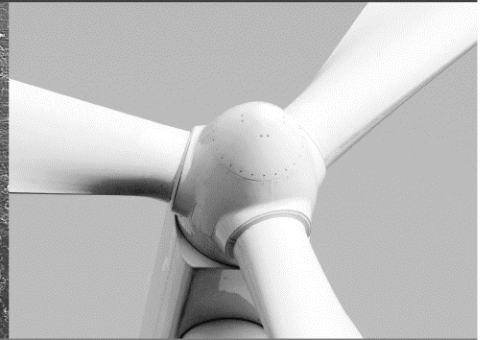
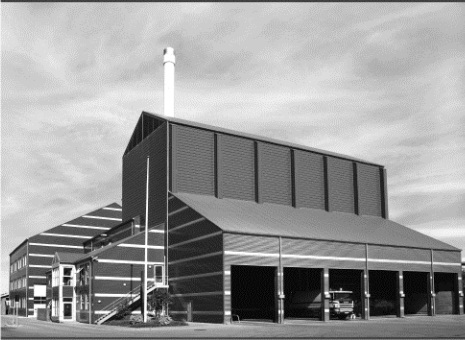




-power in control



## SYSTEM APPLICATION NOTES



### Rudder Angle Indication system

- 4...20 mA current loop



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## 1. About this document

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### General purpose

This document includes system description of a complete Rudder Angle Indication system setup.

It mainly includes examples of different ways of wiring applications suitable for rudder angle indicators.



**For functional descriptions, procedure for parameter setup, complete standard parameter lists, etc., please see the installation instructions.**

The general purpose of the Rudder Angle Indication system application notes is to offer the designer information about suitable applications for the rudder angle indicators.

### Intended users

The Application Notes is mainly intended for the person responsible for designing Rudder Angle Indication systems. In most cases, this would be a design engineer. Naturally, other users might also find useful information in this document.

### Contents/overall structure

The Application Notes is divided into chapters and in order to make the structure of the document simple and easy to use, each chapter will begin from the top of a new page.

## 2. Warnings and legal information

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### Legal information and responsibility

DEIF takes no responsibility for installation or operation of the Rudder Angle Indication systems' external components. If there is any doubt about how to install or operate the external components possibly integrated into the system, the company responsible for the installation or the operation of the setup must be contacted.

**The indicators are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.**

### Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

### Safety issues

The installation should only be carried out by authorised personnel who understand the risks involved in working with electrical equipment.

### Definitions

Throughout this document a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

#### Notes



The notes provide general information which will be helpful for the reader to bear in mind.

#### Warning



The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment if certain guidelines are not followed.

