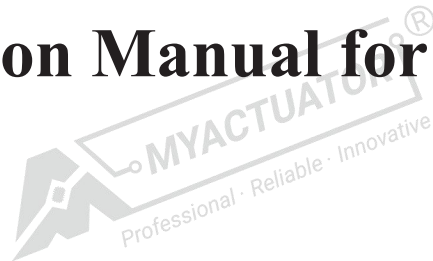


Instruction Manual for the Product



Applicable series: RH series

Version: V1.2

Date: 2024.08



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.



Figure I Physical diagram of RH series module

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.



CN WEB



EN WEB

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Imprint Notice

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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

Catalog

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




	<p>Please check whether the module and its accessories are complete</p> <p>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.</p>
-----------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------


Installation and maintenance phase	
	<p>Please assemble the module in place</p> <p>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.</p>
	<p>Do not plug or unplug the power cord while the power is on</p> <p>Make sure the power indicator light goes out before wiring and maintaining the device.</p>
	<p>Do not plug or unplug communication lines while the power is on</p> <p>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.</p>
	<p>Do not disassemble the module and its associated equipment while the power is on</p> <p>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.</p>
	<p>Please keep the module shell grounded and use shielding layer properly</p> <p>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</p>



	corresponding wire diameter and shielding requirements, and the shielding layer of the shielded cable must be reliably grounded.
	<p>Please use a multi-turn encoder power battery that meets the specifications</p> <p>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. .</p>
	<p>It is strictly prohibited to connect the power supply to the output of the device</p> <p>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.</p>
	<p>Please do a risk assessment</p> <p>Please conduct a risk assessment before use and take appropriate measures to ensure personal safety and equipment safety.</p>
	<p>Please observe the technical data and specifications</p> <p>Please refer to the parameters of each model in the manual to set reasonable parameters to prevent damage to the module.</p>
	<p>Please set appropriate protection limits</p> <p>Set appropriate position limits, speed limits, current limits, etc. Exceeding the limits may damage the motor or even threaten personal safety.</p>
	<p>Please perform a no-load test run before using the module</p> <p>To prevent accidents, please perform a no-load test run on the module.</p>
	<p>Do not disassemble or replace parts by yourself</p> <p>Product failure due to abnormal use will void the warranty rights of the product.</p>

	<p>Do not hit or squeeze the module and its components with gravity</p> <p>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.</p>
	<p>The use environment complies with regulations</p> <p>The working environment temperature of the module is -10~55°C. 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.</p>
	<p>Be careful of high temperature burns</p> <p>During the operation of the module, the surface may be very hot, please pay attention to protection. When the surface temperature exceeds 40°C, please avoid long-term contact, which may cause low-temperature burns. When the surface temperature exceeds 85°C, please avoid touching it, which may cause minor burns.</p>

Storage

	<p>Storage environment meets standards</p> <p>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.</p>
	<p>Storage time should not be too long</p> <p>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.</p>
	<p>Do not mix and transport equipment that may cause damage</p> <p>Please pack the module strictly before transporting it. It is strictly prohibited to transport it mixed with equipment that may affect it.</p>

	<p>Regular inspection and maintenance</p> <p>Please perform daily and regular inspection and maintenance on the module, and keep maintenance records.</p>
-----------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------

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

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”.

① All 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;

② Users 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;

③ If 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

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

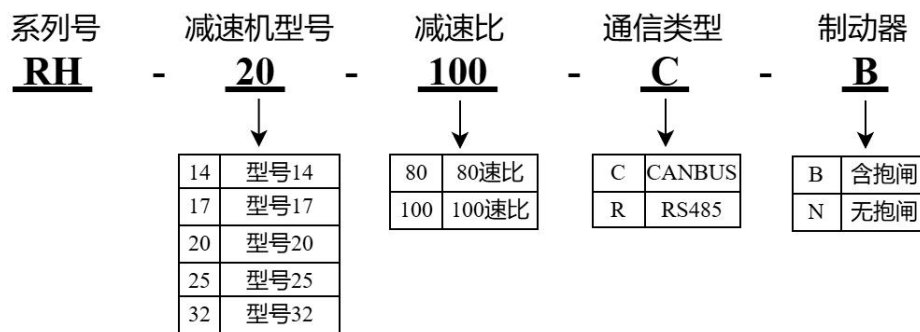
Please read this statement carefully before use. Once used, it is deemed to be recognition and acceptance of the entire content of this statement. Please install and use this product in strict compliance with the manual, product instructions, and relevant laws, regulations, policies, and guidelines. 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,

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



Taking RH-20-100-C-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.
C	Indicates the communication interface type of the module, including CANBUS and RS485.
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.

