Rudder angle indicator equipment

Rudder angle indicators types
- KLPQ...
- BCI...
- NOA...
- NB09...
- 136-065
- Rudder position amplifier 139-147

1 Description
2 Setting into operation and operating instructions
3 Maintenance and Repair

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Note:

If “RAI Signal Calibration Box” is used, please refer to the supplied manual for installation and configuration instructions.

The software for this Signal Calibration Box can be downloaded (for Raytheon Anschwetz personnel only, Log-on ID and Password necessary):

www.raytheon-anschwetz.com → Service Network → Partners Area → Service Software → Rudder Angle Indicator System → RAI System Software cpt.zip
# Rudder angle equipment with amplifier

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## Further Documents

- SCB-RAI Signal Calibration Box for Rudder Angle Indicators

## Appended Drawings

- **Cable and connection diagram**: Rudder angle indicator system 25-CA-D-X00002-C
- **Dimensional drawing**: Rudder position amplifier 139 E 147.HP012
- **Connection diagram**: Rudder position amplifier 139 D 147.HP050
- **Dimensional drawing**: Rudder angle indicator NB09-066.HP024
- **Dimensional drawing**: Rudder angle indicator NB09-066.HP026
- **Dimensional drawing**: Rudder angle indicator NB09-066.HP033
- **Dimensional drawing**: Rudder angle indicator 136 D 065.HP005
- **Dimensional drawing**: Dimmer mounting set 148 E 367.HP005
- **Dimensional drawing**: Dimmer 148 E 377.HP015
- **Dimensional drawing**: Dimmer 148 E 380.HP005
- **Dimensional drawing**: Dimmer mounting kit Extract of 148 E 363.HP004
- **Dimensional drawing**: Rudder angle indicator ans-BCI-240-96
- **Dimensional drawing**: Rudder angle indicator ans-BCI-240-144
- **Dimensional drawing**: Rudder angle indicator ans-KLPQ-96wp
- **Dimensional drawing**: Rudder angle indicator ans-KLPQ-144wp
- **Dimensional drawing**: Rudder angle indicator ans-KLPQ-192wp
- **Dimensional drawing**: Rudder angle indicator ans-NOA-170
- **Dimensional drawing**: Dimmer-potentiometer with knob dp-1-k
1 Description

1.1 Application

The rudder position (angle) indicator equipment consists of:
- Rudder angle indicator(s):

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<th>Dimensions</th>
<th>Rudder Angle</th>
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<tbody>
<tr>
<td>NB06–066–024</td>
<td>2012896</td>
<td>flush</td>
<td>96 mm</td>
<td>45°</td>
</tr>
<tr>
<td>NB06–066–033</td>
<td>2010084</td>
<td>flush</td>
<td>96 mm</td>
<td>75°</td>
</tr>
<tr>
<td>NB06–066–026</td>
<td>2012900</td>
<td>flush</td>
<td>144 mm</td>
<td>45°</td>
</tr>
<tr>
<td>NB06–066–035</td>
<td>1503600</td>
<td>flush</td>
<td>144 mm</td>
<td>75°</td>
</tr>
<tr>
<td>KLPQ–96WP</td>
<td>2010701</td>
<td>flush</td>
<td>96 mm</td>
<td>45°</td>
</tr>
<tr>
<td>KLPQ–96WP</td>
<td>2010703</td>
<td>flush</td>
<td>96 mm</td>
<td>75°</td>
</tr>
<tr>
<td>KLPQ–144WP</td>
<td>2010693</td>
<td>flush</td>
<td>144 mm</td>
<td>45°</td>
</tr>
<tr>
<td>KLPQ–144WP</td>
<td>2010695</td>
<td>flush</td>
<td>144 mm</td>
<td>75°</td>
</tr>
<tr>
<td>BCI–240–96</td>
<td>2010700</td>
<td>wall</td>
<td>96 mm</td>
<td>45°</td>
</tr>
<tr>
<td>BCI–240–96</td>
<td>2010702</td>
<td>wall</td>
<td>96 mm</td>
<td>75°</td>
</tr>
<tr>
<td>BCI–240–144</td>
<td>2010692</td>
<td>wall</td>
<td>144 mm</td>
<td>45°</td>
</tr>
<tr>
<td>BCI–240–144</td>
<td>2010694</td>
<td>wall</td>
<td>144 mm</td>
<td>75°</td>
</tr>
<tr>
<td>136–065 NG001</td>
<td>4000075</td>
<td>ceiling</td>
<td>192 mm</td>
<td>45°</td>
</tr>
<tr>
<td>136–065 SA001</td>
<td>4000078</td>
<td>ceiling</td>
<td>192 mm</td>
<td>75°</td>
</tr>
<tr>
<td>NOA–170</td>
<td>2010704</td>
<td>wall</td>
<td>192 mm</td>
<td>45°</td>
</tr>
<tr>
<td>NOA–170</td>
<td>2010705</td>
<td>wall</td>
<td>192 mm</td>
<td>75°</td>
</tr>
<tr>
<td>KLPQ–192</td>
<td>2010744</td>
<td>flush</td>
<td>192 mm</td>
<td>45°</td>
</tr>
<tr>
<td>KLPQ–192</td>
<td>2010743</td>
<td>flush</td>
<td>192 mm</td>
<td>75°</td>
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- Rudder position amplifier, type 139–147
- SCB–RAI 10 Signal Calibration Box for Rudder Angle Indicators

Above mentioned equipment especially the amount of rudder angle indicators are normally not used in one application.

