

WLF-40

Mini rudder control lever

User manual



User notice

► Disclaimer

Warning: Before using this product, please refer to the important safety information in the user manual and review all warnings, limitations and disclaimers.

This product is no substitute for proper training and careful seamanship. Proper installation and proper use of the equipment is the responsibility of the owner to avoid accidents, personal injury or property damage. The user of this product is solely responsible for compliance with maritime safety practices.

The owner is solely responsible for installing and using the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for compliance with maritime safety navigation practices.

This document represents the product at the time of release. Ningbo SHANBEI Technology Co., Ltd. reserves the right to change product specifications at any time without prior notice. If you need any further assistance, please contact your nearest dealer.

► Governing language

This Statement, any instruction manuals, user guides and other Product-related information (documentation) may be or have been translated into another language (translation). If there is any conflict between any translated version of the document, the Chinese version of the document will be the official version of the document.

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► Cautions

- 1 Do not place the equipment at will without fixing it, so as to avoid serious damage when it is dropped due to turbulence or other factors during the voyage.
- 2 Do not use any power adapter that is not equipped with this product. Otherwise, the device may not work due to the different circuit design, or the performance may be affected or even damaged.
- 3 Do not disassemble the equipment. If the maintenance engineer is not authorized by the company to disassemble the equipment, the free warranty will be lost.
- 4 During use or cleaning, avoid any liquid or other objects falling into the equipment to avoid circuit damage or short circuit.
- 5 Do not place the device and its accessories in an environment prone to humidity or direct sunlight. Keep the device in a dry environment.
- 6 In case of hardware failure (such as damage to the machine shell or foreign matter falling into the machine, etc.), please stop using the machine immediately and contact the dealer in time.
- 7 The company shall not assume any legal or other liability for any maritime accident, monetary loss or loss of interests that occurs on vessels using this equipment.

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1 Introduction

1.1 Overview

The WLF-40 mini rudder control lever is used for the servo control of the ship's steering system. It can send out rudder command values and is equipped with a potentiometer and a dial. Features include:
-Aluminum alloy housing, standard 5KΩ potentiometer output, damping feel; adjustable backlight for the scale; customizable scale and rotation angle.

The basic customization items of the product include the following categories, as shown in Table 1.1. Other customization items will be agreed upon separately during the order process.

Basic options		(Note: Option 1 is the default option)
Handle style	Steering wheel - black (WLF-40W)	
	Grip - Stainless Steel (WLF-40L)	
Film scale	-35°~0~35°, Left red, right green	
	-45°~0~45°, Left red, right green	
	-50°~0~50°, Left red, right green	
	-100~0~100%, White	
	Other Customizations	
Rotation range	-60°~0~60°, Detent at 0° position	
	-90°~0~90°, Detent at 0° position	
	-140°~0~140°, Detent at 0° position	
Output channel	Single-channel single potentiometer output	
	Dual-channel dual potentiometer output	
Output method	Standard 5K potentiometer output	
	4~20 milliampere current output	
Electric shaft synchronization	No	
	Yes	
Protective rear cover	No	
	Yes	
omization of scales	Uniform scale	
	0°~5°The scale is widened	

Table 1.1

1.2 Product appearance

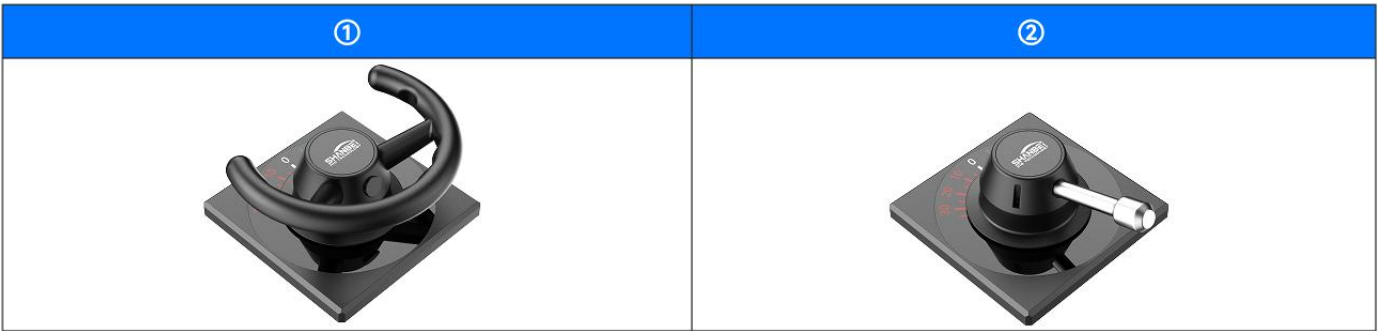


Figure 1.1

The product offers the option of different handles and scale films. When making a choice, please consider your personal needs and inform our sales staff. This will help avoid unnecessary economic losses!

1 Introduction

1.3 Product composition

Number	Name	Quantity
1	Mini rudder control lever	1
2	16-pin terminal connector	1
3	Certificate of Conformity	1
4	Warranty card	1
5	Instruction Manual	1
6	Factory test report and wiring diagram	1