3.2. Module appearance size

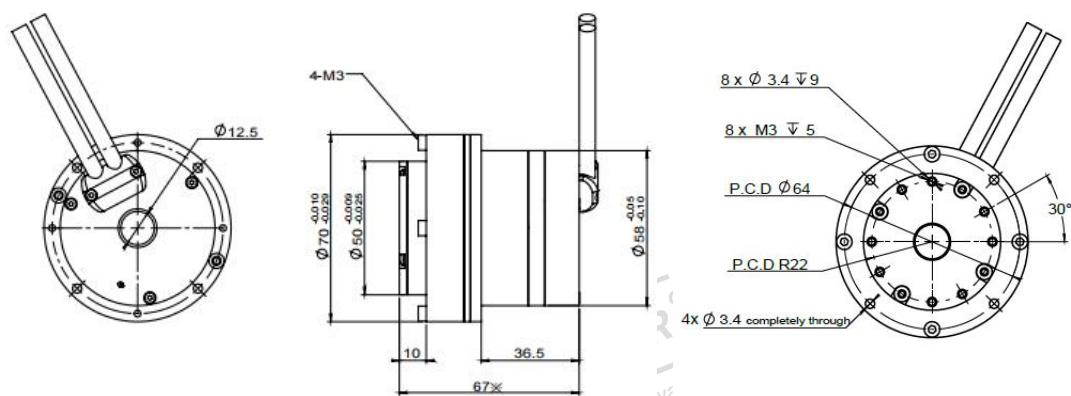


Figure 3-1 RH-14-N appearance dimension drawing

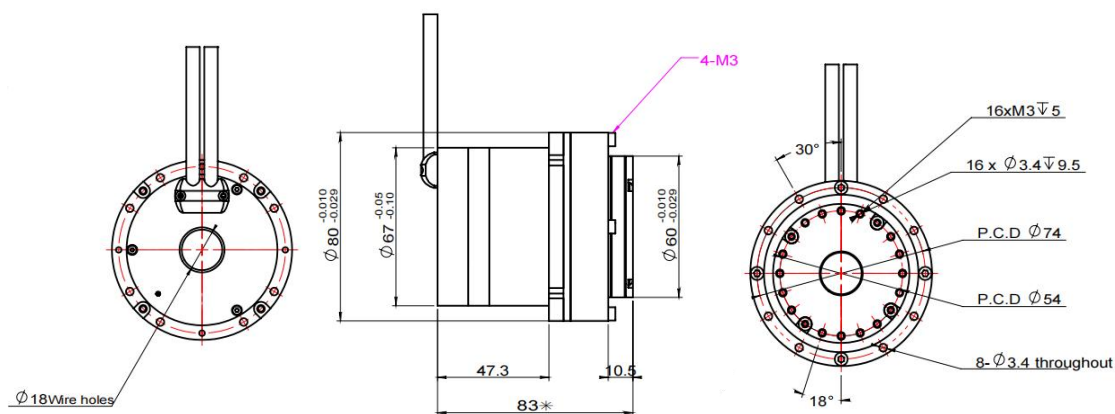


Figure 3-2 RH-17-N appearance dimension drawing

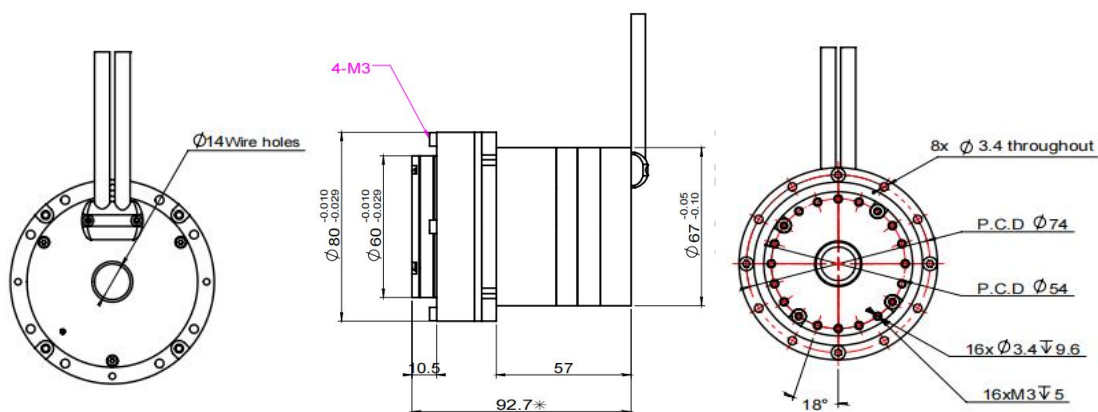


Figure 3-3 RH-17-B appearance dimension drawing

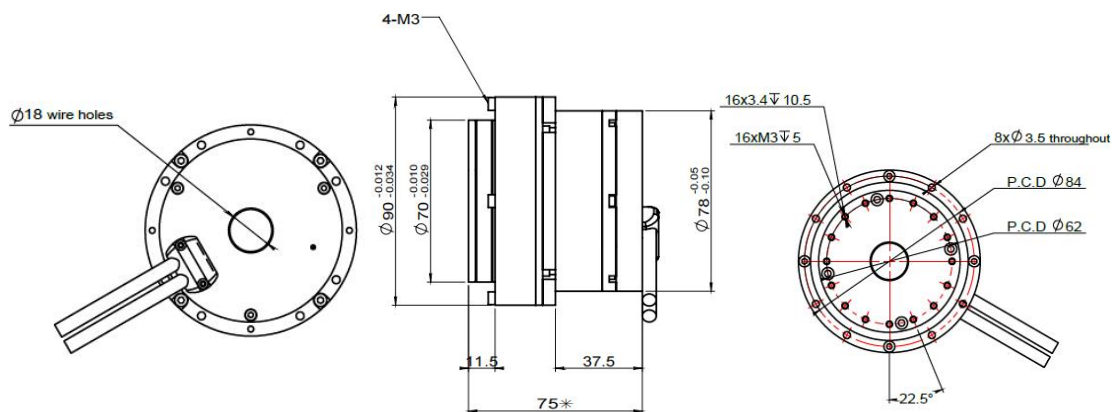


Figure 3-4 RH-20-N appearance dimension drawing

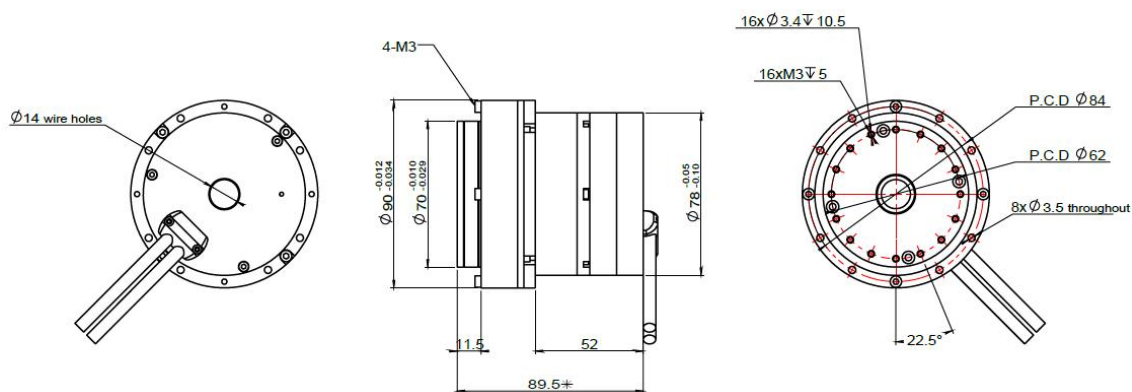


Figure 3-5 RH-20-B appearance dimension drawing

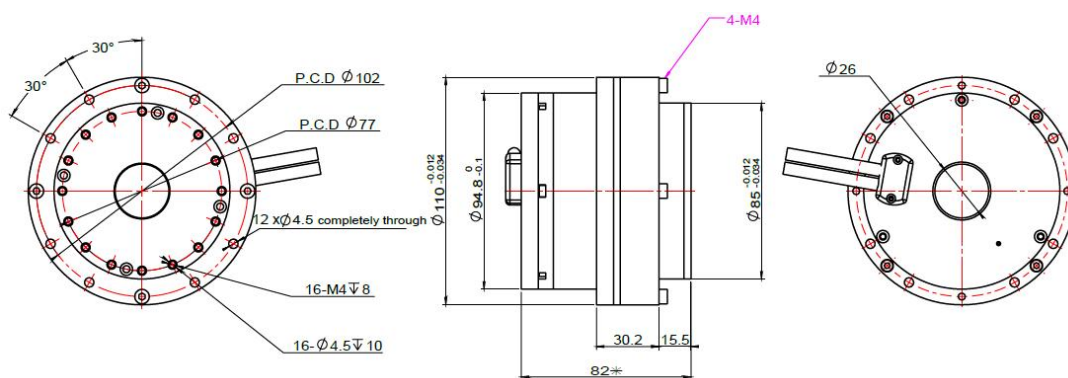


Figure 3-6 RH-25-N appearance dimension drawing

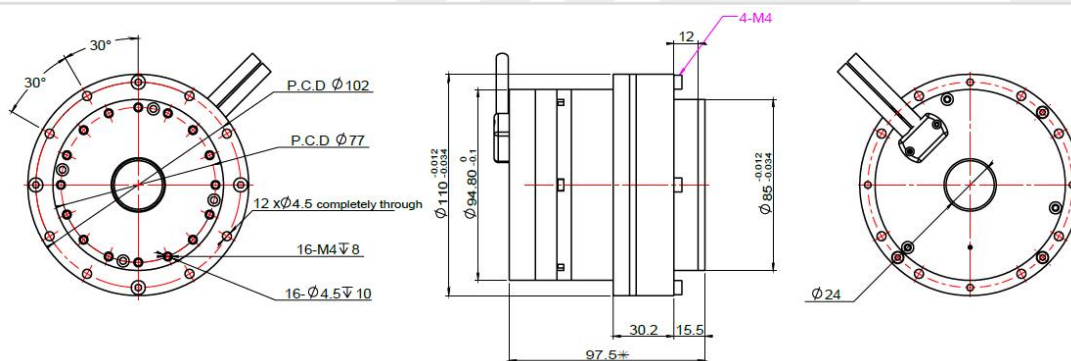


Figure 3-7 RH-25-B appearance dimension drawing

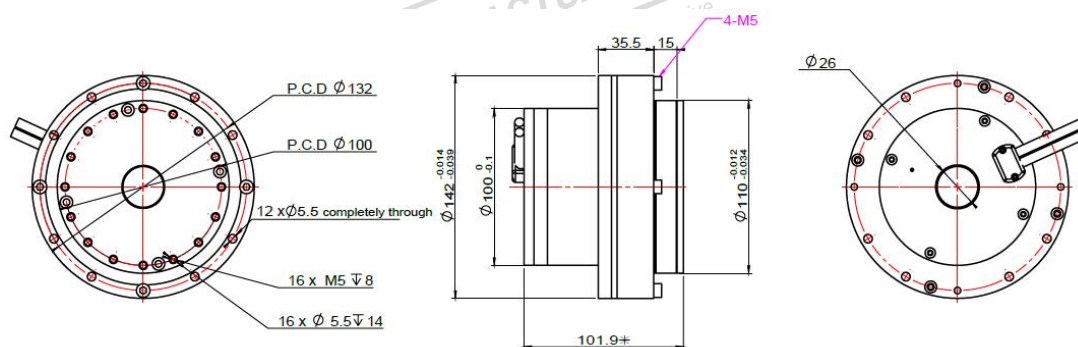


Figure 3-8 RH-32-N appearance dimension drawing

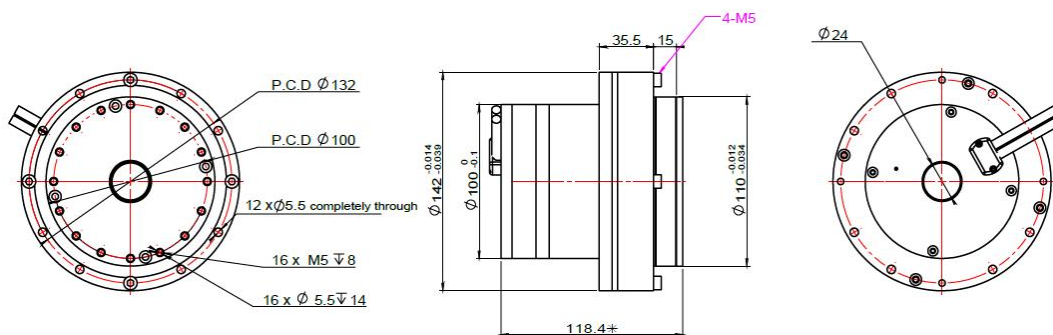


Figure 3-9 RH-32-B appearance dimension drawing

3.3. Module parameters

Table 3-2 Module parameter list 1

Parameter		RH-14		RH-17		RH-20	
Ratio		80	100	80	100	80	100
Input Voltage(V)		48					
Peak Speed (RPM)		37	30	37	30	37	30
