2 Explanation of the status of the indicator

Expression	Situation
The green light is always on	The motor is operating normally
The green light flashes rapidly	There is a level 1 error in the motor
The green light flashes slowly	There is a level 2 error in the motor

If there is an error in the operation of the motor, please read the specific error information from the host computer or CAN command, and refer to the "Setup Software

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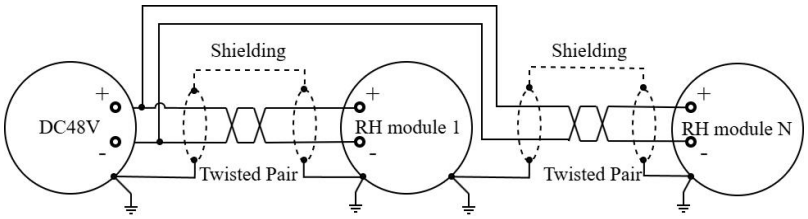
Instruction Manual" and "Servo Motor Control Protocol" for the specific error reason.

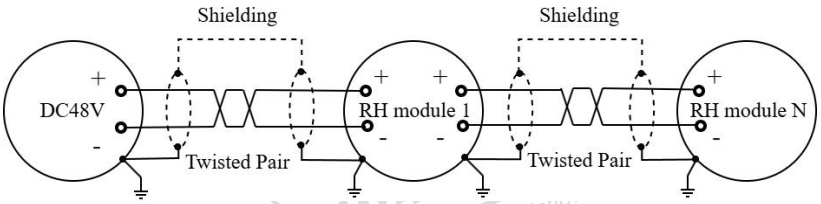
6. Cable Connection between Multi-joint Modules

6.1. Description of the Power Supply Wiring

There are two power wiring modes for this series of joint modules: single-axis direct connection and chain topology connection, as shown in Figure 6-1. When it is applied to the collaborative work of multiple modules, the performance of the two wiring methods is different, the wiring resistance of single-axis direct connection is small, and the line loss voltage drop is small; The chain topology has a bit large wiring resistance and a little large line loss voltage drop, so it is recommended to use a single-axis direct connection for high-power modules and a chain-type topology connection for low-power modules. Note: Do not connect to other electrical devices in series, as it may cause unpredictable voltage drops or voltage boosts that may cause module failure.



(a)Schematic diagram of a single-axis direct connection



(b)Schematic diagram of the chain topology

Figure 6-1 Schematic diagram of multi-module power supply

6.2. CAN Communication Wiring Instructions

The CAN communication line is made of twisted pair cables, which are shielded separately, and it is important to ensure that the ID of each module is unique before establishing CAN communication. In addition, the CAN communication controller and

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module use the ground connection method for power supply, as shown in Figure 6-2. In order to eliminate signal reflections in the communication cables, a 120Ω termination resistor is required in parallel at the CAN communication interface of both the controller and the end module.

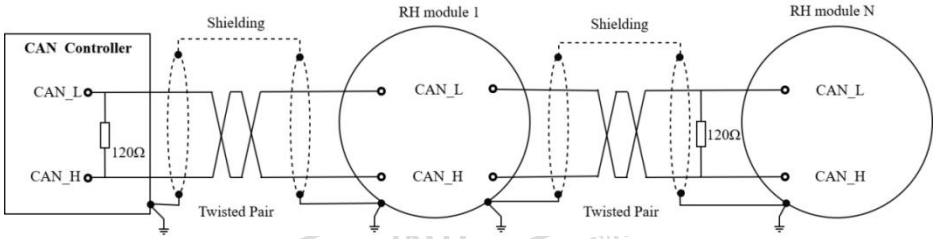

Figure 6-2 Schematic diagram of CAN communication wiring

6.3. EtherCAT Communication Wiring Instructions

The EtherCAT communication cable uses twisted pair cables and is individually shielded, as shown in Figure 6-3. If this communication method is used, it is recommended to keep the CAN communication line during the connection process and set the communication ID for subsequent debugging and troubleshooting.

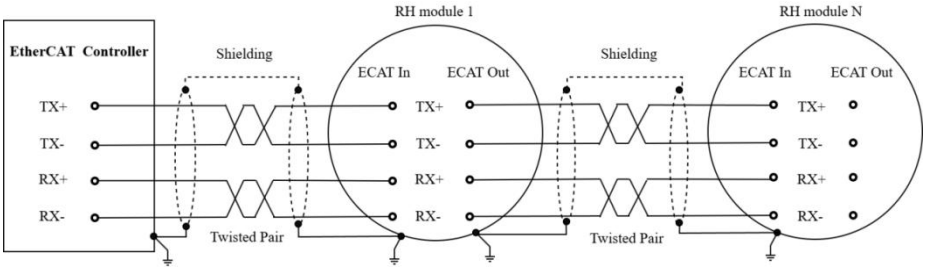

Figure 6-3 Schematic diagram of EtherCAT communication wiring

7. Precautions for Brake Use

7.1. Instructions and Precautions for Use

The brakes are powered by the module's DC power connector and do not require additional power supply. As a static holding brake, it can handle dynamic braking conditions at low loads and low rpm, but care should be taken to avoid using it as a dynamic brake. Triggering a fault at high speeds and loads can cause permanent damage to the brake components. In addition, the strong magnetic environment may cause the

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brake to not work properly, and magnetic shielding measures should be taken for the module.