Table 1.2

1.4 Product size drawing

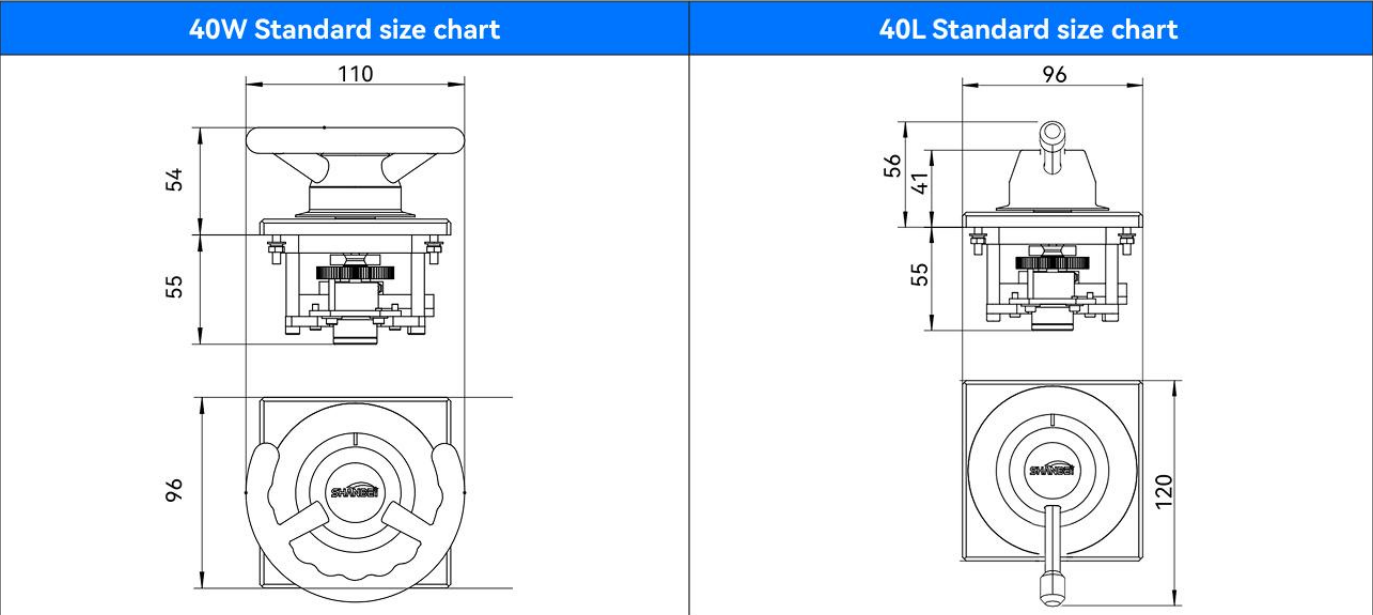


Figure 1.2

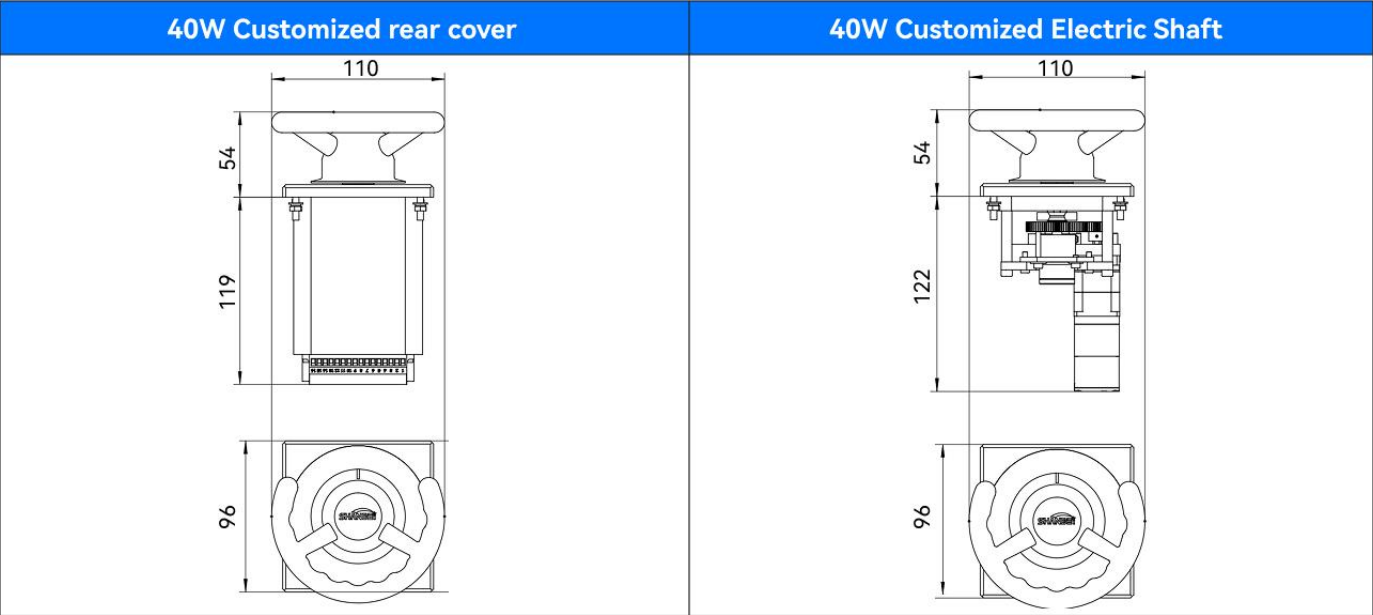


Figure 1.3

1 Introduction

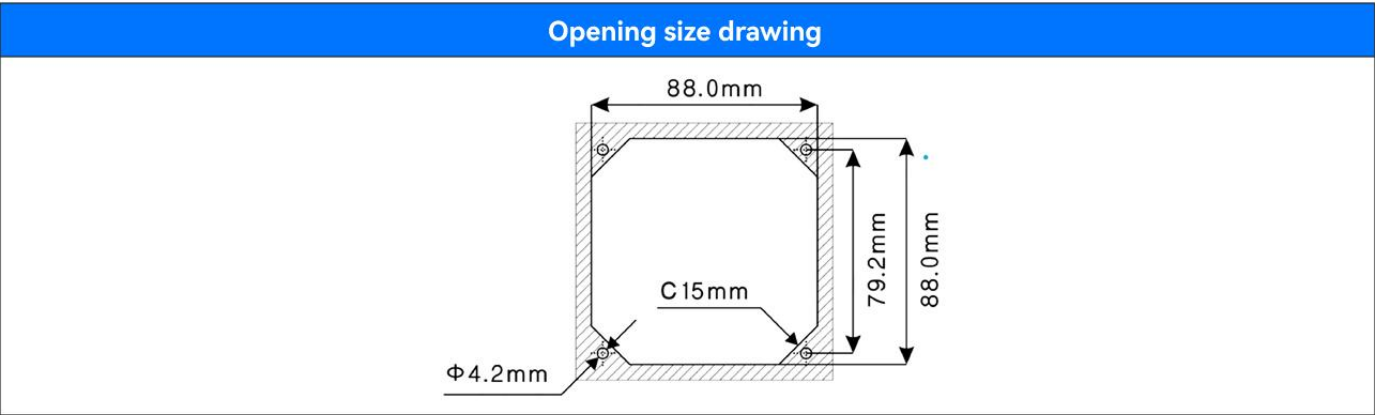


Figure 1.4

1.5 Product wiring diagram

The output section provides 16 terminals for wiring. The wiring diagram has three types. Please pay attention to the distinction:

1. Standard version, including terminals 1#, 2# and 3# for connecting the steering wheel potentiometer output, 24V power supply for backlighting, and connected to terminals 13# and 14#.