### **3. System overview**

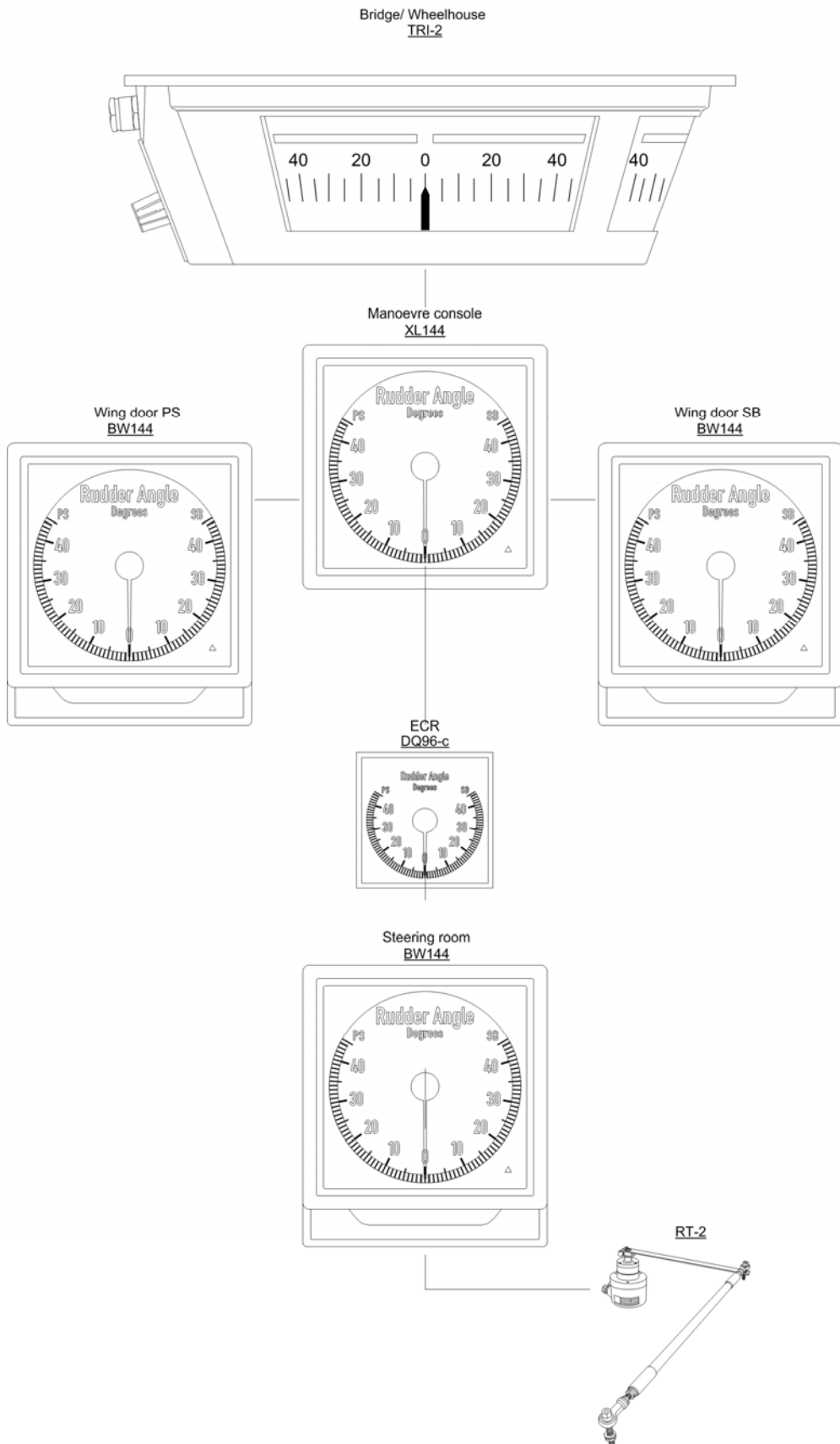
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The Rudder Angle Indication system provides continuous indication of the actual rudder position of the steering gear. The indication system shown is for a single steering gear, but it can easily be duplicated for applications with double rudder systems.

The main components are:

- Panorama indicator, type TRI-2
- Panel-mounted indicators, type XL72/96/144/192
- Bridge wing indicators, type BW144/192
- Bridge wing indicator, type BRW-2
- Rudder angle transmitter, type RT-2
- Switchboard instruments, type DQ96-c

The example shown is one of many possible combinations of products, inputs, scales and wiring. Depending on the actual needs, this might inspire to make the best use of the DEIF product range for the actual application.



## 4. System characteristics

---

The 4...20 mA current loop is easy and simple to install, it only requires a single signal wire routed from a 24V DC voltage source in a loop through the transmitter and each individual indicator and back to the voltage source.

The current loop is not sensitive to fluctuations in the supply voltage, but it is important that the voltage source driving the current loop is able to supply sufficient voltage to drive all the connected indicators and the rudder angle transmitter including the voltage drop in the signal wire loop at the maximum of 20 mA.

The RT-2 rudder angle transmitter used in this document is coupled in "2-wire mode" and needs no extra aux. power supply voltage; this also applies to the TRI-2 indicator, whereas the XL indicators require a 24V DC aux. power supply.

If many indicators are needed in a rudder angle indication system, a higher voltage drop will arise in the current loop. For these applications it might be necessary to couple the RT-2 in "4-wire mode", which requires a 24V DC aux. power supply for the RT-2 transmitter. For details regarding "4-wire mode" of RT-2, please see the RT-2 data sheet.

See **chapter 7, Voltage drop calculation** for further details and limitations.

