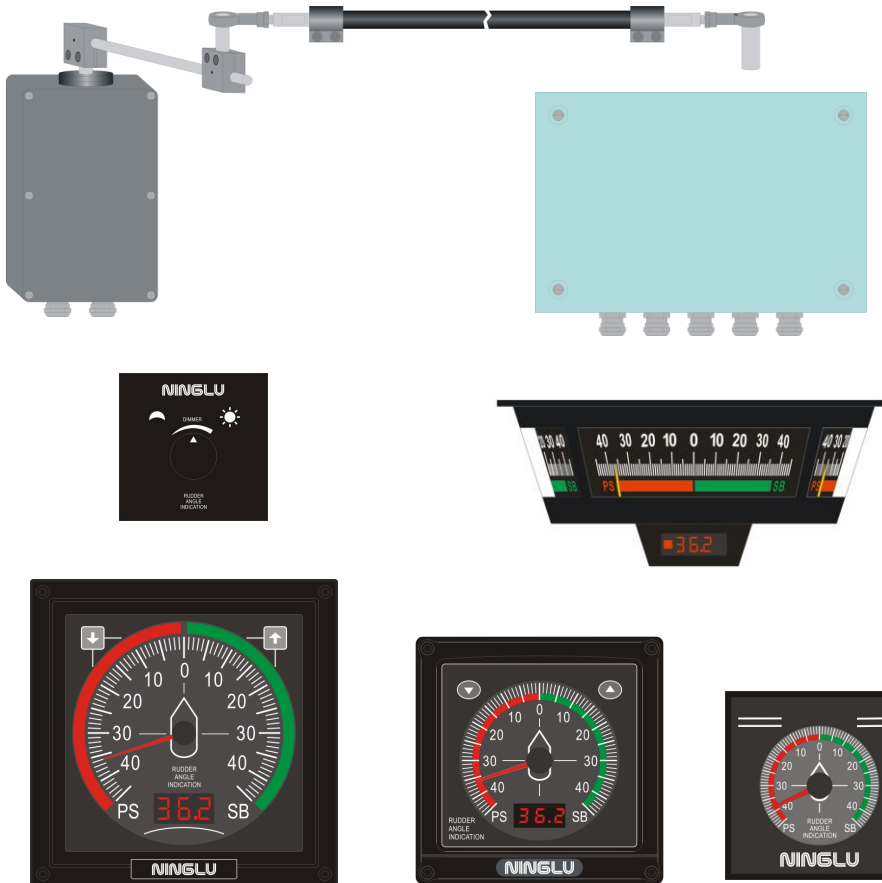


Rudder Angle Indication System

Installation & Operation & Maintenance Manual

Type : AD80



Nanjing Ninglu Technology Ltd., Co

NINGLU

Document: NLT-AD80-SSEN

Edition: V200220

0575/YYYY



Version

Date	Manual Version	Issued by	Description
18.10.2018	V181018	Ninglu Technical Department	Create
20.02.2020	V200220	Ninglu Technical Department	Add the gland dimension into installation dimension of the device
Date	Software Version	Issued by	Description
10.10.2017	V1.0	Ninglu Technical Department	Create

IMPORTANT SAFETY MESSAGE

Safety operation of the vessel is the responsibility of the onboard navigation officers and other users.

The use of the equipment does not release the users of any safety precautions & checks as needed in accordance to international and national rules.

SAFETY INSTRUCTIONS



This notice indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury



This notice indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or property damage.



This notice indicates an unsafe operation which, if not avoided, could result in property damage or equipment malfunction.

Contents

- Introduction 1**
 - System Composition 1
 - Working Principle 2
- Specification 3**
- Configuration and Operation 6**
 - Rudder Angle Transmitter AD803 6
 - Control Unit AD802 7
 - Three-face Rudder Angle indication Unit AD801 10
 - Rudder Angle Indication Unit AD804, AD805, AD806 11
 - Remote Dimmer AD807 12
 - Invalid Signal and Power Failure 12
- Calibration of Rudder Angle 14**
- Installation 17**
 - Installation of Rudder Angle indication Unit AD801 17
 - Installation of Control Unit AD802 18
 - Installation of Rudder Angle Transmitter AD803 19
 - Installation of Rudder Angle Indication Unit AD804 24
 - Installation of Rudder Angle Indication Unit AD805 24
 - Installation of Rudder Angle Indication Unit AD806 25
 - Installation of Remote Dimmer AD807 25
- Wiring 26**
 - System View 26
 - Connection 27
- Maintenance 26**

Figure List

Figure 1	Rudder Angle Transmitter AD803	6
Figure 2	Control Unit AD802	7
Figure 3	Control Unit Terminal diagram-1A	7
Figure 3	Control Unit Terminal diagram-1B	8
Figure 4	Control Unit Terminal diagram-2	9
Figure 5	Three-face Rudder Angle indication Unit AD801	10
Figure 6	Wall Rudder Angle indication Unit AD804 and AD805	11
Figure 7	Panel Rudder Angle Indication Unit AD806	14
Figure 8	Remote Dimmer AD807	14
Figure 9	Calibration-1	14
Figure 10	Calibration-2	14
Figure 11	Calibration-3	15
Figure 12	Calibration-4	15
Figure 13	Calibration-5	16
Figure 14	Dimension of Rudder Angle Indication Unit AD801	17
Figure 15	Dimension of Control Unit AD802	18
Figure 16	Dimension of Rudder Angle Transmitter AD803	19
Figure 17	Installation of Rudder Angle Transmitter AD803-1	20
Figure 18	Installation of Rudder Angle Transmitter AD803-2	21
Figure 19	Installation of Rudder Angle Transmitter AD803-3	22
Figure 20	Dimension of Rudder Angle Indication Unit AD804	24
Figure 21	Dimension of Rudder Angle Indication Unit AD805	24
Figure 22	Dimension of Rudder Angle Indication Unit AD806	25
Figure 23	Dimension of Remote Dimmer AD807	25
Figure 24	System View	26
Figure 25	Maintenance for the link rod	26

Introduction

Rudder angle indication system AD80 is used to accurately and real timely indicate the direction and position of the rudder in wheel house, ECC room and steering gear room for the crew. With the functions of flexible configuration, good dimming, easy to install and maintain, AD80 fully complies with the regulations of IMO and the standard IEC61162 sentences. It is one kind of very important equipment for steering and can be widely used in various passenger and cargo vessels.

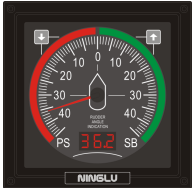
System Composition

➤ Display Part

Three-face Rudder Angle Indication Unit AD801 : Analog display the direction and position of the rudder. Flush mounting in wheel house.



Wall Rudder Angle Indication Unit AD804 : Digital and analog display the direction and position of the rudder. Table, Hang and Flush mounting in wheel house or the port wing and starboard wing of the ship.



Wall Rudder Angle Indication Unit AD805: Digital and analog display the direction and position of the rudder. Table, Hang and Flush mounting in wheel house.

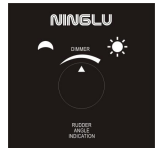


Introduction

Panel Rudder Angle Indication Unit, AD806: Analog display the direction and position of the rudder. Flush mounting in wheel house.

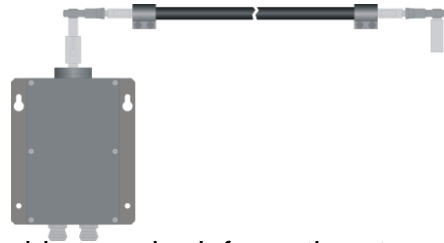


Remote Dimmer AD807: Adjust the display brightness. Flush mounting in wheel house and steering fear room.



➤ Control Part

Rudder Angle Transmitter AD803: Convert the direction and position of the rudder into electrical signal.



Control Unit AD802: Transfer the rudder angle information to external devices.




Working Principle

The link rod is between the ship rudder and the rudder angle transmitter AD803. The rudder angle transmitter AD803 is to convert the rudder angle information into electrical signal, which is to transfer to the control unit AD802. Through the control unit AD802, the rudder angle information is sent to different kinds of rudder angle indicators, which displays the rudder angle in a continuous way, such as an arrow pointer sweeping over a graduated scale, three-face indicator AD801.

Specification

➤ Technical Specification

Type	Dimension	Weight
Three-face Indication Unit AD801	φ370mm, High 156mm	5.0kg
Control Unit AD802	350mm×222mm×122mm	4.8kg
Transmitter AD803	239mm×160mm×83mm	2.6kg
Indication Unit AD804	192mm×192mm×86mm	2.4kg
Indication Unit AD805	144mm×144mm×86mm	1.3kg
Indication Unit AD806	96mm×96mm×93mm	0.5kg
Remote Dimmer AD807	96mm×96mm×53mm	0.2kg
	Total	16.8kg
Supply Power	AC 110/220V 50/60Hz (Default AC220V) DC 24V (21.6-31.2V)	
Each unit of the system AD80 has one connection to an electrical earth. 		
Power Consumption	70W/AC220V 60W /DC24V	
Fuse Specification	250V0.5A 5x20mm/AC 250V3A 5x20mm/DC	
Data Interface	2 RS-422 standard output interfaces in NMEA0183 protocol	
Rudder Angle Range	- 45°~+45° (Port Wing max. 45.0° and Starboard Wing max. 45.0°)	
Rudder Angle accuracy	0.1°	
Display Error	The difference between the actual angle and the display angle should be within 1.5% of the actual angle (greater than display angle) or within 1.5% of the maximum display angle (45°).	