For an overview of the respective application, please see the Cable and Connection Diagram of respective order.
Rudder angle equipment
with amplifier

Note:
If “RAI Signal Calibration Box” is used, please refer to the supplied manual for installation and configuration instructions.

The software for this Signal Calibration Box can be downloaded (for Raytheon Anschuetz personnel only, - Logon ID and Password necessary):

www.raytheon-anschuetz.com → Service Network → Partners Area → Service Software → Rudder Angle Indicator System → RAI System Software cpt.zip
The rudder angle indicator equipment provides continuous and analog indication of the steering gear’s actual position.

The individual rudder angle indicators can be installed in any reasonable place of the ship. The equipment is suitable for sea-going ships of any type and size.
The central part of the equipment is the amplifier.

For more information see:
- Section 1.2.1 Rudder position amplifier, type 139–147
- Manual SCB–RAI 10 Signal Calibration Box for Rudder Angle Indicators

The sensor of the rudder angle is a Feedback unit that is coupled with the rudder.

The power supply of the equipment is ensured by 24V DC from the ship's mains (emergency supply).
1.2 Construction and principle of operation

1.2.1 Rudder position amplifier, type 139-147

(For installation see appended dimensional drawing 139 E 147 HP005).
(For connections see also appended connection diagram 132 D 147 HP050).

Fig. 1-2: Rudder position amplifier, type 139–147

All electronic elements as well as the terminals of the amplifier are arranged on a PCB. This PCB is located in a casing that can be mounted on rails. A transparent plastic hood protects the elements from mechanical damage. The amplifier is short-circuit-proof.

The amplifier comprises two trimming potentiometers. One of them (R7 “SCALE”) ensures adjustment of the slope of the feedback unit for the indication scaling, the other (R6 “OFFSET”) permits slight midships inaccuracies to be compensated that might occur on mounting the feedback unit.

The supply voltage of 24V DC is passed on in the amplifier via the fuse E1 (2A, slow) for illuminating the rudder angle indicators. This voltage is also used to generate the necessary internal stabilized supply voltage (+/−15V DC) but the fuse does not protect these internal supply voltages.

With this stabilized voltage (+/−15V DC), the feedback potentiometer is supplied. The rudder angle signal of the feedback potentiometer and passed on to the connected rudder angle indicators. Readiness for operation of the amplifier is signalized by a LED.
Connection hints:
see also documents for the equipment application.

Each output for a rudder angle indicator can be used for up to 5 single indicators, but in total not more than 9 indicators for one amplifier.

**Fig. 1-3:** Rudder position amplifier connections
Hints for adjustment:

- Put the rudder exactly to midships position.
- In case of small deviations of the feedback potentiometer in the rudder position transmitter unit, adjust the indication of the measuring instruments for zero by means of the trimming potentiometer R6 (1) “OFFSET”.
- Put the rudder hard to port. Adjust the actual position of the rudder blade by means of the trimming potentiometer R7 (2) “SCALE” on the indication of the measuring instrument.
- Compare the indication also for hard-to-starboard rudder position.

**Fig. 1-4:** Rudder position amplifier adjustment points

A jumper has to set according to the desired voltage for the connected rudder angle indicator – either 5V DC or 10V DC (for full scale).

**Fig. 1-5:** Jumper for full scale adjustment
### 1.2.2 Rudder angle indicators and equipment

Multitude of different rudder angle indicators can be used in this rudder angle indicator system.

Determinations are:
- Mounting location (as there are flush, bulkhead or ceiling).
- With dimmer potentiometer
- Size of instrument
- Protection grade

The below mentioned rudder angle indicators are arranged according to mounting location:

**for indoor use, flush mount:**
- Rudder angle indicator, type NB09-066-24 (see section 1.2.2.1)
- Rudder angle indicator, type NB09-066-26 (see section 1.2.2.2)
- Rudder angle indicator, type NB09-066-33 (see section 1.2.2.3)
- Rudder angle indicator, type NB09-066-35 (see section 1.2.2.4)
- Rudder angle indicator, type 136-065 NG001 (ceiling mount) (see section 1.2.2.5)
- Rudder angle indicator, type 136-065 SA 001 (ceiling mount) (see section 1.2.2.6)
- Dimmer, type 148-380, (see section 1.2.2.8)
- Dimmer, type 148-367 (potentiometer only) (see section 1.2.2.7)
- Dimmer, type 148-377 NG010 (see section 1.2.2.9)
- Dimmer, type 148-363 (potentiometer only) (see section 1.2.2.10)

**for outdoor use, flush mount:**
- Rudder angle indicator, type KLPQ-96WP (see section 1.2.2.11)
- Rudder angle indicator, type KLPQ-144WP (see section 1.2.2.12)
- Rudder angle indicator, type KLPQ-192WP (see section 1.2.2.13)
- Dimmer for KLPQ-xxx, type dp–1–k (see section 1.2.2.14)