- The other terminals are left empty for future use, as shown in Figure 1.5.

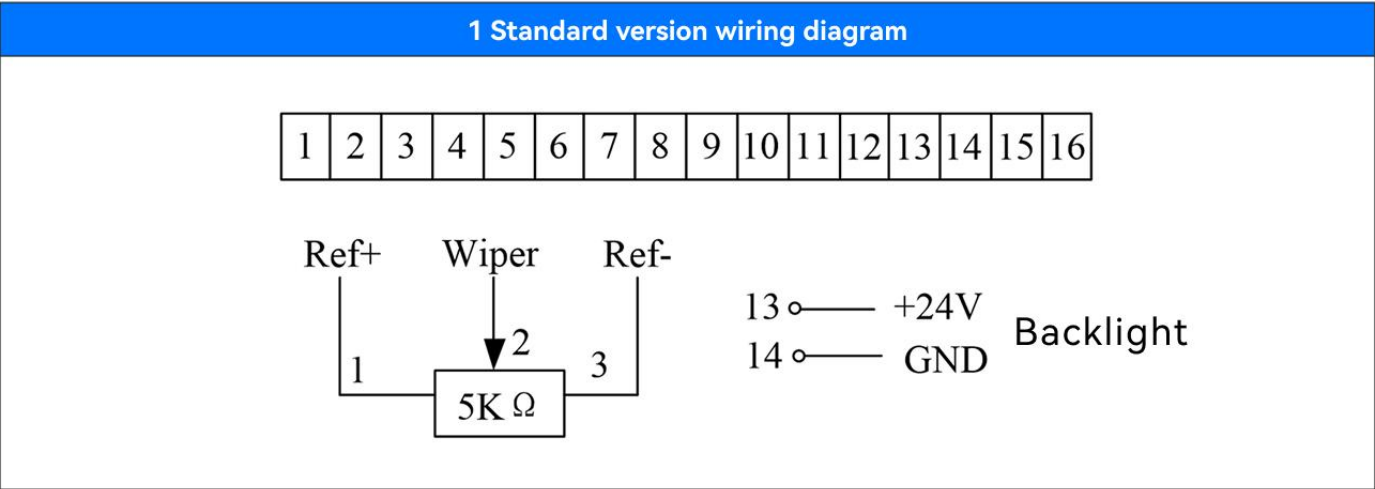


Figure 1.5

2. If there are two potentiometers inside, the wiring should be done as follows, as shown in Figure 1.6.

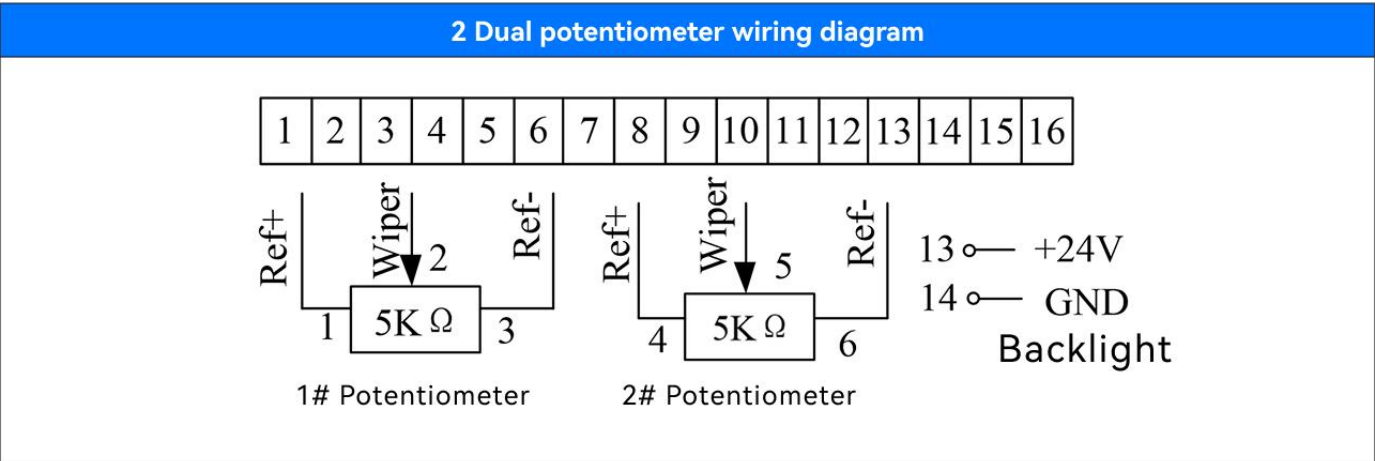


Figure 1.6

1 Introduction

3. If the system has the function of electric axes, connect the wires in the following manner, as shown in Figure 1.7 and Table 1.3.

