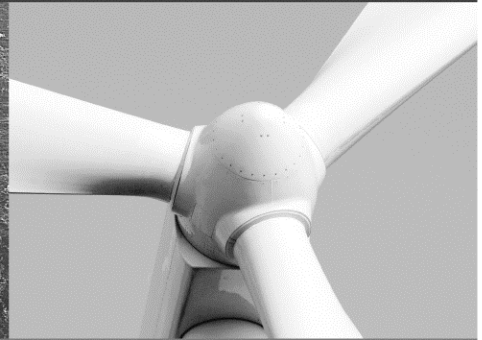
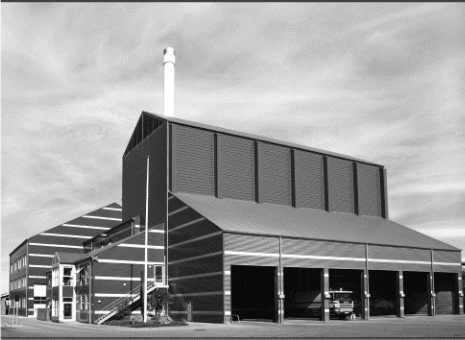




-power in control



SYSTEM APPLICATION NOTES



Rudder Angle Indication system

- -10...0...10 V voltage input



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1. About this document

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

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.