**for outdoor use, bulkhead mount:**
- Rudder angle indicator, type BCI 240–96 (see section 1.2.2.15)
- Rudder angle indicator, type BCI 240–144 (see section 1.2.2.16)

**for outdoor use, wall mount:**
- Rudder angle indicator, Panama-type (NOA 170) (see section 1.2.2.17)

---

**General information about connecting rudder angle indicators to the rudder position amplifier are shown in the appended drawing:**

“Rudder angle indicator system, cable and connection diagram 25–CA–D–X00002–C”
1.2.2.1 Rudder angle indicator, type NB 09-066-24 (± 45°)

(For installation see appended dimensional drawing: NB09-066.HP024)

The rudder angle indicator consists of a 96 mm x 96 mm moving-coil measuring instrument with the measuring input of ±5V DC or ±10V DC with full-scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 53.

Scale illumination is ensured by a lamp of 24V/3W. The illumination can be adjusted by means of an additional dimmer only.

Connections to be made (rudder angle indicator with external dimmer):

Fig. 1-6: Rudder angle indicator, type NB 09-066-24

Fig. 1-7: Rudder angle indicator, type NB 09-066-24
Set jumper B1 of rudder position amplifier to position according selected connection:

- Jumper between pin 2 and 3 = 10V DC
- Jumper between pin 1 and 2 = 5V DC

Fig. 1-8: Rudder angle indicator, type NB 09-066-24
(connection locations)

Information to the dimmers type 148–367 and 148–380 see respective sections and appended drawings:
- Dimensional drawing: 148 E 367. HP005
- Dimensional drawing: 148 E 380. HP005
1.2.2.2 Rudder angle indicator, type NB 09–066–26 (± 45°)

(For installation see appended dimensional drawing NB09–066.HP026)

The rudder angle indicator consists of a 144 mm x 144 mm moving-coil measuring instrument with the measuring input of ±5V DC or ±10V DC with full-scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 53. Scale illumination is ensured by a lamp of 24V/3W. The illumination can be adjusted by means of an additional dimmer only.

Connections to be made (rudder angle indicator with external dimmer):

Fig. 1–10: Rudder angle indicator, type NB 09–066–26
Set jumper B1 of rudder position amplifier to position according selected connection:

- Jumper between pin 2 and 3 = 10V DC
- Jumper between pin 1 and 2 = 5V DC

**Fig. 1-11:** Rudder angle indicator, type NB 09–066–26
(connection locations)

Information to the dimmers type 148–367 and 148–380 see respective sections and appended drawings:
- Dimensional drawing: 148 E 367. HP005 and section 1.2.2.7
- Dimensional drawing: 148 E 380. HP005 and section 1.2.2.8
1.2.2.3 Rudder angle indicator, type NB09–066–33 (± 75°)

(For installation see appended dimensional drawing: NB09–066.HP033)

The rudder angle indicator consists of a 96 mm x 96 mm moving–coil measuring instrument with the measuring input of ±5V DC or ±10V DC with full–scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 53. Scale illumination is ensured by a lamp of 24V/3W. The illumination can be adjusted by means of an additional dimmer only.

Connections to be made (rudder angle indicator with external dimmer):

Fig. 1-12: Rudder angle indicator, type NB 09–066–33

Fig. 1-13: Rudder angle indicator, type NB 09–066–33
Set jumper B1 of rudder position amplifier to position according selected connection:

- Jumper between pin 2 and 3 = 10V DC
- Jumper between pin 1 and 2 = 5V DC

**Fig. 1-14:** Rudder angle indicator, type NB 09–066–33
(connection locations)

Information to the dimmers type 148–367 and 148–380 see respective sections and appended drawings:
- Dimensional drawing: 148 E 367. HP005
- and section 1.2.2.7
- Dimensional drawing: 148 E 380. HP005
- and section 1.2.2.8
1.2.2.4 **Rudder angle indicator, type NB09-066-35 (± 75°)**

(For dimensions see dimensional drawing: NB09-066.HP026 - same as for rudder angle indicator NB09-066-026)

![Rudder angle indicator, type NB09-066-35 (connection diagram)](image)

The rudder angle indicator consists of a 144 mm x 144 mm moving-coil measuring instrument with the measuring input of ±5V DC or ±10V DC with full-scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 53. Scale illumination is ensured by a lamp of 24V/3W. The illumination can be adjusted by means of an additional dimmer only.

Connections to be made (rudder angle indicator with external dimmer):

**Fig. 1-16**: Rudder angle indicator, type NB 09–066–35 (connection diagram)
Set jumper B1 of rudder position amplifier to position according selected connection:

- Jumper between pin 2 and 3 = 10V DC
- Jumper between pin 1 and 2 = 5V DC

**Fig. 1-17:** Rudder angle indicator, type NB 09-066-35 (connection locations)

Information to the dimmers type 148-367 and 148-380 see respective sections and appended drawings:
- Dimensional drawing: 148 E 367. HP005 and section 1.2.2.7
- Dimensional drawing: 148 E 380. HP005 and section 1.2.2.8
1.2.2.5 **Rudder angle indicator, type 136-065 NG 001 (± 45°)**

(For dimensions see appended dimensional drawing: 136 D 065. HP005)

**Fig. 1-18:** Rudder angle indicator, type 136-065 NG001

The rudder angle indicator consists of a 3-face indicator with an average diameter of approx. 291 mm.