A short circuit of the input terminals on one of the indicators will only affect indication on the short-circuited indicator; the other indicators will not be affected.

A single disconnection in the current loop will interrupt operation of the entire indicator system. This will show on all indicators by the pointer moving out of scale. For an indicator with clockwise deflection, the pointer will be in the left side of the scale as an indication of a 0 mA signal current input.

### Cable glands:

For selection of cables, please see the table below. It is very important that the wire gauge matches the type of cable gland for each indicator.

Indicator type	BW144	BW192	BRW-2	TRI-2	RT-2	Dimmer box
Cable gland type	2x PG-9	2x PG-16	2x PG-21	2x PG-16	2x PG-11	PG-13.5/ PG16
Wire gauge	5...8 mm	8...14 mm	13...18 mm	8...14 mm	6...10 mm	7...12 mm/ 10...14 mm

## 5. System description

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The system described in this document consists of the components mentioned below.

Alternatives are also noted, to show different types of indicators that can easily be incorporated into the system described in this document.

<i>Qty</i>	<i>Description</i>
1	Panorama rudder angle indicator, type TRI-2, with built-in dimmer Protection: IP54 Scale range: +/-45 degrees Scale base: Black Scale no.: 4155110161 Pointer: Yellow Input: 4...20 mA
1	Rudder angle indicator, type XL144 Panel-mounted Protection: IP52 Scale range: +/-45 degrees Scale base: Black Scale no.: 4150300273 Pointer: White with yellow illumination Input: 4...20 mA Deflection: 240 degrees CW
2	Bridge wing indicator, type BW144, with built-in dimmer Bulkhead-mounted Protection: IP66 Scale range: +/-45 degrees Scale base: White Scale no.: 4150310085 Pointer: Black Input: 4...20 mA Deflection: 240 degrees CW
1	Rudder angle indicator, type DQ96-c, without illumination Panel-mounted Protection: IP52 Scale range: +/-45 degrees Scale base: White Pointer: Black Input: 4...20 mA Deflection: 240 degrees CW
1	Rudder angle indicator, type BW144, with built-in dimmer Bulkhead-mounted Protection: IP66 Scale range: +/-45 degrees Scale base: Black Scale no.: 4150310085 Pointer: White with yellow illumination Input: 4...20 mA Deflection: 240 degrees CW



- 1 Dimmer kit, dimmer potentiometer and fittings  
Item no. 2951890020
- 1 Rudder angle transmitter, type RT-2, 0...90 degrees with mounting bracket (+/-45 deg.)  
Item no. 2951850010
- 1 Accessory for rudder angle transmitter - position linkage (length 317 mm)  
Item no. 1124410004
- 1 Accessory for rudder angle transmitter - adjustable lever (length max. 990 mm)  
Item no. 1124410003

## Alternatives

Of course, many alternatives are available to implement into or replace any of the mentioned products and designs used in the description of this specific system.

In **chapter 9, Data sheets and other documents**, the documents to use for reference for different scale layouts, and also the possible configurations and sizes of all indicators are listed.

The following products can be added or used instead of those mentioned in this document:

Rudder angle indicator, type XL72, XL96, XL144, XL192  
Panel-mounted  
Protection: IP52  
Scale range: +/-45 deg.  
Scale base: Black or white  
Scale no.: To be specified  
Pointer: Black or white with yellow illumination  
Input: 4...20 mA

IP66 option for the panel indicators type XL72, XL96, XL144 or XL192

Bridge wing indicator, type BW192, with built-in dimmer  
Bulkhead-mounted  
Protection: IP66  
Scale range: +/-45 deg.  
Scale base: Black or white  
Scale no.: To be specified  
Pointer: Black or white with yellow illumination  
Input: 4...20 mA