Specification

Power Failure LED101 for DC power supply and LED102 for AC power supply. OFF is power failure. ON is normally working. LEDs are in Control Unit AD802. The pointer will turn outside the starboard 45.0° for analog display, and the digital display shows red 'PL'.

➤ Technical Specification

Rudder Angle Display

Analog Display The pointer indicates the corresponding scale.
 The range of Port Wing 0.0°~45.0°
 Starboard Wing 0.0°~45.0°
 When out of the range, the pointer will turn outside the starboard 45.0°.

Digital Display The digital tube displays the corresponding rudder angle number, character format is **.°. The range 0.0°~45.0°
 When out of the range, '---' will appear.

Power Failure & Out of Range The pointer will turn outside the starboard 45.0° for analog display and red '_PL' will appear for digital display.

Nominal viewing distance	Three-face Indication Unit AD801	3m
	Indication Unit AD804	3m
	Indication Unit AD805	2.5m
	Indication Unit AD806	2m

Specification

➤ Environmental Conditions

Working Temperature	-15°C~+55°C	
Storage Temperature	-20°C~+70°C	
Humidity	10%~90%RH	
Protection Level	Three-face Indication Unit AD801	IP22
	Control Unit AD802	IP22
	Transmitter AD803	IP56
	Indication Unit AD804	IP56
	Indication Unit AD805	IP56
	Indication Unit AD806	IP22
	Remote Dimmer AD807	IP22

Configuration and Operation

Rudder Angle Transmitter AD803

Rudder Angle Transmitter AD803 is used to convert the ruder angle information into digital information, and to send to the control unit AD802 through the RS422 bus (0.1 degree of accuracy).

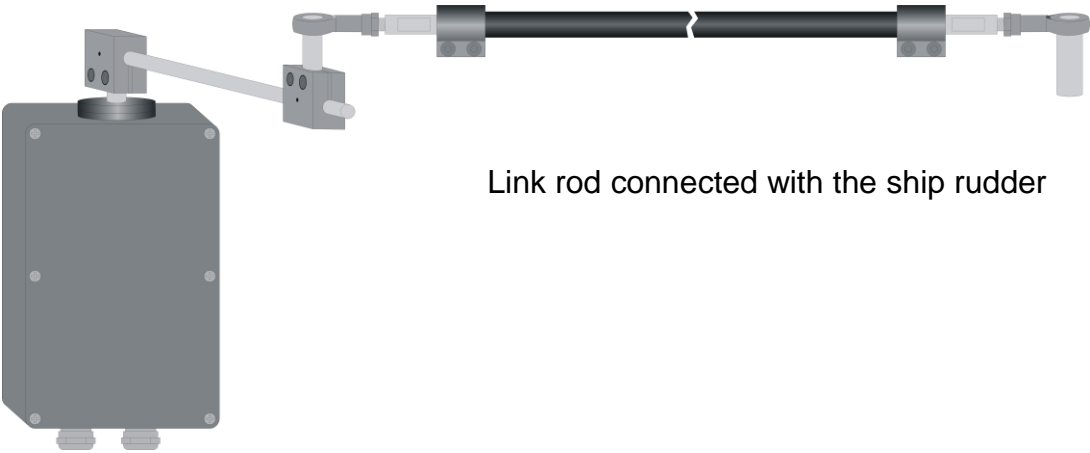


Figure 1 Rudder Angle Transmitter AD803

Rudder Angle Transmitter AD803 can supply 2 channels for rudder angle information output, which one (TO CONTROL UNIT) makes the whole system from Steering Gear Room to Wheel Room and another (TO INDICATOR) is directly connect with rudder angle information indicator for Steering Gear Room or ECC Room. Meanwhile, AD803 can also support online calibration function (Please see Calibration P11) for easier installation and maintenance.

Configuration and Operation

Control Unit AD802

The Control Unit AD802 can supply power for the whole system (AC 110V/220V or DC24V Emergency). It receives the rudder angle information from Rudder Angle Transmitter AD803 and convert to RSA (IEC61162-1) sentence to distribute to other units. Meanwhile, Control Unit AD802 can support combined remote dimming function (adjust all screen brightness) and dry contact output for system error alarm.



Figure 2 Control Unit AD802

Note. 1. When the power supply is AC220V, the transformer should be connected to the terminal strip J103 (FOR 220V ONLY). When the power supply is AC110V, the transformer should be connected to the terminal strip J104 (FOR 110V ONLY). The factory default is to the terminal strip J103 (FOR 220V ONLY)

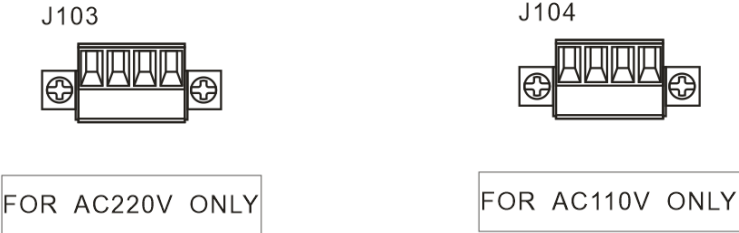


Figure 3 Control Unit Terminal diagram-1A

CAUTION The transformer connection with the power supply should be correct! If not, damage on the equipment!

Configuration and Operation

The terminal strip J103 (FOR 220V ONLY) or J104 (FOR 110V ONLY) is connected to the transformer in color sequence of black, white, red and yellow, which has already been set when leave the factory and not allowed to change the color sequence of the cables.

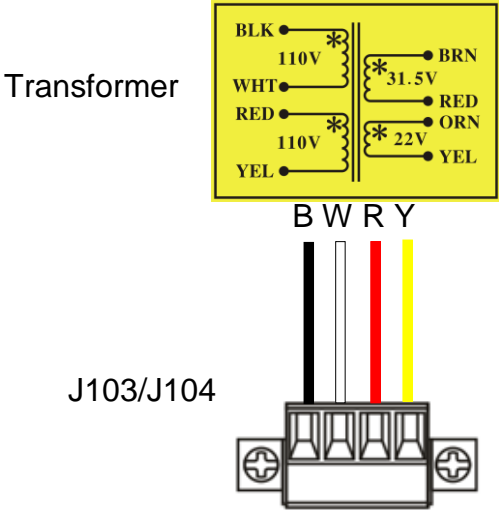


Figure 3 Control Unit Terminal diagram-1B

Configuration and Operation

Control Unit AD802

2. The Control Unit supports the 2 RS-422 standard output interfaces in NMEA0183 protocol. The transmission interval for each sentence is 1 second. The output port can drive up to 10 nodes.

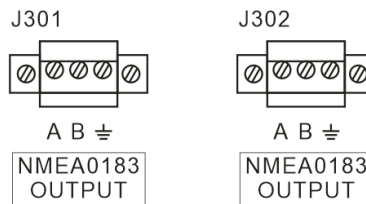
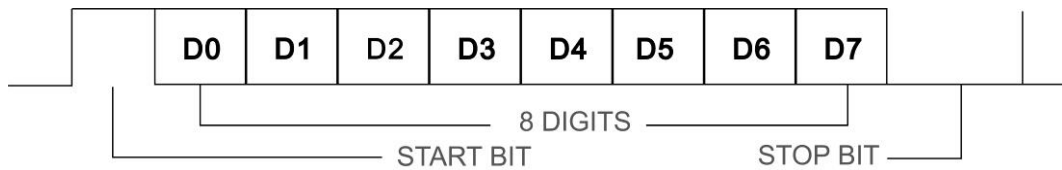


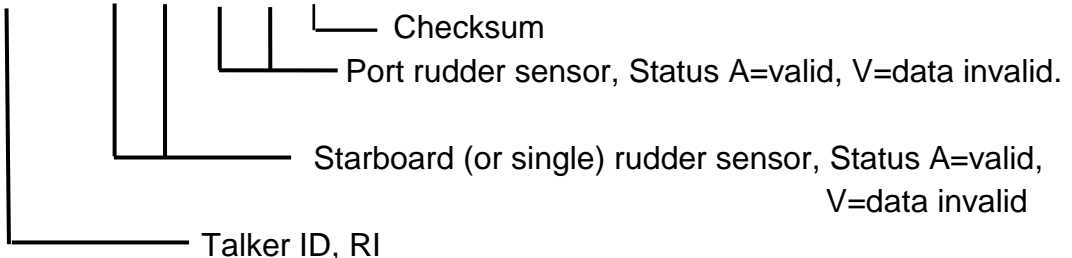
Figure 4 Control Unit Terminal diagram-2

Data transmission: serial asynchronous mode, Baud rate 4800, 8 digits, no parity bit, 1 stop bit.