The measuring input is ±10V DC full-scale deflection for ± 45° rudder angle.

The angle indicator is intended for ceiling mounting. After being installed, the device corresponds to the type of enclosure IP 23.

Scale illumination is ensured by LEDs and is supplied with 24V/12W. The illumination can be adjusted by means of an internal or an additional external dimmer. The meaning of the internal dimmer is a mounting kit to be flush mounted into the housing of the 3-face angle indicator.

There is a rectangular recess with a marker for centering the borehole at the bottom plate of the angle indicator to install the internal dimmer.

**Fig. 1-19:** Rudder angle indicator (connection location)
Rudder angle equipment with amplifier

Connections to be made (rudder angle indicator with external dimmer):

Fig. 1-20: Rudder angle indicator, type 136-065 NG001
(connection diagram with external dimmer)

Set jumper B1 of rudder position amplifier to position:

Information to the dimmer type 148-377
see respective section and appended drawing:
Dimensional drawing: 148 E 377. HP015
and section 1.2.2.9
Connections to be made (rudder angle indicator with internal dimmer):

- **Connection Diagram**:
  - **3-face indicator, type 136-065 NG001**
  - **Dimmer, type 148-363**
  - **Terminal board L1**
  - **Terminal board L2**

  **Rudder position amplifier**

  - **Terminals for angle indicator**
    - + = 4 and - = 3 or + = 6 and - = 5 or + = 8 and - = 7 or + = 10 and - = 9 or + = 13 and - = 12
  - **Terminals for illumination**
    - + = 3 and - = 4 or + = 5 and - = 6 or + = 7 and - = 8 or + = 12 and - = 13

**Fig. 1-21**: Rudder angle indicator, type 136-065 NG001 (connection diagram, with internal dimmer)

- **Set jumper B1 of rudder position amplifier to position**:
  - Jumper between pin 2 and 3 = 10V DC

- **Information to the dimmer type 148-363**
  - See respective section and appended drawing: Extract of drawing 148 E 363 HP004 and section 1.2.2.10
1.2.2.6 **Rudder angle indicator, type 136–065 SA 001 (± 75°)**

(For dimensions see appended dimensional drawing: 136 D 065. HP005)

![Rudder angle indicator, type 136–065 SA 001](image)

**Fig. 1-22:** Rudder angle indicator, type 136–065 SA001

The rudder angle indicator consists of a 3-face indicator with an average diameter of approx. 291 mm.

The measuring input is ±10V DC full-scale deflection for +/- 75° rudder angle.

The angle indicator is intended for ceiling mounting. After being installed, the device corresponds to the type of enclosure IP 23.

Scale illumination is ensured by LEDs and is supplied with 24V/12W. The illumination can be adjusted by means of an internal or an additional external dimmer. The meaning of the internal dimmer is a mounting kit to be flush mounted into the housing of the 3-face angle indicator.

There is a rectangular recess with a marker for centering the borehole at the bottom plate of the angle indicator to install the internal dimmer.

![Rudder angle indicator (connection location)](image)

**Fig. 1-23:** Rudder angle indicator

(connection location)
Connections to be made (rudder angle indicator with external dimmer):

![Diagram showing connections between rudder angle indicator and dimmer](connection_diagram.png)

**Fig. 1-24**: Rudder angle indicator, type 136-065 SA001 (connection diagram with external dimmer)

Set jumper B1 of rudder position amplifier to position:

1. **B1**
2. Jumper between
3. pin 2 and 3 = 10V DC

Information to the dimmer type 148-377
see respective section and appended drawing:
Dimensional drawing: 148 E 377. HP005
and section 1.2.2.9
Connections to be made (rudder angle indicator with internal dimmer):

- 3-face indicator, type 136-065 SA001
- Dimmer, type 148-363

Terminals for illumination:
+ = 1 and - = 2 or
+ = 3 and - = 4 or
+ = 5 and - = 6 or
+ = 7 and - = 8 or
+ = 10 and - = 9 or
+ = 12 and - = 13

Terminals for angle indicator:
+ = 4 and - = 3 or
+ = 6 and - = 5 or
+ = 8 and - = 7 or
+ = 10 and - = 9 or
+ = 13 and - = 12

Fig. 1-25: Rudder angle indicator, type 136-065 SA001
(connection diagram, with internal dimmer)

Set jumper B1 of rudder position amplifier to position:

- Jumper between pin 2 and 3 = 10V DC

Information to the dimmer type 148-363
see respective section and appended drawing:
Extract of drawing 148 E 363 HP004
and section 1.2.2.10
1.2.2.7  
**Dimmer, type 148-367**  
(see also appended dimensional drawing: 148 E 367. HP005)

By means of the dimmer the scale illumination of the rudder angle indicators, type NB 09-066-24, NB 09-066-26, NB 09-066-33 and NB 09-066-035 can be adjusted.