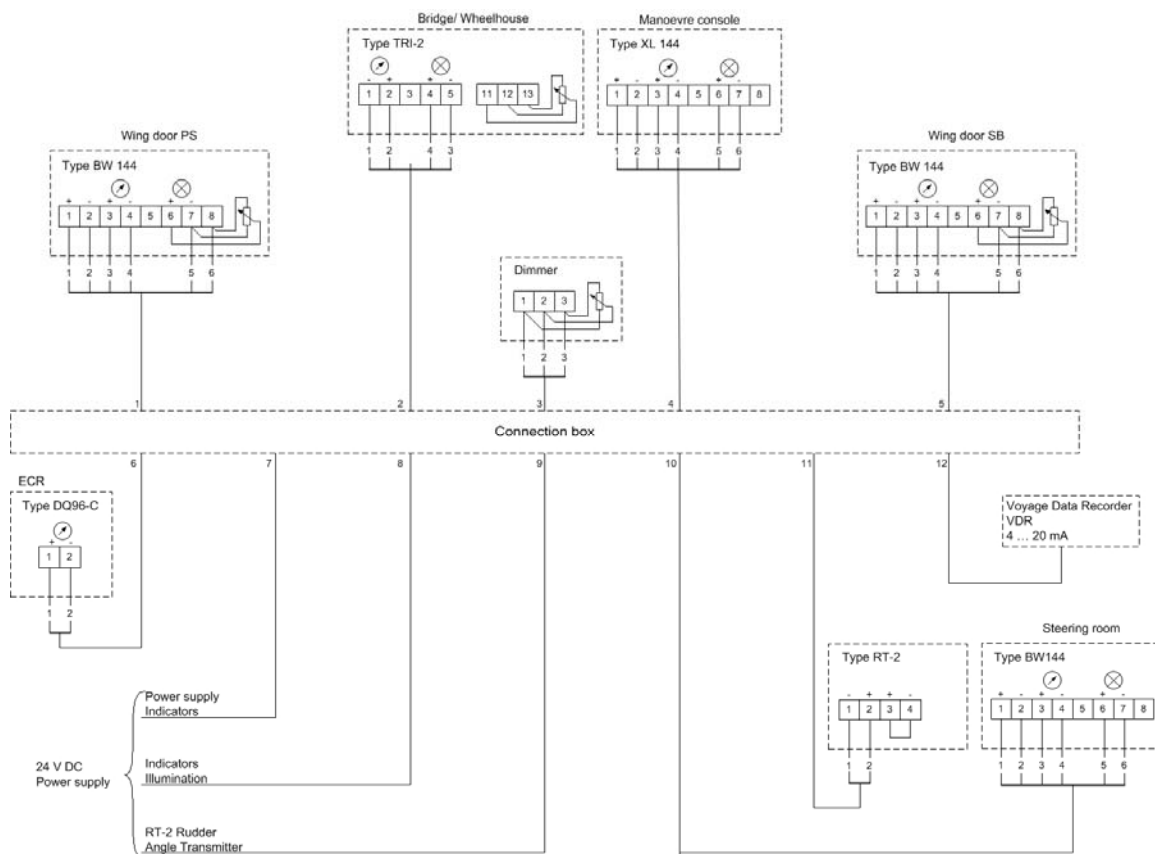
Bridge wing indicator, type BRW-2, with built-in dimmer  
Bulkhead-mounted  
Protection: IP66  
Scale range: +/-45 deg.  
Scale base: Black or white  
Scale no.: To be specified  
Pointer: Black or white with yellow illumination  
Input: 4...20 mA

Insulation amplifier, type TDG-210DG  
Input: 4...20 mA  
Output: 4...20 mA  
Aux. voltage: Either 24V DC or 230V AC (to be specified)