Table 7-1 shows the static torque of the brakes for each type of module.

Table 7-1 Static torque values of brakes

Module model	RH-14	RH-17	RH-20	RH-25	RH-32
Static torque (N.m)	0.2	0.5	0.8	1.2	2

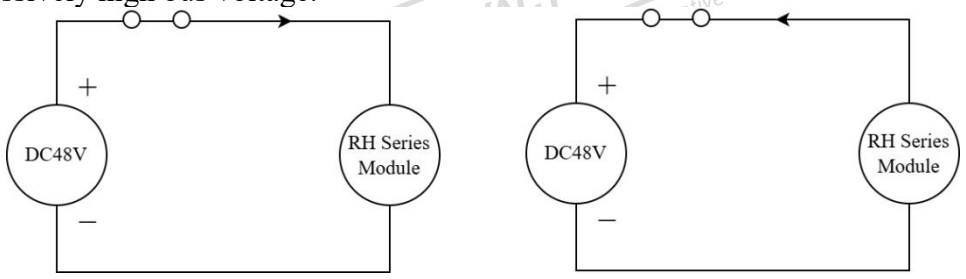
7.2. Brake Life

The brakes used in each type of module have undergone more than 2 million static life tests and more than 200 emergency stop tests to ensure stable product performance.

8. Kinetic Energy Recovery

8.1. Reasons for Kinetic Energy Recovery

During normal operation of the module, the power supply outputs electrical energy to it. When the module is operating in deceleration, the circuit loop engages in the process of kinetic energy recovery. Figure 8-1 shows a simplified circuit diagram of the module during normal operation and deceleration. The amount of kinetic energy recovered is related to torque and rotational speed, and it is directly proportional to the product of torque and rotational speed. Therefore, the faster the speed and the greater the load, the more kinetic energy is recovered. If the power supply voltage rises above the maximum allowable bus voltage set by the drive, the module will report an error for excessively high bus voltage.



(a)Normal operating state (b)Deceleration operating state

Figure 8-1 Diagram of module operating states

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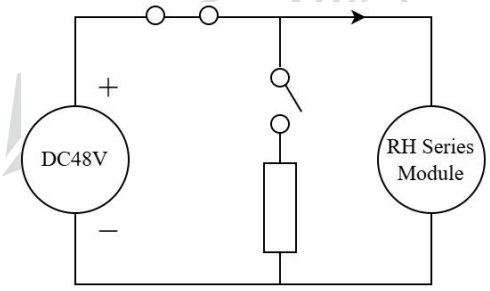
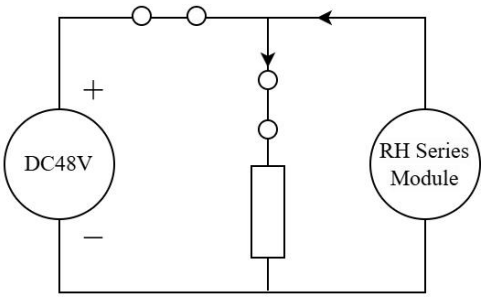
8.2. Handling Methods

1. Adding a bleeder resistor

By paralleling a resistor, when the module is in a deceleration operating state, the recovered kinetic energy is consumed through the resistor, thereby preventing the power supply voltage from becoming too high due to kinetic energy recovery. As shown in Figure 8-2, the disconnection/connection of the resistor can be operated through a logic control circuit.



(a) The resistor is disconnected when the voltage is normal



(b) The resistor is connected when the voltage is too high

Figure 8-2 Diagram of module operating state with bleeder resistor connected

2. Adding a super capacitor

During normal operation, the switching power supply supplies power to both the super capacitor and the module. When the module is in a deceleration operating state, the super capacitor rapidly recovers part of the kinetic energy, thereby preventing the power supply voltage from becoming too high. As shown in Figure 8-3.