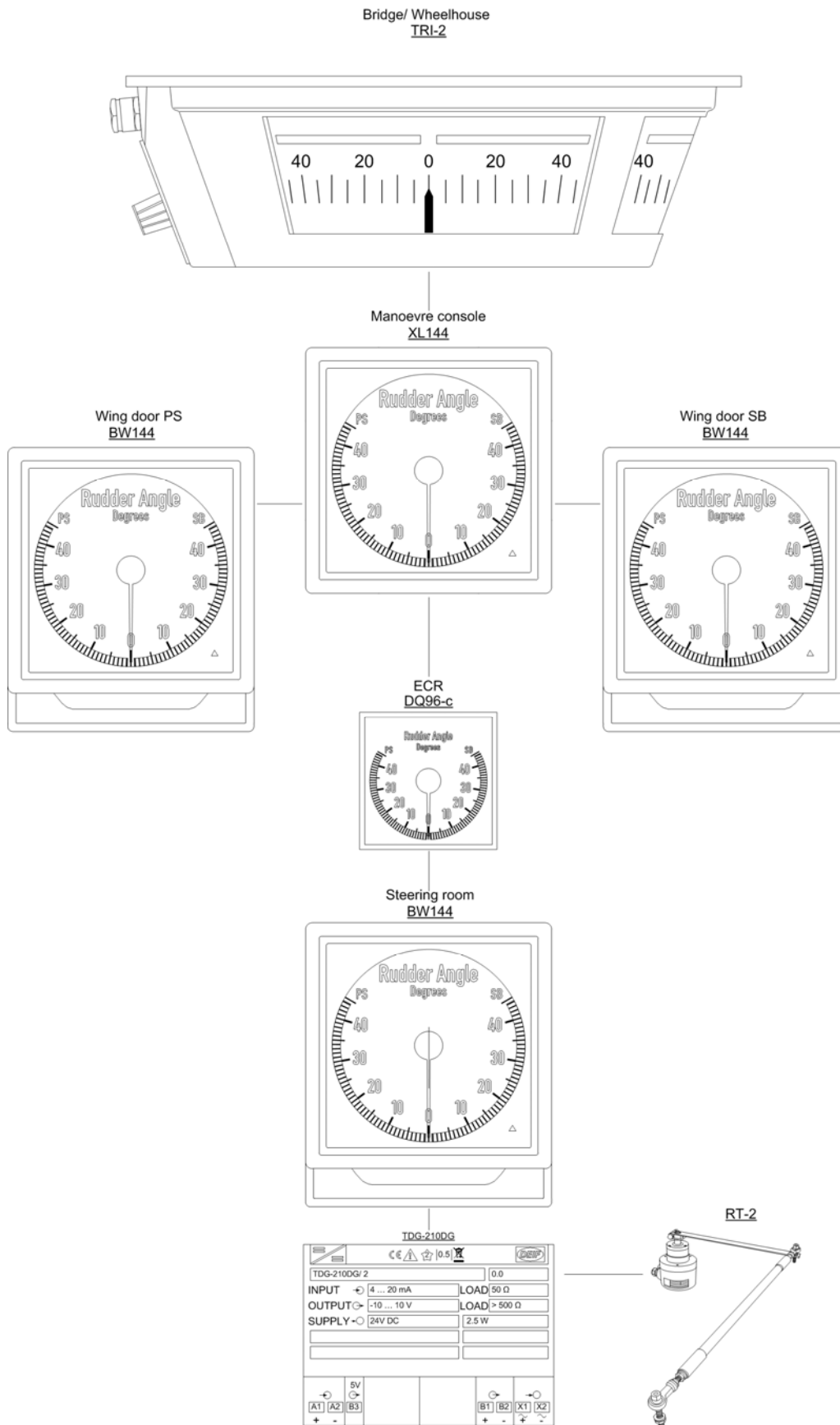
3. System overview

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
- Insulation amplifier, type TDG-210DG
- 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 -10...0...10 V voltage source input requires the signal from the rudder angle transmitter to be routed to each indicator in the system. As opposed to the 4...20 mA current loop input, where all indicators in the loop will lose signal if the loop is broken, the indicators in a voltage system will not be affected if the input to one of the indicators is lost.

The RT-2 rudder angle transmitter used in this document is coupled in “2-wire mode” and needs no extra aux. supply voltage. The TDG-210DG is a galvanically separated amplifier which converts the 4...20 mA signal from the RT-2 to -10...0...10 V and routes it to each indicator in the system. The XL indicators require a 24V DC aux. supply. The TRI-2 does not require 24V DC aux. supply.

The -10...0...10 V voltage output from the TDG-210DG is not sensitive to fluctuations in supply voltage, but it is important that the connected indicators do not draw more than 20 mA in total from the TDG-210DG.

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

A short circuit of the input terminals on any of the indicators will affect all indicators in the system.

A lost connection to the input terminals of any indicator will only affect that specific indicator, the rest of the system will not be affected.

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

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: -10...0...10 V
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: -10...0...10 V 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: -10...0...10 V 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: -10...0...10 V 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: -10...0...10 V Deflection: 240 degrees CW

- 1 TDG-210DG, galvanically separated DC transducer
Input: 4...20 mA
Output: -10...0...10 V
Aux. supply: 24V DC
- 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: -10...0...10 V

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: -10...0...10 V

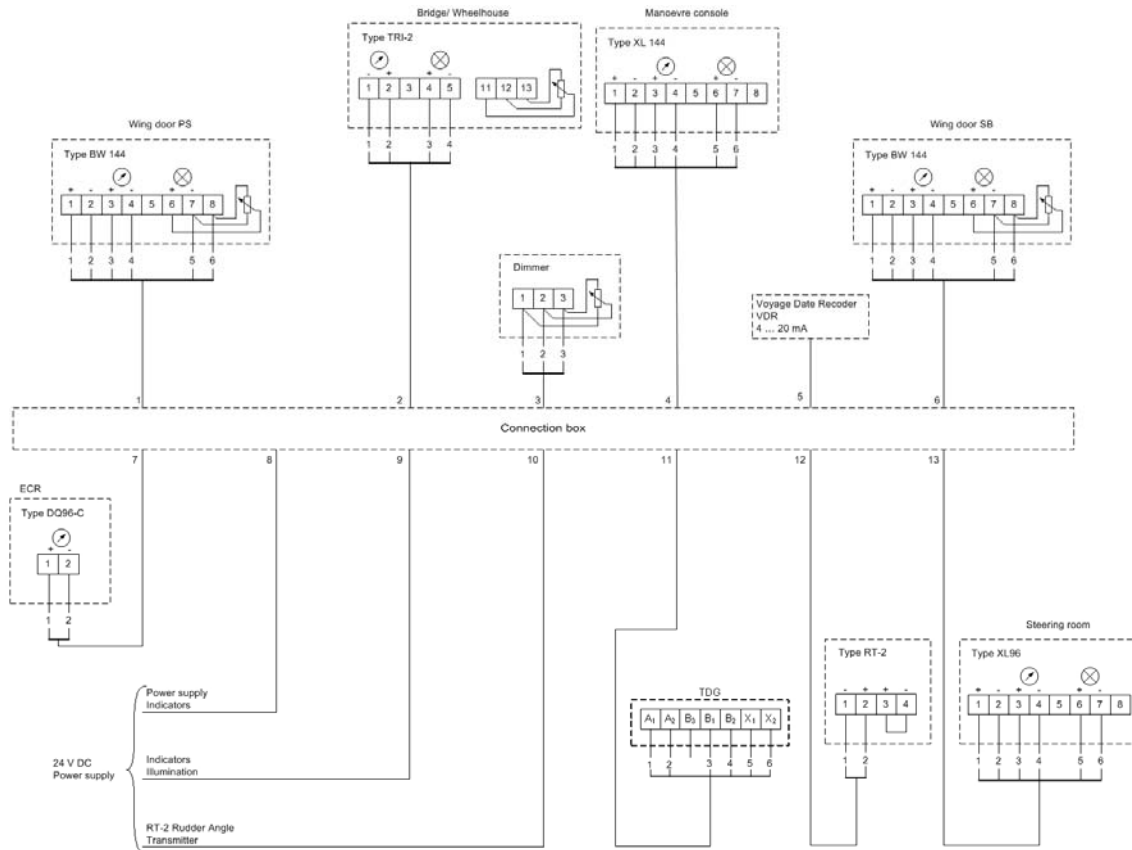
Bridge wing indicator, type BRW-2, with built-in dimmer
Bulkhead-mounted
Protection: IP66
Scale range: +/-45 deg.
Scale base: Black or white
Scale no.: To be specified
Pointer: Black or white with yellow illumination
Input: -10...0...10 V