Rudder Sensor Angle—RSA

\$--RSA, x.x, A, x.x, A*hh<CR><LF>



Configuration and Operation

Three-face Rudder Angle indication Unit AD801

The Three-face Rudder Angle Indication Unit AD801 is mostly installed on the ceiling of Wheel Hose. The rudder angle information can be indicated by the crew from three directions which are 90 degrees to each other, one analog display and one digital display for each direction. There is a knob on AD801 for independently dimming and in the meanwhile, external dimmer can be connected for remote dimming. Automatic zero adjustment once power on. The pointer is indicating the rudder angle for analog display, with red rectangle for port wing and green rectangle for starboard wing of the rudder. The red LED number is indicating the rudder angle value for digital display on bottom, with red block for port wing and green block for starboard wing of the rudder. There is one self-control brightness rotary knob. Rotate clockwise (counterclockwise) the rotary knob to increase (decrease) the indicator brightness.

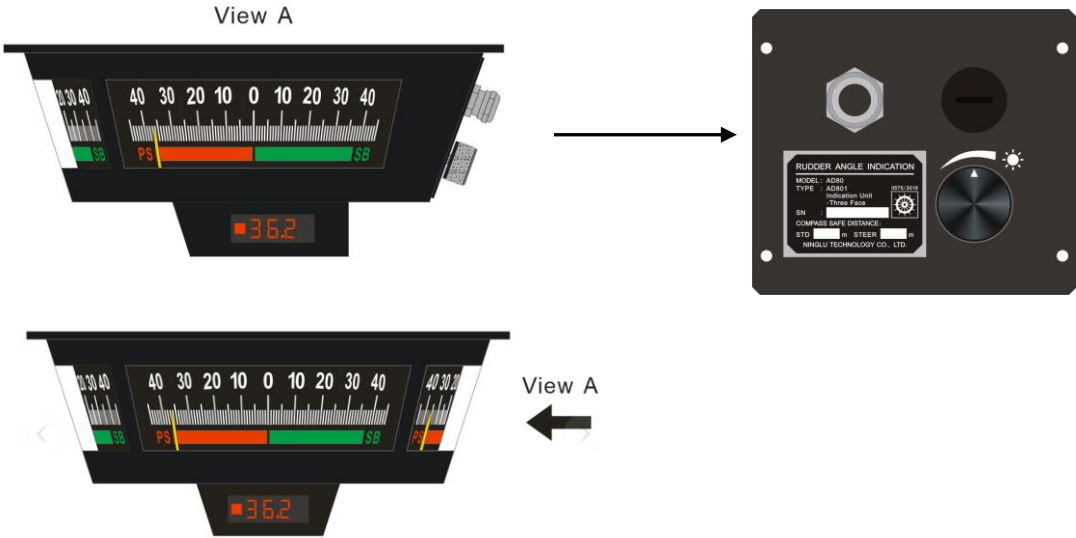


Figure 5 Three-face Rudder Angle indication Unit AD801

Configuration and Operation

Rudder Angle Indication Unit AD804, AD805, AD806

To feed different requirements, Rudder Angle Indication System supply 3 dimensions of indicators: AD804, AD805 and AD806, except for Three-face Rudder Angle Indication Unit AD801.

The pointer is indicating the port wing or starboard wing of the rudder for analog display, with red arc for port wing and green arc for starboard wing of the rudder. The red LED number is indicating the rudder angle value for digital display.

Wall Rudder Angle indication Unit AD804 or AD805 is usually wall installed in two wings of the vessels and Steering Gear Room. They can also support the dimming key “↑”, “↓” or “▲”, “▼” on the unit. Automatic zero adjustment once power on.

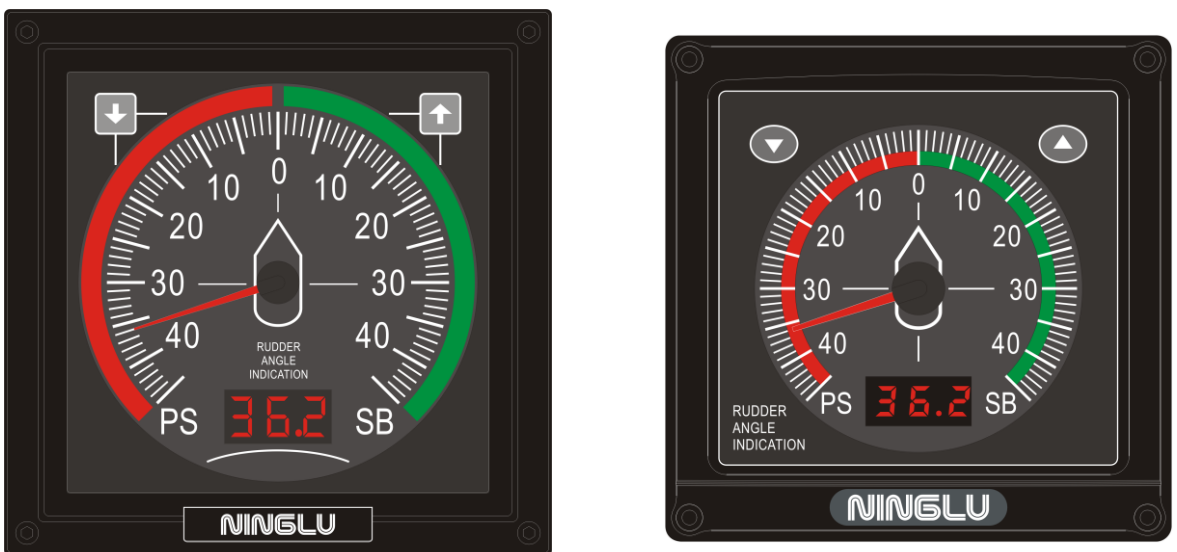


Figure 6 Wall Rudder Angle indication Unit

AD804

AD805

Configuration and Operation

Panel Rudder Angle Indication Unit AD806 is usually installed in ECC Room. Automatic zero adjustment once power on.

The pointer is indicating the port wing or starboard wing of the rudder for analog display, with red arc for port wing and green arc for starboard wing of the rudder. AD806 has no self-control brightness adjustment function. But its brightness adjustment can be controlled by remoter dimmer AD807.



Figure 7 Panel Rudder Angle Indication Unit AD806

Remote Dimmer AD807

Remote Dimmer AD807 is to connect to Control Unit AD802 for remote general control for the brightness of all rudder angle indicators together.

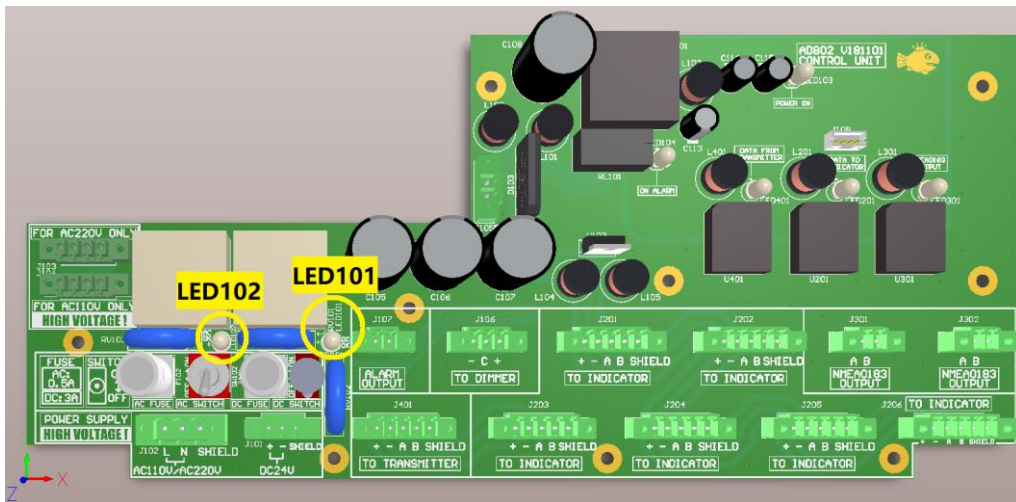


Figure 8 Remote Dimmer AD807

Configuration and Operation

Invalid Signal and Power Failure

1. When out of range ($>45^\circ$), the pointer will turn outside the starboard 45.0° for analog display and red '——' will appear for digital display.
2. When DC power supply is failed and AC power supply is working, LED101 is OFF and LED102 is ON inside control unit AD802.



Layout of Control Unit AD802

When DC power supply is working and AC power supply is failed, LED101 is ON and LED102 is OFF inside control unit AD802.

The analog display is normal working, and the digital display shows red 'PL'.

3. When the system is **BOTH** one-channel power failure (only DC or AC is not working) **AND** out of range, the pointer will turn outside the starboard 45.0° for analog display and red '—PL' will appear for digital display.