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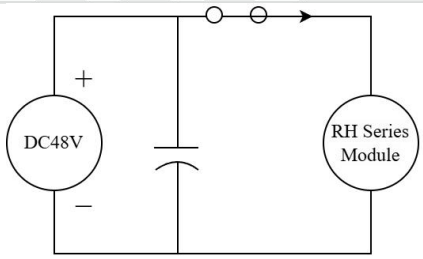
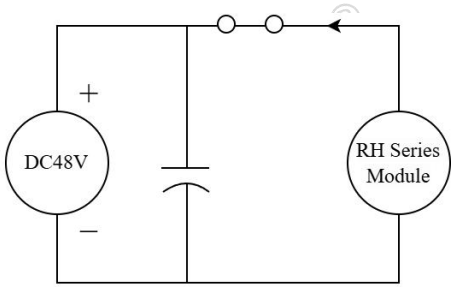


(a) Charging the capacitor when the voltage is normal

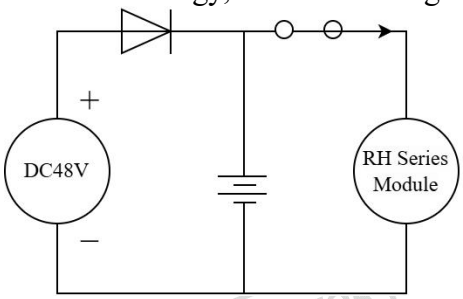


(b) Capacitor kinetic energy recovery when the voltage is too high

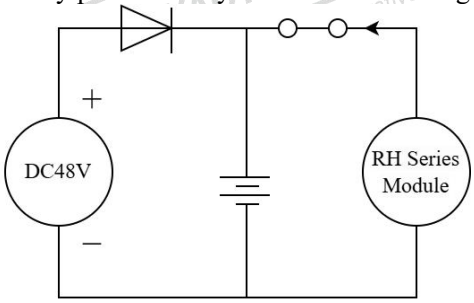
Figure 8-3 Diagram of module operating state with super capacitor added

3. Adding a storage battery

During normal operation, both the switching power supply and the storage battery supply power to the module simultaneously. When the module is in a deceleration state, the storage battery recovers the kinetic energy, as shown in Figure 8-4.



(a)Storage battery powers the system when the voltage is normal



(b)Storage battery recovers kinetic energy when the voltage is too high

Figure 8-4 Diagram of module operating state with storage battery added

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9. Encoder Description

9.1. Resolution and Position Feedback

The module is controlled by double absolute encoders and achieve full closed-loop control. The resolution of the encoder is 17bit, that is, the number of positions output by the rotation of the motor shaft is 2^{17}, the single turn position change range is 0~131071, and the conversion formula between angle and single turn position is:

$$\text{single turn position} = \text{angle} \div 360 \times 131072$$

For example, a lap angle of 30° corresponds to a lap position of $30 \div 360 \times 131072$.

When the encoder position jumps at the boundary, it will count the number of turns of multiple turns, and when the position of 0 moves in the opposite direction, the position change will change from 0 to 131071, and the count of turns will be reduced by 1; When the 131071 position moves in the positive direction, it will jump from 131071 to 0, and the lap count will be increased by 1, so the current position of the encoder is calculated as follows:

$$\text{position} = \text{lap count} \times 131072 + \text{single lap position}$$

For the module, the current position can be obtained through the CAN bus or setup software, the motor operation interface status bar of the setup software will display the current motor angle in real time, the detailed setup software function and operation process can be found in the company's "Setup Software Instruction Manual", and the CAN communication control instructions are detailed in the "Servo Motor Control Protocol".

It is worth noting that it is necessary to install a multi-turn power supply battery before use, and the required battery specification is 2.7~3.6V, and the installation interface is detailed in 5.2.

9.2. Instructions for the Use of the Mechanical Zero Calibration Function

Users can use the mechanical zero point calibration function to flexibly set the

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mechanical zero point value according to the use of the module, and there are two ways to set it:

1. Connect and debug the setup software, and set the zero point in the basic parameter interface, see the "Setup Software Instruction Manual" of the company for details;

2. CAN command setting, please refer to our company's "Servo Motor Control Protocol" for details.

9.3. Instructions for Use of Multiturn Powered Batteries

The multiturn power battery is set to prevent the zero point loss when the module is powered off, and it provides working power for the multiturn encoder and records the multiturn position. During use, the following precautions need to be observed:

1. Do not change the wiring sequence of the battery at will;

2. Do not pull the battery cord vigorously;

3. Do not use wires and other mediums with conductive properties to short-circuit the positive and negative electrodes of the battery;

4. When replacing the battery, please make sure that the module is in a power-off state;

5. Do not carry out safety tests such as extrusion and impact without protection;

6. Do not use, transport or store batteries in high temperature, humid or electrostatic or corrosive environments;

7. Avoid direct sunlight when storing batteries, and keep the storage area clean, dry and ventilated;

8. The degree of impact and vibration should be limited to the lowest range during battery transportation;

9. If you find that the battery is heated, emitted peculiar smell, deformed and other abnormal phenomena, please stop using it immediately;

10. Please dispose of waste batteries in accordance with local environmental regulations.

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10.Connect and Debug the Setup Software

Please download the latest debugging software from the company's official website, and the installation and debugging method is detailed in the "Setup Software Instruction Manual".