No-load Current (A)		0.70	0.90	1.25	1.45	2.31	2.59
Rated Speed (RPM)		31	25	31	25	31	25
Rated Torque (N.m)		9	11	28	35	40	50
Rated Power (W)		100		180		250	
Rated Current (A)		6.5		9		13	
Peak Torque (N.m)		22	28	43	54	64	80
Peak Current (A)		16.25		13.86		20.80	
EMF constant (Vdc/Krpm)		1.39		2.79		2.79	
Torque constant (N.m/A)		0.02		0.04		0.04	
Wire Resistance (Ω)		0.90		0.77		0.38	
Line Inductance (mH)		0.40		0.38		0.33	
Polar		10					
Wiring Method		Y					
Backlash		< 20 Arcsec					
Encoder type and interface		ABS-17bit					
Repeatability		< 0.01 Degree					
Communication method		CAN / RS485					
Weight (kg)	N	0.71		1.10		1.45	
	B	/		1.25		1.60	

Length (mm)	N	67	83	75
	B	/	92.70	89.50
Outer diameter (mm)		70	80	90
Wire hole diameter (mm)	N	12.50	18	18
	B	/	14	14
Insulation level		F		

Table 3-2 Module parameter list 2

Parameter	RH-25		RH-32	
Ratio	80	100	80	100
Input Voltage(V)	48			
Peak Speed (RPM)	35	30	25	20
No-load Current (A)	1.41	1.61	3.70	3.90
Rated Speed (RPM)	30	25	22	18
Rated Torque (N.m)	86	108	120	150