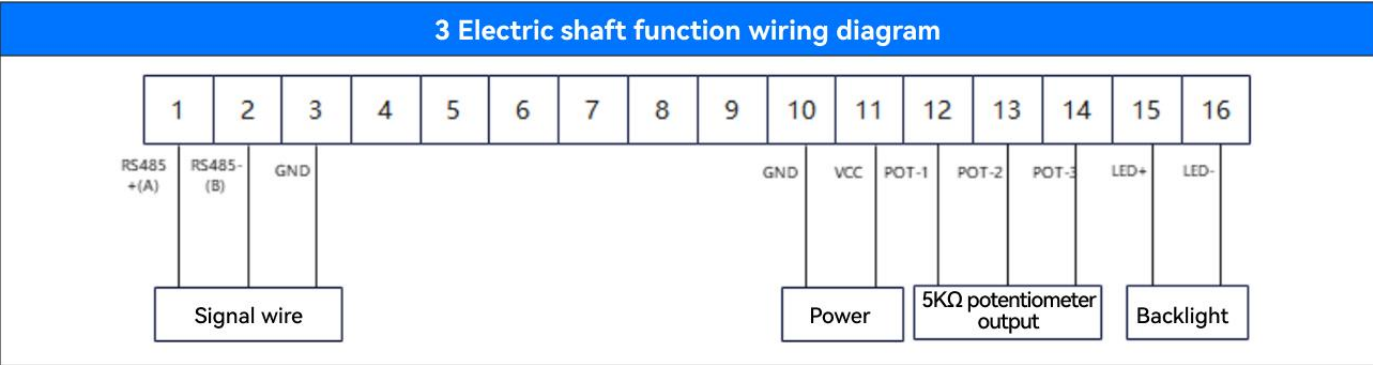


Figure 1.7

Pin number	Name	Function
1	RS485+(A)	Positive terminal of the signal wire
2	RS485-(B)	Signal line negative terminal
3	GND	Communication line
4	DO2	Open Drain Output, Max Current 100mA, Max Voltage 30VDC
5	DO1	Open Drain Output, Max Current 100mA, Max Voltage 30VDC
6	GND	Grounding
7	DI3	Logic 1: Input 5~24VDC; Logic 0: Input 0~2VDC, Non-isolated
8	DI2	Logic 1: Input 5~24VDC; Logic 0: Input 0~2VDC, Non-isolated
9	DI1	Logic 1: Input 5~24VDC; Logic 0: Input 0~2VDC, Non-isolated
10	GND	Power negative terminal
11	VCC	Positive terminal of the power supply
12	Potentiometer 1st pin	5KΩ potentiometer, pin 1
13	Potentiometer 2st pin	5KΩ potentiometer, pin 2
14	Potentiometer 3st pin	5KΩ potentiometer, pin 3
15	LED+	Backlight Power Positive; Dimming is solely adjusted by 0~24VDC power on this pin.
16	LED-	Negative terminal of the backlight power supply

Table 1.3

2 Technical parameter

2.1 Product basic parameter

Power supply voltage	24VDC
Protection level	Front: IP56, Rear: IP20 (with protective cover IP44)
Potentiometer and linearity	5KΩ
Output accuracy	≤1.0%
Scale backlighting	Yes, the brightness can be adjusted.
Roll damping	Yes, the intensity can be adjusted.
Neutral Detent Feel	Yes, the intensity can be adjusted.
Weight	0.8 to 1.5 kilograms (varies depending on configuration and type)
Testing standards	IEC60945
Working temperature	5~55°C
Installation	4×M4 screws, panel thickness < 10mm
Connecting the wires	16-pin terminal connector
Main materials	Aluminum alloy black powder coating, copper alloy gears, stainless steel, POM, etc.

Table 2.1

2.2 Standard version product technical description

1. The steering wheel main body is made of aluminum alloy with black powder-coated surface. The main shaft and grip rod adopt stainless steel material, and the internal transmission adopts gear drive mode.
2. Scale range: -35~0~35; rotation range: -60~0~60°. The dial background is black; scale lines and figures are red on the left and green on the right, with adjustable backlight brightness.
3. Rotational damping torque and detent tactile feel are adjustable.
4. Independent linear tolerance of potentiometer: 1.0%.
5. Output mode: direct linear output via potentiometer, linearly correlated with scale value. The theoretical output is shown in Figure 2.1, and the actual output curve refers to the factory test report of the product.