The dimmer is a mounting kit and consists of a 220 Ohm potentiometer and a rotary knob only. 
Its load capacity is 4W.

1.2.2.8  
**Dimmer, type 148-380**  
(see also appended dimensional drawing: 148 E 380. HP005)

By means of the dimmer the scale illumination of the rudder angle indicators, type NB 09-066-24, NB 09-066-26, NB 09-066-33 and NB09-066-035 can be adjusted.

The dimmer consists of a 96mm x 96mm modular plate with 220 Ohm potentiometer and rotary knob. 
Its load capacity is 4W.

![View from the rear side]

**Fig. 1-26:** External dimmer, type 148-380  
(connection hints)
1.2.2.9 Dimmer, type 148-377
(see also appended dimensional drawing: 148 E 377. HP005)

By means of the dimmer the scale illumination of the rudder angle indicators,
type 136-065 NG001 and 136-065 SA001 can be adjusted.

The dimmer consists of a 96mm x 96mm modular plate with 2,2 kOhm potentiometer
and rotary knob.
Its load capacity is 1W.

![Fig. 1-27: External dimmer, type 148-377](connection hints)

1.2.2.10 Dimmer, type 148-363
(see also appended extract of drawing: 148 E 363. HP004)

By means of the dimmer the scale illumination of the rudder angle indicators,
type 136-065 NG001 and 136-065 SA001 can be adjusted.

The dimmer is a mounting kit and consists of a 2,2 kOhm potentiometer and a rotary
knob only.
Its load capacity is 1W.
1.2.2.11 **Rudder angle indicator, type KLPQ-96wp (± 45° or ± 75°)**

(For installation and technical data see appended dimensional drawing: KLPQ-96wp)
(For connecting and installation of the external dimmer, see also appended dimensional drawing: dp-1-k).

![Rudder angle indicator, type KLPQ-96wp](image1)

![Dimmer for rudder angle indicator illumination, type dp-1-k](image2)

**Fig. 1-28:** Rudder angle indicator, type KLPQ-96wp

The rudder angle indicator consists of a 96mm x 96mm moving-coil measuring instrument with the measuring input of ±10V DC with full-scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 66.

Scale illumination is ensured by LED of 24V DC/85mA. The illumination can be adjusted by means of an additional dimmer only.
Connections to be made (rudder angle indicator *without external* dimmer): 

![Diagram of rudder angle equipment with amplifier](image)

**Rudder position amplifier**

- **Terminals for angle indicator**
  - + = 4 and - = 3 or
  - + = 6 and - = 5 or
  - + = 8 and - = 7 or
  - + = 10 and - = 9 or
  - + = 13 and - = 12

- **Terminals for illumination**
  - + = 1 and - = 2 or
  - + = 3 and - = 4 or
  - + = 5 and - = 6 or
  - + = 7 and - = 8 or
  - + = 12 and - = 13

**Fig. 1-29:** Rudder angle indicator, type KLPQ-96wp

*Connection without external dimmer* 

**Set jumper B1 of rudder position amplifier to position:**

Jumper between

1. Pin 2 and 3 = 10V DC
Connections to be made (rudder angle indicator with external dimmer):

**Fig. 1-30**: Rudder angle indicator, type KLPQ–96wp (Connection with external dimmer)

Set jumper B1 of rudder position amplifier to position:

- Jumper between pin 2 and 3 = 10V DC
1.2.2.12 **Rudder angle indicator, type KLPQ-144wp (± 45° or ± 75°)**

(For installation and technical data see appended dimensional drawing: KLPQ-144wp)
(For connecting and installation of the external dimmer, see also appended dimensional drawing: dp-1-k)

Fig. 1-31: Rudder angle indicator, type KLPQ-144wp

The rudder angle indicator consists of a 144mm x 144mm moving-coil measuring instrument with the measuring input of ±10V DC with full-scale deflection. The indicator is intended for flush mounting. After being installed, the device corresponds to the type of enclosure IP 66.

Scale illumination is ensured by LED of 24V DC/100mA. The illumination can be adjusted by means of an additional dimmer only.
Connections to be made (rudder angle indicator without external dimmer):

**Fig. 1-32:** Rudder angle indicator, type KLPQ-144wp  
(Connection without external dimmer)

Set jumper B1 of rudder position amplifier to position:

- Jumper between pin 2 and 3 = 10V DC
Connections to be made (rudder angle indicator with external dimmer):

**Fig. 1-33:** Rudder angle indicator, type KLPQ-144wp (Connection with external dimmer)

Set jumper B1 of rudder position amplifier to position:

- Jumper between pin 2 and 3 = 10V DC
1.2.2.13 Rudder angle indicator, type KLPQ–192wp (panama-rules) (± 45° or ± 75°)
[with pointer up]

(For installation and technical data see appended dimensional drawing: KLPQ–192wp)
(For connecting and installation of the external dimmer, see also appended dimensional
drawing: dp–1–k)

![Rudder angle indicator, type KLPQ–192wp](Image)

**Fig. 1–34:** Rudder angle indicator, type KLPQ–192wp

The rudder angle indicator consists of a 192mm x 192mm moving–coil measuring instru-
ment with the measuring input of ±10V DC with full–scale deflection. The indicator is in-
tended for flush mounting. After being installed, the device corresponds to the type of
enclosure IP 66.