Rated Power (W)	400		700	
Rated Current (A)	16		20	
Peak Torque (N.m)	126	157	183	229
Peak Current (A)	23.20		33.44	
EMF constant (Vdc/Krpm)	4.89		6.28	
Torque constant (N.m/A)	0.07		0.09	
Wire Resistance (Ω)	0.23		0.08	
Line Inductance (mH)	0.30		0.13	
Polar	10			
Wiring Method	Y			
Backlash	< 20 Arcsec			

Encoder type and interface		ABS-17bit	
Repeatability		< 0.01 Degree	
Communication method		CAN / RS485	
Weight (kg)	N	2.30	4.30
	B	2.82	4.70
Length (mm)	N	82	101.9
	B	97.5	118.4
Outer diameter (mm)		110	142
Wire hole diameter (mm)	N	26	26
	B	24	24
Insulation level		F	

3.4. Output characteristic curve

The following are the motor current-output torque-speed test data and curves of some models of modules.

Table 3-3 RH-14-100 ratio module motor current-output torque-speed

Speed \ Torque	Torque					
	1N.m	2N.m	4N.m	6N.m	8N.m	11N.m
1RPM	1.11A	1.55A	2.51A	3.23A	4.13A	5.98A
10RPM	1.55A	1.98A	2.96A	3.81A	5.03A	6.41A
20RPM	1.67A	2.41A	3.46A	4.49A	5.50A	7.13A
30RPM	2.32A	2.83A	3.95A	4.81A	6.11A	7.55A