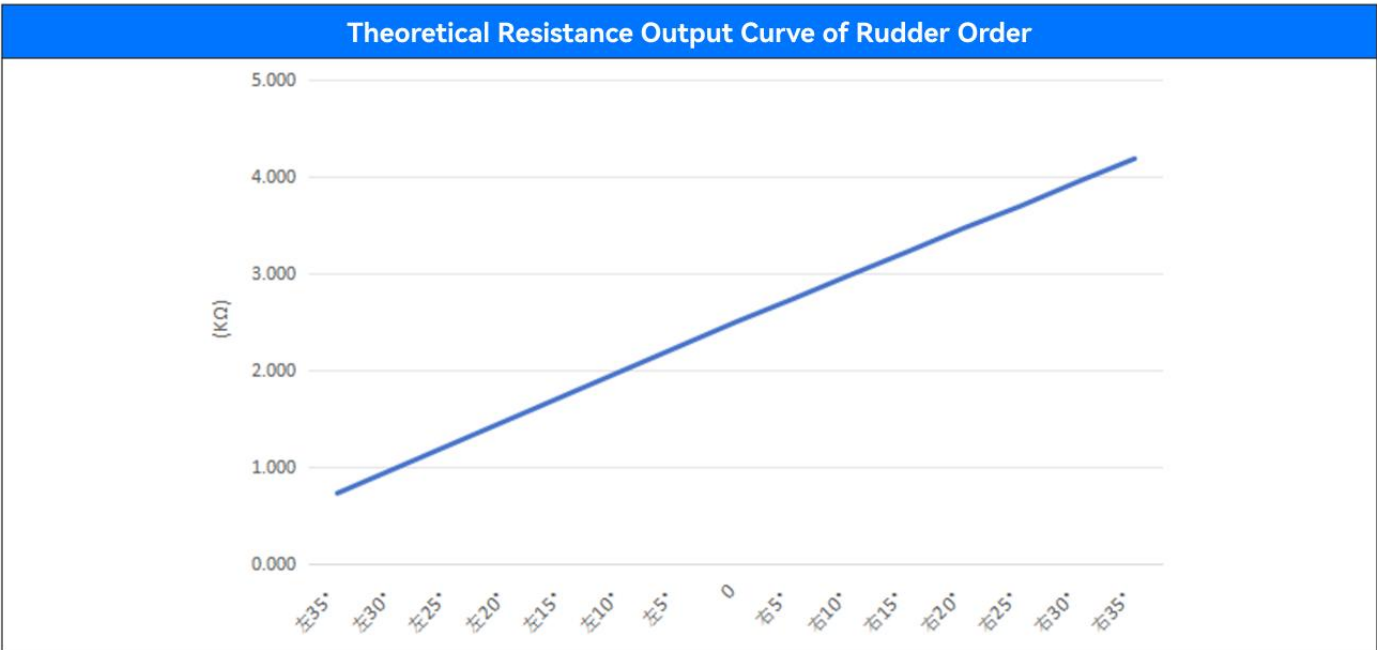


Figure 2.1

2 Technical parameter

2.3 Custom item technical description

1. Rotational travel of the handwheel is optional at $\pm 60^\circ$, $\pm 90^\circ$, $\pm 140^\circ$, with $\pm 60^\circ$ as the default setting, as shown in Figure 2.2.



Figure 2.2

2. The standard steering wheel adopts a single-channel single-potentiometer output scheme. For dual-steering systems or redundant control systems, a completely independent dual-channel configuration is used, as shown in Figure 2.3.



Figure 2.3

3. Electric axis function: The mini rudder wheel supports the electric axis function. An internal driving motor is added to the product to enable two operation modes: conventional manual steering and the rudder wheel rotating driven by the motor. The wiring is shown in Figure 2.4.

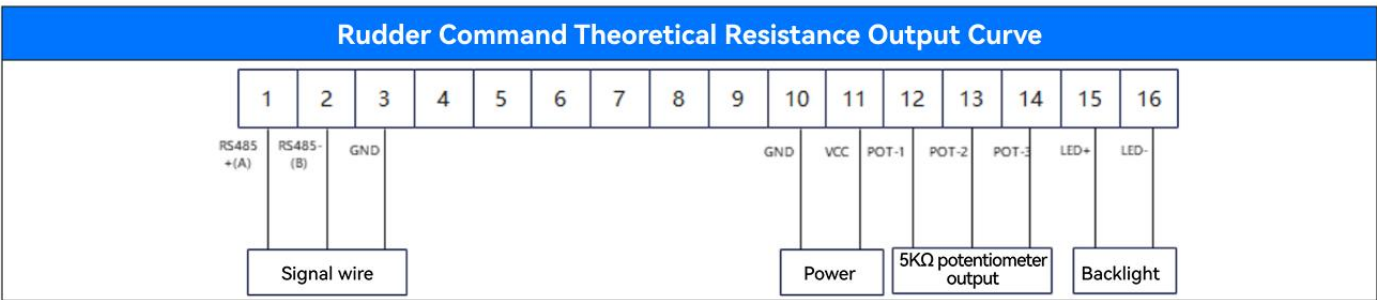


Figure 2.4

4. 4~20mA output signal: The output signal of the handwheel is the default output of the potentiometer. If a 4~20mA signal is required, an additional circuit board needs to be installed and the signal calibration should be completed before leaving the factory. Generally, the correspondence between the output signal and the scale is as follows: 35 degrees on the left corresponds to a 4mA output, 0 on the scale corresponds to a 12mA output, and 35 degrees on the right corresponds to a 20mA output. The wiring diagram is shown in Figure 2.5.