Scale illumination is ensured by LED of 24V DC/100mA. The illumination can be
adjusted by means of an additional dimmer only.
Connections to be made (rudder angle indicator without external dimmer):

Fig. 1-35: Rudder angle indicator, type KLPQ–192wp
(Connection without external dimmer)

Set jumper B1 of rudder position amplifier to position:

- Jumper between pin 2 and 3 = 10V DC
Connections to be made (rudder angle indicator with external dimmer):

Fig. 1-36: Rudder angle indicator, type KLPQ-192wp (Connection with external dimmer)

Set jumper B1 of rudder position amplifier to position:

1. Jumper between pin 2 and 3 = 10V DC
1.2.2.14 Dimmer for KLPQ-xxx, type dp-1-k

(For installation, technical data and connection see also appended dimensional drawing: Knob dp-1-k)

![Dimmer for rudder angle indicator illumination, type dp-1-k](image)

**Fig. 1-37:** Dimmer, type dp-1-k

![Connection diagram](image)

**Fig. 1-38:** Dimmer, type dp-1-k connection diagram
1.2.2.15 Rudder angle indicator, type BCI 240-96 (± 45° or ± 75°)

(For installation and technical data see also appended dimensional drawing: BCI 240-96)

The rudder angle indicator consists of a 96 mm x 96 mm moving-coil measuring instrument with the measuring input of ±10V DC with full-scale deflection. The indicator is intended for bulkhead mounting. After being installed, the device corresponds to the type of enclosure IP 66.

Scale illumination is ensured by LED of 24V DC/85mA. The illumination can be adjusted by means of an integrated dimmer.

**Fig. 1-39:** Rudder angle indicator, type BCI 240-96
Rudder angle equipment
with amplifier

Fig. 1-40: Rudder angle indicator, type BCI 240–96 (connection)

Set jumper B1 of rudder position amplifier to position:

1 2 3
Jumper between pin 2 and 3 = 10V DC
### 1.2.2.16 Rudder angle indicator, type BCI 240-144 (± 45° or ± 75°)

(For installation and technical data see also appended dimensional drawing: BCI 240-144)

The rudder angle indicator consists of a 144 mm x 144 mm moving-coil measuring instrument with the measuring input of ±10V DC with full-scale deflection. The indicator is intended for bulkhead mounting. After being installed, the device corresponds to the type of enclosure IP 66.

Scale illumination is ensured by LED of 24V DC/100mA. The illumination can be adjusted by means of an integrated dimmer.

**Fig. 1-41**: Rudder angle indicator, type BCI 240-144
Rudder angle equipment
with amplifier

![Image of rudder angle equipment]

**Fig. 1-42:** Rudder angle indicator, type BCI 240–144 (connection)

Set jumper B1 of rudder position amplifier to position:

- **Jumper between pin 2 and 3 = 10V DC**
1.2.2.17 Rudder angle indicator, type NOA 170 (panama rules) (± 45° or ± 75°) [with pointer up]

(For installation and technical data see also appended dimensional drawing: NOA-170)

The rudder angle indicator consists of a 192 mm x 192 mm moving-coil measuring instrument with the measuring input of ±10V DC with full-scale deflection. The indicator is intended for bulkhead mounting. After being installed, the device corresponds to the type of enclosure IP 66. Scale illumination is ensured by LED of 24V DC/100mA. The illumination can be adjusted by means of an integrated dimmer.

![Rudder angle indicator, type NOA-170](image)

Fig. 1-43: Rudder angle indicator, type NOA-170
Rudder angle equipment
with amplifier

Fig. 1-44: Rudder angle indicator, type NOA-170
(connection)

Set jumper B1 of rudder position amplifier to position:

1. Jumper between pin 2 and 3 = 10V DC
1.3 Summary of technical data

For further technical data, see respective sections and/or appended drawings.

1.3.1 Electrical data
Total equipment
Power supply: 24V DC ±20%

1.3.2 Amplifier
139-147
Power supply: 18V to 30V DC
Power consumption: max. 48VA incl. illumination
Output voltage: max. ±5V
Output current: max. ±12mA (with 9 indicators)

SCB–RAI 10
See appended manual.

1.3.3 Rudder angle indicators
Test voltage: ±10V DC and ±5V DC
Internal resistance: 1kOhm/V
Class accuracy: 1.5%
Scale span: ±45° and ±70°
Temperature range: -25°C to +55°C
Rudder angle equipment
with amplifier

Intentionally left blank
2 Operating Instructions

Instructed service personnel only is permitted to open the devices or desks. The service personnel must observe all safety measures in order to ensure that no damage might occur to personnel or devices.