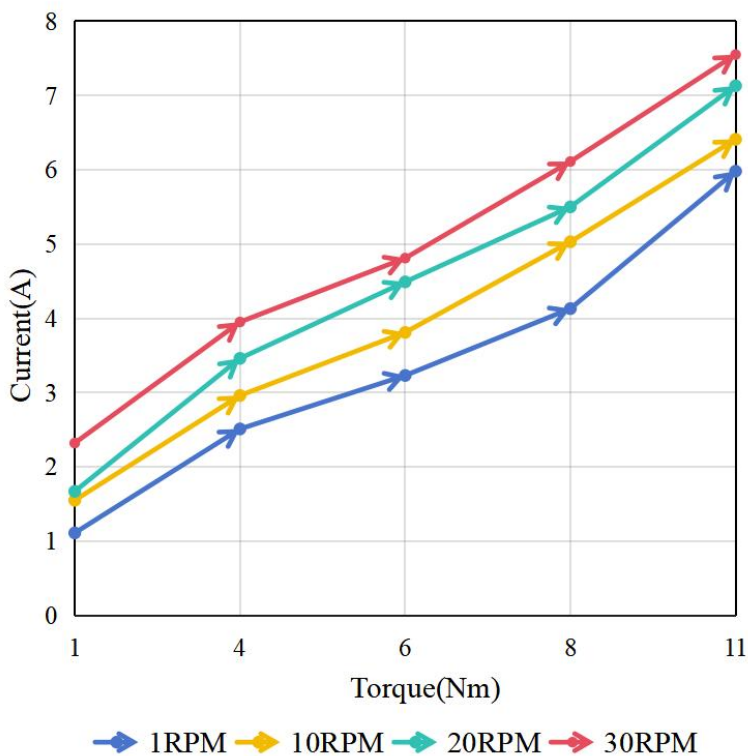


Figure 3-10 RH-14-100 ratio module motor current-output torque-speed curve

Table 3-4 RH-17-100 ratio module motor current-output torque-speed

Speed \ Torque	Torque					
	1N.m	5N.m	10N.m	20N.m	30N.m	35N.m
1RPM	0.49A	1.21A	2.41A	4.26A	6.70A	8.58A
10RPM	0.99A	1.62A	2.65A	5.11A	7.13A	8.91A
20RPM	1.30A	2.13A	3.54A	5.75A	7.61A	9.32A
30RPM	1.67A	2.54A	3.89A	6.12A	8.11A	10.12A

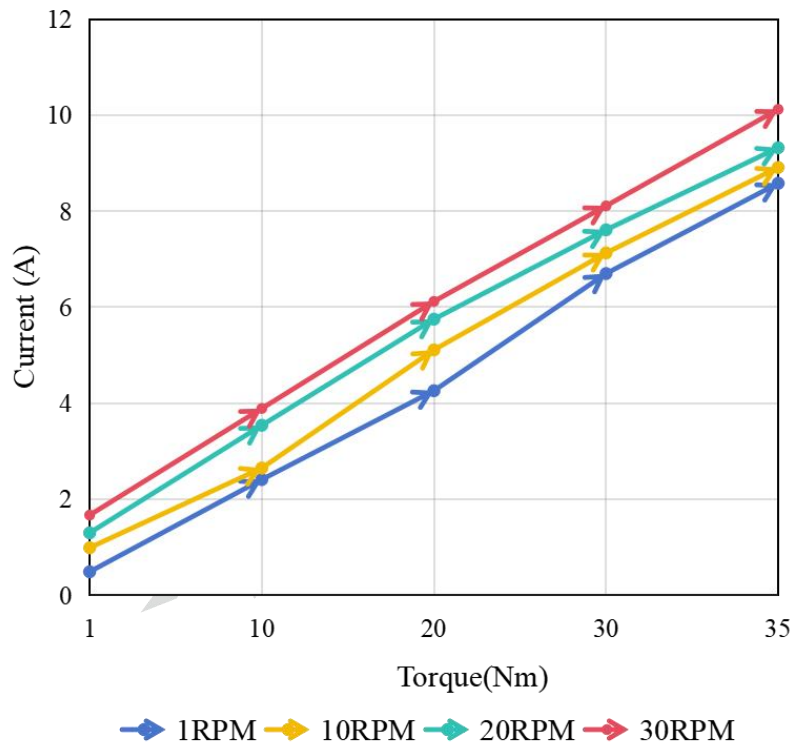


Figure 3-11 RH-17-100 ratio module motor current-output torque-speed curve

Table 3-5 RH-20-80 ratio module motor current-output torque-speed

Torque Speed	Current	Torque				
		1N.m	10N.m	20N.m	30N.m	40N.m
1RPM		0.80A	3.04A	6.23A	9.54A	11.48A
10RPM		1.56A	3.97A	7.11A	10.45A	12.47A
20RPM		1.92A	4.76A	8.12A	11.36A	13.35A
30RPM		2.45A	5.11A	9.66A	12.54A	14.69A
37RPM		3.27A	5.78A	10.11A	13.22A	15.27A

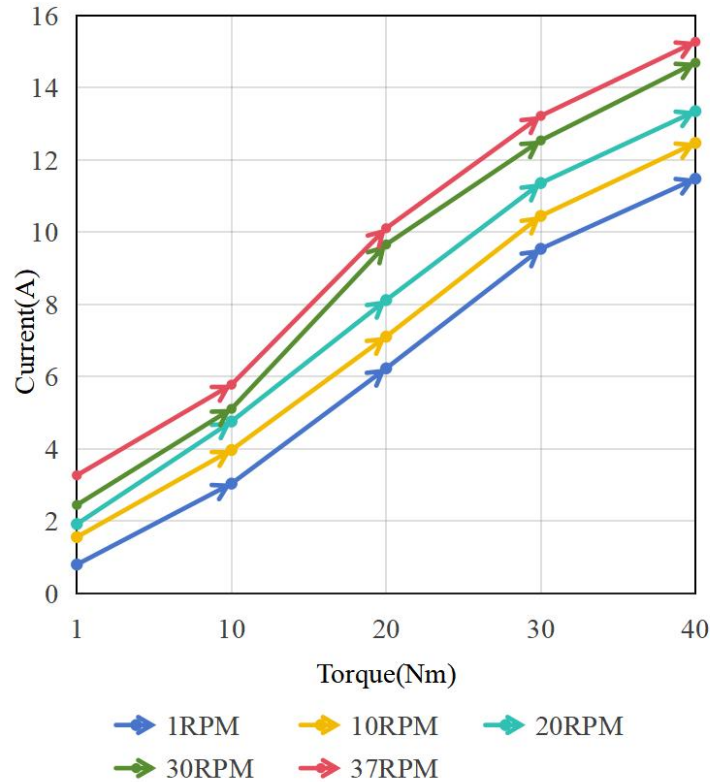


Figure 3-12 RH-20-80 ratio module motor current-output torque-speed curve

3.5. Temperature rise characteristics

The following is the temperature rise data of some models of modules. The test method is to give the module a specific load at room temperature (25°C) and test its temperature rise after a certain holding time.