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

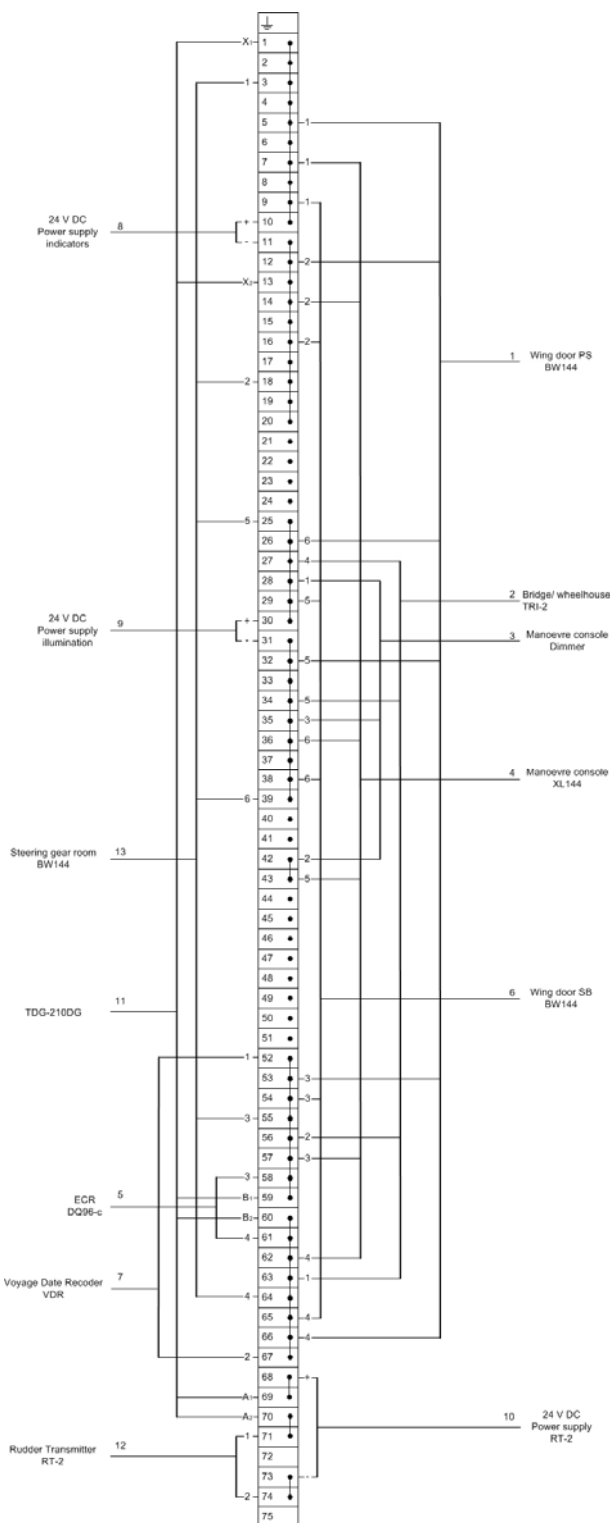
The system is also available for -70...0...70 degrees, in which case all indicators should have a -70...0...70 degree scale, and the rudder angle transmitter must be type RT-2, 0...140 deg.

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.