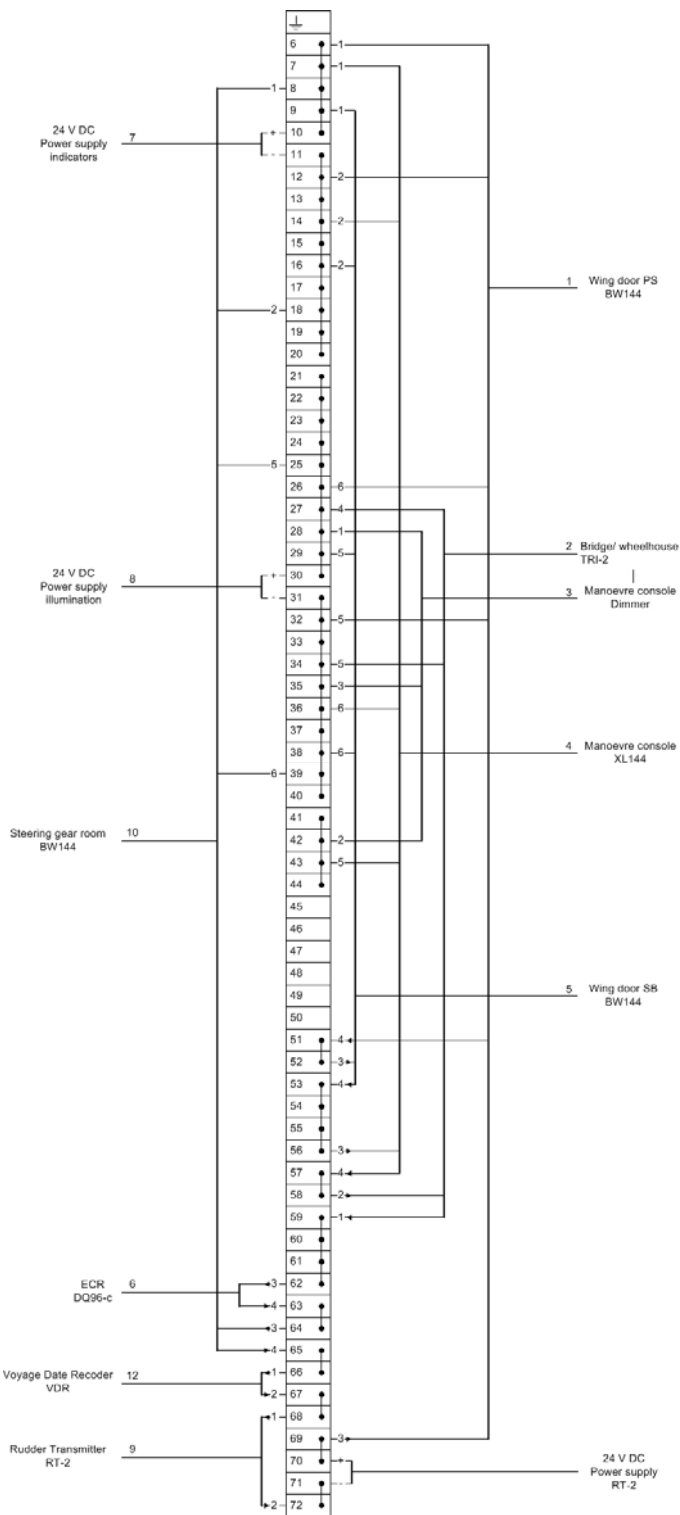
External dimmer for indicators  
Dimmer potentiometer in IP66 box with PG13.5/PG16 cable glands

## 6. Typical application wiring diagram

### System single-line diagram



### Connection box (example)



**Use screened cables only. Screens must be grounded.**



**Please be aware that the connection box shown above is only an example and, consequently, not supplied or supported by DEIF.**

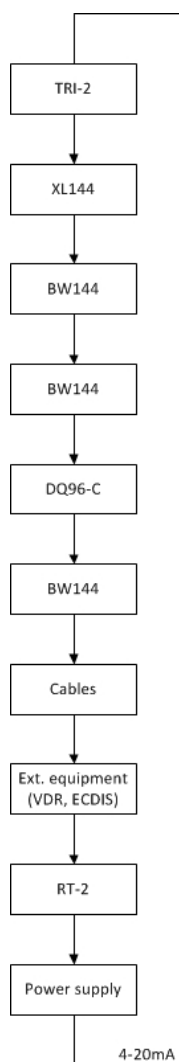
## 7. Voltage drop calculation

Calculation of the voltage drop and minimum voltage supply must always be made for a Rudder Angle Indication system.

If the Rudder Angle Indication system is changed by adding or replacing indicators, the voltage drop must in principle be recalculated to ensure that the new system will work correctly in worst-case situations - lowest auxiliary power supply, highest current (20 mA) and maximum resistance in the current loop.