Table 3-6 RH-14-100 temperature rise test data

Load	Torque (Nm)	Output Maximum Speed(RPM)	Time	Temperature (°C)	
				±90° Loop Operation	90° Suspension Hold
1.0x	11	2500	1h	<50	/
1.5x	16.5	2500	30min	<50	/
2.0x	22	2500	5min	<50	<50
2.5x	27.5	2500	1min	<50	<50
3.0x	33	2500	30s	<50	<50

Note:

- ① Loop operating temperature: The module performs loop operation at $\pm 90^\circ$, maintains it for 5 seconds when reaching $\pm 90^\circ$, and runs the module temperature after a specific time.
- ② Suspension holding temperature: The module temperature after running for a specific time under the premise that the module is maintained at 90° .
- ③ The test bench is made of metal and has good thermal conductivity, which helps the heat generated by the motor to be transferred out faster during operation. Therefore, the above temperature is for reference only.

Table 3-7 RH-17-100 temperature rise test data

Load	Torque (Nm)	Maximum speed (RPM)	Time	Temperature ($^\circ\text{C}$)	
				$\pm 90^\circ$ cycle operation	90° suspension hold
1.0x	35	2500	1h	<50	/
1.5x	52.50	2500	30min	<50	/
2.0x	70.00	2500	5min	<80	<90
2.5x	87.50	2000	1min	<80	<70
3.0x	105.00	2000	30s	<90	<50

Note:

- ① Loop operating temperature: The module performs loop operation at $\pm 90^\circ$, maintains it for 5 seconds when reaching $\pm 90^\circ$, and runs the module temperature after a specific time.
- ② Suspension holding temperature: The module temperature after running for a specific time under the premise that the module is maintained at 90° .
- ③ The test bench is made of metal and has good thermal conductivity, which helps the heat generated by the motor to be transferred out faster during operation. Therefore, the above temperature is for reference only.

Table 3-8 RH-20-80 temperature rise test data

Load	Torque (Nm)	Maximum speed (RPM)	Time	Temperature ($^\circ\text{C}$)	
				$\pm 90^\circ$ cycle operation	90° suspension hold

1.0x	40	2500	1h	<50	/
1.5x	60	2500	30min	<70	/
2.0x	80	2500	5min	<70	<50
2.5x	100	2500	1min	<90	<60
3.0x	120	2500	30s	<80	<70

Note:

- ① Loop operating temperature: The module performs loop operation at $\pm 90^\circ$, maintains it for 5 seconds when reaching $\pm 90^\circ$, and runs the module temperature after a specific time.
- ② Suspension holding temperature: The module temperature after running for a specific time under the premise that the module is maintained at 90° .
- ③ The test bench is made of metal and has good thermal conductivity, which helps the heat generated by the motor to be transferred out faster during operation. Therefore, the above temperature is for reference only.

Table 3-9 RH-25-100 temperature rise test data

Load	Torque (Nm)	Maximum speed (RPM)	Time	Temperature ($^\circ\text{C}$)	
				$\pm 90^\circ$ cycle operation	90° suspension hold
1.0x	108	2000	1h	<50	/
1.5x	162	2000	30min	<60	/
2.0x	216	2000	5min	<70	<50
2.5x	270	2000	1min	<70	<50

Note:

- ① Loop operating temperature: The module performs loop operation at $\pm 90^\circ$, maintains it for 5 seconds when reaching $\pm 90^\circ$, and runs the module temperature after a specific time.
- ② Suspension holding temperature: The module temperature after running for a specific time under the premise that the module is maintained at 90° .
- ③ The test bench is made of metal and has good thermal conductivity, which helps the heat generated by the motor to be transferred out faster during operation. Therefore, the above temperature is for reference only.

Table 3-10 RH-32-100 temperature rise test data

Load	Torque (Nm)	Maximum speed (RPM)	Time	Temperature (°C)	
				±90° cycle operation	90° suspension hold
1.0x	150	2000	1h	<50	/
2.0x	300	2000	5min	/	<70

Note:

- ① Loop operating temperature: The module performs loop operation at ±90°, maintains it for 5 seconds when reaching ±90°, and runs the module temperature after a specific time.
- ② Suspension holding temperature: The module temperature after running for a specific time under the premise that the module is maintained at 90°.
- ③ The test bench is made of metal and has good thermal conductivity, which helps the heat generated by the motor to be transferred out faster during operation. Therefore, the above temperature is for reference only.

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 of the module power interface is DC60V, and the input voltage exceeds 60V, 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: 820uF, 50V; 1000uF, 100V), as shown in Figure 5-1, to suppress overshoot of the input voltage at the moment of power-up phenomenon.

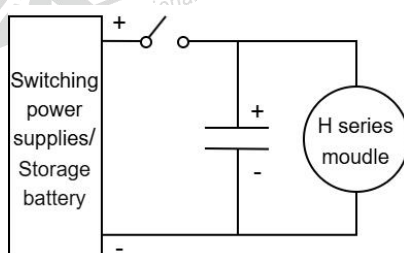


Figure 5-1 Protection circuits in the case of switching power supplies

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.