Calibration of Rudder Angle

After the system is installed, it enters the debugging stage. When the difference between the rudder angle shown in the system AD80 and the real angle is out of error range, the system should be calibrated on the Transmitter AD803.

The meaning of the LED display in Transmitter AD803:

P.09.5	→	P. : Port Wing	09.5: 9.5°
S.12.3	→	S. : Starboard Wing	12.3: 12.3°

Calibration Procedure

1. Screw the six bolts on the front case and remove the case of Transmitter AD803. Repeatedly press the two buttons 'PS' and 'SB' in turn until '-CL-' appears on the LED display (see Figure 9). And then, press the button 'ENT', '- - -' appears on the LED display (see Figure 10), which means the last stored rudder angle calibration value is removed and the factory default of calibration value is restored. Cut off the power supply and the factory default of rudder angle calibration value is enable when the system boots up again.



PS: Port Wing
SB: Starboard Wing
ENT: Enter

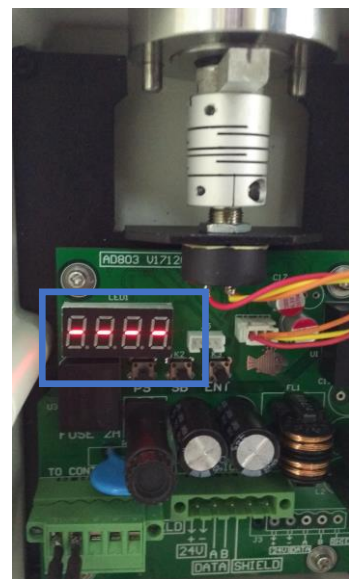


Figure 9 Calibration-1

Figure 10 Calibration-2

Calibration of Rudder Angle

2. Based on Step 1, “- - -” appears on the LED display (see Figure10), which means the last stored rudder angle calibration value is removed and the factory default of calibration value is restored. DO NOT cut off the power supply and press the button ‘SB’, ‘S.00’ appears on the LED display. Then, the angle of steering engine is needed to be adjusted to 0 ° by operators. Press the button ‘ENT’, ‘S.00 0’ appears on the LED display (see Figure 11), which means 0.0° calibration is completed. The second is to press the button ‘SB’ again, ‘S.05’ appears on the LED display (see Figure 12). Then, the angle of steering engine is needed to be adjusted to starboard 5 ° by operators. Press the button ‘ENT’, ‘S.05 0’ appears on the LED display, which means starboard 5.0° calibration is completed. In accordance with this method, continuously calibrate S.10、 S.15、 S.20、 S.25、 S.30、 S.35、 S.40、 S.45 (00° ~45°) and then the rudder angle of starboard wing is completely calibrated.



Figure 11 Calibration-3



Figure 12 Calibration-4

The Starboard Rudder Angle should be calibrated 10 times!

Calibration of Rudder Angle

3. The calibration of portside rudder angle is similar to the calibration of starboard rudder angle. When “- - -” appears on the LED display (see Figure 10), which means the last stored rudder angle calibration value is removed and the factory default of calibration value is restored. DO NOT cut off the power supply and press the button ‘PS’, ‘P.05’ appears on the LED display. Then, the angle of steering engine is needed to be adjusted to portside 5 ° by operators. Press the button ‘ENT’, ‘P.05 0’ appears on the LED display (see Figure 13), which means portside 5.0° calibration is completed. In accordance with this method, continuously calibrate P.10、P.15、P.20、P.25、P.30、P.35、P.40、P.45 (05° ~45°) and then the rudder angle of port wing is completely calibrated.



Figure 13 Calibration-5

The Portside Rudder Angle should be calibrated 9 times!

4. When finish the calibration of Port and Starboard wings, it can be used to enable the calibration value for Transmitter AD803 after power failure.

Installation

Installation of Rudder Angle indication Unit AD801

Three-face Rudder angle indicator AD801 can be installed on the ceiling of Wheel House by Hang mounting method.

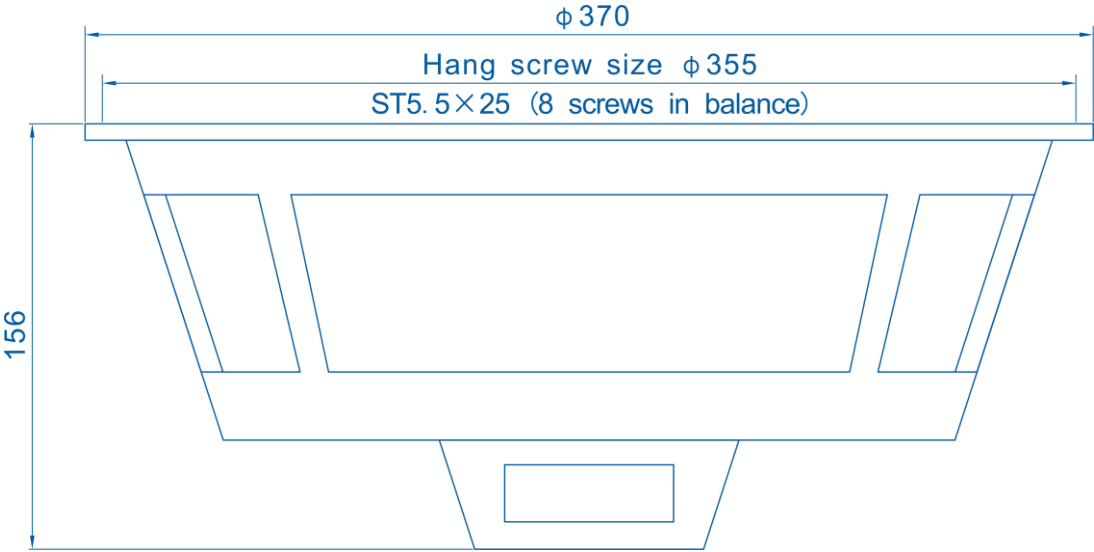


Figure 14 Dimension of Rudder Angle Indication Unit AD801

Installation

Installation of Control Unit AD802

Control Unit AD802 can be installed in Wheel Hose by Table or Hange mounting methods.

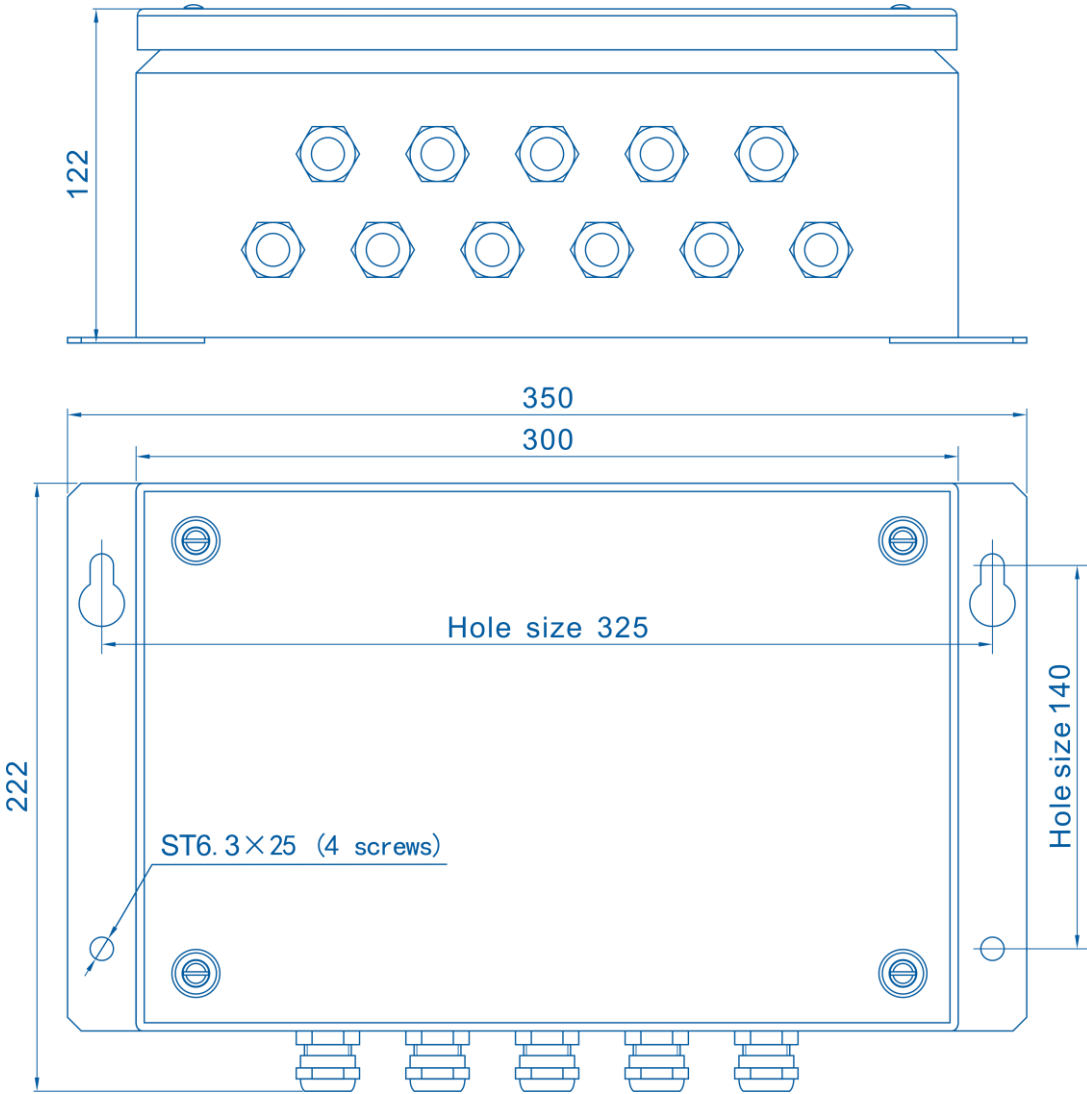


Figure 15 Dimension of Control Unit AD802

Installation

Installation of Rudder Angle Transmitter AD803

Rudder Angle Transmitter AD803 can be installed in Steering Gear Room by Table or Hange mounting methods.