**Safety regulation:**
As a matter of principle, the system is to be made dead when installation work is performed on the equipment as well as during disassembly/assembly of components or during alteration of the circuitry.

2.1 Setting into operation

2.1.1 Power supply and voltage adaption

The 24V DC supply from the main fuse board (>4A), with ON/OFF switch must be connected to the terminals L2.1 (24V) and L2.2 (0V) of the amplifier.

2.1.2 Adjusting the feedback potentiometer

The feedback potentiometer (5kOhm ±10%) is located in the feedback unit (101–528).

1) The feedback potentiometer is to be connected to the terminals of the rudder position amplifier 148–147

   L1.9 (port  negative signal),
   L1.11 (starboard  positive signal), and
   L1.10 (wiper)

2) Adjust the potentiometer with exact midship position of the rudder: turn its casing in such a way that the resistance measured between the potentiometer connections 1 and 2 is just the same as between the potentiometer connections 2 and 3.
2.1.3 Checks to be made before setting into operation

For correct functioning of the Rudder Angle Indicator Equipment, the following power supply is required: 24V DC ±20%.

2.1.4 Checks to be made before departure

By means of the ship’s steering control system, the rudder is successively to be brought into the positions of
- midship
- hard to port and
- hard to starboard
and the corresponding indication is to be checked on the rudder angle indicators.

2.2 Operating the rudder angle indicator equipment

Operation of the Rudder Angle Indicator Equipment is restricted to
- adjusting the brightness of the indicator illumination
- adjusting the zero position
3 Maintenance and repair

Attention:
Before opening devices of the equipment, switch off supply voltages.

3.1 Maintenance

The equipment is maintenance free.

It is to recommend to clean the surface of the equipment time by time.

3.2 Repair

3.2.1 Exchanging Fuses

- Exchanging the fuse in the rudder position amplifier

  - Remove the plastic hood.
  - Exchange the fuse (2A, slow).
  - Put on the plastic hood again.

Attention:
Never insert fuses of other rating! Danger to persons and devices!
3.2.2 Exchanging bulbs

- Exchanging the bulbs in the rudder angle indicators type NB09-066-024, NB09-066-026, NB09-066-033 and NB09-066-035:
  - Draw off bulb holder with bulb from the rear of the measuring device.
  - Replace bulb (24V/3W). The bulb is fastened to the holder by means of a bayonet catch.
  - Re-assembly to be made in reverse order.

3.3 Spare parts

<table>
<thead>
<tr>
<th>Designation</th>
<th>Data</th>
<th>Stock number</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse 2A/250V slow</td>
<td>1.762 018</td>
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<tr>
<td>2</td>
<td>Bulb 24V/3W</td>
<td>1.710 160</td>
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</tbody>
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MAX. WIRE CROSS SECTION: 2.5mm²

TYPE OF ENCLOSURE: IP40

CONNECTION TERMINAL: IP20

DIMENSIONS WITHOUT TOLERANCES ARE MAXIMUM DIMENSIONS

DIMENSIONS ONLY FOR INFORMATION

For the technical drawing all rights reserved.

CADD: Pro/E
ID. NR.: 5008733

SCALE: -
WEIGHT: 125 g

DRAWING TITLE:
Rudder Position Amplifier
DIMENSIONAL DRAWING

DRAWING NO.: 139-147.HP012

SH. 1
BF 1
DRILLING SCHEME

CONNECTOR ILLUMINATION
CONNECTOR MEASURING WORK

TYPE OF ENCLOSURE: EN 50529 IP22 AFTER INSTALLATION
DIMENSIONS WITHOUT TOLERANCES ARE MAXIMUM DIMENSIONS

DISTANCE FROM MAGNETIC COMPASS
STANDARD TYPE: 6.95 m
STEERING TYPE: 6.65 m

CAD 2D  id. Nr. 5009594

SCALE WEIGHT: 0.5 kg

DRAWING TITLE:
RUDDER ANGLE INDICATOR
DIMENSIONAL DRAWING

DRAWING NO.:
NB09-066.HP024

Raytheon
Anschütz
For this technical data bearing the note: "Für diese technische Daten ses sei der Vermerk: "alle Revisionen vor, für diese technische Daten alle Revisionen vor."
* bezieht sich auf das Bohrbild an Bord/
REFERRING TO DRILLING SCHEME ON BOARD SHIP

Befestigung/MOUNTING: ø6 (ø0,24)

Schutzart/TYP OF ENCLOSURE: IP 23 EN 60529

Umgebungstemperatur/AMBIENT TEMPERATURE: -15° bis +70°

Maße ohne Toleranzangabe sind Größtmaße /
DIMENSIONS WITHOUT TOLERANCES ARE MAXIMUM DIMENSIONS

DISTANCE FROM MAGNETIC COMPASS
STANDARD TYPE: 0,60m
STEERING TYPE: 0,50m...