If the power supply is not able to drive the current in the indication system, an insulation amplifier, type TDG, can be connected. The TDG insulation amplifier 4...20 mA/4...20 mA can either be installed as a buffer close to the RT-2, or by dividing the 4...20 mA current loop into two systems, so the 4...20 mA loop goes from the rudder angle transmitter in the steering gear room to an insulation amplifier placed in the wheelhouse where the second loop is then placed.

An example is shown below. The cable resistance is only a proposal. In case the current signal is also connected to external equipment, e.g. VDR and ECDIS, the voltage drop in these must also be included.



Product	Voltage drop
1 pcs. TRI-2	4.0 V
1 pcs. XL144	1.0 V
2 pcs. BW144	2.0 V
1 pcs. DQ96-c	1.0 V
1 pcs. BW144	1.0 V
<b>Total voltage drop in indicators</b>	<b>9.0 V</b>
Cables = $R_{cable} \times I$ ( $R_{cable}$ estimated)	
( $R_{cable}$ is estimated to 10 Ohm)	
= 10 ohm x 0.02 A	0.2 V
External equipment (estimated)	0.6 V
<u>Rudder angle transmitter RT-2</u>	<u>12.0 V</u>
 <u>Minimum voltage supply</u>	 <u>21.8 V</u>



**Please note that in case the 24V DC power supply is from the battery switchboard, the tolerance might be 24V DC - 25%/+30%. This means that the minimum power supply is 18 V, which is too low to supply the above system.**

**A solution could be coupling the RT-2 in “4-wire mode”, which would reduce the voltage drop over the RT-2.**

## 8. Adjustment of system

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The following procedure is recommended for the most efficient adjustment of the Rudder Angle Indication system.

Sequence:

1. Adjust the RT-2 transmitter mechanically.
2. Adjust the RT-2 transmitter electrically; if possible, it is preferable to use a locally mounted XL indicator as reference (min./zero/max.).
3. When the rudder angle transmitter has been properly calibrated, move on to checking the other indicators in the system.
4. If needed, it is possible to fine-tune the indication by means of the adjustment potentiometers on the back of the indicators. However, please note that calibration is not to be made in this way if there is an incorrect signal from the transmitter, which should have been adjusted in step 1. The XL/BW indicators can only be adjusted approx.  $\pm 2\%$ .



**In a Rudder Angle Indication system the zero adjustment should normally be prioritised higher than the min./max. adjustment.**



**The panorama rudder angle indicator TRI-2 is calibrated to class 1.5 from DEIF, so there may be a slightly bigger difference where a compromise between the max. and min. adjustment must be taken into consideration.**

## 9. Data sheets and other documents

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From the DEIF website [www.deif.com](http://www.deif.com), additional documents such as data sheets, installation instructions, type approval certificates and application notes are available for download, this document included.

In the documents listed below you can find further information about the components in the Rudder Angle Indication system:

- Data sheet for panorama rudder indicator, type TRI-2, doc. no. 4921250043.
- Data sheet for illuminated indicators, type XL72/96/144/192, BW144/192 and BRW-2, doc. no. 4921250057.
- Data sheet for switchboard instruments, type DQ96, doc. no. 4921210012.
- Data sheet for rudder angle transmitter, type RT-2, doc. no. 4921250052.
- Standard scale designs, doc. no. 4921290030.
- Dimensional drawing, position linkage 1124410004, drawing no. 4155111164.
- Dimensional drawing, adjustable lever 1124410003, drawing no. 4165350003.
- Data sheet for insulation amplifier, type TDG-210DG, doc. no. 4921220011.
- Dimensional drawing, dimmer kit for panel mounting, drawing no. 4106220062.
- Dimensional drawing, external dimmer box, drawing no. 4106220062.

Additional technical information can be found in the documents listed below:

- Installation instructions for TRI-2, doc. no. 4189350004.
- User's manual for XL, BW and BRW, doc. no. 4189350024.
- Installation note for XL, BW and BRW, doc. no. 4189350025.
- Installation instructions for RT-2, doc. no. 4189350013.
- Installation instructions for TDG-210DG, doc. no. 1159040018.

DEIF A/S reserves the right to change any of the above.