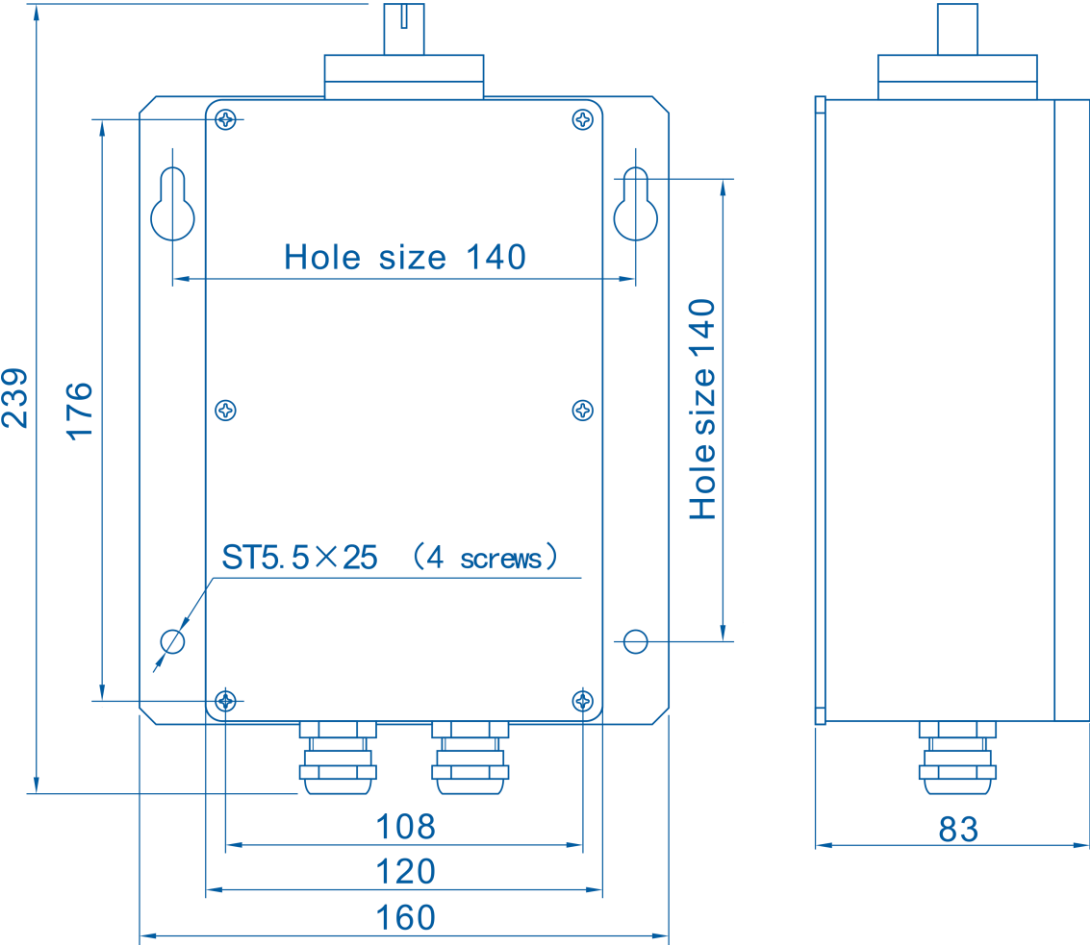


Figure 16 Dimension of Rudder Angle Transmitter AD803

Installation

Installation of Rudder Angle Transmitter AD803

Working Principle

The Transmitter AD803 is connected with the steering engine through the link rod, which becomes a rectangle (better) or a parallelogram. The angle of the steering gear is θ_2 . Based on the parallelogram property, the angle of the link rod is $\theta_1 = \theta_2$, and the Transmitter AD803 can get the real-time angle signal (1:1), shown in Figure 17.

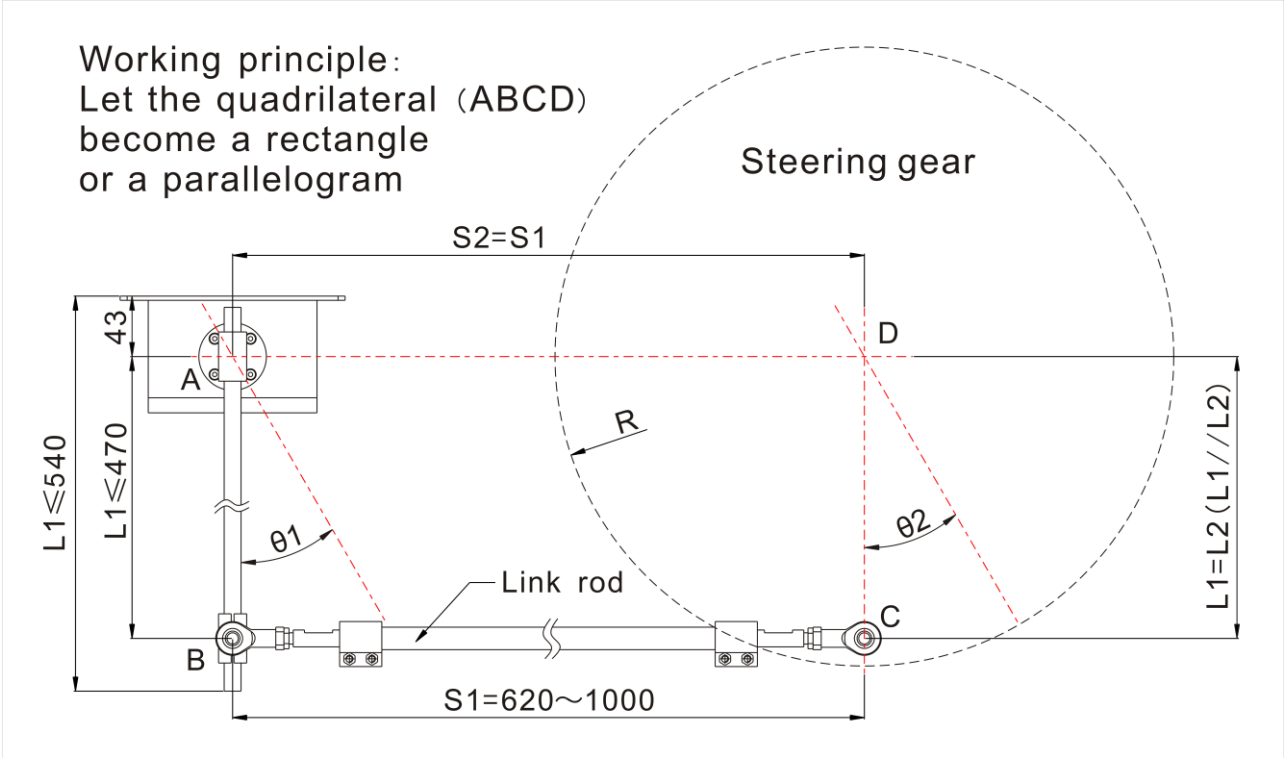


Figure 17 Installation of Rudder Angle Transmitter AD803-1

Installation

Installation of Rudder Angle Transmitter AD803

Installation of Transmitter Box

The installation location of Transmitter box should be chosen the position where the top of the box body is almost same as the steering gear welding position height. For the holes in the mounting bracket, screw the four M6 bolts to fix the installation panel with the mounting bracket of the hull, shown in Figure 18. Ensure that the transmitter shaft is parallel to the steering gear shaft. That is the Transmitter box is vertical to the hull bottom.

The length range of the link rod is 620~1000mm, shown in Figure17. When the distance between the transmitter shaft and the steering gear shaft is out of the range, it is necessary to customize the length of the link rod or reweld the mounting bracket of the Transmitter box.