CAD

<table>
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<table>
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<th>Arbeitsplatz</th>
<th>Geräteart:</th>
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Maßeinheit/UNIT: mm

Maßeinheit/UNIT: mm

Kopfdruck: 11.4.98

Raytheon Marine GmbH
Germany

Raytheon

136 D 065 HP005

B. 1

Zeichnungsnummer: 1

136-065 HP005
MOUNTING PLATE MAX. 3MM (MAX.0.12)

MOUNTING DIMENSIONS

TYPE OF ENCLOSURE: IP56 *(WATERTIGHT) EN 60529

*MEANS THAT THE TYPE OF ENCLOSURE WILL BE OBTAINED ONLY WHEN INSTALLATION OR ASSEMBLY WORK HAVE BEEN TERMINATED

DIMENSIONS ONLY FOR INFORMATION

CAD 3D  Id.Nr.  5002759

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<th>(INCH)</th>
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DATE NAME DRAWING TITLE
DR. 11.12.06 Haf DIMMING-MOUNTING-SET
APPR. 16.12.06 Haf DIMENSIONAL DRAWING
CUR. 11.12.06 Haf

DRAWING NO.: 148-367.HP005

Raytheon
Anschütz

REV. REVISIONS DATE NAME
Mechanical Data

Depth: (b) 23.5 mm max.
Mounting diameter: (a) 23.5 mm
Borehole: (c) 10.1 mm +/- 0.2
Button hight: (d) 22 mm max.
Button diameter: (d) 19 mm max.

Distance washers depending on the thickness of the mounting plate:
- Mounting plate 1.0 to 1.5 mm: 3 distance washers
- 2.0 to 3.5 mm: 2 distance washers
- 4.0 to 5.5 mm: 1 distance washer
- 6.0 to 7.5 mm: no distance washer

Electrical data:
- Resistance: 2.2 kOhm +/- 10%
- Load capacity: 1 W (40°C)
- Operating temperature: -40°C to +90°C

Dimmer mounting kit

Extract of:
Drawing no.: 148 E 363 HP004
Drilling scheme

Illumination: LED, 24V, ca. 80mA with dimmer
Ambiente temperature: -25...60°C
Weight: 2.9kg
Type of enclosure: IP 66
Cable glands for cable: 5-10mm
Compass save distance:
Standard: 0,55m
Steering: 0,3m

<table>
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<tr>
<th>Id - No.</th>
<th>Scale</th>
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</thead>
<tbody>
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<td>2010698</td>
<td>+/-30°/min - ROT</td>
</tr>
<tr>
<td>2010696</td>
<td>+/-100°/min - ROT</td>
</tr>
<tr>
<td>2010700</td>
<td>+/-45° - Rudder Angle</td>
</tr>
<tr>
<td>2010702</td>
<td>+/-75° - Rudder Angle</td>
</tr>
</tbody>
</table>
Drilling scheme

Illumination: LED, 24V, ca. 85mA with dimmer
Ambient temperature: -25...60°C
Weight: 3.8kg
Type of enclosure: IP 66
Cable glands for cable: 5-10mm
Compass save distance:
Standard: 0.55m
Steering: 0.3m

<table>
<thead>
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<th>Scale</th>
</tr>
</thead>
<tbody>
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<td>2010690</td>
<td>+/-30°/min - ROT</td>
</tr>
<tr>
<td>2010688</td>
<td>+/-100°/min - ROT</td>
</tr>
<tr>
<td>2010692</td>
<td>+/-45° - Rudder Angle</td>
</tr>
<tr>
<td>2010694</td>
<td>+/-75° - Rudder Angle</td>
</tr>
</tbody>
</table>

2xCable glands
Illumination: LED, 24V / 85mA
(with dimmer)
Ambiente temperature: -25...60°C
Weight: 0.6kg
Type of enclosure: IP 66 (after installation)

Compass safe distance: Standard 0.75m
Steering 0.5m

Drilling scheme; cut out:

Thickness of mounting area: 1mm-6mm
[0.0394-0.236]
Illumination: LED, 24V / 100mA (with dimmer)
Ambiente temperature: -25...60°C
Weight: 1.2kg
Type of enclosure: IP 66 (after installation)
Compass save distance: Standard 0.75m
Steering 0.5m

<table>
<thead>
<tr>
<th>Id-No.</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010744</td>
<td>+/- 45° Rudder Angle</td>
</tr>
<tr>
<td>2010743</td>
<td>+/- 75° Rudder Angle</td>
</tr>
</tbody>
</table>

Drilling scheme; cut out:
Thickness of mounting area: 1mm-6mm
(0.0394-0.236)
Illumination: LED, 24V, ca. 100mA with dimmer
Ambiente temperature: -25...60°C
Weight: 4.8kg
Type of enclosure: IP 66
Cable glands for cable: 11-16mm
Compass save distance:
Standard: 0.55m
Steering: 0.3m

Id - No.       Scale
2010704       +/−45° - Rudder Angle
2010705       +/−75° - Rudder Angle

Drilling scheme

Ø7 [Ø0.28]
Mounting plat: max. 2mm [0.078] (2 gasket used)
max. 6mm [0.235] (1 gasket used)

Circuit diagram

Tecnical Data:
Typ: dp-1-k
Resistance range: 1kohm
Limiting element voltage: 300V
Power rating: 3W at 70°C
Sealing: IP66

Dimmer-Poti mit Knopf