11.Communication Instruction Description

The RH series module adopts our company's customized communication instructions, and the communication control instructions are detailed in the "Servo Motor Control Protocol".

12.Allowable Force Value of the Module

12.1. Allowable Torque

The allowable torque load (Mc) of the module refers to the maximum torque load that can be applied to the output bearing, within which the module can maintain its basic performance. In this regard, the maximum static load torque shall not exceed its allowable torque load, and the calculation method of the maximum static load torque is as follows.

$$M_{max} = Fr_{max}(Lr + R) + Fa_{max} \cdot La$$

Where M_{max} is the maximum static load torque, Fr_{max} is the maximum radial load, Fa_{max} is the maximum axial load, Lr is the radial load torque and La is the axial load torque, R is the offset, see Figure 12-1 for a schematic diagram.

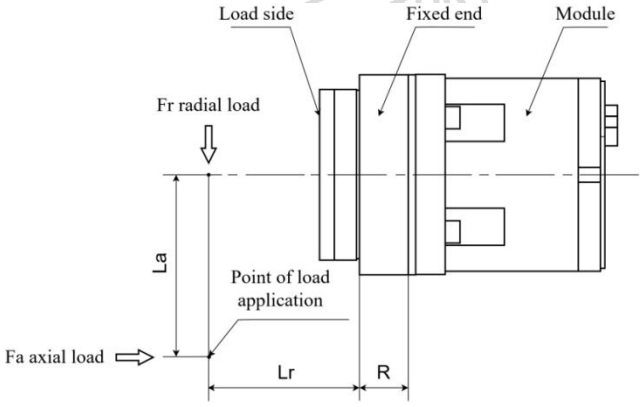

Figure 12-1 Schematic diagram of the load action

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The allowable torque of each type of module is shown in Table 12-1.

Table 12-1 Allowable torque of the module

Model	RH14	RH17	RH20	RH25	RH32
R(m)	0.0141	0.016	0.0175	0.0187	0.0234
Mc(Nm)	41	59	117	213	400

12.2. Stiffness

The wave generator is fixed, and the torque is applied to the flexible wheel, and the angle of torsion of the output shaft is almost proportional to the torque, and this process is described in a curve, as shown in Figure 12-2.

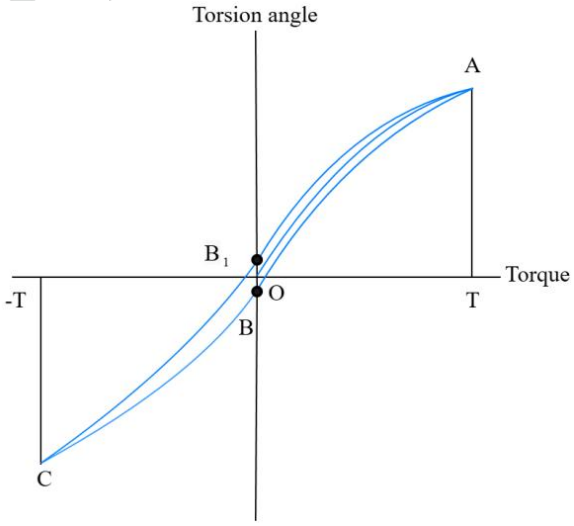

Figure 12-2 Torque-torsion angle diagram

Torque is applied to both sides of the output shaft from 0 to T or 0 to -T. In the process, accompanied by the change of torsion angle, the combined value points of torque and torsion angle are connected to form a torque-torsion angle linear diagram, and its inclination degree is the stiffness coefficient, which describes the rigidity of the module and is called the stiffness value. When the torque is restored to 0, the torsion angle does not completely become 0, and the gap with is called hysteresis loss (hysteresis loss is mainly caused by internal friction, and there is no hysteresis loss when the torque is small).

Table 12-2 shows the stiffness values of each module.

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Table 12-2 The stiffness value of the module

Model	RH14	RH17	RH20	RH25	RH32
Stiffness value（X$10^4 Nm/rad$）	0.43	0.93	1.62	3.33	7.47

Table 12-3 shows the hysteresis loss of each module.

Table 12-3 The hysteresis loss of the module

Model	RH14	RH17	RH20	RH25	RH32
Stiffness value（X$10^4 Nm/rad$）	2	2	1.5	1.5	1.5

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