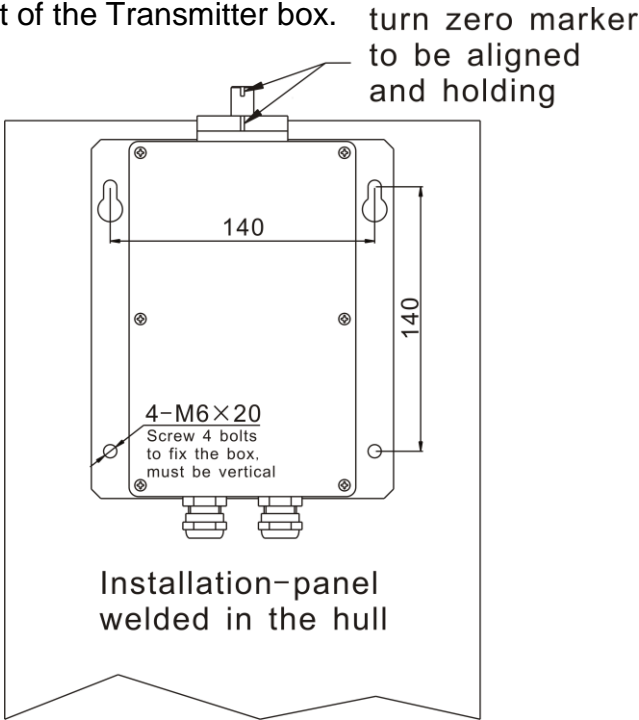


Figure 18 Installation of Rudder Angle Transmitter AD803-2

Installation

Installation of Rudder Angle Transmitter AD803

Installation of Link Rod

In practice, the position and angle of the mounting bracket welding in the hull is different for different vessels. Users should let the quadrilateral become a rectangle or a parallelogram according to the actual situation.

Step 1. After finish the installation of Transmitter box, measure the length of the shadow AD to estimate the length of S2, shown in Figure 19

Step 2. Draw the vertical line CD perpendicular to the line AD and rotate the line CD at the axis point D to check whether the rotation of rudder angle in the range will affect the the link rod BC and steering gear. If not, select the suitable position of point C in the line CD and the length L2 of CD is the same as the length L1 of AB. The suitable range is 200~450mm. Too short length of CD L2 will result the structure damage. There are two situations of welding point C. One is the steering gear is enough great, as $R1 > L2$, and the point C can be welding on the steering gear. Another is the steering gear is enough small, as $R2 < L2$ and a welding lengthening block is required.

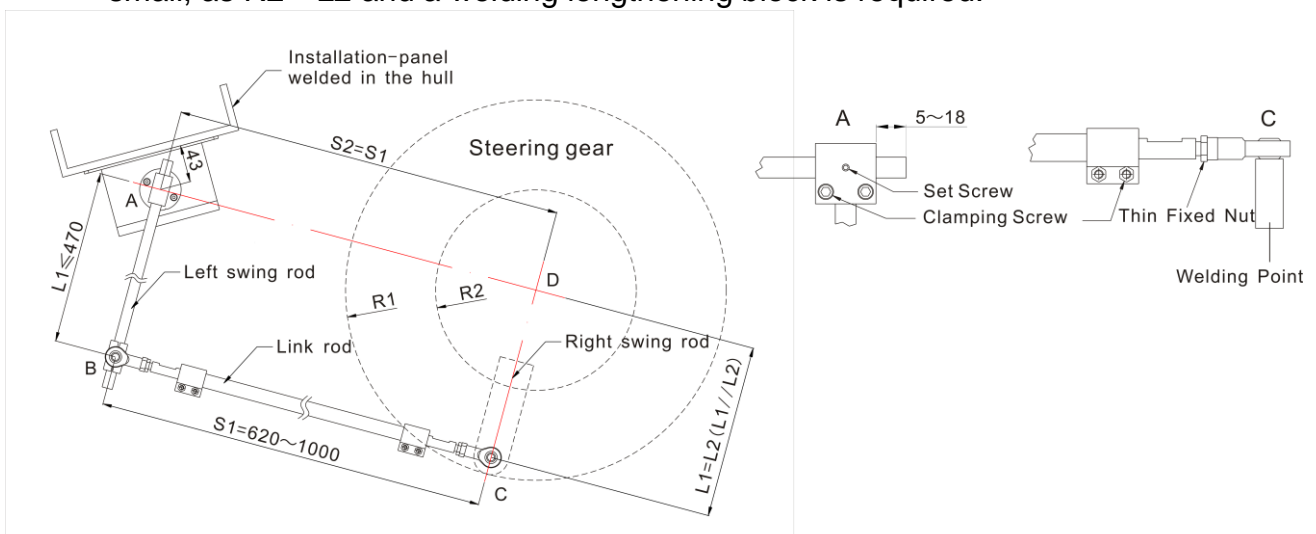


Figure 19 Installation of Rudder Angle Transmitter AD803-3

Installation

Installation of Rudder Angle Transmitter AD803

Step 3. Adjust Point A of the slide block end over the left swing rod 5~18mm. Pre-fix the set screw and place the slider joint on the transmitter shaft of the transmitter box, shown in Figure 19. After the two zero markers aligned, make the line AB perpendicular to the line AD and $L1=L2$, $S1=S2$. Errors may appear but based on the quadrilateral structure, fine adjustment to let ABCD become a rectangle on the projection plane, where a small height error of A and D, B and C is allowed. Tighten the clamping screws on the slide block A and B and the link rod, and then tighten the two thin fixed nuts

For special situation, rotate the line CD at the axis point D within the range of rudder angle. When there appears effect between the link rod the steering gear, the point C needs shift to one side of the transmitter box. Then, do it as Step 2 and Step 3 to let ABCD become a parallelogram and the acute angle should be larger than 70° . If not, it is necessary to reweld the mounting bracket of the transmitter box in the hull.

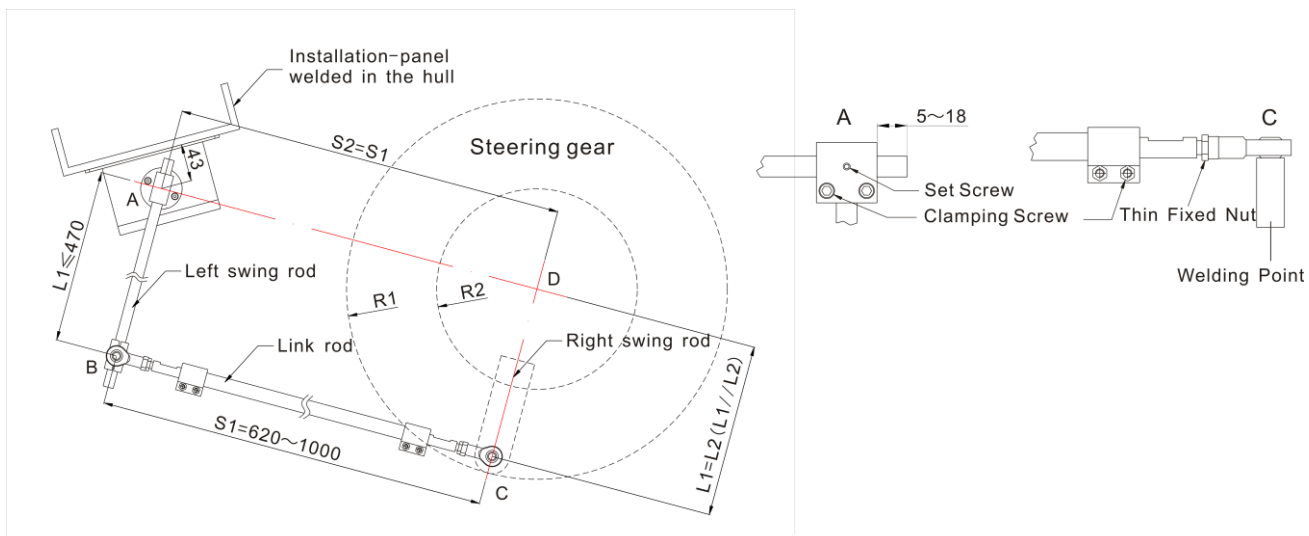


Figure 19 Installation of Rudder Angle Transmitter AD803-3

Installation

Installation of Rudder Angle Indication Unit AD804

Rudder Angle Indicator AD804 can be installed in the port wing and starboard wing of the ship. It has three mounting methods, Table, Hang and Flush mounting.