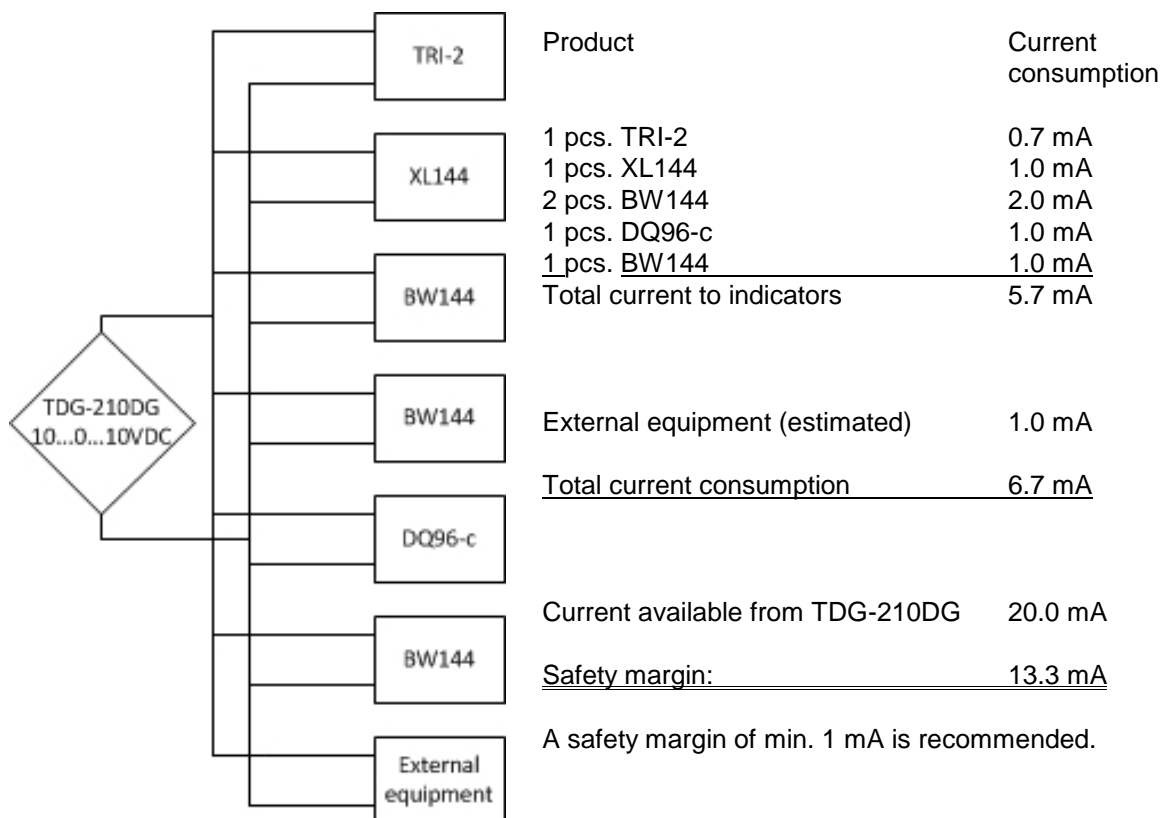
7. Load calculation

The TDG is able to source 20 mA at +10 V or sink 20 mA at -10V; this limits the number of indicators that can be connected without overloading the TDG-210DG. An extra TDG-210DG can be inserted as a current buffer, or to divide the system into two systems where e.g. the 4...20 mA signal from the RT-2 is transferred in current loop to the bridge and via the no. 2 TDG-210 converted to -10...0...10 V for the indicators mounted on the bridge.

It is recommended always to make a load calculation for a -10...0...10 V Rudder Angle Indication system.

If the Rudder Angle Indication system is changed by adding or replacing indicators, it is recommended to recalculate the load to ensure that the new system will work correctly in worst-case situations.

An example is shown below. The cable resistance is not taken into consideration, since it will only have a very small impact on the current consumption. If needed, the small voltage drop from the TDG-210DG to the indicators can be corrected according to the instructions in **chapter 8, Adjustment of system**. In case the signal is also connected to external equipment, e.g. VDR and ECDIS, the current consumption in these must also be included.



8. Adjustment of system

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 100 m 2-wire 0.5 mm² copper cable, at the worst-case load condition of 20 mA in the far end of the cable, the voltage drop is approximately 0.13 V equal to 1.3% and therefore well within the $\pm 2\%$.

In the actual application example with six indicators and one external connection loading 6.7 mA in total, the voltage drop will be less than 0.05 V or 0.5%.

A signal cable of min. 0.5 mm² is recommended.



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

From the DEIF website 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.