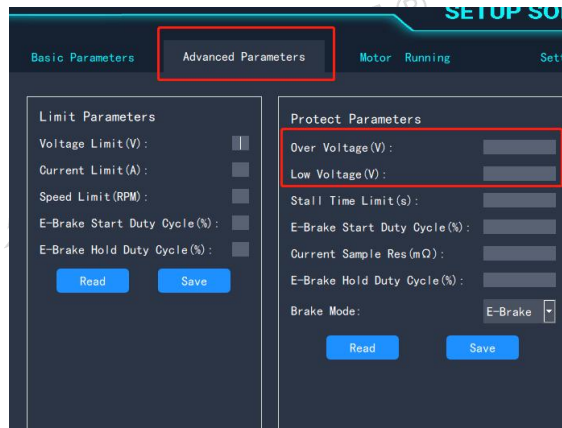


Figure 5-2 Schematic diagram of over voltage/under voltage protection voltage modification

5.2. Interface description

This series of modules has two terminals, namely power terminals and signal terminals, and the interface is described as follows.

Table 5-1 Power interface description

		
Harness color	Port definition	Port function
Red	DC+	DC+
Black	DC-	DC-

Note: The port is an arc structure: the negative pole of the power supply, and the square structure: the positive pole of the power supply.

Table 5-2 Signal interface description

			
Pin	Harness color	Port definition	Port function
1	Purple	CAN_H/RS485-A	CAN/RS485 network signal cables
2	Green	CAN_H/RS485-A	
3	Orange	BRAKE+	The positive pole of the bleeder resistor
4	Brown	BAT+	The positive pole of a multiturn battery
5	Blue	CAN_L/RS485-B	CAN/RS485 network signal cables
6	Yellow	CAN_L/RS485-B	
7	Red	BRAKE-	The negative pole of the bleeder resistor
8	Black	BAT-	The negative pole of a multiturn battery

Note: There are no orange (BRAKE+) and red (BRAKE-) wires for the brake module.

5.3. Indicator Description

Table 5-3 Explanation of the status of the indicator

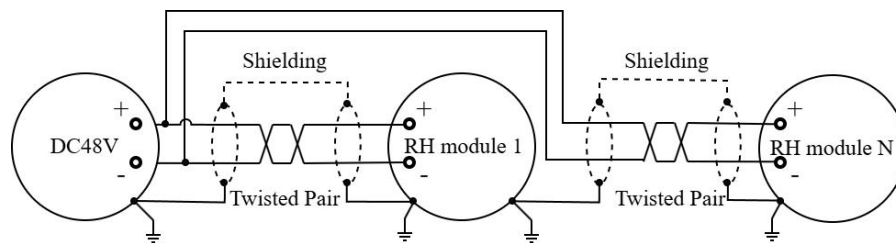
Expression	Situation
The green light is always on	The motor is operating normally
The green light flashes rapidly	There is a level 1 error in the motor
The green light flashes slowly	There is a level 2 error in the motor

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

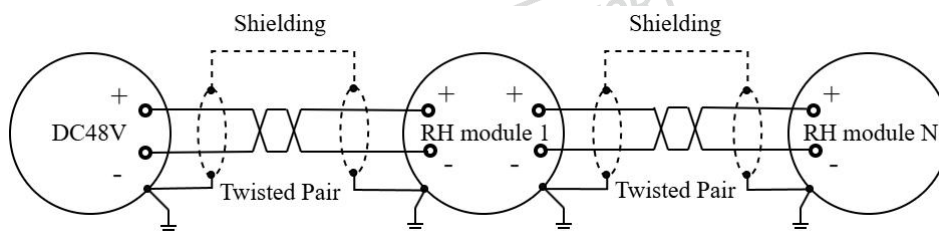
6. Cable connection between multi-joint modules

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 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.

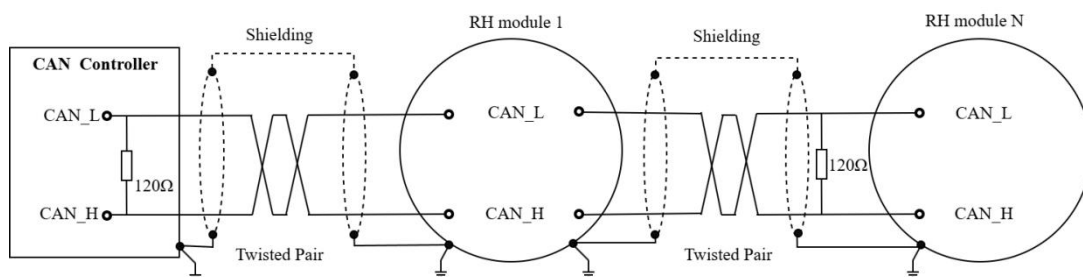


Figure 6-2 Schematic diagram of CAN communication wiring

6.3. RS485 communication wiring instructions

The RS485 communication cable uses twisted pair cables, which are shielded separately, and the wiring diagram is shown in Figure 6-3. In order to eliminate signal reflection in the communication cable, a 120Ω termination resistor is required in parallel at the RS485 communication interface of the controller and the end module.

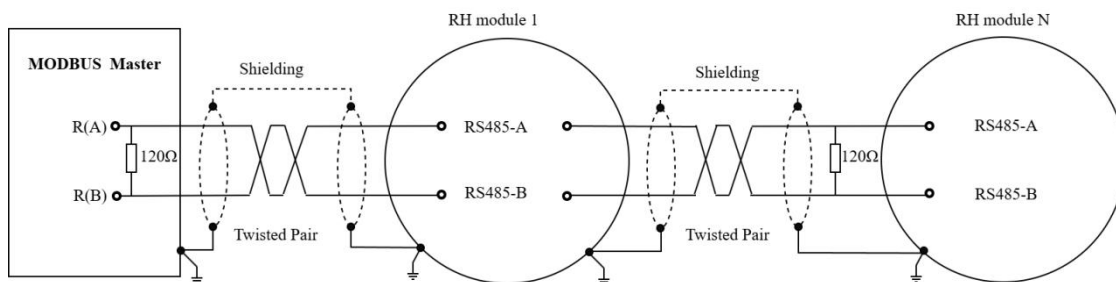


Figure 6-3 Schematic diagram of RS485 communication wiring

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 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.