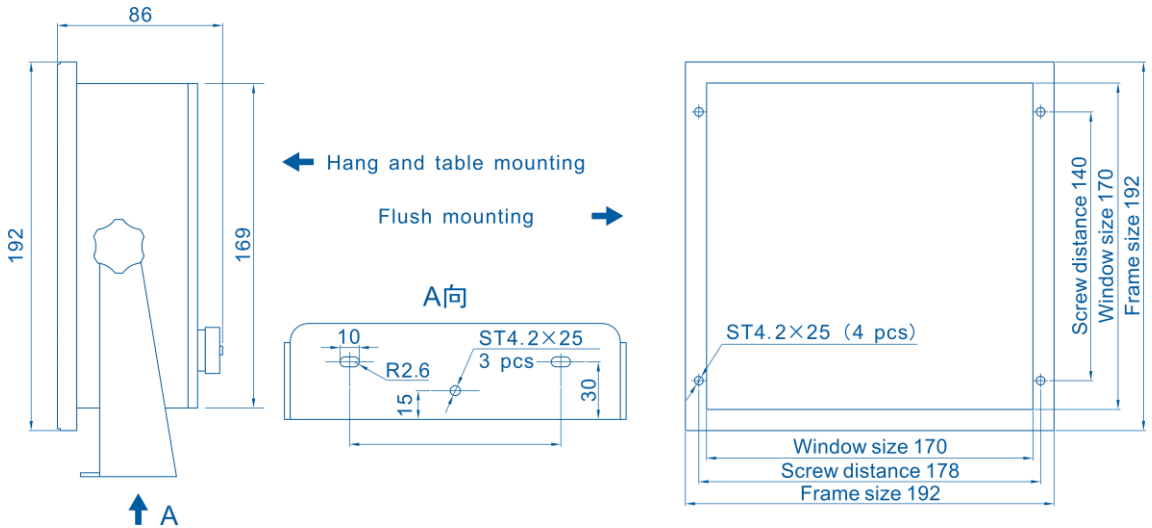


Figure 20 Dimension of Rudder Angle Indication Unit AD804

Installation of Rudder Angle Indication Unit AD805

Rudder Angle Indicator AD805 can be installed in Wheel House. It has three mounting methods, Table, Hang and Flush mounting.

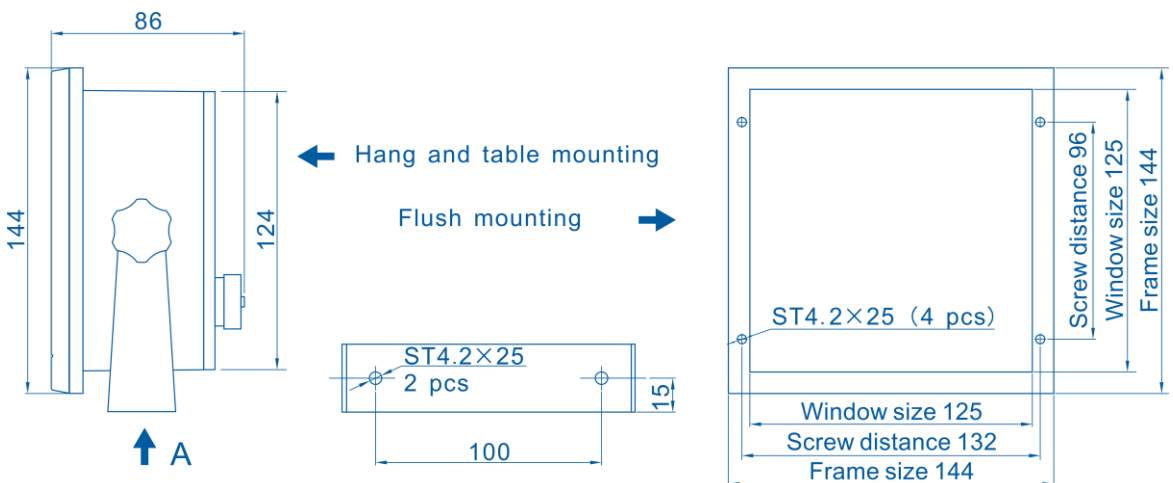


Figure 21 Dimension of Rudder Angle Indication Unit AD805

Installation

Installation of Rudder Angle Indication Unit AD806

Rudder Angle Indicator AD806 can be installed in Wheel House by Flush mounting method.

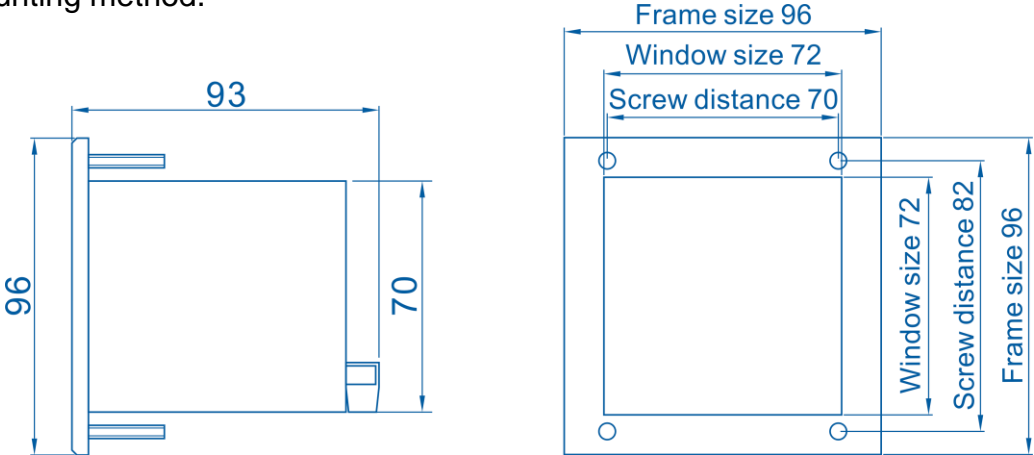


Figure 22 Dimension of Rudder Angle Indication Unit AD806

Installation of Remote Dimmer AD807

Remote Dimmer AD807 can be installed in Wheel House by Flush mounting method.

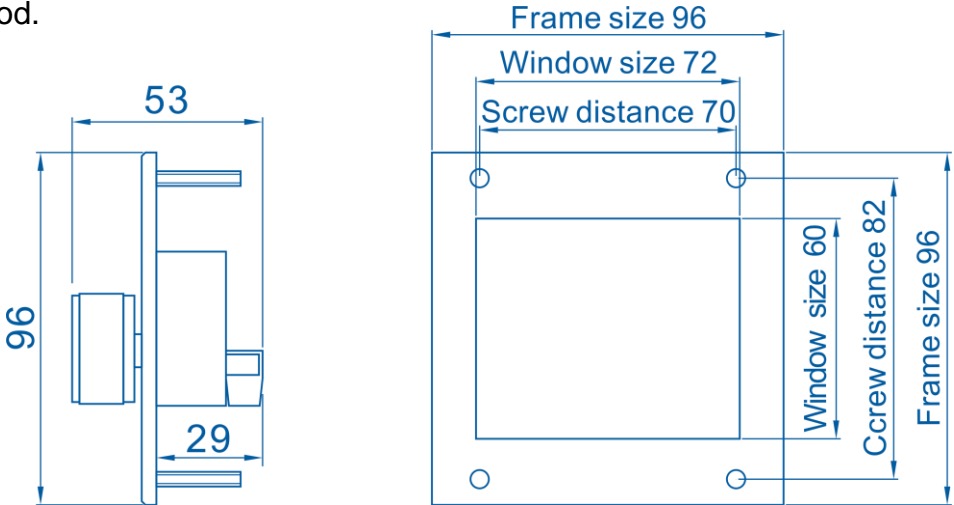
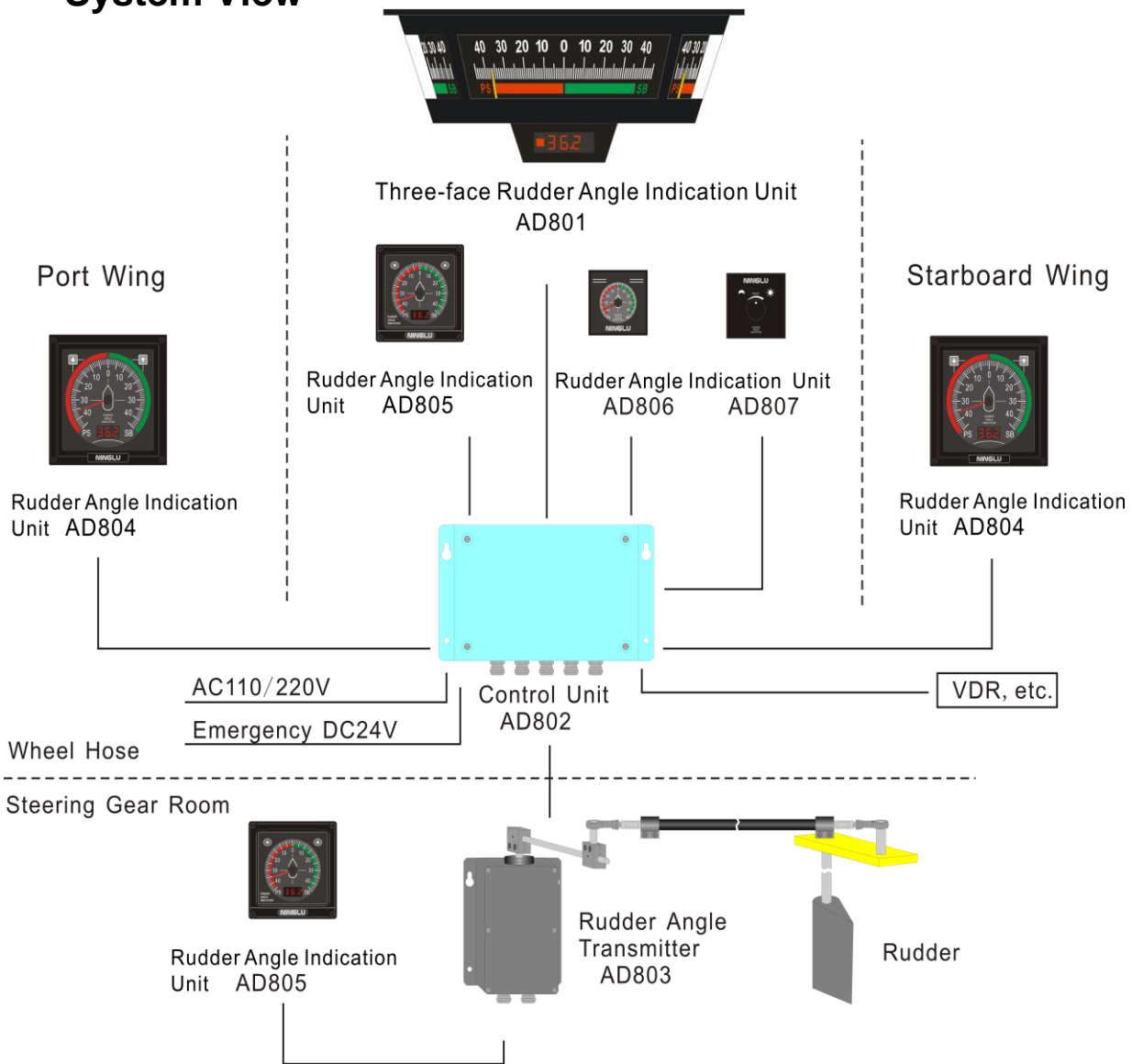