2 Technical parameter

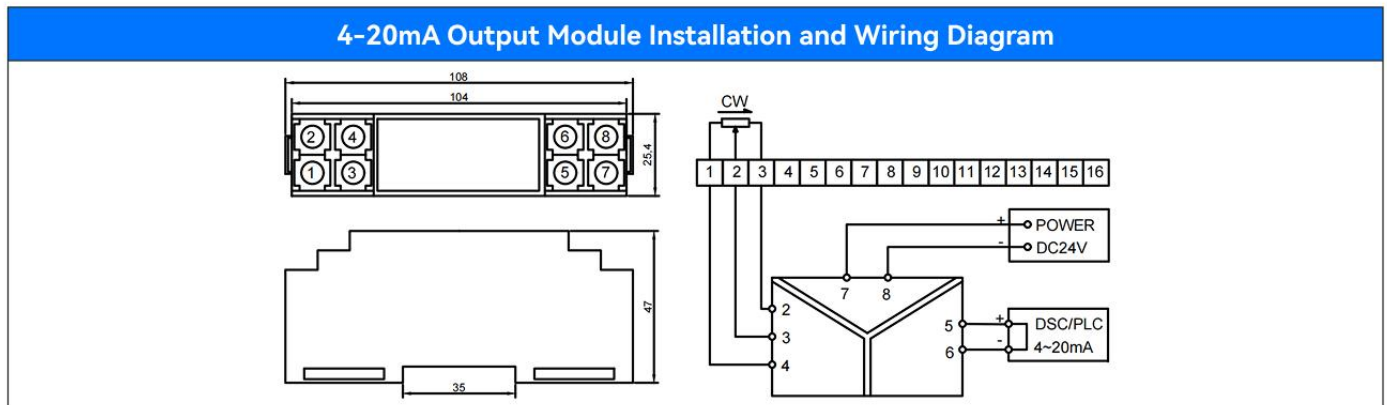


Figure 2.5

2.4 Electric shaft function description

1. Lever (Manual) Operation

This product supports one-hand operation. The operating instructions are as follows:

- 1) Clockwise rotation of the grip: The steering wheel outputs a starboard steering signal. The larger the rotation angle, the greater the starboard steering amplitude. The maximum rotation angle shall not exceed the configured rotational travel (standard $\pm 60^\circ$).
- 2) Counterclockwise rotation of the grip: The steering wheel outputs a port steering signal. The larger the rotation angle, the greater the port steering amplitude. The maximum rotation angle shall not exceed the configured rotational travel.
- 3) Return-to-center operation: Release the grip, and it can be manually returned to the 0° neutral position (with slight neutral detent feel). At this time, the steering wheel outputs a neutral signal, and the steering gear returns to center.

2. Lever (Electric) Operation

Mini rudder control lever electric shaft synchronous model, with built-in closed-loop control, RS485 communication, position feedback, and backlight dimming function. It realizes high-precision steering control through the standard Modbus-RTU protocol, suitable for remote control systems of unmanned boats, centralized control scenarios of ship bridge, scenarios where the Norwegian Lilaas LF80 product needs to be replaced, and high-end ship scenarios with high requirements for steering convenience and accuracy.

- 1) Synchronization (synchronization means internal enable of the motor) enable: After power is connected, send the synchronous enable command for the electric shaft (refer to the communication protocol provided by the manufacturer for specific instructions), at this time, the rudder lever rotation will drive the synchronous rotation of the electric shaft, achieving real-time linkage between the steering gear and the rudder lever;
- 2) Synchronization (synchronization means internal disable) disable: When the synchronous function is not needed, send the synchronous disable command, the electric shaft stops working, the rudder lever can be operated manually normally, and the basic steering function is not affected.
- 3) This product can be remotely operated through the signal line (RS485 bus). The operation method is as follows:
 - ① Send clockwise rotation command: The rudder lever emits a right rudder signal (potentiometer signal), the larger the rotation angle, the greater the right rudder amplitude, the maximum rotation angle does not exceed the configured rotation range (standard $\pm 60^\circ$);
 - ② Send counterclockwise rotation command: The rudder lever emits a left rudder signal (potentiometer signal), the larger the rotation angle, the greater the left rudder amplitude, the maximum rotation angle does not exceed the configured rotation range;

2 Technical parameter

③ Send center operation command: Release the grip handle, the grip handle can be manually returned to 0 position (0 position has a slight stickiness), at this time, the rudder lever emits a center signal (potentiometer signal), the steering gear returns to the center.

4) This product can be remotely operated through the signal line (RS485 bus). The operation method is as follows:

- ① RS485 remote position control
- ② High-precision steering command control
- ③ 1-channel 5K Ω potentiometer analog output
- ④ 0-24V continuous backlight dimming

3. Backlight Adjustment

The backlight supports dimming function. The adjustment method is achieved by using an external 0-24V power supply dimming device to adjust the backlight brightness, which is suitable for different nighttime operating environments.

4. Analog Output

- 1) Signal Calibration: After installation, connect the 1st to 3rd pins of the potentiometer to the reference voltage. Use a multimeter to measure the signal output value between pin 2 of the potentiometer and the reference voltage ground. Rotate the steering wheel to the 0 position to ensure the signal is at 1/2 of the reference voltage (mid-position); rotate to the extreme position to ensure the signal is the minimum output voltage (-limit) and the maximum output voltage (+limit). If the deviation is too large, calibrate using the potentiometer;
- 2) Signal Debugging: According to the requirements of the control system, adjust the signal output to ensure that the signal output is linearly corresponding to the steering wheel rotation angle and meets the sampling requirements of the control system;
- 3) Fault Troubleshooting: If the signal output is abnormal, first check the grounding condition of the shielded line, then check if the wiring is firm, and eliminate electromagnetic interference or loose wiring problems.

5. Precautions

Electric axis synchronous model: Do not forcibly rotate the steering wheel while in synchronous mode to avoid damaging the synchronous motor and gear mechanism; if the synchronous function malfunctions, immediately cut off the power supply, check the synchronous instructions and wiring, and do not attempt to run it forcibly.

3 Installation instructions

1. Remove 4 sets of installation accessories (nuts, spring washers, flat washers), as shown in Figure 3.1. The installation screws do not need to be removed. Place the 4 sets of accessories aside and make sure not to lose any of them.