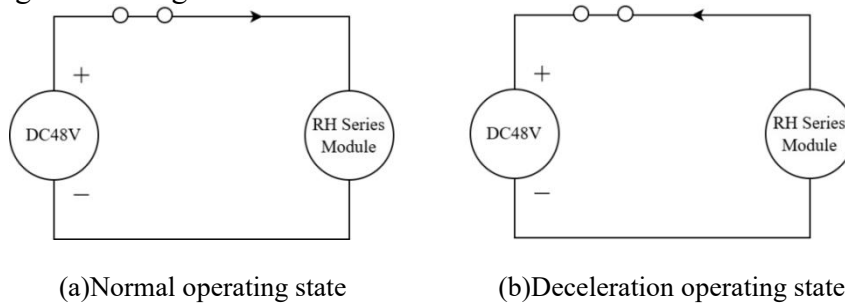
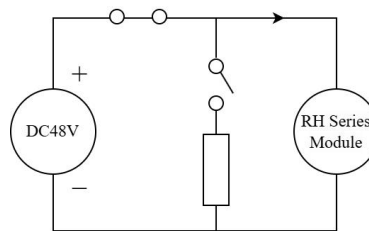


Figure 8-1 Diagram of module operating states

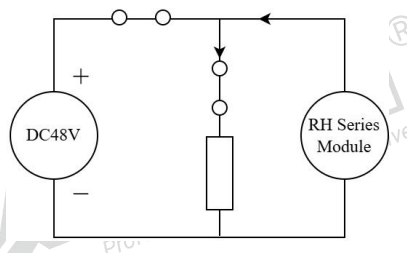
8.2. Handling methods

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



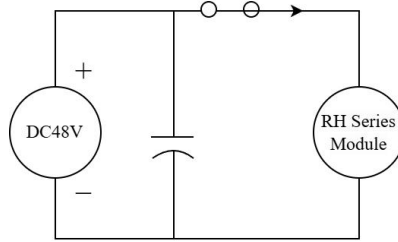
(b) The resistor is connected when the voltage is too high

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

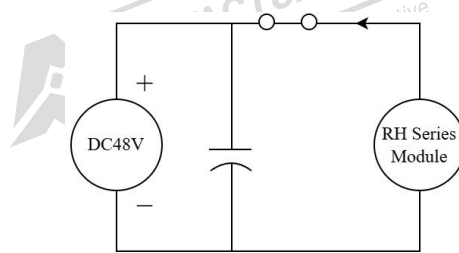
2. Adding a super capacitor

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.



(a) Charging the capacitor when the voltage is normal

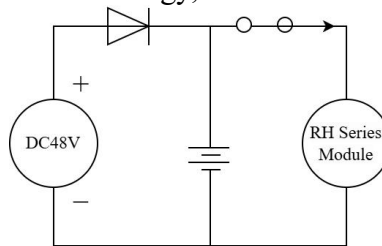


(b) Capacitor kinetic energy recovery when the voltage is too high

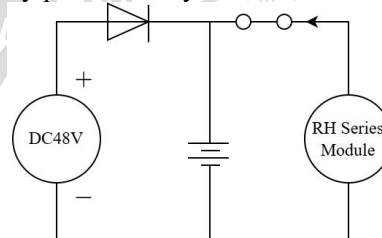
Figure 8-3 Diagram of module operating state with super capacitor added

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

9. Encoder Description

9.1. Resolution and Position Feedback

The module is controlled by an absolute encoder, and 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

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.

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 (M_c) 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.

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

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

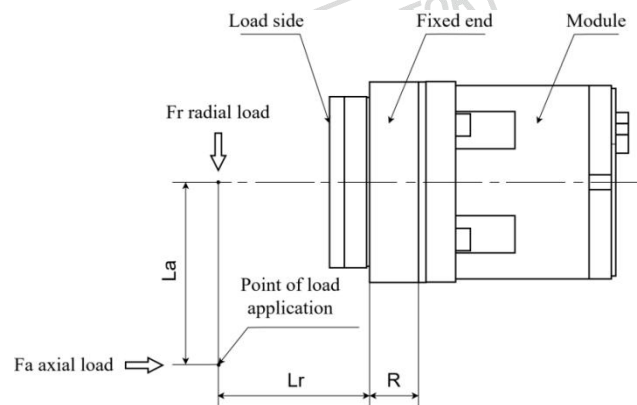


Figure 12-1 Schematic diagram of the load action

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.

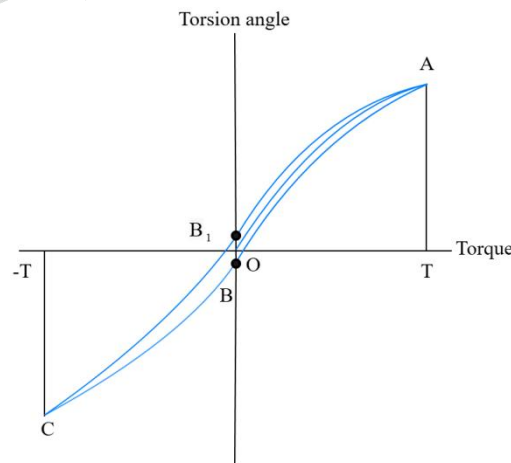


Figure 12-2 Torque-torsion angle diagram

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.

Table 12-2 The stiffness value of the module

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