Figure 23 Dimension of Remote Dimmer AD807

Wiring

System View




Note: Each unit of the system AD80 has one connection to an electrical earth. 

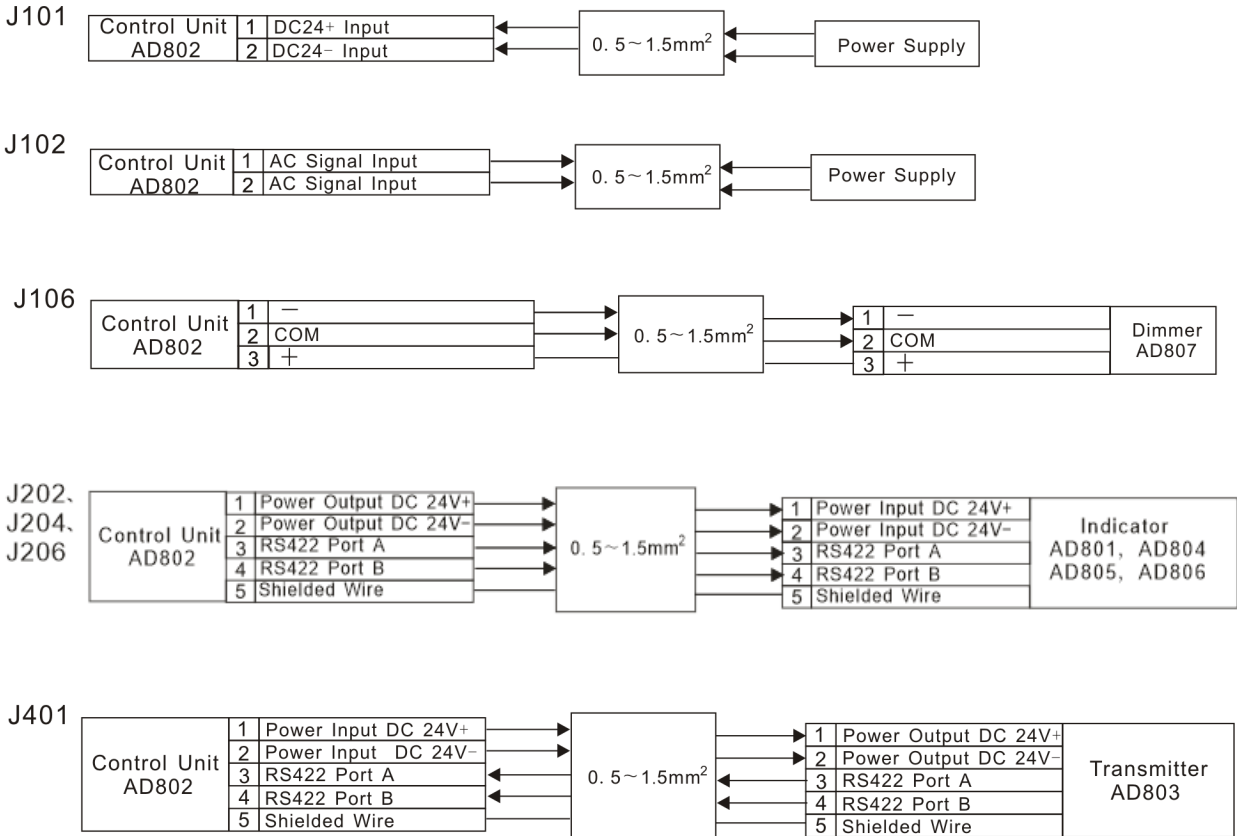
Figure 24 System View

Wiring

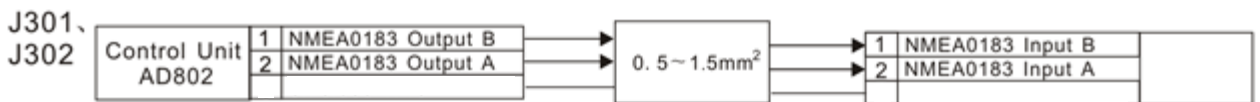
Connection

Control Unit AD802

Internal Wiring



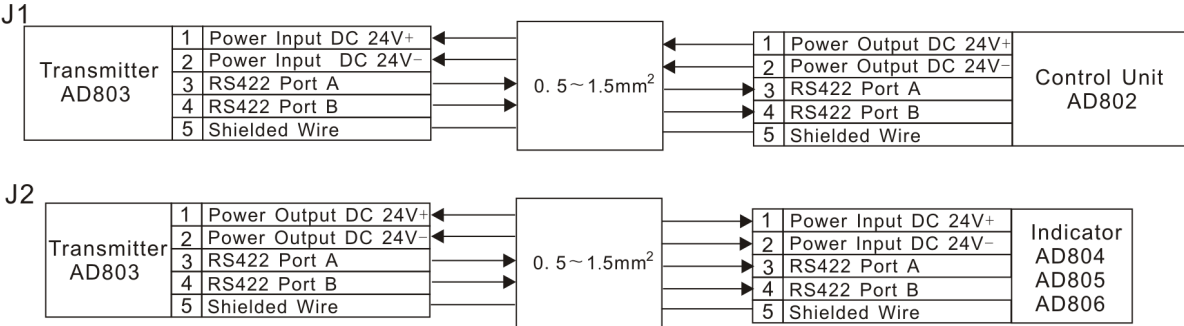
External Wiring



Wiring

Connection

Transmitter AD803



Maintenance

The fastening of the link rod of the Transmitter AD803 is very important. If the link rod is loose, it may make the Rudder Angle Indication System cannot indicate the correct angle. So the link rod needs for a periodic inspection. And the bearing of the link rod needs to add marine water resistant grease regularly, shown in Figure 25 to ensure good lubrication.

Some extreme impact may lead to the indication units have larger indication error, and unable to restore. In this case, it need to shut down all power input, and to restart the whole system. So, the indicators can work normally again.

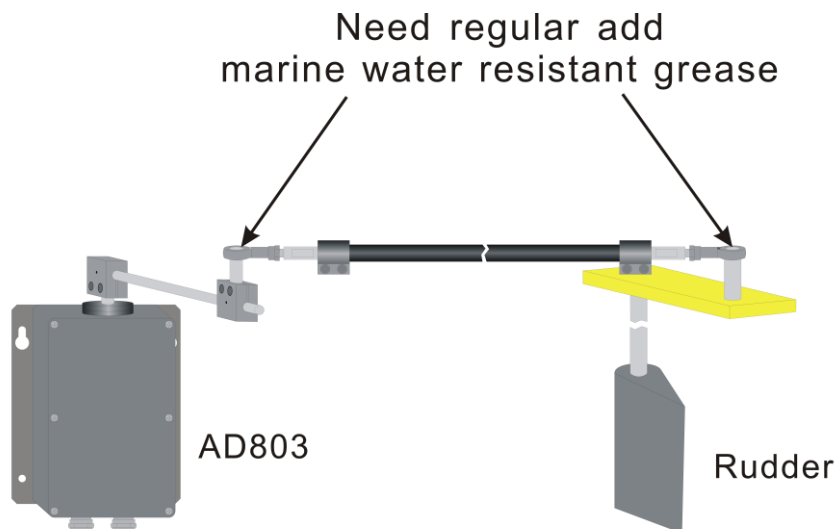


Figure 25 Maintenance for the link rod