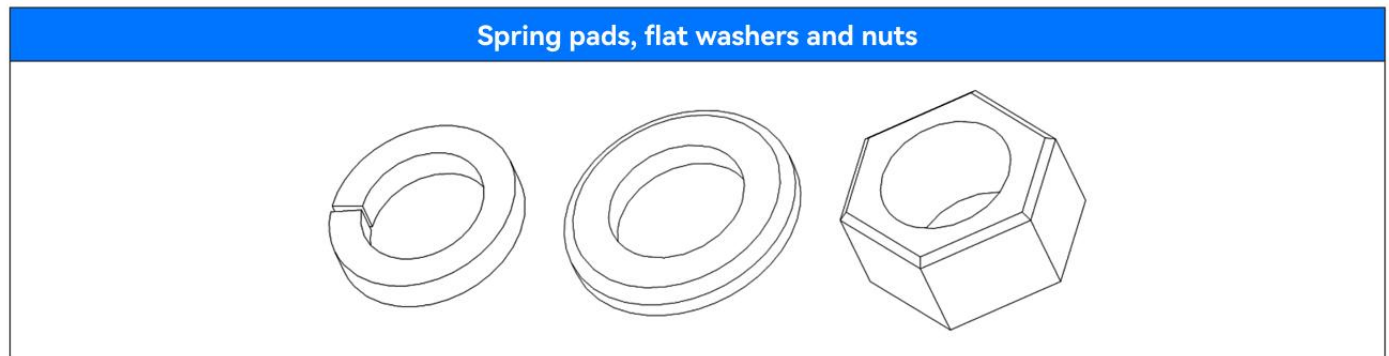


Figure 3.1

2. As shown in Figure 3.2, place the control lever vertically within the opening of the mounting plate, and align the screws with the screw holes B. If there is a protruding part, you can rotate or tilt the control lever to fit it in.

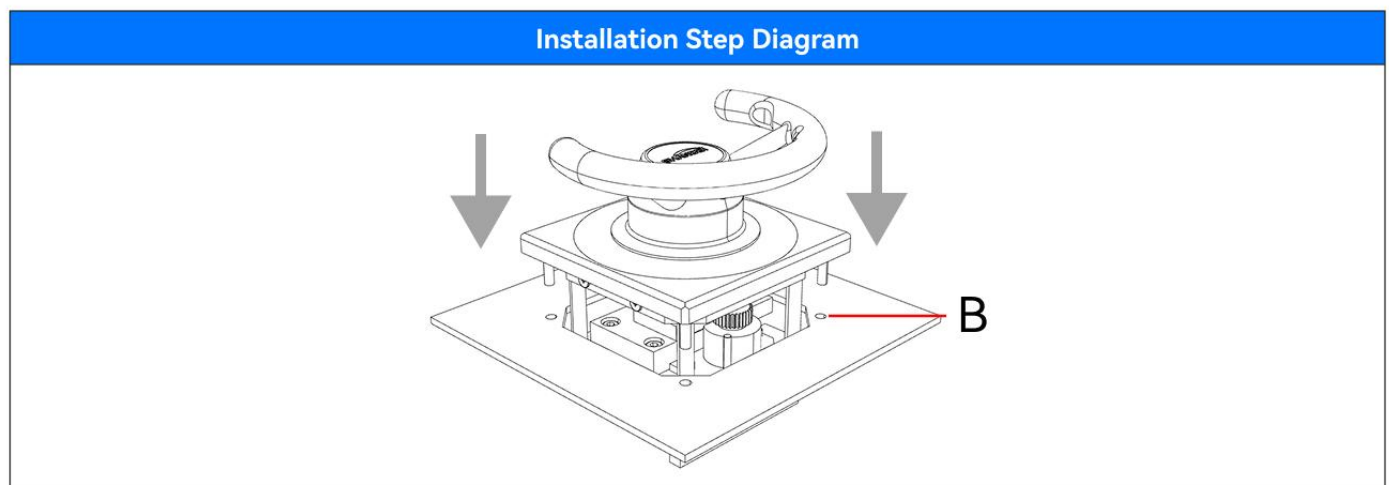


Figure 3.2

3. As shown in Figure 3.3, fix the control lever on the mounting plate by installing screws and accessories, and tighten the nut C. Ensure that the handwheel is securely and reliably fixed to the mounting plate. There should be no gaps on the contact surface and no shaking is allowed.

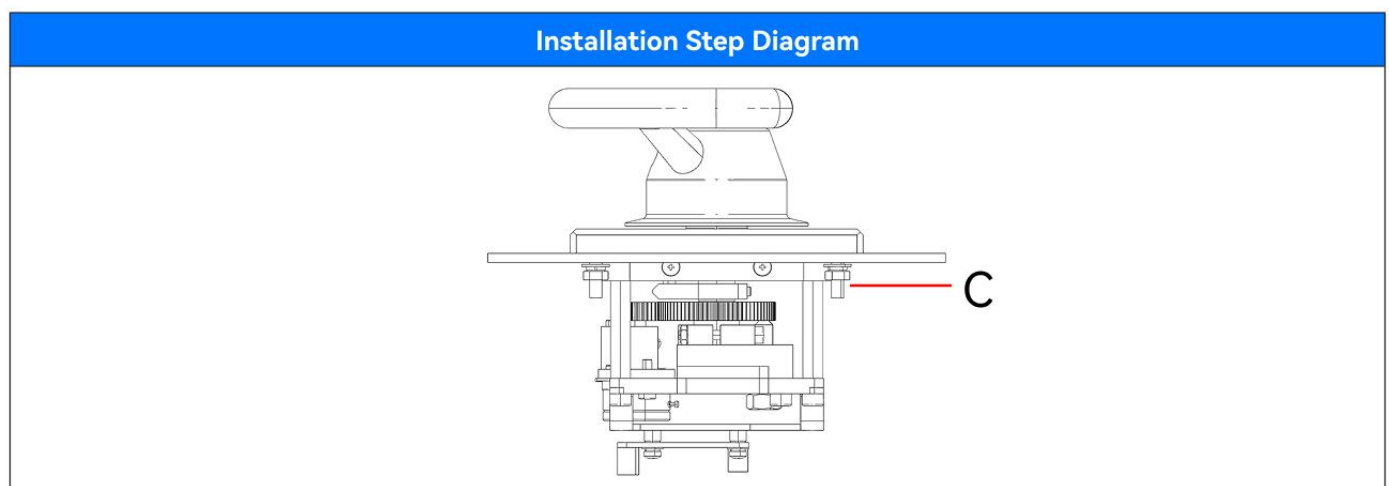


Figure 3.3

3 Installation instructions

4. After installing the control lever onto the mounting plate, proceed with the electrical wiring. After the wiring is completed, it is necessary to confirm that the external wiring is firmly and reliably connected.

5. Test the external wiring; it should be properly connected; the backlight should be functioning normally; when turning the handwheel, the switch should be able to perform the normal on-off operation. After the debugging is completed, disconnect the power supply.

4 Instructions and precautions for use

4.1 Instructions for use

1. The initial position of the control lever pointer is at the center (0 mark), and at this point, the resistance value of the potentiometer (readings of identification numbers 4 and 5) is $2.5K\Omega \pm 10\%$.
2. Connect the power supply, follow the wiring shown in Figure 1.5, adjust the dimming knob, and the brightness of the backlight will change. Turning the steering wheel clockwise or counterclockwise, the resistance reading between identification numbers 4 and 5 will change linearly from 0 to $5K\Omega$ continuously. After completion, place the steering wheel at the 0 mark.
3. When operating the steering wheel, it should be done smoothly and slowly. Avoid pulling or dragging forcefully, as this may cause an impact and damage the limit mechanism.

4.2 Matters needing attention

1. If not used as required, any losses incurred will be the responsibility of the user; the rated voltage of the backlight is $\leq 24V$. If the backlight is damaged due to exceeding the rated voltage, the user shall bear the responsibility.
2. During use, if the output of the propulsion direction exceeds the range of 0 to $5K\Omega$, please stop using immediately; if the output value between identification numbers 7 and 8 cannot change continuously, stop using promptly. The method of stopping use: disconnect the external power supply.
3. According to the characteristics of the accessories used in this product, the instantaneous input voltage at any time shall not exceed 20% of the range specified in Figure 1.5. To avoid excessive instantaneous current and burning out the accessories.

5 Fault analysis and elimination

This product has been put into operation since the use, basically no fault, with our statistics, the after-sales problem is basically due to wiring errors, resulting in normal use, in addition, there is no technical fault. Customers in the use of the process, if you find technical problems, please promptly communicate with our technical personnel.

(Note: Each handle has a unique factory number)

6 Safety protection and accident handling

6.1 Safety protection devices and precautions

1. In the important position of this product, the fastening seals have been processed before leaving the factory, and shall not be disassembled without permission. If the seals are damaged, any product quality problems will be borne by the buyer.
2. The damping part used in this product is a loss part, the warranty period is 1 year, effective from the date of delivery; During the warranty period, damping changes, which can not be used normally or seriously affect the operation, shall be maintained by us free of charge. If damping changes occur outside the warranty period, which can not be used normally or seriously affect the operation, we can charge a small amount of labor and material costs for maintenance. (Troubleshooting)
(Once this product fails to operate normally, please stop using and disconnect the power supply immediately, contact our after-sales service engineer for solutions)

6.2 Troubleshooting procedures and methods

1. In the process of use, there is an unsolvable fault problem, contact our after-sales service engineer.
2. During the warranty period, if the fault occurs due to the product itself, we will provide a complete replacement product and send it to the buyer for free replacement. And provide technical support; If the fault is not caused by the product itself, we can provide two options of complete replacement products and on-site services, which are selected by the buyer. All costs are borne by the recipient.
3. If the warranty period is exceeded and the fault occurs, we can provide two service options that can completely replace the product or replace some parts of the product, which are selected by the buyer. The required cost shall be borne by the purchaser.

7 Maintenance and repair

7.1 Daily maintenance and maintenance

In the daily non-use state, attention should be paid to the maintenance of this product. Through maintenance, maintenance can improve the service life of the product, the specific maintenance and maintenance methods are as follows:

1. Wipe the surface of the product regularly with a dry rag to ensure that the outside of the product is clean and tidy.
2. Disconnect the external power supply of the product, turn it back and forth regularly, repeat about 10 times, and the cycle is 2 to 3 weeks. It can ensure smooth promotion and avoid the phenomenon of "aging" caused by long-term placement, which increases the damping and accelerates the wear of the damping part.

7.2 Operation precautions

1. Stop using the device when the steering wheel cannot position itself at zero position. Contact our after-sales engineer.
2. The use process should be smooth and uniform, the speed is too fast to form an impact and damage the product.
3. The input voltage shall be carried out in strict accordance with the wiring instructions. Failure to operate according to the regulations will cause product failure or other major accidents, which shall be borne by the buyer.

7.3 Long-term maintenance and maintenance

Long-term placement, maintenance maintenance methods, and daily maintenance, maintenance methods are the same.

8 Transportation, storage and warranty

8.1 Transportation precautions

Physical damage to the product caused by violent shaking and collision should be avoided during transportation.

8.2 Storage precautions

Room temperature, dry, cool environment. Avoid high temperature exposure or low temperature freezing, which will cause irreversible damage to the damping parts and reduce the service life.

8.3 Warranty period

The warranty period of this product is 12 months from the date of receipt of the goods by the buyer. Based on the date of receipt of documents for express delivery or the date of receipt of invoice.

9 Other

9.1 Phone number of the after-sales engineer

Contact: Mr.Xu

Tel: 18067343163

9.2 Company information

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